Palouse River
Fecal Coliform Bacteria
Total Maximum Daily Load

Water Quality Improvement Report and Implementation Plan

DEPARTMENT OF
ECOLOGY
State of Washington

December 2010
Publication No. 10-10-067

Publication and Contact Information

This report is available on the Department of Ecology's web site at
http://www.ecy.wa.gov/biblio/1010067.html

For more information contact:

Washington State Department of Ecology
Water Quality Program
4601 N. Monroe St
Spokane, WA 99205
Phone: 509-329-3436

Washington State Department of Ecology - www.ecy.wa.gov/

- Headquarters, Olympia 360-407-6000
- Northwest Regional Office, Bellevue 425-649-7000
- Southwest Regional Office, Olympia 360-407-6300
- Central Regional Office, Yakima 509-575-2490
- Eastern Regional Office, Spokane 509-329-3400

Cover photo: Covered bridge at Manning on the Palouse River.

Project Codes

Data for this project are available at Ecology's Environmental Information Management (EIM) website at www.ecy.wa.gov/eim/index.htm. Search User Study ID, JICA0001.

Study Tracker Code (Environmental Assessment Program) is 05-008-21.

TMDL Study Code (Water Quality Program) is PRRF34FC.

Palouse River
Fecal Coliform Bacteria
Total Maximum Daily Load

Water Quality Improvement Report and Implementation Plan

by

Scott Tarbutton and Jim Carroll
Environmental Assessment Program
Washington State Department of Ecology
Spokane, Washington 99205

and

Elaine Snouwaert
Water Quality Program
Eastern Regional Office
Washington State Department of Ecology
Spokane, Washington 99205

Waterbody Number: WA-34-1030

This page is purposely left blank

Table of Contents

List of Figures

List of Tables

Abstract

The Palouse River and three of its tributaries (Rebel Flat Creek, Willow Creek, and Cow Creek) are listed on the federal Clean Water Act 303(d) list as impaired for fecal coliform bacteria. This total maximum daily load (TMDL) report includes a study of the bacteria impairment, indicates how much the bacteria needs to be reduced to meet Washington State water quality standards (load and wasteload allocations), and describes activities to achieve those reductions.

During June 2007 to May 2008, the Washington State Department of Ecology collected bacteria and streamflow data from 28 sites throughout the study area (part of the Palouse River watershed) twice per month. These data were analyzed to determine how much the current bacteria levels needed to be reduced to meet the water quality standards.

The Palouse River is required to have a geometric mean of less than 200 colony forming units/100 milliliters (cfu/100 mL), and not more than 10% of the samples used to calculate the geometric mean can exceed 400 cfu/100 mL. The tributaries in this study area are required to have a geometric mean of less than 100 cfu/100 mL, and not more than 10% of the samples used to calculate the geometric mean can exceed 200 cfu/100 mL.

This TMDL expresses load allocations as a percent reduction needed to meet the concentration-based standard. Wasteload allocations are expressed as concentration limits. These percent reductions are targets used to prioritize implementation activities to reduce the bacteria. Load allocations are established for nonpoint (diffuse) sources along the Palouse River, North Fork Palouse River, South Fork Palouse River, as well as Rebel Flat, Cow, Dry, Downing, Little Valley, Rock, Union Flat, and Willow Creeks. Wasteload allocations are established for the cities of Colfax and Endicott's wastewater treatment plants.

Compliance with this TMDL will be based on meeting the water quality standards.

Acknowledgements

The authors of this report would like to thank the following people for their contribution to this study:

- The many landowners who granted us access to sample the streams in the watershed.
- Fred Morrison and Bonny Paszkeicz with the Adams County Conservation District.
- Andy Rogers and Matt Hammer with the Colfax Wastewater Treatment Plant.
- Mike Issacs with the Endicott Wastewater Treatment Plant.
- Staff with the Department of Ecology, Environmental Assessment Program for help with stream sampling.
    - Dean Momohara, Nancy Rosenbower, Nancy Jensen, Pam Covey, and Leon Weiks, Manchester Environmental Laboratory
    - Tighe Stuart, Dan Sherratt, Jim Ross, and Mitch Wallace, Eastern Operations Section
    - James Kardouni, Nuri Mathieu, and Christopher Moore, Western Operations Section
    - Brenda Nipp, former staff, Eastern Operations Section
- Staff with the Department of Ecology, Water Quality Program for help with stream sampling.
    - Jon Jones, Donovan Gray, and Elizabeth Herrera, Eastern Regional Office
- Karin Baldwin, Paul Pickett, Helen Bresler, and Chad Atkins for their review of the report.
- Joan LeTourneau, Cindy Cook, Ann Kahler, and Donna Ward for formatting and editing the final report.
- Diane Dent and Kelsey Highfill for review, production and publication of the report.

Executive Summary

Introduction

Historical water quality monitoring has shown that portions of the Palouse River and its tributaries are impaired by elevated levels of fecal coliform bacteria, which do not protect the streams' beneficial uses. Fecal coliform bacteria are used as indicators of fecal contamination and the presence of other disease-causing (pathogenic) organisms. High fecal coliform bacteria numbers in waterways may pose an increased risk of infection from pathogens associated with fecal waste. This report contains a study of the bacteria levels throughout the Palouse River study area and a plan outlining how the streams will be brought into compliance with water quality standards.

What is a total maximum daily load (TMDL)?

The federal Clean Water Act (CWA) requires that states develop a list of impaired water bodies called the 303(d) list. Based on the 2008 303(d) list, the Palouse River, Rebel Flat Creek, and Willow Creek are impaired at certain locations. These sites were determined to be impaired based on sampling from 1988 to 2006 by the Washington State Department of Ecology (Ecology) and the Adams Conservation District.

A total maximum daily load (TMDL) must be developed for each of the water bodies on the 303(d) list. A TMDL:

- Contains a study that identifies pollution problems in the watershed.
- Specifies how much pollution needs to be reduced or eliminated to achieve clean water.
- Includes an *implementation plan* that describes the actions to control the pollution.

Ecology works with local governments, agencies, organizations and the community to develop the *implementation plan.*

The TMDL also includes a monitoring plan to assess the effectiveness of the water quality improvement activities. If monitoring shows that the actions outlined in this report are not reducing the bacteria, Ecology will apply adaptive management. Adaptive management allows us to fine-tune our actions to make them more effective, and to try new strategies if we have evidence that a different approach could help us to achieve compliance. This report is a starting point for addressing the bacteria problems, and the *implementation plan* may be adjusted as the community improves their understanding of the water quality problems.

The U.S. Environmental Protection Agency (EPA) must review and approve all TMDLs.

Watershed and study area description

The Palouse River watershed is located primarily in Whitman County, Washington, and its headwaters are in Latah County, Idaho (Figure 1). The portion of the Palouse watershed within Washington is known as Water Resource Inventory Area (WRIA) 34.

The Palouse River flows westward out of Idaho. The river eventually flows along the border of Whitman, Adams, and Franklin Counties near its confluence with the Snake River.

The TMDL study area (Figure 1) includes the Palouse River from Colfax to the Snake River, including the mouths of the tributaries to the Palouse.

The South Fork Palouse Rivers join the Palouse River at Colfax. The portion of the Palouse River upstream of Colfax is locally referred to as the North Fork Palouse River. Other tributaries in the study area include Dry Creek, Little Valley Creek, Downing Creek, Rebel Flat Creek, Rock Creek, Union Flat Creek, Willow Creek, and Cow Creek.

What needs to be done in this watershed?

The goal of this water quality improvement plan (or TMDL) is to achieve compliance with Washington State fecal coliform bacteria water quality criteria. This will return the Palouse River and its tributaries to a condition that provides a low risk of illness to people and animals using the streams. High levels of these bacteria can indicate untreated sewage or manure is entering streams, making them unsafe for recreation.

Bacteria sources can be diverse. In this watershed, some of the sources or activities that contribute to elevated bacteria include:

- Failing septic systems
- Livestock
- Pet waste
- Wastewater treatment plants
- Wildlife

While wildlife is included as a possible source, their bacteria contributions are considered natural and do not usually cause streams to violate water quality standards. Therefore, this source is not typically indicated for bacteria reductions. However, human activities such as removing vegetation along streams or feeding animals can encourage increased wildlife use. These are activities that can be modified to decrease wildlife bacteria in streams.

During the TMDL study, Ecology collected bacteria and streamflow data from 28 sites in the watershed, twice per month for a full year (June 2007 – May 2008). The results were partitioned into either a dry-season or a wet-season group based on streamflows for the analysis. The dry season was mid-June through October 2007. The wet season was early June 2007 and November 2007 through May 2008.

Bacteria load reduction targets, based on the reductions needed to meet water quality standards, were developed for the dry and wet seasons. Targets were expressed as a percent reduction from current concentration levels.

Bacteria loads were also calculated to help identify areas with the highest sources of pollution. Initial clean-up efforts will focus on areas that need the greatest target percent reductions and that have large bacteria loads. As the stream segments with high bacteria concentrations and loads are cleaned up, it is likely that reductions will also be observed downstream.

Compliance with this TMDL and the water quality standards will be determined by comparing monitoring data with the concentration-based water quality standards.

The range of percent reductions needed to meet the bacteria water quality standards in the various segments of each stream are presented in Table ES-1. Ecology monitored 11 sites on the Palouse River. In the dry season, 1 of the 11 sites required bacteria reductions (77%). In the wet season, none of the 11 sites required bacteria reductions. Eight of ten tributaries needed bacteria reductions in the dry season and six of ten tributaries needed wet season bacteria reductions. Multiple grants for Palouse River riparian and education projects were awarded to the Adams and Palouse-Rock Lake conservation districts prior to and during the TMDL study. These activities may be responsible for the lack of violations at sites that were listed as impaired on the 2008 303(d) list.

Table ES-1. Range of percent reductions needed to meet fecal coliform bacteria water quality standards in streams in the Palouse River study area.

Stream (number of monitoring sites)	Range of Percent Reductions Needed	
	Dry Season	Wet Season
Palouse River (11)	0% - 77%	0%
North Fork Palouse River (1)	43%	0%
South Fork Palouse River (1)	94%	72%
Dry Creek (1)	72%	69%
Little Valley Creek (1)	63%	19%
Downing Creek (1)	38%	0%
Rebel Flat Creek (5)	45% - 91%	0% - 58%
Rock Creek (1)	0%	0%
Union Flat Creek (1)	74%	34%
Willow Creek (1)	0%	0%
Cow Creek (2)	57% - 90%[1]	0% - 73%

[1]estimate due to insufficient number of samples.

Entities that discharge to the streams in the study area must be assigned wasteload allocations (limits) on the amount of fecal coliform bacteria they can discharge to the stream. In this study area, the Colfax and Endicott wastewater treatment plants (WWTP) require wasteload allocations, which are shown in Table ES-2.

Table ES-2. Municipal wastewater treatment plant (WWTP) wasteload allocations.

WWTP	NPDES Permit Limit
City of Colfax	400 cfu/100 mL weekly average 200 cfu/100 mL monthly average
City of Endicott	200 cfu/100 mL weekly average 100 cfu/100 mL monthly average

The water quality of the streams in the Palouse River study area must be improved to ensure these streams are safer for the activities for which we use the water. At current bacteria levels, certain segments of these streams pose a greater risk to anyone playing or working in the water. Achieving the reductions needed to bring these streams into compliance with the fecal coliform water quality standards depends on the participation of a broad range of entities. Implementation activities will generally involve agencies and organizations responsible for addressing nonpoint (diffuse) pollution sources. To effectively reduce nonpoint source pollution, these organizations will need to work with private landowners to implement best management practices (BMPs) designed to address the pollution issues.

Citizens of the watershed can help reduce bacteria levels by:

- Picking up pet waste and disposing of it properly.
- Regularly inspecting septic systems and repairing or replacing those with problems.
- Leaving natural vegetation along streams to filter runoff.
- Keeping animals away from streams and stream banks.
- Educating others about the impacts of everyday actions on water quality.

What is a Total Maximum Daily Load (TMDL)?

Federal Clean Water Act requirements

The Clean Water Act established a process to identify and clean up polluted waters. The Clean Water Act requires each state to have its own water quality standards designed to protect, restore, and preserve water quality. Water quality standards consist of (1) designated uses for protection, such as cold water biota and drinking water supply, and (2) criteria, usually numeric criteria, to achieve those uses.

Every two years, states are required to prepare a list of water bodies – lakes, rivers, streams, or marine waters – that do not meet water quality standards. This list is called the 303(d) list. To develop the list, Ecology compiles its own water quality data along with data from local, state, and federal governments, tribes, industries, and citizen monitoring groups. This is called a water quality assessment. All data are reviewed to ensure that they were collected using appropriate scientific methods before the data are used to develop the 303(d) list. The 303(d) list is part of the larger water quality assessment.

The water quality assessment tells a more complete story about the condition of Washington's water. The assessment divides water bodies into five categories:

Category 1 – Meets standards for parameter(s) for which it has been tested.

Category 2 – Waters of concern.

Category 3 – Waters with no data available.

Category 4 – Polluted waters that do not require a TMDL because:

- 4a. – Has an approved TMDL and it is being implemented.
- 4b. – Has a pollution control program in place that should solve the problem.
- 4c. – Is impaired by a non-pollutant such as low water flow, dams, and culverts.

Category 5 – Polluted waters that require a TMDL – the 303(d) list.

TMDL process overview

The Clean Water Act requires that a TMDL be developed for each of the water bodies on the 303(d) list. The TMDL study identifies pollution problems in the watershed and then specifies how much pollution needs to be reduced or eliminated to achieve clean water. Ecology works with the local community to develop an approach to reduce and control the pollution based on the recommendations and findings of the study and outlines a plan to monitor the results of implementation. This is called the *implementation plan* and is included at the end of this report.

Elements required in a TMDL

The goal of a TMDL is to ensure that impaired water will attain water quality standards. A TMDL includes a written, quantitative assessment of the water quality problems and of the pollutant sources that cause the problem, if known. The TMDL determines the amount of a given pollutant that can be discharged to the water body and still meet standards (the *loading capacity*), and allocates that load among the various sources.

Identifying the pollutant loading capacity for a water body is an important step in developing a TMDL. EPA defines the loading capacity as "the greatest amount of loading that a water body can receive without violating water quality standards" (EPA, 2001). The loading capacity provides a reference for calculating the amount of pollution reduction needed to bring a water body into compliance with the standards.

The portion of the receiving water's loading capacity assigned to a particular source is a *wasteload* or *load* allocation. If the pollutant comes from a discrete (point) source, such as a municipal or industrial facility's discharge pipe, that facility's share of the loading capacity is called a *wasteload allocation*. If the pollutant comes from a set of diffuse (nonpoint) sources such as general urban, residential, or farm runoff, the cumulative share is called a *load allocation*.

The TMDL must also consider seasonal variations, and include a *margin of safety* that takes into account any lack of knowledge about the causes of the water quality problem or its loading capacity. A *reserve capacity* for future loads from growth pressures is sometimes included as well. By definition, a TMDL is the sum of the allocations, which must not exceed the loading capacity. The sum of the wasteload and load allocations, the margin of safety, and any reserve capacity must be equal to or less than the loading capacity.

TMDL = Loading Capacity = sum of all wasteload allocations + sum of all load allocations + margin of safety.

Why Ecology is Developing a TMDL Study in this Watershed

Overview

The Washington State Department of Ecology (Ecology) is developing a *water quality improvement plan* (or TMDL) in the Palouse River watershed because historical data show that the Palouse River is impaired by elevated levels of fecal coliform (FC) bacteria and does not meet "Secondary Contact Recreation" beneficial use standards. The Palouse River, Rebel Flat Creek, and Willow Creek were included on Washington State's 2008 303(d) list of impaired water bodies for FC bacteria impairments.

FC bacteria are used as indicators of fecal contamination and the presence of other disease-causing (pathogenic) organisms. High FC bacteria numbers in waterways may pose an increased risk of infection from pathogens associated with fecal waste. This report includes a technical analysis of the FC loading in the watershed. This report also provides an implementation plan that will help the community reduce FC bacteria sources so the streams meet contact recreation water quality standards.

Study area

The study area for this total maximum daily load (TMDL) is within the Palouse River watershed within Washington State (Figure 1). This watershed is known as the Water Resource Inventory Area (WRIA) 34.

To keep the TMDL sampling to a manageable scale, the study focused on the mainstem Palouse River and the mouths of its tributaries from Colfax to Hooper. Rebel Flat Creek was sampled more extensively than the other tributaries.

Ecology sampled sites on the Palouse River from Colfax to Hooper. Many tributaries were also sampled: South Fork (SF) Palouse River, Dry Creek, Little Valley Creek, Downing Creek, Rebel Flat Creek, Rock Creek, Union Flat Creek, Willow Creek, and Cow Creek. The tributaries were sampled as near as access would allow to their confluence with the Palouse River. The Rebel Flat Creek sampling extended from near its confluence with the Palouse River to Thera in order to address impaired reaches.

The study area (Figure 1) was determined by selecting Hydrologic Unit Code Level 6 basins in Geographic Information System (GIS) that encompassed the Palouse River from Colfax to the Snake River including the mouths of the tributaries.

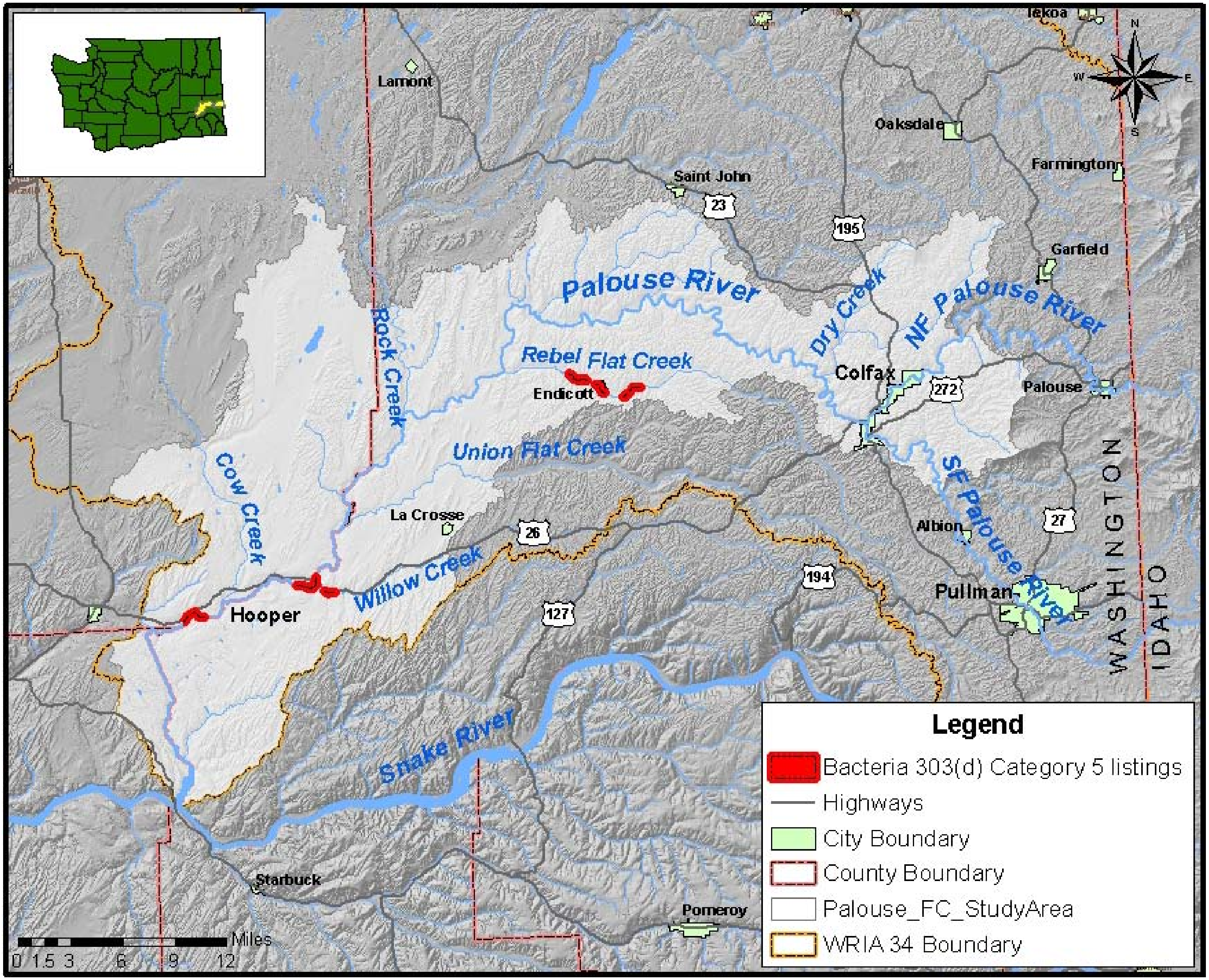


Figure 1. Study area portion of the Palouse River watershed.

Pollutants addressed by this TMDL

This TMDL addresses elevated FC bacteria levels in the Palouse River watershed. FC bacteria include many species of bacteria, including *Escherichia coli* (*E. coli*), which come from the intestines of warm-blooded animals including humans (Figure 2). High levels of these bacteria can indicate untreated sewage or manure is entering streams, making them unsafe for recreation.

Streams in this watershed are also impaired by high temperatures, low dissolved oxygen levels, and pH outside the optimal range to support aquatic life. These impairments are not addressed in this TMDL report but will be addressed in future reports. There are also additional FC bacteria impairments in the smaller SF Palouse River watershed. These are addressed by a separate TMDL report (Carroll and Snouwaert, 2009).

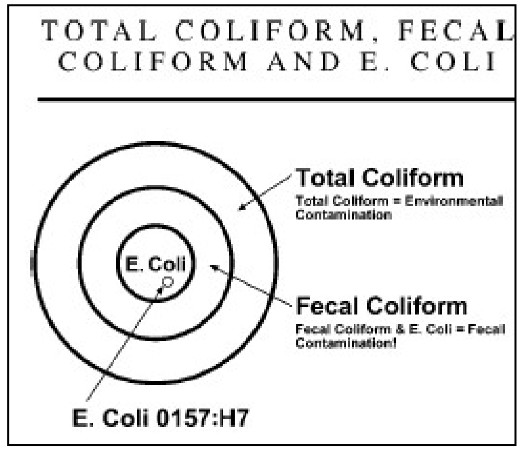


Figure 2. Relationship between total coliform, fecal coliform, and E. coli.

Impaired designated uses and water bodies on Ecology's 303(d) list of impaired waters

The Washington State Water Quality Standards, set forth in Chapter 173-201A of the Washington Administrative Code (WAC), include designated beneficial uses as well as numeric and narrative water quality criteria for surface waters of the state. The numeric and narrative water quality criteria are set at levels to protect the designated beneficial uses. In other words, the criteria are set to protect the streams for the ways people use them.

The mainstem segment of the Palouse River from Colfax (below confluence with the SF Palouse River) to the Palouse Falls is designated as *Secondary Contact* recreation. From the Palouse Falls to the mouth, the river is designated as *Primary Contact* recreation. The tributaries of the Palouse River addressed in this TMDL, including the North Fork (NF) Palouse and SF Palouse, are designated as *Primary Contact* recreation (Chapter 173-201A WAC).

Examples of Secondary Contact and Primary Contact uses are described in the next section, *Water Quality Standards and Designated Uses*.

Many of the 2008 303(d) listings covered by this TMDL (Table 1) were derived from lower Palouse River monitoring conducted by the Adams Conservation District (CD) under an Ecology approved Quality Assurance Project Plan (Resource Planning Unit, Inc., 2002). This monitoring was conducted from 2002 – 2006. The results can be found in the final report (DeVore and Quast, 2006) and online in Ecology's Environmental Information Management (EIM) database.

The monitoring that resulted in the Rebel Flat Creek 303(d) listings was conducted by Ecology in 1988. The results can be found in the final report (Willms and Kendra, 1990).

Table 1. Category 5 waterbody segments on the 2008 303(d) list for fecal coliform addressed in this TMDL study area *(part of the Palouse River watershed).*

Waterbody	Township	Range	Section	2008 Listing ID	TMDL Station
Palouse River	15N	38E	21	46012	34PAL25.7
	15N	37E	32	46013	34PAL15.8
Rebel Flat Creek	17N	40E	25	6714	34REB05.7
	17N	41E	31	6715	34REB06.6
	17N	41E	33	6716	34REB08.2
Willow Creek	15N	38E	27	46014	34WIL00.2

Comparisons between the two sets of data (historical and this TMDL study) are limited because conditions have changed. For example, Endicott constructed a new wastewater treatment plant in 2001, replacing the previous wastewater treatment plant that was constructed in 1953 (Ecology, 2005).

In addition, multiple grants for Palouse River riparian and education projects were awarded to Adams and Palouse Rock-Lake CDs, which may have resulted in fewer water quality standards violations during the TMDL study. The Adams CD grants were awarded during or after the time of the Adams CD lower Palouse monitoring (Paszkeicz, 2009).

Cow Creek was listed on earlier 303(d) lists. Implementation activities, which address the FC bacteria impairment in Cow Creek, have been ongoing. An evaluation of these efforts reclassified these impairments to Category 4b (addressed by a water pollution control program) on the current 2008 303(d) list.

During this TMDL study, Ecology found other stream segments not on the 303(d) list with bacteria levels that exceeded water quality criteria. This TMDL sets pollutant allocations necessary for all impaired segments within the study area to meet water quality standards.

Bacteria impairments on Pleasant Valley Creek and Pine Creek were outside the study area and are not addressed in this study due to resource constraints (Table 2).

Table 2. Category 5 waterbody segments on the 2008 303(d) list for fecal coliform not addressed in the Palouse River Watershed.

Waterbody	Township	Range	Section	2008 Listing ID	TMDL Station
Pleasant Valley Creek	19N	41E	34	42792	NA
Pine Creek	20N	43E	10	16793	NA

Why are we doing this TMDL now?

The Clean Water Act requires TMDLs be developed to return all impaired water bodies to a condition that meets water quality standards. Ecology has a memorandum of agreement with the Environmental Protection Agency that outlines a schedule for completing TMDLS. To meet this schedule, Ecology selects watersheds for TMDL development each year. The Palouse River watershed was selected in 2005 to begin TMDL development. This watershed had multiple impairments throughout that had not been addressed. Bacteria levels had a long record of being too high.

Due to the size of the watershed and the variety of impairments, the work has been divided into several projects. The *Palouse River Chlorinated Pesticide and PCB TMDL* (Johnson, et. al, 2007) addressed the Palouse River and South Fork Palouse River and was completed in 2007.

For other pollutants, the South Fork Palouse River and the main stem Palouse have been studied separately due to the size of the watershed and Ecology's limited resources. *The South Fork Palouse River Fecal Coliform Bacteria TMDL* (Carroll & Snouwaert, 2009) was completed in October 2009 and Ecology is currently developing an implementation plan for that project. Significant reductions at the mouth of the South Fork Palouse River are required by the South Fork Palouse Bacteria TMDL and will also be important to meeting standards in the Palouse River immediately downstream of the confluence.

Other TMDLs for temperature, dissolved oxygen, and pH were in development for both the South Fork Palouse River watershed and the main stem Palouse River watershed at the time this report was published.

This page is purposely left blank

Water Quality Standards and Designated Uses

Bacteria criteria are set to protect people who work and play in and on the water from waterborne illnesses. In Washington State, Ecology's water quality standards use fecal coliform (FC) bacteria as indicator bacteria for the state's freshwaters (e.g., lakes and streams). FC bacteria in water indicate the presence of waste from humans and other warm-blooded animals. Waste from warm-blooded animals is more likely to contain pathogens that will cause illness in humans than waste from cold-blooded animals. The FC bacteria criteria are set at levels that have shown to maintain low rates of serious intestinal illness (gastroenteritis) in people.

The recreational and beneficial uses for most of the Palouse River within the study area are designated as *Secondary Contact* use. The recreational and beneficial uses of the Palouse River from Palouse Falls to the mouth and for the tributaries of the Palouse River are designated as *Primary Contact* use.

> (1) The *Primary Contact* use is intended for waters "where a person would have direct contact with water to the point of complete submergence including, but not limited to, skin diving, swimming, and waterskiing." More to the point, however, the use is designated to any waters where human exposure is likely to include exposure of the eyes, ears, nose, throat, and urogenital system. Since children are also the most sensitive group for many of the waterborne pathogens of concern, even shallow waters may warrant primary contact protection. To protect this use category: "Fecal coliform organism levels must not exceed a geometric mean value of 100 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 200/colonies mL" [WAC 173-201A-200(2)(b), 2003 edition].
>
> (2) The *Secondary Contact* use is intended for waters "where a person's water contact would be limited (e.g., wading or fishing) to the extent that bacterial infections of the eyes, ears, respiratory or digestive systems, or urogenital areas would be normally avoided." To protect this use category: "Fecal coliform organism levels must not exceed a geometric mean value of 200 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 400/colonies mL" [WAC 173-201A-200(2)(b), 2003 edition].

Compliance is based on meeting both the geometric mean criterion and the 10% of samples (or single sample if less than ten total samples) limit. While some discretion exists for selecting sample averaging periods, compliance will be evaluated for seasonal (dry or non-runoff versus wet or runoff) data sets.

The criteria for FC bacteria are based on allowing no more than the pre-determined risk of illness to humans that work or recreate in a water body. The criteria used in the Washington state standards are designed to allow eight or fewer illnesses out of every 1,000 people engaged in Secondary Contact activities. Once the concentration of FC bacteria in the water reaches the numeric criterion, human activities that would increase the concentration above the criteria are not allowed. If the criterion is exceeded, the state requires that human activities be conducted in a manner that will bring FC concentrations back into compliance with the standard.

If natural levels of FC bacteria (from wildlife) cause criteria to be exceeded, no allowance exists for human sources to measurably increase bacterial pollution. While the specific level of illness rates caused by animal versus human sources has not been quantitatively determined, warm-blooded animals (particularly those that are managed by humans and thus exposed to human-derived pathogens as well as those of animal origin) are a common source of serious waterborne illness for humans.

Watershed Description

The Palouse River basin is located primarily in Whitman County, Washington, and its headwaters are in Latah County, Idaho (Figure 1). The portion of the Palouse watershed within Washington is known as Water Resource Inventory Area (WRIA) 34. The headwaters of the Palouse River start within the Palouse Mountain Range in St. Joe National Forest. The river flows roughly 54 river miles downstream to the SF Palouse River confluence at Colfax. The portion of the river from the Idaho state line to Colfax is locally referred to as the North Fork Palouse River. Then the Palouse River travels westward out of Colfax for another 91 river miles, passing through Palouse soils and into the channeled scablands. The river eventually flows along the border of Whitman, Adams, and Franklin Counties near its confluence with the Snake River. The Palouse Falls (182 foot cliff) occurs six river miles upstream of the Palouse River's mouth. The Snake River flows into the Columbia River, which flows into the Pacific Ocean (Resource Planning Unlimited, Inc., 2004).

The Palouse River is approximately 144 miles long, 120 miles of which are within Washington State. The Palouse River watershed area is approximately 3,281 square miles (2,099,832 acres). The NF Palouse River basin area is approximately 495 square miles (316,799 acres) and contributes around 83% of the mean annual flow of the Palouse River at Colfax (Ahmed, 2004). The SF Palouse River basin area is approximately 344 square miles (219,943 acres) and joins the Palouse River at Colfax (Bilhimer et al., 2006).

Climate

The Palouse River watershed has a semi-arid climate. Annual precipitation in this watershed can range from 10 inches in the western region to 50 inches in the eastern region mountains of Idaho. Along the more mountainous eastern region, mean annual precipitation increases roughly seven inches with every 1,000 foot increase in elevation. Precipitation peaks during winter and falls primarily as snow, especially in the mountains (Resource Planning Unlimited, Inc., 2004). A drought was declared in 2001 and 2005. Summer daily maximum air temperatures can range from mid-70ºF to mid-90ºF (around 21ºC to 35ºC) and occasionally over 100ºF (37.8ºC).

Hydrology

The Palouse River watershed includes over 398 miles of streams. Major tributaries and their approximate relative percent contribution of drainage area are as follows (Golder Associates, Inc., 2004):

- Cow Creek 22.4%
- Palouse River Mainstem 17.2%
- NF Palouse River 14.9%
- Rock Creek 12.1%
- Pine Creek 10.8%
- Union Flat Creek 9.6%

- SF Palouse River 8.9%
- Cottonwood Creek 4.2%

The U.S. Geological Survey (USGS) currently operates two streamflow gages on the Palouse River. Average monthly flows for the two gages are displayed in Figure 3.

- USGS streamflow gage #13351000 is located at Hooper, WA at river mile 19.6 downstream of the State Highway 26 Bridge and 0.3 miles upstream of Cow Creek confluence. This gage station captures 2,500 square miles of the Palouse River watershed. It began recording in 1897, ceased during 1916, then started again in 1951 to the present.
- USGS streamflow gage #13345000 is located near Potlatch, ID at river mile 132.2 downstream of US Highway 95. This gage station near Potlatch captures 317 square miles of the Palouse watershed. It has recorded from 1914 to 1919, and 1966 to present.

The majority of the flow is present December through June, peaking in March when the watershed is routing snowmelt runoff from mountains in Idaho. Summertime flow can be very small in comparison to the runoff flow. Time-of-travel during the summer can exceed a month from Colfax to Winona (about 50 miles).

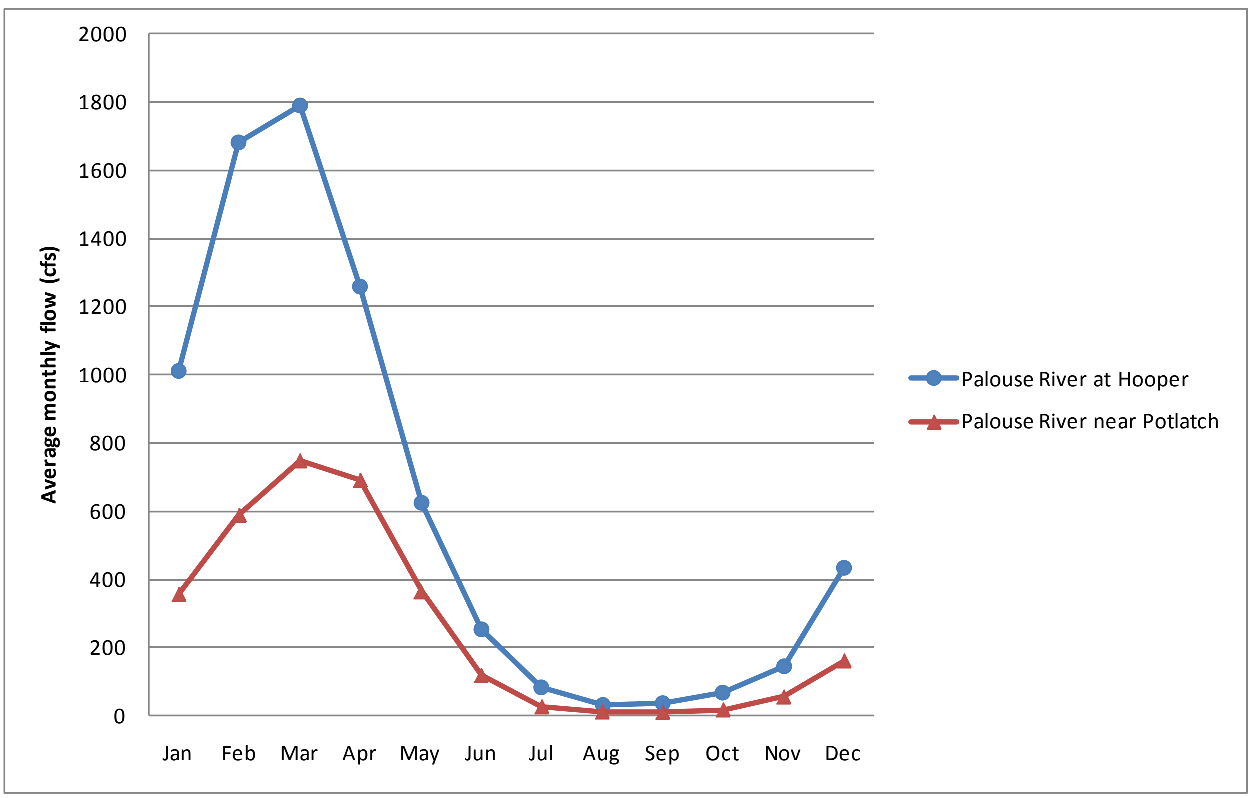


Figure 3. Average monthly flows for the two USGS streamflow gages on the Palouse River.

Geology

Around 110 million years ago, geologic activity forced giant granite slabs upward, initiating the features of southeast Washington. Eventually, regional volcanic activity began. Fissures opened as the Palouse River basin received intermittent lava flows 10-30 million years ago that filled valleys with Columbia River basin basalts. Receding ice-age glaciers, coupled with an arid climate, produced fine-grained sediment that was carried by prevailing winds. This wind-blown sediment, called *loess*, deposited on the basalt forming large dunes known as the Palouse formation. Immense Missoula floods occurred several times, washing away areas of loess, altering the landscape, and creating channeled scablands. These scablands comprise an area of approximately 15,000 square miles including segments of the Spokane, Snake, and Columbia Rivers (Resource Planning Unlimited, Inc., 2004 and Kuttel Jr., 2002).

Vegetation

Historically, the Palouse River watershed supported a variety of vegetation depending on sub-regional climate. For example, the eastern region of the watershed predominantly grew two types of perennial grass: Idaho fescue (*Festuca idahoensis*) and blue bunch wheatgrass (*Pseudoregneria spicata*). The shrubs that often grew on the north aspect of the loess hills included snowberry (*Symphoricarpos* spp.), black hawthorn (*Crataegus douglasii*), and rose (*Rosa* spp.). Riparian areas in the eastern region commonly supported quaking aspen (*Populus tremuloides*) and cow parsnip (*Heracleum lanatum*) among other mentioned species herein.

Forest communities grew in the higher elevations of the eastern region. Species included ponderosa pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menziesii*), western red cedar (*Thuja plicata*), grand fir (*Abies grandis*), and western larch (*Larix occidentalis*), depending on aspect and available water. The forest understory included ocean spray (*Holodiscus discolor*), ninebark (*Physocarpus malvaceus*), serviceberry (*Amelanchier alnifolia*), snowberry, and wild rose.

Wetlands existed across the watershed, with the greatest amount in the northwest region. The highly diverse wetland vegetation was dominated by camas, forbs, sedges, rushes, and grasses.

The western region of the watershed was dominated by bluebunch wheatgrass. The western region riparian corridor also supported trees such as cottonwood (*Populus deltoids*), quaking aspen, mountain maple (*Acer glabrum*), and red alder (*Alnus rubra*).

Currently, most of the Palouse Prairie has been converted to crop or range land (Resource Planning Unlimited, Inc., 2004).

Land-use patterns

Land use is dominated by agriculture (primarily dry-land wheat farming) and rangeland with small rural city populations. Colfax (population about 3,000) is the largest town within the study area. The next largest town in the study area is Endicott (population about 350). Smaller towns, with populations not exceeding 350, are located within the watershed as well (WA OFM, 2007). Agricultural use of water from the Palouse River is limited to adjacent land. To date, slightly over 100 water rights exist that draw from the Palouse River. These surface water withdrawals are typically used for irrigation and stock. Rangeland mostly occurs in the scablands or the western region of the Palouse River watershed (Resource Planning Unlimited, Inc., 2004).

Pollution Sources

The following are potential sources of FC bacteria in the study area (part of the Palouse River watershed).

Point sources / permit holders

FC bacteria can be present in a wide variety of municipal and industrial wastewater and stormwater sources. No method is 100% effective at removing FC bacteria all of the time, so FC bacteria can enter the receiving waters from these sources. FC bacteria and other potential contaminants from industrial and municipal sources are regulated by various National Pollutant Discharge Elimination System (NPDES) and state waste permits issued by Ecology.

Wastewater

The Palouse River within the study area receives water from two wastewater treatment plants (WWTPs): one at Colfax and one at Endicott (via Rebel Flat Creek). Both WWTPs are regulated under NPDES permits.

The Colfax WWTP, at the west edge of town, consists of an aerated lagoon system with chlorine disinfection and disposal to infiltration basins. The basins are adjacent to and topographically upgradient of the Palouse River. The basins were designed to allow seepage to the river (Ecology, 1997).

The Endicott WWTP, at the northwest corner of town, consists of an Aero-Mode proprietary system with ultraviolet (UV) disinfection. Treated effluent from the plant discharges to Rebel Flat Creek via gravity outfall cascade (Ecology, 2005).

Stormwater

During precipitation events, rainwater washes over the surface of the landscape, pavement, rooftops, and other impervious surfaces. This stormwater runoff can accumulate and transport fecal matter via stormwater drains to receiving waters and potentially degrade water quality (Lubliner et al., 2006).

In 1987, Congress changed the federal Clean Water Act by declaring the discharge of stormwater from certain industries and municipalities to be a point source of pollution. Due to this change, certain stormwater discharges now require a NPDES permit or water quality discharge permit. While stormwater in the smaller towns of Colfax and Endicott is not regulated through an NPDES permit, stormwater may be a source of bacterial contamination.

The Washington State Department of Transportation has a state-wide stormwater permit that applies in NPDES Phase I and Phase II coverage areas and to the state highways within TMDL boundaries that are assigned implementation actions. WSDOT highways within the Palouse River TMDL boundary include portions of Highways 23, 26 and 195.

Empire Disposal, Inc. in Colfax has a general industrial stormwater permit.

Nonpoint sources

Nonpoint (diffuse) sources of FC bacteria are not controlled by discharge permits. Potential nonpoint sources in the study area include the following:

- Livestock with direct access to streams and other poor management of livestock manure.
- Poor management of pet waste.
- Poorly constructed or maintained on–site septic systems.
- Wildlife and background sources.

FC bacteria from nonpoint sources are transported to the creeks by direct and indirect means. Manure that is spread over fields during certain times of the year can enter streams via direct discharge to the water, surface runoff, or fluctuating water levels. Often livestock have direct access to water. Manure is deposited in the riparian area where fluctuating water levels, surface runoff, or constant trampling can bring the manure into the water. Pet waste concentrated in public parks or private residences can be a source of contamination, particularly in urban areas. Some residences may have wastewater piped directly to waterways or may have malfunctioning on-site septic systems where effluent seeps to nearby waterways. Swales, sub-surface drains, and flooding through pastures and near homes can carry FC bacteria from sources to waterways.

The Palouse River watershed supports a wide variety of wildlife. Multiple species of perching birds, upland game birds, raptors, and waterfowl are found within the watershed. Birds, elk, deer, beaver, muskrat, and other wildlife are potential sources of FC bacteria. Open fields and riparian areas lacking vegetation are attractive feeding and roosting grounds for some birds (such as geese) whose presence can increase FC counts in runoff. Human activities, such as removing canopy cover and riparian areas, can cause wildlife to congregate near streams, elevating bacteria counts.

Re-suspension and re-growth sources

There is evidence that FC bacteria can settle into the sediments where they can survive to later re-suspend into the water column after sediment disturbance (e.g., increased streamflow). There is also evidence that bacteria can survive the disinfection processes of WWTPs to reactivate or re-grow in downstream receiving waters, particularly when there is a high dissolved organic carbon content in the wastewater. Rifai and Jensen (2002) provide a literature summary of these phenomena. Studies show that bacteria survival rates in sediment increase with declining sediment particle size. Re-growth of bacteria has been seen downstream of WWTP discharges where the chlorine has dissipated from chlorinated discharges or when the discharge was de-chlorinated prior to discharge.

Goals and Objectives

Project goals

The goal of this water quality improvement plan (or TMDL) is to achieve compliance with Washington State fecal coliform criteria, which will return the Palouse River and its tributaries to a condition that provides low illness risk to people and animals using the streams. The TMDL will achieve this goal by establishing load allocations (for nonpoint sources), wasteload allocations (for point sources), and implementation actions to bring the stream into compliance with the FC bacteria water quality criteria.

Study objectives

A quality assurance project plan (Mathieu et al., 2007) was approved in May 2007 to gather data for this water quality improvement plan.

The objectives of the 2007-08 study were to:

- Identify and characterize FC concentrations and loads from all tributaries, point sources, and drainages into the Palouse River under various seasonal or hydrological conditions.
- Establish FC load allocations (for nonpoint sources) and wasteload allocations (for point sources) to protect beneficial uses, including Primary and Secondary Contact.
- Identify relative contributions of FC loading to the Palouse River so clean-up activities can focus on the largest sources first.

This page is purposely left blank

Field Data Collection

Ecology developed a quality assurance (QA) project plan for the *Palouse River Bacteria Total Maximum Daily Load* (Mathieu et al., 2007) to provide background information and detailed description of monitoring and sample processing activities. The QA project plan was reviewed by a Palouse River Technical Advisory Group and approved by Ecology for sampling in May 2007.

Sample dates

Sampling began on June 13, 2007 and continued until May 28, 2008. Table 3 lists the 24 bi-monthly sampling surveys. The surveys were partitioned into either a dry-season or a wet-season group based on graphical assessment of measured streamflows to determine the dry and wet periods.

Table 3. Sampling dates for the Palouse River FC Bacteria TMDL, 2007-08.

Dry Season	Wet Season
June 26-27, 2007	June 13, 2007
July 10-11, 2007	November 13-14, 2007
July 24-25, 2007	November 27-28, 2007
August 7-8, 2007	December 3-4, 2007
August 21-22, 2007	December 18-19, 2007
September 11-12, 2007	January 8-9, 2008
September 25-26, 2007	January 22-23, 2008
October 9-10, 2007	February 12-13, 2008
October 23-24, 2007	February 26-27, 2008
	March 11-12, 2008
	March 25-26, 2008
	April 8-9, 2008
	April 22-23, 2008
	May 13-14, 2008
	May 27-28, 2008

The QA project plan included other parameters to assist in the FC evaluation. FC bacteria are often associated with total suspended solids (TSS) runoff, so TSS and turbidity were included as supplementary parameters. Additionally, instantaneous field measurements included conductivity, temperature, pH, and dissolved oxygen using a calibrated Hydrolab MiniSonde®. Winkler titrations (WAS, 1993) were used as replicate method for the dissolved oxygen measurements.

Seasonal source assessment

Separate bacteria source assessment (or screening) was analyzed for either a dry or wet season (i.e., non-runoff and runoff period). The determination of dry and wet seasons was based on graphical assessment of measured streamflows. Figure 4 shows 2007-08 study year flows at various sampling locations.

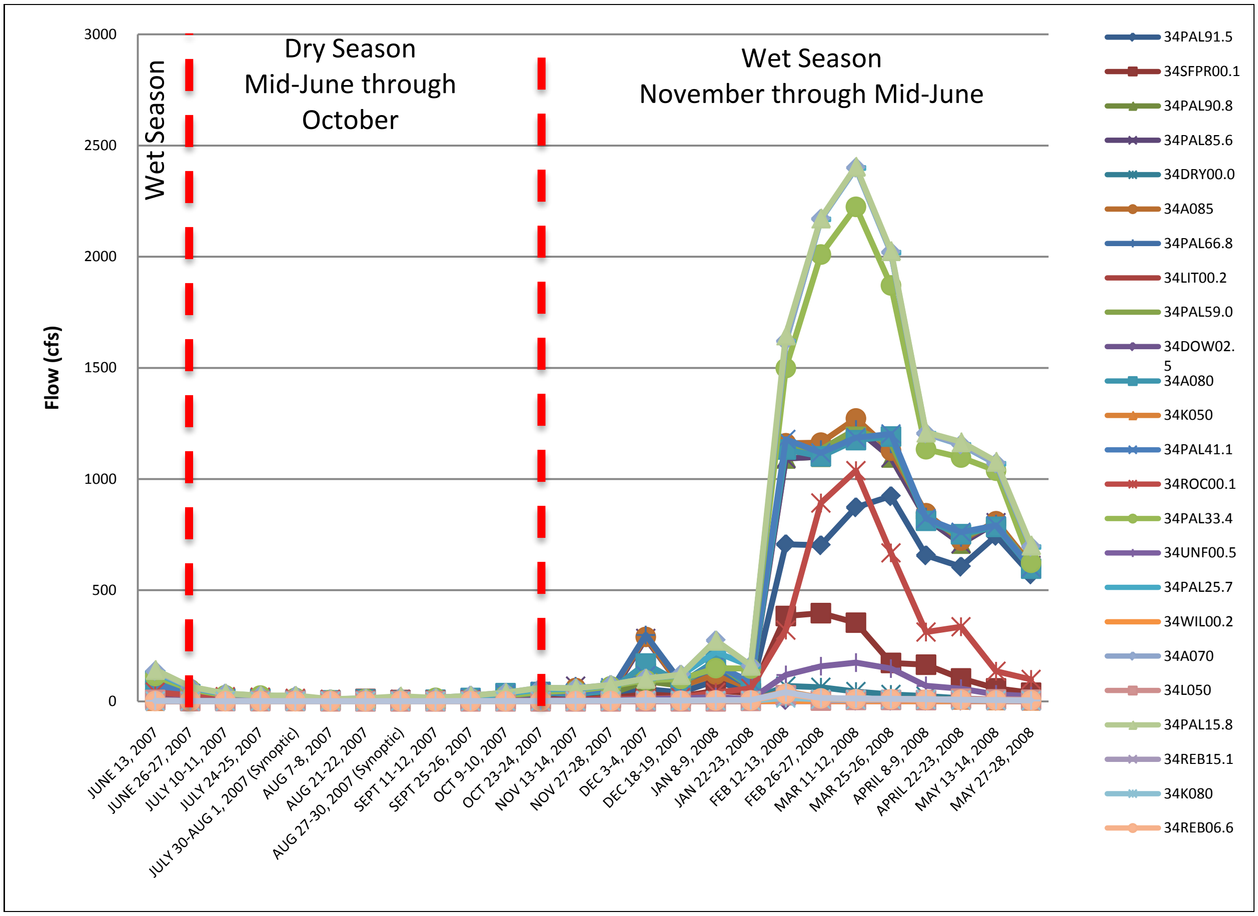


Figure 4. Designation of dry and wet seasons for the 2007-08 TMDL study based on measured streamflows.

The dry period began in mid-June and continued through October. The wet season extended through the rest of the year when flows were higher, including more runoff events. Ecology analyzed the two seasons separately because the modes of pollution differ for the two periods. Dry-season (non-runoff) sources include:

- Direct discharge from wastewater treatment plants.
- Indirect discharge from leaking sanitary sewer and septic systems.
- Direct discharge from failing septic systems.
- Direct deposition of feces into surface waters by animals.

- Contaminated runoff from dry weather outdoor water use, such as landscape irrigation and vehicle washing.
- Direct discharge of contaminated non-stormwater discharges. During non-runoff periods, water from springs and other sources may be discharged to streams. It is possible for this water to be contaminated with bacteria at the source or within the conveyance system.

Wet-season (runoff) sources includes all of the above, but are dominated by urban, rural, and agricultural runoff from precipitation, snowmelt, and stormwater flow.

Sample locations

FC bacteria and streamflow data were collected from 28 sites in the watershed. Figure 5 shows all sampling locations. Table 4 lists the corresponding location identification, description, and latitude/longitude of the sampling sites.

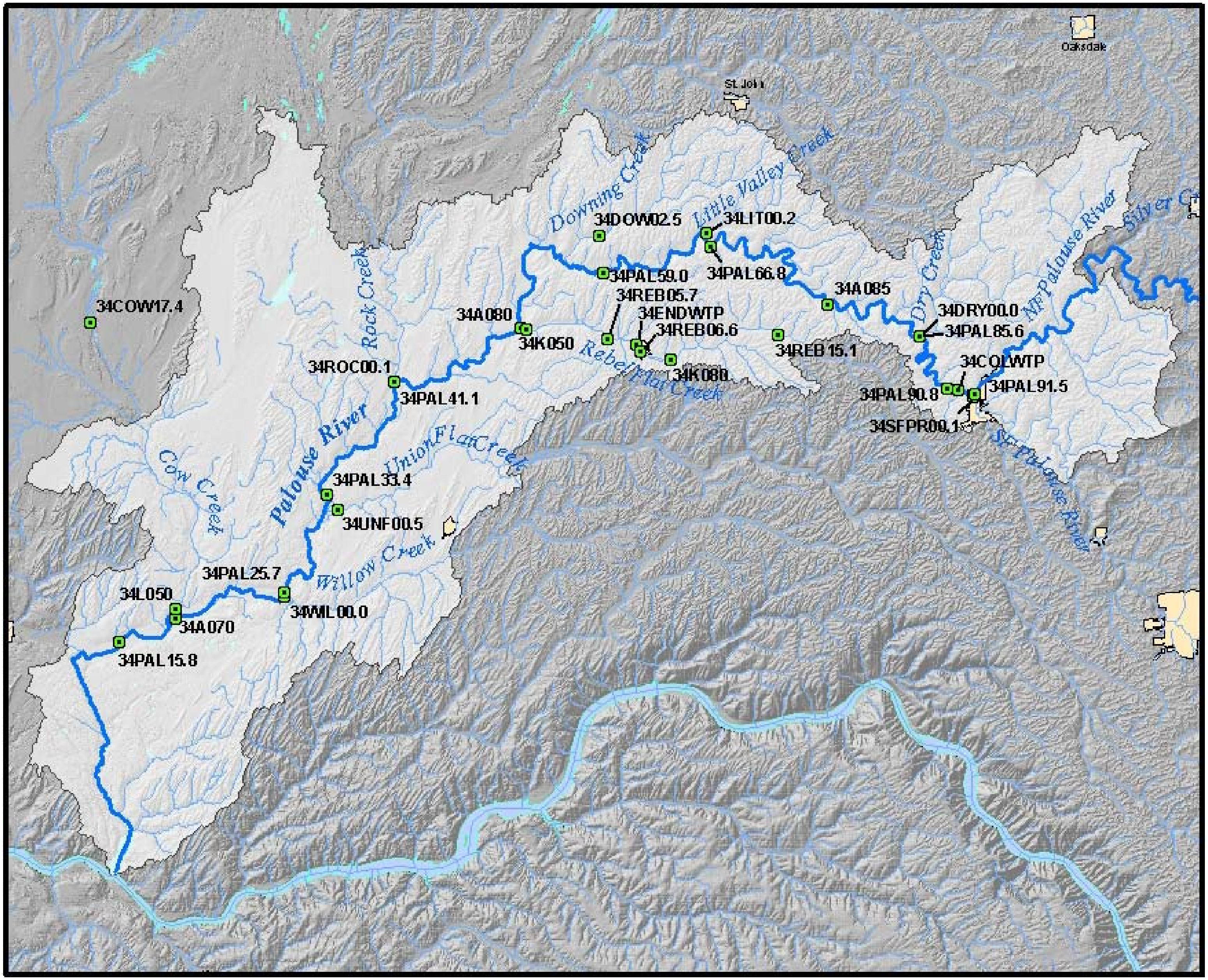


Figure 5. Map of the Palouse River TMDL study area with sampling stations.

Table 4. List of Palouse River FC Bacteria TMDL sampling stations, 2007-08.

Station ID (RM Included)	Station Description	Longitude	Latitude
34COLWTP	Colfax Wastewater Treatment Plant (aka Well ACP674)	-117.3816	46.8927
34COW00.7	Cow Creek at mouth (aka 34L050)	-118.1461	46.7658
34COW17.4	Cow Creek at Benge-Ralston Road	-118.2212	46.9588
34DOW02.5	Downing Creek at Kackman Road near mouth	-117.7244	47.0043
34DRY00.0	Dry Creek at Manning near mouth	-117.4081	46.9317
34ENDWTP	Endicott Wastewater Treatment Plant	-117.6912	46.9311
34LIT00.2	Little Valley Creek near mouth, Jones Road	-117.6181	47.0042
34PAL15.8	Palouse River at West Hooper	-118.2024	46.7439
34PAL19.5	Palouse River at Hooper (aka 34A070)	-118.1480	46.7590
34PAL25.7	Palouse River above Willow Creek, Hwy 26	-118.0418	46.7735
34PAL33.4	Palouse River above Union Flat Creek	-117.9972	46.8381
34PAL41.1	Palouse River above Rock Creek, Hawks Road	-117.9278	46.9116
34PAL49.4	Palouse River above Rebel Flat Creek (aka 34A080)	-117.8033	46.9450
34PAL59.0	Palouse River at Kackman Road far upstream of Downing Creek	-117.7190	46.9801
34PAL66.8	Palouse River at Endicott, St John Road	-117.6167	46.9946
34PAL77.8	Palouse River at Shields Road Bridge (aka 34A085)	-117.5033	46.9527
34PAL85.6	Palouse River at Manning, above Dry Creek	-117.4168	46.9290
34PAL90.8	Palouse River below Colfax WTP	-117.3857	46.8935
34PAL91.5	Palouse River at Colfax (aka North Fork Palouse River near mouth)	-117.3659	46.8897
34REB00.3	Rebel Flat Creek at mouth (aka 34K050)	-117.7967	46.9433
34REB05.7	Rebel Flat Creek at Swent Road	-117.7189	46.9356
34REB06.6	Rebel Flat Creek above Endicott, 3rd Street bridge	-117.6886	46.9266
34REB08.2	Rebel Flat Creek at Repp Road (aka 34K080)	-117.6578	46.9200
34REB15.1	Rebel Flat Creek at Thera near grain elevators	-117.5541	46.9337
34ROC00.1	Rock Creek near mouth, Hawks Road	-117.9229	46.9298
34SFPR00.1	South Fork Palouse River near mouth	-117.3664	46.8879
34UNF00.5	Union Flat Creek near mouth, Wise Road	-117.9864	46.8281
34WIL00.2	Willow Creek near mouth	-118.0412	46.7712

RM = river mile.
Aka = also known as.

This page is purposely left blank

Study Methods

Field collection methods

Field collection study methods were described in the *Quality Assurance Project Plan: Palouse River Bacteria Total Maximum Daily Load* (Mathieu et al., 2007). Some water collection and analyses – including chloride, turbidity, dissolved oxygen, pH, temperature, and conductivity were performed and will be reported in later TMDL reports on temperature, dissolved oxygen and pH processes in the Palouse River. Table 5 describes the analyses, methodologies, and measurement or data quality objectives used in the FC bacteria TMDL study.

Table 5. Study analysis methodologies with precision targets and reporting limits.

Analysis	Method	Field Replicate MQO	Lab Duplicate MQO	Reporting Limits and Resolution
Field Measurements				
Velocity[1]	Marsh McBirney Flow-Mate Flowmeter	0.1 ft/s	n/a	0.01 ft/s
Water Temperature[1]	Hydrolab MiniSonde®	+/- 0.1° C	n/a	0.01° C
Specific Conductivity[2]	Hydrolab MiniSonde®	+/- 0.5%	n/a	0.1 umhos/cm
pH[1]	Hydrolab MiniSonde®	0.05 SU	n/a	1 to 14 SU
Dissolved Oxygen[1]	Hydrolab MiniSonde®	5% RSD	n/a	0.1 - 15 mg/L
	Winkler Titration	+/- 0.1 mg/L	n/a	0.01 mg/L
Laboratory Analyses				
Fecal Coliform – MF	SM 9222D	30% RSD[3]	40% RPD	1 cfu/100 mL
Chloride	EPA 300.0	5% RSD[4]	20% RPD	0.1 mg/L
TSS	SM 2540D	10% RSD[4]	20% RPD	1 mg/L
Turbidity	SM 2130	10% RSD[4]	20% RPD	1 NTU

[1] as units of measurement, not percentages.
[2] as percentage of reading, not relative standard deviation (RSD).
[3] replicate results with a mean of less than or equal to 20 cfu/100 mL will be evaluated separately.
[4] replicate results with a mean of less than or equal to 5 times the reporting limit will be evaluated separately.
MQO = Measurement quality objective.
SU = Standard pH units.
MF = Membrane filter method.
SM = Standard Methods for the Examination of Water and Wastewater, 20th Edition (APHA et al., 2005).
EPA = U.S. Environmental Protection Agency method code.

During the field surveys, streamflow was measured at selected stations, and/or staff gage readings were recorded. Estimation of instantaneous flow measurements followed the Environmental Assessment Program standard operating procedure (Ecology, 2007). Flow volumes were calculated from continuous stage height records, and rating curves were developed prior to, and during, the project. Stage heights were measured by pressure transducer and recorded by a data logger every 15 minutes. Streamflow data collected by USGS were also used.

Analytical methods

Statistical Roll-Back Method

Although TMDL studies normally express allocations as pollutant loads (pollutant concentration multiplied by streamflow), this approach does not work well for bacteria TMDL studies. An allocation of FC bacteria pollutant loads in terms of "numbers of bacteria per day" is awkward and challenging to understand. Instead of managing FC pollution in terms of total load, Ecology has used the Statistical Rollback Method (Ott, 1995) to manage the distribution of FC counts. The approach relates the analysis to the FC concentration standard better and has proven successful in past bacteria TMDL assessments (Cusimano, 1997; Joy, 2000; Sargeant, 2002).

The Statistical Roll-Back Method was used to establish FC reduction targets at all sampling sites that had sufficient sampling size (>4 samplings). The roll-back method assumes that the distribution of FC 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 can then be compared to the FC concentration standards.

The roll-back procedure used is as follows:

- A check was made to ensure the FC data collected in 2007-08 fit a log-normal distribution at each sampling location. WQHYDRO® (Aroner, 2003) was used to test the FC data for log-normal distribution fit.
- An Excel® spreadsheet was used to calculate the geometric mean of the data.
- The 90th percentile of the data was estimated by using the following statistical equation. [The 90th percentile value of samples was used in this TMDL evaluation as an estimate for the "no more than 10% samples exceeding ...." criterion in the FC bacteria standard (WAC 173-201A).]

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

where: μ_{log} = mean of the log-transformed data.

σ_{log} = standard deviation of the log-transformed data.

- The target percent reduction required for the Palouse River was set as the highest of the following two resulting *Secondary Contact* values:

$$\text{Target percent reduction} = \left[\frac{observed\ 90th\ \ percentile - 400\ cfu/100mL}{observed\ 90th\ \ percentile}\right]x100$$

$$\text{Target percent reduction} = \left[\frac{observed\ \ geometric\ mean - 200\ cfu/100mL}{observed\ \ geometric\ mean}\right]x100$$

- The target percent reduction required for the tributaries of the Palouse River was set as the highest of the following two resulting *Primary Contact* values:

$$\text{Target percent reduction} = \left[\frac{observed\ 90th\ \ percentile - 200\ cfu/100mL}{observed\ 90th\ \ percentile}\right]x100$$

$$\text{Target percent reduction} = \left[\frac{observed\ \ geometric\ mean - 100\ cfu/100mL}{observed\ \ geometric\ mean}\right]x100$$

The FC bacteria TMDL targets are developed to assist water quality managers in assessing the progress toward compliance with the FC water quality criteria. Compliance is measured as meeting water quality criteria. Any water body with FC bacteria TMDL targets is expected to meet both the applicable geometric mean and 'not more than 10% of samples' criteria, and also to support beneficial uses of the water body.

Simple loading analysis

FC loads were calculated using a spreadsheet to evaluate the mass balance of FC bacteria and TSS for each reach. Loads were calculated by multiplying the FC concentration by the flow at each site. FC bacteria are measured in colony forming units (cfu) per 100mL and flow is measured in cubic feet per second (cfs). The resulting product was converted to the daily load of FC bacteria, measured in billion cfu per day. TSS loads were calculated in kilograms per day.

The calculated loads were not used to determine the amount of FC reduction needed at sites; only the measured concentration data were used to calculate the target percent reductions needed at each site.

A simple mass-balance of the calculated loads was performed to show the general pattern of loading within the watershed. The loading patterns will help in directing implementation to the highest loading sources first. Cleaning up high loading sources will benefit downstream stations where the upstream loads are also causing exceedances.

To perform a mass balance, measured upstream and tributary loads entering a reach were subtracted from the measured downstream load of that reach to calculate a nonpoint load within that reach. If the downstream load was less than the sum of the upstream load and tributary loads, then there was no apparent nonpoint load to that reach.

The mass balance analysis treated FC bacteria and TSS conservatively. Loss from settling, gain from re-suspension, and FC bacteria loss from die-off were not measured or approximated. Therefore, the nonpoint load of the mass balance (i.e., the unexplained gain or loss in a reach) includes these unmeasured losses and gains, plus any errors in measuring the known loads.

The lack of steady-state flow for some sample dates increased the error of the reach-load analysis. Generally, the flow was steady during the dry season and less so in the wet season. Some sample surveys were not used in the reach-load analysis because of an extreme discrepancy in the flow balance.

Individual calculated reach loads from each survey were averaged over each season and then compared to other seasonal reach loads to develop an overall seasonal loading pattern. Seasonally averaging the loads lessens the impact of any one individual survey load, which helps smooth out the inherent variability of the loads.

Again, the goal of the simple mass-balance was to show the general pattern of loading within the watershed to help in direct implementation efforts.

Study Quality Assurance Evaluation

Quality assurance objectives

Data collected for this 2007-08 Palouse River TMDL study were in compliance with Washington State law (RCW 90.48.585) and Ecology Water Quality Program Policy 1-11. The collection of the data followed standard data quality assurance (QA) procedures. The data were also evaluated to determine whether data QA/quality control (QC) objectives for the project were met. As a result, the data are credible and representative, and appropriate for use in TMDL development. Water quality data QA/QC objectives for precision are described in Table 6.

Sample quality assurance

QA/QC for samples

Ecology field sampling protocols followed those specified in WAS (1993). Field QC requirements include the use of field replicates to assess total precision.

Laboratory

Ecology's Manchester Environmental Laboratory (MEL) conducted all laboratory analyses. Laboratory data were generated according to QA/QC procedures described in MEL, 2005. MEL prepared and submitted QA memos to Ecology's Environmental Assessment Program for each sampling survey. Each memo summarized the QC procedures and results for sample transport and storage, sample holding times, and instrument calibration. The memo also included a QA summary of check standards, matrix spikes, method blanks (used to check for analytical bias), and lab-splits (used to check for analytical precision).

All samples were received in good condition and were properly preserved, as necessary. The temperature of the shipping coolers was between proper ranges of 2°C to 6°C for all sample shipments.

Although all samples were shipped the same day they were collected, holding times were sometimes violated because of delayed in-transport problems or because the samples were held too long at MEL before analysis. MEL qualified all samples that were analyzed beyond holding time as an estimate using a "J" qualifier.

For the most part, data quality for this project met all laboratory QA/QC criteria as determined by MEL. Individual exceptions that caused the results to be qualified as an estimate were qualified by MEL with a "J" qualifier in the data tables. All qualifications will be taken into consideration for the purpose of data analysis.

Precision

Analytical precision

Analytical laboratory precision was determined separately to account for its contribution to overall variability. Precision was determined by calculating a pooled relative standard deviation (%RSD) of lab-split results. About 10% of the TSS and chloride samples were analyzed as laboratory split samples. For FC bacteria samples, about 20% were analyzed as split samples.

The RSD was first calculated as a pooled standard deviation by taking the square root of the sum of the squared differences divided by two times the number of pairs. Then the pooled standard deviation was divided by the mean of the replicate measurements and multiplied by 100 for the %RSD. A higher %RSD is expected for values that are close to their reporting limits. (For example, the %RSD for replicate samples with results of 1 and 2 is 47%, whereas the %RSD for replicate results of 100 and 101 is 0.7%, with each having a difference of 1.)

Because higher %RSD is expected near the reporting limit, two tiers were also evaluated: lab-split results less than five times the reporting limit were considered separately from lab-split results equal to or more than five times the reporting limit. (For FC bacteria, the two tiers were less than or equal to 20 and greater than 20 cfu/100 mL.)

The %RSD of the upper tier was compared to the target precision objective for each parameter. Results are in Tables 6 and 7.

Table 6. Lab precision for dry-season results.
Results at or below the detection limit were excluded from consideration.

Parameter	Reporting Limit	Target Precision %RSD	Average %RSD for samples <5X reporting limit (number of duplicate pairs)	Average %RSD for samples ≥5X reporting limit (number of duplicate pairs)
Chloride	0.1 mg/L	< 5	all samples ≥5X limit	0.72 (28)
Fecal coliform[1]	1 cfu/100 mL	< 30	3.58 (13)	13.88 (15)
Total Suspended Solids	1 mg/L	< 10	5.66 (5)	5.07 (43)

[1]Bacteria duplicates are split into samples ≤20 cfu/100 mL and >20 cfu/100 mL.

Table 7. Lab precision for wet-season results.
Results at or below the detection limit were excluded from consideration.

Parameter	Reporting Limit	Target Precision %RSD	Average %RSD for samples <5X reporting limit (number of duplicate pairs)	Average %RSD for samples ≥5X reporting limit (number of duplicate pairs)
Chloride	0.1 ppm	< 5	all samples ≥5X limit	0.50 (25)
Fecal coliform[1]	1 cfu/100 mL	< 30	19.03 (28)	18.36 (17)
Total Suspended Solids	1 ppm	< 10	6.98 (11)	8.46 (39)

[1]Bacteria duplicates are split into samples ≤20 cfu/100 mL and >20 cfu/100 mL.

Total precision

Field replicate samples (side-by-side duplicates) were collected for at least 10% of the total number of general chemistry samples and at least 20% of the total number of microbiology samples in order to assess total precision (i.e., total variation) for field samples. As was done for the lab precision evaluation, two tiers were also evaluated for total precision: field-replicate results less than five times the reporting limit and field-replicate results equal to or more than five times the reporting limit. (For FC bacteria, the two tiers were less than or equal to 20 and greater than 20 cfu/100 mL.) A pooled %RSD was calculated for each parameter using field replicate results greater then reporting limits. Results are listed in Tables 8 and 9.

Table 8. Total precision for dry-season results.
Results at or below the detection limit were excluded from consideration.

Parameter	Reporting Limit	Target Precision %RSD	Average %RSD for samples <5X reporting limit (number of duplicate pairs)	Average %RSD for samples ≥5X reporting limit (number of duplicate pairs)
Chloride	0.1 ppm	< 5	all samples ≥5x limit	1.75 (74)
Fecal coliform[1]	1 cfu/100 mL	< 30	22.42 (5)	17.09 (41)
Total Suspended Solids	1 ppm	< 10	14.62 (33)	5.47 (26)

[1]Bacteria duplicates are split into samples ≤20 cfu/100 mL and >20 cfu/100 mL.

Table 9. Total precision for wet-season results.
Results at or below the detection limit were excluded from consideration.

Parameter	Reporting Limit	Target Precision %RSD	Average %RSD for samples <5X reporting limit (number of duplicate pairs)	Average %RSD for samples $\geq$5X reporting limit (number of duplicate pairs)
Chloride	0.1 ppm	< 5	all samples $\geq$5X limit	0.73 (74)
Fecal coliform[1]	1 cfu/100 mL	< 30	24.34 (37)	22.06 (49)
Total Suspended Solids	1 ppm	< 10	13.26 (25)	8.73 (49)

[1]Bacteria duplicates are split into samples $\leq$20 cfu/100 mL and >20 cfu/100 mL.

As expected, %RSD for field replicates was higher than that for lab splits because %RSD is a measurement of total variability, including both field and analytical variability.

Total precision %RSD in the upper tier was compared to the target precision for the QA and QC evaluation. This evaluation shows that all parameters met QA and QC requirements.

Conclusion

Overall, the data collected by Ecology for this project met the data quality objectives. There was higher variability in the low-level TSS data, but this is acceptable. Based on the QA and QC review, the Ecology data are of good quality, properly qualified, and acceptable for use in a TMDL analysis.

Results and Discussion

Palouse River TMDL data

All laboratory and field data collected for the *Palouse River FC bacteria TMDL* are loaded into Ecology's environmental information management (EIM) database. These data are available online from the Ecology website at: www.ecy.wa.gov/eim/. Several query options are available. The study identification (study ID) designation is "JICA0001," and the study name is "Palouse River TMDL."

Seasonal variation

Mathieu et al. (2007) reviewed the historical FC data from the long-term monitoring station on the Palouse River at Hooper (Station 34A070). That assessment revealed that considerable monthly variation in FC counts exists at this site. Higher concentrations occurred from June to October. To properly assess the current water quality conditions, Ecology used the most recent data collected during the 2007-08 study.

Figure 6 and 7 show the monthly geometric means and 90^{th} percentiles for all data collected in the Palouse River study area during the 2007-08 study. Higher geometric means and 90^{th} percentiles were observed from May through October, with higher counts in February and December as well. We expect overall lower concentrations in the wet months because of dilution with increased flows.

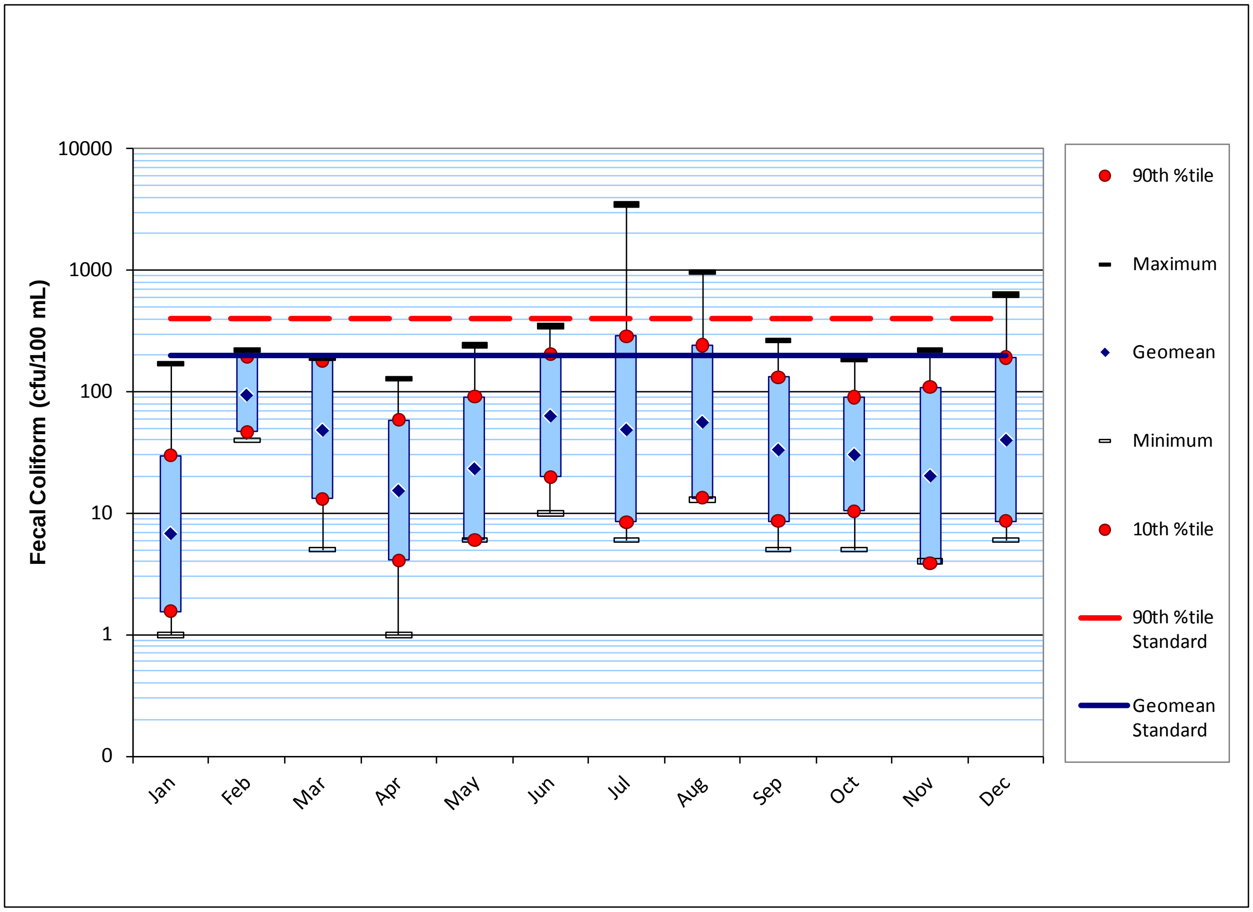


Figure 6. Monthly geometric means and 90th percentile for FC data collected at *Secondary Contact* criteria sites in the Palouse River study area during the 2007-08 TMDL study.

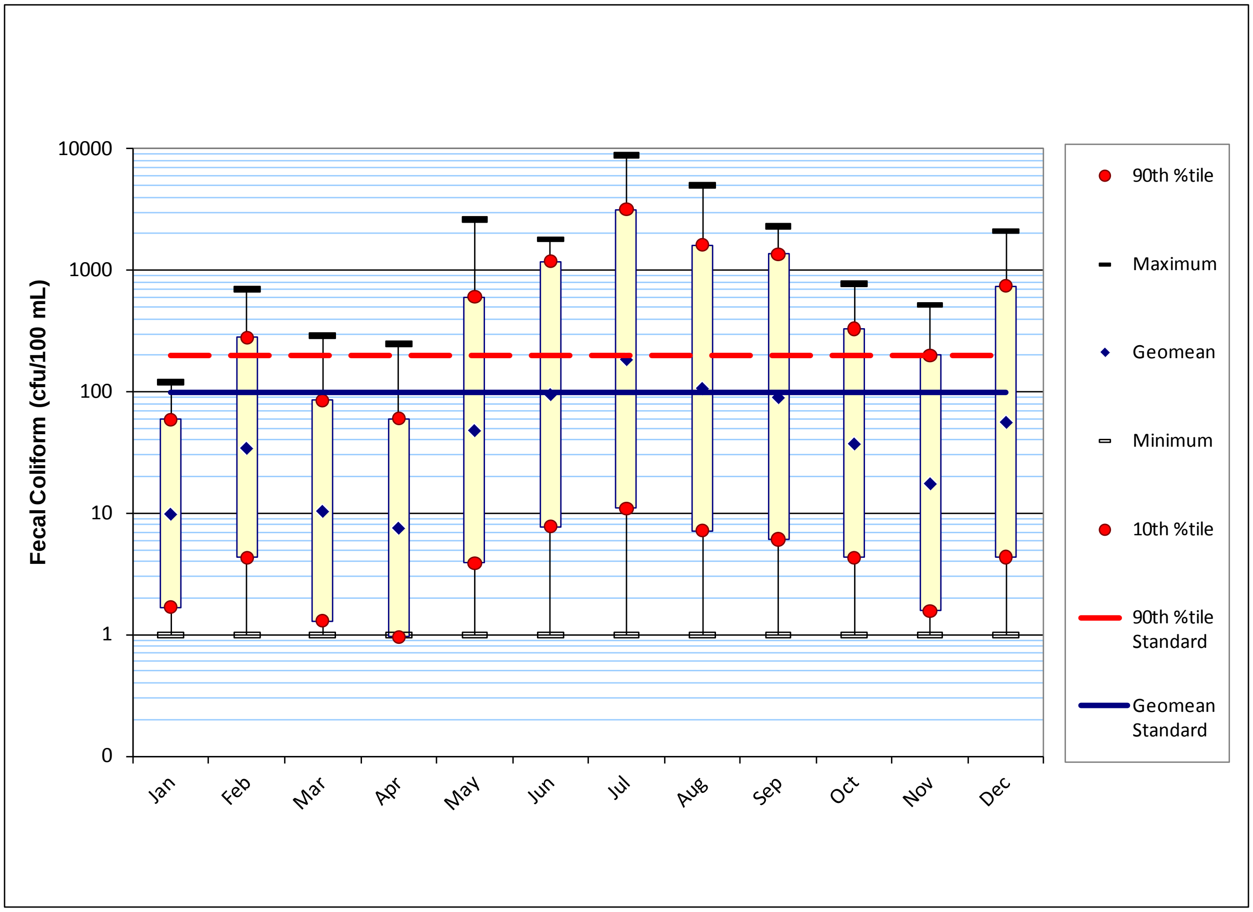


Figure 7. Monthly geometric means and 90th percentile for FC data collected at *Primary Contact* criteria sites in the Palouse River study area during the 2007-08 TMDL study.

TMDL analyses

Ecology divided the study year into two seasons based on streamflow (see Figure 4).

Seasonal loading analysis of the Palouse River had limitations:

- During the dry season, even though there were steady-state flow conditions in the river, the large time-of-travel between sites meant that the conservative transport of bacteria from site to site was unlikely. This means nonpoint contributions between sites could be under-estimated, because losses during the transport of upstream loads are not accounted for (i.e., die-off, settling).
- During the wet season, large rain events can dominate the seasonal trend. Generally, non-steady-state conditions affect the ability to conduct mass balance loading calculations.

The loading analysis is a tool used to assess loading contributions from different sources, which help to identify and prioritize areas in need of cleanup efforts. The loading contributions are expressed as load percentage of the total load.

While the loading percentages are helpful, it is important to remember that they do not equate with a violation in the standard's numeric criteria. Loading is the product of streamflow and concentration, so high loading may at times reflect mostly high streamflows. The numeric criteria exceedances are identified using concentrations only.

Presented below are the seasonal FC bacteria and TSS results for the Palouse River divided into two reaches (Figure 8). TSS results are shown because often there is a relationship between TSS and FC levels.

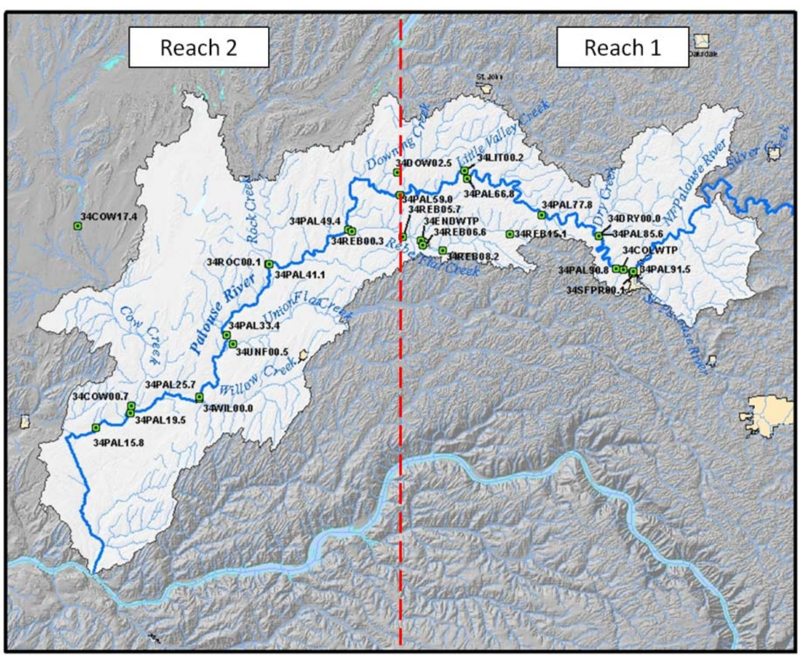


Figure 8. Palouse River reach division for analysis purposes.

Reach 1 - Palouse River from Colfax to Kackman Road bridge

Reach 1 of the Palouse River FC TMDL extends from Colfax (site 34PAL91.5) to Kackman Road bridge (site 34PAL59.0). Within this reach, Ecology sampled at five Palouse River sites, the mouths of the NF and SF Palouse Rivers, Dry and Little Valley Creeks, and groundwater samples from the Colfax WWTP infiltration site.

Table 10, Figure 9, and Figure 10 present the dry- and wet-season summary statistics of FC counts. Table 10 also presents the target reductions necessary to meet the water quality standards in this reach.

The SF Palouse upstream boundary of this reach did not meet water quality criteria for Primary Contact recreation targets year-round. The 2007-08 data nearly duplicated the results from the *SF Palouse FC TMDL* sampled the year before (Carroll and Snouwaert, 2009), calling for large significant target reductions year-round. The *SF Palouse FC TMDL* found that a majority of the load originated within the city of Colfax.

Similarly, the NF Palouse upstream boundary of this reach did not meet water quality criteria for Primary Contact recreation during the dry season. Ahmed (2004) reported similar results for the mouth of the NF Palouse (although his site was about a half mile upstream of the mouth).

FC concentrations for the remaining downstream Palouse River sites in Reach 1 met numeric criteria for the more lenient Secondary Contact recreation for both seasons. For comparison, FC concentrations in the Palouse River did not meet Primary Contact criteria at 34PAL90.8 (just below Colfax) during the dry season, and 34PAL90.8 and 34PAL85.6 (at Manning) during the wet season. However, the standards require that these stations meet the more lenient Secondary Contact criteria and not the Primary Contact criteria.

A natural loss (natural die-off and settling of FC colonies) of the dry-season geometric mean concentrations resulted below Colfax, continuing to the Shields bridge site at RM 77.8 (Figure 9). The travel time between these sites during the summer is estimated to be approximately 7 days, equating to a 30% per day loss. This approximation is within the range of cited loss rates for bacteria (EPA, 1985).

A loss of the wet-season geometric mean concentrations extended throughout Reach 1; however, the travel time is not known for the wet season so a loss rate could not be estimated.

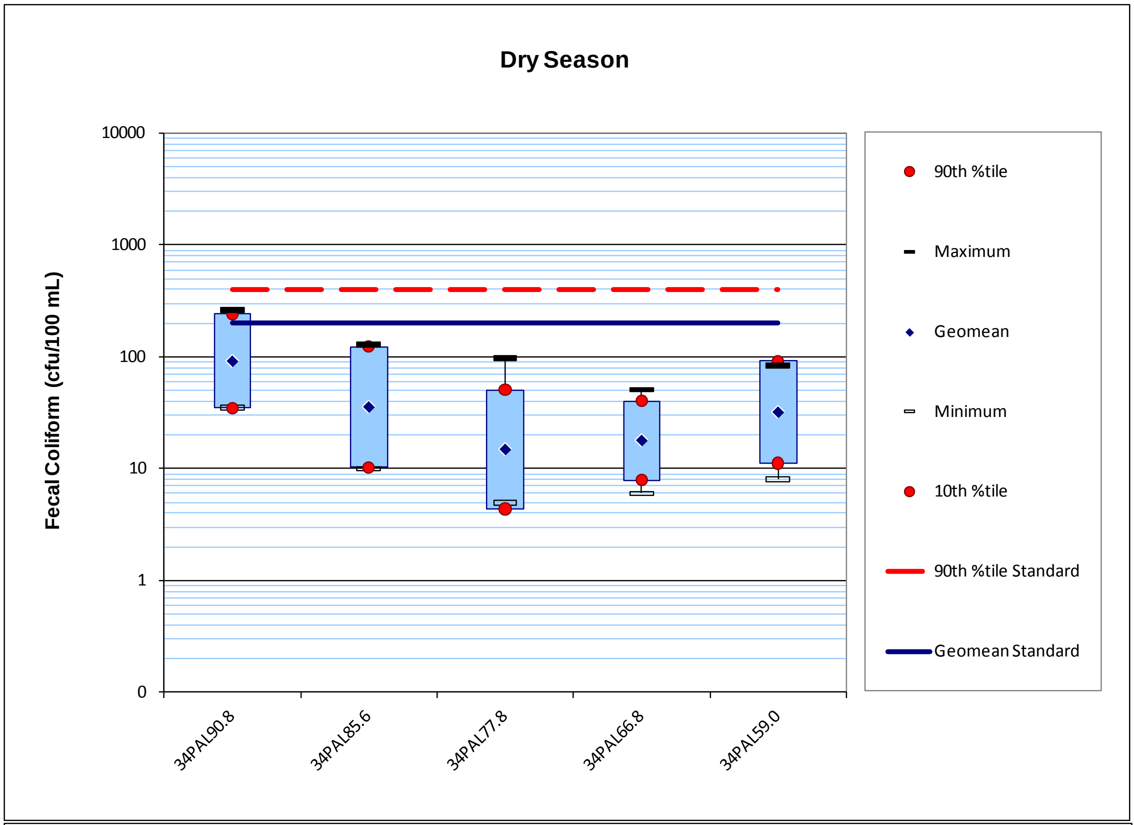
Dry and Little Valley Creeks (tributaries to Reach 1) did not meet either part of the Primary Contact criteria during the dry season, and both did not meet the 90^{th} percentile criteria during the wet season.

Figure 11 presents the average dry- and wet-season FC loads for each tributary and sub-reach. Table 11 summarizes the average loads as their percentage of the total load to Reach 1.

Table 10. Dry-season and wet-season summary statistics of FC counts and target percent reductions for stations in Reach 1 of the Palouse River.

Station ID	Total # of Samples	Min	10th %tile	Geomean > 200 or 100 cfu/100 mL*	90th %tile	Max	% Samples > 400 or 200 cfu/100 mL*	Target % Reduction
	DRY SEASON							
34PAL91.5 (NF Palouse)	9	31	38	115	351	295	33%	43%
34SFPR00.1	9	260	402	1142	3261	5000	100%	94%
34COLWTP	8	1	1	1	1	1	0%	0%
34PAL90.8	9	35	35	91	240	265	0%	0%
34PAL85.6	9	10	10	36	124	130	0%	0%
34DRY00.0	6	160	187	363	704	610	83%	72%
34PAL77.8	9	5	4	15	51	97	0%	0%
34PAL66.8	9	6	8	18	40	51	0%	0%
34LIT00.2	9	27	30	127	538	510	44%	63%
34PAL59.0	9	8	11	32	92	83	0%	0%
	WET SEASON							
34PAL91.5 (NF Palouse)	15	4	4	23	138	180	0%	0%
34SFPR00.1	15	7	15	105	718	1070	40%	72%
34COLWTP	15	1	1	1	1	1	0%	0%
34PAL90.8	15	6	15	75	372	630	7%	0%
34PAL85.6	15	3	6	34	201	280	0%	0%
34DRY00.0	15	6	7	69	636	1800	33%	69%
34PAL77.8	15	2	4	27	197	320	0%	0%
34PAL66.8	15	2	3	18	119	205	0%	0%
34LIT00.2	15	7	15	61	246	325	20%	19%
34PAL59.0	15	1	2	13	94	130	0%	0%

*Cells shaded in these columns are values that do not meet (exceed) Washington State numeric standards.
Bolded station ID indicates a site with *Secondary Contact* criteria.



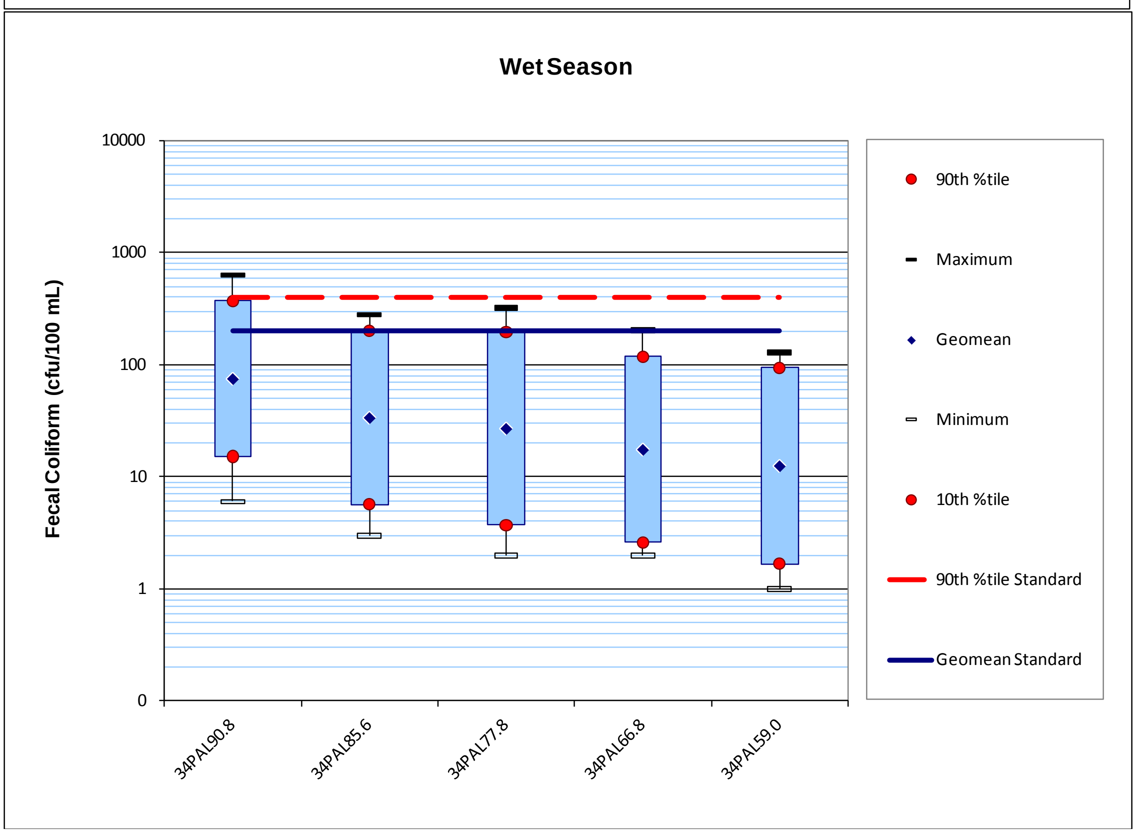


Figure 9. Dry-season and wet-season summary statistics of FC counts for *Secondary Contact* criteria stations in Reach 1 of the Palouse River.

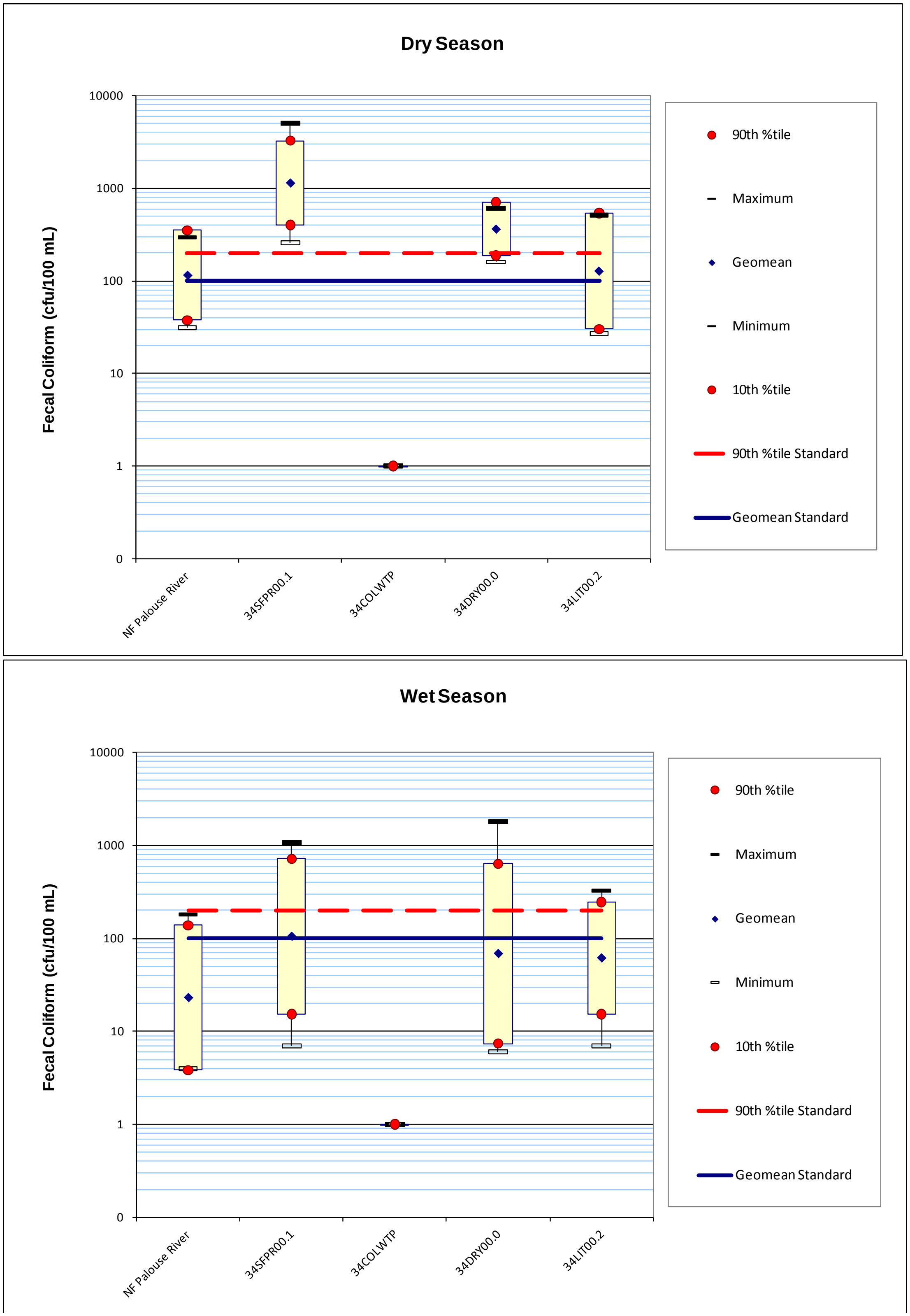


Figure 10. Dry-season and wet-season summary statistics of FC counts for *Primary Contact* criteria stations in Reach 1 of the Palouse River.

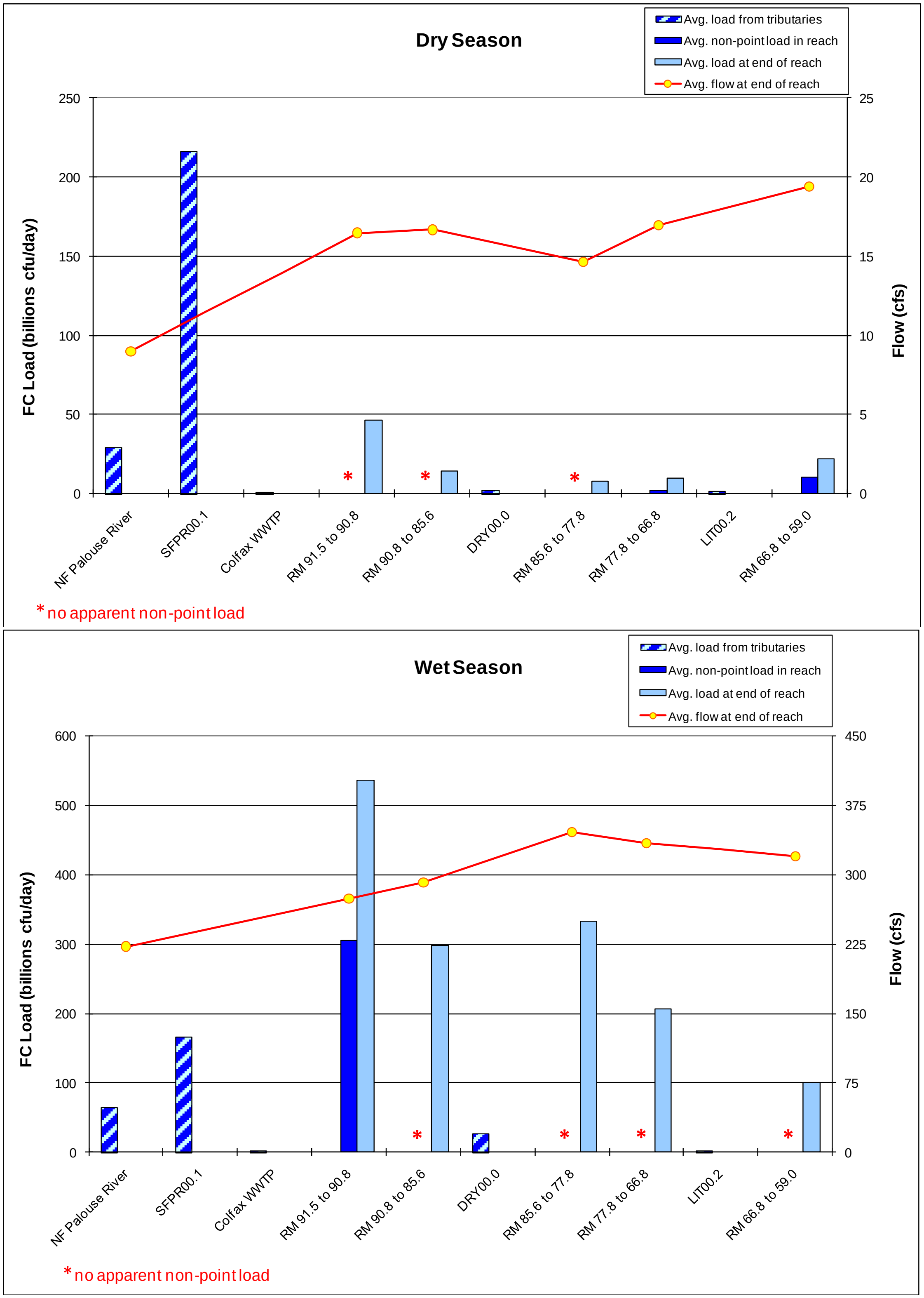


Figure 11. Dry-season and wet-season average FC loads from the 2007-08 TMDL study in Reach 1 of the Palouse River.

Note the differences in vertical axes scale between the charts.

Table 11. Dry-season and wet-season FC loading percentages to Reach 1 of the Palouse River.

Reach (Palouse RM) or Tributary	Site (End of Reach)	Dry Season	Wet Season
Above RM 91.5 (NF Palouse River)	34PAL91.5	11.1%	11.4%
SF Palouse River	34SFPR00.1	83.0%	29.4%
Colfax Wastewater Treatment Plat	34COLWTP	0.0%	0.0%
RM 91.5 to 90.8	34PAL90.8	0.0%	54.3%
RM 90.8 to 85.6	34PAL85.6	0.0%	0.0%
Dry Creek	34DRY00.0	0.7%	4.7%
RM 85.6 to 77.8	34PAL77.8	0.0%	0.0%
RM 77.8 to 66.8	34PAL66.8	0.7%	0.0%
Little Valley Creek	34LIT00.2	0.5%	0.2%
RM 66.8 to 59.0	34PAL59.0	4.1%	0.0%

Most of the dry-season load to Reach 1 of the Palouse River was from the SF Palouse (83%) and the NF Palouse (11%). During the wet season, the NF and SF Palouse accounted for about 41% of the load to the reach, even though the combined FC load from the NF and SF Palouse was nearly the same for both wet and dry seasons.

The largest wet-season load to Reach 1 was from between the confluence of the NF and SF Palouse and the next downstream site at RM 90.8 (54%). Large net loads from two sampling events increased the average net load for this sub-reach. Although, when those two events were not considered in the calculation, the net loading percentage was only reduced, and not eliminated, indicating the presence of additional loading below the NF Palouse and SF Palouse.

The Colfax WWTP discharges its effluent to infiltration basins adjacent to the Palouse River below Colfax, at the west edge of town. The FC concentrations in groundwater obtained from monitoring wells down-gradient of the infiltration basins were well below numeric criteria, and the estimated loads were negligible, eliminating the WWTP basin seepage as the unexplained source. Ecology did not assess other potential sources from the WWTP (e.g., leaky pipes, pumps, or unknown by-passes).

The area below Colfax could also be a depositional area for bacteria that originated upstream but is later re-suspended by higher flows during the wet season.

Water quality sampling, in the SF Palouse River in Colfax during the summer of 2009, indicated that a large portion of the bacteria load at the mouth of this tributary is due to pigeons roosting under the city's bridges (Ross, 2009). The load from the SF Palouse River may be masking loading contributions in the sub-reach of the Palouse River just below Colfax (RM 91.5 to 90.8). After the city of Colfax addresses the pigeons, this reach should be re-evaluated for sources of FC contamination during the wet season.

Tributaries to Reach 1

The water quality standards designate the tributaries to the Palouse River for Primary Contact recreation FC criteria.

The Dry Creek headwaters are just west of Elberton, and the creek flows through Manning to the Palouse River just downstream of RM 85.6. Dry Creek FC concentrations did not meet numeric criteria for both seasons.

Little Valley Creek drains agriculture land south of St. John and meets the Palouse River downstream of RM 66.8. The FC concentrations in Little Valley Creek did not meet numeric criteria for both seasons.

Although the FC loads in Dry and Little Valley Creeks were low compared to the loads in the Palouse River, the high FC concentrations will need to be addressed to meet water quality standards in the creeks.

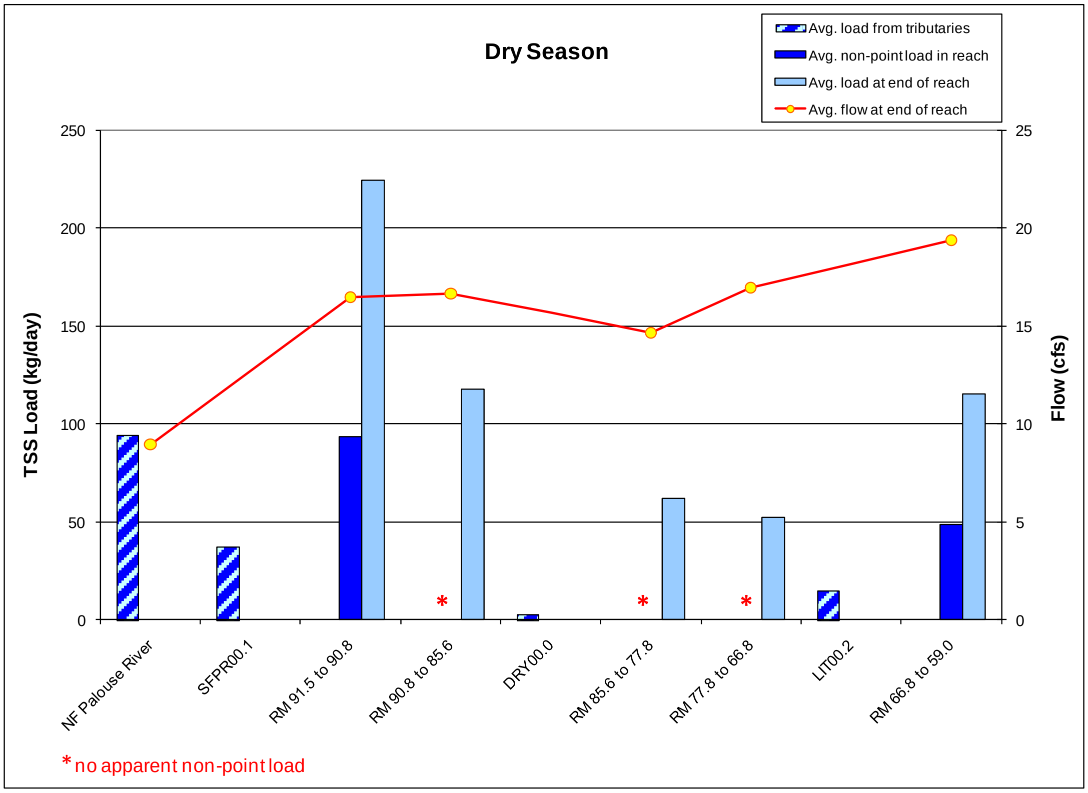
TSS analysis of Reach 1

Figure 12 shows the average dry-season and wet-season TSS loads in the upper Palouse River. Wet-season TSS loads were an order of magnitude higher than dry-season TSS loads.

Table 12 presents the dry-season and wet-season TSS load contribution percentages. The majority of the dry-season loading was from the NF Palouse (33%), the sub-reach between Colfax and RM 90.8 (32%), the sub-reach between RM 66.8 and RM 59.0 (17%), and the SF Palouse River (13%).

The majority of the wet-season loading to Reach 1 was from the NF Palouse (44%), the sub-reach between RM 90.8 and RM 85.6 (27%), the sub-reach between RM 85.6 and RM 77.8 (15%), and the SF Palouse (11%).

There was a very weak but positive relationship between TSS concentrations and FC concentrations in the upper Palouse River during the wet season (Figure 13), suggesting that conditions that elevate TSS, such as high flows or runoff processes (causing soil erosion), could also be elevating FC concentrations. Further investigation is warranted to determine whether soil-erosion controls could also reduce FC bacteria levels.



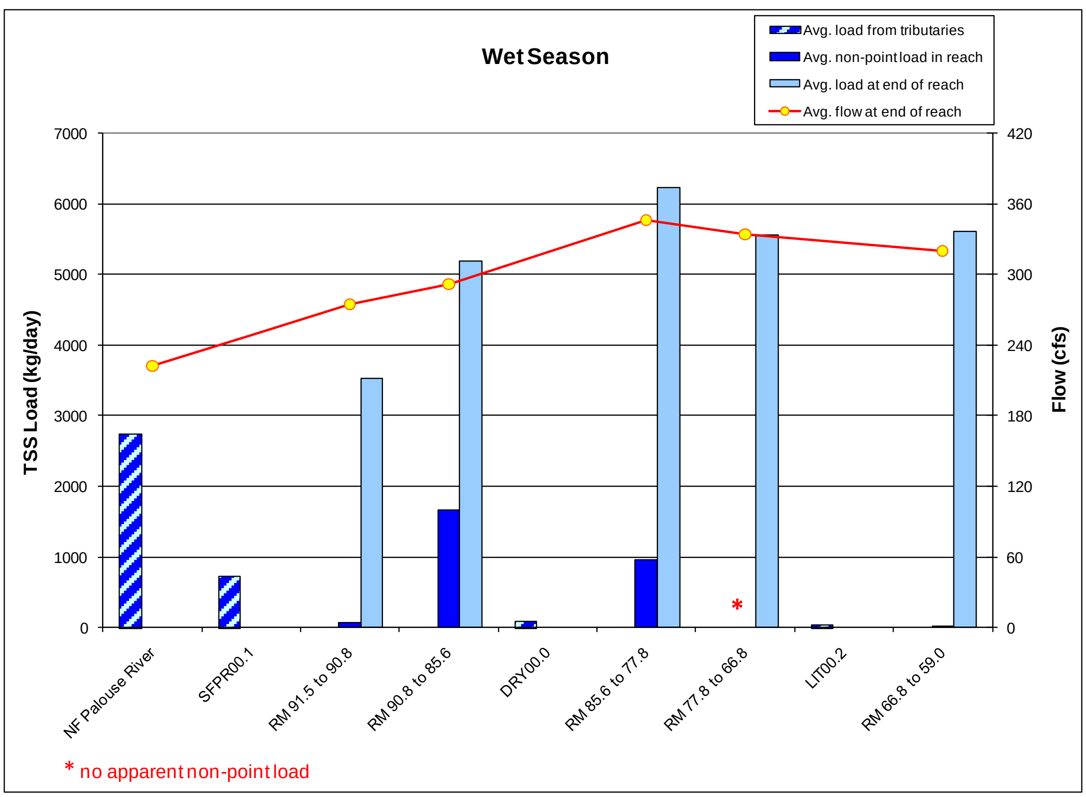


Figure 12. Dry-season and wet-season average TSS loads from the 2007-08 TMDL study in Reach 1 of the Palouse River.

Note the differences in vertical axes scale between the charts.

Table 12. Dry-season and wet-season TSS loading percentages from the 007-08 study to Reach 1 of the Palouse River.

Reach (Palouse RM) or Tributary	Site (End of Reach)	Dry Season	Wet Season
Above RM 91.5 (NF Palouse River)	34PAL91.5	32.5%	43.7%
SF Palouse River	34SFPR00.1	12.7%	11.4%
RM 91.5 to 90.8	34PAL90.8	32.2%	1.1%
RM 90.8 to 85.6	34PAL85.6	0.0%	26.5%
Dry Creek	34DRY00.0	0.8%	1.3%
RM 85.6 to 77.8	34PAL77.8	0.0%	15.4%
RM 77.8 to 66.8	34PAL66.8	0.0%	0.0%
Little Valley Creek	34LIT00.2	5.0%	0.4%
RM 66.8 to 59.0	34PAL59.0	16.7%	0.2%

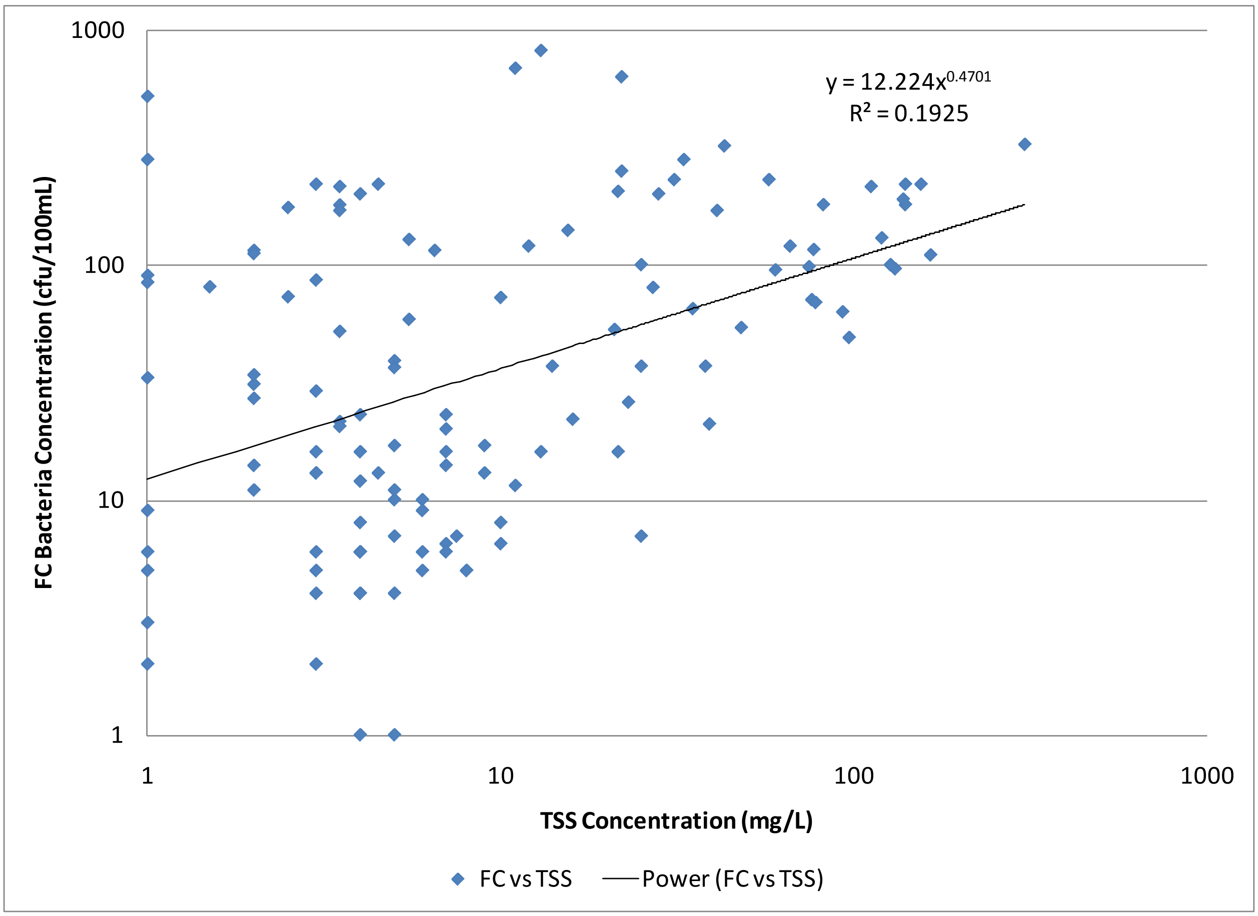


Figure 13. Relationship between wet-season TSS and FC concentrations in Reach 1 of the Palouse River.

Reach 2 – Palouse River from the Kackman Road bridge to the West Hooper bridge

Reach 2 of the Palouse River extends from the Kackman Road bridge (site 34PAL59.0) to the West Hooper bridge (site 34PAL15.8). In this reach, Ecology sampled at seven Palouse River sites, and near the mouths of Downing, Rebel Flat, Rock, Union Flat, Willow, and Cow Creeks.

Table 13, Figures 14, and Figure 15 present the dry- and wet-season summary statistics of FC counts. Table 13 also presents the target reductions necessary to meet the water quality standards. Figure 16 shows the average dry- and wet-season FC loads for the lower Palouse River. Table 14 presents the dry-season and wet-season FC loading percentages for the lower Palouse River.

Rebel Flat and Cow Creeks, tributaries to Reach 2 of the Palouse River, were also sampled upstream of their mouths and are discussed below as separate tributaries.

Table 13. Dry-season and wet-season statistics of FC counts and target percent reductions for stations in Reach 2 of the Palouse River.

Station ID	Total # of Samples	Min	10th %tile	Geomean > 200 or 100 cfu/100mL*	90th %tile	Max	% Samples > 400 or 200 cfu/100 mL*	Target % Reduction**
	DRY SEASON							
34PAL59.0	9	8	11	32	92	83	0%	0%
34DOW02.5	9	51	46	121	322	390	33%	38%
34PAL49.4	9	5	12	145	1772	3500	22%	77%
34REB00.3	9	21	50	297	1788	1500	67%	89%
34PAL41.1	9	15	15	27	49	48	0%	0%
34ROC00.1	9	3	9	29	94	68	0%	0%
34PAL33.4	8	27	38	71	133	113	0%	0%
34UNF00.5	9	28	34	162	767	1100	44%	74%
34PAL25.7	8	14	18	43	101	100	0%	0%
34WIL00.2	8	5	10	42	180	120	0%	0%
34PAL19.5	9	19	19	46	110	150	0%	0%
34COW00.7	4	130	113	468	1952	1400	75%	90%
34PAL15.8	8	18	18	46	119	140	0%	0%
	WET SEASON							
34PAL59.0	15	1	2	13	94	130	0%	0%
34DOW02.5	15	1	1	10	82	360	7%	0%
34PAL49.4	15	2	3	18	100	170	0%	0%
34REB00.3	15	4	5	44	417	2100	20%	52%
34PAL41.1	9	5	6	26	112	170	0%	0%
34ROC00.1	15	1	1	6	34	46	0%	0%
34PAL33.4	15	1	5	25	134	180	0%	0%
34UNF00.5	15	1	5	38	304	360	20%	34%
34PAL25.7	15	14	17	49	143	210	0%	0%
34WIL00.2	15	1	4	18	93	88	0%	0%
34PAL19.5	15	11	11	38	131	240	0%	0%
34COW00.7	11	5	11	89	752	2600	45%	73%
34PAL15.8	15	4	8	28	98	130	0%	0%

*Cells shaded in these columns are values that do not meet (exceed) Washington State numeric standards.
**Cells shaded in this column are values based on less than 5 samples collected at that station.
Bolded station ID indicates a site with *Secondary Contact* criteria.

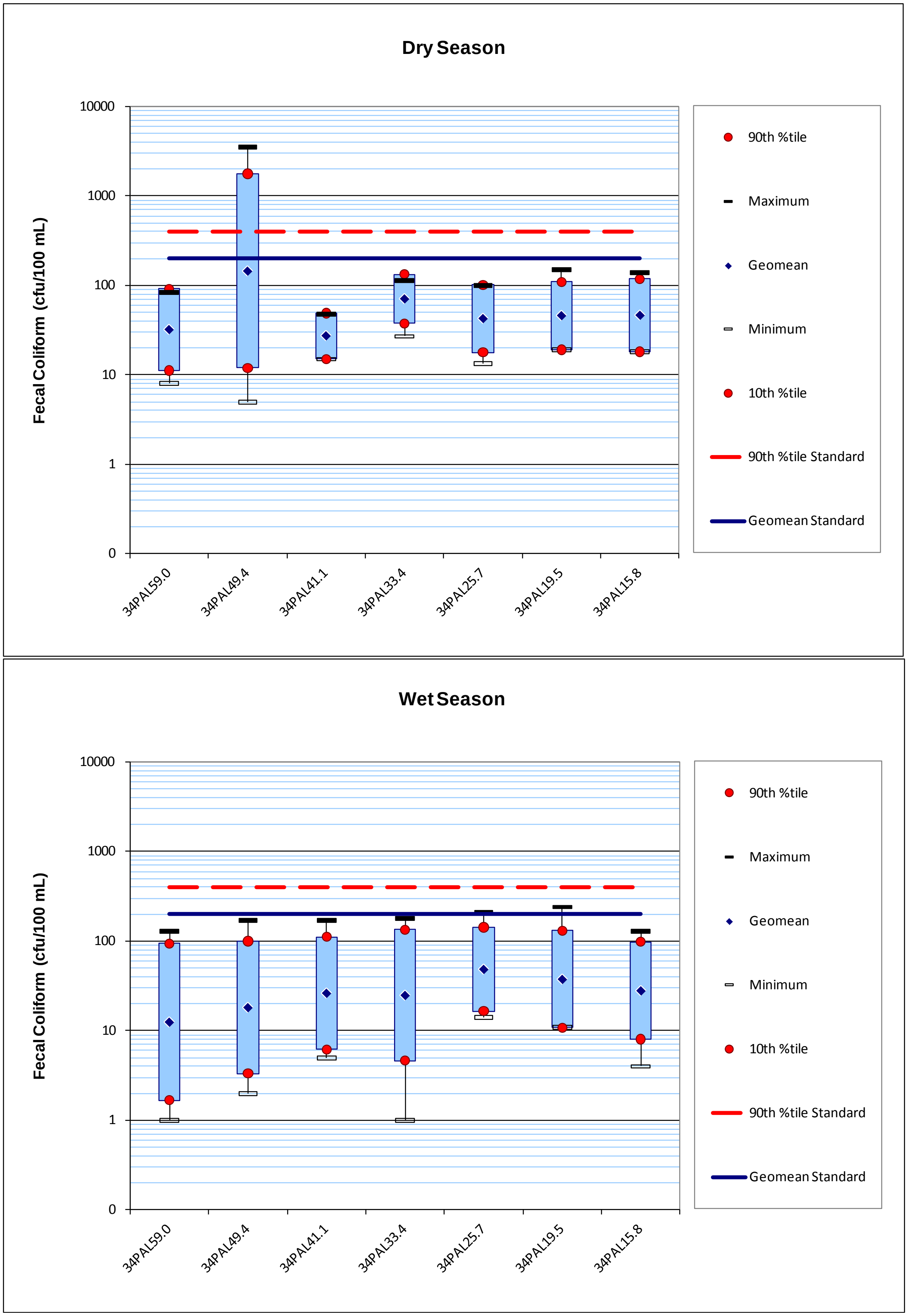


Figure 14. Dry-season and wet-season summary statistics of FC counts for *Secondary Contact* criteria stations in Reach 2 of the Palouse River.

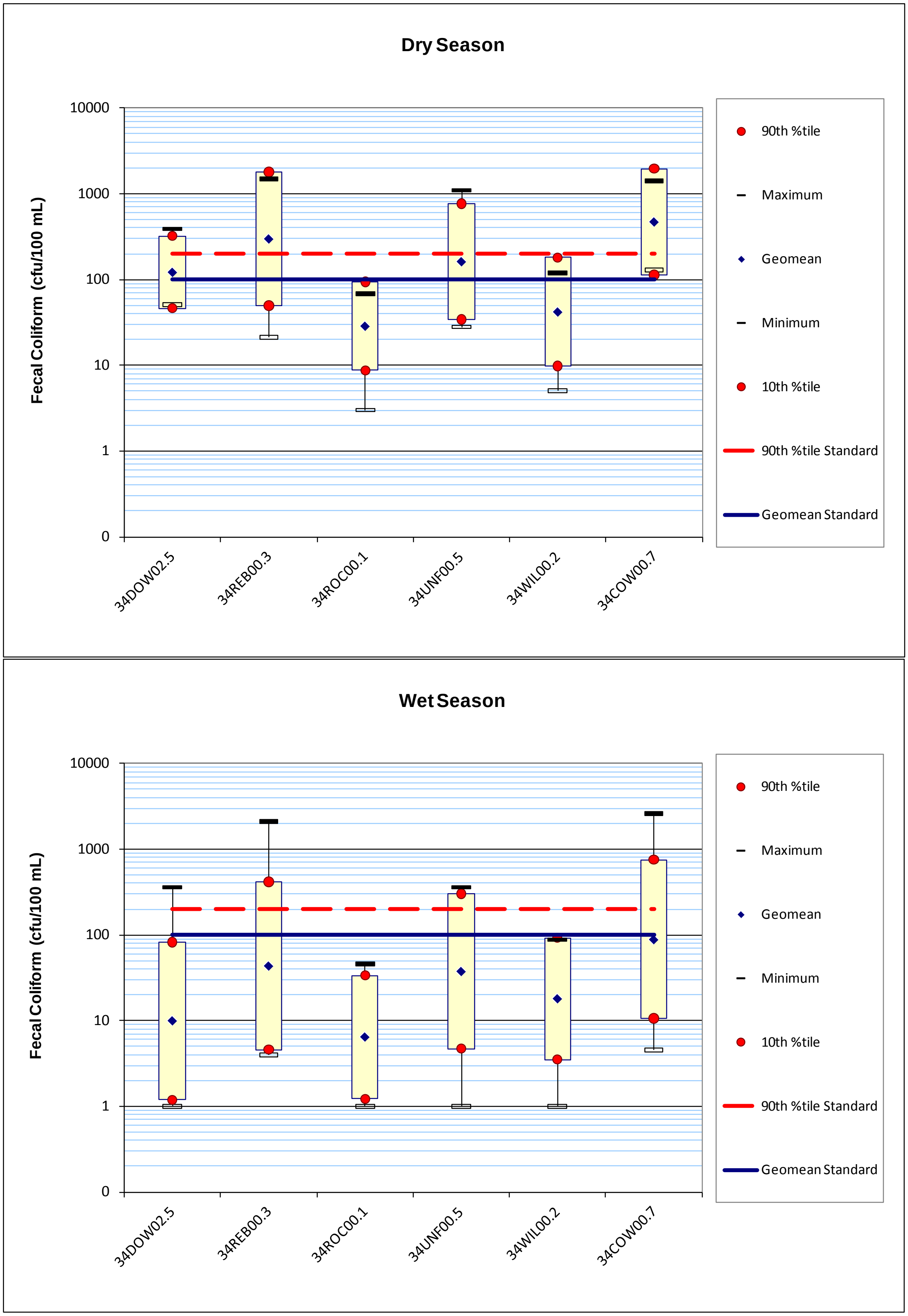


Figure 15. Dry-season and wet-season summary statistics of FC counts for *Primary Contact* criteria stations in Reach 2 of the Palouse River.

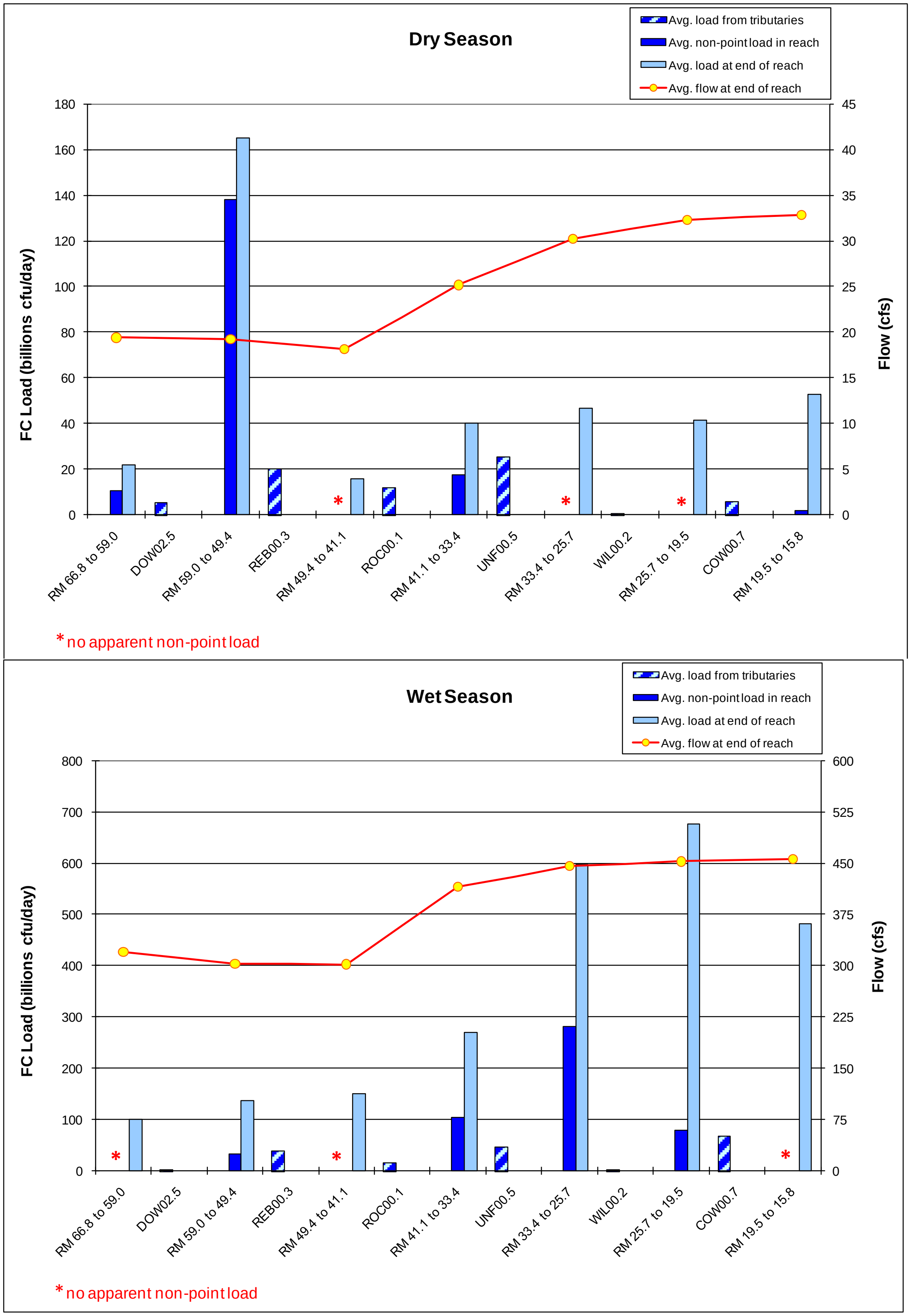


Figure 16. Dry-season and wet-season average FC loads from the 2007-08 TMDL study in Reach 2 of the Palouse River.

Note the differences in vertical axes scale between the charts.

Table 14. Dry-season and wet-season FC loading percentages from the 2007-08 study in Reach 2 of the Palouse River.

Reach (Palouse RM) or Tributary	Site (End of Reach)	Dry Season	Wet Season
RM 66.8 to 59.0	34PAL59.0	4.5%	0.0%
Downing Creek	34DOW02.5	2.2%	0.3%
RM 59.0 to 49.4	34PAL49.4	58.4%	5.0%
Rebel Flat Creek	34REB00.3	8.4%	5.7%
RM 49.4 to 41.1	34PAL41.1	0.0%	0.0%
Rock Creek	34ROC00.1	5.0%	2.3%
RM 41.1 to 33.4	34PAL33.4	7.3%	15.7%
Union Flat Creek	34UNF00.5	10.7%	6.9%
RM 33.4 to 25.7	34PAL25.7	0.0%	42.2%
Willow Creek	34WIL00.2	0.2%	0.1%
RM 25.7 to 19.5	34PAL19.5	0.0%	11.7%
Cow Creek	34COW00.7	2.4%	10.0%
RM 19.5 to 15.8	34PAL15.8	0.8%	0.0%

Similar to Reach 1 above, the mainstem stations in Reach 2 met Primary and Secondary Contact recreation criteria, with the exception of site 34PAL49.4 at Winona during the dry season.

Dry-season FC concentrations in the Palouse River site at Winona (34PAL49.4) were highly variable, sometimes exceeding Secondary Contact recreation criteria. The high concentrations also resulted in most of the dry season loading to Reach 2 originating from the sub-reach between RM 59.0 and RM 49.4 (58%).

Further monitoring would be needed to identify the source of the variable high concentrations and elevated load. Integrated sampling at equal intervals across a transect at RM 49.4 is recommended to determine if there is an isolated plume. The TMDL field study only sampled from the left bank of the river.

The highly variable concentrations and loads seen at Winona were not seen at the next site downstream. Natural loss could account for this disappearance in the summer. Travel time of the water between these two sites is estimated to be greater than six days. A loss rate of about 50% per day could account for the loss that is within the range of published loss rates (EPA, 1985).

The majority of the wet-season loading to Reach 2 was between RM 33.4 and RM 25.7 (42%), and between RM 41.1 and RM 33.4 (16%); however, the concentrations below both sub-reaches met the numeric criteria.

The wet-season loads might be decreased by implementing additional best management practices for rangelands in these sub-reaches. Ecology observed a large number of cattle with access to the river in these sub-reaches.

During the wet season, average FC loads in Reach 2 of the Palouse River were an order of magnitude higher than the dry season, suggesting bacteria are entering the river through contaminated runoff.

RM 25.7 and RM 15.8 were listed on the 2008 303(d) list for FC exceedances, but met water quality criteria during the TMDL study. The FC pollution in these reaches may have been decreased by the riparian and education projects conducted by the Adams Conservation District.

The West Hooper station at RM 15.8 was the last downstream station sampled in the Palouse River during the TMDL study and upstream of the Palouse Falls. The designation of the Palouse River changes from Secondary Contact to Primary Contact recreation below the Palouse Falls near RM 7.0.

In 2007-08, the West Hooper site met both Primary and Secondary Contact numeric criteria. Although further contamination could occur downstream, the Primary Contact recreation beneficial uses were protected to the mouth of the Palouse River from sources upstream of West Hooper.

Tributaries to Reach 2

The tributaries to Reach 2 of the Palouse River are all designated in the water quality standards to meet the Primary Contact recreation criteria.

Downing Creek flows along Lancaster Road from agriculture lands southwest of St. John to the Palouse River, downstream of RM 59.0. Downing Creek FC concentrations did not meet numeric criteria during the dry season, but standards were met in the wet season. Downing Creek did not contribute much to the total FC load in Reach 2 during either season.

The Rebel Flat Creek headwaters are located southwest of Colfax near the Whitman County Memorial Airport. The creek flows west until it meets the Palouse River in Winona.

The FC loads and concentrations at the mouth of Rebel Flat Creek were high and did not meet Primary and Secondary Contact recreation criteria for both seasons. Rebel Flat Creek was sampled at four other upstream sites from the mouth, which are discussed below.

Rock Creek is the outlet of Rock Lake, and it flows south to the Palouse River just downstream of RM 41.1. FC concentrations at the mouth were below numeric criteria for both seasons. Rock Creek contributed very little to the total FC loads in Reach 2 of the Palouse River during either season.

The Union Flat Creek watershed is long and narrow. It stretches westerly from near the state line south of Pullman to the Palouse River downstream of RM 33.4. The FC concentrations at the mouth of Union Flat Creek were high, not meeting numeric criteria for both seasons. Union Flat Creek provided a moderate contribution to the total FC load in Reach 2 of the Palouse River. Land use around Union Flat Creek includes ranging cattle with access to the creek. Implementing best management practices for rangelands could decrease FC concentrations and loads.

Willow Creek flows along Highway 26, southwest of La Crosse, and meets the Palouse River just downstream of RM 25.7 (Hwy 26 bridge). FC concentrations in Willow Creek met numeric criteria in the dry and wet seasons, and contributed little to the total FC load in the Palouse River. These TMDL results stand in contrast to the 2008 303(d) listing for Willow Creek.

Cow Creek is the outlet for Sprague Lake and runs through Cow and Finnell Lakes. Cow Creek flows into the Palouse River just downstream of Hooper. The FC concentrations for Cow Creek were high and did not meet numeric criteria during both seasons, although only four samples were taken from the mouth of Cow Creek during the dry season before it went dry for the summer.

Cow Creek did not contribute a noticeable load to Reach 2 of the Palouse River in the dry season, but did contribute a moderate load in the wet season.

Besides the mouth, Cow Creek was sampled in one upstream location, which is discussed below.

TSS analysis of Reach 2

Figure 17 shows the average dry-season and wet-season TSS loads in Reach 2 of the Palouse River. Wet-season loads were up to two orders of magnitude higher than dry-season loads.

Table 15 presents the dry-season and wet-season TSS loading percentage contributions to Reach 2.

The majority of the dry-season TSS load originated from Rock Creek (36%), the sub-reach between RM 33.4 and RM 25.7 (25%), and the sub-reach between RM 25.7 and RM 19.5 (18%).

The majority of the wet-season TSS load was from Rock Creek (42%), the sub-reach between RM 41.1 and RM 33.4 (18%), the sub-reach between RM 33.4 and RM 25.7 (15%), and the sub-reach between RM 25.7 and RM 19.5 (11%). All three of the latter sub-reaches were areas with the highest wet-season FC loading.

There was a moderately weak and positive relationship between TSS concentrations and FC concentrations in Reach 2 of the Palouse River during the wet season (Figure 18). This suggests that conditions that elevate TSS, such as high flows or runoff processes (causing soil erosion), could also be elevating FC concentrations. Further investigation is warranted to determine whether soil-erosion controls could also reduce FC bacteria levels.

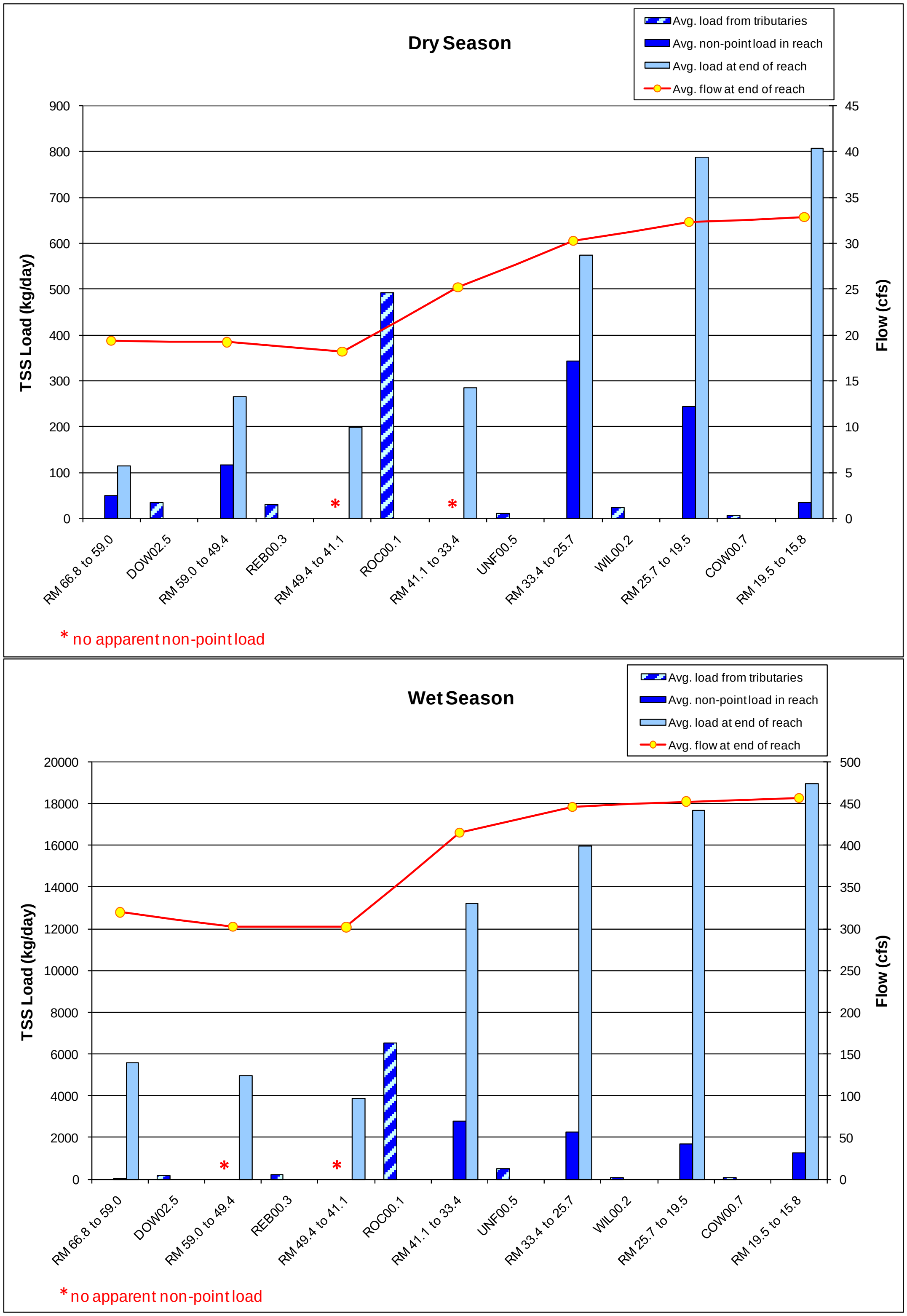


Figure 17. Dry-season and wet-season TSS loads from the 2007-08 TMDL study in Reach 2 of the Palouse River.
Note the differences in vertical axes scale between the charts.

Table 15. Dry-season and wet-season TSS loading percentages from the 2007-08 study in Reach 2 of the Palouse River.

Reach (Palouse RM) or Tributary	Site (End of Reach)	Dry Season	Wet Season
RM 66.8 to 59.0	34PAL59.0	3.5%	0.1%
Downing Creek	34DOW02.5	2.5%	0.9%
RM 59.0 to 49.4	34PAL49.4	8.4%	0.0%
Rebel Flat Creek	34REB00.3	2.0%	1.2%
RM 49.4 to 41.1	34PAL41.1	0.0%	0.0%
Rock Creek	34ROC00.1	35.7%	42.4%
RM 41.1 to 33.4	34PAL33.4	0.0%	18.2%
Union Flat Creek	34UNF00.5	0.8%	3.2%
RM 33.4 to 25.7	34PAL25.7	25.0%	14.6%
Willow Creek	34WIL00.2	1.7%	0.1%
RM 25.7 to 19.5	34PAL19.5	17.6%	10.9%
Cow Creek	34COW00.7	0.4%	0.3%
RM 19.5 to 15.8	34PAL15.8	2.4%	8.1%

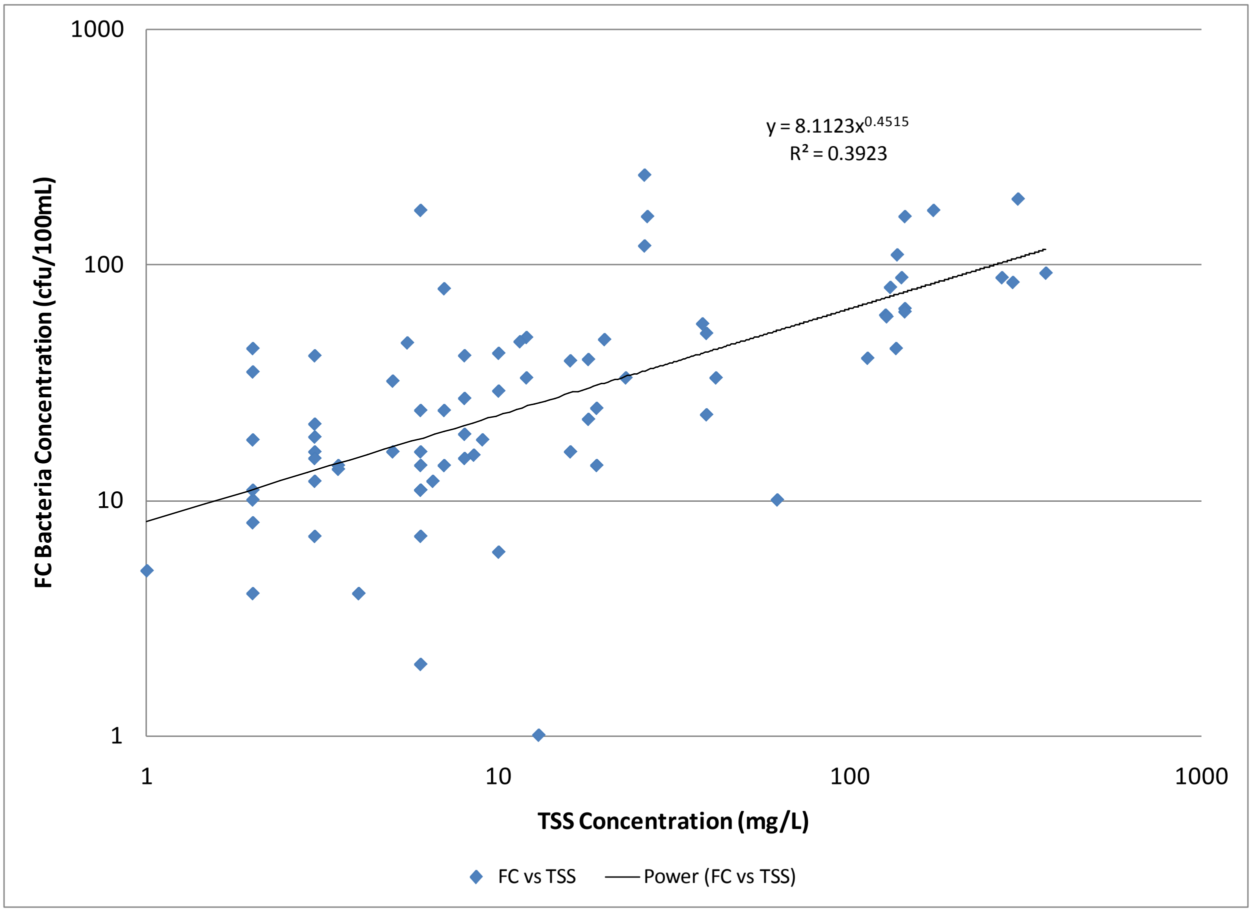


Figure 18. Relationship between wet-season TSS and FC concentrations in Reach 2 of the Palouse River.

Rebel Flat Creek

Rebel Flat Creek was monitored from Thera (site 34REB15.1) to its confluence with the Palouse River (site 34REB00.3 also labeled as 34K050). Ecology sampled at five Rebel Flat Creek sites and the Endicott WWTP. Rebel Flat Creek is designated by the water quality standards to meet the Primary Contact recreation FC bacteria criteria.

Table 16 and Figure 19 present the dry-season and wet-season summary statistics of FC counts. Table 16 also presents the target reductions necessary to meet the water quality standards. Figure 20 shows the average dry-season and wet-season FC loads. Table 17 presents the dry-season and wet-season FC loading percentages.

Table 16. Dry-season and wet-season statistics of FC counts and target percent reductions for stations in Rebel Flat Creek.

Station ID	Total # of Samples	Min	10th %tile	Geomean > 200 or 100 cfu/100mL*	90th %tile	Max	% Samples > 400 or 200 cfu/100 mL*	Target % Reduction
	DRY SEASON							
34REB15.1	9	34	29	253	2232	8900	56%	91%
34REB08.2	9	63	91	339	1274	1500	78%	84%
34REB06.6	9	56	90	224	561	480	78%	64%
34ENDWTP	9	1	1	1	1	2	0%	0%
34REB05.7	9	27	35	112	361	460	22%	45%
34REB00.3	9	21	50	297	1788	1500	67%	89%
	WET SEASON							
34REB15.1	15	1	1	13	155	730	13%	0%
34REB08.2	15	11	12	57	277	310	27%	28%
34REB06.6	15	3	4	37	319	390	20%	37%
34ENDWTP	15	1	0	3	24	77	0%	0%
34REB05.7	15	8	17	91	473	560	47%	58%
34REB00.3	15	4	5	44	417	2100	20%	52%

*Cells shaded in these columns are values that do not meet (exceed) Washington State numeric standards.

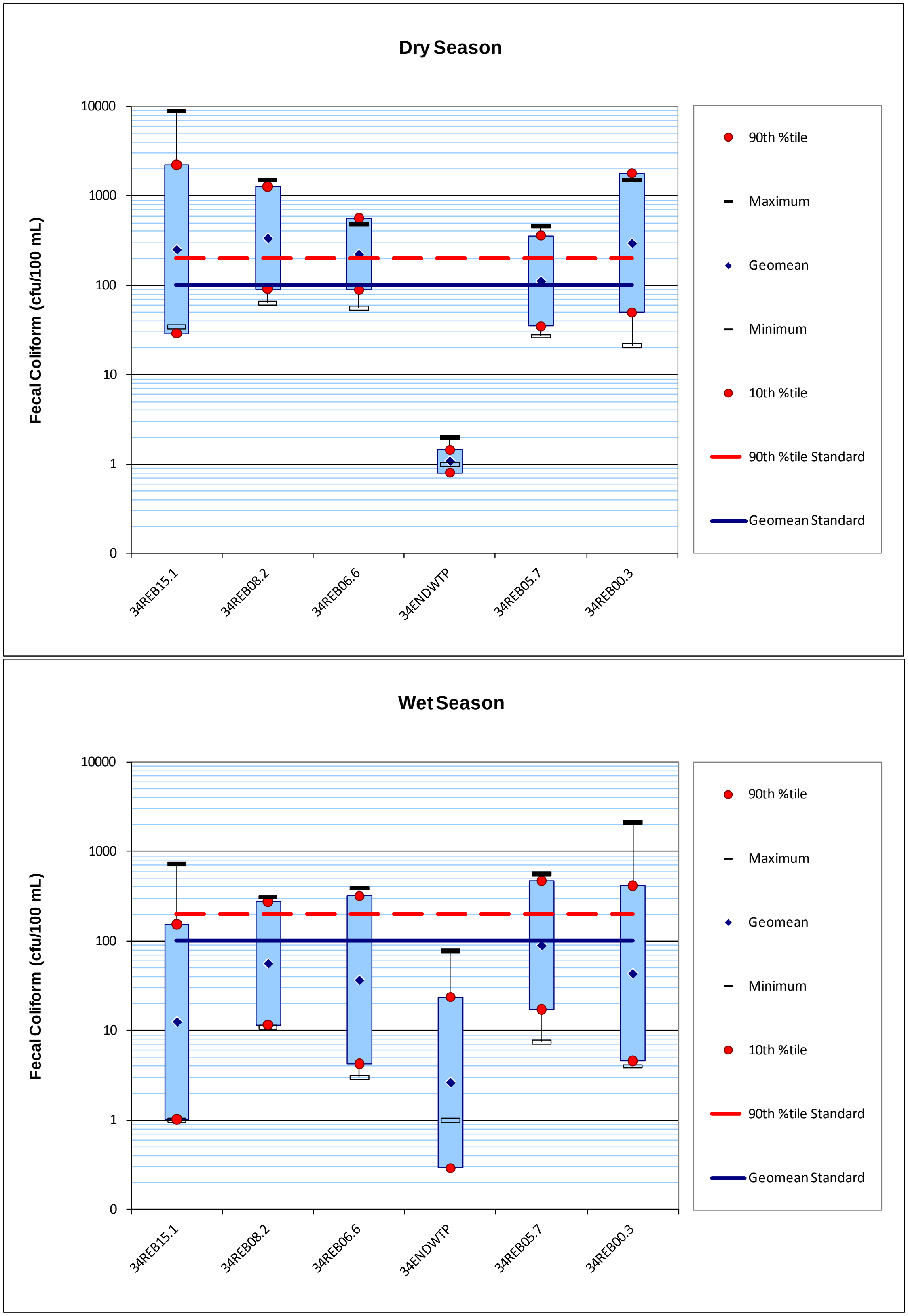


Figure 19. Dry-season and wet-season summary statistics of FC counts for *Primary Contact* criteria stations in Rebel Flat Creek.

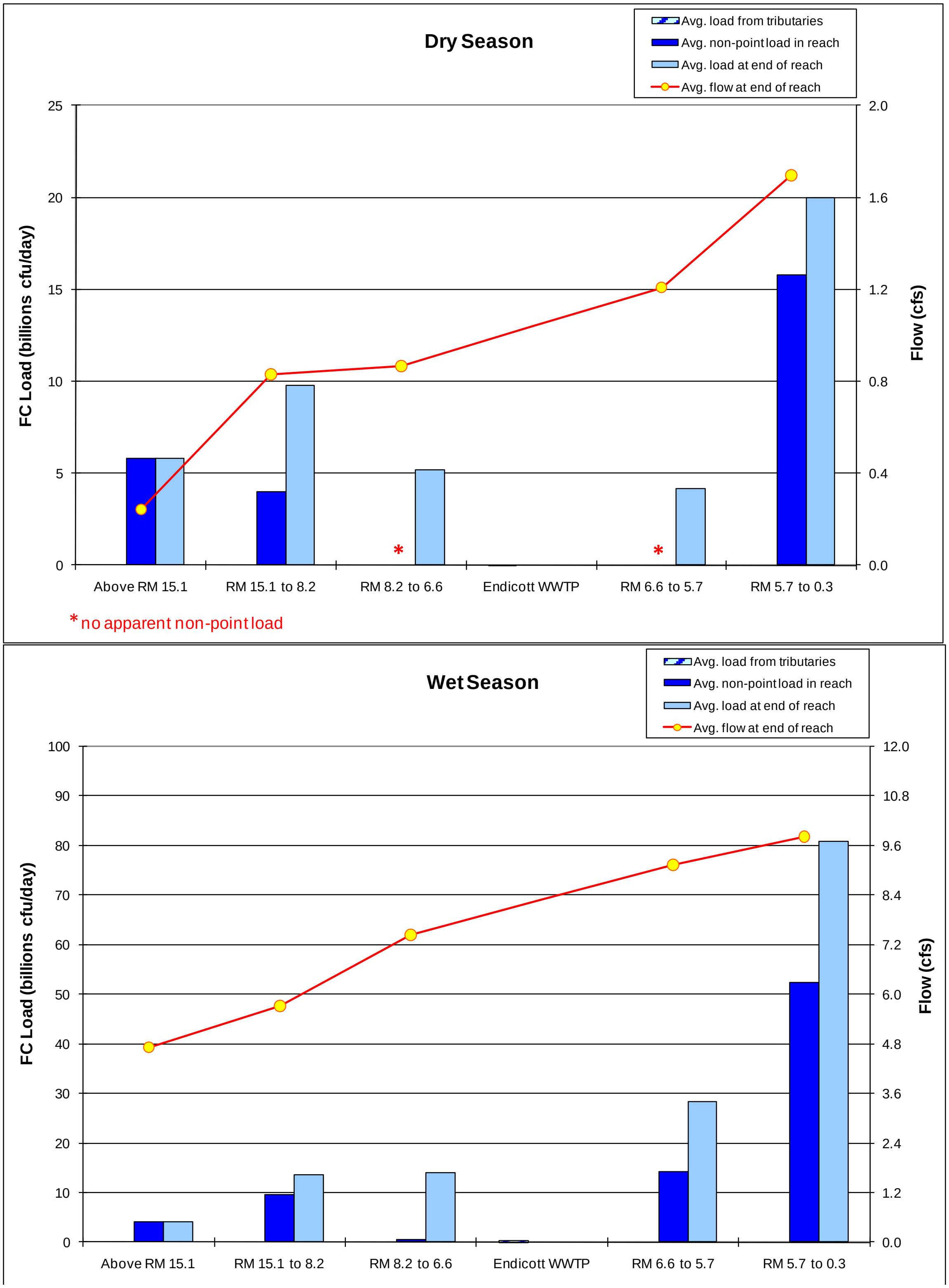


Figure 20. Dry-season and wet-season average FC loads from the 2007-08 TMDL study in Rebel Flat Creek.
Note the differences in vertical axes scale between the charts.

Table 17. Dry-season and wet-season FC loading percentages from the 2007-08 study in Rebel Flat Creek.

Reach (Rebel Flat Ck RM)	Site (End of Reach)	Dry Season	Wet Season
Above RM 15.1	34REB15.1	22.6%	5.1%
RM 15.1 to 8.2	34REB08.2	15.7%	11.7%
RM 8.2 to 6.6	34REB06.6	0.0%	0.6%
Endicott Wastewater Treatment Plant	34ENDWTP	0.0%	0.1%
RM 6.6 to 5.7	34REB05.7	0.0%	17.6%
RM 5.7 to 0.3	34REB00.3	61.7%	64.9%

All five Rebel Flat Creek sites had high FC concentrations and did not meet numeric criteria for both seasons. The dry-season concentrations exceeded both parts of the FC criteria, while the wet-season concentrations only exceeded the second part of the FC criteria. This corroborates the findings on the 2008 303(d) list showing exceedances in Rebel Flat Creek.

Above RM 15.1 (at Thera), which was the upstream boundary condition for the sampling, the average FC load was relatively the same during the dry and wet season, comprising 23% and 5% of the total seasonal loads, respectively. The consistent loading suggests a year-round source.

The sub-reach between RM 15.1 (Thera) and RM 8.2 (Repp Rd) contributed 16% of the dry-season load and 12% of the wet-season load to Rebel Flat Creek, requiring an 84% reduction in the dry season and a 28% reduction in the wet season.

Based on the mass balance, there was no additional seasonal loading within the city of Endicott, above 3rd Street.

From 3rd Street (RM 6.6) to RM 5.7 (Swent Rd), there was no additional dry-season load, but there was a wet-season average load increase. The Endicott WWTP discharges to Rebel Flat Creek within this sub-reach, just downstream of Endicott. FC concentrations and loads from the WWTP were low for both seasons, so the WWTP did not appear to be a source of FC contamination to this sub-reach.

The majority of the loading to Rebel Flat Creek during the dry and wet season was from the sub-reach between RM 5.7 (Swent Rd) and near the mouth at RM 0.3 (62% and 65% of the total FC load, respectively). The wet-season load in this sub-reach was three times the dry-season load.

Rebel Flat Creek below RM 0.3 (at the Winona South Rd crossing) was not sampled, but the mainstem Palouse River sampling did not detect additional load in the reach that includes the creek.

Sub-reaches in Rebel Flat Creek with elevated FC loading should be evaluated for best management practices, such as on-site septic system inspections and livestock BMP installation and maintenance for farms with animals.

TSS analysis of Rebel Flat Creek

Figure 21 shows the average dry-season and wet-season TSS loads in Rebel Flat Creek. Wet-season loads were up to two orders of magnitude higher than dry-season loads.

Table 18 presents the dry-season and wet-season TSS loading percentages for Rebel Flat Creek.

Large increases in dry-season TSS loads to Rebel Flat Creek originated within the sub-reaches between RM 15.1 and RM 8.2 (61%) and between RM 5.7 and RM 0.3 (35%). These were also sub-reaches with the greatest increases in seasonal flow.

The largest wet-season TSS loading to Rebel Flat Creek was from the sub-reach between RM 8.2 (Repp Rd) and RM 6.6 (3rd Street).

Other wet-season loads occurred between RM 5.7 and RM 0.3 (22%), above RM 15.1 (15%), and between RM 15.1 and RM 8.2 (12%).

There was no apparent relationship between TSS concentrations and FC concentrations in Rebel Flat Creek.

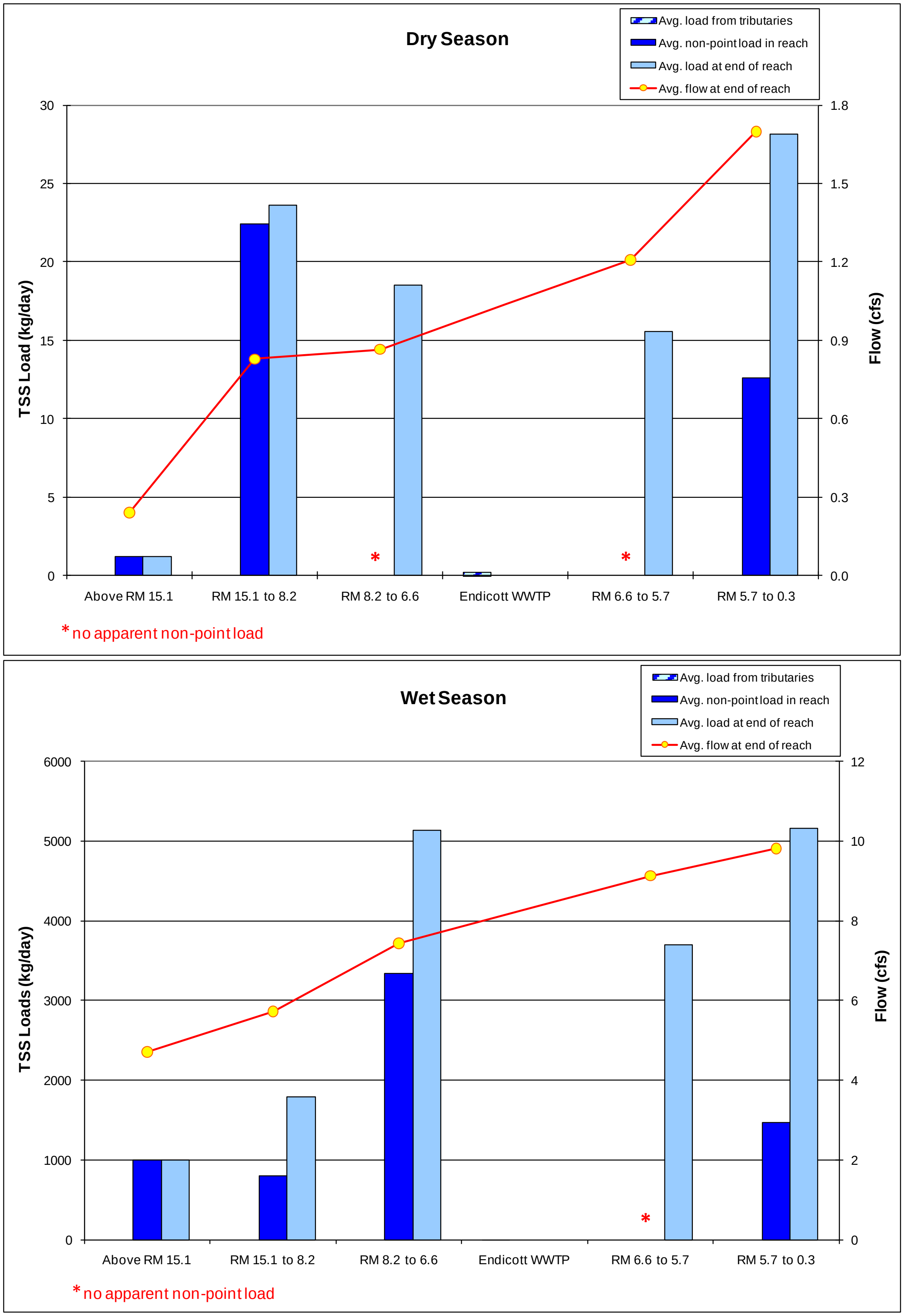


Figure 21. Dry-season and wet-season average TSS loads from the 2007-08 TMDL study in Rebel Flat Creek.

Note the differences in vertical axes scale between the charts.

Table 18. Dry-season and wet-season TSS loading percentages from the 2007-08 study in Rebel Flat Creek.

Reach (Rebel Flat Ck RM)	Site (End of Reach)	Dry Season	Wet Season
Above RM 15.1	34REB15.1	3.4%	15.0%
RM 15.1 to 8.2	34REB08.2	61.4%	12.1%
RM 8.2 to 6.6	34REB06.6	0.0%	50.6%
Endicott Wastewater Treatment Plant	34ENDWTP	0.6%	0.1%
RM 6.6 to 5.7	34REB05.7	0.0%	0.0%
RM 5.7 to 0.3	34REB00.3	34.6%	22.2%

Cow Creek

Cow Creek is the outlet for Sprague Lake and runs through Cow and Finnell Lakes. Cow Creek flows into the Palouse River just downstream of Hooper. Cow Creek is designated for Primary Contact recreation FC bacteria criteria.

Cow Creek was on the 2004 303(d) list for FC bacteria but has been removed. The creek is now listed as a Category 4b on Washington's water quality assessment because there is a program in place to address the bacteria sources.

Ecology has teamed up with conservation districts (CDs), local governments, and landowners to implement best management practices that will be improving water quality in this affected sub-watershed. This program establishes vegetated stream buffers and controlled livestock access to the creek in order to improve degraded riparian corridors. Funding to implement these practices and improvements has been provided by a number of organizations.

For the TMDL, Ecology monitored at the mouth of Cow Creek where it meets the Palouse River (site 34L050) in order to include its contribution in the mass balance for the Palouse River. Ecology also sampled at an upstream Adams CD site at the Benge-Ralston Road crossing (34COW17.4) to assist the Adams CD with their sampling program.

The mouth of Cow Creek was sampled only four times in the dry season before it went dry for the rest of the dry season. Because of the lack of flow, no loading data are reported for the dry season.

Table 19 and Figure 22 present the dry-season and wet-season summary statistics of FC counts. Table 19 also presents the target reductions necessary to meet the water quality standards. Figure 23 shows the average wet-season FC loads for Cow Creek. Table 20 presents the wet-season FC loading percentages for Cow Creek.

Table 19. Dry-season and wet-season statistics of FC counts and target percent reductions for stations in Cow Creek.

Station ID	Total # of Samples	Min	10th %tile	Geomean > 200 or 100 cfu/100mL*	90th %tile	Max	% Samples > 400 or 200 cfu/100 mL*	Target % Reduction**
	DRY SEASON							
34COW17.4	9	20	33	124	462	440	44%	57%
34COW00.7	4	130	113	468	1952	1400	75%	90%
	WET SEASON							
34COW17.4	12	1	2	11	71	130	0%	0%
34COW00.7	11	5	11	89	752	2600	45%	73%

*Cells shaded in these columns are values that do not meet (exceed) Washington State numeric standards.
**Cells shaded in this column are values based on less than 5 samples collected at that station.

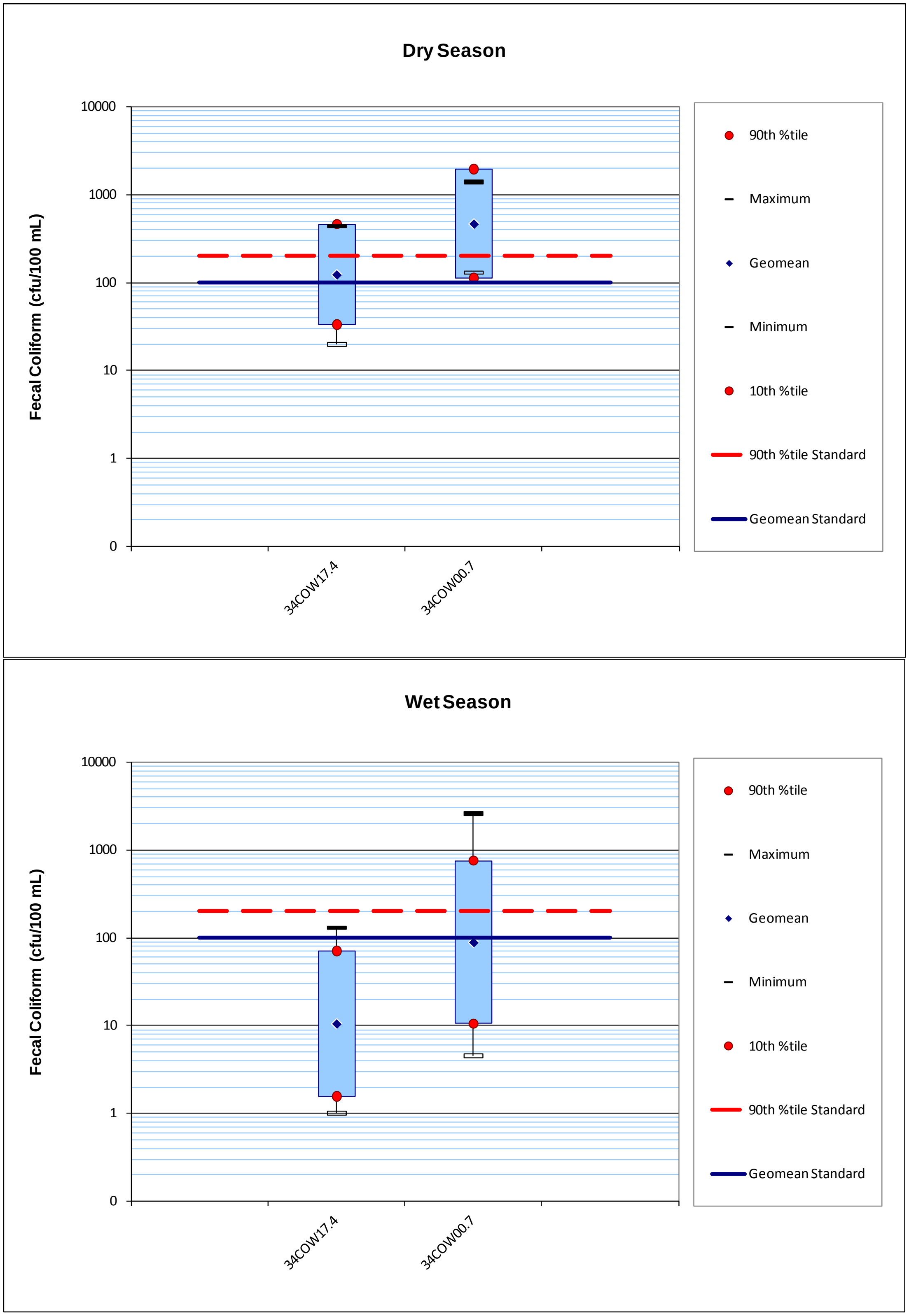


Figure 22. Dry-season and wet-season summary statistics of FC counts for *Primary Contact* criteria stations in Cow Creek.

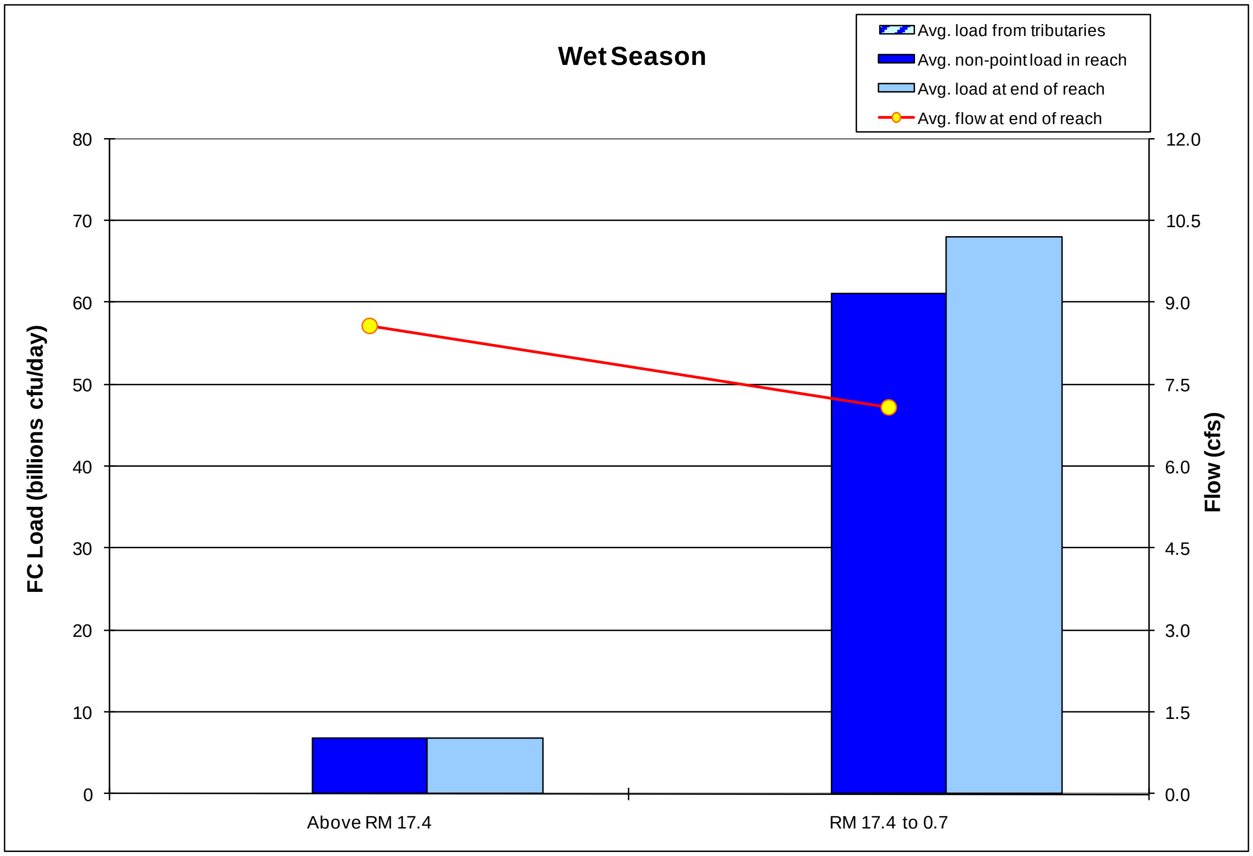


Figure 23. Wet-season average FC loads from the 2007-08 TMDL study in Cow Creek.

Table 20. Wet-season FC loading percentages from the 2007-08 study in Cow Creek.

Reach (Cow Creek RM)	Site	Wet Season
Above RM 17.4	34COW17.4	10.1%
RM 17.4 to 0.7	34COW00.7	89.9%

The FC concentrations at both Cow Creek sites did not meet numeric criteria during the dry season. Only the mouth exceeded numeric criteria during the wet season. The mouth went dry during the dry season and only four samples were used for the analysis.

The majority of the FC loading to Cow Creek during the wet season was from the reach between RM 17.4 and RM 0.7 (90%).

TSS analysis of Cow Creek

Figure 24 shows the average wet-season TSS loads in Cow Creek. Table 21 presents the wet-season TSS loading percentages for Cow Creek.

The majority of the wet-season loading was from the sub-reach between RM 17.4 and RM 0.7 (76%). There was no linear relationship between TSS concentrations and FC concentrations in Cow Creek.

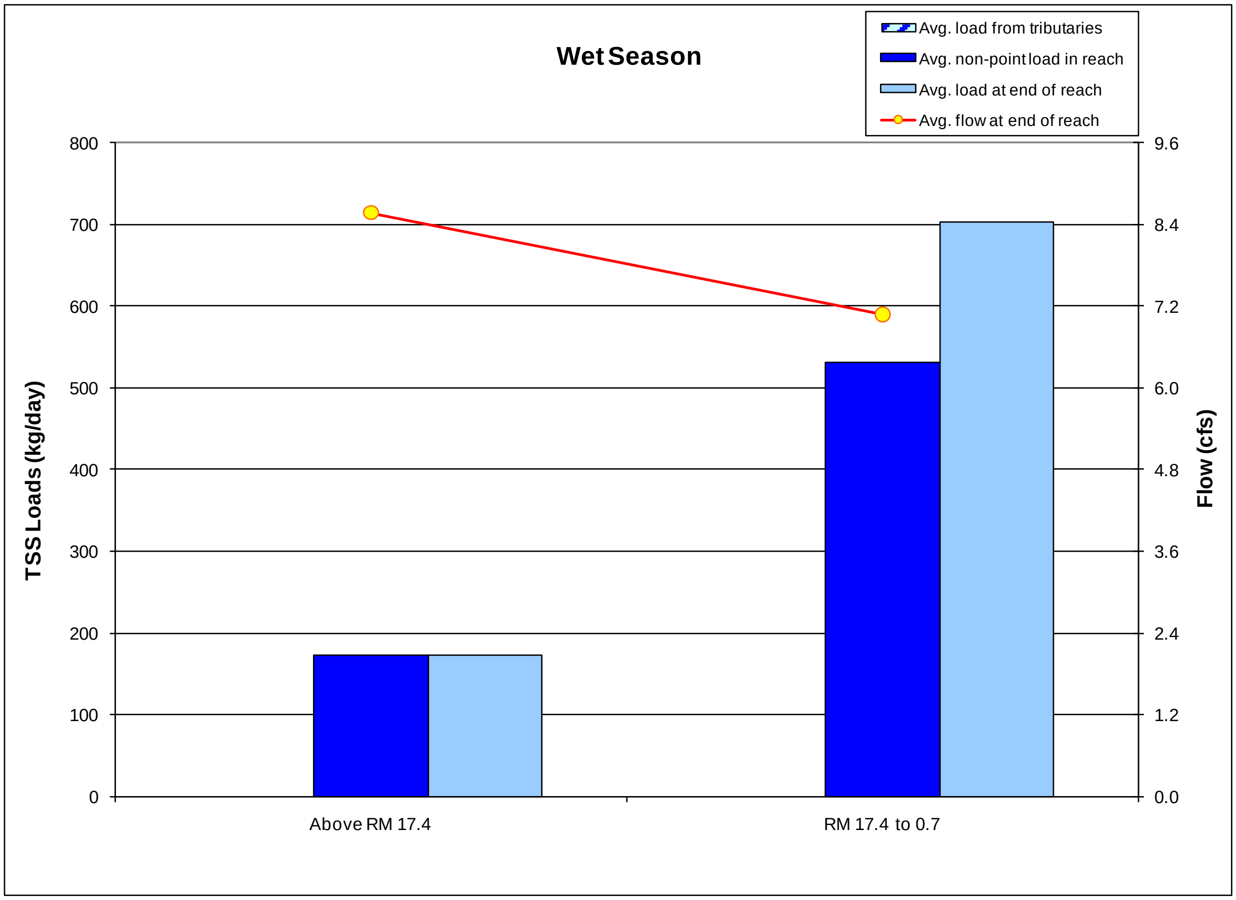


Figure 24. Wet-season average TSS loads from the 2007-08 TMDL study in Cow Creek.

Table 21. Wet-season TSS loading percentages from the 2007-08 study in Cow Creek.

Reach (Cow Creek RM)	Site (End of Reach)	Wet Season
Above RM 17.4	34COW17.4	24.5%
RM 17.4 to 0.7	34COW00.7	75.5%

Margin of safety

A margin of safety to account for scientific uncertainty must be established in all TMDLs to ensure that the targets will protect water quality. The margin of safety for this FC bacteria TMDL analysis is implicit through the use of conservative assumptions in project design and analysis.

Target reductions generally were based on the 90th percentile of FC concentrations. The roll-back method assumes that the variance of the post-management data set will be equivalent to the variance of the pre-management data set. As pollution sources are managed, the frequency of high FC values is likely to decrease, which should reduce the variance and 90th percentile of the post-management condition.

Loading capacity

"Loading capacity" means the maximum amount of FC bacteria pollution a water body can withstand and still meet the Washington State water quality standard. In this TMDL report, it is assumed that if the individual tributaries and various segments (reaches) of the Palouse River were to meet the water quality standard, then the Palouse River as a whole would meet the standard prior to its confluence with the Snake River.

Because the FC bacteria water quality standard is based on statistical targets, this FC bacteria TMDL uses statistical targets to define loading capacities. The applicable statistics from the two-part FC criteria for the Palouse basin are:

- A geometric mean less than 200 cfu/100 mL for the Palouse River from Colfax to the Palouse Falls.
- A geometric mean less than 100 cfu/100 mL for the tributaries and the Palouse River below the Palouse Falls.
- No more than 10% of the samples to exceed 400 cfu/100 mL for the Palouse River from Colfax to the Palouse Falls. (The 90th percentile of the sample distribution is evaluated in this TMDL instead.)
- No more than 10% of the samples to exceed 200 cfu/100 mL for the tributaries and the Palouse River below the Palouse Falls. (The 90th percentile of the sample distribution is evaluated in this TMDL instead.)

Seasonal statistics were developed for each site using current data collected from the 2007-08 TMDL study. The current statistics were compared to the water quality criteria, and the percent reduction required to meet the water quality criteria was calculated. The statistic that needed the greatest percent reduction was chosen for each site as the basis for compliance. In this evaluation, the basis of compliance for all sites was based on the required reduction necessary to meet the second part of the water quality criteria. Therefore, the target reduction to meet this part of the standard is established by calculating the reduction necessary to meet the 90th percentile of the sample distribution.

The percent reduction values in Table 22 indicate the relative degree the water body is currently out of compliance with the water quality criteria (i.e., how far it is over its capacity to receive FC loads and still provide Primary or Secondary Contact recreation). Sites representing reaches or tributaries that are meeting their loading capacity have a zero percent reduction value. Sites that require aggressive reductions in FC sources have high target percent reductions, while sites with minor problems have lower target percent reductions.

Table 22. Load allocations expressed as target percent reductions for sites in the Palouse River TMDL study area.

Station ID	Dry Season Target % Reduction	Wet Season Target % Reduction	Loading capacity (billions cfu/day) based on average seasonal flow	
			Dry Season	Wet Season
Palouse River				
NF Palouse River	43%	0%	43.9	1087
34SFPR00.1	94%	72%	33.1	243
34COLWTP	0%	0%	see permit limits	see permit limits
34PAL90.8	0%	0%	161	2684
34PAL85.6	0%	0%	163	2854
34DRY00.0	72%	69%	0.9	32.4
34PAL77.8	0%	0%	143	3386
34PAL66.8	0%	0%	166	3266
34LIT00.2	63%	19%	1.4	2.6
34PAL59.0	0%	0%	190	3130
34DOW02.5	38%	0%	6.7	10.5
34PAL49.4	77%	0%	188	2962
34REB00.3	89%	52%	8.3	27.9
34PAL41.1	0%	0%	178	2955
34ROC00.1	0%	0%	58.5	575
34PAL33.4	0%	0%	246	4061
34UNF00.5	74%	34%	15.8	113.2
34PAL25.7	0%	0%	296	4364
34WIL00.2	0%	0%	1.4	4.3
34PAL19.5	0%	0%	316	4427
34COW00.7	90%	73%	2.6	19.2
34PAL15.8	0%	0%	321	4465
Rebel Flat Creek				
34REB15.1	91%	0%[1]	1.2	23.1
34REB08.2	84%	28%	4.1	28.0
34REB06.6	64%	37%	4.2	36.4
34ENDWTP	0%	0%	see permit limits	see permit limits
34REB05.7	45%	58%	5.9	44.7
34REB00.3	89%	52%	8.3	48.0
Cow Creek				
34COW17.4	57%	0%	5.0	41.9
34COW00.7	90%	73%	2.6	34.6

Shaded cells are estimates due to insufficient number of samples.
[1] Site had too many seasonal high counts.
Bolded station ID indicates a site with *Secondary Contact* criteria.

In addition, to meet EPA reporting requirements, Table 22 expresses loading capacities in number of FC bacteria per day based on the 2007-08 average seasonal flow. Loading capacity is flow dependent so it changes as the flow changes. The reported loading capacities are specific to the average seasonal flow measured at each station. Higher flow at a station would result in a higher loading capacity while a lower flow would result in a lower loading capacity. Compliance with the water quality standard and this TMDL should compare monitoring results to the concentration-based standard and not the average seasonal loading capacity indicated in Table 22 since it is unlikely the flow conditions will be the same.

Load and wasteload allocations

This TMDL study demonstrated that Primary and Secondary Contact recreation in the Palouse basin are impaired in areas by FC contamination. In order to meet the water quality standards for Primary and Secondary Contact recreation, reductions in FC contamination are needed. Nonpoint sources are assigned load allocations geographically. Point sources, such as municipal WWTPs in the basin, are assigned wasteload allocations to be included in their NPDES permits.

The Clean Water Act states that FC load and wasteload allocations may be expressed as loads, concentrations, or other appropriate measures [40 CFR 130.2(I)]. This TMDL expresses the load allocations in terms of percent reductions necessary to achieve concentration levels that are in accordance with the water quality standards. For all sites with a seasonal target percent reduction, a target geometric mean load capacity can be calculated by applying the target percent reduction to the seasonal geometric mean observed during the TMDL study.

Washington State uses FC concentrations as the most appropriate measure of meeting allocations because the FC concentrations can be directly compared to the water quality concentration-based standards. This TMDL expresses the wasteload allocation for the municipal WWTPs as a permit-based concentration limit.

Load allocations

Table 22 shows load allocations, expressed as percent reductions necessary to meet the water quality standards, for all monitored sites on the Palouse River that are not regulated by permit.

Table 22 also includes load allocations for sites on Rebel Flat Creek, Cow Creek, and the mouths of the other tributaries.

At Rebel Flat site 34REB15.1, the distribution of the data shows the site met standards in the wet season; however, there were too many FC counts just over 200 cfu/100 mL. This site should still be addressed during cleanup efforts since it is an area of additional FC loading.

Municipal wastewater treatment plant (WWTP) wasteload allocations

Wasteload allocations represent the pollution targets for point sources and other sources that are covered under a NPDES permit. Two Washington State WWTPs hold individual NPDES permits to discharge FC bacteria in the Palouse River TMDL study area:

Colfax WWTP

The current permit limit for Colfax requires them to discharge below a weekly average FC concentration of 400 cfu/100 mL and a monthly average FC concentration of 200 cfu/100 mL. The city of Colfax had good disinfection based on TMDL study samples taken from the discharge well. The FC concentrations were well below numeric criteria for both seasons.

Endicott WWTP

The current permit limit for Endicott requires them to discharge below a weekly average FC concentration of 200 cfu/100 mL and a monthly average FC concentration of 100 cfu/100 mL. Endicott had good disinfection based on TMDL study samples taken at the end of the UV disinfection chamber, but there were two occasions in the wet season when FC counts were nearing 100 cfu/100 mL.

An analysis of weekly data reported by Endicott from September 2006 to June 2009 shows concentrations sometimes exceeded permit limits (Figure 25). The exceedances occurred primarily during the wet season when there were higher flows.

Endicott samples once a week, so their weekly average is also a weekly maximum, and their monthly average is calculated from the weekly samples. Weekly sampling is not frequent enough to statistically evaluate if the WWTP is affecting water quality in Rebel Flat Creek on a monthly basis. However, seasonal pooling of the weekly data showed that, with the current distribution of FC data from the WWTP, if the current permit limits were to be met, they should protect water quality.

This TMDL recommends that the Endicott WWTP increase weekly sampling frequency from once per week to two or three times per week during the months of October to June. The additional sampling will allow Ecology staff to assess if sufficient disinfection is occurring on a shorter-term monthly basis during the time period the plant has shown permit limit exceedances.

Table 23 summarizes the current municipal treatment plant NPDES permit limits. These permit limits will suffice as the wasteload allocations for these facilities.

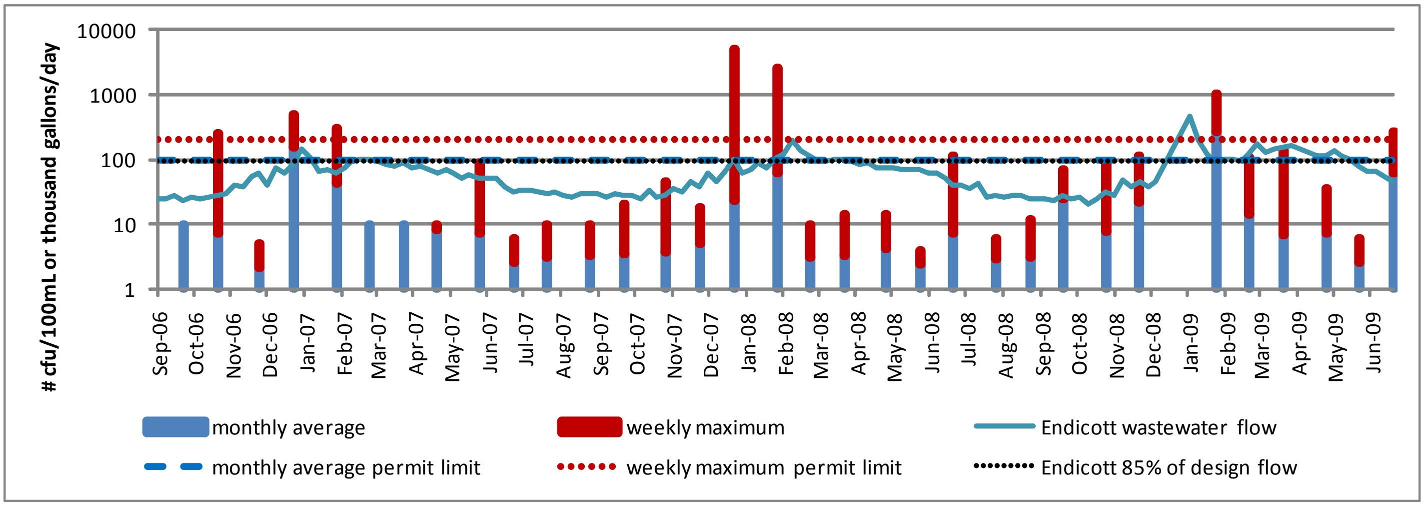


Figure 25. Summary of weekly and monthly FC data reported by the Endicott Wastewater Treatment plant from Sept 2006 to June 2009 compared to permit limits. Daily wastewater flow is also presented.

Table 23. Municipal wastewater treatment plant permit limits.

WWTP	NPDES Permit Limit
City of Colfax	400 cfu/100 mL weekly average 200 cfu/100 mL monthly average
City of Endicott	200 cfu/100 mL weekly average 100 cfu/100 mL monthly average

Stormwater wasteload allocations

The study did not directly evaluate stormwater contributions from Empire Disposal Inc. (industrial stormwater permit holder), but the waterbody that the facility discharges to did have FC bacterial contamination. Facilities covered by the Industrial Stormwater General Permit or Construction Stormwater General Permit have a low potential for contributing or transporting FC bacteria. No additional permit requirements are recommended beyond the good housekeeping practices outlined in the current permit, unless future monitoring shows otherwise.

WSDOT has highways along the Palouse River (State Route 26 and US Route 195). Stormwater outfalls from the highways were not sampled during the study, therefore no target percent reductions are listed for specific outfalls. For future monitoring, the outfalls are expected to meet the FC concentration criteria of the waterbody they discharge to. This TMDL includes specific actions for WSDOT in the i*mplementation plan* section of this report..

Reasonable assurance

When establishing a TMDL, reductions of a particular pollutant are allocated among the pollutant sources (both point and nonpoint sources) in the water body. For the Palouse River FC bacteria TMDL both point and nonpoint sources exist, although the majority of reductions required are from nonpoint sources. TMDLs must show “reasonable assurance” that these sources will be reduced to their allocated amount. Education, outreach, technical and financial assistance, permit administration, and enforcement will all be used to ensure that the goals of this water quality improvement plan are met.

Ecology believes that the following activities already support this TMDL and add to the assurance that FC bacteria in the Palouse River and its tributaries, including Rebel Flat Creek, will meet criteria required by state water quality standards. This assumes that the activities described below are continued and maintained.

The goal of the Palouse River Water Quality Improvement Plan for FC bacteria is for the waters of the basin to meet the state’s water quality standards. The following rationale helps provide reasonable assurance that the nonpoint source TMDL goals will be met by 2021.

As described previously, existing FC bacteria TMDLs on the North Fork Palouse and South Fork Palouse rivers require reductions prior to their junction with the main stem Palouse River. Efforts to reduce bacteria levels in these water bodies will contribute to improvements in the Palouse River, especially in Reach 1, which already meets standards.

The Cow Creek 4B pollution control program efforts will also assure reductions in Cow Creek, which should help the mouth of Cow Creek reach its target.

Current implementation efforts funded by 319 Direct Implementation Funds in the Palouse River watershed are already addressing many of the pollution sources. Ecology is funding two Washington Conservation Corps teams to construct fencing and plant native riparian vegetation throughout the watershed. The goal is to complete 30 miles of projects by December 2010. This project includes a partnership with local conservation districts to assist landowners with this opportunity and other funding and technical resources.

The Palouse-Rock Lake Conservation District has an active program to address livestock impacts along streams in the watershed. Grant funding from Ecology and federal programs is used to cost-share the cost of implementation of best management practices. The Palouse-Rock Lake Conservation District plans to continue to implement this program as long as funding can be secured.

Whitman County Health Department regulates on-site septic systems in the watershed, in accordance with Chapter 246-272 WAC. When the department receives a complaint about a failing system, the department verifies the failure and assists the landowner to come into compliance with the regulation.

While Ecology is authorized under Chapter 90.48 RCW to impose strict requirements or issue enforcement actions to achieve compliance with state water quality standards, it is the goal of all participants in the Palouse River TMDL process to achieve clean water through voluntary control actions.

Conclusions

Whole study area (part of the Palouse River watershed)

Figures 26 and 27 summarize the percent fecal coliform (FC) bacteria reductions required for the TMDL study area monitoring stations. The figures also present the relative FC load contributions to the Palouse River from within the study area, for both the dry and wet seasons.

Figures 28 and 29 are bar charts showing FC bacteria and total suspended solids (TSS) loads to the Palouse River for both the dry and wet seasons during the TMDL study year, 2007-08. In summary:

- The Palouse River stations in the study area are only required to meet Washington State Secondary Contact recreation FC criteria. All sites except one (34PAL49.4) met Secondary Contact criteria, and most sites also met Primary Contract recreation FC criteria for both wet and dry.
- The Palouse River sites listed on the 2008 303(d) list at river mile (RM) 25.7 and RM 15.8 met (did not exceed) water quality criteria during this study.
- In order to maintain water quality and to meet the antidegradation requirements of Washington's water quality standards, sites that did not require FC reductions cannot receive any additional input of FC bacteria.
- All of the tributaries to the Palouse River monitored for the TMDL study needed FC reductions at their mouths in at least one season, except for the mouths of Rock and Willow Creeks. FC exceedances at the mouths of tributaries indicate the need for further upstream monitoring, as was done for Rebel Flat Creek.
- All three Rebel Flat Creek sites listed on the 2008 303(d) list showed FC exceedances during the dry and wet seasons.
- Willow Creek is listed on the 2008 303(d) list but did not exceed water quality criteria during this study.
- The South Fork (SF) Palouse River had the largest FC load contribution to the Palouse River. Eliminating that load will improve water quality in the Palouse River.
- Some sub-reaches of the Palouse River had high, unexplained FC and TSS loads.
- Both the Colfax and Endicott wastewater treatment plants had adequate disinfection based on the samples taken during the TMDL study.

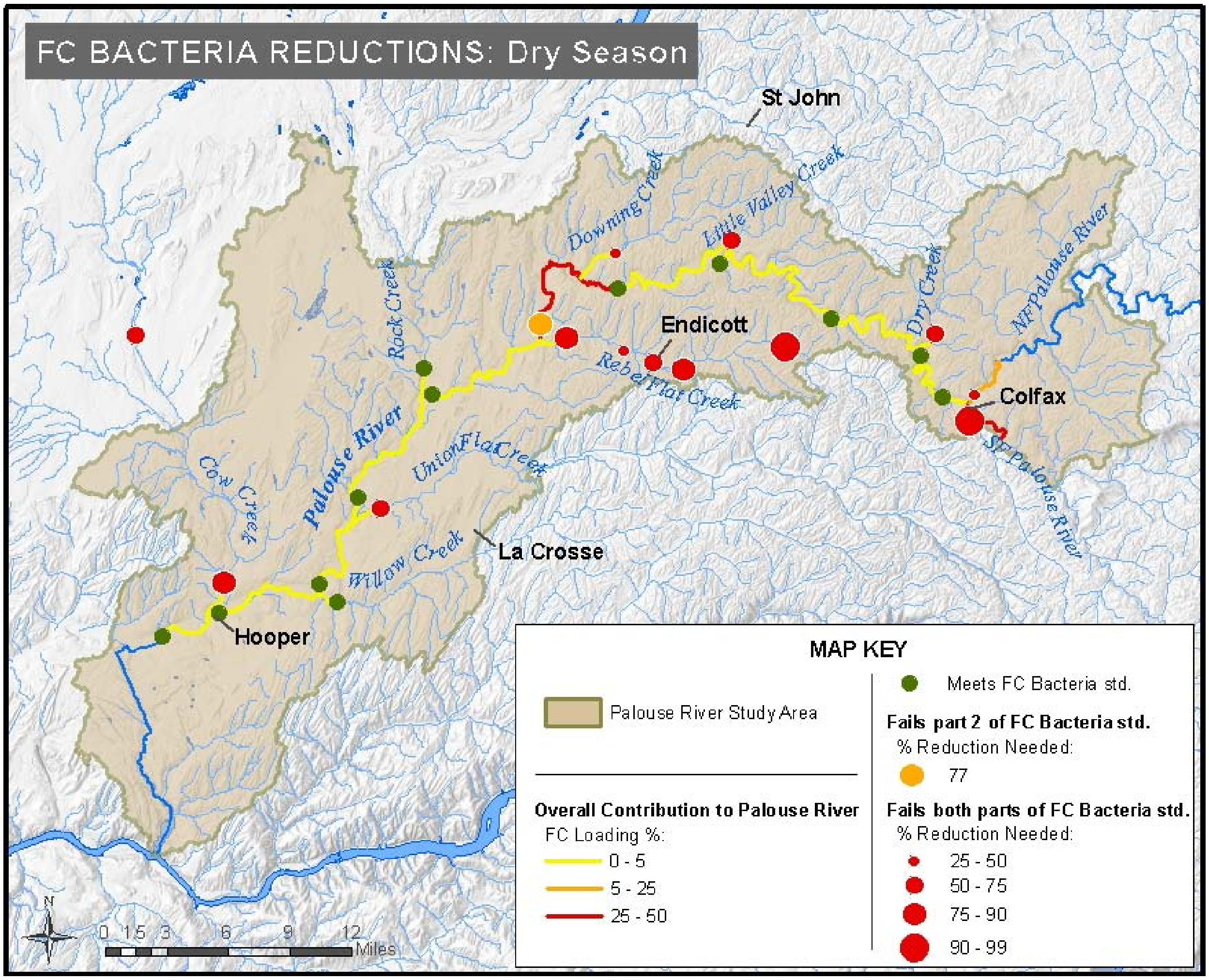


Figure 26. Study area map summarizing the dry-season FC percent reductions at each station location and overall FC load contribution from sub-reaches to the Palouse River.
(FC bacteria standards = Washington State numeric FC criteria.)

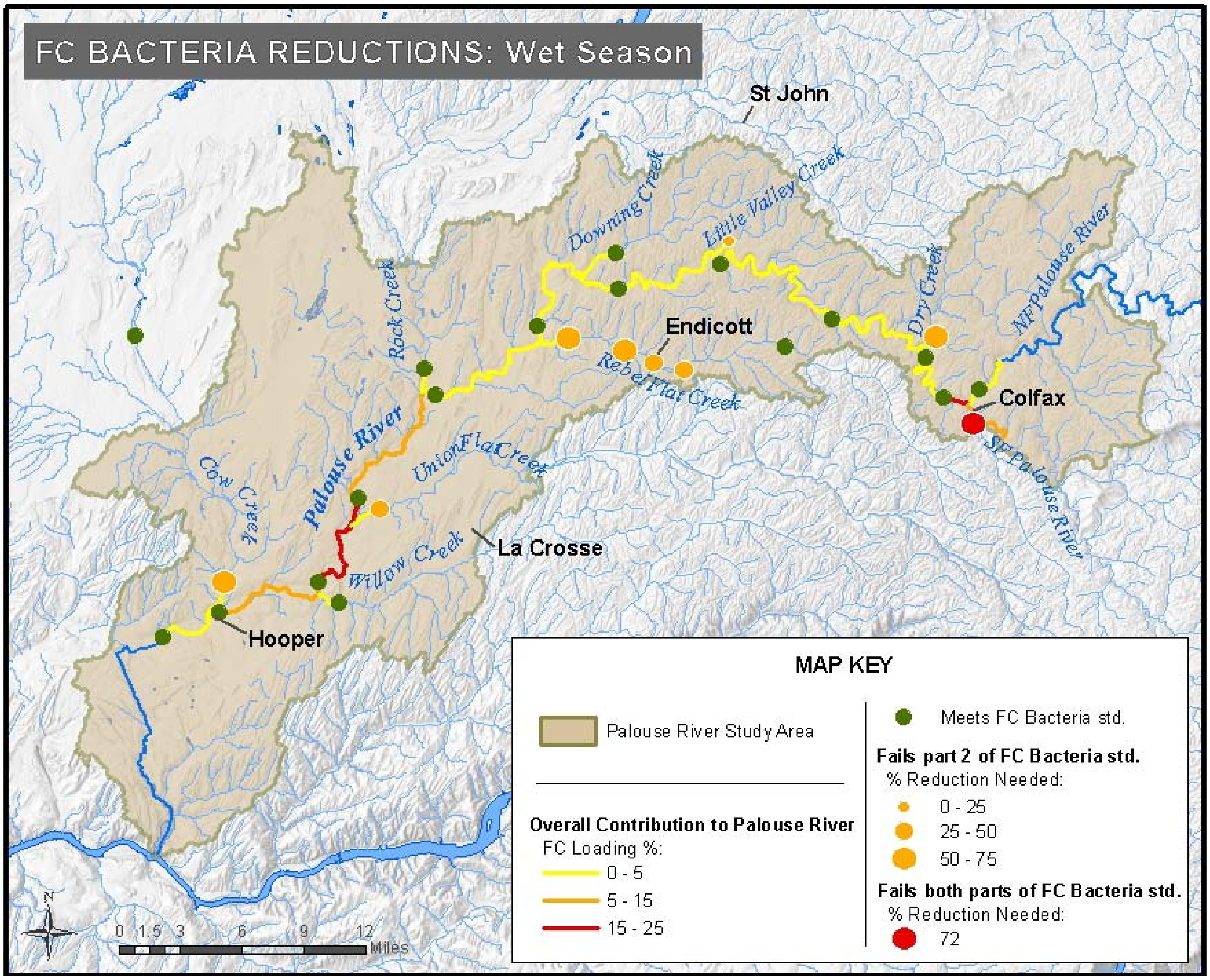


Figure 27. Study area map summarizing the wet-season FC percent reductions at each station location and overall FC load contribution from sub-reaches to the Palouse River.
(FC bacteria standards = Washington State numeric FC criteria.)

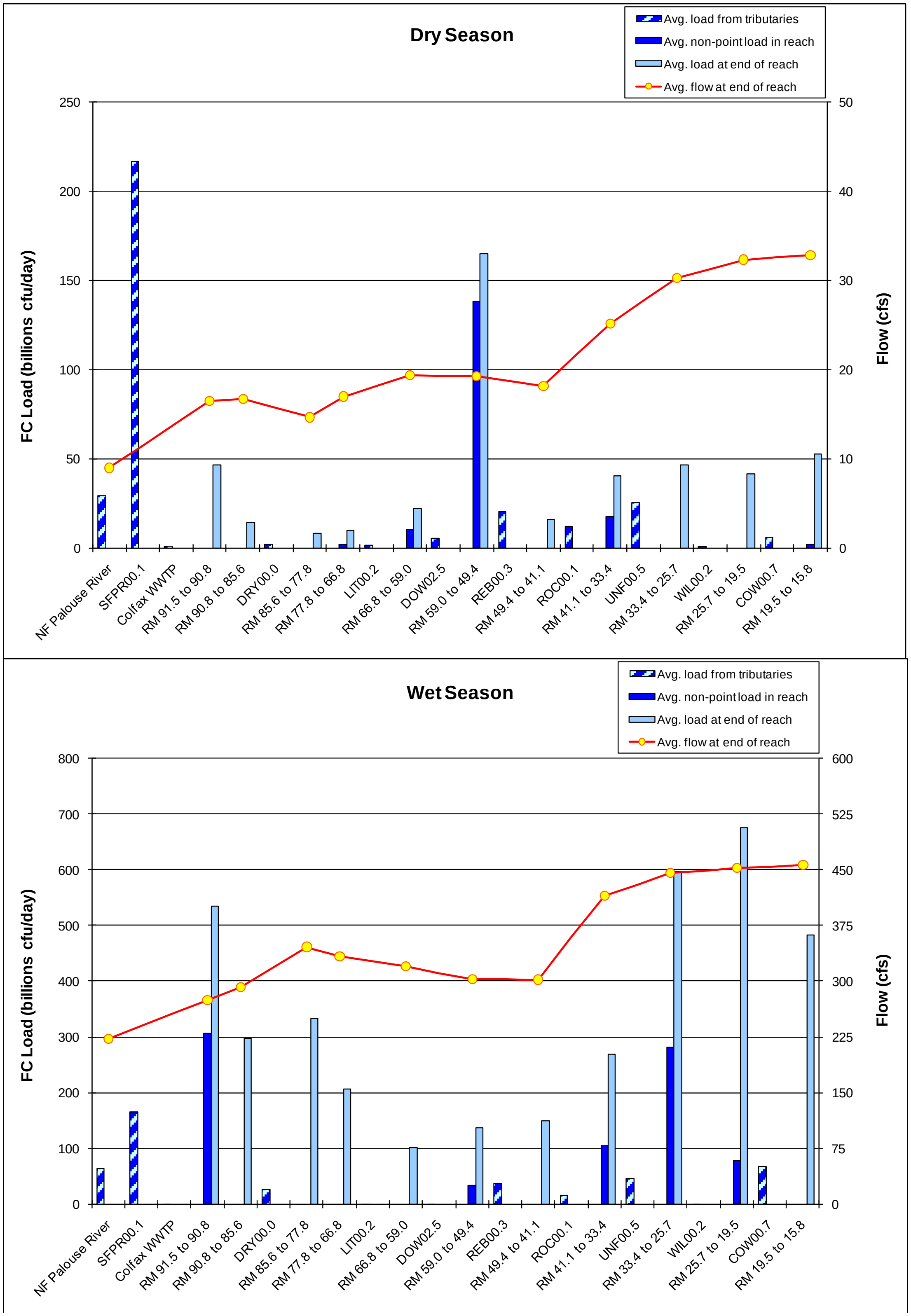
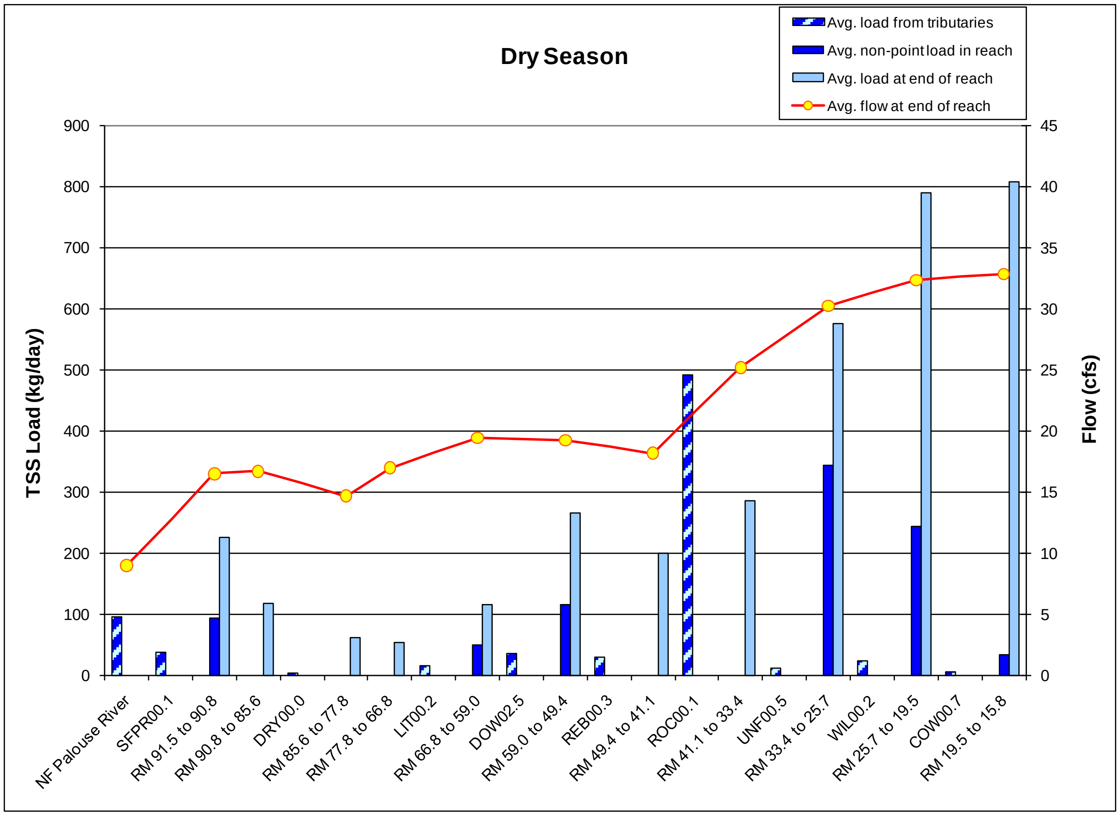


Figure 28. Summary of average dry-season and wet-season FC loads in the Palouse River during the 2007-08 TMDL study.



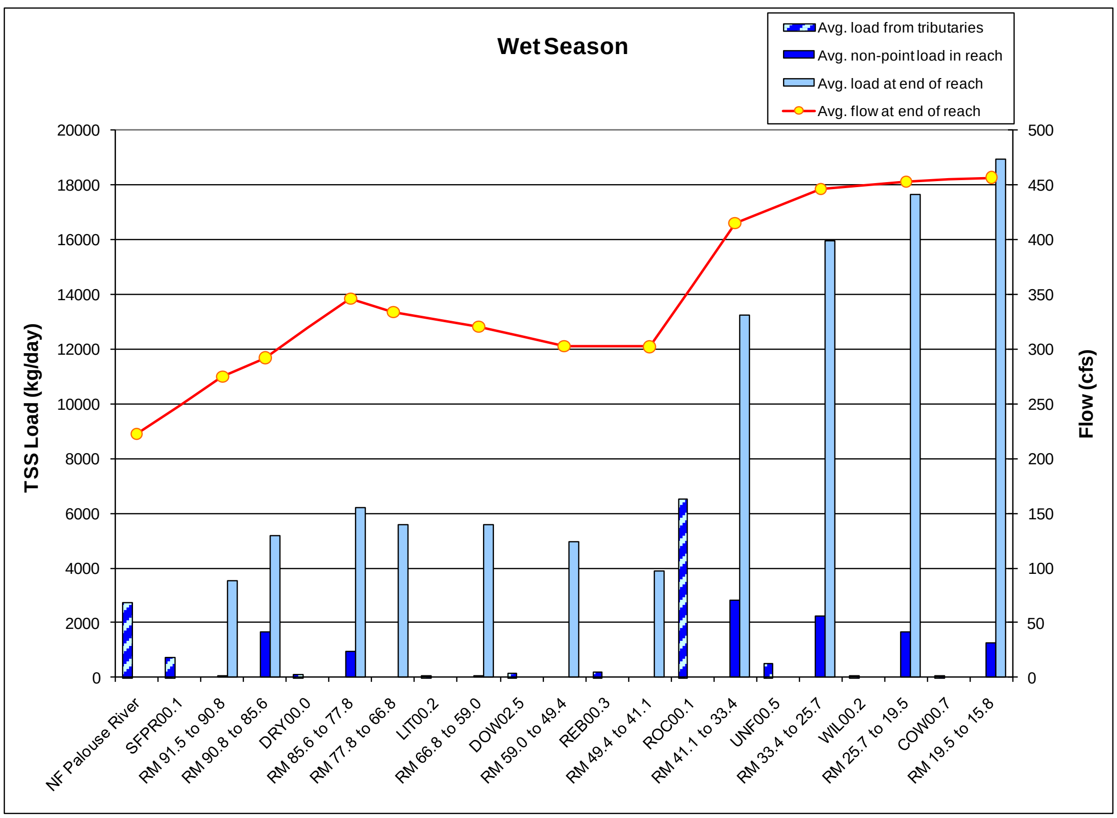


Figure 29. Summary of average dry-season and wet-season TSS loads in the Palouse River during the 2007-08 TMDL study.

Reach 1 of the Palouse River

- FC bacteria concentrations for the Palouse River sampling stations in Reach 1 met (were below) Washington State numeric FC criteria for both wet and dry seasons.
- However, FC concentrations were nearing numeric criteria limits at sampling station 34PAL90.8 (below Colfax) during both the dry and wet season, and nearing criteria limits downstream at 34PAL85.6 (near Manning) for the wet season.
- The majority of the FC loading to Reach 1 of the Palouse River during the dry season was from the SF Palouse River (83%) and the North Fork (NF) Palouse River (11%).
- The majority of the loading to Reach 1 during the wet season was from the sub-reach between RM 91.5 and 90.8 (54%), the SF Palouse River (29%), and the NF Palouse River (11%).
- There was a weak but positive relationship between TSS concentrations and FC concentrations in Reach 1 during the wet season, suggesting that conditions that elevate TSS, such as high streamflow and runoff processes (causing soil erosion), could also be elevating FC concentrations.
- None of the measured tributaries to Reach 1, including the NF Palouse River, SF Palouse River, Dry Creek, and Little Valley Creek, met numeric water quality criteria during one or both seasons.

Reach 2 of the Palouse River

- All of the mainstem stations in Reach 2 met the numeric FC criteria for the dry and wet seasons, except for the Palouse River site in Winona (34PAL49.4) which exceeded numeric criteria for the dry season.
- The majority of the FC loading to Reach 2 of the Palouse River during the dry season was from the sub-reach between RM 59.0 and 49.4 (58%) and Union Flat Creek (11%).
- The majority of the FC loading to Reach 2 during the wet season was from the sub-reach between RM 33.4 and 25.7 (42%), the sub-reach between RM 41.1 and 33.4 (16%), the sub-reach between RM 25.7 and 19.5 (12%), and sampling station 34COW00.7 (10%).
- Three tributaries (Rebel Flat Creek, Union Flat Creek, and Cow Creek) did not meet numeric FC criteria during both seasons. Downing Creek exceeded numeric criteria only during the dry season.
- There was a moderately weak and positive relationship between TSS concentrations and FC concentrations in Reach 2 of the Palouse River during the wet season. This suggests that conditions that elevate TSS, such as high streamflow and runoff processes (causing soil erosion), could also be elevating FC concentrations.

- The last measured downstream station on the Palouse River (West Hooper) at RM 15.8 met both Primary and Secondary Contact numeric criteria. The designation of the Palouse River changes from Secondary Contact to Primary Contact recreation below the Palouse Falls near RM 7.0. Without further FC contamination downstream, the Primary Contact recreation beneficial uses should have been preserved to the mouth of the Palouse River.

Rebel Flat Creek

- All five Rebel Flat Creek sites had high FC concentrations and did not meet numeric FC criteria for both seasons.
- The majority of the loading to Rebel Flat Creek during the dry season was from the sub-reach between RM 5.7 and 0.3 (62%), above RM 15.1 (23%), and the sub-reach between RM 15.1 and 8.2 (16%).
- The majority of the loading to Rebel Flat Creek during the wet season was from the sub-reach between 5.7 and 0.3 (65%), the sub-reach between 6.6 and 5.7 (18%), and the sub-reach between RM 15.1 and 8.2 (12%).
- There was no apparent relationship between TSS concentrations and FC concentrations in Rebel Flat Creek.

Cow Creek

- The FC concentrations at both Cow Creek sites did not meet numeric criteria for the dry season.
- Sampling station 34COW00.7 went dry during the latter part of the dry season, so only four samples were taken and used for analysis.
- Because of the lack of streamflow, no FC loading data are reported for the dry season.
- FC concentrations were high at 34COW00.7 during the wet season, and did not meet numeric criteria.
- The majority of the FC loading to Cow Creek during the wet season was from the reach between RM 17.4 and 0.7 (90%).

This page is purposely left blank

Recommendations

As a result of this 2007-08 TMDL study, the following recommendations are made.

Implementation of TMDL targets

The goal of this TMDL project is to reduce fecal coliform (FC) bacteria at all sampling sites that are assigned target percent FC reductions so that all sites within the Palouse River basin comply with Washington State water quality standards. While many sites did not require a reduction, in order to maintain water quality and to meet the antidegradation requirements of Washington's water quality standards, these sites cannot receive additional inputs of FC bacteria.

The following FC loads are prioritized (based on size of load and concentration) for implementation actions to reduce FC loads and concentrations during the dry season and wet season. Implementation may include further assessment, if necessary.

Unexplained FC loads to the Palouse River during the dry season (mid-June through October)

- From the South Fork Palouse River.
- Between river mile (RM) 59.0 and 49.4 of the Palouse River.
- From the North Fork Palouse River.
- From Union Flat Creek.
- From Rebel Flat Creek.
    - Between RM 5.7 and 0.3 of Rebel Flat Creek.
    - Above RM 15.1 of Rebel Flat Creek.
    - Between RM 15.1 and 8.2 of Rebel Flat Creek.
- Between RM 41.1 and 33.4 of the Palouse River.
- From Rock Creek.
- Between RM 66.8 and 59.0 of the Palouse River.
- From Downing Creek.

Unexplained FC loads to the Palouse River during the wet season (November through mid-June)

- Between RM 91.5 and 90.8 of the Palouse River.
- Between RM 33.4 and 25.7 of the Palouse River.
- From the South Fork Palouse River.
- Between RM 41.1 and 33.4 of the Palouse River.
- Between RM 25.7 and 19.5 of the Palouse River.

- From Cow Creek.
    - Between 17.4 and 0.7 of Cow Creek.
    - Above RM 17.4 of Cow Creek.
- From the North Fork Palouse River.
- From Union Flat Creek.
- From Rebel Flat Creek.
    - Between RM 5.7 and 0.3 of Rebel Flat Creek.
    - Between RM 6.6 and 5.7 of Rebel Flat Creek.
    - Between RM 15.1 and 8.2 of Rebel Flat Creek.
    - Above RM 15.1 of Rebel Flat Creek.
- Between RM 59.0 and 49.4 of the Palouse River.
- From Dry Creek.
- From Rock Creek.

Total suspended solids (TSS) loading and soil-erosion control

Relatively weak but positive correlations between TSS and FC concentrations suggest that conditions that elevate TSS, such as high streamflow and runoff processes (causing soil erosion), could also be elevating FC concentrations. Further investigation in Reach 1 and Reach 2 during the wet season is warranted to determine whether soil-erosion controls could also reduce FC levels.

Stormwater management

In addition to the requirements outlined in the stormwater general permits, jurisdictions should focus source identification and management efforts in the areas with FC reduction targets identified in this study.

Future monitoring for FC bacteria

Ecology and other implementing organizations often include monitoring in their projects. Any additional monitoring should take the following recommendations into consideration to assure the most useful and relevant data are collected.

Compliance with the FC bacteria water quality criteria and the target reduction goals should be monitored by sampling at the sites where data were used to generate those goals. Streamflow measurements should also be taken when samples are collected in order to estimate FC loads.

The following should be considered for further monitoring to isolate or better define possible FC sources to the Palouse River:

- The source of year-round FC loading from the South Fork Palouse River needs to be isolated and stopped.
- The consistent high FC concentrations from Dry Creek should be investigated to reveal pollution sources.
- The consistent high FC concentrations from Little Valley Creek should be investigated to reveal pollution sources.
- An assessment of dry-season, non-runoff FC sources from Downing Creek may reveal sources leading to high concentrations.
- An assessment of dry-season, non-runoff FC sources between RM 59.0 and 49.4 of the Palouse River may reveal isolated plume sources. Particular attention should be given to septic tanks in the reach.
- The consistent high FC concentrations and loading from Rebel Flat Creek should be investigated. Particular attention should be given to the Rebel Flat Creek reach between RM 5.7 and 0.3.
- The consistent high FC concentrations and loading from Union Flat Creek should be investigated to reveal pollution sources.
- The consistent high FC concentrations from Cow Creek should be investigated to reveal pollution sources.
- An assessment of wet-season, runoff FC sources between RM 91.5 and 90.8 of the Palouse River may reveal loading sources.
- An assessment of wet-season, runoff FC sources between RM 33.4 and 25.7 of the Palouse River may reveal loading sources.
- An assessment of wet-season, runoff FC sources between RM 41.1 and 33.4 of the Palouse River may reveal loading sources.
- The consistent FC loading from above RM 91.5 of the Palouse River should be investigated to reveal pollution sources.

This page is purposely left blank

Implementation Plan

Introduction

This *implementation plan* describes what will be done to improve water quality. It expands on the recommendations made in Part 1 of this report. This plan describes the roles and authorities of cleanup partners (i.e., those organizations with jurisdiction, authority, or direct responsibility for cleanup) and the programs or other means through which they will address these water quality issues.

Typically, Ecology produces an i*mplementation strategy*, which is submitted with the technical analysis to the U.S. Environmental Protection Agency (EPA) for approval of the TMDL. Then, following EPA approval, Ecology and interested and responsible parties develop a *water quality implementation plan*. However, this implementation plan will serve as both the *implementation strategy* and the i*mplementation plan*.

This plan describes how fecal coliform bacteria levels will be reduced to meet water quality standards. Bacteria TMDL reductions should be achieved by 2021 in the main stem Palouse River, Rebel Flat Creek and the mouth of impaired tributaries.

Summary of actions

Fecal coliform bacteria primarily enter water ways from the following sources:

- Livestock with direct access to streams or with poor manure management.
- Failing or improperly constructed septic systems.
- Stormwater (including pet waste).
- Wildlife.

The most effective means of addressing these sources is prevention. If these sources are managed and maintained properly, bacteria can be prevented from entering waterways both directly and through runoff. Healthy riparian areas are a key component to ensure runoff is filtered prior to it reaching the streams. In addition, healthy riparian areas discourage animals and birds from congregating along streams where they can deposit wastes. In several portions of the watershed, a relationship between total suspended solids (mainly sediment) and bacteria was found, indicating that methods to reduce erosion could also reduce bacteria levels.

While the TMDL study showed that many segments of the Palouse River did not need bacteria reductions during the 2007-2008 year, these segments must not receive additional bacteria inputs in order to maintain compliance with the water quality standards. Under state law, it is always illegal for anyone to cause or allow pollutants to enter streams (RCW 90.48.080).

The follow section describes addressing each of the sources listed earlier in more detail. It also describes implementation efforts underway on several tributaries to achieve reductions.

Activities to address pollution sources

Fecal coliform from animals (livestock and wildlife)

When livestock or wildlife congregate along streams, they deposit fecal matter, trample vegetation, and break up the soil. When the vegetation is removed and the soil is loosened, it increases erosion and removes any filtering effect for the deposited fecal matter. To address these issues, riparian fencing and off-stream watering should be installed in areas with livestock to ensure the stream corridor is protected. In areas without livestock, riparian vegetation should be planted, enhanced, or maintained to discourage wildlife congregation and filter polluted runoff.

Fecal coliform from failing or improper constructed on-site septic systems

Improperly maintained septic systems can fail and lead to pollutants entering waterways. Untreated or partially treated sewage can accumulate on the ground's surface and flow into streams. Improperly treated sewage can also leach pollutants into the ground water, which can travel to nearby streams.

To combat failing septic systems, homeowners should be educated about the proper maintenance and inspection of septic systems. This education should include the negative effects of garbage disposals and what should and should not be disposed of through in-home drains to septic systems.

Sub-reaches of the streams with consistent year-round loading should be further investigated for failing or improperly constructed septic systems. If failing or straight pipe (direct discharge without treatment to a ditch or stream) septic systems are found, they will need to be repaired or replaced under proper permitting regulations.

Fecal coliform from stormwater (including pet waste)

Many best management practices (BMPs) exist to reduce runoff that can transport bacteria to streams via stormwater. The towns (primarily Colfax and Endicott) and Washington State Department of Transportation (WSDOT) should inventory stormwater outfalls to determine where stormwater may be delivering pollutants to streams, and work to prevent delivery of unnatural levels of fecal coliform to their stormwater conveyance systems. Because bacteria loading was sometimes correlated with total suspended solids (mainly sediment), the inventory should include assessing potential sediment discharges. Efforts to prevent sources and reduce fecal coliform contributions could include the use of BMPs, pollution prevention measures such as Illicit Discharge Detection and Elimination (IDDE) programs, increased public education, and other methods.

An important source of bacteria in stormwater can be pet waste that is left on the ground. Towns should have pet waste ordinances in place to require citizens to pick up and properly dispose of pet waste. Educating the town residents regarding this practice is an important step cities can take to reduce bacteria in stormwater.

Fecal coliform from the North Fork Palouse River

The North Fork Palouse River is a significant bacteria load contributor to Reach 1 of the main stem Palouse River. Ecology completed an implementation plan for the North Fork Palouse River in June 2006. Implementation of that TMDL is underway and the necessary reductions from the North Fork will be implemented and tracked under the North Fork TMDL. The North Fork Palouse FC TMDL calls for reductions, primarily from livestock operations and failing septic systems.

Fecal coliform from the South Fork Palouse River

The South Fork Palouse River is a significant bacteria load contributor to Reach 1 of the main stem Palouse River. The South Fork Palouse River FC TMDL was approved by EPA in January 2010. The South Fork Palouse River TMDL Implementation Plan was under development at the time this plan was published. The South Fork Palouse River TMDL requires reductions primarily from stormwater, livestock, failing septic systems, and a large unknown source in the city of Colfax. Further monitoring revealed this unknown source to be in part the result of pigeons under several bridges in town. Discouraging pigeon roosting and reducing the droppings will result in significant bacteria reductions in Reach 1 of the main stem Palouse River. This will be implemented and tracked under the South Fork Palouse River FC TMDL Implementation Plan (Snouwaert, in production).

Fecal coliform from Cow Creek

Ecology funded several projects in the Cow Creek watershed through the Adams Conservation District. These projects fenced livestock from the stream, provided off-stream water, and planted native riparian vegetation. A significant amount of this work is complete and more is scheduled. This effort has resulted in Cow Creek being reclassified from the 303(d) list (impaired) to a Category 4B (has a pollution control program) water body. Bacteria reductions called for in this TMDL from the mouth of Cow Creek will be implemented through that 4B pollution control program. If the necessary reductions are not realized in an acceptable timeframe, Cow Creek will be reconsidered for additional implementation during adaptive management of this TMDL. For more information on the water pollution control program in the Cow Creek sub-watershed, see www.ecy.wa.gov/programs/wq/303d/2008/4bCow.pdf.

Organizations' implementation actions, goals, and schedules

Activities to be carried out by different entities in the watershed are described below. Entities are listed alphabetically after Ecology.

Washington State Department of Ecology (Ecology)

Ecology will oversee and track the implementation of this and the North Fork River and South Fork River TMDLs to ensure implementation is on schedule and pollution sources are being addressed. Ecology will also continue to coordinate implementation of the 4B pollution control program on Cow Creek.

At the time of publication, Ecology had federal 319 Direct Implementation Funding to focus implementation in the Palouse River watershed. This effort includes fencing and/or riparian plantings on 30 miles of stream in the watershed. The funding pays for a Washington Conservation Corp crew and some materials to implement riparian protection in this watershed. This effort is in partnership with the local conservation districts. Funding programs available to the conservation districts also help with the cost of these projects. Table 24 lists a sampling of the completed and scheduled projects. Even after this funding expires, Ecology will continue to seek opportunities to continue this effort in the watershed.

Ecology will administer NPDES permits for the wastewater treatment plants (WWTP). These permits will reflect permit limits and actions to prevent impairment of water quality standards from WWTP discharges.

Ecology will provide funding, through its competitive water quality grant and loan funding cycle, to projects that address the goals of this TMDL and rank high enough to receive funding. Additional points are awarded, during the application evaluation, for projects implementing TMDLs. The Ecology TMDL lead will provide feedback on grant applications prior to their submission to help applicants refine their scope of work to develop the best project that has the highest likelihood of being funded.

Ecology will refer nonpoint sources of pollution to the appropriate entity, such as a conservation district, to receive technical and financial assistance to correct the pollution problem. If necessary, Ecology will use its authority under Revised Code of Washington (RCW) 90.48 to enforce water quality regulations.

Table 24. Planned/completed water quality projects in the study area and upstream tributaries.

Stream	Project Type	Details[1]	Status
Palouse River	Fencing & riparian planting	2 miles; 19,000 trees and shrubs	Completed
Palouse River	Fencing & riparian planting	4 miles	Partially complete
Palouse River	Fencing & riparian planting	1 mile; 3600 trees and shrubs	Completed
Palouse River	Riparian planting	3 miles; 10,500 trees and shrubs	Completed
Palouse River	Riparian planting	½ mile	Planned
Palouse River	Riparian planting	1 ½ miles	Planned
Palouse River	Fencing	5 miles	Partially completed
Palouse River	Fencing	1 mile	Planned
Palouse River	Fencing	1 mile	Completed
Palouse River	Fencing	1 mile	Planned
Imbler Creek (tributary to Rock Creek)	Riparian planting	2 miles; 18,000 trees and shrubs	Completed
Packer Creek (tributary to Rock Creek)	Riparian planting	2 miles	Planned
Packer Creek	Riparian planting	½ mile	Planned
Downing Creek	Fencing & riparian planting	1 mile	Partially complete
Negro Creek (tributary to Rock Creek)	Fencing & riparian planting	3 miles	Completed
Cottonwood Creek (tributary to Rock Creek)	Riparian planting	½ miles	Planned
Kamiache Creek (tributary to Cottonwood)	Riparian planting	1 mile	Planned
Kamiache Creek	Fencing & riparian planting	¼ mile	Planned
Pleasant Valley Creek (tributary to Rock Creek)	Conservation Reserve Program (CRP) grassed waterway	¼ mile	Planned
Pleasant Valley Creek	Fencing & riparian planting	¼ mile	Planned
Cow Creek	Fencing & riparian planting	2 miles	Partially completed

Adams Conservation District (CD)

The Adams CD is a non-regulatory organization that assists land managers in implementing conservation practices. The Adams CD has conducted well over 50 miles of riparian restoration and fencing projects on Cow Creek and the Palouse River over the past several years. These efforts are early implementation activities for all of the TMDLs being developed for the Palouse River and should substantially help these streams meet the targets in this TMDL. In addition, the Adams CD received a grant from Ecology, scheduled to begin in Fiscal Year 2011 (July 2010-June 2011), called the Palouse River Implementation Project. This grant has a goal of establishing six off-stream water sites for livestock, 12 miles of livestock fencing, and the installation of 12,000 native shrubs and plants to restore and protect the riparian areas. Many of these projects are also listed in Table 24. The Adams CD will also educate landowners about the water quality problems and steps they can take to help reduce pollutants reaching the streams.

Colfax, City of

The TMDL study revealed high bacteria loading during the wet season in the stream segment between RM 91.5 and RM 90.8. This segment is from the confluence of the North and South Forks of the Palouse River to just over a mile downstream. The loading cannot be attributed to the excessive loading from the mouth of the South Fork Palouse River. Since this loading is only found during the wet season, it is suspected that it is stormwater or runoff related. The city of Colfax (Colfax) will sample flows from a stormwater outfall near the edge of the wastewater treatment plant to determine if it could be a source of the high loading.

A draft stormwater ordinance is currently being developed for Colfax. The ordinance will govern requirements for the flow, treatment, and discharge of stormwater from post-construction development. Colfax will also consider developing an illicit discharge and connection stormwater ordinance to prohibit non-stormwater discharges and connections to the storm sewer. Ecology's guidance for developing these regulations can be found at www.ecy.wa.gov/biblio/0810061.html.

Colfax will operate the wastewater treatment plant to ensure it continues to meet its fecal coliform bacteria limits as stated in the NPDES permit.

Colfax will also remind the city's residents about the existing pet waste ordinance and the responsibilities of pet owners to properly dispose of their pet's waste. Colfax may do this through educational flyers in utility bills or other methods.

In addition, Colfax's efforts to address pigeons under the city street bridges and investigate suspicious stormwater outfalls under the South Fork Palouse River TMDL will benefit reductions in Reach 1 of the Palouse River.

Endicott, Town of

The town of Endicott (Endicott) will consider projects to enhance the segment of Rebel Flat Creek that flows through town with assistance from the Palouse-Rock Lake Conservation District. Projects will be dependent on financial and technical assistance.

Endicott will also remind citizens of their responsibility for proper animal waste management as opportunities arise. Animal waste should not be deposited in streams, and pet waste deposited on the ground should be picked up and disposed of in the garbage.

Endicott will operate the wastewater treatment plant to ensure it meets its fecal coliform bacteria limits as stated in the NPDES permit.

Palouse-Rock Lake Conservation District (PRLCD)

The PRLCD is a non-regulatory organization that assists land managers in implementing conservation practices. PRLCD provides technical and financial assistance to landowners to restore riparian areas and protect water quality. At the time of publication, the PRLCD had a grant from Ecology titled, "Livestock Upgrades Along Creeks" to provide technical and financial assistance to livestock owners along the Palouse River and its tributaries. PRLCD will continue this program for the life of the grant and will continue these efforts through a second grant awarded in July 2010. PRLCD is also a partner in Ecology's Direct Implementation Fund effort in the Palouse. The PRLCD plans to have over 30 miles of the Palouse River and its tributaries addressed by 2013. Many of these projects are included in Table 24.

Washington State Department of Transportation (WSDOT)

Ecology did not directly measure stormwater outfalls from WSDOT during the TMDL study; therefore, there is no water quality data indicating that WSDOT stormwater is a source of fecal coliform. However, there are multiple WSDOT highways within the study area that have the potential to discharge stormwater to the study area that may contribute fecal coliform.

WSDOT will implement the following, which include some pollution-prevention measures that address fecal coliform bacteria concentrations, for state road and highway runoff according to its stormwater management program plan (SWMPP) and municipal stormwater NPDES permit in all applicable Phase I and II coverage areas:

- The discharge inventory/IDDE (source identification and control).
- The Highway Runoff Manual (stormwater BMP design manual equivalent to Ecology's Stormwater Management Manual).
- The baseline fecal coliform stormwater grab sampling of highways (at selected sites statewide per the Permit requirements).
- The Stormwater BMP retrofit program.
- The Highway maintenance program.

WSDOT will inventory highway discharge locations within the Palouse River FC Bacteria TMDL Boundary. The inventory will include the identification of illicit bacteria and excessive sediment discharges to WSDOT's conveyance system. Prioritization of inventory efforts should be:

- Highway 26 and Highway 195 discharge locations to the Palouse River near Colfax and the ditches leading up to the discharge.
- Highway 26 crossing and discharge locations to the Palouse River at the Adams/Whitman County line.
- Highway 195 discharge locations to Dry Creek and the ditches leading up to the discharge.
- Highway 26 crossings and discharge locations to Rebel Flat, Union Flat, and Willow creeks.
- Highway 23 discharge locations and ditches leading up to the discharge.

WSDOT will implement source identification for fecal coliform within the Palouse River TMDL boundary. If discharges that transport bacteria to the streams are found, WSDOT will apply best management practices from their SWMPP or perform remediation to correct the situation. If source identification reveals this area has significant WSDOT-related contributions, WSDOT's fecal coliform programmatic approach (currently under development) may be applied where these highways discharge to a water body within the TMDL boundary.

In addition, as part of the South Fork Palouse River Bacteria TMDL, WSDOT will inspect under the Highway 195 bridge in Colfax to make sure pigeons are not roosting there.

Whitman Conservation District (CD)

Whitman CD is a non-regulatory organization that assists land managers who choose to implement conservation practices. Whitman CD provides educational, technical, and financial assistance through incentive-based and cost-share programs. The CD will seek funding sources, as opportunities and resources allow, to assist landowners in this watershed with practices that will reduce polluted runoff and protect stream health.

Whitman County Health Department

The 2007 Washington Legislature strengthened the legal statutes (WAC 246-272A) regulating on-site septic systems (OSS). Whitman County Health Department adopted the state code and is developing procedures to implement the new requirements. The requirements include developing a written plan to guide development and management activities for all OSS. This plan must describe educational efforts regarding operation and maintenance of all types of systems, and how the department will remind and encourage homeowners to complete required operation and maintenance inspections.

For most OSS, homeowners will be required to have the system components and property inspected to determine functionality, maintenance needs, and compliance with regulations and permits at least once every three years.

Whitman County Health Department will emphasize areas the TMDL study showed to have high bacteria loading along the Palouse River and Rebel Flat Creek in their education and outreach.

An educational brochure regarding OSS maintenance and operation is under development. The Whitman County Health Department will send this brochure as a direct mailing to residents in target areas. The brochure will explain the updates in regulations and homeowner responsibilities.

Schedule for achieving water quality standards

Significant implementation to restore riparian areas and reduce runoff from livestock is already occurring or planned in the watershed. Therefore, it is expected that streams in this TMDL study area will achieve water quality standards by 2021. While most of the Palouse River sites met water quality standards, it is important to remember that in order to maintain compliance with the standards and achieve success at the remaining sites, no location should receive additional inputs of fecal coliform bacteria.

The most difficult part of achieving water quality standards will be in areas where sources are not apparent, such as reaches affected by failing septic systems. Further investigation of areas with obscure sources may be necessary before applying the appropriate implementation measures to achieve water quality standards. If implementation does not result in significant reductions in areas with high loading by 2015, Ecology may apply adaptive management (see section below) to ensure streams are on target for meeting water quality standards by 2021.

Compliance with this TMDL will be based on meeting the two-part fecal coliform bacteria standards. If the targets (percent reductions) are not met, but the water quality standards are met, the purpose of this TMDL will be satisfied.

Monitoring progress

A monitoring program for evaluating progress is an important component of any implementation plan. Monitoring is needed to keep track of what activities have been done, measure the success or failure of actions, and evaluate if water quality standards are achieved. Monitoring should continue after water quality standards are attained to ensure implementation measures are effective and standards continue to be met.

Ecology will monitor the progress of implementation and resulting in-stream FC bacteria concentrations. Ecology will use this information to make sure the Palouse River and its tributaries are on track for meeting the schedule above.

A quality assurance project plan (QAPP) should be prepared before any water quality monitoring is conducted. The QAPP should follow Ecology guidelines (Lombard and Kirchmer, 2004), paying particular attention to consistency in sampling and analytical methods.

Performance measures and targets

The activities listed in this implementation plan need to be tracked to determine:

- What activities were performed and where.

- Whether the actions worked and could be applied elsewhere.
- What practices should be considered for adaptive management, if necessary.
- If resources or some other factor are preventing some actions from occurring.
- Whether this implementation plan is adequate to meet water quality standards.

Ecology's TMDL coordinator will work with the organizations outlined in this document to track implementation activities occurring in the watershed. Depending on Ecology's resources and current implementation tracking tools, the coordinator will either use an Excel© spreadsheet, Ecology's TMDL management database or geographic information system (GIS) mapping to track where implementation has occurred or is planned.

Each organization should track the progress they have made on implementation. Entities conducting restoration projects or installing best management practices (BMPs) are responsible for monitoring plant survival rates and maintenance of improvements, structures and fencing. Agencies with enforcement authority are responsible for following up on any enforcement actions. Wastewater treatment plants are responsible for monitoring effluent bacteria concentrations and reporting those to Ecology on their discharge monitoring reports (DMRs).

Effectiveness monitoring plan

Effectiveness monitoring is usually conducted approximately five years after implementation has begun to determine if the interim targets and water quality standards have been met. Effectiveness monitoring of TMDLs is usually conducted by the Environmental Assessment Program.

The Ecology TMDL coordinator will recommend monitoring schedules and locations based on this report and completed implementation. The coordinator will use the results of monitoring by Ecology and others to determine if this plan is working as written. If sufficient progress is not made the coordinator will begin adaptive management (discussed in the next section).

The minimum locations that should be considered for monitoring to determine effectiveness include:

- 34PAL91.5 (aka NF Palouse River)
- 34SFPR00.1 (aka SF Palouse River)
- 34PAL90.8
- 34PAL49.4 (aka 34A080)
- 34REB00.3 (aka 34K050)

In addition, Ecology's long term ambient station at Hooper (34PAL19.5 or 34A070) should be continued so trends can be analyzed.

Adaptive management

Natural systems are complex and dynamic. The way a system will respond to human management activities is often unknown and can only be described as probabilities or possibilities. Adaptive management involves testing, monitoring, evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings. In the case of TMDLs, Ecology uses adaptive management to assess whether the actions identified as necessary to solve the identified pollution problems are the correct ones and whether they are working. As we implement these actions, the system will respond, and it will also change. Adaptive management allows us to fine-tune our actions to make them more effective, and to try new strategies if we have evidence that a new approach could help us to achieve compliance.

TMDL reductions should be achieved by 2021. Adaptive management will be applied if effectiveness monitoring conducted in or near 2015 does not show significant improvement towards meeting the assigned percent reductions. Partners will work together to monitor progress towards these goals, evaluate successes, obstacles, and changing needs, and make adjustments to the implementation plan as needed.

Ecology will use adaptive management when water monitoring data show that the TMDL targets are not being met or implementation activities are not producing the desired result. A feedback loop (Figure 30) consisting of the following steps will be implemented:

Step 1. The activities in the water quality implementation plan are put into practice.

Step 2. Programs and (best management practices) BMPs are evaluated for technical adequacy of design and installation.

Step 3. The effectiveness of the activities is evaluated by assessing new monitoring data and comparing it to the data used to set the TMDL targets.

- Step 3a. If the goals and objectives are achieved, the implementation efforts are adequate as designed, installed, and maintained. Project success and accomplishments should be publicized and reported to continue project implementation and increase public support.
- Step 3b. If not, then BMPs and the implementation plan will be modified or new actions identified. The new or modified activities are then applied as in Step 1.

Additional monitoring may be necessary to better isolate the bacteria sources so that new BMPs can be designed and implemented to address all sources of bacteria to the streams.

It is ultimately Ecology’s responsibility to assure that implementation is being actively pursued and water standards are achieved.

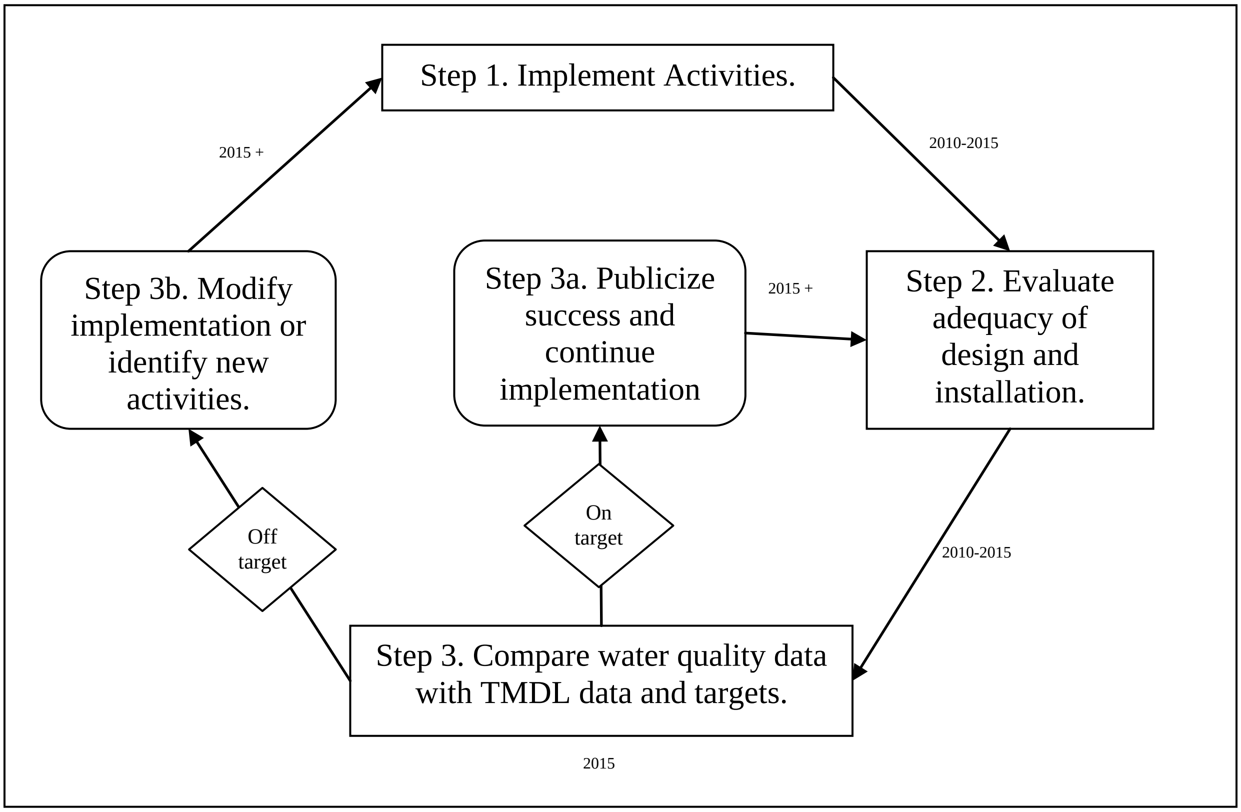


Figure 30. **Feedback loop for determining need for adaptive management.** *Dates are estimates and may change depending on resources and implementation status.*

Funding Opportunities

Ecology's Centennial Clean Water Fund, Section 319, and State Water Pollution Control Revolving Fund grants and loans can provide funding to help implement this TMDL. In addition to Ecology's funding programs, there are many other funding sources available for watershed planning and implementation, point and nonpoint source pollution management, fish and wildlife habitat enhancement, stream restoration, and water quality education. Public sources of funding include federal and state government programs, which can offer financial as well as technical assistance. Private sources of funding include private foundations, which most often fund nonprofit organizations with tax-exempt status. Forming partnerships with other government agencies, nonprofit organizations, and private businesses can often be the most effective approach to maximize funding opportunities. Some of the most commonly accessed funding sources for TMDL implementation efforts are shown in Table 25 and are described after the table.

Table 25. Potential funding sources for implementation projects.

Fund Source	Type of Project Funded	Maximum Amounts
Centennial Clean Water Fund	Watershed planning, stream restoration, & water pollution control projects.	$500,000
Section 319 Nonpoint Source Fund	Nonpoint source control; i.e., pet waste, stormwater runoff, & agriculture, etc.	$500,000
State Water Pollution Control Revolving Fund	Low-interest loans to upgrade pollution control facilities to address nonpoint source problems; failing septic systems.	10% of total SRF annually
Coastal Zone Protection Fund (also referred to as Terry Husseman grants)	Stream restoration projects to improve water quality.	~$50,000
Conservation Reserve Program (CRP)	Establishes long-term conservation cover of grasses, trees and shrubs on eligible land.	Rental payments based on the value of the land; plus 50% - 90% cost share dependent on practices implemented
Environmental Quality Incentives Program (EQIP)	Natural resource protection.	Dependent on practices implemented
Wildlife Habitat Incentive Program (WHIP)	Provide funds to enhance and protect wildlife habitat including water.	$25,000 dependent on practices implemented
Conservation Stewardship Program (CSP)	Provides financial assistance for conservation on private working lands	Dependent on practices implemented
Community Action Center (CAC) Housing Rehabilitation Loan Program	Loans to low-income homeowners for safety & sanitation.	0-6% interest dependent on household income
Wetland Reserve Program (WRP)	Wetland enhancement, restoration, and protection by retiring agricultural land.	Dependent on appraised land value

Centennial Clean Water Fund (CCWF)

A 1986 state statute created the Water Quality Account, which includes the Centennial Clean Water Fund (CCWF). Ecology offers CCWF grants and loans to local governments, tribes, and other public entities for water pollution control projects. The application process is the same for CCWF, 319 Nonpoint Source Fund, and the State Water Pollution Control Revolving Fund.

Section 319 Nonpoint Source Fund

The 319 Fund provides grants to local governments, tribes, state agencies and nonprofit organizations to address nonpoint source pollution to improve and protect water quality. These organizations can apply to Ecology during the annual combined funding cycle for grants to provide implementation technical and financial assistance.

State Water Pollution Control Revolving Fund

Ecology also administers the Washington State Water Pollution Control Revolving Fund. This program uses federal funding from U.S. Environmental Protection Agency and monies appropriated from the state's Water Quality Account to provide low-interest loans to local governments, tribes, and other public entities. The loans are primarily for upgrading or expanding water pollution control facilities, such as public wastewater and stormwater plants, and for activities to address nonpoint source water quality problems, such as on-site septic systems.

Coastal Zone Protection Fund

Since July 1998, Ecology deposits water quality penalties issued under Chapter 90.48 RCW into a sub-account of the Coastal Protection Fund (also referred to as Terry Husseman grants). A portion of this fund is made available to regional Ecology offices to support on-the-ground projects to perform environmental restoration and enhancement. Local governments, tribes, and state agencies must propose projects through Ecology staff. Stakeholders with projects that will reduce bacteria pollution are encouraged to contact their local TMDL coordinator to determine if their project proposal is a good candidate for Coastal Zone Protection funding.

Conservation Reserve Program (CRP)

The Conservation Reserve Program (CRP) is a voluntary program for agricultural landowners. Through CRP, landowners can receive annual rental payments and cost-share assistance to establish long-term, resource conserving vegetative or vegetation covers on eligible farmland. Included under CRP is the Continuous Conservation Reserve Program (CCRP), which provides funds for special practices for both upland and riparian land. Landowners can enroll in CCRP at anytime. There are designated sign up periods for CRP.

The Commodity Credit Corporation (CCC) makes annual rental payments based on the agriculture rental value of the land, and it provides cost-share assistance for 50 to 90 percent of the participant's costs in establishing approved conservation practices. Participants enroll in CRP contracts for 10 to 15 years.

The program is administered by the CCC through the Farm Service Agency (FSA), and program support is provided by Natural Resources Conservation Service, Cooperative State Research and Education Extension Service, state forestry agencies, and local conservation districts. (Farm Service Agency, 2006)

Environmental Quality Incentives Program (EQIP)

The federally funded Environmental Quality Incentives Program (EQIP) is administered by NRCS. EQIP is the combination of several conservation programs that address soil, water, and related natural resource concerns. EQIP encourages environmental enhancements on land in an environmentally beneficial and cost-effective manner. The EQIP program:

- Provides technical assistance, cost share, and incentive payments to assist crop and livestock producers with environmental and conservation improvements on the farm.
- Has 75 percent cost-share, but allows 90 percent if the producer is a limited resource or beginning farmer.
- Has contracts lasting five to ten years.
- Has no annual payment limitation; sum not to exceed $450,000 per farm.

Wildlife Habitat Incentive Program

The Wildlife Habitat Incentive Program (WHIP) is administered by NRCS. WHIP is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. Through WHIP, NRCS provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from five to ten years from the date the agreement is signed.

Conservation Stewardship Program

The Conservation Stewardship Program (CSP) through NRCS will provide financial and technical assistance to eligible producers to conserve and enhance soil, water, air, and related natural resources on their land. Eligible lands include cropland, grassland, prairie land, improved pastureland, rangeland, nonindustrial private forest lands, agricultural land under the jurisdiction of an Indian tribe, and other private agricultural land (including cropped woodland, marshes, and agricultural land used for the production of livestock) on which resource concerns related to agricultural production could be addressed. Participation in the program is voluntary.

CSP encourages land stewards to improve their conservation performance by installing and adopting additional activities, and improving, maintaining, and managing existing activities on agricultural land and nonindustrial private forest land. The NRCS will make CSP available nationwide on a continuous application basis.

The state conservationist, in consultation with the state technical committee and local work groups, will focus program impacts on natural resources that are of specific concern for a state, or the specific geographic areas within a state. Applications will be evaluated relative to other applications addressing similar priority resource concerns to facilitate a competitive ranking process among applicants within a state who face similar resource challenges.

The entire operation must be enrolled and include all eligible land that is operated separate from other operations.

CSP offers participants two possible types of payments:

1. Annual payment for installing and adopting additional activities, and improving, maintaining, and managing existing activities.
2. Supplemental payment for the adoption of resource-conserving crop rotations.

Community Action Center Housing Rehabilitation Loan Program

The Housing Rehabilitation Loan Program provides zero-interest and low-interest loans to residents to repair and improve the quality and safety of their homes. These loans can be used to repair and replace failing septic systems. Interest rates are based on household income. To qualify for funding, homeowners must have an inspection performed for their residence and upgrade any other potential health risks that are identified.

Rural Housing Repair and Rehabilitation Loans

The Rural Housing Repair and Rehabilitation Loans are funded directly by the federal government. Loans are available to low-income rural residents who own and occupy a dwelling in need of repairs. Funds are available for repairs to improve or modernize a home, or to remove health and safety hazards such as a failing on-site system. This loan is a one percent loan that may be repaid over a 20-year period.

To obtain a loan, homeowner-occupants must have low income (defined as under 50 percent of the area median income), and be unable to obtain affordable credit elsewhere. They must need to make repairs and improvements to make the dwelling more safe and sanitary. Grants (up to $7,500) are available only to homeowners who are 62 years old or older and who cannot repay a Section 504 loan (USDA, 2006).

Wetland Reserve Program (WRP)

The Wetland Reserve Program (WRP) is a voluntary program administered by NRCS to restore and protect wetlands on private property (including farmland that has become a wetland as a result of flooding). The WRP provides technical and financial assistance to eligible landowners to address wetland, wildlife habitat, soil, water, and related natural resource concerns on private lands. The program offers three enrollment options: permanent easement, 30-year easement, and restoration cost-share agreement. Landowners receive financial incentives to enhance wetlands in exchange for retiring marginal agricultural land.

Under WRP, the landowner limits future use of the land, but retains ownership, controls access, and may lease the land for undeveloped recreational activities and possibly other compatible uses. Compatible uses are allowed if they are fully consistent with the protection and enhancement of the wetland.

Summary of public involvement methods

Ecology held a public meeting on April 25, 2007, in Colfax WA, to introduce the study and process for developing this TMDL. A mailing list was maintained and periodic updates were sent to interested residents and organizations.

Several organizations are responsible for participating in actions to address the water quality problems addressed by this TMDL. Individual discussions and meetings were held with each entity identified in this implementation plan. Each organization was invited to participate in the development of the language drafted to describe their role.

Ecology held a public comment period on the draft version of this report from October 18, 2010 to November 17, 2010. Letters announcing the comment period were sent to Ecology's Palouse Watershed mailing list. A press release was issued to local media outlets and display advertisements were placed in the Whitman Gazette and the Ritzville Adams County Journal.

Comments from seven individuals or organizations were received during the public comment period. The comments and Ecology's responses are in Appendix B.

This page is purposely left blank

References

Ahmed, A., 2004. *North Fork Palouse River Fecal Coliform Bacteria Total Maximum Daily Load Recommendations*. Washington State Department of Ecology, Olympia, WA. 46 pages. Publication No. 04-03-022. www.ecy.wa.gov/biblio/0403022.html.

Aroner, E.R., 2003. WQHYDRO: Water Quality/Hydrology Graphics/Analysis System. Portland, OR.

Bilhimer, D., J. Carroll, and K. Sinclair, 2006. *South Fork Palouse River Temperature Total Maximum Daily Load Study*. Washington State Department of Ecology, Olympia, WA. Publication No. 06-03-104. www.ecy.wa.gov/biblio/0603104.html.

Carroll, J. and N. Mathieu, 2006. *Quality Assurance Project Plan: South Fork Palouse River Fecal Coliform Bacteria Total Maximum Daily Load Study*. Washington State Department of Ecology, Olympia, WA. Publication No. 06-03-105. www.ecy.wa.gov/biblio/0603105.html.

Carroll, J. and E. Snouwaert, 2009. *South Fork Palouse River Fecal Coliform Bacteria Total Daily Maximum Load: Water Quality Improvement Report*. Washington State Department of Ecology, Olympia, WA. Publication No. 09-10-060. www.ecy.wa.gov/biblio/0910060.html.

Cusimano, R., 1997. *Water Quality Assessment of Tributaries to the Snohomish River and Nonpoint Source Pollution TMDL Study*. Washington State Department of Ecology, Olympia, WA. Publication No. 97-334. 52 pages. www.ecy.wa.gov/biblio/97334.html.

DeVore, G. and L. Quast, 2006. Lower Palouse River Scoping Project: Grant # G0300037. Adams Conservation District, Ritzville, WA.

Ecology, 2009. Laws & Rules: Index of Rules. www.ecy.wa.gov/laws-rules/ecywac.html.

Ecology, 1993. *Field Sampling and Measurement Protocols for the Watershed Assessments Section.* Washington State Department of Ecology, Olympia, WA. Publication No. 93-e04. www.ecy.wa.gov/biblio/93e04.html.

Ecology, 1997. Fact Sheet for NPDES Permit WA-00206013: City of Colfax. www.ecy.wa.gov/programs/wq/permits/eastern_permits.html.

Ecology, 2005. Fact Sheet for NPDES Permit WA-002398-1: Town of Endicott. www.ecy.wa.gov/programs/wq/permits/eastern_permits.html.

Ecology, 2007. Standard Operating Procedures for Estimating Streamflow. Environmental Assessment Program, Washington State Department of Ecology. Olympia, WA. www.ecy.wa.gov/programs/eap/quality.html.

EPA, 1985. *Rates, Constants, and Kinetics Formulation in Surface Water Quality Modeling* (Second Edition). U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA 30613. EPA/600/3-85/040, June 1985.

EPA, 2001. Overview of Current Total Maximum Daily Load - TMDL - Program and Regulations. U.S. Environmental Protection Agency. www.epa.gov/owow/tmdl/overviewfs.html.

Golder Associates, Inc., 2004. Phase II – Level 1 Technical Assessment for the Palouse Basin (WRIA 34). Spokane, WA.

Johnson, A., E. Snouwaert, B. Era-Miller, and K. Kinney, 2007. *Palouse River Chlorinated Pesticide and PCB Total Maximum Daily Load: Water Quality Improvement Report and Implementation Plan*. Washington State Department of Ecology, Olympia, WA. Publication No. 07-03-018. www.ecy.wa.gov/biblio/0703018.html.

Joy, J., 2000. *Lower Nooksack River Basin Bacteria Total Daily Maximum Load Evaluation*. Washington State Department of Ecology, Olympia, WA. Publication No. 00-03-006. www.ecy.wa.gov/biblio/0003006.html.

Kuttel Jr., Mike, 2002. Salmonid Habitat Limiting Factors Water Resource Inventory Areas 33 (Lower) and 35 (Middle) Snake Watersheds, and Lower Six Miles of the Palouse River. Washington State Conservation Commission, Olympia, WA.

Lubliner, B., J. Ross, and J. Ryf, 2006. *Pullman Stormwater Pilot Study for Pesticides, PCBs, and Fecal Coliform Bacteria, 2005-2006*. Washington State Department of Ecology, Olympia, WA. Publication No. 06-03-034. www.ecy.wa.gov/biblio/0603034.html.

Mathieu, N., J. Carroll, and B. Nipp., 2007. *Quality Assurance Project Plan: Palouse River Bacteria Total Maximum Daily Load*. Washington State Department of Ecology, Olympia, WA. Publication No. 07-03-108. www.ecy.wa.gov/biblio/0703108.html.

MEL, 2005. Manchester Environmental Laboratory Lab Users Manual. Seventh Edition. Washington State Department of Ecology, Manchester Environmental Laboratory, Manchester, WA.

Ott, W.R., 1995. Environmental Statistics and Data Analysis. CRC Press LLC. Boca Raton, FL. 313 pages.

Paszkeicz, B., 2009. Personal communication. Adams Conservation District, Ritzville, WA.

Resource Planning Unlimited, Inc., 2002. Quality Assurance Project Plan: Lower Palouse River Scoping Project 2002. Sponsored by Adams Conservation District, Ritzville, WA.

Resource Planning Unlimited, Inc., 2004. Palouse Subbasin Management Plan. Sponsored by Palouse-Rock Lake Conservation District, St. John, WA.

Rifai, H. and P. Jensen, 2002. Total Maximum Daily Loads for Fecal Pathogens in Buffalo Bayou and Whiteoak Bayou. Quarterly Report No. 2. University of Houston. Under contract No. 582-0-80121 with the Texas Natural Resource Conservation Commission, Austin, TX 78711.

Ross, J., 2009. Memo to J. Bellatty, K. Baldwin, E. Snouwaert on 12/30/09. Unpublished data: South Fork Palouse River FC Bacteria TMDL - Colfax Study. Washington State Department of Ecology, Spokane, WA.

Sargeant, D., 2002. *Dungeness River and Matriotti Creek Fecal Coliform Bacteria Total Maximum Daily Load Study*. Washington State Department of Ecology, Olympia, WA. Publication No. 02-03-014. 46 pages. www.ecy.wa.gov/biblio/0203014.html.

Swanson, T., 2007. Standard Operating Procedure (SOP) for Hydrolab® DataSonde® and MiniSonde® Multiprobes, Version 1.0. Washington State Department of Ecology, Olympia, WA. SOP No. EAP033. www.ecy.wa.gov/programs/eap/quality.html.

WAC 173-201A: Water Quality Standards for Surface Waters in the State of Washington.

WA OFM, 2007. 2007 Data Book: Whitman County Profile. www.ofm.wa.gov/databook/county/whit.asp#03cities.

WAS, 1993. *Field Sampling and Measurement Protocols for the Watershed Assessment Section. Environmental Assessment Program of the Washington State Department of Ecology*, Olympia, WA. Publication Number 93-e94. www.ecy.wa.gov/biblio/93e04.html

Washington State Department of Transportation (WSDOT), 2008. Highway Runoff Manual. Washington State Department of Transportation, Olympia, WA. Publication No. M 31-16, Version M31-16.01. 601 Pages. www.wsdot.wa.gov/Publications/Manuals/M31-16.htm.

Willms, R. and W. Kendra, 1990. *Endicott Wastewater Treatment Plant Limited Class II Inspection and Impact of Discharge to Rebel Flat Creek*. Washington State Department of Ecology, Olympia, WA. 46 pages. Publication Number 90-e70. www.ecy.wa.gov\biblio\90e70.html.

This page is purposely left blank

Appendices

This page is purposely left blank

Appendix A. Glossary, acronyms, and abbreviations

Glossary

303(d) list: Section 303(d) of the federal Clean Water Act requires Washington State to periodically prepare a list of all surface waters in the state for which designated uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality limited estuaries, lakes, and streams that fall short of state surface water quality standards, and are not expected to improve within the next two years.

90th percentile: A statistical number obtained from a distribution of a data set, above which 10% of the data exists and below which 90% of the data exists.

Best management practices (BMPs): Physical, structural, and/or operational practices that, when used singularly or in combination, prevent or reduce pollutant discharges.

Clean Water Act: A federal act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the Clean Water Act establishes the TMDL program.

Conductivity: A measure of water's ability to conduct an electrical current. Conductivity is related to the concentration and charge of dissolved ions in water.

Designated uses: Those uses specified in Chapter 173-201A WAC (Water Quality Standards for Surface Waters of the State of Washington) for each water body or segment, regardless of whether or not the uses are currently attained.

Dry season: For the purposes of this study, the dry season is mid-June through October.

Enterococci: A subgroup of the fecal streptococci that includes *S. faecalis*, *S. faecium*, *S. gallinarum,* and *S. avium*. The enterococci are differentiated from other streptococci by their ability to grow in 6.5% sodium chloride, at pH 9.6, and at 10 degrees C and 45 degrees C.

Exceeded criteria: Did not meet criteria.

Fecal coliform (FC): That portion of the coliform group of bacteria which is present in intestinal tracts and feces of warm-blooded animals as detected by the product of acid or gas from lactose in a suitable culture medium within 24 hours at 44.5 plus or minus 0.2 degrees Celsius. Fecal coliform bacteria are "indicator" organisms that suggest the possible presence of disease-causing organisms. Concentrations are measured in colony forming units per 100 milliliters of water (cfu/100 mL).

Geometric mean: A mathematical expression of the central tendency (an average) of multiple sample values. A geometric mean, unlike an arithmetic mean, tends to dampen the effect of very high or low values, which might bias the mean if a straight average (arithmetic mean) were calculated. This is helpful when analyzing bacteria concentrations, because levels may vary anywhere from 10 to 10,000 fold over a given period. The calculation is performed by either: (1) taking the nth root of a product of n factors, or (2) taking the antilogarithm of the arithmetic mean of the logarithms of the individual values.

Load allocation: The portion of a receiving waters' loading capacity attributed to one or more of its existing or future sources of nonpoint pollution or to natural background sources.

Loading capacity: The greatest amount of a substance that a water body can receive and still meet water quality standards.

Margin of safety: Required component of TMDLs that accounts for uncertainty about the relationship between pollutant loads and quality of the receiving water body.

National Pollutant Discharge Elimination System (NPDES): National program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements under the Clean Water Act. The NPDES program regulates discharges from wastewater treatment plants, large factories, and other facilities that use, process, and discharge water back into lakes, streams, rivers, bays, and oceans.

Nonpoint source: Pollution that enters any waters of the state from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the National Pollutant Discharge Elimination System Program. Generally, any unconfined and diffuse source of contamination. Legally, any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

Parameter: Water quality constituent being measured (analyte). A physical, chemical, or biological property whose values determine environmental characteristics or behavior.

Pathogen: Disease-causing microorganisms such as bacteria, protozoa, viruses.

Plume: Describes the three-dimensional concentration of particles in the water column (example, a cloud of sediment).

Point source: Sources of pollution that discharge at a specific location from pipes, outfalls, and conveyance channels to a surface water. Examples of point source discharges include municipal wastewater treatment plants, municipal stormwater systems, industrial waste treatment facilities, and construction sites that clear more than 5 acres of land.

Pollution: Such contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the state. This includes change in temperature, taste, color, turbidity, or odor of the waters. It also includes discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state. This definition assumes that these changes will, or is likely to, create a nuisance or render such waters harmful, detrimental, or injurious to (1) public health, safety, or welfare, or (2) domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or (3) livestock, wild animals, birds, fish, or other aquatic life.

Primary contact recreation: Activities where a person would have direct contact with water to the point of complete submergence including, but not limited to, skin diving, swimming, and water skiing.

Reach: A specific portion or segment of a stream.

Riparian: Relating to the banks along a natural course of water.

Salmonid: Any fish that belong to the family *Salmonidae*. Basically, any species of salmon, trout, or char. www.fws.gov/le/ImpExp/FactSheetSalmonids.htm

Stormwater: The portion of precipitation that does not naturally percolate into the ground or evaporate but instead runs off roads, pavement, and roofs during rainfall or snow melt. Stormwater can also come from hard or saturated grass surfaces such as lawns, pastures, playfields, and from gravel roads and parking lots.

Surface waters of the state: Lakes, rivers, ponds, streams, inland waters, salt waters, wetlands and all other surface waters and watercourses within the jurisdiction of Washington State.

Total maximum daily load (TMDL): A distribution of a substance in a water body designed to protect it from exceeding water quality standards. A TMDL is equal to the sum of all of the following: (1) individual wasteload allocations for point sources, (2) the load allocations for nonpoint sources, (3) the contribution of natural sources, and (4) a margin of safety to allow for uncertainty in the wasteload determination. A reserve for future growth is also generally provided.

Total suspended solids (TSS): The suspended particulate matter in a water sample as retained by a filter.

Turbidity: A measure of water clarity. High levels of turbidity can have a negative impact on aquatic life.

Wasteload allocation: The portion of a receiving water's loading capacity allocated to existing or future point sources of pollution. Wasteload allocations constitute one type of water quality-based effluent limitation.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Wet season: For the purposes of this study, the wet season is November through mid-June.

Acronyms and abbreviations

BMP	(See Glossary above)
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FC	(See Glossary above)
Max	Maximum
Min	Minimum
NF	North Fork
NPDES	(See Glossary above)
QA	Quality assurance
QC	Quality control
RM	River mile
SF	South Fork
TMDL	(See Glossary above)
TSS	(See Glossary above)
USGS	United States Geological Survey
WAC	Washington Administrative Code
WRIA	Water Resources Inventory Area
WWTP	Wastewater treatment plant

Units of measurement

cfs	cubic feet per second
cfu	colony forming unit
kg	kilograms, a unit of mass equal to 1,000 grams.
kg/d	kilograms per day
mg	milligrams
mgd	million gallons per day
mg/d	milligrams per day
mg/L	milligrams per liter (parts per million)
mL	milliliters
NTU	nephelometric turbidity units
psu	practical salinity units
s.u.	standard units
µg/L	micrograms per liter (parts per billion)
µs	microsiemens per centimeter
µS/cm	microsiemens per centimeter, a unit of conductivity
ww	wet weight

Appendix B. Response to public comments

Comments from Burgess Lange, Citizen

Comment 1: I wish to compliment you on your objective and unbiased work. Hopefully, the N. North of the Palouse River will retain the better quality rating.

Response 1: Thank you. While progress is being made in the North Fork Palouse River, the bacteria water quality standard for the North Fork is more restrictive than the standard for the section of the river addressed by this TMDL (Palouse River from Colfax to the Palouse Falls). In addition, the bacteria standard is a concentration based standard so the additional water in the Palouse River downstream of the North Fork helps dilute the concentration bringing it into compliance with the water quality standards. It's important to note that most of the tributaries tested during the study require bacteria reductions.

Comment 2: I do observe large crowns of foam at times on the N.F. of the Palouse; and it seems to me the people population is more of a problem than wildlife and livestock.

Response 2: Foam on rivers is often the result of nutrients and proteins in the water, which may or may not be an indicator of a pollution problem. A future report will examine the river's dissolved oxygen, pH, and nutrient levels and if necessary set limits on the amount of nutrients entering the river.

Comments from Dave Lange, Citizen

Comment 1: Plan needs to specifically identify coliform species that is the trouble maker, example, deer, bovine, dog, human, goose...

Response 1: There are several methods to determine the source of bacterial contamination. Many sources can be narrowed down using conventional bacteria sampling methods. One of the most economical methods to identify sources is to conduct intensive upstream-downstream water quality monitoring. Bacteria samples and flow measurements can then be used to determine where a load significantly increases. Combining land use observations with the knowledge of where a bacteria load enters a stream can often lead us to a source.

When conventional methods are unable to determine a source, other microbial source tracking techniques may be employed. However, these techniques, including DNA analysis of the bacteria, have limitations. The techniques are still in the research phases and there is not an approved method that can quantify what proportion of bacteria is coming from a particular animal species. The results of these studies usually reveal that there are several different species of animals contributing bacteria. Since these bacteria can be carried a long way downstream, knowing the species of animal does not always help determine where they need to be addressed. For example if we found dogs were contributing bacteria to the stream we still would not know whose dogs or where they are located so it would leave us with the same conclusion that all pet waste should be managed to keep it away from streams.

More information can be found in our "Focus on Microbial Source Tracking" publication at: http://www.ecy.wa.gov/biblio/0810092.html.

Comment 2: Very difficult to find public comment website address

Response 2: We are sorry it was difficult to find the website. Our goal is to make it easily accessible to all interested parties. We included it in our correspondence and the display advertisements we posted in the newspapers. It was also included in the press release we issued to the media, however we cannot control whether or not the newspapers and radio stations include it in their story.

Comments from Kenneth M. Stone & Jana Ratcliff, Washington State Department of Transportation

The Washington State Department of Transportation (WSDOT) Environmental Services Office reviewed the Palouse River Fecal Coliform Bacteria TMDL Water Quality Improvement Report and Implementation Plan Draft - October 2010 (Washington State Department of Ecology Publication No. 10-10-067). We appreciate the opportunity to provide comment on this TMDL document.

Comment 1: We are committed to working collaboratively with others to address the fecal coliform contributions of state highways to the Palouse River.

Response 1: Thank you. We look forward to working with you.

Comment 2: We are listed as a point source throughout the document however, we have not been issued a Waste Load Allocation (WLA). Based on our understanding of the TMDL boundary, the only highways within the WSDOT Municipal Permit coverage area are near Pullman (e.g., SR 27 and 270), which is outside of the study area. Were WLAs not issued to WSDOT because our permit coverage does not fall within the study area? If so, to avoid confusion, we suggest WSDOT be referenced as a non-point source. Clarification should be added because it is confusing that a permitted discharger is listed as a point source that has not been issued a WLA.

Response 2: Thank you for bringing this omission to our attention. Unfortunately, several paragraphs written to address stormwater wasteload allocations did not make it into the final version of the report due to an oversight. The missing language has been included in the final document. The language indicates that we are not assigning numeric wasteload allocations but that discharges from WSDOT's highways must meet the numeric water quality standards for the stream receiving the discharge. Please see the "load and wasteload allocations" section of the report for the complete language.

Comment 3: Page 15, last paragraph: "The Washington State Department of Transportation has a state-wide stormwater permit that applies to the state highways in the watershed study area (e.g., State Route 26 and US Route 195)."

<u>Comment</u>: WSDOT's NPDES Municipal Stormwater Permit coverage is congruent with the NPDES Phase I and II coverage areas. The highways mentioned above do not fall within the Phase I and II boundaries and therefore are not covered under the WSDOT Permit. Suggest revising to read, "The Washington State Department of Transportation has a ~~state wide~~ municipal stormwater permit that applies in NPDES Phase I and II areas." ~~to the state highways in the watershed study area (e.g., State Route 26 and US Route 195).~~

Response 3: The WSDOT permit covers the NPDES Phase I and II coverage areas *and* any water body where there is an approved TMDL with load allocations and associated implementation documents specifying actions for WSDOT stormwater discharges (permit reference: S1.B2.). The TMDL study area does not include any Phase I or II coverage areas but it does include streams with potential WSDOT highway discharge areas. Therefore, Ecology has assigned implementation actions to WSDOT, which would mean the permit coverage would also include the TMDL boundary. The language referenced above has been revised to clarify the permit coverage as follows: "The Washington State Department of Transportation has a state-wide stormwater permit that applies NPDES Phase I and Phase II coverage areas and to the state highways within TMDL boundaries that are assigned implementation actions. WSDOT highways within the Palouse River TMDL boundary include portions of Highways 23, 26 and 195."

Comment 4: Page 68, last paragraph: "In this evaluation, the basis of compliance for all sites was based on the required reduction necessary to meet the second part of the water quality criteria."

<u>Comment:</u> As described elsewhere in the document, the 90th percentile of the sample distribution is evaluated instead of the second part of the water quality criteria. For clarity, suggest revising the sentence to read, "In this evaluation, the basis of compliance for all sites was based on the required reduction necessary to meet the 90th percentile of the sample distribution."

Response 4: This sentence was kept the same but the following sentence was added to clarify the evaluation method: "The target reduction to meet this part of the standard is established by calculating the reduction necessary to meet the 90th percentile of the sample distribution."

Comment 5: Page 84, Section titled "Future monitoring for FC bacteria"

<u>Comment:</u> Will Ecology be performing this monitoring? If so, that detail should be included in this section of the report. As is, it is not clear who will be performing the needed monitoring.

Response 5: This section outlines future monitoring that could provide useful information to entities involved in implementation or assessing the success of the TMDL. While Ecology may perform some of this monitoring, this section lists recommendations for any organization that wants to do monitoring. Many of our partners conduct water quality monitoring so this is included to assist them. A clarifying paragraph was added to the beginning of this section.

Comment 6: Page 88, 5th paragraph: "Many best management practices (BMPs) exist to reduce runoff that can transport bacteria to streams via stormwater."

Comment: Ecology has no approved or designated stormwater BMPs for bacteria treatment in their stormwater manuals, nor does WSDOT in the Highway Runoff Manual. In order to have a clear understanding regarding expectations and compliance pathways, a list of Ecology-approved BMPs should be added to Ecology's Stormwater Management Manual, or this document, that are considered sufficient to "reduce runoff than can transport bacteria to streams via stormwater."

Response 6: The sentence referenced in your comments states that there are BMPs for reducing runoff rather than suggesting treatment for bacteria. Examples of BMPs for stormwater reduction include water dispersion into vegetated areas; infiltration via trenches; bioretention or rain gardens; soil amendments for lawn and landscaped areas; permeable paving; and other methods described in the Low Impact Development (LID) Manual for the Puget Sound Basin. LID principles and management practices in this manual are readily applied in Eastern Washington and many are usable in a highway setting.

Your comments regarding the need for BMPs for bacteria treatment will be shared with staff working on stormwater permits and the Stormwater Management Manuals.

Comment 7: Page 88, 5th paragraph: "The towns (primarily Colfax and Endicott) and Washington State Department of Transportation (WSDOT) should inventory stormwater outfalls to determine where stormwater may be delivering pollutants to streams, and apply BMPs to the drainage."

Comment: WSDOT's highways tend not to be the source of fecal coliform, but rather a pathway for fecal coliform generated from other sources. Additionally, with the lack of Ecology approved BMPs for fecal coliform, suggest revising the sentence to read, "The towns (primarily Colfax and Endicott) and Washington State Department of Transportation (WSDOT) should inventory stormwater outfalls to determine where stormwater may be delivering pollutants to streams, and ~~apply BMPs~~ work to prevent sources of fecal coliform within their control. Effort should also be made to reduce unnatural concentrations of fecal coliform in stormwater discharges. Work to prevent sources and reduce fecal coliform contributions could include the use of BMPs, or other pollution prevention measures such as Illicit Discharge Detection and Elimination (IDDE) programs, increased public education by cities/counties, etc."

Response 7: Based on your suggestions, this section was revised to read: "The towns (primarily Colfax and Endicott) and Washington State Department of Transportation (WSDOT) should inventory stormwater outfalls to determine where stormwater may be delivering pollutants to streams, and work to prevent delivery of unnatural levels of fecal coliform to their stormwater conveyance systems. Because bacteria loading was sometimes correlated with total suspended solids (mainly sediment), the inventory should include assessing potential sediment discharges. Efforts to prevent sources and reduce fecal coliform contributions could include the use of BMPs, pollution prevention measures such as Illicit Discharge Detection and Elimination (IDDE) programs, increased public education and other methods."

Comment 8: Page 93, 5th paragraph

Comments: Suggest adding the following sentences prior to listing WSDOT's action items: "Ecology did not directly measure stormwater outfalls from WSDOT during the TMDL study; therefore, there is no evidence that WSDOT stormwater is a source of fecal coliform. However, there are multiple WSDOT highways within the study area that have the potential to discharge stormwater to the study area that may contribute fecal coliform."

Response 8: Your suggestion has been added to this section except "evidence" has been modified to "water quality data indicating".

Comment 9: Page 94, Paragraph 2: "In addition, WSDOT's efforts to address the pigeons under the Highway 195 bridge in Colfax, as part of the South Fork Palouse River Bacteria TMDL, will significantly help address loading to Reach 1 of the Palouse River."

Comments: Suggest the following revisions based on the findings from the July 8th, 2010 site visit. "In addition, WSDOT's efforts to address ~~the~~ pigeons under the Highway 195 bridge in Colfax, as part of the South Fork Palouse River Bacteria TMDL, ~~will significantly~~ may help address loading to Reach 1 of the Palouse River." Since pigeons were not found to be roosting under the SR195 bridge, WSDOT will be inspecting the bridge annually. These inspections and subsequent action to prevent roosting, if necessary, may help address loading rather than "will significantly help address loading."

Response 9: This section should have been updated based on the findings of the July 8, 2010 site visit. It has been revised to read, "In addition, as part of the South Fork Palouse River Bacteria TMDL, WSDOT will inspect under the Highway 195 bridge in Colfax to make sure pigeons are not roosting there."

Comments from Tom Kammerzell, Whitman County Cattleman's President &Farmer

Comment 1: It is a fact that there is fecal coliform, a possible cause of disease, in all open bodies of water. This report states that there is fecal coliform in the Palouse River system.

However, the reports credibility is flawed. On page 29, the report states sampling protocols were violated and the statement "for the most part" brings into question the viability of the data. These statements do not enhance the credibility of the report.

Response 1: Any data that did not meet the laboratory quality assurance (QA)/quality control (QC) criteria were flagged with a "J" qualifier indicating that the result was an estimate. This qualifier was taken into consideration to determine if the qualified data should be used in the analysis. It is typical in all studies that some data may need to be flagged with a qualifier; however, it is scientific protocol to report all data regardless of whether or not it had a qualifier. It is against Ecology's practice to only report partial datasets.

Comment 2: While stating in several places in the report that wildlife (natural) contributions cannot be counted in the criteria, there is never any scientific data as to how the wildlife portion of the count can be determined. There has not been any DNA testing completed to prove or disprove the assumptions by the Department of Ecology.

The implementation plan states "The most effective means of addressing these sources is prevention", but, without scientific data proving the sources, how can one prevent what you do not know.

Response 2: The state's water quality standards set the allowable level of fecal coliform bacteria concentration in streams. In any stream with bacteria, a certain portion of it will be from wildlife and therefore, any additional capacity of the stream is reduced by the level of wildlife bacteria. While wildlife bacteria is considered natural and not targeted for reductions, Ecology feels it is the most equitable to try to reduce bacteria from all sources including wildlife.

While DNA testing may indicate which species of animals are contributing bacteria to the streams, it will not tell how much of the load can be contributed to each species. Because degraded riparian areas lead to congregation of wildlife and unfiltered runoff reaching the stream, the Implementation Plan recommends restoring riparian vegetation in the degraded areas as the best means of prevention.

Comment 3: In addition, one component of the proposed solution is to be completed before the report is even out of the final draft stage (pg 73). "The goal is to complete 30 miles of projects by December 2010.

It appears that this report is nothing more than an effort to justify the pre-determined agenda of building fences, employing staff, and having a public relations project to point to.

Response 3: The purpose of a TMDL is to bring the streams back into compliance with the water quality standards; therefore our TMDLs often include information on implementation that has occurred since the study was conducted and that which is planned in the future. It's important to document all progress made, underway, or planned so there is a clear understanding of what has changed since the study and what remains to be completed.

Comment 4: While the project could scientifically determine where and what is contributing to the fecal coliform counts in the Palouse River, this report appears to be nothing more than an expensive speculation without substance.

If this report is going to be the driving factor for money spent by taxpayers as well as government agencies, then a more comprehensive work must be completed.

Response 4: In this study, we conducted a simple mass-balance loading analysis to determine where bacteria loads are entering the system. Figures 11, 16, and 20 show the size of the bacteria load entering the stream in each stream segment. Combining land use observations with the knowledge of where a bacteria load enters a stream can often lead us to a source. The most economical way for Ecology to accurately characterize bacteria loading is to use the study method applied in this study. This approach has been used in many TMDLs statewide and is acceptable to the Environmental Protection Agency, which approves the TMDL. The organizations listed in this plan can then use our study results to prioritize areas that need implementation activities or additional monitoring to further locate a source.

Please also see Response 1 to Mr. D. Lange above.

Comments from Nancy Belsby, Citizen

Comments: My name is Nancy Belsby and I reside in Whitman County, WA. I am located in the Rock Creek Subbasin of the Palouse Aquifer, WRIA 34. I am a member of the Washington Cattlemen's Association.

On Page 88 under the Implementation Plan, the report states: ". . . riparian fencing and off-stream watering should be installed in areas with livestock to ensure the stream corridor is protected…"

Firstly, I would like to state that one size does not fit all. One needs to take a holistic approach and look at grazing management, not just the riparian corridor. We also have to look at the benefits of grazing and the negative effects of riparian fencing on a site by site basis. Furthermore, in some areas where fencing of riparian areas has taken place, there have been issues with weeds taking over the riparian corridor and an increase in water temperature.

I was a member of the WRIA 34 Planning Unit from 2003 until they concluded with the Detailed Implementation Plan in the spring of 2009. Included in the Palouse Watershed Plan (WRIA 34) is acknowledgement of RCW 90.22.040: "Riparian livestock rights have been and will continue to be recognized as an inherent water right. . ."

It should also be noted that fencing is not a one-time occasion. It must also be maintained and may be injurious to wildlife seeking access to water.

Livestock watering in riparian areas does not necessarily equate to damaging the streambank and causing pollution. Rotational grazing and timing of grazing are important ingredients in pasture management and management of riparian areas.

Lastly, we must acknowledge that livestock production is not only important to our food supply but also is an important part of our economic well being.

The Washington Cattlemen's Association (WCA) recently adopted policy which states: "…the WCA (shall) encourage its members to work with their local conservation districts to develop site-specific, locally determined, strategies for managing their water resources based upon the NRCS FOTG Manual."

Thank you for the opportunity to testify.

Response: Ecology agrees that livestock production is very important to our food supply and our state's economy. This is one of the reasons why we provide cost-share funding to conservation districts to assist livestock owners with coming into compliance with water quality laws. In this watershed, the Department of Ecology has awarded several grants totaling over $2,000,000 to conservation districts that can be used to address water quality impacts. Often the improvements made to the livestock operation also benefit production and reduce overall operation costs. Please see Ecology's publication "Riparian Restoration: A Collection of Landowner's Perspectives" for examples at: www.ecy.wa.gov/pubs/0410068.pdf.

When Ecology finds a livestock operation impairing water quality, we refer them to their local conservation district for technical and financial assistance. We expect the conservation district to work with the landowner to develop a strategy for managing their livestock in a manner that protects water quality. To ensure success, this strategy should include a maintenance schedule and methods to address weeds and other concerns.

Comments from Cory Aeschliman, Chair of Whitman County Conservation District Board of Supervisors

After careful review of the above noted Report, please find following a summary of comments that we would like to become of record regarding concerns that have been found in the Draft Report:

Comment 1: Page xii: *"While wildlife is included as a possible source, their bacteria contributions are considered natural and do not usually cause streams to violate water quality standards. Therefore, this source is not typically indicated for bacteria reductions. "*

This statement indicates that wildlife's fecal *coliform* does not *on its own* cause streams to violate water quality standard, yet coupled with other forms, it could be a strong contributor. If wildlife is considered a natural contributor as it's stated, their contributing effects to the streams *should not* be taken into account in the daily load counts. Unless DNA testing is performed, it is speculation as to what fecal coliform is causing the stream violations. How can a stream's fecal coliform criteria be exceeded if wildlife's contribution is considered natural and no DNA testing has been performed to determine that it is not wildlife?

Response 1: The state's water quality standards for bacteria limit the total concentration of fecal coliform bacteria. These criteria are set to protect human health. Studies have shown that there is an increased risk of getting ill from water containing greater concentrations of bacteria. The standards are not written to allow a certain amount of bacteria over natural levels. Wildlife bacteria make up a portion of the bacteria in the stream reducing the capacity left for bacteria from other sources.

Comment 2: Page 10: *"If natural levels of FC (fecal coliform) bacteria (from wildlife) cause criteria to be exceeded, no allowance exists from human sources to measurably increase bacterial pollution."*

Without DNA testing there is *no* scientific proof to base the knowledge that it is in fact wildlife or human sources that are causing the criteria to be exceeded, it's speculation. Wildlife's contribution to the streams is considered a *natural* source; why then is it included in the equation *of* exceeding standards?

Response 2: See Response 1 above. Wildlife bacteria cannot be excluded from the analysis because the water quality standards set limits on the total fecal coliform bacteria concentration. As the total concentration of bacteria increases so does the risk of getting ill from working or playing in the water. As in most bacteria impaired streams, it is likely that the bacteria are from both human related sources and wildlife. Human's often alter landscapes and land uses that result in abnormal deposition of wildlife feces in riparian areas, therefore both wildlife sources resulting from human actions and other human related sources should be controlled to bring the streams into compliance with the water quality standards.

Comment 3: Page 29: "*… holding times were sometimes violated because of delayed in-transport problems or because the samples were held too long at MEL before analysis. MEL qualified all samples that were analyzed beyond holding time as an estimate using a "J" qualifier. For the most part,"*

This statement indicates that not all water samples were held to Ecology's Standards for water quality testing and that adjustments needed to be made, changing *true fact to estimated data. For the most part....* There is an issue with this. The data that did not meet Standards should not be included as credible data; it's inadequate and problematic.

Response 3: Any data that did not meet the laboratory quality assurance (QA)/quality control (QC) criteria were flagged with a "J" qualifier indicating that the result was an estimate. This qualifier was taken into consideration to determine if the qualified data should be used in the analysis. It is typical in all studies that some data may need to be flagged with a qualifier; however, it is scientific protocol to report all data regardless of whether or not it had a qualifier. It is against Ecology's practice to only report partial datasets.

Comment 4: Page 42: *"After the large FC load contribution from the SF Palouse is found and eliminated,"*

One contributing factor has been located and identified as roosting pigeons under the bridge. Why is this statement being made? If Ecology acknowledges that there are additional/large FC load contributions' to be found, the water should be retested for DNA to determine the additional sources.

Response 4: The language has been revised to read: "Water quality sampling in the SF Palouse River in Colfax during the summer of 2009, indicated that a large portion of the bacteria load at the mouth of this tributary is due to pigeons roosting under the city's bridges. The load from the SF Palouse River may be masking loading contributions in the sub-reach of the Palouse River just below Colfax (RM 91.5 to 90.8). After the city of Colfax addresses the pigeons, this reach should be re-evaluated for sources of FC contamination during the wet season."

Comment 5: Page 73: *"Current implementation efforts … are already addressing many of the pollution sources … to construct fencing and plant native riparian vegetation throughout the watershed. The goal is to complete 30 miles of projects by December 2010."*

If this is a *draft* Plan which has yet to be finalized, this timeline is inaccurate unless this Plan and Report is fully driven by the lofty goal. Without DNA testing, it's speculation that the implementation of such activities will in fact reduce the fecal coliform loads to the local streams. On the contrary/ providing riparian vegetation enhances wildlife food and cover with the potential outcome being higher levels of fecal coliform loads due to these enhanced areas drawing wildlife to the streams.

Response 5: TMDLs are driven by regulatory requirements within the Federal Clean Water Act. The purpose of a TMDL is to bring the streams back into compliance with the water quality standards; therefore our TMDLs often include information on implementation that has occurred since the study was conducted and that which is planned in the future. It's important to document all progress made, underway, or planned so there is a clear understanding of what has changed since the study and what remains to be completed.

While healthy riparian areas provide additional wildlife habitat, the presence of vegetation reduces runoff and filters the runoff that does reach the stream. This usually results in less pollution reaching the stream.

Comment 6: Page 75: *"Some sub-reaches of the Palouse River had high, unexplained FC and TSS loads."*

The *unexplained* could be explained if DNA testing had been conducted in the sub-reaches of the Palouse River at the time the high loads were indicated. A more complete picture of the overall problem could have been attained.

Response 6: Many sources can be narrowed down using conventional bacteria sampling methods. One of the most economical methods to identify sources is to conduct intensive water quality monitoring. Bacteria samples and flow measurements can then be used to determine where a load significantly increases. Combining land use observations with the knowledge of where a bacteria load enters a stream can often lead us to a source.

When conventional methods are unable to determine a source, other microbial source tracking techniques may be employed. However, these techniques, including DNA analysis of the bacteria, have limitations. The techniques are still in the research phases and there is not an approved method that can quantify what proportion of bacteria is coming from a particular animal species. The results of these studies usually reveal that there are several different species and a large unknown contingent contributing the bacteria. Since these bacteria can be carried a long way downstream, knowing the species of animal does not always help determine where they need to be addressed. So while the results could indicate that wildlife is a contributor, we would still need to control for human sources by using the appropriate best management practices to address those sources.

Microbial source tracking techniques are also very expensive because the field work and laboratory analysis is very intensive. With our limited resources, Ecology is able to more accurately characterize bacterial loading using conventional bacteria sampling methods in more areas than it would be able to with microbial source tracking methods. The organizations listed in this plan can then use our study results to prioritize areas that need implementation activities or additional monitoring to locate a source.

More information can be found in our "Focus on Microbial Source Tracking" publication at: http://www.ecy.wa.gov/biblio/0810092.html.

Comment 7: Page 87: *"The most effective means of addressing these sources is prevention."*

First determine which sources need to be addressed by gathering scientifically based data; then use the taxpayer's money to address those specific concerns thereby being cost-effective. The blanketed-effect is problematic due to it potentially being only a visual fix to the situation; without knowing specifically what needed to be fixed.

Your consideration on the above is appreciated.

Response 7: All data analyzed for this report was collected under a quality assurance project plan (Mathieu et.al, 2007) to ensure it met the scientific quality assurance and quality control criteria. Using the simple mass-balance loading analysis, we are able to determine which reaches of the river are receiving the largest bacteria loads so efforts can be concentrated in these reaches. Our methods are much more cost effect than DNA microbial source tracking methods.

Comments from William C. Stewart, U.S. Environmental Protection Agency

Comments: Thank you for the opportunity to comment on the draft *Palouse River Fecal Coliform Bacteria Total Maximum Daily Load*. The document is well written and well organized.

After a thorough review of this document, I have no comments at this time.

Again, thank you for the opportunity to review this TMDL and I look forward to seeing the final version of this document. I would be happy to discuss this project with you at your convenience.

Response: Thank you.