South Fork Palouse River Fecal Coliform Bacteria Total Maximum Daily Load

Water Quality Improvement Report

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For more information contact:

Water Quality Program
Eastern Regional Office
Washington State Department of Ecology
N. 4601 Monroe
Spokane, WA 99205-1295
Phone: 509-329-3557

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

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Fecal Coliform Bacteria
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by

Jim Carroll
Environmental Assessment Program
Washington State Department of Ecology
Olympia, Washington 98504-7710

and

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

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Abstract

The South Fork Palouse River and several of its tributaries (Paradise Creek, Missouri Flat Creek and Dry Fork Creek) are listed as impaired by fecal coliform bacteria on the Clean Water Act's 303(d) list of impaired water bodies. 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 water quality standards (load and wasteload allocations), and describes activities to achieve those reductions.

During a study from May 2006 to May 2007, the Department of Ecology (Ecology) collected bacteria and streamflow data from 64 sites throughout the watershed twice per month. This data was analyzed to determine how much the current levels of bacteria needed to be reduced to meet the water quality standards. The streams in this watershed are required to have a geometric mean of less than 100 colony forming units/100 milliliters (cfu/mL) and not more than 10% of the samples used to calculate the geometric mean can exceed 200 cfu/100mL.

This TMDL expresses load and wasteload allocations as a percent reduction needed to meet the concentration based standard. These percent reductions are targets used to prioritize implementation activities to reduce the bacteria. Load allocations are established for nonpoint sources along the South Fork Palouse River, and Paradise, Missouri Flat, Dry Fork, Four Mile, Hatley, Staley and Sunshine creeks. Wasteload allocations are established for the cities of Pullman and Albion's wastewater treatment plants and municipal separate stormwater sewer systems in the watershed. Compliance with this TMDL will be based on meeting the water quality standards.

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Executive Summary

Introduction

Historical water quality monitoring has shown that portions of the South Fork Palouse River and its tributaries are impaired by elevated levels of fecal coliform bacteria and are not protective of "primary contact recreation" 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 South Fork Palouse River watershed and a strategy outlining recommendations for cleaning up the streams.

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. 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 strategy that describes the actions to control the pollution.

Ecology works with an advisory group made up of local governments, agencies, and the community to develop the implementation strategy.

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 strategy may be adjusted as the community improves their understanding of the water quality problems.

This TMDL will be submitted to the U.S. Environmental Protection Agency (EPA) for review and approval. After the TMDL is approved, Ecology will work with the community to develop an implementation plan that expands on the recommendations and activities outlined in this report.

Watershed Description

The South Fork Palouse River originates in Idaho and flows through the cities of Pullman and Albion before entering the Palouse River in Colfax (see Figure 1). Paradise Creek, a major tributary, also originates in Idaho flowing through the city of Moscow before it crosses the stateline and enters the South Fork Palouse River in Pullman. Other tributaries include Dry Fork Creek, Missouri Flat Creek, Four Mile Creek, Spring Flat Creek, Airport Road Creek, Staley Creek, Parvin Creek, and Sunshine Creek.

Land use within this watershed is dominated by dryland agriculture interspersed with several clusters of urban population. Major crops include spring and winter wheat, barley, peas, and lentils. Precipitation in this watershed can range from 15-25 inches of rain per year.

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 South Fork Palouse River and its tributaries to a condition that provides a low risk of illness to people and animals using the streams.

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

- Failing septic systems
- Land use practices
- Livestock
- Pet waste
- Stormwater
- Wastewater treatment plants
- Wildlife

For example, the TMDL study revealed that a large bacteria load is entering the South Fork Palouse River within the concrete flood works in the city of Colfax.

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 64 sites in the watershed, twice per month for a full year (May 2006 – May 2007). The results were partitioned into either a dry season or wet season group based on streamflows for the analysis. The dry season was July through mid-December 2006 and the wet season included the time periods of May through June 2006 and mid-December 2006 through April 2007.

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 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.

Ecology monitored multiple sites in each stream in the watershed. 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 17 sites on the South Fork Palouse River. In the dry season 11 of the 17 sites required bacteria reductions ranging from 33% to 96%. In the wet season 13 of the 17 sites required bacteria reductions ranging from 35% to 83%.

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

Stream (number of monitoring sites)	Range of Percent Reductions Needed	
	Dry Season	Wet Season
South Fork Palouse River (17)	0% - 96%	0% - 83%
Paradise Creek (4)	59% - 91%	37% - 85%
Missouri Flat Creek (5)	80% - 94%	38% - 62%
Dry Fork Creek (4)	14% - 89%	7% - 91%
Four Mile Creek (2)	43%	4% -66%
Hatley Creek (1)	NC	50%
Staley Creek (2)	14% - 80%	64% - 87%
Sunshine Creek (1)	NC	6%
Airport Creek (1)	93%	84%

NC – Not calculated due to insufficient data or no measurable flow.

Entities that discharge to the streams in the watershed must be assigned wasteload allocations (limits) on the amount of fecal coliform bacteria they can discharge to the stream. In this watershed, the Pullman and Albion wastewater treatment plants (WWTP) and stormwater from Pullman, Washington State University's (WSU) campus and Washington State Department of Transportation's highways and facilities require wasteload allocations. The municipal WWTP limits are shown in Table ES-2.

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

WWTP	NPDES Permit Limit
City of Pullman	Year-round: 100 cfu/100 mL weekly average
City of Albion	January to May: 200 cfu/100 mL monthly and weekly average June to December: 100 cfu/100 mL monthly and weekly average

There are approximately 90 outfalls draining stormwater from the city of Pullman and WSU's campus. Ecology sampled bacteria and flow from 14 of these outfalls. Some outfalls discharge year round which could indicate groundwater or natural overland drainage is entering the storm sewers. Based on the data collected, Ecology assigned wasteload allocations for the stormwater outfalls for the dry season, wet season, and storm events (Table ES-3). For the majority of outfalls, too little data was collected during storm events to assign a wasteload allocation. For these outfalls, estimates based on a single storm are provided in Table ES-3. A combined wasteload allocation for all outfalls during a storm event is also provided.

Table ES-3. Wasteload allocations expressed as target percent reductions needed to meet water quality standards for selected stormwater outfalls.

Stormwater outfall	Dry season target % reduction	Wet Season target % reduction	Storm event target % reduction
South Fork Palouse River stormwater outfalls			
34SFPR-SD360	0%	0%	91%
34SFPR-SD320	0%	0%	87%
34SFPRWSU1	91%	72%	96%
34SFPR-SD260	91%	23%	97%
34SFPRWSU2	63%	61%	94%
34SFPR-SD180	33%	84%	97%
34SFPR-SD170	NC	29%	72%
34SFPR-SD140	NC	NC	97%
34SFPR-SD120	72%	99%	94%
Paradise Creek stormwater outfalls			
34ParaWSU3	0%	0%	0%
Missouri Flat Creek stormwater outfalls			
34MissSD60	95%	0%	97%
34MissSD120	92%	92%	93%
34MissSD200	NC	NC	94%
34MissSD210	95%	83%	94%
City of Pullman and WSU stormwater outfalls			
Combined outfalls	----	----	78%

Shaded cells are estimates due to insufficient # of samples.
NC – not calculated due to no measureable flow during season

The water quality of the streams in the South Fork Palouse River watershed must be improved to ensure these streams are safer for the activities for which we use the water. At current bacteria levels 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 stormwater and nonpoint 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 way 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. 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 is a list that tells a more complete story about the condition of Washington's water. This list assigns water bodies to one of 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 it:

- 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 (also called a water quality improvement report) be developed for each of the water bodies on the 303(d) list. The TMDL identifies pollution problems in the watershed and then specifies how much pollution needs to be reduced or eliminated to achieve clean water. Ecology then works with the local community to develop (1) an overall approach to control the pollution, called the i*mplementation strategy*, and (2) a monitoring plan to assess effectiveness of the water quality improvement activities. This is included in the TMDL report sent to the Environmental Protection Agency (EPA) for approval.

Once EPA approves this TMDL, a w*ater quality implementation plan* must be developed within one year. This plan identifies specific tasks, responsible parties, and timelines for achieving clean water.

Elements required in a TMDL

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

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 development process 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 in this Watershed

Overview

Ecology is developing a w*ater quality improvement plan* (or TMDL) in this watershed because historical data have shown that the South Fork Palouse River and its tributaries are impaired by elevated levels of fecal coliform (FC) bacteria and do not meet "primary contact recreation" beneficial use standards. The South Fork Palouse River, Paradise Creek, and Missouri Flat Creek were included on Washington State's 303(d) list of impaired water bodies in 1998 and 2004 for FC bacteria impairments. These same streams and Dry Fork Creek are also included on the 2008 303(d) list.

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 bacteria loading in the watershed. This report also provides an implementation strategy which will help the community reduce FC bacteria sources so the streams meet primary contact recreation water quality standards.

Study area

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

Ecology sampled sites on the South Fork Palouse River from the state line to its confluence with the North Fork Palouse River in Colfax. Many tributaries, including Missouri Flat Creek, Dry Fork Creek, Paradise Creek, Staley Creek, Sunshine Creek, Airport Creek, Spring Flat Creek, and Four Mile Creek, were also sampled. The Paradise Creek sampling extended into Idaho to include the city of Moscow Wastewater Treatment Plant, a stormwater outfall below the treatment plant, and a site upstream of the treatment plant.

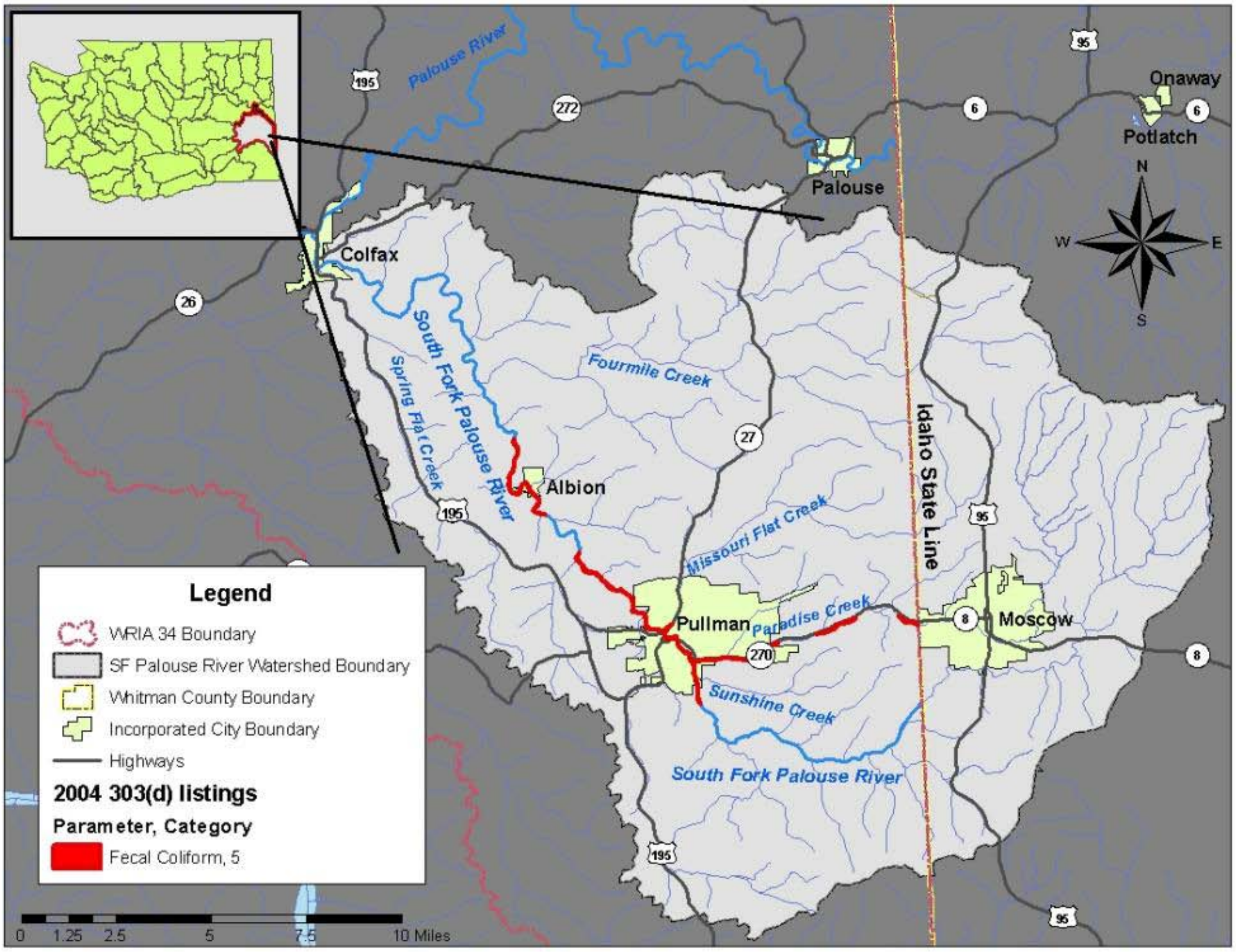

Figure 1. Study area - South Fork Palouse River watershed.

Pollutants addressed by this TMDL

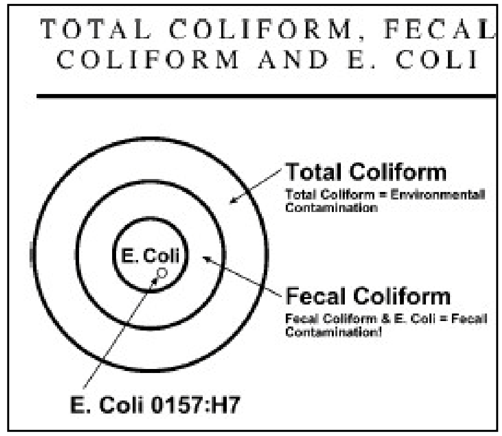

Figure 2. Relationship between total coliforms, fecal coliforms, and E. coli.

This TMDL addresses elevated FC bacteria levels in the South Fork 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. While E. coli 0157:H7 is most often associated with food contamination, research indicates it can be transported through watersheds via runoff and streams, and survive in sediments (Cooley et.al, 2007).

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 listings in the larger Palouse River watershed (WRIA 34). These listings will be addressed by a separate TMDL report in the near future.

Impaired beneficial 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.

All of the streams covered by this TMDL are designated for *primary contact recreation* use (Chapter 173-210A-600(1) WAC). Examples of primary contact uses are swimming and other activities where the water and skin or body openings (e.g., eyes, ears, mouth, nose, and urogenital) come into direct and extended contact.

The 2004 303(d) listings covered by this TMDL are listed in Table 1. Besides the listings from the 2004 list, there is one additional FC bacteria listing on the 2008 303(d) list (Table 2). Other stream segments were found to not meet (exceed) standards during the TMDL study. This TMDL sets load allocations necessary for this watershed to meet water quality standards.

Table 1. Waterbody segments with Clean Water Act Section 303(d) listings (2004 list) for not meeting fecal coliform standards that are addressed in this TMDL report.

Water body	Township	Range	Section	2004 Listing ID	TMDL station
South Fork Palouse River	15N	45E	06	6707	34SFPR22.0
	15N	44E	26	6708	34SFPR19.2
	15N	44E	25	6709	34SFPR21.5
	14N	45E	06	6710	34SFPR22.8
	14N	45E	05	6711	34SFPR23.6
	14N	45E	08	6712	34SFPR24.3
	15N	44E	36	10448	34SFPR21.5
	15N	44E	15	10450	34SFPR15.8
	15N	44E	10	10452	34SFPR11.5
Paradise Creek	14N	45E	04	10439	34Air00.0
	14N	46E	05	10441	34Para06.6
	14N	45E	01	10442	34Para03.8
	14N	45E	03	10443	34Para01.1
	14N	45E	05	10444	34Para00.1
Missouri Flat Creek	14N	45E	05	6713	34Miss00.1

Table 2. New fecal coliform bacteria impairment from the 2008 303(d) list and segment found to exceed standards during the 2006-07 TMDL study.

Water body	Township	Range	Section	2008 Listing ID	TMDL station
Dry Fork Creek	14N	45E	05	46406	34Dry00.1

Note: All 2004 303(d) listings in Table 1 are also on the 2008 303(d) list.

Water Quality Standards and Beneficial Uses

Bacteria criteria are set to protect people who work and play in and on the water from waterborne illnesses. In Washington State, the Department of Ecology's (Ecology) 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 been shown to maintain low rates of serious intestinal illness (gastroenteritis) in people.

The recreational use for the SF Palouse River and tributaries is designated as *primary contact* use. 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, and throat. Since children are the most sensitive group for many of the waterborne pathogens of concern, even shallow waters may warrant primary contact protection.

To protect this use primary contact use category: "FC bacteria organism levels must not exceed a geometric mean value of 100 colonies/100 mL, with not more than 10% 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].

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 a 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 seven or fewer illnesses out of every 1,000 people engaged in primary contact activities. Once the concentration of FC bacteria in the water reaches the numeric criterion, human activities that would increase the concentration above that criterion are not allowed. If the criterion is exceeded, the state requires that human activities be conducted in a manner that will bring FC bacteria counts 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.

Other beneficial uses designated for the streams in the South Fork Palouse River watershed include:

- Salmonid (trout and other fish species) spawning, rearing and migration.
- Domestic, agricultural, industrial, and stock watering water supplies.
- Wildlife habitat.
- Harvesting.
- Commerce and navigation.
- Boating.
- Aesthetics.

Watershed Description

The South Fork Palouse River (SFPR) drains 295 square miles from its headwaters in Idaho to its confluence with the mainstem Palouse River (also known as the North Fork Palouse River) at Colfax, Washington. The mainstem then drains into the Snake River at the convergence of Whitman, Franklin, Columbia, and Walla Walla Counties.

The SFPR sub-watershed is located in Whitman County of eastern Washington and Latah County of north Idaho, within the larger Palouse River watershed. This area of rolling hills is known as The Palouse. The portion of the Palouse watershed within Washington is known as Water Resource Inventory Area (WRIA) 34.

Major tributaries to the SFPR include Paradise Creek, Missouri Flat Creek, Four Mile Creek, and Spring Flat Creek. Other smaller tributaries of interest within the study area include Sunshine, Airport Road, Dry Fork, Parvin, Rose, and Staley Creeks.

Paradise Creek drains about 35 square miles from its headwaters at Moscow Mountain in Idaho to its confluence with the SFPR near the eastern Pullman city limits. The creek serves as the receiving waters for the Moscow Wastewater Treatment Plant (WWTP), located approximately 0.5 miles east of the state line. During low-flow periods (June to October), the WWTP discharge can account for up to 87% of the flow in Paradise Creek at the state line (Hallock, 1993).

Missouri Flat Creek originates north of Moscow in Idaho and flows west across the state border where it bends south, travels through Pullman along Highway 27/Grand Avenue and converges with the SFPR near downtown Pullman. The 27-square-mile drainage area is influenced primarily by nonpoint dry-land agricultural runoff; however, the stretch of the creek within the Pullman city limits receives residential and commercial runoff from 26 separate storm drains.

Land use within the study area (Figure 3 and Table 3) is dominated by dryland agriculture and interspersed with several clusters of urban population. The majority of population is concentrated in the cities of Pullman and Moscow, with a greater concentration on and around university campuses in both cities. Smaller communities include the towns of Colfax, at the mouth of the SFPR, and Albion, located along the SFPR between Pullman and Colfax. Major crops include spring and winter wheat, barley, peas, and lentils. These crops are produced without irrigation, thus the term “dryland agriculture” (RPU, Inc., 2002).

Annual precipitation in this watershed can range from 15-25 inches of rain per year. A drought was declared in 2001, and the climatic condition has continued for the last several years. Summer daily maximum air temperatures can range from mid-80ºF to mid-90ºF (around 29ºC to 35ºC) and occasionally exceed 100ºF (37.8ºC). There is a weather monitoring station located at the Pullman-Moscow regional airport for collecting data on air and dewpoint temperatures, wind speed and direction, barometric pressure, and weather observations.

 

Figure 3. Photos of land use in the SF Palouse River watershed (dryland agriculture and city/university).

Table 3. Land use in the SF Palouse River watershed (RPU, Inc., 2002).

Land use	Acres	Percent of watershed
Cropland	154,764	82%
Urban use (including roadways)	15,100	8%
Forestland	11,324	6%
Rangeland	3,774	2%
Riparian/wetland	3,774	2%
Total	188,736	

Pollution Sources

The following are potential sources of FC bacteria in the South Fork Palouse (SFPR) 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 general permits issued by Ecology.

Wastewater

The SFPR receives water from separate wastewater treatment plants (WWTP) at Albion and Pullman in Washington and Moscow in Idaho (via Paradise Creek). The Pullman WWTP is a secondary treatment plant that provides nitrification and discharges to the SFPR at river mile (RM) 21.3. Wastewater is treated for pathogens using a chlorine gas and then dechlorinated using sulfur dioxide (Heffner, 1987).

The Albion WWTP consists of two facultative lagoons that drain to a chlorinator/dechlorinator and effluent control structure before discharging into the SFPR at RM 14.1. The permit allows the WWTP to discharge year round; however, discharges typically occur between January and May. The control structure provides chlorine disinfection contact time, dechlorination and regulates the discharge period to minimize effluent impact to the receiving water.

Treatment from the Moscow WWTP occurs in Idaho approximately 0.5 miles east of the Washington state line. The Moscow WWTP is a Biological Nutrient Removal (BNR) treatment facility serving over 23,000 Moscow residents. The plant reduces BOD, TSS, total phosphorus, and temperature before discharging effluent year round to Paradise Creek. Plant efficiencies are continuing to grow with the addition and construction of final effluent polishing treatment consisting of an up flow sand filtration system. Moscow's WWTP currently uses gaseous chlorine for disinfection and sulfur dioxide for de-chlorination prior to discharging. During periods of low flow, the Moscow WWTP comprises nearly the entire flow of Paradise Creek and the SFPR until confluence with the Pullman WWTP discharge (Pelletier, 1993).

Stormwater

During precipitation events, rainwater washes over the surface of the landscape, pavement, rooftops, and other impervious surfaces. Stormwater can also result from precipitation on hard or saturated grass surfaces such as lawns, pastures, playfields, and from gravel roads and parking lots. 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. These regulations were issued in two phases. Phase I stormwater NPDES permits cover stormwater discharges from certain industries, construction sites involving five or more acres, and municipalities with a population of more than 100,000. Phase II stormwater regulations expand the requirement for stormwater permits to all municipalities located in urbanized areas with populations greater than 50,000 and to construction sites between one and five acres. The rule also requires an evaluation of cities outside of urbanized areas that have a population greater than 10,000, to determine if a permit is necessary for some or all of these cities.

Ecology determined that the city of Pullman required coverage under the Eastern Washington Phase II Municipal Stormwater Permit. This permit was issued on January 17, 2007 and went into effect on February 16, 2007. Washington State University (WSU) is a secondary permit holder under the Phase II Municipal Stormwater Permit. Stormwater from the city of Pullman and WSU discharges to the SFPR, Paradise Creek, Dry Fork Creek, and Missouri Flat Creek. Some stormwater outfalls discharge during dry weather.

While stormwater in the smaller towns of Albion and Colfax is not regulated through an NPDES permit, it may also be a source of bacterial contamination.

The Washington State Department of Transportation (WSDOT) highways and facilities are also regulated under a NPDES permit in areas covered by Phase I and Phase II of the municipal stormwater permit program and in areas covered by a TMDL.

Wildlife and background sources

The SFPR 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 (Figure 4). Open fields and riparian areas lacking vegetation are attractive feeding and roosting grounds for some birds whose presence can increase FC bacteria counts in runoff.

Figure 4. Evidence of beaver activity on the SF Palouse River.

Ecology is not aware of any streams that have exceeded the state FC bacteria criteria due to naturally dispersed wildlife. Human activities, such as removing canopy cover and riparian areas, can cause wildlife to congregate near streams elevating bacteria counts.

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.

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 surface runoff or fluctuating water levels. Often livestock have direct access to water. Manure is deposited in the riparian area of the access points 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.

Re-suspension and re-growth sources

There is evidence that FC bacteria can settle to the sediments where they can survive to later re-suspend into the water column after sediment disturbance (e.g., increased flow). There is also evidence that bacteria can survive the disinfection processes of WWTPs to re-activate 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 have shown that stream sediments can have bacteria concentrations an order of magnitude or higher than the overlying water concentration and that bacteria can survive for several months. 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.

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Goals and Objectives

Project goal

The goal of this water quality improvement plan (or TMDL) is to achieve compliance with Washington State fecal coliform criteria, which will return the South Fork Palouse River and its tributaries to a condition that provides low illness risk to people and animals using the streams. This 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 TMDL field study (Carroll and Mathieu, 2006) was initiated in 2006 to gather data for this Water Quality Improvement Plan.

The objectives of the 2006-07 TMDL study were to:

- Identify and characterize FC bacteria concentrations and loads from all tributaries, point sources, and drainages into the SFPR under various seasonal or hydrological conditions, including stormwater contributions.
- Establish FC load allocations (for nonpoint sources) and wasteload allocations (for point sources) to protect beneficial uses, including primary and secondary contact. Load and wasteload allocations are expressed as percent reductions needed to meet concentration based FC bacteria water quality standards.
- Identify relative contributions of FC loading to the SFPR so clean-up activities can focus on the largest sources first.

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Field Data Collection

Ecology developed a quality assurance (QA) project plan for the *South Fork Palouse River Fecal Coliform Bacteria Total Maximum Daily Load Study* (Carroll and Mathieu, 2006) to provide background information and detailed description of monitoring and sample processing activities. The QA project plan was reviewed by a SF Palouse River Technical Advisory Group and approved for sampling on May 18, 2006.

Sampling dates

Sampling began on May 23, 2006 and continued until May 2, 2007. Table 4 lists the 23 sampling surveys, approximately bi-monthly, partitioned into either a dry season or wet season group based on streamflows. In addition, a storm event was sampled on May 2, 2007 in and around the city of Pullman.

Table 4. Sampling dates for the SF Palouse River Fecal Coliform Bacteria TMDL.

Dry season	Wet season
July 11 – 12, 2006	May 23 – 24, 2006
July 24 – 26, 2006	June 6 – 7, 2006
August 8 – 9, 2006	June 20 – 21, 2006
August 29 – 30, 2006	December 18 – 20, 2006
September 11 – 12 , 2006	January 8 – 10, 2007
September 25 – 26, 2006	January 22 – 24, 2007
October 3 – 4, 2006	February 11 – 13, 2007
October 17 – 18, 2006	February 26 – 28, 2007
November 13 – 15, 2006	March 12 – 14, 2007
November 27 – 29, 2006	March 26 – 28, 2007
December 4 – 6, 2006	April 9 –11, 2007
	April 23 –25, 2007

The QA project plan included other parameters to assist in the FC bacteria 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 check standards for the dissolved oxygen measurements.

Seasonal source assessment

Separate bacteria source assessment (or screening) was analyzed for either a wet or dry season (i.e., runoff and non-runoff periods). The determination of wet and dry seasons was made by observing the streamflow within the basin. Figure 5 shows study year flows at various sampling locations.

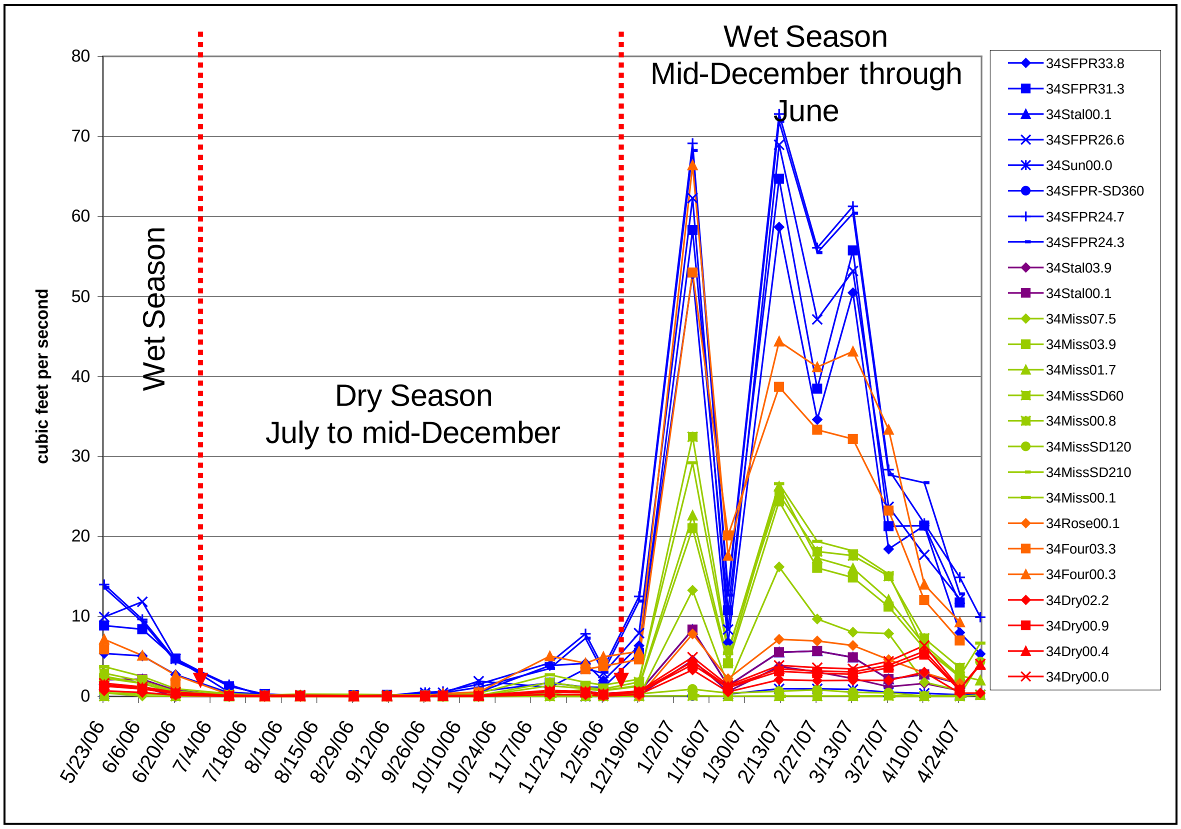

Figure 5. Designation of dry- and wet seasons for the 2006-07 TMDL study based on measured flows.

The dry period was determined to begin in July and continue through mid-December. The wet season extended through the rest of the year when flows were higher, affording more runoff events. The two seasons were distinguished because the modes of pollution are different for the two periods. Dry-season (non-runoff) sources include:

- Direct discharge from wastewater treatment plants.
- Indirect discharge from leaking sanitary sewer 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.
- Illegal dumping of waste to storm sewer systems or directly to surface waters.

- 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.
- Direct discharge from failing septic systems.

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

Sampling locations

FC bacteria and streamflow data were collected from 64 sites in the watershed. Figures 6 and 7 show all sampling sites. Tables 5 and 6 list the corresponding location identification, description, and latitude/longitude of the sampling sites.

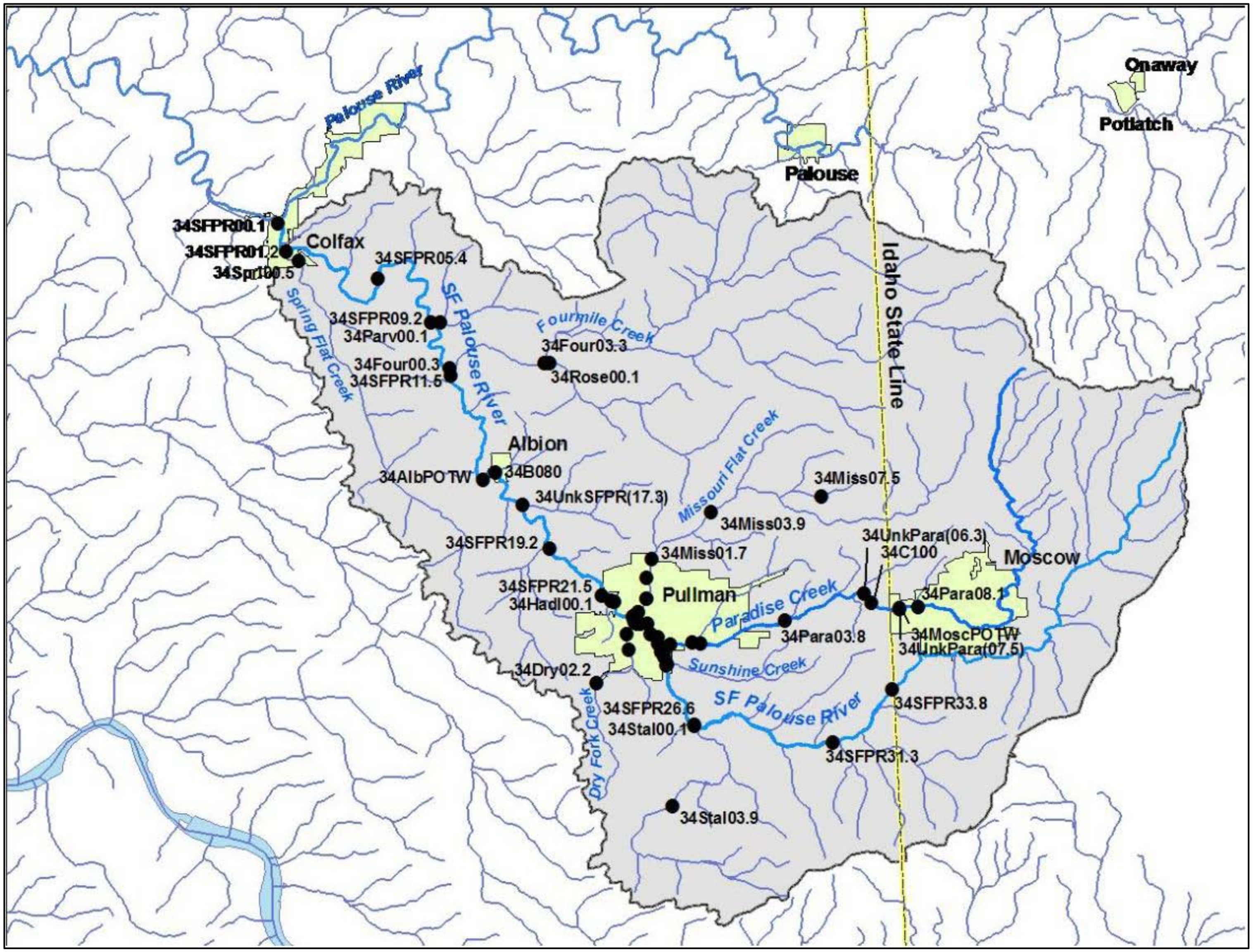

Figure 6. Map of all sampling stations, South Fork Palouse River watershed, 2006-07 TMDL study.

Table 5. Description of sampling sites outside of Pullman in the SF Palouse River (SFPR) watershed, 2006-07 TMDL study.

Station ID (RM included)	Station Description	Longitude	Latitude
34ALBPOTW	City of Albion wastewater outfall into SFPR	-117.25961	46.78749
34B080	SFPR at the Albion bridge (aka 34SFPR15.8)	-117.25153	46.78978
34C100	Paradise Ck at the state line (aka 34Para06.6)	-117.04305	46.73250
34DRY02.2	Dry Fork Ck at Pullman city limits near furniture store	-117.20120	46.70895
34FOUR00.3	Near mouth of Fourmile Ck on Shawnee-Parvin Rd	-117.27569	46.83006
34FOUR03.3	Fourmile Ck above Rose Creek confluence (McIntosh Rd)	-117.22321	46.83092
34HADL00.1	Mouth of Hatley Ck at Hayward Rd	-117.19247	46.73930
34MISS01.7	Missouri Flat Ck at Kitzmiller Rd	-117.16909	46.75448
34MISS03.9	Missouri Flat Ck on Whelan Rd upstream of Pullman	-117.13532	46.77125
34MISS07.5	Missouri Flat Ck at O’Donnell Rd downstream of state line	-117.07338	46.76516
34MOSCPOTW	City of Moscow wastewater outfall into Paradise Ck	-117.03460	46.73170
34PARA03.8	Paradise Ck below Sunshine Rd on road to gravel company	-117.09636	46.72927
34PARA06.6	Paradise Ck at the state line on driveway to Wilbur-Ellis Inc.	-117.05017	46.73445
34PARA08.1	Paradise Ck above Moscow POTW at Perimeter Rd	-117.02465	46.73196
34PARV00.1	Mouth of Parvin Ck above Parvin Rd bridge	-117.28019	46.84773
34ROSE00.1	Mouth of Rose Ck at McIntosh Rd	-117.22072	46.83051
34SFPR01.2	SFPR just above flood control structure in Colfax	-117.36206	46.87727
34SFPR05.4	SFPR just above grain silo that burned in 2006 fire	-117.31285	46.86555
34SFPR09.2	SFPR at the Parvin Rd bridge	-117.28453	46.84775
34SFPR11.5	SFPR at the Shawnee Rd bridge	-117.27486	46.82743
34SFPR19.2	SFPR at the Armstrong Rd bridge	-117.22528	46.76009
34SFPR21.5	SFPR at end of Hayward Rd	-117.19770	46.74113
34SFPR26.6	SFPR above Staley Creek	-117.14943	46.69038
34SFPR31.3	SFPR near Sand Rd	-117.07448	46.68164
34SFPR33.8	SFPR at WA-Idaho state line	-117.04166	46.70054
34SPRI00.5	Spring Flat Creek just above the Colfax city limits	-117.35654	46.87284
34STAL00.1	Mouth of Staley Creek	-117.14946	46.68998
34STAL03.9	Staley Creek at river mile 3.9	-117.16286	46.66045
34SUN00.0	Mouth of Sunshine Creek (outfall to SFPR)	-117.16391	46.71438
34UNKPARA(06.3)	Unknown drainage to Paradise Ck at Airport Rd east	-117.05377	46.73833
34UNKPARA(07.5)	Unknown drainage to Paradise Ck below Moscow POTW	-117.03484	46.73161
34UNKSFPR(17.3)	Unknown drainage to SFPR at Pat Old Rd	-117.23861	46.77714

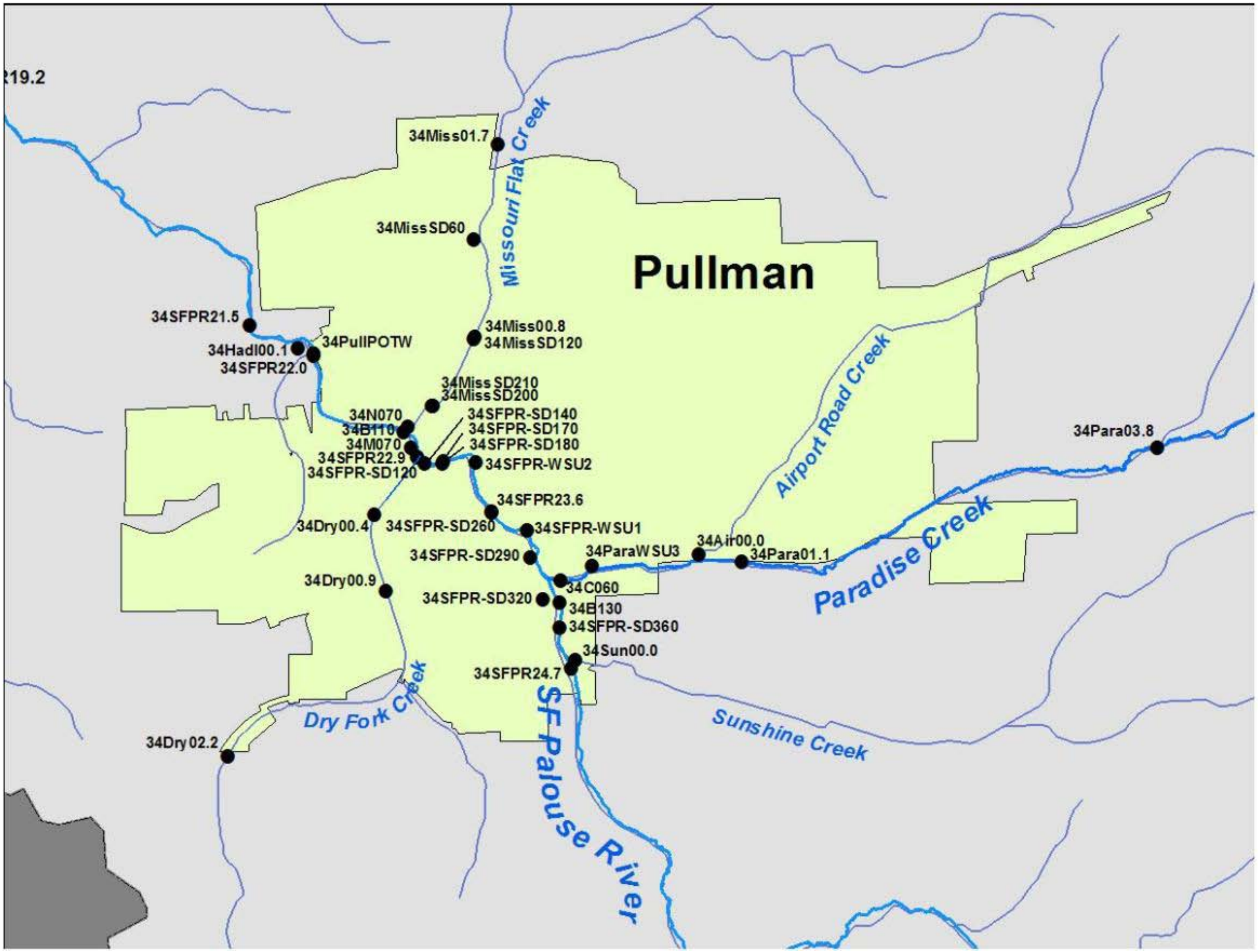

Figure 7. Map of sampling stations within the city of Pullman, 2006-07 TMDL study.

Table 6. Description of sampling sites within the Pullman city limits, 2006-07 TMDL study.

Station ID (RM included)	Station Description	Longitude	Latitude
34AIR00.0	Mouth of Airport Rd Creek	-117.14772	46.72167
34B110	SFPR at State St bridge in Pullman (aka 34SFPR22.8)	-117.18100	46.73266
34B130	SFPR at Bishop Blvd bridge in Pullman (aka 34SFPR24.3)	-117.16461	46.71861
34C060	Mouth of Paradise Ck (aka 34Para00.1)	-117.16305	46.72055
34DRY00.4	Dry Fork Ck near Grand Ave at Texaco Station.	-117.18477	46.72644
34DRY00.9	Dry Fork Ck near Grand Ave across from Post Office	-117.18391	46.72022
34DRY02.2	Dry Fork Ck at Pullman city limits near furniture store	-117.20120	46.70895
34HADL00.1	Mouth of Hatley Ck at Hayward Rd	-117.19247	46.73930
34M070	Mouth of Dry Fork Ck (aka 34Dry00.1)	-117.17858	46.73058
34MISS00.8	Missouri Flat Ck just upstream of Jack in the Box on Grand Ave	-117.17250	46.73971
34MISS01.7	Missouri Flat Ck at Kitzmiller Rd	-117.16909	46.75448
34MISSSD120	Storm drain #120 outfall into Missouri Flat Ck	-117.17243	46.73977
34MISSSD200	Storm drain #200 outfall into Missouri Flat Ck	-117.17778	46.73434
34MISSSD210	Storm drain #210 outfall into Missouri Flat Ck	-117.17811	46.73419
34MISSSD60	Storm drain #60 outfall into Missouri Flat Ck	-117.17238	46.74752
34N070	Missouri Flat Ck at State St bridge in Pullman (aka 34Miss00.1)	-117.17953	46.73303
34PARA01.1	Paradise Ck above confluence of Airport Road Ck	-117.14410	46.72147
34PARAWSU3	WSU storm drain #3 outfall to Paradise Ck	-117.16091	46.72166
34PULLPOTW	City of Pullman wastewater outfall into SFPR	-117.19072	46.73893
34SFPR-SD120	Storm drain #120 outfall into SF Palouse River under Kamiaken	-117.17962	46.73044
34SFPR-SD140	Storm drain #140 outfall into SFPR below pedestrian walk	-117.17880	46.73000
34SFPR-SD170	Storm drain #170 outfall into SFPR behind Taco Time	-117.17628	46.73010
34SFPR-SD180	Storm drain #180 outfall into SFPR across from SD170	-117.17617	46.73024
34SFPR-SD260	Storm drain #260 outfall into SFPR below South St bridge	-117.17183	46.72597
34SFPR-SD290	Storm drain #290 outfall into SFPR end of Pro Mall Blvd	-117.16768	46.72231
34SFPR-SD320	Storm drain #320 outfall into SFPR below Bishop Blvd bridge	-117.16609	46.71918
34SFPR-SD360	Storm drain #360 outfall into SFPR east of Klemgard	-117.16492	46.71597
34SFPR-WSU1	WSU storm drain #1 outfall to SFPR on Benewah St	-117.16814	46.72467
34SFPR-WSU2	WSU storm drain #2 outfall to SFPR on Riverview Rd	-117.17323	46.73006
34SFPR21.5	SFPR at end of Hayward Rd (just below Pullman city limits)	-117.19770	46.74113
34SFPR22.0	SFPR just above Pullman POTW outfall	-117.19081	46.73884
34SFPR22.9	SFPR at the Kamiaken Rd bridge	-117.17962	46.73056
34SFPR23.6	SFPR at the South St bridge	-117.17128	46.72558
34SFPR24.7	SFPR off Bishop Blvd next to cinema	-117.16327	46.71303
34SUN00.0	Mouth of Sunshine Creek (outfall to SFPR)	-117.16391	46.71438

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Study Methods

Field collection methods

Field collection study methods were described in the *South Fork Palouse River Fecal Coliform Bacteria TMDL Study QA Project Plan* (Carroll and Mathieu, 2006). Some collection and analysis of carbon, nitrogen, and phosphorus forms in water were performed and will be reported in a later TMDL report on dissolved oxygen and pH processes in the SF Palouse River. Table 7 describes the analyses, methodologies, and measurement or data quality objectives used in the FC bacteria TMDL study.

Table 7. Study analysis methodologies with precision targets and reporting limits.

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

[1] as units of measurement, not percentages.
[2] as percentage of reading, not 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 5X the reporting limit will be evaluated separately.

SU = Standard pH Units.
MF = Membrane filter method.
SM = Standard Methods for the Examination of Water and Wastewater, 20th Edition (APHA, AWWA and WEF, 1998).
EPA = EPA 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 Watershed Technical Support Unit protocols manual (Ecology, 2000). Flow volumes were calculated from continuous stage height records and rating curves developed prior to, and during, the project. Stage heights were measured by pressure transducer and recorded by a data logger every 15 minutes. Staff gages were installed at several selected sites. Streamflow data collected by the USGS were also used.

Analytical methods

Statistical Rollback 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 bacteria counts. The approach relates the analysis to the water quality concentration standard better and has proven successful in past FC bacteria TMDL assessments (Cusimano, 1997; Joy, 2000; Sargeant, 2002).

The Statistical Roll-Back Method was used to establish FC bacteria reduction targets at all sampling sites that had sufficient sampling size (5 or more 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 is as follows:

- A check was made to make sure the FC bacteria data collected in 2006-07 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 was set as the highest of the following two resulting 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 only in place to assist water quality managers in assessing the progress toward compliance with the FC bacteria 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

Simple load analyses were performed using a spreadsheet to evaluate the mass balance of FC bacteria and TSS for each reach. 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. A simple mass-balance was performed to show the general pattern of loading within the watershed. The 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.

Loads were calculated by multiplying the FC concentration by the flow at each site. FC bacteria are measured in colony forming units (cfu) per 100 mL, and flow is measured in cubic feet per second (cfs). The resulting product, reported in loading units, was not converted to the actual load of FC bacteria, measured in cfu per day, because that would result in a large, awkward number that would make comparing loads more difficult. To convert from loading units to cfu per day, multiply the number of loading units by the constant, 24,465,067.

For each sampling survey, measured upstream and tributary loads entering a stream 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 loading 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 residual term 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.

While treating the FC bacteria and TSS conservatively may not be an actual representation of what is occurring in the stream, most reaches were short enough to make a general assumption that most or some of the upstream load was transported to the next downstream station. Travel times of loads were generally on the order of hours (not days) between stations. Still, because the loads were implicitly regarded as conservative, calculated nonpoint loads may underestimate the actual nonpoint loading in a reach.

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. Also, some sample surveys were discarded from the loading analysis when samples were not collected from all sites.

Individual reach loads were averaged over each season and then compared to other reach loads to develop an overall loading pattern. Averaging the loads lessened the impact of any one individual survey load, which helped 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 direct implementation efforts.

Study Quality Assurance Evaluation

Quality assurance objectives

Data collected for this 2006-07 South Fork Palouse River TMDL study were evaluated to determine whether data quality assurance/quality control (QA/QC) objectives for the project were met. Water quality data QA/QC objectives for precision are described in Table 7.

Sample quality assurance

QA/QC for samples

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) was used for 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 the proper range 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 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 (e.g., 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 in the upper tier was compared to the target precision objective for each parameter. Results are in Tables 8 and 9.

Table 8. 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 (# of duplicate pairs)	Average %RSD for samples ≥5X reporting limit (# of duplicate pairs)
Chloride	0.1 mg/L	<5	all samples >5x limit	1 (4)
Fecal coliform[1]	1 cfu/100 mL	<30	26 (9)	16 (13)
Total Suspended Solids	1 mg/L	<10	7 (20)	6 (20)

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

Table 9. 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 (# of duplicate pairs)	Average %RSD for samples ≥5X reporting limit (# of duplicate pairs)
Chloride	0.1 mg/L	<5	1 (2)	<1 (5)
Fecal coliform[1]	1 cfu/100 mL	<30	26 (39)	12 (36)
Total Suspended Solids	1 mg/L	<10	6 (8)	6 (91)

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

Total Precision

Field replicate samples 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 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 10 and 11.

Table 10. 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 (# of duplicate pairs)	Average %RSD for samples ≥5X reporting limit (# of duplicate pairs)
Chloride	0.1 mg/L	< 5	all samples >5X limit	< 1 (6)
Fecal coliform[1]	1 cfu/100 mL	<30	25 (4)	23 (61)
Total Suspended Solids	1 mg/L	<10	20 (27)	40 (12)

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

Table 11. 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 (# of duplicate pairs)	Average %RSD for samples ≥5X reporting limit (# of duplicate pairs)
Chloride	0.1 mg/L	< 5	all samples >5X limit	< 1 (16)
Fecal coliform[1]	1 cfu/100 mL	<30	28 (42)	19 (112)
Total Suspended Solids	1 mg/L	<10	10.9 (32)	10.6 (77)

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

Total precision %RSD in the upper tier was compared to the target precision. As expected, %RSD for field replicates were higher than that for lab splits because %RSD is a measurement of total variability, including both field and analytical variability.

Only the %RSD for TSS during the dry season did not meet the target precision objectives. The analytical precision for TSS was very good, so most of the variability appears to be field variability. TSS concentrations are inherently variable because of patchy distributions in the environment and intermittent discharge. The dry-season TSS data were not qualified for not meeting the target precision objectives; however, the higher variability of the data was taken into consideration for the analysis and interpreting results.

Conclusion

Overall, the data collected by Ecology for this project met the data quality objectives. There was high variability in the TSS data during the dry season; however, the QA and QC review suggests that the Ecology data are of good quality and properly qualified.

Results and Discussion

South Fork Palouse River TMDL data

All laboratory and field data collected for the *South Fork Palouse River Fecal Coliform Bacteria TMDL* are loaded into Ecology's Environmental Information Management (EIM) database. These data are available on-line from the Ecology web-site at: www.ecy.wa.gov/eim/. Several query options are available. The study identification (study ID) designation is "JICA0000" and the study name is "S. F. Palouse R. TMDL".

Additional data collected by Ecology's Freshwater Monitoring Unit (FMU) were used in this TMDL analysis and are also available on-line at the above EIM web-site. The study identification (study ID) designation for these data is AMS001. Table 12 shows the FMU stations used in support of the South Fork Palouse River TMDL effort.

Table 12. Ecology's freshwater monitoring unit (FMU) stations used in the SF Palouse River TMDL study and the project station equivalent.

FMU Station	SF Palouse River TMDL project station equivalent	Site Description
34B080	34SFPR15.8	SF Palouse River at the Albion bridge
34B110	34SFPR22.8	SF Palouse River at State Street in Pullman
34B130	34SFPR24.3	SF Palouse River at Bishop Blvd in Pullman (below Sunshine Ck)
34C060	34Para00.1	Paradise Creek at mouth
34C100	34Para06.6	Paradise Creek at the Washington-Idaho state line
34M070	34Dry00.1	Dry Fork Creek at mouth
34N070	34Miss00.1	Missouri Flat Creek at mouth

Seasonal variation

Carroll and Mathieu (2006) reviewed the historical FC bacteria data from the long-term monitoring station on the SF Palouse River at State Street in Pullman. That assessment revealed that considerable monthly variation in FC bacteria counts exists at this site with higher concentrations from May to October. To assess the current water quality conditions, Ecology used the most recent data collected during the 2006-07 study.

Figure 8 shows the monthly geometric means and 90^{th} percentiles for all data collected in the SF Palouse watershed during the 2006-07 study. Again, higher geometric means were observed from May to October; however, considerable variability (expressed as the 90^{th} percentile) exists throughout the year. We expect overall lower concentrations in the wet months because of dilution with increased flows.

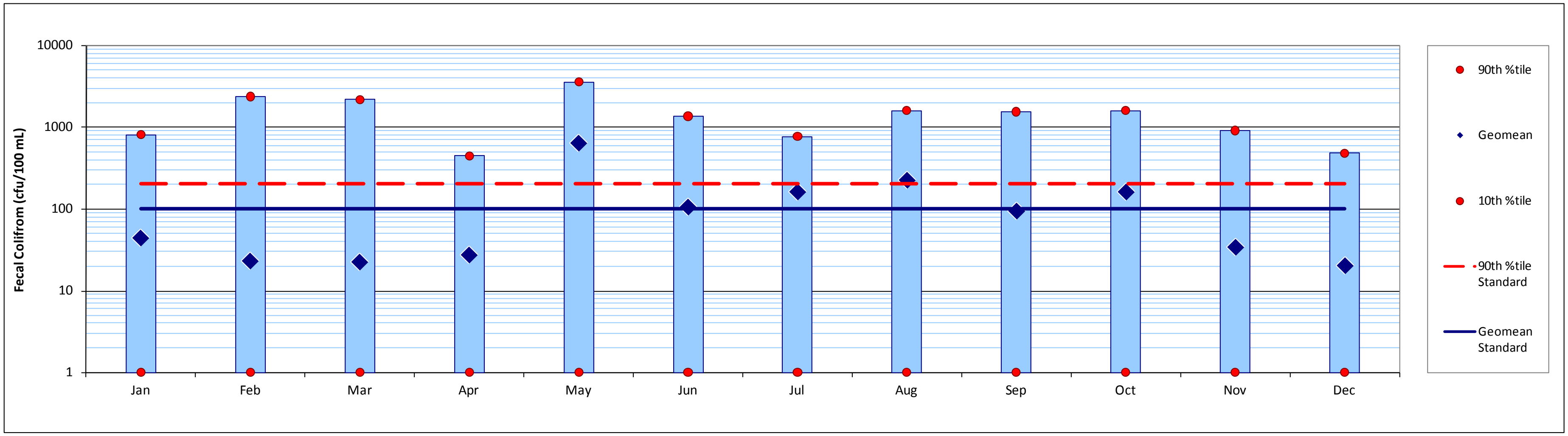


Figure 8. Monthly geometric means and 90th percentiles for all FC bacteria data collected in the SF Palouse watershed during the 2006-07 TMDL study.

TMDL Analyses

Upper SF Palouse River

Results and discussion

The Washington portion of the upper SF Palouse River extends from the Idaho-Washington state line to just inside the Pullman city limits (above Paradise Creek), encompassing a large dryland agricultural area of Whitman County. Ecology sampled at five upper SF Palouse sites, two Staley Creek sites, one Sunshine Creek site, and one city of Pullman storm drain.

Table 13 presents the dry- and wet-season summary statistics of FC bacteria counts and the target reductions necessary to meet the water quality standards. Figure 9 shows the average dry- and wet-season FC bacteria loads for the upper SF Palouse River.

Table 13. Dry-season and wet-season summary statistics of bacteria counts and target percent reductions for stations in the upper SF Palouse River and tributaries.

Station ID	Total # of Samples	Mini-mum	10th percen-tile	Geomean*	90th percen-tile	Maxi-mum	% Samples >200 cfu / 100 mL *	Target % Reduction**
Dry Season								
34SFPR33.8	10	100	87	357	1460	1900	60%	**86%**
34SFPR31.3	11	2	4	21	104	170	0%	**0%**
34SFPR26.6	12	2	4	24	155	110	0%	**0%**
34Stal00.1	8	9	9	98	1020	2000	25%	**80%**
34Sun00.0	1	7	----	7	----	7	----	**0%**
34SFPR-SD360	6	1	2	11	75	38	0%	**0%**
34SFPR24.7	10	3	4	22	115	130	0%	**0%**
34SFPR24.3	14	2	3	30	335	720	21%	**40%**
Wet Season								
34SFPR33.8	12	27	30	73	175	200	8%	**0%**
34SFPR31.3	10	27	26	67	170	270	10%	**0%**
34SFPR26.6	12	1	2	31	509	4400	8%	**61%**
34Stal00.1	10	20	15	149	1487	11000	40%	**87%**
34Sun00.0	10	2	1	13	213	2600	10%	**6%**
34SFPR-SD360	11	1	1	5	39	100	0%	**0%**
34SFPR24.7	13	6	11	86	677	2100	38%	**70%**
34SFPR24.3	17	3	6	52	427	2500	24%	**53%**

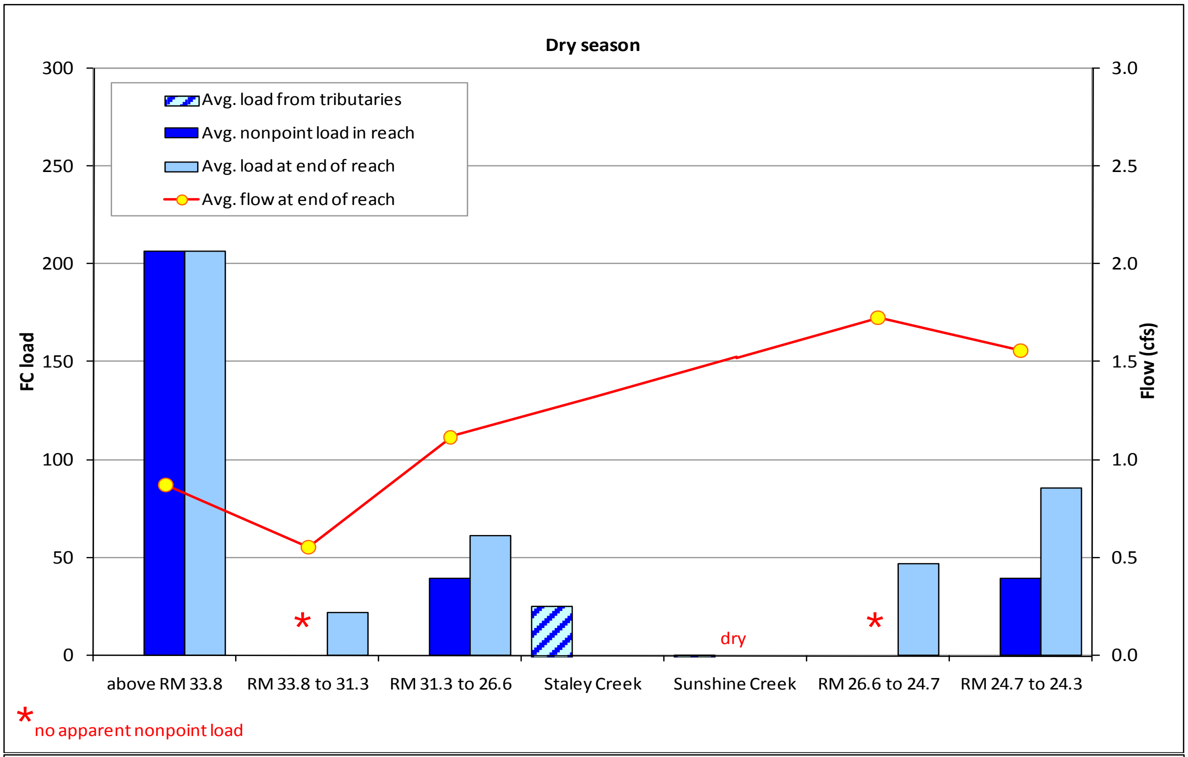
*Cells shaded in these columns are values that exceed Washington State numeric standards.
**Cells shaded in this column are values based on less than 5 samples collected at that station.

On average, the majority of the loading to the upper SF Palouse River was from Idaho during both the wet season (56%) and dry season (67%). During the wet season, average FC bacteria loads were an order of magnitude higher than the dry season; however, FC counts at the state line were in compliance with the water quality standards, but just barely. The average wet-season FC load appears to use up most of the downstream load capacity in the upper SF Palouse.

Staley Creek, a tributary to the SF Palouse, is discussed as a separate tributary below. Sunshine Creek lies between Paradise Creek and the SF Palouse within Whitman County, and enters the SF Palouse just upstream of the Pullman city limits. Sunshine Creek was dry during most of the dry season. During the wet season, Sunshine Creek had generally low FC counts, except for one high count (2600 cfu/100 mL) on May 26, 2006 during an intense thunderstorm.

Storm drain 360 discharges stormwater from the Klemgard Avenue collection points. The storm outfall had a small discharge even in the dry season. Both dry- and wet-season FC counts in storm drain 360 were well below the numeric standards.

Figure 10 shows the average dry- and wet-season TSS loads in the upper SF Palouse River. Wet-season loads were up to two orders of magnitude higher than dry-season loads with the majority of the load coming from Idaho (37%) and rural Whitman County (49%). There was a linear relationship between TSS concentrations and FC bacteria concentrations in the upper SF Palouse River (Figure 11), indicating that the control of runoff processes (soil-erosion control) could result in lower FC concentrations.



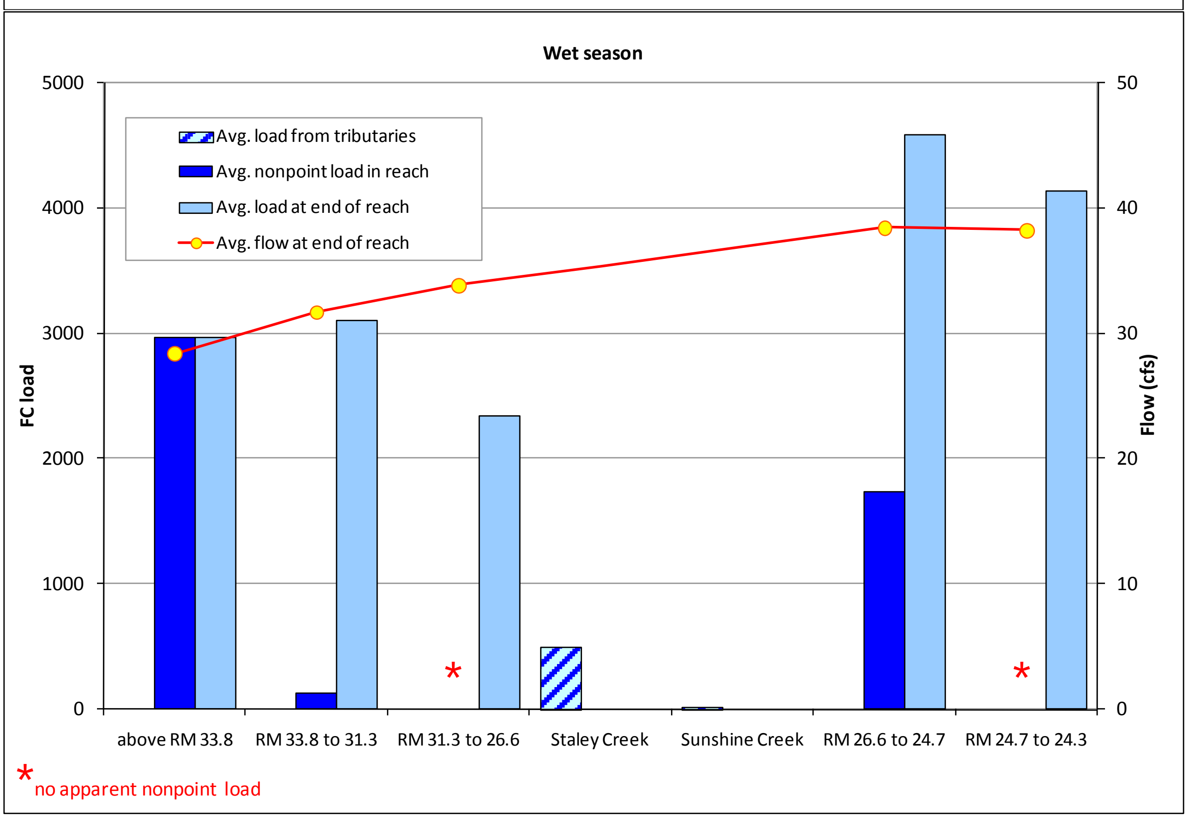
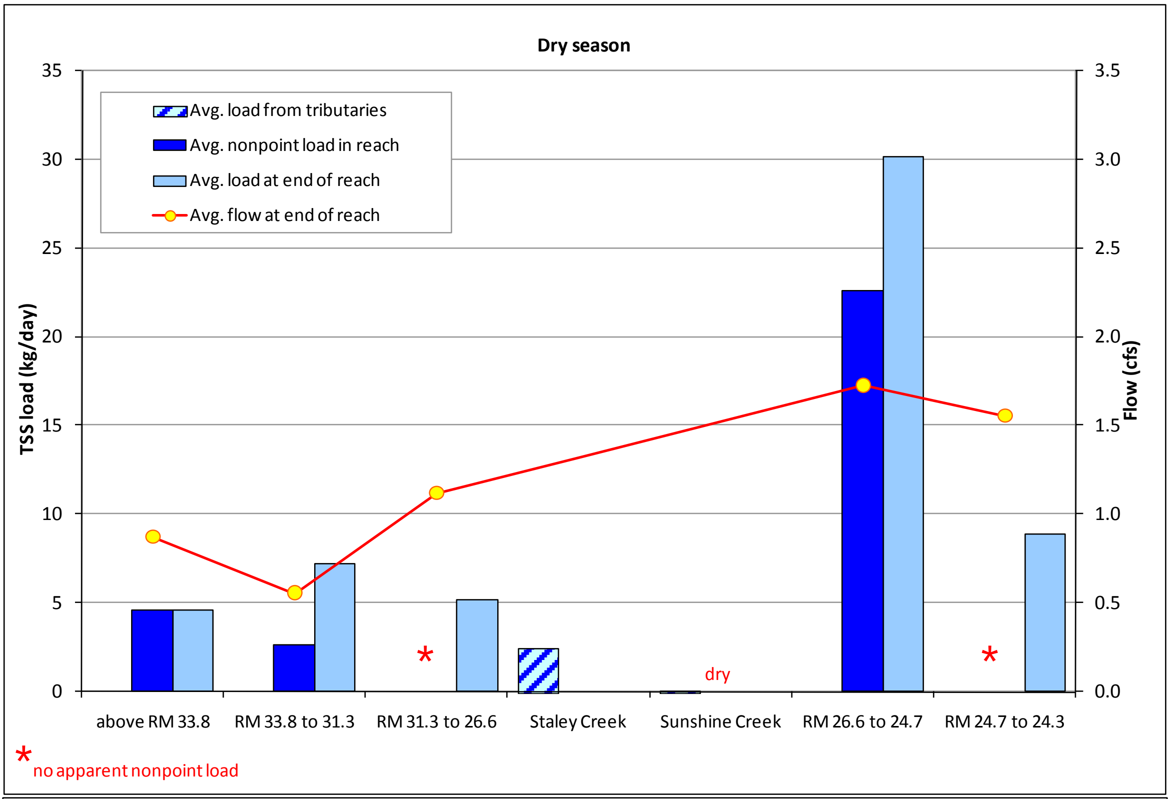


Figure 9. Dry-season and wet-season average fecal coliform (FC) bacteria loads from the 2006-07 TMDL study in the upper SF Palouse River. *Note differences in vertical axes scale between charts. To convert from loading units to number of cfu per day, multiply the number of loading units by the constant, 24,465,067.*



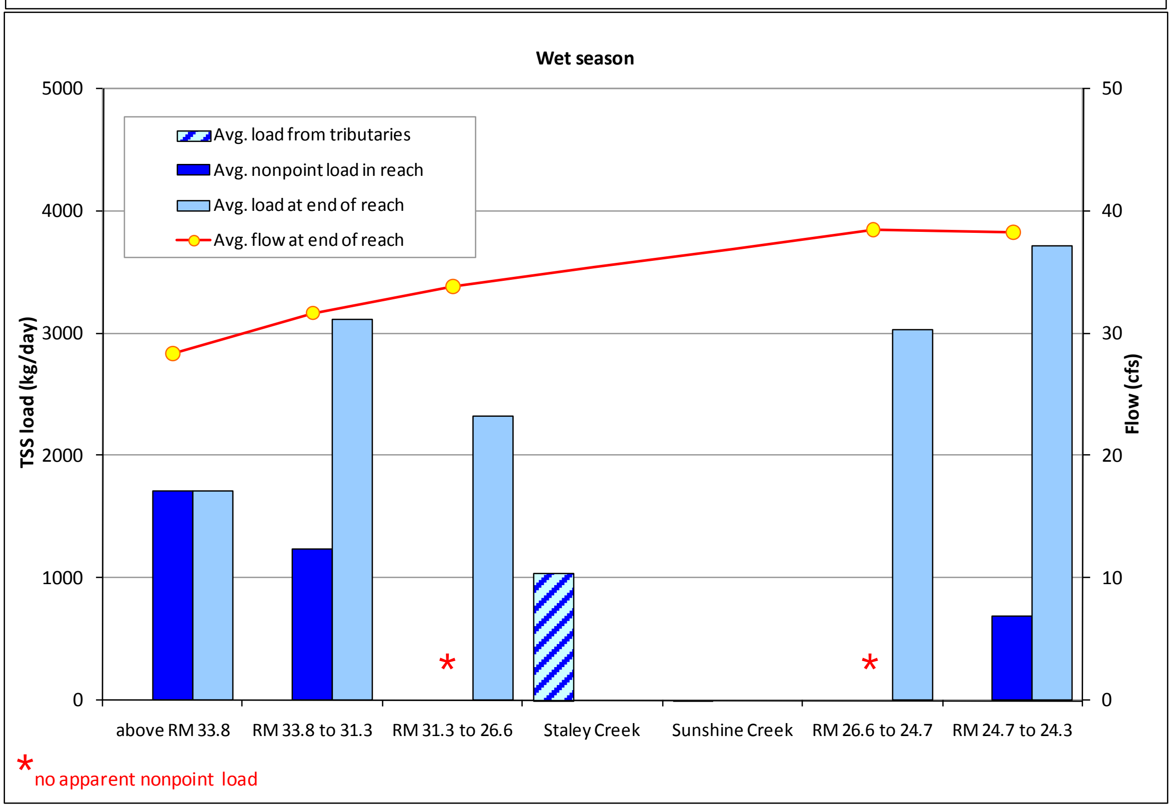


Figure 10. Dry-season and wet-season average total suspended solids (TSS) loads from the 2006-07 TMDL study in the upper SF Palouse River. *Note differences in vertical axes scale between charts.*

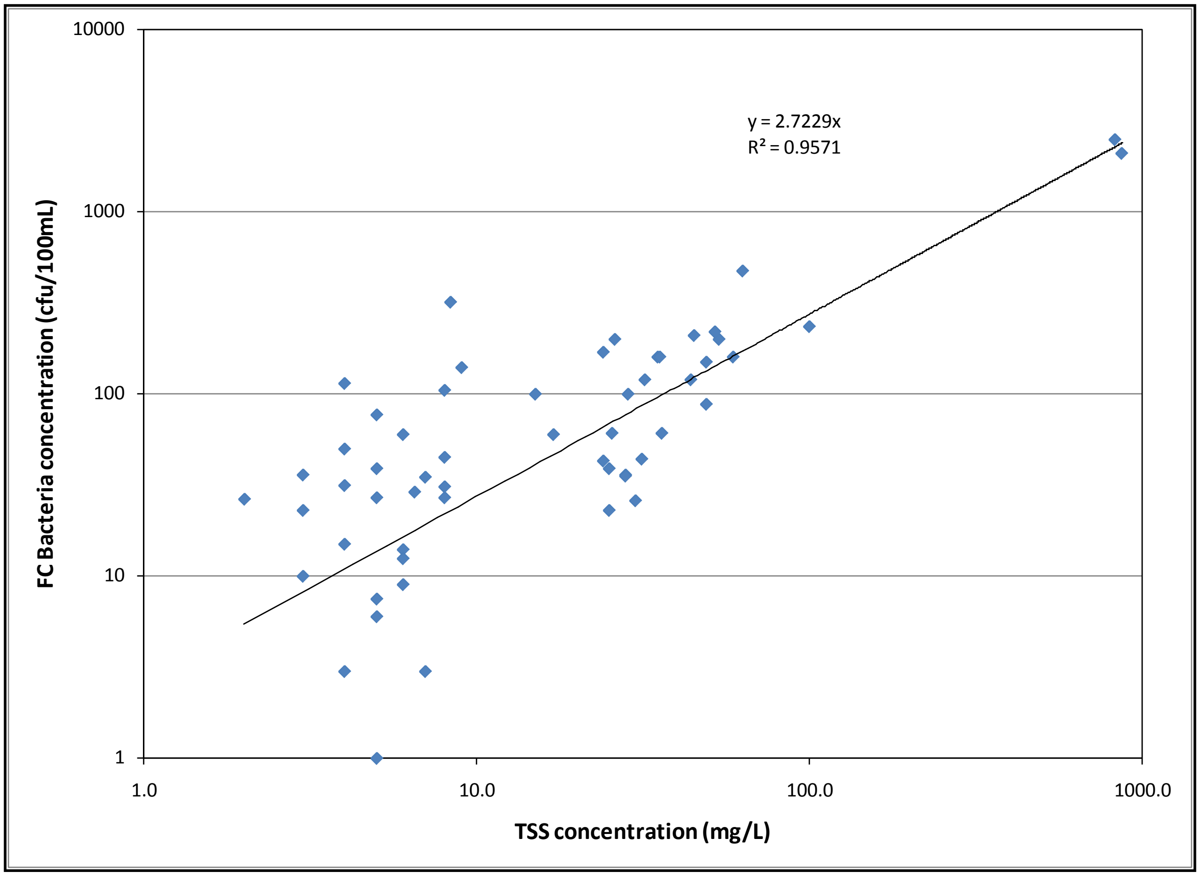


Figure 11. Relationship between total suspended solids (TSS) and fecal coliform (FC) bacteria concentrations in the upper SF Palouse River.

Tributary to upper SF Palouse – Staley Creek

Results and discussion

Staley Creek, a tributary to the SF Palouse River, drains the southern portion of the SF Palouse watershed within Whitman County and enters the SF Palouse River just upstream of the city of Pullman. The Staley Creek watershed is used for dryland agriculture. Ecology sampled at two locations on Staley Creek: at the mouth (RM 0.1) and upstream at RM 3.9.

Table 14 presents the dry- and wet-season summary statistics of FC counts and the target reductions necessary to meet the water quality standards. All Staley Creek locations had too many high counts to be in compliance with the numeric standards. The seasonal geometric means at the upper site (RM 3.9) were generally low, while the mouth had higher geometric means.

Table 14. Dry-season and wet-season summary statistics of FC bacteria counts and target percent FC reductions for stations in Staley Creek.

Station ID	Total # of Samples	Mini-mum	10th percen-tile	Geomean*	90th percen-tile	Maxi-mum	% Samples >200 cfu / 100 mL *	**Target % Reduction****
Dry Season								
34Stal03.9	5	1	1	12	231	200	20%	**14%**
34Stal00.1	8	9	9	98	1020	2000	25%	**80%**
Wet Season								
34Stal03.9	10	1	2	34	549	800	30%	**64%**
34Stal00.1	10	20	15	149	1487	11000	40%	**87%**

*Cells shaded in these columns are values that exceed Washington State numeric standards.
**Cells shaded in this column are values based on less than 5 samples collected at that station.

Figure 12 shows the average dry- and wet-season FC bacteria loads for Staley Creek. On average, Staley Creek contributed less than 10% of the FC bacteria load to the upper SF Palouse River year-round, but almost 25% of the TSS load in the wet-season. The average wet season FC bacteria load was much larger than the dry season load and originated above RM 3.9. The dry season load and flow above RM 3.9 was very low so most of the FC bacterial contamination in the dry season appears to come from unmeasured nonpoint sources in the lower part of Staley Creek. An assessment of non-runoff sources within this reach is warranted.

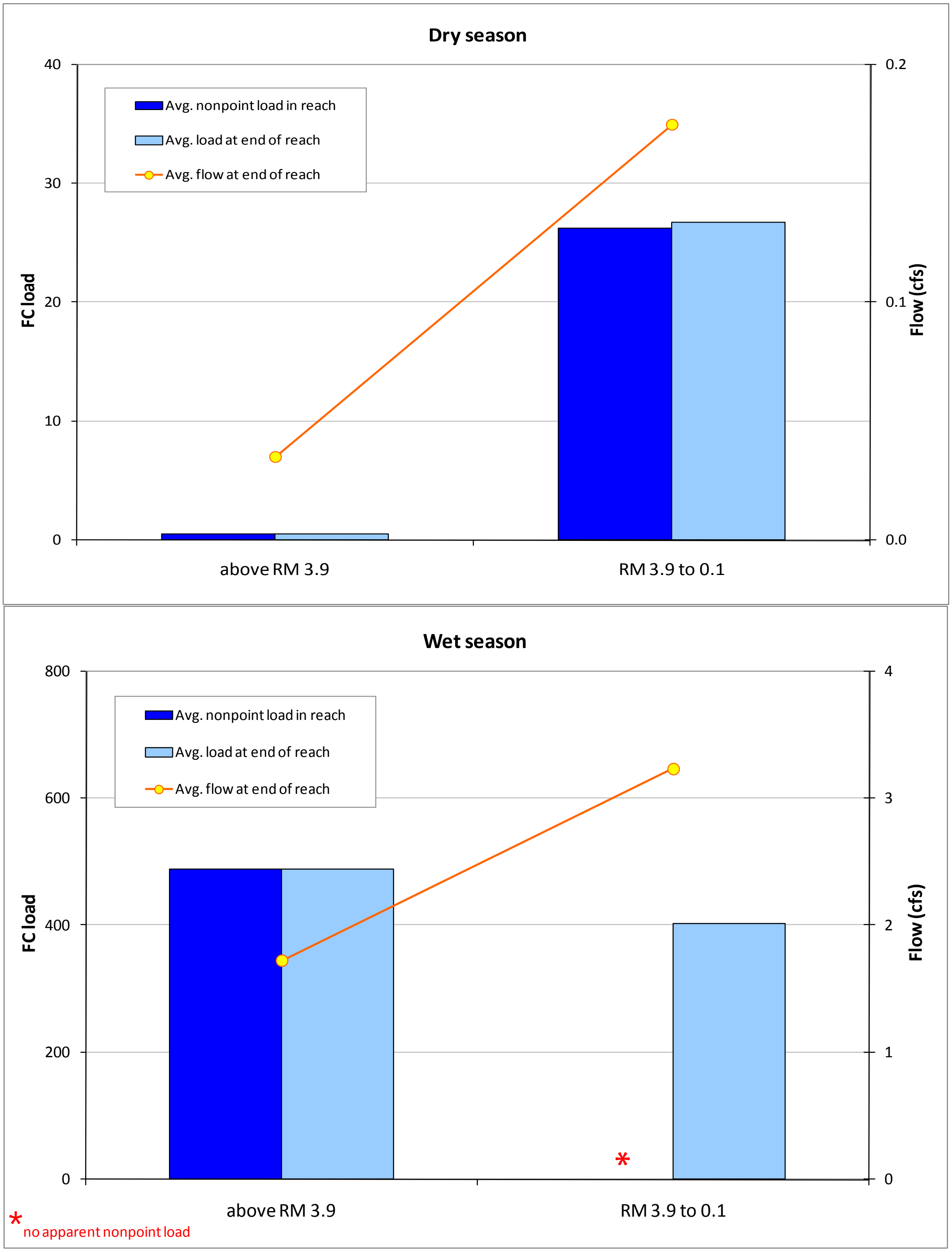


Figure 12. Dry-season and wet-season average fecal coliform (FC) bacteria loads from the 2006-07 TMDL study in Staley Creek. *Note differences in vertical axes scale between charts. To convert from loading units to number of cfu per day, multiply the number of loading units by the constant, 24,465,067.*

Middle SF Palouse River

Results and discussion

The middle portion of the SF Palouse River extends from just inside the Pullman city limits (above Paradise Creek) at RM 24.7 to just below the city limits off of Hayward Road (RM 21.5), primarily within the city limits of Pullman. This is a complex reach which contains the confluences of several tributaries to the SF Palouse River, including Paradise Creek, Dry Fork Creek, Missouri Flat Creek, and Hatley Creek. Besides the tributaries, Ecology sampled six SF Palouse sites, the Pullman WWTP outfall, and numerous storm drains that discharge to the river, some year-round.

Table 15 presents the dry- and wet-season summary statistics of FC counts and the target reductions necessary to meet the water quality standards. Overall, the middle SF Palouse had too many high FC counts during both the dry-season and wet-season at every site to meet the numeric standards. High FC counts were also seen in the tributaries and storm drains. The SF Palouse sites generally met the geometric mean standard in the wet season, but not in the dry season.

Figure 13 shows the average dry- and wet-season FC loads for the middle SF Palouse River.

During the dry season, most of the load (92%) originated from within the city limits. Dry Fork Creek and Missouri Flat Creek contributed just over 5%, and the storm drains (particularly WSU1) contributed almost 5%. The city of Pullman WWTP contributed 17% of the FC load, mainly because the flow doubled with its discharge. But the majority of the load was from unmeasured contributions within these three reaches:

- Between RM 22.8 (on map 34B110) and RM 21.5 - (50%)
- Between RM 22.9 and RM 22.8 (on map 34B110) - (5%)
- Between RM 24.3 and RM 23.6 - (10%)

When developing mass balances for each dry-season sampling survey, the three reaches above showed, on average, a positive residual (i.e., an unexplained increase in load in each reach). This unexplained increase means that there was an unexplained source of FC bacteria that was not sampled.

Smaller positive residuals could be from sampling error of known sources, but the large unexplained increase between RM 22.8 and RM 21.5 is most likely the result of missing a source of FC bacteria. There is a mix of land uses including commercial, residential, industrial, and municipal land uses within this reach.

RM 21.5 is also one-half mile below the Pullman WWTP, so there is potential for re-growth of bacteria discharged from the WWTP. The WWTP is also the single largest source of TSS in the middle SF Palouse during the dry season (Figure 14). The depositional zone of sediment below the WWTP may be a potential propagation area for sediment bacteria.

Further assessment of the reach between RM 22.8 and RM 21.5 during the dry season is warranted.

During the wet season, most of the load originated from outside the city limits, mainly the upper SF Palouse River (50%) and Paradise Creek (19%). There were also contributions from Dry Fork Creek (12%), Missouri Flat Creek (11%), and an apparent nonpoint load contribution (6%) between RM 24.3 (on map 34B130) and RM 23.6 in the wet season. Wet season FC loads and flows were generally an order of magnitude higher than the dry season. Most of the average wet-season load was primarily larger upstream loads passing through the middle SF Palouse, with smaller in-reach load contributions.

Storm drains WSU1 and WSU2 had moderate baseflow year-round with overall low geometric means but with too many high counts to meet the numeric standards. WSU1 contributed nearly 5% of the FC load to the middle SF Palouse during the dry season.

Storm drains 320, 290, 180, 170, 140, and 120 were usually dry during scheduled sampling events throughout the year, but during the occasional times when there was enough flow to sample, these storm drains showed high counts. Storm drain 260 (below the South Street bridge), was discharging during most sampling events (though sometimes just a dribble) and usually had high FC bacteria counts, particularly in the dry season.

Presumably, a storm drain should not have summer baseflow, unless it carries a historically natural drainage, has groundwater infiltration, has an illegal connection of some kind, or has a natural spring that may contribute to year-round baseflow.

The city of Pullman WWTP had generally good disinfection, based on samples from the outfall, but there were two occasions in the dry season when FC counts exceeded 300 cfu/100 mL, above their weekly permitted level of <100 cfu/100 mL. The WWTP was conducting in-house modifications to monitor and control the production of trihalomethanes, and the disinfection process may have been upset in the process.

Hatley Creek was dry during the dry season, but had flow in the wet season when FC counts were too high to meet the numeric standards. The FC assessments for Paradise Creek, Dry Fork Creek, and Missouri Flat Creek – tributaries to the middle SF Palouse River – are discussed separately below.

TSS loadings in the middle SF Palouse followed a similar pattern to the FC loading pattern, with the majority of the dry-season TSS loading coming from within the reach, and the majority of the wet-season TSS loading coming from upstream sources (Figure 14).

Table 15. Dry-season and wet-season summary statistics of bacteria counts and target percent reductions for stations in the middle SF Palouse River and tributaries.

Station ID	Total # of Samples	Mini-mum	10th percen-tile	Geomean*	90th percen-tile	Maxi-mum	% Samples >200 cfu / 100 mL *	Target % Reduction**
Dry Season								
34SFPR24.3	14	2	2.7	30	335	720	21%	**40%**
34Para00.1	12	4	6.1	55	492	1700	17%	**59%**
34SFPR-SD320	3	1	----	3	----	12	----	**0%**
34SFPR-SD290	1	170	----	170	----	170	----	**41%**
34SFPRWSU1	11	1	2.5	74	2216	2200	45%	**91%**
34SFPR23.6	12	17	27	178	1186	2600	58%	**83%**
34SFPR-SD260	6	9	9.1	141	2173	4200	50%	**91%**
34SFPRWSU2	11	1	2.8	39	544	700	27%	**63%**
34SFPR-SD180	1	150	----	150	----	150	----	**33%**
34SFPR-SD170	1	48	----	48	----	48	----	**0%**
34SFPR-SD140	0	----	----	----	----	----	----	**----**
34SFPR22.9	12	20	24	175	1256	2700	42%	**84%**
34SFPR-SD120	2	27	----	87	----	280	----	**72%**
34Dry00.0	11	75	118	474	1901	3600	82%	**89%**
34SFPR22.8	18	31	40	236	1386	6250	56%	**86%**
34Miss00.1	11	48	54	237	1034	1200	55%	**81%**
34SFPR22.0	6	27	27	130	624	780	33%	**68%**
34PullPOTW	11	4	4.7	33	236	330	18%	**15%**
34HADL00.0	0	----	----	----	----	----	----	**----**
34SFPR21.5	12	54	54	146	389	480	50%	**49%**
Wet Season								
34SFPR24.3	17	3	6	52	427	2500	24%	**53%**
34Para00.1	14	3	3	32	320	930	14%	**37%**
34SFPR-SD320	10	1	0	7	119	390	20%	**0%**
34SFPR-SD290	0	----	----	----	----	----	----	**----**
34SFPRWSU1	11	1	2	36	709	1000	18%	**72%**
34SFPR23.6	15	16	14	79	448	2300	13%	**55%**
34SFPR-SD260	11	7	9	48	261	410	18%	**23%**
34SFPRWSU2	12	1	1	19	507	2200	17%	**61%**
34SFPR-SD180	2	170	----	345	----	700	50%	**84%**
34SFPR-SD170	7	3	3	30	281	250	14%	**29%**
34SFPR-SD140	0	----	----	----	----	----	----	**----**
34SFPR22.9	12	15	13	78	472	2300	17%	**58%**
34SFPR-SD120	9	190	153	1695	18752	20000	89%	**99%**
34Dry00.0	12	46	66	380	2199	7500	83%	**91%**
34SFPR22.8	17	11	19	80	330	930	18%	**39%**
34Miss00.1	12	9	13	84	530	2200	25%	**62%**
34SFPR22.0	15	6	12	63	335	840	13%	**40%**
34PullPOTW	12	1	2	9	47	63	0%	**0%**
34HADL00.0	8	29	33	114	396	340	38%	**50%**
34SFPR21.5	13	12	20	103	545	1300	38%	**63%**

*Cells shaded in these columns are values that exceed Washington State numeric standards.
**Cells shaded in this column are values based on less than 5 samples collected at that station.

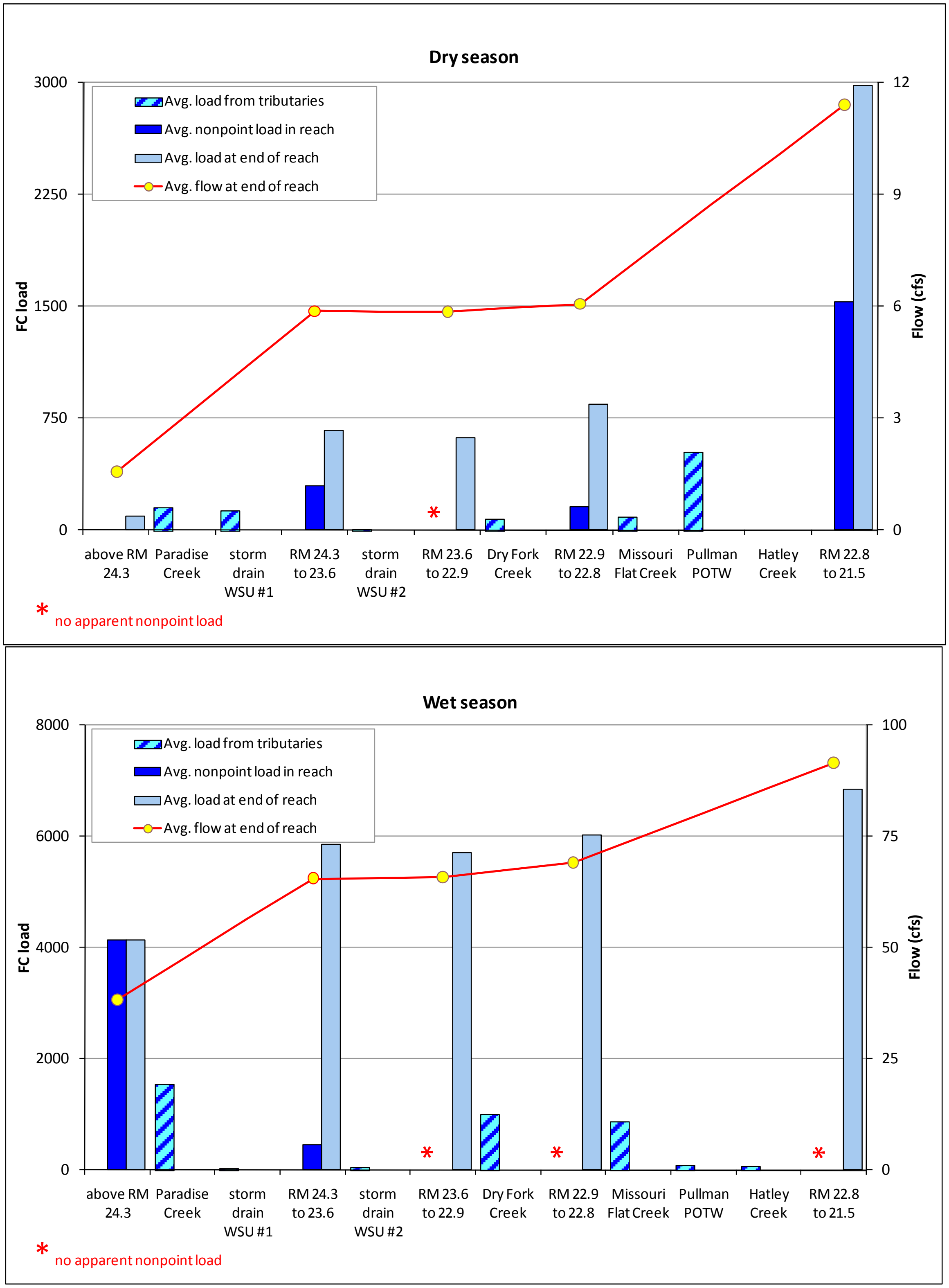


Figure 13. Dry-season and wet-season average fecal coliform (FC) bacteria loads from the 2006-07 TMDL study in the middle SF Palouse River. *Note differences in vertical axes scale between charts. To convert from loading units to number of cfu per day, multiply the number of loading units by the constant, 24,465,067.*

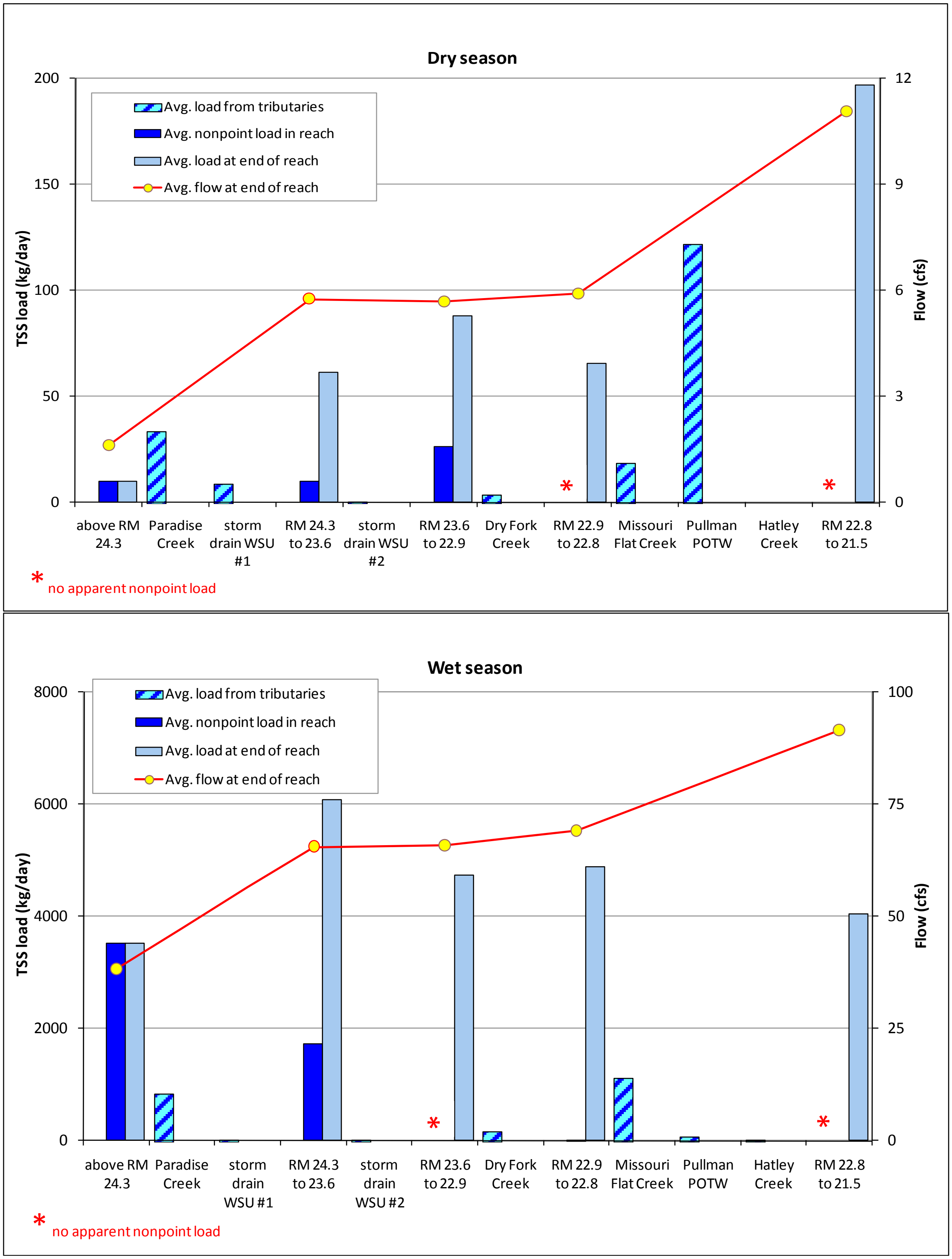


Figure 14. Dry-season and wet-season average total suspended solids (TSS) loads from the 2006-07 TMDL study in the middle SF Palouse River. *Note differences in vertical axes scale between charts.*

Tributary to middle SF Palouse – Paradise Creek

Results and discussion

The Washington State portion of Paradise Creek flows west from the state line near Moscow, Idaho to the city of Pullman where it enters the SF Palouse River. In Idaho, Ecology sampled Paradise Creek at West Perimeter Drive (RM 8.1), at the Moscow WWTP outfall, and at an unidentified pipe discharge just below the outfall (34UnkPara07.5). In Washington, Ecology sampled Paradise Creek in four locations including near the border (RM 6.6) and the mouth (RM 0.1). Additionally, three tributary inputs were sampled: Airport Creek, a WSU stormwater outfall, and an unnamed tributary at RM 6.3.

Table 16 presents the dry- and wet-season summary statistics of FC bacteria counts and the target reductions necessary to meet the water quality standards.

Overall, most sites had too many high FC counts year-round to meet the numeric standards. Exceptions were storm drain WSU3 which met the numeric standards in both seasons, and the Moscow WWTP.

Moscow WWTP met WA state standards during the wet season, but had 1 out of 7 TMDL dry-season samples above 200cfu/100mL. Generally, the Moscow WWTP had low counts, as indicated by the geometric means, and a higher number of samples (e.g. ten or more) may have resulted in a lower 90^{th} percentile count.

Figure 15 shows the average dry- and wet-season FC loads for Paradise Creek. Figure 16 shows the average dry- and wet-season TSS loads for Paradise Creek.

The mass balance showed that the average dry-season FC load in Paradise Creek originated from Idaho. Most of the average load (77%) was from unmeasured sources that occurred between RM 8.1 and the state line station at RM 6.6. Measured sources within this reach included RM 8.1, the Moscow WWTP, and an unidentified pipe discharge just below the WWTP at RM 7.5, but the sum of these measured sources could not account for the average measured load at the state line (RM 6.6).

This situation is similar to the middle SF Palouse reach within Pullman that ends below the Pullman WWTP. The state line station is about one-half mile below the Moscow WWTP, so the potential exists for re-growth of bacteria discharged from the WWTP.

There also appears to be a nonpoint load or re-suspension of sediment above the state line in the dry season (Figure 16).

Further assessment of the reach between RM 8.1 and RM 6.6 (state line) during the dry season is warranted.

In the studied portion of Paradise Creek in Idaho, the wet-season FC load was generally of the same order of magnitude as the dry-season FC load. There was a similar unexplained nonpoint source at the state line; however, it was smaller because the wet-season upstream load in Paradise Creek (above RM 8.1) was tripled compared to dry-season levels.

During the wet season within Washington, there was a large unexplained nonpoint load at RM 1.1 that was not seen in the dry season. The station at RM 1.1 was sampled infrequently during the dry season so it was not assessed for its dry-season FC bacteria load. Further assessment of the reach between RM 3.8 and RM 1.1 during the wet and dry seasons is warranted.

The mouth of Paradise Creek had approximately eight times the FC load in the wet season compared to the dry season, apparently from the upstream loading above RM 1.1.

Airport Creek, the largest tributary to Paradise Creek, consistently had high FC counts exceeding the numeric standards, although it dried up in mid-summer.

An ephemeral unnamed tributary at RM 6.3 (at the eastern end of Airport Rd) met the geometric mean standard during both seasons, but had one high-count result during the wet season. Still, the FC bacteria distribution at the site suggested that it was in compliance with the numeric standards.

The average TSS load from Idaho accounted for 73% of the load in Paradise Creek in the wet season and 87% of the TSS load in the dry season.

Table 16. Dry-season and wet-season summary statistics of bacteria counts and target percent reductions for stations in Paradise Creek.

Station ID	Total # of Samples	Mini-mum	10th percen-tile	Geomean*	90th percen-tile	Maxi-mum	% Samples >200 cfu / 100 mL *	Target % Reduction**
Dry Season								
34Para08.1	11	84	64	508	4038	7500	64%	**95%**
34MoscPOTW	7	3	2.4	29	351	640	14%	**43%**
34UnkPara(07.5)	0	----	----	----	----	----	----	**----**
34Para06.6	13	20	45	324	2321	5700	69%	**91%**
34UnkPara(06.3)	1	3	----	----	----	3	----	**0%**
34Para03.8	11	11	29	194	1276	2800	64%	**84%**
34Air00.0	7	1	4.6	115	2908	1700	43%	**93%**
34Para01.1	6	9	5.6	66	777	1800	17%	**74%**
34ParaWSU3	5	1	0.4	3	29	44	0%	**0%**
34Para00.1	12	4	6.1	55	492	1700	17%	**59%**
Wet Season								
34Para08.1	13	3	20	98	488	445	23%	**59%**
34MoscPOTW	11	1	1	4	14	24	0%	**0%**
34UnkPara(07.5)	8	3	7	90	1164	800	63%	**83%**
34Para06.6	15	24	18	156	1350	4400	27%	**85%**
34UnkPara(06.3)	9	1	0	7	151	640	11%	**0%**
34Para03.8	12	4	4	36	326	460	17%	**39%**
34Air00.0	12	9	9	106	1282	4500	50%	**84%**
34Para01.1	11	6	4	34	324	480	18%	**38%**
34ParaWSU3	11	1	0	4	82	460	9%	**0%**
34Para00.1	14	3	3	32	320	930	14%	**37%**

*Cells shaded in these columns are values that exceed Washington State numeric standards.
**Cells shaded in this column are values based on less than 5 samples collected at that station.

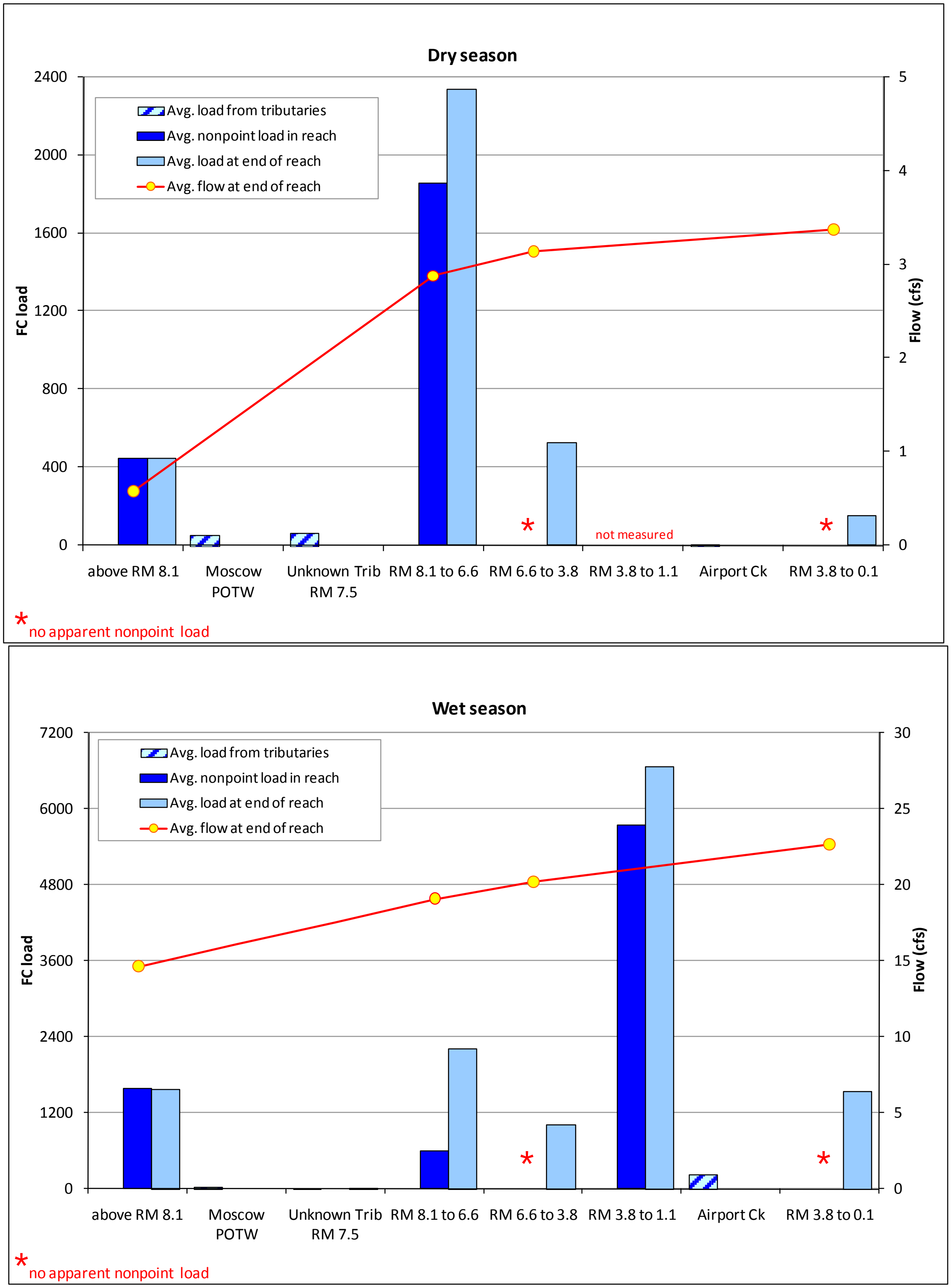


Figure 15. Dry-season and wet-season average fecal coliform (FC) bacteria loads from the 2006-07 TMDL study in Paradise Creek. *Note differences in vertical axes scale between charts. To convert from loading units to number of cfu per day, multiply the number of loading units by the constant, 24,465,067.*

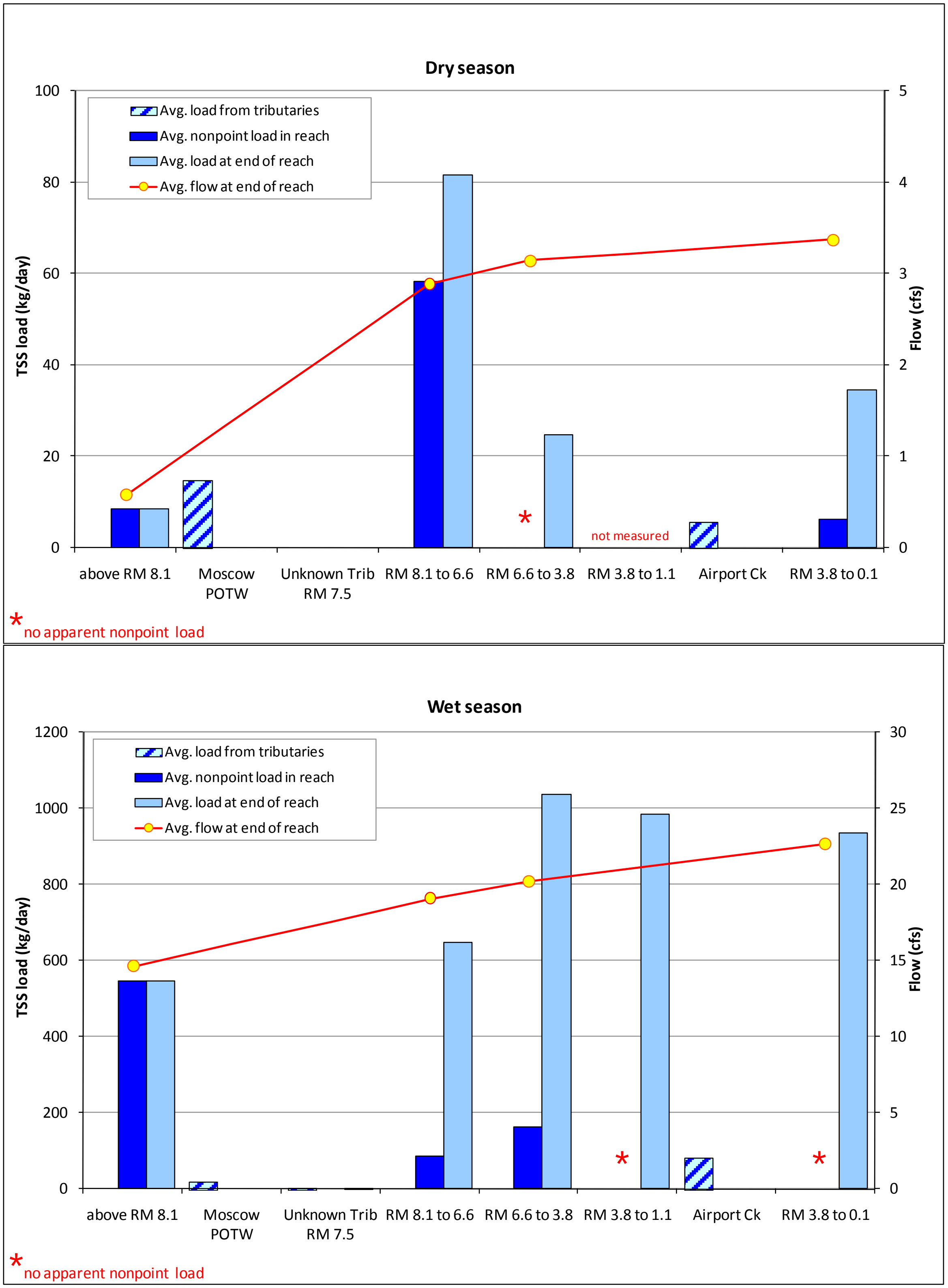


Figure 16. Dry-season and wet-season average total suspended solids (TSS) loads from the 2006-07 TMDL study in Paradise Creek. *Note differences in vertical axes scale between charts.*

Tributary to middle SF Palouse – Dry Fork Creek

Results and discussion

Dry Fork Creek is a small tributary that flows north from Whitman County through the city of Pullman into the SF Palouse River near the city library. Ecology sampled at four sites, starting at the Pullman city limits (RM 2.2) and ending at the mouth (RM 0.0). Within Pullman, much of Dry Fork Creek runs under Grand Avenue in a concrete culvert. Ecology sampled at the beginning of the culvert (RM 0.9) near the post office, and at a break in the culvert at the Texaco station on Grand Avenue (RM 0.4).

Table 17 presents the dry- and wet-season summary statistics of FC bacteria counts and the target reductions necessary to meet the water quality standards. The upper portions of Dry Fork Creek within the city limits (between RM 2.2 and RM 0.9) had fewer violations than the lower portions, with generally decreased FC counts, and therefore lower target reductions. The creek was mostly dry at the city limits (RM 2.2) during the dry season when only two samples were collected, although one sample had a very high bacteria count. Wet-season FC counts at the city limits were below the seasonal geometric mean standard but had too many variably high counts, indicating inconsistent runoff contamination.

The FC bacteria counts were highest within culvert sections under Grand Avenue in the city. During the dry season, the increase in average FC load between RM 0.9 and RM 0.4 (above the Texaco station) accounted for nearly all (98%) of the average load at the mouth (Figure 17). During the wet season, a progressive increase in load was seen within the concrete culvert, combining for a total of 73% of the average load in Dry Fork Creek.

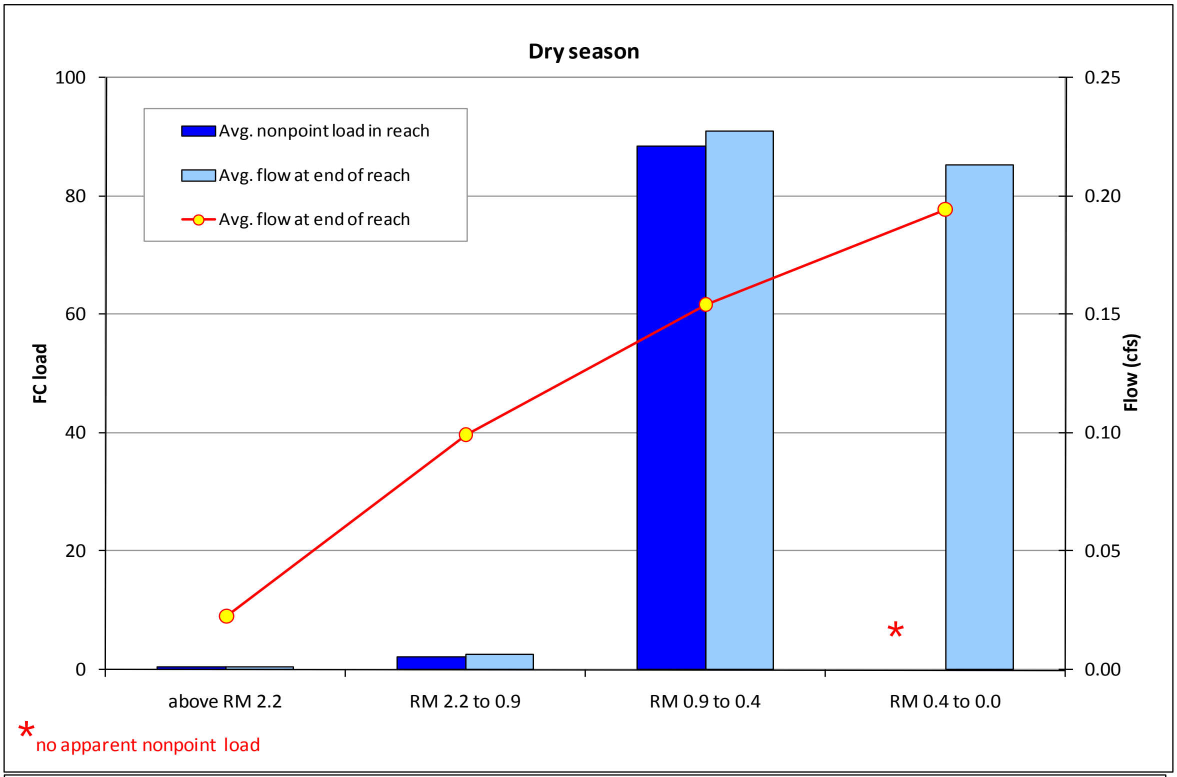
The dry-season TSS loads generally mimicked the dry-season FC loads, with the majority of the load being generated between RM 0.9 and RM 0.4 (Figure 18). However, the dry-season TSS load was a fraction of the wet-season TSS load, most of which was generated outside of the city limits, but with contributions from within the concrete culvert sections too. Pullman has numerous stormwater outfalls that discharge to the concrete culvert portion of Dry Fork Creek.

Table 17. Dry-season and wet-season summary statistics of FC bacteria counts and target percent reductions for stations in Dry Fork Creek.

Station ID	Total # of Samples	Mini-mum	10th percen-tile	Geomean*	90th percen-tile	Maxi-mum	% Samples >200 cfu / 100 mL *	Target % Reduction**
Dry Season								
34Dry02.2	2	17	----	----	----	3800	----	**99%**
34Dry00.9	11	1	1	18	234	300	9%	**14%**
34Dry00.4	11	120	145	370	943	1700	82%	**79%**
34Dry00.0	11	75	118	474	1901	3600	82%	**89%**
Wet Season								
34Dry02.2	9	1	1	23	614	1200	22%	**67%**
34Dry00.9	12	1	1	15	214	700	17%	**7%**
34Dry00.4	12	11	16	112	788	1100	50%	**75%**
34Dry00.0	12	46	66	380	2199	7500	83%	**91%**

*Cells shaded in these columns are values that exceed Washington State numeric standards.

**Cells shaded in this column are values based on less than 5 samples collected at that station.



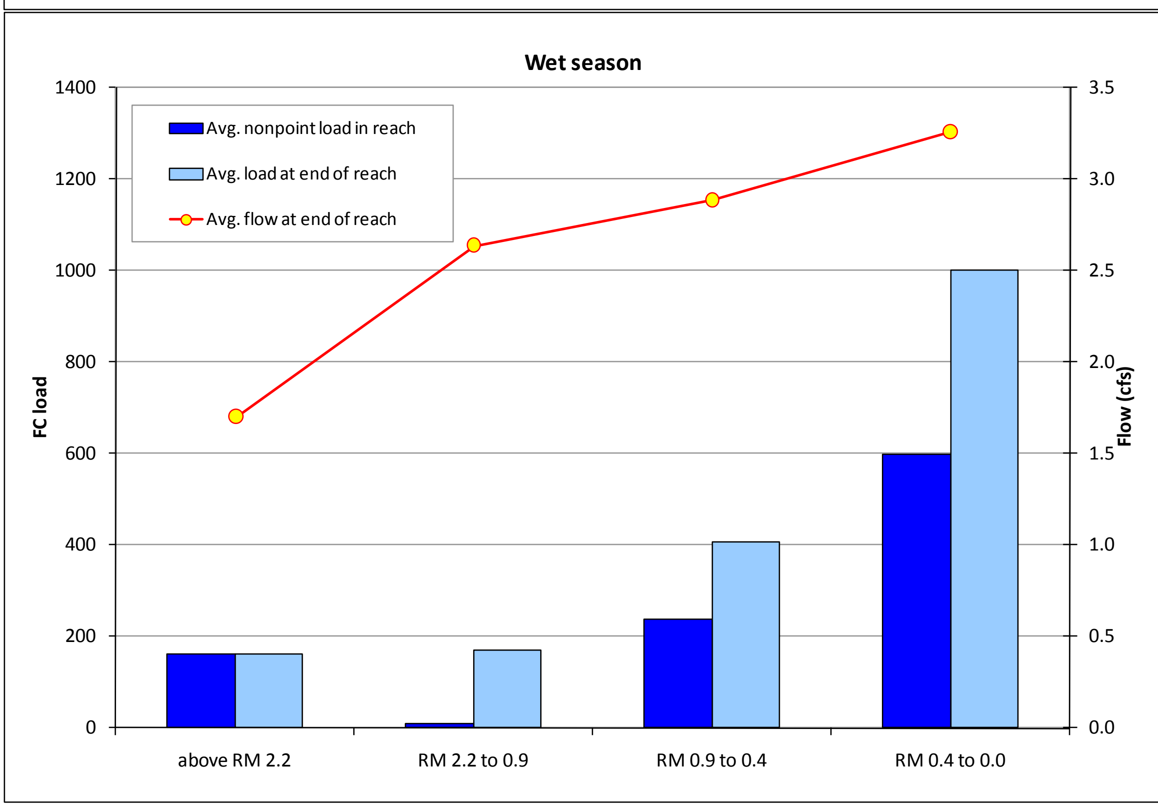
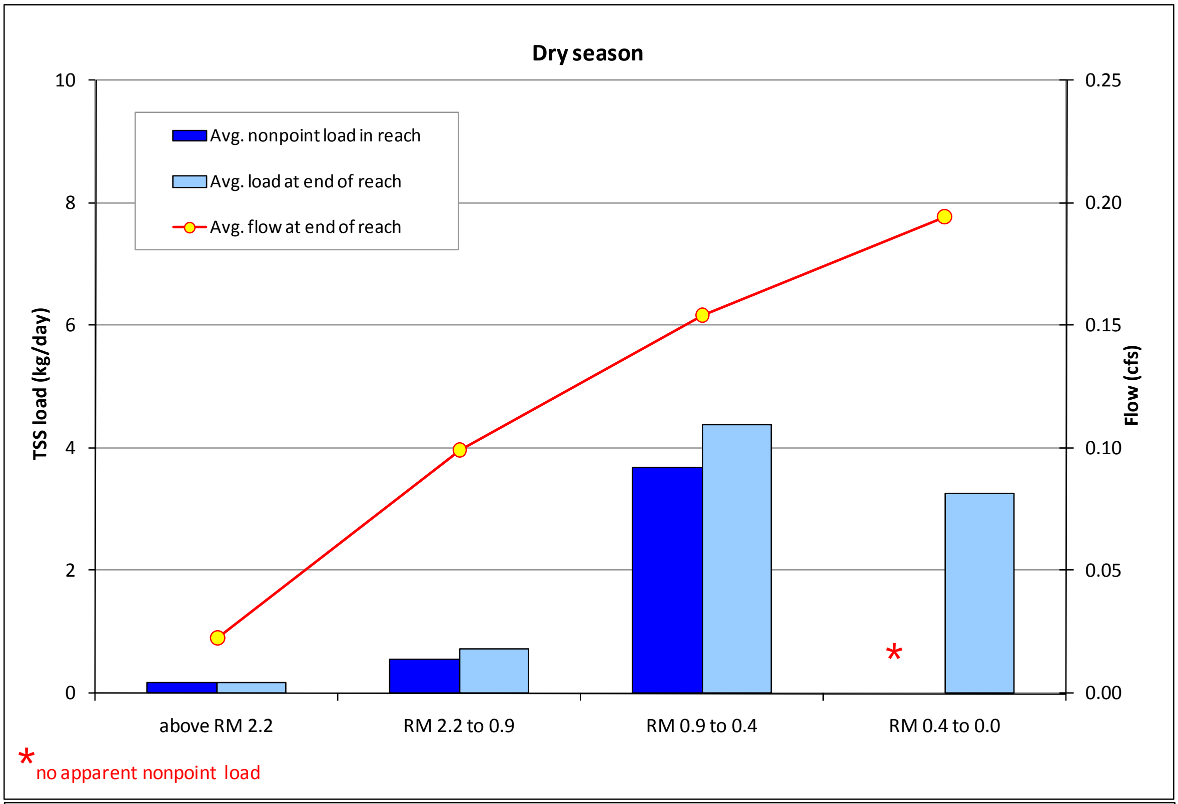


Figure 17. Dry-season and wet-season average fecal coliform (FC) bacteria loads from the 2006-07 TMDL study in Dry Fork Creek. *Note differences in vertical axes scale between charts. To convert from loading units to number of cfu per day, multiply the number of loading units by the constant, 24,465,067.*



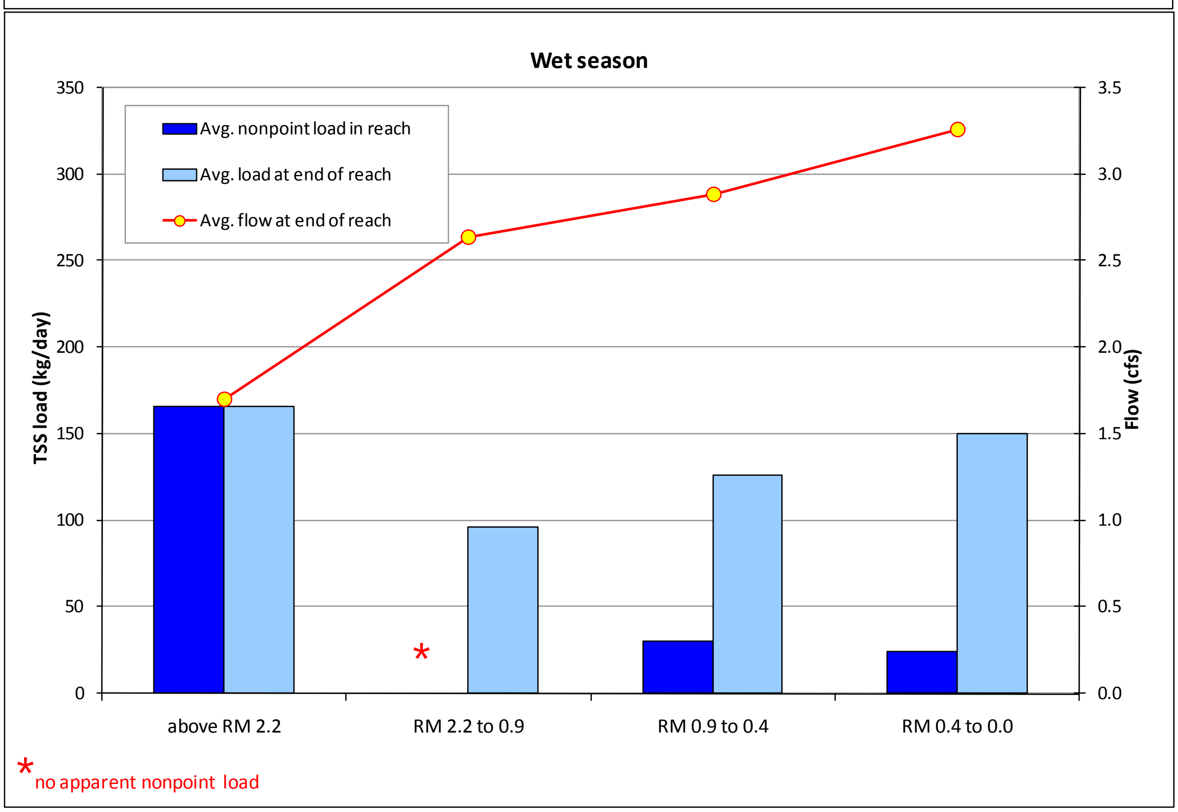


Figure 18. Dry-season and wet-season average total suspended solids (TSS) loads from the 2006-07 TMDL study in Dry Fork Creek. *Note differences in vertical axes scale between charts.*

Tributary to middle SF Palouse – Missouri Flat Creek

Results and discussion

Missouri Flat Creek extends from Idaho to the confluence with the SF Palouse River within the Pullman city limits. Outside of the city limits, the Missouri Flat Creek watershed is used primarily for dryland agriculture in Whitman County, WA and Latah County, ID. Ecology sampled at five Missouri Flat Creek sites: one near the state line (RM 7.5), one outside of Pullman (RM 3.9), one near the city limits at Kitzmiller Rd (RM 1.7), and two inside the city limits (RM 0.8 and 0.1). Ecology also sampled four storm-drain outfalls within the city limits (SD 60, 120, 200, and 210).

Table 18 presents the dry- and wet-season summary statistics of FC bacteria counts and the target reductions necessary to meet the water quality standards. Significant reductions are required within the city limits (from RM 1.7 downstream) during both dry- and wet-seasons. There was minimal or no flow above the city limits during the dry season.

Figure 19 shows the average dry- and wet-season FC loads for Missouri Flat Creek. During the dry season, most of the load originated within the city limits. The wet season data indicated that almost one-third of the wet-season FC loads originated in Idaho, with another 11% contributed from Whitman County, outside of the Pullman city limits.

Storm drain 60 (at the end of Larry St.) discharged throughout the wet season, but only during half of the dry season, accounting for a very small percentage of the FC load in Missouri Flat Creek throughout the year. However, while the FC counts were low in the winter, the summer FC counts were high, requiring a large reduction to achieve water quality standards. Presumably, a storm drain should not have summer baseflow, unless it is draining a historical drainage, has groundwater infiltration, or has an illegal connection of some kind.

Storm drain 120 (at Jack in the Box) had moderate baseflow year-round, with consistently high FC bacteria counts. This outfall accounted for 90% of the dry-season load and 21% of the wet-season load to Missouri Flat Creek. The average FC load discharged was about the same for both seasons, indicating a constant or persistent source of baseflow and contamination.

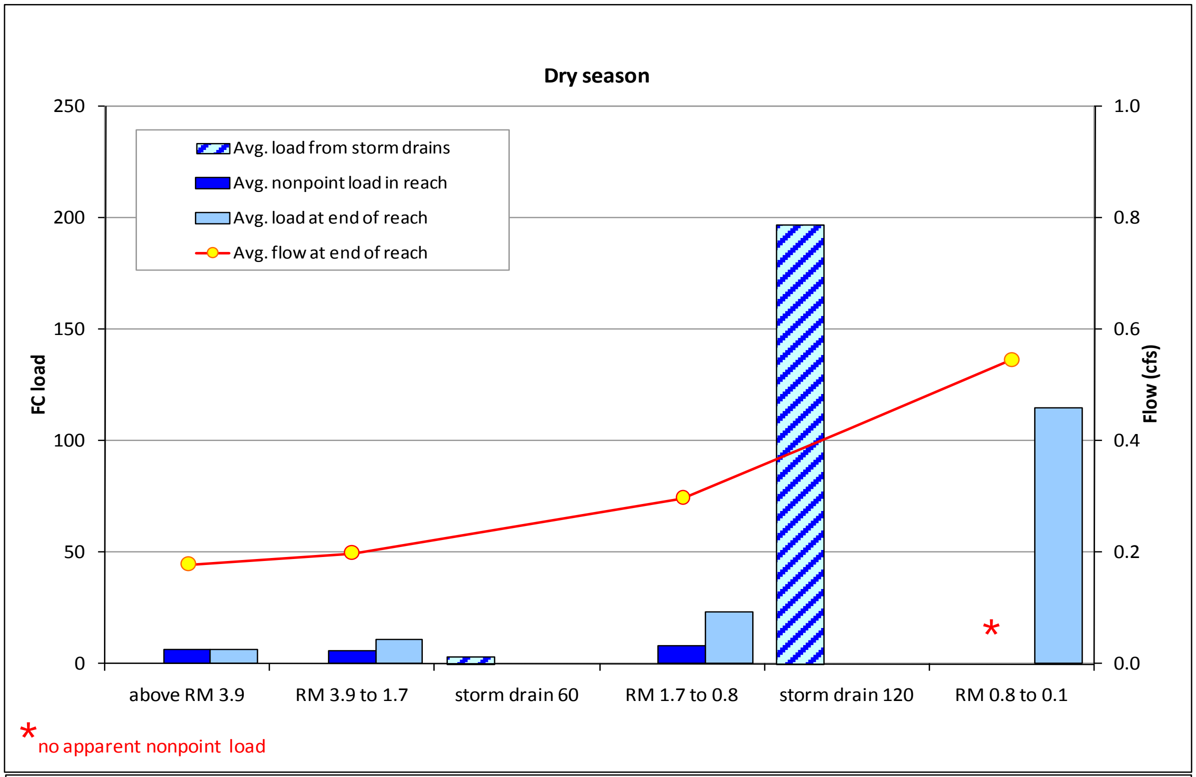
Storm drain 200 was mostly dry but was sampled once during a wet-season sampling. Storm drain 210 was dry during the dry season but had a very small discharge (sometimes just a drip) during the wet season. Concentrations were almost always high in SD 210.

TSS loadings in the Missouri Flat Creek watershed followed a similar pattern to the FC bacteria loading pattern, with the majority of the dry-season TSS loading coming from SD 120, and the majority of the wet-season TSS loading coming from upstream sources, primarily from across the state line (Figure 20). A positive relationship between wet-season TSS concentrations and wet-season FC concentrations from upstream of the city limits is shown in Figure 21. It is not significant though because there are too few data points to resolve the skewed distribution and spurious high r^2.

Table 18. Dry-season and wet-season summary statistics of FC bacteria counts and target percent reductions for stations in Missouri Flat Creek.

Station ID	Total # of Samples	Mini-mum	10th percen-tile	Geomean*	90th percen-tile	Maxi-mum	% Samples >200 cfu / 100 mL *	Target % Reduction**
Dry Season								
34Miss07.5	1	6	----	6	----	6	0%	**0%**
34Miss03.9	1	9	----	9	----	9	0%	**0%**
34Miss01.7	7	1	1	45	3557	2800	43%	**94%**
34MissSD60	6	27	37	373	3810	4000	67%	**95%**
34Miss00.8	9	3	14	116	987	690	33%	**80%**
34MissSD120	11	130	229	769	2587	3450	91%	**92%**
34MissSD200	0	----	----	----	----	----	----	**----**
34MissSD210	1	2000	----	----	----	2000	----	**95%**
34Miss00.1	11	48	54	237	1034	1200	55%	**81%**
Wet Season								
34Miss07.5	8	1	2	26	455	650	25%	**56%**
34Miss03.9	11	1	1	11	194	1800	9%	**0%**
34Miss01.7	12	1	1	27	499	2800	17%	**60%**
34MissSD60	11	1	1	14	160	215	9%	**0%**
34Miss00.8	12	2	2	27	325	1800	17%	**38%**
34MissSD120	11	29	111	536	2594	2800	91%	**92%**
34MissSD200	1	410	----	----	----	410	----	**76%**
34MissSD210	6	69	65	275	1152	1700	67%	**83%**
34Miss00.1	12	9	13	84	530	2200	25%	**62%**

*Cells shaded in these columns are values that exceed Washington State numeric standards.
**Cells shaded in this column are values based on less than 5 samples collected at that station.



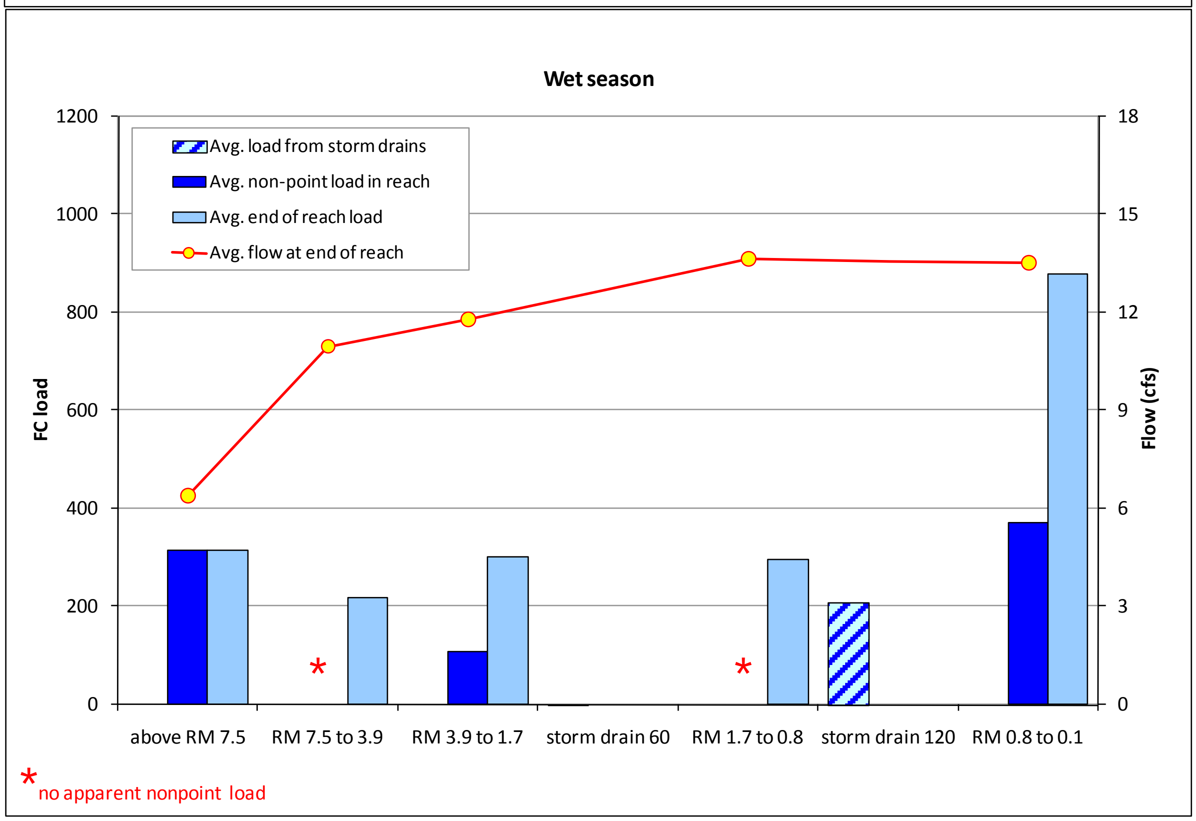
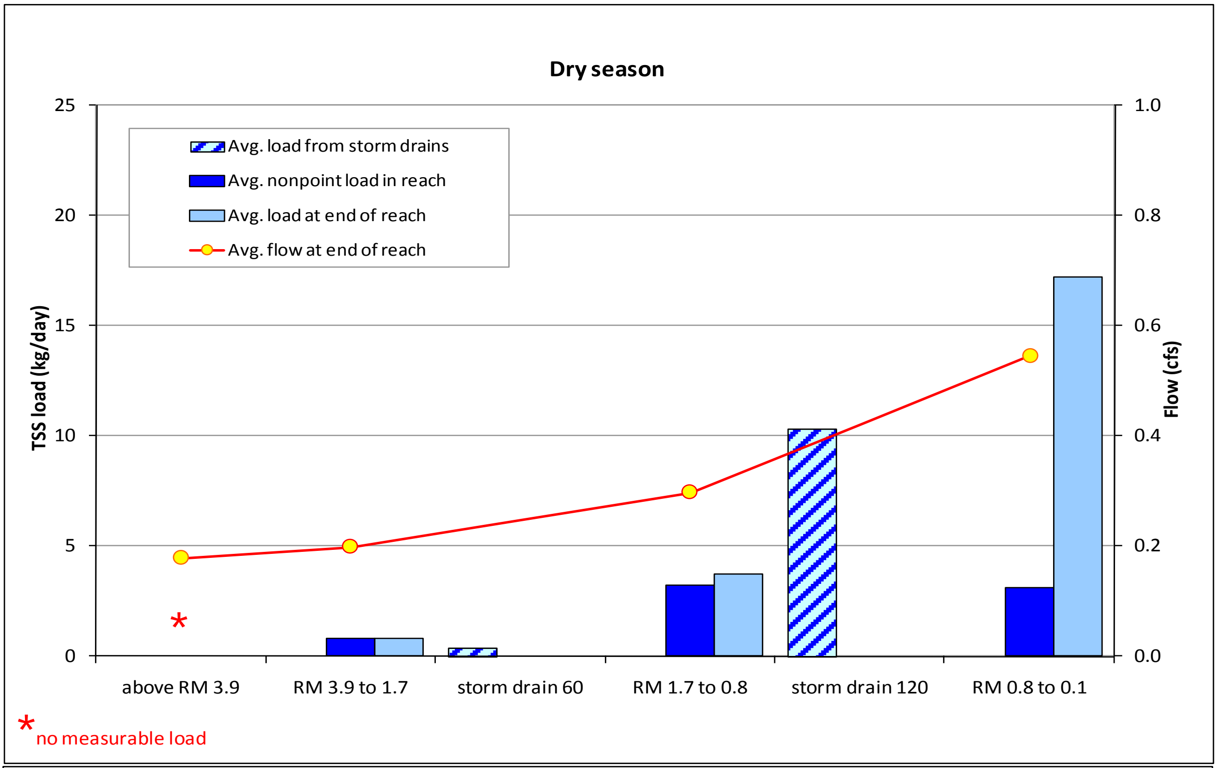


Figure 19. Average dry-season and wet-season fecal coliform (FC) bacteria loads from the 2006-07 TMDL study in Missouri Flat Creek. *Note differences in vertical axes scale between charts. To convert from loading units to number of cfu per day, multiply the number of loading units by the constant, 24,465,067.*



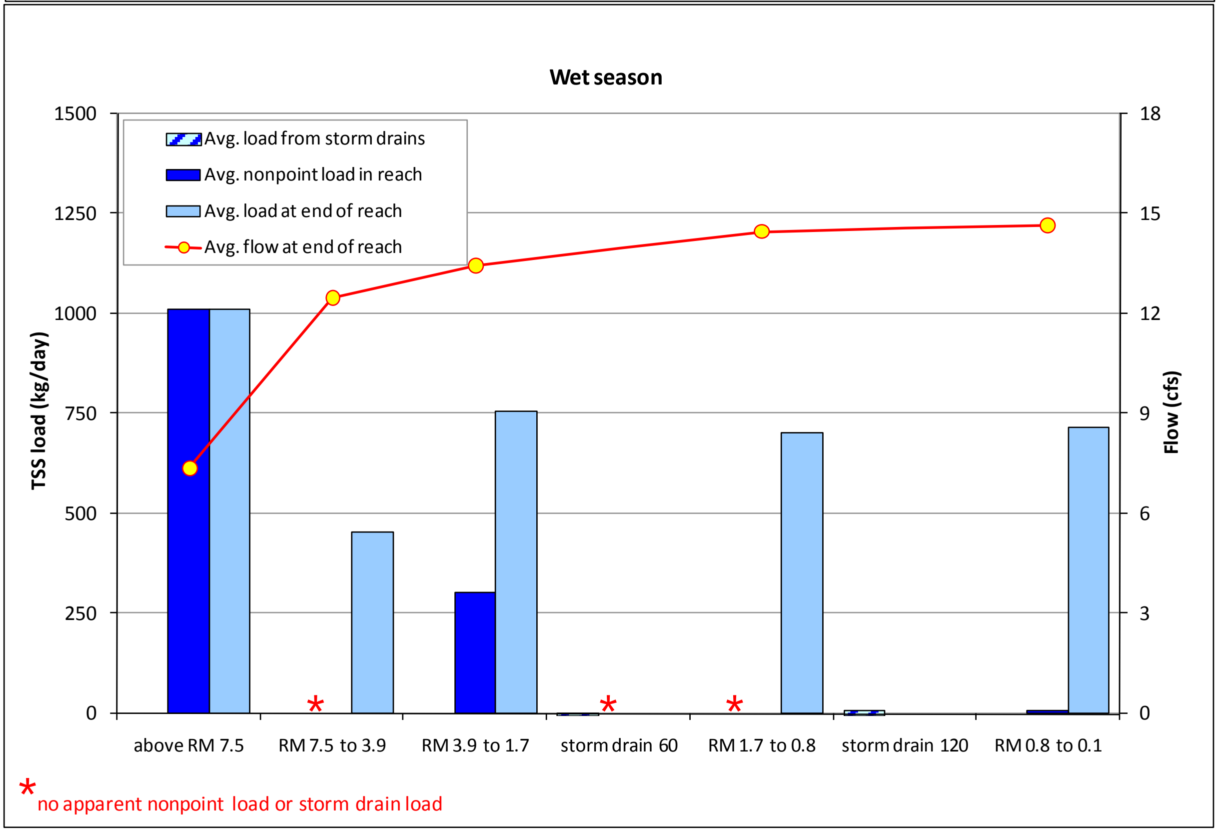


Figure 20. Dry-season and wet-season average total suspended (TSS) loads from the 2006-07 TMDL study in Missouri Flat Creek. *Note differences in vertical axes scale between charts*.

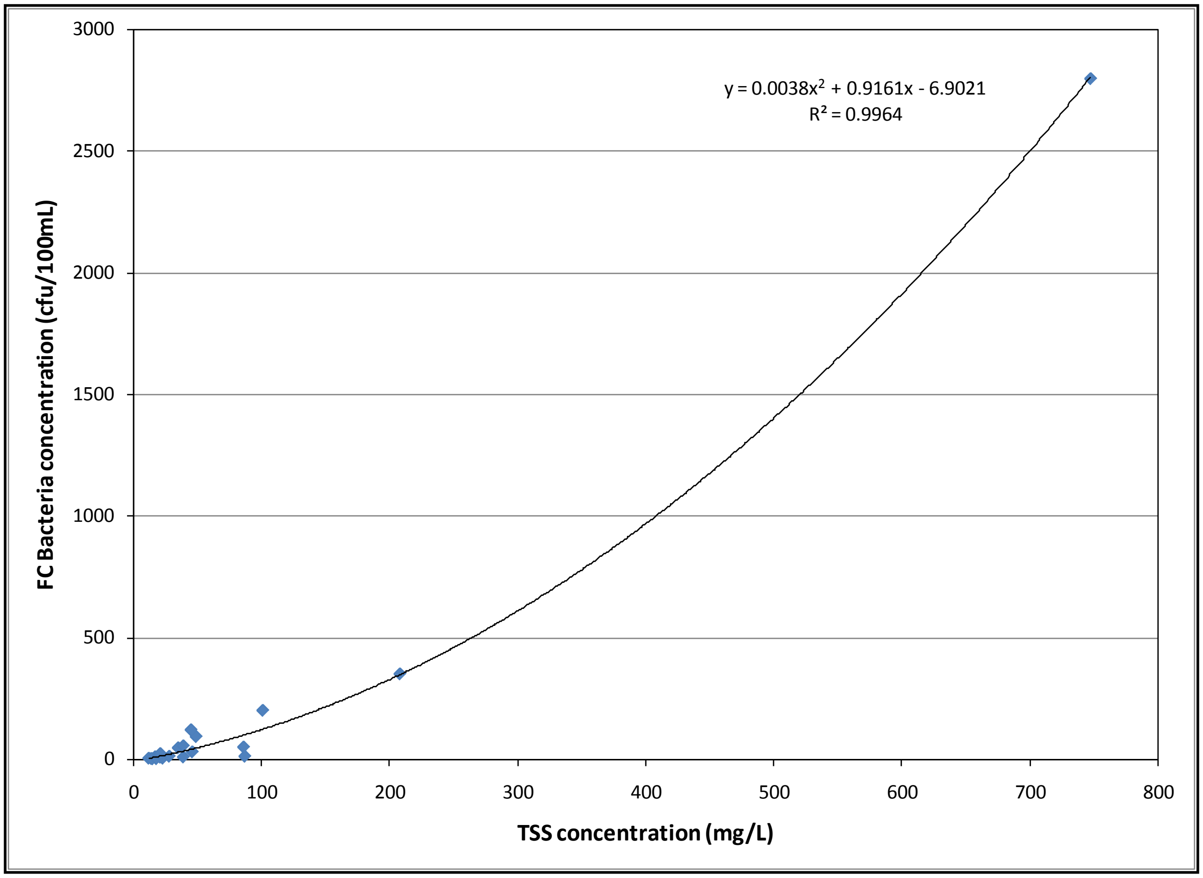


Figure 21. Relationship between total suspended solids (TSS) and fecal coliform (FC) bacteria concentrations in upper Missouri Flat Creek (upstream of Pullman city limits).

Lower SF Palouse River

Results and discussion

The lower portion of the SF Palouse River extends from just downstream of the Pullman city limits (off of Hayward Road at RM 21.5) to the confluence with the mainstem Palouse River at Colfax. This reach also contains the confluences of Fourmile Creek, Parvin Creek, and Spring Flat Creek. Besides the mouths of the tributaries, Ecology sampled eight lower SF Palouse sites, the Albion WWTP outfall (wet season only), and one unnamed tributary at RM 17.3. Except for the cities of Albion and Colfax, the rest of the lower watershed is mostly dryland agricultural lands within Whitman County.

Table 19 presents the dry- and wet-season summary statistics of FC bacteria counts and the target reductions necessary to meet the water quality standards. In comparison to the upriver portions of the SF Palouse, most of the lower portion of the SF Palouse had fewer violations, generally decreased FC counts, and therefore lower target reductions. However, the FC counts within the city of Colfax were an exception and were very high during both dry and wet seasons.

A review of the loading analysis for the 2006 dry season (Figure 22) showed most of the FC bacteria load in the lower SF Palouse came from upstream. The decline of average FC loads downstream of Pullman appeared to follow a first-order decay pattern. There was no apparent increase in nonpoint loading until between RM 9.2 (Parvin Rd.) and RM 5.4 (just upstream of the grain elevator that burned in 2006). Overall, the indication is that if upstream loads could be reduced, the lower SF Palouse would be nearer to compliance during the dry season, except for within Colfax.

The 2006-07 wet-season FC loads followed a similar pattern of declining loads moving downstream from Pullman (Figure 22), except there was additional nonpoint loading between RM 15.8 (Albion) and RM 11.5 (Shawnee Rd). The average wet-season load was two to three times higher than the dry season in most of the river. However, the increased FC load within Colfax was exceptionally high and nearly equal in both the wet and dry seasons.

The unnamed tributary at RM 17.3 is the drainage that runs down along the Pullman-Albion Road as it descends to the river. The tributary was sampled near the mouth. The tributary was dry most of the dry season, but was sampled during the entire wet season. The concentrations in this tributary were always in compliance with the water quality standards.

Likewise, the mouth of Parvin Creek was frequently dry in the dry season, and when sampled in the wet season had FC counts well below the numeric standards. Albion POTW only discharged during the winter months (February to April) and was sampled only four times, always showing almost complete disinfection of the discharge water.

Spring Flat Creek runs along Hwy 195 for most of the distance between Pullman and Colfax, sometimes acting as the highway drainage ditch along the way. There is no riparian area for the creek until approaching Colfax; in fact, farmers often plow right to the edge of the creek. There is some grazing along the creek near Colfax. The creek was sampled just at the Colfax city limit off of Hwy 195. Dry-season flow was minimal and when sampled had concentrations below numeric standards. Wet-season concentrations met the geometric mean standard but high variability was a problem, with 25% of the samples greater than 200 cfu/100 mL.

The portion of Spring Flat Creek within the city limits of Colfax was not assessed and may contribute to the large increase in FC load observed within the city.

Fourmile Creek is discussed below as a separate tributary.

The average dry-season TSS loads in the lower SF Palouse followed a similar pattern to the average FC bacteria loads (Figure 23). The average dry-season TSS load declined out of Pullman, apparently settling out of the water column to the sediments. During the wet season, there was an average increase in TSS loading from these depositional reaches below Pullman; however, the increase was of at least an order of magnitude higher than the dry-season deposition. This may indicate additional erosion of the streambank or runoff of eroded soils from the adjacent slopes. The area below Pullman was one of the few areas with noticeable domestic animal access within the river riparian areas.

Table 19. Dry-season and wet-season summary statistics of FC bacteria counts and target percent reductions for stations in the lower SF Palouse River.

Station ID	Total # of Samples	Mini-mum	10th percen-tile	Geomean*	90th percen-tile	Maxi-mum	% Samples >200 cfu / 100 mL *	Target % Reduction**
Dry Season								
34SFPR21.5	12	54	54	146	389	480	50%	**49%**
34SFPR20.1	1	200	----	200	----	200	----	**50%**
34SFPR19.2	7	6	11	71	459	460	29%	**56%**
34UnkSFPR(17.3)	3	4	----	11	----	54	----	**0%**
34SFPR15.8	11	13	20	78	299	345	18%	**33%**
34AlbPOTW	0	----	----	----	----	----	----	**----**
34SFPR11.5	5	4	7.5	54	388	220	20%	**48%**
34Four00.3	6	5	4.1	38	351	430	17%	**43%**
34Parv00.1	3	1	0.8	2	4.9	4	----	**0%**
34SFPR09.2	11	6	5.5	20	73	100	0%	**0%**
34SFPR05.4	5	11	8.6	40	182	200	20%	**0%**
34SFPR01.2	12	7	5.6	26	121	200	8%	**0%**
34Spri00.5	3	41	32	52	84	80	----	**0%**
34SFPR00.1	11	19	85	630	4661	2650	82%	**96%**
Wet Season								
34SFPR21.5	13	12	20	103	545	1300	38%	**63%**
34SFPR20.1	0	----	----	----	----	----	----	**----**
34SFPR19.2	11	13	9	64	436	3900	9%	**54%**
34UnkSFPR(17.3)	11	1	1	9	65	200	9%	**0%**
34SFPR15.8	12	4	4	34	306	3200	8%	**35%**
34AlbPOTW	4	1	----	2	----	3	0%	**0%**
34SFPR11.5	11	7	4	50	563	7000	9%	**64%**
34Four00.3	12	2	1	17	209	1400	8%	**4%**
34Parv00.1	11	2	2	9	39	54	0%	**0%**
34SFPR09.2	12	4	3	35	441	9000	8%	**55%**
34SFPR05.4	10	4	4	20	93	260	10%	**0%**
34SFPR01.2	12	3	3	18	120	170	0%	**0%**
34Spri00.5	12	9	5	57	592	2000	25%	**66%**
34SFPR00.1	12	9	6	80	1155	3600	25%	**83%**

*Cells shaded in these columns are values that exceed Washington State numeric standards.

**Cells shaded in this column are values based on less than 5 samples collected at that station.

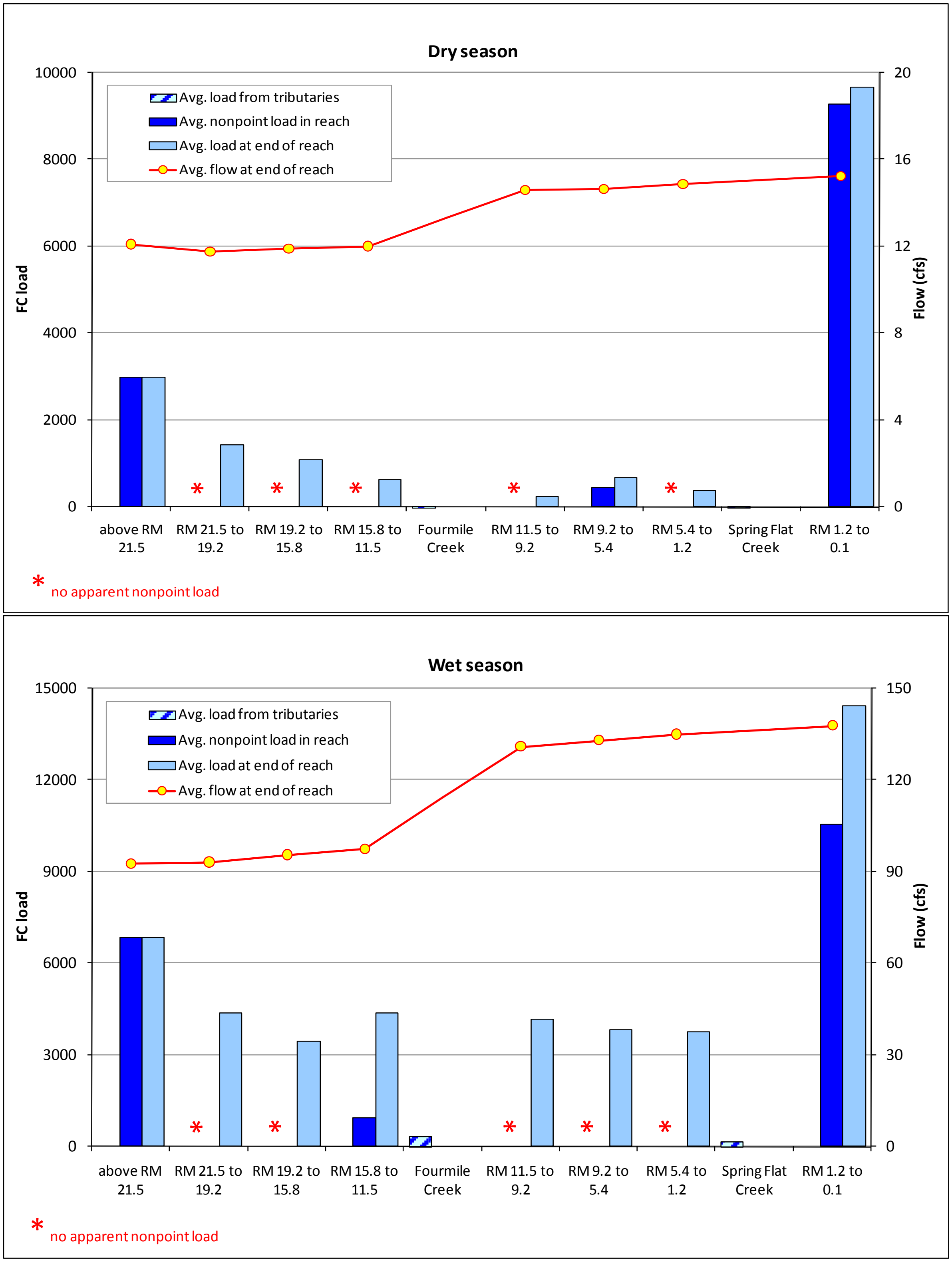


Figure 22. Dry-season and wet-season average fecal coliform (FC) bacteria loads from the 2006-07 TMDL study in the lower SF Palouse River. *Note differences in vertical axes scale between charts. To convert from loading units to number of cfu per day, multiply the number of loading units by the constant, 24,465,067.*

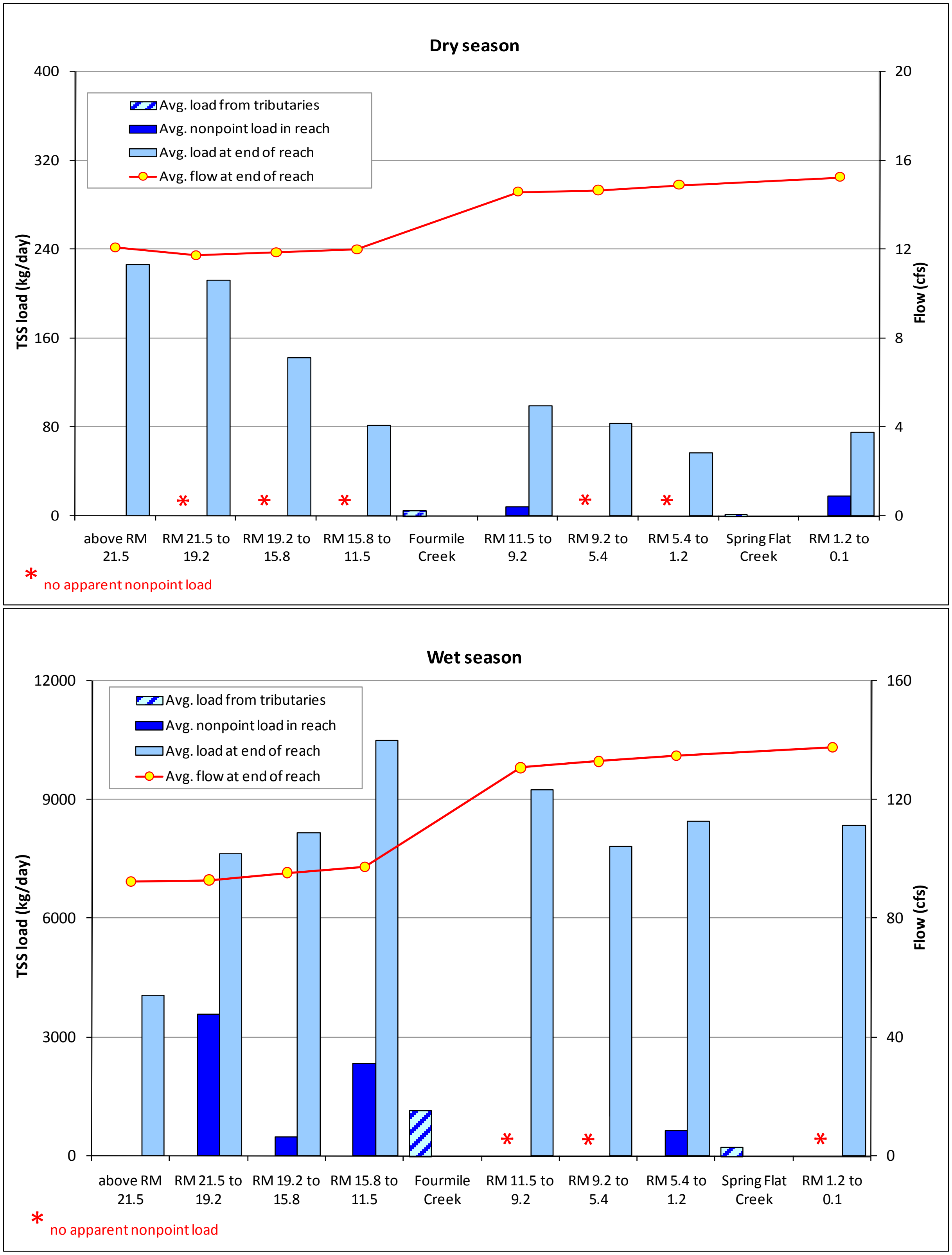


Figure 23. Dry-season and wet-season average total suspended solids (TSS) loads from the 2006-07 TMDL study in the lower SF Palouse River. *Note differences in vertical axes scale between charts.*

Tributary to lower SF Palouse – Fourmile Creek

Results and discussion

Fourmile Creek extends from across the state line in Idaho to the confluence with the SF Palouse River just below the Shawnee Road bridge near RM 11.0. The Fourmile Creek watershed accounts for nearly 35% of the area of the SF Palouse watershed. Most of the creek watershed is used for dryland agriculture in Whitman County, WA and Latah County, ID. Ecology did limited sampling in the Fourmile Creek watershed to screen for potential bacterial contamination. The Rose Creek junction was the furthest upstream sampling point. Ecology sampled the mouth of Rose Creek and Fourmile Creek just above the confluence of Rose Creek (RM 3.3), and near the mouth (RM 0.3).

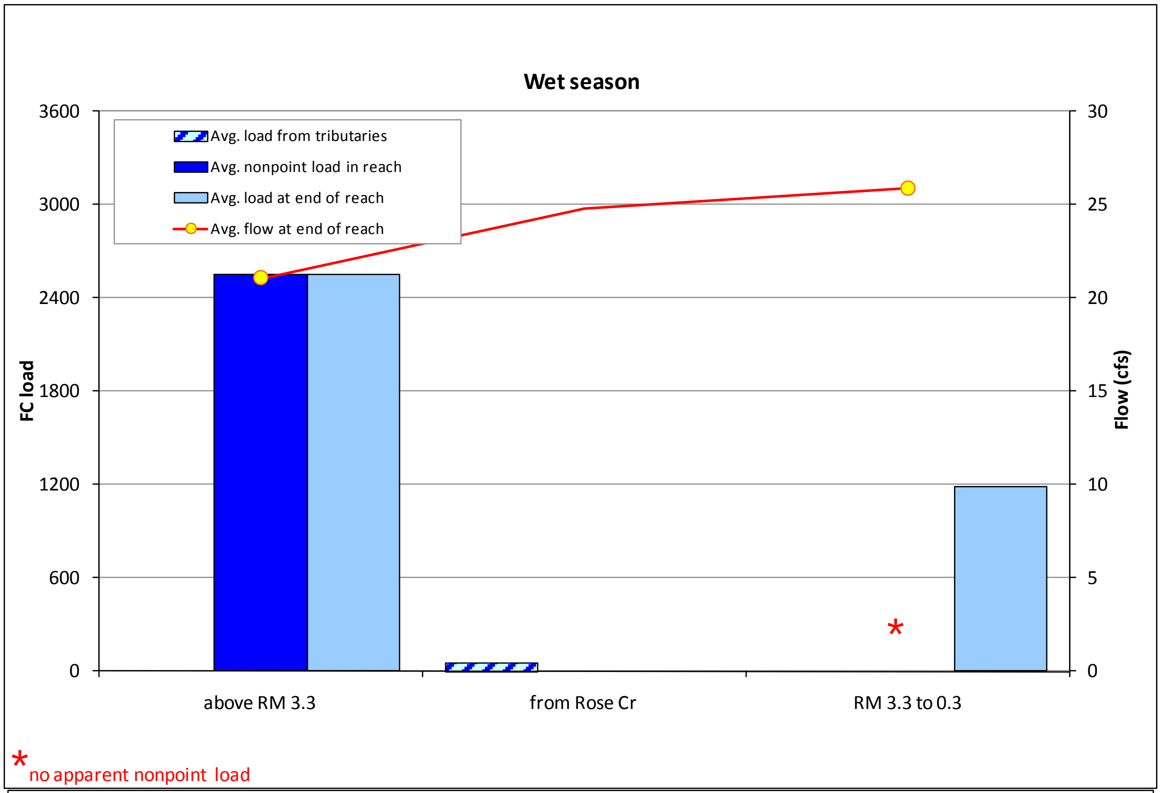
Table 20 presents the dry- and wet-season summary statistics of FC bacteria counts and the target reductions necessary to meet the water quality standards. The mouth of Rose Creek was in compliance during both the dry and wet seasons. There was very little flow in the dry season so only one sample was taken in Rose Creek, and a few samples were taken in Fourmile Creek. When flowing water was present, FC counts were highest at RM 3.3, though there were some high counts at the mouth of Fourmile Creek too. The wet-season FC counts indicated that RM 3.3 had greater variance with a higher 90th percentile concentration.

Table 20. Dry-season and wet-season summary statistics of FC bacteria counts and target percent reductions for stations in Fourmile Creek.

Station ID	Total # of Samples	Mini-mum	10th percen-tile	Geomean*	90th percen-tile	Maxi-mum	% Samples >200 cfu / 100 mL *	Target % Reduction**
Dry Season								
34Rose00.1	1	3	----	----	----	3	----	**0%**
34Four03.3	4	11	----	101	----	2400	25%	**91%**
34Four00.3	6	5	4	38	351	430	17%	**43%**
Wet Season								
34Rose00.1	10	2	2	12	62	95	0%	**0%**
34Four03.3	11	4	2	30	592	2100	18%	**66%**
34Four00.3	12	2	1	17	209	1400	8%	**4%**

*Cells shaded in these columns are values that exceed Washington State numeric standards.
**Cells shaded in this column are values based on less than 5 samples collected at that station.

Figure 24 shows the average wet-season FC bacteria and TSS loads for the Fourmile Creek sampling stations. The analysis indicates that the majority of the loading is from the upper watershed of Fourmile Creek. There was not enough data collected to establish a relationship between TSS and FC bacteria concentrations; however, controlling soil erosion and sediment transport would likely reduce FC concentrations. Branches of upper Fourmile Creek cross into Idaho in at least three areas. Ecology did not sample near the Idaho border in the Fourmile Creek watershed so contributions from Idaho remain unknown. Further study of the upper watershed (above Rose Creek) is warranted.



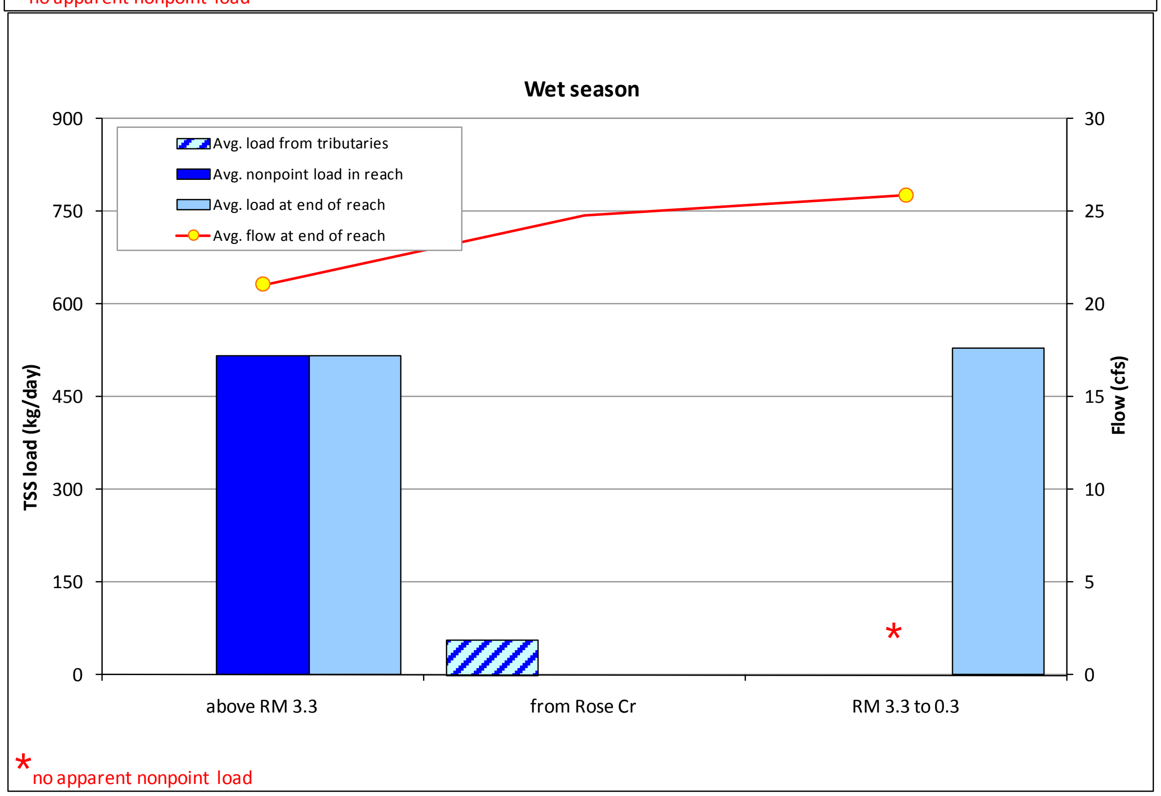


Figure 24. Average wet-season fecal coliform (FC) bacteria and total suspended solids (TSS) loads from the 2006-07 TMDL study in the Fourmile Creek watershed. *Note differences in vertical axes scale between charts. To convert from loading units to number of cfu per day, multiply the number of loading units by the constant, 24,465,067.*

Phase II stormwater evaluation for Pullman and WSU

FC bacteria loads in stormwater are generated from a variety of sources. Elevated FC values in stormwater runoff from developed land, including highways, are well established (Pitt et al., 2004). In the past few years, stormwater-generated FC pollution has come under scrutiny by federal and state regulating authorities. Certain jurisdictions are now responsible for the quality and quantity of stormwater discharged by their systems under the federal Clean Water Act.

Ecology currently has a National Pollutant Discharge Elimination System (NPDES) Eastern Washington Phase II municipal stormwater permit for entities with populations greater than 10,000. Recently, the city of Pullman and the Washington State University (WSU) campus were required to obtain the stormwater permit for Phase II municipal separate stormwater sewer systems. The Washington State Department of Transportation (WSDOT) also has statewide responsibility for all highway runoff under the Phase II permit process. Under the permits, the jurisdictions are required to evaluate their stormwater systems, use best management practices, and reduce FC bacteria loads.

In 2002, EPA directed all TMDLs in jurisdictions with NPDES permits for stormwater systems to include the pollutant loads from those systems as wasteload allocations (Wayland and Hanlon, 2002). Stormwater wasteload allocations should be expressed in numeric form. However, rough estimates are acceptable when data are limited. In addition, where multiple outfall points are within a NPDES-regulated area, a single categorical wasteload allocation can be assigned when there is insufficient data to assign individual wasteload allocations.

In this report, stormwater was generally assessed using collected data. Some data were collected during this TMDL study to specifically characterize the stormwater from the city of Pullman and WSU stormwater systems. Also, Ecology sampled storm events prior to the TMDL as part of a pilot study of pesticides and PCBs in stormwater (Lubliner et al, 2006). Some FC data were collected during the pilot study too. Stormwater data from the WSDOT highways through Pullman were not available for evaluation.

The city of Pullman has an extensive stormwater collection system throughout the city limits. All water collected in stormwater sewers is routed to outfalls that eventually discharge to the SF Palouse River. Maps obtained from the city show 38 outfalls that discharge directly to the SF Palouse River, 26 outfalls that discharge to Dry Fork Creek, and 21 outfalls that discharge to Missouri Flat Creek.

WSU routes most of its stormwater collection system to five outfalls: two discharge directly to the SF Palouse River (34SFPRWSU1 and 34SFPRWSU2), one discharges to Paradise Creek (34PARAWSU3), one discharges to Airport Road Creek, and one discharges from a city of Pullman outfall on Missouri Flat Creek (34MissSD120). A small water body on the WSU campus, located off Merman Road behind the Chief Joseph Apartments, discharges to two catch basins which eventually discharge to MissSD120.

Of about 90 outfalls, Ecology monitored 14 stormwater outfalls at end-of-pipe. Ecology chose the outfalls that had the potential for the most flow, based on either sizes of collection area or pipes. Of the 14, most of the outfalls discharged through the wet season, even when there was no storm event. Some of the outfalls had baseflow discharge year-round. All 14 outfalls discharged during storm events.

Table 21 summarizes the minimum, maximum, and geometric mean of the FC counts at the 14 outfalls for the storm events, wet season, and dry season. Storm event FC concentrations were greater than dry- or wet-season concentrations.

Table 21. Summary of FC bacteria concentrations from 14 stormwater outfalls in Pullman.

	Storm Events				Wet Season				Dry Season			
Stormwater outfall ID	n	Minimum	Maximum	Geometric mean	n	Minimum	Maximum	Geometric mean	n	Minimum	Maximum	Geometric mean
34MissSD60	2	1100	8400	3040	11	1	215	14	6	27	4000	373
34MissSD120	8	190	3000	952	11	29	2800	536	11	130	3450	769
34MissSD200	2	--	1700	--	1	410	410	----	0	----	----	----
34MissSD210	2	800	3000	1549	6	69	1700	275	1	2000	2000	----
34ParaWSU3	2	5	8	6	11	1	460	4	5	1	44	3
34SFPR-SD120	2	1200	2200	1625	9	190	20000	1695	2	27	280	87
34SFPR-SD140	2	2500	4000	3162	0	----	----	----	0	----	----	----
34SFPR-SD170	2	240	520	353	7	3	250	30	1	48	48	48
34SFPR-SD180	2	3100	4400	3693	2	170	700	345	1	150	150	150
34SFPR-SD260	2	1100	1100	1100	11	7	410	48	6	9	4200	141
34SFPR-SD320	2	490	1300	798	10	1	390	7	3	1	12	3
34SFPR-SD360	2	760	1700	1137	11	1	100	5	6	1	38	11
34SFPRWSU1	8	315	4900	1421	11	1	1000	36	11	1	2200	74
34SFPRWSU2	8	39	2650	615	12	1	2200	19	11	1	700	39

Additionally, Ecology sampled Dry Fork Creek, Missouri Flat Creek, and Airport Creek - all of which convey routed stormwater to the SF Palouse River.

A storm event was defined in the Quality Assurance Project Plan as a minimum of 0.1 inches of rainfall in a 24-hour period preceded by no more than a trace of rainfall in the previous 24 hours. These parameters are difficult to predict in advance, and storm-event chasing with a Spokane-based field crew was difficult. Ecology planned on sampling several stormwater events for the TMDL study; however, we were only successful in sampling one event on May 2, 2007.

The earlier pilot study by Lubliner et al. (2006) was limited to sampling only three storm events at three stormwater outfalls in the city of Pullman. The three outfalls were:

- Stadium Way (TMDL station 34MissSD120) – at the Jack-in-the-Box near Stadium Way and Grand.
- College Street (TMDL station 34SFPRWSU2) – at the end of College Street near the skateboard park.
- Benewah Street (TMDL station 34SFPRWSU1) – near Benewah Street next to the pedestrian bridge.

Including the three pilot-study storm events with the one TMDL storm event, the three stormwater outfalls were sampled on the following days:

- October 31, 2005 – 0.66 total inches of rain (pilot).
- January 30, 2006 – 0.10 total inches of rain (pilot).
- April 5, 2006 – 0.20 total inches of rain (pilot).
- May 2, 2007 – 0.26 total inches of rain (TMDL).

In both the TMDL and the pilot-study stormwater sampling events, two rounds of FC sampling were completed for each day. Combining the TMDL storm sampling with the earlier pilot-study sampling gave Ecology eight samples to assess for each of the three storm outfalls listed above. Table 22 shows the four storm event results for the three stormwater outfalls. In general, all of the outfalls had a similar range of FC concentrations and loads for all four storm events.

Table 22. Storm event results for three stormwater outfalls in the city of Pullman.

Stormwater outfall	Storm event date	Total daily rainfall (inches)	First rotation FC count (cfu/ 100 mL)	First rotation discharge (cfs)	Second rotation FC count (cfu/ 100 mL)	Second rotation discharge (cfs)	Average storm bacterial load
34MissSD120 (Stadium Way)	10/13/2005	0.66	1250	3.7	940	4.5	4472
	1/30/2006	0.10	1900	3.1	190	2.2	3188
	4/5/2006	0.20	1300	7.5	510	2.7	5575
	5/2/2007	0.26	3000	4.3	800	0.3	6578
34SFPRWSU2 (College St.)	10/13/2005	0.66	1065	1.7	2650	0.3	1265
	1/30/2006	0.10	400	0.6	39	0	112
	4/5/2006	0.20	2400	0.1	325	0.6	203
	5/2/2007	0.26	1100	0.3	550	0.1	171
34SFPRWSU1 (Benewah St.)	10/13/2005	0.66	2650	3.7	2100	0.9	5907
	1/30/2006	0.10	315	1.4	380	0.1	231
	4/5/2006	0.20	2100	2.3	4900	1.4	5727
	5/2/2007	0.26	1100	2.4	2200	2.7	4351

In addition, the three stormwater outfalls were sampled during the wet and dry seasons since they always had baseflow. Figure 25 compares the range of concentrations for the three stormwater outfalls for the dry season, wet season, and storm events. Storm-event concentrations were much higher in the Benewah and College Street outfalls while the Stadium Way outfall was just slightly higher (note the log scale). However, the larger stormwater-runoff flow volumes created much larger average FC loads in all three outfalls (Figure 26). Storm events and storm runoff greatly increased FC pollution in the three outfalls compared to levels found during the dry or wet season.

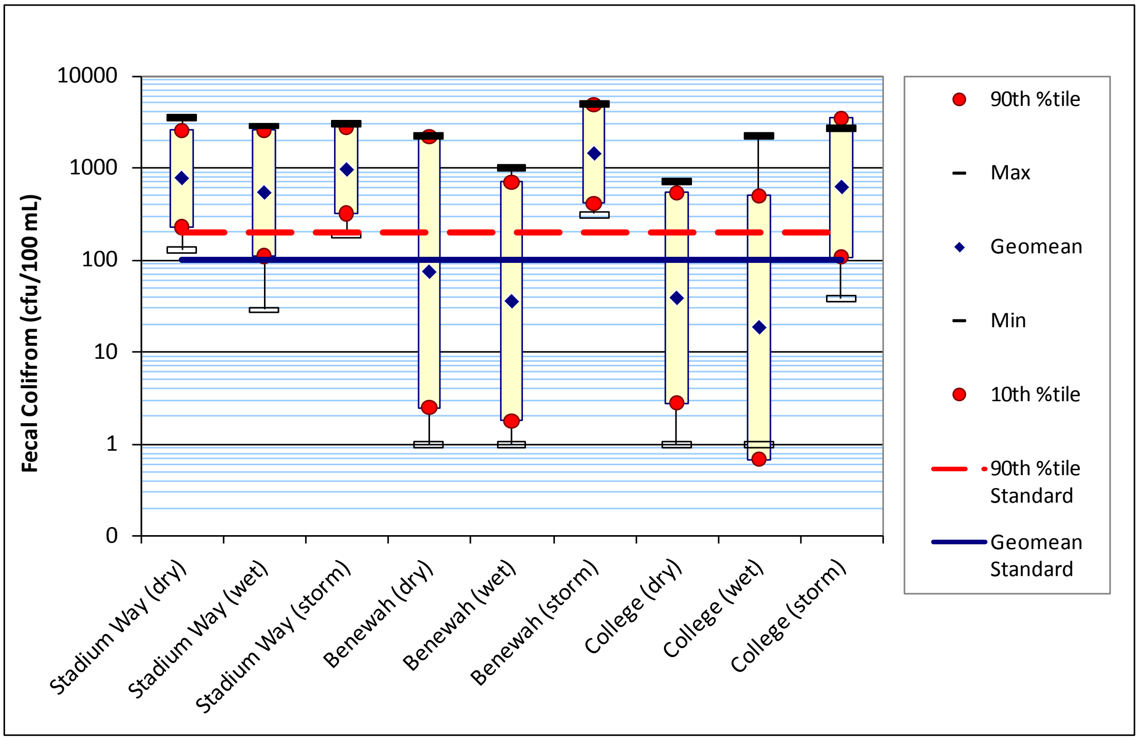


Figure 25. Comparison of pooled fecal coliform (FC) bacteria concentrations for three stormwater outfalls during storm events, dry season, and wet season.

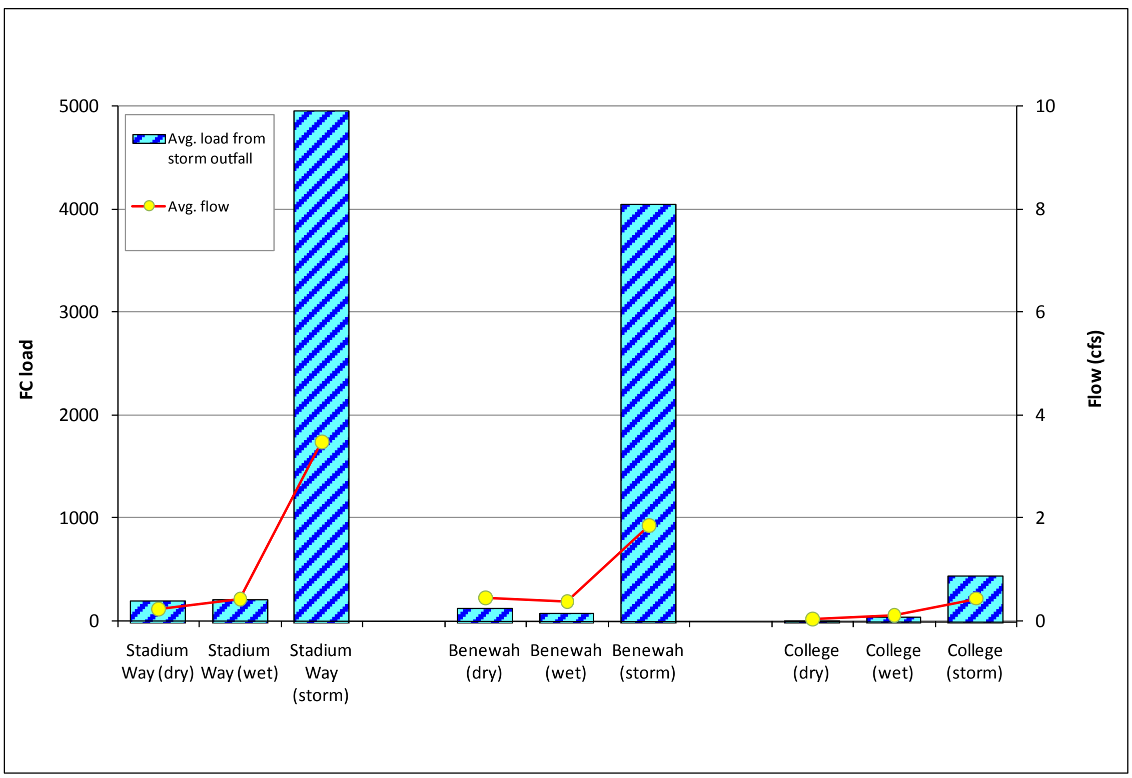


Figure 26. Comparison of average fecal coliform (FC) bacteria loads from three stormwater outfalls during storm events, dry season, and wet season. *To convert from loading units to number of cfu per day, multiply the number of loading units by the constant, 24,465,067.*

TMDL stormwater sampling event (May 2, 2007)

During this event, four Ecology teams sampled the stream segments at the jurisdictional boundaries of Pullman and points within for a total of 27 sites. This includes the 14 stormwater outfalls, two locations on Dry Fork Creek, the mouths of Missouri Flat, Paradise, Sunshine, and Airport Road Creeks, and the SF Palouse downstream boundary below Pullman at RM 21.5.

The storm event produced just over 0.25 inches of rainfall with three distinct intensive bursts spread over about 11 hours, beginning around 3:00 am and ending around 2:00 pm (Figure 27). The storm event was not preceded by rainfall the day before. Ecology began sampling at 10:00 am and completed two rounds of sampling at each site by 4:30 pm. Flow measurements and FC samples were taken at each site.

A mass balance of the average flow and loads measured throughout the city from each site (average of the two measured flows or samples taken at each site) was conducted. Table 23 shows the estimated flow and mass balance of FC loads for the May 2, 2007 storm event. The average FC bacteria load at the downstream end of Pullman (RM 21.5) accounted for most of the cumulated FC load measured upstream during the event, but only about 72% of the flow. Figure 28 shows a map of Pullman and the estimated percent contributions from the monitored sites.

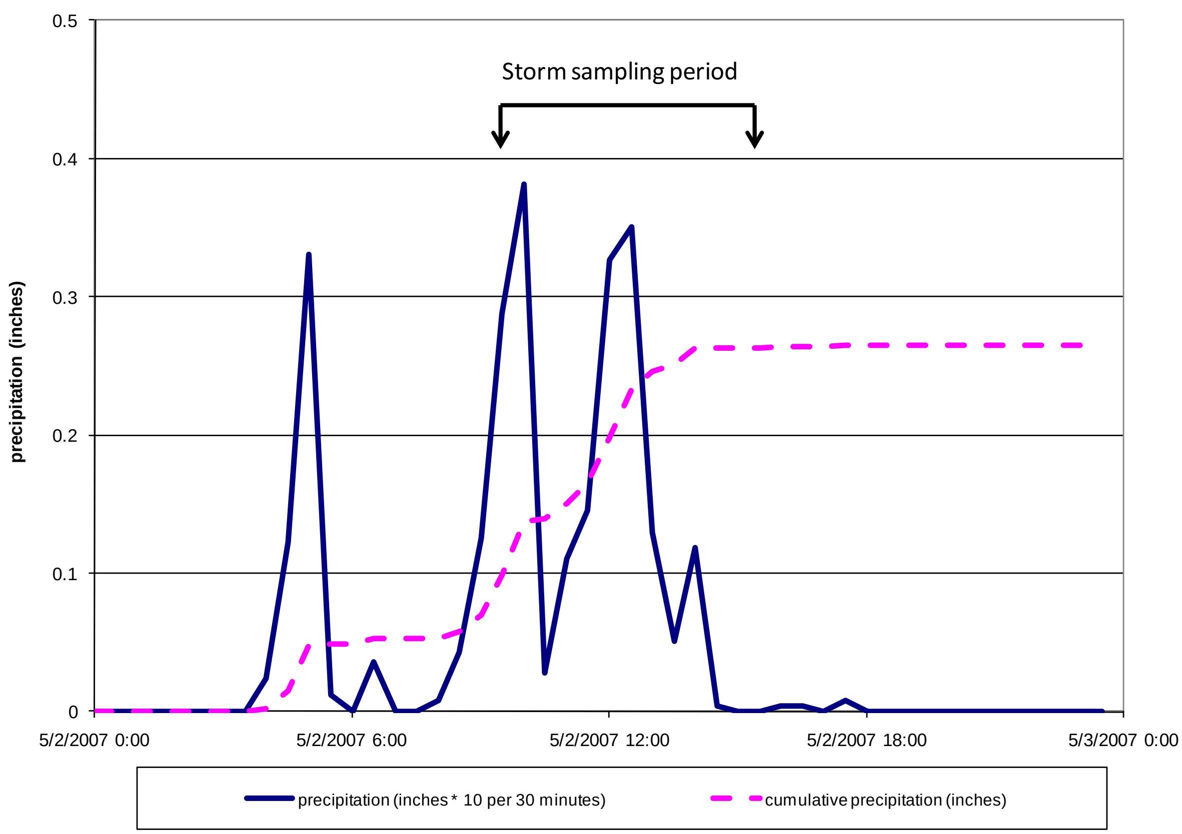


Figure 27. Precipitation data and sampling period for the May 2, 2007 storm event in Pullman.

Table 23. Estimated flow and FC bacteria mass balance of the May 2, 2007 storm event including percent contributions from sources.

Tributary or location	Station name	Average flow (cfs)	Net flow (cfs)	% of tributary flow	Average FC Load[1]	Net FC load[1]	% of tributary load
Paradise Creek							
upstream boundary	34PARA01.1	6.5	6.5	76.1%	490	490	93.9%
tributary	34AIR00.0	0.9	1	11.1%	169	169	32.4%
stormdrain	34PARAWSU3	0.03	0	0.4%	0	0	0.0%
mouth	34PARA00.1	8.6	1.1	12.5%	522	-137	-26.2%
Dry Fork Creek							
upstream boundary	34Dry02.2	0.4	0.4	15.9%	88	88	0.6%
instream boundary	34Dry00.4	2.9	2.9	101.7%	8752	8664	58.9%
mouth	34Dry00.0	2.8	-0.5	-17.6%	14721	5969	40.5%
Missouri Flat Creek							
upstream boundary	34Miss01.7	2.1	2.1	42.7%	52	52	0.3%
stormdrain	34MissSD120	2.3	2.3	46.3%	6593	6593	44.0%
stormdrain	34MissSD200	0.03	0.0	0.6%	54	54	0.4%
stormdrain	34MissSD210	0.1	0.1	1.2%	54	54	0.4%
stormdrain	34MissSD60	0.1	0.1	2.2%	764	764	5.1%
mouth	34Miss00.1	5.0	0.4	7.0%	14974	7456	49.8%
SF Palouse River							
upstream boundary	34SFPR24.7	9.7	9.7	23.5%	662	662	1.8%
stormdrain	34SFPR-SD120	0.1	0.1	0.2%	175	175	0.5%
stormdrain	34SFPR-SD140	0.1	0.1	0.3%	524	524	1.4%
stormdrain	34SFPR-SD170	0.01	0.0	0.0%	3	3	0.0%
stormdrain	34SFPR-SD180	0.1	0.1	0.3%	491	491	1.4%
stormdrain	34SFPR-SD260	0.03	0.0	0.1%	29	29	0.1%
stormdrain	34SFPR-SD320	0.1	0.1	0.2%	124	124	0.3%
stormdrain	34SFPR-SD360	0.2	0.2	0.5%	243	243	0.7%
stormdrain	34SFPRWSU1	2.6	2.6	6.3%	4354	4354	12.0%
stormdrain	34SFPRWSU2	0.2	0.2	0.4%	173	173	0.5%
tributary	34SUN00.0	0.2	0.2	0.5%	69	69	0.2%
tributary	34PARA00.1	8.6	8.6	20.8%	522	522	1.4%
tributary	34Dry00.0	2.8	2.8	6.8%	14721	14721	40.6%
tributary	34Miss00.1	5.0	5.0	12.1%	14974	14974	41.3%
downstream boundary	34SFPR21.5	41.2	11.5	28%	36265	-796	-2.2%

[1] Loads were calculated by multiplying the FC concentration by the flow at each site. FC bacteria are measured in colony forming units (cfu) per 100 mL, and flow is measured in cubic feet per second (cfs). To convert from loading units to number of cfu per day, multiply the number of loading units by the constant, 24,465,067.

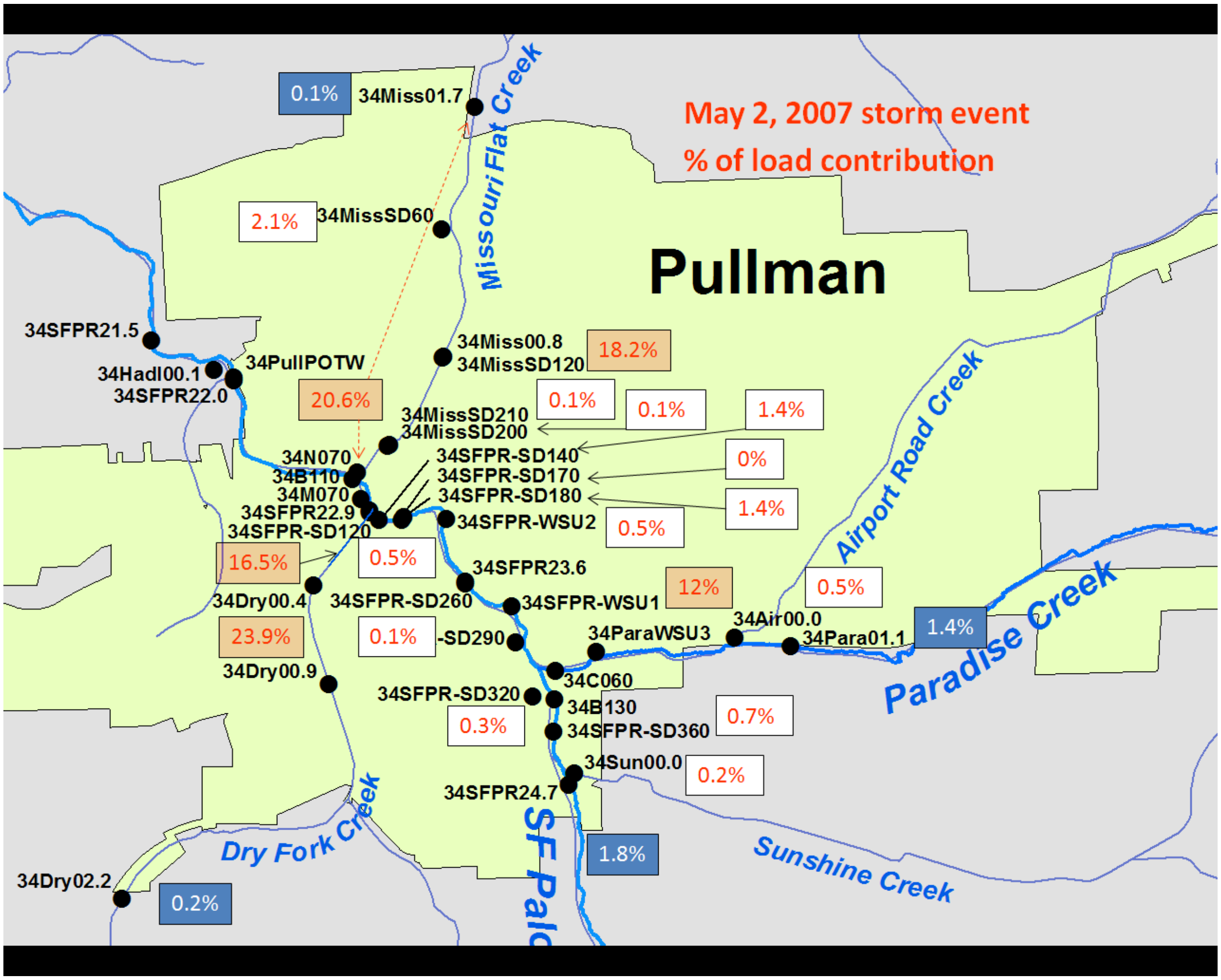


Figure 28. Mass-balance percent contributions from stormwater outfalls and specific reaches during the May 2, 2007 storm event.

Less than 5% of the FC load is estimated to have originated from upstream of city limits (i.e., above RM 1.7 on Missouri Flat Creek, above RM 1.1 on Paradise Creek, above RM 24.7 on the upper SF Palouse River, and above RM 2.2 on Dry Fork Creek).

Of the remaining >95% of the total FC load that originated from within the Pullman city limits, over 90% is estimated to have originated from five sources:

1. ≈ 21% from unmeasured loads to Missouri Flat Creek between the city limits (RM 1.7) and the mouth (shown as 34N070 on the map).
2. ≈ 18% from storm drain 120 to Missouri Flat Creek (34MissSD120).
3. ≈ 24% from Dry Fork Creek between RM 2.2 and RM 0.4 (at the Texaco station on Grand Ave).
4. ≈ 17% from Dry Fork Creek between RM 0.4 and the mouth at RM 0.1 (shown as 34M070 on the map).
5. ≈ 12% of the load came from the storm drain WSU1 to the SF Palouse River at Benewah St. (34SFPRWSU1).

In summary, over 40% of the FC load came from Dry Fork Creek, much of which is likely contributed by the 26 stormwater outfalls that discharge to creek in the culvert under Grand Avenue.

Also, more than 40% of the FC load came from the portion of Missouri Flat Creek within the city limits. Storm drain 120 accounted for most of the flow within this reach and may account for more of the FC load than measured, due to the transitory and variable nature of FC runoff during a storm event.

In both creeks, indirect runoff from streets that parallel the creeks could be a loading source too.

Finally, the estimated average FC load leaving the city of Pullman on May 2, 2007 was more than five times higher than the average load leaving Pullman during the wet season and seven times higher than during the dry season.

Stormwater conclusions

- Based on the results of three stormwater outfalls, the May 2, 2007 storm-event sampling had similar results to three storm events monitored the previous year.
- The city of Pullman and WSU campus generated most of the FC load in the SF Palouse River that left the Pullman city limits during the May 2, 2007 event.
- The storm-event data show that storm runoff increased FC pollution beyond the levels of average dry- or wet-season FC pollution.

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 SF Palouse River were to meet the water quality standard, then the SF Palouse River as a whole would meet the standard prior to its confluence with the Palouse 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 bacteria criteria for the SF Palouse basin are:

- A geometric mean less than 100 cfu/100 mL.
- No more than 10% of the samples to exceed 200 cfu/100 mL (the 90^{th} percentile of the sample distribution is evaluated in this TMDL instead).

Seasonal statistics were developed for each site using current data collected from the 2006-07 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.

The percent reduction values in Tables 24 and 25 indicate the relative degree the water body is currently out of compliance with the number of samples above 200 cfu/100 mL (i.e., how far it is over its capacity to receive FC loads and still provide *primary 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.

In addition, to meet EPA reporting requirements, Tables 24 and 25 express load capacities in number of FC bacteria per day based on the 2006 average seasonal flow. Load capacity is flow dependent and changes as the flow changes. The reported load capacities are specific to the average seasonal flow measured at each station. Higher flow at a station would result in a higher load capacity while a lower flow would result in a lower load 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 Tables 24 and 25 since its unlikely the flow conditions will be the same.

Load and wasteload allocations

Nonpoint loads are assigned load allocations. Point sources, such as municipal WWTPs in the basin, are assigned wasteload allocations to be included in their NPDES permits. Stormwater and stormwater outfalls are assigned wasteload allocations based on their Phase II Eastern Washington Stormwater General Permit requirements and reductions needed from stormwater sources collectively. In some cases, where specific stormwater outfalls were sampled, outfall-specific wasteload allocations are assigned. Stormwater outside the Phase II permit areas are included in the load allocations for nonpoint sources.

The Clean Water Act states that FC wasteload and load allocations may be expressed as loads, concentrations, or other appropriate measures [40 CFR 130.2(I)]. This TMDL expresses the load allocations and stormwater wasteload allocations in terms of percent reductions necessary to achieve concentration levels which 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 24 shows load allocations, expressed as percent reduction in concentrations necessary to meet the water quality standards and the load capacity in number of FC bacteria per day. The load capacity is based on average seasonal flow and will change with different flows. Load allocations are given for all monitored sites on the SF Palouse River that are not regulated by permit, including the mouths of tributaries.

A reduction of 41% for the wet season was included for RM 33.8 on the SF Palouse River based on the Idaho DEQ TMDL (IDEQ, 2007) that required a year-round 41% reduction to meet the Idaho E. coli standard. Split samples (i.e., *E. coli* vs. FC) taken at the border during the present TMDL study showed that meeting the Idaho E. coli standard of 126 cfu/100 mL would be protective of the Washington State FC bacteria standard of 100 cfu/100 mL.

At two sites on the SF Palouse River, RM 31.3 and RM 5.4, the distribution of the data showed that the site met standards; however, there were too many FC counts just over 200 cfu/100 mL. These sites should still be addressed during implementation since they are areas of additional FC loading.

Table 25 shows the necessary percent reductions in FC concentrations and load capacities at all monitored tributary sites.

Table 24. Load allocations expressed as target percent reductions and loading capacity for sites on the SF Palouse River and its tributaries.

Station ID	Dry season target % reduction	Wet season target % reduction	Loading capacity (cfu/day) based on average seasonal flow	
			Dry season	Wet season
South Fork Palouse River and tributary mouths				
34SFPR33.8	86%	41%[1]	4.3E+09	1.4E+11
34SFPR31.3	0%	0%[2]	2.7E+09	1.6E+11
34SFPR26.6	0%	61%	5.5E+09	1.7E+11
34Stal00.1	80%	87%	8.6E+08	1.6E+10
34Sun00.0	0%	6%	3.8E+06	3.2E+09
34SFPR24.7	0%	70%	8.5E+09	1.9E+11
34SFPR24.3	40%	53%	7.6E+09	1.9E+11
34Para00.1	59%	37%	1.7E+10	1.1E+11
34SFPR23.6	83%	55%	2.9E+10	3.2E+11
34SFPR22.9	84%	58%	2.9E+10	3.2E+11
34Dry00.0	89%	91%	9.5E+08	1.6E+10
34SFPR22.8	86%	39%	3.0E+10	3.4E+11
34Miss00.1	81%	62%	2.7E+09	7.2E+10
34SFPR22.0	68%	40%	3.1E+10	4.2E+11
34PullPOTW	15%[3]	0%	see permit limits	see permit limits
34HADL00.0	NC	50%	NC	1.8E+09
34SFPR21.5	49%	63%	5.6E+10	4.5E+11
34SFPR19.2	56%	54%	5.6E+10	4.5E+11
34UnkSFPR(17.3)	0%	0%	1.5E+08	5.5E+09
34SFPR15.8	33%	35%	5.7E+10	4.6E+11
34AlbPOTW	NC	0%	see permit limits	see permit limits
34SFPR11.5	48%	64%	5.9E+10	4.7E+11
34Four00.3	43%	4%	6.1E+09	1.3E+11
34Parv00.1	0%	0%	6.3E+07	4.2E+09
34SFPR09.2	0%	55%	6.9E+10	6.5E+11
34SFPR05.4	0%[2]	0%[2]	7.1E+10	6.6E+11
34SFPR01.2	0%	0%	7.4E+10	6.7E+11
34Spri00.5	0%	66%	7.0E+08	2.0E+10
34SFPR00.1	96%	83%	7.6E+10	6.9E+11

Shaded cells are estimates due to insufficient # of samples.
[1]using the Idaho DEQ TMDL % reduction for wet season
[2]site had too many seasonal high counts
[3]reduction was needed in 2006 dry season to meet permit limit
NC – not calculated due to no measureable flow during season

Table 25. Load allocations expressed as target percent reductions and loading capacity for tributaries to the SF Palouse River.

Station ID	Dry season target % reduction	Wet season target % reduction	Loading capacity (cfu/day) based on average seasonal flow	
			Dry season	Wet season
Staley Creek				
34Stal03.9	14%	64%	1.7E+08	8.4E+09
34Stal00.1	80%	87%	8.6E+08	1.6E+10
Paradise Creek				
34Para06.6	91%	85%	1.4E+10	9.3E+10
34UnkPara(06.3)	NC	0%[1]	NC	6.2E+09
34Para03.8	84%	39%	1.5E+10	9.9E+10
34Air00.0	93%	84%	4.4E+08	9.6E+09
34Para01.1	74%	38%	1.6E+10	1.0E+11
34Para00.1	59%	37%	1.7E+10	1.1E+11
Dry Fork Creek				
34Dry02.2	99%	67%	1.1E+08	8.3E+09
34Dry00.9	14%	7%	4.9E+08	1.3E+10
34Dry00.4	79%	75%	7.6E+08	1.4E+10
34Dry00.0	89%	91%	9.5E+08	1.6E+10
Missouri Flat Creek				
34Miss07.5	0%	56%	2.1E+06	3.6E+10
34Miss03.9	0%	0%	8.7E+08	6.1E+10
34Miss01.7	94%	60%	9.7E+08	6.6E+10
34Miss00.8	80%	38%	1.5E+09	7.1E+10
34Miss00.1	81%	62%	2.7E+09	7.2E+10
Fourmile Creek				
34Rose00.1	0%	0%	3.9E+08	1.8E+10
34Four03.3	91%	66%	4.7E+09	1.0E+11
34Four00.3	43%	4%	6.1E+09	1.3E+11

Shaded cells are estimates due to insufficient # of samples.
[1]site had too many seasonal high counts
NC – not calculated due to no measureable flow during season

Municipal wastewater treatment plant wasteload allocations

Wasteload allocations represent the pollution reduction 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 to the SF Palouse River:

- Pullman WWTP
- Albion WWTP

The current permit limit for Pullman requires them to discharge below a weekly average FC concentration of 100 cfu/100 mL. The city of Pullman WWTP had generally good disinfection, based on TMDL study samples from the outfall, but there were two occasions in the dry season when FC counts exceeded 300 cfu/100 mL, above their weekly permitted level. The 15% reduction in Table 24 is a result of these permit exceedances. The WWTP was conducting in-house modifications to monitor and control the production of trihalomethanes, and the disinfection process may have been upset in the process. The current permit limit should be sufficient if they meet it.

The Albion WWTP has a current permit limit of 200 cfu/100 mL for a monthly and weekly average. The Albion WWTP only discharged during the winter months (February to April) and was only sampled four times, always showing almost complete disinfection of the discharge water. If Albion only discharges during high-flow months (January to May), their current permit limit should be sufficient. If Albion is permitted to discharge June through December, their permit limit should be reduced to 100 cfu/100 mL for this time period. Table 26 summarizes the municipal treatment plant NPDES wasteload allocations.

Table 26. Municipal wastewater treatment plant (WWTP) wasteload allocations.

WWTP	NPDES Permit Limit
City of Pullman	Year-round: 100 cfu/100 mL weekly average
City of Albion	January to May: 200 cfu/100 mL monthly and weekly average June to December: 100 cfu/100 mL monthly and weekly average

Stormwater and other general permit wasteload allocations

The area covered by the Phase II municipal stormwater NPDES permit includes the city of Pullman (and the WSU campus). WSDOT also has a statewide stormwater permit which includes Phase II areas and areas covered by TMDLs. Through WSDOT's memorandum of understanding with the Association of Washington's cities, the maintenance of stormwater facilities within the city of Pullman is allocated to the city (WSDOT, 2009). WSDOT is responsible for any highway or facility stormwater outfalls outside the city limits.

During both routine TMDL study monitoring and targeted stormwater monitoring, stormwater outfalls and conveyances in the city of Pullman had FC levels that did not meet water quality standards.

Only three stormwater outfalls were sampled enough to establish a distribution of FC levels. Data for the three sites are shown in Table 27. Target percent reductions were higher for storm events than for dry or wet seasons for these three sites, though considerable reductions were needed year-round.

Table 27. Comparison of FC bacteria data and calculated target percent reductions for three stormwater outfalls during dry and wet seasons and during storm events.

Station ID	Total # of Samples	Mini-mum	10th percen-tile	Geomean*	90th percen-tile	Maxi-mum	% Samples >200 cfu / 100 mL *	Target % Reduction
Dry Season								
34MissSD120 (Stadium Way)	11	130	229	769	2587	3450	91%	**92%**
34SFPRWSU1 (Benewah St)	11	1	2.5	74	2216	2200	45%	**91%**
34SFPRWSU2 (College St)	11	1	2.8	39	544	700	27%	**63%**
Wet Season								
34MissSD120 (Stadium Way)	11	29	111	536	2594	2800	91%	**92%**
34SFPRWSU1 (Benewah St)	11	1	2	36	709	1000	18%	**72%**
34SFPRWSU2 (College St)	12	1	1	19	507	2200	17%	**61%**
Stormwater								
34MissSD120 (Stadium Way)	8	190	323	952	2807	3000	88%	**93%**
34SFPRWSU1 (Benewah St)	8	315	414	1421	4880	4900	100%	**96%**
34SFPRWSU2 (College St)	8	39	108	615	3506	2650	88%	**94%**

* Shaded cells in these columns have values that exceed Washington State numeric criteria.

Table 28 shows estimated waste load allocations for 14 stormwater outfalls monitored for the TMDL study. The waste load allocations are expressed as percent reductions in FC levels needed to meet the water quality standards and a loading capacity in number of FC bacteria per day based on the average seasonal flow or storm-event flow; the loading capacity will change with changing flows. The “shaded” waste load allocations are estimated from two samples and are shown for information purposes only to help with implementation.

A single, collective waste load allocation for the city of Pullman and WSU was estimated from the single storm event monitored on May 2, 2006. Stormwater from within the city of Pullman is estimated to have generated more than 95% of the FC load measured at the downstream end of Pullman on this day.

The average measured streamflow at the downstream boundary of Pullman on May 2, 2006 was 41.2 cfs. Using the allowable 90th percentile concentration of 200 cfu/100 mL from the water quality standards, a load capacity of about 200 billion FC cfu can be calculated for this site on this day. The average measured FC load at this site on this day was 4.4 times this load capacity, requiring a 78% reduction in FC load to meet the estimated load capacity.

Table 28. Wasteload allocations and target FC percent reductions needed to meet the water quality standards for selected stormwater outfalls.

Station ID	Dry season		Wet season		Storm event	
	Target % reduction	Load capacity (cfu/day) based on average seasonal flow at the outfall	Target % reduction	Load capacity (cfu/day) based on average seasonal flow at the outfall	Target % reduction	Load capacity (cfu/day) based on average storm event flow at the outfall
South Fork Palouse River stormwater outfalls						
34SFPR-SD360	0%	3.1E+07	0%	1.4E+08	91%	9.1E+08
34SFPR-SD320	0%	9.8E+06	0%	1.4E+08	87%	4.4E+08
34SFPRWSU1	91%	1.8E+09	72%	1.7E+09	96%	9.1E+09
34SFPR-SD260	91%	1.1E+07	23%	6.3E+07	97%	1.3E+08
34SFPRWSU2	63%	1.2E+08	61%	5.9E+08	94%	2.2E+09
34SFPR-SD180	33%	1.1E+08	84%	2.2E+06	97%	5.9E+08
34SFPR-SD170	NC	NC	29%	2.5E+07	72%	3.2E+07
34SFPR-SD140	NC	NC	NC	NC	97%	6.5E+08
34SFPR-SD120	72%	2.2E+06	99%	4.5E+07	94%	5.0E+08
Paradise Creek stormwater outfalls						
34ParaWSU3	0%	2.5E+07	0%	1.7E+08	0%	1.5E+08
Missouri Flat Creek stormwater outfalls						
34MissSD60	95%	4.7E+07	0%	2.2E+08	97%	5.4E+08
34MissSD120	92%	9.9E+08	92%	2.1E+09	93%	1.7E+10
34MissSD200	NC	NC	NC	NC	94%	1.5E+08
34MissSD210	95%	3.8E+05	83%	1.5E+07	94%	2.9E+08
City of Pullman and WSU stormwater outfalls						
Combined outfalls	----	----	----	----	78%	2.0E+11

Shaded cells are estimates due to insufficient # of samples.
NC – not calculated due to no measureable flow during season

The study did not directly evaluate stormwater contributions from industrial stormwater permit holders (Table 29), but the water bodies that the facilities discharge to did have FC bacterial contamination. Four of the five facilities covered by the Industrial Stormwater General Permit or Construction Stormwater General Permit have a low potential for contributing or transporting FC bacteria. While the city of Pullman WWTP has some potential for contributing or transporting FC bacteria from their biosolids holding area, the WWTP has best management practices in place to prevent transport to the stream. No additional permit requirements are recommended beyond the good housekeeping practices outlined in the current permits, and current best management practices being implemented, unless future monitoring shows otherwise.

WSDOT has highways along Paradise Creek, Missouri Flat Creek, Dry Fork Creek and Spring Flat Creek. While no stormwater outfalls from the highways were sampled, the target percent reductions listed for three of these streams in Table 25 can be used as estimates for target reductions for WSDOT. The WSDOT Stormwater NPDES permit will include actions for WSDOT to comply with this TMDL. This TMDL recommends specific actions in the i*mplementation strategy* section of this report.

Table 29. Department of Ecology permitted industrial stormwater discharges in Pullman, WA.

Permit number	Site name	Site address	Water body
SO3000979D	Horizon Air Pullman Moscow Airport	3200 Airport Complex N.	Airport Road Creek
SO3000975D	Inter State Aviation Inc.	Pullman-Moscow Airport	Airport Road Creek
SO3004625A	City of Pullman WWTP	N.W. 1025 Guy Street	SF Palouse River
SO3000942D	Pullman-Moscow Regional Airport	Rt. 3 Box 850	Airport Road Creek
SO3004624A	City of Pullman Transit Facility	NW 775 Guy Street	SF Palouse River

Recommendation for future growth

This 2006-07 FC bacteria TMDL does not include a specific reserve capacity for future growth. Future monitoring programs should quantify both (1) the effect of growth since the study was conducted, and (2) the beneficial effect of ongoing management practices.

Margin of safety

A margin of safety to account for scientific uncertainty must be considered in all TMDLs to ensure that the targets will protect water quality in cases when the data and other factors in the analysis are naturally variable or unknown. 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 bacteria concentrations. The rollback 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 bacteria values is likely to decrease, which should reduce the variance and 90th percentile of the post-management condition.

Conclusions

South Fork Palouse River watershed

Figure 29 and Figure 30 show fecal coliform (FC) bacteria and total suspended solids (TSS) loads for the entire South Fork (SF) Palouse River for both the dry and wet seasons. In summary:

- During the dry season, the FC and TSS loads appeared to be generated more locally, either from unexplained nonpoint sources in specific reaches, or from specific point sources.
- During the wet season, much of the FC and TSS load appeared to be generated from upstream sources and transported downstream, though smaller locally-generated loads contributed as well.

Figure 31 shows the summarized FC and TSS loads delineated by jurisdiction for both dry and wet seasons. The total FC loads generated within the urban areas of Colfax, Pullman, and Moscow (Idaho portion of Paradise Creek) were of similar magnitude for both dry and wet seasons. Outside of the urban areas, the wet-season FC loads were dominant. TSS loads were always wet-season dominant.

Upper SF Palouse River

- On average, the majority of the loading to the upper SF Palouse River was from Idaho during both the wet season (56%) and dry season (67%).
- While the bacteria counts at the Idaho border were within standards, the average wet-season FC bacteria load appears to use up most of the downstream load capacity in the upper SF Palouse.
- There was a linear relationship between TSS and FC bacteria concentrations, indicating soil-erosion control could reduce bacteria.
- Staley Creek violated water quality standards.

Middle SF Palouse River

- Overall, the middle SF Palouse River had too many high FC counts during both the dry and wet season at every site to meet the numeric standards.
- High FC counts were seen in the tributaries and storm drains.
- The middle SF Palouse sites generally met the geometric mean standard in the wet season, but not in the dry season.
- The majority of the dry season loads were from apparent nonpoint contributions within three SF Palouse reaches through the city of Pullman.

Dry Fork Creek

- FC counts were highest within the culvert sections under Grand Avenue within the city of Pullman.
- The creek was mostly dry at the city limits during the dry season.
- During the wet season, the FC counts were variably high, indicating inconsistent runoff contamination.

Paradise Creek

- Overall, most sites had too many high FC counts year-round to meet the numeric standards.
- The mass balance showed that the average dry-season FC load in Paradise Creek originated from the Idaho segment of the creek.
- The mass balance showed that the average wet-season FC load in Paradise Creek originated between RM 3.8 and RM 1.1.
- The average TSS load from Idaho accounted for 73% of the TSS load in Paradise Creek in the wet season and 87% of the TSS load in the dry season.

Missouri Flat Creek

- Significant reductions are required within the Pullman city limits (from RM 1.7 downstream) during both dry and wet seasons.
- The average load discharged from storm drain 120 (at Jack in the Box) was about the same for both wet and dry seasons, indicating a constant or persistent source of baseflow and contamination.

Lower SF Palouse River

- In comparison to the upriver portions of the SF Palouse, most of the lower portion of the river had fewer water quality standards violations and generally decreased FC bacteria counts.
- If upstream FC loads are reduced, the lower SF Palouse River might be nearer to compliance during the dry season.
- The FC counts within the city of Colfax were very high during both the dry and wet seasons.

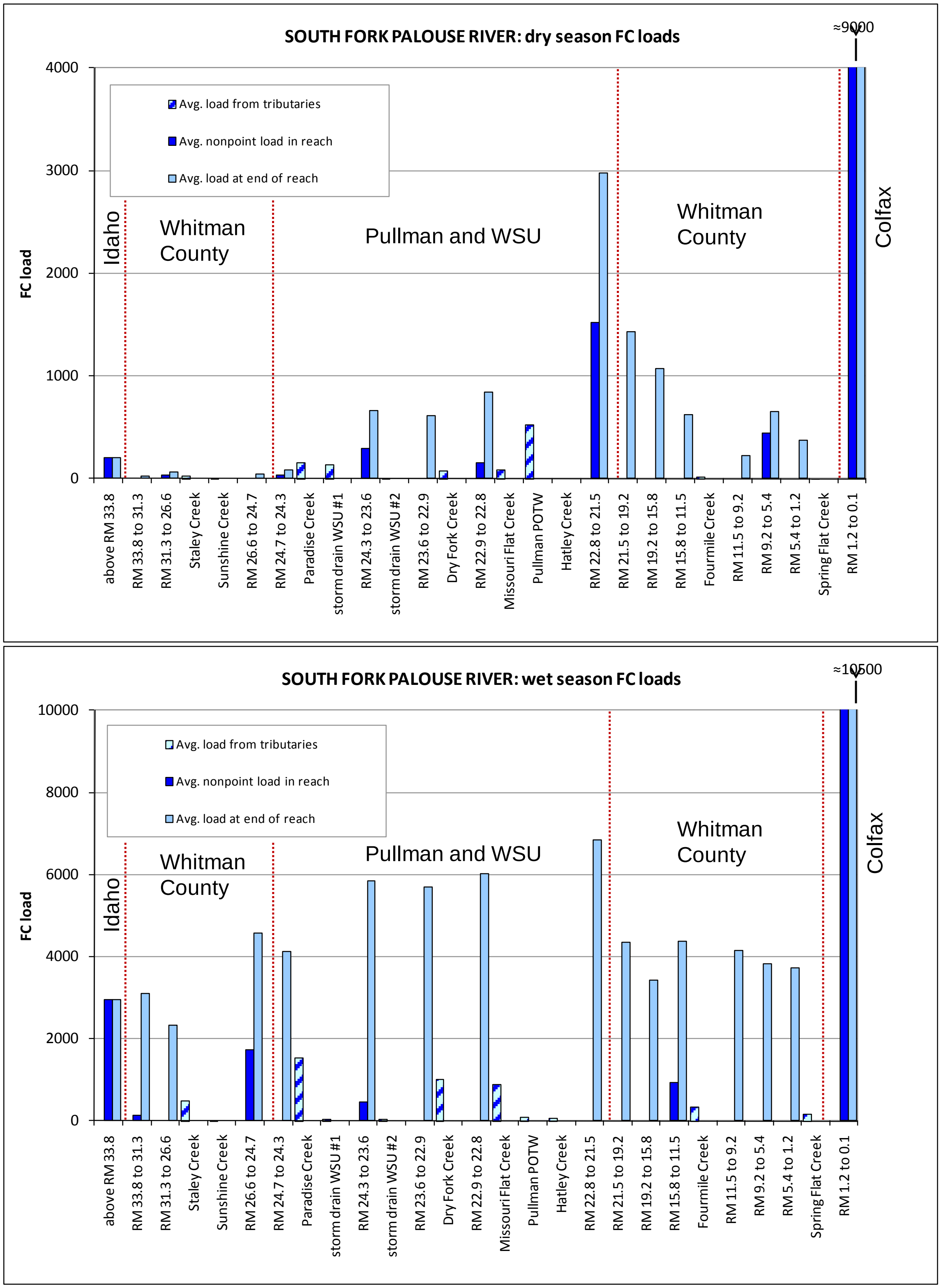
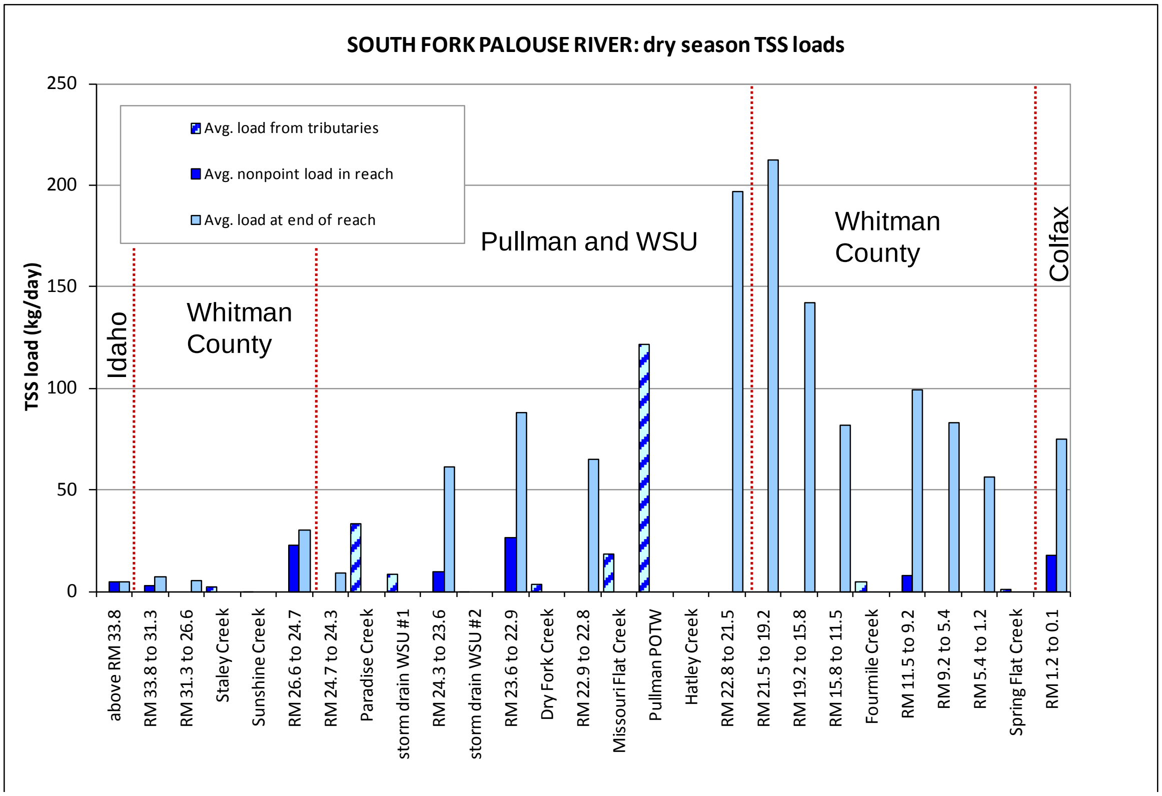


Figure 29. Summary of average dry- and wet-season fecal coliform (FC) bacteria loads in the SF Palouse River during the 2006-07 TMDL study. *To convert from loading units to number of cfu per day, multiply the number of loading units by the constant, 24,465,067.*



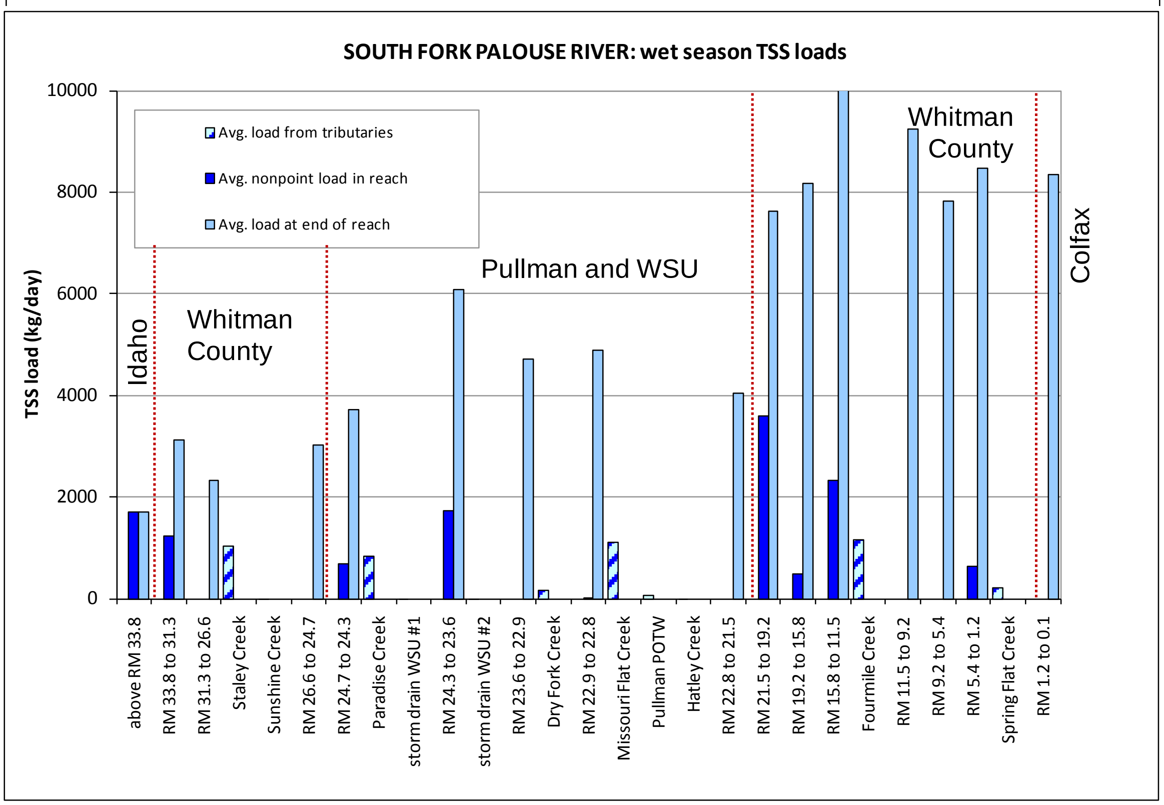


Figure 30. Summary of average dry- and wet-season total suspended solids (TSS) loads in the SF Palouse River during the 2006-07 TMDL study.

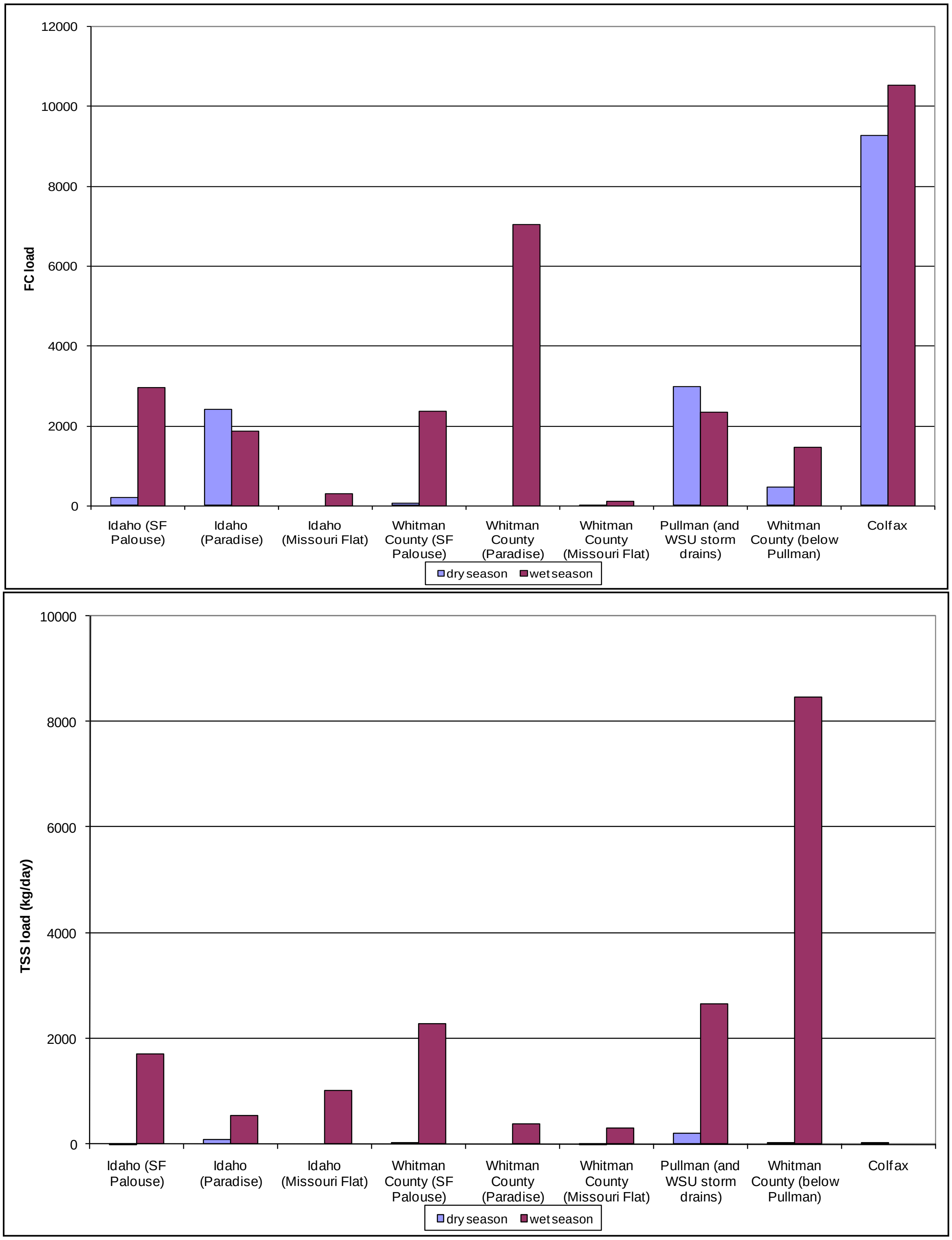


Figure 31. Comparison of total dry- and wet-season fecal coliform (FC) bacteria and total suspended solids (TSS) loads for different jurisdictions during the 2006-07 TMDL study. *To convert from loading units to number of cfu per day, multiply the number of loading units by the constant, 24,465,067.*

Stormwater analysis for Pullman and WSU

- Based on comparison of water quality at three stormwater outfalls during four storm events and the mass balance of FC bacteria for one event, storm events and storm runoff increased FC pollution and degraded the water quality in the SF Palouse and its tributaries beyond the levels of dry- or wet-season pollution.

- During the May 2, 2007 storm event, less than 5% of the FC load originated from outside of the Pullman city limits. Within the city, almost 90% came from five sources:

  1. ≈ 21% from unmeasured loads to Missouri Flat Creek between the city limits (RM 1.7) and the mouth (site 34N070 on the map).
  2. ≈ 18% from storm drain 120 to Missouri Flat Creek (site 34MissSD120).
  3. ≈ 24% from Dry Fork Creek between RM 2.2 and RM 0.4 (at the Texaco station on Grand Ave).
  4. ≈ 17% from Dry fork Creek between RM 0.4 and the mouth at RM 0.1 (site 34M070 on the map).
  5. ≈ 12% of the load came from the storm drain WSU1 to the SF Palouse River at Benewah Street (site 34SFPRWSU1).

  - The total FC load leaving the city of Pullman on May 2, 2007 was more than five times higher than the average wet-season load measured at RM 21.5.

Recommendations

Implementation of TMDL targets

The goal of this TMDL is to reduce fecal coliform (FC) bacteria at all sites that are assigned target percent reductions so that all sites within the SF Palouse River basin comply with Washington State water quality standards. The following FC bacteria loads are prioritized (based on size of load and concentration) for implementation actions, including further assessment if necessary, to reduce FC loads and concentrations during the dry season, wet season, and storm events.

Dry season

- Unexplained load within Colfax
- Unexplained load between RM 22.8 and RM 21.5
- Point source load from Pullman Wastewater Treatment Plant (meet permit limit)
- Unexplained nonpoint load between RM 9.2 and RM 5.4
- Unexplained load between RM 24.3 and RM 23.6
- Unexplained load above RM 33.8 (Idaho)
- Unexplained load to Paradise Creek above the state line
- Point source load from storm drain WSU1
- Unexplained load between RM 22.9 and RM 22.8
- Point source load (storm drain 120) and other load from Missouri Flat Creek
- Unexplained load from Dry Fork Creek

Wet season

- Unexplained load within Colfax
- Unexplained load above RM 33.8 (Idaho)
- Unexplained nonpoint load between RM 26.6 and RM 24.7
- Unexplained load to Paradise Creek above state line and RM 1.1
- Unexplained load from Dry Fork Creek
- Point and nonpoint loads from Missouri Flat Creek
- Unexplained nonpoint load between RM 15.8 and RM 11.5
- Nonpoint load from Staley Creek
- Unexplained load between RM 24.3 and RM 23.6
- Nonpoint load from Fourmile Creek
- Nonpoint load from Spring Flat Creek (upstream of Colfax)

Storm events

- Unexplained load in Dry Fork Creek between RM 0.4 and the city limit (RM 2.2), with emphasis on the ten stormwater outfalls discharging to the culvert between RM 0.4 and RM 0.9.
- Unexplained load in Missouri Flat Creek between the mouth and the city limit (RM 1.7), including the 17 stormwater outfalls that discharge to reaches that were not sampled by this TMDL study.
- Storm drain 120 (34MissSD120) that discharges to Missouri Flat Creek (next to Jack-in-the-Box).
- Unexplained load in Dry Fork Creek between the mouth and RM 0.4 (at the Texaco station on Grand Ave), with emphasis on the 16 stormwater outfalls discharging to the culvert between the mouth and RM 0.4.
- Storm drain WSU1 (34SFPRWSU1) that discharges to the SF Palouse River (near Benewah Street).
- Storm drain 60 (34MissSD60) that discharges to Missouri Flat Creek (at the end of Larry Street).

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

Correlations between TSS and FC bacteria concentrations indicate that some areas may reduce FC loads if TSS loading and soil runoff and erosion are controlled, particularly during wet season runoff events. These include:

- Upper South Fork Palouse River
- Upper Missouri Flat Creek
- Upper Four Mile Creek

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

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 be taken when samples are collected in order to estimate FC loads.

Idaho and Washington jurisdictions need to continue to work cooperatively to monitor and alleviate year-round, cross-border sources of FC bacteria in Paradise Creek and the SF Palouse River, as well as cross-border sources in Missouri Flat Creek during the wet season. Control of TSS loading is also recommended to improve FC contamination.

The following areas should be considered for further monitoring to isolate or better define possible FC bacteria sources:

- The source of year-round FC loading in the city of Colfax needs to be isolated and stopped.
- The areas below the Moscow and Pullman Wastewater Treatment Plants (WWTPs) should be better evaluated for all potential sources that increase FC bacteria. At a minimum, sampling should be done directly above the WWTPs, at the WWTP outfall discharges, and at the TMDL stations below the WWTPs.
- If the monitoring of FC loads above the Pullman WWTP accounts for the downstream load, then further assessment of the SF Palouse reach between RM 22.8 and directly above the WWTP during the dry season is warranted.
- If the monitoring of loads above the Moscow WWTP accounts for the state line load, further assessment of the Paradise Creek reach between RM 8.1 and directly above the Moscow WWTP during the dry season is warranted.
- An assessment of dry-season, non-runoff FC sources in the lower part (below RM 3.9) of Staley Creek may reveal pollution sources.
- An assessment of dry season, non-runoff FC sources between RM 9.2 (Parvin Rd) and RM 5.4 in the SF Palouse River may reveal pollution sources. In particular attention should be given to potential septic failures and illicit discharges.
- Further assessment of the Paradise Creek reach between RM 3.8 and RM 1.1 during the wet and dry season is warranted.
- Further assessment of upper Fourmile Creek (above RM 2.2) during the wet season is warranted.
- The consistent source of FC contamination to Missouri Flat Creek storm drain 120 (34MissSD120) should be investigated.
- The consistent sources of FC contamination from Dry Fork Creek should be investigated.
- The consistent source of FC contamination to storm drain outfalls WSU1 and WSU2 should be investigated.
- Storm drain 34SFPRSD120 (small outfall under Kamiaken bridge) had unusually high FC concentrations in the wet season and storm event. This site should be investigated for cross connections.
- Any storm drains that had flow in the dry season, or those with particularly high FC concentrations, should be investigated for cross connections.

Implementation Strategy

Introduction

The South Fork Palouse River Water Quality Advisory Group (advisory group) formed in June of 2008 to review the fecal coliform bacteria TMDL study results and recommend strategies to improve water quality. This i*mplementation strategy* is a result of their collaboration and reflects their awareness of the water quality problems and related issues. This report was developed locally to reflect the local needs, values, and priorities.

This implementation strategy describes the approach that will be used to improve water quality. It describes the roles and authorities of cleanup partners (that is, 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.

After the U.S. Environmental Protection Agency (EPA) approves this TMDL, Ecology and the advisory group, along with other interested and responsible parties, will work together to develop a w*ater quality implementation plan* (WQIP). The plan will describe and prioritize specific actions planned to improve water quality and achieve water quality standards.

What needs to be done?

The goal of this TMDL is to bring the streams in the South Fork Palouse River Watershed into compliance with Washington water quality standards for fecal coliform bacteria. The water quality standards protect these streams for primary contact recreation (such as swimming and wading).

The advisory group prioritized where work should first begin. The advisory group recommends that the top priorities for implementation measures are areas most likely used for recreational purposes. Children have been observed playing in sections of the South Fork Palouse Watershed (Figure 32). In addition, areas with the highest loads of bacteria should also be a top priority. Working up stormwater sewer lines, stream segments, and tributaries with high loads may reveal sources that can be addressed more readily than other unknown, dispersed sources.

The advisory group identified the following sources (listed alphabetically) that need to be addressed to bring the streams into compliance with the fecal coliform water quality standards.

City of Colfax

The study analysis revealed a large bacteria load entering the South Fork Palouse between sampling stations 34SFPR01.2 and 34SFPR00.1 within the Colfax city limits. This load is larger than any other single load to a stream segment and must be investigated and remedied immediately.

Figure 32. The South Fork Palouse River near the Washington-Idaho state line.

Failing septic systems

Failing septic systems and those piped to streams (straight pipes) may exist in the watershed. Areas with suspected failing systems should be investigated. If failing systems or straight pipes are found they should be reported to the Whitman County Health Department. Such systems need to be repaired or replaced to protect public and environmental safety.

Idaho contributions

According to the study analysis, in the South Fork Palouse River much of the average load (see Figure 9) came from Idaho during both the wet and dry seasons. While the wet season fecal coliform bacteria counts met Washington State concentration based water quality standard they use up most of the downstream loading capacity. During the dry season an 86% reduction is needed to meet the standards at the South Fork Palouse River state line site (34SFPR33.8). The Idaho TMDL for the South Fork Palouse River (Idaho, 2007) established a year round 41% reduction in *E. Coli* concentration. In Paradise Creek, during the dry season, a large average load was noted at the state line site (34Para06.6) (See Figure 15). The two states will need to work together to ensure standards are met at the border and some capacity remains in the river for Washington sources in the South Fork Palouse River.

Land use

TMDLs need to be considered during State Environmental Policy Act (SEPA) and other local land use planning reviews. If the land use action under review is known to potentially impact riparian areas or increase bacteria loading to the stream, then the project may have a significant adverse environmental impact. SEPA lead agencies and reviewers are required to look at potentially significant environmental impacts and alternatives and to document that the necessary environmental analyses have been made. Land use planners and project managers should use this TMDL to help prevent new land uses from violating water quality standards.

Water quality and riparian protection should be incorporated into local regulatory programs and policies. Local governments should use their sensitive area protection authority (under the Shoreline Management Act and Growth Management Act) and incorporate relevant TMDL actions and incentives in the revision or development of their Critical Areas Ordinances, Shoreline Management Plans, and other land use regulations to protect and improve the quality of degraded riparian areas.

Livestock

Livestock operations may contribute bacteria to streams if best management practices are not properly implemented. There are private livestock and animal boarding operations within the watershed. Efforts should be made to increase the owners' awareness of potential water quality impacts from livestock. If impacts are occurring, best management practices will need to be implemented to protect public and environmental safety. Riparian vegetation should be left in place or reestablished to protect streams from the impacts of animals.

Pet waste

Pet waste can be a major source of bacteria in urban watersheds. Many people think their dog does not produce a lot of waste and bacteria, but when you consider all the dogs in a city it can add up to a significant source. Residents and students in the watershed should be educated about proper pet waste management through educational campaigns, articles in local publications, and signs near where people walk dogs. Cities should consider establishing pet waste ordinances or reeducating their residents about existing ordinances. Ordinances should require dog owners and walkers to scoop, bag, and place pet waste in a trash receptacle.

Sediment in Runoff

Data indicated there is a correlation between total suspended solids and fecal coliform bacteria in some portions of the watershed. In these areas, bacteria may be reduced through efforts to reduce sediment in runoff. Agricultural, construction and stormwater best management practices designed to reduce runoff and erosion should be implemented throughout watershed.

Stormwater

The study and analysis showed stormwater outfalls to be a significant source of bacteria to the streams during storm events and also year round at some outfalls. Stormwater outfalls with year-round discharges need to be investigated for cross connections with sanitary sewer lines and illegal connections. Additional source investigation and correction will need to occur for all outfalls with elevated bacteria levels. These efforts may include catch basin maintenance, storm sewer line cleaning, and other best management practices. Educational programs need to teach citizens about the importance of good pet waste and yard care practices to prevent bacteria sources from entering storm drains.

Elevated bacteria levels in storm event flows will benefit from much of the same activities. Sewer line and catch basin maintenance and citizen education will be important methods of reducing bacteria in storm flows.

In addition, efforts to decrease stormwater runoff will also likely reduce bacteria levels in the stream. Stormwater washes bacteria sources, like pet waste, off the land into storm drains and streams.

Preliminary sampling by the city of Pullman (outside the TMDL study) indicates that a small lake and wetland off Merman Road may also be contributing bacteria to the storm sewer line that discharges at 34MissSD120 (near Jack-In-The-Box). This water body needs further investigation to determine how much load is coming from it, and if it is a significant source, methods to reduce bacteria will be needed.

Wastewater treatment plants (WWTPs)

Wastewater treatment plants (WWTPs) are regulated under NPDES permits to limit the amount of pollutants discharged to streams. These permit limits ensure the WWTP does not cause a water quality impairment. The wastewater treatment plants have fecal coliform bacteria limits expressed as concentration-based limits in their discharge permits. The current numeric permit limits for both Pullman and Albion are adequate if they are met and if Albion's discharge is seasonally limited. The town of Albion is currently allowed to discharge year round; however, the existing permit limit will only be protective during the high-flow months (January to May).

Wildlife

Some areas of the watershed may have wildlife using the corridor along streams. Wildlife's bacteria contributions are considered natural and are not usually considered for reduction in a TMDL. However, human activities can result in larger than normal numbers of wild animals congregating in riparian areas. Animals, especially waterfowl, may congregate along streams if there are no shrubs or trees in the area. Practices that remove natural vegetation, such as farming to the stream's edge or unmanaged grazing, can contribute bacteria to streams by inviting waterfowl or other animal use. Washington State Department of Fish and Wildlife encourages and promotes the establishment of healthy-functioning riparian areas to protect water quality. Healthy-functioning riparian areas will not only discourage wildlife from concentrating along streams, they will also help filter any runoff before it enters the stream.

Who needs to participate?

Implementation activities will generally involve agencies and organizations responsible for addressing stormwater and nonpoint pollution sources. The success of this *implementation strategy* will depend on participation from a broad range of entities. 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.

The following entities (listed alphabetically after Ecology) will participate in implementation of this TMDL.

Department of Ecology

Ecology will work with the various agencies in the watershed to ensure progress is being made toward meeting the water quality standards for fecal coliform bacteria. Ecology, in cooperation with the advisory group, will develop a water quality implementation plan (WQIP) which will provide detail about the specific activities that will be done to meet these goals.

Ecology will include wasteload allocations (WLAs) for fecal coliform bacteria in the NPDES permits for the Pullman and Albion WWTPs to ensure these facilities are not causing the streams to exceed water quality standards.

Ecology may incorporate stormwater management actions for the city of Pullman and WSU to address the TMDL into the Eastern Washington Phase II Municipal Stormwater Permit (Municipal Stormwater Permit) when it is renewed. These actions will target the WLAs assigned in the TMDL to the city of Pullman and WSU stormwater systems to ensure point sources are not causing the streams to violate water quality standards. The Municipal Stormwater Permit:

- Bases requirements on recognized practices from existing programs.
- Uses compliance schedules where appropriate.
- Focuses efforts on development of local programs that protect water quality.
- Requires each permit holder to evaluate the effectiveness of the entity's Stormwater Management Program (SWMP).

Ecology designated the city of Pullman for coverage under the Municipal Stormwater Permit. This determination was made, in part, because the city is a public entity that operates a municipal separate storm sewer system (MS4) that discharges to impaired streams. The city of Pullman and WSU are included under the Municipal Stormwater Permit for Eastern Washington and will need to meet the requirements of this permit.

Ecology regulates stormwater from state highways and road facilities through a NPDES stormwater permit for the Washington State Department of Transportation (WSDOT). The permit requires WSDOT implement a stormwater management program, monitoring water quality and investigate illicit discharges into its conveyances.

Ecology also regulates industrial facility and construction site stormwater discharges to surface water. However, neither activity should result in bacterial discharges.

Ecology's Water Quality Program will also monitor the progress of the WQIP, review monitoring data, and apply adaptive management if implementation does not move the streams towards meeting water quality goals in a timely enough manner.

City of Albion

Wastewater Treatment Plant

The town of Albion's WWTP operates under an NPDES permit with permit limits for fecal coliform bacteria. The current limit of 200 cfu/100 mL monthly and weekly average is adequate for discharges from January through May. From June to December, a stricter permit limit of 100 cfu/100 mL monthly and weekly average will be necessary to protect water quality during lower flows. Ecology will update their NPDES permit with this seasonal limit; however, the Albion WWTP typically does not discharge during this period.

City of Colfax

Planning and Engineering Department

The Planning and Engineering Department for the city of Colfax needs to consider this and other TMDLs in the watershed during State Environmental Policy Act (SEPA) and other local land use planning reviews. If the land use action under review is known to potentially increase fecal coliform levels, then the project may have a significant adverse environmental impact. Land use planners and project managers should consider findings and actions in this TMDL to help prevent new land uses from violating water quality standards. Ecology recently published a focus sheet on how TMDLs play a role in SEPA impact analysis, threshold determinations, and mitigation (www.ecy.wa.gov/biblio/0806008.html).

Unexplained load/Stormwater

The city of Colfax started to investigate the large load entering the South Fork Palouse River within the city limits. This investigation needs to continue until the source or sources can be located and remedied. The small drainage on the south end of town and all pipes emptying into the concrete channel need to be monitored to determine if they are sources of bacteria.

City of Pullman

Planning Department

The Planning Department for the city of Pullman needs to consider this and other TMDLs in the watershed during state Environmental Policy Act (SEPA) and other local land use planning reviews. If the land use action under review is known to potentially increase fecal coliform levels, then the project may have a significant adverse environmental impact. Land use planners and project managers should consider findings and actions in this TMDL to help prevent new land uses from violating water quality standards. Ecology recently published a focus sheet on how TMDLs play a role in SEPA impact analysis, threshold determinations, and mitigation (www.ecy.wa.gov/biblio/0806008.html).

Stormwater Management Program

Fecal coliform bacteria loading from stormwater must be reduced to protect water quality. The city of Pullman is included under the Municipal Stormwater Permit. The permit will be re-issued in 2012. The permit requires the implementation of the following stormwater management elements:

- Public education and outreach
- Public involvement and participation
- Illicit discharge detection and elimination
- Construction site stormwater runoff control
- Post-construction stormwater management
- Pollution prevention and good housekeeping for municipal operations
- Requirements based on approved Total Maximum Daily Loads (TMDLs)
- Evaluations of program compliance

As a result of the TMDL study, this implementation strategy recommends that the city of Pullman conduct the following activities:

- Focus illicit discharge detection and elimination efforts in the stormwater system on areas draining to outfalls with continuous year-round discharge. Prioritize program implementation in areas draining to storm sewer outfalls with the highest concentrations and loadings.
- Source identification and control needs to focus on any storm drain outfall that needs a percent reduction. Additional attention should be given to addressing the unexplained loading to Dry Fork Creek, Missouri Flat Creek and storm drains 34MissSD120, and 34MissSD60. Addressing loading to 34MissSD120 will be a joint effort between Pullman and WSU.
- Monitor fecal coliform bacteria in stormwater to better characterize pollutant loads coming from this source. If necessary, wasteload and load allocations may be adjusted based on an improved understanding of stormwater pollutant loads.
    - At a minimum, the three stormwater outfalls assigned numeric WLAs (34MissSD120, 34SFPRWSU1, and 34SFPRWSU2) should be monitored monthly after the city of Pullman and/or WSU implements source control methods to determine if those methods have been successful. The city of Pullman should monitor 34MissSD120, but all monitoring efforts could be a joint effort between Pullman and WSU.
    - A minimum of two storm events per year should be monitored to compare to results of storm sampling in the TMDL study. This monitoring can be used to determine progress towards meeting WLAs.
    - All bacteria monitoring should be accompanied with flow monitoring, so estimates of the bacteria load can be calculated.
    - WSU and the city of Pullman need to investigate the size and cause of the load coming from the small lake and wetland near Merman Road on the WSU campus. University and city land drain to this wetland.
    - All stormwater monitoring requires a Quality Assurance Project Plan approved by Ecology (Lombard and Kirchmer, 2004).
- Monitoring results need to be compared to the WLAs established in this TMDL. If the WLA reductions have not been met, appropriate BMPs will need to be put into place to protect

water quality. The city of Pullman can work with Ecology to determine compliance and seek advice on remedies.

- Public education and outreach efforts must focus on proper pet waste and yard care practices.
- Efforts to reduce stormwater runoff, such as implementing best management practices and encouraging low impact development, should be considered.

Once the Municipal Stormwater Permit activities are fully implemented and the effectiveness has been evaluated, Ecology may need to consider additional activities to address pollutants from stormwater sources.

Wastewater Treatment Plant

The city of Pullman's Wastewater Treatment Plant (WWTP) operates under an NPDES permit with permit limits for fecal coliform bacteria. The current limit of 100 cfu/100 mL weekly average is adequate to protect water quality. During the study year, the treatment plant had several counts above their permit level. These exceedances may have been due to plant modifications, but the WWTP operators will need to ensure the permit limit is met consistently.

The WWTP will also continue best management practices during their transportation and handling of biosolids to ensure they do not enter any catch basins on the WWTP grounds. During biosolid hauling the catch basin in the vicinity is sealed with a double layer of plastic forcing any runoff into an adjacent catch basin which is routed back to the headworks. During future upgrades of the WWTP, the city will evaluate the plant's storm drain system.

Idaho (City of Moscow and Latah County)

Paradise Creek Unexplained Loading

The TMDL study indicated that there is unexplained loading to Paradise Creek upstream of the Washington-Idaho state line site. The city of Moscow should investigate Paradise Creek to determine if the loading is occurring within the city limits. If the load is entering Paradise Creek upstream of the city of Moscow, sources in the county should be investigated and remedied.

Stormwater Management

The city of Moscow will be covered under EPA's municipal Stormwater NPDES permit in the future. If stormwater pollution is contributing bacteria to Paradise Creek, the NPDES permit should include activities to address this source.

Wastewater Treatment Plant

The city of Moscow WWTP should remain in compliance with their NPDES bacteria permit limits and ensure that their discharge does not contribute to downstream water quality standards violations.

Idaho Department of Environmental Quality

The United States Environmental Protection Agency (EPA) approved Idaho Department of Environmental Quality's (IDEQ) TMDLs for bacteria on both Paradise Creek and the South Fork Palouse River. EPA approved the Paradise Creek TMDL in February 1998. The data collected during the Washington TMDL study should be compared to the load allocations established in the Paradise Creek TMDL to determine if the creek is meeting required reductions at the Washington-Idaho state line. If the water quality is not in compliance with the TMDL, adaptive management should be applied.

EPA approved the Idaho South Fork Palouse River TMDL in October 2007. IDEQ began developing an implementation plan at the time Ecology published this document. This TMDL called for a 41% year-round reduction in *E. coli*. The relationship between *E. coli* and fecal coliform bacteria in this watershed is very comparable; therefore, Idaho's TMDL will likely result in a similar reduction in fecal coliform bacteria. According to Ecology's study, an 86% reduction in fecal coliform bacteria is needed during the dry season to meet Washington's water quality standards at the border. IDEQ and Ecology should work together to ensure Washington's standards are met at the border.

Environmental Protection Agency

The EPA issues NPDES permits in Idaho. The Moscow WWTP permit contains limits designed to meet Washington's water quality standards. EPA should continue to ensure new issues of Moscow's permit contribute to Paradise Creek meeting Washington's water quality standards at the state line.

EPA recently determined that Moscow needed coverage under the municipal stormwater NPDES permit. If necessary, EPA should ensure the city of Moscow takes appropriate actions to reduce stormwater bacteria loading to Paradise Creek.

Palouse Conservation District

The Palouse Conservation District (Palouse CD) is a non-regulatory organization that actively assists land managers (rural and urban) to implement conservation practices. The Palouse CD provides educational, technical, and financial assistance through various voluntary, incentive-based programs.

The Palouse CD applied for and was awarded a grant to help implement this TMDL during Ecology's Fiscal Year 2010 grant cycle. The grant would pay for riparian restoration, livestock BMP implementation, water quality education and other activities to reduce nonpoint source pollution.

Residents and Landowners

The bacteria contributions in the rural parts of the South Fork Palouse River watershed are primarily from nonpoint sources of pollution. Nonpoint source pollution results from the actions of all people living in a watershed; therefore, everyday activities by citizens can have a significant impact on local water quality.

In some rural areas in the watershed there is a correlation between bacteria and total suspended solids. Agricultural landowners may be able to help reduce bacteria entering the streams by implementing agricultural practices that reduce runoff and erosion.

In addition, actions by residents and landowners within urban areas can contribute bacteria to stormwater. Actions watershed residents can take to lessen their impact include:

- Properly disposing of and managing animal waste.
- Restoring their riparian areas.
- Repairing failing or regularly pumping septic systems.
- Educating others about the impacts of their everyday actions on water quality.

Many of the agencies and organizations mentioned in this plan can provide technical or financial assistance to landowners and residents for these activities.

Washington State Department of Transportation

The Washington State Department of Transportation (WSDOT) has a NPDES permit to address stormwater in Phase I and Phase II municipal areas and in areas covered by TMDLs. The permit became effective March 4, 2009 and regulates how WSDOT will manage stormwater from highway systems to prevent pollution to water bodies. The permit requires WSDOT to implement its stormwater management program (SWMP), which includes water quality monitoring and field investigations of illicit discharges into its conveyances. WSDOT shall report the findings of its investigations and the actions taken to implement its SWMP to Ecology in a report the permit requires the agency to submit annually. In areas, like the city of Pullman, WSDOT allocates maintenance responsibilities between WSDOT and the city according to a memorandum of understanding (MOU) signed with the Association of Washington Cities (WSDOT, 2009).

Three WSDOT highways traverse (195, 270, and 27) the South Fork Palouse River watershed. Ecology did not observe any continuous flows from outfalls along these highways, however, it can be expected that during a storm event, runoff from outfalls could be similar to those observed in the May 2, 2007 stormwater sampling in Pullman. Therefore, WSDOT will need to:

- Inventory outfalls discharging to Paradise Creek, Missouri Flat Creek, Dry Fork Creek, and Spring Flat Creek outside of the Pullman city limits.
- Monitor stormwater discharges as opportunities arise to establish a baseline bacteria level to determine compliance with standards.
- Implement BMPs for any outfalls that may be contributing bacteria to the streams.
- Operate and Maintain existing BMPs.

Washington State University

Capital Planning and Development

The Capital Planning and Development Department for WSU needs to consider this and other TMDLs in the watershed during state Environmental Policy Act (SEPA) and other local land use planning reviews. If the land use action under review is known to potentially increase fecal coliform levels, then the project may have a significant adverse environmental impact. Land use planners and project managers should consider findings and actions in this TMDL to help prevent new land uses from violating water quality standards. Ecology recently published a focus sheet on how TMDLs play a role in SEPA impact analysis, threshold determinations, and mitigation (www.ecy.wa.gov/biblio/0806008.html).

Stormwater Management

Fecal coliform bacteria loading from stormwater must be reduced to protect water quality. WSU is included under the Municipal Stormwater Permit as a secondary permittee. The permit will be re-issued in 2012. The permit requires the implementation of the following stormwater management elements:

- Public education and outreach
- Public involvement and participation
- Illicit discharge detection and elimination
- Construction site stormwater runoff control
- Post-construction stormwater management
- Pollution prevention and good housekeeping for municipal operations
- Requirements based on approved Total Maximum Daily Loads (TMDLs)
- Evaluations of program compliance

As a result of the TMDL study, this implementation strategy recommends that WSU conduct the following activities:

- Focus illicit discharge detection and elimination efforts in the stormwater system on areas draining to outfalls with continuous year round discharge and prioritize program implementation in areas draining to storm sewer outfalls with the highest concentrations and loadings.
- Source identification and control needs to focus on any storm drain outfall that needs a percent reduction. Additional attention should be given to addressing the unexplained loading to Missouri Flat Creek and storm drains 34MissSD120 and 34SFPRWSU1. Addressing loading to 34MissSD120 will be a joint effort between Pullman and WSU.
- Monitor fecal coliform bacteria in stormwater to better characterize pollutant loads coming from this source. If necessary, wasteload and load allocations may be adjusted based on an improved understanding of stormwater pollutant loads.
    - At a minimum, the three stormwater outfalls assigned numeric WLAs (34MissSD120, 34SFPRWSU1, and 34SFPRWSU2) should be monitored monthly after WSU and/or the city of Pullman implements source control methods to determine if those methods have been successful. Monitoring 34MissSD120 could be a joint effort between the city of Pullman and WSU.
    - A minimum of two storm events per year should be monitored to compare to results of storm sampling in the TMDL study. This monitoring can be used to determine progress towards meeting WLAs.

- All bacteria monitoring should be accompanied with flow monitoring so estimates of the bacteria load can be calculated.
- WSU and the city of Pullman need to investigate the size and cause of the load coming from the small lake and wetland near Merman Road on the WSU campus. University and city land drain to this wetland.
- All stormwater monitoring requires a quality assurance project plan approved by Ecology (Lombard and Kirchmer, 2004).

- Monitoring results need to be compared to the WLAs established in this TMDL. If the WLA reductions have not been met, appropriate BMPs will need to be put into place to protect water quality. WSU can work with Ecology to determine compliance and seek advice on remedies.
- Public education and outreach efforts must focus on proper pet waste and campus landscaping and yard care practices.
- Efforts to reduce stormwater runoff, such as implementing best management practices and encouraging low impact development, should be considered.

Once the Municipal Stormwater Permit activities are fully implemented and the effectiveness has been evaluated, Ecology may need to consider additional activities to address pollutants from stormwater sources.

Whitman County

Health Department

The Whitman County Health Department regulates small on-site septic systems in the county. If and when failing septic systems are found, the Health Department will work with the landowners to identify the cause of the failure and necessary actions to fix the problem. The Health Department has information for landowners on their website at: www.whitmancounty.org/ssi.aspx?ssid=28.

Planning Department

The Whitman County Planning Department needs to consider this and other TMDLs in the watershed during State Environmental Policy Act (SEPA) and other local land use planning reviews. If the land use action under review is known to potentially increase fecal coliform levels, then the project may have a significant adverse environmental impact. Land use planners and project managers should consider findings and actions in this TMDL to help prevent new land uses from violating water quality standards. Ecology recently published a focus sheet on how TMDLs play a role in SEPA impact analysis, threshold determinations, and mitigation (www.ecy.wa.gov/biblio/0806008.html).

What is the schedule for achieving water quality standards?

The water quality goal of this TMDL for all water bodies in the South Fork Palouse River watershed is to consistently meet both parts of the two-part fecal coliform bacteria water quality standard. Currently, the South Fork Palouse River, Paradise Creek, Missouri Flat Creek and Dry Fork Creek were listed on the 303(d) list as not meeting water quality standards for bacteria. In addition this TMDL study showed that other tributaries are also not meeting the bacteria standard. If the activities described in this implementation strategy and detailed in the future implementation plan are carried out in a timely manner these water bodies should meet the bacteria standard by 2020. It is expected that the concentrations and loads in these streams will be significantly reduced in the first five years of implementation. If upstream loads are reduced or eliminated it should result in reductions of downstream loads and concentrations in many areas. Based on this assumption, these streams should achieve at least 50 % of the target reductions specified in this report by 2015. For example, if an 80 % target reduction was assigned to a location, it would be expected that a 40 % reduction would occur at that location by 2015. If implementation does not meet this goal, Ecology may apply adaptive management (see section below) to ensure these streams are on target for meeting water quality standards by 2020.

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

Monitoring progress

The success of this TMDL will be measured by tracking the progress of implementation activities and monitoring bacteria levels in the streams. Ecology will review this progress to determine if the streams are moving toward meeting water quality standards or if adaptive management is needed.

Implementation activities

Ecology's TMDL Coordinator will work with the organizations outlined in this document to track implementation activities occurring in the watershed. 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. Stormwater permittees are responsible for meeting the requirements of their permits. Wastewater treatment plants are responsible for monitoring effluent bacteria concentrations and reporting those to Ecology on their discharge monitoring reports (DMRs).

In-stream monitoring

Ecology will conduct in-stream monitoring to determine the effectiveness of this TMDL. This monitoring will be used to ensure implementation activities are achieving the necessary load reductions and the streams are meeting or coming into compliance with water quality standards. The timing of this monitoring will depend upon when implementation results should be identifiable and the availability of resources. Typically, Ecology strives to conduct effectiveness monitoring five years after implementation activities begin if that allows adequate time for the implementation to take effect.

Ecology also monitors water quality at site 34SFPR22.8 (also known as 34B110) monthly. This monitoring should show trends that will help determine if water quality is improving over time.

The *recommendations* section of this report (pages 89-91) includes monitoring that may help better define bacteria sources. Monitoring in accordance with these recommendations may also help direct the best implementation actions for reducing bacteria. These recommendations will be taken into consideration during the development of the *water quality implementation plan* which will describe the coordinated monitoring strategy.

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 2020. The w*ater quality implementation plan* may identify interim targets. These targets will be described in terms of percent reductions, concentrations, and implementation activities. Partners will work together to monitor progress towards these goals, evaluate successes, obstacles, and changing needs, and make adjustments to the implementation strategy 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 33) 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.

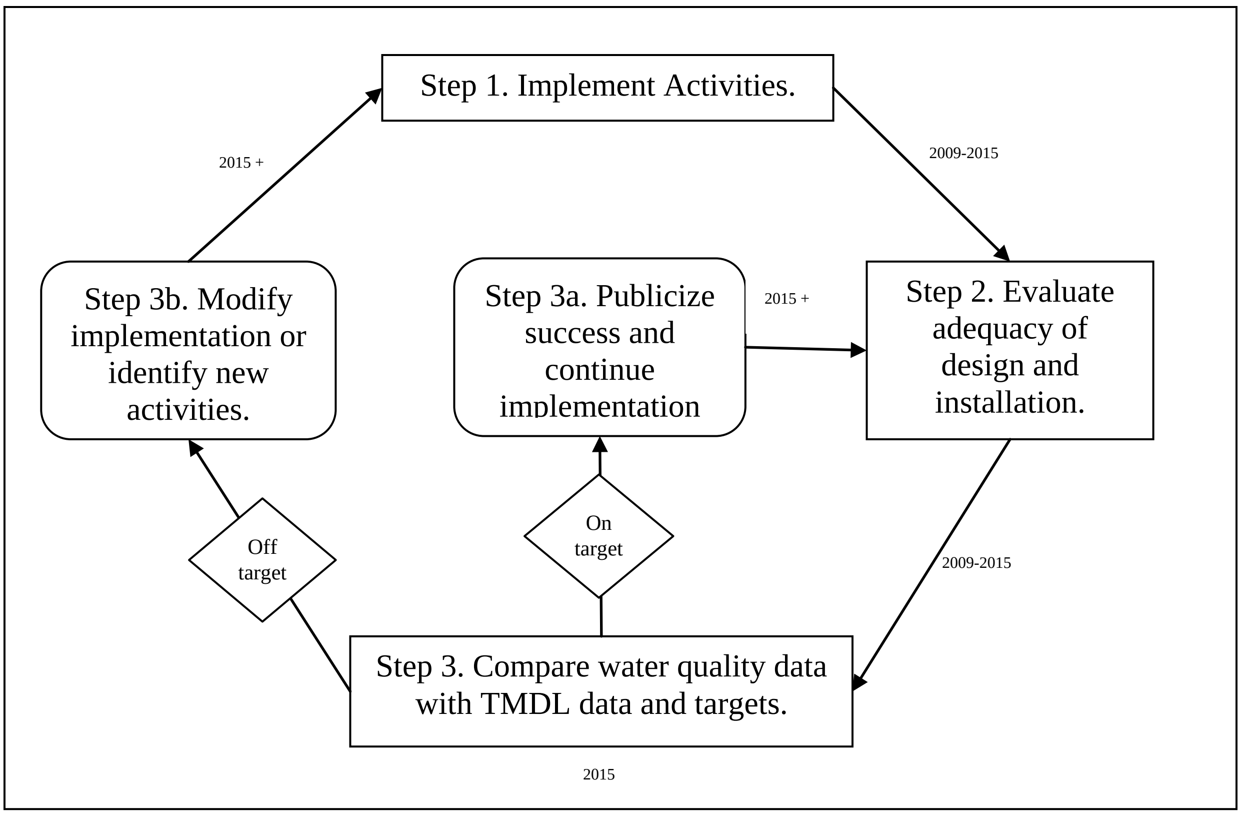


Figure 33. Feedback loop for determining need for adaptive management. Dates are estimates and may change depending on resources and implementation status.

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. In the South Fork Palouse River watershed both point and nonpoint fecal coliform sources exist. TMDLs (and related action plans) must show "reasonable assurance" that these sources will be reduced to their allocated amount. Ecology and other organizations will use education, outreach, technical and financial assistance, permit administration, and enforcement to ensure that the goals of this water improvement plan are met.

Improved water quality will be achieved through the combined efforts of many organizations and citizens in the watershed. There is considerable interest and local involvement toward resolving the water quality problems. Organizations and agencies are already engaged in stream restoration and source correction actions that will help resolve the fecal coliform problems.

Ecology believes that the following activities already support this TMDL and add to the assurance that fecal coliform levels in the streams will meet conditions required by Washington State water quality standards. This assumes that the activities described below are continued and maintained.

To support this TMDL, Ecology will work cooperatively with all entities to promote the implementation of activities contained in this plan. Organizations and their commitments under laws, rules and programs to resolve bacteria problems in the watershed are described below.

City of Colfax

The city of Colfax has a pet waste ordinance (City Code 6.08.130) requiring pet owners clean up their pet's waste and dispose of it properly.

City of Moscow, ID

The city of Moscow is required to apply for the Municipal Stormwater NPDES permit and provide a proposed Stormwater Management Program to EPA by September 2009. Stormwater Management in the city of Moscow will help protect Paradise Creek from fecal coliform bacteria.

In addition, the Moscow WWTP is currently installing a filtration system. This system should reduce nutrient inputs to Paradise Creek, reducing the potential for re-growth downstream of the WWTP.

City of Pullman

Stormwater from the city of Pullman is regulated under the Clean Water Act under the Municipal Stormwater Permit. The permit requires Pullman to reduce the discharge of pollutants by using all known, available, and reasonable methods to prevent and control stormwater pollution. Pullman must develop and implement a stormwater management program. In February 2009, the city of Pullman adopted a Stormwater Utility Fee Ordinance to help pay for this program.

A city of Pullman policy also requires dye testing of all new or retrofitted sewer connections to ensure sewer lines have not been misconnected to stormwater sewer lines.

Pullman City Code 9.20.110 requires pet owners to pick up after pets in public places and private premises not owned by the pet owner. The pet owner also has to carry in their possession the necessary tools to remove wastes when walking their pet.

The city of Pullman is also implementing their Grand Avenue Initiative which is restoring riparian areas along the stream segments running through the city.

Department of Ecology

Ecology was delegated authority of the federal Clean Water Act by the U.S. EPA to establish water quality standards, administer the NPDES wastewater permitting program and to enforce water quality regulations under Washington State law [Chapter 90.48 Revised Code of Washington (RCW)].

Chapter 90.48 RCW states "It shall be unlawful for any person to throw, drain, run, or otherwise discharge into any of the waters of this state, or to cause, permit or suffer to be thrown, run, drained, allowed to seep or otherwise discharged into such waters any organic or inorganic matter that shall cause or tend to cause pollution of such waters according to the determination of the department, as provided for in this chapter."

Ecology responds to complaints, conducts inspections, and issues NPDES permits as part of its responsibilities under state and federal laws and regulations. In cooperation with conservation districts, Ecology will pursue implementation of BMPs for agricultural and other land uses and may use enforcement, including fines, for water quality violations that are not actively being corrected. Ecology also offers funding for water quality projects through its Centennial Clean Water Fund and Section 319 Nonpoint Source Fund to implement TMDLs.

Natural Resources Conservation Service (NRCS)

NRCS works closely with conservation districts to implement farm plans and agricultural BMP programs. NRCS is one of the primary entities for technical assistance and financial support to assist in the implementation of agricultural and livestock BMPs throughout the watershed.

Palouse Conservation District

Conservation districts have authority under Chapter 89.08 RCW to develop farm plans to protect water quality and provide animal waste management information, education and technical assistance to residents on a voluntary basis. Ecology and local health jurisdictions refer landowners with water quality violations to the local conservation district for assistance. When developing farm plans, the district uses guidance and specifications from the U.S. Natural Resources Conservation Service.

Palouse Watershed Planning Unit

The Palouse Watershed Planning Unit was formed under Chapter 90.82 RCW to develop local solutions to watershed issues. Watershed Planning Units are primarily focused on water quantity issues, but individual planning units can elect to also address water quality issues. The Palouse Watershed Planning Unit elected to address water quality and be informed about the development of TMDLs. The Palouse Watershed Plan (HDR/EES, 2007) includes many basin-wide and South Fork Palouse-specific management objectives and actions for addressing water quality problems including fecal coliform bacteria.

Washington State Department of Transportation

The WSDOT has a NPDES permit and a Stormwater Management Program Plan to address stormwater in Phase I and Phase II municipal areas. These regulate how WSDOT will manage stormwater from highway systems to prevent pollution to water bodies. WSDOT also pays stormwater utility fees to help finance development and implementation of local government stormwater management programs in areas where highways and municipal systems comingle.

Washington State University

Stormwater from the WSU campus is regulated under the Clean Water Act under the Municipal Stormwater Permit. The permit requires WSU to reduce the discharge of pollutants by using all known, available, and reasonable methods to prevent and control stormwater pollution. WSU must develop and implement a stormwater management program. Information about WSU's stormwater management program is available at www.ehs.wsu.edu/PH/SW/Stormwater.html. As part of WSU's stormwater efforts, approximately 900 storm drain inlets were labeled with plaques stating "No Dumping, Drains to River." WSU also obtains construction stormwater permits for all projects one acre or greater in size and uses BMPs for projects less than one acre.

On campus, the landscape irrigation system is in the process of being replaced with computerized evapotranspiration irrigation controllers to help eliminate off-site water discharges.

WSU has a spill response plan and responds to all sewage spills in a timely manner.

Washington State Administrative Code (WAC) 504-36-020, labeled Control of Animals, took effect December 25, 2008 for the WSU campus. It spells out guidelines for having animals on campus. These guidelines prohibit animals in university buildings, require animals to be under immediate control (physical restraint), and require the owners/handlers to pick up fecal matter.

The animal holding facilities exposed to precipitation at WSU do not currently discharge to the sanitary sewer or surface water and do not have the potential to discharge; therefore, their Concentrated Animal Feeding Operation NPDES permit was terminated in 2008.

Whitman County Health Department

The Whitman County Health Department's mission is to educate, promote, maintain, and improve the health status of the people they serve in Whitman County. The Environmental Health Division of the department uses education to protect citizens from environmental health threats.

The Health Department also regulates on-site sewage systems in the county in accordance with Chapter 246-272A WAC. When the department receives a complaint about a failing system, the department verifies the failure and assists the landowner with coming into compliance with Chapter 246-272A WAC. In addition, the Whitman County Health Department is often involved in the investigation of complaints about agricultural animal waste.

Potential funding sources

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 30 and are described below.

Table 30. 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 Security 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 funding through a 319 grant to provide additional implementation 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.

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 % 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 % cost-share, but allows 90 % 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 % 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 Security Program

The Conservation Security Program (CSP) is a voluntary program that provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on tribal and private working lands. Working lands include cropland, grassland, prairie land, improved pasture, and range land, as well as forested land that is an incidental part of an agriculture operation. The program provides equitable access to benefits to all producers, regardless of size of operation, crops produced, or geographic location. CSP is administered by NRCS (NRCS, 2006).

Each year, different watersheds are selected for CSP enrollment. It is not known when this program will come to the South Fork Palouse River watershed. However, since the program rewards producers who already have conservation practices in place, producers are encouraged to use other federal, state, and local funding sources to prepare their land for enrollment.

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 % 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 May 17, 2006 in Pullman, Washington to introduce the public to the TMDL process and explain the studies planned for the South Fork Palouse River watershed. During the study and data analysis, Ecology maintained a mailing list which was used to keep people interested in the TMDL up to date on its progress. In addition, Ecology maintained a Palouse Watershed TMDL Website (http://www.ecy.wa.gov/programs/wq/tmdl/palouse/index.html) to provide information about all TMDL work in the watershed.

Prior to the study, a technical advisory group reviewed and provided comments on the Quality Assurance Project Plan (Matheiu & Carroll, 2006) for the study that resulted in this TMDL.

In June 2008, Ecology formed the South Fork Palouse River (SFPR) Water Quality Advisory Group to review the study findings and assist with the development of this TMDL report. The advisory group's membership included city and county representatives, university environmental management representatives, livestock owners, agriculture, riparian landowners, upstream governments and concerned citizens. The advisory group met approximately monthly from June

2008 to June 2009 to assist Ecology with the development of this report. Meeting agendas and notes are available on the South Fork Palouse River TMDL Advisory Group webpage (http://www.ecy.wa.gov/programs/wq/tmdl/palouse/sfpradvgp.html). The advisory group also reviewed and commented on previous versions this document prior to its completion. Advisory group comments and Ecology's responses are also available on the advisory group webpage.

A public comment period on this report was held from August 24, 2009 to September 25, 2009. Letters announcing the public comment period were sent to Ecology's Palouse Watershed mailing list. A press release was issued to local media outlets and display ads were placed in the Moscow-Pullman Daily News and Whitman Gazette newspapers. The comments received are responded to in Appendix B of this report.

Next steps

Once EPA approves the TMDL, a *water quality implementation plan* must be developed within one year. Ecology will work with local people to create this plan, choosing the combination of possible solutions they think will be most effective in their watershed. Elements of this plan include:

- Who will commit to do what.
- How to determine if the implementation plan works.
- What to do if the implementation plan doesn't work.
- Potential funding sources.

References

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

Bush, J.H. and D.L. Garwood, 2005a and 2005b. Bedrock Geology Map of the Albion and Pullman 7.5 Minute Quadrangle, WA.

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.

Cooley M., D. Carychao, L. Crawford-Miksza, M.T. Jay, C. Myers,2007. Incidence and Tracking of Escherichia coli O157:H7 in a Major Produce Production Region in California. PLoS ONE 2(11): e1159. http://www.plosone.org/article/info:doi/10.1371/journal.pone.0001159.

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 pgs. www.ecy.wa.gov/biblio/97334.html.

Ecology, 2000. Determination of Instantaneous Flow Measurements of Rivers and Streams. Stream Hydrology Unit (SHU), Washington State Department of Ecology, Olympia, WA.

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.

Hallock, D., 1993. South Fork Palouse River Analysis of Ambient Monitoring Data. Washington State Department of Ecology, Olympia, WA. Publication No. 93-e25. www.ecy.wa.gov/biblio/93e25.html.

HDR/EES, Inc., 2007. Palouse Watershed Plan. Pasco, WA. (www.ecy.wa.gov/watershed/misc/34/wria34_wsplan_final.pdf).

IDEQ, 2007. South Fork Palouse River Watershed Assessment and TMDLs. Idaho Department of Environmental Quality, Lewiston Idaho. www.deq.state.id.us/water/data_reports/surface_water/tmdls/palouse_river_sf/palouse_river_sf_entire.pdf

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.

Lombard, S. and C. Kirchmer, 2004. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. Washington State Department of Ecology, Olympia, WA. Publication No. 04-03-030. www.ecy.wa.gov/biblio/0403030.html.

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.

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 pgs.

Pelletier, G., 1993. South Fork Palouse River TMDL of Ammonia. Washington State Department of Ecology, Olympia, WA. Publication No. 93-e48. www.ecy.wa.gov/biblio/93e48.html

Pitt, R., A. Maestre, and R. Morquecho, 2004. National Stormwater Quality Database (NSQD, Version 1.1). Department of Civil and Environmental Engineering, University of Alabama, Tuscaloosa, AL. unix.eng.ua.edu/~rpitt/Research/ms4/Paper/recentpaper.htm.

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.

RPU, Inc., 2002. South Fork Palouse River Watershed Characterization and Implementation Plan. Resource Planning Unlimited, Inc., Moscow, ID.

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 pgs. www.ecy.wa.gov/biblio/0203014.html.

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

Washington State Department of Transportation (WSDOT), 2009. Washington State Department of Transportation Stormwater Management Program Plan (Appendix 7). Olympia, WA. 79 pgs. www.ecy.wa.gov/programs/wq/stormwater/municipal/wsdot/finalPermitdocs2009/WSDOT7.pdf

Wayland R.H., and J.A. Hanlon, 2002. Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water and NPDES Permit Requirements Based on those WLAs. U.S. Environmental Protection Agency, Office of Water, Memorandum to Water Directors USEPA Regions 1 – 10, Washington, D.C. November 22, 2005. 6 pgs.

Appendices

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Appendix A. Glossary and acronyms

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 beneficial 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.

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.

Fecal coliform bacteria (FC bacteria): 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 twenty-four hours at 44.5 plus or minus 0.2 degrees Celsius. FC 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 water body's 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.

Municipal separate storm sewer systems: A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains): (i) owned or operated by a state, city, town, borough, county, parish, district, association, or other public body having jurisdiction over disposal of wastes, storm water, or other wastes and (ii) designed or used for collecting or conveying stormwater; (iii) which is not a combined sewer; and (iv) which is not part of a Publicly Owned Treatment Works (POTW) as defined in the Code of Federal Regulations at 40 CFR 122.2.

Municipal stormwater permit: In this document this term refers to the Eastern Washington Phase II Municipal Stormwater Permit. This permit is an NPDES permit that regulates stormwater discharges from municipal separate storm sewer systems.

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.

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

Phase I stormwater permit: The first phase of stormwater regulation required under the federal Clean Water Act. The permit is issued to medium and large municipal separate storm sewer systems (MS4s) and construction sites of five or more acres.

Phase II stormwater permit: The second phase of stormwater regulation required under the federal Clean Water Act. The permit is issued to smaller municipal separate storm sewer systems (MS4s) and construction sites over one acre.

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.

Reach: A specific portion or segment of a stream.

Secondary contract recreation: Activities where a person's water contact would be limited to the extent that bacterial infections of the eyes, ears, respiratory or digestive systems, or urogential areas would normally be avoided.

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.

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.

Acronyms and abbreviations

Following are acronyms and abbreviations used frequently in this report.

BMP	Best management practices
cfs	Cubic feet per second
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FC	Fecal coliform
GIS	Geographic Information System software
NAF	New Approximation Flow
NPDES	National Pollution Discharge Elimination System
NSDZ	Near-stream disturbance zones
POTW	Publicly owned treatment works (wastewater treatment facilities)
QA	Quality assurance
QC	Quality control
RM	River mile
SF	South Fork
SFPR	South Fork Palouse River
TIR	Thermal infrared radiation
TMDL	Total Maximum Daily Load (water quality improvement plan)
TSS	Total suspended solids
USFS	United States Forest Service
USGS	United States Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation
WSU	Washington State University
WWTP	Wastewater treatment plant

Appendix B. Response to public comments

Comments from Camille Wadligh, citizen

Comment: It was surprising to learn that water quality in urban settings is worse than in rural areas. However, what can be done about those farmers who choose to disregard the Clean Water Act and keep cows fenced into creeks or other water ways, areas that pass through their land? We have complained to the ASCS office many times and nothing has been done – for years.

Response: The Department of Ecology (Ecology) refers landowners whose cattle are adversely affecting a stream to their local conservation district for assistance to address the problem(s). The conservation districts in partnership with the Natural Resources Conservation Service (NRCS) will recommend livestock best management practices that prevent the adverse effects of livestock and assist the landowner in obtaining cost-share funding to pay a majority of the costs of implementing these practices.

Comments from Cheryl Morgan, landowner and member of SFPR TMDL Advisory Group

Comment 1: As one of my public comments, I request that the [jurisdictional] lines appear on the graphs within the final document.

Response 1: Jurisdictional lines have been added to Figures 29 and 30 as requested.

Comment 2: I know I have commented on this issue before. I want to make sure that Hadley Creek is changed to Hatley Creek on the Final Document. If the document cannot be changed from Hadley to Hatley, **I request a correction be indicated through a footnote**.

Response 2: We searched the document and could not find any remaining references to "Hadley Creek." We believe all such occurrences have been corrected to read "Hatley Creek."

Comment 3: In reference to:

<u>**Page (11)**</u> The last paragraph states "there are approximately 90 outfalls draining stormwater from the city of Pullman and WSU's campus. Ecology sampled bacteria and flow from 14 of these outfalls".

I realize the largest outfalls were focused on first for this improvement project.

Does ecology plan to continue to sample bacteria and flows from the remaining outfalls? If yes, when? If the answer is no, please explain why not.

The Federal Clean Water Act is a Public Welfare Law to protect all people from the dangers of water pollution.

The 1972 Federal Clean Water Act clearly states that "waste transport to our nation's waters shall no longer be used as waste conveyance or treatment systems".

Page (24) As of Feb. 16, 2007 the City of Pullman and WSU were required coverage under the Eastern Washington Phase II Municipal Stormwater Permit.

The permit requires continued mandated monitoring and reporting of pollutant flows from stormwater outfalls located within the city and WSU. Will monitoring and reporting of pollutants be required for the 90 plus outfalls? If no, why not?

Response 3: Ecology does not currently have plans to monitor remaining stormwater outfalls in Pullman. The Municipal Stormwater National Pollutant Discharge Elimination System (NPDES) permit requires the city of Pullman and WSU to address, reduce, and prevent pollution from their stormwater outfalls by implementing the programmatic requirements of the permit. The current permit does not mandate monitoring and reporting of pollutant flows from stormwater as stated in your comments. The current permit only requires the development of a monitoring strategy. Future versions of the Municipal Stormwater NPDES permit will have monitoring requirements, however at this time the extent of that monitoring has not been determined. The TMDL implementation strategy recommends monitoring actions for the city and WSU to use to help them determine the best actions to reduce pollutant loading. Ecology expects that the city and WSU will use the monitoring results from this TMDL study to prioritize their efforts.

Comment 4: This SFPR Bacteria Water Quality Improvement Project did not focus on sampling bacteria and flows coming from stormwater detention ponds. Detention ponds are collectors and conveyance systems for urban stormwater runoff. The soils of the Palouse exhibit low to moderate infiltration rates, thus close to 100% of the untreated stormwater collected within the detention ponds is conveyed to natural waterways transposing the natural waterways into urban stormwater utility sewer systems. Urban stormwater detention systems present a high pollutant risk to the public, thus they should have been included within this project. Will DOE be including these stormwater detention systems in future water quality improvement projects for the SFPR? If yes, when? If no, why not?

Response 4: Ecology sampled the largest stormwater outfalls to characterize bacteria concentrations and loading coming for stormwater. If any detention ponds discharged to the stormwater system that delivers stormwater to one of these outfalls, their contributions would have been captured before discharging to the stream. There are multiple detention ponds throughout the city of Pullman which may or may not have been discharging during our sampling efforts.

Our study sampled the South Fork Palouse River in several locations throughout the city of Pullman. Data from these sites may bracket upstream and downstream affects of some of the detention ponds. The city of Pullman could use our results to focus their implementation and source identification efforts if they suspect detention ponds could be elevating bacteria levels in a specific reach.

See response 3 concerning future monitoring.

Comment 5: In summary:
I have lived along the SFPR riparian corridor for over 60 years. The SFPR was listed on the May 1996 Federal Clean Water Act section 303(d) list as an impaired water body of the State of Washington. The SFPR water quality exceeded Washington State Standards for temperature, dissolved oxygen, ammonia, pH, phosphorus, sediment, **fecal coliform** and habitat modifications.

I knew the elevated levels of fecal coliform within the SFPR presented a **high risk of infectious diseases especially to children causing them to suffer neurological and intestinal symptoms that could be life threatening if not treated in a timely manner**. I am very aware that children and their dogs enter the river (urban and rural) for recreational activities, thus the health of the SFPR is of a great concern to me and should be of a great concern to all citizens (urban and rural) of this community. In 1998 I joined the local watershed-planning group for the SFPR. I have continued to be an active participant in watershed planning of the entire Palouse Basin Watershed.

The Palouse Basin Water Resource Inventory Area (WRIA-34) Plan which was adopted in Nov. 2007 clearly identifies four areas of concern within all of the sub-basins of the Palouse watershed: (1.) Insufficient water supply, **(2.) Poor water quality,** (3.) Loss of riparian and aquatic habitat, and (4.) Inadequate instream flows. **The citizens of this community must recognize the fact, that these impairments are of significance and offer no sustainability to present and future generations.**

Pullman, WSU and Whitman County have been active participants of watershed planning of the SFPR just as I have. They simply [have not] taken a proactive approach [*sic*] in the clean-up and protection of the water quality of the SFPR and its tributaries, thus placing citizens (urban and rural) of this community at a high risk of waterborne illnesses. It is of great concern as to why our local and state health departments have not been active participants in the numerous Palouse Basin Watershed Planning processes.

It is imperative that all citizens become involved in the clean-up activities proposed for the SFPR. Remind local, state and federal government employees that their jobs are funded by the public, thus they become public servants. Their number one responsibility is to **protect** the safety and welfare of **all** citizens of this community (urban and rural) without exception. They are not only socially and ethically responsible, they are **lawfully** responsible. Continued lawsuits because of non-compliance of State and Federal water quality laws are extremely costly to taxpayers of Washington State.

Response 5: Thank you for your commitment to water quality issues in the area. Addressing these issues requires broad support. Improving the health of these streams means everyone doing their part to reduce pollution, educating their friends and neighbors about the issues, and getting involved restoration efforts. We will continue to work with our partners in the watershed to restore the streams and protect them from future degradation.

Comments from Kevin Gardes, PE, Deputy Public Works Director, City of Pullman

Comment 1: Pg. 91 second bullet, I still think it is speculative to link re-growth to WWTP discharges, both in Pullman and Moscow, as there are a number of other potential sources (e.g. Hatley Creek, livestock, wetlands, storm drains). I'd rather see any evaluation look at "all potential sources", not just "re-growth" from the plant, in any future work.

Response 1: The bullet statement was reworded to say: "The areas below the Moscow and Pullman Wastewater Treatment Plants (WWTPs) should be better evaluated for all potential sources that increase FC bacteria."

Comment 2: Pg. 109, dye testing is currently "policy" not a design standard or Pullman Public Works.

Response 2: The paragraph referring to the city of Pullman's dye testing requirement has been corrected.

Comments from Tom Kammerzell, landowner, Whitman Co. Cattleman's Assoc., Whitman County Conservation District

Comments: After reviewing the documentation presented at the Aug. 27, 2009 meeting regarding the South Fork Palouse River Water Quality Improvement Plan, it was apparent that there was a need to bring into compliance the water due to elevated fecal coliform counts.

However, the data that is totally lacking in the report and thus severely reduces the report's validity, is information that determines which warm blooded animals (humans, wildlife, domestic pets or farm animals) are the contributors. This information seems to be especially important given, according to your information, the greatest contributors of fecal coliform are in the urban areas. The Water Quality Improvement Plan should not be implemented without this information.

DNA testing can identify the contributors and thus the exact source of the fecal coliform.

Without this information, the plan is either a shot in the dark or a tool to place undue burden on those individuals that have been targeted by staff.

Response: 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.

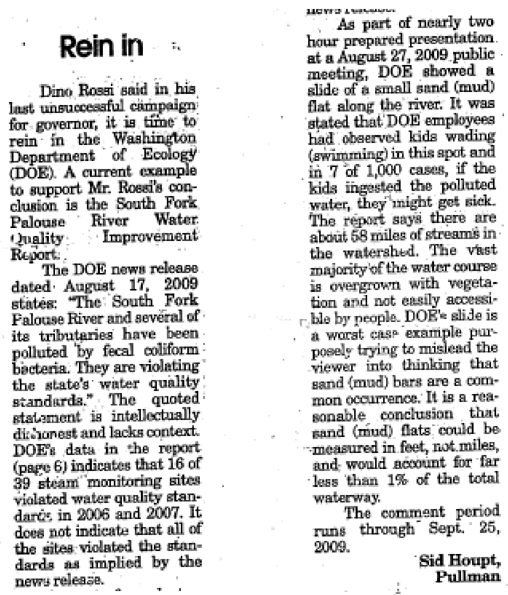
When conventional methods are unable to determine a source, other microbial source tracking techniques may be employed. However, these techniques, including DNA analysis of the bacteria, have limitations. The techniques are still in the research phases and there is not an approved method that can quantify what proportion of bacteria is coming from a particular animal species. Inconclusive results could lead implementation efforts in the wrong direction. 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 cities, universities, and other organizations 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.

Comments from Sid Houpt, Pullman resident

Comment 1: See enclosed published letters to Whitman County Gazette and Moscow-Pullman Daily News.



Rein in

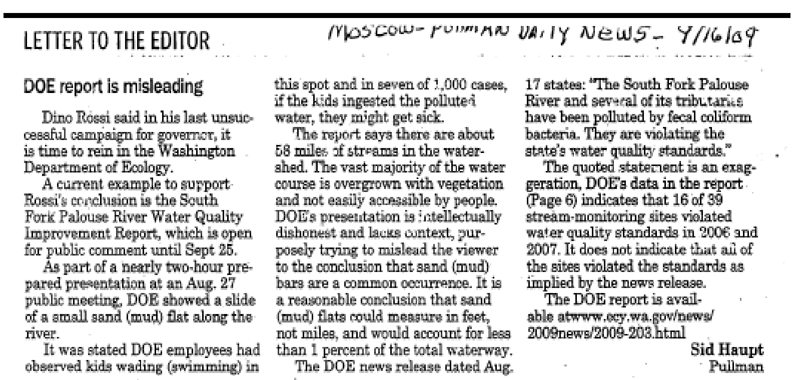
Dino Rossi said in his last unsuccessful campaign for governor, it is time to rein in the Washington Department of Ecology (DOE). A current example to support Mr. Rossi's conclusion is the South Fork Palouse River Water Quality Improvement Report.

The DOE news release dated August 17, 2009 states: "The South Fork Palouse River and several of its tributaries have been polluted by fecal coliform bacteria. They are violating the state's water quality standards." The quoted statement is intellectually dishonest and lacks context. DOE's data in the report (page 6) indicates that 16 of 39 steam monitoring sites violated water quality standards in 2006 and 2007. It does not indicate that all of the sites violated the standards as implied by the news release.

As part of nearly two hour prepared presentation at a August 27, 2009 public meeting, DOE showed a slide of a small sand (mud) flat along the river. It was stated that DOE employees had observed kids wading (swimming) in this spot and in 7 of 1,000 cases, if the kids ingested the polluted water, they might get sick. The report says there are about 58 miles of streams in the watershed. The vast majority of the water course is overgrown with vegetation and not easily accessible by people. DOE's slide is a worst case example purposely trying to mislead the viewer into thinking that sand (mud) bars are a common occurrence. It is a reasonable conclusion that sand (mud) flats could be measured in feet, not miles, and would account for far less than 1% of the total waterway.

The comment period runs through Sept. 25, 2009.

Sid Houpt,
Pullman



LETTER TO THE EDITOR

Moscow-Pullman Daily News - 9/16/09

DOE report is misleading

Dino Rossi said in his last unsuccessful campaign for governor, it is time to rein in the Washington Department of Ecology.

A current example to support Rossi's conclusion is the South Fork Palouse River Water Quality Improvement Report, which is open for public comment until Sept 25.

As part of a nearly two-hour prepared presentation at an Aug. 27 public meeting, DOE showed a slide of a small sand (mud) flat along the river.

It was stated DOE employees had observed kids wading (swimming) in this spot and in seven of 1,000 cases, if the kids ingested the polluted water, they might get sick.

The report says there are about 58 miles of streams in the watershed. The vast majority of the water course is overgrown with vegetation and not easily accessible by people. DOE's presentation is intellectually dishonest and lacks context, purposely trying to mislead the viewer to the conclusion that sand (mud) bars are a common occurrence. It is a reasonable conclusion that sand (mud) flats could measure in feet, not miles, and would account for less than 1 percent of the total waterway.

The DOE news release dated Aug. 17 states: "The South Fork Palouse River and several of its tributaries have been polluted by fecal coliform bacteria. They are violating the state's water quality standards."

The quoted statement is an exaggeration, DOE's data in the report (Page 6) indicates that 16 of 39 stream-monitoring sites violated water quality standards in 2006 and 2007. It does not indicate that all of the sites violated the standards as implied by the news release.

The DOE report is available atwww.ecy.wa.gov/news/2009news/2009-203.html

Sid Haupt
Pullman

Response 1: The Clean Water Act and state water quality law (RCW 90.48) requires the Department of Ecology to protect and restore streams for the ways people use the water. Children have been witnessed in the streams by both Ecology staff and citizens of the watershed. While there may be not public access areas to the streams, people who live along them may access them from private property. Children are especially likely to access the water for their enjoyment and recreation.

Table 1 on page 6 of the report lists the stream reaches we knew to be impaired prior to conducting the 2006-2007 study. These impaired reaches were listed on the 303(d) list based on historical data, not data collected during this study.

The 2006-2007 found that of the 42 stream sampling sites (not including stormwater outfalls and wastewater treatment plants sites), a total of 34 sites needed bacteria reductions. Twenty-seven sites needed bacteria reductions in both the wet and dry seasons and another seven sites needed bacteria reductions during the wet season only. Only eight of the 42 sites did not require bacteria reductions based on this study (see tables 24 and 25).

Comment 2:

Specific Comments

Page 5 of the Report states: "All of the streams covered by this TMDL are designated for primary contact recreation." According to the DOE website, all streams in WRIA 34 (the entire Palouse River watershed) are designated for primary contact recreation use. None of the streams are designated for secondary contact recreation use. Very few of the streams in Washington are designated for secondary contact recreation use. See letters to editor for SFPR specifics.

What standards, criteria, etc were used to classify specific streams as primary or secondary contact recreation use? These standards, criteria should be stated in the Report. The draft version of the Report states the conclusion without any documentation to support that conclusion. Some of the criteria which reasonably should be used are: (1) accessability of the steam by people (2) general amount of flow in the stream when people would (or could) access the stream i.e summer or fall.

The potential importance of a secondary contact designation is that this designation would have less stringent water quality requirements than a primary contact designation.

Page 11 of the Report states: "During precipitation events, rainwater washes over the surface of the landscape, pavement, rooftops, and other impervious surfaces." The preceding quoted statement is partially correct, see further discussion in glossary definitions.

Page A-123- Glossary definition of "Stormwater"- runoff occurs from all surfaces not just "hard"or "impervious" surfaces for example, cultivated land, pasture, etc. This conclusion is supported by numerous scientific publications identifying runoff coefficients.

The final version of the Report should include a brief section describing the appeal/protest process.

Response 2:

The streams in the South Fork Palouse watershed are designated for "primary contact recreation" in Washington State's Water Quality Standards (Chapter 173-201A of the Washington Administrative Code). Most streams in the state have the potential for people to access them from public or private land; therefore the state must protect this beneficial use. All streams not specifically designated for “secondary contact recreation” or “extraordinary primary contact recreation” are designated for “primary contact recreation.” “Extraordinary primary contact” requires the most restrictive bacteria level protection. There are streams designated for secondary contact recreation, including the Palouse River from Colfax to the Palouse Falls within WRIA 34.

The description of stormwater on page 11 has been revised to clarify that stormwater can also result from hard or saturated grass and gravel surfaces.

Ecology’s Water Quality Program Policy 1-12, “Dispute Resolution Related to Total Maximum Daily Loads,” describes the process for formally disputing a technical or procedural step in the TMDL development process. This policy is available at: http://www.ecy.wa.gov/programs/wq/tmdl/documents/1-25Pol-TMDLDispResolrev.pdf.

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

Comments: Thank you for the opportunity to comment on the draft *South Fork 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.