Quality Assurance Project Plan

South Fork Palouse River Pesticide, PCB, and Fecal Coliform Stormwater Pilot Study

by
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Pesticide, PCB, and Fecal Coliform
Stormwater Pilot Study

November 2005

303(d) Listings Addressed in this Study

South Fork Palouse River (WRIA 34) – 4,4'-DDE, alpha BHC, Dieldrin, Heptachlor Epoxide, PCB-1260, Fecal Coliform.

Waterbody Number: (ZX82FM or WA-34-1020)

Project Code: 06-503

Approvals

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Abstract

This Quality Assurance (QA) Project Plan describes a pilot project to estimate the municipal stormwater load of several 303(d) listed pollutants from Phase II stormwater systems in the South Fork Palouse River basin. Given the sparse population throughout much of the watershed, the entities discharging stormwater to the river will likely only include the city of Pullman and Washington State University discharges on the South Fork Palouse River (SFPR).

Grab samples will be taken for chlorinated pesticides, PCBs, and fecal coliform bacteria concentrations from three stormwater discharges. An attempt will be made to collect samples representing three storm events. Discharge measurements will be made at each sampling location during each storm event sampled. Results from this study may be used in the development of Total Maximum Daily Loads (TMDLs) for toxic compounds and fecal coliform bacteria in the SFPR.

This study will not only provide data for the TMDL development but also a foundation for development of a general Phase II stormwater loading approach for use in TMDLs.

Background

Phase II Stormwater Permits and TMDLs

As mandated by the Federal 1972 Clean Water Act, Section 303(d), the Department of Ecology (Ecology) maintains a list of waterbodies that do not meet water quality standards. This list of impaired waterbodies is commonly referred to as the 303(d) list. A water cleanup plan, also known as a TMDL, must be developed for each of the waterbodies on the 303(d) list. The TMDL identifies how much pollution needs to be reduced or eliminated to achieve water quality standards and outlines activities that may help the stream stewards achieve those targets. The last Washington State 303(d) list was compiled in 1998; a draft 2002/04 list has been compiled but has yet to be approved by the U.S. Environmental Protection Agency (EPA), see Appendix A.

On October 29, 1999, the final Phase II stormwater regulations were signed into rule by the EPA. The Phase II regulations expand the requirement for stormwater permits to all municipalities located in urbanized areas or cities outside of urbanized areas that are more than 10,000 in population. Ecology will issue a Phase II Municipal Stormwater Permit for Eastern Washington. The anticipated issue date is summer of 2006. Phase II communities are identified under the rule as jurisdictions that: 1) own and operate a storm drain system; 2) discharge to surface waters; 3) are located in urbanized areas; and 4) have a population greater than 1,000. There are no urbanized areas in the Palouse River basin.

Ecology criteria for determining whether other towns outside urbanized areas should also get a Phase II permit are stated as any city outside an urban area with a population greater than 10,000 with over 1,000 people per square mile. Pullman is the only Washington town in the Palouse River basin with a population over 10,000 people and is likely to be regulated as a small municipal separate storm sewer system (MS4) under Phase II. Figure 1 illustrates the location and land use of the Palouse River basin.

The EPA has not yet made a final determination on Phase II permitting for Moscow, Idaho, which is also located within the basin (Misha Vakock, EPA Region 10, 1/18/05 E-mail). If Pullman meets the permit coverage criteria, then other publicly owned storm sewer districts within the city would be required to apply for Phase II permit coverage as a special district. This may include stormwater from Washington State University (WSU), hospitals, prisons, ports, diking and drainage districts, and flood districts and may also include the Washington State Department of Transportation (WSDOT) highways. Currently permitted discharges in the South Fork Palouse River (SFPR) basin include industrial discharges, municipal wastewater permits, and construction stormwater general permit holders.

On November 22, 2002, EPA issued a Policy Memorandum on Wasteload Allocations for Stormwater to indicate that stormwater discharges from permitted entities must be assigned a numeric wasteload allocation for inclusion in the development of TMDLs. EPA requires that states set priorities for cleaning up 303(d) listed waters and establish a TMDL for each. A TMDL entails an analysis of how much of a pollutant load a waterbody can assimilate without violating water quality standards. Due to 303(d) listings, several TMDLs are slated to be developed for the entire Palouse River watershed in the next couple years. TMDLs will be developed for several historical chlorinated pesticides, PCBs, temperature, fecal coliform bacteria, nutrients, dissolved oxygen and pH. Due to the age of the data for the listings, fish tissue concentrations are being reassessed for chlorinated pesticides and their breakdown products, and PCBs to determine if there is a need for a fish consumption advisory and a TMDL. A study to assess the concentrations of toxic compounds in fish tissue began in the spring of 2005. The fish samples are being collected from the lower mainstem, the North Fork, and the South Fork (Johnson, 2005). Additional TMDL studies are scheduled to begin in 2006 for the other listed parameters.

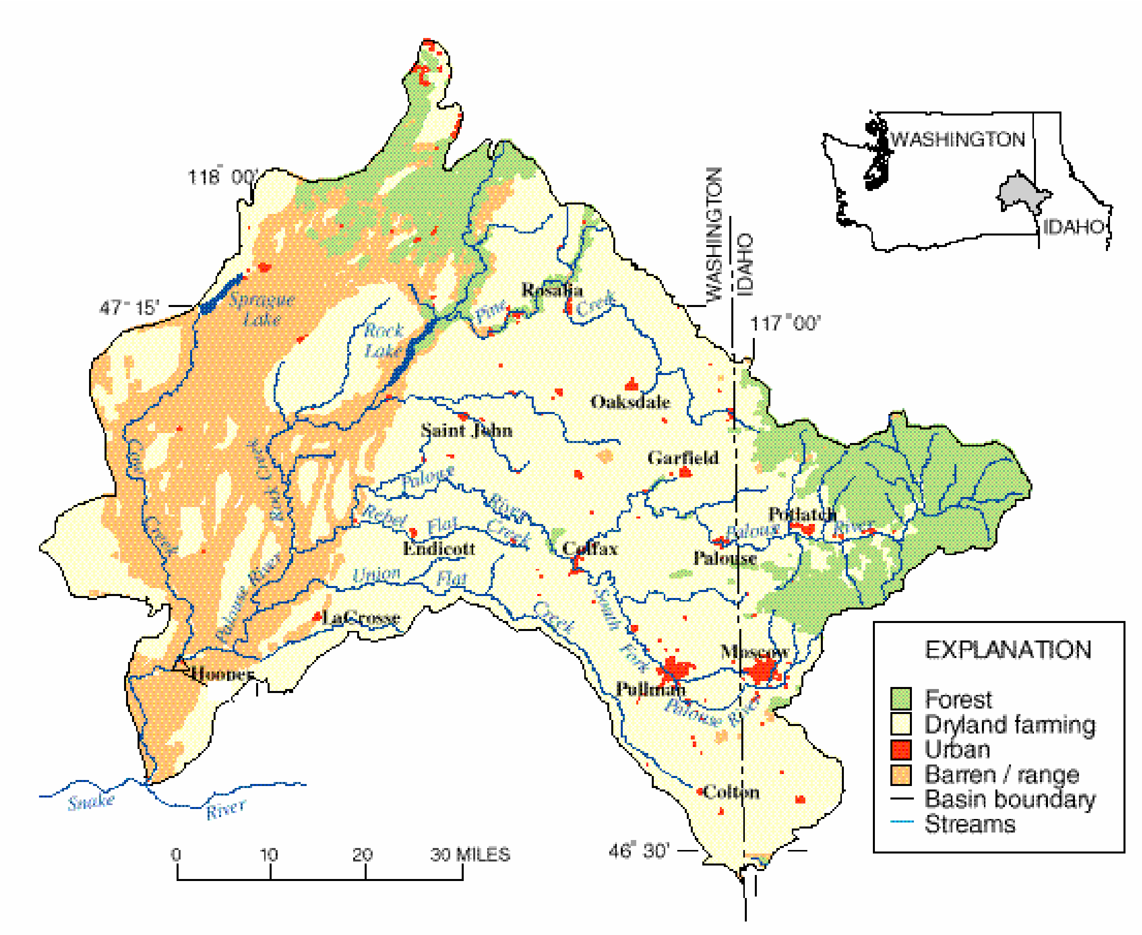


Figure 1: Palouse River Basin (from Ebbert and Roe, 1998)

The General Stormwater Phase II Permit is expected to be issued in 2006. It is anticipated that Pullman will be the only Phase II city, due to its population, required to be covered under this permit. In addition to city stormwater discharges, any other publicly operated storm sewers, such as WSU, will be covered under the permit.

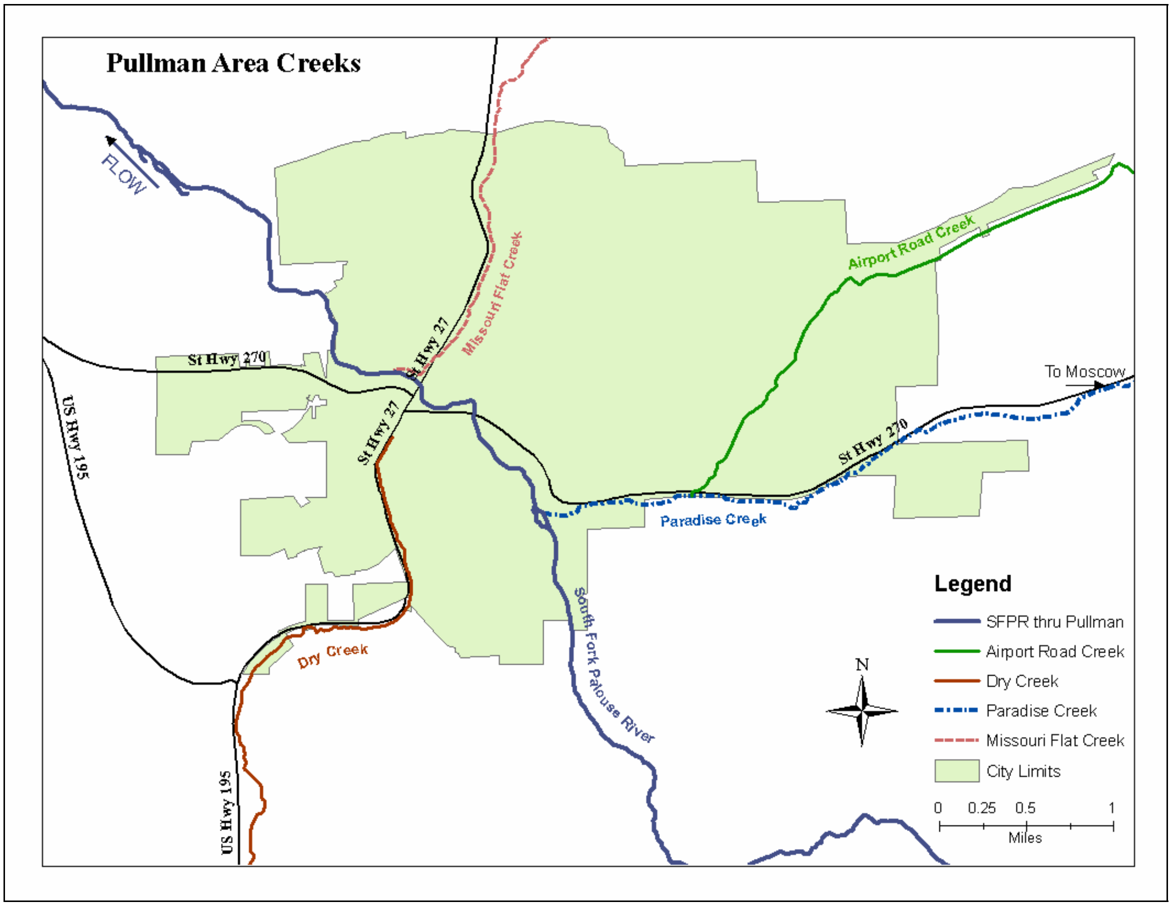
Stormwater from the municipal wastewater treatment plant (WWTP), industrial discharges, construction stormwater general permit holders, and WSDOT will be evaluated as part of the TMDL studies in the coming year. This study will focus on the stormwater loads draining from the Phase II municipality and special districts.

Basin Description

The SFPR drains approximately 130 square miles around Pullman, Washington, and Moscow, Idaho (Pelletier, 1993.) The area is predominantly dry land agriculture. The urban, commercial, and industrial developments are located at the two towns: Pullman and Moscow. The SFPR and tributaries have been monitored for water quality contaminants by Ecology since the early 1970s. The SFPR originates on the southwest slope of Moscow Mountain in Idaho and drains forested and agricultural lands and the southeastern side of the city of Moscow, including the WWTP. The SFPR is 13.4 stream miles from its headwaters to the Washington-Idaho border. The SFPR meets the mainstem Palouse River at the town of Colfax, Washington. The Palouse River then empties into the Snake River in Whitman County.

Stormwater runoff from the city of Pullman and associated special district, WSU, drains to four area creeks: Airport Creek, Paradise Creek, Missouri Flat Creek, and Dry Creek which empty into the SFPR. Airport Creek empties into Paradise Creek just before the Pullman city limits. The other three creeks are tributaries that converge with the SFPR within the city limits of Pullman. Figure 2 shows the Pullman city limits and the creeks draining the city and surrounding areas.

Figure 2: Pullman Area Creeks



In the Figure 2, the stream direction flows northwest toward the upper left corner.

Palouse Basin Water Quality

Segments of the Palouse River have been listed by the state of Washington under Section 303(d) of the Clean Water Act for non-attainment of the U.S. Environmental Protection Agency (EPA) human health criteria for the toxic compounds 4,4'-DDE, dieldrin, heptachlor epoxide, alpha-BHC, and PCB-1260 in edible fish tissue. Additionally, both the SFPR and the mainstem Palouse River are listed on the State 303(d) list for fecal coliform bacteria, dissolved oxygen, pH, and temperature. Appendix A contains a timeline of 303(d) listings on the mainstem and the SFPR. The mainstem toxicity listings are based on fish samples from Ecology studies conducted from 1984 and 1994. The fecal coliform bacteria listings on the SFPR are based on sampling done by Ecology in 1987, 1991, 1994 -1999, and 2001-2004.

Ecology is planning to develop TMDLs for all 303(d) listings in the Palouse River basin. These TMDLs will be developed through studies. One study will develop a TMDL for toxic compounds. The second study will develop a TMDL for fecal coliform bacteria, dissolved oxygen, and pH. The third study will address temperature impairments.

This study is designed to determine the amount of loading to the stream from stormwater. Given the sparse population throughout the watershed, this study will focus solely on the stormwater pollutant loads from the Phase II city. The stormwater pollutants of concern for this study are the listed toxic compounds and fecal coliform bacteria.

Toxic impairments are caused by chlorinated pesticides/breakdown products and polychlorinated biphenyls (PCBs) which were banned in the United States due to ecological concerns in the 1970s and 1980s, respectively. They are now classified as probable human carcinogens by the EPA. PCBs are mixtures of congeners (individual PCB compounds). Aroclor-1260 is one of several PCB mixtures that was produced historically. Appendix B provides some background information on these 303(d) listed pollutants. Detailed profiles including use, regulations, environmental occurrence, and health effects have been prepared by the Agency for Toxic Substances and Disease Registry and are available at www.atsdr.cdc.gov/atsdrhome.html.

This pilot stormwater project will aid TMDL development by measuring the stormwater loads of chlorinated pesticides, PCBs, and fecal coliform bacteria contributed to the receiving waters by the Phase II stormwater systems. Stormwater may be an important source for these contaminants.

Additional opportune sampling for the presence of the other 303(d) listed contaminants and common conventional pollutants in stormwater will coincide with the main effort of the project but will not be extensively addressed here. These parameters include, but are not limited to, temperature, pH, DO, turbidity, suspended solids, nutrients, chloride, alkalinity, and organic carbon.

Previous Stormwater Sampling Results

Several studies of surface water contaminants have been conducted on the mainstem Palouse River and the SFPR. Instream water quality sampling that has occurred on the SFPR near the study area for PCBs, pesticides, and fecal coliform bacteria and is described below.

PCBs and Organochlorine Pesticides

To date, no known sampling for PCBs and organochlorine pesticides has occurred on storm drains in the Pullman city limits or on the permitted stormwater discharges.

As part of the National Water Quality Assessment (NAWQA) Program, the U.S. Geological Survey collected water and sediment samples for analysis of pesticides from the Palouse watershed as part of the much larger Central Columbia Plateau - Yakima River basin study effort. In 1994, two samples were collected in the vicinity of Pullman, Table 1.

Table 1: USGS NAWQA Pesticide Concentrations from Sample Sites near Pullman

Location	Parameter	Measured Value	Units
Water Sample			
Mouth of Paradise Creek[1]			
	Dieldrin	<0.001	µg/L, ppb
	alpha BHC	<0.002	µg/L, ppb
	gamma BHC	0.045	µg/L, ppb
	Triallate	0.06	µg/L, ppb
	Diazinon	0.021	µg/L, ppb
Sediment Sample			
SFPR at Armstrong Road[2]			
	Aldrin[a]	<1	µg/kg, ppb
	o,p'-DDD[a]	1	µg/kg, ppb
	p,p'-DDD[a]	<1	µg/kg, ppb
	o,p'-DDE[a]	<1	µg/kg, ppb
	p,p'-DDE[a]	8	µg/kg, ppb
	o,p'-DDT[a]	<2	µg/kg, ppb
	p,p'-DDT[a]	<2	µg/kg, ppb
	Dieldrin[a]	<1	µg/kg, ppb
	alpha-BHC[a]	<1	µg/kg, ppb
	Heptachlor epoxide[a]	<1	µg/kg, ppb
	PCBs[a]	160	µg/kg, ppb

[1]Wagner et al. 1998.
[2]USGS NAWQA Website.
[a]Bed sediment smaller than 2 millimeters, dry weight basis.

A water sample from Paradise Creek (Station # 13346990; Site Code PAR000) collected on April 20, 1994, was found to exceed drinking water guidelines for gamma-BHC and exceeded aquatic-life water quality criteria for diazinon (Wagner and Roberts, 1998). NAWQA also found a low concentration of DDE in the one-stream sediment sample taken from the SFPR at Armstrong Road, approximately five miles downstream of the city limits. This site (464539117133000) was sampled on July 12, 1994. The PCB concentration, 160µg/kg, in this sediment sample was elevated compared to results from other parts of the drainage (U.S. Geological Survey). This may have exceeded the Washington State freshwater water quality criteria for acute exposure of 2.5ug/L, if the sample was reported as a 24-hour average, see Table 2.

Fecal Coliform Studies

Fecal coliform concentrations have been studied on the SFPR and tributaries. There are no studies to date that quantify the bacterial concentrations of specific storm drains in the city of Pullman.

Ecology has conducted monthly water quality monitoring in Pullman at State Street bridge, Station #34B110, (RM 22.2) for several conventional parameters including fecal coliform bacteria since 1971. These ambient water quality samples are taken monthly. The USGS recorded daily discharge in the SFPR at Pullman (RM 22.2) from 1933 to the present time. Ambient water quality results suggest the SFPR continues to have high fecal coliform counts.

Hallock (1993) studied one water year (WY 1992) at four river locations in the SFPR basin and tributaries to locate conventional contaminant loading areas. Hallock found that most conventional pollutant loads were high at the mouth of Paradise Creek in Pullman and even higher at the state border. He attributed the loads to the Moscow WWTP, due to his evidence that the WWTP effluent comprised over 85% of the flow of Paradise Creek from June to October. Bacteria and suspended sediment sources are considered to be basin-wide and not attributed to just Paradise Creek or the SFPR. Hallock concluded specifically that during winter months (December to September) concentrations at the Ecology Station 34B110 were higher than expected, indicating a consistent point source between the upstream station (at Busby) and the downstream station at 34B110. Paradise Creek was indicated as a source particularly during summer and fall months. High fall fecal coliform counts were thought to be the result of the "first flush" effect from the first fall rains in October and November washing off some of the summer's accumulated bacteria.

Airport Road Creek drains a relatively undeveloped portion of the Pullman city limits. The WSU research animals, compost facility, storage ponds, fields, and orchards comprise the main activities that drain to Airport Road Creek. A study by WSU in 1993 (Marty O'Malley-personal communication) identified the major pollutant sources from university activities to Airport Road Creek and subsequently to Paradise Creek. Fifteen conventional parameters were measured which included fecal coliform, fecal streptococcus, and E. *coli*. Results of the study lead to improvements in management of the Confined Animal Feeding Operation Plan, the composting facility, and construction of a new storage/detention pond for stormwater along Airport Road. This compost facility upgrade was permitted by Ecology and the industrial permit has since been canceled.

No known studies of fecal coliform concentrations have been performed on Dry Creek. This is likely to be an overlooked creek as it is ephemeral in nature and is channeled into a tunnel under Grand Avenue for much of its length within the city limits. Dry Creek is only accessible at the mouth and prior to its capture at the Grand Avenue and Crestview Road intersection.

Water Quality Standards

The Washington State Water Quality Standards, set forth in Chapter 173-201A of the Washington Administrative Code, include designated beneficial uses, waterbody classifications, and numeric and narrative water quality criteria for surface waters of the state. The SFPR, from its headwaters to the point of convergence with the South Fork at Colfax, is a Class A waterbody.

Characteristic Uses

Characteristic uses for a Class A designation include, but are not limited to, the following (WAC 173-201A-602):

i. Aquatic Life (non-Core Salmon/Trout).
ii. Recreation (Primary contact).
iii. Water Supply (Domestic, Industrial, Agricultural, and Stock).
iv. Miscellaneous (Wildlife Habitat, Harvesting, Commerce/Navigation and Aesthetics).

Toxic Substances

Toxics substances are addressed in WAC 173-201A-240 as follows (selected sections):

1) Toxic substances shall not be introduced above natural background levels in waters of the state which have the potential either singularly or cumulatively to adversely affect characteristic water uses, cause acute or chronic toxicity to the most sensitive biota dependent upon those waters, or adversely affect public health, as determined by the department.

(2) The department shall employ or require chemical testing, acute and chronic toxicity testing, and biological assessments, as appropriate, to evaluate compliance with subsection (1) of this section and to ensure that aquatic communities and the existing and characteristic beneficial uses of waters are being fully protected.

(3) The following criteria … shall be applied to all surface waters of the state of Washington for the protection of aquatic life. The department may revise the following criteria on a statewide or water body-specific basis as needed to protect aquatic life occurring in waters of the state and to increase the technical accuracy of the criteria being applied. The department shall formally adopt any appropriate revised criteria as part of this chapter in accordance with the provisions established in chapter 34.05 RCW, the Administrative Procedure Act. The department shall ensure there are early opportunities for public review and comment on proposals to develop revised criteria.

Washington State water quality criteria that apply to 303(d) listed pesticides and PCBs in the Palouse River basin are shown in Table 2 (from section WAC 173-201A-240). Human health-based water quality criteria used by the state are contained in 40 CFR 131.36 (known as the

National Toxics Rule). Risk-based criteria for carcinogenic substances shall be selected such that the upper-bound excess cancer risk is less than, or equal to, one in one million.

Table 2: Applicable Washington State Water Quality Criteria for Chlorinated Pesticides, PCBs (µg/L is Equivalent to Parts per Billion)

	Freshwater (µg/L)	
Substance	**Acute**	**Chronic**
Alpha-BHC	-	-
DDT (and metabolites)	1.1a	0.001b
Dieldrin/Aldrin	2.5a	0.0019b
Heptachlor	0.52a	0.0038b
PCBs	2.0b	0.014b

a-An instantaneous concentration not to be exceeded at any time.
b-A 24-hour average not to be exceeded.
- No Criteria.

Fecal Coliform Bacteria

Water quality standards for fecal coliform bacteria are based upon the designated beneficial uses for the river, and the specified numeric criteria are intended to protect designated uses. The SFPR is designated as a Class A to maintain the beneficial uses including drinking water recharge, recreation, and stock watering. Reaches of the river in the study area are available to the public for primary and secondary contact recreation (swimming, wading, and fishing).

> • *For Class A waters*: "…fecal coliform organism levels shall both not exceed a geometric mean value of 100 colonies/100mL, and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 200 colonies/100 mL."

Ecology revised the state water quality standards in July 2003, although the revisions have not been evaluated and approved by EPA to date. Under the revised water quality standards, the waterbody classification system will change; however, the fecal coliform bacteria numeric target, for each of the waterbodies included in the present study, will not. Proposed new classifications and standards can be found on the Ecology website:
www.ecy.wa.gov/programs/wq/swqs/index.html.

Stormwater Pollution Sources

Precipitation over the rural and urban landscape often transports pollutants into nearby receiving waters. During precipitation events, rainwater washes the surface of the landscape, pavement, rooftops, and other impervious surfaces. This stormwater runoff can accumulate and transport pollutants such as pesticides, fertilizers, fecal matter, oil and grease, trash, and sediment via the stormwater conveyance system to receiving waters and degrade water quality. Watershed pollutant sources are commonly divided into two groups: point sources (end-of-pipe) and non-point sources.

Nonpoint Sources

Chlorinated Pesticides and PCBs
Nonpoint sources of historical chlorinated pesticides and PCBs are expected to be a fairly minimal contribution from Pullman's city storm system. Allan Felsot, WSU (personal communication August 15, 2005) said that historically, in and around Pullman, DDT was most likely used in the 1950's. Dieldrin may have been another commonly used insecticide, into the late 1960's. No known publications exist on the use of these pesticides in the Palouse. Likely nonpoint sources for the pesticides of interest would be storm event washing from pesticide mixing centers, transfer centers, vehicle loading areas, and waste disposal areas. The historical locations of these areas are not currently known; however, this study may detect the presence of these historical pesticides.

Nonpoint PCB sources could include any historical transformer manufacturers, transformer storage areas, or transformer waste deposition throughout the watershed. In some areas throughout the country, PCBs were used as the binder for DDT when applied in urban areas. It is not known if this practice occurred in Pullman. Nonpoint sources of PCBs are not suspected to be common enough to influence the PCB concentration of stormwater within the confines of this storm drain study.

Fecal Coliform bacteria
Nonpoint sources of fecal coliform bacteria are numerous and widely distributed. Fecal coliform bacteria are found in the waste from warm blooded animals (including humans) and are known to self replicate in the environment. Environmental sources for bacteria in the watershed include unmanaged grazing and winter-feeding operations on riparian floodplains and wildlife contributions via drainage ditches (e.g., pheasant, waterfowl, deer, and rabbit) and domesticated animals within the city itself (e.g., dogs, cats, and others). The most likely controllable sources in an urbanizing watershed are livestock, pets, septic systems, and improperly connected sewers. Septic systems for domestic waste treatment are prevalent in the rural residences in the watershed. Installations or repairs have been permitted since the mid-1970s; however, the extent of bacterial loads from septic systems is not known.

Point Sources

Permitted Stormwater Discharges
In the Palouse River basin (WRIA 34) there are seven permitted industrial facilities for stormwater. All the permitted facilities are in or near Pullman, Washington. Table 3 list the seven permitted stormwater dischargers in the study area. Additionally, the Washington State Department of Transportation has a state-wide stormwater permit; however, the extent of permit coverage within Phase II entities is still to be decided. The concentrations of PCBs, chlorinated pesticides, and fecal coliform bacteria from the currently permitted stormwater discharges, if known or attainable, will be incorporated into the wasteload assessment as part of the future TMDL study.

Chlorinated Pesticides and PCBs
The WWTP, airport, and power plant are the most likely potential point sources for PCBs, due to the likelihood of older transformers and insulators to be present on site. Industrial permittees may be sources for pesticides, particularly if onsite landscaping was treated.

Table 3: Department of Ecology Permitted Stormwater Discharges in Pullman, WA

Permit Number	Site name	Site Address	City	Other Waterbody Numbers	Waterbody
SO3000979D	Horizon Air Pullman Moscow Airport	3200 Airport Complex N.	Pullman	HK68ZM	Paradise Creek
SO3000975D	Inter State Aviation Inc	Pullman-Moscow Airport	Pullman	JK84XF	Airport Creek
SO3004625A	Pullman City Of WWTP	N.W. 1025 Guy Street.	Pullman	WA-34-1020	South Fork Palouse River
SO3000942D	Pullman Moscow Regional Airport	RT. 3 Box 850	Pullman	JK84XF	Airport Creek
SO3004624A	Pullman, City Of Transit Facility	NW 775 Guy Street	Pullman	WA-34-1020	South Fork Palouse River
SO3000445D	United Parcel Service WAPUL	615 N Grand Ave	Pullman	WA-34-1024	Missouri Flat Creek
SO3001115D	WA State University Power Plant*	College Avenue	Pullman	WA-34-1020	South Fork Palouse River

*WSU Power Plant permit Notice of Termination has been filed with Ecology (Marty O'Malley – personal communication 7/2005).

Fecal Coliform bacteria

All industrial permits are likely to have a bacterial concentration in their stormwater, which often can have surprisingly high fecal coliform counts from such diverse sources as misconnected sanitary lines to roosting birds on roofs. However, the total contributing area for each of these permitted industrial facilities is a very small percentage of the overall city's outline area.

The fecal coliform concentrations are monitored as part of the permit requirement for the City Transit Facility and the Pullman WWTP. The self monitoring results for the transit facility and the Pullman WWTP will be evaluated as part of the wasteload assessment in the future TMDL study.

Project Description

This study will serve as a pilot project to estimate stormwater pollutant loads from the only anticipated Phase II entity, Pullman and associated special districts, in the Palouse River basin. Resultant loads may be used in the development of the Palouse River toxics and fecal coliform TMDLs. The goal of this study is to characterize stormwater pollutants and estimate the storm load of chlorinated insecticides, PCBs, and fecal coliform bacteria. In addition, general chemistry, and other common conventional pollutants in stormwater will be monitored. Listed below in Table 4, are the specific (bolded) and opportune parameters to be measured from the city of Pullman storm drains:

Table 4: Targeted Stormwater Pollutants to be Measured

Toxics[1]	*Conventionals*[2]	*Conventionals*[3]
4,4'-DDE*	**Fecal coliform**	Temperature
Dieldrin*	Ammonia (NH_3)	pH
Heptachlor epoxide*	Nitrate (NO_3^-)	DO
alpha-BHC*	Persulfate N (TPN)	Conductivity
Aroclor 1260	Orthophosphate (Ortho-PO_4^{3-})	
PCB congeners	Total Suspended Solids	
	Turbidity	
	Chloride	
	Total/Dissolved Organic Carbon	

[1]Measured at Manchester Laboratory; except PCB congeners which will be measured at a commercial contract laboratory – tbd.
[2]Measured at Manchester Laboratory.
[3]Measured in the field with calibrated meters (if available).
*The chlorinated pesticide list analyzed by Manchester Laboratory includes more constituents than listed above, see Appendix C for a complete list of pesticides.

The sampling program will be based on the assumption that Pullman will be the urban entity in the Washington portion of the Palouse basin that will qualify for initial Phase II permit coverage. Development of the stormwater allocations by future planned TMDL studies is likely to include storm loads from the separate industrial dischargers and WSDOT.

The specific objective of this study is to determine the concentrations of the above listed parameters and to estimate the load carried by stormwater to the receiving waters within the Pullman city limits. There are several uses of the study results acquired by the project. These additional goals for the study will be to:

1) Develop a stormwater loading analysis which will quantify the stormwater pollutant load for the city of Pullman, including WSU, into the planned Palouse River Toxics and Fecal Coliform TMDLs.
2) Identify critical input data to incorporate into future stormwater sampling plans for use in TMDLs.

3) Develop a factor to relate land use to stormwater pollutant loading.
4) Evaluate models, if applicable, used to estimate stormwater loads.

The study area consists of three selected storm drains and associated subwatershed (the area draining to that storm drain) within the Pullman city limits. Three storms will be sampled over the course of the winter wet season 2005-2006. Stormwater samples will be collected and analyzed for chlorinated pesticides, PCB congeners and fecal coliform concentrations. Each sample will be coordinated with a discharge measurement taken at the same time. The load estimated for each parameter from each drain will be extrapolated to areas with similar land use and impervious area to determine the estimated stormwater load to the SFPR for the city of Pullman and WSU. Land use within the subwatershed will be evaluated and compared with literature values for loading estimates from similar land uses.

There are several practical constraints that have influenced the study design. Factors such as sufficient seasonal rainfall, logistics of catching the first flush of the storm, and availability of field personnel may complicate the project. The project manager will keep the laboratory informed of the sampling events and expected delivery of samples.

Organization and Schedule

Responsibilities

Table 5: Organization and Personnel

Project Personnel		
Ecology Eastern Regional Office Client	Elaine Snouwaert	509-329-3503
EA Program Project Lead	Brandi Lubliner	360-407-7140
Ecology ERO Project Assistants	Jeremy Ryf	509-329-3610
	James Ross	509-329-3425
EA Program Technical Assistance	Art Johnson	360-407-6766
EA Program Toxics Studies Unit Supervisor	Dale Norton	360-407-6765
Manchester Environmental Laboratory Director	Stuart Magoon	360-871-8801
Manchester Laboratory Organics Unit Supervisor	Dean Momohara	360-871-8808
Manchester Laboratory QC & Sample Management	Karin Feddersen	360-871-8829
Ecology Quality Assurance Coordinator	Stew Lombard	360-895-6148
Ecology Environmental Information Management System Data Entry	Brandee Era-Miller	360-407-6771

Table 6: Schedule

Project Schedule	
Reconnaissance Visits	August and September 2005
Field Work	October 2005 to December 2005
Laboratory Analyses Completed	January 2006
Environmental Information System (EIM) Data Set	
Data Engineer	Brandee Era-Miller
EIM User Study ID	brwa0001
EIM Study Name	South Fork Palouse River Pesticide, PCB, and Fecal Coliform Stormwater Pilot Study
EIM Completion Due	July 2006
Final Report	
Author Lead	Brandi Lubliner
Schedule	
Draft to Supervisor	May 2006
Draft to Client/Peer	June 2006
External Draft	July 2006
Report Final Due (original)	August 2006

Estimated Analytical Costs

The laboratory costs for this project are estimated to be $20K (50% discounted price at Manchester Environmental Laboratory). The goal of the study is to sample three storm drains for three separate storm events. Each sampling includes one duplicate sample set taken at all the storm drains for all parameters except pesticides and PCBs. A duplicate sample for pesticides will be sent once per storm, for a total of three for the project. PCBs will have only one duplicate over the course of the project. A cost breakdown is shown in Table 7.

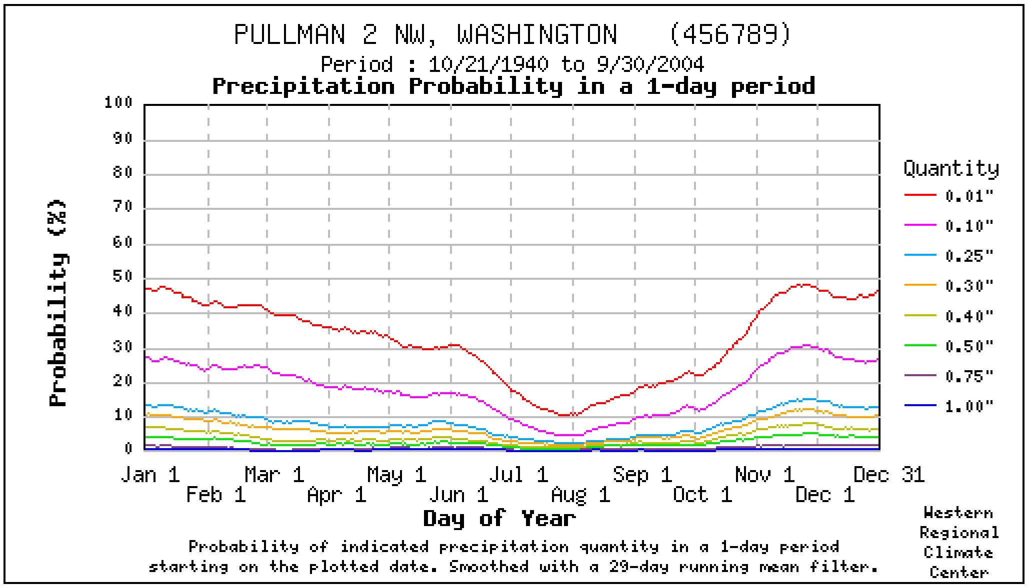
Table 7: Estimated Laboratory Costs*

Parameter	Matrix	Number of Samples per Storm	Duplicates per Storm	Cost per Sample	Number of Storms to Sample	Number of Blanks per Project	Total Cost
PCB Congeners[a]	Water	3	1 (project)[b]	$1000	3	1 blank	$11,000
Chlorinated Pesticides	Water	3	1	$200	3	1 blank & 1 ms/msd[c]	$3,000
Fecal Coliform	Water	6	3	$21	3	--	$567
Total Suspended Solids (TSS) + TNVSS	Water	6	3	$22	3	--	$594
Turbidity	Water	6	3	$10	3	--	$270
Total Organic Carbon		6	3	$32	3	--	$864
Dissolved Organic Carbon	Water	6	3	$30	3	--	$810
Alkalinity	Water	6	3	$16	3	--	$432
Chloride	Water	6	3	$12	3	--	$324
Total Persulfate Nitrogen (TPN)	Water	6	3	$16	3	--	$432
Nutrients 5 (NO_2^-+NO_3^-, NH_3,O-P, T-P)	Water	6	3	$64	3	--	$1,728
TOTAL							**$20,021**

*The cost for analyses conducted by Manchester Laboratory is the 50% discounted price; true cost is 2X.
[a]There is a 25% contracting fee included in the listed price; approximately $800 plus 25%.
[b]A single duplicate for the project will be collected for PCBs from one storm drain during one storm event.[c]ms/msd = matrix spike and matrix spike duplicate will be collected for the first storm (prices included).

Sampling Process Design (Experimental Design)

Fall storms are targeted for personnel safety due to the spring flood potential, storm pipe submergence, and high storm discharge velocities at the storm drain pipe outfalls. A storm event for this study will be defined as 0.2 inches of rainfall in a 24-hour period as measured at the Spokane Regional Airport via real time gages, with an antecedent dry period (no measurable rain) for at least 24 hours. The Washington State University rain gage should be checked to verify rain, as Pullman can have a differing weather pattern from Spokane, airdata.ce.wsu.edu/weather.htm. Figure 3 illustrates the probability of incremental rainfall during a calendar year; (the third line down is 0.25 inches).



Graph lines and legend are in the same order with 0.01" at the top.

Figure 3: One-Day Precipitation Probabilities in Pullman, WA

Chlorinated pesticide and PCB samples will be collected using a manual compositing technique. All other parameters will be sampled at each drain in duplicate in the first hourly rotation and sampled again in the third hourly rotation. Flow measurements will accompany the first and last grab samples. Flow measurements will be made either using a pipe flow measurement, or end of pipe bucket, estimation. Contaminant loads will be calculated from selected storm drain effluents. The primary land uses within the selected subwatershed will be characterized. Measured loads will be applied throughout the city limits to areas of similar population and land use.

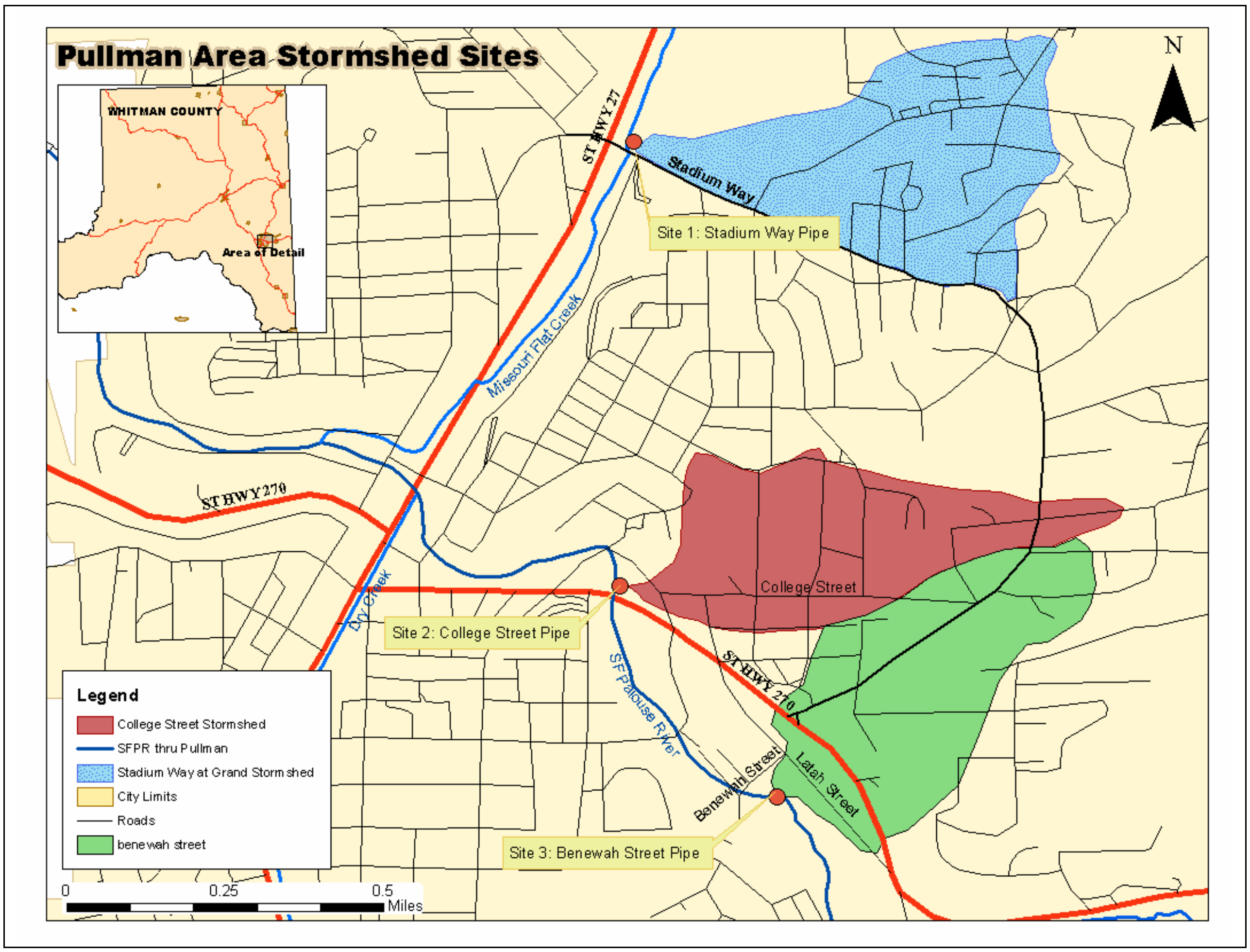
Sampling Locations

The contaminant loads for chlorinated pesticides, PCBs, and fecal coliform bacteria will be assessed for the Phase II permittees from selected storm drain effluents. The storm drains were selected for ease of access and safety during storm flows, land use within the subwatershed, and relative size of the subwatershed. The storm drain at the intersection of Grand Avenue and Stadium Way will be one of the three measured storm drains. This site offers the largest subwatershed and stormwater can be easily collected. Flow estimates will likely be made from the end of the pipe at the river for this location. The land use of this subwatershed is very characteristic of the city of Pullman as a whole. There exists light commercial use, residential use, and portions of the WSU campus.

The second site (College Street) drains the southwestern side of WSU. Both the man hole and end of pipe for this drain are easily accessible on foot. This drains both the old and new built environment on campus. The discharge measurement will be made using a portable flow meter.

The third site (Benewah Street) drains the southern end of the WSU campus including the high density residential, the hospital, and several commercial areas along Highway 270 and Latah Street. This site is easily accessible and comprises a mixture of land uses. The discharge measurement will be made using a portable flow meter.

Figure 4 shows the approximate storm drain locations and subwatershed of three sites. These locations will facilitate characterization of the city of Pullman's stormwater runoff.



* This map may be inaccurate and is the approximate estimated areas of the subwatersheds of interest. Based on hand drawn engineering specifications provided by the City of Pullman.

Figure 4: Pullman Area Storm Drains and Subwatersheds

Sampling and flow determinations for this study will be made by Ecology staff. Assistance from the City of Pullman and WSU will be sought as necessary to provide access, knowledge of city limits, and land use information. Ecology staff will likely travel from the Eastern (Spokane) regional office and potentially from Headquarters (Lacey) to conduct the study.

Storm Drain Study Limitations:

- The storm drain system for metropolitan Pullman is not cumulative in nature. A hundred or more drains empty small subwatersheds directly to Dry Creek, Missouri Flat Creek, or SFPR as opposed to collecting stormwater from multiple small areas into a catch basin and then discharging to the river.

- Access to many of the storm drain pipes may be in confined spaces or underwater during storm flows, which limited the selection to only a few sites and primarily fall storms.

Sampling Technique

Storm event loads will be sampled using both single grab and compositing grab sample techniques. Pesticide and PCB samples will be collected as manual composites spanning three hours of the storm duration. This technique will involve adding one-third the volume for analysis to the sample container at a rate of once per hour for three hours. Samples will be taken from mid-pipe flow or at the end of the pipe for each of the three storm drain locations. Each storm drain will have a certified clean sampling jar to collect the sample for transfer. The composites will be poured into appropriate containers for pesticide and PCB congener analysis. Composites will be kept on ice at all times.

Fecal coliform bacteria and other stormwater characterization parameters (TSS, turbidity, alkalinity, chloride, TPN, nutrients, and TOC/DOC) will be sampled as single grab samples at each drain in duplicate on the first hourly rotation and sampled again on the third hourly rotation. Sterile technique will be used for the fecal coliform samples. Temporal variability is expected, and this technique will begin to evaluate this variability at least for a three hour window. All samples will be kept on ice.

The sampling date, flow, storm event time, and other environmental parameters will be noted at the time of collection. The latitude and longitude of the sampling sites will be recorded with a handheld GPS receiver. The samples will be shipped overnight in coolers with ice to the Manchester Environmental Laboratory and chain-of-custody will be maintained.

Flow Measurements

Flow will be measured at the point of sampling in the first and third hourly rotation in one of the two following procedures. Given the actual site characteristics, the velocity of the pipe flow will be measured using a portable flow meter or calibrated bucket. The discharge rate of the storm flow can be calculated if the pipe dimensions, height of the water column, and flow rate are known. In the event the pipe is too small for a flow meter, the discharge of the pipe will be estimated using a calibrated bucket to capture flow for a timed interval.

Other Design Considerations

Consideration was given to other study designs to assess the stormwater loading from the Phase II storm systems in Pullman. One such design considered was capturing sediment from the storm drains over a period of time. A second design considered was a receiving water analysis performed using a mass balance approach from upstream to downstream change in concentration approach.

These designs, although explored, were ruled out for the following reasons:

- Storm drain sediments usually collect at the bottom of catch basins. The lack of catch basins (only two known basins at this point in time on the Missouri Flat Creek) effectively rules out the use of storm drain sediment traps. The sediment traps do not work well when placed in-line in a pipe (Norton, 1996).

- Although a receiving water study would shed light on the impact of stormwater on the river itself, it does not answer the question of what the Phase II stormwater load for purposes of TMDL development is. There is a strong likelihood that the dilution factor would be significant and the study may be performed without ever really answering the goal of the study. This approach may be used in the future once the Phase II stormwater loads are characterized.

Quality Objectives

The quality and usefulness of the data collected as part of this study will be influenced by the precision, bias, and sensitivity imparted to the data during the process of collection, analysis, and reporting of the results. Manchester Environmental Laboratory and their contract laboratories are expected to meet all quality control (QC) requirements for the analytical methods used for this project. Surrogates, or radio-labeled compounds for the chlorinated pesticide and PCB congener analysis, are added to every sample and their percent recovery provides an estimate of accuracy for the entire method, including sample preparation. The measurement quality objectives (MQOs) are shown in Table 8.

Table 8: Measurement Quality Objectives

Analysis	Surrogate Standards	Duplicate Sample RPD[a]
Chlorinated Pesticides	50-150% surrogate recovery	± 20%
PCB Congeners*	25-150% labeled congeners	± 50%
Fecal Coliform Bacteria	NA	±40%
TSS	NA	±40%
Turbidity	NA	±15%
Alkalinity	NA	±15%
NO_2^-+NO_3^-, NH_3, TPN, TP	NA	±15%
Ortho-PO_4^{3-}	NA	±15%
Chloride	NA	±15%
TOC/DOC	NA	±15%
pH**	±0.20 standard units	NA
Conductivity**	±10% standard	NA
Temperature**	NA	NA
DO**	NA	NA

[a]RPD – Relative percent difference (range as a percent of the mean).
NA – Not applicable.
*Recovery in a standard solution of 27 congeners.
**Measured in the field, and accuracy is ensured by calibrating the instrument before use.

Sampling Procedures

Stormwater grab samples from each location will be made by hand using a certified clean sampling jar for each site. Field personnel will wear clean nitrile gloves at each site. A composite will consist of three separate grabs, at the same drain, collected once-per-hour over a three-hour period. The stormwater samples will be shipped overnight at 4ºC in coolers to arrive at Manchester Laboratory within 24 hours of collection. Table 9 lists the appropriate sample size, container, and handling for each parameter.

Table 9: Containers, Preservatives, and Holding Times for SFPR Stormwater Study

Parameter	Min. Sample Size	Container*	Preservation	Holding Time
Chlorinated pesticides	1 gallon	1 gal. glass; Teflon® lid	Cool to 4ºC	7 days
PCB Congeners	1 gallon	1 gal. glass; Teflon® lid	Cool to 4ºC	1 year
Fecal Coliform	240 mL (fill to shoulder)	Sterile 250 or 500mL poly bottle	Cool to 4ºC	24 hours
TSS	1000 mL	1000 mL poly bottle	Cool to 4ºC	7 days
Turbidity	500 mL	500 mL poly bottle	Cool to 4ºC	48 hours
Alkalinity, Chloride	500 mL	500 mL poly bottle	Cool to 4ºC	14 days, 28 days
NO_2^-+NO_3^-, NH_3, TPN	125 mL	125 mL poly, pre-acidified	Pre-acidification with H_2SO_4, Cool to 4ºC	28 days
Total P	50 mL	60 mL poly bottle, pre-acidified	1:1 HCl to pH<2; Cool to 4°C	28 days
Ortho-PO_4^{3-}	125 mL	125 mL amber poly	Cool to 4ºC	48 hours
TOC/DOC	50 mL	60 mL poly bottle, pre-acidified	HCl to pH<2, Cool to 4ºC	28 days

*Sample containers to be obtained from Manchester Laboratory, except PCB congener containers from a contract laboratory.

An extra set of sample containers will be available should any of the bottles be lost or contaminated.

Laboratory Analysis

Table 10 shows the parameters and numbers of samples to be analyzed, expected range of results, and sample preparation and analysis methods. Other methods may by used by Manchester and their contractor after consulting with the project lead.

Manchester Environmental Laboratory (MEL) will select a contract laboratory to analyze PCB congeners in the stormwater samples and ship the samples to the contractor. Method 1668A permits congener specific determination of more than 150 chlorinated biphenyl congeners by isotope dilution high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS). The contractor will report total PCBs as well as individual congeners. PCB compounds that assume a dioxin-like planar shape due to the lateral position of substituted chlorine atoms are far more toxic than non-planar PCBs (EPA, 1996). The congener data will show the relative amounts of planar vs. non-planar PCBs in the samples.

MEL will analyze all remaining samples for this project. Excess sample extracts will be saved for a period of 60 days after reporting the data to the project lead (when applicable). Manchester's routine turn-around times will meet the needs of this project. Chlorinated pesticides will be analyzed by large volume injection.

The quality objectives for the measured parameters in the project are based upon the published reporting limits by MEL for each parameter and sample matrix in the Lab Users Manual, (MEL, 2005). MEL will follow standard quality control procedures, which include routine laboratory duplicates' analysis on all conventional parameters.

The lowest concentrations of interest for project samples are listed in Table 10, (lowest concentrations practically attainable within the constraints of this project). These limits are the lowest currently achievable with the selected methods. The water limits are lower than the EPA human health criteria by factors of approximately two to ten. These reporting limits should be adequate to consistently quantify pollutant concentrations in stormwater samples.

Table 10: Laboratory Procedures

Analysis	Number of Field Samples[a]	Expected Range of Results	Sample Prep Method	Analytical Method	Reporting Limit
Chlorinated Pesticides[b]	10	<0.005-10 ng/L	SW3510/3620/ 3665[c]	EPA Method 608 or SW-846 Method 8081 (Large Volume Injection)	0.035ng/L
PCB Congeners	10	<1 – 10 ng/L	N/A	EPA Method 1668A	0.05 ng/L
Fecal Coliform	13	$1\text{-}10^4$ CFU/mL	N/A	SM MF 922D	1 cfu/100mL
TSS	13	1-500 mg/L	N/A	EPA Method 160.3 or SM 2540	1 mg/L
Turbidity	13	1-1000 NTU	N/A	EPA 180.1	1 NTU
Alkalinity	13	50-100mg/L	N/A	EPA Method 310.2 or SM 2320B	5 mg/L
NO_2^-+NO_3^-,	13	0.01 – 10.0 mg/L	N/A	SM 4500 (Nitrate+Nitrite)H	0.01 mg/L
NH_3	13	0.01 – 0.5 mg/L	N/A	SM 4500 (Ammonia)I	0.01 mg/L
TPN	13	0.025 – 10.0 mg/L	N/A	SM 4500 (TPN)B	0.025 mg/L
Total P	13	0.01 – 1.0 mg/L	N/A	EPA Method 200.8	0.001 mg/L
Ortho-PO_4^{3-}	13	0.01 – 0.5 mg/L	Whatman Puradisc 25 PP, 0.45µm pore size	SM 4500-PG	0.003 mg/L
Chloride	13	1-10 mg/L	N/A	EPA Method 300.0 or SM 4110C	0.1 mg/L
TOC/DOC	13	1-10 mg/L	Whatman Puradisc 25 PP, 25mm diameter, 0.45µm pore size	EPA Method 415.1 or SM 5310B	1 mg/L

All analyses are done on stormwater samples.
SM = *Standard Methods for the Examination of Water and Wastewater* 20th Edition.
[a]Not including periodic blanks and duplicates.
[b] 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, dieldrin, heptachlor, heptachlor epoxide.
[c]Corresponding Manchester SOPs and modifications.

Quality Control Procedures

Field

The field QC samples to be analyzed for this project are shown in Table 11. Field duplicate samples are those taken at the same time in a side-by-side manner, to provide an estimate of total variability in the data (field + laboratory). All field measured parameters using a portable device will be made in duplicate.

A laboratory replicate is the sample from the field analyzed a second time in the laboratory. The difference between the field duplicates and laboratory replicates is an estimate of the sample field variability. A single duplicate water sample for PCBs and three duplicate chlorinated pesticide samples will be collected and analyzed from one of the storm drains. All other parameters will be duplicated at each storm at each storm drain site.

Table 11: Field Quality Control Samples

Parameter	Duplicate	Field Transfer Blank
PCB Congeners	1/project	1/project
Chlorinated Pesticides	3/project	1/project
Fecal Coliform Bacteria	3/storm	NA
Other Stormwater Samples		
TSS	3/storm	NA
Turbidity	3/storm	NA
Alkalinity	3/storm	NA
Nutrients	3/storm	NA
Chloride	3/storm	NA
TOC/DOC	3/storm	NA
Temperature	In-situ measurement duplicate once stabilized reading achieved	NA
Conductivity	In-situ measurement duplicate once stabilized reading achieved	NA
DO	In-situ measurement duplicate once stabilized reading achieved	NA
pH	In-situ measurement duplicate once stabilized reading achieved	NA

NA- Not applicable.

The potential for contamination arising from the stormwater sample containers, preservation, or transport will be assessed with transfer blanks. Transfer blanks will be prepared in the field by pouring organic-free water, obtained from MEL, from one sample bottle to another, and the bottle re-sealed. One field transfer blank will be analyzed for samples being collected for chlorinated pesticides and PCBs as indicated in Table 11.

Laboratory

MELs routine QC samples for all conventional parameters will be satisfactory for the purposes of this project. The routine QC samples for chlorinated pesticides to be analyzed by MEL are shown in Table 12. MEL will follow their routine practice of adding surrogates (tetrachloro-m-xylene, dibutylchlorendate, decachlorobiphenyl) to the water sample prior to analyzing for chlorinated pesticides. Results from these samples will be used to verify that analytical precision is in control and that the level of bias, due to calibration, is acceptable. Manchester will do a matrix pike and matrix spike duplicate on one water sample from the first storm to assess the matrix for interferences and the effect on the analyte recovery. With each shipment of water samples a single duplicate will be analyzed for chlorinated pesticides.

Table 12: Laboratory Quality Control Samples

Parameter	Method Blank	OPR[a] Standards	Surrogate Spikes	Matrix Spike Pair[b]	Duplicate
Chlorinated Pesticides	1/batch	Each batch	All samples	1/project	1/storm
PCBs[b]	1/batch	Each batch	NA	1/project	1/project
Conventional Pollutants	NA	Each batch	NA	NA	1/drain for each storm

NA – Not applicable.
[a]On-going precision and recovery.
[b]Matrix spike and matrix spike duplicate is a pair of samples.
[c]To be analyzed by a contract laboratory.
[d]Includes: Fecal coliform bacteria.

Additionally, a duplicate water sample for each storm drain location for each storm will be analyzed for the conventional pollutants.

The PCB congener analysis will be performed by a contracted laboratory using an isotopic dilution method where each sample is spiked with labeled PCB congeners. One duplicate for the project will be sent to the contract laboratory for PCB congener analysis.

Data Management, Verification, and Validation

Field notes will be verified by reviewing the information prior to leaving each sampling site. Data reduction, review, and reporting will follow the procedures outlined in the Lab Users Manual (MEL, 2005). Laboratory staff will be responsible for internal quality control validation and for proper data transfer and reporting data to the project manager. All water quality data will be entered into Ecology's Environmental Information Management (EIM) system.

MEL will conduct a review of all laboratory data and case narratives, including the data from the contracted laboratory. MEL will verify that methods and protocols specified in the QA Project Plan were followed: that all calibrations, checks on quality control, and intermediate calculations were performed for all samples; and that the data are consistent, correct, and complete, with no errors or omissions. Evaluation criteria will include the acceptability of holding times, instrument calibration, procedural blanks, spike sample analyses, precision data, laboratory control sample analyses, standard reference materials' analyses, and appropriateness of data qualifiers assigned. Manchester will prepare written reports on the results of their data review.

To determine if project MQOs have been met, results for surrogate spikes and labeled PCB congeners will be compared to QC limits. To evaluate whether the targets for reporting limits have been met, the results will be examined for *non-detects* to determine if any values exceed the required reporting limits.

The project lead will review the laboratory data packages and Manchester's data verification report. The project lead will check the data and reports for completeness and reasonableness. Based on these assessments, the data will be either accepted, accepted with appropriate qualifications, or rejected and re-analysis considered.

Audits and Reports

The following reports are planned for this project:
1) A technical report which reports stormwater concentrations and estimated loads for the targeted parameters on the 303(d) list. The completion date for this report is August 2006. The report will include all chemical and QC data, case narratives, Manchester's data reviews, and ancillary biological data.

2) The project data will be entered into Ecology's Environmental Information Management System. Data entry is scheduled to be completed by July 2006.

Data Quality (Usability) Assessment

Once the data have been reviewed, verified, and validated, the project lead will make a determination if the data can be used to make the calculations, determinations, and decisions for which the project was conducted. If the results are satisfactory, the following will be done:
1) Pollutant loads to the river will be calculated for each measured parameter at each storm drain.

2) Land use and pollutant loads will be compared between the storm drains and an overall stormwater load will be estimated using the Simple Method model based upon annual runoff volume and pollutant concentration, as follows:

$$L = 0.226 * R * C * A$$

Where: L = Annual load (lbs)
R = Annual runoff (inches)
C = Pollutant concentration (mg/l)
A = Area (acres)
0.226 = Unit conversion factor

The annual runoff is a product of annual runoff volume, and a runoff coefficient (Rv). Runoff volume is calculated as:

$$R = P * Pj * Rv$$

Where: R = Annual runoff (inches)
P = Annual rainfall (inches)
Pj = Fraction of annual rainfall events that produce runoff (usually 0.9)
Rv = Runoff coefficient

In the Simple Method, the runoff coefficient is calculated based on impervious cover in the subwatershed. The Simple Method provides a general planning estimate of likely storm pollutant export from areas at the scale of a development site, catchment, or subwatershed. More sophisticated modeling may be needed to analyze larger and more complex watersheds.

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Pesticide-Use Map: water.usgs.gov/pubs (look under pesticides).

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Appendix A

303(d) Listings for the South Fork Palouse River

Washington State has produced a list that divides all waterbodies into one of five categories. This information can also be found at www.ecy.wa.gov/programs/wq/303d/wq_assessment_cats.html.

Category 1: *Meets Tested Standards.* Placement in this category does not necessarily mean that a waterbody is free of all pollutants. Most water quality monitoring is designed to detect a specific array of pollutants, so placement in this category means that the waterbody met standards for all pollutants for which it was tested. Specific information about the monitoring results may be found in the individual listings.

Category 2: *Waters of Concern.* Waters where there is some evidence of a water quality problem, but not enough to require production of a TMDL at this time. There are several reasons why a waterbody would be placed in this category. A waterbody might have pollution levels that are not quite high enough to violate the water quality standards, or there may not have been enough violations to categorize it as impaired according to Ecology's' listing policy. There might be data showing water quality violations, but the data were not collected using proper scientific methods. In all of these situations, these are waters that we will want to continue to test.

Category 3: *No Data*. A category that will be largely empty. Waterbodies that have not been tested will not be individually listed; but, if they do not appear in one of the other categories, they are assumed to belong here.

Category 4: *Polluted Waters that Do Not Require a TMDL.* Waters that have pollution problems that are being solved in one of three ways.

> Category 4a has a TMDL and is for waterbodies that have an approved TMDL in place and are actively being implemented.
>
> Category 4b has a pollution control plan and is for waterbodies that have a plan in place that is expected to solve the pollution problems. While pollution control plans are not TMDLs, they must have many of the same features and there must be some legal or financial guarantee that they will be implemented.
>
> Category 4c is impaired by a non-pollutant and is for waterbodies impaired by causes that cannot be addressed through a TMDL. These impairments include low water flow, stream channelization, and dams. These problems require complex solutions to help restore streams to more natural conditions.

Category 5: *Polluted Waters that Require a TMDL.* The 303(d) list is the traditional list of impaired waterbodies. Placement in this category means that Ecology has data showing that the water quality standards have been violated for one or more pollutants, and there is no TMDL or pollution control plan. TMDLs are required for the waterbodies in this category.

Table A-1: 303(d) Listings for the SFPR

SOUTH FORK PALOUSE RIVER IMPAIRED WATERS LISTING HISTORY			
TIMELINE	LISTING ID	CATEGORY OF WATERBODY	PARAMETER
303(d) LIST AS OF 1996	8142	5	Dissolved oxygen
	8105	5	Dissolved oxygen
	6709	5	Fecal Coliform
	6712	5	Fecal Coliform
	6711	5	Fecal Coliform
	6707	5	Fecal Coliform
	6708	5	Fecal Coliform
	6710	5	Fecal Coliform
	10448	5	Fecal Coliform
	10450	5	Fecal Coliform
	10452	5	Fecal Coliform
	6729	5	pH
	8130	5	Temperature
	8132	2	Dissolved oxygen
	8126	2	Dissolved oxygen
	8137	2	Dissolved oxygen
	8133	2	Dissolved oxygen
	8141	2	Dissolved oxygen
	11135	2	pH
	8131	2	Temperature
	10453	1	Fecal Coliform
Although included on the 1996 list these were not included on the 1998 list.	3724	5	Temperature
	8125	2	Dissolved oxygen
	8139	2	Dissolved oxygen
	8128	2	pH
	8129	2	Temperature
NEW TO LIST 2002/2004	11137	5	Dissolved oxygen
	6712	5	Fecal Coliform
	10450	5	Fecal Coliform
	3724	5	Temperature
	8827	4A	Ammonia-N
	11136	2	Ammonia-N
	8125	2	Dissolved oxygen
	8128	2	pH
	8129	2	Temperature
	42554	1	pH

Table A-2: 303(d) Listings for the Mainstem Palouse River

MAINSTEM PALOUSE RIVER IMPAIRED WATERS LISTING HISTORY				
TIMELINE	LISTING ID	CATEGORY OF WATERBODY	PARAMETER	MATRIX
303(d) LIST AS OF 1996	8819	5	4,4'-DDE	Tissue
	8818	5	Dieldrin	Tissue
	11133	5	Dissolved oxygen	Water
	16791	5	Fecal Coliform	Water
	8822	5	Heptachlor epoxide	Tissue
	6732	5	pH	Water
	3723	5	Temperature	Water
	11130	5	Temperature	Water
	8115	5	Temperature	Water
	8820	5	Total PCBs	Tissue
	16792	4A	Fecal Coliform	Water
	8118	2	Dissolved oxygen	Water
	8106	2	Dissolved oxygen	Water
	8122	2	pH	Water
	8112	2	pH	Water
	8114	2	Temperature	Water
	8123	2	Temperature	Water
	8821	1	Chromium	Water
Although included on the 1996 list these were not included on the 1998 list.	16922	5	pH	Water
	11129	2	Ammonia-N	Water
	8108	2	Dissolved oxygen	Water
	8110	2	Dissolved oxygen	Water
	8113	2	pH	Water
	8119	2	pH	Water
	16923	2	Temperature	Water
	8117	2	Temperature	Water
	8817	1	Ammonia-N	Water
NEW TO LIST 2002/2004	14190	5	4,4'-DDE	Tissue
	14191	5	ALPHA-BHC	Tissue
	16922	5	pH	Water
	42553	5	pH	Water
	42531	4A	Fecal Coliform	Water
	11129	2	Ammonia-N	Water
	8108	2	Dissolved oxygen	Water
	8121	2	Dissolved oxygen	Water
	8110	2	Dissolved oxygen	Water
	42522	2	Dissolved oxygen	Water
	8113	2	pH	Water
	8119	2	pH	Water
	16923	2	Temperature	Water
	8117	2	Temperature	Water
	14200	1	1,2-Dichlorobenzene	Tissue
	14206	1	1,2-Diphenylhydrazine	Tissue
	14201	1	1,3-DICHLOROBENZENE	Tissue

	14202	1	1,4-Dichlorobenzene	Tissue
	14194	1	2,4,6-TRICHLOROPHENOL	Tissue
	14195	1	2,4-DICHLOROPHENOL	Tissue
	14196	1	2,4-DINITROPHENOL	Tissue
	14203	1	2,4-DINITROTOLUENE	Tissue
	14204	1	3,3-Dichlorobenzidine	Tissue
	14189	1	4,4'-DDD	Tissue
	14188	1	4,4'-DDT	Tissue
	11132	1	Ammonia-N	Water
	8817	1	Ammonia-N	Water
	14205	1	Anthracene	Tissue
	14199	1	BIS(2-CHLOROETHYL)ETHER	Tissue
	14208	1	Bis(2-chloroisopropyl)ether	Tissue
	14193	1	Chlordane	Tissue
	11910	1	Copper	Water
	14213	1	Dimethyl phthalate	Tissue
	16921	1	Dissolved oxygen	Water
	14207	1	Fluorene	Tissue
	14209	1	Hexachlorobutadiene	Tissue
	14210	1	HEXACHLOROCYCLOPENTADIENE	Tissue
	14198	1	HEXACHLOROETHANE	Tissue
	11909	1	Lead	Water
	14192	1	Mercury	Tissue
	14211	1	NITROBENZENE	Tissue
	14212	1	N-nitrosodiphenylamine	Tissue
	14197	1	Pentachlorophenol	Tissue
	42582	1	pH	Water
	42583	1	pH	Water
	42584	1	pH	Water
	42769	1	pH	Water
	11908	1	Silver	Water
	11911	1	Zinc	Water

Appendix B

Background Information on SFPR River 303(d) Pesticides and PCBs*

Alpha-BHC – Prior to 1977, alpha-BHC was a component of lindane, an insecticide used to control pests including flies, aphids, and grain weevils. Alpha-BHC is no longer produced in the United States.

DDT – Insecticide on a variety of crops and for control of insect borne diseases. DDT was banned in 1972. DDE and DDD are toxic breakdown products. DDD also had some use as the insecticide Rothane. Total DDT measurements includes DDT+DDE+DDD.

Dieldrin – Broad spectrum insecticide primarily used on termites; other soil-dwelling insects; and on corn, cotton, and citrus. Production and most major uses of dieldrin were banned in 1974. All uses were voluntarily canceled by industry in 1987. Aldrin and dieldrin have similar chemical structures and commercial uses. Aldrin rapidly breaks down to dieldrin in plants and animals and when exposed to sunlight or bacteria.

Heptachlor epoxide – A breakdown product of heptachlor and a contaminant in heptachlor and chlordane formulations. Heptachlor was used to control soil insects and as a seed protectant and household insecticide. Major uses of heptachlor were suspended in 1978.

PCBs – Widely used in industrial applications as insulating fluids, plasticizers, in inks and carbonless paper, and as heat transfer and hydraulic fluids, but also had a variety of other uses. EPA restricted manufacture of PCBs to sealed systems in 1977. In 1979, EPA banned PCB manufacture, processing, and distribution but allowed continued use in closed electrical systems. EPA phased out the use of electrical equipment containing PCBs through regulations in 1982 and 1985.

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*Summarized from information in EPA (1992, 2000) and the Agency for Toxics Substances and Disease Registry (ATSDR) Website www.atsdr.cdc.gov/toxpro2.html.

Appendix C

Complete List of Pesticides Measured at Manchester Environmental Laboratory

PESTICIDES LIST1
alpha-BHC
beta-BHC
gamma-BHC (lindane)
delta- BHC
Heptachlor
Aldrin
Heptachlor epoxide
trans-chlordane (gamma)
cis-Chlordane (alpha)
Endosulfan I (Alpha-endosulfan)
Dieldrin
Endrin
Endrin Ketone
Endosulfan II (Beta-endosulfan)
Endrin Aldehyde
Endosulfan Sulfate
4,4'-DDE
4,4'-DDD
4,4'-DDT
Methoxychlor
Toxaphene
Chlordane (technical)