Palouse River Watershed PCB and Dieldrin Monitoring, 2007-2008

Wastewater Treatment Plants and Abandoned Landfills

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Cover photo: City of Pullman Wastewater Treatment Plant discharge to the South Fork Palouse River (taken by Department of Ecology staff, April 2008).

Palouse River Watershed PCB and Dieldrin Monitoring. 2007-2008

Wastewater Treatment Plants and Abandoned Landfills

by
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303(d) Listings Addressed in this Study:

Total PCBs
Dieldrin

Waterbody Numbers:
Palouse River - WA-34-1010
South Fork Palouse River - WA-34-1020

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Abstract

During 2007-2008, the Washington State Department of Ecology monitored polychlorinated biphenyls (PCBs) and dieldrin at three wastewater treatment plants (WWTPs) and two abandoned landfills in the South Fork Palouse River watershed. This work was done as a result of wasteload allocations recently established through a Total Maximum Daily Load (TMDL) study for the Palouse River.

The goals of this study were to (1) establish whether the Pullman, Albion, and Colfax WWTP discharges exceed U.S. Environmental Protection Agency (EPA) National Toxics Rule (NTR) human health criteria for PCBs and dieldrin, (2) assess if the contamination is internal or external to each facility, and (3) assess two abandoned City of Pullman landfills as sources of PCBs and dieldrin.

All WWTPs were found to reduce influent concentrations of PCBs and dieldrin compared to levels measured in effluents. However, effluent concentrations of PCBs exceeded NTR criteria at the Pullman, Albion, and Colfax WWTPs. Load reductions of 88% (Pullman), 85% (Albion), and 47% (Colfax), are needed to meet the interim wasteload allocations set forth in the TMDL. The Pullman WWTP effluent was the only discharge exceeding the NTR human health criterion for dieldrin. A 48% load reduction is necessary to meet the interim wasteload allocations set forth in the TMDL.

Sediment and soil samples from the abandoned landfills were higher in PCBs than the background river sediment. Dieldrin was detected at low levels in the sediment and soil samples but not in the surface water sample from the upland landfill.

This project assists the three cities in making the first step to quantify PCB and dieldrin concentrations being delivered to and discharged from the WWTPs. A series of recommendations are made to continue (1) pollution-source tracking and (2) reducing sources of PCBs and dieldrin to the South Fork Palouse River.

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Introduction

A recent Total Maximum Daily Load (TMDL) for the Palouse River addressed the lower Palouse River 303(d) listings for polychlorinated biphenyls (PCBs), dieldrin, and other chlorinated pesticides (Johnson et al., 2007). The listings were for non-attainment of the human health criteria for PCB-1260 and dieldrin in edible fish tissue, based on samples collected by the Washington State Department of Ecology (Ecology) in 1984 and 1994. The TMDL determined the current status of the river with respect to loading capacity for 303(d) pesticides and PCB. As a result, it was concluded that dieldrin and PCBs were the two parameters exceeding the loading capacity in the mainstem and, especially, the South Fork Palouse River. PCBs and dieldrin are no longer used in the United States, having been banned in the 1970s and 1980s for ecological concerns.

Water quality standards for surface waters of Washington State are set in Chapter 173-201A of the Washington Administrative Code (WAC), amended in 2006 and approved by EPA in 2008.

Characteristic uses (defined in WAC 173-201A-600) in the South Fork Palouse River include:

- Water supply
- Stock watering
- Fish and Shellfish
- Wildlife habitat
- Recreation (primary contact)
- Commerce and navigation

Chapter 173-201A WAC includes a provision that "*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 conditions to the most sensitive biota dependent on those waters, or adversely affect public health as determined by the department [Ecology]*."

The numeric criteria to protect aquatic life from PCB exposure spelled out in Chapter 173-201A-240 WAC were originally derived by EPA to protect the most sensitive aquatic species (EPA, 1980). Washington State's human health-based water quality criteria are known as the National Toxics Rule (NTR). The NTR criteria values are based on a daily fish consumption rate of 6.5 grams/day and a human health cancer risk level of 10^{-6} for long-term exposure. The acute and chronic criteria for PCBs and dieldrin are shown in Table 1.

Table 1. Washington State Water Quality Criteria* for PCBs and Dieldrin (ng/L; parts per trillion).

Chemical	Criteria for Protection of Aquatic Life		Criteria for Protection of Human Health	
	Freshwater Chronic[1]	Freshwater Acute [2]	Fish Consumption	Water & Fish Consumption
PCBs	14	2,000	0.17	0.17
Dieldrin	1.9	2,500	0.14	0.14

*WAC 173-201A-040

[1] 24-hour average not to be exceeded

[2] an instantaneous concentration not to be exceeded at any time

The TMDL established load and wasteload allocations for nonpoint and point sources within the Palouse River watershed. The main sources of PCBs and dieldrin are suspected to be nonpoint. These contaminants are widespread in the environment and are therefore likely present in wastewater treatment plant (WWTP) effluents. The TMDL study did not collect effluents from the WWTPs in this watershed. Therefore PCBs and dieldrin in final effluents from the Albion, Colfax, and Pullman WWTPs were collected as part of this study.

These WWTPs are located on the mainstem Palouse and South Fork, as shown in Figure 1. The Albion and Pullman WWTPs discharge to the South Fork. The Colfax WWTP discharges to the mainstem Palouse River. The river segment between the Washington-Idaho state line and the city of Colfax is locally referred to as the North Fork. The North Fork and South Fork merge at Colfax to form the mainstem of the Palouse River.

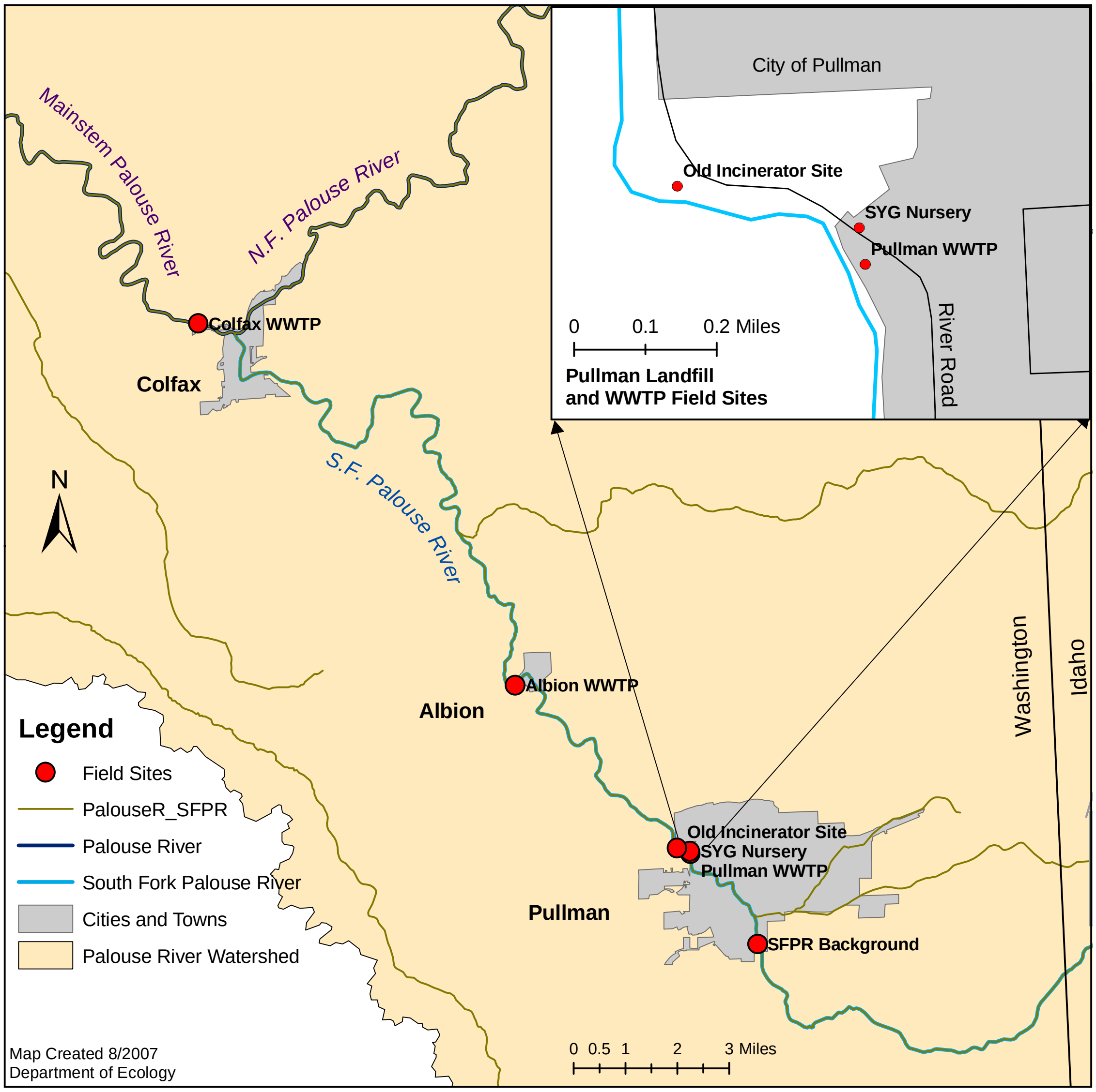

Figure 1. Location of the Albion, Colfax, and Pullman WWTPs, Abandoned Landfills, and the Palouse River.

The TMDL proposed that natural attenuation, monitoring, and best management practices be relied on to bring the Palouse River into compliance with water quality standards for dieldrin and PCBs (Johnson et al., 2007). As required by the federal Clean Water Act, wasteload allocations were assigned to the three WWTPs that discharge to parts of the Palouse River where the loading capacity is exceeded. In the TMDL study, fish in the South Fork had the highest PCBs and dieldrin levels of all the locations sampled in the Palouse watershed. The TMDL set wasteload allocations to meet the Washington State human health criterion at the "end of pipe" for each facility's design flow. See Table 2.

Table 2. Interim Wasteload Allocations for Palouse River WWTPs.

WWTP	Chemical	Design Flow (mgd[1])	Human Health Criteria (ng/L)	Interim WLA[2] (grams/day)
Pullman	Total PCBs	3.4	0.17	0.0022
	Dieldrin	3.4	0.14	0.0018
Albion	Total PCBs	0.12	0.17	0.0001
	Dieldrin	0.12	0.14	0.0001
Colfax	Total PCBs	0.60	0.17	0.0004
	Dieldrin	0.60	0.14	0.0003

[1] = mgd x criteria/1000 x 3.79 (mgd = million gallons per day)
[2] = Wasteload allocations. From Johnson et al., 2007.

Old or unwanted substances and products often end up in landfills. Some of these items may contain or were even made of PCBs. These items could include heat transfer fluid, plasticizers, wax and pesticide extenders, lubricants, dielectric fluids, inks, paints, vacuum pumps, compressors, and transformers. Also, dieldrin was a common pesticide, so old canisters, drums, or barrels containing dieldrin may have been thrown into these types of drive-by landfills.

Sediment (below water) and soil (above water) samples from two abandoned landfills along the South Fork Palouse River were also tested for PCBs and dieldrin, to assess their relative importance as nonpoint sources to the river:

- The *Uphill Landfill* is located along River Road above and behind the SYG Nursery. Sediments were collected from a small gully coming down the hill through the nursery property. Landfill material fills the top half of the gully, and a small rivulet drains the site almost year-round. Stormwater collected from a development above the landfill also mixes with the rivulet.
- The *Old Incinerator Site* is just downriver on the South Fork. The City of Pullman used to burn garbage at this location.

Concentrations of PCBs and dieldrin in the South Fork surface water are higher than the loading capacity for these contaminants; therefore, potential sources of the contaminants must be evaluated.

The goals of this study, as outlined in the Quality Assurance Project Plan (Lubliner, 2007a), are to characterize PCBs and dieldrin concentrations in effluent discharges from Albion, Colfax, and Pullman's WWTPs. Objectives are to:

- Determine if concentrations are meeting the interim wasteload allocations set forth in the TMDL, based on water quality criteria.
- Assess the extent to which the contamination is internal or external to each WWTP.
- Ascertain the relative importance of abandoned landfill's as sources of PCBs and dieldrin to the South Fork.

Other Studies

Ecology has found PCBs in other water quality assessments of WWTP effluents.

In a similarly designed study (Lubliner, 2007b), Ecology tested the Walla Walla and College Place WWTP influents and effluents. Both WWTPs were reducing influent PCB concentrations by two orders of magnitude to yield mean total PCB concentrations of 0.38 ng/L and 0.30 ng/L at Walla Walla and College Place, respectively. The final effluents were approximately double the Washington State human health criteria of 0.17 ng/L total PCBs. The PCB contamination was traced, to a limited extent, into the sewer network for the Walla Walla WWTP to help the city identify sources to the wastewater system. Ecology recommended PCB source tracking efforts within the sewer service area, particularly around the two highest concentration influent lines to the Walla Walla WWTP.

Ecology also sampled two Spokane area WWTPs for PCBs (Golding, 2002). Total PCBs from two-day composite effluent samples were estimated at 1.73 ng/L for the Liberty Lake WWTP and 1.79 ng/L for Spokane WWTP effluent. Both WWTPs are investing in technologies for phosphorus removal that are expected to also reduce PCBs. These monitoring programs will attempt to verify the effectiveness of the tertiary treatment to reduce phosphorus and other pollutants.

A summary of findings from other Ecology studies of PCBs in WWTPs is shown in Table 3.

Table 3. Mean Concentrations of PCBs in Other WWTPs (ng/L).

Location of WWTP	Year	Influent Total PCBs	Effluent Total PCBs
Walla Walla[1]	2007	21.35	0.38
College Place[1]		15.41	0.30
Spokane[2]	2002	--	1.79
Liberty Lake[2]		--	1.73

[1] Lubliner, 2007b
[2] Golding, 2002

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Methods

Study Design

In accordance with the Quality Assurance Project Plan for this project (Lubliner, 2007a), composite wastewater samples were collected from mainstem Palouse and South Fork Palouse WWTPs on three occasions:

- August 7-8, 2007
- February 20-21, 2008
- April 7-8, 2008

Both influent and effluent were sampled to assess treatment efficiency for PCBs and dieldrin at each of the three WWTPs.

The Pullman WWTP has two influent main lines that were both sampled from manholes just before the headworks. The East pipe (30" diameter) serves the south and east side of Pullman and the West pipe (36" diameter) runs up Grand Avenue on the north side of the city. See the map in Appendix D. Pullman's effluent was sampled from the discharge point at the South Fork.

The influent sample at Colfax was collected from their ISCO sampler stationed at the headworks. The effluent was sampled from a monitoring well, approximately 30 feet deep, using their pump to pull water up a PVC monitoring well that tapped into the effluent migrating from the holding pond to the river. For both of the Colfax samples new tubing was used at the beginning of the study.

Albion influent was sampled from a pipe that fills the first of two holding ponds. The Albion ponds are the only treatment process used. The effluent is held over the winter and released in the warmer months. Discharging of effluent began in April 2008.

A background reference sediment sample was collected from the South Fork Palouse River sediments at the upstream Pullman city limit. Soil and sediment were also sampled for PCBs and dieldrin at two abandoned landfills in Pullman. The first abandoned landfill is located just on the hill above and behind the SYG Nursery (the Upland Landfill). The other is an old garbage incinerator site (Old Incinerator Site) less than a half-mile downriver from the Upland Landfill.

Surface water was also collected as a one-time grab, for PCBs and dieldrin, from the Upland Landfill.

All wastewater and landfill surface water samples were analyzed for PCBs, dieldrin, and total suspended solids (TSS). Soil and sediment samples were analyzed for PCBs and dieldrin.

Sampling and Analytical Procedures

Influent and effluent samples from WWTPs were collected as manual composites which consisted of four grabs: two in the morning and two in the afternoon. The grabs were taken by hand using clean[1] glass jars for Albion and Pullman's effluents and clean pole samplers for Albion and Pullman influents. The Colfax WWTP pumps were used to collect samples. Each grab filled the sample container in 1/4 increments. The leachate was collected as a one-time grab sample.

Landfill locations were selected with assistance from John Skyles from the Whitman County Health Department. Soil and sediment samples were collected by scooping five grabs using a stainless steel spoon into a stainless steel bowl and placing the homogenized sample into clean jars for shipment. At the Upland Landfill, the rivulet bank and bottom sediments along the length of the gully to the nursery's culvert (about 100 feet) were collected for the sample and sample duplicate. Soil was collected from five locations along the toe of the embankment (about 200 feet) at the Old Incinerator Site, along the western bank of the South Fork. The surface water sample was collected into a clean glass jar from the rivulet coming down from the Upland Landfill.

Field personnel wore powder-free nitrile gloves at all times during sample collection and followed standard health and safety procedures. The samples were maintained on ice in coolers and transported to Manchester Environmental Laboratory (MEL). MEL sent the samples to either Pace Analytical or Pacific Rim Laboratories, Inc. Chain of custody was maintained. A summary of the samples taken in the study, laboratory methods, and reporting limits can be found in Table 4.

Table 4. Laboratory Methods and Reporting Limits for Monitored Parameters

Parameter	Number of Samples	Analytical Method	Reporting Limit	Analytical Laboratory
PCB Congeners for waters	10	EPA Method 1668A	0.01 ng/L	Pace Analytical Services, Inc.
	15			Pacific Rim Laboratories, Inc.
Dieldrin for waters	9	EPA Method 3535M and EPA SW-846 Method 8081	5 ng/L	Ecology Manchester Laboratory
	12	EPA Method 1668A	0.035 ng/L	Pacific Rim Laboratories, Inc.
PCB Aroclors for soils	7	EPA SW-846 Method 8082	1 – 5 ug/Kg dw	Ecology Manchester Laboratory
Dieldrin for soils	6	EPA SW-846 Method 8081	0.25 ug/Kg dw	Ecology Manchester Laboratory
Total Suspended Solids	22	Standard Method 2540D	1 mg/L	Ecology Manchester Laboratory

mg/L = parts per million. ng/L = parts per trillion. ug/Kg = parts per billion.

[1] Priority pollutant cleaned according to EPA QA/QC specifications (EPA, 1990).

The PCB congener analysis quantifies 209 individual congeners, including the 12 most toxic PCBs (also known as dioxin-like PCBs), designated by the World Health Organization. Samples are analyzed by high-resolution gas chromatography/mass spectrometry (HRGC/MS) (EPA Method 1668A), an isotopic dilution method using labeled congeners. This method was chosen for low detection limits, and because it has the potential for enhanced tracking of PCB sources throughout the sewer service network. Total PCBs are reported as the sum of detected congeners for water samples and the sum of detected Aroclors for sediment samples. Non-detects are reported at the minimum reporting limit, but are not part of the summed total.

Soil and sediment samples were tested for PCB Aroclors and dieldrin using EPA SW-846 Methods 8081 and 8082, respectively.

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Data Quality

WWTP and Surface Water Samples

Qualitative and quantitative precision and bias in methods, protocols, and results from all laboratories were reviewed by MEL and the project lead. This verification process includes checking that:

1. Holding times, blanks, instrument calibration, laboratory control sample analyses, and appropriateness of data qualifiers assigned were acceptable and appropriate.
2. All calibrations, checks on quality control, and intermediate calculations were performed for all samples.
3. Data are consistent, correct, and complete, with no errors or omissions.
4. Targets for reporting limits have been met (non-detects were not counted in the total PCB values).

All samples arrived at MEL within the appropriate timeframe for analysis and at the proper temperature limit, and were subsequently stored at 4°C. Coolers containing the PCB and dieldrin samples to be sent to contract laboratories and were kept to 4°C.

Most of the measurement quality objectives set forth in the Quality Assurance Project Plan for this project (Lubliner, 2007a) were met with two exceptions: (1) Pace Analytical had unexplained PCB contamination in the laboratory blank, and (2) the dieldrin reporting limit was too high for the first round of samples.

As a result of PCBs in Pace's method blank, reporting limits were raised for those congeners in the first round of samples. Results within 10 times the concentration of the laboratory blank were flagged as J or UJ. The reporting limit for non-detects for these samples was 5 ng/L, which was too high for this method. All remaining water samples for PCB analysis were sent to Pacific Rim, Inc. for improved sample sensitivities.

Dieldrin levels in the wastewater were unknown. The first round of dieldrin water samples were analyzed by MEL using EPA Method 3535 solid phase extraction (SPE). This resulted in a reporting limit of 5 ng/L, which did not meet data quality objectives. Because there were no detections at this level, all remaining dieldrin water samples were contracted to Pacific Rim for a HRGCMS (EPA Method 1668A) analysis with a lower reporting limit of 0.035 ng/L.

All other PCB and dieldrin results for water samples are considered acceptable.

Laboratory Quality Control

Laboratory control samples, method blanks, standards/labeled compounds, and laboratory duplicates for this study are acceptable. Results for check standards/laboratory control samples, duplicate samples, and labeled compounds were compared to QC limits. The results for field and method blanks were examined for significant contamination of the samples. Non-detects are reported at the method reporting limit and flagged with either a U or UJ.

MEL and the project lead reviewed the laboratory data packages, verified the case summaries, and assessed the usability of the data. Based on these assessments, the data are accepted with the appropriate qualifications, and the data are considered usable for making calculations, determinations, and decisions for which the project was conducted. Case narrative summaries for all data reports are available from the author.

For all parameters, the calibrations, recoveries, and ongoing precision were performed in accordance with the appropriate method. A summary of calibration, ongoing precision, and internal standards recovery is provided in Appendix A.

Field Quality Control

Transfer blanks were analyzed to detect contamination arising from sample containers or sample handling. The blanks were prepared by transferring organic-free water supplied by the laboratories from one bottle to another in the field, which mimicked the grab sampling procedure. The transfer blanks were poured onsite at the Pullman and Colfax WWTPs. The field blank values were lower than the laboratory method blank values which indicate there was no container or sample handling contamination.

Duplicates were taken side-by-side from the Pullman and Colfax WTP effluents. Duplicates provide estimates of field and laboratory variability. Variability can be expressed as the relative percent difference (RPD) between a sample and its duplicate, Equation 1.

Equation 1

$$\text{RPD} = \left(\frac{\text{difference of 2 results}}{\text{mean}} \right) \times 100$$

Table 5 shows total PCBs, dieldrin, and total suspended solids RPDs for the field duplicate samples.

Table 5. Relative Percent Difference between Field Duplicate Effluent Samples for Pullman and Colfax WWTPs.

Chemical	Date	Pullman			Colfax		
		Effluent	Effluent Duplicate	RPD	Effluent	Effluent Duplicate	RPD
Total PCBs (ng/L)	Aug 2007	0.63J	0.49J	25%	0.085J	0.075J	13%
	Apr 2008	2.2	2.0	10%	-	-	-
Dieldrin (ng/L)	Aug 2007	<5.1	< 5	-	<5.3	<5.1	-
	Feb 2008	0.3	-	-	0.2	-	-
	Apr 2008	0.32	0.26	23%	-	-	-
TSS (mg/L)	Aug 2007	3	3	0%	12	6	67%

Total PCB RPDs ranged from 10 to 25%, which are acceptable amounts of variation for Method 1668A. The dieldrin RPD was 23%, which is also acceptable. The TSS RPD was zero for Pullman's duplicate; however, it was very high (67%) for the Colfax duplicate. The Colfax duplicate was twice the value which is excessive for TSS. These values of 6 and 12 mg/L are atypical for TSS and should be considered invalid.

The difference in effluent PCB congener duplicate samples ranged from 0.01 to <0.2 ng/L for Colfax and Pullman, respectively. The duplicate difference for dieldrin was 0.06 ng/L in Pullman’s effluent, which is considered acceptable.

Field Transfer Blanks

Field transfer blanks are used to measure sample contamination from the glassware, water origination, or field handling. Results for the two field blanks used in the study are presented in Table 6.

Table 6. Field Transfer Blank Results (ng/L) for PCB Congeners.

Sample Name	Sample Number	Total PCB Congeners		Dieldrin
Field Transfer Blank 1	07324169	0.06	NJ	<0.5
Field Transfer Blank 2	08154159	0.19	J	--

NJ - There is evidence that the analyte is present. The associated numerical result is an estimate.
J - Analyte positively identified; numerical value is the approximate concentration.

Little to no PCB contamination was found in the transfer blanks. PCB Congener sums are provided in Appendix C. The detection limit for the dieldrin results was very high; blank contamination was zero at this high detection limit.

Soil and Sediment Samples

The first set of sediment samples from the Upland Landfill location showed evidence of very high PCB levels, but the sample may have been incompletely homogenized. A routine quality control matrix spike returned atypically high (MEL, 2006) concentrations for the landfill sediments from the gully sampled at the Upland Landfill in August 2007. Matrix interferences of a soil or sediment sample are tested using a spike. The analytical chemist verified that the signal was from the native sample and not from laboratory contamination. The chemist re-extracted the sample in duplicate (REX1 and REX2) to find very different concentrations, 51 and 551 ug/Kg dry weight (dw), respectively. See the data in Table 8. See PCB Aroclor data and the case narrative dated November 9, 2007 in Appendix B for more review.

The gully was revisited in February 2008 to better define the PCB contamination at the site. Two locations were sampled; uphill and downhill. The uphill sample laboratory duplicates had poor precision with results of 28 and 287 ug/Kg dw of total PCB Aroclors. Aroclors 1254 and 1260 were identified. All other PCB Aroclor results were low. Due to the poor precision, the uphill sample was re-extracted for a final verification of laboratory or field variability. The results for total PCB Aroclor concentrations were 18 J and 14 J ug/Kg dw.

Results

Influent and Effluent

Influent and effluent samples were collected from the Colfax and Pullman WWTPs on three occasions. At the Albion WWTP, three influent samples, but only one effluent sample, were collected. Freezing spring temperatures delayed the onset of the effluent discharge.

The concentrations for PCBs, dieldrin, and total suspended solids (TSS) measured in the wastewater samples are presented in Table 7.

Table 7. Influent and Effluent Results from South Fork Palouse Area WWTPs.

Sample Location	Total PCBs (ng/L)			Dieldrin (ng/L)			TSS (mg/L)		
	Aug 2007	Feb 2008	Apr 2008	Aug 2007	Feb 2008	Apr 2008	Aug 2007	Feb 2008	Apr 2008
Pullman									
East Influent	15.4	12.5	65.6	<5	0.93	0.71	164	172	189
West Influent	26.3	18.7	14.2	<5	1.19	0.88	287	204	159
Effluent	0.63 J	1.47	2.2	<5.1	0.3	0.32	3	9	7
Effluent (Dup)	0.49 J	-	2.0	<5	-	0.26	3	-	-
Albion									
Influent	16.8	2.2	7.7	<5	0.18	0.54	129	45	84
Effluent	-	-	1.8	-	-	<0.03	-	-	60
Colfax									
Influent	15.2	7.76	12.4	<5	0.7	0.71	202	135	183
Effluent	0.085 J	0.65	0.5	<5.1	0.18	broken	12	<2	4
Effluent (Dup)	0.075 J	-	-	<5.3	-	-	6	-	-

< = Not detected at reporting limit shown.
J= Analyte positively identified; numerical value is the approximate concentration.
Broken = The sample jar broke in transit.

PCB homologue group results are provided in Appendix C. Data for individual 209 PCB congeners are available through the Ecology Environmental Information Management (EIM) database: https://fortress.wa.gov/ecy/eimreporting.

Landfills

Sediment and Soil

The background sediment sample collected from the South Fork Palouse River had low concentrations of dieldrin and no detected PCBs.

The Upland Landfill sediments (named with prefix SYG below) and the Old Incinerator Site soils had detectable PCBs and dieldrin concentrations. PCB results from the landfills are presented in Table 8. As previously described, the Upland Landfill gully sediments were sampled on two occasions, to better define the geographic area of contamination.

Table 8. Sediment and Soil Concentrations of PCB and Dieldrin.

General Location	Sample Name	Sample Number (date [a] - number)	Total PCBs (µg/Kg dw)		Dieldrin (µg/Kg dw)		Notes
Background South Fork	SFPRBKGRD	07324167	<2.9		1.1		
Gully sediments at Upland Landfill	SYGSED	07324168	11		0.58		Field Duplicate
	SYGSEDDUP	07324169	14		NA		
	SYGSEDDUP (REX1)	07324169	15		NA		Lab Re-extraction Number 1 and 2
	SYGSEDDUP (REX2)	07324169	551		NA		
	SYGUPHILL	08084166	28	J	0.66	J	Routine Lab Duplicate
	SYGUPHILL	LDP1	278	J	3.1	J	
	SYGUPHILL(REX1)	08084166	18	J	NA		Requested re-extraction by project manager
	SYGUPHILL (REX2)	LDP1	14	J	NA		
Gully sediments downhill of Upland Landfill	SYGDWNHILL	08084170	14		1.1		
	SYGDWNHILL (REX3)	08084170	15.1	J	NA		
Old Incinerator Site embankment	INCINERATOR	08154165	32	J	1.3	J	Routine Lab Duplicate
	INCINERATOR	LDP1	55.7	J	2.4	J	

[a] = Date refers to year (07 or 08) and week number. August 7, 2007 was week 32; February 20, 2008 was week 08; and April 7, 2008 was week 15.
< = Analyte not detected at or above the reported sample quantitation limit.
J = Analyte positively identified; numerical value is the approximate concentration.
LDP1 = Laboratory duplicate.
dw = Dry weight.

Surface Water

Water running down from the Upland Landfill site was analyzed for PCB congeners and dieldrin, in a single grab. Results are presented in Table 9.

Table 9. Surface Water Results (ng/L) at Upland Landfill for PCB Congeners and Dieldrin (sample number 07324160).

Parameter	Concentration
Total PCBs	0.76 J
Dieldrin	<4.9*

*= not detected at the reporting limit of 4.9 ng/L
J= Analyte positively identified; numerical value is the approximate concentration.

Unfortunately, the dieldrin result was a non-detect for this sample as a result of the SPE method selection. Another landfill surface water sample for dieldrin was not collected.

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Discussion

Comparison of Design Flow to WWTP Discharge Rates

The WWTP operators provided the 24-hour effluent flow rate for the dates sampled. The flow rates presented in Table 10 are the two-day averages for the days sampled.

Pullman is home to Washington State University, which was out of session on the first sampling date. The actual flow rates were similar to the design flow. Using the design flow in the wasteload allocation seems reasonably accurate for all WWTPs.

Table 10. WWTP Design Flow and Discharge Rate for Sampling Dates

WWTP	Design Flow (mgd)	August 7-8, 2007		February 20-21, 2008		April 7-8, 2008	
Pullman	3.4	1.72	1.68	2.81	2.87	3.06	3.79
Albion	0.12	--	--	--	--	0.089	0.140
Colfax	0.6	0.478	0.498	0.682	0.662	0.573	0.597

All three of these WWTPs appeared to be operating at or near capacity.

Influent and Effluent Concentrations

Summary statistics for the influent and effluent concentrations of PCBs and dieldrin during the present study are presented in Table 11. The August 2007 dieldrin values of less than 5 ng/L were not used when preparing the summary statistics.

Table 11. WWTP Concentrations for Total PCBs, Dieldrin, and Total Suspended Solids, 2007-08.

Sample Location	Mean			50th - 95th Percentile		
	Total PCBs (ng/L)	Dieldrin (ng/L)	TSS (mg/L)	Total PCBs (ng/L)	Dieldrin ng/L)	TSS (mg/L)
Pullman East Influent	31.2	0.82	172	15.5 - 60.6	0.8 - 0.9	168 - 187
Pullman West Influent	19.7	1.04	217	18.7 - 25.6	1 - 1.2	204 - 279
Pullman Effluent	1.4	0.27	5.5	1.5 - 2.2	0.28 - 0.32	5 - 9
Albion Influent	8.9	0.36	86	7.6 - 15.9	0.4 - 0.5	84 - 125
Albion Effluent [a]	1.5	<0.03	60	1.5	<0.03	60
Colfax Influent	11.8	0.70	173	12.4 - 15.9	0.7 - 0.71	183 - 200
Colfax Effluent	0.33	0.20	7	0.3 - 0.6	0.2 - 0.21	5 - 11

[a] = only one data point

The mean TSS results for effluent in Table 11 adhere to NPDES permit limits:

- Albion NPDES Permit Limit for TSS = 159 mg/L average weekly
  (Permit No. WA-002260-8; Ecology, 2005).
- Colfax NPDES Permit Limit for TSS = 45 mg/L average weekly
  (Permit No. WA-0020613: Ecology, 2004).
- Pullman NPDES Permit Limit for TSS = 45 mg/L average weekly
  (Permit No. WA-004465-2; Ecology, 2007).

The 50th percentile or median is a commonly used summary statistic for environmental sampling, because environmental data are often not normally distributed. However, the mean and median agree well for all but one location. The exception is the Pullman East Influent PCB concentration of 31.2 ng/L is twice the median value of 15.5 ng/L. This is a result of the high April 2008 sample 65.6 ng/L having a pronounced effect on the mean.

All PCB concentrations were considerably higher in the influent than the effluent. There was an order of magnitude reduction between influent and effluent at the Albion and Pullman WWTPs, and two orders of magnitude reduction for the Colfax WWTP. Albion has two facultative lagoons in series followed by chlorination. Colfax has a series of aerated lagoons, chlorine disinfection and infiltration cells. Colfax achieved a two orders of magnitude reduction using aerated lagoons. Pullman's WWTP employs an activated sludge process with chlorination and dechlorination.

Dieldrin concentrations were reduced from influent to effluent by approximately a factor of 3 at the Pullman and Colfax WWTPs. At the Albion WWTP, the dieldrin concentration was reduced by an order of magnitude, based on just one sampling.

Comparison to Human Health Criteria

A comparison between the effluent concentrations and the human health criteria is presented in Figure 2. The human health criteria are 0.14 ng/L for dieldrin, and 0.17 ng/L for PCBs. Results from this 2007-08 study did not exceed the aquatic life criteria (Table 1).

A rigorous statistical analysis of these data was not performed because of the small sample size.

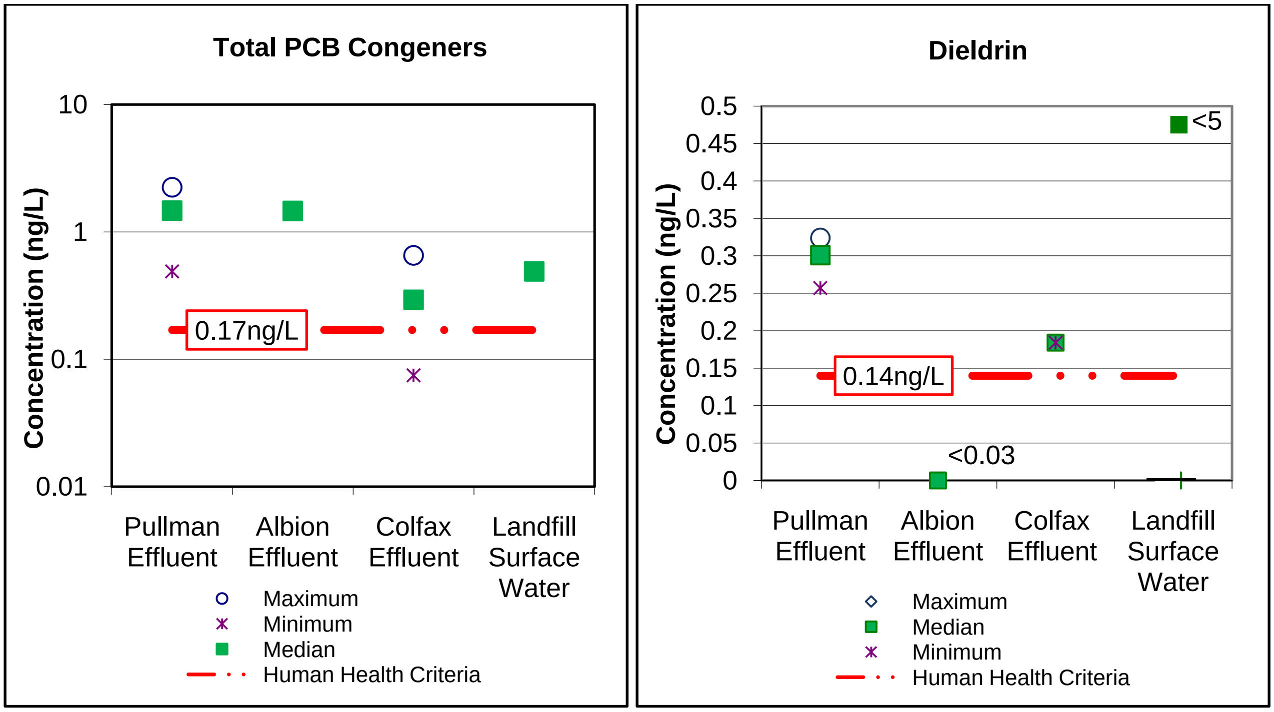

Figure 2. WWTP Effluents and the Human Health Criteria for PCBs and Dieldrin

Total PCBs

The Albion and Pullman WWTPs median effluent concentrations of 1.5 ng/L for total PCBs were 10 times higher than the human health criterion. The Colfax WWTP median effluent concentration of 0.3 ng/L was double the PCB human health criterion of 0.17 ng/L. All three WWTPs were not meeting the interim wasteload allocation set forth in the TMDL.

Influent concentrations at Albion and Pullman are comparable to the Colfax influent, but they both only achieved one order of magnitude reduction of PCBs from influent to effluent, whereas the Colfax plant achieved two orders of magnitude reduction. The Pullman WWTP is a full activated sludge process with chlorination and dechlorination; however, the plant is currently under construction for a series of process improvements and expansions. The Pullman WWTP is currently operating at capacity and with the planned upgrades should be expected to meet the interim wasteload allocation without employing further technologies.

For comparison, the Walla Walla and College Place WWTPs, which also employ activate sludge treatment technology, reduced similar influent total PCB concentrations up to two orders of magnitude (Lubliner, 2007b).

The surface water sample at the Upland Landfill had 0.76 ng/L total PCBs. This concentration is four and a half times the human health criterion. This sample was also analyzed for dieldrin; however, the result was affected by blank contamination at the laboratory and reported as <5 ng/L. The source of water to the landfill is unknown. The marshy landscape and trees at the top of the draw suggest groundwater surfaces in this location and then runs down the gully.

Additional water is supplied to this gully by a stormwater installation that drains a relatively new housing development. The sample taken from the gully may be a mixture of these two sources; however, the relative abundance of each source is unknown.

Dieldrin

The Pullman WWTP mean effluent concentration for dieldrin exceeded the human health criterion by a factor of 2.

Only one effluent sample could be analyzed for the Albion WWTP. The result was well within the dieldrin human health criterion.

The Colfax WWTP mean effluent concentration was only slightly above the dieldrin criterion. The difference (0.06 ng/L) is within the variation seen in duplicate samples (0.04 to 0.08 ng/L) and, on this basis, does not represent an exceedance of the 0.14 ng/L criterion.

TMDL Wasteload Allocations

The TMDL assigned the wasteload allocation at the point of discharge as the human health criteria times the design flow (Johnson et al., 2007). Mixing zones are not used for toxic compounds when assigning wasteload allocations. This means that the dischargers must meet the wasteload allocation at the end of the point of discharge. Table 12 shows the reductions needed to meet the interim wasteload allocation (shown in Table 2) set forth in the TMDL.

Table 12. Reductions in WWTP Concentrations to Meet Interim Wasteload Allocations.

WWTP	Chemical	Mean Concentration (ng/L)	Design Flow (mgd)	Calculated Load (g/day) [b]	WLA from PCB TMDL (g/day) [b]	Percent Reduction Needed to Meet WLA
Pullman	Total PCBs	1.4	3.4	0.0180	0.0022	-88%
	Dieldrin	0.27		0.0035	0.0018	-48%
Albion	Total PCBs	1.5[a]	0.12	0.0007	0.0001	-85%
	Dieldrin	<0.03[a]		0.00001	0.0001	0%
Colfax	Total PCBs	0.33	0.6	0.0007	0.0004	-47%
	Dieldrin	0.18[c]		0.0004	0.0003	NA

[a] = Only one data point.
[b] = Calculated load is the mean concentration times design flow.
[c] = This difference is minimal and within the variations seen in the duplicates.

The design flows adequately describe the discharge rates reported by these WWTPs. Load reductions are necessary for PCBs at each WWTP. Dieldrin load reductions are necessary at only the Pullman WWTP. The single Albion discharge sample for dieldrin was below the dieldrin criterion. Variation in duplicates from the Colfax WWTP exceeded the difference between the mean and the criterion for dieldrin and is therefore considered to be meeting the interim wasteload allocation.

WWTP and Landfill Surface Water Compared to Receiving Waters

The effluent and landfill surface water concentrations of PCBs and dieldrin measured during this study are compared in Table 13 to the estimated river concentrations (based on fish tissue concentrations) from the TMDL (Johnson et al., 2007).

Table 13. Comparison of the Estimated and 2007-08 Sampled Concentrations of PCBs and Dieldrin.

Location	TMDL[a] Estimated River Concentrations			Mean Concentrations in present study August 2007 to April 2008	
	Section of Palouse River	Total PCBs (ng/L)	Dieldrin (ng/L)	Total PCBs ± One Standard Deviation (ng/L)	Dieldrin ± One Standard Deviation (ng/L)
Pullman WWTP Effluent	South Fork	0.58	0.34	1.38 ± 0.77	0.27 ± 0.05
Albion WWTP Effluent	South Fork	0.58	0.34	1.46[b]	<0.03[b]
Colfax WWTP Effluent	Mainstem	0.23	0.18	0.33 ± 0.29	0.20 ± 0.02
Surface Water at Upland Landfill	South Fork	0.58	0.34	0.49J [b]	<5[b]

[a] = Johnson et al., 2007.
[b] = Only one data point.
< = Denotes an undetected concentration at the stated reporting limit.
J = Analyte positively identified; numerical value is the approximate concentration.

All three WWTPs effluents have higher total PCB levels than the estimated river concentration at their locations. These WWTPs convey elevated PCBs to the receiving waters.

The estimated dieldrin river concentrations are higher than the effluent concentrations for the Albion and Pullman WWTPs and equal to the effluent for Colfax. However, the Colfax and Pullman WWTPs were not meeting the human health criteria, and convey dieldrin to the river.

Although the surface water from the Upland Landfill was sampled only once, the City of Pullman and Ecology have noticed that water runs year round down the gully. This gully extends from the top of the bluff off NW Larry Street down the hill through the nursery property to the South Fork. The concentration of 0.76 ng/L was lower than the aquatic life chronic criterion of 14 ng/L but was higher than the estimated river concentration, indicating this landfill may be a year-round source of PCBs to the South Fork.

Sediments

As previously described, highly variable results were obtained on the samples collected from the Uphill Landfill gully. Re-sampling and careful homogenizing of the samples did not resolve the issue. There was no indication that laboratory contamination was the source of the discrepancy, and it appears the concentration in the sample overwhelmed the laboratory standards.

Ecology has not adopted sediment standards for PCBs or dieldrin in freshwater environments. In these situations, the human health or ecological significance of contamination is assessed on a case-by-case basis.

Ecology has previously compared sediment concentrations to the 2003 Apparent Effects Thresholds (AET) developed by Avocet (Avocet, 2003). The lowest AET for total PCBs is 62 µg/Kg which is a proposed sediment quality standard (SQS) (Avocet, 2003). The SQS is the level at which no adverse biological effects occur. The second-lowest AET for total PCBs, 354 µg/Kg, is the proposed cleanup screening level (CSL). The CSL is the level at which minor adverse effects are found. The SQS and CSL have known toxicity to aquatic life (Avocet, 2003). The landfill sediment/soil concentrations are compared to the proposed standards in Table 14.

Table 14. Sediment and Soil Results Compared to Proposed Sediment Quality Standards (µg/Kg)

Sediment/Soil Sample	Mean PCB Concentration
South Fork Background Sediments	<2.9
Gully Sediments Uphill	**116.1**
Gully Sediments Downhill	14.5
Incinerator Site Soil	44

< = undetected at the shown reporting limit.
Bold = sample mean exceeds the proposed SQS AET benchmark of 62 µg/Kg .

The average Upland Landfill and Old Incinerator Site dieldrin concentrations were 1.62 and 1.85 ug/Kg dw, respectively. The background sediment sample from the South Fork was 1.1 ug/Kg dw. The landfill samples were only slightly higher. No SQS or CSL for dieldrin were evaluated or proposed by Avocet.

The sediments in the gully on the SYG Nursery property are believed to contain total PCBs in the range of 11 to 551 µg/Kg. The mean of all the sediment results exceeds the SQS benchmarks but is below the CSL. This suggests that these sediments should be monitored for migration to the river. Cleanup level is not proposed by this report; however these results will be given to Ecology’s Toxic Cleanup Program for review. The Incinerator site samples average is below proposed sediment standards for PCBs.

The contents of the landfills are unknown, and a landfill is not a well-mixed environment. The disparity between duplicate samples suggests the presence of a relatively small number of particles high in PCBs that are difficult to disperse equally throughout the samples. A high PCB content material in the landfill may be breaking down into small particles and washing into the gully. Based on average concentrations, the sediments in the gully above the nursery's culvert exceed the proposed sediment quality standard. There is no reason to believe the SYG Nursery is contributing to PCB contamination at the Upland Landfill.

The average soil PCB concentration at the Old Incinerator Site was below the proposed SQS, but was above the concentration of the background sediment collected from the South Fork at the Pullman city limits.

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Conclusions

The TMDL's use of the human health criteria and the design flow to develop interim wasteload allocations for PCBs and dieldrin in WWTP effluents appears to be reasonable. PCB reduction of influent concentrations appears to range from one to two orders of magnitude, with well operating WWTPs achieving a reduction of two orders of magnitude.

Wastewater Treatment Plants

PCBs

- Ambient (background) river PCB concentrations are lower than the influent and effluent concentrations. This suggests that three WWTPs convey PCBs to the river.
- The Pullman WWTP mean effluent concentration of total PCBs was an order of magnitude higher than the human health criterion and therefore an 88% load reduction is needed to meet the interim wasteload allocation for total PCBs. This plant is currently being upgraded. The Pullman WWTP should be able to meet the load allocations once the upgrades are completed.
- The Albion WWTP PCB concentration from the one sample analyzed was more than an order of magnitude above the human health criterion and therefore an 85% load reduction is needed to meet the interim wasteload allocations for total PCBs. Additional technologies may be needed for the Albion WWTP to achieve the PCB wasteload allocation. Additional samples are needed to determine the average effluent PCB concentration.
- The Colfax WWTP was found to be reducing PCB concentrations by two orders of magnitude from influent to effluent samples. The mean effluent concentration is approximately double the human heath criterion 0.17 ng/L and a 47% load reduction is needed to meet the interim wasteload allocation set forth in the TMDL. The Colfax WWTP should also be able to meet the PCB load allocation with greater solids settling or other operational procedures.

Dieldrin

- The Pullman WWTP effluent dieldrin concentrations exceeded the human health criterion. A 48% load reduction is needed to meet the interim wasteload allocation.
- The Albion WWTP effluent dieldrin concentration was below the human health criterion in the single sample analyzed; therefore, this WWTP is considered to be meeting the interim wasteload allocation. Additional samples are needed to determine the average effluent dieldrin concentration.
- The Colfax WWTP met the human health criterion and interim wasteload allocation for dieldrin.

Landfills

- The two abandoned landfills along the South Fork Palouse River had detected concentrations of PCBs and dieldrin. One sediment sample value from Uphill Landfill was above the cleanup screening level of 345 ug/Kg; however, the remaining landfill sediment samples were below.
- Soil samples from the Old Incinerator Site were well below the cleanup screening level for PCBs.
- The Uphill Landfill surface water sample result 0.76 ng/L was below the aquatic life chronic criterion of 14 ng/L.

Recommendations

The results of this 2007-08 study indicate that the Albion, Colfax, and Pullman WWTPs are not meeting the PCB wasteload allocations set forth in the TMDL (Johnson et al., 2007). Design flows used to calculate the wasteload allocation appear to be reasonable. Therefore, the three WWTPs will need to reduce the concentrations of PCBs in their effluents, in order to meet the wasteload allocations. Colfax and Pullman should be able to reduce the PCBs in their effluent to meet the human heath criteria of 0.17 ng/L by removing more solids. Albion may need to consider the installation of best management practices to reduce solids.

Wastewater Treatment Plants

- The TMDL suggested that natural attenuation would continue to reduce PCBs and dieldrin in the Palouse River. Since these pollutants are widespread in the environment but attenuating over time, it is reasonable to assume that natural attenuation will also be observed in the pollutant concentrations from the WWTPs. The monitoring schedule in the NPDES permits should take into consideration capturing reductions due to natural attenuation.

- PCB source tracking efforts in the sewer or stormwater systems should be done in times of low and high flows to detect concentrated PCB sources. For Pullman, source identification should include collaboration with WSU's study to monitor the manhole sites on campus to determine if sources could be identified/isolated as coming from a particular area.

- All three cities should review their maintenance activity records to see if there is a correlation between flows or maintenance and the higher pollutant concentrations (for example, rain in April 2008 or flushing of the collection systems during August 2007).

- Pullman and Colfax should work to identify PCB sources within their jurisdictions to reduce effluent PCB concentrations. For example, transformers are historically a source of PCBs. WSU has already reduced PCBs in transformers on campus to below the federal PCB regulatory threshold of 50 ppm.

- Albion's plan to address infiltration and inflow to the collection system may help reduce PCBs entering the system. Additional effluent sampling at the Albion WWTP, including QA/QC samples, would be beneficial to determining the representativeness of the results of this study.

- Ecology should request a hazardous waste survey from Ecology's Eastern Regional Office's Hazardous Waste and Reduction Program for the city of Albion to see if any sources can be identified.

Landfills

- Ecology should refer the Uphill Landfill Site results to the Eastern Regional Office's Toxic Cleanup Program to determine if any action is needed under the Model Toxics Cleanup Act.

- The landfill surface water sources and gully sediments should be re-sampled by 2014 in a larger effort better understand the PCB contaminant concentrations and be sure that PCBs are not mobilizing to the river. This should include a more intensive sampling frequency to determine if the higher results seen during this 2007-08 study are consistent or possibly the result of sampling or lab error. A stormwater manhole above the discharge to the upland landfill should be sampled to isolate concentrations from stormwater mixed with the landfill drainage.
- To optimize sampling efforts, the WWTPs should be re-sampled in conjunction with any future landfill sampling. Sampling of Pullman's effluent should not occur until after the current upgrades are completed.

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Appendices

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Appendix A. Summary of Laboratory Quality Control

Calibration

Water and Sediment/Soil Samples

Water samples for dieldrin from the first field trip were analyzed by Manchester Environmental Laboratory (MEL), sample prefix numbers of 0732-####, using EPA Method SW-846, 3535 modified, SPE. The initial calibrations and verification were within quality control (QC) limits. The continuing calibration control standards exceeded the acceptable limit of 115%.

Water samples for dieldrin from the second and third field trips were analyzed by Pacific Rim Laboratories, Inc.; these samples met the quality control requirements.

All initial calibration standards were within the established QC limits of 80 – 120%. Continuing calibration verification (CCV) standards were within control limits of 85-115% with the exception of Aroclor 1016 matrix spike for sample prefix numbers of 0732-####. Matrix spike recoveries were not qualified on the basis of CCV recovery.

Internal Standard Recoveries and Ongoing Precision

Water Samples

Internal standard compounds (referred to as *surrogates*) were used to indicate bias due to sample preparation and calibration. Several of the surrogate recoveries for the dieldrin data by MEL using Method 8081 were below the QC limits. These poor recoveries may have adversely affected sample 07324164. At Pacific Rim Laboratories Inc., dieldrin standards were recovered at an acceptable range (25-150%). Only one laboratory control sample during the second round of samples was low (5.8%).

PCB congener internal standards were found to be within the method specified QC limits of 25-150% for all labeled compounds with several exceptions:

- Congener results in the samples have been qualified with “J” for detected analytes and “UJ” for non-detects as showing a possible low bias.
- A high bias in congeners that were detected has been qualified with a “J”.
- Congener values qualified with “UJ” are not included in the corresponding homolog.

One liter of laboratory water was spiked with 1 ng each of 72 PCB congeners and carried through the extraction and clean-up procedure. Recoveries of all PCBs were within the acceptable range of 50-150%.

Sediment/Soil Samples

The sediment sample surrogates for the PCB Aroclor analyses were reported within the QC range of 50 – 150%. On the first set of sediment samples from the August 2007 sampling, MEL analyzed a matrix spike and matrix spike duplicate (LMX1/LMX2) on sample 07324169. LMX2 produced an unquantifiably high result. Stock standards used at the laboratory are not concentrated enough to have produced the high matrix spike result in LMX2.

Method Blanks

The laboratory method blank is water carried through the extraction and clean-up procedure. Dieldrin was not detected in the laboratory blank water from MEL or Pacific Rim Laboratories, Inc.

Low levels of certain target compounds for PCBs were detected in method blanks and also in the samples. If the concentrations of a congener in a sample were less than ten times that of the corresponding method blank, a "UJ" qualifier was assigned to describe the result as not detected. A "J" was used to qualify the results of the totals for the corresponding homolog indicating it is an estimated value. The values for these congeners are not included in the totals reported for either the corresponding homologue or the total PCBs. In cases where the sample concentration for a congener was greater than ten times that of the blank, the blank result is considered insignificant relative to the native concentrations detected in the sample.

Pace Analytical detected PCBs in the blank water at a relatively high level (2.6 J ug/L total PCB). This caused many congener results from the August 2007 sampling to be qualified as J or UJ. Therefore, samples from the next two events were sent to Pacific Rim Laboratories, Inc. where no PCB congeners (0.5 U ug/L total PCBs) were detected in the laboratory method blank.

Appendix B. Landfill Results and the November 9, 2007 Case Narrative

Table B-1. Landfill leachate PCB homologue sums (ng/L), August 2007 sampling.

Chemical	Upland Landfill* Gully Leachate	
Sample Number	07324160	
PCB, Monochlorobiphenyls		REJ
PCB, Dichlorobiphenyls	1.23	UJ
PCB, Trichlorobiphenyls	0.284	UJ
PCB, Tetrachlorobiphenyls	0.027	J
PCB, Pentachlorobiphenyls	0.109	J
PCB, Hexachlorobiphenyls	0.106	J
PCB, Heptachlorobiphenyls	0.0949	
PCB, Octachlorobiphenyls	0.0379	
PCB, Nonachlorobiphenyls	0.0571	
PCB, Decachlorobiphenyl (PCB-209)	0.0438	
PCB, Sum of Congeners	0.76	J

*In EIM sample, this is identified as SYG Gully Leachate.

Table B-2. Landfill PCB Aroclor results (ng/L).

Chemical	Incinerator Site 4/7/2008		South Fork Palouse R. Background Sediment 8/6/2007		Uphill Landfill* Gully Sediment 8/6/2007		Uphill Landfill* Gully Sediment Duplicate 8/6/2007						Uphill Landfill* Gully Sediment 2/20/2008	
Sample Number	08154165		07324167		07324168		07324169		07324169 REX1		0732416 9 REX2		08084166	
PCB-aroclor 1016	1.6	U	2.9	U	2.5	U	4.2	UJ	4.3	U	86	UJ	2.2	U
PCB-aroclor 1221	3.1	UJ	2.9	U	2.5	U	2.1	U	4.3	U	128	UJ	4.5	UJ
PCB-aroclor 1232	1.6	U	2.9	U	2.5	U	2.1	U	4.3	U	128	UJ	4.5	UJ
PCB-aroclor 1242	2.9		5.9	UJ	5	UJ	4.2	UJ	4.3	U	121		2.2	U
PCB-aroclor 1248	4.7	UJ	2.9	U	5	UJ	8.4	UJ	5.2	UJ	240	UJ	2.2	U
PCB-aroclor 1254	16	J	2.9	U	11		14		15		430		17	J
PCB-aroclor 1260	13	J	2.9	U	9.9	UJ	8.4	UJ	8.6	UJ	94	UJ	11	J
PCB-aroclor 1262	12	UJ	2.9	U	9.9	UJ	8.4	UJ	8.6	UJ	86	UJ	8.9	UJ
PCB-aroclor 1268	1.6	U	2.9	U	2.5	U	2.1	U	2.1	U	86	UJ	2.2	U

*In EIM sample, this is identified as SYG Gully Leachate.

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Appendix C. PCB Congener Homologue Totals for Water Samples

The following tables present homologue sums of the 209 PCB congeners by wastewater treatment plant (WWTP) and sampling date.

Table C-1. PCB homologue sums for Albion WWTP (ng/L).

Chemical	Albion Influent 8/2007		Albion Influent 2/2008		Albion Influent 4/2008		Albion Effluent 4/2008	
Sample Number	07324161		08084161		08154161		08154162	
PCB, Monochlorobiphenyls	0.746	J	0.025	UJ	0.0459	J	0.0609	J
PCB, Dichlorobiphenyls	0.621		0.205	UJ	0.3698		0.461	
PCB, Trichlorobiphenyls	1.272		0.3321		0.6389		0.1783	J
PCB, Tetrachlorobiphenyls	2.867		0.6118		1.2877	J	0.35946	J
PCB, Pentachlorobiphenyls	6.285		0.6651		2.1189		0.469	J
PCB, Hexachlorobiphenyls	3.281		0.254		1.7434	J	0.2419	J
PCB, Heptachlorobiphenyls	1.39		0.0835		1.1653		0.053	
PCB, Octachlorobiphenyls	0.339		0.0359		0.3332		0.011	
PCB, Nonachlorobiphenyls	0.0536		0.0118		0.0425		0.01	U
PCB, Decachlorobiphenyl (PCB-209)	0.0335	N	0.01	U	0.0172		0.01	U
PCB, Sum of Congeners	16.85		2.2242		7.7628	J	1.83456	J

Table C-2. PCB homologue sums for Colfax WWTP (ng/L).

Chemical	Colfax Influent 8/2007		Colfax Effluent (Well ID ACP673) 8/2007		Colfax Effluent (Well ID ACP673) Duplicate 8/2007		Colfax Influent 2/2008		Colfax Effluent (Well ID ACP673) 2/2008		Colfax Influent 4/2008		Colfax Effluent 4/2008	
Sample Number	07324163		07324164		07324165		08084163		08084164		08154163		08154164	
PCB, Monochlorobiphenyls	0.152	J	0.0555	J	0.0114	UJ	0.0448	UJ	0.0218	UJ	0.0599	J	0.023	UJ
PCB, Dichlorobiphenyls	0.289	J	1.07	UJ	0.986	UJ	0.579		0.0906	UJ	0.6864		0.01	U
PCB, Trichlorobiphenyls	0.244		0.262	UJ	0.265	UJ	1.0539		0.0811	J	1.426		0.0901	J
PCB, Tetrachlorobiphenyls	1.209		0.013		0.024		1.5158		0.2152		2.6078	J	0.1419	J
PCB, Pentachlorobiphenyls	6.48		0.017		0.017		2.125		0.1976		3.8095		0.1143	J
PCB, Hexachlorobiphenyls	3.91		0.018	NJ	0.021		1.3722		0.0488		2.5229		0.0658	J
PCB, Heptachlorobiphenyls	2.3	J	0.0117	U	0.0134		0.8158		0.01	U	0.8005		0.012	
PCB, Octachlorobiphenyls	0.516	J	0.0117	U	0.0113	U	0.1827		0.01	U	0.3292		0.01	U
PCB, Nonachlorobiphenyls	0.106		0.0117	U	0.0117	U	0.0572		0.01	U	0.0811		0.01	U
PCB, Decachlorobiphenyl (PCB-209)	0.0457	N	0.0117	U	0.0117	U	0.016		0.01	U	0.0382		0.01	U
PCB, Sum of Congeners	15.2		0.085	J	0.075	J	7.7624		0.6551	J	12.3615	J	0.4471	J

Table C-3. PCB homologue sums for Pullman WWTP (ng/L), August 2007 sampling.

Chemical	Pullman East Influent Pipe		Pullman West Influent Pipe		Pullman Effluent		Pullman Effluent Duplicate		Field Transfer Blank Poured near Pullman Effluent	
Sample Number	07324155		07324156		07324157		07324158		07324159	
PCB, Monochlorobiphenyls	0.156	J	0.112	J	0.113	J	0.0571	J	0.0429	UJ
PCB, Dichlorobiphenyls	0.027	J	0.148	J	1.21	UJ	0.861	UJ	0.693	UJ
PCB, Trichlorobiphenyls	0.44	J	0.037	J	0.591	UJ	0.346	UJ	0.17	UJ
PCB, Tetrachlorobiphenyls	1.305		3.933		0.039	J	0.031	J	0.0123	NJ
PCB, Pentachlorobiphenyls	6.97		12.3		0.161	J	0.137		0.045	
PCB, Hexachlorobiphenyls	4.62		7.46		0.159		0.126		0.0274	UJ
PCB, Heptachlorobiphenyls	1.64		1.82		0.155		0.134		0.0109	U
PCB, Octachlorobiphenyls	0.476		0.377		0.011	U	0.0112	U	0.0109	U
PCB, Nonachlorobiphenyls	0.145		0.11		0.011	U	0.011	U	0.0109	U
PCB, Decachlorobiphenyl (PCB-209)	0.0247		0.0295		0.011	U	0.0112	U	0.0109	U
PCB, Sum of Congeners	15.42		26.33		0.624	J	0.485	J	0.06	NJ

Table C-4. PCB homologue sums for Pullman WWTP (ng/L), February 2008 sampling.

Chemical	Pullman East Influent Pipe		Pullman West Influent Pipe		Pullman Effluent	
Sample Number	08084155		08084156		08084157	
PCB, Monochlorobiphenyls	0.0731	UJ	0.1019	UJ	0.0374	UJ
PCB, Dichlorobiphenyls	0.5904		0.658		0.1685	UJ
PCB, Trichlorobiphenyls	1.4941		2.0855		0.2916	J
PCB, Tetrachlorobiphenyls	2.5273		4.3472		0.343	
PCB, Pentachlorobiphenyls	3.7124		6.5019		0.4051	
PCB, Hexachlorobiphenyls	2.4269		3.6418		0.1837	
PCB, Heptachlorobiphenyls	1.1894		1.0738		0.0403	
PCB, Octachlorobiphenyls	0.4423		0.217		0.01	U
PCB, Nonachlorobiphenyls	0.0766		0.0587		0.01	U
PCB, Decachlorobiphenyl (PCB-209)	0.0204		0.0188		0.01	U
PCB, Sum of Congeners	12.5529		18.704		1.4696	J

Table C-5. PCB homologue sums for Pullman WWTP (ng/L), April 2008 sampling.

Chemical	Pullman East Influent Pipe		Pullman West Influent Pipe		Pullman Effluent		Pullman Effluent Duplicate		Field Transfer Blank Poured near Pullman Effluent	
Sample Number	08154155		08154156		08154157		08154158		08154159	
PCB, Monochlorobiphenyls	0.0803	J	0.0585	J	0.0781	J	0.0786	J	0.0236	J
PCB, Dichlorobiphenyls	0.7674		0.8596		0.2464		0.2773		0.054	
PCB, Trichlorobiphenyls	1.6027		1.8162		0.2734	J	0.2327	J	0.0147	J
PCB, Tetrachlorobiphenyls	13.0093	J	3.5329	J	0.5228	J	0.3997	J	0.0481	J
PCB, Pentachlorobiphenyls	28.625		4.1985		0.7228	J	0.7171	J	0.0221	UJ
PCB, Hexachlorobiphenyls	17.2954		2.543		0.2881	J	0.2362	J	0.0285	UJ
PCB, Heptachlorobiphenyls	3.4556		0.8245		0.1037		0.0691		0.01	U
PCB, Octachlorobiphenyls	0.6405		0.3278		0.01	U	0.01	U	0.01	U
PCB, Nonachlorobiphenyls	0.0639		0.0479		0.01	U	0.01	U	0.01	U
PCB, Decachlorobiphenyl (PCB-209)	0.0289		0.0182	N	0.01	U	0.01	U	0.01	U
PCB, Sum of Congeners	65.569	J	14.2089	J	2.2353	J	2.0107	J	0.191	J

Definitions of Qualifiers

J = Analyte positively identified; numerical value is the approximate concentration.

U = Analyte not detected above the reported sample quantitation limit.

UJ = Analyte not detected above the reported sample quantitation limit; however, the reported quantitation limit is an approximation.

REJ = The sample was rejected due to serious deficiencies in the ability to analyze the sample and meet quality control.

ND = Not detected above the laboratory method blank contamination.

Appendix D. Map of Pullman's Sewer Lines

The Pullman WWTP influent has two main lines that were both sampled from manholes just before the grit chamber.

- East pipe (30" diameter - yellow line) serves the south and east side of Pullman.
- West pipe (36" diameter - red line) runs up Grand Avenue on the north side of Pullman.

A map of the City of Pullman's sewer lines is shown on the next page.

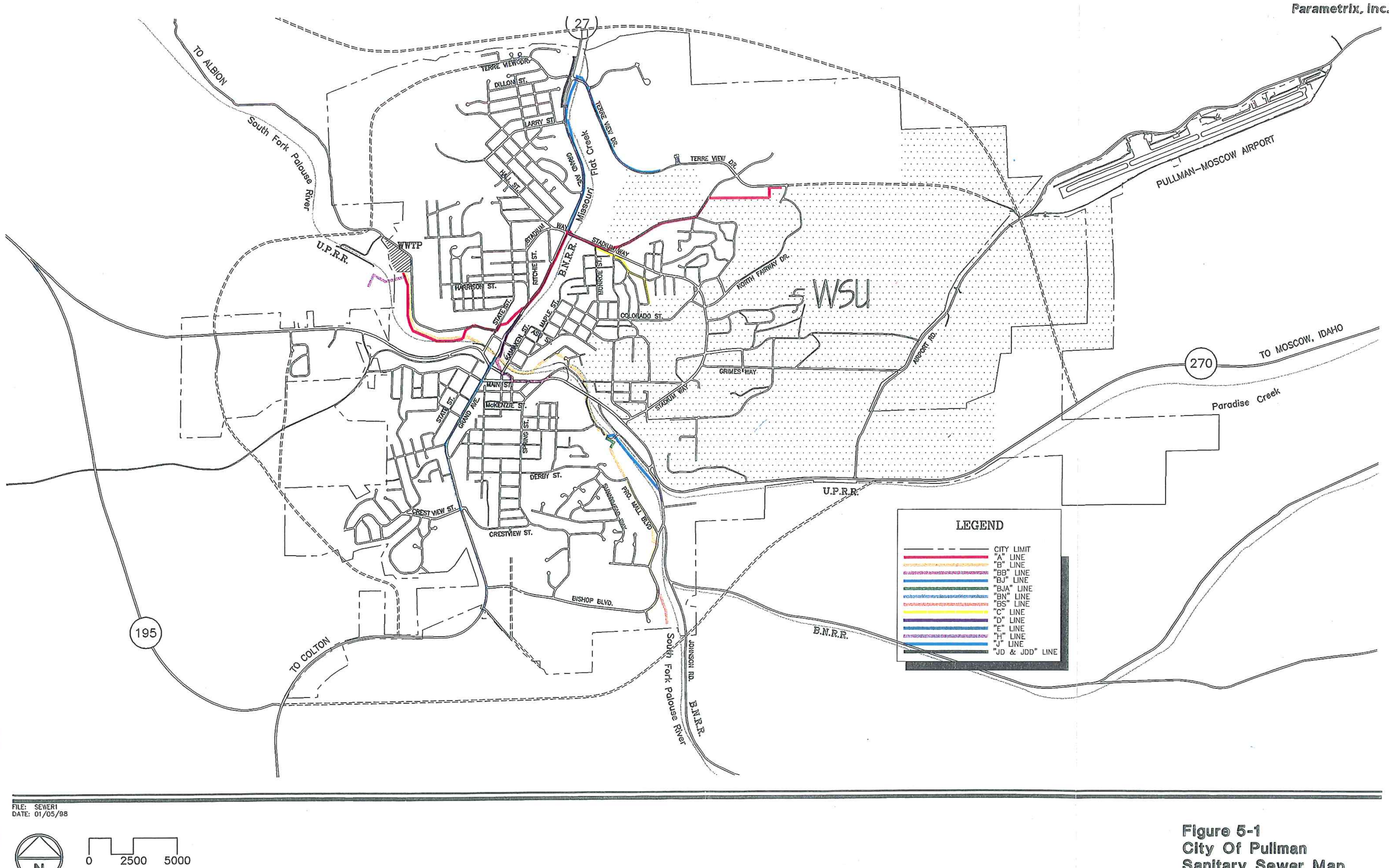

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Figure 5-1
City Of Pullman
Sanitary Sewer Map

Appendix E. Glossary and Acronyms

303(d) List: Section 303(d) of the federal Clean Water Act requires Washington State periodically to 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 waterbodies (ocean waters, estuaries, lakes, and streams) that fall short of state surface water quality standards, and are not expected to improve within the next two years.

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.

Homologue: A group of PCB congeners containing the same number of chlorines.

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

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

Mixing zone: Areas around treated wastewater discharges where the state may allow flexibility in meeting water quality standards.

National Pollutant Discharge Elimination System (NPDES): National program for issuing and revising permits, as well as imposing and enforcing pretreatment requirements, under the Clean Water Act. The NPDES permit 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.

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.

Rivulet: Very small stream.

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.

Total Maximum Daily Load (TMDL): A distribution of a substance in a waterbody 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

Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database (Ecology)
EPA	U.S. Environmental Protection Agency
MEL	Manchester Environmental Laboratory (Ecology)
PCB	Polychlorinated biphenyls
QA	Quality assurance
QC	Quality control
RPD	Relative percent difference
SM	Standard method
TSS	Total suspended solids

WAC	Washington Administrative Code
WLA	Wasteload allocation
WSU	Washington State University
WWTP	Wastewater treatment plant

dw	dry weight
mg/L	milligrams per liter (parts per million)
ng/L	nanograms per liter (parts per trillion)
ug/Kg	ug/Kg- micrograms per kilogram (parts per billion)