Washington State Pesticide Monitoring Program

1997 Surface Water Sampling Report

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Washington State Pesticide Monitoring Program

1997 Surface Water Sampling Report

by
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Abstract

Initiated in 1991 by the Department of Ecology, the Washington State Pesticide Monitoring Program (WSPMP) has analyzed ground water, surface water, fish tissue, and sediments for pesticide residues. The results of these analyses are used to provide information on the distribution of pesticides in Washington State and to determine if these patterns are changing over time.

WSPMP surface water samples were collected at the mouths of two urban streams, Juanita Creek in Kirkland and Indian Creek in Olympia, every other week from April 28 to August 18 of 1997. Samples were also collected from five upstream source identification sites on May 12, July 7, and August 26.

Twenty-one pesticides and breakdown products – 15 herbicides, five insecticides, and one fungicide – were detected in 35 water samples collected for the 1997 WSPMP. The most frequently detected herbicides were dichlobenil, triclopyr, 2,4-D, MCPP, and prometon. Diazinon and chlorpyrifos were the most commonly detected insecticides. Diazinon exceeded water quality criteria in 11 samples from Juanita Creek and in two samples from Indian Creek. Three samples from Juanita Creek (King County) and one from Indian Creek (Thurston County) contained levels of chlorpyrifos above water quality criteria.

Pesticide contamination in Juanita Creek was comparable to the most contaminated agricultural drainages in the state that have been sampled for the WSPMP, including irrigation returns in the Yakima Valley and Mid-Columbia Basin. The total number of pesticides detected and the average number per sample are among the highest in the state. Only 14 pesticides were found in samples from the Indian Creek drainage, and only two of these compounds were detected in more than half of the samples. The average number of pesticides per sample was 5, compared to 10 for Juanita Creek.

The most frequently detected pesticides in samples from both streams are readily available to the general public for home use. The remaining compounds detected are pesticides that have been found in other WSPMP samples from urban areas, and were probably applied by professional applicators. As a group, the home use pesticides were detected almost twice as often as the professionally applied chemicals.

Stormwater runoff samples tended to contain higher numbers of pesticides and/or higher concentrations of the detected pesticides.

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- Larry Goldstein, Dale Norton, and Art Johnson for reviewing the draft report.
- Joan LeTourneau for formatting the final report.

Summary

Washington State Pesticide Monitoring Program (WSPMP) surface water samples were collected at the mouths of two urban streams, Juanita Creek in Kirkland and Indian Creek in Olympia, every other week from April 28 to August 18 of 1997. Twenty-one pesticides and breakdown products – 15 herbicides, five insecticides, and one fungicide – were detected in 35 water samples. All 21 compounds were found in samples from Juanita Creek; 14 pesticides were in samples from the Indian Creek drainage. The most frequently detected herbicides were dichlobenil (29 detections), triclopyr (26), 2,4-D (22), MCPP (21), and prometon (16). Diazinon was the most common insecticide, with 20 detections. Chlorpyrifos was found in six samples, and the other three insecticides were each detected in one sample.

All compounds exceeding water quality criteria were insecticides, which included chlorpyrifos (Lorsban), diazinon, and malathion. Diazinon exceeded criteria in 11 samples from Juanita Creek and in two samples from Indian Creek. Eight of these samples were above the National Academy Sciences recommended water quality criterion of 0.009 µg/L (NAS, 1973), two exceeded the chronic water quality criterion set by the California State Department of Fish and Game of 0.04 µg/L (Menconi and Cox, 1994), and three were above the California acute criterion of 0.08 µg/L. Three samples from Juanita Creek and one from Indian Creek contained levels of chlorpyrifos above the NAS water quality criterion of 0.001 µg/L, but they did not exceed the Washington State chronic standard of 0.041 µg/L (WAC 173-201A). Malathion was detected in one sample from Juanita Creek above the NAS criterion of 0.008 µg/L, but not the USEPA (1986) criterion of 0.1 µg/L.

Pesticide contamination in Juanita Creek was comparable to the most contaminated agricultural drainages in the state that have been sampled for the WSPMP, including irrigation returns in the Yakima Valley and Mid-Columbia Basin. The total number of pesticides detected and the average number per sample are among the highest in the state. Only 14 pesticides were found in samples from the Indian Creek drainage, and only two of these compounds were detected in more than half of the samples. The average number of pesticides per sample was 5, compared to 10 for Juanita Creek. Residential density in the Juanita Creek drainage is much higher than in the Indian Creek drainage.

The most frequently detected pesticides in samples from both streams are readily available to the general public for home use. The remaining compounds detected are pesticides that have been found in other WSPMP samples from urban areas, and were probably applied by professional applicators. As groups, the home use pesticides were detected almost twice as often as the professionally applied chemicals.

Stormwater runoff samples tended to contain higher numbers of pesticides and/or higher concentrations of the detected pesticides. There appeared to be little relationship between the concentrations of pesticides detected at the mouth of the streams and levels in source identification samples collected upstream, but compounds found in the source identification samples were generally also detected in samples from the stream mouth.

Introduction

The Washington State Pesticide Monitoring Program (WSPMP) was initiated in 1991 by the Washington State Department of Ecology (Ecology) to monitor pesticide residues in ground water and surface water, including associated biota such as fish, shellfish, and waterfowl and bed sediments. Ground water and surface water monitoring are implemented as separate tasks; this report addresses surface water sampling for 1997. The goal and objectives of the WSPMP are:

Goal

Characterize pesticide residues geographically and over time in ground water and surface water (including sediments and biota) throughout Washington.

Objectives

- Identify and prioritize aquifers, lakes, and streams with known or potential pesticide contamination.
- Quantify pesticide concentrations in high priority areas.
- Document temporal trends in pesticide types and concentrations at selected sites.
- Provide data to the Washington State Department of Health for assessment of potential adverse effects on human health.
- Assess the potential for adverse effects of pesticides on aquatic biota.
- Construct and maintain a pesticide database for ground water and surface water in Washington.
- Provide information for the improvement of pesticide management in Washington State.

The WSPMP is an ongoing screening survey to identify potential pesticide contamination problems. Most sites are sampled during one year only, unless high concentrations or numbers of pesticides are found. When a potential problem is identified, a site may be sampled again the following year to verify and better define the problem, but intensive sampling is beyond the scope of the WSPMP. True trend monitoring to document statistically significant changes over time is also beyond the scope of this program. Trend monitoring for the WSPMP is limited to simple observations of the types and concentrations of pesticides found at a site over a period of two or three years.

Methods

Sampling Sites and Design

The number of sample sites and the frequency of sampling were determined primarily by available funding. Streams were selected based on their probability of being contaminated with pesticides and potential impacts to the environment. Sources of this information for each site are different and often numerous, so listing them is not practical. Typically, representatives from other government agencies, such as the Conservation District, Cooperative Extension Service, and the U.S. Geological Survey are contacted for their input. Information from the private sector is also used.

Although the rate of pesticide use in urban areas is typically more than three times greater than in agricultural areas (Tetra Tech, 1988), little information is available on pesticide contamination in urban streams. Numerous pesticides were detected in samples collected for the WSPMP in 1992, 1993, and 1994 from Mercer Creek, an urban stream in Bellevue. This prompted a recommendation in the 1994 WSPMP surface water report to sample additional urban streams (Davis, 1996). In 1996, four urban/suburban streams were sampled for the WSPMP (Davis, 1998): Swamp Creek, Springbrook Creek, Big Soos Creek, and Newaukum Creek. Except for Swamp Creek, sampling for these steams was coordinated with monitoring by the U.S. Geological Survey (USGS) for the Puget Sound National Water Quality Assessment (NAWQA). Thornton Creek, another urban stream, was intensively sampled by the USGS in 1996 (Embry, 1997).

The data indicate that a wide variety of pesticides are present in urban streams. Other than data from Thornton Creek, results for each of these streams are from a few samples only. To improve the understanding of pesticide contamination in urban streams, more samples need to be collected from each site. More samples would help identify peak pesticide use periods, pesticides most heavily used, compounds likely to cause adverse impacts, and short-term spikes of individual pesticides. By sampling individual tributaries, we would learn more about specific pesticide sources and their potential impacts, as well as the mobility and transport of urban-use pesticides and resulting short-term impacts from stormwater runoff sampling.

More pesticide data for each of the urban streams already sampled is desirable. However, there are numerous urban streams with no pesticide data. In keeping with the goal of the WSPMP to characterize pesticide residues throughout the state, two new sites were selected based on potential pesticide contamination from urban sources: Juanita Creek near Kirkland, and Indian Creek in Olympia. Figures 1, 2, and 3 show the location of the creeks and sampling sites within each drainage.

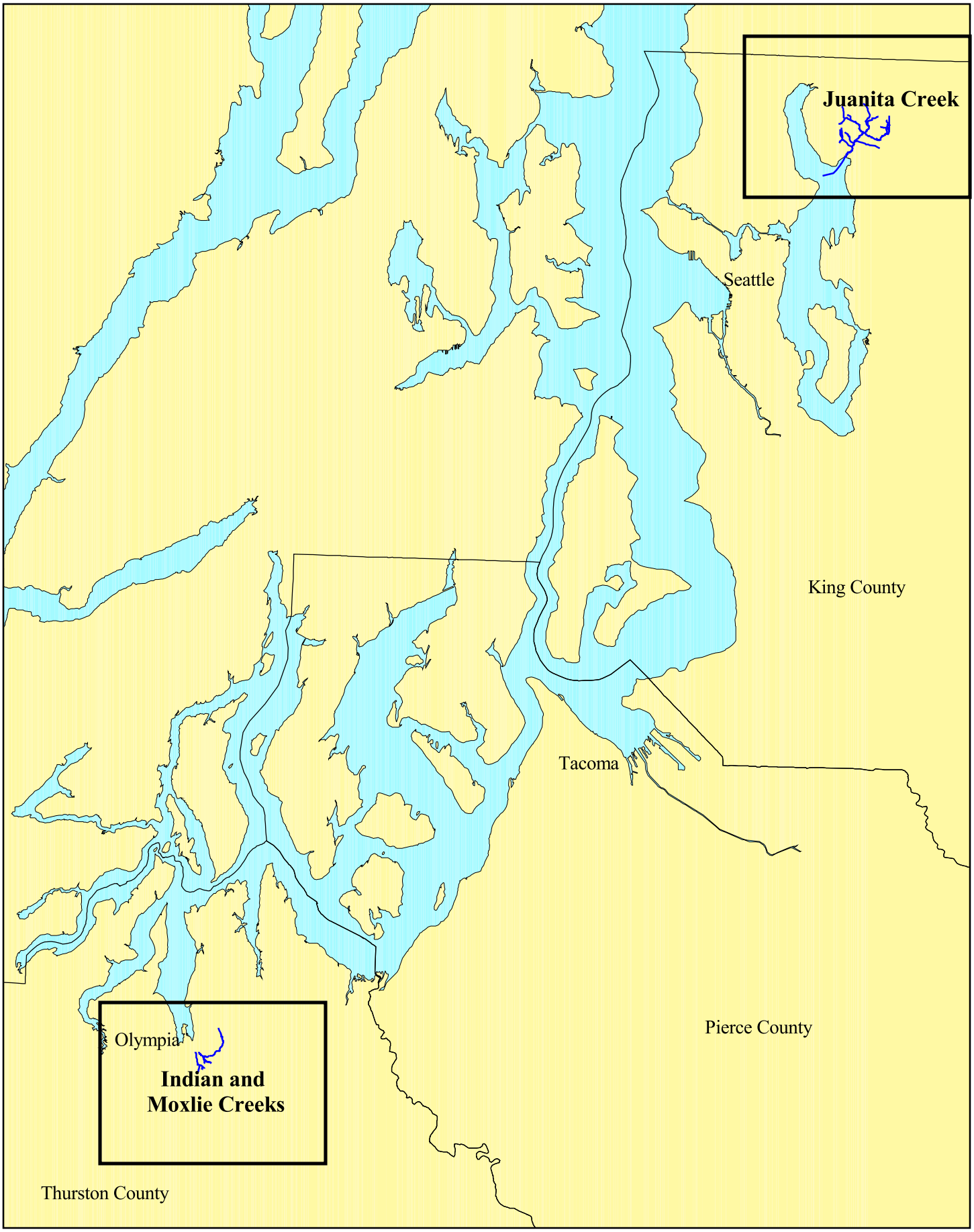

Figure 1. Sampling Sites for the 1997 WSPMP

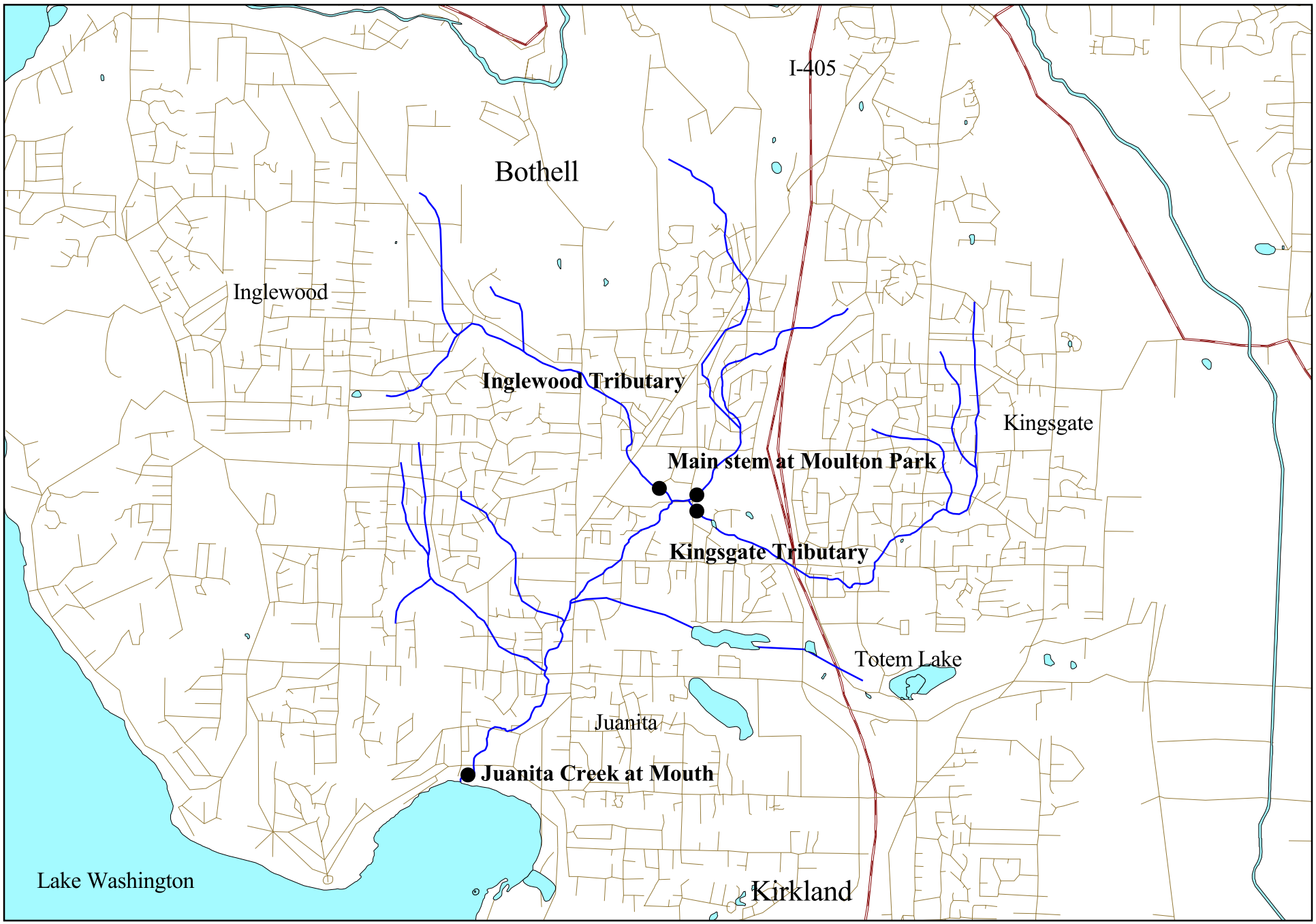

Figure 2. Juanita Creek Drainage Basin

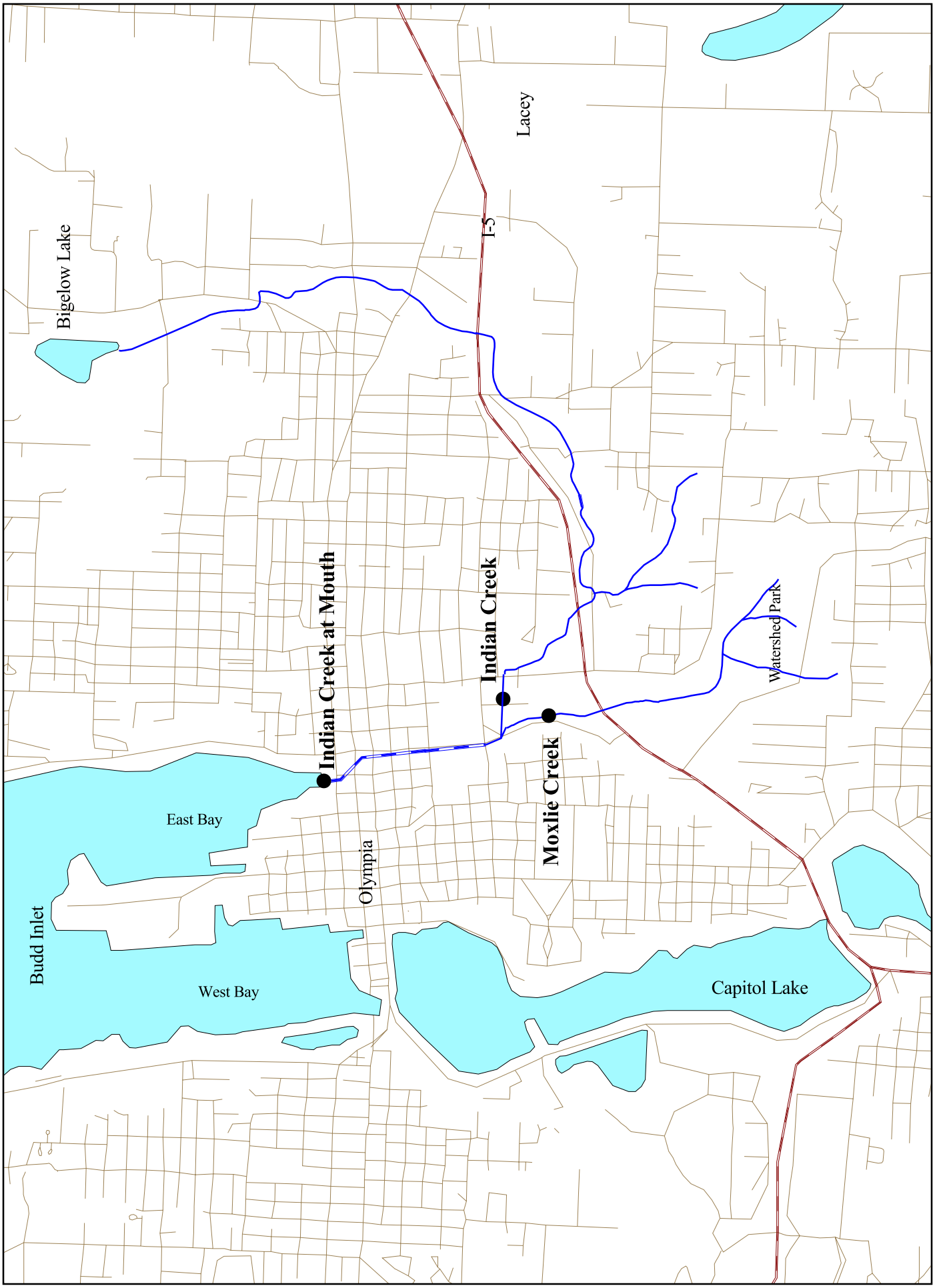

Figure 3. Indian Creek Drainage Basin

Juanita Creek drains an area north of Kirkland that is almost entirely residential (Figure 2). The drainage basin includes parts of the Juanita and Kingsgate districts. Tributaries contribute flow from Finn Hill, the southern portion of the Kingsgate District, Totem Lake and adjacent wetlands, and the northeast edge of the Inglewood District. Much of the creek and its tributaries flow directly through residential backyards with little vegetative buffer. Many of the storm drains also discharge into the creek. Juanita Creek was sampled every other week at the mouth where it flows into Lake Washington to assess pesticide loading to the lake. Source identification samples were collected at the mouth of the Kingsgate and Inglewood tributaries and in the mainstem just above these two tributaries.

Indian Creek drains Bigelow Lake and surrounding wetlands through east Olympia residential areas, and runs along Interstate-5 for about a mile before the confluence with Moxlie Creek at Plum Street (City of Olympia, 1993) (Figure 3). Moxlie Creek begins in the Olympia Watershed Park, and receives runoff from surrounding residential property and streets. Shortly after the confluence, Indian Creek flows through pipes beneath the streets of downtown Olympia and receives surface runoff from numerous storm drains and additional east-side residential areas before discharging into East Bay of Budd Inlet. Indian Creek was sampled at the end of the pipe where it discharges into the bay to quantify loads to the bay. Source identification samples were collected from each creek just before their confluence.

Samples were collected at the mouths of Juanita Creek and Indian Creek every other week from April 28 to August 18 of 1997. Samples were also collected from the source identification sites on May 12, July 7, and August 26. The August 26 samples were collected during a storm to represent runoff-related contamination. It was also raining during sampling on April 28 and June 23, and increased flows indicate that some runoff was occurring.

Latitude, longitude, and state plane coordinates are listed in Appendix A for each site sampled in 1997.

WSPMP samples were analyzed for 161 pesticides and breakdown products (Appendix B). Samples were also collected for total suspended solids (TSS), total organic carbon (TOC), conductivity, and nitrate+nitrite. Field measurements were taken for temperature, pH, and flow.

Sampling Procedures, Analytical Methods, and QA/QC

Details of sampling procedures are outlined by Davis (1993). Procedures essentially followed those described in the Illinois EPA (1987) field methods manual. A report by the Ecology Manchester Environmental Laboratory (Huntamer, et al., 1992) gives details of the analytical methods used for the WSPMP and modifications to the methods necessary to incorporate the expanded target analyte list. A brief discussion of sampling procedures, analytical methods, and quality assurance/quality control is in Appendix C. Case narratives from the laboratory detailing data quality are presented in Appendix D; data quality was generally excellent.

Results and Discussion

Pesticides Detected

A total of 21 pesticides and breakdown products – 15 herbicides, five insecticides, and one fungicide – were detected in 35 water samples collected for the 1997 WSPMP (Tables 1 and 2). Table 1 summarizes results from samples collected every other week at the mouths of Juanita Creek and Indian Creek. Table 2 summarizes results from source identification samples collected on May 12, July 7, and August 26, 1997. All 21 compounds detected were found in samples from Juanita Creek; 14 pesticides were in samples from the Indian Creek drainage. The most frequently detected herbicides were dichlobenil (29 detections), triclopyr (26), 2,4-D (22), MCPP (21), and prometon (16). Diazinon was the most common insecticide, with 20 detections. Chlorpyrifos was found in six samples, and the other three insecticides were each detected in one sample.

Pesticides that exceeded water quality criteria for the protection of aquatic life are highlighted with bold type in Tables 1 and 2. All compounds exceeding criteria were insecticides, which included chlorpyrifos (Lorsban), diazinon, and malathion. Diazinon exceeded criteria in 11 samples from Juanita Creek and in two samples from Indian Creek. Eight of these samples were above the National Academy Sciences recommended water quality criterion of 0.009 µg/L (NAS, 1973), two exceeded the chronic water quality criterion set by the California State Department of Fish and Game of 0.04 µg/L (Menconi and Cox, 1994), and three were above the California acute criterion of 0.08 µg/L. Three samples from Juanita Creek and one from Indian Creek contained levels of chlorpyrifos above the NAS water quality criterion of 0.001 µg/L, but they did not exceed the Washington State chronic standard of 0.041 µg/L (WAC 173-201A). Malathion was detected in one sample from Juanita Creek above the NAS criterion of 0.008 µg/L, but not the USEPA (1986) criterion of 0.1 µg/L.

For easy reference, pesticides detected in surface water for the 1992-1996 WSPMP have been included in Appendices E-1 through E-5.

Breakdown Products

Three breakdown products of target pesticides were detected. Disulfoton sulfone, a breakdown product of disulfoton, was found in one sample from the Inglewood tributary to Juanita Creek. A metabolite of dichlobenil, 2,6-dichlorobenzamide, was detected at all seven sampling sites in 30 samples. A degradation product of parathion, 4-nitrophenol, was found in nine samples from all seven sampling sites.

Table 1. Pesticides Detected in Water Samples Collected Biweekly at the Creek Mouth for the 1997 WSPMP (µg/L, ppb)

	Juanita Creek									
	28-Apr[1]	12-May	27-May	9-Jun	23-Jun	7-Jul	21-Jul	4-Aug	18-Aug	26-Aug[1]
Insecticides										
chlorpyrifos	**0.010 J[2]**			**0.002 NJ[2]**	**0.002 NJ[2]**					
diazinon	**0.085[3]**	**0.0096 J[2]**	**0.014 J[2]**	**0.013 J[2]**	**0.032[2]**	**0.043[3]**	0.004 J	0.002 NJ	0.003 NJ	**0.017 NJ[2]**
hexachlorobenzene										0.035 J
malathion	**0.016[2]**									
Herbicides										
2,4-D	0.16	0.024 J	0.029 J	0.011 J	0.059	0.017 J		0.026 J	0.0089 J	0.17
4-nitrophenol					0.042 NJ					0.033 NJ
atrazine		0.006 J				0.005 J		0.004 NJ		
bromacil		0.003 NJ		0.009 NJ		0.006 NJ	0.007 J			
dichlobenil	0.12	0.034 J	0.035	0.037	0.045	0.022 J	0.010 J	0.012 J	0.013 J	0.029 J
2,6-dichlorobenzamide	0.13 J	0.11 J	0.082 J	0.059 J	0.014 J	0.098 J	0.082 J	0.10 J	0.13 J	
dichlorprop								0.0049 J		
diuron	0.22 NJ					0.06 NJ				
MCPA							0.14		0.0071 J	0.058 J
MCPP	0.12		0.033 J	0.015 J	0.031 J	0.013 J	0.0055 NJ	0.014 J	0.0062 J	0.11
oxadiazon				0.008 J	0.015 J	0.010 J	0.008 NJ		0.008 NJ	
prometon	0.018 J	0.010 J	0.016 J	0.017 J	0.002 J	0.009 J	0.024 J	0.0094 J	0.008 J	
simazine		0.005 J	0.003 NJ	0.003 J		0.002 J		0.003 NJ		
tebuthiuron		0.015 J	0.015 J			0.011 J				
triclopyr	0.15	0.090		0.025 J	0.12	0.032 J		0.017 J	0.015 J	0.24
Fungicide										
pentachlorophenol	0.042	0.018 J	0.019 J		0.021					0.056 NJ

[1] - Values are means of duplicate analyses

[2] - Exceeds National Academy of Sciences (1973) Recommended Maximum Concentration

[3] - Exceeds California State Department of Fish and Game Criteria (Menconi and Cox, 1994)

J = The analyte was positively identified. The numerical value is an estimate.

NJ = There is evidence that the analyte is present. The numerical value is an estimate.

Table 1 (cont.). Pesticides Detected in Water Samples Collected Biweekly at the Creek Mouth for the 1997 WSPMP (µg/L, ppb)

	Indian Creek									
	28-Apr	12-May	27-May	9-Jun	23-Jun	7-Jul	21-Jul	4-Aug	18-Aug	26-Aug
Insecticides										
diazinon										**0.036 J[1]**
Herbicides										
2,4-D			0.040 J		0.0057 NJ					0.051
4-nitrophenol								0.0075 J		0.045 NJ
dichlobenil		0.005 NJ	0.042	0.009 J	0.009 J	0.007 J			0.009 J	0.032 J
2,6-dichlorobenzamide		0.041 J	0.11 J	0.040 J	0.060 J	0.043 J	0.034 J	0.032 J	0.051 J	0.012 J
diuron	0.6 NJ	0.095 NJ		0.13 NJ		0.05 NJ				
MCPP			0.0098 NJ							0.053 J
oxadiazon				0.008 J	0.013 J					0.040 J
prometon			0.087							
tebuthiuron		0.018 J	0.024 J	0.012 J	0.33					
triclopyr	0.022 J	0.011 J	0.029 J	0.018 J	0.027 J	0.0074 J				0.088
Fungicide										
pentachlorophenol	0.027		0.046		0.018 J					0.13

[1] - Exceeds National Academy of Sciences (1973) Recommended Maximum Concentration

J = The analyte was positively identified. The numerical value is an estimate.

NJ = There is evidence that the analyte is present. The numerical value is an estimate.

Table 2. Pesticides Detected in Source Identification Water Samples Collected for the 1997 WSPMP (µg/L, ppb)

May 12

	Juanita Creek				Indian Creek		
	at mouth	at Moulton Park	Kingsgate Tributary	Inglewood Tributary	at mouth	Indian Creek	Moxlie Creek
Insecticides							
chlorpyrifos		0.001 J	**0.002 J**[1]			**0.003 NJ**[1]	
diazinon	**0.0096 J**[1]	0.003 J	**0.012 J**[1]	**0.02**[1]			
Herbicides							
2,4-D	0.024 J	0.0063 NJ	0.14	0.015 J			
atrazine	0.006 J	0.008 J	0.008 J				
bromacil	0.003 NJ	0.018 J				0.011 NJ	
dichlobenil	0.034 J	0.012 J	0.048	0.050	0.005 NJ		
2,6-dichlorobenzamide	0.11 J	0.056 J	0.12 J	0.097 J	0.041 J	0.034 J	0.026 J
diuron					0.095 NJ	0.18 NJ	
MCPP				0.024 J			
oxadiazon			0.031 J				
prometon	0.010 J	0.007 J	0.011 J				
simazine	0.005 J	0.01 J	0.011 J				
tebuthiuron	0.015 J				0.018 J	0.027 J	
triclopyr	0.090	0.065		0.033	0.011 J		0.012 J
Fungicide							
pentachlorophenol	0.018 J	0.012 J	0.095	0.012 J		0.022	

[1] - Exceeds National Academy of Sciences (1973) Recommended Maximum Concentration

J = The analyte was positively identified. The numerical value is an estimate.

NJ = There is evidence that the analyte is present. The numerical value is an estimate.

Table 2 (cont.). Pesticides Detected in Source Identification Water Samples Collected for the 1997 WSPMP (µg/L, ppb)

July 7

	Juanita Creek				Indian Creek		
	at mouth	at Moulton Park	Kingsgate Tributary	Inglewood Tributary	at mouth	Indian Creek	Moxlie Creek
Insecticides							
diazinon	**0.043**[1]	0.006 J	0.009 J	0.007 J			
disulfoton sulfone				0.008 NJ			
Herbicides							
2,4-D	0.017 J	0.029 J	0.063				
atrazine	0.005 J	0.006 J	0.014 J				
bromacil	0.006 NJ						
dichlobenil	0.022 J	0.018 J	0.029 J	0.051	0.007 J	0.003 J	
2,6-dichlorobenzamide	0.098 J	0.062 J	0.14 J	0.085 J	0.043 J	0.048 J	0.024 J
diuron	0.06 NJ	0.02 NJ	0.1 NJ		0.05 NJ	0.1 NJ	
MCPP	0.013 J	0.031 J	0.017 J	0.032 J		0.013 NJ	
oxadiazon	0.010 J		0.043 J			0.004 NJ	0.006 J
prometon	0.009 J	0.006 J	0.010 J	0.017 J		0.001 J	
simazine	0.002 J	0.004 J					
tebuthiuron	0.011 J					0.022 J	0.005 J
triclopyr	0.032 J	0.028 J	0.074	0.0098 J	0.0074 J		0.0063 J

[1] - Exceeds California State Department of Fish and Game Criteria (Menconi and Cox, 1994)

J = The analyte was positively identified. The numerical value is an estimate.

NJ = There is evidence that the analyte is present. The numerical value is an estimate.

Table 2 (cont.). Pesticides Detected in Source Identification Water Samples Collected for the 1997 WSPMP (µg/L, ppb)

August 26

	Juanita Creek				Indian Creek		
	at mouth	at Moulton Park	Kingsgate Tributary	Inglewood Tributary	at mouth	Indian Creek	Moxlie Creek
Insecticides							
diazinon	**0.017 NJ[1]**	**0.13[2]**		**0.12[2]**	**0.036 J[1]**		**0.041[2]**
hexachlorobenzene	0.035 J						
Herbicides							
2,4-D	0.17	0.21	0.17	1.2	0.051	0.089	0.077
4-nitrophenol	0.033 NJ	0.031 NJ	0.012 NJ	0.067 NJ	0.045 NJ	0.059 NJ	0.029 NJ
dichlobenil	0.029 J	0.038	0.049	0.038	0.032 J	0.014 J	0.025 J
2,6-dichlorobenzamide			0.031 J		0.012 J		0.004 NJ
MCPA	0.058 J						
MCPP	0.11	0.20	0.095	2.2	0.053 J	0.14	0.088
oxadiazon			0.071 J		0.040 J		0.059 J
triclopyr	0.240	0.20	0.11		0.088	0.061	0.033
Fungicide							
pentachlorophenol	0.056 NJ	0.16		0.12 NJ	0.13	0.31	0.048

[1] - Exceeds National Academy of Sciences (1973) Recommended Maximum Concentration

[2] - Exceeds California State Department of Fish and Game Criteria (Menconi and Cox, 1994)

J = The analyte was positively identified. The numerical value is an estimate.

NJ = There is evidence that the analyte is present. The numerical value is an estimate.

Conventional Parameters

Results of conventional parameter analyses and field measurements are presented in Table 3. None of the results exceed state water quality standards.

Site Evaluations

Juanita Creek

Pesticide contamination in Juanita Creek was comparable to the most contaminated agricultural drainages in the state that have been sampled for the WSPMP, including irrigation returns in the Yakima Valley and Mid-Columbia Basin. The total number of pesticides detected and the average number per sample are among the highest in the state. The high number of pesticides per sample is due in part to six compounds – diazinon, 2,4-D, dichlobenil, MCPP, prometon, and triclopyr – found in nearly every sample.

Although many of the concentrations were low, the high number of pesticides in each sample is cause for concern. Very little is known about the effects of combinations of pesticides on the aquatic environment. The consistent presence of a high number of chemicals throughout the study period is also cause for concern. Little is known about the impacts of long-term exposure, particularly for a mixture of pesticides. Diazinon, an organophosphate insecticide, was found in all of the samples, and most of the detected concentrations exceeded water quality standards for the protection of aquatic life. Two other organophosphate insecticides, chlorpyrifos (Dursban) and malathion, were also found at levels above water quality standards.

The six pesticides listed above in addition, as well as chlorpyrifos and malathion, are chemicals that were found in Juanita Creek and are readily available to the general public for home use. The remaining compounds detected in Juanita Creek are pesticides that have been found in other samples from urban areas, and were probably applied by professional applicators because they are not available to the general public. As groups, the home use pesticides were detected almost twice as often as the professionally applied chemicals.

Most of the pesticides detected at the mouth of Juanita Creek were also detected in samples from the mainstem at Moulton Park and from the Kingsgate tributary. Samples from the Inglewood tributary consistently had fewer pesticides than the other three sites. Diazinon, 2,4-D, dichlobenil, MCPP, prometon, and triclopyr were present in nearly all of the samples from all four sites. The Kingsgate tributary was the only source for oxadiazon, and bromacil was only at the mouth and the mainstem at Moulton Park.

Table 3. Results of Conventional Parameters for the 1997 WSPMP

	28-Apr[1]	12-May	27-May	10-Jun	23-Jun	7-Jul	21-Jul	4-Aug	18-Aug	26-Aug[1]
Nitrate+Nitrite (mg/L-N)										
Juanita Creek	0.79	1.29	0.82	1.79	0.72	1.68	1.99	2.15	1.99	1.44
Indian Creek	0.83	0.74	0.38	0.80	0.86	0.83	0.81	0.78	0.80	0.86
Total Suspended Solids (mg/L)										
Juanita Creek	15	2	2	3	11	2	1	2	1	208
Indian Creek	11	22	12	17	15	10	9	12	19	84
Conductivity (µmho/cm)										
Juanita Creek	140	203	159	220	162	221	198	214	215	160
Indian Creek	990	950	745	565	620	1000	550	500	490	210
Temperature (°C)										
Juanita Creek	10.9	14.5	15.2	14.2	14.7	14.9	15.3	15.9	16.1	16.7
Indian Creek	10.9	12.5	12.6	12.4	11.9	12.4	12.4	13.0	13.8	15.0
pH										
Juanita Creek	6.4	7.3	7.7	7.5	7.3	7.5	7.5	7.5	7.4	7.2
Indian Creek	6.6	7.4	7.6	7.3	7.4	7.4	7.4	7.6	7.3	6.8
Flow (CFS)										
Juanita Creek	29.0	7.4	7.3	5.4	20	4.9	7.3	3.5	3.6	17.0
Indian Creek	19.0	14.4	12.5	14.4	14.3	13.9	13.9	14.4	DNC[2]	DNC

[1] - Values are means of duplicate analyses

[2] - DNC = Data Not Collected

There does not appear to be any correlation between detected concentrations in the tributaries and levels at the mouth of Juanita Creek. Concentrations in samples from at least one of the tributaries are often higher than at the mouth, even when a compound is found in samples from all four sites. This suggests that there is significant dilution water entering the creek between the Kingsgate tributary and the mouth. Total flow from the two tributaries and the mainstem at Moulton Park on May 12 and July 7 was about half of the flow at the mouth, indicating that there was a large influx of water downstream of the Kingsgate tributary. Flow at the mouth was about the same as the total of the two tributaries and the mainstem on August 26, but these flows may not be comparable due to rapid changes in the flow as rainfall varied.

The number and type of pesticides detected in samples collected when there was storm runoff (April 28, June 23, and August 26) were not substantially different from the other samples. However, the concentrations of many compounds were higher in the runoff samples, particularly on April 28 and August 26. The concentration of most pesticides detected on August 18 were at least an order of magnitude higher in the August 26 sample. The highest levels of diazinon were in the mainstem at Moulton Park and Inglewood tributary samples collected on August 26.

Indian Creek

Only 14 pesticides were found in samples from the Indian Creek drainage, and only two of these compounds, dichlobenil and triclopyr, were detected in more than half of the samples. The average number of pesticides per sample was 5, compared to 10 for Juanita Creek. Eleven of the detected compounds were herbicides and one a fungicide; none exceeded water quality criteria. Two insecticides, chlorpyrifos and diazinon, were detected above criteria. Chlorpyrifos was found only once in the May 12 Indian Creek sample collected above the confluence. Diazinon was detected in the August 26 sample from the Moxlie Creek tributary and in the sample from the mouth, but not in Indian Creek above the confluence.

Dichlobenil, triclopyr, chlorpyrifos, and diazinon are readily available to the general public from home-care centers and nurseries. Two other herbicides, diuron and tebuthiuron, that were commonly detected in Indian Creek samples are not directly available to homeowners, but have been found in other WSPMP samples collected in urban areas.

Comparisons of the pesticides found in the creeks above the confluence did not show any obvious patterns. More pesticides were detected in Indian Creek than Moxlie Creek in samples collected on May 12 and July 7, but the opposite was true for the August 26 samples. The number and type of pesticides found in Indian Creek were similar for the three dates. Many more pesticides were detected in Moxlie Creek on August 26 than the other two dates.

Differences between pesticides found in the two creeks demonstrate different impacts from stormwater runoff. The Indian Creek stormwater sample collected on August 26 was not substantially different from the May and July samples, suggesting minimal runoff impact. The August sample from Moxlie Creek had nine pesticides, and the May and July samples had two and four pesticides respectively, indicating a comparatively large impact from stormwater runoff. Concentrations in the runoff samples were not substantially different from levels in the other samples for both creeks.

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Appendix A

Surface Water Sampling Site Positions for the 1997 WSPMP

Appendix A. Surface Water Sampling Site Positions for the 1997 WSPMP

Site Name	Latitude			Longitude			State Plane	
	deg	min	sec	deg	min	sec	X	Y
Juanita Creek at mouth	47	42	18	122	12	59	1,577,356	869,534
Juanita Creek at Moulton Park	47	43	19	122	11	47	1,582,413	875,608
Juanita Creek Kingsgate Tributary	47	43	19	122	11	47	1,582,413	875,608
Juanita Creek Inglewood Tributary	47	43	26	122	12	03	1,581,334	876,341
Indian Creek at mouth	47	02	49	122	53	41	1,403,080	633,965
Indian Creek above confluence	47	02	01	122	53	39	1,403,071	629,100
Moxlie Creek above confluence	47	01	58	122	53	38	1,403,131	628,794

Appendix B

Target Pesticide List for Water Analysis

Appendix B. Target Pesticides List for Water Analyses

Chlorinated Pesticides

Analyte	Quantitation Limit[1] (µg/L, ppb)	Analyte	Quantitation Limit (µg/L, ppb)
4,4'-DDT	0.035	cis-nonachlor	0.035
4,4'-DDE	0.035	trans-nonachlor	0.035
4,4'-DDD	0.035	oxychlordane	0.035
2,4'-DDT	0.035	dicofol (kelthane)	0.17
2,4'-DDE	0.035	dieldrin	0.035
2,4'-DDD	0.035	endosulfan I	0.035
DDMU	0.035	endosulfan II	0.035
aldrin	0.035	endosulfan sulfate	0.035
alpha-BHC	0.035	endrin	0.035
beta-BHC	0.035	endrin aldehyde	0.035
delta-BHC	0.035	endrin ketone	0.035
gamma-BHC (Lindane)	0.035	heptachlor	0.035
captan	0.14	heptachlor epoxide	0.035
captafol	0.21	methoxychlor	0.035
cis-chlordane	0.035	mirex	0.035
trans-chlordane	0.035	pentachloroanisole	0.035
alpha-chlordene	0.043	toxaphene	0.85
gamma-chlordene	0.035		

Sulfur-Containing Pesticides

propargite	0.28

[1] - Quantitation limits are approximate and are often different for each sample; these values are representative of a typical sample

Appendix B (cont.). Target Pesticides List for Water Analyses

Organophosphorus Pesticides

Analyte	Quantitation Limit[1] (µg/L, ppb)	Analyte	Quantitation Limit (µg/L, ppb)
acephate	0.30	fensulfothion	0.075
azinphos-ethyl	0.12	fenthion	0.055
azinphos-methyl	0.12	fonophos	0.045
carbophenothion	0.80	imidan	0.080
chlorpyrifos	0.055	malathion	0.060
chlorpyrifos-methyl	0.050	merphos	0.12
coumaphos	0.090	methamidophos	0.30
DEF	0.11	mevinphos	0.075
demeton-O	0.055	paraoxon-methyl	0.15
demeton-S	0.060	parathion	0.060
diazinon	0.060	parathion-methyl	0.055
dichlorvos	0.060	phorate	0.055
dimethoate	0.060	phosphamidan	0.18
dioxathion	0.12	propetamphos	0.15
disulfoton	0.045	ronnel	0.055
EPN	0.075	sulfotepp	0.045
ethion	0.055	sulprofos	0.055
ethoprop	0.060	temephos	0.70
fenamiphos	0.12	tetrachlorvinphos	0.15
fenitrothion	0.055		

Chlorinated Herbicides

2,4-D	0.042	bromoxynil	0.042
2,4-DB	0.050	DCPA (Dacthal)	0.033
2,4,5-T	0.033	dicamba	0.042
2,4,5-TB	0.038	dichlorprop	0.046
2,4,5-TP (Silvex)	0.033	diclofop-methyl	0.063
2,3,4,5-tetrachlorophenol	0.023	dinoseb	0.063
2,3,4,6-tetrachlorophenol	0.023	ioxynil	0.042
2,4,5-trichlorophenol	0.025	MCPA	0.083
2,4,6-trichlorophenol	0.025	MCPP	0.083
3,5-dichlorobenzoic acid	0.042	pentachlorophenol	0.021
4-nitrophenol	0.073	picloram	0.042
acifluorfen	0.17	trichlopyr	0.035
bentazon	0.063		

[1] - Quantitation limits are approximate and are often different for each sample; these values are representative of a typical sample

Appendix B (cont.). Target Pesticides List for Water Analyses

Nitrogen-Containing Pesticides

Analyte	Quantitation Limit[1] (µg/L, ppb)	Analyte	Quantitation Limit (µg/L, ppb)
alachlor	0.26	metolachlor	0.28
ametryn	0.071	metribuzin	0.071
atraton	0.21	MGK-264	0.50
atrazine	0.071	molinate	0.14
benefin	0.11	napropamide	0.21
bromacil	0.28	norflurazon	0.14
butachlor	0.25	oxyfluorfen	0.28
butylate	0.14	pebulate	0.14
carboxin	0.78	pendimethalin	0.11
chlorothalonil	0.17	profluralin	0.17
chlorpropham	0.28	prometon	0.071
cyanazine	0.11	prometryn	0.071
cycloate	0.14	pronamide	0.28
diallate	0.27	propachlor	0.17
dichlobenil	0.16	propazine	0.071
diphenamid	0.21	simazine	0.072
diuron	0.48	tebuthiuron	0.11
eptam	0.14	terbacil	0.21
ethalfluralin	0.11	terbutryn	0.071
fenarimol	0.21	triadimefon	0.18
fluridone	0.43	triallate	0.18
hexazinone	0.11	trifluralin	0.11
metalaxyl	0.48	vernolate	0.14

Carbamates

1-naphthol	0.30	carbofuran	0.12
3-hydroxycarbofuran	0.12	methiocarb	0.12
aldicarb	0.12	methomyl	0.12
aldicarb sulfone	0.12	oxamyl	0.12
aldicarb sulfoxide	0.12	propoxur	0.12
carbaryl	0.12		

[1] - Quantitation limits are approximate and are often different for each sample; these values are representative of a typical sample

Appendix C

Sampling Procedures, Analytical Methods, and Quality Assurance/Quality Control

Appendix C.

Sampling Procedures

Samples were collected using U.S. Geological Survey (USGS) depth integrating samplers modified so that the water sample contacts only teflon or glass. Samples were hand composited, filling containers one-third full from each point in a quarter point transect across the streams. Samples were held on ice during transportation to the laboratory.

Analytical Methods

Analytes in Appendix B are grouped by analytical method. Chlorinated pesticides, organophosphates, nitrogen-containing pesticides, chlorinated herbicides, and sulfur-containing pesticides were all analyzed with Draft EPA Method 8085, which uses capillary column Gas Chromatography (GC) with an atomic emission detector (AED) and ion-trap GC/MS confirmation. Carbamates were analyzed with EPA Method 531.1 (modified).

Quality Assurance/Quality Control

Matrix spike and matrix spike duplicate (MS/MSD) and field duplicate (split) samples were collected from Juanita Creek on April 28 and August 26. MS/MSD samples were used to estimate analytical precision and accuracy. Field duplicates were also used to assess analytical precision.

Appendix D

Data Review

Appendix D.

Data Review

Data packages and quality control results from samples analyzed by Ecology's Manchester Environmental Laboratory were reviewed and assessed by Norman Olson, Bob Carrell, and Karin Feddersen.

No significant problems were encountered, all data are acceptable for use as qualified.

Quality Control Samples

No accuracy or precision criteria have been established for any of the analytical methods used, but duplicate field samples, and matrix and surrogate spike analyses provide estimates of accuracy and precision. Results from surrogate and matrix spikes are presented in the case narratives. Duplicate field samples were collected from Juanita Creek on April 28 and August 26, and results are presented in Table D-1.

Table D-1. Duplicate Analysis Results for 1997 WSPMP Water Samples (µg/L, ppb)

Juanita Creek at Mouth

Analyte	Sample 1	Sample 2	RPD[1]
April 28			
2,4-D	0.15	0.17	13
chlorpyrifos	0.009	0.01	11
diazinon	0.076	0.094	21
dichlobenil	0.12	0.11	9
2,6-dichlorobenzamide	0.13	0.12	8
diuron	0.12U[2]	0.22	NC[3]
malathion	0.014	0.018	25
MCPP	0.11	0.12	9
pentachlorophenol	0.04	0.043	7
prometon	0.019	0.017	11
triclopyr	0.14	0.16	13
August 26			
2,4-D	0.18	0.16	12
diazinon	0.017	0.097U	NC
dichlobenil	0.028	0.03	7
hexachlorobenzene	U	0.035	NC
4-nitrophenol	0.027	0.038	34
MCPA	0.062	0.053	16
MCPP	0.11	0.10	10
pentachlorophenol	0.06	0.052	14
triclopyr	0.28	0.20	33

[1] - RPD = Relative Percent Difference (difference/mean) x 100.

[2] - U = Undetected at or above the reported value.

[3] - NC = Not Calculated.

Place Case Narratives Here

Appendix E

Pesticides Detected in the Water Samples Collected for WSPMP, 1992 to 1996

Appendix E-1. Pesticides Detected in Water Samples Collected for the 1992 WSPMP (µg/L,ppb)

	Mission Creek	Crab Creek	Walla Walla River	Glade Creek	Fishtrap Creek	Moxee Drain[1]
Insecticides						
4,4'-DDD						0.027
4,4'-DDE						0.018
4,4'-DDT						0.015
total DDT						**0.060**[3]
azinphos-methyl	**0.033**[2]					
diazinon						
malathion						**0.054**[4]
Herbicides						
2,4-D		0.980	0.055		0.27	0.16
atrazine		0.088		0.24	0.11	
atrazine desethyl				0.38		
bromacil						
chlorpropham						
DCPA (Dacthal)		1.24	12.1	0.028	0.006	0.011
dichloro-DCPA			0.046			
trichloro-DCPA			0.55			
dicamba[5]		0.080		0.019		
dichlobenil						
dichlorprop						
EPTC (Eptam)		0.31		0.20		
glyphosate	1.13	0.38	0.49			0.49
hexazinone			0.063			
MCPP					1.5	
metribuzin				0.043		
prometon						
simazine	0.041	0.033	0.078		0.091	
Fungicide						
pentachlorophenol	0.002					0.015

Values in bold exceed water quality criteria

[1] - Values are means of duplicate analyses

[2] - Exceeds USEPA, 1986 water quality criteria

[3] - Exceeds Washington State water quality standards

[4] - Exceeds NAS, 1973 recommended maximum concentrations

[5] - Listed as disugran in Davis, 1993

Appendix E-1 (cont.). Pesticides Detected in Water Samples Collected for the 1992 WSPMP (µg/L,ppb)

	Mercer Creek[1]	Thornton Creek	Sullivan Slough	Lake River	Tuttle Creek
Insecticides					
4,4'-DDD					
4,4'-DDE					
4,4'-DDT					
azinphos-methyl					
diazinon	**0.091[2]**	**0.077[2]**			
malathion					
Herbicides					
2,4-D	0.20	0.23	0.039		
atrazine			0.24		
atrazine desethyl					
bromacil			0.046		
chlorpropham			0.10		
DCPA (Dacthal)	0.061	0.066	0.017	0.011	
dicamba[3]		0.038			
dichlobenil	0.19	0.054			
dichlorprop		0.052			
EPTC (Eptam)					
glyphosate	0.78	0.58			
hexazinone					
MCPP	1.7				
metribuzin			0.036		
prometon	0.082				
simazine					
Fungicide					
pentachlorophenol					

Values in bold exceed water quality criteria

[1] - Values are means of duplicate analyses

[2] - Exceeds NAS, 1973 recommended maximum concentrations

[3] - Listed as disugran in Davis, 1993

Appendix E-2. Pesticides Detected in Water Samples Collected for the 1993 WSPMP (µg/L, ppb)

	Sample Sites West of the Cascades																Joe Leary Slough	Lynch Coulee Creek
	Adna Creek				Fishtrap Creek				Mercer Creek				Salmon Creek				June	
	April	June	Aug	Oct	April	June	Aug	Oct	April	June	Aug	Oct	April	June	Aug	Oct		
2,4-D						0.069			0.05		0.039	0.29						
4-nitrophenol												0.22						
aldicarb														0.76				
atrazine					0.02	0.024	0.010	0.035		0.025			0.02					
bentazon																	0.075	
bromacil					0.03	0.054	0.047	0.058		0.11	0.037	0.073						
chlorpropham																	6.0	
chlorpyrifos																**0.044**[1]		
DCPA									0.06	0.041	0.032							0.20
diazinon										**0.03**[2]		**0.083**[2]				**0.022**[2]		
dichlobenil							0.035		0.17	0.11	0.034	0.09				0.039		
diuron										0.19								
eptam																	0.17	
malathion												**0.085**[2]						
MCPA												0.10						
MCPP						0.043					0.029	0.17						
methomyl															0.068			
mevinphos																	**11**[2]	
pentachlorophenol					0.008				0.007				0.005					
prometon										0.024		0.089						
propoxur											0.047							
simazine					0.02	0.011				0.048	0.018	0.029		0.38	0.044	0.039		

[1] - Exceeds Washington State Water Quality Standards

[2] - Exceeds NAS, 1973 recommended criteria

Values in bold exceed criteria

* - Values are means of duplicate analyses

Appendix E-2 (cont.). Pesticides Detected in Water Samples Collected for the 1993 WSPMP (µg/L, ppb)

Sample Sites East of the Cascades

	Crab Creek				Foster Creek				Misson Creek				Moxee Drain				Walla Walla River			
	April*	June	Aug	Oct	April	June	Aug	Oct	April	June*	Aug	Oct	April	June	Aug	Oct	April	June	Aug	Oct
2,4-D		0.34	0.090			0.035								0.23	0.24			0.024	0.25	
4,4'-DDD																0.002				
4,4'-DDE									0.002				0.006	0.029		0.003				
4,4'-DDT									0.002	0.018			0.002	0.028						
total DDT									**0.004**[1]	**0.018**[1]			**0.008**[1]	**0.057**[1]		**0.005**[1]				
atrazine	0.02	0.052	0.015	0.015															0.011	0.016
azinphos-methyl		**0.019**[3]				**0.016**[3]				**0.13**[3]		**0.012**[3]		**0.1**[3]	**0.056**[3]					
bentazon		0.093		0.11																
bromacil																	0.02		0.090	
bromoxynil					0.20	0.035	0.023													
chlorpyrifos									**0.14**[1]				**0.078**[1]	0.027	**0.29**[1]	0.01				
DCPA		0.59	0.49	0.96										0.015	0.033	0.009		2.2	3.9	2.7
diazinon												0.007		**0.14**[2]						
dicamba I		0.032												0.022					0.11	
dicamba II																			0.044	
dimethoate		0.022												0.037						
endosulfan I									0.031				0.031	0.012						
endosulfan II									0.013				0.014	0.013						
endosulfan sulfate									0.004				0.008	0.023						
total endosulfan									**0.048**[2]				**0.053**[2]	**0.048**[2]						
eptam		0.13																		
hexazinone		0.033																		
metribuzin																	0.16			
pentachlorophenol													0.005	0.012						
propargite															0.10	0.03				
simazine	0.02	0.016																	0.061	0.018
triallate																			0.034	

[1] - Exceeds Washington State Water Quality Standards

[2] - Exceeds NAS, 1973 recommended criteria

[3] - Exceeds EPA, 1986a criteria

Values in bold exceed criteria

* - Values are means of duplicate analyses

Appendix E-3. Pesticides Detected in Water Samples Collected for the 1994 WSPMP (µg/L, ppb)

	Sample Sites East of the Cascades											
	Mission Creek			Stemilt Creek			Stink Creek			Palouse River		
	April	June	October	April	June	October	April	June[1]	October	April	June	October
Insecticides												
3-hydroxycarbofuran			0.421					0.07				
4,4'-DDE		0.013										
4,4'-DDT		0.012						0.014				
total DDT		**0.025**[2]						**0.014**[2]				
azinphos-methyl (Guthion	**0.004**[4]	**0.027**[3]		**0.010**[4]				**0.058**[3]				
carbaryl		**0.059**[4]										
chlorpyrifos	**0.02**[4]			**0.005**[4]			**0.056**[2]					
diazinon	**0.031**[4]			0.009			**0.021**[4]					
malathion					**0.012**[4]							
Herbicides												
2,4-D										0.028	0.069	
atrazine											0.053	0.069
bromacil		0.022	0.044									
bromoxynil				0.060			0.088					
DCPA (Dacthal)										0.012		
dichlobenil							0.017					
diclofop-methyl										0.030		
MCPA										0.036	0.020	
MCPP											0.029	
norflurazon									0.078			
norflurazon desmethyl									0.10			
simazine	0.25		0.011			0.006	0.025	0.092	0.075		0.55	
triallate										0.018	0.043	
Fungicide												
pentachlorophenol						0.0054					0.0091	

Values in bold exceed water quality criteria

[1] - Values are means of duplicate analyses

[2] - Exceeds Washington State water quality standards

[3] - Exceeds USEPA, 1986 water quality criteria

[4] - Exceeds NAS, 1973 recommended maximum concentrations

Appendix E-3 (cont.). Pesticides Detected in Water Samples Collected for the 1994 WSPMP (µg/L, ppb)

	Sample Sites West of the Cascades											
	Grayland Creek			Joe Leary Slough			Kearny Creek			Mercer Creek		
	April[1]	June	October	April	June	October	April	June	October	April	June	October[1]
Insecticides												
4-nitrophenol				0.084						0.13		
azinphos-methyl (Guthion)		**0.014**[2]										
carbofuran	0.08	0.054										
3-hydroxycarbofuran		0.054			0.059							
chlorpyrifos		**0.021**[3]	**0.03**[3]									
diazinon	**0.011**[3]		**0.029**[3]	**0.017**[3]						**0.032**[3]		**0.042**[3]
malathion										**0.028**[3]		
Herbicides												
2,4-D	0.11	0.22	0.091	0.077						0.17	0.014	0.035
atrazine							0.008					
bromacil										0.014	0.035	
chlorpropham					0.081							
DCPA (Dacthal)					0.0069					0.035	0.021	
dicamba				0.036						0.013		
dichlobenil	1.7	0.21	0.92							0.051	0.032	0.023
dichlorprop		0.011								0.018		
EPTC (Eptam)				0.060								
hexazinone							0.071	0.11	0.15			
MCPA				0.043								
MCPP					0.14						0.019	
metribuzin					0.076							
napropamide	0.20		0.17									
norflurazon	0.16	0.16	0.47									
prometon		0.021								0.012		
triclopyr		0.017			0.019	0.010				0.062	0.046	0.040
Fungicide												
pentachlorophenol					0.075	0.013			0.0047		0.023	0.024

Values in bold exceed water quality criteria

[1] - Values are means of duplicate analyses

[2] - Exceeds USEPA, 1986 water quality criteria

[3] - Exceeds NAS, 1973 recommended maximum concentrations

Appendix E-4. Pesticides Detected in Water Samples Collected for the 1995 WSPMP (µg/L, ppb)

	Clear Creek				GHCDD-1[1]				Olequa Creek				Cherry Creek			
	18-Apr	20-Jun	7-Aug	2-Oct	17-Apr	19-Jun	8-Aug	2-Oct[2]	17-Apr	19-Jun	8-Aug	2-Oct	24-Apr	26-Jun	31-Jul	25-Sep
Insecticides																
4,4'-DDE					0.0081	0.0059	0.0067	0.005								
4,4'-DDD					0.011	0.008	0.013	0.012								
total DDT					**[3]0.019**	**[3]0.014**	**[3]0.02**	**[3]0.017**								
azinphos-methyl (Guthion)						**[4]0.21**	**[4]0.48**	**[4]0.018 J**								
carbofuran					0.4	0.785 J	**[5]2.3**	0.25								
chlorpyrifos (Lorsban)					**[3]0.045 J**	**[6]0.012 J**	**[3]0.13 J**	**[6]0.016 J**								
diazinon	**[6]0.012 J**			0.004 J	**[6]0.014 J**	**[6]0.22**	**[7]0.68**	**[6]0.03 J**						**[6]0.024 J**		
disulfoton sulfone														0.011 J		
malathion			**[6]0.051 J**													
Herbicides																
2,4-D	0.022 J	0.014 J	0.11	0.023 J	0.93	0.75	0.55	0.14				0.003 NJ	0.022 J	0.079	0.089	0.037
atrazine									0.025 J	0.30		0.010J			0.035 J	0.008 J
bromacil	0.013 NJ			0.032 J										0.069 J		
bromoxynil														0.011 NJ		
DCPA (Dacthal)													0.010 J			
dicamba		0.032 J	0.20	0.007 NJ	0.013 NJ							0.004 NJ			0.021 J	0.0098 J
dichlobenil				0.0098 J	3.1	7.5	2.0	0.92								
2,6-dichlorobenzamide					0.43 J	0.54 J	0.50 J	0.71 J								
dichlorprop					0.081		0.035 J	0.033 J								
diuron				0.036 NJ								0.017 NJ				
MCPA			1.2		0.020 NJ								0.066 J	0.010 NJ		0.015 J
MCPP	0.034 J		0.10	0.009 NJ									0.025 NJ			
metribuzin								0.01 NJ								
napropamide					1.5	0.38	0.34	0.26								
norflurazon					0.59	0.44 J	0.36 J	0.49 J								
simazine					0.058 J											
tebuthiuron												0.013 J				
terbacil								0.017 J								
triclopyr	0.015 J	0.006 J	0.23	0.014 J	0.033			0.045				0.006 NJ				
Fungicide																
pentachlorophenol					0.034		0.016 J				0.028					

Values in bold exceed water quality criteria

[1] - GHCDD-1 = Grays Harbor County Drainage Ditch No. 1

[2] - Values are means of duplicate analyses

[3] - Exceeds Washington State Water Quality Standards, WAC 173-201A

[4] - Exceeds USEPA (1986) Quality Criteria for Water

[5] - Exceeds Canadian Water Quality Guidelines (CCREM, 1987)

[6] - Exceeds National Academy of Sciences (1973) Recommended Maximum Concentration

[7] - Exceeds USEPA Lifetime Health Advisory for drinking water

J = The analyte was positively identified. The numerical value is an estimate.

NJ = There is evidence that the analyte is present. The numerical value is an estimate.

Appendix E-4 (cont.). Pesticides Detected in Water Samples Collected for the 1995 WSPMP (mg/L, ppb)

	Crab Creek Lateral				EL 68 D				Cowiche Creek				Yakima River			
	24-Apr	26-Jun[1]	31-Jul	25-Sep	24-Apr	26-Jun	31-Jul	25-Sep	24-Apr	26-Jun	31-Jul	25-Sep	24-Apr[1]	19-Jun	1-Aug[1]	26-Sep
Insecticides																
4,4'-DDE														**[2]0.004 J**	**[2]0.0039**	**[2]0.002 J**
azinphos-methyl (Guthion)		**[3]0.08 J**	**[3]0.025 J**							**[3]0.12**	**[3]0.049 J**	**[3]0.079 J**		**[3]0.036 J**	**[3]0.021 J**	**[4]0.008 NJ**
chlorpyrifos (Lorsban)	**[4]0.036 J**	**[4]0.009 NJ**			**[4]0.028 J**			**[2]0.39 J**	**[4]0.031 J**	**[4]0.004 NJ**				**[2]0.12**		
dimethoate			0.090 J				0.13 J				0.003 NJ				0.003 NJ	
disulfoton															0.027 J	
disulfoton sulfone						0.015 J		0.007 J							0.012 J	0.012 J
endosulfan I			**[4]0.011 J**													
endosulfan II			**[4]0.014 J**													
ethoprop																0.029 J
malathion			0.007 J			**[3]0.13**	**[4]0.011 J**			0.005 NJ					**[4]0.01 J**	
propargite						0.19 J	1.5	0.12 J							0.016 J	
Herbicides																
2,4-D	0.029 J	0.11	0.60	0.008 J	0.051	0.019	0.066	0.013 J			0.001 J			0.029 J	0.065	0.015 J
alachlor	0.019 J	0.02 J			0.008 NJ	0.044 J										
atrazine		0.013 J		0.008 J				0.01 J						0.034 J	0.014 J	0.01 J
bentazon	0.15	0.12		0.15	0.014 J	0.094	0.15	0.13							0.026 J	0.024 J
bromacil					0.016 J	0.049 J	0.024 J	0.037 J								
bromoxynil	0.089				0.063	0.008 J	0.0053 J									
chlorpropham								0.27								
DCPA (Dacthal)	0.83	0.010 J	0.002 NJ		0.098	0.023 J	0.007 J	0.008 J								
dicamba		0.006 NJ	0.002 NJ					0.005 J								
EPTC (Eptam)		0.36				0.068 J										
MCPA					0.042 J		0.007 J									
MCPP							0.011 NJ									
metolachlor		0.033 J														
metribuzin					0.036 J		0.010 J	0.005 NJ								
simazine		0.03 J							0.008 J					0.023 J		0.01 J
terbacil	0.34	0.14 J	0.053 J	0.14 J	0.18 J	0.12 J	0.067 J	0.13 J							0.038 J	0.12 J

Values in bold exceed water quality criteria

[1] - Values are means of duplicate analyses

[2] - Exceeds Washington State Water Quality Standards, WAC 173-201A

[3] - Exceeds USEPA (1986) Quality Criteria for Water

[4] - Exceeds National Academy of Sciences (1973) Recommended Maximum Concentration

J = The analyte was positively identified. The numerical value is an estimate.

NJ = There is evidence that the analyte is present. The numerical value is an estimate.

Appendix E-5. Pesticides Detected in Water Samples Collected for the 1996 WSPMP (mg/L, ppb)

	Swamp Creek			Springbrook Creek			Big Soos Creek			Newaukum Creek		
	15-Apr	10-Jun[1]	12-Aug	15-Apr	10-Jun	12-Aug	15-Apr[1]	10-Jun	12-Aug	15-Apr	10-Jun	12-Aug
Insecticides												
diazinon				[2] **0.013 NJ**								
Herbicides												
2,4-D	0.027 J	0.029 J	0.010 J	0.039 J	0.081	0.026 J	0.007 J	0.011 J				
atrazine							0.007 NJ	0.010 J		0.006 NJ		
bromacil	0.063 J			0.30	0.008 NJ					0.026 J		
dicamba					0.014 J							
dichlobenil	0.052 J	0.033 J		0.037 J	0.044 J	0.004 J						
2,6-dichlorobenzamide		0.055 J			0.085 J	0.12 J						
diuron				1.2 J	0.17 NJ							
MCPA					0.044 J							
MCPP		0.030 J	0.013 J	0.031 J	0.032 J	0.017 J		0.013 NJ			0.007 NJ	
prometon	0.069 J	0.033 J	0.026 J				0.008 NJ					
simazine	0.066	0.042 J	0.050 J							0.009 NJ		
tebuthiuron				0.13 J	0.037 J	0.004 J	0.045 J	0.012 J				
triclopyr		0.085	0.062		0.051	0.043						
Fungicide												
pentachlorophenol	0.015 NJ			0.031 NJ		0.029						

Values in bold exceed water quality criteria

[1] - Values are means of duplicate analyses.

[2] - Exceeds National Academy of Sciences (1973) Recommended Maximum Concentration.

J = The analyte was positively identified. The numerical value is an estimate.

NJ = There is evidence that the analyte is present. The numerical value is an estimate.

Appendix E-5 (cont.). Pesticides Detected in Water Samples Collected for the 1996 WSPMP (mg/L, ppb)

	GHCDD-1[1]			PCDD-1[1]			Latah Creek			Deadman Creek		
	16-Apr	11-Jun	13-Aug	16-Apr	11-Jun	13-Aug[2]	22-Apr	17-Jun	5-Aug	22-Apr	17-Jun	5-Aug
Insecticides												
4,4'-DDD	0.011 J			0.015 J	0.008 J	0.012 J						
4,4'-DDE				0.006 J								
4,4'-DDT				0.002 NJ								
total DDT	[3] **0.011**			[3] **0.023**	[3] **0.008**	[3] **0.012**						
azinphos-methyl (Guthion)					[4] **0.019 J**	[4] **0.20**						
chlorobenzilate						0.020 NJ						
chlorpyrifos (Lorsban)				[5] **0.016 J**	[5] **0.013 J**	[3] **0.11**						
diazinon		[6] **0.45**	[6] **1.5**		[5] **0.027 J**	[6] **0.056 J**						
Herbicides												
2,4-D	0.55	0.075	0.054	0.78	0.12	0.09	0.064	0.014 J	0.043		0.029 J	0.011 J
3,5-dichlorobenzoic acid			0.0012 J			0.028 J						
4-nitrophenol									0.036 J			0.0073 NJ
atrazine										0.011 J		
bromacil							0.012 NJ					
bromoxynil							0.40					
dicamba							0.027 J					
dichlobenil	4.8	0.20	0.087 J	4.0	1.5	0.34						
2,6-dichlorobenzamide	0.61 J	0.20 J	0.24 J	0.31 J	0.11 J	0.15 J						
dichlorprop	0.078	0.012 J	0.010 J			0.017 J						
diclofop-methyl							0.015 J	0.011 NJ				
diuron							0.52 J					
MCPA							0.76	0.057 J			0.027 J	
MCPP		0.014 J	0.018 J	0.038 J	0.013 J	0.017 J			0.012 NJ			
metribuzin							0.43					
napropamide	0.71	0.068 J	0.095 J	0.95	0.63	0.076 J						
norflurazon	0.87	0.066 J	0.054 J	0.48	0.11 J	0.20 J						
propiconazole							0.14 NJ					
simazine	0.025 J											
terbacil	0.016 J											
triallate							0.051 J					
Fungicide												
pentachlorophenol	0.020 NJ			0.033 NJ					0.033			

Values in bold exceed water quality criteria

[1] - GHCDD-1 = Grays Harbor County Drainage Ditch No.1, PCDD-1 = Pacific County Drainage Ditch No.1.

[2] - Values are means of duplicate analyses.

[3] - Exceeds Washington State Water Quality Standards, WAC 173-201A.

[4] - Exceeds USEPA (1986) Quality Criteria for Water.

[5] - Exceeds National Academy of Sciences (1973) Recommended Maximum Concentration.

[6] - Exceeds California State Department of Fish and Game chronic criterion (Menconi and Cox, 1994).

J = The analyte was positively identified. The numerical value is an estimate.

NJ = There is evidence that the analyte is present. The numerical value is an estimate.