Appendices C - G

Surface Water Monitoring Program for Pesticides in Salmonid-Bearing Streams, 2009

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Appendix C. Quality Assurance

Laboratory

Data may be qualified if one or more analytical factors affect confidence in the prescribed data value. Manchester Environmental Laboratory qualifies data according to the National Functional Guidelines for Organic Data Review (EPA, 1999, 2007). Definitions of data qualifiers are presented in Table C-1.

Table C-1. Data qualification.

Qualifier	Definition
(No qualifier)	The analyte was detected at the reported concentration. Data are not qualified.
E	Reported result is an estimate because it exceeds the calibration range.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified," and the associated numerical value represents its approximate concentration.
NAF	Not analyzed for.
NC	Not calculated.
REJ	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
U	The analyte was not detected at or above the reported sample quantitation limit.
UJ	The analyte was not detected at or above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately measure the analyte in the sample.

MEL, 2000, 2008; EPA, 1999, 2007.

Performance measures for quality assurance (QA) and quality control (QC) are presented in Table C-2. Lowest concentrations of interest for surface water grab samples are below reporting limits. Detections quantified below reporting limits are qualified as estimates.

Table C-2. Performance measures for quality assurance and quality control.

Analysis Method[1]	Analysis[2]	Field/Lab Replicates, MS/MSD[3], and Lab Control Samples	MS/MSD[3], Surrogates, and Lab Control Samples
		RPD[4]	% Recovery
GCMS	Pesticide-Cl	±40	30-130
	Pesticide-N	±40	30-130
	Pesticide-OP	±40	30-130
	Pesticide-Py	±40	30-130
GCMS-H	Herbicides	±50	40-130
LCMS	Pesticide-C	±40	50-150
TSS	TSS	±20	80-120
TOC	TOC	±20	80-120
DOC	DOC	±20	80-120

[1] GCMS = Gas chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8270M.
GCMS-H = Derivitizable acid herbicides by GCMS, EPA method (modified) SW 846 3535M/8270M.
LCMS = Liquid chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8321AM.
TSS = Total suspended solids, EPA method 2540D.
TOC, DOC = Total and Dissolved Organic Carbon, EPA method 415.1.
[2] C l = chlorinated, N=nitrogen containing, OP=organophosphorus, Py=pyrethroid, C=carbamate.
[3] MS/MSD = Matrix spike and matrix spike duplicate.
[4] RPD = Relative percent difference.

Lower Practical Quantitation Limits

Lower practical quantitation limits (LPQLs) are the limits at which laboratories may report data without classifying the concentration as an estimate below the lowest calibration standard. The LPQL is determined by averaging the lower reporting values, per analyte, for all batches over each study period. LPQL data are presented in Table C-3.

Table C-3. Mean performance Lower Practical Quantitation Limits (ug/L).

Chemical	[1]Use	Parent	[2]Analysis Method	LPQL[3]		
				2007	2008	2009
1-Naphthol	D-C		LCMS	0.051	0.053	0.050
2,3,4,5-Tetrachlorophenol	D-WP		GCMS-H	0.062	0.063	0.063
2,3,4,6-Tetrachlorophenol	D-WP		GCMS-H	0.062	0.063	0.063
2,4,5-T	H		GCMS-H	0.062	0.063	0.063
2,4,5-TP	H		GCMS-H	0.062	0.063	0.063
2,4,5-Trichlorophenol	F		GCMS-H	0.062	0.063	0.063
2,4,6-Trichlorophenol	F		GCMS-H	0.062	0.063	0.063
2,4-D	H		GCMS-H	0.062	0.063	0.063
2,4-DB	H		GCMS-H	0.062	0.063	0.063
2,4'-DDD	D-OC	DDT	GCMS	0.033	0.033	0.033
2,4'-DDE	D-OC	DDT	GCMS	0.033	0.033	0.033
2,4'-DDT	D-OC	DDT	GCMS	0.033	0.033	0.033
3,5-Dichlorobenzoic Acid	H		GCMS-H	0.062	0.063	0.063
3-Hydroxycarbofuran	D-C	Carbofuran	LCMS	0.040	0.050	0.050
4,4'-DDD	D-OC	DDT	GCMS	0.033	0.033	0.034
4,4'-DDE	D-OC	DDT	GCMS	0.033	0.033	0.034
4,4'-DDT	I-OC		GCMS	0.033	0.033	0.034
4,4'-Dichlorobenzophenone	D		GCMS			0.101
4-Nitrophenol	D-H		GCMS-H	0.062	0.063	0.063
Acetochlor	H		GCMS			0.101
Acifluorfen	H		GCMS-H	0.062	0.063	0.063
Alachlor	H		GCMS	0.033	0.033	0.033
Aldicarb	I-C		LCMS	0.074	0.100	0.100
Aldicarb Sulfone	D-C	Aldicarb	LCMS	0.060	0.050	0.053
Aldicarb Sulfoxide	D-C	Aldicarb	LCMS	0.017	0.020	0.054
Aldrin	I-OC		GCMS	0.033	0.033	0.033
Alpha-BHC	I-OC		GCMS	0.033	0.033	0.033
Atrazine	H		GCMS	0.033	0.033	0.034
Azinphos Ethyl	I-OP		GCMS	0.033	0.033	0.033
Azinphos Methyl	I-OP		GCMS	0.033	0.033	0.050
Benefin	H		GCMS	0.033	0.033	0.033
Bensulide	H		GCMS	0.033	0.033	
Bentazon	H		GCMS-H	0.062	0.063	0.063
Benthiocarb	H-C		GCMS	0.099	0.100	0.101
Beta-BHC	I-OC		GCMS	0.033	0.033	0.033
beta-Cypermethrin 65731-84-2 ([(1R)-1a(S*), 3a] isomer)	I-Py		GCMS			0.101
Bifenthrin	I-Py		GCMS			0.101
Bromacil	H		GCMS	0.034	0.033	0.033
Bromoxynil	H		GCMS-H	0.062	0.063	0.063
Butachlor	H		GCMS			0.304
Butylate	H		GCMS	0.033	0.033	0.033
Captan	F		GCMS	0.033	0.033	0.033
Carbaryl	I-C		LCMS	0.017	0.020	0.020

Chemical	[1]Use	Parent	[2]Analysis Method	LPQL[3]		
				2007	2008	2009
Carbofuran	I-C		LCMS	0.017	0.020	0.020
Carboxin	F		GCMS	0.033	0.034	0.044
Chlorothalonil	F		GCMS	0.033	0.033	0.033
Chlorpropham	H		GCMS	0.033	0.033	0.033
Chlorpyrifos	I-OP		GCMS	0.033	0.033	0.034
Chlorpyrifos O.A.	D-OP		GCMS			0.101
Cis-Chlordane	I-OC		GCMS	0.033	0.033	0.033
Cis-Nonachlor	I-OC		GCMS	0.033	0.033	0.051
Cis-Permethrin	I-Py		GCMS	0.050	0.050	0.051
Clopyralid	H		GCMS-H	0.062	0.063	0.063
Coumaphos	I-OP		GCMS	0.033	0.033	0.051
Cyanazine	H		GCMS	0.033	0.033	0.033
Cycloate	H		GCMS	0.033	0.033	0.033
DCPA	H		GCMS-H	0.062	0.063	0.063
DDVP	I-OP		GCMS	0.059	0.050	0.051
Delta-BHC	I-OC		GCMS	0.033	0.033	0.033
Deltamethrin	I-Py		GCMS	0.099	0.100	0.101
Diallate	H		GCMS	0.033	0.033	0.033
Diazinon	I-OP		GCMS	0.033	0.033	0.033
Diazoxon	D-OP	Diazinon	GCMS			0.101
Dicamba I	H		GCMS-H	0.062	0.063	0.063
Dichlobenil	H		GCMS	0.033	0.033	0.033
Dichlorprop	H		GCMS-H	0.062	0.063	0.063
Diclofop-Methyl	H		GCMS-H	0.062	0.063	0.063
Dieldrin	I-OC		GCMS	0.050	0.050	0.051
Dimethoate	I-OP		GCMS	0.033	0.033	0.033
Dinoseb	H		GCMS-H	0.062	0.063	0.063
Dioxocarb	I-C		LCMS	0.050		
Diphenamid	H		GCMS	0.033	0.033	0.033
Disulfoton	I-OP		GCMS	0.033	0.052	0.112
Disulfoton sulfone	I-OP		GCMS	0.099	0.100	0.101
Disulfoton sulfoxide	D-OP		GCMS			0.135
Diuron	H		GCMS	0.060	0.050	0.058
Endosulfan I	I-OC		GCMS	0.050	0.050	0.051
Endosulfan II	I-OC		GCMS	0.050	0.050	0.051
Endosulfan Sulfate	D-OC	Endosulfan	GCMS	0.033	0.033	0.034
Endrin	I-OC		GCMS	0.050	0.050	0.051
Endrin Aldehyde	D-OC	Endrin	GCMS	0.050	0.050	0.051
Endrin Ketone	D-OC	Endrin	GCMS	0.033	0.033	0.033
EPN	I-OP		GCMS	0.033	0.033	0.033
Eptam	H		GCMS	0.033	0.033	0.033
Ethalfluralin	H		GCMS	0.033	0.033	0.033
Ethion	I-OP		GCMS	0.033	0.033	0.033
Ethoprop	I-OP		GCMS	0.033	0.033	0.033
Fenamiphos	I-OP		GCMS	0.033	0.033	0.038
Fenamiphos Sulfone	D-OP		GCMS			0.101

Chemical	[1]Use	Parent	[2]Analysis Method	LPQL[3]		
				2007	2008	2009
Fenarimol	F		GCMS	0.033	0.033	0.033
Fensulfothion	I-OP		GCMS		0.033	0.033
Fenthion	I-OP		GCMS		0.048	0.033
Fenvalerate (2 isomers)	I-Py		GCMS	0.033	0.033	0.033
Fipronil	I-Pyra		GCMS			0.101
Fipronil Disulfinyl	D-Pyra		GCMS			0.101
Fipronil Sulfide	D-Pyra		GCMS			0.101
Fipronil Sulfone	D-Pyra		GCMS			0.101
Fluridone	H		GCMS	0.099	0.100	0.101
Fonofos	I-OP		GCMS	0.033	0.033	0.033
Heptachlor	I-OC		GCMS	0.033	0.033	0.033
Heptachlor Epoxide	D-OC	Heptachlor	GCMS	0.033	0.033	0.033
Hexachlorobenzene	F		GCMS	0.033	0.034	0.033
Hexazinone	H		GCMS	0.050	0.050	0.051
Imidacloprid	I-N		LCMS		0.020	0.020
Imidan	I-OP		GCMS	0.033	0.033	0.068
Ioxynil	H		GCMS-H	0.062	0.063	0.063
Kelthane	I-OC		GCMS	0.295	0.314	0.304
lambda-Cyhalothrin	I-Py		GCMS			0.101
Lindane	I-OC		GCMS	0.033	0.033	0.033
Linuron	H		GCMS	0.059	0.050	0.051
Malathion	I-OP		GCMS	0.033	0.033	0.033
MCPA	H		GCMS-H	0.062	0.063	0.063
MCPP	H		GCMS-H	0.062	0.063	0.063
Metalaxyl	F		GCMS	0.033	0.033	0.033
Methidathion	I-OP		GCMS	0.295	0.293	0.304
Methiocarb	I-C		LCMS	0.017	0.020	0.021
Methomyl	I-C		LCMS	0.037	0.050	0.050
Methomyl oxime	D-C	Thiodicarb	LCMS	0.017	0.020	0.020
Methoxychlor	I-OC		GCMS	0.033	0.033	0.051
Methyl Chlorpyrifos	I-OP		GCMS	0.033	0.033	0.033
Methyl Paraoxon	D-OP	Methyl parathion	GCMS	0.099	0.100	0.101
Methyl Parathion	I-OP		GCMS	0.033	0.033	0.033
Metolachlor	H		GCMS	0.033	0.033	0.033
Metribuzin	H		GCMS	0.033	0.033	0.033
Mevinphos	I-OP		GCMS	0.050	0.050	0.051
MGK-264	Sy		GCMS	0.033	0.033	0.051
Mirex	I-OC		GCMS	0.033	0.033	0.035
Monocrotophos	I-OP		GCMS	0.050	0.050	0.051
Naled	I-OP		GCMS	0.042	0.059	0.035
Napropamide	H		GCMS	0.050	0.050	0.051
Norflurazon	H		GCMS	0.033	0.033	0.034
Oryzalin	H		GCMS	0.099	0.100	0.114
Oxamyl	I-C		LCMS	0.042	0.050	0.052
Oxamyl oxime	D-C	Oxamyl	LCMS	0.017	0.020	0.020
Oxychlordane	D-OC	Chlordane	GCMS	0.033	0.033	0.033

Chemical	[1]Use	Parent	[2]Analysis Method	LPQL[3]		
				2007	2008	2009
Oxyfluorfen	H		GCMS	0.033	0.033	0.101
Parathion	I-OP		GCMS	0.033	0.033	0.033
Pebulate	H		GCMS	0.033	0.033	0.033
Pendimethalin	H		GCMS	0.033	0.033	0.034
Pentachlorophenol	WP		GCMS-H	0.062	0.063	0.063
Phenothrin	I-Py		GCMS	0.033	0.033	0.033
Phorate	I-OP		GCMS	0.296	0.299	0.291
Phorate O.A.	I-OP		GCMS			0.193
Picloram	H		GCMS-H	0.062	0.063	0.063
Piperonyl Butoxide	Sy		GCMS			0.101
Promecarb	I-C		LCMS	0.031	0.020	0.020
Prometon	H		GCMS	0.033	0.033	0.033
Prometryn	H		GCMS	0.033	0.033	0.033
Pronamide	H		GCMS	0.033	0.033	0.033
Propachlor	H		GCMS	0.033	0.033	0.033
Propargite	I-SE		GCMS	0.033	0.033	0.051
Propazine	H		GCMS	0.033	0.033	0.033
Propoxur	I-C		LCMS	0.040	0.050	0.050
Prothiofos	I-OP		GCMS			0.101
Resmethrin	I-Py		GCMS	0.050	0.050	0.036
Simazine	H		GCMS	0.033	0.033	0.033
Simetryn	H		GCMS	0.099	0.100	0.101
Sulfotepp	I-OP		GCMS	0.033	0.033	0.033
Sulprofos	I-OP		GCMS		0.033	
Tebuthiuron	H		GCMS	0.033	0.033	0.033
Terbacil	H		GCMS	0.033	0.033	0.034
Tetrachlorvinphos	I-OP		GCMS	0.050	0.050	0.051
Thiodicarb	I-C		LCMS		0.020	
Tokuthion	I-OP		GCMS	0.050	0.050	
Total Suspended Solids			TSS			1.059
Tralomethrin	I-Py		GCMS	0.099	0.100	0.101
Trans-Chlordane	I-OP		GCMS	0.033	0.033	0.033
Trans-Nonachlor	I-OC		GCMS	0.033	0.033	0.051
trans-Permethrin	I-Py		GCMS			0.101
Triadimefon	F		GCMS	0.033	0.033	0.033
Triallate	H		GCMS	0.033	0.033	0.033
Trichloronat	I-OP		GCMS	0.050	0.050	0.051
Triclopyr	H		GCMS-H	0.062	0.063	0.063
Tricyclazole	F		GCMS			0.101
Trifluralin	H		GCMS	0.033	0.033	0.034

[1] C = Carbamate, D = Degradate, F = Fungicide, I = Insecticide, H = Herbicide, OC = Organochlorine, OP = Organophosphorus, Py = Pyrethroid, SE = Sulfite Ester, Sy = Synergist, WP = Wood Preservative.
[2] GCMS = Gas chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8270M.
GCMS-H = Derivitizable acid herbicides by GCMS, EPA method (modified) SW 846 3535M/8270M.
LCMS = Liquid chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8321AM.
[3]Blank cells indicate no analysis for the compound in that year.

Quality Assurance Samples

Quality Assurance (QA) samples were collected each year to assure consistency and accuracy of sample analysis.

For this project, QA samples included field replicates, field blanks, and matrix spike and matrix spike duplicates (MS/MSD). QA samples for the laboratory included split sample duplicates, laboratory control samples, surrogate spikes, and method blanks.

Field QA samples as a percentage of total sample budget increased yearly from 2007 to 2009. Each year, more than 10% of field samples had an associated QA sample (Table C-4).

The total count of field QA samples is in Table C-4. The total count of laboratory QA samples is in Table C-5.

Table C-4. Total field QA samples per analysis type, 2007-09.

QA type	Field Replicates				Field Blanks				MS/MSD[2]			Field QA % of sample budget
Analysis[1]	GCMS	GCMS-H	LCMS	TSS	GCMS	GCMS-H	LCMS	TSS	GCMS	GCMS-H	LCMS	
2007	28	26	24	25	12	12	11	13	25	23	24	11%
2008	33	30	32	32	17	17	16	16	17	16	16	16.3%
2009	40	36	36	37	23	18	19	20	17	16	16	16.5%
Total	101	92	92	94	52	47	46	49	59	55	56	14.6%

[1] GCMS = Gas chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8270M.
GCMS-H = Derivitizable acid herbicides by GCMS, EPA method (modified) SW 846 3535M/8270M.
LCMS = Liquid chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8321AM.
TSS = Total suspended solids, EPA method 2540D.
[2]MS/MSD = Matrix spike and matrix spike duplicates.

Table C-5. Total laboratory QA samples per analysis type, 2007-09.

QA	LDP[2]	Lab Blanks				Surrogates			Laboratory Control Samples			
Analysis[1]	TSS	GCMS	GCMS-H	LCMS	TSS	GCMS	GCMS-H	LCMS	GCMS	GCMS-H	LCMS	TSS
2007	76	92	71	74	89	679	659	663	46	67	43	89
2008	76	35	31	28	66	557	529	526	59	47	44	66
2009	115	40	52	32	61	532	498	504	71	93	88	23
Total	193	199	163	130	207	1633	1562	1530	142	146	119	208

[1] GCMS = Gas chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8270M.
GCMS-H = Derivitizable acid herbicides by GCMS, EPA method (modified) SW 846 3535M/8270M.
LCMS = Liquid chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8321AM.
TSS = Total suspended solids, EPA method 2540D.
[2] LDP = Laboratory duplicates.

Results for each QA sample method are outlined in the sections below.

Field Replicates

Results for pesticide field replicates are presented in Tables C-6 and C-7. Table C-6 presents the data value, data qualification (if assigned), and relative percent difference (RPD) between the results for compounds which were consistently identified in both the grab sample and replicate.

Consistent identification refers to compounds which were identified in both the original sample and field replicate. Inconsistently identified replicate pairs are those in which the compound was identified in one sample but not the other. Inconsistently identified grab sample replicates are presented in Table C-7.

Field replicates were used with 5.2%, 7.8%, and 8.1% of all field samples in 2007, 2008, and 2009, respectively. 2.5% of the analysis pairs had a detection in at least one replicate.

Excluding total suspended solids (TSS), 39 parameters were detected in 113 replicate pairs. Of these, 81% were consistently identified in both samples. 79% of consistent pairs were within the 40% RPD criterion.

TSS was detected in 32 replicate pairs. All TSS replicate pairs were consistently identified. 75% were within the 20% RPD criterion.

The 2009 ratio of consistent to inconsistent replicate sets is similar to results from this program's 2003-05 surveys (71%; Burke et al., 2006) and 2006-08 surveys (75%; Sargeant et al., 2010), and the USGS-NAWQA replicate analysis (1992-1997 samples) when the median detected pesticide concentration was less than 0.1 ug/L (84%; calculated from Table 2 *in* Martin, 2002). In both the USGS and our studies, the associated error of inconsistent replicate sets precludes use in variability analysis.

The average RPD of consistent field replicate pairs was very low, 9.6% (Table C-6). Similarly, the median pooled relative standard deviation (RSD) of all replicates was 6.3%. This variation is lower than our 2006-2008 results (8.1%, Sargeant et al., 2010) and the NAWQA median pooled RSD of 15% at concentrations <0.01 ug/L and 12% at concentrations near 0.1 ug/L (Table 8 *in* Martin, 2002).

Among consistent replicates, 4 parameters had a maximum RPD over criteria (Table C-6):

- 4,4'-DDE
- DCPA
- Endosulfan I
- Total Suspended Solids

Overall RPD for the parameters not meeting (exceeding) RPD criteria ranged from 0% to 67%. RPDs for other analyte pairs ranged from 0% to 40%. The failure of these samples to fall within the acceptable range is most likely due to the high amount of variability in detections near the minimum reporting limit (Martin, 2002; Mathieu, 2006).

Table C-6. Detected pairs within field replicate results, 2009 (µg/L).

Parameter	Sample	Replicate	RPD
2,4-D	0.079	0.078	1
	0.99	0.91	8
	0.15	0.1	40
	0.02 J	0.02 J	0
	0.098	0.096	2
	0.11	0.09	20
	0.051 J	0.053 J	4
	0.079	0.078	1
	0.019 J	0.022 J	15
	0.036 J	0.034 J	6
		Mean =	10
4,4'-DDD	0.019 J	0.019 J	0
	0.015 J	0.013 J	14
		Mean =	7
4,4'-DDE	0.022 J	0.02 J	10
	0.016 J	0.016 J	0
	0.026 J	0.014 J	60
	0.044	0.042	5
		Mean =	19
4,4'-DDT	0.022 J	0.023 J	4
	0.027 J	0.022 J	20
	0.036	0.035	3
		Mean =	9
Bentazon	0.025 J	0.024 J	4
	0.13	0.15	14
		Mean =	9
Bromacil	0.019 J	0.027 J	35
	0.074	0.068	8
	0.046	0.042	9
	0.07	0.069	1
	0.045	0.047	4
	0.14	0.15	7
	0.058	0.059	2
		Mean =	10
Bromoxynil	0.072	0.073	1
Carbaryl	0.021	0.022	5
Carbofuran	0.099	0.105	6

Parameter	Sample	Replicate	RPD
Chlorpyrifos	0.041	0.048	16
	0.03 J	0.028 J	7
	0.053	0.056	6
	0.037	0.039	5
	0.08	0.086	7
	0.023 J	0.021 J	9
		Mean =	8
DCPA	0.12	0.064 J	61
	0.017 J	0.012 J	34
		Mean =	48
Diazinon	0.027 J	0.026 J	4
Dicamba I	0.032 J	0.028 J	13
	0.13	0.12	8
	0.011 J	0.01 J	10
	0.008 J	0.009 J	12
	0.021 J	0.021 J	0
	0.01 J	0.01 J	0
		Mean =	7
Dichlobenil	0.022 J	0.023 J	4
	0.004 J	0.004 J	0
	0.009 J	0.009 J	0
	0.008 J	0.008 J	0
	0.014 J	0.013 J	7
	0.013 J	0.012 J	8
	0.01 J	0.01 J	0
	0.019 J	0.021 J	10
	0.064	0.069	8
	0.026 J	0.024 J	8
	0.011 J	0.01 J	10
	0.011 J	0.011 J	0
	0.008 J	0.009 J	12
		Mean =	5
Diphenamid	0.031 J	0.032 J	3
Endosulfan I	0.024 J	0.03 J	22
	0.018 J	0.017 J	6
	0.044 J	0.028 J	44
		Mean =	24
Endosulfan II	0.063 J	0.052 J	19

continued next page...

Table C-6. (continued).

Parameter	Sample	Replicate	RPD
Endosulfan Sulfate	0.041 J	0.046 J	11
	0.043	0.044	2
	0.092 J	0.076 J	19
	0.03 J	0.032 J	6
		Mean =	10
Hexazinone	0.056	0.057	2
Imidacloprid	0.038	0.043	12
	0.092	0.09	2
		Mean =	7
MCPA	0.16	0.15	6
	0.09	0.079	13
	0.091	0.086	6
		Mean =	8
MCPP	0.089	0.077	14
Metalaxyl	0.05	0.051	2
Metolachlor	0.086	0.083	4
	0.061	0.056	9
	0.029 J	0.028 J	4
		Mean =	5
Metribuzin	0.045	0.053	16
Pendimethalin	0.06	0.063	5
Pentachlorophenol	0.053 J	0.051 J	4
Prometon	0.072	0.077	7
Tebuthiuron	0.027 J	0.03 J	11
	0.047	0.041	14
		Mean =	12
Terbacil	0.11	0.12	9
	0.11	0.13	17
		Mean =	13
Triclopyr	0.5	0.46	8
	0.06 J	0.057 J	5
	0.076	0.071	7
		Mean =	7
Trifluralin	0.025 J	0.026 J	4
	0.017 J	0.017 J	0
		Mean =	2

Parameter	Sample	Replicate	RPD
Total Suspended Solids	6	6	0
	19	17	11
	30	29	3
	13	12	8
	9	9	0
	8	8	0
	8	8	0
	3	3	0
	32	29	10
	9	9	0
	5	4	22
	5	5	0
	4	4	0
	8	7	13
	13	13	0
	21 J	23	9
	3	6	67
	16	13	21
	49	49	0
	62	56	10
	1	2	67
	8	8	0
	16	16	0
	3	4	29
	10	10	0
	11	10	10
	5	4	22
	3	3	0
	2	1	67
	3	3	0
	2	3	40
	9	10	11
		Mean =	13

Inconsistent replicate detections are an indicator of sampling uncertainty. Table C-7 compares inconsistent replicate detections to the Lower Practical Quantitation Limit (LPQL) for non-detections in the paired replicate. Most inconsistent detections were found at concentrations near or below the LPQL.

Table C-7. Inconsistent field replicate detections compared to the LPQL, 2009 (µg/L).

Parameter	Sample		Replicate		RPD
2,4-D	0.023	J	0.025	NJ	8
	0.024	J	0.028	NJ	15
				Mean =	12
2,4'-DDE	0.009	J	<0.033	U	114
4,4'-DDT	0.020	J	<0.033	U	49
Atrazine	0.016	NJ	0.015	J	6
	0.049		0.055	NJ	12
	<0.032	U	0.022	J	37
				Mean =	18
Bromacil	<0.033	U	0.021	J	44
Dicamba I	0.016	NJ	0.016	J	0
Dichlobenil	0.009	J	0.010	NJ	11
Endosulfan II	0.023	J	<0.051	UJ	76
Imidacloprid	<0.020	U	0.023		14
MCPA	0.022	NJ	0.026	J	17
Methiocarb	<0.020	U	0.033		49
Norflurazon	0.030	J	0.027	NJ	11
Pendimethalin	0.029	NJ	0.028	J	4
Pentachlorophenol	0.018	NJ	0.020	J	11
Picloram	<0.064	U	0.180		95
Simazine	<0.034	U	0.015	J	78
Tebuthiuron	0.034	NJ	0.037		8

[1] Non-detections are listed as less than the Lower Practical Quantitation Limit (<LPQL).

Laboratory Duplicates

Manchester Laboratory used laboratory split sample duplicates to ensure consistency of TSS analyses. Boxplots of RPD for TSS lab duplicates are presented in Figure C-1.

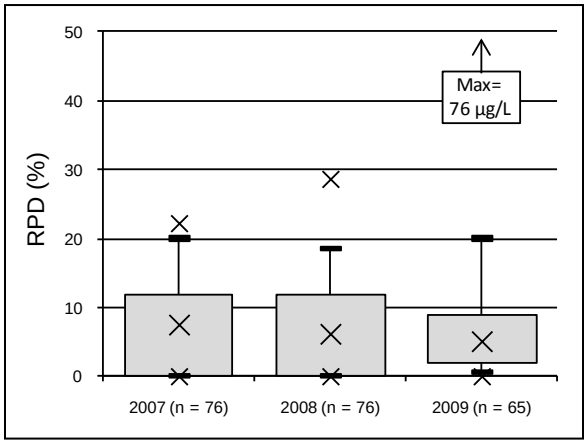

Figure C-1. TSS laboratory duplicate relative percent difference (%).[1]

[1]Boxes show 25th and 75th percentiles, whiskers show 5th and 95th percentiles, and 'X' indicates the minimum, median, and maximum values.

From 2007-09, 95% of all TSS lab duplicate RPDs were less than or equal to the 20% RPD criteria. Some outlier pairs exceeded 20% but did not represent overall recovery.

Field Blanks

Field blank detections indicate the potential for sample contamination in the field and laboratory and the potential for false detections due to analytical error.

Field blank detections for 2009 are listed in Table C-8.

Table C-8. Grab sample field blank detections for 2009 (µg/L).

Analysis[1]	Chemical	Field Date	Site	Sample		Blank	
GCMS	Dichlobenil	3/11/09	LC-1	0.033	U	0.016	J
GCMS	Tricyclazole	4/8/09	BR-1	0.099	U	0.030	J

[1] GCMS = Gas chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8270M.

On March 11, 2009, dichlobenil was found in a field blank for Longfellow Creek (LC-1). Dichlobenil was not found in the associated sample for LC-1, but it was detected at other western Washington sites on the same day. None of these detections were greater than 5 times the blank concentration, so dichlobenil was qualified as tentatively undetected (UJ) for these samples.

On April 8, 2009, tricyclazole was detected in a field blank for Brender Creek (BR-1) but was not detected in any associated samples (Table C-8).

Laboratory Blanks

Manchester Laboratory uses laboratory blanks to assess the precision of equipment and the potential for internal laboratory contamination. If lab blank detections occur, the sample LPQL may be increased, and detections may be qualified as estimates.

Laboratory blank detections for 2009 are presented in Table C-9.

Table C-9. Laboratory blank detections, 2009 (µg/L).

Analysis	Chemical	Analysis Date	Value
LCMS	Aldicarb Sulfone	4/16/09	0.010 J
		4/22/09	0.009 J
	Aldicarb Sulfoxide	4/16/09	0.015 J
	Methiocarb	4/20/09	0.016 J
	Methomyl	4/16/09	0.013 J
	Oxamyl	4/16/09	0.006 J
		4/22/09	0.008 J
	Oxamyl oxime	6/22/09	0.022 J

All lab blank detections were carbamate compounds analyzed by LCMS (Table C-9). Problems with LCMS lab blanks were due to an unidentified low-level interference in the LCMS equipment that resembled the compounds in question (D. Huntamer, 2009, personal communication).

For all lab blank detections, any analytes found in associated samples below 5 times the lab blank detection were reported at the level detected, but qualified as not detected at an estimated detection limit (UJ).

A March 11, 2009 field sample from Sulphur Creek Wasteway had a methiocarb detection of 0.269 ug/L associated with a lab blank detection of 0.016 ug/L. The sample concentration was more than 5 times the lab blank concentration and was not qualified. No other sample detections were associated with lab blank detections.

Surrogates

Surrogates are compounds that are spiked into field samples at the laboratory. They are used to check recovery for a group of compounds. For instance, triphenyl phosphate is a surrogate for organophosphorus insecticides (Table C-10).

High pesticide surrogate recovery requires related detections to be qualified as estimates. Low pesticide surrogate recovery requires all related data to be qualified as estimates.

Table C-10. Pesticide surrogates.

Surrogate compound	Surrogate for...
2,4,6-tribromophenol	Acid-derivitizable herbicides
2,4-dichlorophenylacetic acid	
Chloramben	
Carbaryl C13	Carbamate pesticides
4,4'-DDE-13C12	Chlorinated pesticides
4,4-DDE-D8	
Decachlorobiphenyl (DCB)	
Gamma-BHC-D6	
1,3-dimethyl-2-nitrobenzene	Nitrogen pesticides
Chlorpyrifos-D10	Organophosphorus pesticides
Triphenyl phosphate	

Grab sample surrogate recoveries are presented in Figure C-2.

The majority of surrogate recoveries fell within the control limits established by Manchester Laboratory for all compounds except chlorpyrifos-D10 (Figure C-2). Chlorpyrifos-D10 was used as a surrogate for organophosphorus pesticides in GCMS analysis in late 2009. No sample results were qualified because all other GCMS surrogates, including the other organophosphorus surrogate, triphenyl phosphate, were acceptably recovered in all samples.

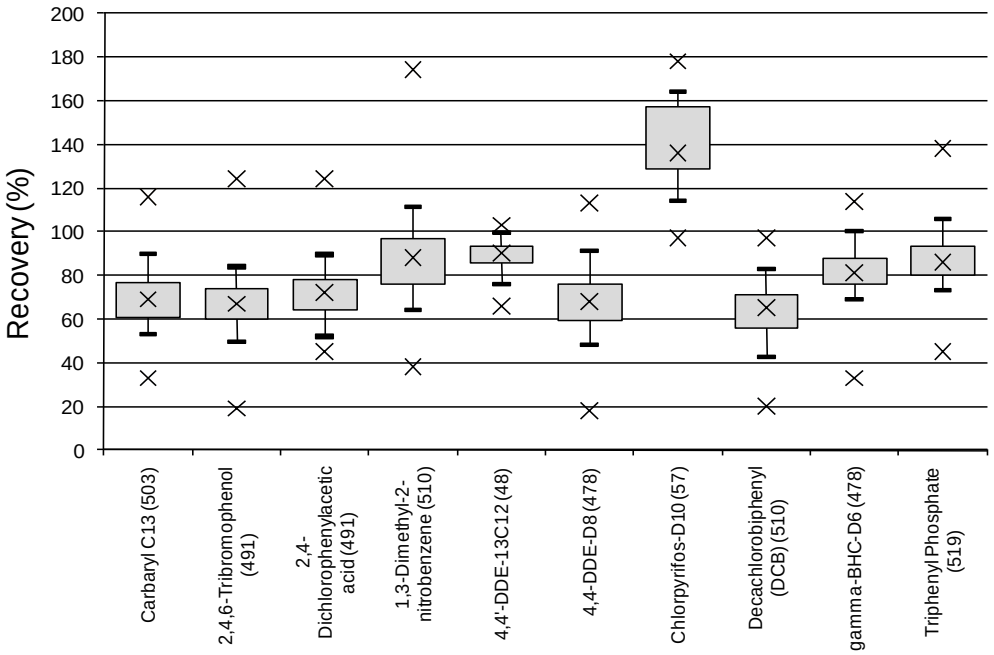

Figure C-2. Grab sample surrogate recoveries (%).[1]

[1]Boxes show 25th and 75th percentiles, whiskers show 5th and 95th percentiles, and 'X' indicates the minimum, median, and maximum values.

Outlier recoveries were outside of control limits for all surrogates. However, outliers represented a small part of overall surrogate recovery and did not qualify the majority of data.

Matrix Spike/Matrix Spike Duplicates (MS/MSD)

MS/MSD results reflect the process of sample duplication (field), analyte degradation, matrix interaction (sample/standard), extraction efficiency, and analyte recovery. This measure is the best overall indicator of accuracy and reproducibility of the entire sampling process.

Figure C-3 shows percent matrix spike recovery for selected pesticides. Figure C-4 shows the RPD between the matrix spike and the matrix spike duplicate for the same set.

In 2009, the average recovery of matrix-spiked compounds was 88.7%, and the average RPD between MS/MSD pairs was 12.2%. For most compounds, the RPD and recovery of MS/MSD pairs showed acceptable performance and were within defined limits for the project. Due to high variability, Aldicarb sulfoxide and Picloram had an average RPD outside the ± 40% criteria. Any unqualified detections of these chemicals were qualified as estimates.

In 2009, diuron recovered very high in some matrix spikes (maximum recovery of 482%). In these cases, Diuron was reanalyzed using derivitization confirmation and passed quality control (J. Westerlund, 2009, personal communication). No Diuron detections were associated with these high matrix spike recoveries.

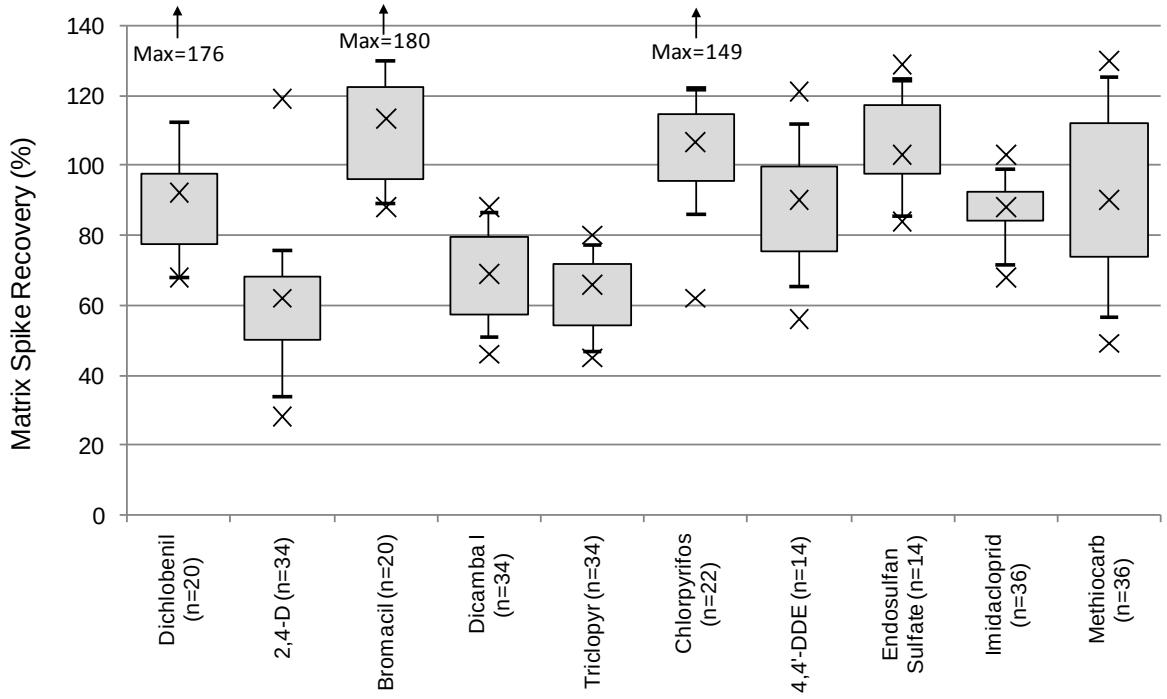

Figure C-3. Matrix spike recovery for selected pesticides. [1]

[1]Boxes show 25th and 75th percentiles, whiskers show 5th and 95th percentiles, and 'X' indicates the minimum, median, and maximum values.

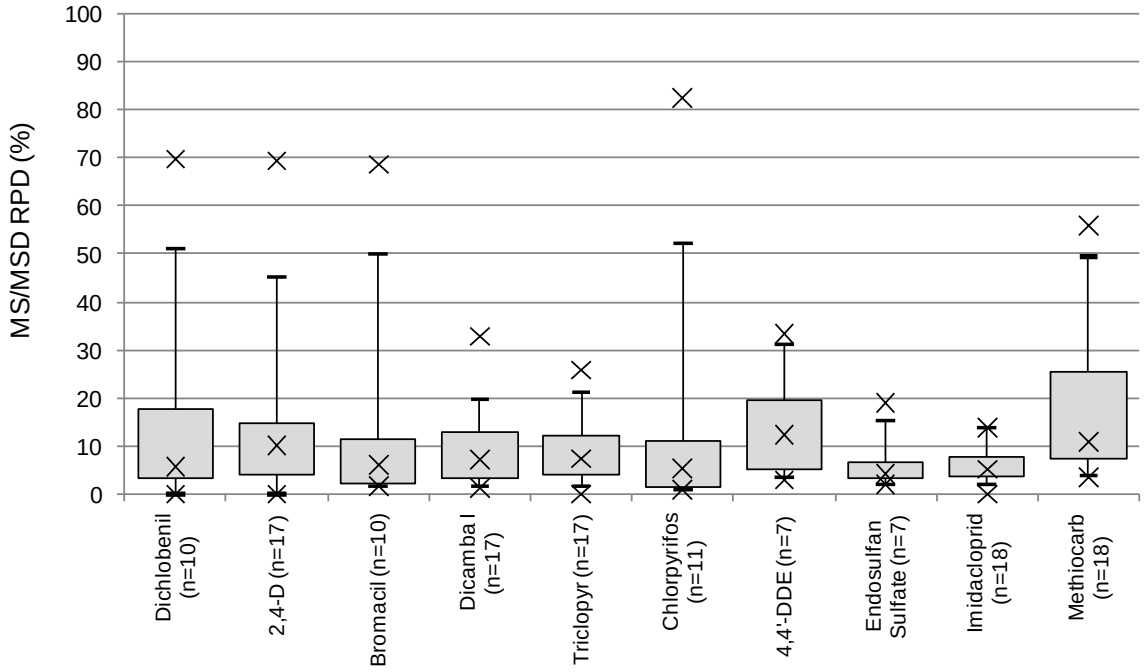

Figure C-4. Paired matrix spike relative percent differences (RPDs) for selected pesticides. [1]

[1]Boxes show 25th and 75th percentiles, whiskers show 5th and 95th percentiles, and 'X' indicates the minimum, median, and maximum values.

Laboratory Control Samples

Laboratory control samples (LCS) are analyte compounds spiked into deionized water at known concentrations and subjected to analysis. They are used to evaluate accuracy of pesticide residue recovery for a specific analyte. Detections may be qualified based on low LCS recovery and/or high RPD between paired LCS.

Figures C-5 through C-8 show LCS recovery results. LCS tests were conducted with each grab sample analysis. Specific analytes were tested on a rotating basis.

Most grab sample LCS recoveries for pesticide analyses fell within the acceptance criteria established by Manchester Laboratory (Table C-2). Results associated with high or low LCS recoveries were qualified as estimates.

All conventional parameter LCS recoveries fell within the criteria of 80 to 120% recovery (Table C-7).

Figures C-9 through C-11 show paired LCS RPDs. Paired LCS tests were conducted for a subset of LCS to understand recovery consistency. If paired LCS show inconsistent recoveries, additional pairs may be tested. If paired LCS recoveries are still inconsistent, associated sample detections may be qualified as tentative or not detected.

The majority of LCS pairs showed acceptable recovery for all analytes. Sample detections associated with high RPD between LCS pairs were qualified as estimates.

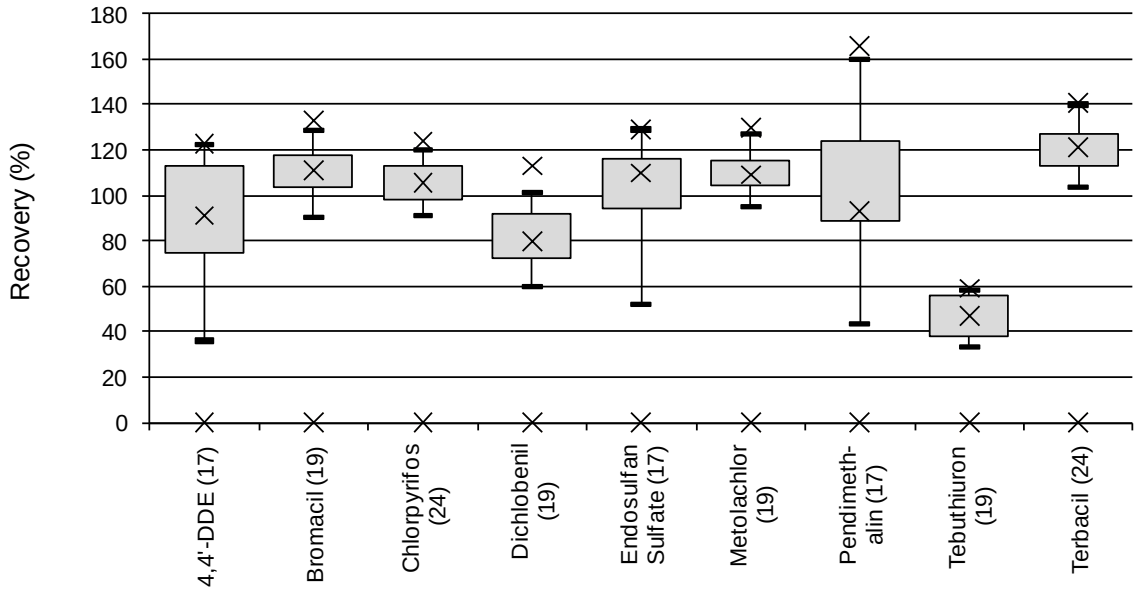

Figure C-5. Laboratory control sample recoveries (%) for selected pesticides by GCMS.[1,2]

[1]Boxes show 25th and 75th percentiles, whiskers show 5th and 95th percentiles, and 'X' indicates the minimum, median, and maximum values.

[2]GCMS = Gas chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8270M.

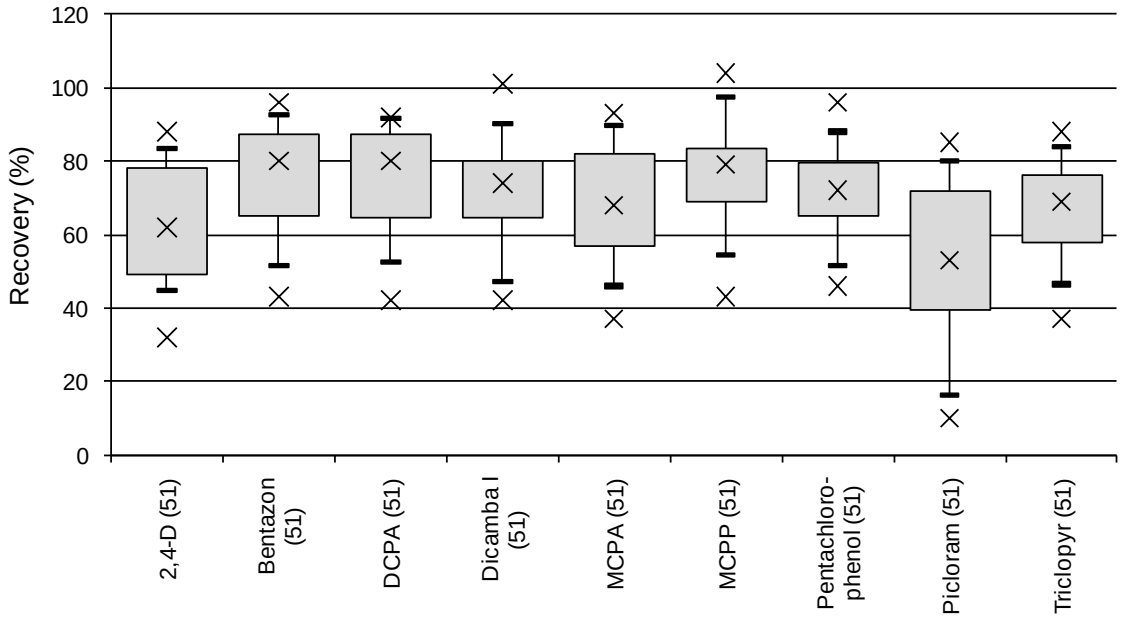

Figure C-6. Laboratory control sample recoveries (%) for selected herbicides by GCMS-H.[1,2]

[1]Boxes show 25th and 75th percentiles, whiskers show 5th and 95th percentiles, and 'X' indicates the minimum, median, and maximum values.

[2]GCMS-H = Derivitizable acid herbicides by GCMS, EPA method (modified) SW 846 3535M/8270M.

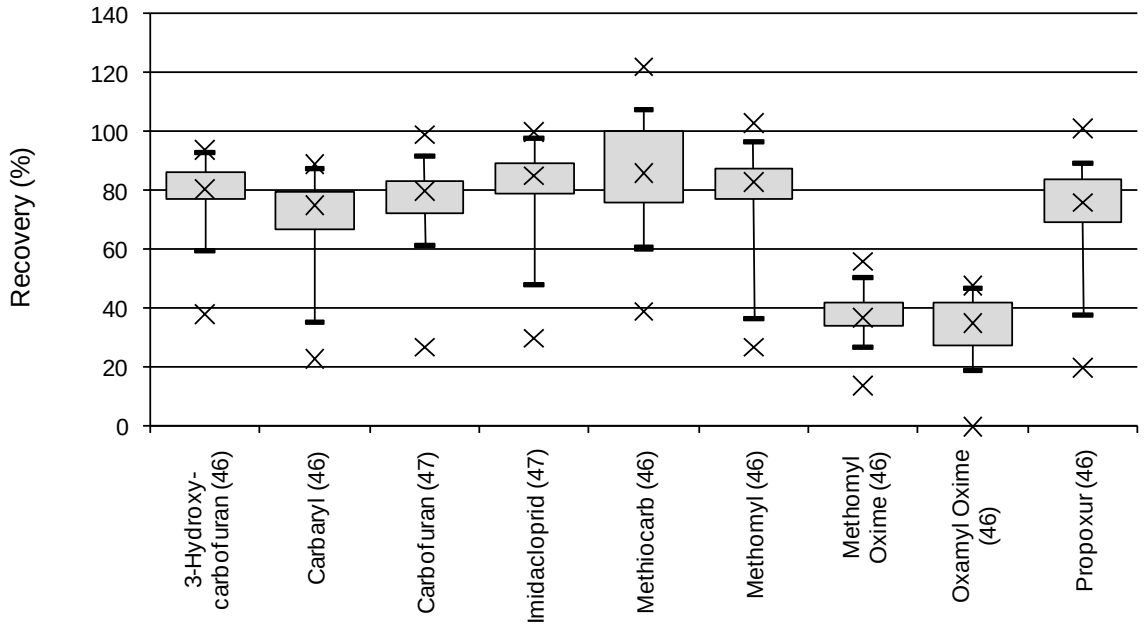

Figure C-7. Laboratory control sample recoveries (%) for selected pesticides by LCMS. [1,2]

[1]Boxes show 25th and 75th percentiles, whiskers show 5th and 95th percentiles, and 'X' indicates the minimum, median, and maximum values.

[2]LCMS = Liquid chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8321AM.

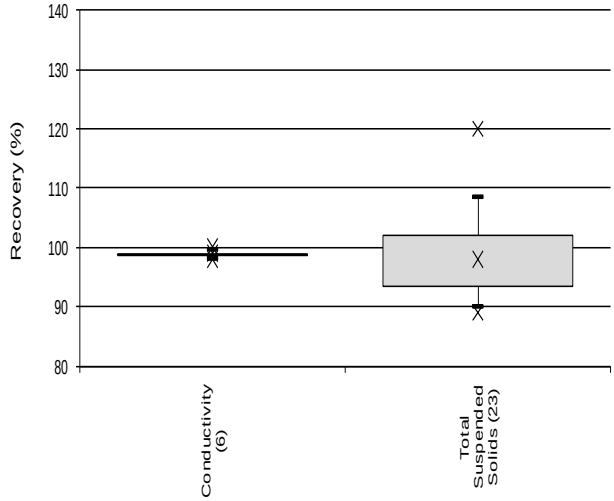

Figure C-8. Laboratory control sample recoveries (%) for conventional parameters. [1]

[1]Boxes show 25th and 75th percentiles, whiskers show 5th and 95th percentiles, and 'X' indicates the minimum, median, and maximum values.

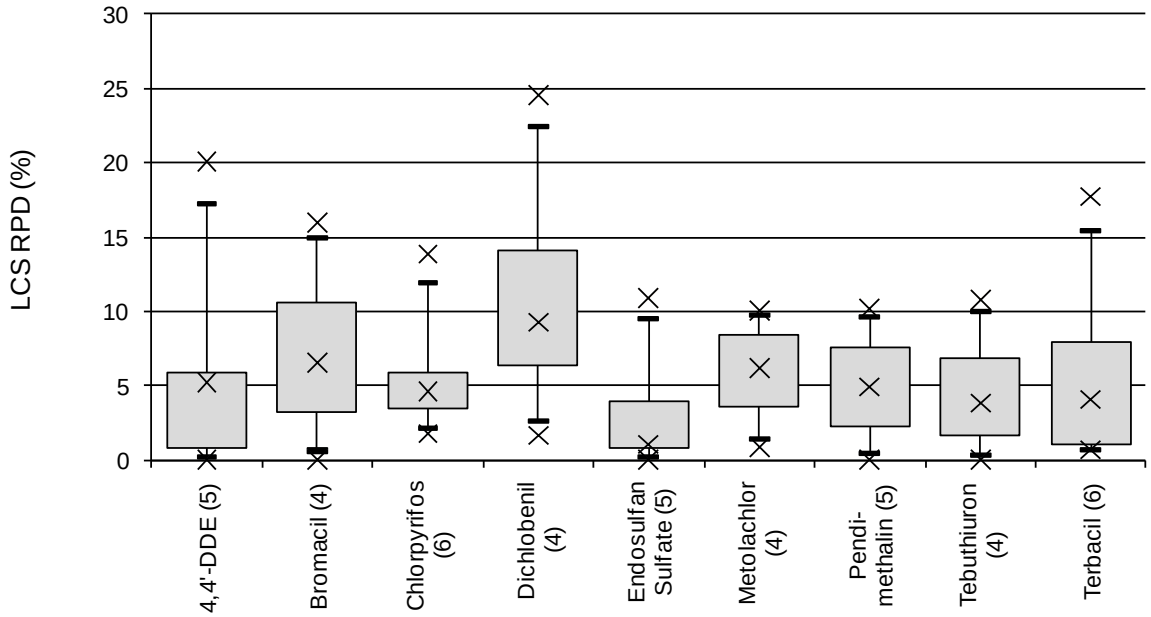

Figure C-9. Paired LCS relative percent differences (%) for pesticides by GCMS. [1,2]

[1]Boxes show 25th and 75th percentiles, whiskers show 5th and 95th percentiles, and 'X' indicates the minimum, median, and maximum values.

[2]GCMS = Gas chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8270M.

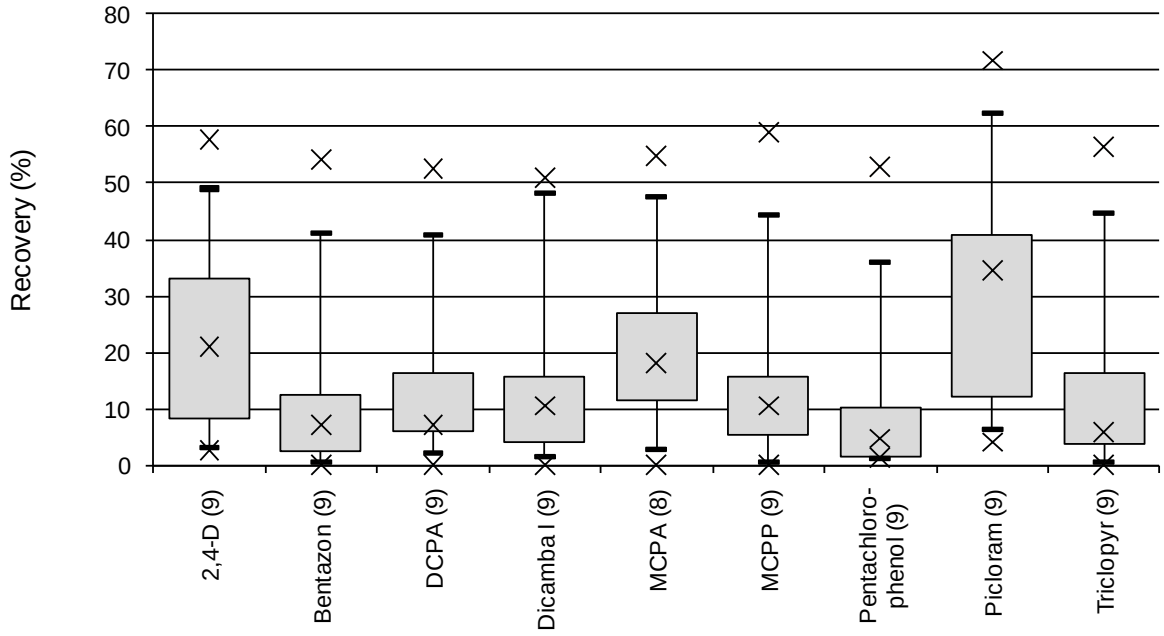

Figure C-10. Paired LCS relative percent differences (%) for pesticides by GCMS-H. [1,2]

[1]Boxes show 25th and 75th percentiles, whiskers show 5th and 95th percentiles, and 'X' indicates the minimum, median, and maximum values.

[2]GCMS-H = Derivitizable acid herbicides by GCMS, EPA method (modified) SW 846 3535M/8270M.

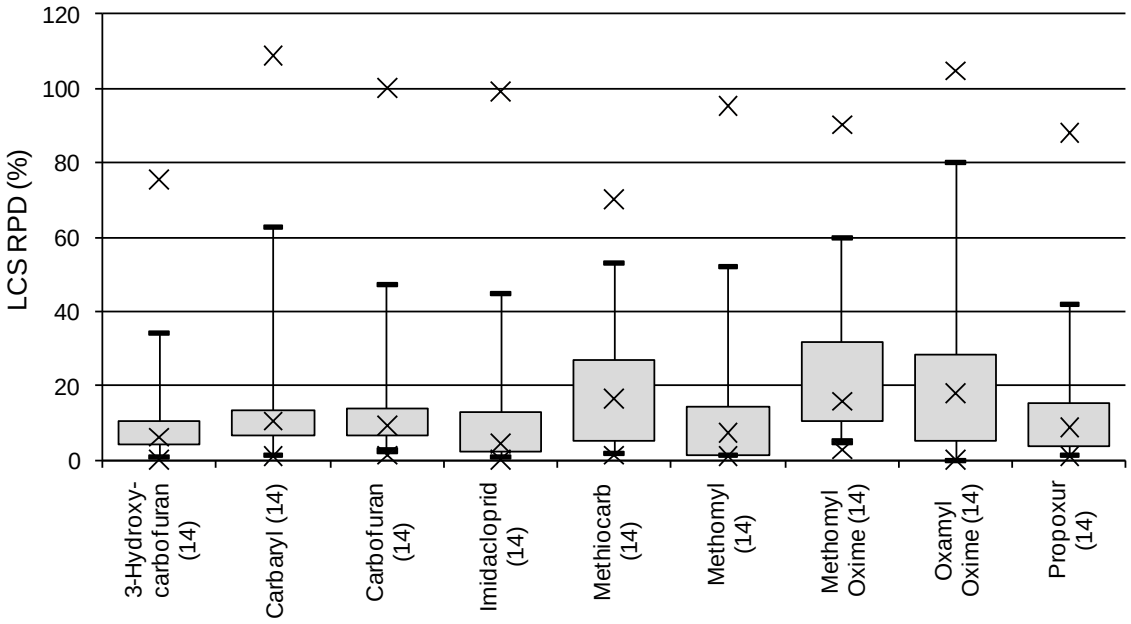

Figure C-11. Paired LCS relative percent differences (%) for pesticides by LCMS. [1,2]

[1]Boxes show 25th and 75th percentiles, whiskers show 5th and 95th percentiles, and 'X' indicates the minimum, median, and maximum values.

[2]LCMS = Liquid chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8321AM.

Field Data Quality

Quality Control Procedures

Prior to the start of the 2009 sampling season, it was identified that numerical field meter quality objectives for conventional parameters were not included in the original QA Project Plan or subsequent addendums. These quality objectives were never identified because when the project started in 2003 conventional parameters were considered ancillary. As the monitoring program evolved over the last six years, conventional parameters became a larger part of understanding the effects of pesticides on salmonids and understanding the fate and transport of pesticides. To ensure the continued use of quality data in future study reports, field meter quality objectives and other QA/QC procedures were documented in Addendum 3 (Sargeant and Anderson, 2009). These are summarized below.

Field meters were calibrated at the beginning of the field day according to manufacturers' specifications, using Ecology standard operating procedures (Swanson, 2007). Meters were post-checked at the end of the field day using known standards. Conventional parameters measured in the field were replicated once per sample day. Dissolved oxygen meter results were compared to Winkler laboratory titration results from grab samples. Two to three Winkler grab samples were obtained during each sample day.

Results for 2009

In 2009 the field meter for the lower Yakima sites and Wenatchee-Entiat sites (eastside sites) met QC objectives including post-checks and Winkler comparisons (Table C-11) except on March 18, 2009. Dissolved oxygen meter readings were biased high that day; meter and Winkler dissolved oxygen %RSD ranged from 11.1% - 13.6% RSD. Only Winkler dissolved oxygen results will be reported for this day.

Table C-11. Quality control results (%RSD) for field meter and Winkler replicates.

Replicate Meter Parameter	Westside		Eastside	
	Average	Maximum	Average	Maximum
Winkler and meter DO	1.5%	7.7%	2.3%	13.7%
Replicate Winkler's for DO	0.6%	2.2%	0.3%	1.3%
Meter DO	1.3%	7.1%	0.8%	5.8%
Meter conductivity	1.3%	17.5%	1.9%	15.6%
Meter pH	0.7%	3.1%	0.7%	2.8%
Meter flow	4.5%	21.5%	4.8%	23.7%

The field meter for the urban sites and the lower Skagit-Samish sites (westside sites) did not meet post-check QC objectives for conductivity for the following dates: March 16 and 25, April 22 and 27, and May 6, 20, and 26, 2009. Conductivity results for these days are rejected and not reported.

Pooled replicate measurements or Winkler results met data quality objectives; all pooled results were less than 10% RSD (C-11). The %RSD for eastside DO meter results were biased high on March 18, 2009; these results were rejected and Winkler results were used for this day.

On July 17, 2009 an Indian Slough (westside meter) conductivity and flow result exceeded data QC objectives. Due to the tidal influence at this site (and Brown's Slough), conductivity and flow results may vary more due to environmental conditions; results are acceptable.

Three replicate flow results and a conductivity result exceeded data QC objectives for the eastside sites. Flow replicates were during low-flow conditions when the RSD statistic produces higher variability. Flow results for these days are acceptable. The June 24, 2009 Mission Creek conductivity result was qualified as an estimate.

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Appendix D. Assessment Criteria and Water Quality Standards

EPA pesticide assessment documents were reviewed to determine the most comparable and up-to- date toxicity guidelines for freshwater (Table D-1) and marine species (Table D-2).

EPA Toxicity Criteria

Rainbow trout are a surrogate for freshwater endangered and threatened species. *Daphnia magna* (invertebrate) and *Selenastrum capricornutum* (green algae also called *pseudokirchneria subcapitata*) represent components of the aquatic food web that may be affected by pesticide use. Alternative species are used only if no data are available for rainbow trout, *Daphnia magna*, or *Selenastrum capricornutum*.

Marine toxicity criteria were evaluated for detections at sites with estuarine influence. These sites were all in the Skagit-Samish watersheds and included lower Big Ditch, Browns Slough, and Indian Slough. Criteria were generated for marine species including (1) sheepshead minnow and tidewater silverside for fish; (2) pink shrimp, Eastern Oyster, Grass Shrimp, *Acartia tonsa* (copepod), and Mysid shrimp for invertebrates; and (3) *Isochrysis galbana*, and *Skeletonema costatum* for aquatic plants.

EPA classifies a laboratory study as 'core' if it meets guidelines appropriate for inclusion in pesticide registration. Usually a core designation may be made if the study is appropriately designed, monitored, and conditions controlled, and duration of exposure is consistent with other studies. Core study criteria are used in the assessment table. Keeping with pesticide review precedent, the most toxic, acceptable criteria from core studies are used.

Water Quality Standards and Assessment Criteria

The most recent versions of Washington State water quality standards and EPA National Recommended Water Quality Criteria (NRWQC) were applied for this report. The NRWQC remained largely unchanged from the 2003 update through 2008.

The toxic standards for Washington State waters also used. These remain essentially unchanged following the 1997 rule and 2003 updates (Washington Administrative Code (WAC), Chapter 173-201A).

Table D-1. Freshwater toxicity and regulatory guideline values. All values reported in ug/L.

Chemical	[1]Freshwater Toxicological and Reregistration Criteria													Freshwater Standards and Criterion			
	Fisheries					Invertebrate				Plant				[2]WAC		[3]NRWQC	
	Acute	Chronic	ESLOC	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	CMC	CCC
1-Naphthol	1400		70	RT	10	700		DM	10	1100		SC	10				
2,4-D (Acids, Salts, Amines)[m]	101000	14200	5050	RT; FM	1	25000	16050	DM	1	3880	1440	ND	1				
2,4-D (BEE Ester)[m]	428		21.4	BS	1	4970	200	DM	1	1020	538	ND	1				
2,4'-DDD																	
2,4'-DDT																	
3-Hydroxycarbofuran	362	5.7	18.1	RT	54; 60	2.23	0.75	CD	54								
	88		4.4	BG	54	29	9.8/27	DM	60								
4,4'-DDD																	
4,4'-DDE														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]
4,4'-DDT														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]
4-Nitrophenol																	
Alachlor	2100	187	105	RT	2	1550	110	DM	2	1.64	0.35	SC	2				
Aldicarb	560	78	28	RT;FM	3	410	20	DM	3								
Aldicarb Sulfone	42000	78	2100	RT;FM	3	280	20	DM	3								
Aldicarb Sulfoxide	7140	78	357	RT-A; FM-C	3	696	20	DM	3								
Atrazine	5300	65	265	RT; BT	4	6900	140	DM	4	49		SC	4				
Azinphos Methyl	2.9	0.23	0.145	RT	5	1.1	0.25	DM	5								0.01
	3.2		0.16	Coho	5												
Bentazon	>100000		>5000	RT	6	>100000		DM	6	4500		SC	6				
Bromacil	36000		1800	RT	7	121000		DM	7	6.8		SC	7				
Bromoxynil	50	18/ 39	2.5	RT-A; FM-C	8	11	2.5/5.9	DM	8	80		SC	8				
Carbaryl	1200		60	RT	9	5.6	1.5	DM	10	1100	370	SC	10				
	2400		120	Chinook	10												
	2400		120	Coho	10												
Carbofuran	362	5.7	18.1	RT	54; 60	2.23	0.75	CD	54								
	88		4.4	BG	54	29	9.8/27	DM	60								
Chlorothalonil	42.3	3	2.12	RT; FM	46	68	39	DM	46	190		SC	46				
Chlorpropham	5700		285	RT	47	3700		DM	47								
Chlorpyrifos	3	0.57	0.15	RT; FM	11; 12	0.1	0.04	DM	11					0.083d	0.041e	0.083	0.041

Continued on next page

Table D-1 (continued). Freshwater toxicity and regulatory guideline values.

Chemical	[1]Freshwater Toxicological and Reregistration Criteria													Freshwater Standards and Criterion			
	Fisheries					Invertebrate				Plant				[2]WAC		[3]NRWQC	
	Acute	Chronic	ESLOC	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	CMC	CCC
cis-Permethrin[n]	2.9;17	0.30/ 0.41	0.145	RT;CS-A FM-C	58	0.039	0.039/ 0.084	DM	58								
	0.79		0.0395	BG	58												
Clopyralid	1968000	N/A	98400	RT	59, 64	113000	N/A	DM	59, 64	6900		SC	59				
Cycloate	4500		225	RT	48	24000		DM	48								
DCPA	6600	N/A	330	RT	56	27000	N/A	DM	56	>12380		SC	56				
Diazinon	90	0.8	4.5	RT; BT	13; 14	0.8	0.17	DM	13	3700		SC	13			0.17	0.17
Dicamba I	28000		1400	RT	15	34600	16400	DM	15	3700	5	SC; AFA	15				
Dichlobenil	4930	330	246.5	RT	16; 17	6200	560	DM	17	1500	160	SC	17				
Dimethoate	6200	430	310	RT	18	3320	40	DM	18								
Diphenamid	97000		4850	RT	59	58000		DM	59								
Disulfoton Sulfone	9200		460	RT	20, 66	35.2	0.14/ 0.27	DM	20, 66								
Diuron	1950	26.4	97.5	RT; FM	21; 22	1400	200	DM	22	2.4		SC	22				
Endosulfan I	0.8	0.1	0.04	RT	23	166	2	DM	23					0.22[b,f]	0.056[c,f]	0.22[i]	0.056[i]
Endosulfan II	0.8	0.1	0.04	RT	23	166	2	DM	23					0.22[b,f]	0.056[c,f]	0.22[i]	0.056[i]
Endosulfan Sulfate	2.2		0.11	ND	23	580		DM	23								
Endrin Aldehyde																	
Eptam	14000		700	ND	24	6500		ND	24	1360		SC	24				
Ethoprop	1020	180	51	RT; FM	25	44	0.8	DM	25								
Fenarimol	2100	430	105	RT	67	6800	113	DM	67		100	SC	67				
Hexachlorobenzene	1000	3.68	50	CH-A; RT-C	59, 26	30	16	DM	26	30		SC	26				
Hexazinone	180000	17000	9000	RT; FM	27; 28	151600	20000	DM	27	7	4	SC	27				
	317000		15850	Chinook	27												
	246000		12300	Coho	27												
	317000		15850	Sockeye	27												
Imidacloprid	>83000	1200/ 2500	4150	RT	61	69	1800/ 3600	CT-A; DM-C	61								
						85200		DM	59								
Linuron	3000	<42	150	RT	49	120		DM	50	67		SC	49				

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Table D-1 (continued). Freshwater toxicity and regulatory guideline values.

Chemical	[1]Freshwater Toxicological and Reregistration Criteria													Freshwater Standards and Criterion			
	Fisheries					Invertebrate				Plant				[2]WAC		[3]NRWQC	
	Acute	Chronic	ESLOC	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	CMC	CCC
Malathion	4.1	21	0.205	RT	30	1	0.06	DM	30								0.1
	170		8.5	Coho	31												
MCPA	1150	916	57.5	RT	32	280	77	DM	32	250	32	SC	32				
MCPP	93000	N/A	4650	RT	65	91000	50800/ 102700	DM	65	14	9	SC	65				
Metalaxyl	132000	9100	6600	RT; FM	51	29000	1270	DM	51	140000		SC	51				
Methiocarb	436		21.8	RT	C	19		DM	C								
Methomyl	860	57/ 117	43	RT-A; FM-C	57	5	>0.4	DM	57								
Methomyl Oxime																	
Metolachlor	3900	780	195	ND	33	25100		DM	33								
Metribuzin	77000		3850	RT	52	4200	1290	DM	52	11.9	8.9	NP	51				
Napropamide	6400	1100	320	RT	53	14300	1100	DM	53	3400		SC					
Norflurazon	8100	770/ 1500	405	RT	34	15000	1000/ 2600	DM	34	9.7	3.2	SC	34-A 59-C				
Oryzalin	3260		163	RT	D	1400		DM	D								
Oxamyl	4200	770/ 1500	210	RT	62	180	1000/ 4200	CP-A; DM-C	62	120	4.6	SC	62				
Oxamyl Oxime																	
Oxyfluorfen	250	38/74	12.5	RT-A; FM-C	35, 36	80	13/28	DM	35, 36	0.29	0.1	SC	35, 36				
Pendimethalin	138	6.3	6.9	RT; FM	37	280	14.5	DM	37	5.4	3	SC	37				
Pentachlorophenol	15	11	0.75	RT	38	450	240	DM	38	50		SC	38	8.2 to 41.0[d,g]	5.2-25.9[e,h]	7.9-107.6[j]	6.1-82.6[k]
Picloram	5500	N/A	275	RT	53	34400	N/A	DM	53								
Promecarb																	
Prometon	12000	9500	600	RT-A; FM-C	68	25700	3500/ 6800	DM	68	98	32	SC	68				
Propargite	118	16	5.9	RT; FM	40	74	9	DM	40	66.2	5	SC	40				
Propoxur	3700		185	RT	63	11		DM	63								
Simazine	70500	1200	3525	RT; FM	41	1100		DM	41	100		SC	41				

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Table D-1 (continued). Freshwater toxicity and regulatory guideline values.

Chemical	[1]Freshwater Toxicological and Reregistration Criteria													Freshwater Standards and Criterion			
	Fisheries					Invertebrate				Plant				[2]WAC		[3]NRWQC	
	Acute	Chronic	ESLOC	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	CMC	CCC
Tebuthiuron	143000	9300	7150	RT; FM	42	297000	21800	DM	42	50	13	SC	42				
Terbacil	46200		2310	RT	43	65000		DM	43	18	4	SC	43				
Triadimefon	4100	41/ 116	205	RT	55	1600	52/119	DM	55	100/1710		SC	55				
Triclopyr	650		32.5	RT	44	12000		DM	44	2300	2	SC; NP	44				
Trifluralin	41	1.14	2.05	RT	45	560	2.4	DM	45	7.52	5.37	SC	45				

*Values are not analytically qualified. Non-asterisk values have been J-qualified as estimates, normally below the practical quantitation limit.
[1]Criteria identified in EPA reregistration and review documents or peer reviewed literature. References listed separately.
Time component of standards are explained in body of report.
ESLOC refers to Endangered Species Level of Concern.
Species abbreviated in table: RT-Rainbow Trout, CS-Coho Salmon, CH-Chinook salmon, FM- Fathead Minnow, BT-Brook Trout, BS-Bluegill Sunfish, ND-Not Described, DM-Daphnia magna, CD-Ceriodaphnia dubia, SC-Selenastrum capricornutum (aka; Pseudokirchneria subcapitata), Anabaena flos-aquae, and Navicula pelliculosa, SM-sheepshead Minnow, CT-Chironomus tentans (midge).
[2]WAC: Promulgated standards according to Chapter 173-201A WAC.
[3]EPA National Recommended Water Quality Criteria (EPA-822-R-02-047).
CMC: Criteria Maximum Concentration; estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect.
CCC: Criteria Continuous Concentration; estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.
a -Criteria applies to DDT and its metabolites (ΣDDT).
b-An instantaneous concentration not to be exceeded at any time.
c-A 24-hour average not to be exceeded.
d-A 1-hour average concentration not to be exceeded more than once every three years on average.
e-A 4-day average concentration not to be exceeded more than once every three years on average.
f-Chemical form of endosulfan is not defined in WAC 173-201A. Endosulfan sulfate may be applied in this instance.
g≤ e[1.005(pH)-4.830], pH range of 6.9 to 9.5 shown.
h≤ e[1.005(pH)-5.29], pH range of 6.9 to 9.5 shown.
i-Value refers to ∑α and β-endosulfan.
j≤ e[1.005(pH)-4.869], pH range of 6.9 to 9.5 shown.
k≤ e[1.005(pH)-5.134], pH range of 6.9 to 9.5 shown.
m-There are many forms of 2,4-D that include acids, salts, amines, and esters all of which have unique toxicity values. The criteria presented are in acid equivalents and are intended to provide a range of possible effects. Toxicity values for each form of 2,4-D are available in the referenced document.
n-Assessment criteria for permethrin are based on a formulation of cis and trans-permethrin isomers. Manchester Laboratory analysis includes only the cis-permethrin isomer, the more toxic of the two; and cis-permethrin concentrations are compared to the assessment criteria for permethrin.

Table D-2. Marine toxicity and regulatory guideline values for three estuarine sites. All values are reported in ug/L

Chemical	EPA Marine Toxicological and Registration Criteria													Marine Standards and Criterion			
	Fisheries					Invertebrate				Plant				[2]WAC		[3]NRWQC	
	Acute	Chronic	ESLOC	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	CMC	CCC
1-Naphthol	1200		60	SM	10	2100		EO	10								
2,4-D (Acids, Salts, Amines) [m]	>80,000 (175,000 definitive)	no data	4000	TS	1	57000	no data	EO	1								
2,4-D (BEE Ester)[m]	no data	555		SM	1	1800	no data	EO	1								
2,4'-DDD																	
2,4'-DDT																	
3-Hydroxycarbofuran	33	2.6	1.65	AS; SM	60	4.6	0.4	PS; MS	60								
4,4'-DDD																	
4,4'-DDE														0.13[a]	0.001[b]		
4,4'-DDT														0.13[a]	0.001[b]		
4-Nitrophenol																	
Alachlor																	
Aldicarb																	
Aldicarb Sulfone																	
Aldicarb Sulfoxide																	
Atrazine	2000	2542	100	SM	4	94	80	AT; M	4	22		IG	4				
Azinphos Methyl																	
Bentazon	136		6.8	SM	6	>132.5; >109		PS; EO	6								
Bromacil	162		8.1	SM		12.9; 130		M; EO	7								
Bromoxynil																	
Carbaryl	2600		130	SM	10	32; >2		PS; EO	10								
Carbofuran	33	2.6	1.65	AS; SM	60	4.6	0.4	PS; MS	60								
Chlorothalonil	32		1.6	SM	46	154; 3.6	1.2	PS; EO; M	46								
Chlorpropham																	
Chlorpyrifos	270	0.38	13.5	SM; TS	11	2.4	<0.0046	PS; M	11					0.011[c]	0.0056[d]	0.011[G]	0.0056[G]
cis-Permethrin[n]	2.2	0.83	0.11	AS; SM	58	0.019	0.011	M	58								
Clopyralid																	
Cycloate																	

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Table D-2 (continued). Marine toxicity and regulatory guideline values for three estuarine sites.

Chemical	EPA Marine Toxicological and Registration Criteria													Marine Standards and Criterion			
	Fisheries					Invertebrate				Plant				[2]WAC		[3]NRWQC	
	Acute	Chronic	ESLOC	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	CMC	CCC
DCPA	>1000		50	SM	56	620		EO	56	>11000		SkC	56				
Diazinon						4.2	0.23	M	13							0.82	0.82
Dicamba I	>180000		>9000	SM	15												
Dichlobenil	14000		700	SM	16	>1000; 2500		PS; EO	16								
Dimethoate																	
Diphenamid																	
Disulfoton Sulfone																	
Diuron	6700		335	SM	22		270	M	22								
Endosulfan I														0.034[a]	0.0087[b]	0.034[a]	0.0087[b]
Endosulfan II														0.034[a]	0.0087[b]	0.034[a]	0.0087[b]
Endosulfan Sulfate																	
Endrin Aldehyde																	
Eptam																	
Ethoprop																	
Fenarimol																	
Hexachlorobenzene																	
Hexazinone																	
Imidacloprid	163000		8150	SM	61	37	>0.6/1.3	MS	61								
Linuron	890		44.5	SM	49	4500; 890		M; EO									
Malathion																	
MCPA	>4100	4100	>205	SM	32	150000	115000	EO	32	300	15	SkC	32				
MCPP																	
Metalaxyl						25700; 4600		M; EO	51								
Methiocarb																	
Methomyl	1160		58	SM	57	>140000; 230		EO; M	57								
Methomyl Oxime																	
Metolachlor	7900	1000	395	ND	33												

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Table D-2 (continued). Marine toxicity and regulatory guideline values for three estuarine sites.

Chemical	EPA Marine Toxicological and Registration Criteria													Marine Standards and Criterion			
	Fisheries					Invertebrate				Plant				[2]WAC		[3]NRWQC	
	Acute	Chronic	ESLOC	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	Spp.	Ref	Acute	Chronic	CMC	CCC
Metribuzin	85000		4250	SM	52	48300; 49800		M; EO	52	8.7	5.8	SkC	52				
Napropamide	14000		700	SM	53	4200; 1400		M; EO									
Norflurazon																	
Oryzalin																	
Oxamyl	2600		130	SM	62	0.4		EO	62								
Oxamyl Oxime																	
Oxyfluorfen																	
Pendimethalin																	
Pentachlorophenol	240		12	SM	38	48		PO	38	27		SkC	38	13.0[c]	7.9[d]		
Picloram																	
Promecarb																	
Prometon	47300		2365	SM	68	18000		MS	68								
Propargite																	
Propoxur																	
Simazine	>4300		215	SM	41	113000; >3700		PS; EO	41	600		SkC	41				
Tebuthiuron						62000		PS	42	31		SkC	42				
Terbacil																	
Triadimefon																	
Triclopyr	450		22.5	TS	44	2470		GS	44	1170	209	SkC	44				
Trifluralin	190		9.5	SM	45	638.5		GS	45	28		SkC	45				

*Values are not analytically qualified. Non-asterisk values have been J-qualified as estimates, normally below the practical quantitation limit.
[1]Criteria identified in EPA reregistration and review documents or peer reviewed literature. References listed separately.
Time component of standards are explained in body of report.
ESLOC refers to Endangered Species Level of Concern
Species abbreviated in table: ND-Not determined, AS-Atlantic silverside, IS-Inland silverside, TS-Tidewater silverside, PS-Pink Shrimp, EO-Eastern Oyster, AT-Acartia tonsa (copepod), M-Mysid, IG-Isochrysis galbana, LG-Lemna gibba, CT-Chironomus tentans (midge), GS - Grass Shrimp, SkC - Skeletonema costatum, PO-Pacific Oyster
[2]WAC: Promulgated standards according to Chapter 173-201A WAC.
[3]EPA National Recommended Water Quality Criteria (EPA-822-R-02-047).
CMC: Criteria Maximum Concentration; estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect.

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CCC: Criteria Continuous Concentration; estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.

a-Criteria applies to DDT and its metabolites (ΣDDT).

b-An instantaneous concentration not to be exceeded at any time.

c-A 24-hour average not to be exceeded.

d-A 1-hour average concentration not to be exceeded more than once every three years on average.

e-A 4-day average concentration not to be exceeded more than once every three years on average.

f-Chemical form of endosulfan is not defined in WAC 173-201A. Endosulfan sulfate may be applied in this instance.

g≤ e[1.005(pH)-4.830], pH range of 6.9 to 9.5 shown.

h≤ e[1.005(pH)-5.29], pH range of 6.9 to 9.5 shown.

i-Value refers to ∑α and β-endosulfan.

j≤ e[1.005(pH)-4.869], pH range of 6.9 to 9.5 shown.

k≤ e[1.005(pH)-5.134], pH range of 6.9 to 9.5 shown.

m-There are many forms of 2,4-D that include acids, salts, amines, and esters all of which have unique toxicity values. The criteria presented are in acid equivalents and are intended to provide a range of possible effects. Toxicity values for each form of 2,4-D are available in the referenced document.

n-Assessment criteria for permethrin are based on a formulation of cis- and trans-permethrin isomers. Manchester Laboratory analysis includes only the cis-permethrin isomer, the more toxic of the two; and cis-permethrin concentrations are compared to the assessment criteria for permethrin.

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[56] Reregistration Eligibility Decision for DCPA (Dacthal) (RED). 11-1998. www.epa.gov/oppsrrd1/REDs/0270red.pdf and DCPA Reregistration science chapter at Docket #EPA-HQ-OPP-2009-0081-0002 at www.regulations.gov/

[57] Methomyl EFED at Docket #EPA-HQ-OPP-2009-0081-0027 at www.regulations.gov and www.epa.gov/oppfead1/endanger/litstatus/effects/redleg-frog/index.html and Reregistration Eligibility Decision for Methomyl (RED). 12-1998. www.epa.gov/oppsrrd1/REDs/0028red.pdf, Docket# EPA-HQ-OAR-2005-0161-0364 at www.regulations.gov

[58] Permethrin EFED at Docket #EPA-HQ-OPP-2004-0385-0069 at www.regulations.gov and www.epa.gov/oppfead1/endanger/litstatus/effects/redleg-frog/index.html and Reregistration Eligibility Decision for Permethrin (RED). 4-2006. www.epa.gov/oppsrrd1/REDs/permethrin_red.pdf

[59] EPA's ECOTOX database at www.ipmcenters.org/Ecotox/DataAccess.cfm and http://cfpub.epa.gov/ecotox/.

[60] Carbofuran at Docket #EPA-HQ-OPP-2007-1088-0003 and Docket #EPA-HQ-OPP-2005-0162-0080 (both are identical) at www.regulations.gov/

[61] Imidacloprid at Docket #EPA-HQ-OPP-2008-0844-0003 www.regulations.gov/

[62] Oxamyl Ecological Risk Assessment at Docket #EPA-HQ-OPP-2009-0081-0009 www.regulations.gov

[63] Propoxur RED at www.epa.gov/oppsrrd1/REDs/2555red.pdf, Docket #EPA-HQ-OPP-2009-0081-0086 at www.regulations.gov/

[64] Clopyralid RED at Docket #EPA-HQ-OPP-2009-0081-0051 at www.regulations.gov/

[65] MCPP RED at www.epa.gov/oppsrrd1/REDs/mcpp_red.pdf and Docket #EPA-HQ-OPP-2006-0943-0013 at www.regulations.gov

[66] Disulfoton RED at Docket #EPA-HQ-OPP-2009-0081-0091 at www.regulations.gov.

[67] Fenarimol EFED at Docket #EPA-HQ-OPP-2006-0241-0012 at www.regulations.gov.

[68] Prometon EFED at Docket #EPA-HQ-OPP-2009-0081-0070 at www.regulations.gov. Prometon RED at www.epa.gov/pesticides/reregistration/REDs/prometon-red.pdf .

Appendix E. Pesticide Calendars

To determine if water quality concentrations were healthy for aquatic life, monitoring data were compared to EPA pesticide registration toxicity criteria and EPA National Recommended Water Quality Criteria (NRWQC), referred to as *assessment criteria* in this report. Data were also compared to numeric Washington State water quality standards, referred to as *water quality standards*. Refer to Appendix D, *Assessment Criteria and Water Quality Standards*, in this report for information on assessment criteria development.

Table E-1 presents the color codes used to compare detected pesticide concentrations to assessment criteria.

Table E-1. Color codes for comparison to assessment criteria in the pesticide calendars.

	Each square represents the period when a sample was taken. If blank, then no pesticide residue detected.
	Analysis not completed.
	Pesticide residue detected. Assessment criteria not available.
	Detection of pesticide residue, concentration below regulatory or toxicological endpoint.
	Magnitude of detection above an EPA[1] acute or chronic invertebrate registration endpoint.
	Magnitude of detection above a WAC[2] or NRWQC[3] acute or chronic regulatory endpoint.
	Magnitude of detection above the ESLOC[4] for fish, which is 1/20th of the acute toxicity endpoint.

[1] EPA = United States Environmental Protection Agency
[2] WAC = Washington Administrative Code
[3] NRWQC = EPA's National Recommended Water Quality Criteria
[4] ESLOC = Endangered Species Level of Concern

Detection of a pesticide concentration above an assessment criteria does not indicate exceedance of (not meeting) the regulatory criteria. The temporal component of the criteria must also be exceeded. The Washington State Department of Agriculture (WSDA) advises pesticide user groups and other stakeholders on the results of this study and determines if assessment criteria are exceeded. If an exceedance is determined, WSDA advises stakeholders of appropriate measures to reduce pesticide concentrations.

For additional information on pesticide assessment criteria, contact the Washington State Department of Agriculture, Natural Resources Assessment Section, toll free at (877) 301-4555, #6 or (360) 902-2067, or e-mail: nras@agr.wa.gov. Their web site is http://agr.wa.gov/PestFert/natresources/SWM/.

Cedar-Sammamish Basin

Thornton Creek

A total of 19 pesticides and degradates were detected in Thornton Creek in 2009 (Table E-2).

No detections were above assessment criteria or water quality standards.

Table E-2. Thornton Creek 2009.

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4,6-Trichlorophenol	D-M								0.510																			
2,4-D	H									0.110	0.037	0.130	0.019									0.020						0.040
3-Hydroxycarbofuran	D-C									0.054		0.076																
4-Nitrophenol	D-M			0.120																								
Carbaryl	I-C					0.025																						
Carbofuran	I-C					0.031																						
Chlorothalonil	F					0.028																						
Dicamba I	H										0.010																	
Dichlobenil	H		0.023	0.046	0.017	0.010	0.025	0.014	0.012	0.053	0.017	0.049	0.015	0.020	0.020	0.011	0.012	0.014	0.037	0.018	0.014	0.027	0.024	0.030	0.028	0.024	0.026	0.051
Diuron	H				0.057																							
MCPP	H			0.041						0.042		0.086																
Methiocarb	I-C	0.099	0.215																									
Methomyl	I-C	0.065																										
Methomyl oxime	D-C											0.079																
Oxamyl oxime	D-C					0.028																						
Pentachlorophenol	WP												0.007													0.015		0.024
Prometon	H							0.075	0.039																			
Propoxur	I-C																0.053											
Triclopyr	H									0.080		0.040																0.044
Total Suspended Solids		3	7	17	5	7	6	6	6	25	4	11	7	10	5	11	4	3	4	4	4	3	3	3	2	3	3	4

D = Degradate, F = Fungicide, H = Herbicide, I = Insecticide, WP = Wood Preservative, C = Carbamate, M = Multiple sources

Green-Duwamish Basin

Longfellow Creek

A total of nine pesticides and degradates were detected in Longfellow Creek in 2009 (Table E-3).

No detections were above assessment criteria or water quality standards.

Table E-3. Longfellow Creek 2009.

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4,6-Trichlorophenol	D-M			0.510																								
2,4-D	H									0.110	0.038	0.085				0.058	0.110							0.042	0.022		0.027	0.035
3,5-Dichlorobenzoic Acid	D-M			0.520																								
Dichlobenil	H		0.046	0.010	0.016	0.013	0.047	0.014	0.014	0.130	0.019	0.025	0.013	0.012	0.011	0.008	0.010	0.009	0.022	0.011	0.011	0.023	0.021	0.021	0.030	0.025	0.030	0.033
MCPA	H											0.025																
MCPP	H									0.051	0.009																	
Methiocarb	I-C	0.117	0.200																									
Pentachlorophenol	WP		0.028							0.037	0.009																	0.020
Triclopyr	H		0.095							0.110	0.024	0.071				0.014	0.098					0.015		0.047	0.048	0.034	0.052	0.074
Total Suspended Solids		13	20	3	3	2	7	3	3	38	2	5	4	5	16	4	3	6	3	18	2	2	2	1		3	2	1

D = Degradate, H = Herbicide, I = Insecticide, WP = Wood Preservative, C = Carbamate, M = Multiple sources

Skagit-Samish Basins

Big Ditch

A total of 27 pesticides and degradates were detected in Big Ditch in 2009. Of these, 18 were found at the upper Big Ditch site (Table E-4). A total of 23 pesticides and degradates were found at the lower Big Ditch site (Table E-5).

At the upper Big Ditch site, one detection of malathion did not meet (exceeded) the Endangered Species Level of Concern (ESLOC) for freshwater fish and the EPA chronic invertebrate assessment criteria in May 2009. No detections were above assessment criteria or water quality standards at the lower Big Ditch site.

The malathion ESLOC is 1/20th of the 50% mortality concentration with a 96-hour exposure time (LC50) for rainbow trout in the lab. A single detection in a weekly sample does not prove or disprove that the 96-hour time component of the ESLOC was exceeded.

The EPA chronic invertebrate criteria for malathion is based on a 21-day No Observable Effects Concentration (NOEC) exposure for *Daphnia magna* (water flea). The single detection of malathion did not exceed the time component of this standard.

Comparison of Upper Big Ditch to Lower Big Ditch

In 2009, the upper and lower sites on Big Ditch were sampled weekly on the same day. During the year, 14 pesticides were detected in common between the two sites: 2,4-D; 3-hydroxycarbofuran; 4-nitrophenol; bromacil; chlorothalonil; dicamba I; dichlobenil; MCPA; MCPP; metalaxyl; methiocarb; metolachlor; pentachlorophenol; and triclopyr.

Four compounds were detected only at the upper site: imidacloprid, malathion, picloram, and tebuthiuron. Nine compounds were detected only at the lower site: atrazine, bentazon, carbaryl, carbofuran, diuron, eptam, ethoprop, metribuzin, and trifluralin.

Table E-4. Lower Big Ditch 2009.

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H						0.210			0.950	1.100	0.370						0.024		0.021					0.045			0.037
3-Hydroxycarbofuran	D-C									0.074																		
4-Nitrophenol	D-M										0.110																	
Atrazine	H							0.076		0.860	0.150																	
Bentazon	H							0.086				0.040																
Bromacil	H		0.047		0.045			0.069	0.071			0.062	0.046	0.025											0.043		0.026	
Carbaryl	I-C						0.024																					
Carbofuran	I-C											0.102																
Chlorothalonil	F																0.014	0.072										
Dicamba I	H									0.125	0.250	0.089	0.012															
Dichlobenil	H		0.018	0.009	0.012	0.010	0.110	0.016	0.013	0.110	0.073	0.032	0.011											0.019	0.022			
Diuron	H				0.140																							
Eptam	H					0.360	0.130	0.200																				
Ethoprop	I-OP									0.160	0.740	0.310																
MCPA	H					0.093	0.190	1.100		0.155		0.060																
MCPP	H	0.029								0.083	0.260	0.052																
Metalaxyl	F																											0.160
Methiocarb	I-C	0.075	0.085																									
Metolachlor	H	0.035	0.054	0.084	0.059	0.160	0.500	0.058	0.085	1.200	0.400	1.900	0.059	0.023	0.018													
Metribuzin	H											0.200																
Pentachlorophenol	WP									0.052	0.036	0.015																
Triclopyr	H						0.097			0.480	0.220	0.140													0.046			0.040
Trifluralin	H			0.019																								
Total Suspended Solids		30	24	35	38	22	19	8	12	11	31	8	5	12	13	4	4	5	10	3	3	2				3	4	2

D = Degradate, F = Fungicide, H = Herbicide, I = Insecticide, WP = Wood Preservative, C = Carbamate, M = Multiple sources, OP = Organophosphate

Table E-5. Upper Big Ditch 2009.

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H			0.270			0.088			0.220	1.200	0.840					0.510			0.023		0.480						
3-Hydroxycarbofuran	D-C																				0.054							
4-Nitrophenol	D-M			0.150																								
Bromacil	H	0.140	0.120		0.100	0.120	0.074	0.120	0.140		0.070	0.170	0.100	0.190	0.180	0.170	0.145	0.220	0.170	0.210	0.190	0.110	0.130	0.088	0.150	0.120	0.120	0.120
Chlorothalonil	F											0.017																
Dicamba l	H		0.022				0.028			0.035	0.380	0.042																
Dichlobenil	H		0.019	0.050	0.013	0.014	0.095	0.025	0.021	0.071	0.067	0.055	0.017	0.016	0.013	0.010	0.011	0.010		0.020	0.015	0.027	0.037	0.028	0.026	0.022	0.028	
Imidacloprid	I-N								0.107	0.082	0.026		0.029	1.740	0.091	0.025		0.026	0.071		0.025			0.057				
Malathion	I-OP											0.940																
MCPA	H									0.077	0.092																	
MCPP	H	0.110	0.150	0.210						0.051	0.200	0.120																
Metalaxyl	F								0.330		0.051			0.075					1.300				0.075	0.096				
Methiocarb	I-C	0.095	0.110																									
Metolachlor	H											0.021																
Pentachlorophenol	WP											0.018									0.009	0.027						0.021
Picloram	H	0.120				0.057			0.220				0.087	0.060	0.130	0.180	0.210	0.210	0.087	0.067	0.063		0.150	0.065	0.040		0.035	
Tebuthiuron	H		0.031			0.023		0.032	0.044					0.030			0.029	0.036	0.044	0.039	0.035				0.037	0.032		
Triclopyr	H						0.043			0.160	0.210	0.260					0.350			0.021		0.360						0.051
Total Suspended Solids		10	6	118	7	4	14	5	3	17	15	59	6	9	11	9	7	13	8	14	19	11	10	37	3	8	6	28

D = Degradate, F = Fungicide, H = Herbicide, I = Insecticide, WP = Wood Preservative, C = Carbamate, M = Multiple sources, N = Neonicotinoid, OP = Organophosphate

Indian Slough

A total of 21 pesticides and degradates were detected in Indian Slough in 2009 (Table E-6).

One detection of malathion at Indian Slough exceeded the ESLOC for freshwater fish and the EPA chronic invertebrate assessment criteria in March 2009. The malathion ESLOC is 1/20th of the LC50 for rainbow trout in the lab. A single detection in a weekly sample does not prove or disprove the 96-hour time component of the ESLOC was exceeded.

The EPA chronic invertebrate assessment criteria for malathion is based on a 21-day exposure for *Daphnia magna* (water flea). The single detection of malathion did not exceed the time component of this criterion.

Table E-6. Indian Slough 2009.

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H						0.092		0.065	0.130	1.100	0.240						0.210		0.050			0.056		0.085			
4-Nitrophenol	D-M																			0.026								
Atrazine	H							0.200	0.080	0.049	0.058	0.039																
Bentazon	H													0.023				0.033	0.025	0.023	0.021		0.017					
Bromacil	H	0.055	0.060	0.059	0.055	0.044	0.086	0.048	0.067	0.044	0.097	0.110	0.041	0.033		0.037		0.084		0.052		0.028			0.060		0.022	
Carbofuran	I-C						0.021																					
Diazinon	I-OP										0.019				0.017											0.034		
Dicamba I	H																			0.010								
Dichlobenil	H		0.027	0.037	0.015	0.013	0.490	0.019	0.013	0.020	0.085	0.110	0.012	0.009	0.011		0.006			0.013	0.009				0.031			
Diphenamid	H	0.020						0.021						0.017	0.018	0.018	0.017	0.030	0.012	0.034	0.032		0.020	0.016	0.013	0.018	0.015	0.020
Hexazinone	H						0.500				0.210	0.240	0.071	0.070	0.064	0.068	0.051	0.065		0.063	0.057				0.065			
Imidacloprid	I-N		0.024								0.023																	
Malathion	I-OP			0.900																								
MCPA	H								0.093	0.091		0.035																
MCPP	H						0.031																					
Metalaxyl	F																						0.036					
Methomyl	I-C	0.074																										
Metolachlor	H												0.170	0.022					0.037	0.051	0.029				0.037			
Pentachlorophenol	WP			0.018							0.018																	
Tebuthiuron	H			0.040	0.036	0.046		0.059	0.071	0.037			0.039	0.039	0.037	0.033	0.035	0.051	0.052	0.044	0.044	0.038	0.036		0.049			0.058
Triclopyr	H									0.059	0.710	0.230						0.120		0.014			0.028	0.020	0.160			
Total Suspended Solids		23	15	13	12	9	15	9	12	9	16	9	9	6	6	2	4	5	4	5	5	3		2	4	11	3	3

D = Degradate, F = Fungicide, H = Herbicide, I = Insecticide, WP = Wood Preservative, C = Carbamate, M = Multiple sources, N = Neonicotinoid, OP = Organophosphate

Browns Slough

A total of 12 pesticides and degradates were detected in Browns Slough in 2009 (Table E-7). No detections were above assessment criteria or water quality standards.

Table E-7. Browns Slough 2009 – Freshwater and Marine Criteria.

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H							0.061		0.140	0.056				0.051													
Bentazon	H														0.100													
Carbofuran	I-C										0.026																	
DCPA	H	0.520	0.420	0.049	0.900	0.910	0.150	0.360	0.080	0.072		0.120	0.025				0.015			0.025								
Dicamba I	H									0.040					0.018													
Dichlobenil	H					0.005	0.010			0.011			0.007		0.007													
Eptam	H								0.840	0.086																		
Metolachlor	H						0.400	0.075	0.130	0.090	0.048	0.036			0.018													
Metribuzin	H												0.030	0.049														
Pentachlorophenol	WP										0.130																	
Simazine	H	0.046	0.085		0.043	0.022	0.034				0.025	0.026																
Triclopyr	H										0.038																	
Total Suspended Solids		9	14	9	9	9	15	13	11	7	7	5	8	4	7	4	8	9	9	8	18	8	8	13	5	5	7	7

H = Herbicide, I = Insecticide, WP = Wood Preservative, C = Carbamate

Samish River

A total of eight pesticides were detected in the Samish River in 2009 (Table E-8). No detections were above assessment criteria or water quality standards.

Table E-8. Samish River 2009.

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H									0.068	0.125										0.021							
Dicamba l	H									0.014	0.016																	
Dichlobenil	H		0.010	0.005			0.010			0.010	0.013		0.007															
Hexazinone	H										0.071																	
MCPA	H										0.085					0.019												
Metolachlor	H			0.015							0.020					0.012												
Pentachlorophenol	WP																											0.015
Triclopyr	H									0.038	0.059																	
Total Suspended Solids		8	13	18	8	20	60	14	9	20	89	16	12	6	8	7	3	3	2	3	4	4	5	2	4	4	8	4

H = Herbicide, WP = Wood Preservative

Lower Yakima Basin

Spring Creek

A total of 19 pesticides and degradates were detected in Spring Creek in 2009. Of these, 15 were detected at the upper Spring Creek site (Table E-9) and 18 were detected in the lower Spring Creek site (Table E-10).

At the upper Spring Creek site, one April sample of 4,4'-DDE was above the chronic water quality standard and NRWQC for fish. A single detection does not prove or disprove the 24-hour time component of this chronic criterion was exceeded.

At the lower Spring Creek site three consecutive detections of chlorpyrifos from March to April were above the chronic water quality standard and NRWQC for fish, and EPA chronic invertebrate criteria. Consecutive detections in three weeks show the 4-day time component of the chlorpyrifos water quality standard and NRWQC were exceeded. In addition, the chronic invertebrate 21-day exposure criterion was also likely exceeded.

Comparison of Upper Spring Creek to Lower Spring Creek

In 2009, the upper and Spring Creek site was sampled biweekly and the lower site was sampled weekly. During the year, 14 chemicals were detected in common between the two sites: 2,4-D; atrazine; bentazon; carbaryl; chlorpyrifos; diazinon; dicamba I; dichlobenil; MCPA; norflurazon; oryzalin; pendimethalin; propoxur; and simazine.

One DDT degradate was detected only at the upper site: 4,4'-DDE. Four compounds were detected only at the lower site: bromacil, endosulfan sulfate, imidan, and pentachlorophenol.

Table E-9. Upper Spring Creek 2009.

Month		March		April		May		June		July			August		Sep
Chemical	Type	11	13	15	17	19	21	23	25	27	29	31	33	35	37
2,4-D	H					0.084	0.020				0.079	0.046			0.028
4,4'-DDE	D-OC				0.011										
Atrazine	H	0.023		0.015						0.025		0.024			0.020
Bentazon	H	0.035	0.040				0.025	0.016							0.029
Carbaryl	I-C			0.031											
Chlorpyrifos	I-OP			0.029	0.033										
Diazinon	I-OP								0.069		0.077	0.027			
Dicamba I	H					0.046					0.010				0.017
Dichlobenil	H			0.004	0.013	0.009					0.009				
MCPA	H					0.027									
Norflurazon	H			0.030					0.025		0.066				
Oryzalin	H				0.300	0.150			0.086		0.310				
Pendimethalin	H					0.027	0.022		0.021						
Propoxur	I-C												0.064		
Simazine	H			0.015											
Total Suspended Solids		7	4	8	27	68	19	27	59	25	29	18	12	7	4

D = Degradate, F = Fungicide, H = Herbicide, I = Insecticide, C = Carbamate, OC = Organochlorine, OP = Organophosphate

Table E-10. Lower Spring Creek 2009.

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H									0.110	0.038	0.057	0.021	0.026	0.038	0.038	0.072	0.100	0.055	0.120	0.033	0.061	0.021		0.024	0.024	0.020	0.038
Atrazine	H	0.025	0.027																									
Bentazon	H			0.028																			0.012					
Bromacil	H	0.036	0.041	0.040	0.023	0.019	0.034	0.046	0.043	0.020		0.022								0.055	0.059		0.035		0.039		0.024	
Carbaryl	I-C					0.046																						
Chlorpyrifos	I-OP				0.045	0.076	0.046	0.028	0.024	0.020																		
Diazinon	I-OP																0.013			0.060		0.024						
Dicamba l	H									0.051		0.011								0.009	0.007		0.007		0.011		0.012	0.017
Dichlobenil	H					0.005	0.009	0.012	0.009	0.009	0.009		0.006							0.009								
Endosulfan Sulfate	D-OC		0.022																									
Imidan	I-OP																											0.059
MCPA	H									0.024																	0.030	
Norflurazon	H	0.033	0.060	0.034												0.023				0.062								
Oryzalin	H						0.540			0.120																		
Pendimethalin	H		0.024				0.044	0.046		0.030	0.032	0.032	0.028	0.032		0.021												
Pentachlorophenol	WP										0.008																	
Propoxur	I-C																						0.099					
Simazine	H	0.024	0.045	0.020																								
Total Suspended Solids		5	3	1	14	12	8	9	25	30	50	20	28	19	49	11	5	2	3	17	8	14	5	7	7	8	8	7

D = Degradate, H = Herbicide, I = Insecticide, WP = Wood Preservative, C = Carbamate, OC = Organochlorine, OP = Organophosphate

Marion Drain

A total of 20 pesticides and degradates were detected in Marion Drain in 2009 (Table E-11).

Chlorpyrifos was found above the EPA chronic invertebrate assessment criteria once in 2009. This single event did not exceed the 21-day time component of the chronic invertebrate criteria. In 2009 no other detections were above assessment criteria or water quality standards.

Table E-11. Marion Drain 2009.

Month		March				April				May				June				July					August				September					October			
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
2,4-D	H								0.032	0.079	0.041	0.032	0.020	0.021	0.078	0.029	0.023	0.055	0.048	0.043	0.033		0.032	0.092	0.031	0.028	0.030	0.034							
Atrazine	H																	0.022																
Bentazon	H													0.062	0.064	0.130	0.140	0.110	0.130	0.140	0.260	0.260	0.280	0.180	0.140	0.078	0.069	0.075							
Bromacil	H						0.026	0.028	0.042		0.020																								
Bromoxynil	H								0.065	0.073	0.039	0.030	0.017	0.010	0.008																				
Chlorpropham	H																									0.049									
Chlorpyrifos	I-OP				0.026	0.029	0.040		0.038		0.018			0.020	0.008													0.016	0.015			0.016				
Dicamba I	H								0.020	0.030	0.015	0.014			0.010	0.011	0.009	0.009	0.010	0.010	0.010	0.008	0.011	0.021	0.014	0.012	0.013	0.016							
Disulfoton sulfone	I-OP																										0.034	0.046	0.044		0.031				
Disulfoton sulfoxide	D-OP																						0.035					0.038	0.160		0.032	0.018			
Eptam	H											0.067																							
Ethoprop	I-OP											0.033															0.480	0.610	0.380	0.130	0.088	0.082	0.070		
Imidacloprid	I-N														0.041																				
Malathion	I-OP																		0.029	0.045															
MCPA	H									0.026		0.020	0.009	0.013																					
Metolachlor	H																					0.091	0.120		0.037										
Pendimethalin	H								0.080	0.065	0.053	0.074	0.062	0.061	0.040	0.034	0.023	0.028																	
Simazine	H		0.023																																
Terbacil	H							0.051	0.070	0.590	0.140	0.200	0.115	0.100	0.089	0.110	0.120	0.120	0.069	0.067	0.680	0.290	0.063	0.045	0.033	0.045	0.066	0.260	0.220	0.250	0.360	0.230	0.053		
Trifluralin	H									0.016	0.019	0.024	0.026	0.024	0.022	0.015	0.015	0.017	0.009																
Total Suspended Solids		15	12	12	22	24	40	12	31	19	19	20	25	23	7	7	5	4	3	2	2	3	4	7	24	26	10	8	8	10	14	6	4	13	12

D = Degradate, H = Herbicide, I = Insecticide, C = Carbamate, N = Neonicotinoid, OP = Organophosphate

Sulphur Creek Wasteway

A total of 21 pesticides and degradates were detected in Sulphur Creek Wasteway in 2009 (Table E-12).

The DDT degradate, 4,4'-DDE, was found above the chronic water quality standard and NRWQC in March and April. The chronic water quality standard for DDT and its metabolites are not met (exceeded) when the 24-hour average concentration exceeds the numerical criteria. Because 4,4-DDE was detected in two consecutive weeks, the 24-hour time component of this criterion was exceeded.

Chlorpyrifos had three consecutive detections above the chronic water quality standard, NRWQC, and EPA chronic invertebrate assessment criteria in March and April. One of these detections was also above the ESLOC for fish. The chlorpyrifos chronic water quality standard and NRWQC are exceeded when the 4-day average concentration exceeds the numerical criteria. Because chlorpyrifos was detected in three consecutive weeks, the time component of the chronic water quality standard and NRWQC was exceeded.

The chlorpyrifos ESLOC is $1/20^{th}$ of the LC50 for rainbow trout. A single detection in a weekly sample does not prove or disprove the 96-hour time component of the ESLOC was exceeded.

Table E-12. Sulphur Creek Wasteway 2009

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H							0.032	0.074	0.170	0.041	0.051	0.077	0.028	0.055	0.097	0.230	0.110	0.052	0.062	0.049	0.074	0.050	0.055	0.061	0.071	0.040	0.041
4,4'-DDE	D-OC			0.022	0.021				0.005																			
Atrazine	H																	0.046										
Bentazon	H	0.028	0.037																		0.015		0.012					
Bromacil	H	0.047	0.054	0.021	0.017	0.019	0.038	0.044	0.045		0.027	0.025					0.023	0.067	0.036	0.043			0.024		0.039	0.027	0.021	
Carbaryl	I-C	0.030	0.024				0.026				0.039							0.022										
Chlorpyrifos	I-OP				0.050	0.280	0.046	0.030			0.020																	
DCPA	H	0.019				0.032				0.018			0.005				0.013							0.023	0.030	0.033		
Diazinon	I-OP																			0.031		0.027		0.025				0.087
Dicamba l	H							0.013	0.048	0.072	0.014	0.022	0.009		0.008	0.011	0.008		0.021	0.015	0.011	0.023	0.017	0.019	0.016	0.012		0.021
Dichlobenil	H						0.012	0.009		0.011	0.010		0.007		0.007		0.007	0.007			0.009							
Dimethoate	I-OP										0.120																	
Hexazinone	H							0.110	0.099		0.047																	
MCPA	H									0.032					0.014				0.089			0.012	0.012					
Methiocarb	I-C	0.269																										
Metribuzin	H																0.420											
Norflurazon	H								0.044																			
Pendimethalin	H	0.043					0.039					0.024																
Simazine	H																0.690											
Terbacil	H							0.120				0.039	0.024	0.033					0.039	0.045	0.039							
Trifluralin	H											0.018	0.021	0.022			0.015				0.032							
Total Suspended Solids		18	7	94	83	23	32	41	67	98	36	38	44	66	64	31	47	13	25	16	10	28	22	20	27	11	44	81

D = Degradate, H = Herbicide, I = Insecticide, C = Carbamate, OC = Organochlorine, OP = Organophosphate

Wenatchee and Entiat Basins

Peshastin Creek

A total of 11 pesticides and degradates were detected in Peshastin Creek from 2007-09 (Tables E-13 to E-15).

Endosulfan I was detected above the ESLOC for rainbow trout once in April 2008 and once in April 2009. A single detection of azinphos methyl exceeded the chronic NRWQC in May 2007. No other detected compounds exceeded assessment criteria or water quality standards.

Table E-13. Peshastin Creek 2007.

Month		February			March				April				May					June				July					August				September	
Chemical	Type	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Azinphos Methyl	I-OP																0.024															
Carbaryl	I-C									0.019																						
Methomyl	I-C																													0.023		
Oxamyl	I-C																												0.026			
Oxamyl oxime	D-C																											0.012				
Total Suspended Solids		2	6	2	3	218	25	12	4	13	3	3	5	31	11	12	7	12	3	3	2	2	2	2	2	2		1	2	1	15	

Table E-14. Peshastin Creek 2008.

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Endosulfan I	I-OC					0.130																						
Endosulfan II	I-OC					0.046																						
Total Endosulfan	I-OC					0.176																						
Oxamyl	I-C						0.010																					
Total Suspended Solids		3	1	1	1	1	11	3	4	8	4	44	16	6	3	2	1	5	2	1	2	1	1	1	1			

Table E-15. Peshastin Creek 2009.

Month		March				April				May				June				July					August				Sep
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Endosulfan I	I-OC					0.040	0.013																					
Fipronil Sulfide	D-Pyra									0.015																		
Fipronil Sulfone	D-Pyra									0.016																		
Simazine	H				0.014																							
Simetryn	H																											0.055
Total Suspended Solids		2		3	3	25	14	52	4	5	6	67	13	11	7	4	2	1	2	1								1

D = Degradate, H = Herbicide, I = Insecticide, OC = Organochlorine, Pyra = Pyrazole

Mission Creek

A total of 11 pesticides, a degradate, and a pesticide synergist were detected in Mission Creek from 2007-09 (Tables E-16 to E-18).

One detection of endosulfan I was above the ESLOC for fish in April 2008. No other detections were above assessment criteria or water quality standards.

Table E-16. Mission Creek 2007.

Month		February			March				April				May					June				July				August					September	
Chemical	Type	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Chlorpyrifos	I-OP							0.024																								
Endosulfan I	I-OC								0.017																							
Endosulfan II	I-OC								0.022																							
Total Endosulfan	I-OC								0.039																							
Methiocarb	I-C										0.034				0.015																	
Methomyl	I-C																		0.019													
Norflurazon	H																												0.027	0.041		
Oxamyl oxime	D-C																									0.017					0.018	
Total Suspended Solids		9	42	17	9	685	82	42	16	33	5	4	31	8	7	30	4	4	3	4	4	4	4	9	3	2	1	4	2			3

Table E-17. Mission Creek 2008.

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Carbaryl	I-C												0.014															
Endosulfan I	I-OC					0.047																						
Norflurazon	H																							0.034		0.018	0.018	
Simazine	H																							0.019				
Total Suspended Solids		8	3	2	2	2	42	3	8	17	5	25	32	10	8	5	4	4	5	3	2	2	3	2	2	4	1	1

Table E-18. Mission Creek 2009.

Month		March				April				May				June				July					August				Sep
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
3-Hydroxycarbofuran	D-C																					0.051						
Endosulfan I	I-OC					0.024																						
Piperonyl Butoxide	Sy					0.095																						
Total Suspended Solids		6	3	11	10	73	42	85	13	23	13	71	14	11	16	17	8	6	8	8	5	20	5	5	3	2		41

D = Degradate, I = Insecticide, Sy = Pesticide synergist, C = Carbamate, OC = Organochlorine, OP = Organophosphate

Brender Creek

A total of 28 pesticides and degradates were detected in Brender Creek from 2007-09 (Tables E-19 to E-21).

Endosulfan was detected above the ESLOC for rainbow trout between March and May in six samples in 2007, eight samples in 2008, and four samples in 2009. Each year showed consecutive detections in two or more weeks. The endosulfan ESLOC is $1/20^{th}$ of the LC50 for rainbow trout. Consecutive detections in two or more weeks show the 96-hour time component of the ESLOC criteria for endosulfan was not met (exceeded).

Three detections of chlorpyrifos in March and April of 2007 and 2009 were above the chronic water quality standard, NRWQC; and the EPA acute and chronic assessment criteria for invertebrates. The two 2009 detections were in consecutive weeks. Consecutive weekly chlorpyrifos detections over numerical criteria indicate the 4-day exposure criteria for the chronic water quality standard and NRWQC were exceeded. The 21-day exposure criterion for the EPA chronic criteria was probably not exceeded with only two consecutive weeks of detections. The single detection over the EPA acute invertebrate criteria in week 17 is not enough data to determine if the 48-hour time component of this criterion was exceeded.

DDT was found consistently throughout all three years, except for one week in April 2008 and two weeks in May and June 2009. The weeks where no detections of DDT and DDT breakdown products occurred coincided with some of the lower TSS detections for all years. All DDT and DDT metabolite concentrations were above the chronic water quality standard and NRWQC. The chronic water quality standard is based on a 24-hour average concentration.

Table E-19. Brender Creek 2007.

Month		February			March				April				May					June				July					August				September	
Chemical	Type	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4'-DDD	D-OC								0.018										0.008													
2,4'-DDT	D-OC												0.017		0.011	0.009	0.011		0.015	0.016	0.009											
4,4'-DDD	D-OC		0.025	0.024	0.023	0.020	0.018		0.020		0.016			0.013		0.012		0.009	0.009	0.010			0.011	0.022					0.004			0.012
4,4'-DDE	D-OC		0.046	0.032	0.034	0.036	0.036	0.019	0.034	0.022	0.014	0.024	0.071	0.026	0.027	0.042	0.030	0.019	0.039	0.032	0.029	0.015	0.017	0.026	0.021	0.011	0.003	0.012	0.030		0.017	0.021
4,4'-DDT	I-OC	0.016	0.036	0.027	0.026	0.021	0.019	0.023	0.023		0.024		0.050	0.021	0.019	0.025	0.027	0.017	0.025	0.033	0.027	0.017	0.013	0.020	0.018	0.013		0.025	0.029		0.017	0.018
DDT and metabolites	OC	0.016	0.107	0.083	0.083	0.077	0.073	0.042	0.095	0.022	0.053	0.024	0.138	0.060	0.057	0.088	0.068	0.045	0.096	0.091	0.065	0.032	0.041	0.068	0.039	0.024	0.003	0.037	0.063		0.034	0.051
Azinphos Methyl	I-OP																0.033								0.034			0.525				
Carbaryl	I-C													0.010	0.023	0.040						0.012										
Chlorpyrifos	I-OP							0.110	0.038	0.027	0.030	0.027	0.019	0.015	0.007	0.007																
Diazinon	I-OP									0.021																						
Diuron	H															0.120																
Endosulfan I	I-OC							0.096	0.020		0.096	0.026	0.050	0.019		0.014																
Endosulfan II	I-OC							0.071			0.071	0.030	0.060	0.031	0.015	0.040																
Total Endosulfan	I-OC							0.167	0.020		0.167	0.056	0.110	0.050	0.015	0.054																
Endosulfan Sulfate	D-OC		0.034				0.015	0.043	0.032	0.041	0.073	0.034	0.100	0.043	0.038	0.057	0.032	0.021	0.027	0.024	0.024		0.020									
MCPA	H															0.072																
Methomyl	I-C					0.017																										
Norflurazon	H													0.029	0.027	0.055		0.035	0.031	0.160	0.023			0.140		0.027		0.027				
Oxamyl	I-C																												0.027			
Prometon	H															0.009																
Simazine	H															0.022								0.028								
Triadimefon	F															0.015																
Total Suspended Solids		34	50	30	31	155	67	34	53	15	41	21	76	30	31	81	34	19	51	49	43	84	30	22	59	13	16	25	108		14	19

D = Degradate, F = Fungicide, H = Herbicide, I = Insecticide, C = Carbamate, OC = Organochlorine, OP = Organophosphate

Table E-20. Brender Creek 2008.

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4'-DDD	D-OC															0.015												
2,4'-DDT	D-OC									0.019	0.053																	
4,4'-DDD	D-OC			0.007					0.007		0.015	0.017	0.013	0.011	0.004	0.025	0.020	0.015	0.019	0.006	0.002	0.003	0.005	0.005	0.001	0.001	0.008	0.008
4,4'-DDE	D-OC	0.023					0.019	0.019	0.014	0.023		0.018	0.040	0.030	0.024	0.045	0.030	0.027	0.034	0.010	0.019	0.025	0.018	0.019	0.021	0.036	0.009	0.018
4,4'-DDT	I-OC	0.019	0.021	0.020	0.018		0.021	0.015	0.013	0.025	0.300	0.023	0.026	0.020	0.010	0.027	0.020	0.025	0.022	0.010	0.010	0.012	0.010	0.009	0.008	0.009	0.014	0.016
DDT and metabolites	OC	0.042	0.021	0.027	0.018		0.040	0.034	0.034	0.067	0.368	0.058	0.079	0.061	0.038	0.112	0.070	0.067	0.075	0.026	0.031	0.040	0.032	0.033	0.030	0.046	0.031	0.042
Carbaryl	I-C												0.024															
Chlorpyrifos	I-OP						0.028	0.015	0.009	0.025	0.019																	
Dichlobenil	H												0.008															
Diuron	H														0.220		0.036											
Endosulfan I	I-OC			0.060		0.049	0.046	0.048	0.089																			
Endosulfan II	I-OC			0.058				0.049	0.084	0.120	0.045	0.040	0.036	0.026														
Total Endosulfan	I-OC			0.118		0.049	0.046	0.097	0.173	0.120	0.045	0.040	0.036	0.026														
Endosulfan Sulfate	D-OC		0.016	0.016	0.018	0.032	0.045	0.047	0.110	0.160	0.066	0.066	0.061	0.050	0.026		0.033	0.048	0.037	0.022	0.017		0.029	0.023	0.013	0.011	0.016	0.014
Imidacloprid	I-N						0.060																0.012					
Norflurazon	H						0.110			0.032		0.047			0.250		0.110						0.042	0.029	0.028		0.032	0.023
Oxamyl oxime	D-C						0.140																					
Simazine	H													0.012														
Total Suspended Solids		54	34	23	15	6	49	87	25	40	39	28	47	38	30	50	25	94	26	13	33	33	29	30	31	55	12	28

D = Degradate, H = Herbicide, I = Insecticide, C = Carbamate, N = Neonicotinoid, OC = Organochlorine, OP = Organophosphate

Table E-21. Brender Creek 2009.

Month		March				April				May				June					July				August					Sep
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4'-DDE	D-OC							0.009															0.007					
2,4'-DDT	D-OC																0.012		0.019									
4,4'-DDD	D-OC		0.023	0.023	0.023			0.019		0.014	0.013	0.013					0.012		0.025			0.029	0.029	0.030		0.030		
4,4'-DDE	D-OC	0.024	0.021	0.033	0.029	0.026	0.021	0.016	0.047	0.020	0.006	0.006			0.007	0.013	0.046	0.024	0.043	0.043	0.016	0.004	0.028	0.026	0.019	0.030	0.037	0.026
4,4'-DDT	I-OC	0.030	0.025	0.027	0.035		0.023	0.020	0.037	0.025	0.021	0.019			0.024	0.014	0.024	0.025	0.028	0.036		0.023	0.027	0.029				0.022
DDT and metabolites	OC	0.054	0.069	0.083	0.087	0.026	0.044	0.064	0.084	0.059	0.040	0.038			0.031	0.027	0.094	0.049	0.115	0.079	0.016	0.056	0.091	0.085	0.019	0.060	0.037	0.048
3-Hydroxycarbofuran	D-C																								0.106			
Chlorpyrifos	I-OP					0.034	0.055	0.083	0.034	0.022	0.020																	
Dicamba I	H																										0.012	
Dichlobenil	H	0.010	0.010	0.005			0.009	0.008	0.010	0.010			0.007						0.030		0.009							
Endosulfan I	I-OC					0.100	0.027	0.018	0.058	0.036																		
Endosulfan II	I-OC					0.049	0.023		0.055	0.058	0.030	0.021																
Total Endosulfan	I-OC					0.149	0.050	0.018	0.113	0.094	0.030	0.021																
Endosulfan Sulfate	D-OC		0.022	0.022	0.021	0.048	0.044	0.044	0.098	0.084	0.050	0.043	0.032	0.029	0.028	0.027	0.030	0.029	0.035	0.031		0.034	0.031	0.031				
Imidacloprid	I-N																			0.022								
Methiocarb	I-C														0.033													
Norflurazon	H		0.031										0.028	0.048	0.039	0.032	0.028						0.045					
Piperonyl Butoxide	Sy					0.070																						
Simazine	H													0.096														
Total Suspended Solids		31	12	33	22	11	24	12	75	52	52	19	13	8	16	15	64	19	116	56	15	10	54	85	7	66	47	53

D = Degradate, H = Herbicide, I = Insecticide, Sy = Pesticide synergist, C = Carbamate, N = Neonicotinoid, OC = Organochlorine, OP = Organophosphate

Wenatchee River

A total of eight pesticides were detected in the Wenatchee River in 2009 (Tables E-22 to E-24).

Endosulfan 1 was detected above the ESLOC for rainbow trout, the chronic water quality standard, and the NRWQC once in March 2008 and once April 2009.

The single weekly detections of endosulfan are not enough data to determine if the 96-hour time component of the ESLOC for fish or the 24-hour time component of the chronic water quality standard and NRWQC were exceeded.

Table E-22. Wenatchee River 2007.

Date		2/14	2/21	2/27	3/6	3/13	3/20	3/28	4/3	4/9	4/18	4/25	5/2	5/9	5/16	5/21	5/30	6/6	6/13	6/18	6/27	7/2	7/10	7/17	7/23	7/31	8/7	8/14	8/22	8/28	9/5	9/10
Month			February			March				April				May					June				July						August			September	
Chemical	Type	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Chlorpyrifos	I-OP								0.035																							
Endosulfan I	I-OC								0.014																							
Methomyl	I-C										0.016																					
Oxamyl	I-C																												0.016			
Total Suspended Solids			4	2	2	102	16	10	7	8	3	3	5	18	13	17	12	25	4	4	3	4	4	3	2	3	4	4	1		2	2

Table E-23. Wenatchee River 2008.

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Endosulfan I	I-OC				0.079	0.024																						
Endosulfan II	I-OC			0.025	0.076																							
Total Endosulfan	I-OC			0.025	0.155	0.024																						
Imidacloprid	I-N						0.028																					
Total Suspended Solids		3	2	2	1	2	9	3	6	10	4	46	14	12	9	13	6	17	8	3	3	2	2	3	4	3	1	

Table E-24. Wenatchee River 2009.

Month		March				April				May				June				July					August				Sep	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H																									0.018		
Chlorpyrifos	I-OP						0.038																					
Endosulfan I	I-OC					0.061																						
Pentachlorophenol	WP															0.014												
Total Suspended Solids		2	1	2	2	6	7	46	4	7	4	37	12	13	15	6	5	4	5	3	4	3	2	8	9	2	3	3

H = Herbicide, I = Insecticide, WP = Wood Preservative, C = Carbamate, N = Neonicotinoid, OC = Organochlorine, OP = Organophosphate

Entiat River

A total of six compounds were detected in the Entiat River from 2007 to 2009 (Tables E-25 to E-27). No pesticide detections exceeded assessment criteria or water quality standards.

Table E-25. Entiat River 2007.

Month		February			March				April				May					June				July					August				September	
Chemical	Type	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Carbaryl	I-C													0.016																		
Chlorpyrifos	I-OP								0.034																							
Dichlobenil	H																										0.065					
Total Suspended Solids		4	4	2	2	64	13	7	3	8	3	5	10	41	20	9	11	18	6	5	3	3	4	7	2	14	3	3	3		3	2

Table E-26. Entiat River 2008.

Month		March				April				May				June				July					August				September	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
3-Hydroxycarbofuran	D-C			0.014																								
Total Suspended Solids		3	2	2	1	2	7	3	6	16	5	24	13	8	5	7	4	9	5	3	3	3	3	2	3	2	1	2

Table E-27. Entiat River 2009.

Month		March				April				May				June				July					August				Sep	
Chemical	Type	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Chlorpyrifos	I-OP					0.023																						
Endosulfan I	I-OC					0.024																						
Piperonyl Butoxide	Sy			0.068		0.083	0.100																					
Total Suspended Solids				2		2	3	12	3	4	5	46	19	13	11	5	4	4	3	2	2	3	2	2	2	2	2	2

D = Degradate, H = Herbicide, I = Insecticide, Sy = Pesticide synergist, C = Carbamate, OC = Organochlorine, OP = Organophosphate

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Appendix F. Continuous Temperature Profiles

Temperature measurements were made at 30-minute intervals for the duration of the 2009 calendar year.

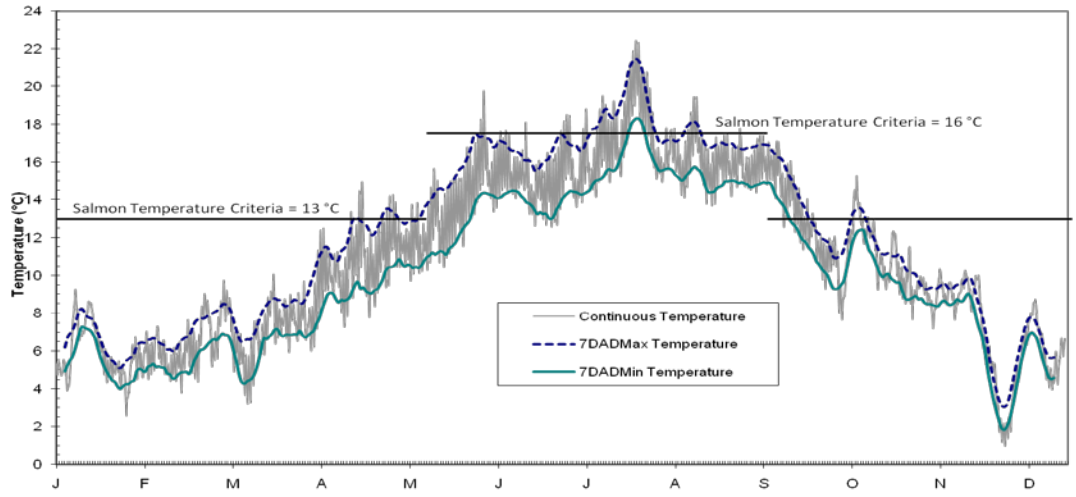

Figure F-1. 2009 continuous temperature profile for the mainstem of Thornton Creek.

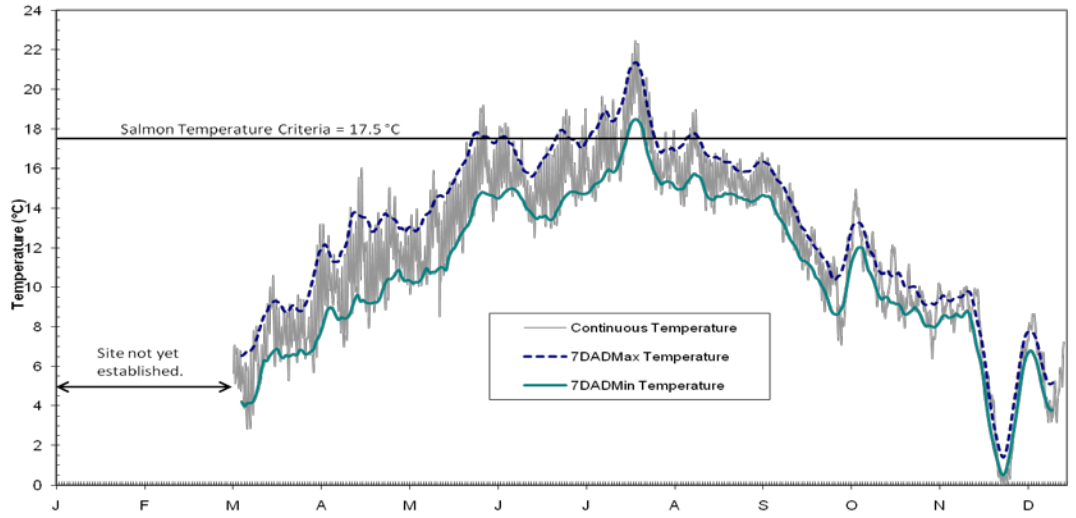

Figure F-2. 2009 continuous temperature profile for Longfellow Creek.

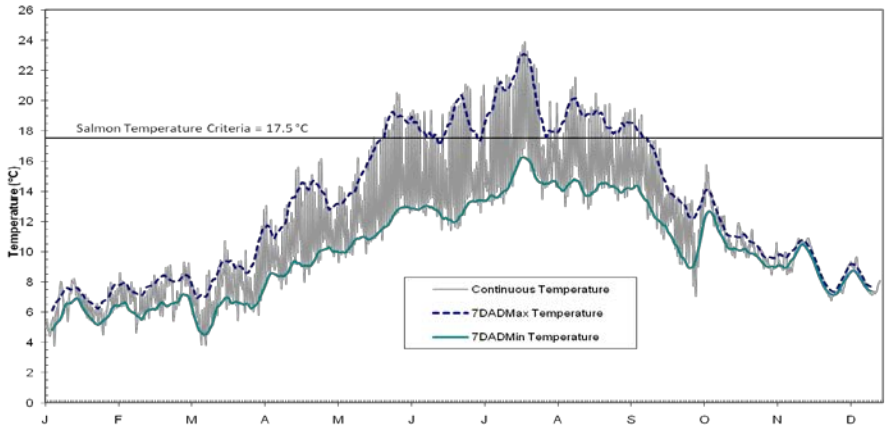

Figure F-3. 2009 continuous temperature profile for upper Big Ditch.

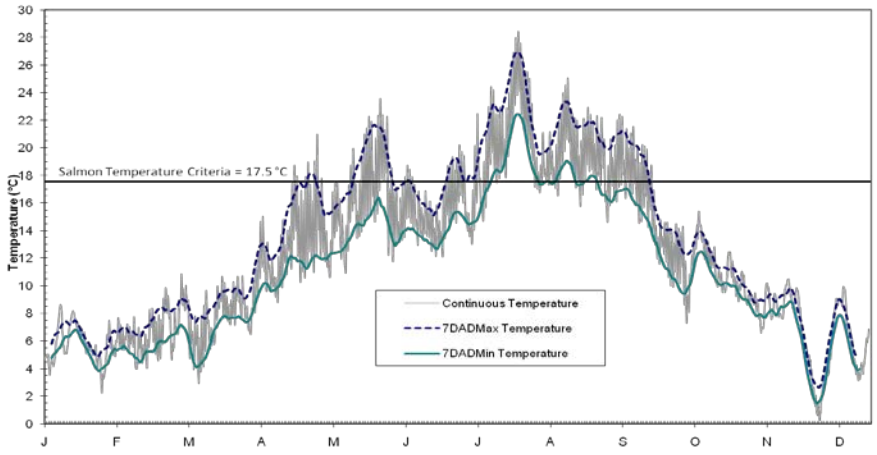

Figure F-4. 2009 continuous temperature profile for lower Big Ditch.

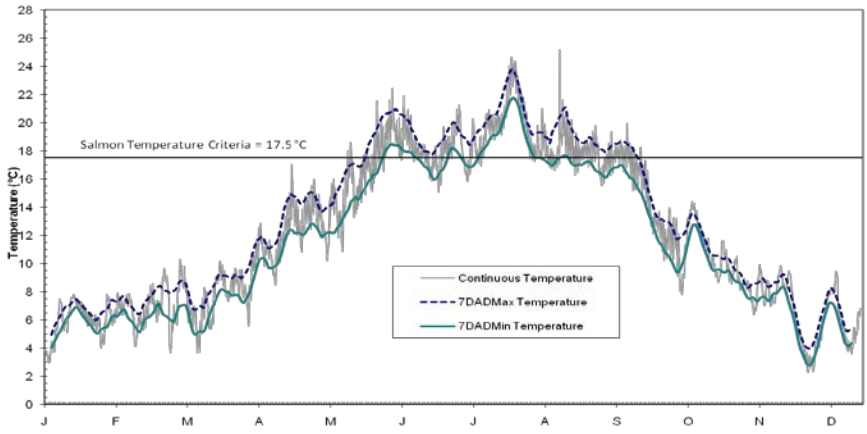

Figure F-5. 2009 continuous temperature profile for Indian Slough.

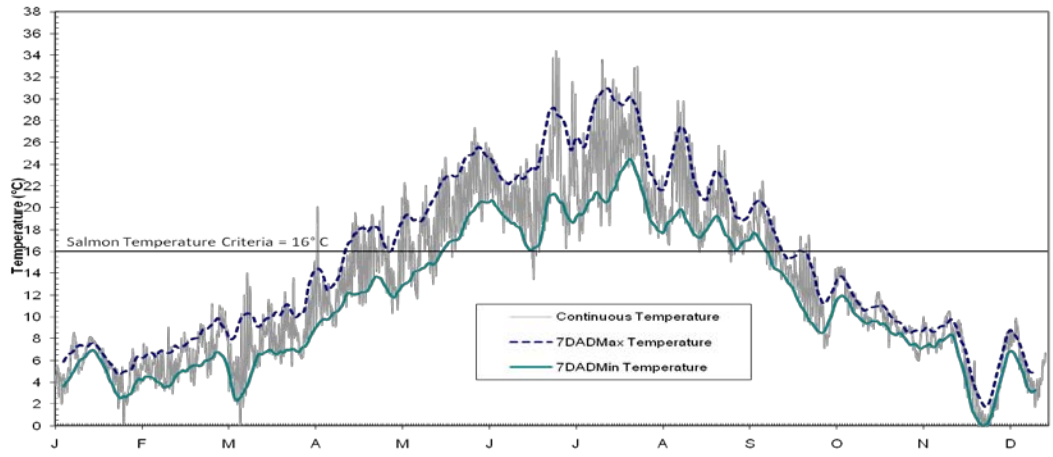

Figure F-6. 2009 continuous temperature profile for Brown Slough.

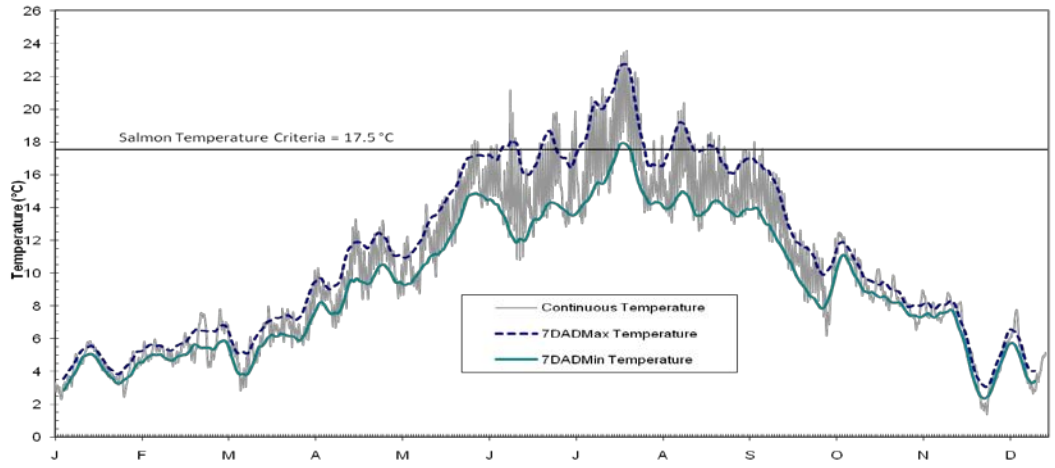

Figure F-7. 2009 continuous temperature profile for the Samish River.

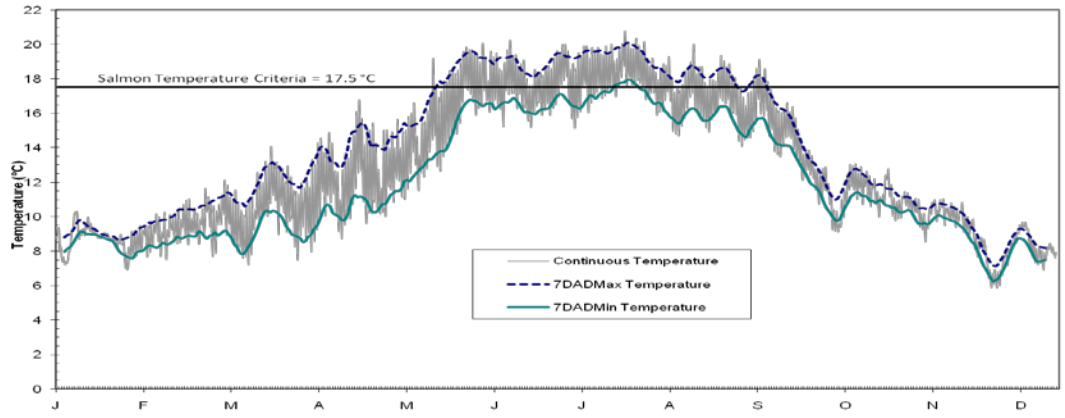

Figure F-8. 2009 continuous temperature profile for upper Spring Creek.

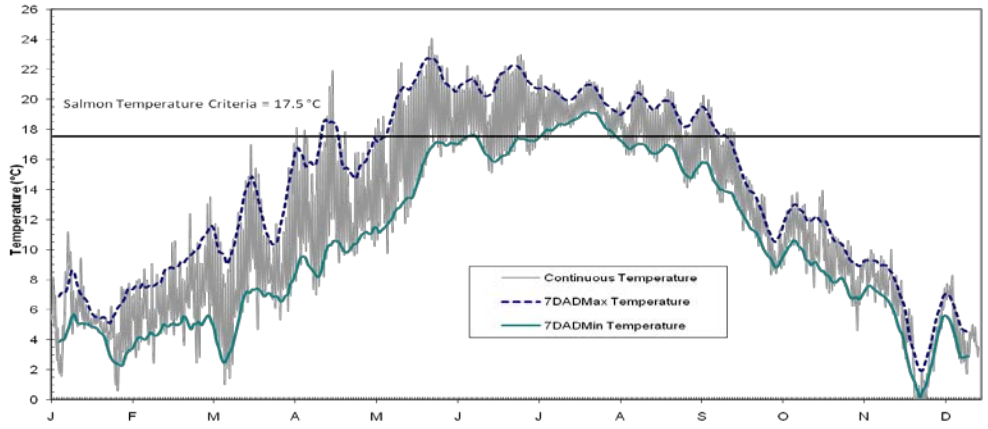

Figure F-9. 2009 continuous temperature profile for lower Spring Creek.

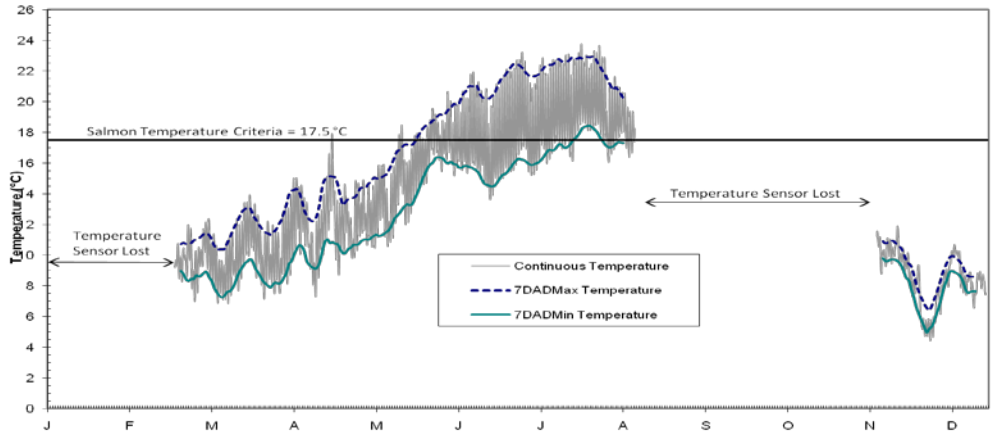

Figure F-10. 2009 continuous temperature profile for Marion Drain.

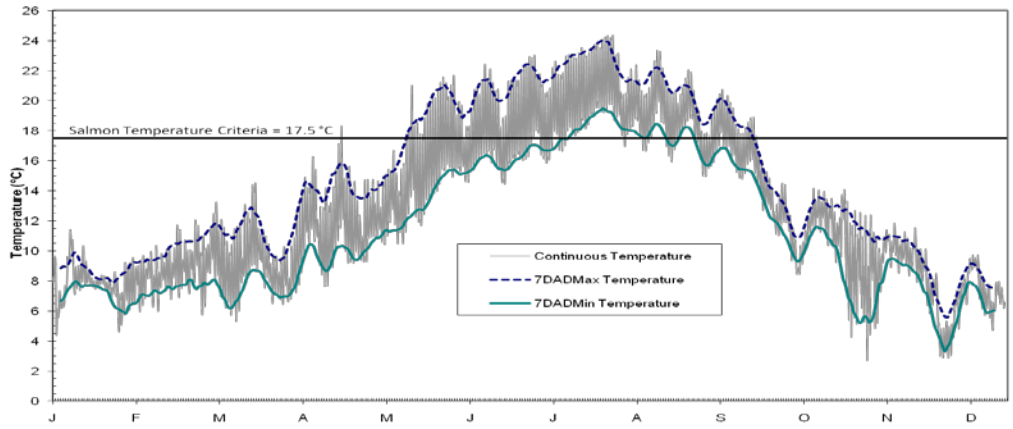

Figure F-11. 2009 continuous temperature profile for Sulphur Creek Wasteway.

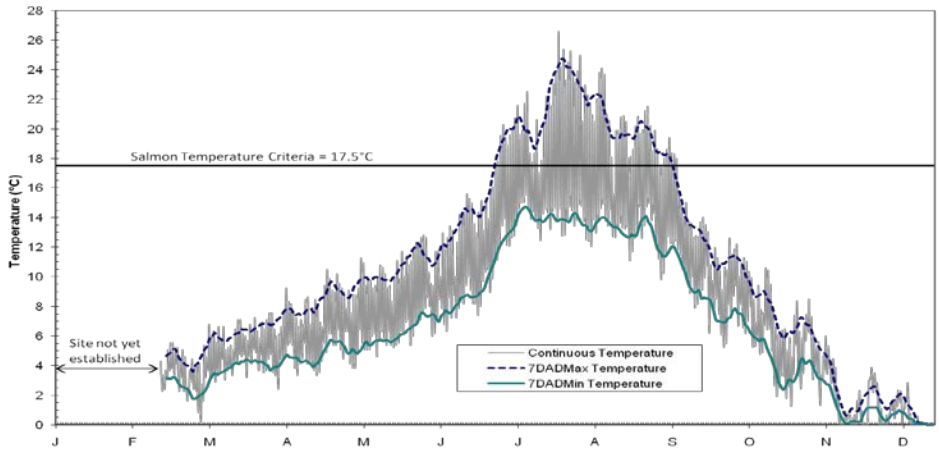

Figure F-12. 2007 continuous temperature profile for Peshastin Creek.

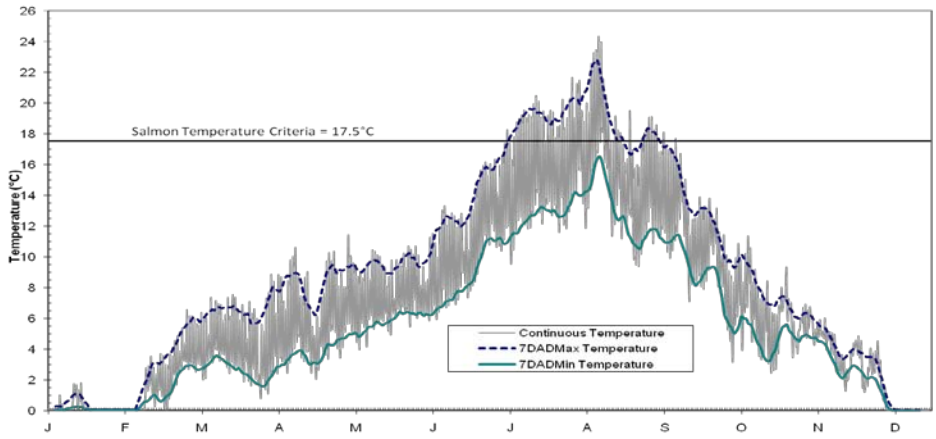

Figure F-13. 2008 continuous temperature profile for Peshastin Creek.

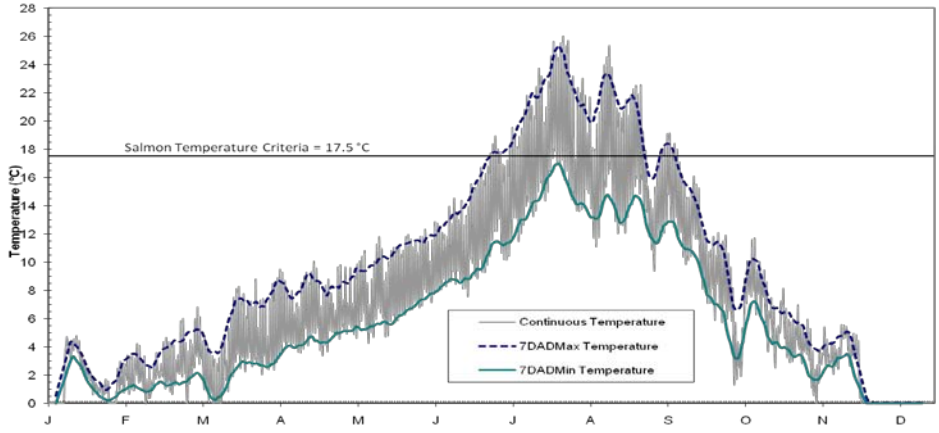

Figure F-14. 2009 continuous temperature profile for Peshastin Creek.

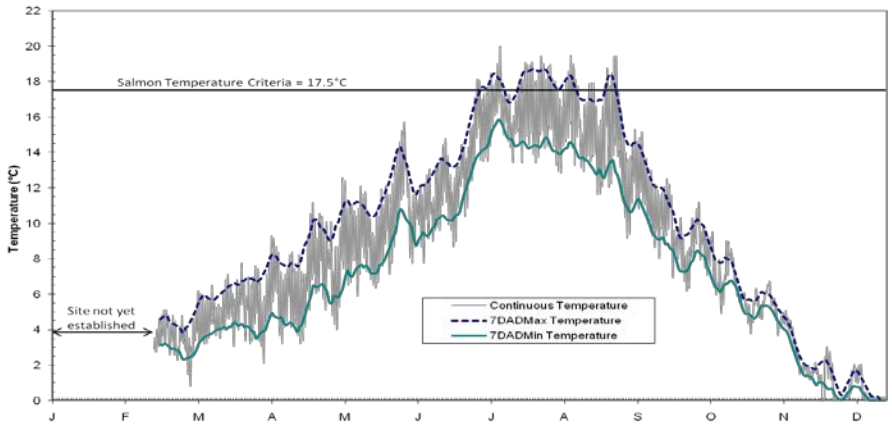

Figure F-15. 2007 continuous temperature profile for Mission Creek.

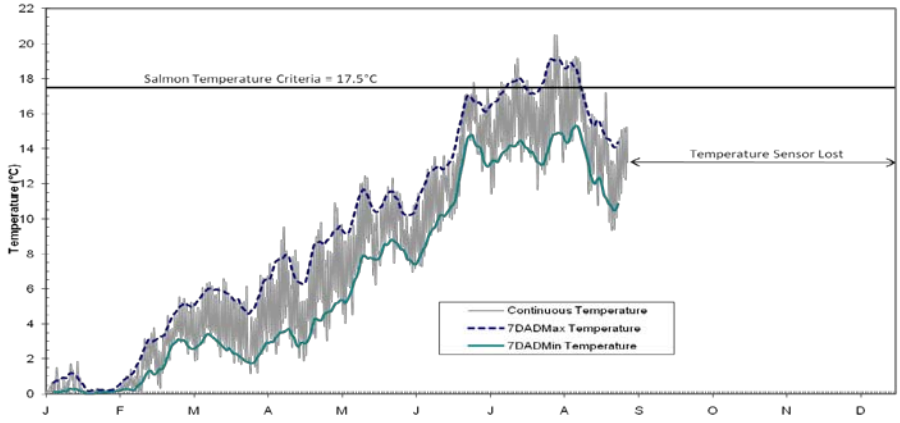

Figure F-16. 2008 continuous temperature profile for Mission Creek.

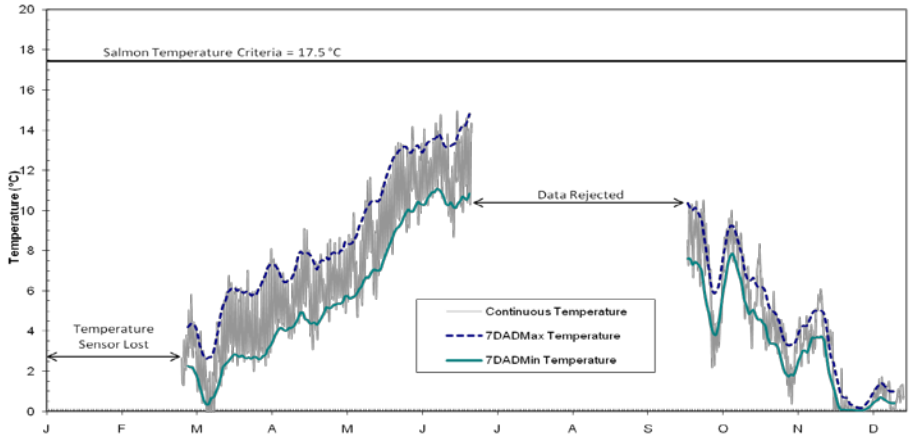

Figure F-17. 2009 continuous temperature profile for Mission Creek.

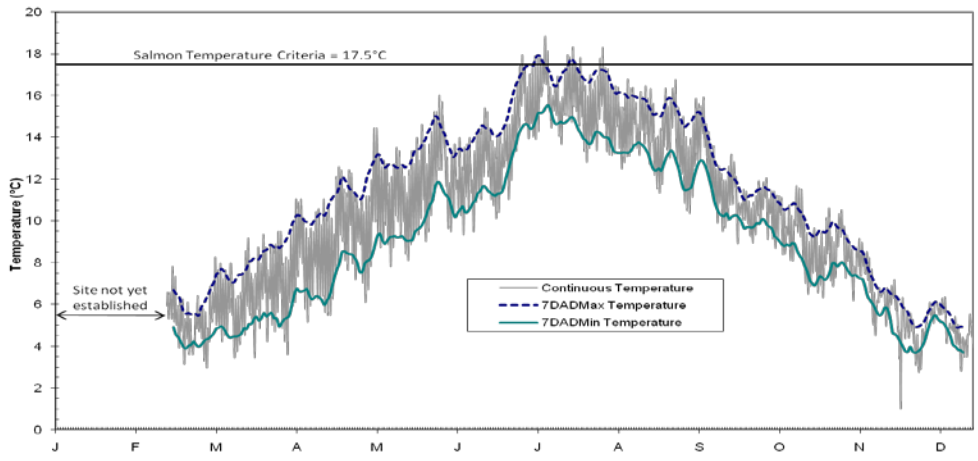

Figure F-18. 2007 continuous temperature profile for Brender Creek.

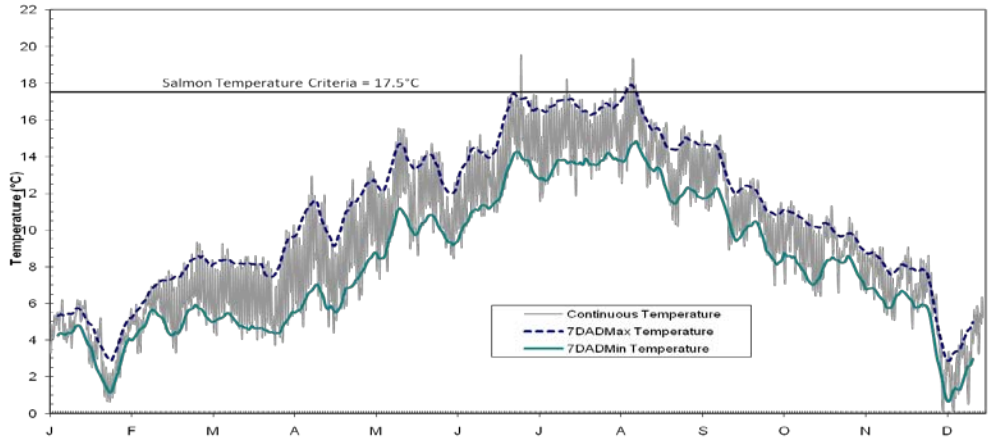

Figure F-19. 2008 continuous temperature profile for Brender Creek.

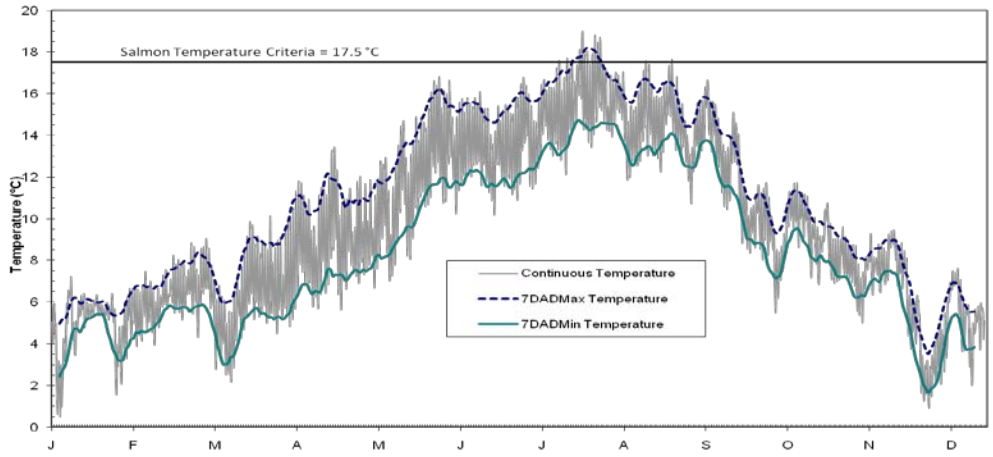

Figure F-20. 2009 continuous temperature profile for Brender Creek.

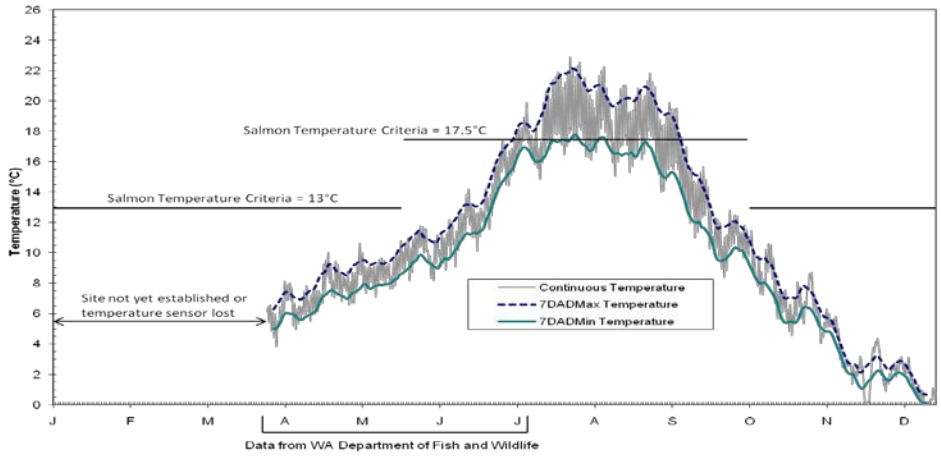

Figure F-21. 2007 continuous temperature profile for the Wenatchee River.

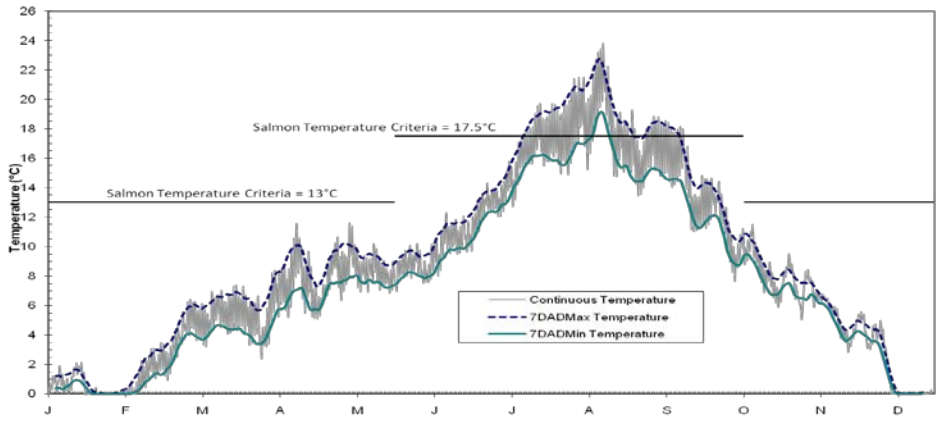

Figure F-22. 2008 continuous temperature profile for the Wenatchee River.

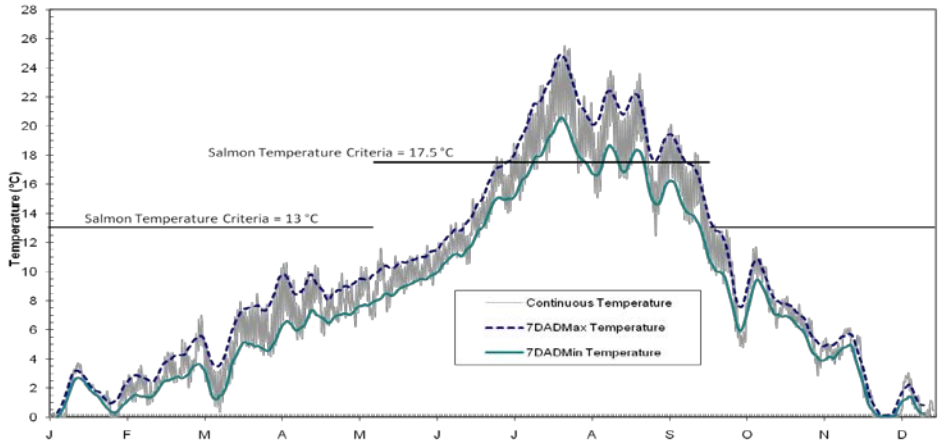

Figure F-23. 2009 continuous temperature profile for the Wenatchee River.

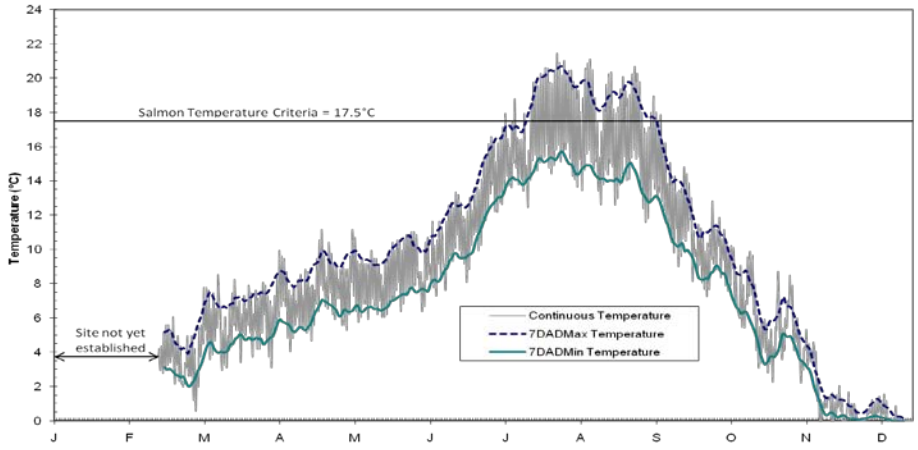

Figure F-24. 2007 continuous temperature profile for the Entiat River.

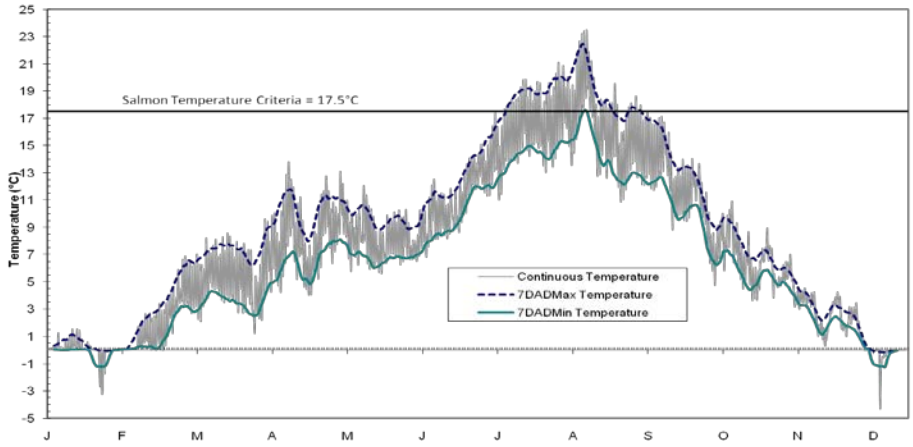

Figure F-25. 2008 continuous temperature profile for the Entiat River.

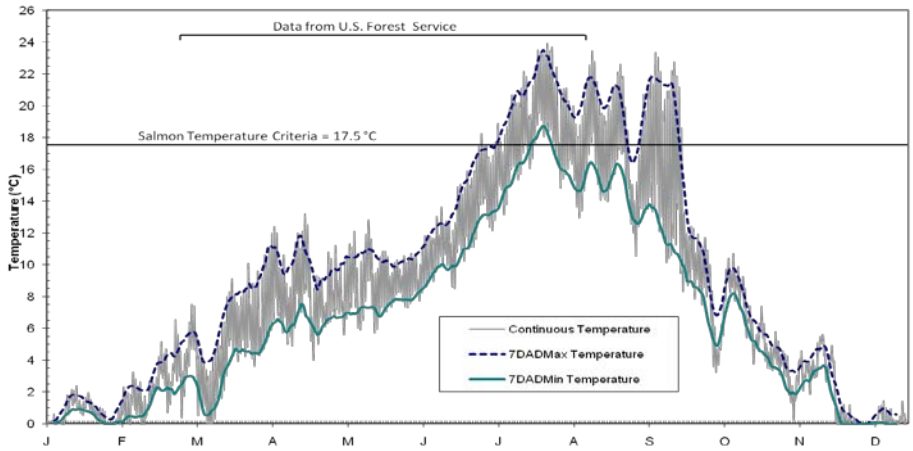

Figure F-26. 2009 continuous temperature profile for the Entiat River.

Appendix G. Flow, Precipitation, and Pesticide Detection Graphs

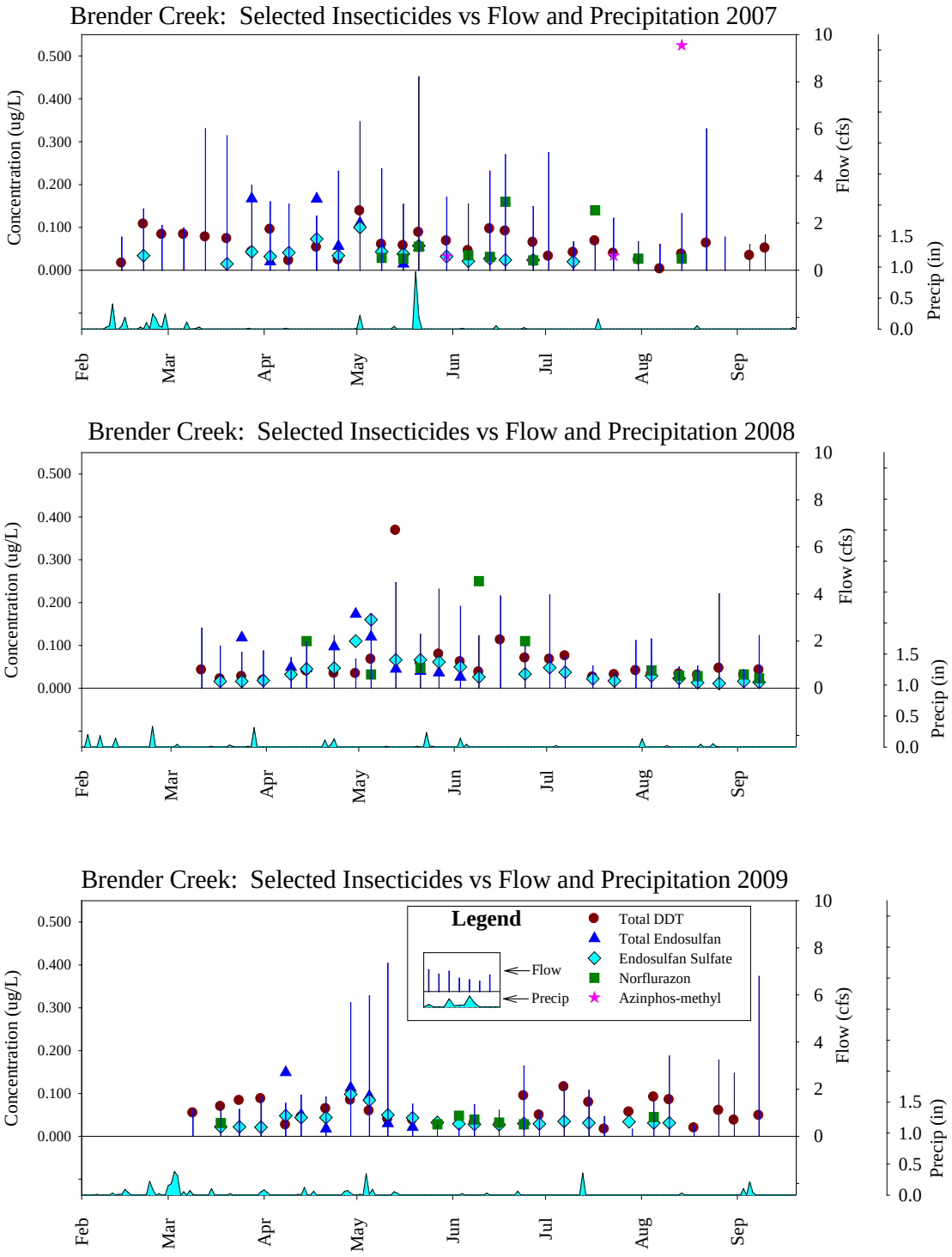

Figure G-1. Flow, precipitation, and most commonly seen insecticide concentrations for upstream Brender Creek, 2007-09.

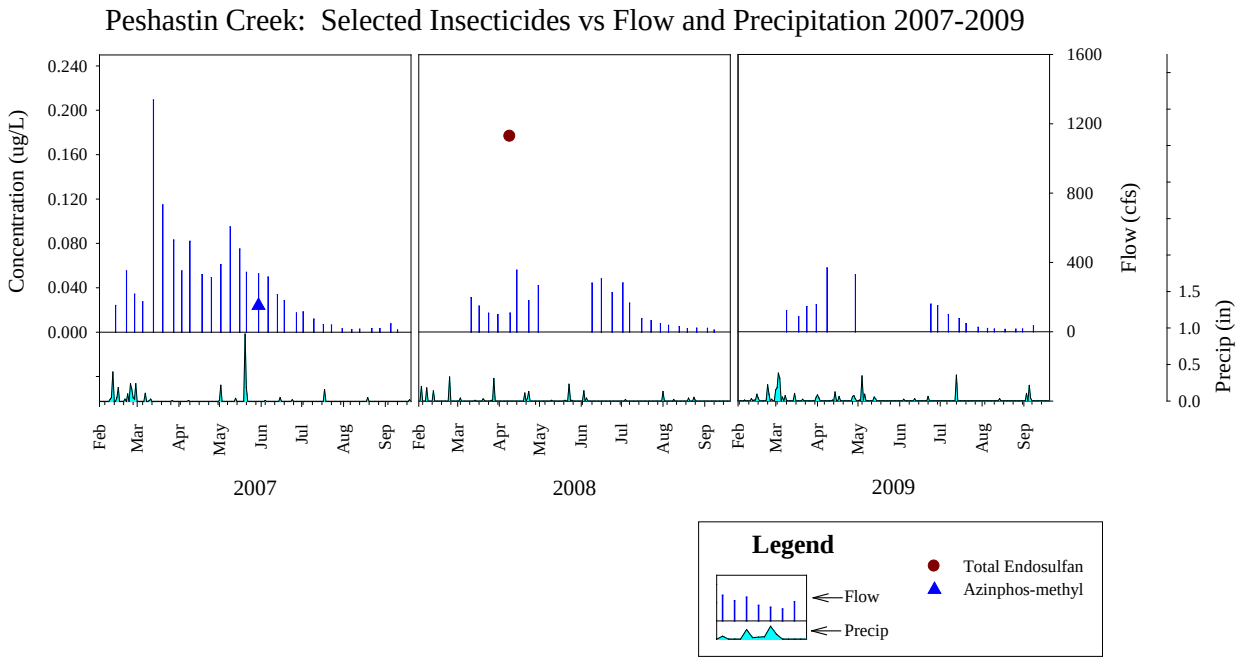

Figure G-2. Flow, precipitation, and most commonly seen insecticide concentrations for Peshastin Creek, 2007-09.

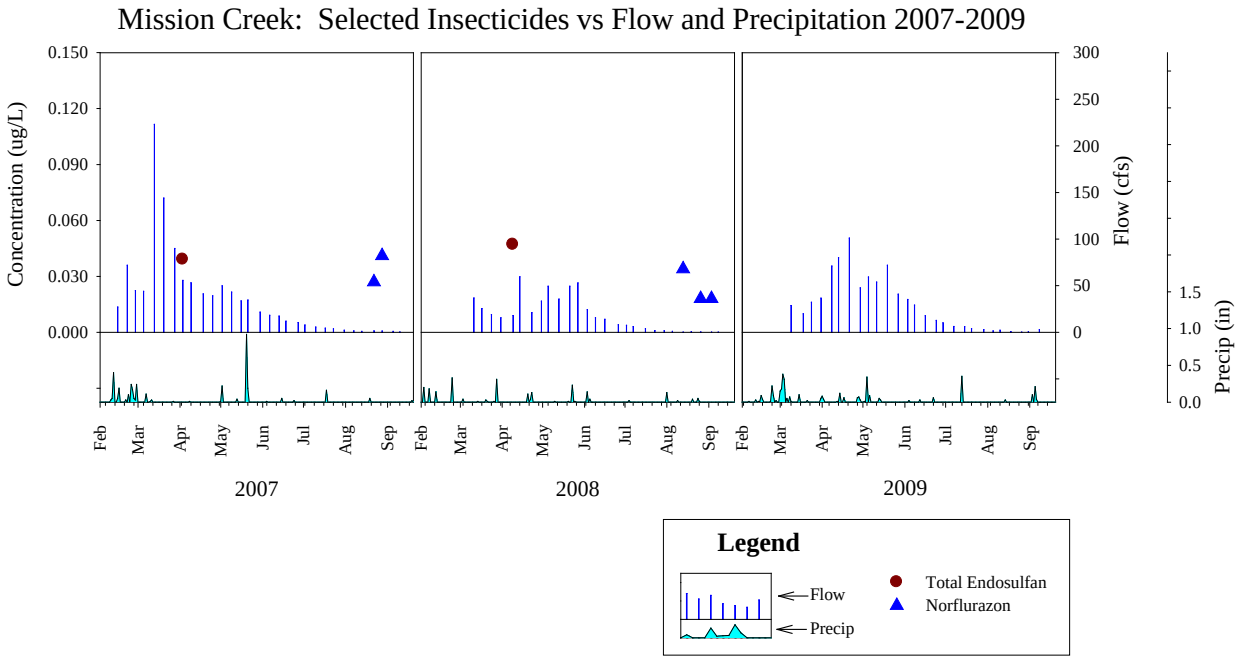

Figure G-3. Flow, precipitation, and most commonly seen insecticide concentrations for Mission Creek, 2007-09.

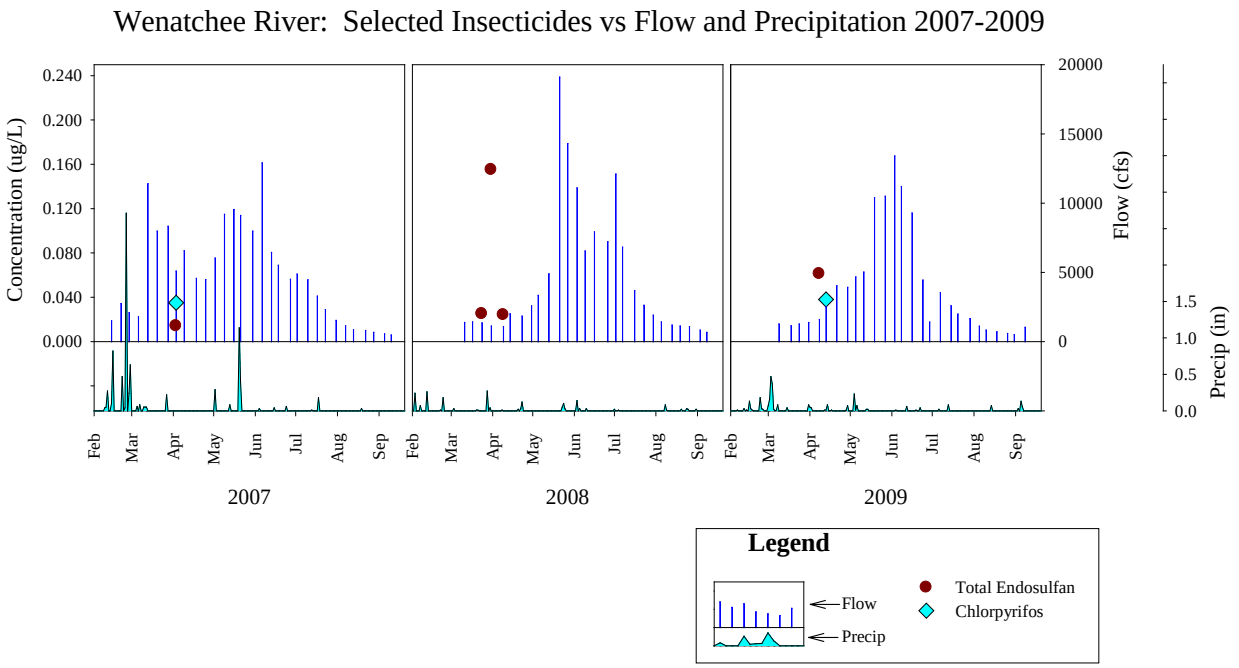

Figure G-4. Flow, precipitation, and most commonly seen insecticide concentrations for the Wenatchee River, 2007-09.

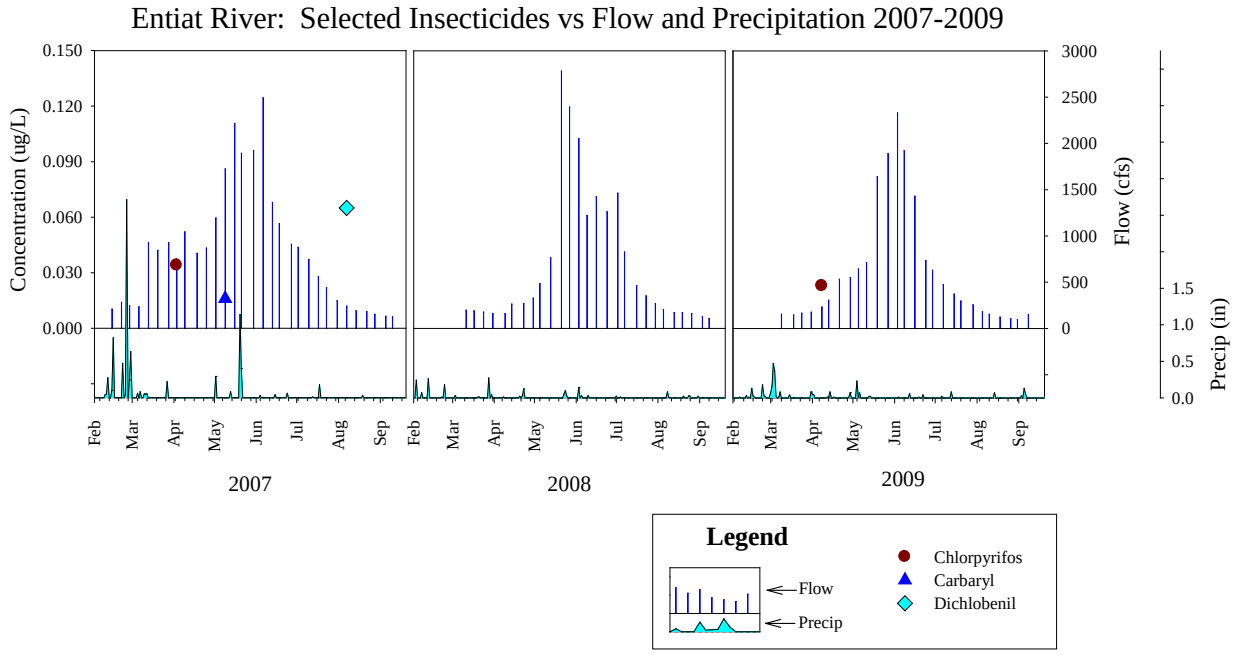

Figure G-5. Flow, precipitation, and most commonly seen herbicide concentrations for the Entiat River, 2007-09.