Appendices C - E

Surface Water Monitoring Program for Pesticides in Salmonid-Bearing Streams, 2010

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Appendix C. Quality Assurance

Laboratory Data Quality

Data may be qualified if one or more analytical factors affect confidence in the prescribed data value. Manchester Environmental Laboratory (MEL) 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-C-l	±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/MS	Pesticide-C	±40	50-150
TSS	TSS	±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/MS: Liquid chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8321AM.
TSS: Total suspended solids, EPA method 2540D.
[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 (LPQL) (ug/L).

Chemical	[1]Use	Parent	[2]Analysis Method	LPQL[3]		
				2008	2009	2010
1-Naphthol	D-C		LCMS\MS	0.053	0.050	0.049
2,3,4,5-Tetrachlorophenol	D-M		GCMS-H	0.063	0.063	0.063
2,3,4,6-Tetrachlorophenol	D-M		GCMS-H	0.063	0.063	0.063
2,4,5-T	H		GCMS-H	0.063	0.063	0.063
2,4,5-TP	H		GCMS-H	0.063	0.063	0.063
2,4,5-Trichlorophenol	D-M		GCMS-H	0.063	0.063	0.063
2,4,6-Trichlorophenol	D-M		GCMS-H	0.063	0.063	0.063
2,4-D	H		GCMS-H	0.063	0.063	0.063
2,4-DB	H		GCMS-H	0.063	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	D-M		GCMS-H	0.063	0.063	0.063
3-Hydroxycarbofuran	D-C	Carbofuran	LCMS\MS	0.050	0.050	0.049
4,4'-DDD	D-OC	DDT	GCMS	0.033	0.034	0.033
4,4'-DDE	D-OC	DDT	GCMS	0.033	0.034	0.033
4,4'-DDT	I-OC		GCMS	0.033	0.034	0.033

Chemical	[1]Use	Parent	[2]Analysis Method	LPQL[3]		
				2008	2009	2010
4,4'-Dichlorobenzophenone	D		GCMS		0.101	0.100
4-Nitrophenol	D-H		GCMS-H	0.063	0.063	0.063
Acetochlor	H		GCMS		0.101	0.100
Acifluorfen	H		GCMS-H	0.063	0.063	0.063
Alachlor	H		GCMS	0.033	0.033	0.033
Aldicarb	I-C		LCMS\MS	0.100	0.100	0.096
Aldicarb Sulfone	D-C	Aldicarb	LCMS\MS	0.050	0.053	0.049
Aldicarb Sulfoxide	D-C	Aldicarb	LCMS\MS	0.020	0.054	0.020
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	0.034	0.033
Azinphos Ethyl	I-OP		GCMS	0.033	0.033	0.033
Azinphos Methyl	I-OP		GCMS	0.033	0.050	0.043
Benefin	H		GCMS	0.033	0.033	0.033
Bensulide	H		GCMS	0.033		
Bentazon	H		GCMS-H	0.063	0.063	0.063
Benthiocarb	H-C		GCMS	0.100	0.101	0.100
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	0.100
Bifenthrin	I-Py		GCMS		0.101	0.100
Bromacil	H		GCMS	0.033	0.033	0.033
Bromoxynil	H		GCMS-H	0.063	0.063	0.063
Butachlor	H		GCMS		0.304	0.303
Butylate	H		GCMS	0.033	0.033	0.033
Captan	F		GCMS	0.033	0.033	0.033
Carbaryl	I-C		LCMS/MS	0.020	0.020	0.020
Carbofuran	I-C		LCMS/MS	0.020	0.020	0.020
Carboxin	F		GCMS	0.034	0.044	0.051
Chlorothalonil	F		GCMS	0.033	0.033	0.033
Chlorpropham	H		GCMS	0.033	0.033	0.033
Chlorpyrifos	I-OP		GCMS	0.033	0.034	0.033
Chlorpyrifos O.A.	D-OP		GCMS		0.101	0.100
Cis-Chlordane	I-OC		GCMS	0.033	0.033	0.033
Cis-Nonachlor	I-OC		GCMS	0.033	0.051	0.051
Cis-Permethrin	I-Py		GCMS	0.050	0.051	0.051
Clopyralid	H		GCMS-H	0.063	0.063	0.063
Coumaphos	I-OP		GCMS	0.033	0.051	0.051
Cyanazine	H		GCMS	0.033	0.033	0.033
Cycloate	H		GCMS	0.033	0.033	0.033
DCPA	H		GCMS-H	0.063	0.063	0.063
DDVP	I-OP		GCMS	0.050	0.051	0.051
Delta-BHC	I-OC		GCMS	0.033	0.033	0.033
Deltamethrin	I-Py		GCMS	0.100	0.101	0.100
Diallate	H		GCMS	0.033	0.033	0.033

Chemical	[1]Use	Parent	[2]Analysis Method	LPQL[3]		
				2008	2009	2010
Diazinon	I-OP		GCMS	0.033	0.033	0.033
Diazoxon	D-OP	Diazinon	GCMS		0.101	0.100
Dicamba I	H		GCMS-H	0.063	0.063	0.063
Dichlobenil	H		GCMS	0.033	0.033	0.033
Dichlorprop	H		GCMS-H	0.063	0.063	0.063
Diclofop-Methyl	H		GCMS-H	0.063	0.063	0.063
Dieldrin	I-OC		GCMS	0.050	0.051	0.051
Dimethoate	I-OP		GCMS	0.033	0.033	0.033
Dinoseb	H		GCMS-H	0.063	0.063	0.063
Diphenamid	H		GCMS	0.033	0.033	0.033
Disulfoton	I-OP		GCMS	0.052	0.112	0.065
Disulfoton sulfone	I-OP		GCMS	0.100	0.101	0.100
Disulfoton sulfoxide	D-OP		GCMS		0.135	0.100
Diuron	H		GCMS	0.050	0.058	0.051
Endosulfan I	I-OC		GCMS	0.050	0.051	0.051
Endosulfan II	I-OC		GCMS	0.050	0.051	0.051
Endosulfan Sulfate	D-OC	Endosulfan	GCMS	0.033	0.034	0.033
Endrin	I-OC		GCMS	0.050	0.051	0.051
Endrin Aldehyde	D-OC	Endrin	GCMS	0.050	0.051	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	0.036
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	0.038	0.042
Fenamiphos Sulfone	D-OP		GCMS		0.101	0.100
Fenarimol	F		GCMS	0.033	0.033	0.033
Fenitrothion	I-OP		GCMS			0.050
Fensulfothion	I-OP		GCMS	0.033	0.033	0.033
Fenthion	I-OP		GCMS	0.048	0.033	0.033
Fenvalerate (2 isomers)	I-Py		GCMS	0.033	0.033	0.038
Fipronil	I-Pyra		GCMS		0.101	0.100
Fipronil Disulfinyl	D-Pyra		GCMS		0.101	0.100
Fipronil Sulfide	D-Pyra		GCMS		0.101	0.100
Fipronil Sulfone	D-Pyra		GCMS		0.101	0.100
Fluridone	H		GCMS	0.100	0.101	0.100
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	0.034	0.033	0.033
Hexazinone	H		GCMS	0.050	0.051	0.051
Imidacloprid	I-N		LCMS\MS	0.020	0.020	0.020
Imidan	I-OP		GCMS	0.033	0.068	0.038
Ioxynil	H		GCMS-H	0.063	0.063	0.063

Chemical	[1]Use	Parent	[2]Analysis Method	LPQL[3]		
				2008	2009	2010
Kelthane	I-OC		GCMS	0.314	0.304	0.303
lambda-Cyhalothrin	I-Py		GCMS		0.101	0.100
Lindane	I-OC		GCMS	0.033	0.033	0.033
Linuron	H		GCMS	0.050	0.051	0.051
Malathion	I-OP		GCMS	0.033	0.033	0.033
MCPA	H		GCMS-H	0.063	0.063	0.063
MCPP	H		GCMS-H	0.063	0.063	0.063
Metalaxyl	F		GCMS	0.033	0.033	0.033
Methidathion	I-OP		GCMS	0.293	0.304	0.303
Methiocarb	I-C		LCMS\MS	0.020	0.021	0.020
Methomyl	I-C		LCMS\MS	0.050	0.050	0.049
Methomyl oxime	D-C	Thiodicarb	LCMS\MS	0.020	0.020	0.020
Methoxychlor	I-OC		GCMS	0.033	0.051	0.051
Methyl Chlorpyrifos	I-OP		GCMS	0.033	0.033	0.033
Methyl Paraoxon	D-OP	Methyl parathion	GCMS	0.100	0.101	0.100
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	0.051	0.051
MGK-264	Sy		GCMS	0.033	0.051	0.051
Mirex	I-OC		GCMS	0.033	0.035	0.033
Monocrotophos	I-OP		GCMS	0.050	0.051	0.051
Naled	I-OP		GCMS	0.059	0.035	0.034
Napropamide	H		GCMS	0.050	0.051	0.051
Norflurazon	H		GCMS	0.033	0.034	0.033
Oryzalin	H		GCMS	0.100	0.114	0.133
Oxamyl	I-C		LCMS\MS	0.050	0.052	0.049
Oxamyl oxime	D-C	Oxamyl	LCMS\MS	0.020	0.020	0.020
Oxychlordane	D-OC	Chlordane	GCMS	0.033	0.033	0.033
Oxyfluorfen	H		GCMS	0.033	0.101	0.100
Parathion	I-OP		GCMS	0.033	0.033	0.033
Pebulate	H		GCMS	0.033	0.033	0.033
Pendimethalin	H		GCMS	0.033	0.034	0.033
Pentachlorophenol	WP		GCMS-H	0.063	0.063	0.063
Phenothrin	I-Py		GCMS	0.033	0.033	0.033
Phorate	I-OP		GCMS	0.299	0.291	0.303
Phorate O.A.	D-OP		GCMS		0.193	0.137
Phosmet O.A.	D-OP		GCMS			0.100
Picloram	H		GCMS-H	0.063	0.063	0.063
Piperonyl Butoxide	Sy		GCMS		0.101	0.100
Promecarb	I-C		LCMS\MS	0.020	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

Chemical	[1]Use	Parent	[2]Analysis Method	LPQL[3]		
				2008	2009	2010
Propargite	I-SE		GCMS	0.033	0.051	0.051
Propazine	H		GCMS	0.033	0.033	0.033
Propoxur	I-C		LCMS\MS	0.050	0.050	0.049
Prothiofos	I-OP		GCMS		0.101	0.100
Resmethrin	I-Py		GCMS	0.050	0.036	0.033
Ronnel	I-OP		GCMS			0.050
Simazine	H		GCMS	0.033	0.033	0.033
Simetryn	H		GCMS	0.100	0.101	0.100
Sulfotepp	I-OP		GCMS	0.033	0.033	0.033
Sulprofos	I-OP		GCMS	0.033		0.050
Tebuthiuron	H		GCMS	0.033	0.033	0.033
Terbacil	H		GCMS	0.033	0.034	0.033
Tetrachlorvinphos	I-OP		GCMS	0.050	0.051	0.051
Thiodicarb	I-C		LCMS	0.020		
Tokuthion	I-OP		GCMS	0.050		
Total Suspended Solids			TSS		1.059	2.000
Tralomethrin	I-Py		GCMS	0.100	0.101	0.100
Trans-Chlordane	I-OP		GCMS	0.033	0.033	0.033
Trans-Nonachlor	I-OC		GCMS	0.033	0.051	0.051
trans-Permethrin	I-Py		GCMS		0.101	0.100
Triadimefon	F		GCMS	0.033	0.033	0.033
Triallate	H		GCMS	0.033	0.033	0.033
Trichloronat	I-OP		GCMS	0.050	0.051	0.051
Triclopyr	H		GCMS-H	0.063	0.063	0.063
Tricyclazole	F		GCMS		0.101	0.100
Trifluralin	H		GCMS	0.033	0.034	0.033

[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\MS: 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

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.

In 2010, 13.4% of the field samples obtained were for QA. In 2010 QA samples included 32 field replicates for carbamates, herbicides, and pesticide GCMS; and 33 replicates for TSS. QA also included 16 field blanks for TSS, herbicides, and pesticide GCMS; and 18 blanks for carbamates. There were also 16 MS/MSD samples for carbamates, herbicides, and pesticide GCMS.

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

Field Replicates

Results for pesticide field replicates are presented in Tables C-4 and C-5. Table C-4 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.

Table C-4. Pooled average %RPD of consistent field replicate pairs by analysis type.

Analysis	Pooled Average %RPD	Number of Replicate Pairs
Herbicides	10.5%	20
Carbamates	3.3%	16
Pesticide GCMS	9.3%	41
TSS	12.4%	33

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-5.

During 2010 field replicate sampling frequency for pesticides was 7.6% and for TSS was 7.7%. Precision between replicate pairs was calculated using percent RPD (%RPD). The percent (%RSD) is calculated by dividing the absolute value of the difference between the replicates by their mean, then multiplying by 100 for a percent value.

Excluding total suspended solids (TSS), there were 77 consistently identified analytes and 19 inconsistently identified analytes detected in 97 replicate pairs. The average %RPD for each of the analytical methods was excellent (Table C-4). Of the consistently identified replicate pairs only two of the 77 pairs exceeded the 40% RPD criterion (Table C-5). One of these replicate pairs (dichlobenil) had a %RPD of 100. This difference is likely because the results were very low and the RPD statistic has limited effectiveness in assessing variability at low levels (Mathieu, 2006).

Of the inconsistently identified replicate pairs, five of the 19 pairs exceeded the 40% RPD criterion (Table C-5). For the inconsistently identified replicate pairs, higher %RPD occurred because a tentative detection or estimated detection was compared to a less than reporting limit value. The tentative detections and estimated detections were all less than the reporting limit, and data for these replicates are of acceptable data quality.

TSS was consistently detected in 33 replicate pairs. The pooled %RPD of all replicates was 12.4%. A total of 81% of the replicates were within the 20% RPD criterion.

Table C-5. Detected pairs within field replicate results (µg/L).

Parameter	Sample	Q	Replicate	Q	RPD
2,4-D	0.041	J	0.041	J	0.0
	0.180		0.320		56.0
	0.040	J	0.039	J	2.5
	0.040	J	0.054	J	29.8
	0.027	J	0.026	J	3.8
	0.240	J	0.230	J	4.3
	0.038	J	0.045	J	16.9
	0.023	J	0.024	J	4.3
				Mean =	**14.7**
4,4'-DDE	0.038		0.037		**2.7**
4,4'-DDT	0.016	J	0.017	J	**6.1**
Bentazon	0.045	J	0.049	J	8.5
	0.063		0.082		26.2
				Mean =	**17.4**
Bromacil	0.036		0.038		5.4
	0.190	J	0.220	J	14.6
	0.070		0.066		5.9
	0.032	J	0.036		11.8
				Mean =	**9.4**
Carbaryl	0.015	J	0.014	J	**6.9**
Carbofuran	0.005	J	0.005	J	0.0
	0.100		0.094		6.2
	0.004	J	0.004	J	0.0
	0.006	J	0.006	J	0.0
				Mean=	**1.5**
Chlorpropham	0.025	J	0.023	J	**8.3**
DCPA	0.063	J	0.072		**13.3**
DDVP	0.070		0.067		**4.4**
Diazinon	0.120		0.120		**0.0**
Dicamba I	0.019	J	0.019	J	0.0
	0.014	J	0.013	J	7.4
	0.150		0.150		0.0
				Mean=	**2.5**
Dichlobenil	0.015	J	0.013	J	14.3
	0.010	J	0.010	J	0.0
	0.078		0.080	J	2.5
	0.006	J	0.006	J	0.0

Parameter	Sample	Q	Replicate	Q	RPD
	0.008	J	0.009	J	11.8
	0.037		0.037		0.0
	0.012	J	0.011	J	8.7
	0.015	J	0.015	J	0.0
	0.001	J	0.003	J	100.0
	0.011	J	0.013	J	16.7
				Mean=	**15.4**
Disulfoton sulfoxide	0.021	J	0.031	J	38.5
Diuron	0.110	J	0.120	J	8.7
	0.017	J	0.015	J	12.5
	3.6	E	3.6	E	0.0
				Mean=	**7.1**
Endosulfan Sulfate	0.036		0.038		**5.4**
Eptam	0.200		0.220		9.5
	0.027	J	0.028	J	3.6
	0.030	J	0.029	J	3.4
	0.063		0.074		16.1
				Mean=	**8.2**
Ethoprop	0.280		0.300		**6.9**
Imidacloprid	0.362		0.411		12.7
	0.005	J	0.005	J	0.0
	0.024		0.024		0.0
	0.020		0.019	J	5.1
	0.007	J	0.007	J	0.0
	0.005	J	0.005	J	0.0
	0.004	J	0.004	J	0.0
	0.005	J	0.005	J	0.0
	0.924		0.833		10.4
	0.009	J	0.008	J	11.8
				Mean=	**4**
MCPA	0.061	J	0.059	J	**3.3**
Methomyl	0.004	J	0.004	J	**0.0**
Metolachlor	0.054	J	0.056		3.6
	0.039		0.044		12.0
	0.008	J	0.008	J	0.0
	0.190		0.200		5.1
				Mean=	**5.2**
Metribuzin	0.210		0.210		**0.0**
Napropamide	0.480		0.400		**18.2**

Parameter	Sample	Q	Replicate	Q	RPD
Pendimethalin	0.076		0.074		**2.7**
Pentachlorophenol	0.016	J	0.016	J	**0.0**
Terbacil	0.098		0.095		3.1
	0.035	J	0.036	J	2.8
	0.090		0.100		10.5
	0.500		0.510		2.0
				Mean=	**4.6**
Triclopyr	0.160		0.190		17.1
	0.042	J	0.043	J	2.4
	0.089		0.083		7.0
	0.030	J	0.032	J	6.5
				Mean=	**8.2**
Trifluralin	0.022	J	0.023	J	**4.4**

Inconsistent replicate detections are an indicator of sampling uncertainty. Table C-6 compares inconsistent replicate detections to the LPQL for non-detections in the paired replicate. Most inconsistent detections were found at concentrations near or below the LPQL.

Table C-6. Inconsistent field replicate detections compared to the lower practical quantitation limit (LPQL) (µg/L).

Parameter	Sample		Replicate		RPD
Bentazon	0.052	J	0.044	NJ	16.7
Bromacil	0.037		0.034	U	8.5
Carbaryl	0.020	UJ	0.016	J	22.2
	0.020	U	0.005	J	120
	Mean=				71.1
Carbofuran	0.006	J	0.020	U	108
Dicamba I	0.015	J	0.016	NJ	6.5
	0.011	J	0.011	NJ	0.0
	Mean=				3.2
Diuron	0.230	J	0.200	NJ	14.0
	0.150		0.170	NJ	12.5
	0.025	J	0.028	NJ	11.3
	0.067	J	0.059	NJ	12.7
	Mean=				12.6
Imidacloprid	0.005	J	0.020	U	120
	0.005	J	0.020	U	120
	Mean=				120
MCPA	0.023	NJ	0.024	J	4.3
Pentachlorophenol	0.015	NJ	0.015	J	0.0
	0.021	J	0.068	U	106
	0.020	J	0.021	NJ	4.9
	Mean=				36.8
Triclopyr	0.035	J	0.035	NJ	0.0
Trifluralin	0.015	J	0.034	U	77.6

Laboratory Duplicates

MEL used laboratory split sample duplicates to ensure consistency of TSS analyses. In 2010 there were 32 laboratory replicate pairs. The pooled average RPD was 12.8%, the maximum RPD was 29%. Six out of 32 replicate pairs exceeded the 20% RPD criteria. For these replicates, results were low, and the RPD statistic has limited effectiveness in assessing variability at low levels (Mathieu, 2006).

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.

In 2010 there were no field blank detections for the pesticide analysis. There was one TSS field blank detection of 3 mg/L on July 20, 2010 for the Samish River site. The reporting limit for TSS was 1 mg/L. All TSS values analyzed that day (July 20, 2010) that are less than 9 mg/L will be qualified as estimates.

Laboratory Blanks

MEL 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 2010 are presented in Table C-7. 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).

Table C-7. Laboratory blank detections (µg/L).

Analysis	Chemical	Analysis Date	Value
GCMS	2,4'-DDT	06/11/2010	0.015 J
	4,4'-DDD	06/11/2010	0.012 J
	4,4'-DDE	06/11/2010	0.007 J
	4,4'-DDT	06/11/2010	0.018 J
	cis-Chlordane	06/11/2010	0.002 J
	Mirex	06/11/2010	0.012 J
	Trans-Chlordane	06/11/2010	0.002 J
LCMS\MS	Imidacloprid	4/14/2010	0.001 J
		9/28/2010	0.002 J
	Carbaryl	6/11/2010	0.003 J
		7/23/2010	0.004 J

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-8).

In 2010 MEL discontinued use of 4,4'-DDE-d8 and gamma-BHC-d6 as surrogates for the pesticide GCMS analysis. MEL could no longer purchase these standards from any supplier. The 4,4'-DDE-d8 standard was replaced with a carbon 13 labeled version, 4,4'-DDE-12C13. Atrazine-D5 and triflurin-D14 labeled surrogates were also added to support pesticide GCMS chemistries.

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-8. Pesticide surrogates.

Surrogate Compound	Surrogate for...
2,4,6-tribromophenol	Acid-derivitizable herbicides
2,4-dichlorophenylacetic acid	
Carbaryl C13	Carbamate pesticides
4,4'-DDE-13C12	Chlorinated pesticides
Decachlorobiphenyl (DCB)	
Atrazine-D5	Chlorinated and nitrogen pesticides
1,3-dimethyl-2-nitrobenzene	Nitrogen pesticides
Trifluralin-D-14	
Chlorpyrifos-d10	Organophosphorus pesticides
Triphenyl phosphate	

The majority of surrogate recoveries fell within the QC limits established by MEL for all compounds except for the compounds and dates described in Table C-9.

Table C-9. Surrogate compounds that did not meet data quality control limits.

Surrogate Compound	Surrogate for	Result Date	Percent Recovery
Atrazine-D5	Chlorinated and nitrogen pesticides	04/23/2010	161%
Chlorpyrifos-d10	Organophosphorus pesticides	04/23/2010	139%
Triphenyl phosphate	Organophosphorus pesticides	04/23/2010	142%
Carbaryl C13	Carbamate pesticides	05/08/2010	39%
1,3-Dimethyl-2-nitrobenzene	Nitrogen pesticides	05/11/2010	0%

On April 23 surrogate recoveries were high for the pesticide GCMS analysis (Table C-9). All positive sample results for pesticide GCMS sampled on April 12 and 13 were qualified as estimated and may be biased high. For the May 8, carbamate analysis, the method blank surrogate recovery was low; the method blank results were qualified as estimates. For the May 11 pesticide GCMS analysis, there were low recoveries for nitrogen pesticide surrogates; affected samples were qualified as estimates.

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.

Table C-10 presents the mean, minimum, and maximum percent recovery for the MS/MSD for the three types of analysis as well as the RPD between for the MS/MSD for 2010.

In 2010, the average recovery for all three analyses and the average RPD was good, showing acceptable performance for most compounds.

Table C-10. Mean, minimum, and maximum percent recovery for MS/MSD and MS/MSD RPD.

Analysis	MS\MSD Recovery			%RPD for MS\MSD		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
LCMS\MS	74%	36%	99.4%	10%	5%	35%
GCMS-Herbicides	82%	24%	299%	9%	5%	19%
GCMS-Pesticides	108%	5%	238%	7%	2%	31%

The percent recoveries for the LCMS\MS analysis were excellent, within the target range of 50-150% recovery, except for methomyl oxime which had low recoveries (34-37%). Methomyl oxime was not detected at any site in 2010.

The percent recoveries for the GCMS-Herbicide analysis were also good, with most analyte recoveries between the acceptable range of 40-130%. Acifluorfen had high recoveries (298-300%). Acifluorfen was not detected in any of the 2010 samples. Picloram had low recoveries (24%). The upstream Big Ditch site had two detections of picloram; both detections were qualified as estimates due to low recoveries.

The percent recoveries for the GCMS-Pesticides included many analytes, and generally were good. Percent recoveries for resmethrin were low (4-5%). Resmethrin was not detected in any 2010 samples.

Fifteen analytes exceeded the acceptable range of 30-130% recoveries. Table C-11 presents the MS/MSD average percent recoveries for these compounds. Chlorothalonil, terbacil, ethoprop, and diuron were the only compounds detected during 2010. Detections of these compounds were qualified as estimates if MS/MSD recoveries were low for that day.

Table C-11. Analytes that exceeded the % MS/MSD recovery range of > 130%.

Analyte	MS/MSD Average % Recovery	Number of Detections
Tetrachlorvinphos	139	0
Ethalfluralin	140	0
Chlorothalonil	143	1
Fenarimol	147	0
Terbacil	150	29
Cyanazine	150	0
Ethoprop	151	5
Fenamiphos	158	0
Diuron	160	62
Methyl Paraoxon	160	0
Fluridone	166	0
Azinphos Ethyl	178	0
Mevinphos	192	0
Coumaphos	219	0
Azinphos Methyl	238	0

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.

Table C-12 presents the mean, minimum, and maximum percent recovery for the LCS and paired LCS for the three types of analysis, as well as the RPD between the LCS and the paired LCS for 2010.

Table C-12. Mean, minimum, and maximum percent recovery for LCS and paired LCS and the LCS and paired LCS RPD.

Analysis	LCS Recovery			%RPD for LCS\LCS-Duplicate		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
LCMS\MS	70%	23%	95%	13%	7%	33%
GCMS-Herbicides	72%	37%	196%	18%	7%	108%
GCMS-Pesticides	106%	36%	155%	9%	3%	45%

In 2010, the average recovery for all three analyses and the average RPD was good, showing acceptable performance for most compounds.

The percent recoveries for the LCMS\MS analysis were good. Four compounds (1-naphthol, aldicarb, methomyl oxime, and oxamyl oxime) had average recovery rates just below the target range of 50-150%. Methomyl oxime recoveries averaged 23%, while the other compounds averaged 41-48% recovery. If LCS recoveries were low and that compound was detected, the result was qualified as an estimate.

The percent recoveries for the GCMS-Herbicide analysis were also good with most analyte recoveries between the acceptable range of 40-130%. Acifluorfen had high recoveries (195-197%); but acifluorfen was not detected in any of the 2010 samples.

The percent recoveries for the GCMS-Pesticides included many analytes, and generally percent recoveries were good. Nine analytes slightly exceeded the acceptable range of 30-130% recoveries. These analytes were: azinphos methyl (147%), beta-BHC (135%), chlorothalonil (142%), coumaphos (155%), fluridone (136%), methyl paraoxon (138%), mevinphos (133%), napropamide (133%), and tetrachlorvinphos (132%). Of these analytes only two were detected once in Indian Slough: chlorothalonil and napropamide. The chlorothalonil detection was qualified as an estimate, and the napropamide detection needed no qualification because recoveries were within acceptable limits that day.

Field Data Quality

Quality Control Procedures

Field meters were calibrated at the beginning of the field day according to manufacturers' specifications, using Ecology's 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 2010

In 2010 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-13) except the conductivity post-checks for July 7, August 9 and 25, and October 20. Conductivity data for these days did not meet post-check standards, and data were qualified as estimates.

The field meter for the urban sites and the lower Skagit-Samish (westside sites) met QC objectives including post-checks and Winkler comparisons (Table C-13) except two dissolved oxygen measurements for Indian Slough. Two meter and Winkler dissolved oxygen results had an 11.3 and 14.5% RSD on June 15 and 28, respectively. This slightly exceeds the QC objective of ≤ 10% RSD. In addition, a replicate conductivity reading for Indian Slough on August 20 had a 42.5% RSD, exceeding the QC objective of ≤ 10% RSD.

Table C-13. Quality control results (%RSD) for field meter and Winkler replicates.

Replicate Meter Parameter	Westside		Eastside	
	Average	Maximum	Average	Maximum
Winkler and meter DO	1.6%	14.5%	1.4%	5.5%
Replicate Winkler's for DO	0.6%	2.5%	0.3%	1.8%
Meter DO	0.6%	5.5%	n/a	n/a
Meter conductivity	2.1%	42.5%	2.1%	6.9%
Meter pH	0.6%	4.2%	0.9%	2.4%
Meter flow	5.2%	29.0%	4.5%	32.6%

DO= dissolved oxygen.

At times the Indian Slough site is influenced by incoming marine water. When this occurs, temperature, dissolved oxygen, and conductivity values can vary greatly by depth. Thus, it is difficult to obtain consistent meter readings at the Indian Slough site. It is likely that environmental factors are the cause of the differences in the dissolved oxygen and conductivity replicates. Field QC objectives were met. Indian Slough dissolved oxygen and conductivity results for these days will be qualified as estimates.

Four replicate flow results exceeded data QC objectives, three for the eastside sites and one for the westside sites (Table C-14). Flow replicates were during low-flow conditions when the RSD statistic produces higher variability. Flow results for these days are acceptable.

Table C-14. Streamflow results where the %RSD exceeded the quality control of 10% RSD.

Site	Date	Flow (cfs)	Replicate flow (cfs)	Difference in %RSD
Westside Meter				
BD-2	09/03/10	0.8	0.6	21%
Eastside Meter				
BR-1	3/9/10	0.5	0.3	33%
BR-1	6/14/10	3.6	2.9	14%
MI-1	8/16/10	2.1	1.6	17%

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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 were 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

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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
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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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. In the calendars, the number below the months indicate sample week.

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 was detected.
	Analysis not completed.
	Pesticide residue detected. Assessment criteria not available.
	Detection of pesticide residue, concentration below regulatory or toxicological criteria or standard.
	Magnitude of detection above an EPA[1] acute or chronic invertebrate registration criteria.
	Magnitude of detection above an WAC2 or NRWQC[3] acute or chronic regulatory standard.
	Magnitude of detection above an EPA[1] acute or chronic invertebrate registration criteria.

[1] EPA: United States Environmental Protection Agency
[2] WAC: Washington Administrative Code
[3] NRWQC: EPA's National Recommended Water Quality Criteria

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 WSDA, 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

In 2010 there were 58 detections of 10 pesticides in Thornton Creek (Table E-2).

No detections were above assessment criteria or water quality standards.

Table E-2. Thornton Creek 2010.

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				0.073				0.110	0.056										0.095						0.087	0.033	0.067
Carbaryl	I-C								0.005																			
Dichlobenil	H	0.017	0.008	0.013	0.027	0.011	0.009	0.009	0.044	0.014	0.010		0.008	0.021	0.012	0.014	0.014	0.007	0.001	0.002		0.012	0.012	0.016	0.012	0.015	0.008	
Diuron	H								0.039					0.053												0.028		
Imidacloprid	I-N											0.005		0.005							0.004	0.003	0.003						
MCPA	H																										0.031	
MCPP	H								0.050																		0.022	
Pentachlorophenol	WP		0.018	0.032			0.019	0.021	0.031					0.021				0.018									0.024	0.049
Propoxur	I-C								0.008																			
Triclopyr	H													0.035						0.063						0.064	0.150	0.210
Total Suspended Solids	NA	6.0	2.0	13.0	9.0	5.0	6.0	6.0	15.0	7.0	5.0	8.0	18.5	5.0	6.0	9.0	6.0	4.3	4.0	8.0	11.0	7.3	5.0	5.0	6.0	4.0	5.0	12.0

C: Carbamate, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, WP: Wood Preservative

Green-Duwamish Basin

Longfellow Creek

In 2010 there were 78 detections of 15 pesticides and degradates in Longfellow Creek (Table E-3).

No detections were above assessment criteria or water quality standards.

Table E-3. Longfellow Creek 2010.

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				0.057		0.036	0.032	0.540	0.150	0.068										0.024		0.030		0.130	0.042	0.038	0.086
Carbaryl	I-C								0.003																			
Carbofuran	I-C												0.003															
Dicamba I	H								0.076																			
Dichlobenil	H	0.017	0.011		0.054	0.027	0.017	0.021	0.210	0.078	0.026	0.008	0.010	0.024	0.010		0.014	0.006	0.002			0.013	0.011	0.015	0.012	0.011		0.017
Diuron	H								0.030																			
Imidacloprid	I-N		0.007									0.005	0.006		0.005						0.004	0.005	0.003	0.006			0.004	
MCPP	H								0.160	0.055																		
Metalaxyl	F				0.042																							
Methomyl	I-C												0.004															
Oxamyl	I-C												0.004															
Oxamyl oxime	D-C			0.013																								
Pentachlorophenol	WP		0.018						0.035							0.017				0.033	0.016							
Prometon	H							0.110																				
Triclopyr	H	0.034	0.033	0.031	0.080			0.049	0.140	0.092	0.049			0.070	0.053	0.031	0.036	0.031			0.031		0.037		0.080	0.052	0.048	0.150
Total Suspended Solids	NA	3.0	2.0	2.0	7.0	8.0	2.0	<3.0	17.0	6.0	5.3	4.0	4.0	4.0	4.0	4.0	3.0	4.0	2.0	9.0	2.0	3.0	2.0	4.0	2.0	9.0	2.0	3.0

C: Carbamate, D: Degradate, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, WP: Wood Preservative

Skagit-Samish Basins

Big Ditch

A total of 30 pesticides and degradates were detected in Big Ditch in 2010. Of these, 22 were found at the upper Big Ditch site (Table E-4). A total of 26 pesticides and degradates were found at the lower Big Ditch site (Table E-5).

During 2010 no detections at either Big Ditch site were above pesticide assessment criteria or water quality standards.

Comparison of Upper Big Ditch to Lower Big Ditch

In 2010 the upper and lower sites on Big Ditch were sampled weekly on the same day. During the year, 18 pesticides were detected in common between the two sites: 2,4-D, bromacil, carbaryl, carbofuran, chlorpropham, dicamba, dichlobenil, diuron, eptam, imidacloprid, MCPA, mecoprop (MCPP), metalaxyl, Methiocarb, Metolachlor, pentachlorophenol, prometon, and triclopyr. Four compounds were detected only at the upper site: oxamyl, picloram, tebuthiuron, and the synergist piperonyl butoxide. Eight compounds were detected only at the lower site: 3-hydroxycarbofuran, atrazine, bentazon, cycloate, ethoprop, fipronil, linuron, and trifluralin.

Table E-4. Upper Big Ditch 2010.

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			0.063	0.045		0.160		0.120	0.170			0.052	0.170		0.235								0.058				0.073
Bromacil	H	0.045	0.050		0.055	0.043		0.059			0.048	0.037	0.035	0.060	0.021	0.061	0.068	0.058	0.042	0.033	0.050	0.057	0.062	0.051	0.050	0.055	0.057	
Carbaryl	I-C								0.005																			
Carbofuran	I-C												0.003															
Chlorpropham	H																						0.038					
Dicamba I	H								0.026					0.016		0.150												
Dichlobenil	H	0.029	0.022	0.067	0.046	0.013	0.022	0.012	0.056	0.097	0.011	0.009	0.010	0.062	0.020	0.022	0.015	0.007	0.002		0.006	0.011	0.011	0.015	0.021	0.012	0.007	
Diuron	H								0.032				0.017	0.062	0.041	0.074								0.041			0.130	0.089
Eptam	H										0.027																	
Imidacloprid	I-N		0.017			0.009	0.012	0.016	0.072	0.095	0.093	0.387	0.079	0.023	0.133	0.016	0.012	0.018	0.215	0.095	0.035	0.303	0.033	0.009	0.879		0.005	
MCPA	H								0.041							0.060												
MCPP	H								0.048	0.120				0.026														0.040
Metalaxyl	F										0.060				0.049					0.250	0.190	1.000			0.083			
Methiocarb	I-C	0.003																										
Metolachlor	H															0.041												
Oxamyl	I-C																0.003	0.004		0.003								
Pentachlorophenol	WP	0.025	0.019						0.032	0.025			0.021	0.024	0.021	0.020												
Picloram	H											0.061						0.120										
Piperonyl Butoxide	Sy									0.120																		
Prometon	H	0.130		0.046										0.040														
Tebuthiuron	H																	0.054				0.035				0.036	0.047	
Triclopyr	H			0.040	0.051				0.077	0.070			0.063	0.110	0.042	0.043	0.030							0.043				0.066
Total Suspended Solids	NA	12.0	3.0	12.0	5.0	3.0	3.0	4.0	8.5	15.0	3.5	6.0	7.0	9.0	4.0	4.0	4.0	8.0	7.0	5.0	4.0	11.5	9.0	6.5	16.0	8.0	5.5	7.0

C: Carbamate, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, Sy: Synergist, WP: Wood Preservative

Table E-5. Lower Big Ditch 2010.

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		0.057	0.086	0.098			0.077		0.110			0.140	0.160	0.110	0.033												0.041
3-Hydroxycarbofuran	D-C													0.004														
Atrazine	H		0.054														0.059											
Bentazon	H				0.056																							
Bromacil	H											0.022																
Carbaryl	I-C					0.012																						
Carbofuran	I-C					0.067						0.005	0.005	0.584	0.018	0.008	0.004											
Chlorpropham	H	0.770	1.500	0.690	0.260	0.056	0.250	0.067	0.024																			
Cycloate	H													0.073														
Dicamba I	H	0.053	0.026													0.026												
Dichlobenil	H		0.024	0.009	0.037		0.012		0.010	0.052	0.006	0.007	0.006	0.032	0.016	0.011	0.009										0.006	0.009
Diuron	H						1.500	1.300	0.230	3.400	0.115	0.160	0.100	1.100	0.098	0.290		0.012										
Eptam	H						0.080	0.081			0.210		0.024															
Ethoprop	I-OP													0.200														
Fipronil	I-Pyra													0.037														
Imidacloprid	I-N								0.034	0.166	0.055	0.055	0.024	0.024	0.023	0.014	0.027	0.022	0.007		0.003		0.008					
Linuron	H																											0.014
MCPA	H			0.250	0.110		0.270		0.029				0.300	0.092	0.034													
MCPP	H							0.026	0.022																			
Metalaxyl	F									0.096				0.110														
Methiocarb	I-C	0.002				0.060																						
Metolachlor	H	0.036	0.045	0.036	0.065	0.028	0.049	0.027	0.056	0.066	0.042	0.110	0.060	0.190	0.074	0.081	0.040	0.024										0.029
Pentachlorophenol	WP	0.022		0.022	0.031				0.021	0.029			0.020		0.022	0.019											0.026	0.026
Prometon	H												0.046														0.034	0.042
Triclopyr	H				0.064					0.058			0.089	0.092	0.052	0.031	0.086	0.034									0.026	0.040
Trifluralin	H										0.015																	
Total Suspended Solids	NA	7.0	13.0	10.0	10.0	6.0	9.0	9.0	11.0	12.0	8.5	25.0	8.0	11.0	9.0	6.0	4.3	4.0	5.0	4.0	2.0	2.0	2.0	<1.0	2.0	2.0	2.0	1.0

C: Carbamate, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, OP: Organophosphate, Pyra: Pyrethroid, WP: Wood Preservative

Indian Slough

A total of 23 pesticides and degradates were detected in Indian Slough in 2010 (Table E-6). No detections were above assessment criteria or water quality standards.

Table E-6. Indian Slough 2010.

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	0.120	0.049						0.051	0.250		0.040	0.044	0.440					0.073					0.043			3.000	1.600
Bentazon	H		0.035																									
Bromacil	H	0.037				0.031	0.037	0.040	0.082	0.120	0.035	0.029	0.035	0.205	0.140	0.080	0.060	0.047	0.032	0.027	0.036	0.041	0.042	0.038	0.035	0.041	0.650	0.310
Carbaryl	I-C													0.015														
Carbofuran	I-C									0.004			0.004	0.033	0.006	0.004												
Chlorothalonil	F														0.024													
Chlorpropham	H									0.110																		
Dicamba I	H																							0.019			0.200	0.073
Dichlobenil	H	0.009	0.022	0.026	0.039	0.011	0.009		0.018	0.130	0.006	0.006		0.037	0.075	0.011	0.007						0.009				0.007	0.026
Diphenamid	H					0.017	0.022				0.006	0.007	0.005			0.025	0.026	0.022			0.014		0.017			0.014	0.022	
Diuron	H								0.038	0.280				3.600	0.260	0.440		0.012								0.310	1.000
Eptam	H											0.036	0.022	0.069														
Ethoprop	I-OP													0.290														
Hexazinone	H	0.079		0.085		0.069	0.110			0.084	0.073	0.060	0.058	0.110	0.061	0.120	0.120	0.065	0.045		0.050							
Imidacloprid	I-N													0.020	0.007													
MCPP	H																										0.330	0.140
Metolachlor	H				0.038									0.195	0.018	0.043							0.029		0.015	0.015	0.028	0.079
Metribuzin	H													0.210														
Napropamide	H													0.440														
Pentachlorophenol	WP		0.023		0.028	0.019			0.023						0.023	0.019												
Prometon	H									0.036																	0.055	
Tebuthiuron	H																					0.040		0.039	0.040	0.045	0.049	
Triclopyr	H	0.089	0.029		0.043				0.053	0.175			0.036	0.230	0.083	0.037	0.040		0.062	0.033							0.530	0.640
Total Suspended Solids	NA	14.3	9.8	9.0	7.0	8.5	7.0	9.8	6.0	11.0	9.0	7.8	7.0	10.0	6.0	6.0	7.3	9.0	6.8	6.0	3.0	22.0	4.0	4.0	4.0	2.0	3.0	5.0

C: Carbamate, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, OP: Organophosphate, WP: Wood Preservative

Browns Slough

A total of 15 pesticides and degradates were detected in Browns Slough in 2010 (Table E-7). No detections were above assessment criteria or water quality standards.

Table E-7. Browns Slough 2010 – Freshwater and Marine Criteria.

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											0.063		0.043							0.047	0.370						
Bentazon	H	0.096	0.084											0.250		0.110												
Carbofuran	I-C												0.004	0.097	0.023	0.015	0.006	0.004										
DCPA	H	0.100	0.091	0.075	0.120	0.091	0.250	0.230	0.047	0.100	0.041	0.046	0.050	0.110	0.072	0.200	0.045	0.098	0.051	0.049				0.032				
Dicamba I	H																				0.022	0.160						
Dichlobenil	H	0.013	0.014	0.008			0.010							0.009														0.010
Diuron	H								0.031					0.190		0.042												
Eptam	H							0.037				0.050	0.030	0.034														
Imidacloprid	I-N													0.020	0.008	0.004			0.007	0.008								
MCPA	H							0.410	0.066			0.066	0.033	0.044														
Metalaxyl	F													0.064														
Metolachlor	H							0.130	0.021	0.015		0.011	0.008	0.590	0.028	0.046	0.035											
Simazine	H			0.037		0.072	0.034							0.031														
Terbacil	H													0.056														
Triclopyr	H						0.055							0.042														
Total Suspended Solids	NA	4.0	7.0	17.3	8.0	8.0	6.0	15.0	5.0	6.0	6.0	6.0	7.0	5.0	5.0	5.0	4.0	6.0	6.0	6.5	5.0	2.0	5.0	8.0	4.0	8.0	4.0	10.3

C: Carbamate, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable

Samish River

A total of five pesticides were detected in the Samish River in 2010 (Table E-8). No detections were above assessment criteria or water quality standards.

Table E-8. Samish River 2010.

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																0.022	0.031										0.120
Dicamba I	H																0.010	0.013										
Dichlobenil	H									0.019				0.010														
Ethoprop	I-OP													0.054														
Triclopyr	H																											0.050
Total Suspended Solids	NA	8.0	7.0	10.5	17.0	10.5	11.0	8.0	12.0	151.0	12.0	10.0	6.0	51.0	18.0	13.0	9.0	5.0	5.0	2.0	3.5	5.0	3.0	5.0	4.0	4.0	7.0	8.0

H: Herbicide, I: Insecticide, NA: Not Applicable, OP: Organophosphate

Lower Yakima Basin

Spring Creek

A total of 17 pesticides and degradates were detected in Spring Creek in 2010. Of these, 14 were detected at the upper Spring Creek site (Table E-9) and 15 were detected in the lower Spring Creek site (Table E-10).

The upstream Spring Creek site met pesticide assessment criteria and water quality standards. At the lower Spring Creek site, one detection of chlorpyrifos on March 30 was above the chronic water quality standard and NRWQC for fish and the EPA chronic invertebrate criteria. Because the chlorpyrifos concentration exceeded criteria and standards only once, it is unlikely that the time component of the chronic water quality standard and NRWQC was exceeded.

Comparison of Upper Spring Creek to Lower Spring Creek

In 2010 the upper Spring Creek site was sampled every other week and the lower site was sampled weekly. During the year, 12 pesticides and degradates were detected in common between the two sites: 2,4-D, atrazine, bentazon, carbaryl, chlorpyrifos, diazinon, dicamba I, dichlobenil, diuron, imidacloprid, MCPA, and oxamyl oxime.

Carbofuran and oryzalin were detected only at the upstream site. Three pesticides were detected only at the lower site: bromacil, norflurazon, and prometon.

Table E-9. Upper Spring Creek 2010.

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					0.040	0.050		0.037	0.038	0.050				
Atrazine	H							0.028	0.027						
Bentazon	H	0.051	0.047												
Carbaryl	I-C					0.027	0.024								
Carbofuran	I-C									0.005					
Chlorpyrifos	I-OP			0.020											
Diazinon	I-OP											0.120			
Dicamba I	H					0.019	0.017								
Dichlobenil	H			0.010											
Diuron	H					0.150		0.045							
Imidacloprid	I-N						0.005	0.007	0.005	0.006	0.004	0.006	0.004		
MCPA	H						0.025								
Oryzalin	H			1.000											
Oxamyl oxime	D-C		0.019												
Total Suspended Solids	NA	7.0	10.0	23.0	29.0	16.0	143.0	46.0	19.0	50.0	17.0	22.0	15.0	7.5	10.0

C: Carbamate, D: Degradate, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not Applicable, OP: Organophosphate

Table E-10. Lower Spring Creek 2010.

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				0.031	0.031		0.100	0.032	0.041		0.047	0.027			0.022	0.051	0.047	0.130	0.038	0.029	0.046	0.041		0.065	0.097	0.050	0.110
Atrazine	H													0.027												0.012		
Bentazon	H		0.035				0.032																					
Bromacil	H																				0.030	0.029		0.026			0.024	
Carbaryl	I-C								0.010	0.015	0.021	0.016	0.005	0.007														
Chlorpyrifos	I-OP			0.034	0.061	0.033																						
Diazinon	I-OP																					0.021						
Dicamba I	H									0.017		0.015	0.014						0.015	0.010				0.014				
Dichlobenil	H		0.005		0.012																							
Diuron	H									0.053				0.060														
Imidacloprid	I-N											0.005		0.006	0.005	0.004	0.005	0.005				0.005	0.005	0.004		0.003	0.003	
MCPA	H											0.024																
Norflurazon	H											0.030																
Oxamyl oxime	D-C			0.026																								
Prometon	H								0.009																			
Total Suspended Solids	NA	2.0	2.0	2.0	30.0	14.0	3.0	9.0	7.0	11.0	13.0	30.0	18.0	8.0	7.0	2.0	2.0	2.0	7.0	4.0	5.0	12.5	12.0	13.0	12.0	3.0	3.0	2.0

C: Carbamate, D: Degradate, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not Applicable, OP: Organophosphate WP: Wood Preservative, OP: Organophosphate

Marion Drain

A total of 23 pesticides and degradates were detected in Marion Drain in 2010 (Table E-11).

Malathion was detected above EPA chronic invertebrate assessment criteria once in 2010; however, this single event did not exceed the 21-day time component of the chronic invertebrate criteria. No other detections were above assessment criteria or water quality standards.

Table E-11. Marion Drain 2010.

Month		March				April				May				June					July				August					Sep				Oct			
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							0.045	0.051	0.064	0.034	0.056	0.029	0.037		0.040	0.033	0.042	0.038	0.050	0.048	0.079	0.059	0.040	0.045	0.043	0.081	0.032							
Atrazine	H									0.041																									
Bentazon	H																0.051	0.073	0.160	0.250	0.150	0.230	0.094	0.170	0.130			0.097							
Bromacil	H									0.052							0.051	0.026																	
Bromoxynil	H							0.051	0.076	0.050	0.032	0.035																							
Carbaryl	I-C								0.009	0.011	0.016						0.008	0.007																	
Chlorpyrifos	I-OP																										0.023		0.027		0.022	0.020	0.020		
Dicamba I	H								0.017	0.019	0.016	0.023	0.011	0.011		0.011	0.019	0.011	0.013	0.014	0.029	0.027	0.032	0.016	0.014	0.011		0.015							
Disulfoton sulfone	I-OP																								0.023		0.044		0.045						
Disulfoton sulfoxide	D-OP																								0.011		0.110								
Diuron	H								0.030	0.210	0.016	0.097		0.033		0.037																			
Eptam	H										0.028																								
Ethoprop	I-OP																									0.057	0.110								
Imidacloprid	I-N		0.004						0.004			0.006	0.006	0.005	0.005	0.005	0.006	0.004	0.005	0.004		0.005	0.006	0.005	0.006	0.006	0.009								
Malathion	I-OP											0.062	0.044																						
MCPA	H							0.066		0.032		0.036	0.022				0.025				0.026														
Methomyl	I-C												0.004						0.003	0.003		0.043				0.004									
Metolachlor	H													0.034		0.032		0.023																	
Pendimethalin	H							0.099	0.075	0.087	0.075	0.098	0.039	0.042	0.032	0.064	0.049	0.037		0.025																
Propargite	I-SE															0.110																			
Simazine	H									0.081				0.023																					
Terbacil	H							0.200	0.160	0.420	0.097	0.160	0.050	0.064	0.059	0.180	0.190	0.080	0.032	0.270	0.220	0.087	0.050	0.043		0.034	0.057	0.270	0.580	0.505	0.150	0.038	0.170		
Trifluralin	H							0.020		0.030	0.023	0.023	0.015	0.028	0.012	0.027																			
Total Suspended Solids	NA	6.3	10.0	16.5	10.0	16.0	47.0	48.3	19.0	16.5	13.0	12.3	21.0	23.0	23.0	9.0	4.0	5.0	1.0	3.0	5.0	3.0	26.0	6.0	2.0	5.0	11.0	9.0	8.0	11.0	17.0	4.0	8.8	5.0	9.0

C: Carbamate, D: Degradate, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not Applicable, OP: Organophosphate SE: Sulfite Ester

Sulphur Creek Wasteway

A total of 22 pesticides and degradates were detected in Sulphur Creek Wasteway in 2010 (Table E-12).

In March there were two consecutive detections of chlorpyrifos that did not meet (were above) the chronic water quality standard and EPA's chronic invertebrate criteria. In addition, one of these detections also did not meet the acute water quality standard and EPA's acute invertebrate criteria. Chlorpyrifos chronic water quality standard and NRWQC are not met when the 4-day average concentration is above the numerical criteria. Because chlorpyrifos was detected in two consecutive weeks, the time component of the chronic water quality standard and NRWQC was not met.

Table E-12. Sulphur Creek Wasteway 2010.

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				0.041	0.036	0.028	0.073	0.074	0.068	0.120	0.093	0.040	0.057	0.031	0.058	0.210	0.054	0.038	0.440	0.100	0.087		0.050	0.110	0.270	0.350	0.210
Acetochlor	H									0.032				0.041														
Bentazon	H	0.052	0.049																									
Bromacil	H	0.048	0.047			0.018	0.024			0.020		0.028		0.044		0.045	0.041	0.036		0.017	0.024							
Carbaryl	I-C								0.023	0.015	0.013	0.040	0.005	0.009		0.011	0.007	0.012	0.009					0.004				
Chlorpyrifos	I-OP			0.096	0.053	0.028	0.024																					
DCPA	H		0.044							0.031							0.029	0.047	0.038	0.033								
DDVP	I-OP																	0.069										
Diazinon	I-OP																										0.033	
Dicamba I	H									0.026	0.024	0.024			0.015		0.015	0.013	0.015	0.021	0.017			0.017	0.019			0.018
Dichlobenil	H		0.004											0.005									0.009					
Disulfoton sulfoxide	D-OP																											0.026
Diuron	H								0.030	0.097	0.051	0.260		0.540		0.083	0.044											
Hexazinone	H	0.062									0.410			0.057														
Imidacloprid	I-N			0.005								0.005	0.005	0.006	0.005	0.004	0.005	0.042			0.004	0.004	0.003	0.003	0.003		0.003	
MCPA	H								0.029	0.029		0.037																
Methomyl	I-C											0.004	0.004															
Oxamyl	I-C																			0.003								
Pendimethalin	H							0.055																				
Simazine	H													0.049														
Terbacil	H																	0.036								0.025		0.095
Trifluralin	H										0.017					0.025												
Total Suspended Solids	NA	10.0	7.0	251.0	48.0	56.0	50.0	94.0	160.0	45.0	26.0	39.0	53.0	60.0	39.0	9.0	27.0	15.0	16.4	15.0	17.0	8.0	41.0	16.0	18.0	17.0	18.0	21.0

C: Carbamate, D: Degradate, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not Applicable, OP: Organophosphate

Wenatchee and Entiat Basins

Peshastin Creek

A total of four pesticides and degradates were detected in Peshastin Creek in 2010 (Tables E-13).

Endosulfan I was detected above the ESLOC for rainbow trout once in March. No other detected pesticides were above assessment criteria or water quality standards.

Table E-13. Peshastin Creek 2010.

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					0.004																						
Diuron	H																											0.120
Endosulfan I	I-OC			0.045																								
Simazine	H																											0.047
Total Suspended Solids	NA	2.0	2.0	1.0	7.0	2.0	<3.0	39.0	9.5	2.0	2.0	55.0	5.0	12.0	10.0	12.0	5.0	3.5	2.0	2.0	1.0	1.0	4.0	2.0	1.0	<1.0	6.0	42.0

C: Carbamate, D: Degradate, H: Herbicide, I: Insecticide, NA: Not Applicable, OC: Organochlorine

Mission Creek

In 2010 two compounds were detected in Mission Creek, an insecticide and a pesticide synergist (Tables E-14).

No detections were above assessment criteria or water quality standards.

Table E-14. Mission Creek 2010.

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
Carbaryl	I-C								0.007				0.006															
Piperonyl Butoxide	Sy			0.660																								
Total Suspended Solids	NA	7.0	4.0	2.0	25.0	8.0	3.0	268.0	105.0	10.0	10.0	143.0	24.0	22.5	427.0	95.0	32.0	30.0	12.0	9.0	8.0	5.0	6.0	2.0	2.0	2.0	3.0	4180

C: Carbamate, I: Insecticide, NA: Not Applicable, Sy: Synergist

Brender Creek

A total of 15 pesticides and degradates were detected in Brender Creek in 2010 (Tables E-15).

On March 24, total endosulfan was detected above the ESLOC for fish and above the chronic water quality standard.

One detection of chlorpyrifos on April 12 was above the acute and chronic water quality standard and EPA criteria. Because there was only one detection, the time component of the 4-day exposure criteria for the chronic water quality standard and NRWQC was likely not exceeded. The 21-day exposure criterion for the EPA chronic criteria was probably not exceeded with only two consecutive weeks of detections.

On September 8, one detection of diazinon was above EPA's acute and chronic criteria.

DDT and DDT degradates were found consistently throughout 2010; however, these compounds were detected less than in previous years. In 2010 there were 18 sample events out of 27 where total DDT concentrations were above the chronic water quality standard. 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-15. Brender Creek 2010.

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
4,4'-DDD	D-OC									0.018						0.025	0.027	0.020	0.023	0.024				0.014		0.012	0.013	0.027
4,4'-DDE	D-OC								0.042	0.042	0.026					0.043	0.029	0.012	0.006	0.014	0.024	0.021	0.038	0.011		0.024	0.033	0.045
4,4'-DDT	I-OC									0.028	0.023	0.023	0.017		0.020	0.045	0.041	0.023	0.024	0.027	0.024			0.026		0.021	0.026	0.045
Carbaryl	I-C									0.028	0.017		0.005	0.006														0.006
Chlorpyrifos	I-OP					0.024	0.120	0.029	0.027																			
Diazinon	I-OP								0.028																	0.019		0.230
Dichlobenil	H														0.004													
Diuron	H								0.031	0.180	0.024	0.860	0.025	0.038		0.070							0.067					0.047
Endosulfan I	I-OC			0.054	0.027																							
Endosulfan II	I-OC			0.029					0.029	0.035																		
Endosulfan Sulfate	D-OC			0.043	0.052	0.035	0.052	0.058	0.100	0.065	0.054	0.059	0.037	0.045	0.044	0.056	0.046	0.040	0.049	0.049				0.022		0.021	0.027	0.062
Imidacloprid	I-N											0.006		0.005								0.005	0.003	0.008	0.003	0.003		0.037
Norflurazon	H											0.470						0.049	0.022						0.032		0.040	0.120
Pendimethalin	H									0.041							0.048											
Pentachlorophenol	WP						0.016	0.016		0.020	0.015			0.015														
Total Suspended Solids	NA	11.0	13.0	7.0	7.0	7.0	44.0	14.0	249.0	108.0	53.5	50.5	25.0	7.0	36.0	83.0	68.0	25.0	30.0	54.0	37.0	25.0	103.0	21.0	12.0	31.0	143.0	125.0

C: Carbamate, D: Degradate, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not Applicable, OC: Organochlorine, OP: Organophosphate, WP: Wood Preservative

Wenatchee River

A total of five pesticides were detected in the Wenatchee River in 2010 (Tables E-16). No pesticide detections were above assessment criteria or water quality standards.

Table E-16. Wenatchee River 2010.

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																											0.040
Carbaryl	I-C													0.006														
Chlorpyrifos	I-OP					0.025																						
Dicamba I	H																											0.017
Diuron	H																											0.027
Total Suspended Solids	NA	2.0	2.0	2.0	4.0	3.0	4.0	25.5	6.0	6.0	3.0	70.0	8.0	12.0	18.0	17.0	15.0	10.0	4.0	6.0	6.0	3.0	9.0	3.0	2.0	2.0	2.0	30.0

C: Carbamate, H: Herbicide, I: Insecticide, NA: Not Applicable, OP: Organophosphate

Entiat River

A total of four pesticides and one synergist were detected in the Entiat River in 2010 (Tables E-17).

On September 1, there was one detection of DDT that was above the chronic water quality standard and EPA criteria. The chronic water quality standard is based on a 24-hour average concentration.

Table E-17. Entiat River 2010.

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					0.040	0.095																					
4,4'-DDT	I-OC																										0.021	
Carbaryl	I-C								0.003		0.017																	
Imidacloprid	I-N														0.006													
Piperonyl Butoxide	Sy		0.280																									
Total Suspended Solids	NA	3.0	4.0	2.0	4.0	3.0	4.0	21.0	7.0	4.0	5.0	31.0	8.0	11.0	7.0	31.0	13.0	8.0	7.0	6.0	4.0	3.0	5.0	3.0	3.0	2.0	2.0	2.0

H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not Applicable, OC: Organochlorine, Sy: Synergist