Results of Sampling to Verify 303(d) Metals Listings for Selected Washington State Rivers and Creeks

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Results of Sampling to Verify 303(d) Metals Listings for Selected Washington State Rivers and Creeks

by
Art Johnson and Steven Golding

Environmental Assessment Program
Olympia, Washington 98504-7710

August 2002

Waterbody Numbers: WA-07-1050, WA-08-1130, WA-09-1015, WA-34-1010, WA-37-1010, WA-37-1040, WA-38-1010, WA-54-1020.

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Abstract

A review of the 1998 303(d) list of water quality limited waterbodies in Washington State identified 45 listings for 11 rivers and streams where there was reason to question the appropriateness of their being listed for violations of state water quality standards for metals, due to the listing being based on questionable historical data, availability of newer data, or expected water quality improvements as a result of cleanups. It was recommended that 29 of these listings be removed, based on existing information.

The remaining listings were for the Snohomish River (copper and mercury), Naches River (silver), Yakima River (silver and mercury), Palouse River (chromium), Spokane River (chromium), May Creek (copper, lead, and zinc), and Mill Creek (mercury). May and Mill creeks are in King County. To determine if these listings accurately represented current conditions, water quality was monitored every other month from July 2001 through May 2002. Results showed no exceedances of the metals standards. It is recommended that these waterbodies also be removed from the 303(d) list for the metals in question.

Acknowledgements

Jonathan Frodge and Douglas Henderson of King County and Bill Enkeboll of Landau Associates provided water quality data and other information related to May and Mill creeks. Jim Ross of the Ecology Freshwater Monitoring Unit collected the samples from the Palouse and Spokane rivers. Ecology's Carolyn Lee, Richard Jack, and Mike Sherman assisted with much of the other field work. The help of all these people is very much appreciated.

Samples for this study were analyzed by the Ecology Manchester Environmental Laboratory. Their good work is acknowledged, especially the efforts of Jim Ross, Sally Cull, Randy Knox, Dean Momohara, and Meredith Jones.

Introduction

To comply with requirements of the federal Clean Water Act, Section 303(d), every four years the Washington State Department of Ecology (Ecology) identifies polluted waterbodies that are not meeting state surface water quality standards and are not expected to improve within the next four years. The 303(d) list of water quality limited estuaries, lakes, rivers, and streams is then submitted to the U.S. Environmental Protection Agency (EPA). EPA requires the states to set priorities for cleaning up threatened waters and to establish a Total Maximum Daily Load (TMDL) for each. A TMDL entails an analysis of how much pollution a waterbody can assimilate and still remain healthy for its intended uses.

In June 2001, Ecology's Environmental Assessment Program (EAP) reviewed the 1998 303(d) listings for waterbodies that exceeded standards for toxic chemicals in the water column or in edible fish tissue. During the course of this review, 45 metals listings for 11 rivers and streams were identified where newer water quality data justified their removal from the 303(d) list or where further sampling was recommended to verify old or questionable data on which the listing was based (Appendix A).

The verification sampling was conducted on seven 303(d) listed waterbodies where metals concentrations were reported to have exceeded aquatic life standards. These listings and the reasons for re-sampling are summarized in Table 1. Results from this effort are the subject of the present report.

Ecology's current policy for placing a waterbody on the 303(d) list for metals in the water column is as follows: "A segment will be placed on the 303(d) list due to toxic pollutants in the water column when two or more samples within a three-year period exceed the numeric state water quality criteria (WAC 173-201A-040) or the National Toxic Rule criteria (40CFR Part 131). A segment will be placed in the *Waters of Concern* category if any one sample exceeds the criteria." (Draft Water Quality Program Policy 1-11, May 2002).

Table 1. Waterbodies Where Sampling Was Done to Verify 1998 303(d) Metals Listings
[see Appendix A for a more detailed discussion of this information]

Segment Waterbody Parameter	Data Source Basis for Listing	Reason for Verification Sampling
WA-07-1050 Snohomish River Cu,Hg	USGS ambient data (dates uncertain) 4 excursions near Monroe (07A111)	Inconsistent with Ecology data for nearby locations.
WA-08-1130 May Creek Cu,Pb,Zn	METRO 1994 ambient data Numerous excursions at various sites	Determination that dissolved standards were exceeded was based on theoretical calculations using total recoverable data.
WA-09-1015 Mill Creek Hg	Ecology ambient 1987-90 data Numerous excursions at station 09E090 (r.m. 1.5)	Cleanup of major source (Western Processing) has occurred.
WA-09-1015 Mill Creek Hg	METRO 1989-90 data 2 excursions at station 0317 (r.m. 1.0)	Cleanup of major source (Western Processing) has occurred.
WA-09-1015 Mill Creek Hg	Ecology ambient 1984-90 data Numerous excursions at station 09E070 (r.m. 0.1)	Cleanup of major source (Western Processing) has occurred.
WA-34-1010 Palouse River Cr	Ecology ambient 1987-91data 5 excursions at Hooper (34A070)	Ecology Cr data prior to 1994 are suspect.
WA-37-1040 Yakima River Hg,Ag	USGS Fuhrer (1996) 2 excursions (1987-90) above Ahtanum Cr. (station #32)	USGS metals data from this time period are known to be unreliable.
WA-37-1010 Yakima River Hg,Ag	USGS Fuhrer (1996) 2 excursions (1987-90) above Satus Cr. (station #52)	USGS metals data from this time period are known to be unreliable.
WA-37-1010 Yakima River Hg	USGS Fuhrer (1996) 3 excursions (1987-90) at Kiona (station #50)	USGS metals data from this time period are known to be unreliable.
WA-38-1010 Naches River Ag	USGS Fuhrer (1996) 2 excursions (1987-90) near north Yakima (station #26)	USGS metals data from this time period are known to be unreliable.
WA-54-1020 Spokane River Cr	Ecology ambient 1989-91 data 2 excursions at station 54A120 (r.m. 66)	Ecology Cr data prior to 1994 are suspect .

Sampling Design

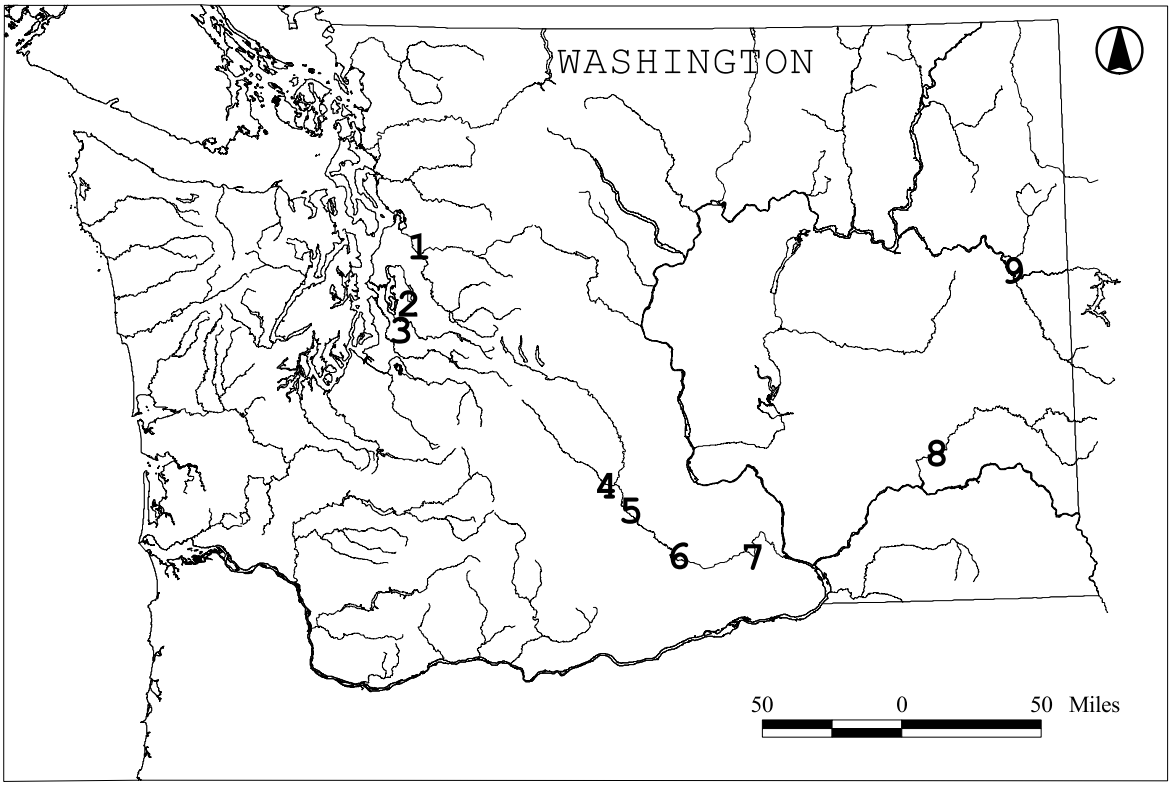
Water sampling was conducted at the 11 sites shown in Figure 1. Each site for which there is a 303(d) metals listing was sampled, except for May and Mill creeks. Because of the proximity of the historical stations on these two creeks, only the upper and lower sites were monitored. The metals analyzed for each waterbody were generally limited to those on the 303(d) list, although data on other metals were obtained for some sites.

The 303(d) listings for the Snohomish River are for an historical U.S. Geological Survey (USGS) station on the Highway 522 bridge. This bridge has become unsafe for field personnel because of its narrow sidewalk and heavy traffic. Therefore the site for verification sampling was moved downstream approximately three miles. The new site affords better mixing of the Snoqualmie and Skykomish rivers, which meet just upstream of Highway 522. Detailed descriptions of the Snohomish River site and other sampling locations for this study are provided in Appendix B.

In an effort to cover a range of water quality conditions, sampling was conducted at each site every other month over a one-year period. Six sets of samples were collected in all, beginning in July 2001 and ending in May 2002. Sample size was selected to balance representativeness against cost. Although the historical data on which some of the listings are based included larger numbers of samples (e.g., USGS data for the lower Yakima River), it has already been established that these data are unreliable (Appendix A) and, therefore, a larger sampling effort was not warranted.

All samples were collected as simple grabs. Clean sampling techniques were used, following the guidance in EPA (1995) *Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Levels*. Metals were analyzed as dissolved or total, in keeping with the form specified in the water quality standards. Samples for dissolved zinc, copper, lead, chromium, and silver were filtered in the field. Mercury was analyzed as the total concentration in whole water samples. Ancillary parameters included temperature, conductivity, hardness, and total suspended solids. Flow data were obtained from USGS, the U.S. Bureau of Reclamation, or King County.

A quality assurance project plan was prepared for this study (Johnson, 2001).



1. Snohomish River below Monroe
2. May Creek (upper and lower)
3. Mill Creek (river miles 1.5 and 0.1)
4. Naches River near Yakima
5. Yakima River above Ahtanum Creek
6. Yakima River above Satus Creek
7. Yakima River @ Kiona
8. Palouse River @ Hooper
9. Spokane River @ Riverside State Park

Figure 1. Sampling Sites for Verifying Selected 1998 303(d) Metals Listings

Methods

Field

Table 2 lists the sample size, container, preservation, and holding time for each study parameter. Sample containers were obtained from the Ecology Manchester Environmental Laboratory.

Table 2. Field Procedures

Parameter	Sample Size	Container	Preservation	Holding Time
Silver	500 mL	500 mL Teflon bottle	HNO_3 to pH<2, 4°C	6 months
Chromium	500 mL	500 mL Teflon bottle	HNO_3 to pH<2, 4°C	6 months
Copper	500 mL	500 mL Teflon bottle	HNO_3 to pH<2, 4°C	6 months
Mercury	500 mL	500 mL Teflon bottle	HNO_3 to pH<2, 4°C	28 days
Hardness	100 mL	125 mL poly bottle	HNO_3 to pH<2, 4°C	6 months
TSS	1000 mL	1000 mL poly bottle	Cool to 4°C	7 days
Conductivity	300 mL	500 mL poly bottle	Cool to 4°C	28 days

Metals sampling methods followed EPA Method 1669 guidance. For most waterbodies, the samples were taken by wading into center channel or from the bank with the sample bottle attached to the end of a polyethylene pole. The Palouse and Spokane river samples were collected with a stainless steel bridge sampler developed by the EAP Freshwater Monitoring Unit (Hopkins, 1996). Metals samples were collected directly into pre-cleaned 500 mL Teflon bottles.

Samples for dissolved metals were filtered in the field through a pre-cleaned 0.45 um Nalgene filter unit (#450-0045, type S). The filtrate was transferred to a new pre-cleaned 500 mL Teflon bottle. Whole and filtered water samples were preserved to pH <2 with sub-boiled 1:1 nitric acid, carried in small Teflon vials, one per sample. Teflon sample bottles, Nalgene filters, and Teflon acid vials were cleaned at Manchester Laboratory, as described in Kammin et al. (1995), and sealed in plastic bags. Non-talc nitrile gloves were worn by personnel filtering the samples. Filtering was done in a glove box constructed of a PVC frame and polyethylene cover.

The water samples were placed in polyethylene bags and held on ice for transport to Ecology headquarters. The samples were kept in a secure cooler and transported to Manchester Laboratory within one to two days of collection. Chain of custody was maintained.

Laboratory

Table 3 shows the laboratory procedures used in the study. All samples were analyzed at Manchester Laboratory.

Table 3. Analytical Methods

Analyte	Sample Matrix	Sample Prep Method	Analytical Method
Silver	filtered water	analyze directly	EPA 200.8
Chromium	filtered water	analyze directly	EPA 200.8
Copper	filtered water	analyze directly	EPA 200.8
Mercury	whole water	EPA 245.7[a]	EPA 245.7[a]
Hardness	whole water	N/A	SM2340B
TSS	whole water	N/A	EPA 160.2
Conductivity	whole water	N/A	EPA 120.1

[a]a CVAF method modified by Manchester to use CVAA

Data Quality

Manchester Laboratory prepared written quality assurance reviews on the quality of the metals data for this project (Appendix C). The reviews include an assessment of sample condition on receipt at the laboratory, compliance with holding times, instrument calibration, procedural blanks, laboratory control samples, standard reference material, matrix spike and matrix spike duplicate recoveries, and duplicate sample analyses. No problems were encountered that compromise the accuracy, validity, or usefulness of the data. The complete chemical data for this project are available from the author.

Two standard reference materials (SRMs) were analyzed with each set of metals samples: SLRS-4, River Water Reference Material for Trace Metals, National Research Council of Canada; and 1641d, Mercury in Water, National Institute of Standards & Technology. SLRS-4 has low certified values for zinc, copper, lead, and chromium in the range normally encountered in uncontaminated rivers and streams. 1641d was diluted to 0.032 ug/L, a concentration slightly above the state chronic standard. The results from analyzing the SRMs were in close agreement with certified values (Table 4). No appropriate reference material was available for silver.

Table 4. Results from Analyzing Standard Reference Materials[a] (ug/L)

Sample Set	Zinc	Copper	Lead	Silver	Mercury	Chromium
July 2001	0.98	1.71	0.080	<0.02	0.0324	0.25
"	0.99	1.71	0.081	0.022	na	0.23
September 2001	0.97	1.75	0.069	0.007	0.0361	0.29
"	1.0	1.74	0.064	0.006	0.0347	0.19
November 2001	0.57	1.80	0.079	<0.02	0.0327	0.39
"	0.53	1.76	0.076	<0.02	0.0329	0.38
January 2002	0.96	1.77	0.076	na	0.0322	0.39
"	0.94	1.75	0.096	na	0.0169	0.39
March 2002	1.0	1.78	0.075	na	0.0305	0.37
"	0.83	1.77	0.076	na	0.0295	0.36
June 2002	1.1	1.81	0.094	<0.02	0.0301	0.35
"	1.3	1.80	0.100	na	0.0320	0.36
certified value =	0.93 +/-0.10	1.81 +/-0.08	0.086 +/-0.007	nc nc	0.0318	0.33 +/-0.02

[a]SLRS-4 (River Water Reference Material for Trace Metals, Nat. Res. Council Canada) and 1641d (Mercury in Water (diluted), Nat. Inst. Standards & Technology)
na = not analyzed
nc = not certified

Field blanks were analyzed to detect metals contamination arising from sample containers or the filtration procedure. Bottle blanks were prepared at Manchester Laboratory by filling the 500 mL Teflon sample bottles with deionized water. Filter blanks were prepared by filtering half the contents of a bottle blank.

Bottle and filter blanks were analyzed on three occasions during the project (Table 5). Except for a trace amount of zinc in the July filter blank (0.2 ug/L), metals were not detected in the blanks. This demonstrates that the sample collection, preservation, and filtration procedures were not contributing significant amounts of metals to the samples.

Table 5. Metals Concentrations in Field Blanks (ug/L)

Sample Type	Date	Sample No.	Zinc	Copper	Lead	Mercury	Silver	Chromium
Filter Blank	07/25/01	308115	0.2	<0.05	<0.02	na	<0.02	<0.1
	11/13/01	468086	<1.0	<0.05	<0.02	na	<0.02	<0.25
	03/20/02	128161	<0.4	<0.05	<0.02	na	<0.02	<0.25
Bottle Blank	07/25/01	308114	<0.2	<0.05	<0.02	<0.002	<0.02	<0.1
	11/13/01	468087	<1.0	<0.05	<0.02	<0.002	<0.02	<0.25
	03/20/02	128162	<0.4	<0.05	<0.02	<0.002	<0.02	<0.25

na = not analyzed

The variability in the metals data reported here (field + laboratory) can be assessed from results on replicate samples collected from each waterbody (Table 6). In most cases (14 of 18) the replicates agreed within 33% or better. For unknown reasons, poor agreement was found for zinc (149%) and chromium (102%) in a pair of replicates collected from the Yakima River at Kiona. The Yakima is not listed for either of these metals. The replicate average is used in the remainder of this report, using the detection limit for non-detected values.

Table 6. Variability between Replicate Field Samples (ug/L)

Location	Sampling Date	Sample Number	Zinc	Copper	Lead	Chromium	Mercury	Silver
Naches River	09/12/01	378085	0.34	0.46	<0.02	<0.2	0.0023	<0.02
near Yakima	09/12/01	378086	0.33	0.45	<0.02	0.28	0.0027	<0.02
		RPD[a] =	3%	2%	0%	>33%	16%	0%
Yakima River	09/12/01	378089	4.4	0.78	<0.02	0.55	<0.002	<0.02
@ Kiona	09/12/01	378090	0.65	0.72	<0.02	1.7	0.0030	<0.02
		RPD =	149%	8%	0%	102%	>40%	0%
Mill Creek	11/13/01	468081	na	na	na	na	0.0044	na
@ R.M. 0.1	11/13/01	468082	na	na	na	na	0.0042	na
		RPD =					4%	
Snohomish River	3/20/02	128159	na	0.54	na	na	0.0038	na
below Monroe	3/20/02	128160	na	0.53	na	na	0.0034	na
		RPD =		2%			11%	
May Creek	5/15/02	208157	1.8	0.78	0.07	na	na	na
@ mouth	5/15/02	208158	1.9	0.74	0.05	na	na	na
		RPD =	5%	5%	33%			

[a]RPD = range as percent of replicate mean
na = not analyzed

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Results and Discussion

Streamflow and general water quality conditions at the time the metals samples were collected are shown in Table 7. The flows sampled generally covered the range of runoff conditions typical of these waterbodies. Table 8 illustrates this point by comparing the flows on sampling dates with the monthly averages, for sites where this information was available.

The highest of the flows sampled in May Creek and the Yakima River were lower than the historical average high flow. However, the reported exceedances of the metals standards that resulted in 303(d) listing of these waterbodies occurred during both high and low flows (King County, 1994: Fuhrer et al., 1996).

Table 9 has the metals data. Table 10 summarizes these data in terms of mean concentration, maximum concentration, and detection frequency. A few observations follow:

- The highest zinc and lead concentrations – 20 ug/L and 0.13 ug/L, respectively – occurred in the Spokane River, long known to be contaminated from historical mining activity in the Coeur D'Alene River drainage in Idaho.
- Copper concentrations were similar among sampling sites, ranging from 0.37 - 2.3 ug/L.
- The highest mercury concentrations – up to 0.0083 ug/L – were found in lower Mill Creek. This may represent residual contamination from the Western Processing superfund site, although upstream concentrations at river mile (R.M.) 1.5 were sometimes higher than downstream.
- Silver was not detected at or below 0.02 ug/L at any of the sites.
- Chromium concentrations ranged from 0.24 - 4.5 ug/L. The highest concentrations were in the Palouse and Spokane rivers, the two waterbodies listed for chromium.
- Zinc, copper, and chromium were detectable in most samples. Lead and mercury were detectable in relatively few samples. Silver was not detected in any samples.

In general, the highest zinc, copper, lead, and mercury concentrations occurred in the winter and spring. The highest chromium concentrations were in the summer or fall.

Table 11 shows the range of metals concentrations found in each waterbody and compares these values with the chronic standards for protection of aquatic life (Chapter 173-201A WAC). The standards for dissolved metals vary with hardness. The lowest hardness values observed in the study were used to calculate the standard, resulting in overstating how close metals concentrations approached standards. The acute standard is shown for silver because there is no chronic standard. A bold font is used to highlight results for those metals on the 1998 303(d) list for that waterbody.

Table 7. Flow and General Water Quality Conditions

Location	Date	Sample Number	Flow (cfs)	Temp. (oC)	Cond. (umhos/cm)	TSS (mg/L)	Hardness (mg/L)
Snohomish River	07/24/01	308109	3,010	17.2	52	2	20
below Monroe	09/11/01	378084	2,110	16.4	55	1	22
	11/13/01	468085	6,300	8.5	45	4	17
	01/30/02	058084	8,500	3.4	46	8	18
	03/20/02	128159	10,700	na	45	8	17
	05/15/02	208160	15,100	7.5	28	13	11
Upper May Creek	07/24/01	- -	- -	na	na	na	na
	09/11/01	378083	- -	13.3	170	<1	70
	11/13/01	468084	- -	9.8	159	5	62
	01/30/02	058083	- -	3.6	113	7	41
	03/20/02	128158	- -	na	101	11	38
	05/15/02	208159	- -	11.0	146	2	59
May Creek	07/24/01	308107	4.7	14.4	189	2	79
@ mouth	09/11/01	378082	3.9	12.0	196	<1	83
	11/13/01	468083	16	10.3	144	28	59
	01/30/02	058082	51	na	121	6	44
	03/20/02	128157	61	na	107	23	41
	05/15/02	208157	13	10.1	165	3	67
Mill Creek	07/24/01	308105	- -	17.7	274	5	na
@ R.M. 1.5	09/11/01	378080	- -	14.6	282	3	na
	11/13/01	468080	- -	10.7	75	6	na
	01/30/02	058080	- -	4.5	143	8	na
	03/20/02	128155	- -	5.6	80	10	na
	05/15/02	208155	- -	11.4	267	7	na
Mill Creek	07/24/01	308106	3.8	18.1	296	3	na
@ R.M. 0.1	09/11/01	378081	1.3	15.0	269	4	na
	11/13/01	468081	59	10.6	80	6	na
	01/30/02	058081	22	4.6	152	11	na
	03/20/02	128156	57	na	110	11	na
	05/15/02	208156	6.0	11.3	351	5	na
Naches River	07/25/01	308110	- -	19.3	95	5	38
near Yakima	09/12/01	378085	2,289	18.2	78	12	33
	11/14/01	468088	668	9.8	103	18	41
	01/29/02	058085	899	0.8	81	2	32
	03/21/02	138000	950	na	99	6	40
	05/16/02	208161	3,216	11.2	66	7	26

Table 7. (continued)

Location	Date	Sample Number	Flow (cfs)	Temp. (oC)	Cond. (umhos/cm)	TSS (mg/L)	Hardness (mg/L)
Yakima River	07/25/01	308111	- -	18.2	102	8	42
above Ahtanum Cr.	09/12/01	378087	- -	16.7	107	10	43
	11/14/01	468089	- -	9.5	155	4	59
	01/29/02	058086	- -	0.8	126	2	50
	03/25/02	138001	- -	na	131	7	51
	05/16/02	208162	- -	10.7	99	9	41
Yakima River	07/25/01	308112	- -	22.2	196	12	76
above Satus Creek	09/12/01	378088	- -	19.5	205	11	81
	11/14/01	468090	- -	9.4	209	11	82
	01/29/02	058087	- -	2.2	165	11	66
	03/25/02	138002	- -	na	178	11	69
	05/16/02	208163	- -	13.1	136	11	56
Yakima River	07/25/01	308113	681	23.7	259	7	99
@ Kiona	09/12/01	378089	948	20.7	300	1	118
	11/14/01	468091	1,640	8.9	261	9	102
	01/29/02	058088	3,140	3.0	186	10	74
	03/25/02	138003	2,710	na	193	10	98
	05/16/02	208164	3,120	17.7	171	21	68
Palouse River	07/10/01	286065	67	27.8	314	42	124
@ Hooper	09/11/01	378091	31	18.6	352	39	136
	11/06/01	468092	108	7.6	307	12	111
	01/15/02	058089	832	3.7	197	24	78
	03/13/02	128163	5,280	3.9	150	995	70
	05/15/02	208165	676	13.9	169	4.0	65
Spokane River	07/10/01	286060	1,460	17.5	210	1	93
@ Riverside St. Pk.	09/11/01	378092	1,000	11.9	280	3	139
	11/04/01	468093	2,500	10.6	147	1	66
	01/13/02	058090	6,130	5.2	90	4	41
	03/12/02	128164	6,670	3.6	111	490	54
	05/13/02	208166	16,200	9.6	62	5.0	29

Table 8. Streamflow during Sampling Events Compared to Historical Flows (cfs)

Location	Flow during metals sampling	Range of monthly average flows	Source of flow data
Snohomish River below Monroe	2,110 - 15,100	3,091 - 13,650	USGS #12150800 Snohomish River nr. Snohomish
May Creek @ mouth	3.9 - 61	9.7 - 107	King County
Mill Creek @ R.M. 0.1	1.3 - 59	4.3 - 36	USGS #12113349 Mill Creek @ Orilla
Naches River near Yakima	668 - 3,216	statistics not available	USBR NRYW Naches River nr. Yakima
Yakima River @ Kiona	681 - 3,140	1,459 - 5,830	USGS #12510500 Yakima River @ Kiona
Palouse River @ Hooper	31 - 5,280	34 - 1,845	USGS #1335100 Palouse River @ Hooper
Spokane River @ Riverside St. Pk.	1,000 - 16,200	1,749 - 17,930	USGS #12422500 Spokane River @ Spokane

Table 9. Metals Concentrations (ug/L; dissolved except total mercury)
[Results for metals that are on the 1998 303(d) list are highlighted in bold font.]

Location	Date	Sample Number	Zinc	Copper	Lead	Mercury	Silver	Chromium
Snohomish River	07/24/01	308109	1.1	**0.39**	0.028	**<0.002**	<0.02	0.21
below Monroe	09/11/01	378084	0.81	**0.43**	<0.02	**0.0031**	<0.02	0.33
	11/13/01	468085	<1.0	**0.46**	<0.02	**<0.002**	<0.02	<0.25
	01/30/02	058084	na	**0.53**	na	**<0.002**	na	na
	03/20/02	128159/60	na	**0.54**	na	**0.0036**	na	na
	05/15/02	208160	na	**0.53**	na	**0.0030**	na	na
Upper May Creek	07/24/01	- -	**na**	**na**	**na**	na	na	na
	09/11/01	378083	**0.24**	**0.48**	**<0.02**	na	<0.02	1.9
	11/13/01	468084	**1.3**	**1.2**	**0.096**	na	<0.02	0.76
	01/30/02	058083	**1.3**	**1.0**	**0.087**	na	na	na
	03/20/02	128158	**1.2**	**1.2**	**0.13**	na	na	na
	05/15/02	208159	**0.68**	**0.73**	**0.07**	na	na	na
May Creek	07/24/01	308107	**0.73**	**0.60**	**0.028**	na	<0.02	1.3
@ mouth	09/11/01	378082	**3.1**	**0.57**	**0.020**	na	<0.02	2.1
	11/13/01	468083	**12**	**2.3**	**0.28**	na	<0.02	0.80
	01/30/02	058082	**2.9**	**1.1**	**0.10**	na	na	na
	03/20/02	128157	**2.1**	**1.3**	**0.13**	na	na	na
	05/15/02	208157/58	**1.8**	**0.76**	**0.06**	na	na	na
Mill Creek	07/24/01	308105	na	na	na	**0.0026**	na	na
@ R.M. 1.5	09/11/01	378080	na	na	na	**<0.002**	na	na
	11/13/01	468080	na	na	na	**0.0047**	na	na
	01/30/02	058080	na	na	na	**0.0037**	na	na
	03/20/02	128155	na	na	na	**0.0074**	na	na
	05/15/02	208155	na	na	na	**0.0060**	na	na
Mill Creek	07/24/01	308106	na	na	na	**<0.002**	na	na
@ R.M. 0.1	09/11/01	378081	na	na	na	**0.0031**	na	na
	11/13/01	468081/82	na	na	na	**0.0043**	na	na
	01/30/02	058081	na	na	na	**<0.002**	na	na
	03/20/02	128156	na	na	na	**0.0083**	na	na
	05/15/02	208156	na	na	na	**0.0054**	na	na
Naches River	07/25/01	308110	0.26	0.42	<0.02	0.0025	**<0.02**	0.25
near Yakima	09/12/01	378085/86	0.33	0.45	<0.02	0.0032	**<0.02**	0.24
	11/14/01	468088	na	na	na	<0.002	**<0.02**	<0.25
	01/29/02	058085	<0.40	0.37	<0.02	0.0030	**<0.02**	0.98
	03/21/02	138000	na	na	na	<0.002	**<0.02**	na
	05/16/02	208161	na	na	na	0.0031	**<0.02**	na

Table 9. (continued)

Location	Date	Sample Number	Zinc	Copper	Lead	Mercury	Silver	Chromium
Yakima River	07/25/01	308111	0.76	0.47	0.020	**0.0024**	**<0.02**	0.47
above Ahtanum Cr.	09/12/01	378087	0.66	0.49	<0.02	**0.0033**	**<0.02**	0.53
	11/14/01	468089	na	na	na	**<0.002**	**<0.02**	0.43
	01/29/02	058086	na	na	na	**0.0032**	**<0.02**	na
	03/25/02	138001	na	na	na	**0.0029**	**<0.02**	na
	05/16/02	208162	na	na	na	**0.0034**	**<0.02**	na
Yakima River	07/25/01	308112	0.39	0.68	0.034	**<0.002**	**<0.02**	0.69
above Satus Creek	09/12/01	378088	0.43	0.58	<0.02	**0.0021**	**<0.02**	0.88
	11/14/01	468090	na	na	na	**<0.002**	**<0.02**	0.56
	01/29/02	058087	na	na	na	**<0.002**	**<0.02**	na
	03/25/02	138002	na	na	na	**0.0021**	**<0.02**	na
	05/16/02	208163	na	na	na	**0.0027**	**<0.02**	na
Yakima River	07/25/01	308113	0.49	0.79	0.024	**<0.002**	<0.02	0.77
@ Kiona	09/12/01	378089/90	2.5	0.75	<0.02	**0.0025**	<0.02	1.1
	11/14/01	468091	na	na	na	**<0.002**	<0.02	0.64
	01/29/02	058088	na	na	na	**<0.002**	<0.02	na
	03/25/02	138003	na	na	na	**0.0032**	<0.02	na
	05/16/02	208164	na	na	na	**0.0029**	<0.02	na
Palouse River	07/10/01	286065	0.57	1.6	0.025	na	<0.02	**2.2**
@ Hooper	09/11/01	378091	2.3	1.2	<0.02	na	<0.02	**4.5**
	11/06/01	468092	na	na	na	na	<0.02	**0.43**
	01/15/02	058089	na	na	na	na	na	**2.3**
	03/13/02	128163	na	na	na	na	na	**0.45**
	05/15/02	208165	na	na	na	na	na	**0.39**
Spokane River	07/10/01	286060	20	0.50	0.080	na	<0.02	**1.5**
@ Riverside St. Pk.	09/11/01	378092	6.6	0.60	0.079	na	<0.02	**3.1**
	11/04/01	468093	na	na	na	na	<0.02	**0.58**
	01/13/02	058090	na	na	na	na	na	**1.1**
	03/12/02	128164	8.9	0.97	0.13	na	na	**0.28**
	05/13/02	208166	na	na	na	na	na	**<0.25**

Table 10. Summary Statistics for Metals (ug/L)

Location	Zinc			Copper			Lead		
	median	max.	det. freq.	median	max.	det. freq.	median	max.	det. freq.
Snohomish River bw. Monroe	0.81	1.1	2/3	0.39	0.54	6/6	<0.02	0.028	1/3
Upper May Creek	0.24	1.3	5/5	0.73	1.2	5/5	<0.02	0.13	4/5
May Creek @ mouth	0.73	12	6/6	0.57	2.3	6/6	0.020	0.28	6/6
Mill Creek @ R.M. 1.5	na	na	na	na	na	na	na	na	na
Mill Creek @ R.M. 0.1	na	na	na	na	na	na	na	na	na
Naches River nr. Yakima	0.26	<0.40	2/3	0.37	0.45	3/3	<0.02	<0.02	0/3
Yakima R. ab. Ahtanum Cr.	0.66	0.76	2/2	0.47	0.49	2/2	<0.02	0.020	1/2
Yakima R. ab. Satus Cr.	0.39	0.43	2/2	0.58	0.68	2/2	<0.02	0.034	1/2
Yakima R. @ Kiona	0.49	0.25	2/2	0.75	0.79	2/2	<0.02	0.024	1/2
Palouse R. @ Hooper	0.57	2.3	2/2	1.2	1.6	2/2	<0.02	0.025	1/2
Spokane R. @ Riverside	6.6	20	3/3	0.50	0.97	3/3	0.079	0.13	3/3

Location	Mercury			Silver			Chromium		
	median	max.	det. freq.	median	max.	det. freq.	median	max.	det. freq.
Snohomish River bw. Monroe	<0.002	0.0036	3/6	<0.02	<0.02	0/3	0.21	0.33	2/3
Upper May Creek	na	na	na	<0.02	<0.02	0/2	0.76	1.9	2/2
May Creek @ mouth	na	na	na	<0.02	<0.02	0/2	1.3	2.1	2/2
Mill Creek @ R.M. 1.5	<0.002	0.0074	5/6	na	na	na	na	na	na
Mill Creek @ R.M. 0.1	<0.002	0.0083	4/6	na	na	na	na	na	na
Naches River nr. Yakima	<0.002	0.0032	4/6	<0.02	<0.02	0/6	0.24	0.98	3/4
Yakima R. ab. Ahtanum Cr.	<0.002	0.0034	4/6	<0.02	<0.02	0/6	0.47	0.53	3/3
Yakima R. ab. Satus Cr.	<0.002	0.0027	4/6	<0.02	<0.02	0/6	0.56	0.88	2/2
Yakima R. @ Kiona	<0.002	0.0032	3/6	<0.02	<0.02	0/6	0.64	1.1	3/3
Palouse R. @ Hooper	na	na	na	<0.02	<0.02	0/3	0.39	4.5	6/6
Spokane R. @ Riverside	na	na	na	<0.02	<0.02	0/3	<0.25	3.1	5/6

na = not analyzed

Table 11. Metals Concentrations Compared to State Standards for Protection of Aquatic Life (ug/L). [Results for metals that are on the 1998 303(d) list are highlighted in bold font.]

Location	Zinc		Copper		Lead	
	concentration range	chronic standard*	concentration range	chronic standard*	concentration range	chronic standard*
Snohomish River bw. Monroe	0.81-1.1	16	**0.39-0.54**	**1.7**	<0.02-0.028	0.21
Upper May Creek	**0.24-1.3**	**46**	**0.73-1.2**	**5.0**	**<0.02-0.13**	**0.87**
May Creek @ mouth	**0.73-12**	**49**	**0.57-2.3**	**5.3**	**0.020-0.28**	**0.94**
Mill Creek @ R.M. 1.5	na	- -	na	- -	na	- -
Mill Creek @ R.M. 0.1	na	- -	na	- -	na	- -
Naches River nr. Yakima	0.26-<0.40	33	0.37-0.45	3.6	<0.02	0.57
Yakima R. ab. Ahtanum Cr.	0.66-0.76	50	0.47-0.49	5.4	<0.02-0.20	0.97
Yakima R. ab. Satus Cr.	0.39-0.43	64	0.58-0.68	6.9	<0.02-0.34	1.3
Yakima R. @ Kiona	0.49-0.25	75	0.75-0.79	8.2	<0.02-0.24	1.6
Palouse R. @ Hooper	0.57-2.3	72	1.2-1.6	7.9	<0.02-0.25	1.6
Spokane R. @ Riverside	6.6-20	36	0.5-0.97	3.9	0.079-0.13	0.64

Location	Mercury		Silver		Chromium	
	concentration range	chronic standard	concentration range	acute standard*	concentration range	chronic standard*
Snohomish River bw Monroe	**<0.002-0.0036**	**0.012**	<0.02	0.08	0.21-0.33	29
Upper May Creek	na	- -	<0.02	0.65	0.76-1.9	81
May Creek @ mouth	na	- -	<0.02	0.74	1.3-2.1	86
Mill Creek @ R.M. 1.5	**<0.002-0.0074**	**0.012**	na	- -	na	- -
Mill Creek @ R.M. 0.1	**<0.002-0.0083**	**0.012**	na	- -	na	- -
Naches River nr. Yakima	**<0.002-0.0032**	**0.012**	**<0.02**	**0.34**	0.24-0.98	59
Yakima R. ab. Ahtanum Cr.	**<0.002-0.0034**	**0.012**	**<0.02**	**0.78**	0.47-0.53	87
Yakima R. ab. Satus Cr.	**<0.002-0.0027**	**0.012**	**<0.02**	**1.3**	0.56-0.88	111
Yakima R. @ Kiona	**<0.002-0.0032**	**0.012**	<0.02	1.8	0.64-1.1	130
Palouse R. @ Hooper	na	- -	<0.02	1.6	**0.39-4.5**	**125**
Spokane R. @ Riverside	na	- -	<0.02	0.41	**<0.25-3.1**	**65**

*calculated for the lowest hardness measured during present study (there is no chronic standard for silver)
na = not analyzed

As can be seen from Table 11, all metals concentrations were well within the chronic standard. The waterbody most closely approaching the standard was Mill Creek where the maximum mercury concentration was approximately 25% lower than the standard. For the other waterbodies, metals concentrations were lower than the standard by at least a factor of 2 and more often by a factor of 10 or greater.

Among the metals analyzed, only mercury has a human health water column criterion used by Washington State (National Toxics Rule). This criterion is 0.015 ug/L and was not approached in any of the waterbodies.

The finding of low metals concentrations in the Snohomish River, May Creek, and Mill Creek is supported by other recent data presented in Appendix A. The 303(d) listings for silver and/or mercury in the Naches and Yakima rivers and the chromium listing for the Palouse and Spokane rivers can be attributed to inaccurate historical data, also discussed in Appendix A. The low metals concentrations observed in this study are similar to levels Ecology has measured in other rivers and streams in Washington (Ambient Monitoring Program database http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html; Hopkins, 1995; Johnson, 1994, 2000; Johnson and Hopkins, 1991).

Recommendations

The following changes to the 303(d) list are recommended:

- Remove the Snohomish River listings for copper and mercury.
- Remove the May Creek listings for copper, lead, and zinc.
- Remove the Mill Creek listing for mercury.
- Remove the Naches River listing for silver.
- Remove the Yakima River listings for silver and mercury.
- Remove the Palouse River and Spokane River listings for chromium.

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Appendices

Appendix A

Ecology Memorandum Regarding 1998 303(d) Metals Listings in Certain Rivers and Creeks

DEPARTMENT OF ECOLOGY

June 4, 2001

TO: Alison Beckett, Water Quality Program

FROM: Art Johnson, Environmental Assessment Program

SUBJECT: **Recommendations to De-list or Verify Certain 303(d) Waterbodies for Metals Excursions in Water**

In light of our agreement with EPA, Northwest Environmental Advocates, and Northwest Environmental Defense Center on a cleanup schedule for 303(d) listed waterbodies, EAP has been reviewing the 1998 list to determine the best approach for addressing these pollution problems.

During the course of this review, 45 metals listings for 11 rivers and streams were identified where newer water quality data justify their removal from the 303(d) list or where further sampling should be conducted to verify old or questionable data on which the listing is based (Table 1). The reasoning behind these recommendations is described in more detail below.

People considering these recommendations should be aware that metals data collected in the 1980s (and more recently in some instances) were often subject to contamination in the field or laboratory (see, for example, Windom, 1991). Newer data can be more accurate when clean sampling techniques and low-level analytical methods are used. EAP has made several efforts to verify 303(d) metals listings based on older data (Hopkins, 1995; Johnson and Hopkins, 1991; Johnson, 2000). In each of these, no evidence was found that state standards were being exceeded.

1. **WA-07-1160 / Skykomish River / Cu, Pb**, **Ag -** These listings are based on a single composite effluent sample from the Monroe WWTP where calculations indicated water quality standards could be exceeded at the edge of the dilution zone (Golding, 1996). In the opinion of NWRO, this sample is not representative of current effluent quality (Kevin Fitzpatrick, Ecology-NWRO, personal communication).

   Verification sampling is recommended for these listings. [Note to reader: Following completion of this memo, it was decided that any additional sampling would be the responsibility of Monroe WWTP.]

2. **WA-07-1020, 1050 / Snohomish River / Cu, Hg -** These listings are for Ecology station 07A090 (Snohomish River @ Snohomish - Cu) and USGS station 07A111 (Snohomish River near Monroe – Cu, Hg). The Ecology data are from 1982 - 1984; the USGS data appear to be from the 1980s but exact dates are uncertain.

EAP has more recent Cu data for the station at Snohomish (Table 2). In 12 samples collected over a three-year period between October 1995 and August 1997, dissolved Cu concentrations ranged from 0.43 - 0.94 ug/L. The chronic state standard for the minimum hardness measured at this station (11 mg/L) is 1.7 ug/L. Therefore, it appears there is sufficient data to justify removing the Cu listing for the Snohomish River @ Snohomish.

No new data are available for the Snohomish River further upstream near Monroe. Sampling is recommended to verify the Cu and Hg listings for this station.

3. **WA-08-1095 / Bear-Evans / Creek Hg -** The mercury listing for METRO station 0484 on this creek appears to be due to a reporting error (Jonathan Frodge, King County, personal communication). Sediment samples were apparently included in the database without the matrix code (which identifies the sample matrix, i.e., water, sediment, tissue, etc.). I reviewed all of King County's Hg in water data for station 0484 from Jan 1, 1988, to the present (the last five years of data are in Table 3). No samples have had Hg detected.

   The Bear-Evans Creek Hg listing should be removed.

4. **WA-08-1130 / May Creek / Cu, Pb, Zn -** May Creek is listed for Cu, Pb, and Zn excursions at several sites sampled by METRO in 1994. However, the dissolved concentrations which exceeded the standards were calculated values, not measured directly (King County, 1994).

   King County has more recent measurements of dissolved metals concentrations in May Creek at a station just east of I-410 (Table 4). Eight samples collected between May 1998 and December 1999 had maximum Cu, Pb, and Zn concentrations of 3.9, <0.5, and 5.6 ug/L, respectively. At the lowest hardness measured at this station (37 mg/L), the state chronic criteria are 4.8 ug/L for Cu, 0.84 ug/L for Pb, and 45 ug/L for Zn.

   Because the listings were based on a theoretical calculation and recent direct measurements show no violations of standards, it is recommended that the May Creek Cu, Pb, and Zn listings be removed. [Note to reader: After reviewing this memo, the Ecology Water Quality Program requested that verification sampling be conducted for May Creek.]

5. **WA-09-1020 / Green River / Cr -** Among the Green River listings is one excursion of the Cr standard at each of two Ecology ambient monitoring stations during 1987 – 1991. Ecology's ambient monitoring data for Cr prior to 1994 are suspect and have been removed from the EAP data base (Dave Hallock, EAP, personal communication).

   King County provided dissolved Cr data for two stations sampled on the Green River from May 1998 through December 1999 (Table 5). Fifteen samples have been analyzed and Cr has not been detected at or above 0.4 - 0.5 ug/L. The chronic water quality standard for the lowest hardness measured at these stations (17 ug/L) is 42 ug/L.

   The Green River Cr listing should be removed.

6. **WA-09-1015 / Mill Creek / Cd, Cr, Cu, Hg, Zn -** These listings are based on 1984 - 1990 METRO and Ecology data for four stations in the lower 1.5 mile of the creek. A major pollution source, the Western Processing superfund site, is located in this reach but has since been cleaned up. The cleanup site is between the river mile 1.5 and 1.0 sampling stations listed in Table 1.

   King County has recent metals data for river mile 1.0 downstream of Western Processing (station 0317 at S. 196th Street) (Table 6). In six sets of samples collected from May 1998 to December 1999, the maximum dissolved Cd, Cr, Cu, and Zn concentrations were <0.2, 0.57, 3.4, and 23 ug/L, respectively. At the lowest hardness value measured (25 mg/L), the chronic state standards are 0.37, 57, 3.5, and 32 ug/L, respectively. Hg was not detected at or above 0.2 ug/L; the state chronic standard is 0.012 ug/L total recoverable and the acute standard is 2.1 ug/L dissolved. All samples were within standards for Cd, Cr, Cu, and Zn. The reporting limit for Hg was not low enough to compare to the chronic standard.

   Landau Associates has done routine water quality monitoring in Mill Creek above and below the Western Processing site. The data collected since 1990 for Cd, Cr, Hg, Zn, hardness, and flow are in Table 7. The most significant improvements to water quality are thought to have occurred in the late 1980's when steps were taken to control surface water runoff from Western Processing (Bill Enkeboll, Landau Associates, personal communication). Landau station C1 is located immediately upstream of the Western Processing site; station C4 is 2500 feet downstream of the site.

   In the early 1990s, some of Laundau's results for dissolved Cd and dissolved Zn exceeded chronic water quality standards (e.g., Cd in 1993). However, in each of these instances the corresponding total Cd and Zn concentrations were much lower than in the dissolved sample suggesting contamination occurred in the filtration process. These data should be rejected. The remaining Landau data show no violations of the chronic standards for Cd, Cr, or Zn.

   Upstream station C1: The maximum dissolved Cd concentration measured was 0.78 ug/L (1/15/90); at the corresponding hardness of 69 mg/L, the chronic standard is 0.78 ug/L. Dissolved Cr was below the reporting limit of 10 ug/L in all samples; at the lowest hardness value measured (34 mg/L), the chronic standard is 74 ug/L. Except for two samples collected in 1990, the maximum dissolved Zn concentration was 57 ug/L (12/2/96); at the corresponding hardness of 54 mg/L, the chronic standard is 62 ug/L.

   Downstream station C4: The maximum dissolved Cd concentration measured was 0.65 ug/L (3/22/94); at the corresponding hardness of 59 mg/L, the chronic standard is 0.84 ug/L. Landau stopped analyzing dissolved Cd at station C4 in 1997. All but one of the <u>total</u> Cd results for 1997 – 2000 have been at or below the chronic standard for the dissolved fraction. Dissolved Cr was below the reporting limit of 10 ug/L in all samples; at the lowest hardness value measured (34 mg/L), the chronic standard is 74 ug/L. Except for two samples collected in 1990, the maximum dissolved Zn concentration was 54 ug/L (12/2/96); at the corresponding hardness of 44 mg/L, the chronic standard is 52 ug/L.

Landau's Hg data show the acute standard is being met. As with the King County data, Hg reporting limits were not low enough to compare to the chronic standard.

The King County and Landau Associates data show that Mill Creek is meeting standards for Cd, Cr, Cu, and Zn. Therefore, it is recommended that these listing be removed. There is a need for low-level Hg data on Mill Creek; verification sampling is recommended.

7. **WA-10-1087 / Wilkeson Creek / Cu** - This listing is based on a single composite effluent sample from Wilkeson WWTP where calculations indicated water quality standards could be exceeded at the edge of the dilution zone (Hoyle-Dodson, 1997). EAP recently conducted an intensive sampling program for Cu at Wilkeson WWTP that included the final effluent and Wilkeson Creek above and below the outfall (Golding and Johnson, 2001). In eight sets of samples collected between July and November 2000, no violations of the chronic state standard were found. Calculations showed there was no reasonable potential for the chronic standard to be exceeded under critical low flow conditions or for any of the sampling events.

   The Cu listing for Wilkeson Creek should be removed.

8. **WA-34-1010 / Palouse River / Cr** - The Palouse River @ Hooper (Ecology station 34A070) is listed for five Cr excursions between 1987 and 1991. As previously mentioned, Ecology's Cr data prior to 1994 are suspect.

   Verification sampling is recommended.

9. **WA-37-1010, 1040 / Lower Yakima River / Ag, Hg -** These listing are based on 1987 - 1990 USGS data showing two or three excursions for Ag and/or Hg in the main stem above Ahtanum Creek, above Satus Creek, and at Kiona (Fuhrer, 1996). Metals sampling by EAP in the upper Yakima River has shown that USGS metals data from this time period may be unreliable. Upper river 303(d) listings for Ag, Hg, and other metals do not appear to be justified (Johnson, 2000 - see WRIA 39 below).

   USGS has obtained more recent Ag data for their station above Ahtanum Creek (Table 8); Hg was not analyzed. Of 16 samples obtained between May 1999 and January 2000, all had less than 1 ug/L dissolved Ag. The acute state standards for the two lowest hardness values measured at this site (38 and 50 mg/L) are 0.65 and 1.0 ug/L (there is no state chronic standard for Ag). Although these USGS results and previous upstream sampling by EAP suggest the Ag listings for the lower river may not be warranted, a lower detection limit will be required to demonstrate it.

   Verification sampling is recommended for the lower Yakima Ag and Hg listings.

10. **WA-38-1010 / Naches River / Ag -** This listing for the Naches River near Yakima is also based on potentially unreliable USGS data reported in Fuhrer (1996).

    Verification sampling is recommended.

11. **WA-39-1010, 1030 / Upper Yakima River / Ag, Cd, Cu, Hg -** The listings are for the Yakima River @ Cle Elum and @ Umtanum. Again, these conclusions are based on USGS 1987 - 1990 data. Ecology collected eighteen sets of mainstem samples and eighteen sets of tributary samples in this reach during March 1999 - January 2000 and found no violations of water quality standards for any of the listed metals (Johnson, 2000). Limited recent sampling by USGS in 1999 also showed no violations of the Ag, Cd, or Cu standards at Cle Elum or at Umtanum; Hg was not analyzed (Johnson, 2000).

    The upper Yakima listings for Ag, Cd, Cu, and Hg should be removed.

12. **WA-54-1020 / Spokane River / Cr -** The Spokane River is listed for Cr, based on suspect 1989 - 91 Ecology data for a station at Riverside State Park (54A120).

    Verification sampling is recommended.

In summary, I recommend that the following 303(d) listings be removed, based on new data or an error in the listing:

WA-07-1020 Snohomish River @ Snohomish - Cu
WA-08-1095 Bear-Evans Creek - Hg
WA-08-1130 May Creek - Cu, Pb, Zn
WA-09-1020 Green River - Cr
WA-09-1015 Mill Creek - Cd, Cr, Cu, Zn
WA-10-1087 Wilkeson Creek - Cu
WA-39-1010, 1030 Upper Yakima River - Ag, Cd, Cu, Hg

Verification sampling is recommended for the following listings:

WA-07-1160 Skykomish River @ Monroe - Cu, Pb, Ag
WA-07-1050 Snohomish River near Monroe - Cu, Hg
WA-09-1015 Springbrook Mill Creek - Hg
WA-34-1010 Palouse River @ Hooper - Cr
WA-37-1010, 1040 Lower Yakima River - Ag, Hg
WA-38-1010 Naches River - Ag
WA-54-1020 Spokane River @ Riverside State Park – Cr

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AJ:cn
Attachments

cc: Pam Elardo, IPMU, NWRO
Kevin Fitzpatrick, WQ, NWRO
Chris Hall, WQ, CRO
Nora Jewitt, WQ, HQ
Will Kendra, EAP, HQ
Ron McBride, WQ, HQ
Chris Mauer, TCP, HQ
Ken Merrill, WQ, ERO
Dale Norton, EAP, HQ
Glenn Pieritz, WQ, SWRO

Table 1. 1998 303(d) Listings for Metals in Water Where De-Listing or Verification Sampling is Proposed

WRIA	Waterbody	Parameter	Data Source	Basis for Listing	Recommendation		Reason for Recommendation
					De-list	Verify	
7	Skykomish River	Cu,Pb,Ag	Ecology (Golding, 1996)	Calculated excursion based on a Monroe WWTP effluent sample		x	Data may not be representative of effluent quality
7	Snohomish River	Cu	Ecology ambient 1982-84 data	Many excursions at Snohomish (07A090)	x		Newer Ecology ambient data show standards being met
7	Snohomish River	Cu,Hg	USGS ambient data	4 excursions near Monroe (07A111)		x	Inconsistent with EAP data for nearby locations
8	Bear-Evans Creek	Hg	Seattle-Metro 1988/90 data	2 excursions at station 0484 (r.m. 1.0)	x		Listed in error; newer King Co. data shows no detections
8	May Creek	Cu	METRO 1994 data	1 excursion at SR-900 crossing	x		Newer King Co. data show no excursions
8	May Creek	Cu	METRO 1994 data	1 excursion upstream of Honey Creek	x		"
8	May Creek	Cu	METRO 1994 data	1 excursion at mouth of Lk. Washington	x		"
8	May Creek	Pb, Zn	METRO 1994 data	2-3 excursions at mouth	x		"
8	May Creek	Pb,Zn	METRO 1994 data	2-3 excursions upstream of Honey Creek	x		"
8	May Creek	Pb	METRO 1994 data	2 excursions at SR-900 culvert crossing	x		"
8	May Creek	Pb	METRO 1994 data	2 excursions at 164 NE	x		"
8	May Creek	Pb	METRO 1994 data	2 excursions at upstream canyon end	x		"
9	Green River	Cr	Ecology 1987 ambient data	1 excursion near Kent (09A090)	x		Newer King Co. data show no excursions
9	Green River	Cr	Ecology 1991 ambient data	1 excursion at Tukwila (09A080)	x		"
9	Mill Creek	Cr,Hg	Ecology ambient 1987-90 data	2 Cr excursions / numerous Hg excursions at station 09E090 (r.m. 1.5)	x	x(Hg)	Cleanup of major source (Western Processing) has occurred
9	Mill Creek	Hg	METRO 1989-90 data	2 excursions at station 0317 (r.m. 1.0)	x	x(Hg)	"
9	Mill Creek	Cd,Cu,Zn	Ecology (Yake, 1985)	2 excursions near 196th St. (r.m. 1.1)	x	x(Hg)	"
9	Mill Creek	Cd,Cr,Hg,Zn	Ecology ambient 1984-90 data	2-4 excursions / numerous Hg excursions at station 09E070 (r.m. 0.1)	x	x(Hg)	"
10	Wilkeson Creek	Cu	Ecology (Hoyle-Dodson, 1997)	Calculated excursion based on a Wilkeson WWTP effluent sample	x		Newer Ecology data show standards being met
34	Palouse River	Cr	Ecology ambient 1987-91data	5 excursions at Hooper (34A070)		x	Ecology Cr data prior to 1994 are suspect
37	Yakima River	Hg,Ag	USGS Fuhrer (1996)	2 excursions (1987-90) above Ahtanum Cr. (station #32)		x	EAP sampling has shown USGS metals data from this time period may be unreliable.
37	Yakima River	Hg,Ag	USGS Fuhrer (1996)	2 excursions (1987-90) above Satus Cr. (station #52)		x	"
37	Yakima River	Hg	USGS Fuhrer (1996)	3 excursions (1987-90) at Kiona (station #50)		x	"
38	Naches River	Ag	USGS Fuhrer (1996)	2 excursions (1987-90) near north Yakima (station #26)		x	"
39	Yakima River	Cd,Cu,Hg	USGS Fuhrer (1996)	2-6 excursions (1987-90) at Cle Elum (station #6)	x		Newer Ecology data show standards being met
39	Yakima River	Ag,Cd,Cu,Hg	USGS Fuhrer (1996)	2-4 excursions (1987-90) at Umtanum (station #19)	x		"
54	Spokane River	Cr	Ecology ambient 1989-91 data	2 excursions at station 54A120 (r.m. 66)		x	Ecology Cr data prior to 1994 are suspect

Table 2. EAP Dissolved Metals Data for the Snohomish River at Snohomish (station 07A090)

Date	**Cu** (ug/L)	Cd (ug/L)	Pb (ug/L)	Ni (ug/L)	Zn (ug/L)	Hardness (mg/L)
16-Oct-95	**0.71**	0.04 U	0.039	1 U	3.4	15
17-Dec-95	**0.73**	0.04 U	0.03 U	1 U	5.0 U	17
19-Feb-96	**0.94**	0.03	0.051	0.40	1.1 B	13
22-Apr-96	**0.64**	0.02 U	0.026	0.38	0.69	16
17-Jun-96	**0.50**	0.02 U	0.022	0.27	0.9	16
19-Aug-96	**0.49**	0.02 U	0.02 U	0.41	1.2	22
21-Oct-96	**0.65**	0.01 U	0.037	0.38	1.2 J	16
15-Dec-96	**0.48**	0.01 U	0.03 U	0.35	0.87	20
17-Feb-97	**0.77**	0.03 U	0.03 U	0.29	1.3	13
21-Apr-97	**0.83**	0.02 U	0.02 U	0.46	0.61	11
16-Jun-97	**0.49**	0.02 U	0.026	0.22	0.62	11
18-Aug-97	**0.43**	0.02 U	0.02	0.27	1.2	20

U = not detected at or above reported value
B = blank contamination
J = estimated value

Table 3. King County Data on Mercury Concentrations in Bear-Evans Creek (station 0484) (<MDL, mgL) [Data obtained through Jonathan Frodge, King County]

Date	Analysis	Result
1-Apr-96	Total, CV	0.002
16-Apr-96	Total, CV	0.002
18-Mar-97	Total, CV	0.006
18-Mar-97	Total, CV	0.006
2-Oct-97	Total, CV	0.006
29-Oct-97	Total, CV	0.006
16-Dec-97	Total, CV	0.006
5-Jan-98	Total, CV	0.006
14-Jan-98	Total, CV	0.006
27-May-98	Total, CV	0.006
18-Sep-98	Total, CV	0.006
18-Sep-98	Dissolved	0.006
28-Oct-98	Total, CV	0.006
28-Oct-98	Dissolved	0.006
7-Dec-98	Total, CV	0.006
7-Dec-98	Dissolved	0.006
24-Feb-99	Total, CV	0.006
24-Feb-99	Dissolved	0.006
24-Jun-99	Total, CV	0.006
24-Jun-99	Dissolved	0.006
9-Nov-99	Total, CV	0.006
9-Nov-99	Dissolved	0.006
6-Dec-99	Total, CV	0.006
6-Dec-99	Total, CV	0.006
6-Dec-99	Dissolved	0.006
6-Dec-99	Dissolved	0.006
1-Feb-00	Total, CV	0.006
1-Feb-00	Dissolved	0.006
29-Feb-00	Total, CV	0.006
29-Feb-00	Dissolved	0.006
12-Jun-00	Total, CV	0.006
12-Jun-00	Dissolved	0.006
8-Nov-00	Total, CV	0.006
8-Nov-00	Dissolved	0.006

Table 4. King County Data on Dissolved Copper, Lead, and Zinc Concentrations in May Creek East of I-405 [Data obtained through Jonathan Frodge, King County]

Date	Cu (ug/L)	Pb (ug/L)	Zn (ug/L)	Hardness (mg/L)
27-May-98	1.6	<0.5	1.9	41
18-Sep-98	3.9	<0.5	5.7	68
28-Oct-98	1.4	<0.5	1.9	63
7-Dec-98	1.4	<0.5	2.6	42
24-Feb-99	1.6	<0.5	2.1	37
24-Jun-99	1.7	<0.5	1.5	46
9-Nov-99	1.7	<0.5	3.1	48
6-Dec-99	1.4	<0.5	2.6	38

Table 5. King County Data on Dissolved Chromium Concentrations in the Green River above Newaukum Cr. (B319) and at Fort Dent Park (3106) [Data obtained from Douglas Henderson, King County]

Station	Date	Cr (ug/L)	Hardness (mg/L)
B319	27-May-98	<0.5	17
B319	28-Oct-98	<0.5	27
B319	7-Dec-98	<0.4	19
B319	24-Feb-99	<0.4	22
B319	24-Jun-99	<0.4	17
B319	24-Jun-99	<0.4	17
B319	9-Nov-99	<0.4	22
B319	6-Dec-99	<0.4	17
3106	27-May-98	<0.5	25
3106	28-Oct-98	<0.5	52
3106	7-Dec-98	<0.5	27
3106	24-Feb-99	<0.4	29
3106	24-Jun-99	<0.4	26
3106	9-Nov-99	<0.4	35
3106	6-Dec-99	<0.4	23

Table 6. King County Metals Data for Mill Creek at Station 0317.
[Data obtained through Douglas Henderson, King County]

Date	Metal	Value (ug/L)	Hardness (mg/L)
27-May-98	Cadmium, Dissolved	<0.2	25
28-Oct-98	Cadmium, Dissolved	<0.2	45
7-Dec-98	Cadmium, Dissolved	<0.2	66
24-Feb-99	Cadmium, Dissolved	<0.1	39
9-Nov-99	Cadmium, Dissolved	<0.1	37
6-Dec-99	Cadmium, Dissolved	<0.1	49
27-May-98	Chromium, Dissolved	<0.5	25
28-Oct-98	Chromium, Dissolved	<0.6	45
7-Dec-98	Chromium, Dissolved	<0.7	66
24-Feb-99	Chromium, Dissolved	0.49	39
9-Nov-99	Chromium, Dissolved	0.57	37
6-Dec-99	Chromium, Dissolved	0.42	49
27-May-98	Copper, Dissolved	2.6	25
28-Oct-98	Copper, Dissolved	3.4	45
7-Dec-98	Copper, Dissolved	2.7	66
24-Feb-99	Copper, Dissolved	2.6	39
9-Nov-99	Copper, Dissolved	2.7	37
6-Dec-99	Copper, Dissolved	3.1	49
27-May-98	Mercury, Dissolved	<0.2	25
28-Oct-98	Mercury, Dissolved	<0.2	45
7-Dec-98	Mercury, Dissolved	<0.2	66
24-Feb-99	Mercury, Dissolved	<0.2	39
9-Nov-99	Mercury, Dissolved	<0.2	37
6-Dec-99	Mercury, Dissolved	<0.2	49
18-Mar-97	Mercury, Total	<0.2	50
2-Oct-97	Mercury, Total	<0.2	39
29-Oct-97	Mercury, Total	<0.2	32
16-Dec-97	Mercury, Total	<0.2	33
5-Jan-98	Mercury, Total	<0.2	33
14-Jan-98	Mercury, Total	<0.2	40
27-May-98	Mercury, Total	<0.2	25
28-Oct-98	Mercury, Total	<0.2	45
7-Dec-98	Mercury, Total	<0.2	66
24-Feb-99	Mercury, Total	<0.2	39
9-Nov-99	Mercury, Total	<0.2	37
6-Dec-99	Mercury, Total	<0.2	49
27-May-98	Zinc, Dissolved	13	25
28-Oct-98	Zinc, Dissolved	15	45
7-Dec-98	Zinc, Dissolved	23	66
24-Feb-99	Zinc, Dissolved	17	39
9-Nov-99	Zinc, Dissolved	17	37
6-Dec-99	Zinc, Dissolved	21	49

Table 7. Landau Associates Data on Metals Concentrations in Mill Creek [Data obtained through Bill Enkeboll, Landau Associates]

Station	Date	Hardness (mg/L)	Flow (cfs)	Cadmium Dissolved (µg/L)	Cadmium Total (µg/L)	Chromium Dissolved (µg/L)	Chromium Total (µg/L)	Mercury Dissolved (µg/L)	Mercury Total (µg/L)	Zinc Dissolved (µg/L)	Zinc Total (µg/L)
C1	1/15/90	69	17.4	0.78	0.5 U	16	10 U			403	47
C1	2/14/90	78	13.2	0.5 U	0.5 U					47	62
C1	3/13/90	88	10.0	0.5 U	0.5 U					38	177
C1	4/17/90	57	18.6	0.5 U	0.5 U	10 U	10 U			82	86
C1	5/2/90	57		0.5 U	0.5 U					88	76
C1	6/13/90	65	13.9	0.5 U	0.5 U	10 U	10 U	0.2 U	0.2 U	36	51
C1	7/17/90	121	1.3	0.5 U	0.5 U					23	37
C1	8/27/90	110	1.9	0.5 U	0.5 U					20 U	50
C1	9/19/90	111	0.9	0.5 U	0.5 U					22	34
C1	10/10/90	86	1.9	0.5 UJ	0.5 UJ	10 U	10 U			64 UJ	26
C1	12/17/90	95	12.5	0.5 UJ	0.5 UJ					36	44
C1	1/22/91	108	13.3	0.5 U	0.5 U	10 U	10 U			26	35
C1	2/25/91	94	11.4	0.5 U	0.5 U					24	31
C1	3/26/91	93	12.5	0.5 U	0.5 UJ					28	29
C1	4/15/91	100	8.2	0.5 U	0.5 UJ	10 U	10 U			47 UJ	33
C1	5/22/91	118	3.5	0.5 U	0.5 U					33	21
C1	11/13/91	47.7	7.4	0.5 U	0.5 U					47	65
C1	12/11/91	79.5	5.6	0.5 U	0.5 U					42	49
C1	2/4/92	68.4	16.3	0.5 U	0.5 U	10 U	10 U			36	39
C1	2/25/92	77	11.5	0.5 U	0.5 U					22	37
C1	3/23/92	103	3.3	0.5 U	0.5 U					26	25
C1	4/13/92	65	6.6	0.5 UJ	0.5 U	10 U	10 U			22	44
C1	5/5/92	97.8	2.2	0.5 U	0.5 UJ					20 U	20 U
C1	6/2/92	110	1.5	0.5 U	0.5 U					20 U	20 U
C1	7/15/92	88	2.4	0.5 U	0.5 U	10 U	10 U	0.056 UJ	0.059 UJ	20 U	20 U
C1	8/17/92	118	2.9	0.5 U	0.5 U					20 U	20 U
C1	9/16/92	118	3.5	3.93	0.5 U					20 U	20 U
C1	10/12/92	89.5	2.8	0.5 U	0.5 U	10 U	10 U			20 U	20 U
C1	11/23/92	51.3	7.9	0.5 U	0.5 U					84	42
C1	12/16/92	74.6	7.3	0.664	0.5 U					39	43
C1	2/1/93	90.4	6.8	0.5 U	0.5 U	10 U	10 U			24	30
C1	2/22/93	96	3.5	0.5 U	0.5 U					28	47
C1	3/30/93	73	7.5	0.528 J	0.5 U					20 U	31

Table 7. Laundau Mill Creek Data (continued)

Station	Date	Hardness (mg/L)	Flow (cfs)	Cadmium Dissolved (µg/L)	Cadmium Total (µg/L)	Chromium Dissolved (µg/L)	Chromium Total (µg/L)	Mercury Dissolved (µg/L)	Mercury Total (µg/L)	Zinc Dissolved (µg/L)	Zinc Total (µg/L)
C1	4/28/93	74.9	10.8	0.5 U	0.5 U	10 U	10 U			20 U	28
C1	5/17/93	120	3.2	0.5 U	0.5 U					20 U	20 U
C1	6/22/93	113	0.9	0.5 U	0.5 U					20 U	20 U
C1	7/8/93	113	1.2	0.5 U	0.5 U	10 U	10 U	0.154 UJ	0.172 UJ	20 U	20 U
C1	8/18/93	93.3		13.8	0.5 U					28	44
C1	10/4/93	108	2.8	0.5 UJ	0.5 U					20 U	20 U
C1	10/27/93	70.5	0.5	0.5 U	0.5 U	10 U	10 U			23	31
C1	11/18/93	46.7	1.0	0.5 U	0.5 U					40	85
C1	12/6/93	60.9	1.4	0.5 U	0.5 U					20 U	31
C1	1/17/94	94.1	2.0	0.5 U	0.5 U	10 U	10 U			24	38
C1	2/22/94	76.2		0.5 U	0.5 U					20 U	30
C1	3/22/94	63.6		0.5 U	0.5 U					21	35
C1	4/18/94	97.8		0.5 U	0.5 U	10 U	10 U			20 U	20 U
C1	5/17/94	80.4		0.5 U	0.5 U					117	20 U
C1	6/20/94	86.6		0.5 U	0.5 U					20 U	20 U
C1	7/18/94	111		0.5 U	0.5 U	10 U	10 U	0.2 U	0.2 U	20 U	20 U
C1	8/22/94	104		0.5 U	0.5 U					20 U	20 U
C1	9/19/94	99.2		0.5 U	0.5 U					20 U	21
C1	10/18/94	95.9	0.4	0.5 U	0.5 U	10 U	10 U			20 U	20 U
C1	11/15/94	34.5		0.5 UJ	0.5 U					42	66
C1	12/5/94	54.7		0.5 UJ	0.5 U					28	39
C1	1/17/95	76.4		0.706 J	0.5 U					20	24
C1	4/17/95	103		0.5 U	0.5 U					20 U	20 U
C1	7/18/95	105		0.5 U	0.5 U	10 U	10 U	0.212	0.2 U	20 U	20 U
C1	10/16/95	39.7		0.25 U	0.25 U					35	44
C1	2/28/96	111		0.5 U	0.5 U					21	30
C1	5/6/96	104		0.5 U	0.5 U					20.1	32.8
C1	8/5/96	96.5		0.5 U	0.5 U	10 U	10 U	0.2 U	0.2 U	112	39.3
C1	12/2/96	54.2		0.5 U	0.5 U					56.9	60 UJ
C1	2/17/97	92.5			0.5 U						53.7 UJ
C1	5/27/97	83.3			0.63 J						72.7 UJ
C1	8/4/97										
C1	11/5/97	62.1			5 U						24

Table 7. Laundau Mill Creek Data (continued)

Station	Date	Hardness (mg/L)	Flow (cfs)	Cadmium Dissolved (µg/L)	Cadmium Total (µg/L)	Chromium Dissolved (µg/L)	Chromium Total (µg/L)	Mercury Dissolved (µg/L)	Mercury Total (µg/L)	Zinc Dissolved (µg/L)	Zinc Total (µg/L)
C1	1/23/98	22.4			5 U						42
C1	5/1/98	110			0.5 U						20 U
C1	9/30/98	99.7			0.5 U						17
C1	12/29/98	25.2			0.5 U						38
C1	1/19/99	36.6			0.5 U						28
C1	4/5/99	78			0.5 U						22
C1	7/6/99	99.9			1.5 U						44
C1	10/20/99	96			0.5 U						20 U
C1	1/5/00	61.3			0.66						29.4
C1	4/6/00	86.8			0.5 U						43.4
C1	7/10/00	112			0.5 U						20 U
C1	10/2/00	68.4			0.5 U						20 U
C4	2/1/93	89		2.32	0.5 U	10 U	10 U			37	50
C4	2/22/93	88		0.5 U	0.5 U					44	62
C4	3/30/93	87		2.54 J	0.5 U					29	52
C4	4/28/93	72.5		0.5 U	0.5 U	10 U	10 U			39	53
C4	5/17/93	120		0.5 U	0.62 J					35	70
C4	6/22/93	114		3.06 J	0.593 J					28	59
C4	7/7/93	109		11	0.577 J	10 U	10 U	0.178 UJ	0.176 UJ	31	53
C4	8/18/93	106		0.565 UJ	1.2 J					53	128
C4	10/4/93	97.8		0.5 UJ	0.5 U					20 U	21
C4	10/27/93	54.6		0.5 U	0.5 U	10 U	10 U			20 U	24
C4	11/17/93	63.1		1.89 J	0.507 J					48	61
C4	12/6/93	58.4		0.5 U	0.5 U					25	45
C4	1/17/94	93		0.5 U	0.5 U	10 U	10 U			20 U	36
C4	2/22/94	74.3		0.5 U	0.5 U					24	36
C4	3/22/94	59.2		0.649 J	0.5 U					33	42
C4	4/18/94	99.6		0.5 U	0.5 U	10 U	10 U			20 U	22
C4	5/17/94	66.4		0.5 U	0.5 U					20 U	23
C4	6/20/94	80.1		0.5 U	0.5 U					20 U	20 U
C4	7/18/94	115		0.5 U	0.5 U	10 U	10 U	0.2 U	0.2 U	20 U	60
C4	8/22/94	119		0.5 U	0.713 J					20 U	84

Table 7. Laundau Mill Creek Data (continued)

Station	Date	Hardness (mg/L)	Flow (cfs)	Cadmium Dissolved (µg/L)	Cadmium Total (µg/L)	Chromium Dissolved (µg/L)	Chromium Total (µg/L)	Mercury Dissolved (µg/L)	Mercury Total (µg/L)	Zinc Dissolved (µg/L)	Zinc Total (µg/L)
C4	9/19/94	93.6		0.5 U	0.5 U					20 U	20
C4	10/18/94	92.8		0.5 U	0.5 U	10 U	10 U			20 U	30
C4	11/15/94	41.3		0.5 UJ	0.5 U					37	54
C4	12/5/94	57.2		0.5 U	0.5 U					40	48
C4	1/17/95	75.5		0.5 U	0.5 U					31	35
C4	4/17/95	102		0.5 U	0.5 U					21	20 U
C4	7/17/95	104		0.5 U	0.5 U	10 U	10 U	0.2 U	0.2 U	20 U	20 U
C4	10/16/95	34.9		0.25 U	0.25 U					20 U	22
C4	2/28/96	112		0.5 U	0.519					51	59
C4	5/6/96	103		0.5 U	0.5 U					34.8	46.5
C4	8/5/96	85		0.5 U	0.5 U	10 U	10 U	0.2 U	0.2 U	127	49
C4	12/2/96	44.5		0.5 U	0.5 U					54.1	63.8 UJ
C4	2/17/97	85.4			0.5 U						57.9 UJ
C4	5/27/97	109			1.75 J						72.1 UJ
C4	8/4/97										
C4	11/5/97	60.8			5 U						26
C4	1/23/98	22.9			5 U						44
C4	5/1/98	106			0.8						20 U
C4	9/30/98	92.9			0.5						18
C4	12/29/98	21.2			0.5 U						27
C4	1/19/99	35.9			0.5 U						34
C4	4/5/99	78.9			0.5 U						36
C4	7/6/99	90.5			0.9 U						33
C4	10/20/99	97.1			0.5 U						37.8
C4	1/5/00	65.1			0.85						80.4
C4	4/6/00	100			0.5 U						51.2
C4	7/10/00	110			0.5 U						20 U
C4	10/2/00	62.9			0.5 U						31

U = Indicates compound was analyzed for, but was not detected at the reported sample detection limit.
UJ = The analyte was not detected in the sample; the reported sample detection limit is an estimate.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
B = Possible method blank contamination.

Table 8. USGS Data on Dissolved Silver Concentrations in the Yakima River above Ahtanum Creek, Station 12510500 [Data obtained through Jennifer Morace, Yakima NAWQA]

Date	Ag (ug/L)	Hardness (mg/L)
19-May-99	< 1	67
9-Jun-99	< 1	
17-Jun-99	< 1	38
30-Jun-99	< 1	
13-Jul-99	< 1	51
29-Jul-99	< 1	
5-Aug-99	< 1	93
6-Aug-99	< 1	93
6-Aug-99	< 1	93
24-Aug-99	< 1	
31-Aug-99	< 1	95
21-Sep-99	< 1	
19-Oct-99	< 1	98
18-Nov-99	< 1	71
7-Dec-99	< 1	50
13-Jan-00	< 1	66

Appendix B

Description of Sampling Sites

Appendix B. Description of Sampling Sites for 303(d) Metals Verification Study, July 2001 - May 2002

Site Name	Description*	Latitude**	Longitude
Snohomish River bw. Monroe	At boat launch 3.2 miles below Highway 522 bridge (off right bank)	47° 51.980'	122° 04.610'
Upper May Creek	At power lines downstream of Coal Creek Parkway	47° 31.26	122° 10.06'
May Creek @ mouth	At gaging station on Lake Washington Boulevard	47° 31.79'	122° 12.08'
Mill Creek @ R.M. 1.5	Where creek crosses under West Valley Highway, at Boeing Space Center, upstream side of road	47° 46.74'	122° 14.99'
Mill Creek @ R.M. 0.1	At USGS gage at Orilla, upstream side of railroad trestle, Ecology ambient station 09E070	47° 26.33'	122° 14.47'
Naches River near Yakima	Downstream side of Highway 82 bridge, Ecology ambient station 38A050 (off right bank)	46° 37.77'	120° 30.83'
Yakima River ab. Ahtanum Cr.	Below Union Gap at Yakima Greenway Century Landing, upstream of Highway 82 (off left bank)	46° 31.85'	120° 28.22'
Yakima River ab. Satus Creek	Near Sunnyside, at west end of S. Emerald Road, USGS station 12507585 (off left bank)	46° 16.17'	120° 05.61'
Yakima River @ Kiona	Upstream side of bridge to Kiona, Ecology ambient station 37A090 (off right bank)	46° 15.19'	119° 28.54'
Palouse River @ Hooper	Near train tracks at bridge on old Highway 26, Ecology ambient station 34A070 (center channel)	46° 45.52'	118° 08.80'
Spokane River @ Riverside State Park	Wooden foot bridge at park, Ecology ambient station 54A120 (center channel)	47° 41.80'	117° 29.80'

*facing downstream
**NAD 83

Appendix C

Case Narratives for Metals Data

Washington Department of Ecology
Manchester Environmental Laboratory
7411 Beach Drive East
Port Orchard, WA 98366

Case Narrative

March 1, 2002

Subject: Metals Quality Assurance Memo for 303d Metals week 05
Officer(s): Art Johnson
By: Randy Knox

Summary

The data generated by the analysis of these samples can be used noting qualifications discussed in this memo. Mercury on sample number 02058081 is qualified as an estimate due to a low concluding calibration verification standard. All analyses requested were evaluated by established regulatory quality assurance guidelines.

Sample Information

Samples for 303d Metals week 05 project were received by Manchester Environmental Laboratory on 1/31/02 in good condition

Holding Times

All analyses were performed within established EPA holding times.

Calibration

Instrument calibration was checked by initial calibration verification standards and blanks. All initial and continuing calibration verification standards were within control limits. The exception is that a concluding continuing calibration verification standard used in analysis of sample 02058081 was 81%, less than the allowed 85%. Data for this sample is qualified UJ, as undetected at estimated detection level. A correlation coefficient of 0.995 or greater was met. Balances are professionally calibrated yearly and checked in-house daily.

Blanks

No analytically significant levels of analyte were detected in the method blanks associated with these samples.

Matrix Spikes

Spiked sample analyses were performed where applicable with all spike recoveries within acceptance limits of ± 25%. Spiked sample analysis is performed at a frequency of at least 5%.

Replicates

Relative Percent Differences (RPD) for metal parameters were within acceptance limits of ± 20% for duplicate analysis. Laboratory duplication is performed at a frequency of at least 5%. Precision and accuracy specifications are based on sample concentrations greater than five times the reporting limit or on spiked duplicate samples. For results near the reporting limit, the criteria are not guaranteed to be better than +/- the reporting limit.

Laboratory Control Samples

LCS analyses were within the windows established for each parameter.

Other Quality Assurance Measures and Issues

The "U" qualification indicates that the analyte was not detected at or above the reporting limit.

The "UJ" qualification indicates that the analyte was not detected at or above the reported estimated result.

Please call or Meredith Jones at (360) 871-8833 or Randy Knox at (360) 871-8811 to further discuss this project.

cc: Project File

Data Qualifier Codes

U	-	The analyte was not detected at or above the reported result.
J	-	The analyte was positively identified. The associated numerical result is an estimate.
UJ	-	The analyte was not detected at or above the reported estimated result.
REJ	-	The data are unusable for all purposes.
NAF	-	Not analyzed for.
N	-	For organic analytes there is evidence the analyte is present in this sample.
NJ	-	There is evidence that the analyte is present. The associated numerical result is an estimate.
NC	-	Not Calculated
E	-	The concentration exceeds the known calibration range.
bold	-	The analyte was present in the sample. (Visual Aid to locate detected compounds on report sheet.)

Manchester Environmental Laboratory

7411 Beach Dr E, Port Orchard, Washington 98366

April 30, 2002

Subject: Metals QA Memo for 303d Metals – 12

To: Art Johnson

By: Meredith Jones

Summary

The data generated by the analysis of these samples can be used without qualification. All analyses requested were evaluated by established regulatory quality assurance guidelines.

Copper sample number 02128160 was analyzed initially on 3/28/02, and then again in duplicate on 4/29/02.

Sample Receipt

The samples were received by the Manchester Laboratory on 3/26/02 in good condition.

Holding Times

All analyses were performed within the specified holding time (28 days Hg, 180 days all other metals).

Calibration

Instrument calibration was performed before each analytical ran and checked by initial calibration verification standards and blanks. Continuing calibration standards and blanks were analyzed at a frequency of 10% during the run and again at the end of the analytical run. All initial and continuing calibration verification standards and blanks were within the relevant control limits. A correlation coefficient of 0.995 or greater was met.

Procedural Blanks

No analytically significant levels of analyte were detected in the method blanks associated with these samples.

Matrix Spikes

Spiked sample analyses were performed where applicable with all spike recoveries within acceptance limits of ± 25%.

Precision

Relative Percent Differences (RPD) were within acceptance limits of ± 20% for duplicate analysis. Precision and accuracy specifications are based on sample concentrations greater than five times the reporting limit. For results near the reporting limit, the criteria are not guaranteed to be better than +/- the reporting limit.

Laboratory Control Samples

All LCS analyses were within the acceptance criteria for the individual analytes.

Other Quality Assurance Measures and Issues

The "U" qualification indicates that the analyte was not detected at or above the reporting limit.

Comments

Please call Dean Momohara at (360) 871-8808 to further discuss this project.

Washington Department of Ecology
Manchester Environmental Laboratory
7411 Beach Drive East
Port Orchard, WA 98366

Case Narrative

June 13, 2002

Subject: Metals Quality Assurance Memo for 303d Metals - 20
Officer: Art Johnson
By: Dean Momohara

Summary

The data generated by the analysis of these samples can be used without qualification.

All analyses requested were evaluated by established regulatory quality assurance guidelines.

Sample Information

Samples were received by Manchester Environmental Laboratory on 05/17/02 in good condition.

Holding Times

All analyses were performed within established EPA holding times.

Calibration

Instrument calibrations and calibration checks were performed in accordance with the appropriate method. All calibration checks were within control limits. Where appropriate, all calibration correlation coefficients were ≥ 0.995. Balances are professionally calibrated yearly and calibrated in-house daily.

Blanks

No analytically significant levels of analyte were detected in the method blanks associated with these samples.

Matrix Spikes

All matrix spike recoveries were within the acceptance limits of $\pm$ 25%.

Replicates

All duplicate relative percent differences were within acceptance limits of < 20%.

Laboratory Control Samples

All laboratory control sample recoveries were within acceptance limits.

Other Quality Assurance Measures and Issues

All internal standard recoveries were within acceptance limits.

U - The analyte was not detected at or above the reported result.

Please call Dean Momohara at (360) 871-8808 to further discuss this project.

cc: Project File

Data Qualifier Codes

J	-	The analyte was positively identified. The associated numerical result is an estimate.
UJ	-	The analyte was not detected at or above the reported estimated result.
REJ	-	The data are unusable for all purposes.
NAF	-	Not analyzed for.
N	-	For organic analytes there is evidence the analyte is present in this sample.
NJ	-	There is evidence that the analyte is present. The associated numerical result is an estimate.
NC	-	Not Calculated
E	-	The concentration exceeds the known calibration range.
bold	-	The analyte was present in the sample. (Visual Aid to locate detected compounds on report sheet.)

Washington Department of Ecology
Manchester Environmental Laboratory
7411 Beach Drive East
Port Orchard, WA 98366

September 6, 2001

TO: Art Johnson
FROM: Jim Ross, Manchester Lab
SUBJECT: Metals Quality Assurance memo for 303d Metals wk 28

SUMMARY
Data for this project met all quality assurance and quality control criteria and can be used without qualification. To simplify reporting, all analytes requested for this project for analysis by ICP-MS were reported for all the samples

SAMPLE RECEIPT
The samples were received by the Manchester Laboratory on 08/01/01 in good condition.

HOLDING TIMES
All analyses were performed within the specified holding time (28 days Hg, 180 days all other metals).

INSTRUMENT CALIBRATION
Instrument calibration was performed before each analytical run and checked by initial calibration verification standards and blanks. Continuing calibration standards and blanks were analyzed at a frequency of 10% during the run and again at the end of the analytical run. All initial and continuing calibration verification standards and blanks were within the relevant control limits.

PROCEDURAL BLANKS
The procedural blanks associated with these samples showed no analytically significant level of requested analyte.

SPIKED SAMPLE ANALYSES
All spike recoveries were within normal QA/QC limits (75-125%).

PRECISION DATA
Precision estimates based on duplicate spike analysis were within the acceptance criteria for duplicate analysis ($\pm$20%).

LABORATORY CONTROL SAMPLE (LCS) ANALYSES
All LCS analyses were within the acceptance criteria for the individual analytes. M1229DL2 and M1229DL3 are SLRS-4. M1229DL4 is NIST 1643d.

Please call Jim Ross at (360) 871-8808 to further discuss this project.

Washington Department of Ecology
Manchester Environmental Laboratory
7411 Beach Drive East
Port Orchard, WA 98366

October 10, 2001

TO: Art Johnson
FROM: Jim Ross, Manchester Lab
SUBJECT: Metals Quality Assurance memo for 303d Metals wk 37

SUMMARY
Data for this project met all quality assurance and quality control criteria and can be used without qualification. To simplify reporting, all analytes requested for this project for analysis by ICP-MS were reported for all the samples

SAMPLE RECEIPT
The samples were received by the Manchester Laboratory on 09/14/01 in good condition.

HOLDING TIMES
All analyses were performed within the specified holding time (28 days Hg, 180 days all other metals).

INSTRUMENT CALIBRATION
Instrument calibration was performed before each analytical run and checked by initial calibration verification standards and blanks. Continuing calibration standards and blanks were analyzed at a frequency of 10% during the run and again at the end of the analytical run. All initial and continuing calibration verification standards and blanks were within the relevant control limits.

PROCEDURAL BLANKS
The procedural blanks associated with these samples showed no analytically significant level of requested analyte.

SPIKED SAMPLE ANALYSES
All spike recoveries were within normal QA/QC limits (75-125%).

PRECISION DATA
Precision estimates based on duplicate spike analysis were within the acceptance criteria for duplicate analysis ($\pm$20%).

LABORATORY CONTROL SAMPLE (LCS) ANALYSES
All LCS analyses were within the acceptance criteria for the individual analytes. M1270DL1 and M1270DL2 are HPS TMDW. M1270DL3 and M1270DL4 are NRCC SLRS-4. A spreadsheet is attached with a summary of associated QC.

Please call Jim Ross at (360) 871-8808 to further discuss this project.

Washington Department of Ecology
Manchester Environmental Laboratory
7411 Beach Drive East
Port Orchard, WA 98366

December 14, 2001

TO: Art Johnson
FROM: Jim Ross, Manchester Lab
SUBJECT: Metals Quality Assurance memo for 303d Metals wk 46

SUMMARY

Data for this project met all quality assurance and quality control criteria and can be used without qualification.

SAMPLE RECEIPT

The samples were received by the Manchester Laboratory on 11/15/01 in good condition.

HOLDING TIMES

All analyses were performed within the specified holding time (28 days Hg, 180 days all other metals).

INSTRUMENT CALIBRATION

Instrument calibration was performed before each analytical run and checked by initial calibration verification standards and blanks. Continuing calibration standards and blanks were analyzed at a frequency of 10% during the run and again at the end of the analytical run. All initial and continuing calibration verification standards and blanks were within the relevant control limits.

PROCEDURAL BLANKS

The procedural blanks associated with these samples showed no analytically significant level of requested analyte.

SPIKED SAMPLE ANALYSES

All spike recoveries were within normal QA/QC limits (75-125%).

PRECISION DATA

Precision estimates based on duplicate spike analysis were within the acceptance criteria for duplicate analysis ($\pm$20%).

LABORATORY CONTROL SAMPLE (LCS) ANALYSES

All LCS analyses were within the acceptance criteria for the individual analytes. Please see the attached QC spreadsheet for detailed QC information

Please call Jim Ross at (360) 871-8808 to further discuss this project.