

## **Appendix C.**

### **Metals Data Summary and Analysis**

Ohio EPA collected samples between 1/19/1999 and 3/17/2010 and analyzed the samples for the certain metals (Table C-1). Ohio's standards for the following six metals are dependent upon hardness: cadmium, chromium, copper, lead, nickel, and zinc. A summary of hardness samples is presented in Figure C-1; note that one outlier and one non-detect were excluded from the evaluation.

**Table C-1. Summary of metals data collected by Ohio EPA**

	Aluminum	Arsenic	Cadmium <sup>a</sup>	Chromium <sup>a</sup>	Dissolved Chromium (hexavalent)	Copper <sup>a</sup>	Copper (low level) <sup>a</sup>	Iron	Lead <sup>a</sup>	Manganese	Mercury	Nickel <sup>a</sup>	Selenium	Zinc <sup>a</sup>
OMZM <sup>b</sup>	-	340	4.5	1,800	16	14		-	120	-	1.7	470	--	120
OMZA <sup>b</sup>	-	150	2.5	86	11	9.3		-	6.4	-	0.9	52	5.0	120
<i>All samples</i>														
Samples <sup>c</sup>	373	373	373	373	28	373	42	373	373	373	229	373	373	373
Detections	177	185	6	3	15	14	21	368	43	350	0	7	0	95
Detection limit (µg/L) <sup>d</sup>	200	2	0.2	30 <sup>e</sup>	10	10	2	50	2	10	0.2	40 <sup>f</sup>	2	10
<i>Grand River (04110004 06)</i>														
Detections	118	105	5	1	15	9	13	184	25	184	-	7	-	46
Min (µg/L)	201	2.0	0.2	3.3	10	2.6	2.0	179	2.0	15	-	2.1	-	10
Max (µg/L)	10,500	9.5	0.3		21	<b>15.0</b>	6.0	23,200	<b>15.5</b>	693	-	4.2	-	78
<i>Mill Creek (04110004 04)</i>														
Detections	22	31	1	-	-	1	-	46	8	45	-	-	-	10
Min (µg/L)	202	2.0	0.2	-	-	<b>25.0</b>	-	236	2.1	13	-	-	-	10
Max (µg/L)	1,820	5.2		-	-		-	-	2,720	<b>6.7</b>	568	-	-	-
<i>Tributaries in the Big Creek – Grand River HUC (04110004 06)</i>														
Detections	27	33	-	2	-	3	2	113	8	96	-	-	-	32
Min (µg/L)	206	2.0	-	40.0	-	10.0	2.0	51	2.4	10	-	-	-	11
Max (µg/L)	7,480	7.4	-	47.0	-	<b>16.0</b>	9.0	14,400	<b>13.0</b>	362	-	-	-	79
<i>Tributaries in the Griggs Creek – Mill Creek HUC (04110004 04)</i>														
Detections	10	16	-	-	-	1	6	25	2	25	-	-	-	7
Min (µg/L)	268	2.0	-	-	-	13.0	3.0	150	2.0	22	-	-	-	10
Max (µg/L)	1,500	4.5	-	-	-		6.0	2,050		186	-	-	-	-

**Notes**

**Bolded** values are greater than OMZM standard.

- a. The standards for these metals is dependent upon hardness. The values displayed in this table represent the standards for a hardness of 100 mg/L calcium carbonate.
- b. The outside mixing zone maximum (OMZM) and outside mixing zone average (OMZA) from Table 7-1 and Table 7-9 of OAC-3745-1-07. Standards displayed in this table are for total recoverable metals.
- c. The number of samples and number of detections includes field duplicates. A total of 374 samples were collected, including one field blank and 44 field duplicates.
- d. In isolated cases, a single or a few samples had a different detection limit than the vast majority of the rest. If more than two samples had a different detection limit, then other detection limit is identified.
- e. The detection limit for chromium was 30 µg/L for 363 samples and 2.0 µg/L for 11 samples on the Lower Grand River.
- f. The detection limit for nickel was 40 µg/L for 366 samples and 2.0 µg/L for 8 samples on the Grand River.

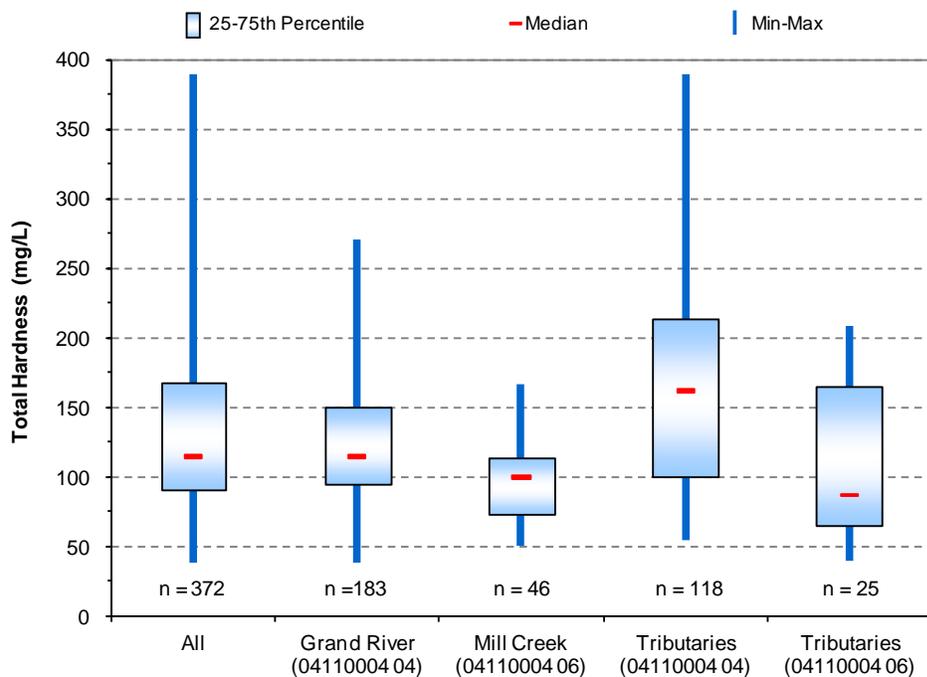


Figure C-1. Evaluation of Ohio EPA hardness data.

Mercury and selenium were never detected in any sample.

When arsenic, chromium, lead, nickel, or zinc were detected, the concentrations never exceeded the outside mixing zone maximum (OMZM) standards. Though the concentrations did not exceed the OMZM standards, two elevated chromium detections occurred on 7/31/2000 in Coffee Creek (40.0 ug/L) and Ellison Creek (47.0 ug/L).

Ohio EPA collected hexavalent chromium samples from the Lower Grand River from 8/17/2004 through 10/12/2004. Of the 15 detections, two samples (19 and 21 ug/L) exceeded the OMZM standard and 11 additional samples were greater than the OMZA value (11 – 16 ug/L). All of the detections occurred downstream of the confluence of Red Creek with the Grand River.

Copper was analyzed using two methodologies; one method had a detection limit of 10 ug/L, the other method had a detection limit of 2 ug/L. All nine of the copper detections on the Grand River occurred at OH-84 in Painesville. The sample collected on 5/6/2003 (15 ug/L) exceeded the OMZM standard. One sample each collected from Ellison Creek (16.0 ug/L on 7/31/2000) and from Mill Creek (04110004 06; 25.0 ug/L on 12/10/2003) exceeded the OMZM standard.

Lead exceeded the OMZA numeric criteria at three locations in the watershed. Single samples from the following two creeks exceeded their hardness-dependent criteria: Mill Creek (04110004 04 02; 6.7 µg/L at G02G13 on 9/23/2003)<sup>1</sup>, and Mill Creek (04110004 06 02; 12.8 µg/L at G02G10 on 7/12/2004)<sup>2</sup>. Lead exceeded criteria six times on the Grand River at OH-84 in Painesville (site 502530; range 3.5 to 15.5 µg/L).

<sup>1</sup> The hardness of this sample was 66 mg/L, which yields a total recoverable lead OZMA criterion of 3.8 µg/L.

<sup>2</sup> The hardness of this sample was 114 mg/L, which yields a total recoverable lead OZMA criterion of 7.6 µg/L.

Iron and manganese do not have OMZM and OMZA standards; however, reference stream data are reported in the appendices of *Associations between Nutrients and Habitat* (Ohio EPA 1999). The pertinent data from this document are presented in Table C-2.

**Table C-2. 75th percentile statistics for reference streams' data in the EOLP ecoregion**

<b>Metal</b>	<b>Headwaters</b>	<b>Wading</b>	<b>Small River</b>
Iron (ug/L)	1,350	1,025	1,325
Manganese (ug/L)	248.75	191.75	-

Based upon: Ohio EPA (1999)

Manganese concentrations from two headwaters streams were greater than the 75<sup>th</sup> percentile of reference streams' data: Ellison Creek (362 ug/L on 7/31/2000) and Mill Creek (04110004 04 03; 330 ug/L on 7/12/2004). Four manganese concentrations were greater than the the 75<sup>th</sup> percentile for wading-sized streams: Big Creek (211 and 308 ug/L) and Mill Creek (04110004 06; 263, and 568 ug/L [the field duplicate for 568 ug/L was 559 ug/L]).

Iron concentrations from five headwaters streams were greater than the 75<sup>th</sup> percentile of reference stream data: Askue Creek (1,360 ug/L), Cemetery Creek (1,960 ug/L), Coffee Creek (1,710 and 2,180 ug/L), Ellison Creek (12,000), and Griggs Creek (n=5, range: 1,410 – 2,050 ug/L). It is noteworthy that the elevated iron concentration on Ellison Creek occurred on 7/31/2000, which is the same date that other metals concentrations were elevated. Concentrations from three wading-sized streams were greater than the 75<sup>th</sup> percentile: Big Creek (n=3, range: 1,720\* – 6,170 ug/L; \*field duplicate was 1,810 ug/L), Mill Creek (04110004 06; n=16, range: 1,070 – 14,400 ug/L; includes one field duplicate), and Paine Creek (n=3, range: 1,200-1,440). Finally, 46 samples on the Lower Grand River had iron concentrations that were greater than the 75<sup>th</sup> percentile for small rivers (1,350\* - 14,800; \* field duplicate was 1,430; includes five field duplicates)