Reconnaissance Assessment of Heavy Metals in the Clay Fraction of Sediments Downstream of the Tar Creek Superfund Site in Northeastern Oklahoma

Prepared for the Six Treaty Tribes of Oklahoma

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Prepared by Tribal Environmental Management Services, PO Box 335, Miami, OK 74355

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1 INTRODUCTION

The jurisdictional lands of the Six Treaty Tribes of Oklahoma[1] are located within the Oklahoma portion of the Grand Lake watershed downstream of the Tri-State Mining District (TSMD). Toxic substances released from the TSMD (i.e. lead, zinc, and cadmium) are known to be transported away from the Superfund site and onto tribal jurisdictional lands via the Neosho River, the Spring River, and Tar Creek (MacDonald, Ingersoll et al. 2010). Tribal members who gather wild plants from floodplain habitats in this area are concerned with potential health hazard posed by exposure to these substances as well as the potential injury to the natural resources under tribal stewardship due to such exposure. To begin assessing whether tribal natural resources exposed to these substances may be injured, we conducted a reconnaissance assessment of the extent to which fluvial sediments may be contaminated with heavy metals on the jurisdictional lands of the Six Treaty Tribes.

The objectives of this study were:

- To document the downstream extent to which contamination of fluvial sediment has occurred
- To assess (for the first time) the level of contamination within floodplain sediments
- To identify areas where sampling should take place for future studies

In this report, we present chemical analysis for total lead and zinc concentrations determined by field portable X-ray fluorescence spectrometry of the <63 micron fraction of sediments from the riverine and floodplain areas downstream of the TSMD. Additionally, results of confirmatory analysis for total lead, zinc, and cadmium determined by inductively coupled plasma-mass spectrometry are presented. These data were compared with toxicological effect levels, thresholds effects levels, and background levels compiled by MacDonald (2000, 2010) and Pope (2004).

2 MATERIALS AND METHODS

2.1 Study Location

Samples were taken within the southern portion of the Grand Lake watershed (Figures 1-4). Control samples were taken from areas upstream of mining activities on both the Spring and Neosho rivers (refer to Figure 1).

2.2 Field Procedures

The number and spacing of samples locations along each transect were dependent upon channel complexity within the study reach and width of channel/floodplain. In-channel samples were collected using a hand operated auger or Van Dorn sampler. Bank and floodplain samples were collected using a hand trowel. At each sample location, a 400 g sample was collected in quart-sized Ziplock™ bags and labeled, and a GPS waypoint was recorded. Between each sample collection, sampling equipment was washed with a laboratory detergent solution using a brush and rinsed with deionized water.

[1] The Six Treaty Tribes consist of the Cherokee Nation, Eastern Shawnee Tribe of Oklahoma, Miami Tribe of Oklahoma, Ottawa Tribe of Oklahoma, Seneca-Cayuga Tribe of Oklahoma, and the Wyandotte Nation of Oklahoma.

Figure 1: Locations of sampling sites.

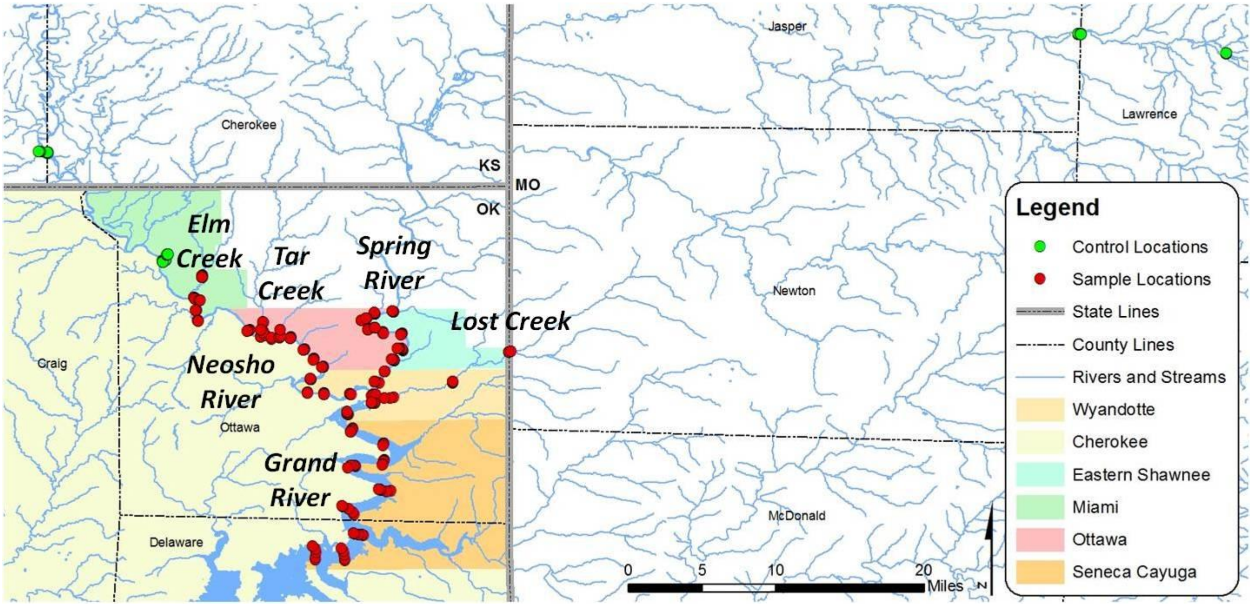
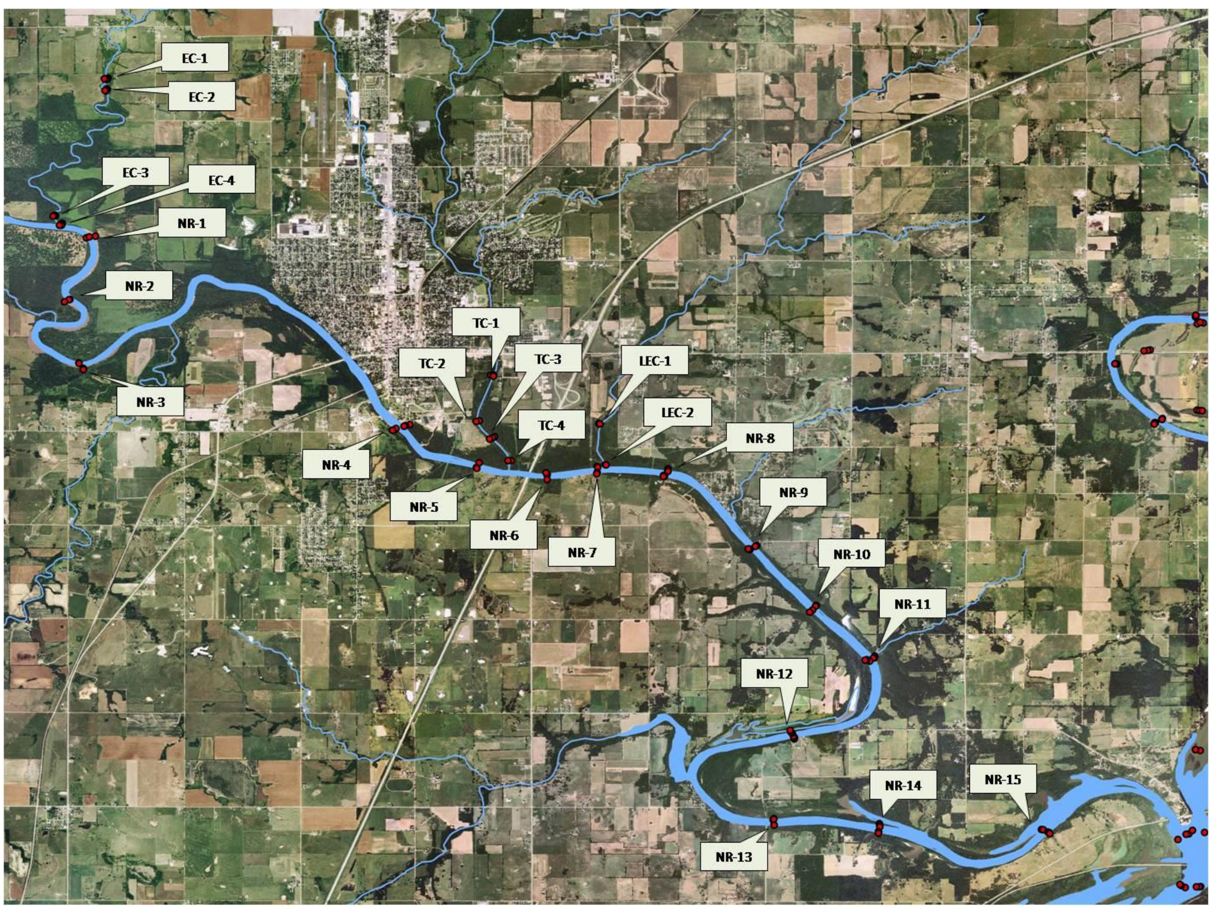


Figure 2: Locations of transects taken along Neosho River (NR), Elm Creek (EC), Tar Creek (TC), and Little Elm Creek (LEC).



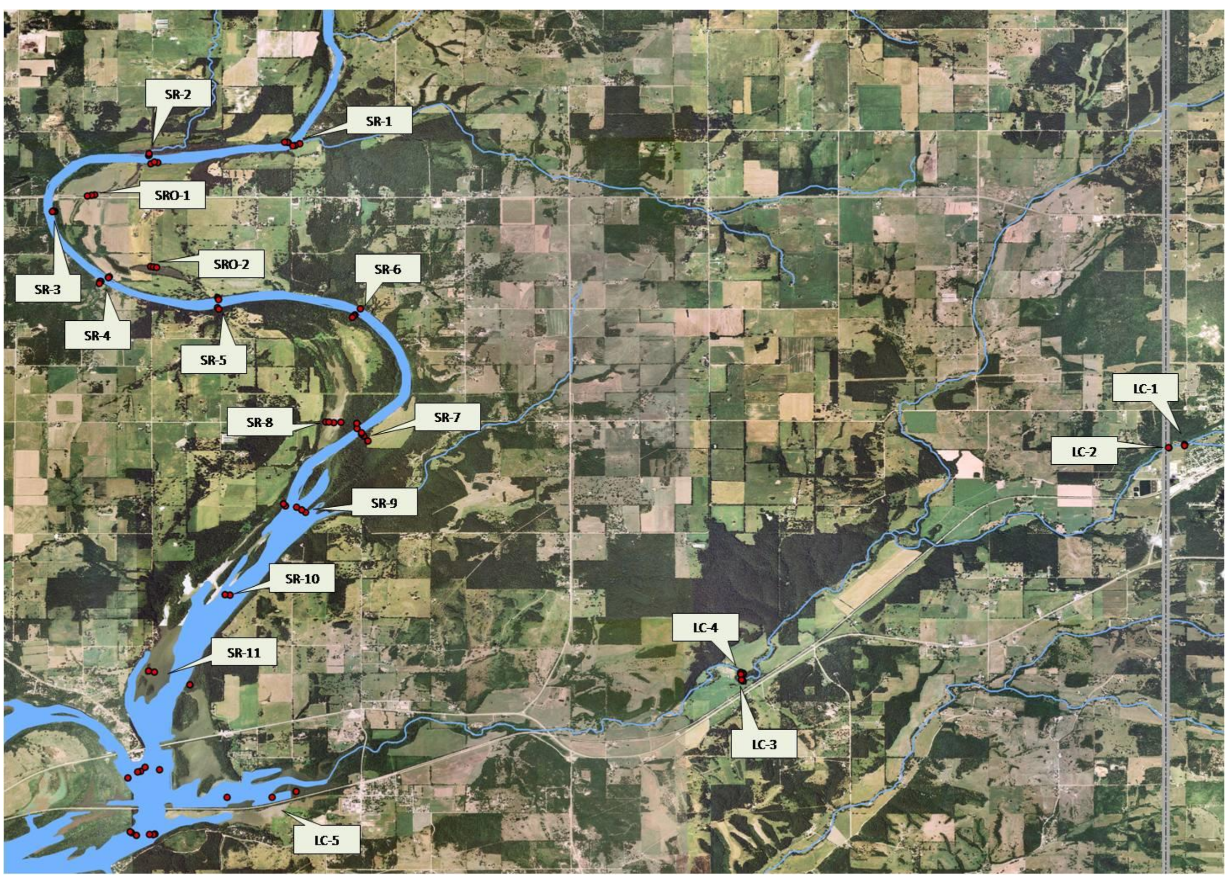
2.3 Laboratory Analysis

Samples were transferred to white Dixie™ bowls and oven dried at 110 °C for 8 hours. Dried samples were then ground with a mortar and pestle and passed through a 5-, 10-, 35-, 60-, 120-, and 230-mesh sieve to achieve a homogenized sample that was less than 63 microns (clay fraction). A portion of the sieved sample was placed in a 31.0-mm polyethylene sample cup so that one-half to two-thirds of the sample cup was full. The sample cup was then covered with a 2.5 µm Mylar film for analysis. The remaining homogenized portions of all samples were stored in Ziplock™ bags. All equipment including mortar, pestle, and sieves were thoroughly cleaned between sample preparations to prevent cross contamination. XRF screening was performed at the Cherokee Nation Environmental Office in Tahlequah, OK by a certified operator.

2.4 Confirmatory Analysis

A total of 30 samples were selected for confirmatory analysis. Samples were selected to represent a range of metal concentrations determined by XRF analysis. Homogenized samples were sent to Trace Element Research Laboratory, Texas A & M University, College Station, TX for heavy metal analysis by inductively coupled plasma mass spectrometry (ICP-MS).

Figure 3: Locations of transects taken along Spring River (SR) and Lost Creek (LC).



2.5 Calculation of PEC-Q Values

The Mean Probable Effect Concentration-Quotient (PEC-Q) for each metal was calculated by dividing the measured concentration of the metal within a sample by the Probable Effect Concentration (PEC) for the particular metal. PECs for lead, zinc, and cadmium calculated by MacDonald (2000) were used where the PEC values for lead, zinc and cadmium were 459 ppm, 128 ppm, and 4.98 ppm, respectively.

$$PEC\text{-}Q = \frac{[x]}{PEC_x}$$

Where, *x* is a metal sampled.

To estimate toxicity of sediments to benthic invertebrates the sum of the PEC-Q values for lead, zinc, and cadmium were used. These values were compared to the site specific toxicity threshold (SSTT) values (<6.47, low risk; 6.47-10.04, moderate risk; and >10.04, high risk) for amphipod survival determined by MacDonald et al. (2010). Only samples analyzed by ICP-MS were included in this estimation.

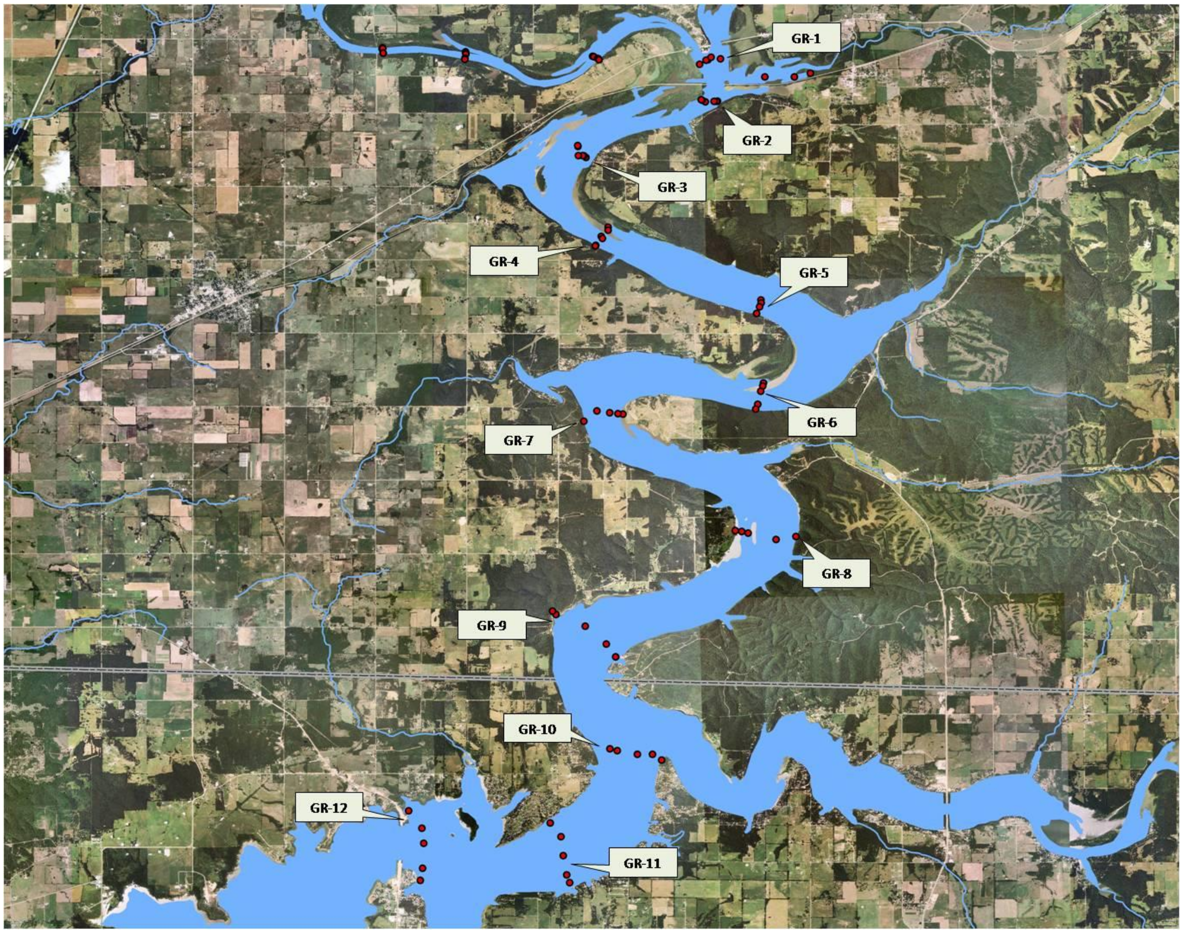
2.6 Statistical Analysis

All statistical tests were performed using Statistica 9 software (Statsoft®, Tulsa, OK). Normality was tested using two methods; firstly, by using histograms to visually inspect the data and secondly, by performing two statistical tests for normality (Kolmogorov-Smirnov and Shipiro-Wilks). All parameters tested to be normal. Therefore, it was concluded that parametric statistical analyses would be used in all cases. The following statistical tests and the circumstances under which they were used are described below:

- Outliers were detected using Grubb's test for outliers as well as box and whisker plots of data with outliers displayed visually.
- Statistical differences between two groups of data were determined using a t-test for independent samples.
- Statistical differences between three or more groups of data were determined using Analysis of Variance (ANOVA) with Fisher LSD post-hoc tests for significance.
- Statistical comparisons between groups of data were made using the Pearson correlation test.

All statistical analyses were performed at a 95% confidence interval.

Figure 4: Locations of transects taken along Grand River (GR).



3 RESULTS AND DISCUSSION

The results, in full, are presented in Appendix A (Tables 6-20).

3.1 Detection of Outliers

Grubb's test for outliers was performed on all groups of data (Zn-XRF, Pb-XRF, Fe-XRF, Zn-ICP, Pb-ICP, and Cd-ICP). Outliers were detected in groups Zn-XRF and Pb-XRF ($p=0.00$ in both cases). A box and whisker plot of these two groups of data determined that the outlying data points were samples NRC-3-5 and NRC-3-6 (bank and overbank samples from the third transect of Neosho River control samples). Inspection of this sampling location revealed that the east bank of the River had been stabilized using production rock from the TSMD, which had likely resulted in the high concentrations of lead and zinc measured. These data points were removed from the dataset for all subsequent analyses.

3.2 Comparison of XRF and ICP-MS Data

Concentrations of lead and zinc in samples analyzed by ICP-MS (10% of the total number of samples taken) were compared to corresponding concentrations of lead and zinc in samples analyzed by XRF. The results of this analysis are shown in Tables 1 and 2.

Table 1: Comparison of zinc concentrations in samples analyzed by XRF and ICP-MS.

			r Value	
	Means (ppm)	Std. Dev.	Zn-XRF	Zn-ICP
Zinc-XRF	2276.067	2233.460	1.00	0.99
Zinc-ICP	2382.953	2319.796	0.99	1.00

Note: Red r-value denotes that p<0.05.

Table 2: Comparison of lead concentrations in samples analyzed by XRF and ICP-MS

			r Value	
	Means (ppm)	Std. Dev.	Pb-XRF	Pb-ICP
Lead-XRF	173.4567	154.2319	1.00	0.99
Lead-ICP	171.4800	151.8269	0.99	1.00

Note: Red r-value denotes that p<0.05.

These data show that a significant, positive correlation existed between data obtained from analysis by ICP-MS and XRF. Additionally, these data were able to meet definitive level data criteria per the requirements set forth by EPA Method 6200 (correlation coefficient of greater than 0.99 between XRF data and confirmatory data).

3.3 Comparison of Data from Control Sites and Impacted Sites

The data shown in Table 3 indicated that data from control sites were significantly different to data from impacted sites (p=0.00 in all cases). These data were generated by using a t-test to compare the difference between the mean value within impacted sites and the mean value within control sites for each respective heavy metal.

Table 3: Means, number of samples, and t-test results for the comparison between control and impacted samples.

DATA SET	Mean Impacted (ppm)	Mean Control (ppm)	N Impacted	N Control	p Value
Zinc-XRF	628.34	89.08	239	58	0.00
Lead-XRF	57.52	17.97	239	58	0.00
Iron-XRF	16804.55	10692.71	239	58	0.00
Zinc-ICP	2962.75	63.77	24	6	0.00
Lead-ICP	210.70	14.58	24	6	0.00
Cadmium-ICP	16.39	0.32	24	6	0.00

3.4 PEC-Q Values

PEC-Q values are presented in Appendix D. 24% of samples had a PEC-Q value of greater than 1 for zinc and 9.7% of samples had a PEC-Q value of greater than 1 for lead.

Table 4 shows ΣPEC-$Q_{Pb,Zn,Cd}$ for samples analyzed by ICP-MS as well as the predicted magnitude of toxicity for each sample. Risk levels were defined as: <6.47, low risk; 6.47-10.04, moderate risk; >10.04, high risk (MacDonald 2010).

Table 4: ΣPEC-$Q_{Pb,Zn,Cd}$ values and predicted magnitude of toxicity for samples analyzed by ICP-MS.

Sample ID	Zn PEC-Q	Pb PEC-Q	Cd PEC-Q)	ΣPEC-$Q_{Zn,Pb,Cd}$	Risk Level		
					Low	Moderate	High
EC-1-3	1.88	0.78	1.34	4.01	X		
EC-2-2	0.72	0.82	0.66	2.20	X		
EC-2-3	5.14	1.27	2.35	8.76		X	
GR-11-2	1.08	0.31	0.54	1.92	X		
GR-11-3	0.97	0.27	0.51	1.76	X		
GR-11-4	1.08	0.30	0.59	1.97	X		
GR-12-2	1.14	0.31	0.51	1.96	X		
GR-12-4	1.09	0.30	0.51	1.90	X		
NRC-3-1	0.12	0.09	0.05	0.25			
NRC-5-4	0.09	0.12	0.03	0.24		Controls	
NRC-5-5	0.10	0.12	0.03	0.24			
SR-1-3	9.59	1.79	5.00	16.38			X
SR-2-5	8.63	1.80	4.32	14.74			X
SR-3-3	4.25	1.66	1.91	7.82		X	
SR-7-4	8.61	1.55	4.72	14.87			X
SR-9-3	4.84	1.95	2.95	9.74		X	
SR-10-1	6.62	1.59	4.72	12.94			X
SR-10-2	3.03	0.70	1.71	5.44	X		
SRC-2-3	0.22	0.14	0.13	0.49			
SRC-3-5	0.19	0.12	0.10	0.41		Controls	
SRC-4-1	0.11	0.10	0.05	0.27			
SRO-2-3	2.29	1.34	1.55	5.18	X		
TC-1-1	17.54	2.97	7.85	28.36			X
TC-1-2	12.22	2.91	5.08	20.21			X
TC-1-3	13.01	2.73	6.14	21.88			X
TC-2-1	12.96	3.08	6.33	22.37			X
TC-2-2	8.00	1.75	4.38	14.12			X
TC-3-2	12.57	2.81	6.39	21.77			X
TC-3-3	9.39	4.77	6.29	20.45			X
TC-4-2	8.28	1.76	2.63	12.67			X

3.5 Presentation of Data from Impacted Sites

Data obtained from this study were compared to those from other studies pertaining to lead, zinc, and cadmium contamination particularly those by MacDonald (2000; 2010) and Pope (2004). Threshold effect concentration is defined by MacDonald, Ingersoll et al. (2010) as “the concentration of a chemical in sediment below which adverse biological changes are unlikely to occur”.

Table 4 shows a summary of the findings of these studies.

Table 5: Background, threshold effects, and probable effects concentrations for zinc, lead, and cadmium (MacDonald, Ingersoll et al. 2000; Pope 2004; MacDonald, Ingersoll et al. 2010).

	Zinc (mg/kg)	Lead (mg/kg)	Cadmium (mg/kg)
Background Concentrations Estimated by Pope, 2004	100	20	0.6
National Background Concentrations Estimated by Horowitz et al., 1991	88	23	No Data
Threshold Effects Concentration Estimated by MacDonald et al., 2000	124	35.8	0.99
General Probable Effects Concentration Estimated by MacDonald et al., 2000	459	128	4.98
Low Risk Threshold Concentration Estimated by MacDonald et al., 2010	1702	123	9.01
High Risk Threshold Concentration Estimated by MacDonald et al., 2010	2409	179	14.1

Figures 5, 6, and 7 present the data obtained from this study. Each sample location is represented by a colored dot on a map of the study area. The color of the dot represents the level at which the sampling location was found to be contaminated by each respective contaminant according to the estimations presented in Table 4.

Figure 5: Lead concentrations at sampling locations shown by dots representing the level of contamination (determined by XRF).

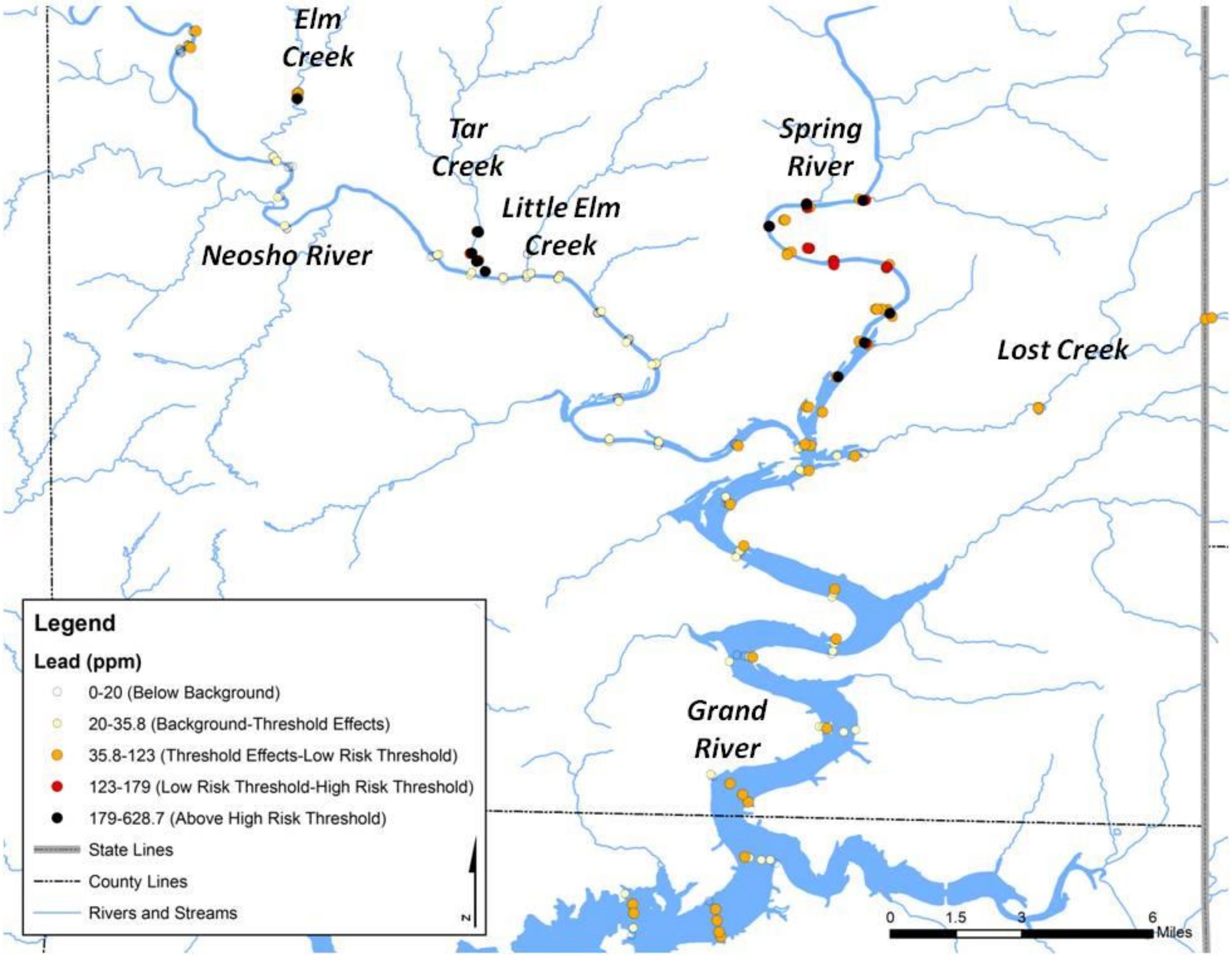


Figure 6: Zinc concentrations at sampling locations shown by dots representing the level of contamination (determined by XRF).

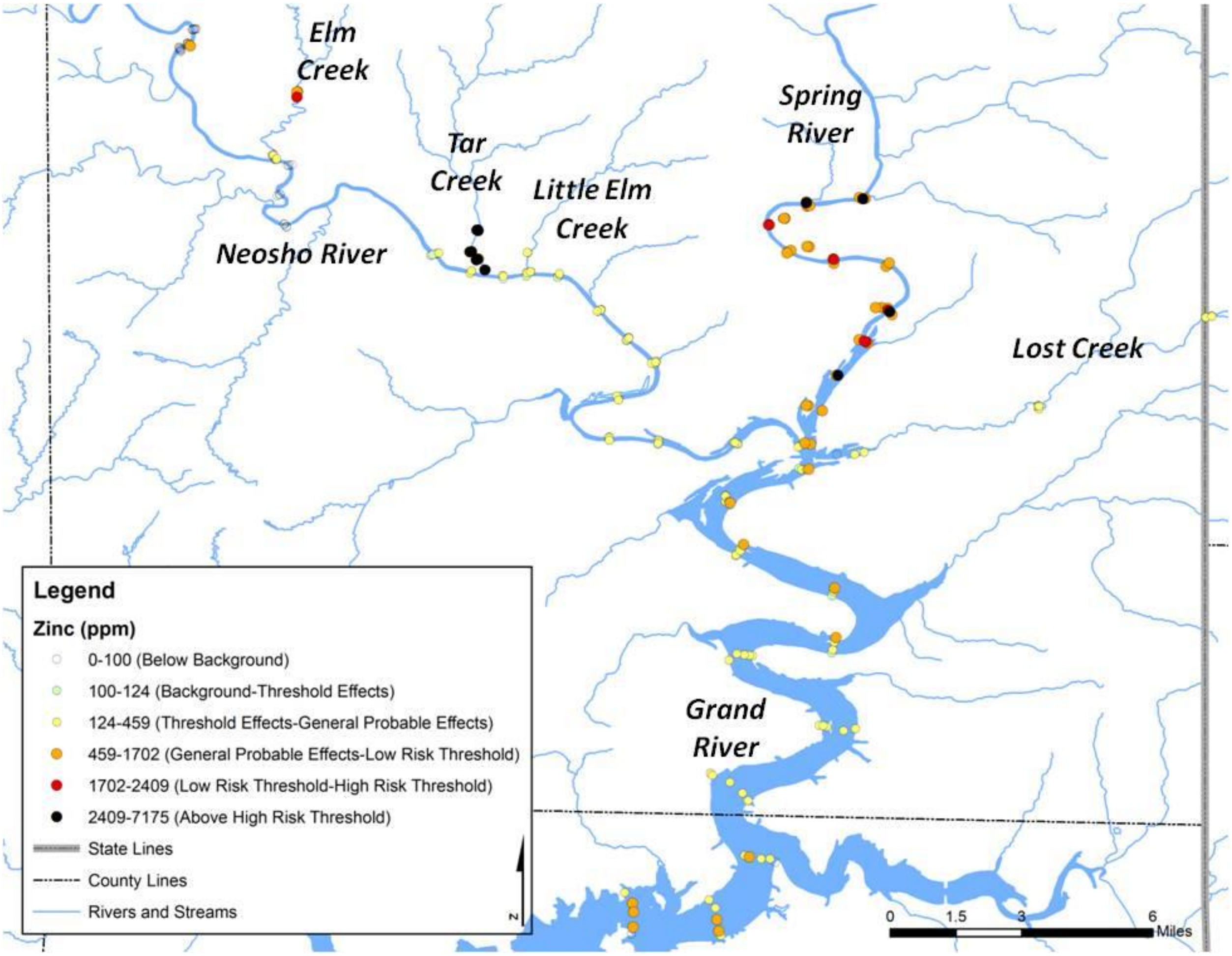
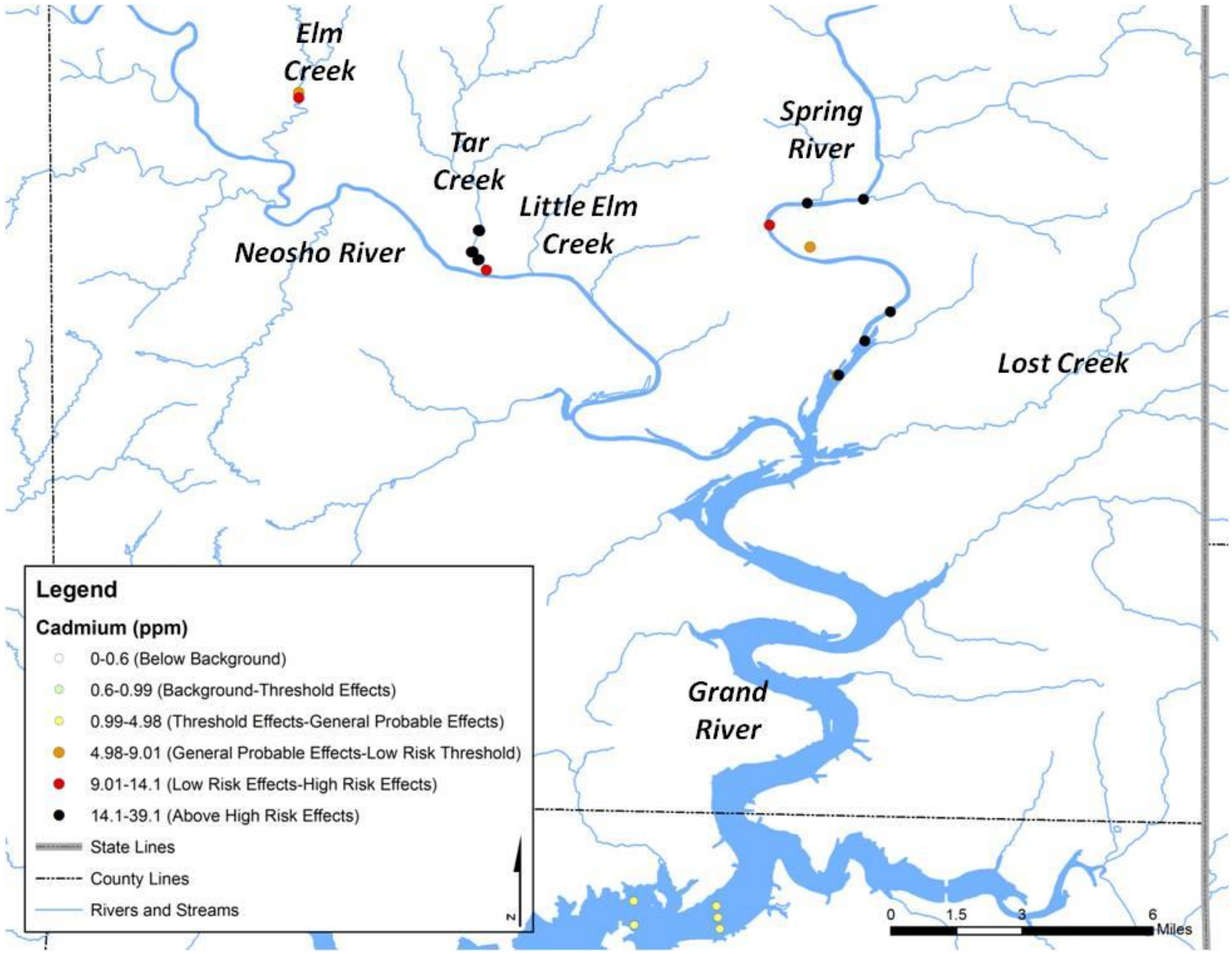


Figure 7: Cadmium concentrations at sampling locations shown by dots representing the level of contamination (determined by ICP-MS).



3.5 Estimation of Background Values

We found the following mean values for zinc, lead, and cadmium at control locations:

Table 6: Mean concentrations of zinc (determined by XRF), lead (determined by XRF), and cadmium (determined by ICP-MS) for control samples taken on the Spring and Neosho rivers.

	Zinc (ppm)	Lead (ppm)	Cadmium (ppm)
Neosho River*	80.6	18.7	0.459
Spring River	97.0	17.2	0.181

*Mean values for zinc and lead exclude samples NRC-3-5 and NRC-5-6

The lowest observed value for zinc was found at location NRC-5-4 and measured at 42.5 ppm (ICP-MS) and 47.5 ppm (XRF). The lowest observed value for lead was seen at NRC-3-1 and measured 11.1 ppm using ICP-MS and was below the detection limit of the XRF. Cadmium was lowest at NRC-5-5 and measured 0.139 ppm using ICP-MS.

4 CONCLUSIONS

This objectives of this study were to i) determine the downstream extent of lead, zinc, and cadmium contamination of fluvial sediment as a result of hazardous substance releases from the TSMD, ii) to assess the concentrations of lead, zinc, and cadmium in floodplain sediments on the jurisdictional lands of the Six Treaty Tribes of Oklahoma, and iii) to identify areas where future sampling should take place.

The results presented in this report showed that hazardous substances released from the TSMD have been transported downstream at least as far south as the northern portion of Grand Lake O' the Cherokees. Several samples taken during the course of this study exceeded the values outlined in Table 4. Importantly:

- 4.61% of samples taken exceeded the high risk threshold concentration of 2409 ppm for zinc and 5.77% exceeded the high risk threshold concentration of 179 ppm for lead.
- 7.69% of samples exceeded the low risk threshold concentration of 1702 ppm for zinc and 11.15% of samples exceeded the low risk threshold concentration of 123 ppm for lead.
- 83.46% of samples exceeded the background value of 100 ppm for zinc, and 65.00% of samples exceeded the background concentration of 20 ppm for lead.

The results of this study clearly show that high concentrations of heavy metals are present in sediment downstream of the Tri-State Mining District.

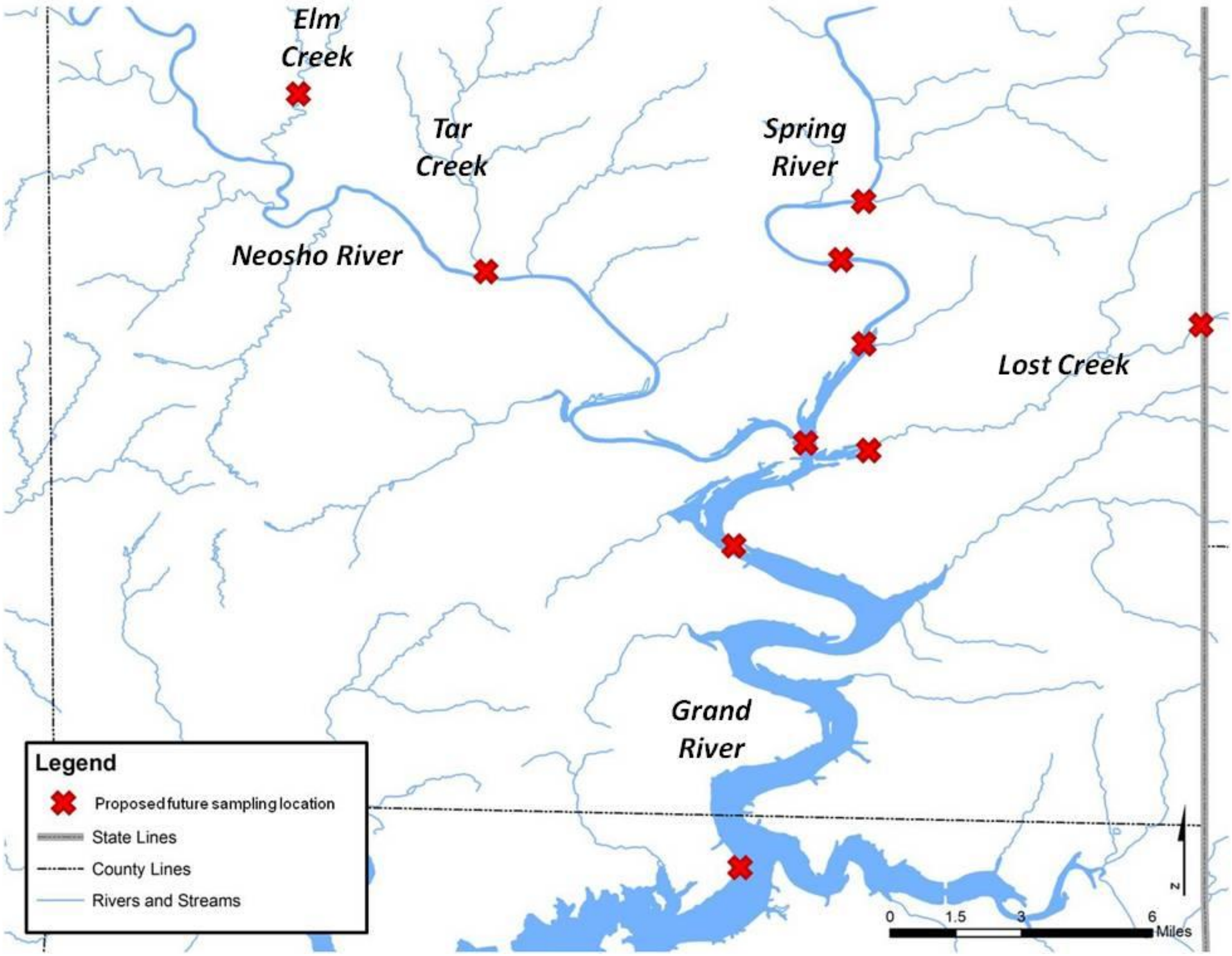
Elevated concentrations of zinc (as high as 516.3 ppm), lead (as high as 53.5 ppm), and cadmium (2.56 ppm) were observed in samples taken from the southern-most transect of this study. These data, combined with the upward trend of the regression lines seen in Figures 23 and 24 (data from the Grand River), indicated that contaminants may have dispersed further downstream than originally anticipated. It would be useful if the Six Treaty Tribes were to extend the scope of this study to include the whole of Grand Lake and possibly below the dam wall in order to ascertain how far south contamination has spread.

The sum of PEC-Q values for lead, zinc, and cadmium were determined and compared to site specific toxicity threshold values for benthic invertebrates determined by MacDonald (2010). This study showed that i) 1 of 3 samples taken on Elm Creek posed a moderate risk, ii) 4 of 7 samples posed a high risk and 2 of 7 samples posed a moderate risk for samples taken on Spring River, and iii) 8 of 8 samples taken on Tar Creek posed a high risk.

Mean concentrations of lead, zinc, and cadmium from control sites showed that the background levels found in this study were largely in agreement with those estimated by Pope in 2004. However, Pope used the lowest values found in his study to estimate background values, which were substantially higher than the lowest values for each contaminant measured in this study.

We advise that future sampling efforts be focused on the locations presented in Figure 8. These locations represent areas where concentrations of the contaminants of concern were particularly high and/or were located on or near Tribal Trust land. It is important that these areas be identified in order for sampling locations of future studies to be collocated with those presented herein.

Figure 8: Proposed future sampling locations for the plant CRI.



This report represents the first in a series of studies aimed at gathering information regarding the extent of contamination as a result of historic mining activities as well the extent to which contaminants have caused potential damage to tribal natural resources.

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MacDonald, D. D., C. G. Ingersoll, et al. (2000). "Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems." Archives of Environmental Contamination and Toxicology **39**: 20-31.

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APPENDIX A: RAW DATA

Table 7:Data from sample locations taken on Elm Creek.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
EC-1-1	210.4	28.8	77.6	14.9	12400	400	-	-	-	36.91372	-94.921	OVERBANK
EC-1-2	987.5	58.0	75.1	15.2	14300	400	-	-	-	36.91354	-94.9211	BANK
EC-1-3	771.4	50.8	97.6	16.4	15500	400	865	100	6.69	36.91351	-94.9212	BANK
EC-2-1	209.9	28.8	51.8	13.1	10500	300	-	-	-	36.91205	-94.921	BANK
EC-2-2	314.1	34.1	122.1	17.9	12900	400	329	105	3.31	36.91195	-94.9212	BANK
EC-2-3	2298.0	89.0	192.2	22.7	17800	500	2360	162	11.7	36.91173	-94.9213	BANK
EC-2-4	339.5	35.5	62.2	14.0	11200	300	-	-	-	36.91181	-94.9214	OVERBANK
EC-3-1	79.4	21.4	15.4	9.6	13800	400	-	-	-	36.89243	-94.929	OVERBANK
EC-3-2	167.7	27.8	20.2	10.6	16100	400	-	-	-	36.89251	-94.9291	BANK
EC-3-3	155.3	27.4	20.9	10.9	18700	500	-	-	-	36.89247	-94.9291	RIVER
EC-3-4	158.1	27.0	14.3	ND @ 14.3	15200	400	-	-	-	36.89252	-94.9293	BANK
EC-3-5	86.7	22.0	23.7	10.7	15100	400	-	-	-	36.89235	-94.9294	OVERBANK
EC-4-1	126.5	25.5	22.0	10.8	18100	500	-	-	-	36.89126	-94.928	OVERBANK
EC-4-2	102.4	24.1	19.6	10.7	17400	400	-	-	-	36.89107	-94.9281	BANK
EC-4-3	133.8	25.9	20.2	10.6	17600	400	-	-	-	36.891	-94.9281	RIVER
EC-4-4	136.2	26.2	25.4	11.3	17600	400	-	-	-	36.89096	-94.9281	BANK
EC-4-5	70.9	20.7	19.3	10.2	13100	400	-	-	-	36.89098	-94.9285	OVERBANK

Table 8: Data from sample locations taken on Little Elm Creek.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
LEC-1-1	138.8	25.6	21.6	10.5	14700	400	-	-	-	36.85394	-94.844	BANK
LEC-1-2	118.1	24.6	14.3	ND @ 14.3	14300	400	-	-	-	36.85391	-94.8439	BANK
LEC-2-1	155.5	26.1	16.2	9.8	11100	300	-	-	-	36.86031	-94.8451	BANK
LEC-2-2	212.8	29.5	13.2	ND @ 13.2	11800	400	-	-	-	36.86022	-94.8449	BANK

Table 9: Data from sample locations taken on Lost Creek.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
LC-1-1	308.5	32.7	35.9	11.4	6402	257	-	-	-	36.83928	-94.6185	BANK
LC-1-2	168.5	26.7	25.2	10.9	6503	267	-	-	-	36.83913	-94.6185	BANK
LC-2-1	252.3	32.4	20.5	10.6	9848	337	-	-	-	36.83886	-94.6206	BANK
LC-2-2	350.4	34.4	36.6	11.3	7039	268	-	-	-	36.83887	-94.6206	BANK
LC-3-1	155.6	25.1	18.3	9.7	6821	265	-	-	-	36.80857	-94.6757	OVERBANK
LC-3-2	231.6	30.3	26.9	10.8	10300	300	-	-	-	36.80872	-94.676	BANK
LC-3-3	195.2	27.9	17.9	9.9	9251	312	-	-	-	36.80874	-94.6759	RIVER
LC-4-1	143.8	25.1	21.8	10.4	5954	254	-	-	-	36.80947	-94.6757	RIVER
LC-4-2	184.4	27.4	35.5	11.6	9175	312	-	-	-	36.80959	-94.6757	BANK
LC-4-3	200.2	28.9	45.8	12.9	9844	330	-	-	-	36.80967	-94.676	BANK
LC-4-4	192.7	27.8	23.6	10.5	8943	306	-	-	-	36.80969	-94.676	OVERBANK
LC-4-5	146.1	24.6	42.7	12.0	740	277	-	-	-	36.80944	-94.676	BANK
LC-5-1	190.8	27.9	17.5	9.8	7206	279	-	-	-	36.79423	-94.7336	RIVER
LC-5-2	130.6	24.4	37.9	12.0	11400	400	-	-	-	36.79348	-94.7368	RIVER
LC-5-3	91.8	21.8	23.7	10.4	11500	400	-	-	-	36.79348	-94.7426	RIVER

Table 10: Data from sample locations taken on Tar Creek.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
TC-1-1	7175.0	192.0	370.6	37.5	121700	1400	8050	380	39.1	36.86779	-94.8617	BANK
TC-1-2	5995.0	162.0	406.3	36.3	53000	900	5610	372	25.3	36.86762	-94.8613	BANK
TC-1-3	6372.0	177.0	403.9	38.3	88300	1200	5970	349	30.6	36.86789	-94.8614	BANK
TC-2-1	5421.0	158.0	370.0	35.5	73200	1100	5950	394	31.5	36.86072	-94.8635	BANK
TC-2-2	3037.0	103.0	176.3	22.2	24200	500	3670	224	21.8	36.86061	-94.864	BANK
TC-3-1	1508.0	71.0	112.8	17.6	23300	500	-	-	-	36.85828	-94.8612	BANK
TC-3-2	5425.0	157.0	341.3	33.9	88800	1200	5770	360	31.8	36.85809	-94.8615	RIVER
TC-3-3	4359.0	122.0	628.7	39.5	18700	500	4310	611	31.3	36.85791	-94.8619	BANK
TC-4-1	376.3	38.3	35.4	12.1	17500	400	-	-	-	36.85456	-94.8586	BANK
TC-4-2	3863.0	127.0	197.8	25.5	57500	900	3800	225	13.1	36.85456	-94.8591	BANK

Table 11: Data from sample locations taken on Spring River.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
SR-1-1	1454.0	70.0	157.8	20.4	13800	400	-	-	-	36.87832	-94.7332	OVERBANK
SR-1-2	746.5	51.7	67.1	14.7	16800	400	-	-	-	36.8781	-94.7338	BANK
SR-1-3	3929.0	116.0	219.4	24.1	16300	400	4400	229	24.9	36.87806	-94.7341	RIVER
SR-1-4	310.7	35.1	18.6	10.4	14500	400	-	-	-	36.87851	-94.7347	RIVER
SR-1-5	99.5	22.8	12.7	ND @ 12.7	14800	400	-	-	-	36.8785	-94.7348	BANK
SR-1-6	1149.0	61.0	109.2	17.2	11300	300	-	-	-	36.87854	-94.7351	OVERBANK
SR-2-1	1419.0	69.0	156.3	20.3	17400	400	-	-	-	36.87572	-94.7525	OVERBANK
SR-2-2	584.0	45.4	65.2	14.3	11800	400	-	-	-	36.87586	-94.7516	BANK
SR-2-3	828.9	53.6	72.6	15.1	12100	400	-	-	-	36.87596	-94.752	RIVER
SR-2-4	2198.0	87.0	196.6	22.9	17400	400	-	-	-	36.87679	-94.7528	RIVER
SR-2-5	4017.0	117.0	238.2	24.9	17600	400	3960	230	21.5	36.87681	-94.7527	BANK
SR-2-6	1581.0	74.0	132.6	19.5	15100	400	-	-	-	36.87706	-94.7527	OVERBANK
SR-3-1	1261.0	65.0	143.4	19.6	15100	400	-	-	-	36.86954	-94.7649	OVERBANK
SR-3-2	1608.0	75.0	153.7	20.7	17400	400	-	-	-	36.86961	-94.7651	BANK
SR-3-3	1878.0	82.0	224.6	24.7	18600	500	1950	213	9.51	36.86953	-94.7652	RIVER
SR-4-1	571.8	42.6	56.6	12.9	10300	300	-	-	-	36.86106	-94.7578	OVERBANK
SR-4-2	119.3	24.7	24.1	11.1	15400	400	-	-	-	36.86097	-94.758	BANK
SR-4-3	104.7	23.0	19.7	10.1	13700	400	-	-	-	36.86093	-94.7579	RIVER
SR-4-4	273.1	34.4	28.4	1.3	15300	400	-	-	-	36.86046	-94.7589	RIVER
SR-4-5	803.4	53.9	75.6	15.6	17900	500	-	-	-	36.86044	-94.759	BANK
SR-4-6	512.6	42.3	37.9	12.0	10600	300	-	-	-	36.8602	-94.7591	OVERBANK
SR-5-1	863.8	55.0	93.8	16.7	13000	400	-	-	-	36.85833	-94.7438	OVERBANK
SR-5-2	1902.0	81.0	178.4	21.7	20100	500	-	-	-	36.85814	-94.7437	BANK
SR-5-3	1861.0	79.0	152.6	20.1	17200	400	-	-	-	36.85808	-94.7437	RIVER
SR-5-4	159.0	25.9	25.9	10.4	11500	300	-	-	-	36.85704	-94.7438	BANK
SR-5-5	1335.0	68.0	142.0	20.0	16200	400	-	-	-	36.85685	-94.7437	OVERBANK

Table 12: Data from sample locations taken on Spring River, continued.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
SR-6-1	513.5	42.9	38.7	12.1	14000	400	-	-	-	36.85689	-94.7253	BANK
SR-6-2	1595.0	74.0	157.8	20.6	17600	400	-	-	-	36.85611	-94.726	RIVER
SR-6-3	1373.0	18.7	131.2	18.7	14500	400	-	-	-	36.85598	-94.7261	BANK
SR-6-4	1087.0	62.0	112.3	18.3	11900	400	-	-	-	36.85577	-94.7264	OVERBANK
SR-7-1	940.1	55.7	91.5	16.0	11900	400	-	-	-	36.83973	-94.7243	OVERBANK
SR-7-2	999.7	57.1	121.5	17.8	14400	400	-	-	-	36.84042	-94.7249	OVERBANK
SR-7-3	285.4	33.2	26.4	10.9	11900	400	-	-	-	36.84065	-94.7252	BANK
SR-7-4	3828.0	113.0	208.6	23.2	18100	500	3950	198	23.5	36.8408	-94.7252	RIVER
SR-7-5	1717.0	76.0	103.7	17.3	15000	400	-	-	-	36.84137	-94.7258	RIVER
SR-7-6	898.5	55.7	119.2	18.1	15200	400	-	-	-	36.84202	-94.7258	BANK
SR-8-1	1193.0	63.0	92.1	16.2	15100	400	-	-	-	36.84217	-94.7278	BANK
SR-8-2	136.3	26.1	14.8	9.8	15400	400	-	-	-	36.84212	-94.7287	RIVER
SR-8-3	339.6	35.3	42.2	12.3.	12200	400	-	-	-	36.8422	-94.7294	RIVER
SR-8-4	1080.0	60.0	83.2	15.5	14400	400	-	-	-	36.84219	-94.7298	BANK
SR-9-1	1201.0	63.0	99.6	16.9	13800	400	-	-	-	36.83047	-94.7324	OVERBANK
SR-9-2	2198.0	85.0	150.9	19.9	15600	400	-	-	-	36.83079	-94.7329	BANK
SR-9-3	1960.0	82.0	259.3	25.9	21400	500	2220	250	14.7	36.83114	-94.7336	RIVER
SR-9-4	312.3	34.5	29.3	11.4	15600	400	-	-	-	36.8313	-94.735	BANK
SR-9-5	1211.0	63.0	96.4	16.5	13800	400	-	-	-	36.83158	-94.7353	OVERBANK
SR-10-1	2646.0	94.0	188.2	22.1	18700	500	3040	204	23.5	36.81974	-94.7422	RIVER
SR-10-2	1235.0	64.0	95.5	16.6	12900	400	1390	89.4	8.53	36.8198	-94.7428	RIVER
SR-11-1	1242.0	61.0	96.4	15.6	13800	400	-	-	-	36.8081	-94.7474	OVERBANK
SR-11-2	1091.0	60.0	73.8	14.7	12100	400	-	-	-	36.80975	-94.752	RIVER
SR-11-3	789.2	49.2	81.4	14.7	10300	300	-	-	-	36.80987	-94.7527	BANK

Table 13: Data from sample locations taken on Neosho River.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
NR-1-1	60.3	20.1	14.9	9.9	11800	400	-	-	-	36.88902	-94.9243	OVERBANK
NR-1-2	76.2	21.7	15.3	ND @ 15.3	12200	400	-	-	-	36.88917	-94.9238	BANK
NR-1-3	59.8	20.0	16.3	9.9	14100	400	-	-	-	36.88927	-94.9229	BANK
NR-2-1	87.3	22.3	18.2	10.4	14500	400	-	-	-	36.8795	-94.9268	OVERBANK
NR-2-2	75.9	21.4	14.3	ND @ 14.3	14200	400	-	-	-	36.87944	-94.9269	BANK
NR-2-3	88.0	23.2	21.7	11.0	16400	400	-	-	-	36.87915	-94.9277	BANK
NR-3-1	75.4	21.8	20.6	10.8	14700	400	-	-	-	36.86968	-94.9254	OVERBANK
NR-3-2	67.2	21.7	21.8	11.1	14400	400	-	-	-	36.8696	-94.9254	BANK
NR-3-3	80.5	21.2	15.9	9.6	13800	400	-	-	-	36.86884	-94.9247	BANK
NR-3-4	75.0	20.8	14.3	ND @ 14.3	13700	400	-	-	-	36.86866	-94.9247	OVERBANK
NR-4-1	215.6	29.2	32.7	11.4	14500	400	-	-	-	36.86015	-94.8743	OVERBANK
NR-4-2	122.0	25.4	26.9	11.5	16600	400	-	-	-	36.85999	-94.875	BANK
NR-4-3	78.8	21.4	13.0	ND @ 13.0	12600	400	-	-	-	36.85987	-94.8752	RIVER
NR-4-4	100.7	23.6	18.6	10.5	12400	400	-	-	-	36.85954	-94.8764	BANK
NR-4-5	101.7	23.7	14.6	ND @ 14.6	14100	400	-	-	-	36.85926	-94.8769	OVERBANK
NR-5-1	90.0	22.1	13.2	ND @ 13.2	14300	400	-	-	-	36.85425	-94.8635	OVERBANK
NR-5-2	131.9	25.6	20.8	10.8	15100	400	-	-	-	36.8542	-94.8635	BANK
NR-5-3	86.1	22.2	14.2	ND @ 14.2	11100	300	-	-	-	36.85352	-94.864	RIVER
NR-5-4	144.2	26.5	29.4	11.6	15300	400	-	-	-	36.85339	-94.8639	BANK
NR-6-1	320.2	35.2	22.0	10.7	14600	400	-	-	-	36.85248	-94.853	BANK
NR-6-2	126.7	25.2	27.0	11.1	15100	400	-	-	-	36.8524	-94.853	RIVER
NR-6-3	96.1	22.7	14.4	9.6	11600	400	-	-	-	36.85164	-94.853	BANK
NR-6-4	187.5	28.7	29.4	11.2	15100	400	-	-	-	36.85268	-94.8532	OVERBANK
NR-7-1	218.9	30.2	18.6	10.2	15700	400	-	-	-	36.85366	-94.8452	OVERBANK
NR-7-2	159.5	27.6	22.6	10.6	18200	500	-	-	-	36.85351	-94.8452	BANK
NR-7-3	106.5	23.6	16.6	10.0	12800	400	-	-	-	36.85275	-94.8453	RIVER
NR-7-4	93.5	23.0	14.3	ND @ 14.3	12000	400	-	-	-	36.85272	-94.8453	BANK
NR-7-5	103.2	23.7	13.6	ND @ 13.6	14200	400	-	-	-	36.85252	-94.8453	OVERBANK

Table 14: Data from sample locations taken on Neosho River, continued.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
NR-8-1	189.0	28.6	13.1	ND @ 13.1	16000	400	-	-	-	36.85329	-94.8343	OVERBANK
NR-8-2	76.9	21.3	13.9	ND @ 13.9	9214	320	-	-	-	36.85303	-94.8344	BANK
NR-8-3	255.9	32.2	31.3	11.5	14800	400	-	-	-	36.85291	-94.8343	RIVER
NR-8-4	114.6	23.5	23.1	10.5	13300	400	-	-	-	36.85225	-94.8349	RIVER
NR-8-5	68.2	20.7	19.5	10.4	10600	300	-	-	-	36.85228	-94.8351	BANK
NR-8-6	112.0	23.6	14.6	9.6	13200	400	-	-	-	36.85209	-94.8351	OVERBANK
NR-9-1	218.6	30.0	30.1	11.1	16300	400	-	-	-	36.84145	-94.8206	OVERBANK
NR-9-2	177.9	27.6	19.3	10.2	14000	400	-	-	-	36.84138	-94.8208	BANK
NR-9-3	200.9	29.2	17.3	9.9	16400	400	-	-	-	36.8413	-94.8208	RIVER
NR-9-4	92.6	22.4	14.7	ND @ 14.7	13300	400	-	-	-	36.84089	-94.8216	RIVER
NR-9-5	120.4	23.9	13.9	ND @ 13.9	12800	400	-	-	-	36.8408	-94.8217	BANK
NR-9-6	127.9	24.8	19.2	10.1	14900	400	-	-	-	36.8409	-94.8219	OVERBANK
NR-10-1	179.5	28.3	18.7	10.4	17100	400	-	-	-	36.8322	-94.8114	OVERBANK
NR-10-2	126.2	24.9	15.1	ND @ 15.1	14000	400	-	-	-	36.83207	-94.8115	BANK
NR-10-3	158.2	27.1	14.3	ND @ 14.3	19100	500	-	-	-	36.83206	-94.8115	RIVER
NR-10-4	268.9	32.4	13.9	ND @ 13.9	15200	400	-	-	-	36.83147	-94.8119	RIVER
NR-10-5	135.1	25.7	13.8	ND @ 13.8	18500	500	-	-	-	36.83146	-94.812	BANK
NR-10-6	117.3	24.1	21.1	10.5	12600	400	-	-	-	36.83114	-94.8124	OVERBANK
NR-11-1	163.4	27.7	33.4	11.9	17400	400	-	-	-	36.82434	-94.8024	OVERBANK
NR-11-2	156.6	27.5	15.0	ND @ 15.0	17100	400	-	-	-	36.82406	-94.8024	BANK
NR-11-3	126.4	25.3	22.1	10.7	15900	400	-	-	-	36.82403	-94.8026	RIVER
NR-11-4	134.9	24.9	14.2	ND @ 14.2	16100	400	-	-	-	36.82357	-94.8031	RIVER
NR-11-5	135.0	25.3	13.5	ND @ 13.5	14600	400	-	-	-	36.82377	-94.8036	BANK
NR-11-6	131.2	25.4	21.6	10.7	16300	400	-	-	-	36.82372	-94.8039	OVERBANK
NR-12-1	235.4	31.4	28.0	11.4	14800	400	-	-	-	36.81174	-94.8148	OVERBANK
NR-12-2	163.6	26.6	21.7	10.3	12000	400	-	-	-	36.81153	-94.8148	BANK
NR-12-3	183.2	28.6	18.1	10.1	22600	500	-	-	-	36.81194	-94.8149	RIVER
NR-12-4	96.9	22.5	18.4	10.1	12000	400	-	-	-	36.81245	-94.8151	RIVER
NR-12-5	195.9	29.4	14.9	ND @ 14.9	16300	400	-	-	-	36.81258	-94.8153	BANK
NR-12-6	173.1	27.6	16.5	9.9	16600	400	-	-	-	36.81287	-94.8154	OVERBANK

Table 15: Data from sample locations taken on Neosho River, continued.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
NR-13-1	123.0	24.9	18.8	10.4	18900	500	-	-	-	36.79922	-94.818	OVERBANK
NR-13-2	281.8	33.8	28.9	11.4	18100	500	-	-	-	36.799	-94.8181	BANK
NR-13-3	142.5	26.1	21.0	10.4	17000	400	-	-	-	36.7991	-94.818	RIVER
NR-13-4	106.4	23.3	13.9	ND @ 13.9	13800	400	-	-	-	36.79821	-94.8179	BANK
NR-13-5	132.2	29.6	33.1	12.9	50300	800	-	-	-	36.79818	-94.8179	OVERBANK
NR-14-1	142.1	25.6	14.3	ND @ 14.3	15600	400	-	-	-	36.79845	-94.8016	OVERBANK
NR-14-2	146.2	26.3	25.7	11.1	18500	500	-	-	-	36.79822	-94.8016	BANK
NR-14-3	140.4	25.9	29.6	11.2	18800	500	-	-	-	36.79795	-94.8016	RIVER
NR-14-4	137.5	25.6	17.4	9.9	16200	400	-	-	-	36.79718	-94.8018	RIVER
NR-14-5	170.2	25.6	14.1	ND @ 14.1	15300	400	-	-	-	36.7972	-94.8018	BANK
NR-14-6	98.2	22.2	15.3	9.6	13600	400	-	-	-	36.79697	-94.8018	OVERBANK
NR-15-1	155.8	27.6	15.9	10.2	18200	500	-	-	-	36.79753	-94.7766	OVERBANK
NR-15-2	159.8	27.1	15.4	9.9	16900	400	-	-	-	36.79749	-94.7763	BANK
NR-15-3	134.1	25.4	14.7	ND @ 14.7	12900	400	-	-	-	36.79747	-94.7763	RIVER
NR-15-4	156.2	27.1	25.8	10.9	19700	500	-	-	-	36.79713	-94.7756	RIVER
NR-15-5	122.1	24.8	22.1	10.6	17100	400	-	-	-	36.79707	-94.7754	BANK
NR-15-6	255.0	32.0	35.9	11.9	17000	400	-	-	-	36.79689	-94.7753	OVERBANK

Table 16: Data from sample locations taken on Grand River.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
GR-1-1	190.4	28.2	21.0	10.2	14200	400	-	-	-	36.79686	-94.7538	BANK
GR-1-2	166.7	28.0	28.7	11.6	17700	500	-	-	-	36.79678	-94.7542	BANK
GR-1-3	163.5	27.1	27.6	11.1	14200	400	-	-	-	36.79599	-94.7555	OVERBANK
GR-1-4	951.2	57.3	58.2	14.0	15700	400	-	-	-	36.79737	-94.7532	BANK
GR-1-5	1199.0	63.0	84.4	15.8	15300	400	-	-	-	36.79706	-94.7514	RIVER
GR-2-1	695.9	49.2	50.3	13.2	13.7	400	-	-	-	36.7887	-94.7519	BANK
GR-2-2	384.7	38.2	35.5	11.9	16500	400	-	-	-	36.78864	-94.7521	RIVER
GR-2-3	150.8	26.3	13.1	ND @ 13.1	16700	400	-	-	-	36.78867	-94.7526	RIVER
GR-2-4	199.9	29.6	33.4	12.0	19600	500	-	-	-	36.78855	-94.7543	RIVER
GR-2-5	96.5	22.4	23.5	10.7	14100	400	-	-	-	36.78888	-94.755	RIVER
GR-2-6	108.4	23.2	13.7	ND @ 13.7	12900	400	-	-	-	36.789	-94.7552	BANK
GR-3-1	510.2	42.4	45.6	12.8	14800	400	-	-	-	36.77761	-94.7779	BANK
GR-3-2	125.8	24.9	23.5	10.8	15000	400	-	-	-	36.77793	-94.7782	RIVER
GR-3-3	128.9	24.6	19.3	10.2	12900	400	-	-	-	36.77796	-94.7785	RIVER
GR-3-4	196.1	28.9	17.1	10.0	14800	400	-	-	-	36.77797	-94.7794	RIVER
GR-3-5	145.4	25.4	18.9	10.0	15300	400	-	-	-	36.77977	-94.7795	BANK
GR-3-6	202.4	28.8	21.8	10.2	12700	400	-	-	-	36.77996	-94.7795	OVERBANK
GR-4-1	466.3	40.6	42.8	12.3	14500	400	-	-	-	36.76384	-94.7735	OVERBANK
GR-4-2	364.2	37.1	31.9	11.6	16700	400	-	-	-	36.76325	-94.7735	BANK
GR-4-3	362.2	36.7	28.7	11.1	13500	400	-	-	-	36.76202	-94.7749	RIVER
GR-4-4	129.8	24.9	16.9	9.9	17.2	400	-	-	-	36.76163	-94.7746	RIVER
GR-4-5	241.8	31.1	17.5	10.0	13900	400	-	-	-	36.76029	-94.7759	RIVER
GR-4-6	259.1	31.6	26.8	10.8	9994	329	-	-	-	36.76013	-94.7761	BANK
GR-5-1	535.0	43.6	43.8	12.7	14100	400	-	-	-	36.7495	-94.7434	BANK
GR-5-2	232.3	34.8	25.7	10.8	13300	400	-	-	-	36.74891	-94.7433	BANK
GR-5-3	288.2	34.3	20.4	10.4	19500	500	-	-	-	36.74816	-94.7436	RIVER
GR-5-4	115.7	23.9	32.7	11.6	17900	400	-	-	-	36.74685	-94.7442	RIVER

Table 17: Data from sample locations taken on Grand River, continued.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
GR-6-1	660.5	47.7	46.2	12.7	13000	400	-	-	-	36.73312	-94.7429	OVERBANK
GR-6-2	377.6	37.5	25.2	10.9	14900	400	-	-	-	36.73251	-94.743	BANK
GR-6-3	251.6	31.5	25.9	10.8	14600	400	-	-	-	36.73149	-94.7434	RIVER
GR-6-4	288.7	34.2	34.9	11.8	19800	500	-	-	-	36.72893	-94.744	RIVER
GR-6-5	103.5	21.9	18.7	9.7	10000	300	-	-	-	36.72798	-94.7444	BANK
GR-7-1	376.8	37.8	37.9	12.2	16700	400	-	-	-	36.72697	-94.7706	OVERBANK
GR-7-2	296.4	34.4	28.3	11.3	18900	500	-	-	-	36.72709	-94.7716	BANK
GR-7-3	295.1	34.0	18.0	10.1	15200	400	-	-	-	36.72726	-94.7732	RIVER
GR-7-4	263.3	36.0	18.7	10.2	20600	500	-	-	-	36.72763	-94.7757	RIVER
GR-7-5	143.4	24.6	21.4	9.9	12700	400	-	-	-	36.72556	-94.7783	BANK
GR-8-1	141.9	26.6	26.5	11.3	18200	500	-	-	-	36.70285	-94.7364	BANK
GR-8-2	279.5	33.8	29.2	11.4	19600	500	-	-	-	36.70224	-94.7404	RIVER
GR-8-3	331.0	36.3	39.6	12.4	16600	400	-	-	-	36.70353	-94.7459	RIVER
GR-8-4	327.2	36.0	28.0	11.3	15700	400	-	-	-	36.70385	-94.7471	BANK
GR-8-5	331.4	36.3	33.4	11.9	17300	400	-	-	-	36.70403	-94.7484	OVERBANK
GR-9-1	413.1	40.3	44.7	12.9	23000	500	-	-	-	36.67912	-94.772	RIVER
GR-9-2	396.4	40.4	38.5	12.5	26300	600	-	-	-	36.68163	-94.7739	RIVER
GR-9-3	429.8	42.0	39.5	12.7	29900	600	-	-	-	36.68516	-94.778	RIVER
GR-9-4	129.8	24.6	18.1	10.2	7529	284	-	-	-	36.68745	-94.7838	BANK
GR-9-5	162.5	25.8	27.1	10.6	12500	400	-	-	-	36.68814	-94.7845	OVERBANK

Table 18: Data from sample locations taken on Grand River, continued.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
GR-10-1	65.3	19.5	18.8	10	6992	272	-	-	-	36.65873	-94.7629	BANK
GR-10-2	309.6	34.7	26.3	11	17600	400	-	-	-	36.65989	-94.7648	RIVER
GR-10-3	399.6	39.6	25.2	11.1	22800	500	-	-	-	36.65987	-94.7677	RIVER
GR-10-4	518	44.3	33.4	11.9	22200	500	-	-	-	36.66058	-94.7717	RIVER
GR-10-5	411	40.4	41.3	12.8	24600	500	-	-	-	36.66097	-94.7731	RIVER
GR-11-1	413.5	42.7	44.2	13.6	35300	700	-	-	-	36.63455	-94.7811	RIVER
GR-11-2	488.3	44.3	38.5	12.6	30100	600	495	39.7	2.67	36.63608	-94.7817	RIVER
GR-11-3	465.4	44	40.9	13.1	27600	600	447	34.6	2.55	36.6399	-94.7823	RIVER
GR-11-4	457.1	42.2	47.6	13.4	25700	500	495	38.7	2.93	36.64362	-94.7828	RIVER
GR-11-5	243	33.3	18.5	11.2	14000	400	-	-	-	36.64633	-94.7849	RIVER
GR-12-1	42.3	18.4	13.6	ND @ 13.6	5647	251	-	-	-	36.63501	-94.8106	BANK
GR-12-2	475.6	44	34.4	12.2	34100	600	525	39.1	2.56	36.63741	-94.8101	RIVER
GR-12-3	465.3	44.2	41.8	13.2	30800	600	-	-	-	36.64233	-94.8099	RIVER
GR-12-4	516.3	46	53.5	14.2	30800	600	500	38.4	2.52	36.64529	-94.8102	RIVER
GR-12-5	315.2	35.1	34.4	11.9	13700	400	-	-	-	36.64874	-94.8129	RIVER

Table 19: Data from sample locations taken on oxbow lakes adjacent to Spring River.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
SRO-1-1	826.6	53.8	93.2	16.6	15700	400	-	-	-	36.87167	-94.7597	OXBOW
SRO-1-2	825.5	53.4	101.3	17.1	12700	400	-	-	-	36.87162	-94.7601	OXBOW
SRO-1-3	122.2	24.5	24.4	10.6	16100	400	-	-	-	36.87155	-94.7607	OXBOW
SRO-2-1	739.3	49.6	90.9	15.9	8904	308	-	-	-	36.86238	-94.7525	OXBOW
SRO-2-2	1217.0	64.0	147.6	19.8	14600	400	-	-	-	36.86232	-94.7521	OXBOW
SRO-2-3	892.6	51.9	158.8	19.2	8927	296	1050	171	7.74	36.86227	-94.7517	OXBOW

Table 20: Data from sample locations taken on Spring River at control locations.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
SRC-1-1	98.4	21.6	13.2	ND @ 13.2	7990	289	-	-	-	37.13115	-93.9176	OVERBANK
SRC-1-2	99.7	21.7	25.4	10.3	8441	295	-	-	-	37.13124	-93.9175	BANK
SRC-1-3	104.9	21.9	18.4	9.6	8662	298	-	-	-	37.13124	-93.9175	RIVER
SRC-1-4	94.8	21.4	13.0	ND @ 13.0	8029	289	-	-	-	37.13135	-93.9174	RIVER
SRC-1-5	121.5	22.7	17.9	9.4	8431	292	-	-	-	37.13135	-93.9173	BANK
SRC-1-6	104.5	22.4	20.2	9.9	9079	310	-	-	-	37.13145	-93.9174	OVERBANK
SRC-2-1	128.2	23.3	28.5	10.6	8727	299	-	-	-	37.13147	-93.9179	OVERBANK
SRC-2-2	104.5	22.4	19.5	9.9	8720	304	-	-	-	37.13156	-93.9178	BANK
SRC-2-3	115.5	22.5	13.3	ND @ 13.3	9027	302	102	18	0.637	37.13161	-93.9178	RIVER
SRC-2-4	119.9	23.4	20.8	10.1	8953	308	-	-	-	37.13166	-93.9178	RIVER
SRC-2-5	102.5	22.3	24.5	10.5	9028	311	-	-	-	37.13172	-93.9177	BANK
SRC-2-6	90.3	21.1	13.4	ND @ 13.4	8533	297	-	-	-	37.1317	-93.9176	OVERBANK
SRC-3-1	77.6	20.1	13.0	ND @ 13.0	8901	303	-	-	-	37.15009	-94.0616	OVERBANK
SRC-3-2	99.6	22.5	14.8	9.5	8976	312	-	-	-	37.15015	-94.0616	BANK
SRC-3-3	92.3	21.3	13.5	ND @ 13.5	7420	279	-	-	-	37.15014	-94.0616	RIVER
SRC-3-4	125.8	23.7	17.9	9.7	7798	287	-	-	-	37.15038	-94.0616	RIVER
SRC-3-5	92.8	21.2	19.2	9.8	7494	279	87.7	15.2	0.483	37.15044	-94.0616	BANK
SRC-3-6	72.9	19.9	12.9	ND @ 12.9	8697	302	-	-	-	37.15049	-94.0616	OVERBANK
SRC-4-1	71.5	19.1	13.6	9.0	7079	265	52.1	13.2	0.257	37.15013	-94.0628	OVERBANK
SRC-4-2	98.2	21.9	17.4	9.6	8569	301	-	-	-	37.15036	-94.0628	BANK
SRC-4-3	92.5	20.9	13.2	ND @ 13.2	8160	288	-	-	-	37.15036	-94.0627	RIVER
SRC-4-4	105.8	22.5	24.5	10.6	8943	309	-	-	-	37.15051	-94.0627	RIVER
SRC-4-5	75.4	19.7	12.5	ND @ 12.5	9384	307	-	-	-	37.15073	-94.0627	BANK
SRC-4-6	78.2	20.1	17.6	9.5	8332	293	-	-	-	37.15075	-94.0626	OVERBANK
SRC-5-1	99.8	21.4	15.1	9.3	8300	290	-	-	-	37.15078	-94.0609	OVERBANK
SRC-5-2	95.0	21.3	21.5	10.1	8336	294	-	-	-	37.1505	-94.0607	BANK
SRC-5-3	68.9	19.3	13.0	ND @ 13.0	8041	286	-	-	-	37.15045	-94.0604	RIVER
SRC-5-4	103.7	21.9	18.7	9.7	8112	289	-	-	-	37.15038	-94.0603	RIVER
SRC-5-5	97.2	21.3	17.8	9.5	8517	293	-	-	-	37.15039	-94.0603	BANK
SRC-5-6	78.2	20.2	13.1	ND @ 13.1	7033	271	-	-	-	37.15024	-94.0603	OVERBANK

Table 21: Data from sample locations taken on Neosho River at control locations.

Sample ID	Zn -XRF (ppm)	+/- (ppm)	Pb -XRF (ppm)	+/- (ppm)	Fe -XRF (ppm)	+/- (ppm)	Zn -ICP (ppm)	Pb -ICP (ppm)	Cd -ICP (ppm)	lat	lon	Location
NRC-1-1	171.8	26.4	29.7	10.8	12800	400	-	-	-	37.03465	-95.0724	OVERBANK
NRC-1-2	153.6	25.6	25.8	10.6	12900	400	-	-	-	37.03447	-95.0726	BANK
NRC-1-3	156.9	25.9	23.7	10.5	12900	400	-	-	-	37.03392	-95.0726	RIVER
NRC-1-4	64.6	20.8	14.9	ND @ 14.9	15100	400	-	-	-	37.03379	-95.0727	BANK
NRC-1-5	77.3	21.5	22.4	10.7	14700	400	-	-	-	37.03351	-95.0725	OVERBANK
NRC-1-6	65.3	20.5	29.6	11.2	14700	400	-	-	-	37.03424	-95.0728	RIVER
NRC-2-1	66.1	21.2	14.4	ND @ 14.4	13800	400	-	-	-	37.03546	-95.0795	OVERBANK
NRC-2-2	76.4	21.6	14.8	ND @ 14.8	12500	400	-	-	-	37.03527	-95.0798	BANK
NRC-2-3	69.3	21	17.7	10.2	12100	400	-	-	-	37.03538	-95.0807	RIVER
NRC-2-4	72.8	21.3	18.5	10.4	12600	400	-	-	-	37.03532	-95.0809	RIVER
NRC-2-5	72.1	21.2	24	10.9	13800	400	-	-	-	37.03525	-95.0811	BANK
NRC-2-6	83	22	19.8	10.3	14500	400	-	-	-	37.03511	-95.0813	OVERBANK
NRC-3-1	66.8	19.4	12.3	ND @ 12.3	10500	300	53.1	11.1	0.241	36.92947	-94.9576	OVERBANK
NRC-3-2	85.4	21.7	15.5	9.7	13900	400	-	-	-	36.92936	-94.9575	BANK
NRC-3-3	87.8	21.9	14.2	ND @ 14.2	13500	400	-	-	-	36.92928	-94.9573	RIVER
NRC-3-4	89.6	22.8	16.5	10.2	14800	400	-	-	-	36.92898	-94.957	RIVER
NRC-3-5	681.8	47.5	106.6	16.9	11700	400	-	-	-	36.92882	-94.9567	BANK
NRC-3-6	656.8	47.4	102.1	16.8	11600	400	-	-	-	36.92871	-94.9565	OVERBANK
NRC-4-1	54.4	19.4	13.3	ND @ 13.3	12000	400	-	-	-	36.92808	-94.9602	OVERBANK
NRC-4-2	64.4	19.8	14.4	9.5	11600	400	-	-	-	36.92789	-94.9601	BANK
NRC-4-3	81.9	22.3	14.7	9.7	15600	400	-	-	-	36.92756	-94.96	RIVER
NRC-4-4	69.6	20.7	14	ND @ 14	14100	400	-	-	-	36.92734	-94.9598	RIVER
NRC-4-5	61	20.5	14.8	ND @ 14.8	12900	400	-	-	-	36.92699	-94.9596	BANK
NRC-4-6	79.6	20.9	13.7	ND @ 13.7	13100	400	-	-	-	36.92676	-94.9599	OVERBANK
NRC-5-1	71.6	20.9	16.9	9.9	14800	400	-	-	-	36.93388	-94.956	OVERBANK
NRC-5-2	62.2	20	16.3	10	10400	300	-	-	-	36.93388	-94.9556	BANK
NRC-5-3	67.1	21	14.9	ND @ 14.9	10400	300	-	-	-	36.93404	-94.9555	RIVER
NRC-5-4	47.5	18.7	17.3	9.8	14800	400	42.5	15	0.163	36.93422	-94.9551	RIVER
NRC-5-5	69.1	20.6	13.7	ND @ 13.7	14900	400	45.2	15	0.139	36.93411	-94.9548	BANK
NRC-5-6	69.5	20.1	46.9	12.6	8765	306	-	-	-	36.93419	-94.9548	OVERBANK

APPENDIX B: GRAPHS OF AVERAGE TRANSECT CONCENTRATIONS FOR LEAD AND ZINC

Figure 9: Mean zinc concentration (ppm) within transects along the Neosho River.

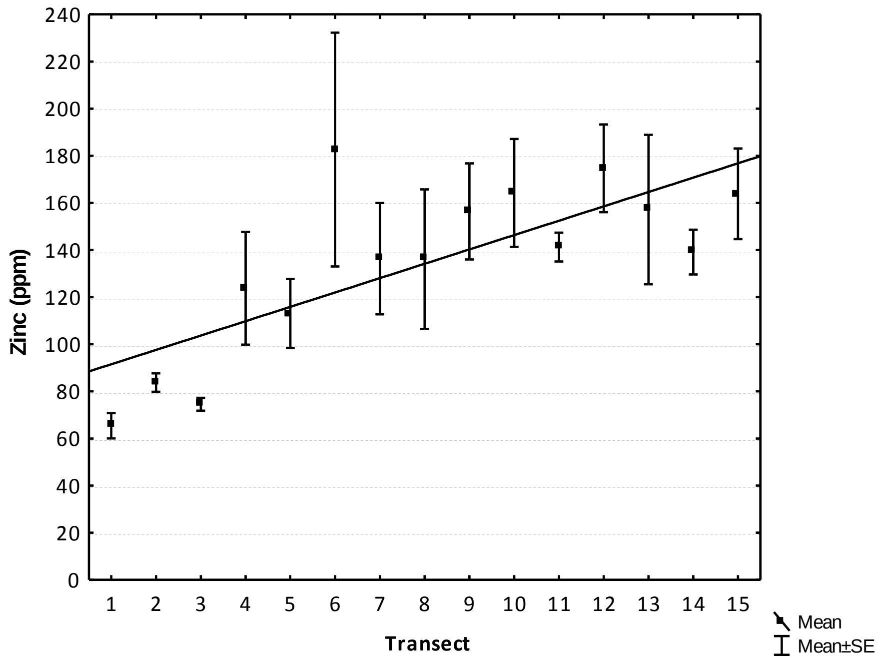

Figure 10: Mean lead concentration (ppm) within transects along the Neosho River.

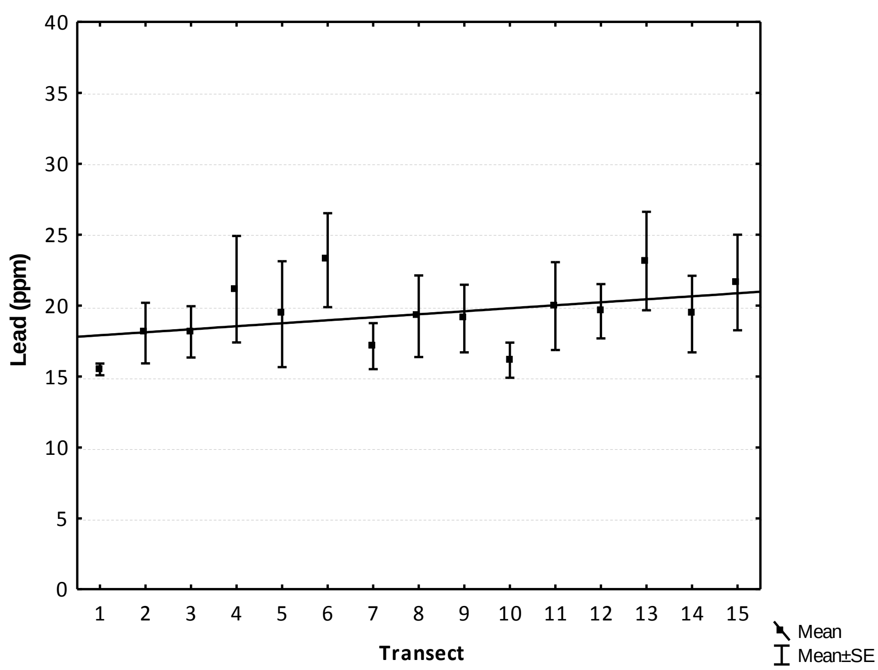

Figure 11: Mean zinc concentration (ppm) within control transects along the Neosho River.

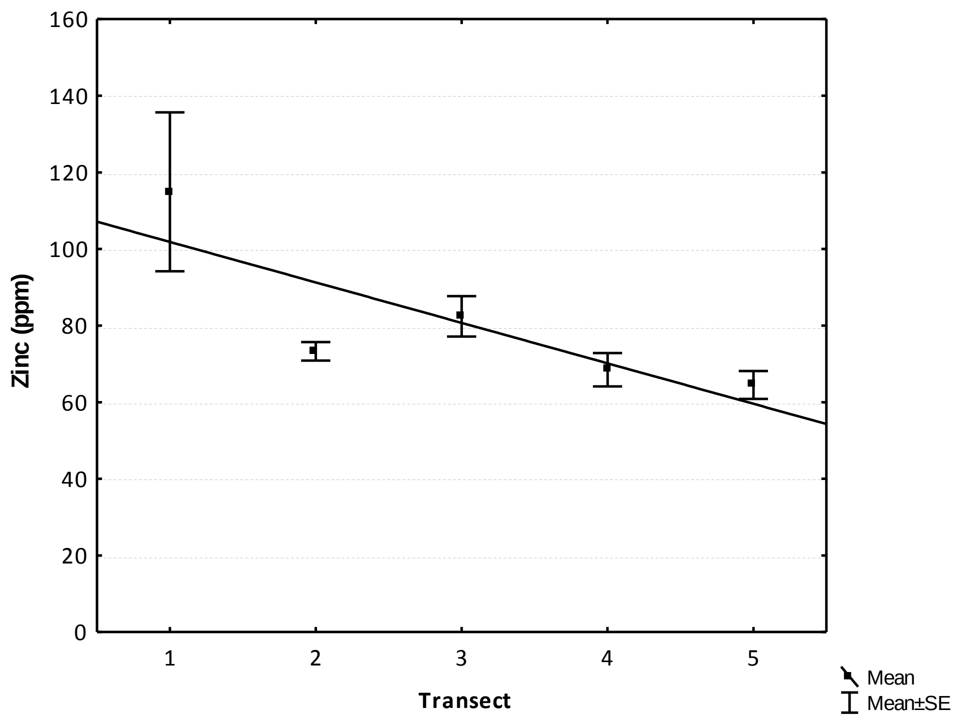

Figure 12: Mean lead concentration (ppm) within control transects along the Neosho River.

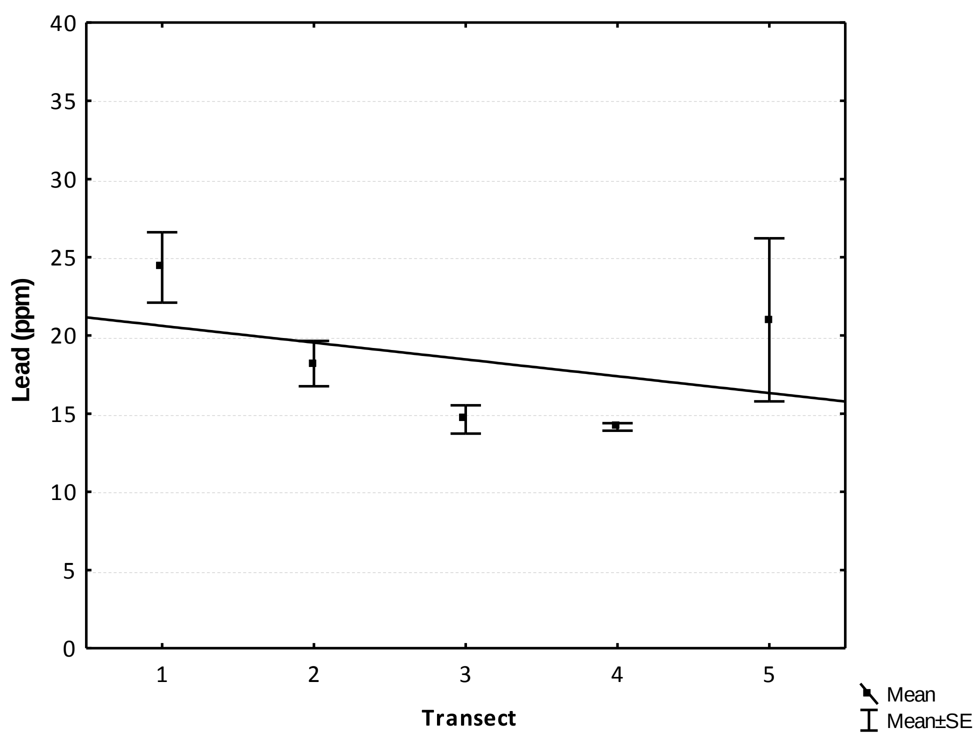

Figure 13: Mean zinc concentration (ppm) within transects along Elm Creek.

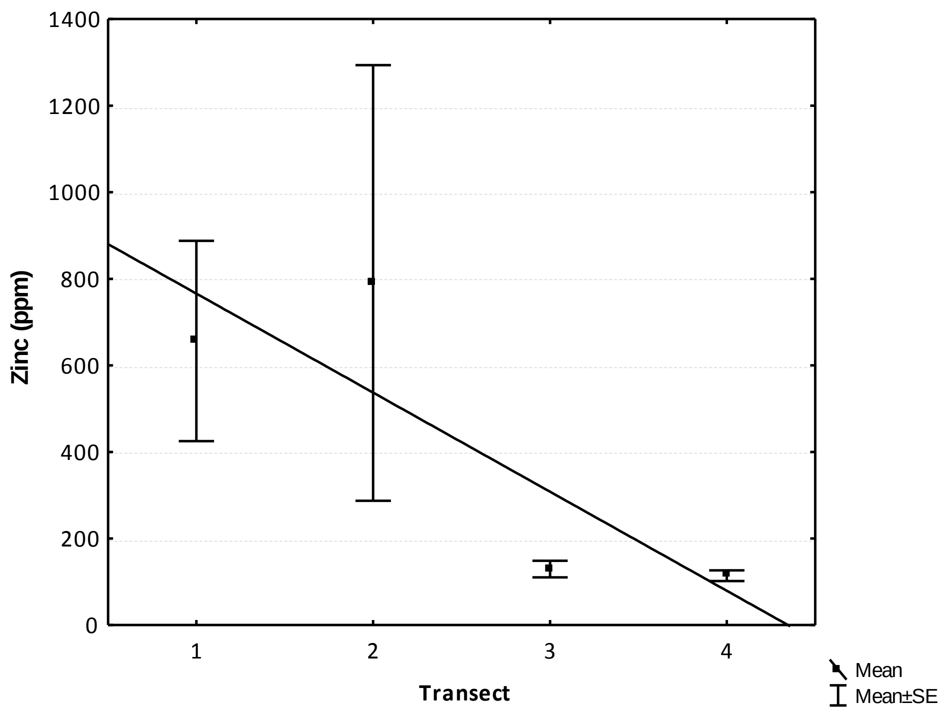

Figure 14: Mean lead concentration (ppm) within transects along Elm Creek.

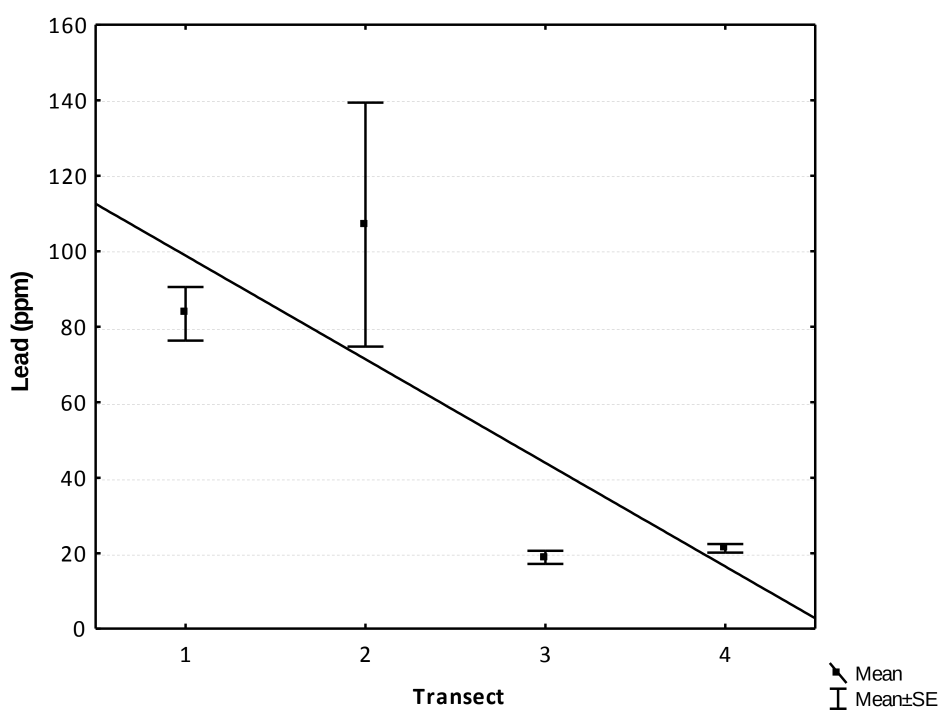

Figure 15: Mean zinc concentration (ppm) within transects along Tar Creek.

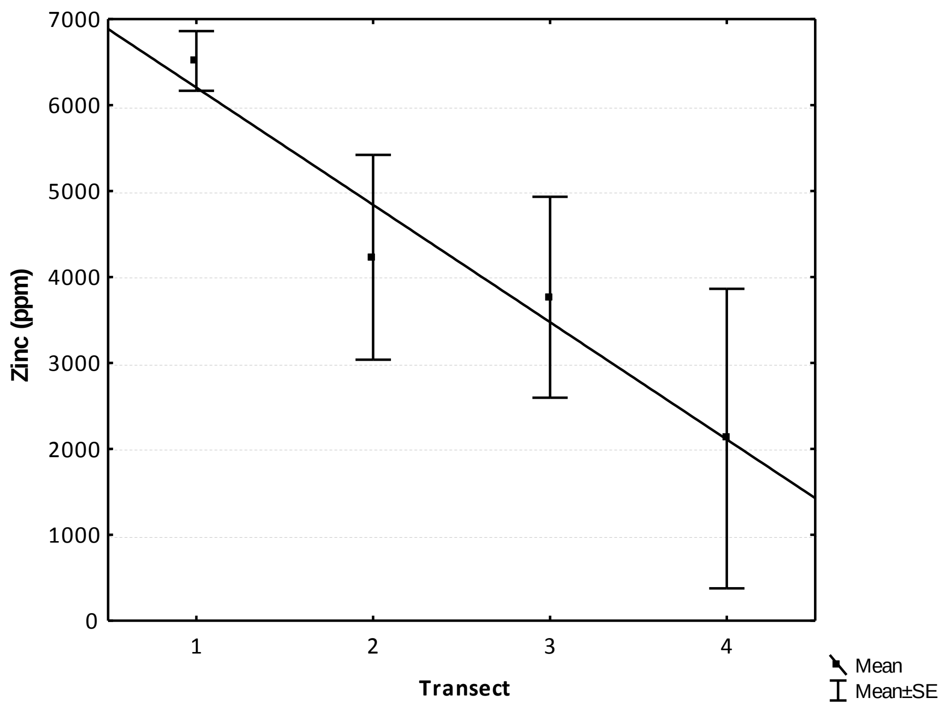

Figure 16: Mean lead concentration (ppm) within transects along Tar Creek.

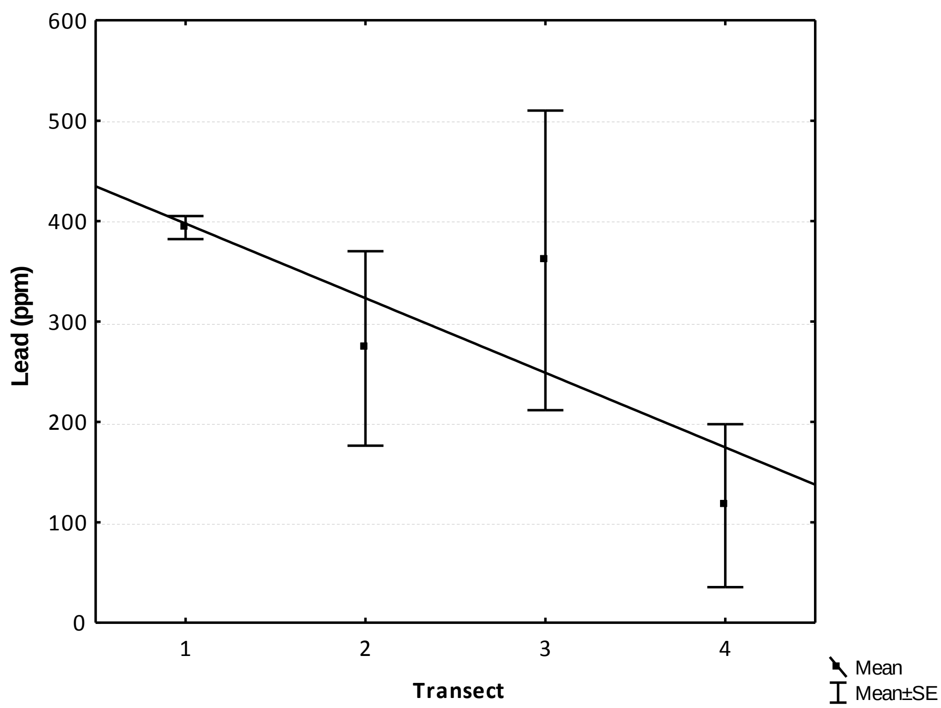

Figure 17: Mean zinc concentration (ppm) within transects along Little Elm Creek.

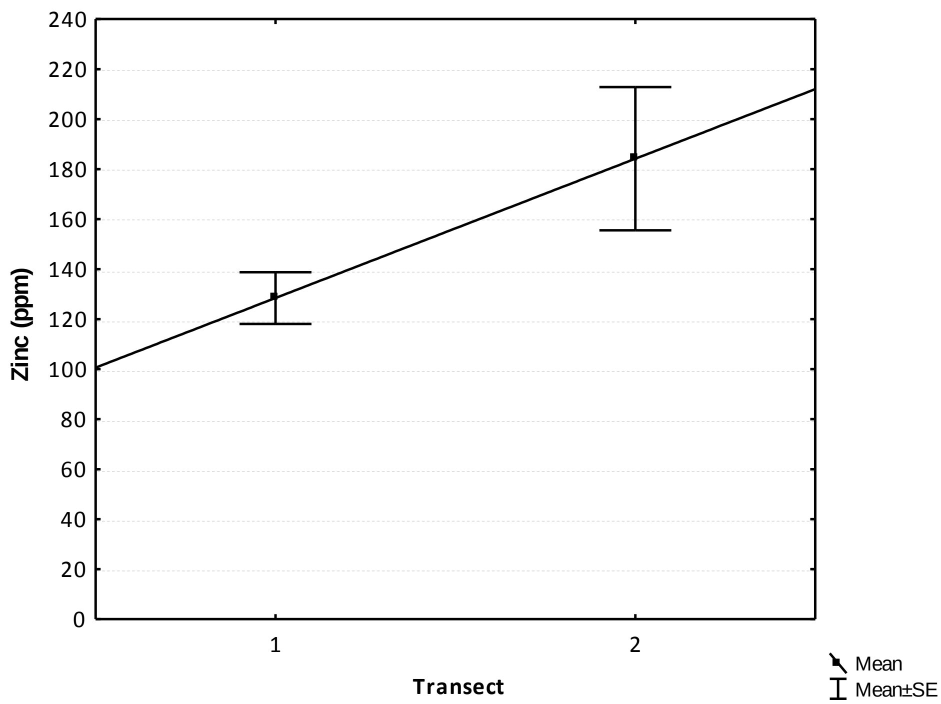

Figure 18: Mean lead concentration (ppm) within transects along Little Elm Creek.

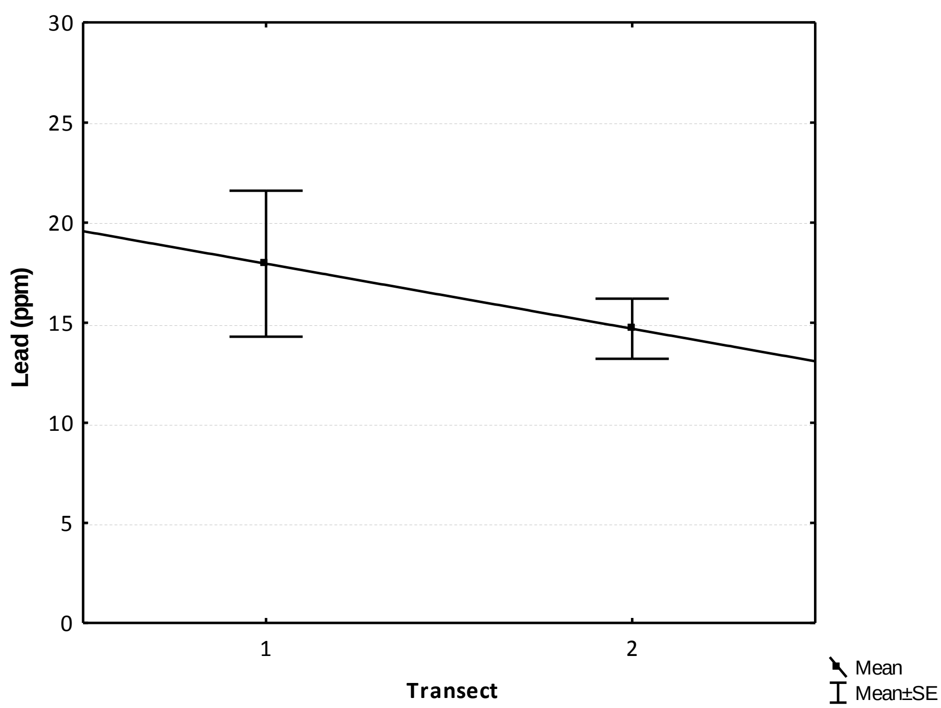

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Figure 19: Mean zinc concentration (ppm) within transects along the Spring River.

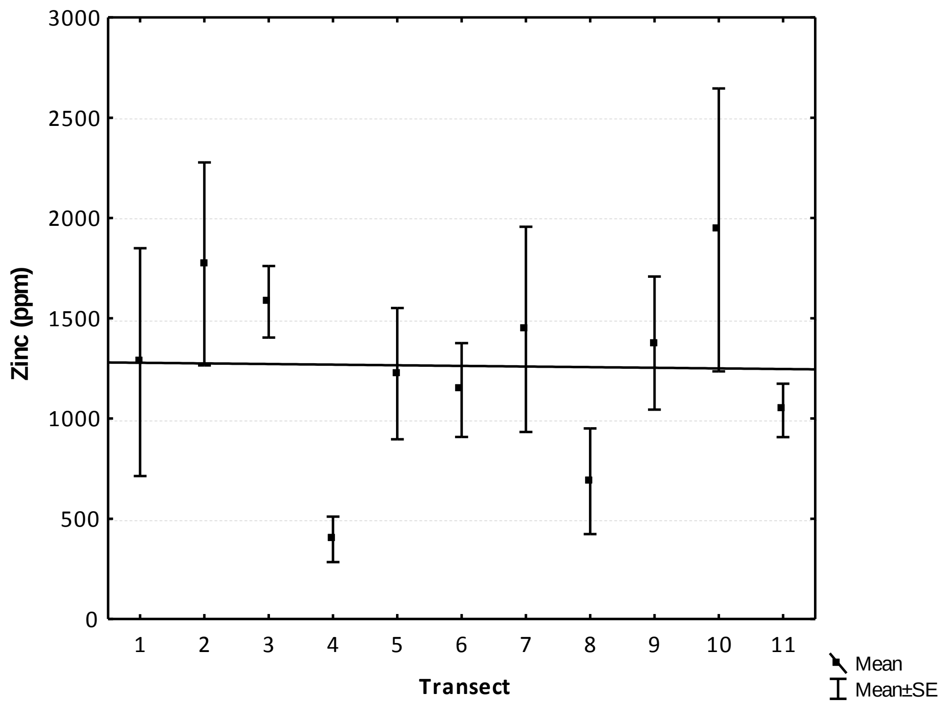


Figure 20: Mean lead concentration (ppm) within transects along the Spring River.

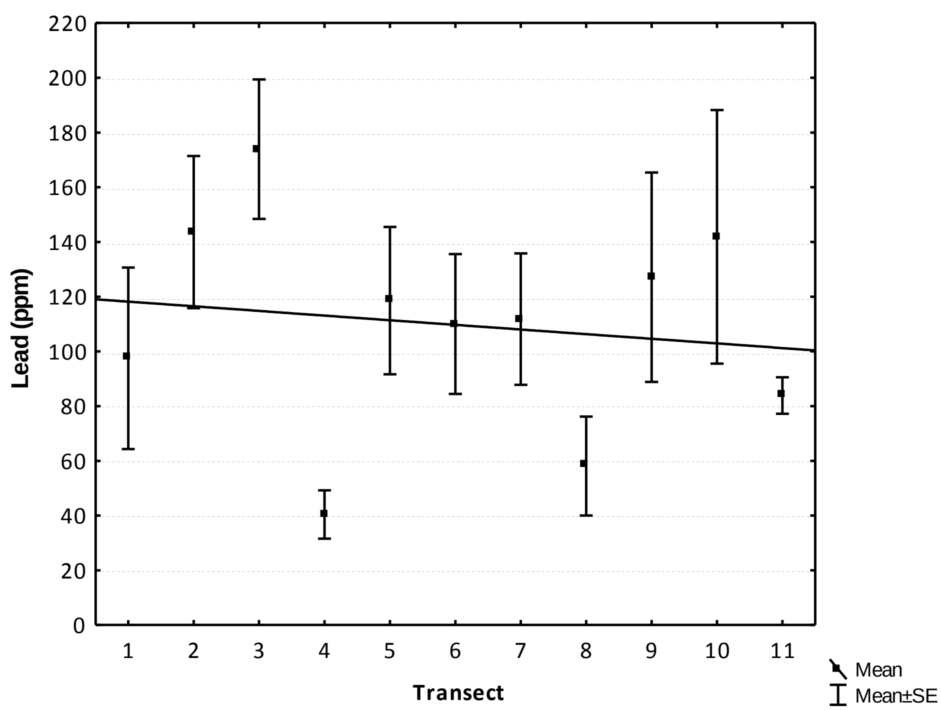


Figure 21: Mean zinc concentration (ppm) within transects taken from oxbow lakes adjacent to the Spring River.

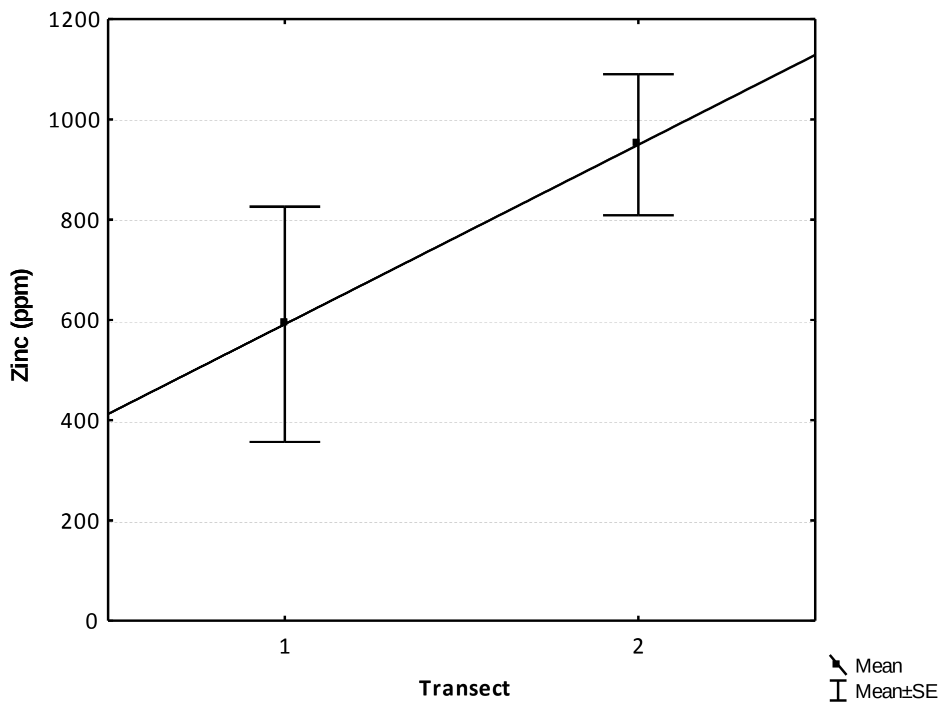


Figure 22: Mean lead concentration (ppm) within transects taken from oxbow lakes adjacent to the Spring River.

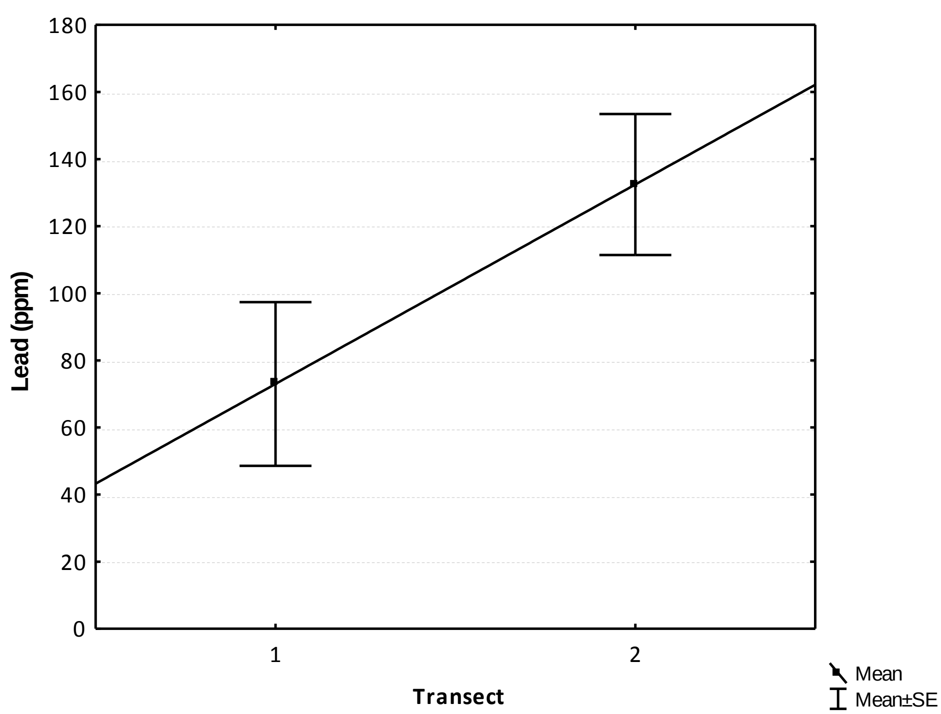


Figure 23: Mean zinc concentration (ppm) within control transects along the Spring River.

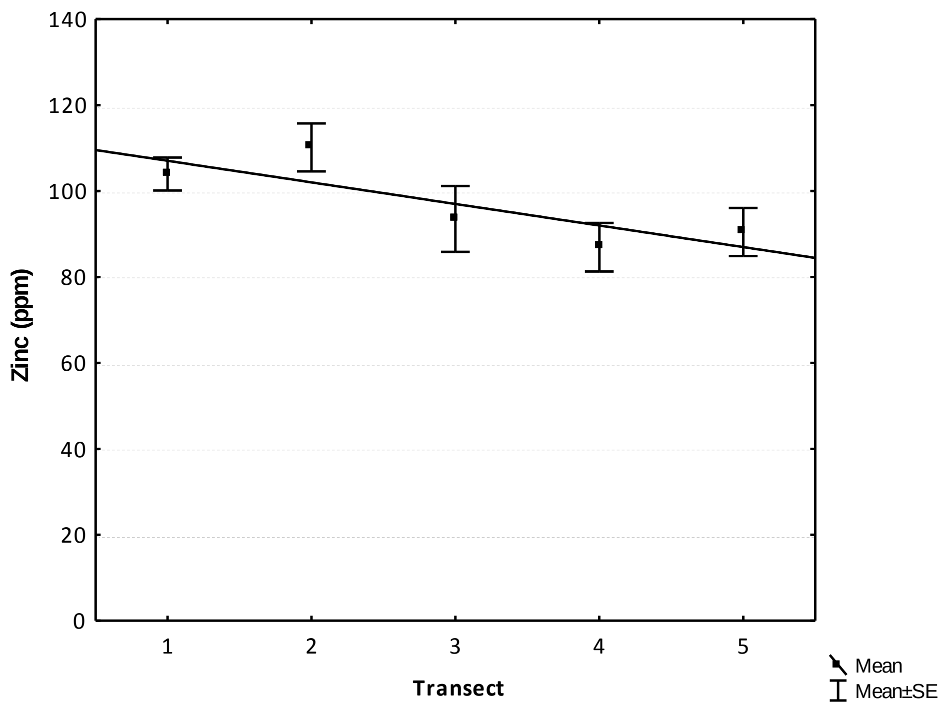


Figure 24: Mean lead concentration (ppm) within control transects along the Spring River.

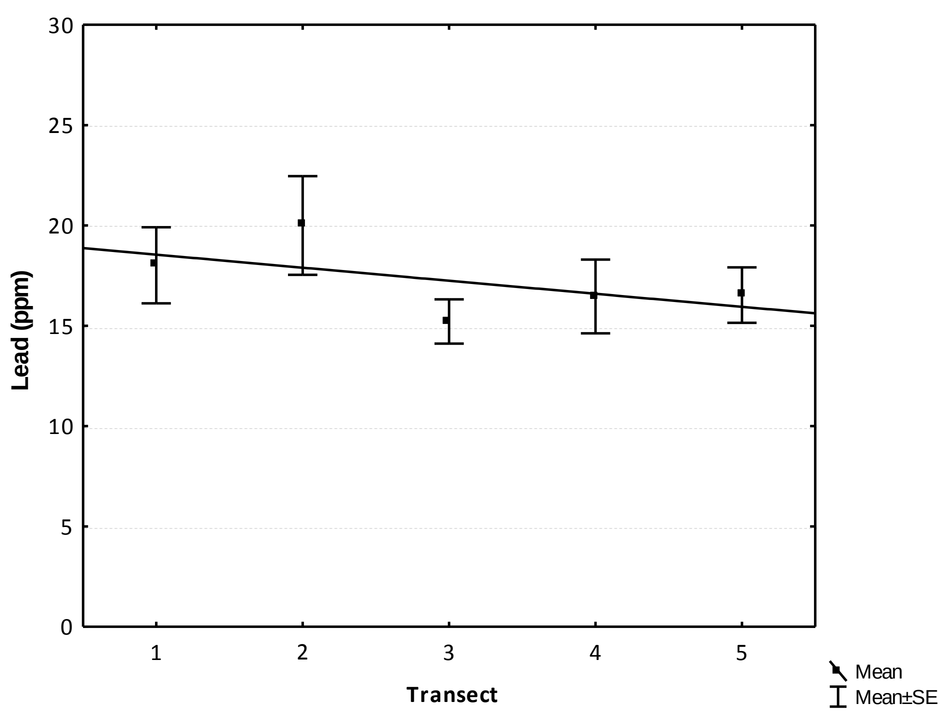


Figure 25: Mean zinc concentration (ppm) within transects along Lost Creek.

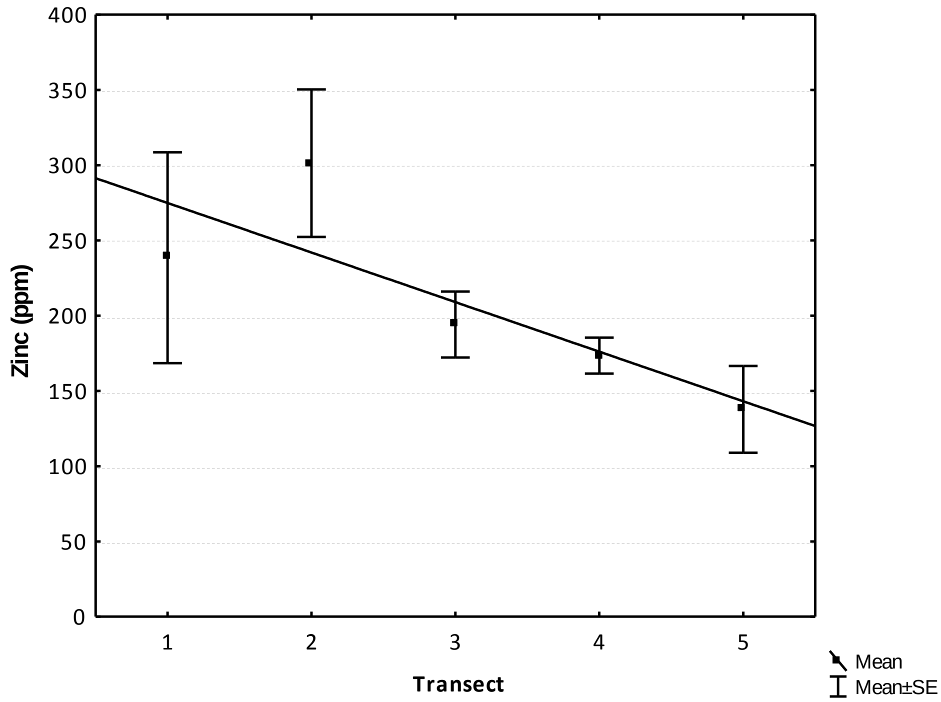


Figure 26: Mean lead concentration (ppm) within transects along Lost Creek.

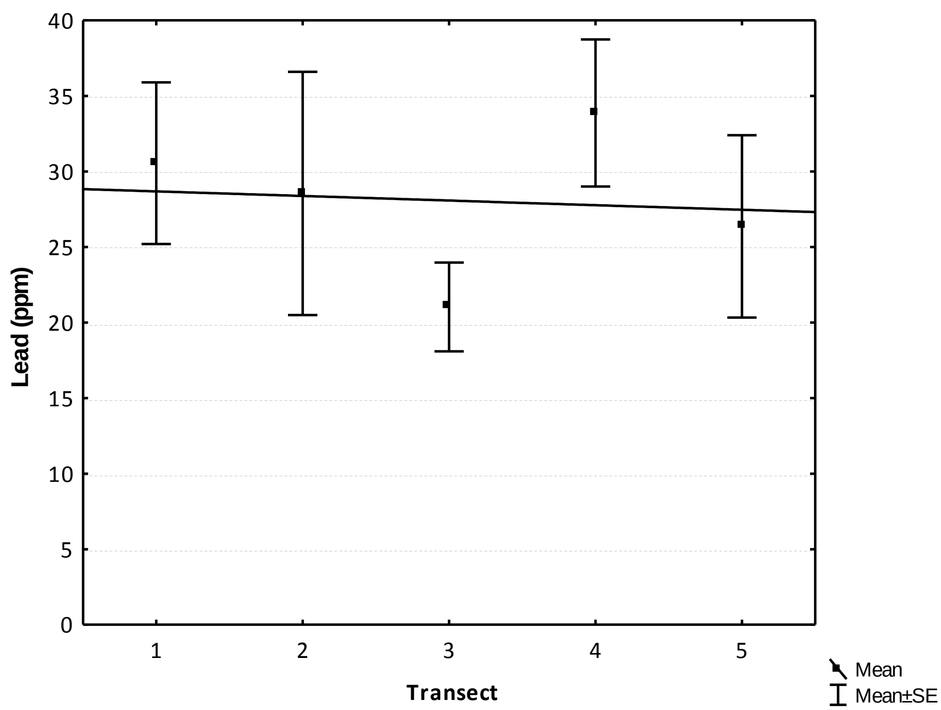


Figure 27: Mean zinc concentration (ppm) within transects along the Grand River.

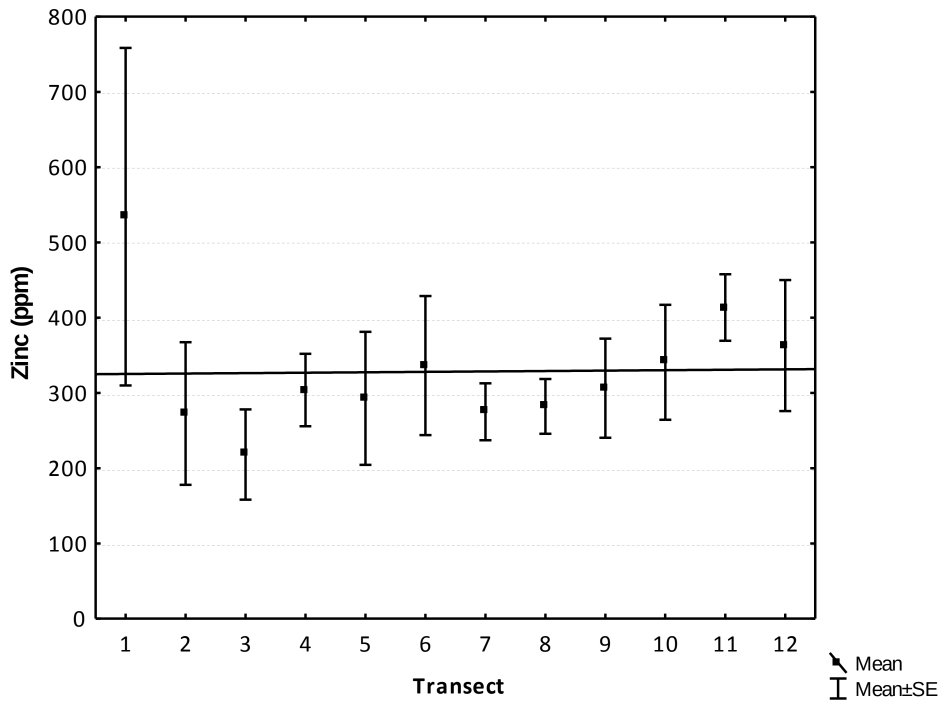
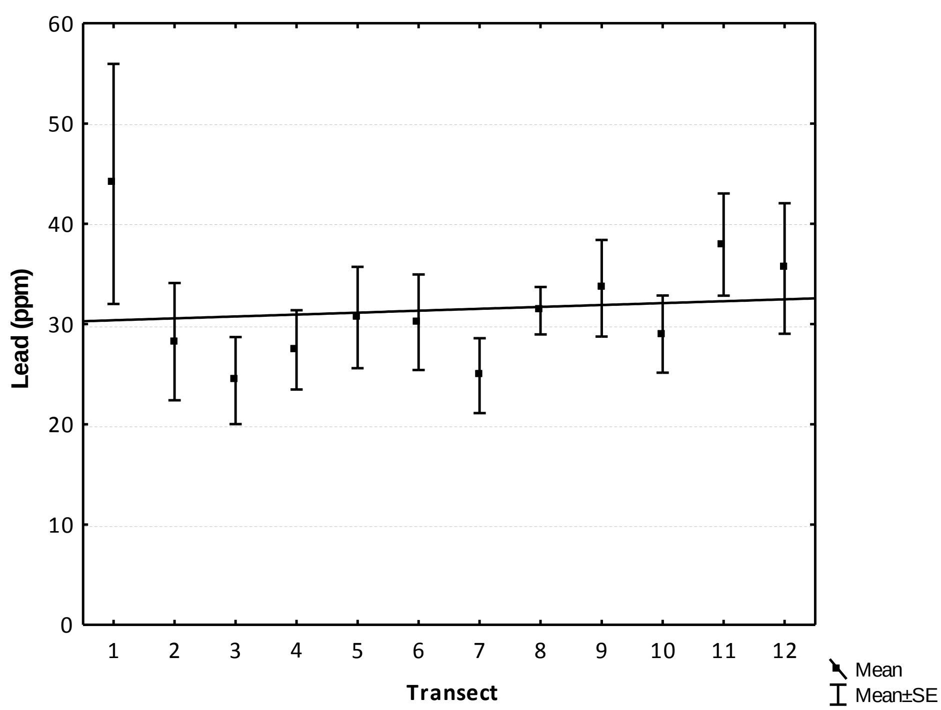


Figure 28: Mean lead concentration (ppm) within transects along the Grand River.



APPENDIX C: GRAPHS OF MEAN LEAD AND ZINC CONCENTRATIONS GROUPED BY LOCATION WITHIN A TRANSECT

Figure 29: Mean lead concentration (ppm) for overbank, bank, river, and oxbow samples from impacted sites.

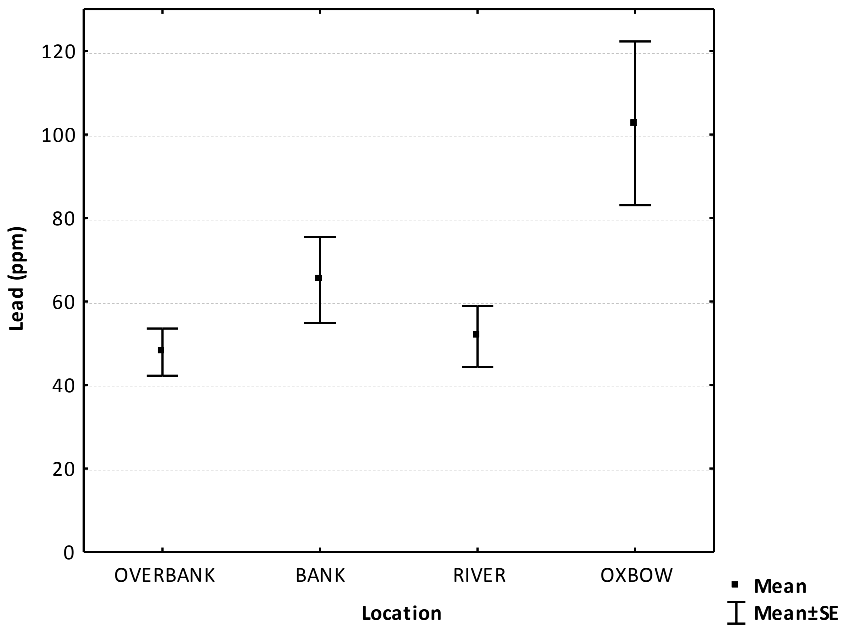
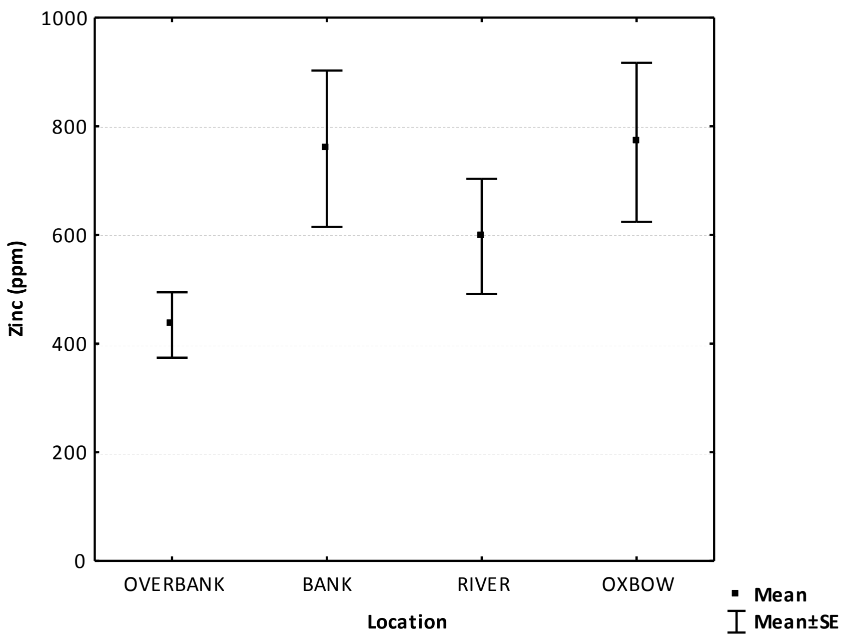


Figure 30: Mean zinc concentration (ppm) for overbank, bank, river, and oxbow samples from impacted sites.



APPENDIX D: PEC-Q Values

Sample ID	Zn PEC-Q (XRF)	Pb PEC-Q (XRF)	Zn PEC-Q (ICP)	Pb PEC-Q (ICP)	Cd PEC-Q (ICP)
EC-1-1	0.46	0.61			
EC-1-2	2.15	0.59			
EC-1-3	1.68	0.76	1.88	0.78	1.34
EC-1-4	0.00	0.00			
EC-2-1	0.46	0.40			
EC-2-2	0.68	0.95	0.72	0.82	0.66
EC-2-3	5.01	1.50	5.14	1.27	2.35
EC-2-4	0.74	0.49			
EC-3-1	0.17	0.12			
EC-3-2	0.37	0.16			
EC-3-3	0.34	0.16			
EC-3-4	0.34	0.11			
EC-3-5	0.19	0.19			
EC-4-1	0.28	0.17			
EC-4-2	0.22	0.15			
EC-4-3	0.29	0.16			
EC-4-4	0.30	0.20			
EC-4-5	0.15	0.15			
GR-1-1	0.41	0.16			
GR-1-2	0.36	0.22			
GR-1-3	0.36	0.22			
GR-1-4	2.07	0.45			
GR-1-5	2.61	0.66			
GR-2-1	1.52	0.39			
GR-2-2	0.84	0.28			
GR-2-3	0.33	0.10			
GR-2-4	0.44	0.26			
GR-2-5	0.21	0.18			
GR-2-6	0.24	0.11			
GR-3-1	1.11	0.36			
GR-3-2	0.27	0.18			
GR-3-3	0.28	0.15			
GR-3-4	0.43	0.13			
GR-3-5	0.32	0.15			
GR-3-6	0.44	0.17			
GR-4-1	1.02	0.33			

Sample ID	Zn PEC-Q (XRF)	Pb PEC-Q (XRF)	Zn PEC-Q (ICP)	Pb PEC-Q (ICP)	Cd PEC-Q (ICP)
GR-4-2	0.79	0.25			
GR-4-3	0.79	0.22			
GR-4-4	0.28	0.13			
GR-4-5	0.53	0.14			
GR-4-6	0.56	0.21			
GR-5-1	1.17	0.34			
GR-5-2	0.51	0.20			
GR-5-3	0.63	0.16			
GR-5-4	0.25	0.26			
GR-6-1	1.44	0.36			
GR-6-2	0.82	0.20			
GR-6-3	0.55	0.20			
GR-6-4	0.63	0.27			
GR-6-5	0.23	0.15			
GR-7-1	0.82	0.30			
GR-7-2	0.65	0.22			
GR-7-3	0.64	0.14			
GR-7-4	0.57	0.15			
GR-7-5	0.31	0.17			
GR-8-1	0.31	0.21			
GR-8-2	0.61	0.23			
GR-8-3	0.72	0.31			
GR-8-4	0.71	0.22			
GR-8-5	0.72	0.26			
GR-9-1	0.90	0.35			
GR-9-2	0.86	0.30			
GR-9-3	0.94	0.31			
GR-9-4	0.28	0.14			
GR-9-5	0.35	0.21			
GR-10-1	0.14	0.15			
GR-10-2	0.67	0.21			
GR-10-3	0.87	0.20			
GR-10-4	1.13	0.26			
GR-10-5	0.90	0.32			
GR-11-1	0.90	0.35			
GR-11-2	1.06	0.30	1.08	0.31	0.54
GR-11-3	1.01	0.32	0.97	0.27	0.51
GR-11-4	1.00	0.37	1.08	0.30	0.59
GR-11-5	0.53	0.14			
GR-12-1	0.09	0.11			

Sample ID	Zn PEC-Q (XRF)	Pb PEC-Q (XRF)	Zn PEC-Q (ICP)	Pb PEC-Q (ICP)	Cd PEC-Q (ICP)
GR-12-2	1.04	0.27	1.14	0.31	0.51
GR-12-3	1.01	0.33			
GR-12-4	1.12	0.42	1.09	0.30	0.51
GR-12-5	0.69	0.27			
LC-1-1	0.67	0.28			
LC-1-2	0.37	0.20			
LC-2-1	0.55	0.16			
LC-2-2	0.76	0.29			
LC-3-1	0.34	0.14			
LC-3-2	0.50	0.21			
LC-3-3	0.43	0.14			
LC-4-1	0.31	0.17			
LC-4-2	0.40	0.28			
LC-4-3	0.44	0.36			
LC-4-4	0.42	0.18			
LC-4-5	0.32	0.33			
LC-5-1	0.42	0.14			
LC-5-2	0.28	0.30			
LC-5-3	0.20	0.19			
LEC-1-1	0.30	0.17			
LEC-1-2	0.26	0.11			
LEC-2-1	0.34	0.13			
LEC-2-2	0.46	0.10			
NR-1-1	0.13	0.12			
NR-1-2	0.17	0.12			
NR-1-3	0.13	0.13			
NR-2-1	0.19	0.14			
NR-2-2	0.17	0.11			
NR-2-3	0.19	0.17			
NR-3-1	0.16	0.16			
NR-3-2	0.15	0.17			
NR-3-3	0.18	0.12			
NR-3-4	0.16	0.11			
NR-4-1	0.47	0.26			
NR-4-2	0.27	0.21			
NR-4-3	0.17	0.10			
NR-4-4	0.22	0.15			
NR-4-5	0.22	0.11			
NR-5-1	0.20	0.10			
NR-5-2	0.29	0.16			

Sample ID	Zn PEC-Q (XRF)	Pb PEC-Q (XRF)	Zn PEC-Q (ICP)	Pb PEC-Q (ICP)	Cd PEC-Q (ICP)
NR-5-3	0.19	0.11			
NR-5-4	0.31	0.23			
NR-6-1	0.70	0.17			
NR-6-2	0.28	0.21			
NR-6-3	0.21	0.11			
NR-6-4	0.41	0.23			
NR-7-1	0.48	0.15			
NR-7-2	0.35	0.18			
NR-7-3	0.23	0.13			
NR-7-4	0.20	0.11			
NR-7-5	0.22	0.11			
NR-8-1	0.41	0.10			
NR-8-2	0.17	0.11			
NR-8-3	0.56	0.24			
NR-8-4	0.25	0.18			
NR-8-5	0.15	0.15			
NR-8-6	0.24	0.11			
NR-9-1	0.48	0.24			
NR-9-2	0.39	0.15			
NR-9-3	0.44	0.14			
NR-9-4	0.20	0.11			
NR-9-5	0.26	0.11			
NR-9-6	0.28	0.15			
NR-10-1	0.39	0.15			
NR-10-2	0.27	0.12			
NR-10-3	0.34	0.11			
NR-10-4	0.59	0.11			
NR-10-5	0.29	0.11			
NR-10-6	0.26	0.16			
NR-11-1	0.36	0.26			
NR-11-2	0.34	0.12			
NR-11-3	0.28	0.17			
NR-11-4	0.29	0.11			
NR-11-5	0.29	0.11			
NR-11-6	0.29	0.17			
NR-12-1	0.51	0.22			
NR-12-2	0.36	0.17			
NR-12-3	0.40	0.14			

Sample ID	Zn PEC-Q (XRF)	Pb PEC-Q (XRF)	Zn PEC-Q (ICP)	Pb PEC-Q (ICP)	Cd PEC-Q (ICP)
NR-12-4	0.21	0.14			
NR-12-5	0.43	0.12			
NR-12-6	0.38	0.13			
NR-13-1	0.27	0.15			
NR-13-2	0.61	0.23			
NR-13-3	0.31	0.16			
NR-13-4	0.23	0.11			
NR-13-5	0.29	0.26			
NR-14-1	0.31	0.11			
NR-14-2	0.32	0.20			
NR-14-3	0.31	0.23			
NR-14-4	0.30	0.14			
NR-14-5	0.37	0.11			
NR-14-6	0.21	0.12			
NR-15-1	0.34	0.12			
NR-15-2	0.35	0.12			
NR-15-3	0.29	0.11			
NR-15-4	0.34	0.20			
NR-15-5	0.27	0.17			
NR-15-6	0.56	0.28			
NRC-1-1	0.37	0.23			
NRC-1-2	0.33	0.20			
NRC-1-3	0.34	0.19			
NRC-1-4	0.14	0.12			
NRC-1-5	0.17	0.18			
NRC-1-6	0.14	0.23			
NRC-2-1	0.14	0.11			
NRC-2-2	0.17	0.12			
NRC-2-3	0.15	0.14			
NRC-2-4	0.16	0.14			
NRC-2-5	0.16	0.19			
NRC-2-6	0.18	0.15			
NRC-3-1	0.15	0.10	0.12	0.09	0.05
NRC-3-2	0.19	0.12			
NRC-3-3	0.19	0.11			
NRC-3-4	0.20	0.13			
NRC-3-5	1.49	0.83			
NRC-3-6	1.43	0.80			
NRC-4-1	0.12	0.10			

Sample ID	Zn PEC-Q (XRF)	Pb PEC-Q (XRF)	Zn PEC-Q (ICP)	Pb PEC-Q (ICP)	Cd PEC-Q (ICP)
NRC-4-2	0.14	0.11			
NRC-4-3	0.18	0.11			
NRC-4-4	0.15	0.11			
NRC-4-5	0.13	0.12			
NRC-4-6	0.17	0.11			
NRC-5-1	0.16	0.13			
NRC-5-2	0.14	0.13			
NRC-5-3	0.15	0.12			
NRC-5-4	0.10	0.14	0.09	0.12	0.03
NRC-5-5	0.15	0.11	0.10	0.12	0.03
NRC-5-6	0.15	0.37			
SR-1-1	3.17	1.23			
SR-1-2	1.63	0.52			
SR-1-3	8.56	1.71	9.59	1.79	5.00
SR-1-4	0.68	0.15			
SR-1-5	0.22	0.10			
SR-1-6	2.50	0.85			
SR-2-1	3.09	1.22			
SR-2-2	1.27	0.51			
SR-2-3	1.81	0.57			
SR-2-4	4.79	1.54			
SR-2-5	8.75	1.86	8.63	1.80	4.32
SR-2-6	3.44	1.04			
SR-3-1	2.75	1.12			
SR-3-2	3.50	1.20			
SR-3-3	4.09	1.75	4.25	1.66	1.91
SR-4-1	1.25	0.44			
SR-4-2	0.26	0.19			
SR-4-3	0.23	0.15			
SR-4-4	0.59	0.22			
SR-4-5	1.75	0.59			
SR-4-6	1.12	0.30			
SR-5-1	1.88	0.73			
SR-5-2	4.14	1.39			
SR-5-3	4.05	1.19			
SR-5-4	0.35	0.20			
SR-5-5	2.91	1.11			
SR-6-1	1.12	0.30			
SR-6-2	3.47	1.23			
SR-6-3	2.99	1.03			

Sample ID	Zn PEC-Q (XRF)	Pb PEC-Q (XRF)	Zn PEC-Q (ICP)	Pb PEC-Q (ICP)	Cd PEC-Q (ICP)
SR-6-4	2.37	0.88			
SR-7-1	2.05	0.71			
SR-7-2	2.18	0.95			
SR-7-3	0.62	0.21			
SR-7-4	8.34	1.63	8.61	1.55	4.72
SR-7-5	3.74	0.81			
SR-7-6	1.96	0.93			
SR-8-1	2.60	0.72			
SR-8-2	0.30	0.12			
SR-8-3	0.74	0.33			
SR-8-4	2.35	0.65			
SR-9-1	2.62	0.78			
SR-9-2	4.79	1.18			
SR-9-3	4.27	2.03	4.84	1.95	2.95
SR-9-4	0.68	0.23			
SR-9-5	2.64	0.75			
SR-10-1	5.76	1.47	6.62	1.59	4.72
SR-10-2	2.69	0.75	3.03	0.70	1.71
SR-11-1	2.71	0.75			
SR-11-2	2.38	0.58			
SR-11-3	1.72	0.64			
SRC-1-1	0.21	0.10			
SRC-1-2	0.22	0.20			
SRC-1-3	0.23	0.14			
SRC-1-4	0.21	0.10			
SRC-1-5	0.26	0.14			
SRC-1-6	0.23	0.16			
SRC-2-1	0.28	0.22			
SRC-2-2	0.23	0.15			
SRC-2-3	0.25	0.10	0.22	0.14	0.13
SRC-2-4	0.26	0.16			
SRC-2-5	0.22	0.19			
SRC-2-6	0.20	0.10			
SRC-3-1	0.17	0.10			
SRC-3-2	0.22	0.12			
SRC-3-3	0.20	0.11			
SRC-3-4	0.27	0.14			
SRC-3-5	0.20	0.15	0.19	0.12	0.10
SRC-3-6	0.16	0.10			

Sample ID	Zn PEC-Q (XRF)	Pb PEC-Q (XRF)	Zn PEC-Q (ICP)	Pb PEC-Q (ICP)	Cd PEC-Q (ICP)
SRC-4-1	0.16	0.11	0.11	0.10	0.05
SRC-4-2	0.21	0.14			
SRC-4-3	0.20	0.10			
SRC-4-4	0.23	0.19			
SRC-4-5	0.16	0.10			
SRC-4-6	0.17	0.14			
SRC-5-1	0.22	0.12			
SRC-5-2	0.21	0.17			
SRC-5-3	0.15	0.10			
SRC-5-4	0.23	0.15			
SRC-5-5	0.21	0.14			
SRC-5-6	0.17	0.10			
SRO-1-1	1.80	0.73			
SRO-1-2	1.80	0.79			
SRO-1-3	0.27	0.19			
SRO-2-1	1.61	0.71			
SRO-2-2	2.65	1.15			
SRO-2-3	1.94	1.24	2.29	1.34	1.55
TC-1-1	15.63	2.90	17.54	2.97	7.85
TC-1-2	13.06	3.17	12.22	2.91	5.08
TC-1-3	13.88	3.16	13.01	2.73	6.14
TC-2-1	11.81	2.89	12.96	3.08	6.33
TC-2-2	6.62	1.38	8.00	1.75	4.38
TC-3-1	3.29	0.88			
TC-3-2	11.82	2.67	12.57	2.81	6.39
TC-3-3	9.50	4.91	9.39	4.77	6.29
TC-4-1	0.82	0.28			
TC-4-2	8.42	1.55	8.28	1.76	2.63