TASK 3 DRAFT FINAL SUMMARY REPORT

for

MONITORING TO ASSESS THE EFFECTIVENESS OF ACTIVITIES PERFORMED UNDER THE GREAT LAKES LEGACY ACT

KINNICKINNIC RIVER SAMPLING

Submitted to

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Contract No. EP-W-04-021
Work Assignment 4-15

February 27, 2009

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1.0 INTRODUCTION

U.S. EPA Work Assignment 4-15 under U.S. EPA Contract Number EP-W-04-021 consists of four areas of concern (AOCs) (Tasks 1-4). This report documents activities on Task 3 – Evaluation of Environmental Dredging for Remediating Contaminated Sediments in the Kinnickinnic River, Milwaukee, WI.

The primary objectives of this work assignment task were to:

- Provide sufficient data to perform a valid statistical comparison of pre- and post-dredging concentrations of COC
- Estimate the spatial distribution of the concentrations of various chemicals in the contaminated sediment of the Kinnickinnic River to define baseline conditions
- Determine the bioavailability, toxicity, and bioaccumulation of organic chemicals and metals.

Sediment remediation is slated for 2009 at a section of the Kinnickinnic River just west of Lake Michigan in Milwaukee, shown in Figure 1-1. The remediation plan calls for mechanically dredging up to 170,000 cu yd of contaminated sediments. The sampling and analysis results detailed in this task will help determine the current baseline conditions of sediments within the defined area of the Great Lakes Legacy Act (GLLA) remediation project of the Kinnickinnic River. Once the planned remediation project has been completed, our study data will be compared with the post-remediation data to evaluate the recovery of this reach of the Kinnickinnic River system, determine success of the project, and help determine the overall GLLA program effectiveness.

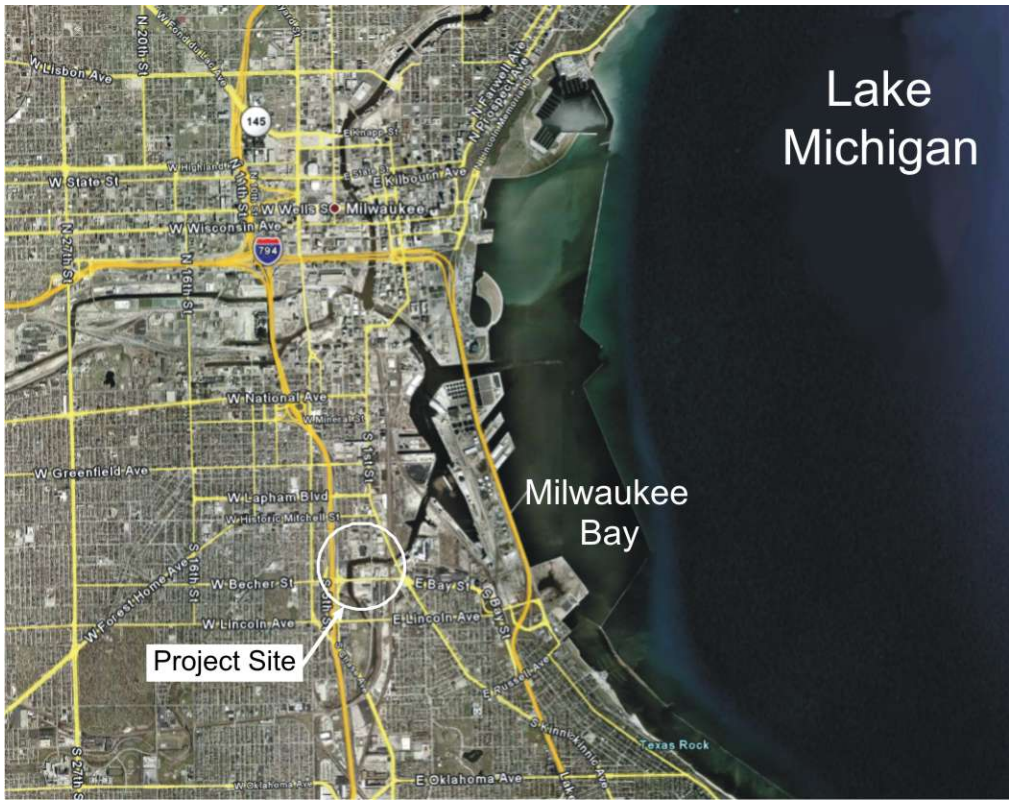

Figure 1-1. Site Location Map

Critical measurements for the Great Lakes National Planning Office (GLNPO) Kinnickinnic River project are:

- Sampling date and location (latitude and longitude) in the field
- Polychlorinated biphenyl (PCB) congeners and Arcolors, polycyclic aromatic hydrocarbons (PAHs), total metals (arsenic, cadmium, chromium, copper, lead, nickel, and zinc), total mercury, acid volatile sulfide/simultaneously extracted metals (AVS/SEM), oil and grease, total organic carbon (TOC), particle size distribution (PSD), and bulk density/percent moisture in sediments;
- Dissolved oxygen in water
- Toxicity/bioaccumulation Testing [survival (%) and growth (mg) with *Hyalella azteca* and *Chronomus dilutus* and bioaccumulation exposure with *Lumbriculus variegates*]; PCB congeners, percent lipids, and percent moisture in biological tissue
- PAH and NH+3 in sediment porewater.

Non-critical parameters are sampling time, water temperature, and water depth.

The baseline monitoring effort at Kinnickinnic River was conducted in one field sampling event in August 2008. The field event was conducted as follows:

The sediment sampling event was conducted on August 19 and 20 onboard the U.S. EPA research vessel (R/V) *Mudpuppy*, equipped with a ponar type grab for surficial sediment sampling and onboard Battelle's (Shallow Vee Jon Boat) *StarCraft Rogue*, also equipped with a ponar type grab sampler. Surficial sediment samples were collected from a total of 24 discrete stations (22 stations on the Kinnickinnic River and 2 stations at a reference site, Root River) to a depth of approximately 15 cm below the surface sediment-water interface. Each of the samples was processed in the field and submitted to various laboratories for analysis. Twenty-seven sediment samples (including three duplicates) collected via a ponar grab were analyzed for PCB (Aroclors), 36 PAHs, total metals (arsenic, cadmium, chromium, copper, lead, nickel, and zinc), total mercury, oil and grease, TOC, PSD, moisture content, and bulk density. In addition, dissolved oxygen and temperature were measured in water just above the sediment water interface at each of the 27 sediment sampling locations.

Additional surficial sediment was collected at six of the 24 discrete sampling stations (KK03, KK10, KK12, KK15, KK20, and RR-01) for further sediment analysis and testing. The extended analysis of the sediment collected from these six stations included PCB congeners, AVS/SEM, and toxicity (both acute and chronic, and a 28-day bioaccumulation test. Ammonia and PAH were analyzed in porewater collected from sediments at these stations. Tissues harvested from the 28-day bioaccumulation test were analyzed for PCB congeners, percent moisture, and percent lipids.

This report presents the results of the field event and sample analyses outlined above. The report appendices contain copies of field records (log books, chain-of-custody forms [COCs]) and laboratory reports (narratives, data tables, and quality assurance and quality control (QA/QC) results.

2.0 FIELD SAMPLING AND SCHEDULE

The sampling and analyses efforts described in this section, and detailed in Section 3.0, describe the plan to determine the current baseline conditions of surficial sediments within the defined area of the GLLA remediation project of the Kinnickinnic River. Sampling sites for the collection of surficial sediment are shown in Figure 2-1 and were developed by Battelle and GLNPO using the Sampling Design described in the *Quality Assurance Project Plan (QAPP) for Monitoring to Assess the Effectiveness of Activities Performed Under the Great Lakes Legacy Act Kinnickinnic River Sampling*, hereafter referred to as the QAPP (Battelle, 2008).

Based on this sampling design, 18 surficial sediment samples were estimated to be sufficient to meet project objectives. Eighteen sampling locations in the dredge area were chosen using a systematic random design using a 100×225 ft grid, which created 18 grid blocks in the 200×2000 ft dredge area. A random sample was placed within each of the 18 grid boxes. In addition, two locations upstream (KK19 and KK20) and two downstream (KK21 and KK22) were selected to serve as reference stations. Two more sampling locations were set in Root River, Racine Harbor. These sampling locations were determined by the EPA GLNPO Technical Lead/Task Manager in the field. Duplicate samples were collected at Stations KK03, KK09, and KK18.

Due to factors such as debris, aquatic construction activities, insufficient water depth, or direction from the EPA GLNPO Technical Lead/Task Manager, two predetermined sample stations (KK11 and KK18) were relocated. Figure 2-1 shows the proposed and actual sample locations and Table 2-2 provides explanations for relocating the sample stations. Table 2-1 summarizes sampling and analysis performed. Included are the actual differential global positioning system (DGPS) coordinates, the numbers of samples collected and analyzed, and samples proposed in the QAPP but not analyzed (NA). The coordinates were obtained from the crew of the RV *Mudpuppy* and from Battelle's S*tarCraft* equipped with a Trimble GPS. The coordinates were provided in WGS 84 format.

The field sampling procedures were consistent with those described in the QAPP. Deviations from the QAPP are noted in this data summary. Table 2-2 summarizes the sediment sample descriptions including collection date and time, platform, water depth, DO, and temperature measurements as well as a description of the sediment. The sediment collection activity is discussed in more detail below.

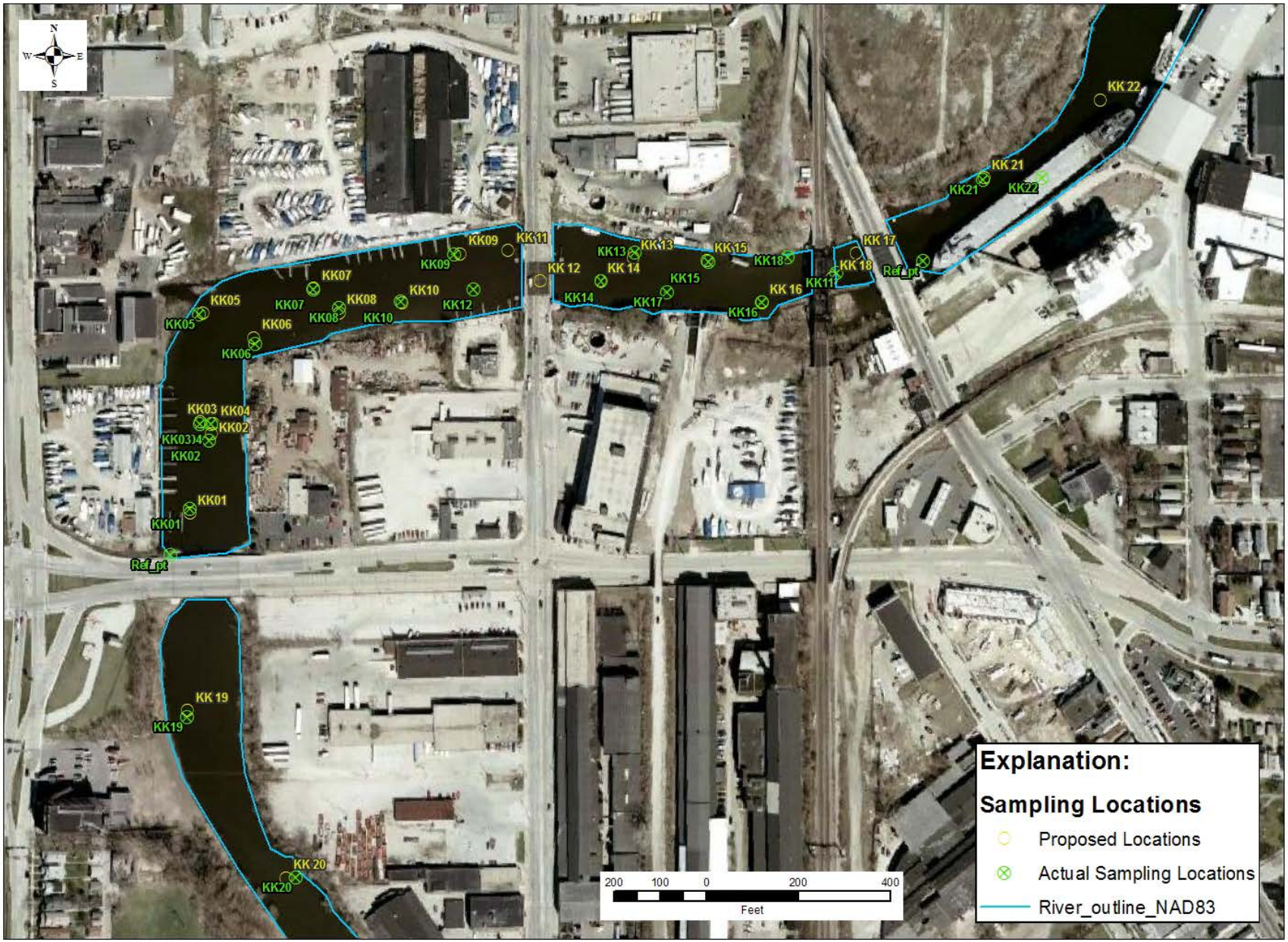

Figure 2-1. Sampling Sites for the Collection of Surficial Sediment

Table 2-1. Summary of Kinnickinnic River Sampling and Analyses by Sampling Station

Station	Actual Latitude North	Actual Longitude West	Sediment Analyses											Tissue Analyses		Overlying Water Analyses	Porewater Analyses	
	(WGS84; Degrees Decimal Minutes)	(WGS84; Degrees Decimal Minutes)	PCB (Aroclors)	PCB (Congeners)	PAH	Total Metals	Total Mercury	AVS/SEM	Oil and Grease	TOC	PSD	Bulk Density	Toxicity/ Bioaccumulation Testing [3]	PCB (Congeners)	Lipids	PAH	PAH[4]	NH_3^+
KK01	43 00.4176	87 54.8421	1		1	1	1		1	1	1	1						
KK02	43 00.4418	87 54.8318	1		1	1	1		1	1	1	1						
KK03[1]	43 00.4478	87 54.8361	1	1	1	1	1	1	1	1	1	1	5	5	5	1	NA	1
KK04	43 00.4477	87 54.8307	1		1	1	1		1	1	1	1						
KK05	43 00.4867972	87 54.8360212	1		1	1	1		1	1	1	1						
KK06	43 00.4756990	87 54.8091202	1		1	1	1		1	1	1	1						
KK07	43 00.4948	87 54.7792	1		1	1	1		1	1	1	1						
KK08	43 00.4877668	87 54.7679801	1		1	1	1		1	1	1	1						
KK09[1]	43 00.5059652	87 54.7114065	1		1	1	1		1	1	1	1						
KK10	43 00.4896	87 54.7366	1	1	1	1	1	1	1	1	1	1	5	5	5	1	1	1
KK11	43 00.4960270	87 54.5252082	1		1	1	1		1	1	1	1						
KK12	43 00.4934	87 54.7012	1	1	1	1	1	1	1	1	1	1	5	5	5	1	NA	1
KK13	43 00.5049	87 54.6222	1		1	1	1		1	1	1	1						
KK14	43 00.4950	87 54.6389	1		1	1	1		1	1	1	1						
KK15	43 00.5010	87 54.5864	1	1	1	1	1	1	1	1	1	1	5	NA	NA	1	1	1
KK16	43 00.4859816	87 54.5619392	1		1	1	1		1	1	1	1						
KK17	43 00.4906880	87 54.6079453	1		1	1	1		1	1	1	1						
KK18[1]	43 00.5020229	87 54.5487310	1		1	1	1		1	1	1	1						
KK19	43 00.3434073	87 54.8469957	1		1	1	1		1	1	1	1						
KK20	43 00.2850954	87 54.7959515	1	1	1	1	1	1	1	1	1	1	5	NA	NA	1	NA	1
KK21	43 00.5278285	87 54.4527003	1		1	1	1		1	1	1	1						
KK22	43 00.5281275	87 54.4241725	1		1	1	1	NA	1	1	1	1	NA	NA	NA	NA	NA	NA
RR-01	42 43.7939696	87 47.4473906	1	1	1	1	1	1	1	1	1	1	5	NA	NA	1	1	1
RR-02	42 43.7870055	87 47.1113540	1		1	1	1		1	1	1	1						
Duplicate Samples [1]			3	1	3	3	3	1	3	3	3	3	-	-	-	-	-	-
Equipment Blank Samples:			2[2]		2[2]													
TOTAL SAMPLES			29	7	29	27	27	7	27	27	27	27	30	15	15	8	3	6

[1] Duplicate Samples collected at Stations KK03, KK09, and KK18

[2] One Equipment Blank was collected on each of the two sampling days (PGS-EB1 and PGS-02).

[3] Toxicity/ Bioaccumulation Testing include: Survival % and Growth (mg) with *Hyalella azteca* and *Chronomus dilutus* and Bioaccumulation Exposure with *Lumbriculus variegates*.

[4] Sufficient porewater was not extracted for sediments collected from Stations KK03, KK12, KK20, and KK22

NA = Not Analyzed

Table 2-2. Summary of Kinnickinnic River Sediment Sampling

Station	Sample ID	Date	Sample Time (CST)	Platform	Water Depth (ft)	DO (mg/L)	Temp (°C)	Sample Description
KK01	HAD-001	8/19/2008	1500	EPA Mudpuppy	6.5	5.32	23.9	Dark Grey, Sandy, Minimal Organic, Shells, Slight Sewage Odor, Small Worms with Movement
KK02	HAD-002	8/19/2008	1515	EPA Mudpuppy	7	5.66	23.8	Dark Sandy, Shell Fragments, No Odor, Worms
KK03[(1)]	HAD-003	8/19/2008	1545	EPA Mudpuppy	6.3	5.70	23.8	Coarse Sand, Black/Brown, Sewage Odor, Shell Fragments, Woody Vegetation, Slight Sheen, Worms
KK04	HAD-004	8/19/2008	1530	EPA Mudpuppy	6.7	5.74	23.8	Coarse Grain Sandy, Shells, Organic Matter, Worms, Dark Brown/Black
KK05	HAD-005	8/19/2008	1630	Battelle StarCraft	1.8	6.12	23.6	Sandy, Silt, Grey/Black
KK06	HAD-006	8/19/2008	1706	Battelle StarCraft	2.3	4.53	23.7	Dark Brown/Grey, Silty, Algae
KK07	HAD-007	8/20/2008	1200	EPA Mudpuppy	8.75	5.76	23.7	Brown/Grey Sandy, Minimal Silt, No Worms or Odor
KK08	HAD-008	8/20/2008	906	Battelle StarCraft	2.1	6.28	23.6	Silty Sand, Grey/Brown
KK09[(2)]	HAD-009	8/20/2008	1056	Battelle StarCraft	7.7	5.45	23.7	Sand, Silt, Brown/Grey
KK10	HAD-010	8/19/2008	1700	EPA Mudpuppy	5	5.39	23.6	Dark Brown/Black, Silty Sand, Medium Amount of Vegetative Material, No Sheen
KK11[(3)]	HAD-011	8/20/2008	1042	Battelle StarCraft	14.1	5.18	23.9	Silty Sand, Grey/Brown
KK12	HAD-012	8/19/2008	1815	EPA Mudpuppy	6.0	5.00	23.7	Silty Sand, Minimal Vegetation, Dark Brown/Black, Slight Petroleum Odor
KK13	HAD-013	8/20/2008	1110	EPA Mudpuppy	9	5.22	23.8	Sandy/Silty, Dark Brown/Black, Petroleum/Sewage Odor, Some Organic Material, Slight Sheen
KK14	HAD-014	8/20/2008	1140	EPA Mudpuppy	9.7	5.15	23.7	Sandy, Dark Brown Sand, Slight Sewage Odor, Sheen
KK15	HAD-015	8/20/2008	1030	EPA Mudpuppy	9	5.06	23.8	Dark Greg/Brown/Black, Silty, Minimal Clay, Minimal Organic Material, No Worms, Odor Present
KK16	HAD-016	8/20/2008	929	Battelle StarCraft	10.4	4.98	23.8	Silt, Grey/Brown
KK17	HAD-017	8/20/2008	1010	Battelle StarCraft	10.2	5.14	23.7	Silty Sand, Grey/Brown
KK18[(4)]	HAD-018	8/20/2008	846	Battelle StarCraft	1.7	6.34	24.2	Muddy, Dark Grey/Brown Sediment
KK19	HAD-019	8/19/2008	1410	Battelle StarCraft	7.5	4.75	23.8	Dark Black, Sandy/Silty
KK20	HAD-020	8/19/2008	1430	Battelle StarCraft	6.9	4.37	23.6	Dark, Muddy, Sewage Odor, Vegetative Matter
KK21	HAD-021	8/19/2008	1732	Battelle StarCraft	21.6	1.50	23.3	Sandy, Silt, Grey Brown
KK22	HAD-022	8/19/2008	1827	Battelle StarCraft	22.4	1.90	23.2	Silt, Dark Grey/Brown Sediment
RR-01	RR-01	8/20/2008	1800	Battelle StarCraft	5.2	11.33	25.1	Oily Sheen, Rocky, Petroleum Smell
RR-02	RR-02	8/20/2008	NA	Battelle StarCraft	10	8.90	24.4	Brownish Grey, Rocky, Sandy, Some Silt, 3" diameter Clam

[(1)] Duplicate sample collected (HAD-103)
[(2)] Duplicate sample collected (HAD-109)
[(3)] Moved to between RR and KK bridge per Ajit/Alie after discussion with CH2MHill
[(4)] Buried optic cable at proposed location; moved to alternative location. Duplicate sample collected (HAD-118)

Table 2-3 gives the field schedule for the collection of sediment samples. The field activities are discussed in more detail below.

Table 2-3. Schedule of Field Activity

Activity	Date
Surficial Sediment Collection – Kinnickinnic River	August 19, 2008
Surficial Sediment Collection – Kinnickinnic River and Root River	August 20, 2008

2.1 Sediment Collection

The R/V *Mudpuppy* and *StarCraft* served as the sampling platforms for all surficial sediment collection efforts. DGPS coordinates were acquired from the on-board unit of the R/V *Mudpuppy* and from the *StarCraft's* hand-held Trimble GPS and were then transferred into the field logs (refer to Table 2-1 for the coordinates). Photo documentation, station logs, and field notes were recorded during the field survey. The station logs for each sampling station, as well as the sample chain-of-custody logs, are provided in Appendix A. Each station log includes a description of the sampling location, observations, number and type(s) of samples collected, and comments.

Sediment samples were collected at each of the 24 locations (Figure 2-1) from the R/V *Mudpuppy* and the *StarCraft* with stainless steel Eckman Ponar grab samplers. Grab sample operations were performed in compliance with the U.S. EPA SOP "Surficial Sediment Sampling Using a Ponar Dredge Sampler Onboard the R/V Mudpuppy." Sediment was collected from the top 6 in. of each grab. If debris, rocks, or other circumstances prevented sampling at the exact pre-determined location, then grab samples were relocated as close to the original location as possible so that an acceptable sample could be taken.

Upon retrieval, the sediment sample was inspected for acceptability. If the sediment surface of the grab appeared disturbed (e.g., excessive washing, slumping, interference of jaw closure), then the sample was considered unacceptable and was discarded, and a new one collected. If deemed acceptable, the grab sample was processed as described in Section 4.5 of the QAPP. Samples from all 24 locations plus three replicate locations were analyzed as summarized in Table 2-1. There were no significant technical difficulties during the sediment sampling.

All sediment samples were processed on the *Mudpuppy* or *Starcraft.* Each sample was given a unique identification tag and logged into the chain-of-custody record. Once contained; the samples were transferred to land and packaged for shipment via overnight delivery to the appropriate laboratories for analysis as specified in the QAPP. Table 2-4 identifies the various laboratories and the analyses they performed.

2.2 Extended Sediment Testing, and Toxicity and Bioaccumulation Testing

At the six surficial sediment sampling stations targeted for additional investigation sediment samples were used for toxicity and bioaccumulation testing, and analyzed for additional parameters. Overlying water and porewater recovered from the sediment samples were analyzed for PAHs and ammonia.

Table 2-4. Summary of Analytical Parameters and Laboratories Performing Analyses

Sample Type	Analytical Parameter	Laboratory ID
Surficial Sediment	PCB Aroclors, PAH	Battelle
	Total Metals, Total Mercury, Oil and Grease, Percent Moisture	CAS-Kelso
	TOC, PSD, Moisture Content, Bulk Density,	AMS
Subset of Surficial Sediments for Additional Analyses	PCB Congeners	Battelle
	AVS-SEM	CAS-Kelso
	PAH in Overlying water and Porewater	Battelle
	Toxicity/Bioaccumulation Exposure and Ammonia in Porewater	Great Lake Environmental Center (GLEC)
	PCB Congeners, Percent Moisture, and Percent Lipids (Bioaccumulation Tissue from Exposure Testing)	Battelle

2.2.1 Toxicity and Bioaccumulation Testing. Sediments for toxicity and bioaccumulation testing were collected on August 19 and 20 during the surficial sediment sampling event using the procedures described in Section 2.1. To collect the large sample volumes required for toxicity testing and porewater testing, multiple grabs were collected and aliquotted equally into three separate 2.5-gal high density polyethylene buckets. The samples for porewater analysis were shipped to Battelle Duxbury where they were centrifuged to collect porewater. Samples for toxicity and bioaccumulation testing were shipped to the GLEC for the following toxicological and accumulation tests:

- 28-Day survival and growth test with the Amphipod *Hyalella azteca*
- 20-Day survival and growth test with Midge Larvae *Chironomus tentans (dilutus)*
- 28-Day bioaccumulation exposure with the Oligochaete *Lumbriculus variegatus*

Laboratory testing and analysis were conducted using the protocols described in the QAPP. The SOPs outline procedures to obtain growth, survival, and reproduction endpoints; however, in this instance only the growth and survival endpoints were of interest to GLNPO, as determined during project meetings and later reflected in the QAPP. The test durations were modified to 28-day and 20-day survival and growth endpoints for the *H. azteca and C. tentans*, respectively. Additional details of the methods for conducting the sediment toxicity tests are provided in the GLEC Data Report in Appendix C.

The six investigative samples were received at GLEC on August 22, 2008 where they were logged in and stored at 4ºC until test initiation. Test initiation dates were staggered among the *H. azteca*, *C. tentans*, and *L. variegates* toxicity tests. The 28-day *H. azteca* and 20-day *C. tentans* tests were initiated on September 3 and 6, respectively. The six investigative sediment samples and a laboratory control sediment were used to initiate the 4-day *L. variegates* sediment toxicity screening tests on September 7. The survival results from the 4-day screening tests indicated that there was a statistically significant reduction in *L. variegates* survival after exposure in three of the six investigative samples (HAD-015, HAD-020, and RR-01) when compared to the laboratory control sediment. Based on the 4-day screening test results, the EPA-GLNPO Task Manager chose not to initiate the 28-day whole sediment bioaccumulation tests with the three sediments. which were statistically reduced in survival after four days. The 28-day *L. variegates* bioaccumulation tests were initiated with the three investigative sediments (HAD-003, HAD-010, and HAD-012) on September 24, 2008. Due to a technical error, the bioaccumulation test exposures were actually conducted for 29 days rather than 28 days. This deviation from the test protocol should not impact results.

Tissue samples of the *Lumbriculus* from the three investigative sediments were analyzed for PCB congeners, percent moisture, and percent lipids. The decision to analyze the tissue samples for PCB congeners rather than Aroclors was made by the EPA GLNPO Technical Lead/Task Manager after the QAPP was finalized. This deviation provided important comparison data to the sediment PCB analyses for these stations.

Test-specific details including results of daily monitoring of the animals and water quality, shipping information, and the chain-of custody records are provided in the GLEC Data Report (Appendix C).

2.2.2 Additional Sediment Parameters. Sediments were collected for additional parameters—PCB congeners and sulfide by AVS-SEM—at sampling locations KK03, 10, 12, 15, 20, and RR-01.

2.2.3 Overlying Water and Porewater. Sediment samples were collected for porewater analysis using the ponar grab at six sampling locations (KK03, 10, 12, 15, 20, and RR-01). The samples were shipped to Battelle Duxbury Laboratory and to GLEC.

Overlying Water and Porewater (Battelle Duxbury Laboratory). When the six sediment samples arrived at the Battelle Duxbury laboratory, overlying water was present in the sample containers. Rather than mix the overlying water back into the sediment prior to collection of porewater, the overlying water was decanted and analyzed separately. After removal of the overlying water, the six sediment samples were centrifuged for porewater. Only three of the samples (HAD-010, HAD-015, and RR-01) yielded sufficient porewater for PAH analysis. The six overlying water samples and three porewater samples were analyzed for PAHs (N=36).

Porewater (GLEC). Six sediment samples were shipped to GLEC for porewater analysis. The sediment samples (HAD-003, HAD-010, HAD-012, HAD-015, HAD-020, and RR-01) were centrifuged for porewater and analyzed for ammonia (NH+3) and pH.

3.0 SUMMARY OF BASELINE CHARACTERIZATION RESULTS

A summary of the analytical and toxicological results for the baseline characterization effort is presented in this section. Tables and figures in this section summarize PAHs, PCB congeners, Aroclors, total metals, total mercury, sulfide, oil and grease, particle size and bulk density. PCB congener data are reported as total PCBs and by level of chlorination. PAHs are reported as Total PAH and total 16 PPAH. Total PAH is calculated as the sum of the individual 36 PAHs. Total 16 PPAH is calculated as the sum of the 16 priority pollutant PAHs. Non-detects, reported with a "U" qualifier, were treated as a zero for all total calculations

Appendix B contains the Battelle laboratory reports for PAH, PCB congeners, Aroclors, and level of chlorination analysis in water, sediment, and tissue, with the associated quality control results and any resulting data qualifiers. Appendix C contains the GLEC laboratory reports for acute and chronic toxicity tests and the 28-day bioaccumulation test with *L. variegatu*. Appendix D contains the CAS laboratory reports for total metals, total mercury, sulfide, and oil and grease. Appendix E contains the AMS laboratory reports for TOC, Particle size and bulk density data.

3.1 Surficial Sediment Results

Table 3-1 summarizes the contaminant concentration acquired at all the surficial sediment sampling stations. PCB data for Aroclor 1232 are presented; no other Aroclor were detected in any of the samples. Table 3-2 also shows PAH results as total PAHs and total 16 PPAH.

The surficial sediment PCB (Aroclor 1232), total PAH, and total PPAH concentrations were also plotted using EarthVision™ software, using a 2-D minimum tension gridding. The grid spacing was 40 ft by 40 ft in the *x* and *y* dimensions. The contoured data are presented in Figures 3-1, 3-2, and 3-3, respectively.

Table 3-2 presents the physical parameter results; which consist of moisture content, TOC, wet and dry bulk density and particle size distribution. Table 3-3 shows the surficial sediment percent moisture, oil and grease, total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc) and AVS-SEM analysis. Arsenic was not detected at any of the stations. Oil and grease analysis was specified in the QAPP as an additional parameter targeted for the six subset sample stations. Following the sampling event, during a project meeting (August 27, 2008) the EPA GLNPO Technical Lead/Task Manager requested oil and grease analysis for sediments from all sample stations.

Table 3-1. Surficial Sediment: Contaminant Analyses

Sample ID	Station ID	Contaminant Concentrations (µg/Kg-dry)		
		Aroclor 1232	Total PAH	Total 16 PPAH
HAD-001	KK01	1218.93	107,489.02	84,628.63
HAD-002	KK02	1703.86	67,255.36	50,484.82
HAD-003	KK03	893.42	55,196.86	42,567.23
HAD-103	KK03*	982	27,351.91	19,873.82
HAD-004	KK04	1244.24	122,868.96	97,092.09
HAD-005	KK05	1661.64	141,360.86	105,281.16
HAD-006	KK06	1322.84	36,340.50	26,883.78
HAD-007	KK07	1614.31	71,337.94	54,503.98
HAD-008	KK08	3757.08	257,816.43	201,173.21
HAD-009	KK09	1696.26	131,886.78	102,193.62
HAD-109	KK09*	1814.75	91,448.92	69,999.41
HAD-010	KK10	1865.15	114,769.64	82,161.08
HAD-011	KK11	1472.38	61,421.98	45,059.54
HAD-012	KK12	1118.37	33,812.19	25,007.89
HAD-013	KK13	4886.18	236,474.41	179,932.17
HAD-014	KK14	869.18	25,319.61	18,638.73
HAD-015	KK15	6683.22	293,662.85	225,047.93
HAD-016	KK16	3060.64	170,346.02	127,133.24
HAD-017	KK17	1319.72	61,259.61	47,425.72
HAD-018	KK18	7972.92	164,183.27	122,781.22
HAD-118	KK18*	3973.58	141,974.05	105,504.74
HAD-019	KK19	1333.34	42,943.84	31,972.31
HAD-020	KK20	1464.77	51,282.36	38,898.56
HAD-021	KK21	1643.42	77,660.45	56,583.93
HAD-022	KK22	3157.46	223,710.57	167,977.46
RR-01	RR-01	1.99(U)	34,539.39	15,051.82
RR-02	RR-02	1.99(U)	263,116.35	194,398.26

* Indicates a duplicate sample was taken at the sample location

Note: Total PCBs were calculated as the sum of the individual congeners. Congeners reported with "U" data qualifiers were not included in the total calculations.

Total PAHs calculated as the sum of the individual 36 PAHs. Total 16 PPAH calculated as the sum of the 16 priority pollutant PAHs. Non-detects, reported with "U" data qualifiers, were not included in the total calculations

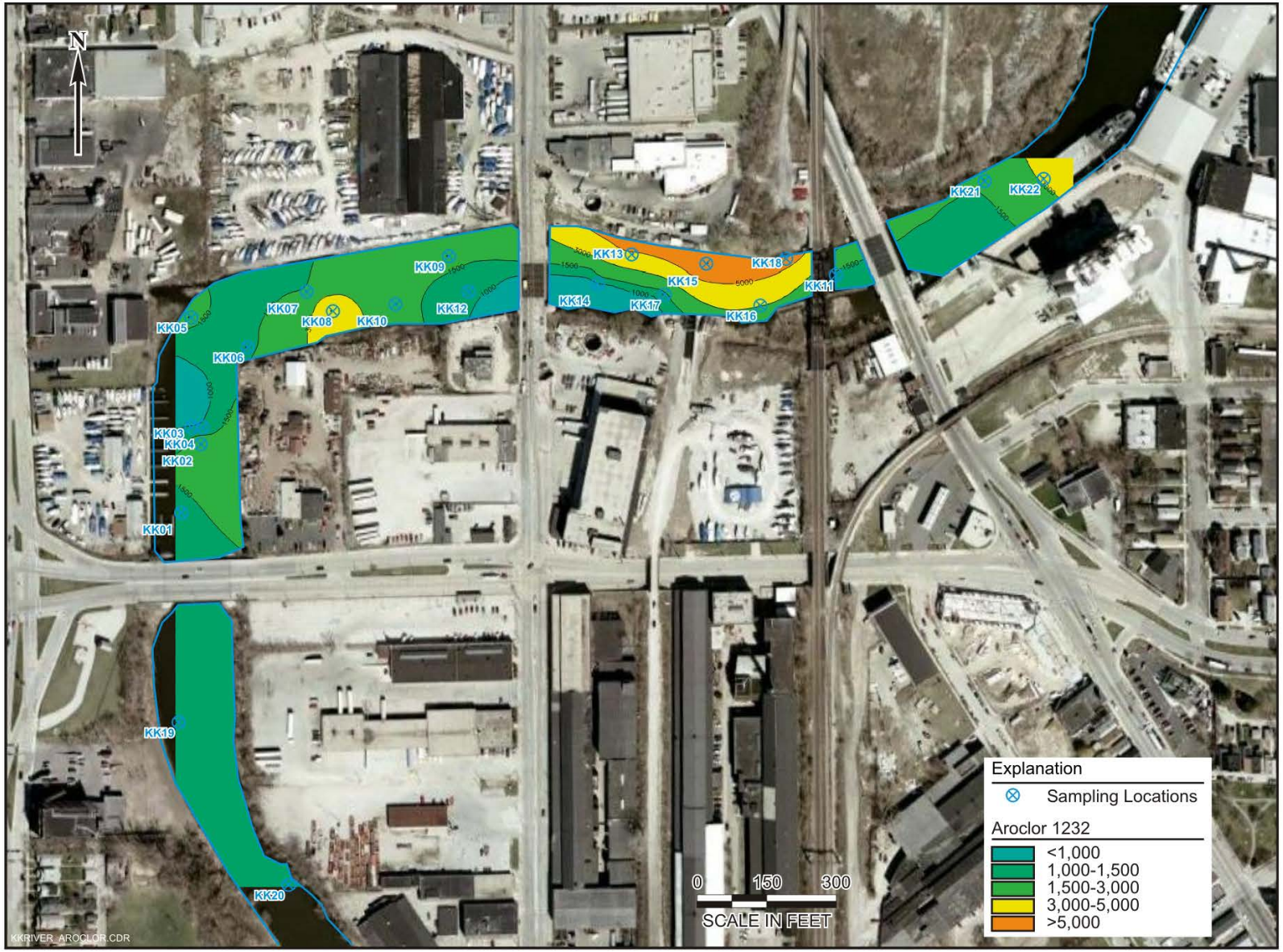

Figure 3-1. Baseline Assessment, Surficial Sediment PCB (Aroclor 1232) Concentrations (µg/kg-dry)

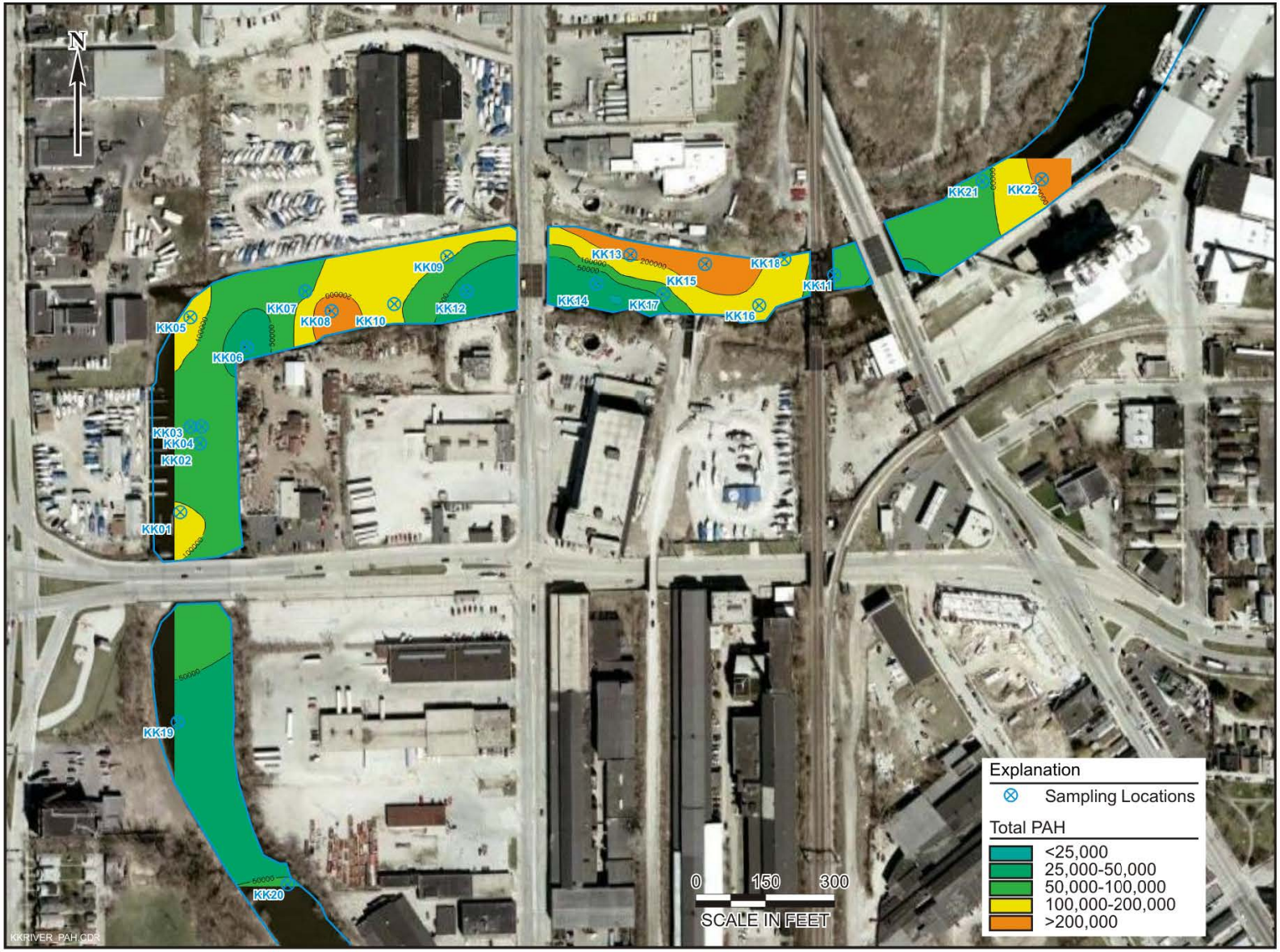

Figure 3-2. Baseline Assessment, Surficial Sediment Total PAH Concentrations (µg/kg-dry)

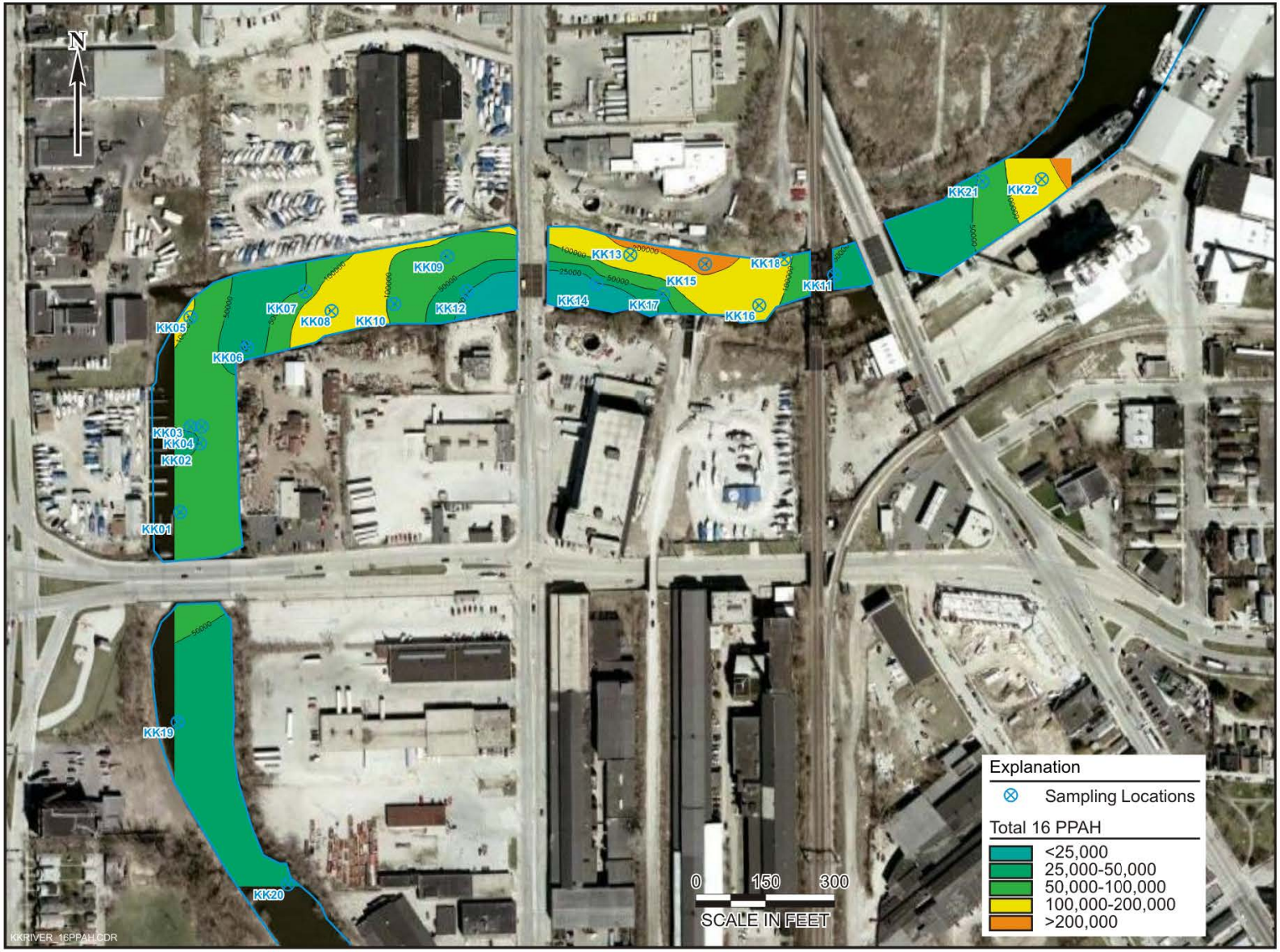

Figure 3-3. Baseline Assessment, Surficial Sediment Total PAH Concentrations (µg/kg-dry)

Table 3-2. Surficial Sediment: Physical Parameter Analyses

Sample ID	Station ID	Moisture Content		Physical Parameters of Sediment								
		ASTM Moisture Content (Ww/Wds) (%)	Moisture Content (Ww/Wws) (%)	TOC (%)	Bulk Density of Soils (wet) g/cm3	Bulk Density of Soils (dry) g/cm3	Particle Size Distribution (%)					
							Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay
HAD-001	KK01	31	23	4.31	1.9	1.46	1.7	2.7	13.9	55.6	18.7	7.6
HAD-002	KK02	26	21	0.43	1.91	1.51	2.6	3.1	39.1	54.8	0.2	0.3
HAD-003	KK03	22	18	0.69	2	1.64	2.2	1.6	51	43.3	0.4	1.6
HAD-103	KK03*	23	19	0.48	2	1.63	0	2.9	52.6	43.1	0.4	1.1
HAD-004	KK04	21	17	0.76	1.97	1.63	5.1	4.1	34.9	51.8	1.2	3
HAD-005	KK05	62	38	4.55	1.74	1.07	0	0.1	2.5	35.7	47.7	13.9
HAD-006	KK06	22	18	0.53	1.95	1.6	0	0	11.3	83.8	1.3	3.6
HAD-007	KK07	29	23	4.4	1.72	1.12	0	6.7	48.5	39.5	5.2	0.2
HAD-008	KK08	67	40	9.35	1.57	0.94	0	1	3.1	67.2	26.4	2.3
HAD-009	KK09	26	21	3.27	1.88	1.49	2	4.5	47.4	39.4	3.8	3
HAD-109	KK09*	108	52	6.55	1.41	0.68	3.4	1.2	4	5.7	30.7	55
HAD-010	KK10	53	35	5.51	1.68	1.09	0.5	0.2	3.6	60.2	22	13.5
HAD-011	KK11	62	38	1.39	1.73	1.07	0.6	0.8	10.5	55.5	24.6	8.1
HAD-012	KK12	28	22	0.64	2.03	1.58	0	0	2.3	90.6	2.3	4.7
HAD-013	KK13	59	37	5.07	1.62	1.02	1.4	1	6.3	31.4	36.3	23.6
HAD-014	KK14	21	17	0.6	1.89	1.56	0	0.1	7.6	89	1	2.4
HAD-015	KK15	95	49	8.57	1.53	0.78	0	0	0.2	8	59	32.8
HAD-016	KK16	93	48	6.95	1.46	0.75	0	0	0.2	12.3	54.3	33.2
HAD-017	KK17	36	26	1.18	1.84	1.35	0	0	1.8	83.4	8.9	5.9
HAD-018	KK18	88	47	7.78	1.54	0.82	0	1.1	0.8	15.3	58.9	24
HAD-118	KK18*	85	46	8.2	1.53	0.83	1.3	0.8	1.7	13	59.5	23.7
HAD-019	KK19	23	18	1.16	1.97	1.6	0	6.1	50.7	41	0.5	1.7
HAD-020	KK20	27	21	1.04	1.95	1.53	6	3.3	46.9	32.7	6.4	4.8

Table 3-2. Surficial Sediment: Physical Parameter Analyses (continued)

Sample ID	Station ID	Moisture Content		Physical Parameters of Sediment								
				TOC (%)	Bulk Density of Soils (wet) g/cm3	Bulk Density of Soils (dry) g/cm3	Particle Size Distribution (%)					
		ASTM Moisture Content (Ww/Wds) (%)	Moisture Content (Ww/Wws) (%)				Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay
HAD-021	KK21	87	47	8.5	1.41	0.75	10.4	4	9.9	6	44.2	25.6
HAD-022	KK22	74	42	5.62	1.51	0.87	0	1.1	3.3	37.7	38.7	19.3
RR-01	RR-01	30	23	1.02	2.14	1.65	25	31.4	32.5	4.5	2.6	4
RR-02	RR-02	29	22	0.93	1.97	1.53	0	0.4	14.6	78.6	3.1	3.3

* Indicates a duplicate sample was taken at the sample location
Ww: weight of water
Wds: weight of dried sample
Wws: weight of wet sample

Table 3-3 gives the results of the analyses of the surficial sediment for percent moisture, oil and grease, total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc) and AVS-SEM analysis. Arsenic was not detected at any of the stations. The details for these metals analyses can be found in Appendix D.

3.2 Additional Parameter Data for Surficial Sediment from Select Locations

Table 3-4 presents the additional parameters that were measured in sediments for the subset of six select locations (KK03, KK10, KK12, KK15, KK20, and RR-01). The QAPP identifies sample station KK22 for additional parameter analysis; however, the decision to replace KK22 with RR-1 was made in the field by the EPA GLNPO Technical Lead/Task Manager. PCB congener data and AVS- SEM sulfide data are summarized in the table. Eight samples were analyzed from the seven stations plus a duplicate at Station KK03. One exception: the sample from Station KK22 was not analyzed for sulfide. The summary includes total PCB concentrations calculated as the sum of the PCB congeners.

Table 3-3. Surficial Sediments: Metals Analyses

Sample ID	Station ID	Total Solids (%)	Oil&Grease Total HEM (mg/Kg-dry)	Total Metals (mg/Kg-dry)							
				Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
HAD-001	KK01	70.9	3,600	20.0 U	1.0 U	36.1	64.5	87.0	0.07	20.1	231
HAD-002	KK02	78.8	1,200	18.0 U	0.91 U	16.5	16.3	70.0	0.04	9.1	186
HAD-003	KK03	82.0	820	17.0 U	1.3	15.2	39.7	40.0	0.04	10.2	167
HAD-103	KK03*	82.2	920	17.0 U	0.87 U	16.3	28.1	50.0	0.05	9.0	167
HAD-004	KK04	78.5	1,200	18.0 U	1.0	20.0	204	101	0.05	11.0	218
HAD-005	KK05	60.0	8,500	24.0 U	1.4	71.5	115	271	0.48	38.6	421
HAD-006	KK06	75.8	850	17.0 U	1.2	21.9	24.9	135	0.05	11.9	153
HAD-007	KK07	78.9	1,300	16.0 U	1.6	21.4	39.0	150	0.04	9.4	176
HAD-008	KK08	51.4	13,000	24.0 U	2.4	55.0	48.4	230	0.1	21.9	335
HAD-009	KK09	74.3	1,900	15.0 U	1.8	438	26.1	71.0	0.05	14.0	211
HAD-109	KK09*	74.8	1,800	15.0 U	1.8	48.4	43.8	228	0.05	12.0	219
HAD-010	KK10	60.8	5,900	24.0 U	1.2	42.8	68.1	120	0.11	19.7	331
HAD-011	KK11	53.2	3,500	14.0 U	1.7	36.8	42.9	140	0.11	14.5	253
HAD-012	KK12	80.8	1,600	21.0 U	1.0 U	23.6	25.3	123	0.04	11.8	187
HAD-013	KK13	57.9	9,300	25.0 U	8.1	1,630	124	940	0.38	32.1	893
HAD-014	KK14	80.8	730	21.0 U	1.5	17.0	60.1	96	0.06	8.0	244
HAD-015	KK15	48.8	12,000	29.0 U	10.8	1,610	128	1,230	0.43	34.7	1,110
HAD-016	KK16	52.1	8,200	27.0 U	4.9	95.2	117	402	0.27	35.0	587
HAD-017	KK17	69.8	2,200	18.0 U	1.5	25.7	54.1	205	0.08	12.8	187
HAD-018	KK18	45.4	11,000	28.0 U	4.6	96.4	105	258	0.24	29.9	525
HAD-118	KK18*	54.7	9,600	23.0 U	5.5	94.3	89.6	292	0.3	25.1	488
HAD-019	KK19	81.2	970	18.0 U	0.87 U	14.5	16.5	41.0	0.03	9.7	152
HAD-020	KK20	73.7	1,800	17.0 U	1.7	19.4	24.3	59	0.07	11.0	200
HAD-021	KK21	46.4	6,900	31.0 U	1.5 U	73.2	105	152	0.14	24.1	415
HAD-022	KK22	58.9	5,900	24.0 U	1.5	57.9	94.4	181	0.13	23.0	381
RR-01	RR-01	49.3	6,300	29.0 U	9.2	251	173	256	0.7	28.8	570
RR-02	RR-02	80.8	190	16.0 U	0.8 U	16.0	813	112	0.03	11.8	59.3

U indicates a non-detected result; NA indicates not analyzed

Table 3-4. Surficial Sediment for Select Locations: Total PCB (as congeners) and SEM/AVS

Sample ID	Station ID	Total PCB (µg/Kg-dry)	Sulfide Metals and SEM/AVS Contaminant Concentrations (mg/Kg-dry)							
			Sulfide	AS (SEM/AVS)	Cd (SEM/AVS)	Cr (SEM/AVS)	Cu (SEM/AVS)	Pb (SEM/AVS)	Hg (SEM/AVS)	Ni (SEM/AVS)	Zn (SEM/AVS)
HAD-003	KK03	538.49	44.7	3.3	0.92	9.3	39.5	46.4	0.01 U	4.9	151
				(0.074)	(0.021)	(0.208)	(0.884)	(1.038)	(-)	(0.110)	(3.378)
HAD-103	KK03*	606.61	66.4	3.8	0.92	8.7	16.5	45.2	0.01 U	6.5	152
				(0.057)	(0.014)	(0.131)	(0.248)	(0.681)	(-)	(0.098)	(2.289)
HAD-010	KK10	713.09	402	12.1 U	1.83	29.4	58.5	164	0.01 U	13.1	331
				(-)	(0.005)	(0.073)	(0.146)	(0.408)	(-)	(0.033)	(0.823)
HAD-012	KK12	624.43	71	2.3	1.09	11.3	25.6	96	0.01 U	5.6	155
				(0.032)	(0.015)	(0.159)	(0.361)	(1.352)	(-)	(0.079)	(2.183)
HAD-015	KK15	1026.26	1250	29.3 U	9.71	1340	124	1210	0.02 U	31.4	1200
				(-)	(0.008)	(1.072)	(0.099)	(0.968)	(-)	(0.025)	(0.960)
HAD-020	KK20	848.25	205	3.8	1.4	11.5	20.5	64	0.01 U	6.1	184
				(0.019)	(0.007)	(0.056)	(0.100)	(0.312)	(-)	(0.030)	(0.898)
RR-01	RR-01	361.05	1210	27.7 U	7.1	157	146	239	0.02 U	26.9	519
				(-)	(0.006)	(0.130)	(0.121)	(0.198)	(-)	(0.022)	(0.429)

***** Indicates a duplicate sample was collected at the sample location
NA = Not Analyzed
U = The compound was analyzed for but not detected at or above the MRL/MDL
- = SEM/AVS was not calculated because the metal value is noted with a U qualifier

Table 3-5 shows the results of the analysis of the overlying water and porewater samples collected for Stations KK03, KK10, KK12, KK15, KK20, and RR-01. Overlying water collected in the lab and two equipment blank samples were analyzed for PAH. Porewater was analyzed for PAHs, ammonia, and pH. Samples HAD-003, HAD-012 and HAD-020 did not yield sufficient porewater for PAH analysis; therefore, PAH data are not reported for these samples.

3.3 Toxicity and PCB Bioaccumulation Results

Toxicity and PCB bioaccumulation tests were conducted for sediment collected from the subset of six stations. The tests included a 20-day survival and growth test with Midge Larvae *Chironomus tentans (dilutus*, a 28-day survival and growth test with the Amphipod *Hyalella Aztec*, and a 28-day bioaccumulation exposure with the Oligochaete *Lumbriculus variegate.* The results for those tests are presented in the following sections.

3.3.1 Whole Sediment Toxicity Tests: 20-Day Test with *Chironomus tentans (dilutus*). The toxicity results for the 20-day survival and growth test with Midge Larvae *C. tentans* are given in Tables 3-6 and 3-7. The laboratory control sediment organisms met the survival (≥70 percent) and growth (≥0.48 mg) acceptance criteria. There was a statistically significant ($p \leq 0.05$) reduction in survival for four investigative samples (Stations KK10, KK15, KK20 and RR01) after 20 days of exposure, compared to the laboratory sediment control sediment sample. In addition, *C. tenans* growth (mg average dry weight) was significantly reduced in two investigative samples (Station KK10 and Station KK20), compared to the laboratory sediment control samples. Station KK15 had 100 percent.

Table 3-5. Surficial Sediment for Select Locations: Overlying Water and Porewater Analyses

Sample ID	Station ID	Matrix	Contaminant Concentrations (ng/L)			
			Total PAH	Total 16 PPAH	Ammonia Concentration mg/L as N	p.H. (s.u.)
HAD-003[(a)]	KK03	Overlaying Water	1759.32	1267.37		
		Porewater			6.85	7.37
HAD-010	KK10	Overlaying Water	3930.49	2920.99		
		Porewater	11965.39	8435.84	35	7.12
Duplicate HAD-010	KK10	Overlaying Water				
		Porewater			30.9	7.19
HAD-012[(a)]	KK12	Overlaying Water	2368.49	1425.07		
		Porewater			21.7	7.17
HAD-015	KK15	Overlaying Water	21849.94	17183.83		
		Porewater	232896.24	158402.06	33.7	7.21
HAD-020[(a)]	KK20	Overlaying Water	4314.49	2855.39		
		Porewater			29.5	7.28
RR-01	RR-01	Overlaying Water	15446.87	2813.19		
		Porewater	31466.25	5594.46	20.3	7.34
PGS-EB1	Equipment Blank	Aqueous	141.78	54.88		
PGS-02	Equipment Blank	Aqueous	121.58	61.27		

(a) HAD-003, HAD-012 and HAD-020 did not yield sufficient porewater for PAH analysis.

Table 3-6. Whole Sediment Toxicity Tests: 20-Day Test with *Chironomus tentans (dilutus)* Average Ash-Free Weight and Percent Survival

Replicate #	Laboratory Control	Station KK03	Station KK10	Station KK12	Station KK15	Station KK20	Station RR-01
		ID# HAD-003	ID# HAD-010	ID# HAD-012	ID# HAD-015	ID# HAD-020	ID# RR-01
1	1.705	1.375	1.100	1.009	0	1.178	1.585
2	1.526	1.048	1.010	1.001	0	0.660	1.093
3	1.553	1.162	0.665	1.035	0	1.020	0.960
4	1.029	0.742	1.080	1.318	0	0.370	1.740
5	1.169	1.050	0.379	0.793	0	0.585	0.897
6	1.293	0.852	0.608	0.970	0	1.597	0.822
7	1.008	1.492	0.313	1.238	0	0.665	0.886
8	1.149	1.095	0.870	1.017	0	0.715	1.142
Average Ash-Free Dry Weight (mg)	**1.304**	**1.102**	**0.753[a]**	**1.048**	**N/A**	**0.849 [a]**	**1.141**
20-Day % Survival	**78.1**	**91.7**	**45.8 [a]**	**86.5**	**0.0 [a]**	**17.7 [a]**	**38.5 [a]**

[a] Significantly different ($p \leq 0.05$) from laboratory control sediment
Note: Average weight of *Chironomus dilutus* at day 10: 0.271 mg
N/A: Not analyzed due to 100 percent mortality

Table 3-7. Whole Sediment Toxicity Tests: 20-Day Test with *Chironomus tentans (dilutus)* Comparison of Number of Organisms Surviving in Each Replicate and Percent Survival

Replicate #	Laboratory Control	Station KK03	Station KK10	Station KK12	Station KK15	Station KK20	Station RR-01
		ID# HAD-003	ID# HAD-010	ID# HAD-012	ID# HAD-015	ID# HAD-020	ID# RR-01
1	8	10	8	12	0	4	4
2	8	11	6	12	0	2	3
3	8	11	4	10	0	1	4
4	12	12	4	8	0	1	4
5	8	11	7	10	0	2	6
6	10	12	6	11	0	3	6
7	12	11	7	8	0	2	5
8	9	10	2	12	0	2	5
20-Day Percent Survival	**78.1**	**91.7**	**45.8** [a]	**86.5**	**0.0** [a]	**17.7** [a]	**38.5** [a]

[a] Significantly different ($p \leq 0.05$) from laboratory control
Note: Replicates initiated with 12 organisms

3.3.2 Whole Sediment Toxicity Tests: 28-Day test with *Hyalella azteca*. The toxicity results for the 28-day survival and growth test with the Amphipod *H. azteca* are shown in Tables 3-8 and 3-9. The laboratory control sediment organisms met the survival (≥80 percent) and growth (≥0.15 mg) acceptance criteria. There was a statistically significant ($p \leq 0.05$) reduction in survival for two investigative samples (Stations KK15 and KK20) after 28 days of exposure, compared to the laboratory sediment control sample. In addition, *H. azteca* growth (mg average dry weight) was significantly reduced in four investigative samples (Stations KK03, KK12, KK15, and RR-01) after 28 days of exposure, compared to the laboratory sediment control sample.

Table 3-8. Whole Sediment Toxicity Test: 28-Day Test with *Hyalella azteca* Average Dry Weight (mg) and Percent Survival

Replicate #	Laboratory Control	Station KK03	Station KK10	Station KK12	Station KK15	Station KK20	Station RR-01
		ID# HAD-003	ID# HAD-010	ID# HAD-012	ID# HAD-015	ID# HAD-020	ID# RR-01
1	0.205	0.196	0.228	0.172	0.218	0.287	0.213
2	0.294	0.195	0.243	0.163	0.183	0.653	0.195
3	0.333	0.150	0.272	0.297	0.213	0.310	0.126
4	0.295	0.152	0.207	0.156	0.165	0.286	0.149
5	0.269	0.193	0.193	0.181	0.212	0.400	0.171
6	0.311	0.162	0.264	0.194	0.235	0.428	0.123
7	0.267	0.198	0.272	0.186	0.213	0.239	0.132
8	0.234	0.163	0.185	0.223	0.282	0.372	0.153
Average Dry Weight (mg)	**0.276**	**0.176** [a]	**0.233**	**0.197** [a]	**0.215** [a]	**0.372**	**0.158** [a]
28-Day % Survival	**95.0**	**90.0**	**82.5**	**96.3**	**51.3** [a]	**65.0** [a]	**92.5**

[a] Significantly different ($p \leq 0.05$) from laboratory control sediment
Note: Average weight of *Hyalella azteca* at day 0: 0.013 mg

Table 3-9. Whole Sediment Toxicity Test: 28-Day Test with *Hyalella azteca* Comparison of Number of Organisms Surviving in Each Replicate and Percent Survival

Replicate #	Laboratory Control	Station KK03 ID# HAD-003	Station KK10 ID# HAD-010	Station KK12 ID# HAD-012	Station KK15 ID# HAD-015	Station KK20 ID# HAD-020	Station RR-01 ID# RR-01
1	10	7	9	9	6	6	8
2	9	8	6	10	4	7	10
3	9	10	10	10	3	7	10
4	10	10	7	10	6	7	8
5	8	9	10	10	6	7	8
6	10	9	7	10	4	6	10
7	10	10	9	10	6	7	10
8	10	9	8	8	6	5	10
28-Day % Survival	**95.0**	**90.0**	**82.5**	**96.3**	**51.3 [a]**	**65.0 [a]**	**92.5**

[a] Significantly different ($p \leq 0.05$) from laboratory control sediment
Note: Replicates initiated with 10 organisms

3.3.3 Whole Sediment Bioaccumulation Toxicity Tests. Prior to initiating the 28-day bioaccumulation test, a four-day screening test (shown in Table 3-10) was conducted on the Oligochaete *L. variegate.* The percent survival was 100%in the control and ranged from 92.5 to 100% for samples from Stations KK03, KK10, and KK12. For Stations KK15, KK20, and RR-01, however, the percent survival was less than 75%. Due to the significant difference between the laboratory control, it was determined that the 28-day bioaccumulation test should not be performed for sediments from those three stations. The 28-day bioaccumulation test was performed on Stations KK03, KK10, and KK12 and the results are shown in Table 3-11 and 3-12.

Adult *L. variegatus* were continuously exposed for 28 days to three of the investigative sediment samples and to a laboratory control sediment sample. After 28 days of exposure, the surviving *L. variegatus* were depurated for 24 h in overlying water to purge all gut contents. After the depuration period, the surviving *L. variegatus* were weighed, recorded, and analyzed for PCBs. A minimum of 20 g of organism per replicate was recovered from the laboratory control sediment and all of the investigative sediment samples. A summary of the wet depurated weight for each investigative sediment sample is presented in Table 3-11.

Table 3-10. Whole Sediment Bioaccumulation Toxicity Tests: 4-Day Test with *Lumbriculus variegatus* Comparison of Number of Organisms Surviving in Each Replicate and Percent Survival

Replicate #	Laboratory Control	HAD-003	HAD-010	HAD-012	HAD-015	HAD-020	RR-01
1	10	10	10	10	7	7	7
2	10	10	7	8	6	7	7
3	10	10	10	10	8	5	8
4	10	10	10	9	5	5	7
4-Day Screening Test, % Survival	**100.0**	**100.0**	**92.5**	**92.5**	**65.0** [a]	**60.0** [a]	**72.5** [a]

[a] Significantly different ($p \leq 0.05$) from laboratory control sediment

Table 3-11. Whole Sediment Toxicity Tests: 28-Day Test with *Lumbriculus variegates* Average Wet Depurated Weight

Relicate #	Laboratory Control	Station KK03 ID# HAD-003	Station KK10 ID# HAD-010	Station KK12 ID# HAD-012
1	14.99	27.38	22.35	32.83
2	26.00	29.75	24.90	26.51
3	17.45	29.11	15.03	33.43
4	21.69	29.38	23.57	33.08
5	22.26	28.90	18.60	28.90
Average Wet Depurated Weight (g)	**20.5**	**28.9**	**20.9**	**31.0**

[a] Significantly different ($p \leq 0.05$) from laboratory control sediment and 28-day bioaccumulation test was not analyzed.
Note: Initiated 28-day test with 35 grams of *L. variegatus* per replicate.

Bioaccumulation test tissue samples of the *Lumbriculus* for three sample locations (KK03, KK10, and KK12) were analyzed for PCB congeners, percent moisture, and percent lipids. The five replicate exposures for each station were analyzed separately. A summary of the PCB results as levels of chlorination is provided in Table 3-12.

Table 3-12. Summary of PCB Accumulated in *Lumbriculus variegatus* after 28-Day Exposure (as Level of Chlorination [LOC] and Total PCBs)

Control										
Client ID	Con-Lumb-Rep 1		Con-Lumb-Rep 2		Con-Lumb-Rep 3		Con-Lumb-Rep 4		Con-Lumb-Rep 5	
Battelle ID	Q5230-P		Q5231-P		Q5232-P		Q5233-P		Q5234-P	
% Moisture	88.29		87.22		85.27		87.5		86.33	
% Lipid	2.31		3.13		2.08		2.04		1.89	
Sample Size (g/wet)	11.10		3.34		13.20		17.32		17.30	
Level of Chlorination					µg/kg, wet					
1	0.06	U	0.21	U	0.05	U	0.03	U	0.03	U
2	0.3	U	1	U	0.26	U	0.19	U	0.19	U
3	0.68	U	2.22	U	0.58	U	0.42	U	0.42	U
4	1.05	U	3.48	U	0.9	U	0.66	U	0.66	U
5	0.78	U	2.68	U	0.69	U	0.5	U	0.5	U
6	0.73	U	2.42	U	0.61	U	0.44	U	0.44	U
7	0.49	U	1.7	U	0.45	U	0.31	U	0.31	U
8	0.39	U	1.28	U	0.33	U	0.23	U	0.23	U
9	0.09	U	0.34	U	0.09	U	0.06	U	0.06	U
10	0.02	U	0.08	U	0.02	U	0.01	U	0.01	U
Total	4.59	U	15.41	U	3.98	U	2.85	U	2.85	U
Station KK03 ID# HAD-003										
Client ID	7422-Lumb-Rep 1		7422-Lumb-Rep 2		7422-Lumb-Rep 3		7422-Lumb-Rep 4		7422-Lumb-Rep 5	
Battelle ID	Q5236-P		Q5237-P		Q5238-P		Q5239-P		Q5240-P	
% Moisture	84.21		82.14		87.5		87.79		84.62	
% Lipid	1.92		1.97		1.79		1.98		1.73	
Sample Size	19.03		19.27		19.12		19.68		19.12	
Level of Chlorination					µg/kg, wet					
1	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U
2	32.34		38.73		35.63		31.23		40.34	
3	282.95		313.74		287.68		272.82		353.38	
4	434.24		444.29		413.7		399.56		479.11	
5	176.63		181.63		158.9		161.07		172.51	
6	57.53		68.04		53.47		58.5		58.91	
7	19.77		25.48		18.84		19.03		19.68	
8	4.14		5.41		3.67		4.11		3.79	
9	0.34	J	0.36	J	0.34	J	0.13	J	0.22	J
10	0.24	J	0.19	J	0.2	J	0.01	U	0.2	J
Total	1008.18		1077.87		972.43		946.45		1128.14	

Table 3-12. Summary of PCB Accumulated in *Lumbriculus variegatus* after 28-Day Exposure (as Level of Chlorination [LOC] and Total PCBs) (continued)

Station KK10 ID# HAD-010										
Client ID	7423-Lumb-Rep 1		7423-Lumb-Rep 2		7423-Lumb-Rep 3		7423-Lumb-Rep 4		7423-Lumb-Rep 5	
Battelle ID	Q5241-P		Q5242-P		Q5243-P		Q5244-P		Q5245-P	
% Moisture	87.82		87.68		89.74		89.57		88.6	
% Lipid	1.61		2.37		1.12		1.29		1.88	
Sample Size	17.88		11.26		20.33		20.09		14.73	
Level of Chlorination					µg/kg, wet					
1	0.03	U	0.06	U	0.03	U	0.03	U	0.05	U
2	46.1		31.71		35.75		44.29		34.06	
3	267.32		315.45		284.23		385.27		311.28	
4	352.15		454.15		416.25		567.91		470.78	
5	152.54		183.16		162.81		206.21		204.03	
6	63.21		76.8		72.03		93.94		85.98	
7	25.81		27.22		28.33		40.66		36.75	
8	5.33		5.01		5.86		7.78		8.02	
9	0.37	J	0.46	J	0.42	J	0.5	J	0.61	J
10	0.01	U	0.02	U	0.01	U	0.19	J	0.4	
Total	912.83		1093.96		1005.68		1346.75		1151.91	
Station KK12 ID# HAD-012										
Client ID	7424-Lumb-Rep 1		7424-Lumb-Rep 2		7424-Lumb-Rep 3		7424-Lumb-Rep 4		7424-Lumb-Rep 5	
Battelle ID	Q5246-P		Q5247-P		Q5248-P		Q5249-P		Q5250-P	
% Moisture	86.34		86.99		83.72		85.45		88	
% Lipid	2.49		2.28		2.47		2.46		2.61	
Sample Size	19.22		19.05		14.33		19.11		19.61	
Level of Chlorination					µg/kg, wet					
1	0.03	U	0.03	U	0.05	U	0.03	U	0.03	U
2	60.09		57.61		60.85		66.31		59.64	
3	464.93		445.93		475.43		477.42		451.79	
4	564.78		605.86		614.13		694.86		584.35	
5	200.09		218.19		222.76		231.61		296.08	
6	70.26		79.14		78.06		78.9		129.28	
7	26.79		29.88		27.34		31.47		34.21	
8	6.05		5.83		5.79		6.12		6.24	
9	0.58	J	0.42	J	0.47	J	0.31	J	0.43	J
10	0.31		0.28		0.02	U	0.23	J	0.21	J
Total	1393.88		1443.14		1484.83		1587.23		1562.23	

J = Analyte detected below the sample-specific Reporting Limit (RL).
U = Analyte not detected at 3:1 signal:noise ratio. The sample-specific method detection limit is reported.
Note: Total PCBs were calculated as the sum of the individual homologues. Homologues reported with "U" data qualifiers were not included in the total.

4.0 REFERENCES

Battelle. 2008. *Quality Assurance Project Plan (QAPP) for Monitoring to Assess The Effectiveness of Activities Performed Under The Great Lakes Legacy Act - Kinnickinnic River Sampling.* Submitted to U.S. EPA under Contract Number EP-W-04-021, August.

APPENDIX A:

DAILY OPERATIONS LOGS, SEDIMENT COLLECTION LOGS, COCs

APPENDIX B:

BATTELLE SEDIMENT CHARACTERIZATION ANALYSES (PCBs, PAHs, AND BIOACCUMULATION, AND QA/QC NARRATIVE

APPENDIX C:

GREAT LAKES ENVIRONMENTAL CENTER (GLEC; BATTELLE SUBCONTRACTOR)
WHOLE SEDIMENT TOXICITY DATA REPORT

APPENDIX D:

COLUMBIA ANALYTICAL SERVICES (BATTELLE SUBCONTRACTOR) AVS-SEM

APPENDIX E:

APPLIED MARINE SCIENCES (BATTELLE SUBCONTRACTOR) TOC, PSD, WET AND DRY BULK DENSITY