

Attachment 8. Preliminary Soils Investigation

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Preliminary Soils Investigation: Vibratory Coring

Athena Technologies, Inc. was procured by CH2M HILL to collect vibracore samples, which was conducted and completed on July 23, 2008. Vibracoring, a technology for collecting core samples of underwater sediments, was conducted along two cross sections across the Tennessee River near the proposed siphon route to obtain sediment samples for contaminant analysis and to obtain data to generate a soils profile.

Each cross section consists of six core locations evenly distributed across the river, as illustrated in Figure 2-3. Tables 2-1 and 2-2 summarize the measurements of the vibracore samples from each cross section. A profile was generated using the data from cross section A-A', which illustrates the composition of the riverbed. This profile is depicted in Figure 2-4 in Section 8.4 of this permit.

As reported in the tables on the following page, five core samples (1, 2, 3, 11, and 12) penetrated the riverbed and recovered sediment prior to encountering refusal at the depths shown. The remaining seven core locations encountered refusal at the riverbed interface. A composite sample was prepared by CH2M HILL in the field from the recovered sediment and analyzed for contaminants by Microbac Laboratories, Inc. The contaminants of concern and laboratory results are discussed in Section 2.3.

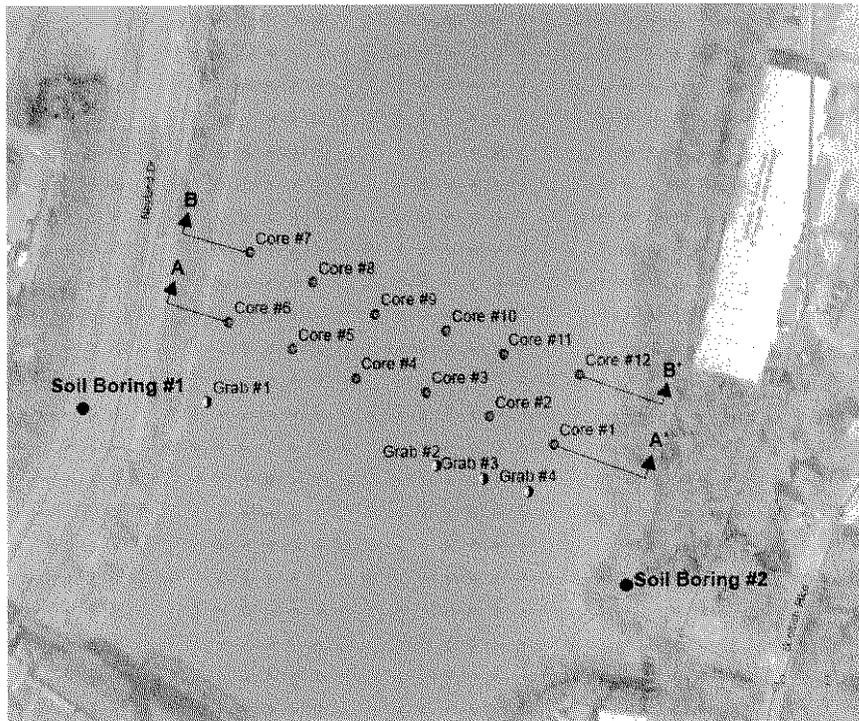


FIGURE 2-3 VIBRACORE AND GRAB SAMPLING LOCATIONS: CROSS SECTIONS A-A' AND B-B'

Vibracore sampling locations are labeled Core #1 through #12. Ponar grab sampling locations are labeled Grab #1 through #4. The sewer (in green) represents the existing alignment.

TABLE 2-1
 Vibracore Results for Cross Section A – A'
 Tennessee River, Knoxville TN

Vibracore ID	Water Depth (ft)	Riverbed Elevation (ft)	Core Sample Penetration (ft)	Native Rock Elevation (ft)
Core 1	5.2	807.4	15.0	792.4
Core 2	18.1	794.5	10.0	784.5
Core 3	24.7	787.9	2.1	785.8
Core 4	26.0	786.6	0.0	786.6
Core 5	28.5	784.1	0.0	784.1
Core 6	23.9	788.7	0.0	788.7

Note: 1) The instantaneous water elevation was measured at 812.6 ft
 2) Refusal is defined as three minutes of vibration with less than six inches of penetration of the vibratory barrel.

TABLE 2-2
 Vibracore Results for Cross Section B – B'
 Tennessee River, Knoxville TN

Vibracore ID	Water Depth (ft)	Riverbed Elevation (ft)	Core Sample Penetration (ft)	Native Rock Elevation (ft)
Core 7	23.3	789.3	0.0	789.3
Core 8	25.9	786.7	0.0	786.7
Core 9	26.1	786.5	0.0	786.5
Core 10	25.8	786.8	0.0	786.8
Core 11	17.7	794.9	10.5	784.4
Core 12	4.2	808.4	14.7	793.7

Note: 1) The instantaneous water elevation was measured at 812.6 ft
 2) Refusal is defined as three minutes of vibration with less than six inches of penetration of the vibratory barrel.

The tables above document the data obtained for each vibracore attempted in the field. At each core location, the water depth was measured to determine the elevation of the riverbed. The penetration depth, which is the distance the core was pushed into the soil profile before encountering refusal, is also recorded. A zero penetration depth is an indication that a native rock material, likely limestone, was encountered at the riverbed surface.

Preliminary Soils Investigation: Sediment Analysis

Chemical Analysis

A chemical analysis was conducted on a composite sample of sediments that were collected using the vibracoring technique during the initial phases of KUB alternative study. The purpose of the analysis was to screen for potential chemical contaminants, which may be a concern if an open cut method is used during construction. The screened contaminants are listed below:

- Volatile Organic Carbons (VOCs)
- Semivolatile Organic Carbons (SVOCs)
- Polynuclear Aromatic Hydrocarbons (PAHs)
- Polychlorinated Biphenyls (PCBs)
- Pesticides
- Resource Conservation Recovery Act (RCRA) Metals
- Total Organic Carbon (TOC)

The U.S. Environmental Protection Agency (EPA) has not established national criteria or standards for chemical concentrations in sediment. Therefore, sediment quality guidelines (SQG) have been developed by the National Oceanic Atmospheric Administration (NOAA) to support protection and management strategies for freshwater and marine ecosystems.

NOAA publishes multiple SQGs of which two, the threshold effects level (TEL) and probable effects level (PEL), are commonly used as chemical screening tools. The TEL represents the lowest concentration at which an adverse effect was observed. Screening chemical contaminants using the TEL guideline ensures with a high degree of confidence that the source poses no potential threat. The PEL represents the concentration at which an adverse effect is anticipated. Using the PEL as a guideline identifies compounds that are more probably elevated to toxic levels. Not all chemicals have TELs or PELs. Typically, those chemicals without an established TEL or PEL have not represented chemicals of concern in the aquatic environment.

The results for each contaminant of concern are summarized in Table 1 below. The VOCs, SVOCs, PAHs, and pesticides all resulted in non-detectable amounts. The PCBs and RCRA metals with the exception of cadmium measured below the TEL. Although the cadmium concentration (1.24 mg/kg) of the composite sample was not below the more stringent TEL guideline (0.596 mg/kg), the concentration was substantially below the PEL (3.53 mg/kg). At this level, the cadmium concentration is not anticipated to have an adverse effect.

The TOC is present in all aquatic environments. An understanding of TOC concentration is important since harmful chemicals can bind to TOC. An assessment of TOC is used to evaluate the bioavailability of organic and inorganic compounds. The normal background TOC concentrations range from 1 percent to 2 percent. The TOC level was observed at 14,800 mg/kg, which is 1.5 percent. Therefore, TOC is not considered an issue based on the results of this analysis.

TABLE 1
Sediment Analysis Results – Vibracoring
Tennessee River, Knoxville TN

Contaminant	Result ¹ (mg/kg)	TEL ² (mg/kg)	PEL ² (mg/kg)	Comments
VOCs	non-detect	-	-	Not established by NOAA
SVOCs	non-detect	-	-	Not established by NOAA
PAH	non-detect	-	-	Not established by NOAA
PCB	non-detect	0.034	0.277	below TEL and PEL
Pesticide	non-detect	-	-	Not established by NOAA
8 RCRA Metals				
Arsenic	2.21	5.9	17.0	below TEL and PEL
Barium	52.8	-	-	Not established by NOAA
Cadmium	1.24	0.596	3.53	above TEL; below PEL
Chromium	9.37	37.3	90.0	below TEL and PEL
Lead	26.2	35.0	91.3	below TEL and PEL
Selenium	<0.29	-	-	Not established by NOAA
Silver	<2.92	-	-	Not established by NOAA
Mercury	0.050	0.174	0.486	below TEL and PEL
TOC	14,800	-	-	Not established by NOAA

1. A non-detect result is defined as a constituent being measured below its detection limit.

2. Threshold Effects Level (TEL) and Probable Effects Level (PEL) were obtained from the National Oceanic and Atmospheric Administration (NOAA).

Grain Size Analysis

A grain size analysis of the composite sediment sample was conducted to evaluate the potential for sediment re-suspension during construction activities. The results of the particle size analysis indicate that the sand fraction contributed 86 percent of the sediment composition. This included 42 percent medium sand, 19 percent fine sand, and 25 percent very fine sand. Silt contributed 12 percent and clay 2 percent to the sediment grain size composition.

This grain size distribution suggests that re-suspension of sediment during dredging operations would generate a minimal plume of silt and clay that would be dispersed downstream. The sand fraction (86 percent) is less concerning due to its more rapid settling characteristics and the fact that sand does not represent the same habitat blanketing or smothering effects as do silts and clays. Sands also tend to contain lower concentrations of potential harmful chemicals.

Second Sampling Event

The purpose of the second sampling event is to provide a thorough investigation of contaminants. Sediment grab samples were attempted at 4 locations across the river profile using a Standard Ponar Grab sampler. As illustrated in Figure 2.3 in the Preliminary Soils Investigation section, one grab sample (Grab #4) was attempted near the location of core 6;

however, no sediment was recovered at this location. Three grab samples (Grab #2, 3, and 4) were collected near the locations of sediment cores 1, 2, and 3. Sediment was recovered and analyzed for the following constituents:

- Volatile Organic Carbons (VOCs)
- Semivolatile Organic Carbons (SVOCs)
- Polynuclear Aromatic Hydrocarbons (PAHs)
- Polychlorinated Biphenyls (PCBs)
- Pesticides
- Resource Conservation Recovery Act (RCRA) Metals
- Zinc
- Total Organic Carbon (TOC)

On the following pages, Table 2 provides grab sampling laboratory analysis results.

TABLE 2
Sediment Analysis Results – Grab Sampling
Tennessee River, Knoxville TN

Station	Contaminant	Result ¹ (mg/kg)	TEL ² (mg/kg)	PEL ² (mg/kg)	Comments	
Grab #2	VOCs	0.0227 (acetone); non-detect (all others)	-	-	Not established by NOAA	
	SVOCs	non-detect	-	-	Not established by NOAA	
	PAH	non-detect	-	-	Not established by NOAA	
	PCB	non-detect	0.034	0.277	below TEL and PEL	
	Pesticide	non-detect	-	-	Not established by NOAA	
	8 RCRA Metals					
	Arsenic	3.98	5.9	17	below TEL and PEL	
	Barium	42.6	-	-	Not established by NOAA	
	Cadmium	1.1	0.596	3.53	above TEL; below PEL	
	Chromium	7.61	37.3	90	below TEL and PEL	
	Lead	10.5	35	91.3	below TEL and PEL	
	Selenium	<0.338	-	-	Not established by NOAA	
	Silver	<3.39	-	-	Not established by NOAA	
	Mercury	0.029	0.174	0.486	below TEL and PEL	
Zinc	155	123.1	315	above TEL; below PEL		
TOC	31,100	-	-	Not established by NOAA		
Grab #3	VOCs	non-detect	-	-	Not established by NOAA	
	SVOCs	non-detect	-	-	Not established by NOAA	
	PAH	non-detect	-	-	Not established by NOAA	
	PCB	non-detect	0.034	0.277	below TEL and PEL	
	Pesticide	non-detect	-	-	Not established by NOAA	
	8 RCRA Metals					
	Arsenic	3.84	5.9	17	below TEL and PEL	
	Barium	43.4	-	-	Not established by NOAA	
	Cadmium	1.06	0.596	3.53	above TEL; below PEL	
	Chromium	8.94	37.3	90	below TEL and PEL	
	Lead	9.6	35	91.3	below TEL and PEL	
	Selenium	<0.495	-	-	Not established by NOAA	
	Silver	<4.95	-	-	Not established by NOAA	
	Mercury	0.007	0.174	0.486	below TEL and PEL	
Zinc	136	123.1	315	above TEL; below PEL		
TOC	15,400	-	-	Not established by NOAA		

TABLE 2
Sediment Analysis Results – Grab Sampling
Tennessee River, Knoxville TN

Station	Contaminant	Result ¹ (mg/kg)	TEL ² (mg/kg)	PEL ² (mg/kg)	Comments	
Grab #4	VOCs	non-detect	-	-	Not established by NOAA	
	SVOCs	non-detect	-	-	Not established by NOAA	
	PAH	non-detect	-	-	Not established by NOAA	
	PCB	non-detect	0.034	0.277	below TEL and PEL	
	Pesticide	non-detect	-	-	Not established by NOAA	
	8 RCRA Metals					
	Arsenic	4.02	5.9	17	below TEL and PEL	
	Barium	47.7	-	-	Not established by NOAA	
	Cadmium	0.912	0.596	3.53	above TEL; below PEL	
	Chromium	7.41	37.3	90	below TEL and PEL	
	Lead	10.9	35	91.3	below TEL and PEL	
	Selenium	<0.376	-	-	Not established by NOAA	
	Silver	<3.77	-	-	Not established by NOAA	
	Mercury	0.012	0.174	0.486	below TEL and PEL	
Zinc	130	123.1	315	above TEL; below PEL		
TOC	27,800	-	-	Not established by NOAA		

1. A non-detect result is defined as a constituent being measured below its detection limit.
2. Threshold Effects Level (TEL) and Probable Effects Level (PEL) were obtained from the National Oceanic and Atmospheric Administration (NOAA).

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