SEDIMENT AND SOIL SAMPLING STUDY REPORT

US EPA RECORDS CENTER REGION 5
501146

NBIA OU1 PRP Group

# North Bronson Industrial Area
# Operable Unit 1
# Bronson, Michigan

August 2010

O'BRIEN & GERE
www.obg.com

12716 | 48145

# REPORT
# SEDIMENT AND SOIL SAMPLING STUDY

**North Bronson Industrial Area**
**Operable Unit 1**

**Bronson, Michigan**

Prepared for:

NBIA OU1 PRP Group

SCOTT L. CORMIER, PE, VICE PRESIDENT
O'Brien & Gere Engineers, Inc.

# TABLE OF CONTENTS

List of Tables ..... ii
List of Figures ..... iii
List of Appendices ..... iii
List of Abbreviations and Acronyms ..... iv
1. Introduction ..... 1
1.1 Background ..... 1
1.2 Purpose and Objectives ..... 1
2. Affected Environmental Media ..... 3
3. Field Sampling and Analysis ..... 4
3.1 Sampling ..... 4
3.1.1 CD #30 Sediment ..... 4
3.1.2 CD #30 Bank Soils ..... 5
3.1.3 Soils Along North Side of CD #30 ..... 5
3.2 Sample Documentation ..... 5
3.3 Laboratory Analysis ..... 5
3.4 Data Validation and Management ..... 5
3.5 Quality Assurance/Quality Control ..... 6
3.6 Decontamination Procedures ..... 6
3.7 Handling of Investigation-Derived Wastes ..... 6
3.8 Surveying ..... 6
4. Refinement of Cleanup Goals ..... 7
4.1 Site-Specific Background Metals Concentrations ..... 7
4.1.1 Sediment ..... 7
4.1.2 Soil ..... 7
4.2 MDNRE Health-Based Direct-Contact Values ..... 8
4.3 Ecological Risks ..... 8
4.4 Site-Specific Soil-to-Groundwater Cleanup Standards ..... 8
4.4.1 GSI Criteria ..... 8
4.4.2 Boundary Criteria ..... 9
4.5 Site-Specific Cleanup Goals ..... 10
5. Evaluation of Impacted Media ..... 12
5.1 Comparisons to Cleanup Goals ..... 12
5.1.1 Sediments ..... 12
5.1.2 Erodible Soils ..... 12
5.1.3 Non-Erodible Soils ..... 12
5.2 Quantities ..... 13
6. References ..... 14

## LIST OF TABLES


1) Sediment Sampling Data Summary – Total Metals
2) Sediment Sampling Data Summary – PAHs
3) Erodible Soil Sampling Data Summary – Total Metals
4) Erodible Soil Sampling Data Summary – PAHs
5) Non-Erodible Soil Sampling Data Summary – Total Metals
6) Non-Erodible Soil Sampling Data Summary – PAHs
7) Non-Erodible Soil Sampling Data Summary – SPLP Metals
8) ROD-Specified County Drain #30 Sediment and Soil Cleanup Goals
9) Background Metals and Cyanide Concentrations in Sediment and Soil
10) Michigan Part 201 Residential Direct Contact Values
11) Site-Specific Groundwater-to-Surface Water Interface (GSI) Criteria
12) Site-Specific Calculated Non-Erodible Soil Cleanup Goals Protective of GSI Criteria
13) Site-Specific Calculated Non-Erodible Soil Cleanup Goals Protective of Groundwater – Boundary Criteria
14) Summary of Proposed Sediment Cleanup Goals
15) Summary of Proposed Erodible Soil Cleanup Goals
16) Summary of Proposed Non-Erodible Soil Cleanup Goals
17) Summary of Proposed Cleanup Goals
18) Sediment Sampling Data Comparison to Cleanup Goals – Total Metals
19) Sediment Sampling Data Comparison to Cleanup Goals – PAHs
20) Erodible Soil Sampling Data Comparison to Cleanup Goals – Total Metals
21) Erodible Soil Sampling Data Comparison to Cleanup Goals – PAHs
22) Non-Erodible Soil Sampling Data Comparison to Cleanup Goals – Total Metals

## LIST OF FIGURES

1) Site Location Map

2) County Drain #30 Layout

3) Site Layout

4) Typical County Drain #30 Cross-Sections

## LIST OF APPENDICES

| | |
|---|---|
| Appendix A | Photographic Documentation of Sediment Sampling Locations |
| Appendix B | Sample Collection Field Notes |
| Appendix C | Analytical Laboratory Reports (on compact disc located inside back cover) |
| Appendix D | Data Validation Reports |
| Appendix E | Statistical Evaluation of Background Metals Concentrations in Sediments and SPLP and Corresponding Total Metals |
| Appendix F | Summary of Historic Metals Concentrations in Sediments and Non-Erodible Soils Associated with County Drain #30 |

## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| CD #30 | County Drain #30 |
| COC | Constituent of concern |
| cy | Cubic yards |
| DCV | (Michigan Part 201) Direct-Contact Value |
| ELA | Eastern Lagoon Area |
| EPC | Exposure point concentration |
| FSQAP | Field Sampling and Quality Assurance Plan |
| ft-bgs | Feet below the ground surface |
| GPS | Global positioning system |
| GSI | Groundwater to surface water interface |
| IDW | Investigation-derived waste |
| MDEQ | Michigan Department of Environmental Quality |
| MDNRE | Michigan Department of Natural Resources and Environment |
| µg/kg | Microgram per kilogram |
| µg/L | Microgram per liter |
| mg/kg | Milligram per kilogram |
| MZD | Mixing Zone Determination |
| NBIA | North Bronson Industrial Area |
| PAH | Polycyclic aromatic hydrocarbon |
| PDI | Pre-Design Investigation |
| QA | Quality assurance |
| QC | Quality control |
| ROD | Record of Decision |
| RI | Remedial Investigation |
| SPLP | Synthetic Precipitation Leaching Procedure |
| SQB | Sediment quality benchmark |
| TAL | Target analyte list |
| 95% UCL | 95-Percent upper confidence level of the mean |
| USCS | Unified Soil Classification System |
| USEPA | U.S. Environmental Protection Agency |
| WLA | Western Lagoon Area |

## PROFESSIONAL ENGINEER ACKNOWLEDGEMENT

**North Bronson Industrial Area, Operable Unit No. 1, Bronson, Michigan**
**Sediment and Soil Sampling Study Report – August 2010**

The undersigned certifies that they have reviewed the attached document. To the best of our knowledge, this report is in material compliance with applicable state, federal, and local regulations. The data presentations contained herein are consistent with O'Brien & Gere standards and generally accepted practices in the environmental profession.

Scott L. Cormier, PE

Vice President

Michigan Professional Engineer No. 6201039613

Date: 8/5/10

SEAL

# 1. INTRODUCTION

The North Bronson Industrial Area (NBIA) Site Operable Unit 1 Potentially Responsible Parties Group (Group) retained O'Brien & Gere to conduct sampling of sediments and soils associated with County Drain #30 (CD #30) at the NBIA Superfund Site in Bronson, Michigan (Figure 1). This report documents the completed study activities, presents the results of analyses of collected sediment and soil samples, and evaluates the collected data as they relate to Remedial Design. The completed work has been performed in accordance with the *County Drain #30 Sediment and Soil Sampling Work Plan* (February 27, 2009), as revised and clarified in the Group's letter to the U.S. Environmental Protection Agency (USEPA) dated December 1, 2009. USEPA approved the revised work plan via letter dated December 29, 2009.

## 1.1 BACKGROUND

CD #30 is a man-made, unlined ditch that was originally excavated prior to 1930 to provide improved drainage for local agricultural fields. The ditch extends a total distance of approximately 2.5 miles, originating in a marshy area to the northeast of Bronson, then running southwest, west, and then northwest to where it discharges to Swan Creek. Figure 2 shows the alignment of CD #30.

Between about 1939 and 1980, CD #30 received discharges from the Western Lagoons and from 1949 to 1981 received discharges from the Eastern Lagoons. Both sets of lagoons were operated by the City of Bronson and received wastewater from certain industries located in the northern portion of the City. Closure of these lagoons is a primary focus of NBIA Operable Unit 1. As a result of these discharges and other inflows, sampling during the Remedial Investigation (RI) (Warzyn, Inc., 1993) and a 2001 Pre-Design Investigation (PDI) found sediments in CD #30 to be impacted with metals and, to a lesser degree, polycyclic aromatic hydrocarbons (PAHs).

CD #30 currently receives the treated discharge from the City of Bronson wastewater treatment plant and storm water drainage from the City. Several agricultural field drains also currently discharge to CD #30. The Douglas Autotech, Inc. and Bronson Plating Company facilities also formerly discharged to CD #30, but neither of these discharges reportedly continued past 2007 (MDEQ, 2008).

Since the time of its original construction, CD #30 has been reconstructed or dredged several times to restore or increase its flow capacity. In 1963, the Branch County Drain Commission reconstructed CD #30 throughout the entire length of the NBIA Site. In 1983 and 1984, Bronson Plating Company dredged the reach of CD #30 between its outfall and the City wastewater treatment plant outfall (Figure 3). Dredged materials were removed for off-site disposal. Most recently, in 2004, the Branch County Drain Commission dredged a portion of CD #30, placing the dredged spoils along the north bank and in the right-of-way north of the drain.

The 1998 Record of Decision (ROD) for NBIA Operable Unit 1 issued by the Michigan Department of Environmental Quality (MDEQ), now the Michigan Department of Natural Resources and Environment (MDNRE),[1] and USEPA in June 1998 specified dredging of impacted sediments from CD #30 and placing the removed materials in the Western Lagoons prior to closure. In December 2006, the Group provided USEPA and MDNRE an evaluation of the cleanup goals for sediment removal as described in the ROD and raised technical concerns regarding the derivation and basis of the ROD-specified cleanup goals. In consultation with USEPA and MDNRE, the Group developed plans to collect the data needed to allow refinement of the CD #30 cleanup goals to address these technical concerns. To this end, the Group developed the *County Drain #30 Sediment and Soil Sampling Work Plan* (February 27, 2009), which was revised via letter dated December 1, 2009. USEPA approved the revised work plan via letter dated December 29, 2009.

## 1.2 PURPOSE AND OBJECTIVES

The purpose and objectives of the CD #30 sediment and soil sampling were as follows:

---

[1] For simplicity in this report, the acronym MDNRE is used to refer to both the current and predecessor agencies, except in citations to specific guidance documents or reports.

- Evaluate background sediment in CD #30 upstream of the Site to allow for determination of statistically valid, Site-specific background sediment concentrations for use in establishing sediment cleanup goals;
- Evaluate the extent of impacted sediments remaining in CD #30 following the Branch County Drain Commission's dredging activities in 2004;
- Compare current sediment concentrations to historical sediment concentrations (*i.e.*, RI and PDI data collected prior to the 2004 dredging of CD #30);
- Evaluate constituent concentrations in erodible soils on the banks of CD #30; and
- Evaluate constituent concentrations in non-erodible soils north of CD #30, which may have been impacted by the 2004 placement of sediments along the northern bank and right-of-way during CD #30 dredging.

This information serves as a basis of the Remedial Design for removal and consolidation of sediments into the Western Lagoon Area (WLA) as part of Operable Unit 1 for the NBIA Site.

## 2. AFFECTED ENVIRONMENTAL MEDIA

Remediation of CD #30 will address impacted sediment, bank soils, and soils situated along the north side of the drain. In delineating and planning the remediation of these impacted materials, three distinct environmental media are defined, as follows:

- *Sediment* – Solid and semi-solid materials at the bottom of CD #30 that are submerged under normal flow conditions and which form the substrate for the benthic community in this surface water body;
- *Erodible soil* – Soil exposed to surface water runoff or stream flow conditions that have the potential to cause erosion or bank scour sufficient to yield sediment to CD #30; and
- *Non-erodible soil* – Soil that does not have the potential to erode or scour sufficiently to yield sediment to CD #30 because of spatial location, depth, slope, vegetation, or other surface characteristics.

Figure 4 provides typical cross-sections of CD #30 illustrating the general layout and orientation of these three types of affected environmental media. Figure 4 also shows the correlation of sample locations to each of these media.

Potential exposure pathways, and the resultant application of cleanup goals, vary among these three media, as follows:

| Potential Pathway | Sediment | Erodible Soil | Non-Erodible Soil |
|---|---|---|---|
| Direct Human Contact | ✓ | ✓ | ✓ |
| Ecological Risk | ✓ | ✓ | |
| Soil-to-Groundwater | | ✓ | ✓ |

Direct human contact is considered a potentially operative exposure pathway for all surface media, whether sediment, erodible soil, or non-erodible soil.

Erodible soils along the banks of CD #30 could, under natural soil erosion processes, be transported to CD #30 and be deposited as sediment. To be protective in the long term, sediment and erodible soils need to be addressed similarly with respect to the Remedial Design cleanup goals that are based on protection of ecological receptors. In remediation, potentially erodible soils can be rendered non-erodible through the implementation of engineering controls. Such controls may include erosion-resistant linings (*e.g.*, riprap), durable vegetation, and cover soil.

Non-erodible soils do not have the potential to become sediment and will not affect ecological receptors associated with this surface water body. Cleanup goals based on protection of aquatic ecosystems are not applicable to non-erodible soils. Cleanup goals for these soils address potential direct human contact and the possible leaching of constituents of concern (COCs) from soil to groundwater. Because sediments are exposed to leaching by surface water flow, soil-to-groundwater cleanup standards are not applicable to sediment.

The distinctions among the three types of environmental media were also noted in the 1998 ROD, in which specific cleanup goals were provided for sediment, surface soils close to CD #30 (*i.e.*, within the 10-year flood plain), and other soils. However, it is noted that, based on long-term observations (O'Rourke, 2010; Buckley, 2010) and hydrologic analyses, the 10-year flood flow of CD #30 is contained within the banks of the incised ditch, and no 10-year floodplain exists outside of the flow channel.

## 3. FIELD SAMPLING AND ANALYSIS

The completed scope of work for sampling and analysis of sediments and soils associated with CD #30 is summarized as follows:

- Collection of nine background sediment samples from the approximate centerline of CD #30 at uniformly spaced intervals, starting approximately 200 feet upstream of the location of RI background sediment sample location SD-11 (collected in 1991), approximately 1,400 feet east of the Eastern Lagoon Area (ELA), and working upstream approximately 1,600 feet (Figure 3). Sediment samples were analyzed for target analyte list (TAL) metals.
- Collection of one sediment and eight soil samples from each of seven transects (Figures 3 and 4), beginning downstream of the WLA (near RI sample location SD-16, collected in 1991) and extending upstream of the ELA (near PDI sample location SD-18, collected in 2001). Sediment and soil samples were analyzed for TAL metals, and selected samples were also analyzed for PAHs.

Sediment and soil sampling were performed according to the methods described herein and consistent with the methods described in the *Field Sampling Quality Assurance Plan* (FSQAP), as amended, and the *County Drain #30 Sediment and Soil Sampling Work Plan (NBIA OU1 PRP Group, 2009)*. The completed CD #30 sampling provides a basis for scoping the Remedial Design and provides current data regarding the extent of impacted materials exceeding the proposed cleanup goals for sediment, erodible soils, and non-erodible soils.

### 3.1 SAMPLING

The following section presents a description of the activities performed during the sediment and soil sampling study, and the data collected between March 29, 2010 and June 9, 2010.

#### 3.1.1 CD #30 Sediment

Sediment samples were collected within the 0- to 6-inch depth interval at each sampling station near the center of the active drainage channel, in general accordance with USEPA Standard Operating Procedure #2016 (1994). The samples were collected with an attempt to be representative of the relative percentage of both fine- and coarse-grained sediments observed in CD #30 at the prescribed sampling location, to the extent both exist at the 0- to 6-inch sampling interval. Sediment samples were collected using a stainless steel scoop. The sampler was driven vertically through the sediment until the underlying granular soil was encountered. The stainless steel scoop was then rotated and drawn up through the sediments to retrieve the sample. Attempts to use a soil corer equipped with a butterfly valve to allow sample collection where sediments were soft failed because fibrous organic material (*i.e.*, leaf litter) comprising a portion of the sediment either fouled the proper operation of the corer/butterfly valve, or precluded the softer, less fibrous, sediment from entering the corer.

Upon retrieval, each sediment sample was inspected for layering, characterized, and emptied into a clean stainless-steel bowl. Excess water was carefully decanted to avoid washing away finer-grained sediments. Materials were then homogenized with the stainless steel scoop prior to placing the sample into a pre-cleaned and certified glass sample container with a Teflon®-lined lid.

The samples were sealed, labeled, and placed on ice in a cooler in preparation for shipping to the laboratory for analysis in accordance with the methods described in the FSQAP. Proper chain-of-custody and additional sample documentation, including a description of the soil/sediment texture in general accordance with the Unified Soil Classification System (USCS) per American Society for Testing and Materials Method D2488. In addition, each sampling location was photo documented (Appendix A).

The volume of the sediments in CD #30 was estimated based on the measured width and sediment thickness at each of the seven transect locations. Sediment thickness was determined by examining the sediments versus underlying soils and comparing the thickness of retrieved materials by color and texture. These calculations are discussed in Section 5.2.

### 3.1.2 CD #30 Bank Soils

Samples of the CD #30 bank soil (both north and south banks) were collected within the 0- to 6-inch depth interval at each of the seven transect locations. The bank samples were collected using a soil core sampler and were taken about one foot above the water line to conservatively represent the erodible soils associated with each bank. Samples were retrieved from the sampler and visually inspected and characterized prior to homogenization and placing the sample into the appropriate sample container, as discussed in the previous section. The general erodibility of the bank material was described, and the sample location and sample texture using the USCS were documented.

### 3.1.3 Soils Along North Side of CD #30

Soil samples were collected within the 0- to 6-inch and 12- to 18-inch depth intervals from three points north of CD #30 at each of the seven transect locations. Sampling points at each transect were located at distances of approximately 10, 30, and 70 feet north of the crest of the bank slope. Samples were collected using a soil core sampler. Samples were retrieved from the sampler and visually inspected and characterized prior to homogenization and placing the sample into the appropriate sample container. Sample texture was documented according to the USCS.

As part of the sampling effort, the field team mapped visibly identifiable mounds of materials piled on either bank of CD #30. Such mounds, which were previously noted in a 2006 MDNRE survey, are primarily located near the north bank of CD #30 west of South Matteson Street and south of CD #30 just east of the Consumers Power substation (Figure 3). The quantity of materials associated with these mounds was estimated from field measurements and observations (Section 5.2).

## 3.2 SAMPLE DOCUMENTATION

Sample collection was documented in a bound site-specific field notebook. Copies of the field notes pertaining to the sediment sampling activities are contained in Appendix B. The collection, transfer of custody, and shipping of the samples to the analytical laboratory were documented using chain-of-custody forms, which are included in the analytical laboratory reports for each sample delivery group (Appendix C).

## 3.3 LABORATORY ANALYSIS

The collected sediment and soil samples were analyzed for TAL metals. Sediment and soil samples were also analyzed for PAHs at transects SD-32 and SD-34 where higher PAH levels were detected in prior sampling events.

Based on the results of the total metals analyses, the 10 non-erodible soil samples exhibiting the highest total metals levels were selected for testing by the Synthetic Precipitation Leaching Procedure (SPLP). The SPLP leachate was analyzed for metals, including hexavalent chromium, and free cyanide.

Sediment samples were submitted to TestAmerica Laboratories, Inc. (TestAmerica) in Pittsburgh, Pennsylvania, which specializes in the analysis of sediment samples. The erodible and non-erodible soil samples were submitted to TestAmerica in North Canton, Ohio. Tables 1 through 6 summarize the results for metals and PAHs in sediments, erodible soils, and non-erodible soils. Table 7 summarizes the results for SPLP metals, including hexavalent chromium, and cyanide in non-erodible soils. These data tables provide results for all TAL metals analyzed, including those metals that are not identified as COCs for the NBIA Site. Copies of analytical laboratory reports are provided on the compact disc included with this report as Appendix C.

## 3.4 DATA VALIDATION AND MANAGEMENT

The sediment and soil sampling data generated during the investigation were validated (100 percent full data validation) according to the procedures described in Section A18.1 of the FSQAP. The purpose of this data assessment was to evaluate the usability of the data for delineating the extent of Site-related constituents and to determine the uncertainty and bias in the data as considerations for decision-making. Appendix D provides the data validation reports. With very few exceptions, the data were determined to be useful for their intended purpose.

Of the 2,080 metals analyzed (*i.e.*, 23 TAL metals in each of 80 total metals samples plus 23 TAL metals and hexavalent chromium in 10 SPLP samples), 2,067 results (99.37 percent) were accepted, and 13 were rejected (0.63 percent). The rejected data were included five sodium results, two zinc results, and seven silver results. The sodium and zinc results were rejected due to elevated detections in associated blank samples; the silver data were rejected where reproducibility did not meet quality standards. None of the PAH or cyanide results were rejected

In the attached data tables, a "J" qualifier is used to indicate estimated concentrations irrespective of the basis on which the value is estimated. The data validation report contained in Appendix D provides specific sample results and the reasons for their qualification (*e.g.*, detection below reporting limit, corresponding blank contamination, low bias due to sample recovery).

Data management procedures were established to process the data generated during the investigation such that the relevant data descriptions (*e.g.*, sample numbers, methods, and procedures) are readily accessible and accurately maintained. Data were collected and recorded in a variety of ways during the sampling program. These included using standard field forms, field notebooks, and laboratory generated data. The original forms and data are maintained in O'Brien & Gere's files. Data amenable to computerization, such as analytical data, were input to a data storage system.

## 3.5 QUALITY ASSURANCE/QUALITY CONTROL

Quality control/quality assurance (QA/QC) measures implemented during field sampling activities included field equipment calibration, chain-of-custody protocols, and QC sample collection. In accordance with the Work Plan and Section A.4.1 of the FSQAP, field QA/QC samples for sediment and soil sampling consisted of sampling equipment rinsate blanks, duplicate samples, and matrix spike/matrix spike duplicate samples.

## 3.6 DECONTAMINATION PROCEDURES

The field sampling program included decontamination procedures to minimize the potential for contaminants to be introduced into the sample locations or transferred across the study area. Reusable sampling tools that came into contact with sediment or soil underwent an initial cleaning process, were cleaned between sample locations to prevent cross-contamination, and were cleaned prior to leaving the study area at the conclusion of sampling in accordance with the Work Plan and Section A5.3.6 of the FSQAP.

## 3.7 HANDLING OF INVESTIGATION-DERIVED WASTES

Investigation-derived waste (IDW), including sediments, soils, and decontamination fluids resulting from the field activities, was segregated and placed in new, properly labeled U.S. Department of Transportation 17H 55-gallon drums. In accordance with the approved FSQAP, as amended, the drums of solid IDW (*e.g.*, sediment, soils, used personal protection equipment) were staged in the WLA for disposition as part of the Operable Unit 1 source control remedial action. IDW disposal methods will correspond to the methods employed in addressing similar remediation wastes generated at that time. Drums of decontamination liquids will be managed with those from the recently completed Groundwater Delineation Study. The liquid IDW will be profiled, manifested, and disposed of off-site in accordance with local, State, and Federal regulations.

## 3.8 SURVEYING

The sampling locations were surveyed using global positioning system (GPS) techniques. The locations were recorded by latitude and longitude, which were then converted to the same coordinate system used for other surveys for the NBIA Site. These survey data were used to plot the sample locations on the existing Site layout map (Figure 3).

## 4. REFINEMENT OF CLEANUP GOALS

The 1998 ROD identified cleanup goals for three categories of environmental media associated with CD #30. As shown in Table 8, the ROD-identified cleanup goals for sediments were based on assumed background concentrations, sediment quality benchmarks (SQBs) identified in generic guidance for protection of aquatic ecosystems, and MDNRE health-based direct-contact values (DCVs). Specific cleanup goals were also defined for surface soils within the 10-year floodplain based on soil background concentrations. For other soils, cleanup goals were set at levels protective of groundwater, based on State-wide default groundwater to surface water interface (GSI) criteria or health-based DCVs.

This section discusses the refinement of these cleanup goals based on the results of the CD #30 sediment and soil sampling and other project developments since the issuance of the 1998 ROD. It is anticipated that USEPA will issue an Explanation of Significant Differences to update the 1998 ROD with the refined CD #30 cleanup goals.

### 4.1 SITE-SPECIFIC BACKGROUND METALS CONCENTRATIONS

#### 4.1.1 Sediment

In the ROD, the sediment background values applied as cleanup goals were defined by the results of a single sediment sample (SD-11) collected during the RI. In reviewing this situation with USEPA and MDNRE, it was agreed that the results from a single sample were not appropriate for definition of background and additional sediment sampling would be performed to establish a statistically valid basis for determining background metals concentrations in CD #30 sediments. Accordingly, one of the objectives of the current study was to refine the definition of background to be applied to sediments. As indicated in Section 3, the scope of the current study included the collection and analysis of nine sediment samples located upstream of the area of impacted sediments within CD #30 and upstream of RI Sample SD-11. The results of analyses of these nine samples are included in Table 1 (*i.e.*, Samples SD-35 through SD-43).

The background sediment sample results were evaluated using the procedures defined in MDEQ (2002) guidance, *Sampling Strategies and Statistics Training Materials for Part 201 Cleanup Criteria*. Calculations were facilitated through the use of ProUCL 4.0 software (USEPA, 2009). The ProUCL 4.0 output is provided in Appendix E. The results of the statistical analyses are presented in Table 9, which lists the statistically defined background metals concentrations in CD #30 sediments. These concentrations are the statistically determined 95-percent upper confidence level of the mean (95% UCL) values. Individual point concentrations representative of background conditions can be, and in some cases are, higher than these 95% UCL values.

The statistically determined Site-specific background values are higher than the ROD-specified cleanup goals in sediment for the three metals for which the ROD-specified cleanup goals were based on background (rather than SQBs or DCVs), *i.e.,* barium, manganese, and vanadium. The ROD cleanup goals need to be adjusted to these Site-specific background values in order to provide appropriate cleanup goals for these metals in sediment.

#### 4.1.2 Soil

In the RI, background concentrations of metals in soils were determined using the results of six sample locations selected as remote from Site-related activities and by applying MDNRE procedures for statistical evaluation. The guidance applied in the RI was the then-applicable Michigan Department of Natural Resources, Waste Management Division "Clean-up Verification Document," dated November 1991. That guidance was superseded by the MDEQ 2002 guidance. The statistical method applied in the RI to establish the background concentration, *i.e.*, mean plus three standard deviations, remains an acceptable approach for point-by-point comparisons under the more-recent MDEQ guidance. These Site-specific background concentrations for soils are listed in Table 9. In assigning cleanup goals for surface soils within the 10-year floodplain, however, the ROD-applied background values were not consistent with the background values calculated in the RI and provided no explanation of the differences.

## 4.2 MDNRE HEALTH-BASED DIRECT-CONTACT VALUES

Michigan Part 201 residential DCVs (MDEQ, May 2006a) represent potential cleanup goals for sediments and surface soils. These DCVs (Table 10) are considered in developing cleanup goals for sediments, erodible soils, and non-erodible soils associated with CD #30.

## 4.3 ECOLOGICAL RISKS

Under current USEPA ecological risk assessment guidance, SQBs are primarily used as ecological risk screening levels to determine if additional Site-specific ecological risk assessment is needed and, except in unusual circumstances, are not applied as cleanup goals. Without a Site-specific ecological risk assessment for CD #30, however, such SQBs are used as surrogate, conservative cleanup goals for sediment. These sediment cleanup goals are applied only to materials that are in contact with surface water and which form the biologically active zone (*e.g.*, uppermost 6± inches of material below the bottom and lower side slopes of the ditch). In determining attainment of these SQBs as surrogate cleanup goals, post-remedial average concentrations (*i.e.*, arithmetic means) serve as the appropriate exposure point concentrations (EPCs) that are compared to the SQBs.

## 4.4 SITE-SPECIFIC SOIL-TO-GROUNDWATER CLEANUP STANDARDS

USEPA and MDNRE have identified certain COCs in soils that have the potential to impact groundwater at concentrations that would exceed the GSI criteria or exceed the Site boundary criteria for groundwater specified in the ROD. For these COCs, the derived soil concentrations protective of groundwater, calculated in accordance with MDNRE procedures, would also apply as cleanup goals. Because sediments are exposed to constant leaching by surface water flow, derivation of soil-to-groundwater cleanup standards are not applicable to sediment.

### 4.4.1 GSI Criteria

On September 16, 2008, MDNRE presented a revised mixing zone determination (MZD) for groundwater discharges at the NBIA Site to CD #30, which serves as a basis for revising the cleanup goals for soils based on GSI criteria as given in Table 1 of the ROD. In this memorandum, MDNRE identified the following inorganic COCs whose concentrations could potentially exceed water quality standards in CD #30 under the assumptions used in its MZD:

- Arsenic
- Barium
- Cadmium
- Chromium (trivalent)
- Chromium (hexavalent)
- Copper
- Lead
- Nickel
- Silver
- Zinc
- Cyanide (free)

Table 11 summarizes the results of the MZD and presents the allowable acute and chronic concentrations for discharges of these COCs to CD #30 based on the assumptions made in MDNRE's calculations. Table 11 also includes the allowable acute and chronic concentrations for discharges of other COCs (*i.e.*, antimony, manganese, mercury, selenium, and vanadium) calculated using the same assumption and bases as the MDNRE's MZD.

These Site-specific GSI criteria were then used to calculate acceptable soil concentrations as follows:

$$S_i = \frac{GSI_i \times T_i}{SPLP_i}$$

Where,

| | | |
|---|---|---|
| $S_i$ | = | cleanup goal for specific metal as total concentration, milligrams per kilogram (mg/kg); |
| $GSI_i$ | = | GSI criterion for specific metal, micrograms per liter (µg/L); |
| $T_i$ | = | specific total metal concentration, mg/kg; and |
| $SPLP_i$ | = | SPLP concentration of specific metal, µg/L. |

The SPLP and total metals concentrations used in these calculations are listed in Table 12.

With the exception of antimony and silver, the SPLP value corresponded to the mean (arithmetic average) of the SPLP results determined from the analysis of the 10 samples with the highest total metals concentrations (Table 7). Similarly, the total metal concentration was taken as the mean concentration for each metal from these same 10 samples. Antimony and silver were only detected in one of the SPLP samples, *i.e.*, the sample from SD29-10N from 0.0 to 0.5 feet below the ground surface (ft-bgs). For antimony, which was detected in some of the most-recent groundwater samples associated with the WLA (O'Brien & Gere, 2010), the SPLP result and the corresponding total metals concentrations from this sample interval were used in the calculation of the Site-specific cleanup goals.

Table 12 also lists the calculated cleanup goals for soils based on protection of groundwater to GSI criteria. No criteria were calculated for barium, hexavalent chromium, or mercury because these metals were not detected in any of the SPLP analyses. Similarly, no free or total cyanide was detected in any of the 10 SPLP analyses, and no criteria were calculated for cyanides.

No silver was detected in any sample in any well located north of CD #30 or any other recent groundwater samples, including WLA source area samples (O'Brien & Gere, 2010). The conclusion drawn from these groundwater data, as supported by the sole detectable SPLP concentration, is that silver does not pose a threat to surface water quality in CD #30. Because concentrations of silver found in soils do not affect groundwater and ultimately surface water quality, it is not necessary or appropriate to calculate a GSI-based cleanup goal based on the assumptions presented above. Therefore, no GSI-based cleanup goal is proposed for silver.

### 4.4.2 Boundary Criteria

The 1998 ROD specified boundary cleanup goals in groundwater for the following metals and cyanide:

- Cadmium – 5 µg/L;
- Lead – 4 µg/L;
- Mercury – 1 µg/L;
- Nickel – 100 µg/L;
- Silver – 34 µg/L;
- Zinc – 2,400 µg/L; and
- Cyanide – 200 µg/L.

Except for cadmium, lead, mercury, and nickel, the GSI criteria (Table 11) are more restrictive than the boundary criteria.

These Site-specific boundary criteria were then used to calculate acceptable soil concentrations for cadmium, lead, and nickel based on protection of groundwater to boundary cleanup goals. These calculations were made in similar fashion to those for deriving GSI-based cleanup goals, as follows:

$$S_i = \frac{BC_i \times T_i}{SPLP_i}$$

Where,

| | | |
|---|---|---|
| $S_i$ | = | cleanup goal for specific metal as total concentration, mg/kg; |
| $BC_i$ | = | boundary criterion for specific metal, µg/L; |
| $T_i$ | = | specific metal mean concentration, mg/kg; and |
| $SPLP_i$ | = | SPLP concentration of specific metal, µg/L. |

Mercury was not detected in any of the SPLP analyses, and no cleanup goal was calculated. Again, because no silver was detected in any sample in any well located north of CD #30 or any other recent groundwater samples, including WLA source area samples (O'Brien & Gere, 2010), it is concluded that silver does not pose a threat to the ROD-specified boundary criteria, and no cleanup goal for silver based on this criteria is proposed. Results for cadmium, lead, and nickel are shown in Table 13.

## 4.5 SITE-SPECIFIC CLEANUP GOALS

Tables 14 through 16 provide a summary of the proposed revised cleanup goals for sediment, erodible soils, and non-erodible soils, respectively. Figure 4 provides three typical cross-sections of CD #30 and illustrates the distinctions of the three types of impacted environmental media.

- Sediment: Consistent with the ROD, the proposed Site-specific cleanup goals for sediments (Table 14) are a combination of Site-specific background, SQBs, and health-based DCVs. As shown in Table 14, proposed cleanup goals for sediments differ from those specified in the ROD based on the development of statistically based background levels (*i.e.*, for barium, manganese, and vanadium) and where MDNRE revised its applicable Part 201 DCV (*i.e.*, for arsenic).
- Erodible (Bank) Soil: The proposed Site-specific cleanup goals for erodible soils are listed in Table 15. These cleanup goals are determined from the same SQBs and DCVs as for sediment, as well as the calculated cleanup goals from the GSI and boundary criteria. In addition to these risk-based values, Site-specific background concentrations from historic soil samples were used for those COCs where background is also the cleanup basis for sediments (*i.e.*, for barium, manganese, and vanadium) or where the Site-specific soil background value was higher than the lowest risk-based value, indicating that a cleanup goal based on such risk-based values could not be attained.
- Non-Erodible Soil: The proposed Site-specific cleanup goals for non-erodible soils are listed in Table 16. These cleanup goals are derived from the calculated Site-specific GSI protection and boundary (*i.e.*, groundwater) protection values and DCVs. Where the Site-specific soil background value was higher than the lowest risk-based value, indicating that a cleanup goal based on such risk-based values could not be attained, the Site-specific soil background value was used as the proposed cleanup goal.

Table 17 summarizes the proposed cleanup goals for sediment, erodible soils, and non-erodible soils associated with CD #30.

Compliance with these cleanup goals will be demonstrated through the collection and analysis of post-excavation samples and determination of the post-remedial EPC of each COC in each applicable environmental medium. Post-remedial EPCs for sediments and soils associated with CD #30 will be calculated as follows:

- For comparisons to cleanup goals based on SQBs, the post-remedial EPC for each COC in sediment or erodible soil will be calculated as the mean (arithmetic average) value.
- For comparisons to cleanup goals based on RI-determined background concentrations in soil, the post-remedial EPC for each COC in erodible or non-erodible soil will be calculated as the maximum value.
- For all other comparisons, the post-remedial EPC for each COC in each medium will be calculated as the 95% UCL value in accordance with USEPA and MDNRE guidance.
- When the cleanup goal for soil is based on a DCV, the cleanup goal only applies to the uppermost 2 feet of the soil column.

Determinations will be based using databases that include a sufficient number of samples for meaningful statistical analysis. Post-remedial databases will include both post-excavation samples and pre-remedial samples collected from areas that were not targeted for remediation.

## 5. EVALUATION OF IMPACTED MEDIA

This section provides a brief summary of the impacted media associated with CD #30 at the NBIA Site as determined by comparing individual results from sediment, erodible soil, and non-erodible soil sampling to the proposed cleanup goals. Preliminary (scoping) estimates of the quantities of impacted media based on these comparisons are also presented. For remedial planning purposes, this evaluation is conservatively based on point-by-point comparisons to cleanup goals and does not rely on statistical determinations of EPCs for each COC in each applicable environmental medium. The Remedial Design will refine this initial evaluation and the locations and quantities of materials targeted for remediation as part of Operable Unit 1 for the NBIA Site.

### 5.1 COMPARISONS TO CLEANUP GOALS

#### 5.1.1 Sediments

Individual results for CD #30 sediment samples from the recent sampling activities that exceed the proposed cleanup goals are highlighted in Table 18, and a comparison of historic metals concentrations in individual CD #30 sediment samples is provided in Appendix F, Table F-1. Examination of these data indicates that metals concentrations in CD #30 sediments were reduced by the dredging activities that the Branch County Drain Commission conducted in 2004. On average, metals concentrations in the most recent sampling are about one-third lower than those from sampling conducted earlier than 2004. Accordingly, incorporating historical data into remedial planning provides a degree of conservatism.

The recent sampling results indicate that the impacted sediments generally extend between the easternmost and westernmost sample locations. Earlier RI and PDI data indicate that historically impacted sediments extended from just upstream of Sample SD-12 located approximately 500 feet upstream (*i.e.*, east) of the ELA to SD-25 located approximately 1,250 feet downstream (*i.e.*, west) of the WLA (Figures 2 and 3). Sample SD-12, which was originally identified as a background sample location in the RI, exceeded the cleanup goals for several metals. Moving upstream a short distance is expected to result in sediment that meets cleanup goals for all COCs. On the downstream end, Sample SD-25 met cleanup goals for all COCs, although further downstream, Sample SD-17 (Figure 2) showed elevated concentrations of several metals. This location, however, is more than 3,500 feet downstream of the NBIA Site with at least two intervening sediment samples (*i.e.*, SD-26 and SD-27) that showed no elevated Site-related metals concentrations. The means for addressing sediments at SD-17 (*e.g.*, localized removal, if needed to achieve overall cleanup goals) will be addressed in Remedial Design.

CD #30 sediment data from the recent sampling activities that exceed the cleanup goals for total PAHs of 4 mg/kg (or 4,000 micrograms per kilogram [µg/kg]) are highlighted in Table 19. Sample SD-34 exhibited individual PAH concentrations above their respective DCVs and total PAH concentration above the 4 mg/kg cleanup goal. The sample from SD-32 exhibited a total PAH concentration below the cleanup goal and all individual PAH concentrations were below their respective DCVs.

#### 5.1.2 Erodible Soils

Individual results for CD #30 erodible soil samples from the recent sampling activities are highlighted in Table 20. No historical bank (erodible) soil sample data are available.

Spatially, the locations of the impacted erodible (bank) soils generally correlate with the impacted sediments in CD #30, although the concentrations of most metals in the erodible soils, including cadmium, chromium, copper, lead nickel and zinc, are generally one-half to one-third of those in the corresponding sediments. Impacted erodible soils extend from upstream of Sample SD-34 located just upstream (*i.e.*, east) of the former ELA to just downstream of SD-28 located approximately 740 feet downstream (i.e., west) of the WLA.

The total PAH concentration for Sample SD-34-SB (south bank) exceeded the cleanup goal (Table 21). The remaining erodible soil samples for PAHs were below the cleanup goal.

#### 5.1.3 Non-Erodible Soils

Individual results for CD #30 non-erodible soil samples from the recent sampling activities that exceed the cleanup goals are highlighted in Table 22, and a comparison of the historic COC concentrations in non-erodible

soils associated with CD #30 (collected during the 2008 groundwater delineation study) is provided in Appendix F, Table F-2.

As shown in Tables 22 and F-2, four metals (*i.e.*, arsenic, cadmium, copper, and lead) exceed proposed cleanup goals in at least one non-erodible soil sample with arsenic showing the most frequent exceedances of proposed cleanup goals (13 of 42 locations).

Metals concentrations are lower in the deeper (1.0 to 1.5 foot) horizon samples, and, except for one location (i.e., lead at 92.7 mg/kg at SD-32-10N), only arsenic was detected above proposed cleanup goals in any of the deeper horizon samples. Similarly, metals concentrations are lower as the distance from CD #30 increases. In the samples taken 70 feet north of CD #30, only one of seven samples in the upper (0.0 to 0.5 foot) horizon showed any metals levels above the proposed cleanup goals (*i.e.*, arsenic at 11.2 and 10.8 at SD-32-70N) and none of the deeper horizon at 70 feet north indicate metals impacts above cleanup goals. The sampling was effective in adequately delineating the horizontal and vertical extent of impacted non-erodible soils for purposes of remedial planning.

The arsenic concentrations, especially those found in non-erodible soil samples taken 30 or 70 feet north of CD #30, appear to be randomly distributed and are generally not co-located with other metal concentrations above proposed cleanup goals. Accordingly, it is not clear to what extent the observed arsenic levels in non-erodible soils are related to impacts from CD #30 versus naturally occurring arsenic in soils. In Remedial Design, further geochemical evaluations (Myers and Thorbjornsen, 2005) may be conducted to assess arsenic and other metals concentrations in an effort to differentiate materials impacted by Site-related arsenic and naturally occurring concentrations.

## 5.2 QUANTITIES

The results of the most recent and historical sampling and conservative point-by-point comparisons of COC concentrations to proposed cleanup goals were used to estimate the quantities of impacted environmental media associated with CD #30. These preliminary estimates, which will be refined and used in developing the Remedial Design, are summarized as follows:

- Sediments: 1,100 cubic yards (cy) based on an average width of sediments in CD #30 of 12.4 feet (from Site observations, GPS survey results and historic site survey maps), an average sediment thickness of 6 inches, and a 4,600 foot length of impacted materials. This length extends from just upstream of Sample SD-12 on the upstream (eastern) end to just downstream of the location of Sample SD-24 on the downstream (western) end (figures 2 and 3).
- Erodible (Bank) Soils: 1,700 cy based on the same 4,600-foot length of CD #30 as estimated for sediments, an average depth of impacted soils of one foot, and an assumed width of impacted bank material of five feet, times two (for each side of the drain).
- Non-Erodible Soils: 3,300 cy based on the following
  - Length: 1,800 feet from just upstream of Sample Transect SD-32 on the upstream end to just downstream of Sample Transect 28 on the downstream end;
  - Width and Depth: 20-foot width to a depth of 2 feet plus an additional 10-foot wide 1 foot deep.

In addition to these quantities, approximately 500 cy of impacted sediments will be removed from the mounds located adjacent to the substation south of CD #30. This volume is based on an average width of sediments in the mounds of 40 feet, an average removal depth of 2.5 feet (high), and a 125-foot average length for the mounds.

In all cases, these calculated quantities are based on the length, width, and depth of the delineated impacted areas and media. These quantity estimates will be refined in Remedial Design, and, for non-erodible soils, the Remedial Design will examine the cost-effectiveness of addressing materials in a patchwork fashion based on more comprehensive grid sampling. As part of Remedial Construction, post-excavation sampling will be conducted to develop the database needed to confirm the completeness of removal.

## 6. REFERENCES

ASTM. 2000. *Standard practice for description and identification of soils (visual-manual procedure)*, Designation D2488-00. American Society for Testing and Materials, West Conshohocken, PA.

Buckley, Charles. 2010. City of Bronson Wastewater Treatment Plant Operator. Personal Communication with Clifford Yantz. June 10.

Long, E.R. and L.G. Morgan. 1990. "The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program," *NOAA Technical Memorandum NOS OMA 52*. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Seattle, Washington.

MDEQ. 2002. *Sampling Strategies and Statistics Training Materials for Part 201 Cleanup Criteria*. Remediation and Redevelopment Division, Lansing, Michigan.

MDEQ. 2006a. "RRD Operational Memorandum No. 1." Remediation and Redevelopment Division, Lansing, Michigan. January 23.

MDEQ. 2006b. "RRD Operational Memorandum No. 1, Attachment 1, Table 2, Soil: Residential and Commercial I, Part 201 Generic Cleanup Criteria and Screening Levels and Part 213 Tier 1 Risk-Based Screening Levels (RBSLS)." Remediation and Redevelopment Division, Lansing, Michigan. May.

MDEQ. 2008. "Venting Groundwater Mixing Zone Review – Revised, North Bronson Industrial Area Superfund Site, Branch County." Interoffice Communication from Mike Waterhouse, Surface Water Assessment Section, Water Bureau, to Patty Brandt, Field Operations Section, Remediation and Redevelopment Division. September 16.

MDEQ and USEPA. 1998. "Declaration, Selected Remedial Alternative for the North Bronson Industrial Site, Operable Unit 1, City of Bronson, Branch County, Michigan." ("Record of Decision" [ROD]).

MDNR. 1991. *Clean-up Verification Document.* November.

Myers, Jonathan and Karen Thorbjornsen. 2005. "Identifying Metals Contamination in Soil: A Geochemical Approach," *Soil and Sediment Contamination: An International Journal*, 13:1, 1 – 16.

NBIA OU1 PRP Group. 2009. *Revisions and Clarifications, County Drain #30 Sediment and Soil Sampling Work Plan, North Bronson Industrial Area Site Operable Unit 1.* December 1.

O'Brien & Gere Engineers, Inc. 2006a. *Field Sampling and Quality Assurance Plan, Revision 2, Addendum 1. North Bronson Industrial Area. Operable Unit 1.* February 9.

O'Brien & Gere Engineers, Inc. 2006b. *Field Sampling and Quality Assurance Plan, Revision 2, Addendum 2. North Bronson Industrial Area. Operable Unit 1.* July.

O'Brien & Gere Engineers, Inc. 2006c. *Field Sampling and Quality Assurance Plan, Revision 2, Addendum 3. North Bronson Industrial Area. Operable Unit 1.* August 24.

O'Brien & Gere, 2010. *Groundwater Delineation Study Report, North Bronson Industrial Area. Operable Unit 1.* July.

O'Rourke, David. 2010. Bronson City Manager. Personal Communication with Leo Brausch. June 9.

Persaud, D., R. Jaagumagi, and A. Hayton, 1993. "Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario," Ontario Ministry of the Environment and Energy.

USEPA. 1994. Standard Operating Procedure #2016, Sediment Sampling, Revision 0.0. November 17.

USEPA. 2009. ProUCL Version 4.00.04 User Guide (Draft). EPA/600/R-07/038, February 2009. Download from http://www.epa.gov/nerlesd1/databases/datahome.htm

Warzyn, Inc., 1993. *Remedial Investigation, North Bronson Industrial Area, Bronson, Michigan.* Prepared for the Michigan Department of Natural Resources, Lansing, Michigan. Four volumes. July.

# *TABLES*

# *TABLES*

**Table 1**
**Sediment Sampling Data Summary - Total Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SD-28 | SD-29 | SD-29 | SD-30 | SD-31 | SD-32 | SD-33 | SD-34 |
| | 0.0 to 0.5 | 0.0 to 0.5 | (DUP-01) 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 |
| ***Metals (mg/kg)*** | | | | | | | | |
| Aluminum | **9,020** | **4,610** | **4,980** | **10,000** | **9,070** | **2,300** | **5,620** | **3,660** |
| Antimony | 1.6 UJ | **2.7 J** | **1.9 J** | 1.9 UJ | 1.8 UJ | 0.72 UJ | **1.2 J** | **1.2 J** |
| Arsenic | **15.2** | **10.1** | **11.1** | **16.2** | **12.6** | **2.7** | **6.3** | **2.8** |
| Barium | **108** | **94.3** | **97.1** | **137** | **120** | **18.3** | **55.1** | **41.7** |
| Beryllium | 0.65 U | 0.67 U | 0.62 U | 0.76 U | 0.74 U | 0.29 U | 0.45 U | 0.36 U |
| Cadmium | **23.2 J** | **16.7 J** | **41.5 J** | **28.6 J** | **15.2 J** | **1.3 J** | **15.5 J** | **2.5 J** |
| Calcium | **49,600** | **34,400** | **37,100** | **53,300** | **78,700** | **71,600** | **45,500** | **20,700** |
| Chromium (total) | **197** | **153** | **196** | **383** | **233** | **65.8** | **149** | **68.5** |
| Cobalt | 8.2 U | 8.4 U | 7.8 U | 9.5 U | 9.2 U | 3.6 U | 5.6 U | 4.5 U |
| Copper | **164** | **181** | **282** | **187** | **127** | **21.4** | **58.1** | **32.6** |
| Iron | **19,600** | **18,800** | **19,900** | **25,100** | **23,200** | **5,430** | **14,400** | **8,630** |
| Lead | **90.4 J** | **82.2 J** | **107 J** | **43.6 J** | **29.1 J** | **6.2 J** | **15.2 J** | **16.1 J** |
| Magnesium | **18,600** | **9,270** | **9,740** | **11,500** | **15,700** | **14,500** | **10,900** | **7,460** |
| Manganese | **249** | **219** | **227** | **461** | **466** | **177** | **192** | **111** |
| Mercury | **0.16** | **0.18** | **0.13** | **0.15** | **0.14** | 0.024 U | **0.039** | 0.029 U |
| Nickel | **106 J** | **160 J** | **210 J** | **270 J** | **156 J** | **29.2 J** | **106 J** | **35.6 J** |
| Potassium | 815 U | 840 U | 778 U | 952 U | 923 U | 358 U | 559 U | 447 U |
| Selenium | **2.1** | **2.3** | **2.1** | **2.9** | **2.6** | 0.36 U | **1.5** | **0.76** |
| Silver | **8.0** | **7.0** | **8.0** | **5.4** | **2.3** | 0.36 U | 0.56 U | 0.45 U |
| Sodium | 815 U | 840 U | 778 U | 952 U | 923 U | 358 U | 559 U | 447 U |
| Thallium | 1.6 U | 1.7 U | 1.6 U | 1.9 U | 1.8 U | 0.72 U | 1.1 U | 0.89 U |
| Vanadium | **26.9** | **17.2** | **18.8** | **25.6** | **24.9** | **8.2** | **18.8** | **14.4** |
| Zinc | **334** | **292** | **414** | **241** | **192** | **36.2** | **97.5** | **83.7** |
| ***Percent Solids (%)*** | **30.7** | **29.8** | **32.1** | **26.3** | **27.1** | **69.7** | **44.7** | **55.9** |

*See notes at end of table.*

**Table 1**
**Sediment Sampling Data Summary - Total Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | |
|---|---|---|---|---|---|
| | SD-35 | SD-36 | SD-37 | SD-38 | SD-39 |
| | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 |
| ***Metals (mg/kg)*** | | | | | |
| Aluminum | **8,950** | **5,170** | **4,360** | **5,450** | **4,780** |
| Antimony | 1.6 UJ | 1.3 UJ | 1.3 UJ | 1.1 UJ | 0.7 UJ |
| Arsenic | **3.4** | **3.6** | **5.7** | **9.2** | **1.0** |
| Barium | **90.2** | **65.3** | **51.1** | **54.7** | **30.7** |
| Beryllium | 0.63 U | 0.52 U | 0.54 U | 0.44 U | 0.28 U |
| Cadmium | 0.79 UJ | 0.65 UJ | 0.67 UJ | 0.54 UJ | 0.35 UJ |
| Calcium | **18,800** | **9,310** | **18,900** | **50,700** | **1,910** |
| Chromium (total) | **17.4** | **10.8** | **9.5** | **11.5** | **9.1** |
| Cobalt | 7.9 U | 6.5 U | 6.7 U | 5.4 U | 3.5 U |
| Copper | **18.0** | **12.9** | **12.7** | **14.2** | **6.0** |
| Iron | **14,100** | **11,400** | **12,000** | **16,600** | **3,840** |
| Lead | **13.7 J** | **7.7 J** | **6.7 J** | **7.3 J** | **7.7 J** |
| Magnesium | **6,810** | **2,800** | **6,680** | **12,900** | **1,150** |
| Manganese | **275** | **176** | **211** | **219** | **46.6** |
| Mercury | 0.052 U | 0.043 U | 0.045 U | 0.036 U | 0.023 U |
| Nickel | **15.5 J** | **11.7 J** | **9.7 J** | **12.2 J** | **5.7 J** |
| Potassium | 793 U | 649 U | 674 U | 545 U | 352 U |
| Selenium | **2.4** | **3.3** | **2.5** | **1.7** | **0.5** |
| Silver | 0.79 U | 0.65 U | 0.67 U | 0.54 U | 0.35 U |
| Sodium | 793 U | 649 U | 674 U | 545 U | 352 U |
| Thallium | 1.6 U | 1.3 U | 1.3 U | 1.1 U | 0.7 U |
| Vanadium | **26.6** | **17.7** | **15.5** | **19.6** | **10.3** |
| Zinc | **75.1** | **44.6** | **38.8** | **38.2** | **20.7** |
| ***Percent Solids (%)*** | **31.5** | **38.5** | **37.1** | **45.9** | **71.0** |

*See notes at end of table.*

**Table 1**
**Sediment Sampling Data Summary - Total Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | |
|---|---|---|---|---|---|
| | SD-40 | SD-41 | SD-42 | SD-42 | SD-43 |
| | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | (DUP-08) 0.0 to 0.5 | 0.0 to 0.5 |
| ***Metals (mg/kg)*** | | | | | |
| Aluminum | **3,260** | **4,880** | **4,100** | **4,720** | **2,530** |
| Antimony | 1.4 U | 1.9 U | **0.54 J** | **0.31 J** | **0.94 J** |
| Arsenic | **5.2** | **5.2** | **3.6** | **5.6** | **2.8** |
| Barium | **31.1** | **40.3** | **36.0 J** | **44.5** | **25.9 J** |
| Beryllium | **0.25 J** | **0.30 J** | **0.25 J** | **0.32 J** | **0.19 J** |
| Cadmium | **0.057 J** | 0.96 U | **0.16 J** | **0.076 J** | 0.75 U |
| Calcium | **80,500 J** | **11,800 J** | **47,100 J** | **33,000** | **14,500** |
| Chromium (total) | **8.2** | **9.5** | **8.2** | **10.3** | **6.8** |
| Cobalt | **5.2 J** | **5.4 J** | **4.7 J** | **6.2** | **3.1 J** |
| Copper | **15.2** | **10.0** | **8.7** | **13.6** | **8.3** |
| Iron | **11,600** | **11,200** | **9,450** | **13,200** | **7,970** |
| Lead | **6.4** | **6.6** | **5.6** | **7.6** | **4.2** |
| Magnesium | **28,100** | **3,490** | **21,000** | **7,340** | **3,900** |
| Manganese | **160** | **237** | **144** | **201** | **62.0** |
| Mercury | 0.046 U | 0.064 U | 0.070 U | 0.061 U | 0.050 U |
| Nickel | **12.2** | **10.5** | **8.1 J** | **11.3** | **7.3** |
| Potassium | **429 J** | **429 J** | **366 J** | **400 J** | **241 J** |
| Selenium | 0.70 U | **1.3** | **1.1** | **0.99** | **0.80** |
| Silver | 0.70 U | 0.96 U | 1.1 U | 0.92 U | 0.75 U |
| Sodium | 698 U | 963 U | 1,060 U | 921 U | 752 U |
| Thallium | 1.4 U | 1.9 U | 2.1 U | 1.8 U | 1.5 U |
| Vanadium | **15.9** | **17.8** | **17.9** | **22.1** | **12.2** |
| Zinc | **50.4 J** | **34.2 J** | **50.0 J** | **58.7 J** | **23.1 J** |
| ***Percent Solids (%)*** | **72.0** | **52.0** | **47.0** | **54.0** | **66.0** |

*See notes at end of table.*

**Table 1**
**Sediment Sampling Data Summary - Metals**

*Notes:*

1. *For soil sampling locations, see Figure 3.*
2. *See Appendix C for analytical reports and complete analytical results.*
3. *Inorganic Data Qualifiers:*
   *J - Estimated concentration. See Data Validation Reports (Appendix D) for basis.*
   *U - Constituent not detected at indicated Reporting Limit.*
4. *For clarity, all detections are shown in* ***bold-face*** *type.*

**Table 2**
**Sediment Sampling Data Summary - PAHs**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | |
|---|---|---|
| | SD-32 | SD-34 |
| | 0.0 to 0.5 | 0.0 to 0.5 |
| ***PAHs (ug/kg)*** | | |
| Anthracene | 95 U | **620** |
| Benzo(a)anthracene | 95 U | **3,600** |
| Benzo(a)pyrene | 95 U | **4,100** |
| Benzo(b)fluoranthene | **120 J** | **7,400 J** |
| Benzo(ghi)perylene | 95 U | **3,700** |
| Chrysene | 95 U | **4,500** |
| Dibenz(a,h)anthracene | 95 U | **650** |
| Fluoranthene | **140** | **10,000** |
| Indeno(1,2,3-cd)pyrene | 95 U | **2,900** |
| Phenanthrene | 95 U | **5,700** |
| Pyrene | **130** | **8,100** |
| ***Percent Solids (%)*** | **69.7** | **55.9** |

*Notes:*

1. *For soil sampling locations, see Figure 3.*
2. *Only constituents detected in one or more soil samples are listed in this table. See Appendix C for analytical reports and complete*
3. *Organic Data Qualifiers:*
   *J - Estimated concentration. See Data Validation Reports (Appendix D) for basis.*
   *U - Constituent not detected at indicated Reporting Limit.*
4. *For clarity, all detections are shown in* ***bold-face*** *type.*

**Table 3**
**Erodible Soil Sampling Data Summary - Total Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SD-28-SB | SD-28-NB | SD-29-SB | SD-29-NB | SD-30-SB | SD-30-NB | SD-31-SB | SD-31-NB |
| | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 |
| ***Metals (mg/kg)*** | | | | | | | | |
| Aluminum | **4,750** | **5,870** | **2,160** | **3,570** | **2,780** | **2,920** | **5,510** | **5,230** |
| Antimony | 0.786 UJ | 0.751 U | 0.804 UJ | 1.11 UJ | 0.602 UJ | 0.6 UJ | 0.63 UJ | 0.651 UJ |
| Arsenic | **6.15** | **9.8** | **73.4** | **44.4** | **6.25** | **19.3** | **8.97** | **7.74** |
| Barium | **54.3** | **68.2** | **11.3** | **21.4** | **20.5** | **23.3** | **67.8** | **59.5** |
| Beryllium | 0.252 U | 0.204 U | 0.184 U | 0.188 U | 0.193 U | 0.192 U | 0.202 U | 0.208 U |
| Cadmium | **8.5** | **15.2** | **0.301** | **2.61** | **2.35** | **2.43** | **7.11** | **6.34** |
| Calcium | **16,300 J** | **19,700 J** | **26,500 J** | **38,700 J** | **17,900 J** | **68,400 J** | **37,600 J** | **25,200 J** |
| Chromium (total) | **73.9** | **71.1** | **10.5** | **39.9** | **59.2** | **44.8** | **52.8** | **49.7** |
| Cobalt | **4.35** | **5.18** | **4.93** | **4.15** | **3.41** | **3.82** | **3.98** | **4.63** |
| Copper | **50.9** | **79.8** | **18.5** | **40.5** | **31.3** | **32.2** | **48.9** | **52.3** |
| Iron | **8,590** | **11,800** | **14,400** | **12,500** | **6,020** | **8,800** | **7,920** | **8,720** |
| Lead | **33.9** | **34.4** | **6.19** | **21.8** | **9.77** | **9.78** | **11.4** | **11.2** |
| Magnesium | **8,420** | **8,750** | **13,300** | **17,300** | **4,230** | **20,100** | **19,700** | **11,000** |
| Manganese | **112 J** | **294 J** | **115 J** | **168 J** | **143 J** | **155 J** | **158 J** | **132 J** |
| Mercury | **0.0749 J** | **0.0937 J** | 0.0918 U | **0.0334 J** | 0.0963 U | 0.096 U | **0.025 J** | **0.0737 J** |
| Nickel | **30.7** | **43.2** | **53.1** | **26.6** | **58.7** | **26.7** | **35.3** | **35.8** |
| Potassium | 629 U | 601 U | 459 U | 469 U | 482 U | 480 U | 504 U | 521 U |
| Selenium | **0.516 J** | **0.7** | **0.381 J** | 0.469 U | 0.482 U | **0.484** | **0.56** | **1.01** |
| Silver | **3.97** | **3.15** | 0.459 U | **0.354 J** | **0.886** | **0.584** | **1.96** | **0.862** |
| Sodium | 126 U | 120 U | 91.8 U | 93.8 U | 96.3 U | 98.8 U | 101 U | 104 U |
| Thallium | 1.26 U | 1.2 U | 0.918 U | 0.938 U | 0.963 U | 0.96 U | 1.01 U | 1.04 U |
| Vanadium | **13.6** | **18.3** | **10** | **13.2** | **9.16** | **11.2** | **21.2** | **22** |
| Zinc | **115** | **155** | **46.3** | **71.6** | **46.3** | **50** | **60.9** | **55.2** |
| ***Percent Solids (%)*** | **63.6** | **66.6** | **87.2** | **85.3** | **83.1** | **83.3** | **79.3** | **76.8** |

*See notes at end of table.*

**Table 3**
**Erodible Soil Sampling Data Summary - Total Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SD-32-SB | SD-32-NB | SD-33-SB | | SD-33-NB | SD-34-SB | SD-34-NB | |
| | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | DUP-06 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | DUP-07 0.0 to 0.5 |
| ***Metals (mg/kg)*** | | | | | | | | |
| Aluminum | **3,340** | **4,200** | **6,930** | **2,340** | **1,240** | **10,100 J** | **5,340** | **5,690** |
| Antimony | 0.604 UJ | 0.592 UJ | 0.688 UJ | 0.6 UJ | 0.582 UJ | 1.08 UJ | 0.619 UJ | 0.654 UJ |
| Arsenic | **7.95** | **5.47** | **12.8** | **6.10** | **3.18** | **4.79 J** | **5.98** | **3.0** |
| Barium | **25.9** | **25.8** | **37.4 J** | **7.91 J** | **9.25** | **88.7 J** | **33.9** | **33.0** |
| Beryllium | 0.193 U | 0.189 U | 0.220 U | 0.192 U | 0.186 U | 0.346 U | 0.198 U | 0.209 U |
| Cadmium | **1.63** | **3.34** | **14.9 J** | **3.08 J** | **0.146** | **2.29 J** | **1.62** | **1.58** |
| Calcium | **35,900 J** | **70,800 J** | **13,900 J** | **90,200 J** | **114,000 J** | **23,100 J** | **7,640 J** | **5,830 J** |
| Chromium (total) | **29** | **95.6** | **77.1** | **52.3** | **75.2** | **81.2 J** | **146** | **172** |
| Cobalt | **3.09** | **3.66** | **3.97** | **2.97** | **2.34** | **6.59 J** | **4.27** | **4.24** |
| Copper | **22.2** | **55.2** | **43.5** | **17.5** | **30.8** | **243 J** | **18.7** | **18** |
| Iron | **7,000** | **9,160** | **20,500** | **9,120** | **6,270** | **14,300 J** | **12,400** | **8,870** |
| Lead | **8.57** | **16.2** | **11.9** | **5.01** | **3.99** | **34.2 J** | **17.8** | **20.4** |
| Magnesium | **13,900** | **14,200** | **5,020** | **14,100** | **17,700** | **11,000 J** | **3,290** | **3,290** |
| Manganese | **118 J** | **243 J** | **275 J** | **162 J** | **252 J** | **168 J** | **200 J** | **156 J** |
| Mercury | 0.0967 **U** | 0.0947 **U** | **0.0284 J** | 0.0959 U | 0.0931 U | **0.0745 J** | **0.0211 J** | **0.0282 J** |
| Nickel | **27.7** | **69.8** | **110** | **49.5** | **83.7** | **86.1 J** | **43.5** | **45.9** |
| Potassium | 483 U | 474 U | 550 U | 480 U | 466 U | 865 U | 495 U | 523 U |
| Selenium | 0.483 U | **0.391 J** | 0.55 U | 0.48 U | **0.636** | **1.18 J** | 0.495 U | 0.523 U |
| Silver | **0.178 J** | **0.411 J** | **0.189 J** | **0.14 J** | 0.466 U | 0.865 UJ | 0.495 U | 0.523 U |
| Sodium | 96.7 U | 94.7 U | 110 U | 120 U | 93.3 U | 428 UJ | 99.1 U | 105 U |
| Thallium | 0.967 U | 0.947 U | 1.1 U | 0.959 U | 0.931 U | 1.73 U | 0.991 U | 1.05 U |
| Vanadium | **11.2** | **14.2** | **20.9** | **9.77** | **7.03** | **27.5 J** | **21.2** | **17.3** |
| Zinc | **46.7** | **54.4** | **54.9** | 29.5 R | 21.7 R | **112 J** | **61.5** | **64.8** |
| ***Percent Solids (%)*** | **82.8** | **84.4** | **72.7** | **83.4** | **85.9** | **46.2** | **80.7** | **76.5** |

*See notes at end of table.*

**Table 3**
**Erodible Soil Sampling Data Summary - Total Metals**

*Notes:*

1. *For soil sampling locations, see Figure 3.*
2. *See Appendix C for analytical reports and complete analytical results.*
3. *Inorganic Data Qualifiers:*
   *J - Estimated concentration. See Data Validation Reports (Appendix D) for basis.*
   *U - Constituent not detected at indicated Reporting Limit.*
   *R - Sample result was rejected in validation and deemed unusable.*
4. *For clarity, all detections are shown in* ***bold-face*** *type.*

**Table 4**
**Erodible Soil Sampling Data Summary - PAHs**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | |
|---|---|---|---|---|---|
| | SD-32-SB | SD-32-NB | SD-34-SB | SD-34-NB | |
| | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | DUP-07 0.0 to 0.5 |
| ***PAHs (ug/kg)*** | | | | | |
| Acenaphthene | 8.1 U | 7.9 U | **36 J** | 8.3 U | 8.7 U |
| Acenaphthylene | 8.1 U | 7.9 U | **38 J** | 8.3 U | **12** |
| Anthracene | 8.1 U | 7.9 U | **140 J** | 8.3 U | **19** |
| Benzo(a)anthracene | **22** | **28** | **740 J** | **45** | **120** |
| Benzo(a)pyrene | **54** | **53** | **1,100 J** | **80** | **170** |
| Benzo(b)fluoranthene | **78 J** | **79 J** | **1,900 J** | **120 J** | **240 J** |
| Benzo(ghi)perylene | **36** | **34** | **960 J** | **68** | **130** |
| Benzo(k)fluoranthene | **22 J** | **15 J** | **730 J** | **37 J** | **120 J** |
| Chrysene | **45** | **38** | **1,200 J** | **69** | **160** |
| Dibenz(a,h)anthracene | **31** | **32** | **250 J** | **38** | **50** |
| Fluoranthene | **83** | **74** | **2,400 J** | **130** | **340** |
| Fluorene | 8.1 U | 7.9 U | **51 J** | 8.3 U | 8.7 U |
| Indeno(1,2,3-cd)pyrene | **50** | **48** | **820 J** | **70** | **120** |
| Phenanthrene | **33** | **28** | **790 J** | **48** | **130** |
| Pyrene | **63** | **58** | **1,900 J** | **100** | **260** |
| ***Percent Solids (%)*** | **82.8** | **84.4** | **46.2** | **80.7** | **76.5** |

*See notes at end of table.*

**Table 4**
**Erodible Soil Sampling Data Summary - PAHs**

*Notes:*

1. *For soil sampling locations, see Figure 3.*
2. *Only constituents detected in one or more soil samples are listed in this table. See Appendix C for analytical reports and complete analytical results.*
3. *Organic Data Qualifiers:*
   *J - Estimated concentration. See Data Validation Reports (Appendix D) for basis.*
   *U - Constituent not detected at indicated Reporting Limit.*
4. *For clarity, all detections are shown in* ***bold-face*** *type.*

**Table 5**
**Non-Erodible Soil Sampling Data Summary - Total Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | | |
|---|---|---|---|---|---|---|
| | SD-28-10N | | SD-28-30N | | SD-28-70N | |
| | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | |
| Aluminum | **7,600** | **14,800** | **7,410** | **9,010** | **8,530** | **8,080** |
| Antimony | 0.643 U | 0.608 U | 0.623 U | 0.59 U | 0.611 U | 0.601 U |
| Arsenic | **12.8** | **5.32** | **10.4** | **10.0** | **6.52** | **2.79** |
| Barium | **88.3** | **255** | **66.0** | **71.6** | **64.5 J** | **65.4** |
| Beryllium | **0.228** | **0.853** | **0.229** | **0.26** | **0.196 J** | 0.192 U |
| Cadmium | **8.49 J** | **1.53 J** | **4.19 J** | **0.298 J** | **0.454 J** | 0.141 UJ |
| Calcium | **18,300** | **6,330** | **20,400** | **3,440** | **3,140** | **2,090** |
| Chromium (total) | **87.6** | **26.2** | **39.1** | **17.3** | **16.3** | **18.0** |
| Cobalt | **5.03** | **6.37** | **3.95** | **4.14** | **4.04** | **5.09** |
| Copper | **67.7** | **58.2** | **32.2** | **8.23** | **10.8** | **5.58** |
| Iron | **16,400** | **14,300** | **15,200** | **19,400** | **13,900** | **12,100** |
| Lead | **49.0** | **16.6** | **21.2** | **11.8** | **12.5** | **9.31** |
| Magnesium | **8,500 J** | **3,800 J** | **10,500 J** | **2,350 J** | **2,420 J** | **3,170 J** |
| Manganese | **256 J** | **162 J** | **182 J** | **112 J** | **161 J** | **112 J** |
| Mercury | **0.113** | **0.0504 J** | **0.0688 J** | **0.0312 J** | **0.0652 J** | 0.0961 U |
| Nickel | **52.7** | **18.8** | **22.6** | **10.8** | **11.6** | **15.0** |
| Potassium | **669** | 486 U | **611** | 472 U | **620** | 481 U |
| Selenium | **0.679** | **0.637** | **0.625** | **0.492** | **0.564** | **0.408 J** |
| Silver | **1.72 J** | 0.486 UR | **0.889 J** | 0.472 UR | 0.489 UR | 0.481 UR |
| Sodium | 103 U | 97.2 U | 99.7 U | 94.4 U | 97.8 U | 96.1 U |
| Thallium | **1.03** | 0.972 U | **0.861 J** | 0.944 U | 0.978 U | **0.927 J** |
| Vanadium | **21.8** | **28.6** | **19.8** | **24.2** | **21.4** | **22.8** |
| Zinc | **167** | **113** | **83.3** | **32.9** | **41.8** | **35.7** |
| ***Percent Solids (%)*** | **77.8** | **82.3** | **80.2** | **84.8** | **81.8** | **83.2** |

*See notes at end of table.*

**Table 5**
**Non-Erodible Soil Sampling Data Summary - Total Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | SD-29-10N | | | SD-29-30N | | SD-29-70N | |
| | 0.0 to 0.5 | 1.0 to 1.5 | DUP-02 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | | |
| Aluminum | **3,060** | **3,950** | **3,800** | **3,660** | **5,970** | **8,990** | **13,100** |
| Antimony | 0.618 U | 0.634 U | 0.586 U | 0.608 U | 0.624 U | 0.657 U | 0.606 U |
| Arsenic | **7.68** | **18.8** | **27.8** | **8.17** | **5.65** | **6.7** | **4.05** |
| Barium | **48.2** | **40.1** | **28.5** | **54.7** | **53.8** | **85.1** | **110** |
| Beryllium | 0.198 U | 0.203 U | 0.188 U | 0.195 U | 0.200 U | **0.362** | **0.572** |
| Cadmium | **19.9 J** | **4.14 J** | **1.78** | **18.3 J** | **2.21 J** | **1.36 J** | **0.223 J** |
| Calcium | **28,800** | **23,900** | **41,400 J** | **31,500** | **8,410** | **7,120** | **4,410** |
| Chromium (total) | **308** | **62.5** | **31.9** | **260** | **19.8** | **30.0** | **19.5** |
| Cobalt | **4.38** | **3.91** | **4.88** | **4.73** | **3.01** | **3.73** | **6.25** |
| Copper | **976** | **70.8** | **36.7** | **193** | **18.5** | **26.0** | **17.5** |
| Iron | **8,700** | **8,660** | **10,200** | **10,200** | **9,020** | **10,700** | **13,300** |
| Lead | **109** | **13.6** | **9.18** | **93.0** | **14.8** | **15.9** | **13.0** |
| Magnesium | **9,960 J** | **8,780 J** | **20,000** | **9,060 J** | **2,910 J** | **2,740 J** | **4,210 J** |
| Manganese | **128 J** | **149 J** | **191 J** | **160 J** | **141 J** | **194 J** | **103 J** |
| Mercury | **0.102** | **0.0667 J** | 0.0938 U | **0.111** | **0.0567 J** | **0.0676 J** | 0.097 U |
| Nickel | **229** | **37.9** | **27.0** | **248** | **12.5** | **19.8** | **17.1** |
| Potassium | 494 U | 507 U | 469 U | 487 U | **499** | **813** | **819** |
| Selenium | 0.494 U | **0.674** | 0.469 U | **0.598** | **0.594** | **0.615** | **0.546** |
| Silver | **9.76 J** | **1.71 J** | **0.516 J** | **13 J** | **0.414 J** | **0.293 J** | 0.485 UR |
| Sodium | 98.9 U | 101 U | 93.8 U | 97.3 U | 99.9 U | 105 U | 97 U |
| Thallium | **0.79 J** | **0.896 J** | 0.938 U | 0.973 U | 0.999 U | 1.05 U | **1.05** |
| Vanadium | **9.83** | **13.9** | **16.3** | **12.1** | **14.9** | **22.7** | **25.8** |
| Zinc | **380** | **55.6** | **47.6** | **306** | **57.6** | **56.9** | **52.2** |
| ***Percent Solids (%)*** | **80.9** | **78.8** | **85.3** | **82.2** | **80.1** | **76.1** | **82.5** |

*See notes at end of table.*

**Table 5**
**Non-Erodible Soil Sampling Data Summary - Total Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | SD-30-10N | | SD-30-30N | | SD-30-70N | | |
| | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | DUP-03 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | | |
| Aluminum | 5,500 | 8,430 | 5,320 | 8,680 | 8,420 | 6,680 | 10,600 |
| Antimony | 0.65 U | 0.774 U | 0.639 U | 0.683 U | 0.633 U | 0.633 U | 0.654 U |
| Arsenic | 11.7 | 13.1 | 13.4 | 15.1 | 4.41 | 3.72 | 4.28 |
| Barium | 79.2 | 135 | 76.3 | 129 | 67.4 | 61.3 | 111 |
| Beryllium | 0.208 U | 0.553 | 0.205 U | 0.485 | 0.278 | 0.216 | 0.539 |
| Cadmium | 22.4 J | 2.04 J | 36.2 J | 1.98 J | 2.06 J | 1.93 | 0.872 J |
| Calcium | 22,800 | 20,500 | 55,500 | 14,000 | 4,190 | 4,040 J | 6,740 |
| Chromium (total) | 401 | 23.1 | 1060 | 25.9 | 35.2 | 32.7 | 17 |
| Cobalt | 5.28 | 3.54 | 7.05 | 4.78 | 3.51 | 3.09 | 3.44 |
| Copper | 229 | 55.8 | 382 | 44.2 | 21.2 | 20.2 | 26.6 |
| Iron | 11,600 | 10,700 | 13,500 | 12,300 | 10,600 | 8,780 | 11,400 |
| Lead | 31.2 | 14.2 | 44.8 | 13.7 | 13.8 | 12.7 | 11 |
| Magnesium | 8,970 J | 3,920 J | 15,500 J | 5,260 J | 1,780 J | 1,510 | 2,280 J |
| Manganese | 179 J | 222 J | 229 J | 229 J | 209 J | 193 J | 203 J |
| Mercury | 0.135 | 0.187 | 0.262 | 0.0979 J | 0.0649 J | 0.0779 J | 0.159 |
| Nickel | 232 | 22 | 554 | 22.9 | 21.6 | 20.5 | 12.1 |
| Potassium | 680 | 619 U | 644 | 547 U | 877 | 576 | 523 U |
| Selenium | 1.08 | 2.83 | 1.23 | 1.84 | 0.433 J | 0.523 | 0.953 |
| Silver | 9.11 J | 0.351 J | 20.5 J | 0.364 J | 0.33 J | 0.399 J | 0.523 UR |
| Sodium | 104 U | 124 U | 102 U | 109 U | 101 U | 101 U | 105 U |
| Thallium | 0.716 J | 0.988 J | 0.716 J | 1.09 U | 1.01 U | 1.01 U | 1.05 U |
| Vanadium | 17.7 | 34.3 | 17.4 | 28.3 | 19.5 | 16.6 | 37.2 |
| Zinc | 146 | 47.5 | 198 | 55 | 43.4 | 44 | 44.3 |
| ***Percent Solids (%)*** | 76.9 | 64.6 | 78.2 | 73.2 | 79.0 | 78.9 | 76.4 |

*See notes at end of table.*

**Table 5**
**Non-Erodible Soil Sampling Data Summary - Total Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | | |
|---|---|---|---|---|---|---|
| | SD-31-10N | | SD-31-30N | | SD-31-70N | |
| | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | |
| Aluminum | **4,230** | **9,300** | **4,510** | **4,820** | **7,480** | **6,930** |
| Antimony | 0.628 U | 0.685 U | 0.605 U | 0.593 U | 0.625 U | 0.58 U |
| Arsenic | **9.63** | **11.7** | **8.56** | **5.54** | **5.27** | **2.79** |
| Barium | **62.3** | **137** | **55.3** | **58.5** | **58.2** | **48.2** |
| Beryllium | 0.201 U | **0.643** | 0.194 U | **0.243** | **0.328** | **0.317** |
| Cadmium | **37.1 J** | **4.03 J** | **39.8** | **12** | **1.33** | **0.367** |
| Calcium | **35,900** | **35,000** | **41,700** | **17,700** | **3,050** | **2,740** |
| Chromium (total) | **508** | **36.3** | **574** | **189** | **17.7** | **10.6** |
| Cobalt | **4.69** | **4.3** | **4.98** | **3.23** | **3.16** | **1.86** |
| Copper | **191** | **101** | **220** | **70.8** | **13** | **10.4** |
| Iron | **11,400** | **12,700** | **9,280 J** | **7,170** | **10,900** | **6,950** |
| Lead | **28.2** | **18.2** | **26.8** | **13.7** | **12.2** | **6.63** |
| Magnesium | **11,600 J** | **17,000 J** | **10,300 J** | **4,980 J** | **1,480 J** | **1,310 J** |
| Manganese | **169 J** | **313 J** | **264** | **212** | **202** | **61.7** |
| Mercury | **0.136** | **0.116** | **0.129** | **0.0861 J** | **0.0453 J** | **0.0341 J** |
| Nickel | **277** | **55.1** | **324** | **105** | **11.2** | **7.47** |
| Potassium | 503 U | 548 U | 484 U | 475 U | **921** | 464 U |
| Selenium | **1.25** | **1.33** | **0.795** | **1.02** | **0.711** | **0.405 J** |
| Silver | **14 J** | **0.841 J** | **14.1** | **5.32** | **0.148 J** | 0.464 U |
| Sodium | 101 U | 110 U | 96.8 U | 94.9 U | 99.9 U | 92.8 U |
| Thallium | **0.757 J** | **0.779 J** | **0.822 J** | **0.713 J** | **0.695 J** | 0.928 U |
| Vanadium | **16** | **35.6** | **15.4** | **16.9** | **19.1** | **19.4** |
| Zinc | **231** | **74.7** | **159 J** | **52.3 J** | **31.7 J** | **15.6 J** |
| ***Percent Solids (%)*** | **79.6** | **72.9** | **82.6** | **84.3** | **80.1** | **86.2** |

*See notes at end of table.*

**Table 5**
**Non-Erodible Soil Sampling Data Summary - Total Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SD-32-10N | | | SD-32-30N | | SD-32-70N | | |
| | 0.0 to 0.5 | DUP-04 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | DUP-05 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | | | |
| Aluminum | **3,800** | **3,710** | **4,510** | **4,890** | **9,610** | **9,990** | **8,690** | **7,030** |
| Antimony | 0.598 U | 0.595 U | 0.551 U | 0.616 U | 0.635 U | 0.639 U | 0.629 U | 0.578 U |
| Arsenic | **7.65** | **7.1** | **11.5** | **8.43** | **23.2** | **11.2** | **10.8** | **2.83** |
| Barium | **44.8** | **41.7** | **46.7** | **52.5** | **91.3** | **96.6** | **88.1** | **72.8** |
| Beryllium | 0.191 U | 0.191 U | 0.176 U | 0.197 U | **0.477** | **0.406** | **0.344** | 0.185 U |
| Cadmium | **15.9** | **14.2** | **13.4** | **16.3** | **0.272** | **1.07** | **0.878** | **0.164** |
| Calcium | **40,100** | **40,800 J** | **32,800** | **45,800** | **3,840** | **4,520** | **3,740 J** | **2,260** |
| Chromium (total) | **302** | **272** | **20.9** | **354** | **16.3** | **31.5** | **26.2** | **17.4** |
| Cobalt | **4.08** | **3.92** | **2.96** | **4.33** | **3.19** | **4.22** | **3.65** | **4.35** |
| Copper | **113** | **101** | **128** | **102** | **5** | **23.7** | **21.6** | **6.98** |
| Iron | **9,250** | **9,040** | **9,810** | **11,200 J** | **32,600 J** | **15,900** | **14,600** | **9,590** |
| Lead | **26.5** | **24.1** | **92.7** | **27** | **10.2** | **18.2** | **16.5** | **6.32** |
| Magnesium | **10,800 J** | **8,530** | **8,700 J** | **8,720 J** | **1,950 J** | **2,660 J** | **2,090** | **2,720 J** |
| Manganese | **162** | **161 J** | **159** | **186** | **91.6** | **194** | **175 J** | **77.2** |
| Mercury | **0.0809 J** | **0.0695 J** | **0.117** | **0.0715 J** | **0.0649 J** | **0.0804 J** | **0.0998 J** | **0.0306 J** |
| Nickel | **268** | **219** | **61.7** | **239** | **10.1** | **23.0** | **19.3** | **12.5** |
| Potassium | 479 U | 476 U | 441 U | **681** | 508 U | **1090** | **888** | 463 U |
| Selenium | **0.685** | **0.466 J** | **0.363 J** | **0.574** | 0.508 U | **0.616** | 0.503 U | 0.463 U |
| Silver | **1.82** | **1.45** | **0.344 J** | **0.994** | 0.508 U | 0.511 U | 0.503 U | 0.463 U |
| Sodium | 95.7 U | 95.3 U | 88.2 U | 98.6 U | 102 U | 102 U | 101 U | 92.5 U |
| Thallium | 0.957 U | 0.953 U | 0.882 U | **0.841 J** | 1.02 U | **0.739 J** | 1.01 U | 0.925 U |
| Vanadium | **13.9** | **12.1** | **16.6** | **14.6** | **28.1** | **28.7** | **27.6** | **21.8** |
| Zinc | **104 J** | **111** | **68.7 J** | **120 J** | **24.4 J** | **50 J** | **47.2** | **27.5 J** |
| ***Percent Solids (%)*** | **83.6** | **84.0** | **90.7** | **81.1** | **78.8** | **78.2** | **79.5** | **86.5** |

*See notes at end of table.*

**Table 5**
**Non-Erodible Soil Sampling Data Summary - Total Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | | |
|---|---|---|---|---|---|---|
| | SD-33-10N | | SD-33-30N | | SD-33-70N | |
| | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | |
| Aluminum | **4,990** | **3,970** | **3,610** | **5,950** | **5,360** | **3,020** |
| Antimony | 0.578 U | 0.542 U | 0.593 U | 0.553 U | 0.573 U | **0.439 J** |
| Arsenic | **5.01** | **2.07** | **7.1** | **2.95** | **2.95** | **2.32** |
| Barium | **24.5** | **17.7** | **30.2** | **19.7** | **21.4** | **14.9** |
| Beryllium | 0.185 U | 0.174 U | 0.19 U | 0.177 U | 0.183 U | 0.174 U |
| Cadmium | **10.7** | **0.42** | **12** | **0.215** | **0.548** | 0.087 U |
| Calcium | **19,800** | **939** | **23,400** | **1,320** | **1,640** | **568** |
| Chromium (total) | **356** | **14.4** | **236** | **12.6** | **13.0** | **9.26** |
| Cobalt | **3.84** | **2.66** | **3.45** | **3.42** | **2.77** | **2.42** |
| Copper | **60.7** | **3.65** | **58.1** | **4.72** | **6.43** | **2.06** |
| Iron | **10,300** | **7,000** | **11,600 J** | **11,300** | **9,240** | **7,620** |
| Lead | **12.1** | **4.85** | **14.9** | **6.79** | **10.8** | **5.35** |
| Magnesium | **5,060 J** | **1,110 J** | **6,710 J** | **1,140 J** | **1,090 J** | **852 J** |
| Manganese | **157** | **66.2** | **170** | **71.7** | **83.3** | **52.4** |
| Mercury | **0.0238 J** | 0.0868 U | **0.0226 J** | 0.0885 U | 0.0916 U | 0.087 U |
| Nickel | **208** | **7.59** | **163** | **7.21** | **8.0** | **4.53** |
| Potassium | 463 U | 434 U | 474 U | 442 U | 458 U | 435 U |
| Selenium | **0.536** | 0.434 U | **0.52** | 0.442 U | **0.418 J** | 0.435 U |
| Silver | **0.275 J** | 0.434 U | **0.182 J** | 0.442 U | 0.458 U | 0.435 U |
| Sodium | 97.1 U | 86.8 U | 94.8 U | 88.5 U | 91.6 U | 87 U |
| Thallium | **0.755 J** | 0.868 U | 0.948 U | **0.843 J** | 0.916 U | 0.87 U |
| Vanadium | **13.9** | **15.6** | **13.1** | **22.6** | **19.2** | **17.4** |
| Zinc | **36.9 J** | **10.3 J** | **122 J** | **18.1 J** | **25.0 J** | **9.53 J** |
| ***Percent Solids (%)*** | **86.5** | **92.2** | **84.4** | **90.4** | **87.3** | **92.0** |

*See notes at end of table.*

**Table 5**
**Non-Erodible Soil Sampling Data Summary - Total Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | | |
|---|---|---|---|---|---|---|
| | SD-34-10N | | SD-34-30N | | SD-34-70N | |
| | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | |
| Aluminum | **5,290** | **4,770** | **5,130** | **4,090** | **6,180** | **5,220** |
| Antimony | 0.578 U | 0.564 U | 0.605 U | 0.548 U | 0.574 U | 0.562 U |
| Arsenic | **4.77** | **3.33** | **2.99** | **3.1** | **2.84** | **2.77** |
| Barium | **60.1** | **32** | **38.4** | **25.1** | **39.1** | **33.1** |
| Beryllium | 0.185 U | 0.181 U | 0.194 U | 0.175 U | 0.184 U | 0.180 U |
| Cadmium | **1.74** | **1.64** | **1.45** | **0.242** | **0.674 J** | **0.201 J** |
| Calcium | **6,250** | **12,000** | **10,500** | **1,630** | **1,780** | **1,310** |
| Chromium (total) | **234** | **224** | **136** | **11.9** | **14.4** | **10.7** |
| Cobalt | **5.26** | **3.62** | **3.38** | **2.22** | **3.65** | **2.97** |
| Copper | **18.3** | **18.4** | **29.7** | **4.03** | **7.0** | **3.9** |
| Iron | **14,100** | **9,850** | **8,700 J** | **9,310** | **10,100** | **13,500** |
| Lead | **27.2** | **26** | **20** | **5.6** | **12.7** | **6.37** |
| Magnesium | **3,260 J** | **3,230 J** | **4,670 J** | **1,030 J** | **1,480 J** | **1,390 J** |
| Manganese | **498** | **152** | **173** | **81.4** | **248 J** | **183 J** |
| Mercury | **0.0199 J** | 0.0903 U | 0.0968 U | **0.0221 J** | **0.018 J** | **0.0225 J** |
| Nickel | **55.0** | **55.0** | **41.2** | **5.46** | **9.15** | **5.6** |
| Potassium | **464** | 452 U | **554** | 439 U | **482** | 494 U |
| Selenium | 0.462 U | 0.452 U | 0.484 U | 0.439 U | 0.459 U | **0.381 J** |
| Silver | 0.462 U | 0.452 U | 0.484 U | 0.439 U | 0.459 UR | 0.449 UR |
| Sodium | 92.4 U | 90.3 U | 96.8 U | 87.7 U | 91.8 U | 89.8 U |
| Thallium | 0.924 U | **0.779 J** | **0.708 J** | 0.877 U | 0.918 U | 0.898 U |
| Vanadium | **20.1** | **15.4** | **15.3** | **15.9** | **18.9** | **20.6** |
| Zinc | **52.7 J** | **52.1 J** | **70.6 J** | **25 J** | **32.7** | **25.8** |
| ***Percent Solids (%)*** | **86.6** | **88.6** | **82.6** | **91.2** | **87.1** | **89.0** |

*See notes at end of table.*

**Table 5**
**Non-Erodible Soil Sampling Data Summary - Total Metals**

*Notes:*

1. *For soil sampling locations, see Figure 3.*
2. *See Appendix C for analytical reports and complete analytical results.*
3. *Inorganic Data Qualifiers:*
   *J - Estimated concentration. See Data Validation Reports (Appendix D) for basis.*
   *U - Constituent not detected at indicated Reporting Limit.*
   *R - Sample result was rejected in validation and deemed unusable.*
4. *For clarity, all detections are shown in* ***bold-face*** *type.*

**Table 6**
**Non-Erodible Soil Sampling Data Summary - PAHs**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SD-32-10N | | | SD-32-30N | | SD-32-70N | | |
| | 0.0 to 0.5 | DUP-04 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | DUP-05 0.0 to 0.5 | 1.0 to 1.5 |
| ***PAHs (ug/kg)*** | | | | | | | | |
| 1-Methylnaphthalene | **11** | 7.9 U | 7.4 U | 8.2 U | 8.5 U | 8.5 U | 8.4 U | 7.7 U |
| 2-Methylnaphthalene | **14** | 7.9 U | **8.8** | 8.2 U | 8.5 U | 8.5 U | 8.4 U | 7.7 U |
| Acenaphthene | **23** | 7.9 U | 7.4 U | 8.2 U | 8.5 U | 8.5 U | 8.4 U | 7.7 U |
| Acenaphthylene | **15** | **13** | 7.4 U | 8.2 U | 8.5 U | 8.5 U | 8.4 U | 7.7 U |
| Anthracene | **110 J** | **12 J** | **9.5** | **9.4** | 8.5 U | 8.5 U | 8.4 U | 7.7 U |
| Benzo(a)anthracene | **170** | **61** | **33** | **53** | 8.5 U | **12** | **11** | 7.7 U |
| Benzo(a)pyrene | **170** | **91** | **54** | **100** | 8.5 U | **34** | **32** | 7.7 U |
| Benzo(b)fluoranthene | **250 J** | **140 J** | **71 J** | **160 J** | 8.5 U | **40 J** | **40 J** | 7.7 U |
| Benzo(ghi)perylene | **120** | **73** | **33** | **97** | 8.5 U | **12** | **11** | 7.7 U |
| Benzo(k)fluoranthene | **100 J** | **50 J** | **25 J** | **62 J** | 8.5 U | **10 J** | 8.4 U | 7.7 U |
| Chrysene | **190** | **84** | **46** | **96** | 8.5 U | **16** | **13** | 7.7 U |
| Dibenz(a,h)anthracene | **50** | **39** | **31** | **41** | 8.5 U | 8.5 U | 8.4 U | 7.7 U |
| Fluoranthene | **470 J** | **150 J** | **84** | **160** | 8.5 U | **28** | **22** | 7.7 U |
| Fluorene | **53 J** | 7.9 UJ | 7.4 U | 8.2 U | 8.5 U | 8.5 U | 8.4 U | 7.7 U |
| Indeno(1,2,3-cd)pyrene | **120** | **72** | **46** | **93** | 8.5 U | **33** | **32** | 7.7 U |
| Naphthalene | **13** | 7.9 U | 7.4 U | 8.2 U | 8.5 U | 8.5 U | 8.4 U | 7.7 U |
| Phenanthrene | **370 J** | **51 J** | **43** | **49** | 8.5 U | **12** | **8.8** | 7.7 U |
| Pyrene | **330** | **130** | **65** | **130** | 8.5 U | **22** | **18** | 7.7 U |
| ***Percent Solids (%)*** | **83.6** | **84.0** | **90.7** | **81.1** | **78.8** | **78.2** | **79.5** | **86.5** |

*See notes at end of table.*

**Table 6**
**Non-Erodible Soil Sampling Data Summary - PAHs**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | | |
|---|---|---|---|---|---|---|
| | SD-34-10N | | SD-34-30N | | SD-34-70N | |
| | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 |
| ***PAHs (ug/kg)*** | | | | | | |
| 1-Methylnaphthalene | 7.7 U | 7.5 U | 8.1 U | 7.3 U | 7.7 U | 7.5 U |
| 2-Methylnaphthalene | 7.7 U | 7.5 U | 8.1 U | 7.3 U | 7.7 U | 7.5 U |
| Acenaphthene | 7.7 U | 7.5 U | 8.1 U | 7.3 U | 7.7 U | 7.5 U |
| Acenaphthylene | **11** | **13** | **14** | 7.3 U | 7.7 U | 7.5 U |
| Anthracene | **11** | **12** | **37** | 7.3 U | 7.7 U | 7.5 U |
| Benzo(a)anthracene | **70** | **65** | **200** | 7.3 U | **18** | 7.5 U |
| Benzo(a)pyrene | **98** | **96** | **260** | **23** | **42** | **20** |
| Benzo(b)fluoranthene | **150 J** | **140 J** | **380 J** | **24 J** | **54 J** | **19 J** |
| Benzo(ghi)perylene | **75** | **71** | **210** | 7.3 U | **22** | 7.5 U |
| Benzo(k)fluoranthene | **58 J** | **51 J** | **200 J** | 7.3 U | **16 J** | 7.5 U |
| Chrysene | **83** | **78** | **280** | 7.3 U | **26** | 7.5 U |
| Dibenz(a,h)anthracene | **38** | **38** | **65** | 7.3 U | **29** | 7.5 U |
| Fluoranthene | **160** | **140** | **520** | **12** | **53** | 7.5 U |
| Fluorene | 7.7 U | 7.5 U | **12** | 7.3 U | 7.7 U | 7.5 U |
| Indeno(1,2,3-cd)pyrene | **78** | **74** | **180** | **25** | **39** | 7.5 U |
| Naphthalene | 7.7 U | 7.5 U | 8.1 U | 7.3 U | 7.7 U | 7.5 U |
| Phenanthrene | **49** | **37** | **180** | 7.3 U | 17 | 7.5 U |
| Pyrene | **130** | **120** | **420** | **9** | **41** | 7.5 U |
| ***Percent Solids (%)*** | **86.6** | **88.6** | **82.6** | **91.2** | **87.1** | **89.0** |

*See notes at end of table.*

**Table 6**
**Non-Erodible Soil Sampling Data Summary - PAHs**

*Notes:*

1. *For soil sampling locations, see Figure 3.*
2. *Only constituents detected in one or more soil samples are listed in this table. See Appendix C for analytical reports and complete analytical results.*
3. *Organic Data Qualifiers:*

   *J - Estimated concentration. See Data Validation Report (Appendix D) for basis.*

   *U - Constituent not detected at indicated Reporting Limit.*
4. *For clarity, all detections are shown in* ***bold-face*** *type.*

**Table 7**
**Non-Erodible Soil Sampling Data Summary - SPLP Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | |
|---|---|---|---|---|---|
| | SD-28-10N | SD-29-10N | SD-29-30N | SD-30-10N | SD-30-10N |
| | 1.0 to 1.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (ug/L)*** | | | | | |
| Aluminum | **446 J** | **898 J** | **358 J** | **1270 J** | 200 U |
| Antimony | 300 U | **1.9 J** | 300 U | 300 U | 300 U |
| Arsenic | 500 U | **7.8 J** | **3.6 J** | **5.6 J** | 500 U |
| Barium | 10,000 U | 10,000 U | 10,000 U | 10,000 U | 10,000 U |
| Beryllium | 5 U | 5 J | 5 U | 5 U | 5 U |
| Cadmium | 100 U | **4.5 J** | **0.98 J** | **2.1 J** | 100 U |
| Calcium | 5,000 U | **11,400** | **11,700** | **12,400** | **13,500** |
| Chromium (hexavalent) | 20 U | 20 U | 20 U | 20 U | 20 U |
| Chromium (total) | 500 U | **86.3 J** | **23.7 J** | **55.2 J** | 500 U |
| Cobalt | 50 U | **2.9 J** | 50 U | 50 U | 50 U |
| Copper | 1,000 U | **46.2** | **20.2 J** | **28.5 J** | **5.4 J** |
| Iron | **301 J** | **1,580 J** | **535 J** | **1,190 J** | 100 U |
| Lead | 500 U | **17.8 J** | **4.3 J** | **3.3 J** | 500 U |
| Magnesium | 5,000 U | 5,000 U | 5,000 U | 5,000 U | 5,000 U |
| Manganese | 15 U | 15 U | 15 U | 15 U | 15 U |
| Mercury | 2 U | 2 U | 2 U | 2 U | 2 U |
| Nickel | 40 U | **56.7** | **29.2 J** | **38.3 J** | 40 U |
| Potassium | **126 J** | **2,460 J** | **2,020 J** | **856 J** | **94.2 J** |
| Selenium | 250 U | 250 U | 250 U | 250 U | 250 U |
| Silver | 500 U | **5.5 J** | 500 U | 500 U | 500 U |
| Sodium | 5,000 U | 20,000 R | 7,220 R | 23,700 R | 5,000 U |
| Thallium | 2,000 U | 2,000 U | 2,000 U | 2,000 U | 2,000 U |
| Vanadium | **1.7 J** | **5.9 J** | **2.1 J** | **4.7 J** | **1.7 J** |
| Zinc | 1,000 U | **71.3 J** | **22.9 J** | **19.1 J** | 1,000 U |
| ***Cyanide (ug/L)*** | | | | | |
| DI Leachable Cyanide | 10 U | 10 U | 10 U | 10 U | 10 U |
| Weak Acid Dissociable Cyanide | 10 U | 10 U | 10 U | 10 U | 10 U |

*See notes at end of table.*

**Table 7**
**Non-Erodible Soil Sampling Data Summary - SPLP Metals**

| Constituent | Concentration by Sample Location and Depth (ft-bgs) | | | | |
|---|---|---|---|---|---|
| | SD-30-30N | SD-31-10N | SD-31-30N | SD-32-30N | SD-34-10N |
| | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 |
| ***Metals (ug/L)*** | | | | | |
| Aluminum | 200 U | 200 U | **425 J** | **3610 J** | **3910 J** |
| Antimony | 300 U | 300 U | 300 U | 300 U | 300 U |
| Arsenic | 500 U | 500 U | 500 U | **12.6 J** | 500 U |
| Barium | 10,000 U | 10,000 U | 10,000 U | 10,000 U | 10,000 U |
| Beryllium | 5 U | 5 U | 5 U | 5 U | 5 U |
| Cadmium | 100 U | 100 U | **2.5 J** | 100 U | 100 U |
| Calcium | **14,000** | **13,200** | **12,000** | 5,000 U | **7,170** |
| Chromium (hexavalent) | 20 U | 20 U | 20 U | 20 U | 20 U |
| Chromium (total) | **14.7 J** | **7.9 J** | **40.9 J** | **6.5 J** | **49.8 J** |
| Cobalt | 50 U | 50 U | 50 U | 50 U | 50 U |
| Copper | **19.6 J** | **16.5 J** | **24.2 J** | 1,000 U | **5.9 J** |
| Iron | 100 U | 100 U | **413 J** | **13,300 J** | **3,830 J** |
| Lead | 500 U | 500 U | **2.2 J** | **2.8 J** | **6.3 J** |
| Magnesium | 5,000 U | 5,000 U | 5,000 U | 5,000 U | 5,000 U |
| Manganese | 15 U | 15 U | 15 U | **17.1** | **49.5** |
| Mercury | 2 U | 2 U | 2 U | 2 U | 2 U |
| Nickel | **33.4 J** | **20.3 J** | **36.4 J** | **3.7 J** | **15.3 J** |
| Potassium | **5,100** | **4,930 J** | **1,260 J** | **254 J** | **1,190 J** |
| Selenium | 250 U | 250 U | 250 U | 250 U | 250 U |
| Silver | 500 U | 500 U | 500 U | 500 U | 500 U |
| Sodium | 5,000 U | 5,000 U | 5,000 U | 16,300 R | 20,100 R |
| Thallium | 2,000 U | 2,000 U | 2,000 U | 2,000 U | 2,000 U |
| Vanadium | **1.6 J** | **2.9 J** | **3.3 J** | **11.8 J** | **10 J** |
| Zinc | 1,000 U | 1,000 U | **10.8 J** | **7.6 J** | **20.7 J** |
| ***Cyanide (ug/L)*** | | | | | |
| DI Leachable Cyanide | 10 U | 10 U | 10 U | 10 U | 10 U |
| Weak Acid Dissociable Cyanide | 10 U | 10 U | 10 U | 10 U | 10 U |

*See notes at end of table.*

**Table 7**
**Non-Erodible Soil Sampling Data Summary - SPLP Metals**

*Notes:*

1. *For soil sampling locations, see Figure 3.*
2. *See Appendix C for analytical reports and complete analytical results.*
3. *Inorganic Data Qualifiers:*

   *J - Estimated concentration. See Data Validation Reports (Appendix D) for basis.*

   *U - Constituent not detected at indicated Reporting Limit.*

   *R - Sample result was rejected and unusable due to major blank excursions.*
4. *For clarity, all detections are shown in* ***bold-face*** *type.*

**Table 8**

**ROD-Specified County Drain #30 Sediment and Soil Cleanup Goals**

| Constituent of Concern | ROD-Specified Cleanup Goal | | | | | |
|---|---|---|---|---|---|---|
| | Sediment | | Surface Soil in 10-Year Floodplain | | Other Site Soil | |
| | Concentration | Basis | Concentration | Basis | Concentration | Basis |
| Antimony | 2.0 | SQB | 7.0 | Soil Bkgd | 36 | GSI |
| Arsenic | 6.6 | DCV | 6.0 | Soil Bkgd | 6.6 | DCV |
| Barium | 10 | Sed Bkgd | 85 | Soil Bkgd | 130 | GSI |
| Cadmium | 5.0 | SQB | 1.2 | Soil Bkgd | 3.6 | GSI |
| Chromium (hexvalent) | NS | -- | 7.0 | Soil Bkgd | 3.3 | GSI |
| Chromium (total) | 80 | SQB | NS | -- | NS | -- |
| Copper | 70 | SQB | 32 | Soil Bkgd | 4,000 | GSI |
| Lead | 35 | SQB | 21 | Soil Bkgd | 1.0 | GSI |
| Manganese | 97 | Sed Bkgd | NS | -- | NS | -- |
| Mercury | 0.20 | SQB | 0.13 | Soil Bkgd | 0.17 | GSI |
| Nickel | 30 | SQB | 20 | Soil Bkgd | 88 | GSI |
| Selenium | NS | -- | NS | -- | 0.40 | GSI |
| Silver | 1.0 | SQB | 1.0 | Soil Bkgd | 0.067 | GSI |
| Vanadium | 5.4 | Sed Bkgd | 41 | Soil Bkgd | 130 | GSI |
| Zinc | 120 | SQB | 72 | Soil Bkgd | 190 | GSI |
| Cyanide (total) | 0.1 | SQB | 0.4 | Soil Bkgd | 0.1 | GSI |
| Total PAHs | 4 | SQB | NS | -- | NS | -- |

*See notes at end of table.*

**Table 8**

**ROD-Specified County Drain #30 Sediment and Soil Cleanup Goals**

*Notes:*

1. *All concentrations presented in units of mg/kg to two significant figures.*
2. *Table adapted from 1998 ROD Tables 1 and 2. Listed constituents are those for which a cleanup goal is specified in the ROD for at least one affected environmental medium ( i.e., sediment or soil).*
3. *Sediment Quality Benchmarks (SQBs) include the following:*

   *"NOAA Exposure Risk - Low" - Sediment concentration with low potential risk to aquatic organisms, from Long and Morgan (1990).*

   *"Ontario Lowest Effect Level" - Lowest concentration in sediment at which effects to aquatic organisms was observed, from Persaud, et al. (1993).*
4. *"DCV" - Michigan Part 201 residential direct contact value in use at time of ROD.*
5. *"Sed Bkgd" - Sediment background ( i.e., value at RI sediment sample SD-11).*
6. *"NS" - No standard.*
7. *Total PAHs = Sum of concentrations of 16 polycyclic aromatic hydrocarbon (PAH) compounds, as specified in Persaud, et al. (1993).*
8. *"Soil Bkgd" - Soil background; basis of determination not specified in ROD.*
9. *"GSI" - Soil concentration protective of groundwater based on groundwater-to-surface water interface criteria.*

**Table 9**
**Background Metals and Cyanide Concentrations in Sediment and Soil**

| Constituent | Site-Specific | | Michigan State-Wide Soil Background |
|---|---|---|---|
| | Sediment | Soil | |
| Antimony | 0.96 | 6.6 | NS |
| Arsenic | 4.8 | 8.9 | 5.8 |
| Barium | 60 | 96 | 75 |
| Cadmium | 0.2 | 0.79 | 1.2 |
| Chromium (hexvalent) | ND | ND | NS |
| Chromium (total) | 10 | 25 | 18 |
| Copper | 14 | 45 | 32 |
| Lead | 7.3 | 49 | 21 |
| Manganese | 218 | 1,000 | 440 |
| Mercury | ND | 0.14 | 0.13 |
| Nickel | 12 | 12 | 20 |
| Selenium | 2.2 | ND | 0.41 |
| Silver | ND | ND | 1.0 |
| Vanadium | 20 | 41 | NS |
| Zinc | 52 | 82 | 47 |
| Cyanide (total) | ND | 0.19 | NS |

*Notes :*

1. *All concentrations presented in units of mg/kg to two significant figures.*
2. *Site-specific sediment background calculated using 2010 data and MDEQ 2002 guidance. See Appendix E.*
3. *Site-specific soil background from 1993 RI.*
4. *State-wide background from MDEQ RRD Op Memo No. 1 (January 23, 2006).*
5. *"ND" - Constituent not detected in background sampling. Reporting Limits vary.*
6. *"NS" - No standard.*

**Table 10**
**Michigan Part 201**
**Residential Direct Contact Values**

| Constituent of Concern | Residential Direct Contact Value (DCV) |
|---|---|
| Antimony | 180 |
| Arsenic | 7.6 |
| Barium | 37,000 |
| Cadmium | 550 |
| Chromium (hexavalent) | 2,500 |
| Chromium (total) | NS |
| Copper | 20,000 |
| Lead | 400 |
| Manganese | 25,000 |
| Mercury | 160 |
| Nickel | 40,000 |
| Selenium | 2,600 |
| Silver | 2,500 |
| Vanadium | 750 |
| Zinc | 170,000 |
| Cyanide (total) | 12 |
| Polycyclic Aromatic Hydrocarbons | Varies |

*Notes:*

1. *Values from MDEQ RRD Op Memo No. 1 (January 23, 2006).*
2. *All concentrations presented in units of mg/kg to two significant figures.*
3. *"NS" - No standard.*
4. *Specific direct-contact values apply to individual PAHs. Value range from 2 mg/kg for benzo(a)pyrene to 230,000 mg/kg for anthracene.*

**Table 11**
**Site-Specific Groundwater-to-Surface Water Interface (GSI) Criteria**

| Constituent | Acute Conditions | | Chronic Conditions | |
|---|---|---|---|---|
| | Concentration (µg/L) | Loading (lbs/day) | Concentration (µg/L) | Loading (lbs/day) |
| cis-1,2-dichlorotheylene | 11,000 | 20 | 670 | 1.2 |
| 1,2-dichloroethylene (total) | 19,000 | 34 | 1,200 | 2.1 |
| Ethylbenzene | 320 | 0.58 | 19 | 0.035 |
| Tetrachloroethylene | No standard | | 73 | 0.13 |
| Trichloroethylene | 3,500 | 6.3 | 210 | 0.39 |
| Vinyl chloride | No standard | | 16 | 0.029 |
| Xylene | 730 | 1.3 | 44 | 0.080 |
| Antimony | 2,300 | 4.2 | 260 | 0.5 |
| Arsenic | No standard | | 160 | 0.29 |
| Barium | No standard | | 1,300 | 2.4 |
| Cadmium | 50 | 0.091 | 10 | 0.018 |
| Chromium (trivalent) | No standard | | 260 | 0.47 |
| Chromium (hexavalent) | 32 | 0.058 | 12 | 0.021 |
| Copper | 99 | 0.18 | 32 | 0.058 |
| Lead | 2,300 | 4.2 | 140 | 0.25 |
| Manganese | 19,200 | 35 | 10,000 | 18 |
| Mercury | 2.0 | 0.0036 | 0.70 | 0.0013 |
| Nickel | 2,300 | 4.2 | 140 | 0.25 |
| Selenium | 100 | 0.18 | 5.4 | 0.010 |
| Silver | 1.1 | 0.0020 | 0.064 | 0.00012 |
| Vanadium | 220 | 0.40 | 13 | 0.023 |
| Zinc | 1,100 | 2.0 | 600 | 1.1 |
| Cyanide (free) | 44 | 0.080 | 5.6 | 0.010 |

*Notes:*

1. *Values provided in MDEQ Memorandum of September 16, 2008, except where shown in blue. These constituents were not specifically listed in the MDEQ Memorandum; the listed values were calculated using the same assumptions and bases as identified in the MDEQ Memorandum.*

**Table 12**
**Site-Specific Calculated Non-Erodible Soil Cleanup Goals Protective of GSI Criteria**

| Constituent of Concern | Mean SPLP Concentration (µg/L) | Mean Total Metals Concentration (mg/kg) | GSI Criterion (µg/L) | Calculated Cleanup Goal (mg/kg) |
|---|---|---|---|---|
| Antimony | 1.9 | 0.618 | 260 | 85 |
| Arsenic | 7.4 | 9.15 | 160 | 200 |
| Barium | ND | 73.6 | 1,300 | NS |
| Cadmium | 2.5 | 17.9 | 10 | 72 |
| Chromium (hexavalent) | ND | NA | 12 | NS |
| Chromium (total) | 35.6 | 341.1 | 260 | 2,500 |
| Copper | 20.8 | 150.3 | 32 | 230 |
| Lead | 3.8 | 40.1 | 140 | 1,500 |
| Manganese | 33.3 | 178.3 | 10,000 | 54,000 |
| Mercury | ND | 0.12 | 0.70 | NS |
| Nickel | 29.2 | 197 | 140 | 940 |
| Selenium | ND | 0.93 | 5.4 | NS |
| Silver | 5.5 | 9.76 | 0.064 | NS |
| Vanadium | 4.6 | 20 | 13 | 56 |
| Zinc | 16.2 | 165.8 | 600 | 6,100 |
| Cyanide (free) | ND | NA | 5.6 | NS |

*Notes:*

1. *"ND" - Constituent not detected in SPLP analyses.*
2. *"NS" - No standard.*
3. *"NA" - Not available. Samples not analyzed for this COC.*
4. *The SPLP and total metals data for SD-29-10N (0.0 to 0.5') were utilized in the calculation of the Site-specific cleanup goals for antimony because antimony was only detected in the SPLP sample from this location.*
5. *No cleanup goal is applicable to silver because silver has not been detected in any well located north of CD #30 (where the subject non-erodible soils are situated) or any other recent groundwater samples, including WLA source area samples.*

**Table 13**
**Site-Specific Calculated Non-Erodible Soil Cleanup Goals Protective of Groundwater Boundary Criteria**

| Constituent of Concern | Mean SPLP Concentration (µg/L) | Mean Total Metals Concentration (mg/kg) | Site Boundary Criterion (µg/L) | Calculated Cleanup Goal (mg/kg) |
|---|---|---|---|---|
| Cadmium | 2.5 | 17.9 | 5.0 | 36 |
| Lead | 3.8 | 40.1 | 4.0 | 42 |
| Mercury | ND | 0.12 | 1.0 | NS |
| Nickel | 29.2 | 197 | 100 | 670 |
| Silver | 5.5 | 9.76 | 34 | 60 |
| Zinc | 16.2 | 165.8 | 2,400 | 25,000 |
| Cyanide (free) | ND | NA | 200 | NS |

*Notes :*

1. *"ND" - Constituent not detected in SPLP analyses.*
2. *"NS" - No standard.*
3. *"NA" - Not available. Samples not analyzed for this COC.*
4. *No cleanup goal is applicable to silver because silver has not been detected in any well located north of CD #30 (where the subject non-erodible soils are situated) or any other recent groundwater samples, including WLA source area samples .*

**Table 14**
**Summary of Proposed Sediment Cleanup Goals**

| Constituent of Concern | ROD-Specified Cleanup Goal | | Proposed Cleanup Goal | | |
|---|---|---|---|---|---|
| | Value | Basis | Site-Specific Background | Sediment Quality Benchmark | Direct Contact |
| Antimony | 2.0 | SQB | 0.96 | **2.0** | 180 |
| Arsenic | 6.6 | DCV | 4.8 | NS | **7.6** |
| Barium | 10 | Sed Bkgd | **60** | NS | 37,000 |
| Cadmium | 5.0 | SQB | 0.2 | **5.0** | 550 |
| Chromium (total) | 80 | SQB | 10 | **80** | NS |
| Copper | 70 | SQB | 14 | **70** | 20,000 |
| Lead | 35 | SQB | 7 | **35** | 400 |
| Manganese | 97 | Sed Bkgd | **220** | NS | 25,000 |
| Mercury | 0.20 | SQB | ND | **0.20** | 160 |
| Nickel | 30 | SQB | 12 | **30** | 40,000 |
| Silver | 1.0 | SQB | ND | **1.0** | 2,500 |
| Vanadium | 5.4 | Sed Bkgd | **20** | NS | 750 |
| Zinc | 120 | SQB | 52 | **120** | 170,000 |
| Cyanide (total) | 0.1 | SQB | ND | **0.10** | 12 |
| Total PAHs | 4 | SQB | -- | **4** | Varies |

*Notes:*

1. *The list of COCs in this table is from ROD Table 2.*
2. *All concentrations presented in units of mg/kg to two significant figures.*
3. *Controlling values for porposed cleanup goals are shaded.*
4. *"NS" - No standard.*
5. *"ND" - Constituent not detected in background sampling. Reporting Limits vary.*
6. *"--" - Background concentration not determined.*

**Table 15**
**Summary of Proposed Erodible Soil Cleanup Goals**

| Constituent of Concern | ROD-Specified Cleanup Goal | | Proposed Cleanup Goal | | | | |
|---|---|---|---|---|---|---|---|
| | Value | Basis | Site-Specific Soil Background | Groundwater to Surface Water Interface Protection | Groundwater Boundary Protection | Sediment Quality Benchmark | Direct Contact |
| Antimony | 7.0 | Soil Bkgd | **6.6** | 85 | NA | 2.0 | 180 |
| Arsenic | 6.0 | Soil Bkgd | **8.9** | 200 | NA | NS | 7.6 |
| Barium | 85 | Soil Bkgd | **96** | NS | NA | NS | 37,000 |
| Cadmium | 1.2 | Soil Bkgd | 0.79 | 72 | 36 | **5.0** | 550 |
| Chromium (hexavalent) | 7.0 | Soil Bkgd | ND | NS | NA | NS | 2,500 |
| Chromium (total) | NS | -- | 25 | 2,500 | NA | **80** | NS |
| Copper | 32 | Soil Bkgd | 45 | 230 | NA | **70** | 20,000 |
| Lead | 21 | Soil Bkgd | **49** | 1,500 | 42 | 35 | 400 |
| Manganese | NS | -- | **1,000** | 54,000 | NA | NS | 25,000 |
| Mercury | 0.13 | Soil Bkgd | 0.14 | NS | NS | **0.20** | 160 |
| Nickel | 20 | Soil Bkgd | 12 | 940 | 670 | **30** | 40,000 |
| Silver | 1.0 | Soil Bkgd | ND | NS | NS | **1.0** | 2,500 |
| Vanadium | 41 | Soil Bkgd | **41** | 56 | NA | NS | 750 |
| Zinc | 72 | Soil Bkgd | 82 | 6,100 | 25,000 | **120** | 170,000 |
| Cyanide (total) | 0.4 | Soil Bkgd | **0.19** | NS | NA | 0.10 | 12 |
| Total PAHs | NS | -- | -- | NA | NA | **4** | Varies |

*Notes:*

1. *List of COCs from ROD Tables 1 and 2.*
2. *All concentrations presented in units of mg/kg to two significant figures.*
3. *"NA" - Cleanup goals are not applicable to this COC via indicated pathway.*
4. *Controlling values are boxed, shaded, and shown in* ***bold-face*** *type.*

**Table 16**
**Summary of Proposed Non-Erodible Soil Cleanup Goals**

| Chemical of Concern | ROD-Specified Cleanup Goal | | Proposed Cleanup Goal | | | |
|---|---|---|---|---|---|---|
| | Value | Basis | Site-Specific Soil Background | Groundwater to Surface Water Interface Protection | Groundwater Boundary Protection | Direct Contact |
| Antimony | 36 | GSI | 6.6 | **85** | NA | 180 |
| Arsenic | 6.6 | DCV | **8.9** | 200 | NA | 7.6 |
| Barium | 130 | GSI | 96 | NS | NA | **37,000** |
| Cadmium | 3.6 | GSI | 0.79 | 72 | **36** | 550 |
| Chromium (hexavalent) | 3.3 | GSI | ND | NS | NA | **2,500** |
| Chromium (total) | NS | -- | 25 | **2,500** | NA | NS |
| Copper | 4,000 | GSI | 45 | **230** | NA | 20,000 |
| Lead | 1.0 | GSI | **49** | 1,500 | 42 | 400 |
| Mercury | 0.17 | GSI | 0.14 | NS | NS | **160** |
| Nickel | 88 | GSI | 12 | 940 | **670** | 40,000 |
| Selenium | 0.40 | GSI | ND | NS | NA | **2,600** |
| Silver | 0.067 | GSI | ND | NS | NS | **2,500** |
| Vanadium | 130 | GSI | 41 | **56** | NA | 750 |
| Zinc | 190 | GSI | 82 | **6,100** | 25,000 | 170,000 |
| Cyanide (total) | 0.1 | GSI | 0.19 | NA | NA | **12** |

*Notes:*

1. *List of COCs from ROD Tables 1 and 2 and MDEQ (2008).*
2. *All concentrations presented in units of mg/kg to two significant figures.*
3. *"NA" - Cleanup goals are not applicable to this COC via indicated pathway.*
4. *Controlling values are shaded.*
5. *"NS" - No standard.*
6. *"--" - Background concentration not determined.*
7. *"ND" - Constituent not detected in background sampling. Reporting Limits vary.*

**Table 17**
**Summary of Proposed CD #30 Cleanup Goals**

| Chemical of Concern | Sediment | Erodible Soil | Non-Erodible Soil |
|---|---|---|---|
| Antimony | 2.0 | 6.6 | 85 |
| Arsenic | 7.6 | 8.9 | 8.9 |
| Barium | 60 | 96 | 37,000 |
| Cadmium | 5.0 | 5.0 | 36 |
| Chromium (total) | 80 | 80 | 2,500 |
| Copper | 70 | 70 | 230 |
| Lead | 35 | 49 | 49 |
| Manganese | 220 | 1,000 | 25,000 |
| Mercury | 0.20 | 0.20 | 160 |
| Nickel | 30 | 30 | 670 |
| Selenium | NS | NS | 2,600 |
| Silver | 1.0 | 1.0 | 2,500 |
| Vanadium | 20 | 41 | 56 |
| Zinc | 120 | 120 | 6,100 |
| Cyanide (total) | 0.10 | 0.19 | 12 |
| Total PAHs | 4 | 4 | NS |

*Notes :*

1. *All concentrations presented in units of mg/kg to two significant figures.*
2. *"NS" - No standard.*
3. *Total PAHs = Sum of concentrations of 16 polycyclic aromatic hydrocarbon (PAH) compounds, as specified in Persaud, et al. (1993).*
4. *Specific direct-contact values apply to individual PAHs. Value range from 2 mg/kg for benzo(a)pyrene to 230,000 mg/kg for anthrcene.*

**Table 18**
**Sediment Sampling Data Comparison to Cleanup Goals - Total Metals**

| Constituent | Proposed Cleanup Goal | Concentration by Sample Location and Depth (ft-bgs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | SD-28 | SD-29 | SD-29 | SD-30 | SD-31 | SD-32 | SD-33 | SD-34 |
| | | 0.0 to 0.5 | 0.0 to 0.5 | (DUP-01) 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 |
| ***Metals (mg/kg)*** | | | | | | | | | |
| Antimony | 2.0 | 1.6 UJ | **2.7 J** | **1.9 J** | 1.9 UJ | 1.8 UJ | 0.72 UJ | **1.2 J** | **1.2 J** |
| Arsenic | 7.6 | **15.2** | **10.1** | **11.1** | **16.2** | **12.6** | **2.7** | **6.3** | **2.8** |
| Barium | 60 | **108** | **94.3** | **97.1** | **137** | **120** | **18.3** | **55.1** | **41.7** |
| Cadmium | 5.0 | **23.2 J** | **16.7 J** | **41.5 J** | **28.6 J** | **15.2 J** | **1.3 J** | **15.5 J** | **2.5 J** |
| Chromium (total) | 80 | **197** | **153** | **196** | **383** | **233** | **65.8** | **149** | **68.5** |
| Copper | 70 | **164** | **181** | **282** | **187** | **127** | **21.4** | **58.1** | **32.6** |
| Lead | 35 | **90.4 J** | **82.2 J** | **107 J** | **43.6 J** | **29.1 J** | **6.2 J** | **15.2 J** | **16.1 J** |
| Manganese | 220 | **249** | **219** | **227** | **461** | **466** | **177** | **192** | **111** |
| Mercury | 0.20 | **0.16** | **0.18** | **0.13** | **0.15** | **0.14** | 0.024 U | **0.039** | 0.029 U |
| Nickel | 30 | **106 J** | **160 J** | **210 J** | **270 J** | **156 J** | **29.2 J** | **106 J** | **35.6 J** |
| Silver | 1.0 | **8.0** | **7.0** | **8.0** | **5.4** | **2.3** | 0.36 U | 0.56 U | 0.45 U |
| Vanadium | 20 | **26.9** | **17.2** | **18.8** | **25.6** | **24.9** | **8.2** | **18.8** | **14.4** |
| Zinc | 120 | **334** | **292** | **414** | **241** | **192** | **36.2** | **97.5** | **83.7** |
| ***Percent Solids (%)*** | -- | **30.7** | **29.8** | **32.1** | **26.3** | **27.1** | **69.7** | **44.7** | **55.9** |

*Notes:*

1. *Inorganic Data Qualifiers:*
   *J - Estimated concentration. See Data Validation Reports (Appendix D) for basis.*
   *U - Constituent not detected at indicated Reporting Limit.*
2. *For clarity, all detections are shown in* ***bold-face*** *type.*
3. *Values highlighted in yellow exceed proposed cleanup goals.*

**Table 19**
**Sediment Sampling Data Comparison to Cleanup Goals - PAHs**

| Constituent | Proposed Cleanup Goal | Concentration by Sample Location and Depth (ft-bgs) | |
|---|---|---|---|
| | | SD-32 | SD-34 |
| | | 0.0 to 0.5 | 0.0 to 0.5 |
| ***PAHs (ug/kg)*** | | | |
| Anthracene | 2.30E+08 | 95 U | **620** |
| Benzo(a)anthracene | 20,000 | 95 U | **3,600** |
| Benzo(a)pyrene | 2,000 | 95 U | **4,100** |
| Benzo(b)fluoranthene | 20,000 | **120 J** | **7,400 J** |
| Benzo(ghi)perylene | 2.50E+06 | 95 U | **3,700** |
| Chrysene | 2.00E+06 | 95 U | **4,500** |
| Dibenzo(a,h)anthracene | 2.00E+06 | 95 U | **650** |
| Fluoranthene | 4.60E+07 | **140** | **10,000** |
| Indeno(1,2,3-cd)pyrene | 20,000 | 95 U | **2,900** |
| Phenanthrene | 1.60E+06 | 95 U | **5,700** |
| Pyrene | 2.90E+07 | **130** | **8,100** |
| Total PAHs | 4,000 | **390** | **51,270** |
| ***Percent Solids (%)*** | | **69.7** | **55.9** |

*Notes :*

1. *Only constituents detected in one or more sediment samples are listed in this table. See Appendix C for analytical reports and complete analytical results.*
2. *Proposed cleanup goals for individual PAHs are residential DCVs from MDEQ (2006b).*
3. *Total PAH cleanup goal from ROD Table 2.*
4. *Only detected values (including estimated values) are used in calculating total PAH concentrations.*
5. *Organic Data Qualifiers :*
   *J - Estimated concentration detected above minimum detection limit, but below Reporting Limit.*
   *U - Constituent not detected at indicated Reporting Limit.*
6. *For clarity, all detections are shown in* ***bold-face*** *type.*
7. *Values highlighted in yellow exceed proposed individual cleanup goals or cause an exceedance of the total PAH cleanup goal.*

**Table 20**
**Erodible Soil Sampling Data Comparison to Cleanup Goals - Total Metals**

| Constituent | Proposed Cleanup Goal | Concentration by Sample Location and Depth (ft-bgs) | | | | | |
|---|---|---|---|---|---|---|---|
| | | SD-28-SB | SD-28-NB | SD-29-SB | SD-29-NB | SD-30-SB | SD-30-NB |
| | | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 |
| ***Metals (mg/kg)*** | | | | | | | |
| Antimony | 6.6 | 0.786 UJ | 0.751 U | 0.804 UJ | 1.11 UJ | 0.602 UJ | 0.600 UJ |
| Arsenic | 8.9 | **6.15** | **9.8** | **73.4** | **44.4** | **6.25** | **19.3** |
| Barium | 96 | **54.3** | **68.2** | **11.3** | **21.4** | **20.5** | **23.3** |
| Cadmium | 5.0 | **8.5** | **15.2** | **0.301** | **2.61** | **2.35** | **2.43** |
| Chromium (total) | 80 | **73.9** | **71.1** | **10.5** | **39.9** | **59.2** | **44.8** |
| Copper | 70 | **50.9** | **79.8** | **18.5** | **40.5** | **31.3** | **32.2** |
| Lead | 49 | **33.9** | **34.4** | **6.19** | **21.8** | **9.77** | **9.78** |
| Manganese | 1,000 | **112 J** | **294 J** | **115 J** | **168 J** | **143 J** | **155 J** |
| Mercury | 0.20 | **0.0749 J** | **0.0937 J** | 0.0918 U | **0.0334 J** | 0.0963 U | 0.096 U |
| Nickel | 30 | **30.7** | **43.2** | **53.1** | **26.6** | **58.7** | **26.7** |
| Silver | 1.0 | **3.97** | **3.15** | 0.459 U | **0.354 J** | **0.886** | **0.584** |
| Vanadium | 41 | **13.6** | **18.3** | **10.0** | **13.2** | **9.16** | **11.2** |
| Zinc | 120 | **115** | **155** | **46.3** | **71.6** | **46.3** | **50** |
| ***Percent Solids (%)*** | -- | **63.6** | **66.6** | **87.2** | **85.3** | **83.1** | **83.3** |

*See notes at end of table.*

**Table 20**
**Erodible Soil Sampling Data Comparison to Cleanup Goals - Total Metals**

| Constituent | Proposed Cleanup Goal | Concentration by Sample Location and Depth (ft-bgs) | | | | | |
|---|---|---|---|---|---|---|---|
| | | SD-31-SB | SD-31-NB | SD-32-SB | SD-32-NB | SD-33-SB | |
| | | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | DUP-06 0.0 to 0.5 |
| ***Metals (mg/kg)*** | | | | | | | |
| Antimony | 6.6 | 0.630 UJ | 0.651 UJ | 0.604 UJ | 0.592 UJ | 0.688 UJ | 0.600 UJ |
| Arsenic | 8.9 | **8.97** | **7.74** | **7.95** | **5.47** | **12.8** | **6.1** |
| Barium | 96 | **67.8** | **59.5** | **25.9** | **25.8** | **37.4 J** | **7.91 J** |
| Cadmium | 5.0 | **7.11** | **6.34** | **1.63** | **3.34** | **14.9 J** | **3.08 J** |
| Chromium (total) | 80 | **52.8** | **49.7** | **29** | **95.6** | **77.1** | **52.3** |
| Copper | 70 | **48.9** | **52.3** | **22.2** | **55.2** | **43.5** | **17.5** |
| Lead | 49 | **11.4** | **11.2** | **8.57** | **16.2** | **11.9** | **5.01** |
| Manganese | 1,000 | **158 J** | **132 J** | **118 J** | **243 J** | **275 J** | **162 J** |
| Mercury | 0.20 | **0.025 J** | **0.0737 J** | 0.0967 U | 0.0947 U | **0.0284 J** | 0.0959 U |
| Nickel | 30 | **35.3** | **35.8** | **27.7** | **69.8** | **110** | **49.5** |
| Silver | 1.0 | **1.96** | **0.862** | **0.178 J** | **0.411 J** | **0.189 J** | **0.14 J** |
| Vanadium | 41 | **21.2** | **22** | **11.2** | **14.2** | **20.9** | **9.77** |
| Zinc | 120 | **60.9** | **55.2** | **46.7** | **54.4** | **54.9** | 29.5 R |
| ***Percent Solids (%)*** | -- | **79.3** | **76.8** | **82.8** | **84.4** | **72.7** | **83.4** |

*See notes at end of table.*

**Table 20**
**Erodible Soil Sampling Data Comparison to Cleanup Goals - Total Metals**

| Constituent | Proposed Cleanup Goal | Concentration by Sample Location and Depth (ft-bgs) | | | |
|---|---|---|---|---|---|
| | | SD-33-NB | SD-34-SB | SD-34-NB | |
| | | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | DUP-07 0.0 to 0.5 |
| ***Metals (mg/kg)*** | | | | | |
| Antimony | 6.6 | 0.582 UJ | 1.08 UJ | 0.619 UJ | 0.654 UJ |
| Arsenic | 8.9 | **3.18** | **4.79 J** | **5.98** | **3.00** |
| Barium | 96 | **9.25** | **88.7 J** | **33.9** | **33** |
| Cadmium | 5.0 | **0.146** | **2.29 J** | **1.62** | **1.58** |
| Chromium (total) | 80 | **75.2** | **81.2 J** | **146** | **172** |
| Copper | 70 | **30.8** | **243 J** | **18.7** | **18** |
| Lead | 49 | **3.99** | **34.2 J** | **17.8** | **20.4** |
| Manganese | 1,000 | **252 J** | **168 J** | **200 J** | **156 J** |
| Mercury | 0.20 | 0.0931 U | **0.0745 J** | **0.0211 J** | **0.0282 J** |
| Nickel | 30 | **83.7** | **86.1 J** | **43.5** | **45.9** |
| Silver | 1.0 | 0.466 U | 0.865 UJ | 0.495 U | 0.523 U |
| Vanadium | 41 | **7.03** | **27.5 J** | **21.2** | **17.3** |
| Zinc | 120 | 21.7 R | **112 J** | **61.5** | **64.8** |
| ***Percent Solids (%)*** | -- | **85.9** | **46.2** | **80.7** | **76.5** |

*See notes at end of table.*

**Table 20**
**Erodible Soil Sampling Data Comparison to Cleanup Goals - Total Metals**

*Notes:*

1. *Inorganic Data Qualifiers:*
   *J - Estimated concentration. See Data Validation Reports (Appendix D) for basis.*
   *U - Constituent not detected at indicated Reporting Limit.*
   *R - Sample result was rejected and unusable due to major blank excursions.*
2. *For clarity, all detections are shown in* ***bold-face*** *type.*
3. *Values highlighted in yellow exceed proposed cleanup goals.*

**Table 21**
**Erodible Soil Sampling Data Comparison to Cleanup Goals - PAHs**

| Constituent | Proposed Cleanup Goal | Concentration by Sample Location and Depth (ft-bgs) | | | | |
|---|---|---|---|---|---|---|
| | | SD-32-SB | SD-32-NB | SD-34-SB | SD-34-NB | |
| | | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | DUP-07 0.0 to 0.5 |
| ***PAHs (ug/kg)*** | | | | | | |
| Acenaphthene | 4.1E+07 | 8.1 U | 7.9 U | **36 J** | 8.3 U | 8.7 U |
| Acenaphthylene | 1.6E+06 | 8.1 U | 7.9 U | **38 J** | 8.3 U | **12** |
| Anthracene | 2.3E+08 | 8.1 U | 7.9 U | **140 J** | 8.3 U | **19** |
| Benzo(a)anthracene | 20,000 | **22** | **28** | **740 J** | **45** | **120** |
| Benzo(a)pyrene | 2,000 | **54** | **53** | **1,100 J** | **80** | **170** |
| Benzo(b)fluoranthene | 20,000 | **78 J** | **79 J** | **1,900 J** | **120 J** | **240 J** |
| Benzo(ghi)perylene | 2.5E+06 | **36** | **34** | **960 J** | **68** | **130** |
| Benzo(k)fluoranthene | 2.0E+05 | **22 J** | **15 J** | **730 J** | **37 J** | **120 J** |
| Chrysene | 2.0E+06 | **45** | **38** | **1,200 J** | **69** | **160** |
| Dibenz(a,h)anthracene | 2.0E+06 | **31** | **32** | **250 J** | **38** | **50** |
| Fluoranthene | 4.6E+07 | **83** | **74** | **2,400 J** | **130** | **340** |
| Fluorene | 2.7E+07 | 8.1 U | 7.9 U | **51 J** | 8.3 U | 8.7 U |
| Indeno(1,2,3-cd)pyrene | 20,000 | **50** | **48** | **820 J** | **70** | **120** |
| Phenanthrene | 1.6E+06 | **33** | **28** | **790 J** | **48** | **130** |
| Pyrene | 2.9E+07 | **63** | **58** | **1,900 J** | **100** | **260** |
| Total PAHs | 4,000 | **517** | **487** | **13,055** | **805** | **1,840** |
| ***Percent Solids (%)*** | | **82.8** | **84.4** | **46.2** | **80.7** | **76.5** |

*See notes at end of table.*

**Table 21**
**Erodible Soil Sampling Data Comparison to Cleanup Goals - PAHs**

*Notes:*

1. *Only constituents detected in one or more soil samples are listed in this table. See Appendix C for analytical reports and complete analytical results.*
2. *Proposed cleanup goals for individual PAHs are residential DCVs from MDEQ (2006b).*
3. *Total PAH cleanup goal from ROD Table 2.*
4. *Organic Data Qualifiers:*
   *J - Estimated concentration detected above minimum detection limit, but below Reporting Limit.*
   *U - Constituent not detected at indicated Reporting Limit.*
5. *For clarity, all detections are shown in* ***bold-face*** *type.*
6. *Values highlighted in yellow exceed proposed individual cleanup goals or cause an exceedance of the total PAH cleanup goal.*

**Table 22**
**Non-Erodible Soil Sampling Data Comparison to Cleanup Goals - Total Metals**

| Constituent | Proposed Cleanup Goal | Concentration by Sample Location and Depth (ft-bgs) | | | | | |
|---|---|---|---|---|---|---|---|
| | | SD-28-10N | | SD-28-30N | | SD-28-70N | |
| | | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | | |
| Antimony | 85 | 0.643 U | 0.608 U | 0.623 U | 0.59 U | 0.611 U | 0.601 U |
| Arsenic | 8.9 | **12.8** | **5.32** | **10.4** | **10.0** | **6.52** | **2.79** |
| Barium | 37,000 | **88.3** | **255** | **66** | **71.6** | **64.5 J** | **65.4** |
| Cadmium | 36 | **8.49 J** | **1.53 J** | **4.19 J** | **0.298 J** | **0.454 J** | 0.141 UJ |
| Chromium (total) | 2,500 | **87.6** | **26.2** | **39.1** | **17.3** | **16.3** | **18** |
| Copper | 230 | **67.7** | **58.2** | **32.2** | **8.23** | **10.8** | **5.58** |
| Lead | 49 | **49** | **16.6** | **21.2** | **11.8** | **12.5** | **9.31** |
| Manganese | 25,000 | **256 J** | **162 J** | **182 J** | **112 J** | **161 J** | **112 J** |
| Mercury | 160 | **0.113** | **0.0504 J** | **0.0688 J** | **0.0312 J** | **0.0652 J** | 0.0961 U |
| Nickel | 670 | **52.7** | **18.8** | **22.6** | **10.8** | **11.6** | **15** |
| Selenium | 2,600 | **0.679** | **0.637** | **0.625** | **0.492** | **0.564** | **0.408 J** |
| Silver | 2,500 | **1.72 J** | 0.486 UR | **0.889 J** | 0.472 UR | 0.489 UR | 0.481 UR |
| Vanadium | 56 | **21.8** | **28.6** | **19.8** | **24.2** | **21.4** | **22.8** |
| Zinc | 6,100 | **167** | **113** | **83.3** | **32.9** | **41.8** | **35.7** |
| ***Percent Solids (%)*** | -- | **77.8** | **82.3** | **80.2** | **84.8** | **81.8** | **83.2** |

*See notes at end of table.*

**Table 22**
**Non-Erodible Soil Sampling Data Comparison to Cleanup Goals - Total Metals**

| Constituent | Proposed Cleanup Goal | Concentration by Sample Location and Depth (ft-bgs) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | SD-29-10N | | | SD-29-30N | | SD-29-70N | |
| | | 0.0 to 0.5 | 1.0 to 1.5 | DUP-02 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | | | |
| Antimony | 85 | 0.618 U | 0.634 U | 0.586 U | 0.608 U | 0.624 U | 0.657 U | 0.606 U |
| Arsenic | 8.9 | **7.68** | **18.8** | **27.8** | **8.17** | **5.65** | **6.7** | **4.05** |
| Barium | 37,000 | **48.2** | **40.1** | **28.5** | **54.7** | **53.8** | **85.1** | **110** |
| Cadmium | 36 | **19.9 J** | **4.14 J** | **1.78** | **18.3 J** | **2.21 J** | **1.36 J** | **0.223 J** |
| Chromium (total) | 2,500 | **308** | **62.5** | **31.9** | **260** | **19.8** | **30** | **19.5** |
| Copper | 230 | **976** | **70.8** | **36.7** | **193** | **18.5** | **26** | **17.5** |
| Lead | 49 | **109** | **13.6** | **9.18** | **93** | **14.8** | **15.9** | **13** |
| Manganese | 25,000 | **128 J** | **149 J** | **191 J** | **160 J** | **141 J** | **194 J** | **103 J** |
| Mercury | 160 | **0.102** | **0.0667 J** | 0.0938 U | **0.111** | **0.0567 J** | **0.0676 J** | 0.097 U |
| Nickel | 670 | **229** | **37.9** | **27** | **248** | **12.5** | **19.8** | **17.1** |
| Selenium | 2,600 | 0.494 U | **0.674** | 0.469 U | **0.598** | **0.594** | **0.615** | **0.546** |
| Silver | 2,500 | **9.76 J** | **1.71 J** | **0.516 J** | **13 J** | **0.414 J** | **0.293 J** | 0.485 UR |
| Vanadium | 56 | **9.83** | **13.9** | **16.3** | **12.1** | **14.9** | **22.7** | **25.8** |
| Zinc | 6,100 | **380** | **55.6** | **47.6** | **306** | **57.6** | **56.9** | **52.2** |
| ***Percent Solids (%)*** | -- | **80.9** | **78.8** | **85.3** | **82.2** | **80.1** | **76.1** | **82.5** |

*See notes at end of table.*

**Table 22**
**Non-Erodible Soil Sampling Data Comparison to Cleanup Goals - Total Metals**

| Constituent | Proposed Cleanup Goal | Concentration by Sample Location and Depth (ft-bgs) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | SD-30-10N | | SD-30-30N | | SD-30-70N | | |
| | | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | DUP-03 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | | | |
| Antimony | 85 | 0.65 U | 0.774 U | 0.639 U | 0.683 U | 0.633 U | 0.633 U | 0.654 U |
| Arsenic | 8.9 | **11.7** | **13.1** | **13.4** | **15.1** | **4.41** | **3.72** | **4.28** |
| Barium | 37,000 | **79.2** | **135** | **76.3** | **129** | **67.4** | **61.3** | **111** |
| Cadmium | 36 | **22.4 J** | **2.04 J** | **36.2 J** | **1.98 J** | **2.06 J** | **1.93** | **0.872 J** |
| Chromium (total) | 2,500 | **401** | **23.1** | **1,060** | **25.9** | **35.2** | **32.7** | **17** |
| Copper | 230 | **229** | **55.8** | **382** | **44.2** | **21.2** | **20.2** | **26.6** |
| Lead | 49 | **31.2** | **14.2** | **44.8** | **13.7** | **13.8** | **12.7** | **11** |
| Manganese | 25,000 | **179 J** | **222 J** | **229 J** | **229 J** | **209 J** | **193 J** | **203 J** |
| Mercury | 160 | **0.135** | **0.187** | **0.262** | **0.0979 J** | **0.0649 J** | **0.0779 J** | **0.159** |
| Nickel | 670 | **232** | **22** | **554** | **22.9** | **21.6** | **20.5** | **12.1** |
| Selenium | 2,600 | **1.08** | **2.83** | **1.23** | **1.84** | **0.433 J** | **0.523** | **0.953** |
| Silver | 2,500 | **9.11 J** | **0.351 J** | **20.5 J** | **0.364 J** | **0.33 J** | **0.399 J** | 0.523 UR |
| Vanadium | 56 | **17.7** | **34.3** | **17.4** | **28.3** | **19.5** | 16.6 | **37.2** |
| Zinc | 6,100 | **146** | **47.5** | **198** | **55** | **43.4** | **44** | **44.3** |
| ***Percent Solids (%)*** | -- | **76.9** | **64.6** | **78.2** | **73.2** | **79.0** | **78.9** | **76.4** |

*See notes at end of table.*

**Table 22**
**Non-Erodible Soil Sampling Data Comparison to Cleanup Goals - Total Metals**

| Constituent | Proposed Cleanup Goal | Concentration by Sample Location and Depth (ft-bgs) | | | | | |
|---|---|---|---|---|---|---|---|
| | | SD-31-10N | | SD-31-30N | | SD-31-70N | |
| | | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | | |
| Antimony | 85 | 0.628 U | 0.685 U | 0.605 U | 0.593 U | 0.625 U | 0.58 U |
| Arsenic | 8.9 | **9.63** | **11.7** | **8.56** | **5.54** | **5.27** | **2.79** |
| Barium | 37,000 | **62.3** | **137** | **55.3** | **58.5** | **58.2** | **48.2** |
| Cadmium | 36 | **37.1 J** | **4.03 J** | **39.8** | **12** | **1.33** | **0.367** |
| Chromium (total) | 2,500 | **508** | **36.3** | **574** | **189** | **17.7** | **10.6** |
| Copper | 230 | **191** | **101** | **220** | **70.8** | **13** | **10.4** |
| Lead | 49 | **28.2** | **18.2** | **26.8** | **13.7** | **12.2** | **6.63** |
| Manganese | 25,000 | **169 J** | **313 J** | **264** | **212** | **202** | **61.7** |
| Mercury | 160 | **0.136** | **0.116** | **0.129** | **0.0861 J** | **0.0453 J** | **0.0341 J** |
| Nickel | 670 | **277** | **55.1** | **324** | **105** | **11.2** | **7.47** |
| Selenium | 2,600 | **1.25** | **1.33** | **0.795** | **1.02** | **0.711** | **0.405 J** |
| Silver | 2,500 | **14 J** | **0.841 J** | **14.1** | **5.32** | **0.148 J** | 0.464 U |
| Vanadium | 56 | **16** | **35.6** | **15.4** | **16.9** | **19.1** | **19.4** |
| Zinc | 6,100 | **231** | **74.7** | **159 J** | **52.3 J** | **31.7 J** | **15.6 J** |
| ***Percent Solids (%)*** | -- | **79.6** | **72.9** | **82.6** | **84.3** | **80.1** | **86.2** |

*See notes at end of table.*

**Table 22**
**Non-Erodible Soil Sampling Data Comparison to Cleanup Goals - Total Metals**

| Constituent | Proposed Cleanup Goal | Concentration by Sample Location and Depth (ft-bgs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | SD-32-10N | | | SD-32-30N | | SD-32-70N | | |
| | | 0.0 to 0.5 | DUP-04 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | DUP-05 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | | | | |
| Antimony | 85 | 0.598 U | 0.595 U | 0.551 U | 0.616 U | 0.635 U | 0.639 U | 0.629 U | 0.578 U |
| Arsenic | 8.9 | **7.65** | **7.1** | **11.5** | **8.43** | **23.2** | **11.2** | **10.8** | **2.83** |
| Barium | 37,000 | **44.8** | **41.7** | **46.7** | **52.5** | **91.3** | **96.6** | **88.1** | **72.8** |
| Cadmium | 36 | **15.9** | **14.2** | **13.4** | **16.3** | **0.272** | **1.07** | **0.878** | **0.164** |
| Chromium (total) | 2,500 | **302** | **272** | **20.9** | **354** | **16.3** | **31.5** | **26.2** | **17.4** |
| Copper | 230 | **113** | **101** | **128** | **102** | **5.0** | **23.7** | **21.6** | **6.98** |
| Lead | 49 | **26.5** | **24.1** | **92.7** | **27** | **10.2** | **18.2** | **16.5** | **6.32** |
| Manganese | 25,000 | **162** | **161 J** | **159** | **186** | **91.6** | **194** | **175 J** | **77.2** |
| Mercury | 160 | **0.0809 J** | **0.0695 J** | **0.117** | **0.0715 J** | **0.0649 J** | **0.0804 J** | **0.0998 J** | **0.0306 J** |
| Nickel | 670 | **268** | **219** | **61.7** | **239** | **10.1** | **23** | **19.3** | **12.5** |
| Selenium | 2,600 | **0.685** | **0.466 J** | **0.363 J** | **0.574** | 0.508 U | **0.616** | 0.503 U | 0.463 U |
| Silver | 2,500 | **1.82** | **1.45** | **0.344 J** | **0.994** | 0.508 U | 0.511 U | 0.503 U | 0.463 U |
| Vanadium | 56 | **13.9** | **12.1** | **16.6** | **14.6** | **28.1** | **28.7** | **27.6** | **21.8** |
| Zinc | 6,100 | **104 J** | **111** | **68.7 J** | **120 J** | **24.4 J** | **50 J** | **47.2** | **27.5 J** |
| ***Percent Solids (%)*** | -- | **83.6** | **84.0** | **90.7** | **81.1** | **78.8** | **78.2** | **79.5** | **86.5** |

*See notes at end of table.*

**Table 22**
**Non-Erodible Soil Sampling Data Comparison to Cleanup Goals - Total Metals**

| Constituent | Proposed Cleanup Goal | Concentration by Sample Location and Depth (ft-bgs) | | | | | |
|---|---|---|---|---|---|---|---|
| | | SD-33-10N | | SD-33-30N | | SD-33-70N | |
| | | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | | |
| Antimony | 85 | 0.578 U | 0.542 U | 0.593 U | 0.553 U | 0.573 U | **0.439 J** |
| Arsenic | 8.9 | **5.01** | **2.07** | **7.1** | **2.95** | **2.95** | **2.32** |
| Barium | 37,000 | **24.5** | **17.7** | **30.2** | **19.7** | **21.4** | **14.9** |
| Cadmium | 36 | **10.7** | **0.42** | **12** | **0.215** | **0.548** | 0.087 U |
| Chromium (total) | 2,500 | **356** | **14.4** | **236** | **12.6** | **13** | **9.26** |
| Copper | 230 | **60.7** | **3.65** | **58.1** | **4.72** | **6.43** | **2.06** |
| Lead | 49 | **12.1** | **4.85** | **14.9** | **6.79** | **10.8** | **5.35** |
| Manganese | 25,000 | **157** | **66.2** | **170** | **71.7** | **83.3** | **52.4** |
| Mercury | 160 | **0.0238 J** | 0.0868 U | **0.0226 J** | 0.0885 U | 0.0916 U | 0.087 U |
| Nickel | 670 | **208** | **7.59** | **163** | **7.21** | **8.0** | **4.53** |
| Selenium | 2,600 | **0.536** | 0.434 U | **0.52** | 0.442 U | **0.418 J** | 0.435 U |
| Silver | 2,500 | **0.275 J** | 0.434 U | **0.182 J** | 0.442 U | 0.458 U | 0.435 U |
| Vanadium | 56 | **13.9** | **15.6** | **13.1** | **22.6** | **19.2** | **17.4** |
| Zinc | 6,100 | **36.9 J** | **10.3 J** | **122 J** | **18.1 J** | **25 J** | **9.53 J** |
| ***Percent Solids (%)*** | -- | **86.5** | **92.2** | **84.4** | **90.4** | **87.3** | **92.0** |

*See notes at end of table.*

**Table 22**
**Non-Erodible Soil Sampling Data Comparison to Cleanup Goals - Total Metals**

| Constituent | Proposed Cleanup Goal | Concentration by Sample Location and Depth (ft-bgs) | | | | | |
|---|---|---|---|---|---|---|---|
| | | SD-34-10N | | SD-34-30N | | SD-34-70N | |
| | | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 1.0 to 1.5 |
| ***Metals (mg/kg)*** | | | | | | | |
| Antimony | 85 | 0.578 U | 0.564 U | 0.605 U | 0.548 U | 0.574 U | 0.562 U |
| Arsenic | 8.9 | **4.77** | **3.33** | **2.99** | **3.1** | **2.84** | **2.77** |
| Barium | 37,000 | **60.1** | **32** | **38.4** | **25.1** | **39.1** | **33.1** |
| Cadmium | 36 | **1.74** | **1.64** | **1.45** | **0.242** | **0.674 J** | **0.201 J** |
| Chromium (total) | 2,500 | **234** | **224** | **136** | **11.9** | **14.4** | **10.7** |
| Copper | 230 | **18.3** | **18.4** | **29.7** | **4.03** | **7.0** | **3.9** |
| Lead | 49 | **27.2** | **26** | **20** | **5.6** | **12.7** | **6.37** |
| Manganese | 25,000 | **498** | **152** | **173** | **81.4** | **248 J** | **183 J** |
| Mercury | 160 | **0.0199 J** | 0.0903 U | 0.0968 U | **0.0221 J** | **0.018 J** | **0.0225 J** |
| Nickel | 670 | **55** | **55** | **41.2** | **5.46** | **9.15** | **5.6** |
| Selenium | 2,600 | 0.462 U | 0.452 U | 0.484 U | 0.439 U | 0.459 U | **0.381 J** |
| Silver | 2,500 | 0.462 U | 0.452 U | 0.484 U | 0.439 U | 0.459 UR | 0.449 UR |
| Vanadium | 56 | **20.1** | **15.4** | **15.3** | **15.9** | **18.9** | **20.6** |
| Zinc | 6,100 | **52.7 J** | **52.1 J** | **70.6 J** | **25 J** | **32.7** | **25.8** |
| ***Percent Solids (%)*** | -- | **86.6** | **88.6** | **82.6** | **91.2** | **87.1** | **89.0** |

*See notes at end of table.*

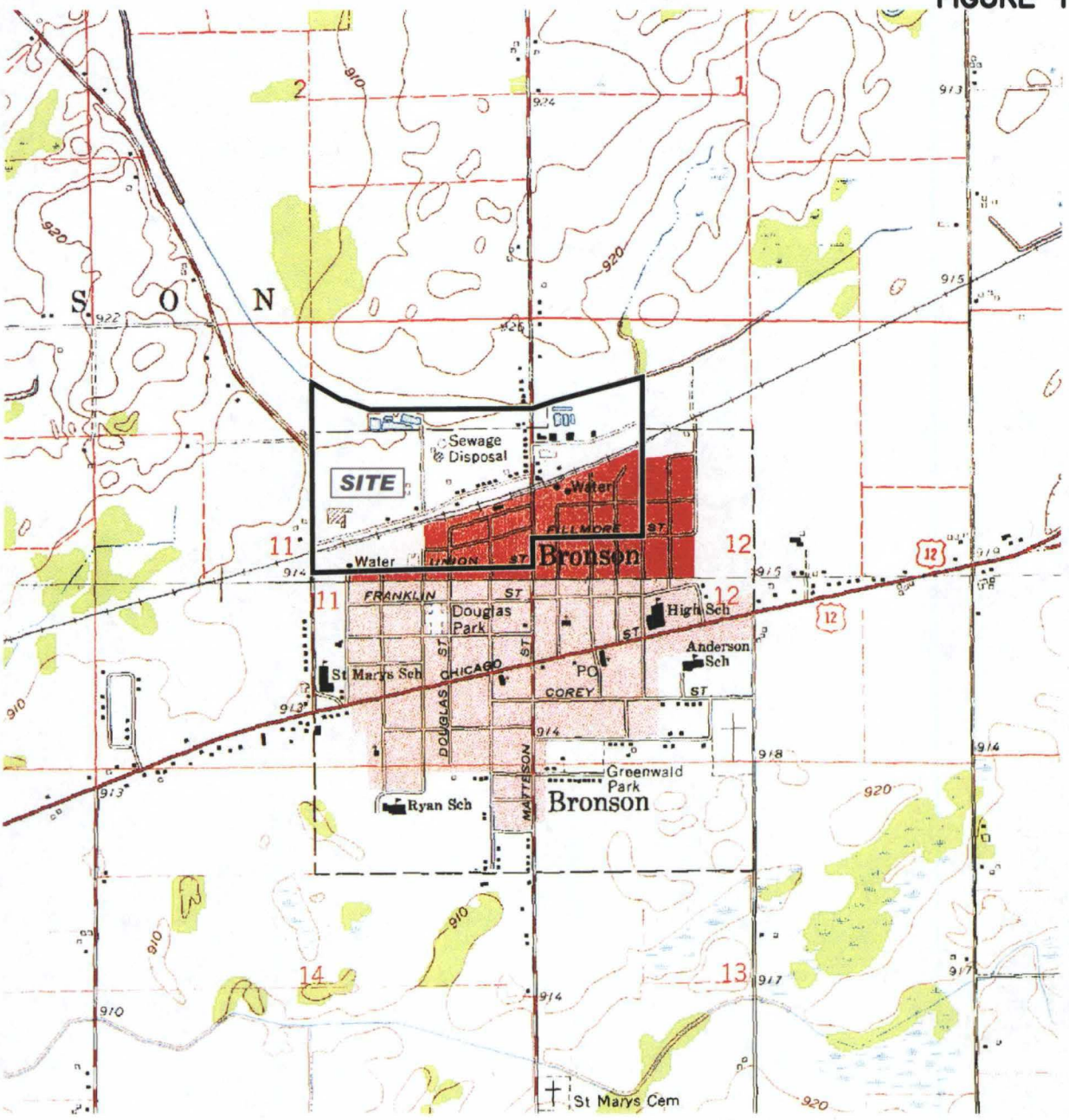
**Table 22**
**Non-Erodible Soil Sampling Data Comparison to Cleanup Goals - Total Metals**

*Notes:*

1. *Inorganic Data Qualifiers:*
   *J - Estimated concentration. See Data Validation Reports (Appendix D) for basis.*
   *U - Constituent not detected at indicated Reporting Limit.*
   *R - Sample result was rejected and unusable due to major blank excursions.*
2. *For clarity, all detections are shown in* ***bold-face*** *type.*
3. *Values highlighted in yellow exceed proposed cleanup goals.*

# *FIGURES*

FIGURE 1




ADAPTED FROM: BRONSON NORTH AND BRONSON SOUTH, MI U.S.G.S. 7.5 MIN. QUAD

QUADRANGLE LOCATION

# NORTH BRONSON INDUSTRIAL AREA SUPERFUND SITE BRONSON, MICHIGAN

## SITE LOCATION MAP

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

SCALE: 1:24000

FILE NO. 12716.
JULY 2010

NOTE: SITE AREA IN FIGURE 1 PER RECORD OF DECISION (MDEQ AND USEPA, 1998)

O'BRIEN & GERE

I:\PROJECTS\north bronson 12716\41845\DOC\DWG\001.DWG

07/12/10 jmo

# FIGURE 2

**LEGEND**

- APPROXIMATE SITE BOUNDARY
- STAFF GAUGE
- SURFACE-WATER FLOW DIRECTION
- RI/PDS SURFACE WATER/SEDIMENT SAMPLING LOCATION AND NUMBER
- SEDIMENT SAMPLING LOCATION AND NUMBER

**NORTH BRONSON INDUSTRIAL AREA SITE OPERABLE UNIT 1 BRONSON, MICHIGAN**

**COUNTY DRAIN #30 LAYOUT**

800 0 800
1"=800'

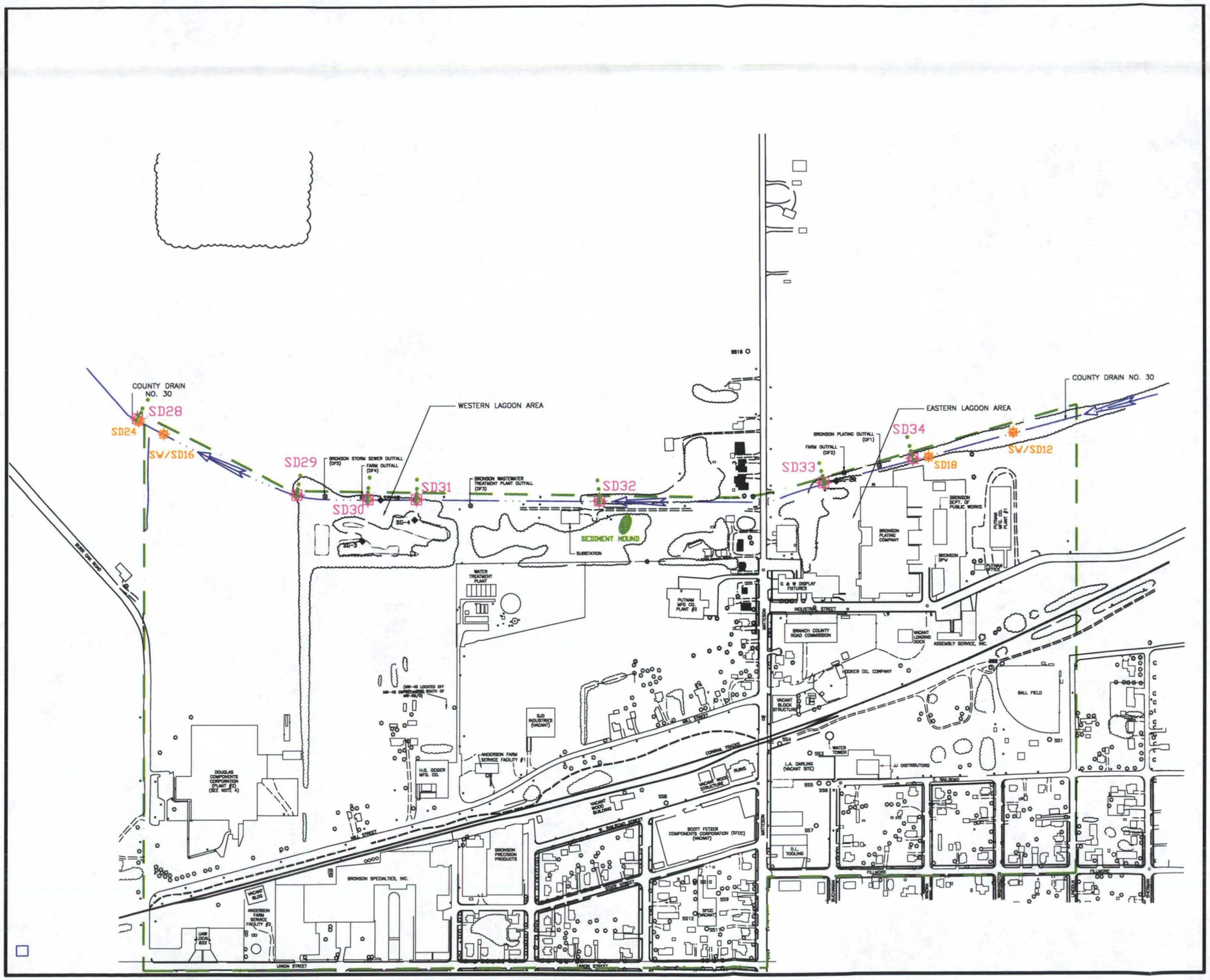
FILE NO. 12716.41845.017
JUNE 2010

O'BRIEN & GERE

I:\PROJECTS/12716/41845/DOC/DWG/017.DWG

PLOT DATE: 06/22/2010 jmo

# FIGURE 3




**LEGEND**

- APPROXIMATE SITE BOUNDARY
- STAFF GAUGE
- SURFACE-WATER FLOW DIRECTION
- RI/PDI SURFACE WATER/SEDIMENT SAMPLING LOCATION AND NUMBER SHOWN ARE THOSE USED TO DEFINE THE LIMITS OF IMPACTS. FOR OTHER RI/PDI SAMPLING LOCATIONS SEE APPENDIX F
- SEDIMENT SAMPLING LOCATION AND NUMBER
- TRANSECT SOIL SAMPLING LOCATION

**NORTH BRONSON INDUSTRIAL AREA SITE**
**OPERABLE UNIT 1**
**BRONSON, MICHIGAN**

## SITE LAYOUT

400 0 400
1"=400'

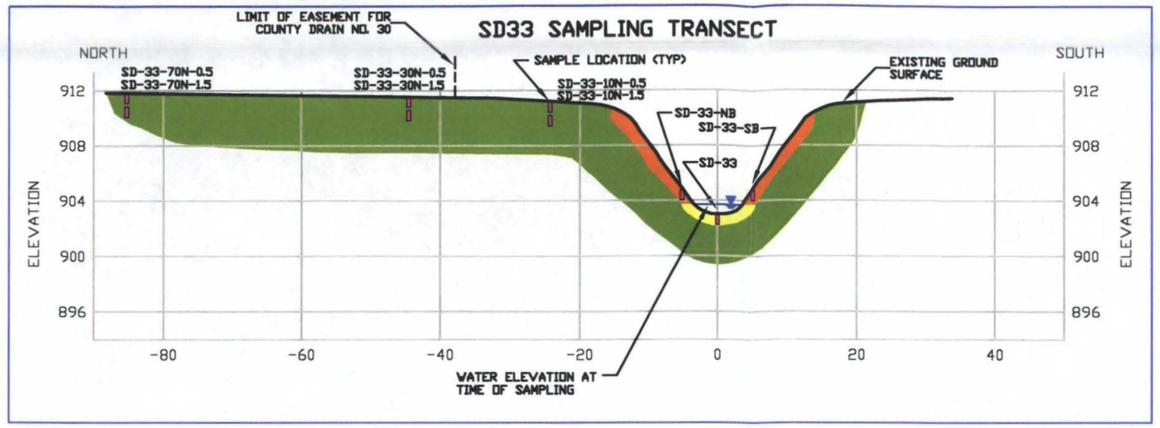
FILE NO. 12716.41845.014
JUNE 2010

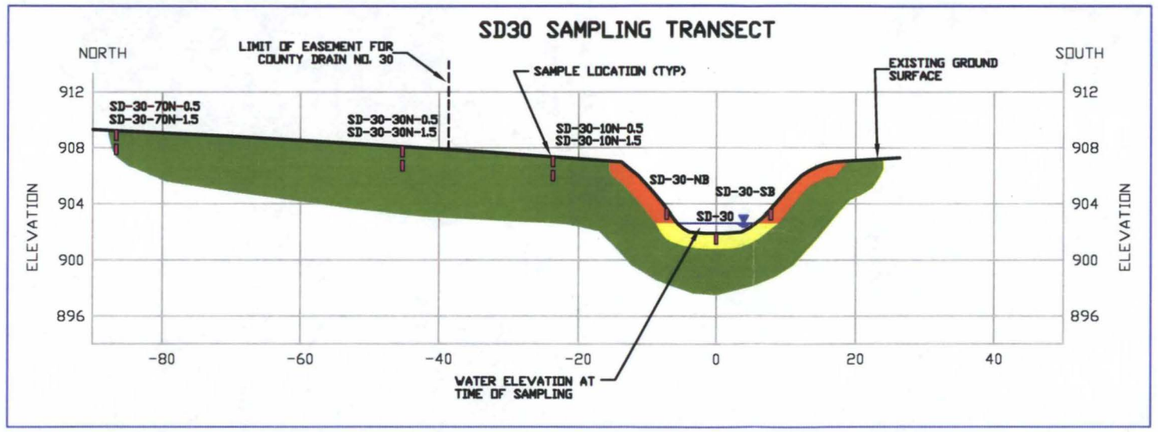
O'BRIEN & GERE

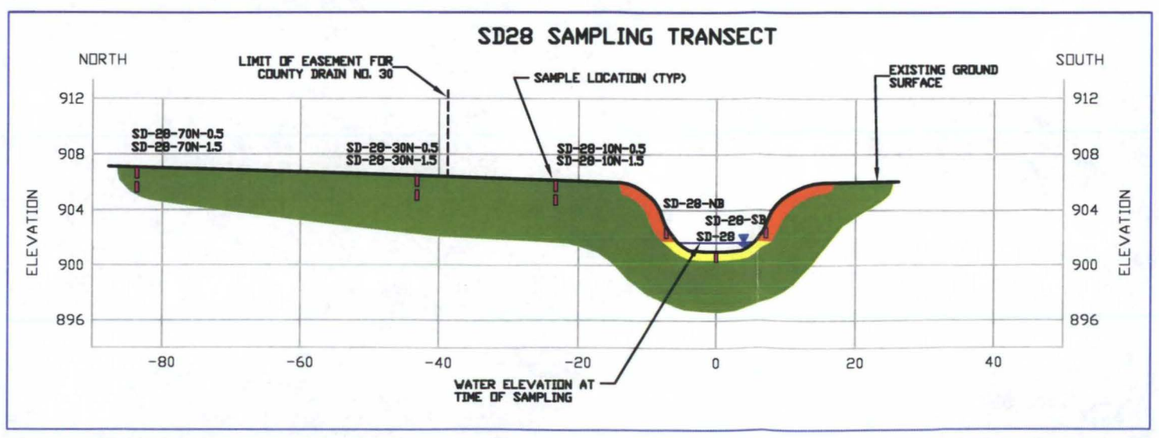
I:\PROJECTS/12716/41845/DOC/DWG/014.DWG

PLOT DATE: 05/26/2010 cay

# FIGURE 4




**LEGEND**

- SOIL SAMPLING LOCATION IN TRANSECT VIEW
- APPROXIMATE WATER LEVEL AT TIME OF SAMPLING
- SEDIMENT
- ERODIBLE SOIL
- NON-ERODIBLE SOIL

**NORTH BRONSON INDUSTRIAL AREA SITE OPERABLE UNIT 1 BRONSON, MICHIGAN**

**TYPICAL COUNTY DRAIN #30 CROSS SECTIONS**

FILE NO. 12716.41845.016
JUNE 2010

O'BRIEN & GERE

2010 © O'Brien & Gere Engineers, Inc.

I:PROJECTS/12716/41845/DOC/DWG/016.DWG
PLOT DATE: 05/26/2010 jmo

# *APPENDIX A*

# *PHOTOGRAPHIC DOCUMENTATION OF SEDIMENT SAMPLING LOCATIONS*

O'BRIEN & GERE

# PHOTOGRAPHIC LOG

| | | | |
|---|---|---|---|
| Client: | NBIA OU1 PRP | Project Number: | 41845 |
| Site Name: | NBIA | Location: | Bronson, Michigan |

Photo Number:
01: 100_0776.jpg

Photographer:
Clifford Yantz

Date:
03/29/2010

Orientation:
View looking south.

Description:
CD #30 at location SD-28.
South bank soil sample at location SD-28.

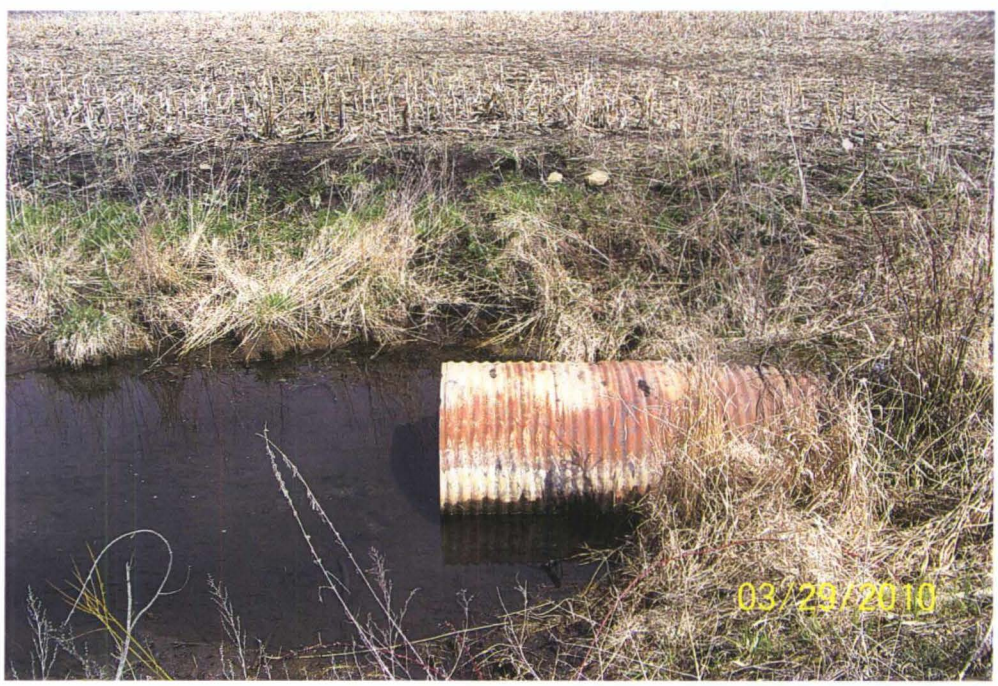
Photo Number:
02: 100_0777.jpg

Photographer:
Clifford Yantz

Date:
03/29/2010

Orientation:
View looking north.

Description:
North bank soil sample at location SD-28.
SD-28 taken just left (west) and just south of culvert.
Non-erodible soil samples taken in field.



O'BRIEN & GERE

# PHOTOGRAPHIC LOG

| | | | |
|---|---|---|---|
| Client: | NBIA OU1 PRP | Project Number: | 41845 |
| Site Name: | NBIA | Location: | Bronson, Michigan |

Photo Number:
03: 100_0781.jpg

Photographer:
Clifford Yantz

Date:
03/29/2010

Orientation:
View looking north.

Description:
CD #30 at location SD-29.

South bank on bottom of photo.

North bank sample was collected 1 ft above water line just left of stand of grass on bank.

Photo Number:
04: 100_0782.jpg

Photographer:
Clifford Yantz

Date:
03/29/2010

Orientation:
View looking north.

Description:
North bank sample at location SD-29.

Location SD-29-10N marked by hand auger. Decon equipment adjacent to sampling location

O'BRIEN & GERE

# PHOTOGRAPHIC LOG

| | | | |
|---|---|---|---|
| Client: | NBIA OU1 PRP | Project Number: | 41845 |
| Site Name: | NBIA | Location: | Bronson, Michigan |

Photo Number:
05: 100_0793.jpg

Photographer:
Clifford Yantz

Date:
03/29/2010

Orientation:
View looking south.

Description:
CD #30 at location SD-30.

South bank sample collected in center of bank shown in photo.

North bank sample location marked by hand auger.

Photo Number:
06: 100_0789.jpg

Photographer:
Kevin Schneider

Date:
03/29/2010

Orientation:
View looking east.

Description:

Location SD-30-10N (i.e., 10 ft sample at location SD-30).

Note: very slight rise (< 1ft) moving toward north bank of CD #30.

O'BRIEN & GERE

# PHOTOGRAPHIC LOG

| | | | |
|---|---|---|---|
| Client: | NBIA OU1 PRP | Project Number: | 41845 |
| Site Name: | NBIA | Location: | Bronson, Michigan |

Photo Number:
07: 100_0799.jpg

Photographer:
Clifford Yantz

Date:
03/29/2010

Orientation:
View looking south.

Description:
No photos of location SD-31 were taken

CD #30 at location SD-32.

South bank in background, with top of north bank in foreground.

Photo Number:
08: 100_0795.jpg

Photographer:
Kevin Schneider

Date:
03/29/2010

Orientation:
View looking south.

Description:
South bank core sample at location SD-32.

O'BRIEN & GERE

# PHOTOGRAPHIC LOG

| | | | |
|---|---|---|---|
| Client: | NBIA OU1 PRP | Project Number: | 41845 |
| Site Name: | NBIA | Location: | Bronson, Michigan |

Photo Number:
09: 100_0800.jpg

Photographer:
Clifford Yantz

Date:
03/29/2010

Orientation:
View looking south.

Description:
CD #30 at location SD-33.

Photo Number:
10: 100_0802.jpg

Photographer:
Kevin Schneider

Date:
03/29/2010

Orientation:
View looking south.

Description:
Collecting sample at SD-33-10N (10 ft north of top of north bank of CD #30), with SD-33-30N in foreground of picture (look for sample jar).

O'BRIEN & GERE

# PHOTOGRAPHIC LOG

| | | | |
|---|---|---|---|
| Client: | NBIA OU1 PRP | Project Number: | 41845 |
| Site Name: | NBIA | Location: | Bronson, Michigan |

Photo Number:
11: 100_0807.jpg

Photographer:
Clifford Yantz

Date:
03/29/2010

Orientation:
View looking south.

Description:
CD #30 at location SD-34.

Photo Number:
12: 100_0806.jpg

Photographer:
Clifford Yantz

Date:
03/29/2010

Orientation:
View looking south.

Description:
Sample location SD-34-10N.

Typical decon setup shown with two buckets, brushes, sprayer and plastic sheeting.

O'BRIEN & GERE

# PHOTOGRAPHIC LOG

| | | | |
|---|---|---|---|
| Client: | NBIA OU1 PRP | Project Number: | 41845 |
| Site Name: | NBIA | Location: | Bronson, Michigan |

Photo Number:
13: 100_0808.jpg

Photographer:
Clifford Yantz

Date:
03/29/2010

Orientation:
View looking south.

Description:
CD #30 at location SD-35.

Photo Number:
14: 100_0810.jpg

Photographer:
Clifford Yantz

Date:
03/29/2010

Orientation:
View looking west.

Description:
North bank of CD# 30 looking west from SD-36 location. No photo of SD-36.

Note: Very slight rise (< 1 foot) moving toward north bank of CD #30.

O'BRIEN & GERE

# PHOTOGRAPHIC LOG

| | | | |
|---|---|---|---|
| Client: | NBIA OU1 PRP | Project Number: | 41845 |
| Site Name: | NBIA | Location: | Bronson, Michigan |

Photo Number:
15: 100_0812.jpg

Photographer:
Clifford Yantz

Date:
03/30/2010

Orientation:
View looking south.

Description:
CD #30 at location SD-37.

SD-37 was collected just upstream of this deer trail/path.

Photo Number:
16: 100_0813.jpg

Photographer:
Clifford Yantz

Date:
03/30/2010

Orientation:
View looking southwest.

Description:
CD #30 from location SD-37.

Note farm field outfall alone southern bank of CD #30. Several farm field outfalls exist long CD #30.

O'BRIEN & GERE

# PHOTOGRAPHIC LOG

| | | | |
|---|---|---|---|
| Client: | NBIA OU1 PRP | Project Number: | 41845 |
| Site Name: | NBIA | Location: | Bronson, Michigan |

Photo Number:
17: 100_0815.jpg

Photographer:
Kevin Schneider

Date:
03/30/2010

Orientation:
View looking south.

Description:
CD #30 at location SD-38.

Note: open jar was used to keep the GPS unit clean/dry, not for sample collection.

Photo Number:
18: 100_0818.jpg

Photographer:
Clifford Yantz

Date:
03/30/2010

Orientation:
View looking south

Description:
CD #30 at location SD-39.

O'BRIEN & GERE

# PHOTOGRAPHIC LOG

| | | | |
|---|---|---|---|
| Client: | NBIA OU1 PRP | Project Number: | 41845 |
| Site Name: | NBIA | Location: | Bronson, Michigan |

Photo Number:
19: 100_0838.jpg

Photographer:
Clifford Yantz

Date:
03/30/2010

Orientation:
View looking south.

Description:
Mound of sediment east of Consumers Energy substation.

Photo Number:
20: 100_0844.jpg

Photographer:
Clifford Yantz

Date:
03/30/2010

Orientation:
View looking west.

Description:
Along north bank of CD #30 across from City of Bronson WWTP outfall.

# *APPENDIX B*

# *SAMPLE COLLECTION FIELD NOTES*

12+16/41845 #4

# LEVEL BOOK

#101596

North Bronson

Industrial Area

GW Delineation Study

BEN MEADOWS℠

www.benmeadows.com | 1-800-241-6401

When the Outdoors is Your Office®

1348 MW-5S DTW 8.12

1347 MW-9S DTW-7.15

1358 PZ-5 DTW-7.11

1400 Began to look for PZ6

1530 Quit looking for PZ6

located SG-4 length
DTW 2.4? Total ~~depth~~ 3.2
not sure how deep ice is?

located SG-3 length
DTW 2.4? Total ~~depth~~ 3.2
not sure how deep ice is?

located SG-2R
DTW 0.78? difficult to see
Total length 6.66

1610 off site



# NBIA - Soil & Sediment Sampling Program

3/29/10

8:00 - 10:00 Drive to Bronson
Purchase Ice and drive to site

10:00 - 10:15 Check out fields to see if we can drive into fields, which will save us from walking everything in. Fields feel firm even though it rained yesterday.

10:15 - 10:45 Set up at SD-28 to begin sampling furthest downstream
Decon equipment, fill out labels, etc.

Weather: Cloudy, ~33°F, light breeze to light wind (~2-6 mph), humid, cold.

SD-28 N 41.88165°
W 85.20442°

SD-28-SB- N 41.88163°
W 85.20443°

3/29/10

Irwin soil + sediment sampling program

3/27/10

SD-28-NB N 41.88168°
W 85.20440°

Top of slope
N 41.88169°
W 85.20439°

SD-28

11" of Recovery out of 18"
7" water over sample
Sediment

0-6" Black to Dark gray, wet
organic MUCK 30 to 40% organics
some leaf, root and plant fibers
10-15% clay particles
15-30% silt
10-15% coarse to fine sand and
trace gravel

6-18" grayish brown, coarse to fine sand
little fine gravel, some silt
trace to little clay, wet

1115 collected SD-28 SD-28 MS/MSD



Soil + Sediment Sampling

3/27/10

Recovery South Bank SD-28-SB
17"-18" grayish brown Moist
0-18" Coarse to fine sand Moist Med to fine sand
trace to little fine gravel, little to
some silt trace to little clay
little root fibers and humus
at 18" - coarse to fine sand Moist
light to med brown, trace silt and
clay trace to little gravel.
no sediment pic say.

1130 Collected SD-28 SB

Recovery SD-28-NB
17"-18"

0-9" Moist dark brown to dark grayish brown
coarse to fine sand, some silt,
trace to little clay, trace to little
fine roots and humus,

9-11" ~~coarse~~ Moist, grayish, coarse to fine
sand trace silt trace clay,
trace fine gravel.

11"-18" grayish dark brown, silty coarse to
fine sand moist med fine, some to little clay
trace roots

3/29/10

1140 collected SD-28-NB

North and South Banks at 45° Angle
no sediment present appears to be the soil

SD-28-10N – N 41.88172°
W 85.20436°

SD-28-10N

18"-18"

0-10" dark brown, moist, med to fine silty sand, trace fine gravel trace coarse sand, trace to little silt, some humus

12"-15" dark brown, greenish mottling, tan sand, coarse to fine sand, some silt little clay, little fine gravel

15-18" dark brown to grayish brown silty clay, trace med to fine sand little ~~some~~ trace humus



1210 collected SD-28-10N-0.5

1220 collected SD-28-10N-1.5

SD-28-30N – N 41.88177
W 85.20434

SD-28-30N

18"-18"

0-10" dark brown, moist coarse to fine sand moist med to fine, little to some silt trace to little clay, trace fine gravel little humus,

10-17" yellow brown coarse to fine silty sand little to some clay, trace fine gravel greenish mottling

17-18" greenish gray coarse to fine sand, some silt, little clay, little fine gravel.

1245 collected SD-28-30N-0.5

1250 collected SD-28-30N-1.5

3/29/10 Sediment & Soil Sampling

SD-28-70N — N 41.88187
W 85.20426

SD-28-70N

18"-18"

0-10" Moist, dark brown coarse to fine sand some silt trace to little clay little humus

10-18" Moist med gray to greenish gray coarse to fine sand med to fine trace to little fine gravel, little to some silt some clay 10-12" otherwise trace clay

1305 Collected SD-28-70N-0.5

1310 Collected SD-28-70N-1.5

1st photo SB Bank location
2nd photo NB Bank location
3rd photo 10' looking south
4th photo 30' looking south
5th photo 70' looking south



3/29/10 Soil & Sediment Sampling

1340 off site for lunch
1430 on site

1455 Equipment Blank for Soil collected after SD-28-70N
No water bottles provided by the Lab will collect when they arrive

Moved to SD-29
just outside tree line to the west

SD-29-SB — N 41.88078
W 85.20191

SD-29 — N 41.88081
W 85.20190

SD-29-NB — N 41.88083
W 85.20187

TOP of slope NB — N 41.88084
W 85.20188

3/29/10 Soil & Sediment Sampling

SD-29 collected Middle of creek all depositional 4" of water on

0-6" 80% organic material, Med-fine sand trace clay
13" of sediment total

13-16" dark gray to black, C-F sand, trace to little silt, trace clay, trace fine gravel

★ SD-DUP-01 collected at SD-29

SD-29 collected

SD-29-SB

11"-12"

0-1" dark brown F-M sand, little silt little humus, trace roots moist

1-9" grayish brown C-F sand, little silt trace fine gravel, trace roots moist

9-12" brown to reddish brown C-F sand, little silt, Trace to little fine gravel

1540 Collected SD-29 SB



SD-29-NB - 12" ~~above~~ on bank

9"-9"

0-2" dark brown, moist, C-F sand, little fine gravel, little to some silt, trace to little humus, trace roots

2-9" grayish brown, moist C-F sand, some to and fine gravel, trace to little silt and clay.

NB at SD-29 at 60° angle
SB at SD-29 at 45-60° angle

SD-29-10N - N 41.88087°
W 85.20184°

SD-29-10N-

18-18"

0-8.5" dark brown C-F sand, little silt, trace fine gravel, trace to little roots + humus

8.5-17.5" dark brown M-F sand, trace fine gravel trace to little humus, little to some silt

17.5-18" grayish brown C-F sand, trace to little fine gravel, trace to little silt

1615 Collected SD-29-10N-0.5

Collected SD-29-10N-1.5

* SD-DUP-02 collected at SD-29-10N-1.5

6th Photo SD-29
7th Photo NB - facing North
8th Photo SD-29-10N
9th Photo on NB facing South SB
10th Photo looking down at SD-29-16N

SD-29-30N

18-18"

0-2.5" dark brown, moist, M-F sand, some silt, trace coarse sand little humus

2.5-9" piece of plastic, grayish brown moist C-F sand, little to some silt, trace fine gravel, trace root and humus

9-18" dark brown, M-F sand, trace coarse sand, trace fine gravel, trace roots trace clay



SD-29-30N - N 41.88093°
W 85.20190°

SD-29-70N

18-18"

0-10.5" dark brown, moist, M-F sand, some silt, trace fine gravel, trace clay, trace to little humus, trace fine roots

10.5-18" gray w/ green grayish brown mottling, C-F sand, little fine gravel, little silt,

SD-29-70N - N 41.88103°
W 85.20186°

1700 collected SD-29-70N-0.5

1710 collected SD-29-70N-1.5

Moved to SD-30

SD-30 top of slope N side
N 41.88081°
W 85.20079°

~~60~~ 3/29/10

SD-30-10N - N 41.88084
W 85.20080

SD-30-10N

17-18"

0-18" dark brown moist C-F sand, most med fine little to some silt, trace fine gravel trace to little humus and roots

1745 collected SD-30-10N-0.5

11th photo looking N SD-29-70N
12th photo looking S at SD-30-10N
13th photo looking E at SD-30-10N
Well * in background

1800 Collected SD-30-10N-1.5

Cleaned equipment
1815 off site



3/30/10 Sediment & Soil Sampling 

~~800~~ Arrived on site spoke with Chuck Buckley
weather — 30°F partly sunny

SD-30-30N - N 41.88089
W 85.20076

SD-30-70N - N 41.88101
W 85.20076

SD-30-30N

16-18"

0-8" dark brown, moist, M-F sand, trace coarse sand, little to some silt, trace roots, little humus

8-18" Same as above, no roots, trace fine gravel, little silt

840 Collected SD-30-30N-0.5
845 Collected SD-30-30N-1.5

3/30/16

SD-30-70N

18-18"

0-18" dark brown, moist, C-F sand
percentally M-F sand, little to
some silt, little humus, trace roots

* SD-DUP-03 collected at SD-30-70N-0.5

14th photo looking south at SD-30-70N
15th photo looking south at SD-30-30N
16th photo looking south at SB and SD-30

900 Collected SD-30-70N-0.5
905 collected SD-30-70N-1.5

SD-30-NB

9-9"

0-0.5 dark brown, moist, M-F sand,
some silt, little humus
to light grayish brown
0.5-9 light brown, moist to wet, C-F sand,
little to some fine gravel, little silt

930 Collected SD-30-NB
1 ft above water line

3/30/16



SD-30

sediment 10" thick 6" water

0-10" dark greenish gray to black, wet, silty +
Muck and silt, little clay, little MF sand
abundant organic material, leaf litter

under sediment grayish C-F sand, wet, trace to
little fine gravel

NB 60-70° slope
SB 45° angle at drain 1ft of vert
drain 12' wide
940 collected SD-30
SD-30-SB

14-18"

0-3" dark brown, moist, C-F sand, little roots
little humus, little silt

3-18" med gray, moist, wet C-F sand, trace fine
gravel, trace roots, little silt

SD-30-SB N 41.88074
W 85.20081

955 Collected SD-30-SB

64 3/30/10 Soil & Sediment Sampling

SD-30 — N 41.88075
W 85.20079

SD-30-NB N 41.88078
W 85.20079

1000 Moved to location SD-31

SD-30-SB - 1ft above water level

9-9"

0-2.5" dark brown, moist, M-F sand, little to some silt, little humus, little roots

2.5-9" Med gray, grading to light gray, C-F sand, little to some silt, trace roots, trace to little fine gravel

SD-31-SB N 41.88076
W 85.20000

1020 Collected SD-31-SB

3/30/10 Soil & Sediment Sampling 65

SD-31

Sediment 13" thick 4" water

0-13" 1"-dark brown, 1-13" black, some silt, some organic humus, little fibrous, leaf litter, trace to little M-F sand little clay

under sediment Med gray, Med fine sand, little silt, wet,

1040 collected SD-31

SD-31 — N 41.88076
W 85.20004

SD-31-NB- N 41.88079
W 85.20004

SD-31 top of slope N 41.88081
W 85.20004

SD-31NB

13-13"

0-5" dark brown, M-F sand, trace fine gravel, little root little humus, some silt, moist

5-12" dark brown, C-F sand, little to some silt, little roots trace fine gravel, moist to wet

12-13" light gray moist to wet C-F sand, trace fine gravel, trace to little silt

11/1/10 Soil & Sediment Sampling

1050 SD-31-NB collected at 1050

SD-31-10N

18-18"

0-10.5" dark brown, M-F Sand, moist, trace fine gravel trace coarse sand, little humus, little roots, some silt

10.5-18" Med to grayish brown, moist, C-F sand, little to some silt, trace to little fine gravel trace humus

1105 collected SD-31-10N-0.5
1110 Collected SD-31-10N-1.5

SD-31-30N

18-18"

0-8" dark brown, C-F sand, predominantly med fine some silt, little humus and roots, trace fine gravel, moist

8-18" Med brown, C-F sand, trace to little fine gravel little to some silt, trace humus moist

MS/MSD collected at SD-31-30N-0.5



3/30/10

1130 collected SD-31-30N-0.5
1135 collected SD-31-30N-1.5

1195 Collected SD-31-70N-0.5
1150 Collected SD-31-70N-1.5

SD-31-70N

18-18"

0-17.5 dark brown, moist, M-F sand, some silt little humus, trace roots, trace clay,

17.5-18" moist, C-F sand, predominantly M-F light grayish brown, trace to little silt

| | |
|---|---|
| SD-31-10N | N 41.88084<br>W 85.20003 |
| SD-31-30N | N 41.88092<br>W 85.20003 |
| SD-31-70N | N 41.88100<br>W 85.20003 |

3/30/10

1230 SD-EB-01 Lab $H_2O$ off scoop collect after SD-31-70N-0.5

1235 SD-EB-02 collected after SD-31-70N-1.5
Lab $H_2O$ off hand auger

17th photo cliff collecting SD-32-SB looking S
18th photo " "

SD-32-SB - N 41.88082
W 85.19721

SD-32-SB 1ft above water level
12-12"

0-2" dark brown, C-F sand, little to some silt
some roots, moist to wet 2-12"

2-12" grayish brown, C-F sand, little silt,
little to some fine gravel, trace roots

1245 collected SD-32-SB

SD-32 - N 41.88078
W 85.19718



3/30/10

SD-32-NB - N 41.88079
W 85.19718

SD-32 Top of slope N 41.88081
W 85.19718

SD-32-10N - N 41.88081
W 85.19718

SD-32 - collected 16oz jar
Sediment 1" thick, 8" water

0-1" Black, very fibrous, organic, some silt
and clay, some M-F sand, wet

Under sediment Med gray, C-F sand, wet, trace
fine gravel, trace to little silt

1305 collected SD-32

1310 SD-EB-03 collected after SD-32
Lab $H_2O$ off bowl/scoop

3/30/10

SD-32-NB

9-9"

0-4" dark brown, M-F sand, some silt, moist trace to little roots + humus, trace fine gravel

5-9" Med gray moist to wet, C-F sand, little fine gravel, trace to little silt, trace roots and humus

1315 collected SD-32-NB

★ SD-DUP-04 collected at SD-32-10N-0.5

1330 collected SD-32-10N-0.5
1335 collected SD-32-10N-1.5

SD-32-10N

18-18"

0-10" dark brown, moist, C-F sand, some silt little roots + humus, trace fine gravel

10-18" grayish brown to dark brown, moist, C-F sand little silt, trace fine gravel, trace root + humus.



3/30/10

SD-32-30N

18-18

0-13" dark brown, moist, C-F sand, some silt trace fine gravel, little roots + humus

13-18" Yellowish brown w/ gray mottling, silty clay, some C-F sand, trace fine gravel, moist some desiccation cracks

1345 collected SD-32-30N-0.5
1350 collected SD-32-30N-1.5

SD-32-30N N 41.88088
W ~~85.2~~ 85.19719

SD-32-70N N 41.88098
W 85.19721

★ SD-DUP-05 collected at SD-32-70N-0.5

1400 collected SD-32-70N-0.5
1405 collected SD-32-70N-1.5

SD-32-70N-

17-18"

0-14" dark brown, moist, M-F sand, trace fine gravel, some silt to silty, little roots and humus

14-18" greenish gray moist, C-F sand, more Med to fine silty, little clay, trace fine gravel

store bought $H_2O$ off scoop

N20 SD-EB-04 collected after SD-32-70N-0.5

1425 SD-EB-05 collected after SD-32-70N-1.5

Lab $H_2O$ off hand auger

17th photo look south at SD-32-70N

18th " " south at SD-32-30N

19th " " south at SD-32-10N

20th " " south at SD-32

1440 off site

1545 ~~off~~ site

on

Moved to SD-33

1620 ★ SD-DUP-06 collected at SD-33-SB



SD-33-SB

15-16"

0-8" grayish brown, moist, M-F sand, some silt trace clay, trace roots and humus

8"-9" light gray, moist to wet, C-F sand, trace to little fine gravel, trace roots trace to little silt

9-16" light gray, M-F sand, trace fine gravel trace silt

South Bank at a 80° angle

North Bank at a 60° angle

SD-33-SB N 41.88094
W 85.19370

SD-33 N 41.88097
W 85.19370

1620 Collected SD-33-SB

3/30/10

SD-33

Sediment 8" thick, 4" water

Brown on surface, Black underneath

fiberous, leaf litter, organics, more muck than soil, some c-F sand, wet

under sediment gray, C-F sand, trace silt, trace fine gravel

SD-33-NB - N 41.88101
W 85.19367

SD-33 Top of slope N 41.88103
W 85.19367

SD-33-10N - N 41.88105
W 85.19370

SD-33-30N - N 41.88111
W 85.19372

SD-33-70N N 41.88120
W 85.19376



3/30/10

1630 Collected SD-33

SD-33-NB 1ft above water level
erosion along bank

6-6"

0-6" light to med gray, C-F SAND, trace to little silt, trace fine gravel, moist

1640 Collected SD-33-NB

21st photo looking South SD-33 NB/SB
22nd " " SD-33-10N
23rd " " SD-33-30N
24th " " SD-33-70N

SD-33-10N

17-18"

0-17" dark brown moist 0-2" abundant Root M-F SAND, trace c-Sand and fine gravel, some silt, little humus

17-18" Yellowish brown, moist, M-F SAND, trace fine gravel, trace to little silt,

3/30/10

1700 SD-EB-06 collected after
SD-33-10N-0.5 ~~using~~ off Scoop
using stone $H_2O$

SD-33-30N

15-18"

0-14" dark brown, moist, M-F SAND, trace fine gravel, some silt, abundant roots 0-2",

14"-18" light grayish brown some yellowish brown mottling C-F SAND, little fine gravel little silt,

collected SD-33-30N-0.5.
Collected SD-33-30N-1.5

SD-33-70N

16.5-18"

0-16" dark brown, moist, M-F SAND, trace fine gravel, some silt, little humus

16-18" light grayish brown, some yellowish brown mottling, C-F SAND, little fine gravel little silt

1725 collected SD-33-70N-0.5



3/30/10

1735 Moved to location SD-34

SD-34-10N-

18-18"

0-18" dark brown, moist, M-F SAND, some silt, 0-2.5" Roots, trace humus and roots trace fine gravel

1745 collected SD-34-10N-0.5
1750 collected SD-34-10N-1.5

1800 SD-EB-07 collected after SD-34-10N-1.5 off hand auger w/ stone $H_2O$

SD-34-30N

10-18"

0-16" dark brown, moist MF SAND, some silt ROOT 0-2", trace fine gravel, some humus

16-18" gray moist, reddish brown mottling C-F SAND, little fine gravel

1805 collected SD-34-30N-0.5
1810 collected SD-34-30N-1.5

7.8 3/30/10

1815 collected SD-34-70N-0.5
1820 collected SD-34-70N-1.5

SD-34-70N
18-18"
0-18" dark brown, moist, M-F SAND
some silt, trace fine gravel
some humus, trace to little roots

cleaned equipment
1840 off site

3/31/10



800 Arrived on site and began
collecting remaining samples
45° sunny

☆ SD-DUP-07 collected at SD-34-NB

MS/MSD collected at SD-34-NB

SD-34-NB
11 - 17"
0-6" grayish brown, moist, M-F SAND, some silt
trace fine gravel, trace clay, some roots and
trace humus

6-17" M-F SAND, light gray, little silt, trace fine gravel
wet

820 collected SD-34-NB

SD-34
sediment 5" thick 3" water
Brown surface, black underneath, Muck, 40% silt + clay
more silt, some M-F sand, some fibrous, leaf litter

under sediment C-F SAND, trace fine gravel, little silt
med gray, wet

3/31/10

| | |
|---|---|
| SD-34-10N | N 41.88134<br>W 85.19233 |
| SD-34-30N | N 41.88140<br>W 85.19234 |
| SD-34-70N | N 41.88150<br>W 85.19238 |
| SD-34-SB | N 41.88124<br>W 85.19229 |
| SD-34 | N 41.88126<br>W 85.19230 |
| SD-34-NB | N 41.88130<br>W 85.19233 |
| SD-34 Top of slope | N 41.88132<br>W 85.19234 |



3/31/10

SD-34-SB

5-8"

0-8" Dark brown, moist, silty clay, roots
some humus, some M-F sand

? 25th Photo looking south at SD-34-70N
26th " " south at SD-34-30N
27th " " south at SD-34-10N
28th " " south at SD-NB/SB
29th " " south at SD-35
30th " " east at SD-35
31st " " west at SD-35

SD-35 banks at 45° angle
30' west of farm out fall

SD-35 - N 41.88236
W 85.18762

SD-35 sediment 9" thick 6" water
Muck, silty, little to some M-F sand, little clay
fibrous, leaf litter, organics, some humus

Under sediment Med grayish brown M-F SAND, little silt, trace humus
trace fine gravel

3/31/10

SD-36 - N 41.88282
W 85.18629

32nd Photo looking south of SD-36

SD-36 - 40 ft east of farm drain
Sediment 4.5" thick 3" water

Muck, silty, little clay, some humus, some fibers
leaf litter, little trace M-F sand, wet, brown surface
dark brown to dark grayish brown underneath

Under sediment med grayish brown, wet C-F sand
trace fine gravel, trace to little silt

33rd photo looking south at SD-37
34th photo looking east at SD-37
35th photo looking west at SD-37

SD-37 - N 41.88350
W 85.18507

SD-37
sediment 5" thick 3" water



3/31/10

Collected at 1000 SD-37

brown surface, dark grayish brown underneath, Muck
some organic, fibers, humus, some silt, little clay, some M-F sand

Under sed C-F SAND, trace fine gravel, little roots
humus, med grayish brown, little silt

36th photo looking south of SD-38
37th photo looking west of SD-38
38th photo looking east of SD-38

SD-38 N 41.88407
W 85.18381

SD-38 45° angle banks
5' wide
sediment 4" thick 3" water

brown surface, dark grayish brown underneath, little fibers
organic, humus, some silt, leaf litter, some C-F sand

Under sediment dark brown, wet, C-F SAND, most M-F
some silt, trace humus, trace fine gravel

1010 collected SD-38

3/31/10

39th Photo looking South at SD-39
40th " " west at SD-39
41st " " east at SD-39

SD-39 - N 41.88485
W ~~85.18296~~ KBS
85.18269

SD-39

Sediment less than 1" thick 2" water

dark grayish brown little fibrous organics, leaf litter
little humus, some to and c-F sand, some silt

Under sediment med gray m-F sand, trace fine gravel
little to some silt, trace humus

1030 collected sample SD-39

42nd Photo looking east 400' last bedding on bug
43rd photo looking west 400' " "
44th photo looking east 200' west of 43rd
45th photo looking west " "
46th photo looking east from SD-33-10N
47th photo looking west from SD-33-10N

CJH 3/31/10



48th Photo looking East from Matteson Rd (North side of CD#30)
49th Photo looking West from Matteson Rd (North side of CD#30)
50th Photo looking East from Matteson Rd. South side of CD#30 - this is the only possible area east of Matteson Rd where CD#30 sediments could have been placed based on mature trees on South bank of CD#30
51st Photo looking west from Matteson Rd on south side of CD#30
52nd Photo looking west toward Substation about 1/3 down entrance road to Substation
53rd Photo looking east toward Matteson Rd No noticable mounds along southern edge of CD#30 and somewhat unlikely that sediments would have been placed on north bank because residence fence is just about at top of Bank.
54th Photo looking north at north Bank of CD#30 where residence fence ends. possibly slight

CJH 3/31/10

"mound" - less than 1 ft tall in this area

55th Photo looking NW no real noticable mound along northor South Banks

56th Photo looking NW from about 150 ft west of Photo 55
- no real noticable mounds on north bank. - corn planted right up to the edge of CD#30

57th Photo looking SW at mounds on Consumers Power Property about 150 ft east of substation Mounds look like sediments from CD#30 - mounds are 2.0 to 3.5 ft high averaging about 2.5 ft and are about 125 ft long by up to 40 ft wide - averaging about 30 ft wide.

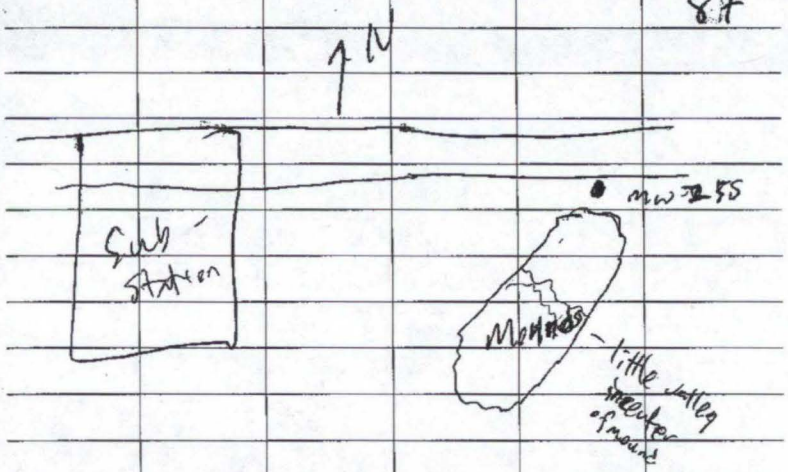
58th Photo - looking down at mound soils with leaf litter removed.

59th Photo - looking SW at southern end of the (mound) from center of mound

60th Photo - looking N to northend of mound from center of mound.

CJ 3/31/00






61st Photo looking west from substation on South side of CD#30

62nd Photo looking east from west of substation

63rd Photo looking west from North side of CD#30 at Bronson WWTP outfall - Typical appearance of area north of CD#30 - sediments have been plowed into fields along CD#30 there is a slight rise as you approach CD#30 which designates about 20-25 ft from edge of CD#30 typically.

64th Photo looking east from north side of CD#30 at Bronson WWTP outfall

CJ 3/31/00

6/8/10

1260 KBS set up at MW-47 - our flow cell

1405 KBS collected MW-47

fan out of tubing waiting for shipment to come to WW plant

1500 Pack cooler / cleaned equipment added reflectors to bollards

1530 off site



6/9/10

730 arrived on site to collect 4 additional / sediment samples at mid points between SD-35 and SD-36 SD-36 and SD-37 SD-37 and SD-38 SD-38 and SD-37

830 found location between SD-35 and SD-36 using GPS accurate within 7ft called location SD-40

dark brown, MUCK, leaf litter organics sediment 2" thick 6" water

840 collected at 840
SD-40
N 41.88259
W 85.18696

found location between SD-36 and SD-37 using GPS accurate 7.5ft called location SD-41
N 41.88316
W 85.18568

Sediment 6" Thick - 6" water
dark brown muck little silt and
clay, leaf litter, organics
900 collected at 900

found location between SD-37 and
SD-38 using GPS location
accurate within 7.5 ft called
* SD-42 also collected SD-DUP-08
N
W
sediment 4" Thick - 6" water
dark brown, muck, little silt and
clay, organics
920 collected at 920

found location between SD-38 and
SD-39 using GPS location accurate
within 15 ft call SD-43
N
W
sediment 3" thick - 6" water
dark brown, muck, little silt and clay
leaf litter grass, organics
little sand
940 collected at 940



calibrated flow cells
and setup at MW-41 (cox)
MW-46 (KBS)

KBS collected sample from MW-46
turb

chris cox collected sample from MW-41
turb
decanted and dumped water

KBS setup at MW-43

cox setup at MW-45s

* GW-DUP-01 collected at MW-45s

GW EB-01 collected on KBS pump
Meijer distilled water

cox collected sample from MW-45s
setup and sampled MW-45D

# *APPENDIX C*

# *ANALYTICAL LABORATORY REPORTS (ON COMPACT DISK LOCATED INSIDE BACK COVER)*

# *APPENDIX D*

# *DATA VALIDATION REPORTS*

# MEMORANDUM

**TO:** C Yantz **cc:**
**FROM:** KA Storne
**RE:** North Bronson Industrial Area, Bronson, Michigan, Data Validation Report
**FILE:** 12716/41845.007.002
**DATE:** July 15, 2010

This report presents the results of data validation performed for soil and sediment samples collected as part of the North Bronson Industrial Area (NBIA) Site in Bronson, Michigan. Sample collection activities were conducted by O'Brien & Gere in March 2010.

TestAmerica Laboratories, Inc. of North Canton, Ohio (TA North Canton) and TestAmerica, Inc. of Pittsburgh (TA Pittsburgh) performed the laboratory analyses for this sampling event. The laboratory packages generated contained summary forms for quality control analysis and supportive raw data.

Table 1 below summarizes the sample analyses submitted for data validation.

**Table 1.** *Analytical methods and references*

| Parameter | Method | Reference |
|---|---|---|
| PAHs/SVOCs | USEPA Methods 3540/8270C | 1 |
| Metals | USEPA Method 3010A/ 3050B/ 6010B | 1 |
| Mercury | USEPA Method 7470A/7471A | 1 |
| DI Leachable Cyanide | USEPA Method 9012A | 1 |
| Weak Acid Dissociable Cyanide | SM18 4500-CN-I | 2 |
| Hexavalent chromium | USEPA Method 7196A | 1 |
| Percent solids | USEPA Method 160.3 modified | 3 |
| SPLP (Sample preparation) | USEPA Method 1312 | 1 |

Note:

1. United States Environmental Protection Agency (USEPA). 2004. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846,* 3rd Edition, Update IIIB. Washington D.C.
2. American Water Works Association (AWWA), American Public Health Association (APHA) and Water Environment Federation (WEF). 1992. *Standard Methods for the Examination of Water and Wastewater*, 18th Edition. Washington, D.C.
3. USEPA. 1983. *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020. Cincinnati, Ohio.

PAHs indicates polynuclear aromatic hydrocarbons
SVOCs indicates semivolatile organic compound
DI indicates dionized water.
SPLP indicates synthetic precipitation leaching procedure

The samples submitted for data validation are summarized in the attached Table 2. Table 3 presents the specific data validation approach applied to data generated for this investigation. Table 4 presents the Laboratory QA/QC analyses definitions.

Full validation was performed on the soil and sediment samples collected for this investigation. The analytical data generated for this investigation were evaluated by O'Brien & Gere using the quality assurance/quality control (QA/QC) criteria established in the following documents:

- AWWA, APHA and WEF. 1992. *Standard Methods for the Examination of Water and Wastewater*, 18th Edition. Washington, D.C.
- O'Brien & Gere. 2008. *Field Sampling and Quality Assurance Plan, Revision 2, Addendum 4, North Bronson Industrial Area Operable Unit 1, Bronson, Michigan.* Farmington Hills, Michigan.

- USEPA. 2004. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846,* 3rd Edition, Update IIIB. Washington, D.C.

- USEPA. 1983. *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020. Cincinnati, Ohio.

Data affected by excursions from criteria presented in the methods and the QAPP are qualified using guidance provided in the following documents and professional judgment:

- USEPA. 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA-540/R-99-008.* Washington D.C.

- USEPA. 2004. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540/R-04-004.* Washington D.C.

The application of these validation guidelines has been modified to reflect the requirements of the methods and the QAPP.

The data validation included an evaluation of the following parameters, where applicable:

- Chain-of-custody records
- Documentation completeness
- Sample collection and preservation
- Percent solids
- Holding times
- Blank analysis
- Calibrations
- Gas chromatography/mass spectrometry (GC/MS) instrument check
- Surrogate recoveries
- Matrix spike/matrix spike duplicate (MS/MSD) analysis
- Laboratory control sample (LCS) analysis
- Internal standards performance
- Field duplicate analysis
- ICP interference check analysis
- ICP serial dilution analysis
- Target analyte quantification, identification, and quantitation limits (QLs)

The following sections of this memorandum present the results of the comparison of the analytical data to the QA/QC criteria specified above.

<u>Chain-of-custody record</u>

The chain-of-custody records associated with samples collected 3/29/10 to 3/31/10 was incomplete. The year that the samples were transferred was not included on every page of the record.

The courier and air bill numbers were not included on the records.

Although not documented on the chain-of-custody, the Project Manager instructed the laboratory verbally to perform weak acid dissociable cyanide and for SPLP preparation and analyses for metals, hexavalent chromium, and DI leachable cyanide.

Percent solids

The following soil sample was qualified as approximate (UJ, J) due to low percent solids: SD-34-SB.

**PAH/SVOC DATA EVALUATION SUMMARY**

The following QA/QC parameters were found to meet method and validation criteria or did not result in additional qualification of sample results:

- Documentation completeness
- Sample collection and preservation
- Holding times
- Blank analysis
- Calibrations
- GC/MS instrument check
- Surrogate recoveries
- MS/MSD analysis
- LCS analysis
- Internal standards performance
- Target analyte identification

Excursions and additional observations are described below.

I. Field duplicate analysis

Results in the following field duplicate pairs were qualified as approximate (UJ, J) due to minor precision excursions:

- Benzo(b) fluoranthene in samples SD-DUP-07 [SD-34-NB]/ SD-34-NB
- Anthracene, fluoranthene, fluorene and phenanthrene in samples SD-DUP-04 [SD-32-10N-0-0.5]/ SD-32-10N-0-0.5

II. Target analyte quantitation and QLs

Due to poor peak separation between benzo (b) fluoranthene and benzo (k) fluoranthene in the samples, the laboratory utilized manual integration to establish two separate peak areas in reporting the concentration of the two isomers. As a result of the manual integration applied to the sample results, detected results for benzo (b) fluoranthene and benzo (k) fluoranthene were qualified as approximate (J) in the following samples: SD-32-SB, SD-32-NB, SD-DUP-04[SD-32-10N-0.5], SD-34-NB, SD-34-SB, SD-32-10N-0.5, SD-32-10N-1.5, SD-32-30N-.0.5, SD-32-70N-0.5, SD-34-10N-0.5, SD-34-30N-0.5, SD-34-70N-0.5, SD-34-70N-1.5, SD-34-10N-1.5, SD-DUP-07[SD-34-NB].

The detected results for benzo (b) fluoranthene were qualified as approximate (J) in the following samples: SD-32, SD-34, SD-DUP-05[SD-32-70N-0.5], SD-34-30N-1.5, SD-34-70N-1.5, SD-34-30N-1.5.

Samples were diluted during the analysis process so that the laboratory could report the results for the target analytes within the calibration range of the instrument.

**METAL, MERCURY, DI LEACHABLE CYANIDE, WEAK ACID DISSOCIABLE CYANIDE, AND HEXAVALENT CHROMIUM DATA EVALUATION SUMMARY**

The following QA/QC parameters were found to meet method and validation criteria or did not result in additional qualification of sample results:

- Documentation completeness
- Sample collection and preservation
- Holding times
- Calibrations
- LCS analysis
- ICP interference check analysis

Excursions and additional observations are described below.

I. Field duplicate analysis

Results in the following samples were qualified as approximate (J) due to minor precision excursions:

- Silver in SD-DUP-02[SD-29-10N-1.5], SD-29-10N-1.5.
- Barium, calcium, cadmium in SD-DUP-06[SD-33-SB], SD-33-SB.

II. Blank analysis

Results in the following samples were qualified as non-detected (U) due to minor blank excursions:

- SPLP Calcium in SD-28-10N-1.5, SD-32-30N-1.5.
- SPLP Magnesium and barium in SD-28-10N-1.5, SD-29-10N-0.5, SD-29-30N-0.5, SD-30-10N-0.5, SD-30-10N-1.5, SD-30-30N-0.5, SD-31-10N-0.5, SD-31-30N-0.5, SD-32-30N-1.5, SD-34-10N-0.5.
- SPLP Manganese in SD-28-10N-1.5, SD-29-10N-0.5, SD-29-30N-0.5, SD-30-10N-0.5, SD-30-10N-1.5, SD-31-10N-0.5, SD-31-30N-0.5, SD-30-30N-0.5.
- SPLP Thallium in SD-28-10N-1.5, SD-29-10N-0.5, SD-30-10N-0.5, SD-31-10N-0.5. SD-32-30N-1.5.
- SPLP Sodium in SD-28-10N-1.5, SD-30-10N-1.5, SD-30-30N-0.5, SD-31-10N-0.5, SD-31-10N-0.5.
- SPLP Iron in SD-30-30N-0.5, SD-31-10N-0.5.
- Beryllium in SD-31-SB, SD-28-NB, SD-31-NB, SD-33-SB, SD-34-NB, SD-34-SB, SD-DUP-04[SD-32-10N-0.5], SD-28-70N-0.5, SD-29-30N-1.5, SD-30-10N-0.5, SD-30-30N-0.5, SD-31-10N-0.5, SD-31-30N-0.5, SD-32-10N-0.5, SD-32-10N-1.5, SD-32-30N-.0.5, SD-34-10N-0.5, SD-34-30N-0.5, SD-34-30N-1.5
- Cadmium in SD-28-70N-1.5, SD-33-70N-1.5.
- Potassium in SD-28-SB, SD-28-NB, SD-29-SB, SD-29-NB, SD-DUP-02[SD-29-10N-1.5], SD-30NB, SD-30-SB, SD-31-SB, SD-31-NB, SD-32-SB, SD-32-NB, SD-DUP-04[SD-32-10N-0.5], SD-33-SB, SD-DUP-06[SD-33-SB], SD-33-NB, SD-34-NB, SD-DUP-07[SD-34-NB], SD-34-SB, SD-28-10N-1.5, SD-28-30N-1.5, SD-28-70N-1.5, SD-29-10N-0.5, SD-29-10N-1.5, SD-29-30N-0.5, SD-30-10N-1.5, SD-30-30N-1.5, SD-30-70N-1.5, SD-31-10N-0.5, SD-31-10N-1.5, SD-31-30N-0.5, SD-31-30N-1.5, SD-31-70N-1.5, SD-32-10N-0.5, SD-32-10N-1.5, SD-32-30N-1.5, SD-32-70N-1.5, SD-33-10N-0.5, SD-33-10N-1.5, SD-33-

30N-0.5, SD-33-30N-1.5, SD-33-70N-0.5, SD-33-70N-1.5, SD-34-10N-1.5, SD-34-30N-1.5, SD-34-70N-1.5.

- Antimony in SD-33-70N-1.5, SD-28-NB, SD-29-SB, SD-29-NB
- Sodium in SD-31-30N-0.5, SD-32-10N-0.5, SD-33-10N-0.5, SD-29-10N-0.5, SD-30-NB, SD-32-SB, SD-32-NB, SD-DUP-06[SD-33-SB], SD-33-NB, SD-34-SB.

Results in the following samples were rejected (R) due to major blank excursions:

- SPLP Sodium in SD-29-10N-0.5, SD-29-30N-0.5, SD-30-10N-0.5, SD-32-30N-1.5, SD-34-10N-0.5.
- Zinc in SD-33-NB, SD-DUP-06[SD-33-SB].

III. MS and MSD analysis

Results in the following samples were qualified as approximate (UJ, J-) due to minor accuracy excursions:

- Cadmium and antimony in SD-28, SD-29, SD-DUP-01[SD-29], SD-30, SD-31, SD-32, SD-33, SD-34, SD-35, SD-36, SD-37, SD-38, SD-39.

Results in the following samples were qualified as approximate (J) due to minor accuracy excursions:

- Nickel and lead in SD-28, SD-29, SD-DUP-01[SD-29], SD-30, SD-31, SD-32, SD-33, SD-34, SD-35, SD-36, SD-37, SD-38, SD-39.

Results in the following samples were qualified as approximate (UJ, J-) due to minor accuracy excursions:

- Antimony in SD-31-30N-0.5, SD-31-30N-1.5, SD-31-70N-0.5, SD-31-70N-1.5, SD-32-10N-0.5, SD-32-10N-1.5, SD-32-30N-.0.5, SD-32-30N-1.5, SD-32-70N-0.5, SD-32-70N-1.5, SD-33-10N-0.5, SD-33-10N-1.5, SD-33-30N-0.5, SD-33-30N-1.5, SD-33-70N-0.5, SD-33-70N-1.5, SD-34-10N-0.5, SD-34-10N-1.5, SD-34-30N-0.5, SD-34-30N-1.5.

Results in the following samples were qualified as approximate (J) due to minor accuracy and precision excursions:

- Magnesium in SD-31-30N-0.5, SD-31-30N-1.5, SD-31-70N-0.5, SD-31-70N-1.5, SD-32-10N-0.5, SD-32-10N-1.5, SD-32-30N-.0.5, SD-32-30N-1.5, SD-32-70N-0.5, SD-32-70N-1.5, SD-33-10N-0.5, SD-33-10N-1.5, SD-33-30N-0.5, SD-33-30N-1.5, SD-33-70N-0.5, SD-33-70N-1.5, SD-34-10N-0.5, SD-34-10N-1.5, SD-34-30N-0.5, SD-34-30N-1.5.

Results in the following samples were qualified as approximate (J) due to minor accuracy excursions:

- Zinc in SD-31-30N-0.5, SD-31-30N-1.5, SD-31-70N-0.5, SD-31-70N-1.5, SD-32-10N-0.5, SD-32-10N-1.5, SD-32-30N-.0.5, SD-32-30N-1.5, SD-32-70N-0.5, SD-32-70N-1.5, SD-33-10N-0.5, SD-33-10N-1.5, SD-33-30N-0.5, SD-33-30N-1.5, SD-33-70N-0.5, SD-33-70N-1.5, SD-34-10N-0.5, SD-34-10N-1.5, SD-34-30N-0.5, SD-34-30N-1.5.

Results in the following samples were qualified as approximate (UJ, J) due to minor accuracy excursions:

- Antimony and cadmium in SD-28-10N-0.5, SD-28-10N-1.5, SD-28-30N-0.5, SD-28-30N-1.5, SD-28-70N-0.5, SD-28-70N-1.5, SD-29-10N-0.5, SD-29-10N-1.5, SD-29-30N-0.5, SD-29-30N-1.5, SD-29-70N-0.5, SD-29-70N-1.5, SD-30-10N-0.5, SD-30-10N-1.5, SD-30-30N-0.5, SD-30-30N-1.5, SD-30-70N-0.5, SD-30-70N-1.5, SD-31-10N-0.5, SD-31-10N-1.5, SD-34-70N-0.5, SD-34-70N-1.5.

Results in the following samples were qualified as approximate (J) due to minor accuracy and precision excursions:

- Magnesium and manganese in SD-28-10N-0.5, SD-28-10N-1.5, SD-28-30N-0.5, SD-28-30N-1.5, SD-

28-70N-0.5, SD-28-70N-1.5, SD-29-10N-0.5, SD-29-10N-1.5, SD-29-30N-0.5, SD-29-30N-1.5, SD-29-70N-0.5, SD-29-70N-1.5, SD-30-10N-0.5, SD-30-10N-1.5, SD-30-30N-0.5, SD-30-30N-1.5, SD-30-70N-0.5, SD-30-70N-1.5, SD-31-10N-0.5, SD-31-10N-1.5, SD-34-70N-0.5, SD-34-70N-1.5.

Results in the following samples were rejected (R) due to major accuracy excursions:

- Silver in SD-28-10N-1.5, SD-28-30N-1.5, SD-28-70N-0.5, SD-28-70N-1.5, SD-29-70N-1.5, SD-30-70N-1.5, SD-34-70N-0.5, SD-34-70N-1.5

Results in the following samples were qualified as approximate (J-) due to minor accuracy excursions:

- Silver in SD-28-10N-0.5, SD-28-30N-0.5, SD-29-10N-0.5, SD-29-10N-1.5, SD-29-30N-0.5, SD-29-30N-1.5, SD-29-70N-0.5, SD-30-10N-0.5, SD-30-10N-1.5, SD-30-30N-0.5, SD-30-30N-1.5, SD-30-70N-0.5, SD-31-10N-0.5, SD-31-10N-1.5.

Results in the following samples were qualified as approximate (UJ, J-) due to minor accuracy excursions:

- Antimony and calcium in SD-28-SB, SD-28-NB, SD-29-SB, SD-29-NB, SD-DUP-02[SD-29-10N-1.5], SD-DUP-03[SD-30-70N-0.5], SD-30NB, SD-30-SB, SD-31-SB, SD-31-NB, SD-32-SB, SD-32-NB, SD-DUP-04[SD-32-10N-0.5], SD-DUP-05[SD-32-70N-0.5], SD-33-SB, SD-DUP-06[SD-33-SB], SD-33-NB, SD-34-NB, SD-DUP-07[SD-34-NB], SD-34-SB.

Results in the following samples were qualified as approximate (J -) due to minor accuracy and precision excursions:

- Manganese in SD-28-SB, SD-28-NB, SD-29-SB, SD-29-NB, SD-DUP-02[SD-29-10N-1.5], SD-DUP-03[SD-30-70N-0.5], SD-30NB, SD-30-SB, SD-31-SB, SD-31-NB, SD-32-SB, SD-32-NB, SD-DUP-04[SD-32-10N-0.5], SD-DUP-05[SD-32-70N-0.5], SD-33-SB, SD-DUP-06[SD-33-SB], SD-33-NB, SD-34-NB, SD-DUP-07[SD-34-NB], SD-34-SB.

The result in the following sample was qualified as approximate (UJ) due to a minor accuracy excursion:

- Di Leachable cyanide in SD-29-30N-0.5.

IV. ICP serial dilution analysis

The following results were qualified as approximate (J) due to minor excursions:

- SPLP Silver in samples SD-32-30N-1.5, SD-34-10N-0.5, SD-31-30N-0.5, SD-30-10N-0.5, SD-28-10N-1.5, SD-29-10N-0.5, SD-29-30N-0.5.
- SPLP Iron in samples SD-28-10N-1.5, SD-29-10N-0.5, SD-29-30N-0.5, SD-30-10N-0.5, SD-30-30N-0.5, SD-31-10N-0.5, SD-31-30N-0.5, SD-32-30N-1.5.
- SPLP Zinc (SPLP) in samples SD-29-10N-0.5, SD-29-30N-0.5, SD-30-10N-0.5, SD-31-30N-0.5, SD-32-30N-1.5, SD-34-10N-0.5.

V. Target analyte quantitation and QLs

Metal results reported by TA North Canton were reported to the instrument detection limit (IDL) level. Metal results reported by TA Pittsburgh were reported to the QL.

Samples were diluted during the analysis process so that the laboratory could report the results for the target analytes within the calibration range of the instrument.

## DATA USABILITY

The following samples were rejected as a result of major excursions identified during the data validation process:

Results in the following samples were rejected (R) due to major blank excursions:

- SPLP Sodium in SD-29-10N-0.5, SD-29-30N-0.5, SD-30-10N-0.5, SD-32-30N-1.5, SD-34-10N-0.5.
- Zinc in SD-33-NB, SD-DUP-06[SD-33-SB].

Results in the following samples were rejected (R) due to major accuracy excursions:

- Silver in SD-28-10N-1.5, SD-28-30N-1.5, SD-28-70N-1.5, SD-29-70N-1.5, SD-30-70N-1.5, SD-34-70N-0.5, SD-34-70N-1.5

Overall data usability with respect to completeness for the sample results reported is greater than 95 percent considering the complete data set for PAH, metals, mercury, total cyanide, weak acid dissociable cyanide, and hexavalent chromium results. The majority of the data were identified as usable for qualitative and quantitative purposes. Based on the validation performed, the completeness goal of 95 percent was met for these analyses.

Table 2. Sample cross reference list

| Laboratory | Date Collected | Lab ID | Client ID | Matrix | Analysis Requested |
|---|---|---|---|---|---|
| TA Pittsburgh | 3/29/2010 | A0D010442-001 | SD-28, MS/MSD | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 3/29/2010 | A0D010442-002 | SD-29 | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 3/29/2010 | A0D010442-003 | SD-DUP-01[SD-29] | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 3/29/2010 | A0D010442-004 | SD-30 | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 3/29/2010 | A0D010442-005 | SD-31 | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 3/29/2010 | A0D010442-006 | SD-32 | Sediment | PNAs, Metals, Percent Solids |
| TA Pittsburgh | 3/29/2010 | A0D010442-007 | SD-EB-03 | Aqueous | PNAs, Metals |
| TA Pittsburgh | 3/29/2010 | A0D010442-008 | SD-33 | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 3/29/2010 | A0D010442-009 | SD-34 | Sediment | PNAs, Metals, Percent Solids |
| TA Pittsburgh | 3/29/2010 | A0D010442-010 | SD-35 | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 3/29/2010 | A0D010442-011 | SD-36 | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 3/29/2010 | A0D010442-012 | SD-37 | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 3/29/2010 | A0D010442-013 | SD-38 | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 3/29/2010 | A0D010442-014 | SD-39 | Sediment | Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010417-001 | SD-28-SB | Soil | Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010417-002 | SD-28-NB | Soil | Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010417-003 | SD-29-SB | Soil | Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010417-004 | SD-29-NB | Soil | Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010417-005 | SD-DUP-02[SD-29-10N-1.5] | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010417-006 | SD-DUP-03[SD-30-70N-0.5] | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010417-007 | SD-30NB | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010417-008 | SD-30-SB | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010417-009 | SD-31-SB | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010417-010 | SD-31-NB | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010417-011 | SD-EB-01 | Aqueous | Metals |
| TA NCanton | 3/30/2010 | A0D010417-012 | SD-EB-02 | Aqueous | Metals |
| TA NCanton | 3/30/2010 | A0D010417-013 | SD-32-SB | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010417-014 | SD-32-NB | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010417-016 | SD-DUP-04[SD-32-10N-0.5] | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010417-021 | SD-DUP-05[SD-32-70N-0.5] | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010417-023 | SD-EB-04 | Aqueous | PNAs, Metals |
| TA NCanton | 3/30/2010 | A0D010417-024 | SD-EB-05 | Aqueous | Metals |
| TA NCanton | 3/30/2010 | A0D010417-025 | SD-33-SB | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010417-026 | SD-DUP-06[SD-33-SB] | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010417-027 | SD-33-NB | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010417-028 | SD-EB-06 | Aqueous | Metals |
| TA NCanton | 3/30/2010 | A0D010417-031 | SD-EB-07 | Aqueous | Metals |
| TA NCanton | 3/31/2010 | A0D010417-036 | SD-34-NB, MS/MSD | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/31/2010 | A0D010417-037 | SD-DUP-07[SD-34-NB] | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/31/2010 | A0D010417-038 | SD-34-SB | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010409-001 | SD-28-10N-0.5 | Soil | Metals, Percent Solids |

Table 2. Sample cross reference list

| Laboratory | Date Collected | Lab ID | Client ID | Matrix | Analysis Requested |
|---|---|---|---|---|---|
| TA NCanton | 3/29/2010 | A0D010409-002 | SD-28-10N-1.5 | Soil | Metals, Percent Solids, SPLP Metals, SPLP Hexavalent Chromium, SPLP Cyanide, SPLP Weak Acid Dissociable Cyanide |
| TA NCanton | 3/29/2010 | A0D010409-003 | SD-28-30N-0.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010409-004 | SD-28-30N-1.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010409-005 | SD-28-70N-0.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010409-006 | SD-28-70N-1.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010409-007 | SD-29-10N-0.5 | Soil | Metals, Percent Solids, SPLP Metals, SPLP Hexavalent Chromium, SPLP Cyanide, SPLP Weak Acid Dissociable Cyanide |
| TA NCanton | 3/29/2010 | A0D010409-008 | SD-29-10N-1.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010409-009 | SD-29-30N-0.5, MS/MSD | Soil | Metals, Percent Solids, SPLP Metals, SPLP Hexavalent Chromium, SPLP Cyanide, SPLP Weak Acid Dissociable Cyanide |
| TA NCanton | 3/29/2010 | A0D010409-010 | SD-29-30N-1.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010409-011 | SD-29-70N-0.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010409-012 | SD-29-70N-1.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/29/2010 | A0D010409-013 | SD-30-10N-0.5 | Soil | Metals, Percent Solids, SPLP Metals, SPLP Hexavalent Chromium, SPLP Cyanide, SPLP Weak Acid Dissociable Cyanide |
| TA NCanton | 3/29/2010 | A0D010409-014 | SD-30-10N-1.5 | Soil | Metals, Percent Solids, SPLP Metals, SPLP Hexavalent Chromium, SPLP Cyanide, SPLP Weak Acid Dissociable Cyanide |
| TA NCanton | 3/30/2010 | A0D010409-015 | SD-30-30N-0.5 | Soil | Metals, Percent Solids, SPLP Metals, SPLP Hexavalent Chromium, SPLP Cyanide, SPLP Weak Acid Dissociable Cyanide |
| TA NCanton | 3/30/2010 | A0D010409-016 | SD-30-30N-1.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-017 | SD-30-70N-0.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-018 | SD-30-70N-1.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-019 | SD-31-10N-0.5 | Soil | Metals, Percent Solids, SPLP Metals, SPLP Hexavalent Chromium, SPLP Cyanide, SPLP Weak Acid Dissociable Cyanide |
| TA NCanton | 3/30/2010 | A0D010409-020 | SD-31-10N-1.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-021 | SD-31-30N-0.5, MS/MSD | Soil | Metals, Percent Solids, SPLP Metals, SPLP Hexavalent Chromium, SPLP Cyanide, SPLP Weak Acid Dissociable Cyanide |
| TA NCanton | 3/30/2010 | A0D010409-022 | SD-31-30N-1.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-023 | SD-31-70N-0.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-024 | SD-31-70N-1.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-025/ A0D010417-015 | SD-32-10N-0.5 | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-026/ A0D010417-017 | SD-32-10N-1.5 | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-027/ A0D010417-018 | SD-32-30N-.0.5 | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-028/ A0D010417-019 | SD-32-30N-1.5 | Soil | PNAs, Metals, Percent Solids, SPLP Metals, SPLP Hexavalent Chromium, SPLP Cyanide, SPLP Weak Acid Dissociable Cyanide |
| TA NCanton | 3/30/2010 | A0D010409-029/ A0D010417-020 | SD-32-70N-0.5 | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-030/ A0D010417-022 | SD-32-70N-1.5 | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-031 | SD-33-10N-0.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-032 | SD-33-10N-1.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-033 | SD-33-30N-0.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-034 | SD-33-30N-1.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-035 | SD-33-70N-0.5 | Soil | Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-036 | SD-33-70N-1.5 | Soil | Metals, Percent Solids |

Table 2. Sample cross reference list

| Laboratory | Date Collected | Lab ID | Client ID | Matrix | Analysis Requested |
|---|---|---|---|---|---|
| TA NCanton | 3/30/2010 | A0D010409-037/ A0D010417-029 | SD-34-10N-0.5 | Soil | PNAs, Metals, Percent Solids, SPLP Metals, SPLP Hexavalent Chromium, SPLP Cyanide, SPLP Weak Acid Dissociable Cyanide |
| TA NCanton | 3/30/2010 | A0D010409-038/ A0D010417-030 | SD-34-10N-1.5 | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-039/ A0D010417-032 | SD-34-30N-0.5 | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-040/ A0D010417-033 | SD-34-30N-1.5 | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-041/ A0D010417-034 | SD-34-70N-0.5 | Soil | PNAs, Metals, Percent Solids |
| TA NCanton | 3/30/2010 | A0D010409-042/ A0D010417-035 | SD-34-70N-1.5 | Soil | PNAs, Metals, Percent Solids |

Note:
TA Pittsburgh indicates TestAmerica Pittsbugh in Pittsburgh, Pennsylvania.
TA NCanton indicates TestAmerica North Canton in Canton, Ohio.
PNAs indicates polynuclear aromatics.
SPLP indicates Synthetic Precipitation Leaching Procedure, used to prepare samples for analysis.
MS indicates matrix spike.
MSD indicates matrix spike duplicate.
DUP indicates field duplicate.
The sample identification utilized for the field duplicate location is listed in brackets.
EB indicates eqipment blank.

| *Table 3. O'Brien & Gere Data validation approach using USEPA National Functional Guidelines* | |
|---|---|
| General Validation Approach | For certain parameters, USEPA guidance for data validation indicates that professional judgment is to be utilized to identify the appropriate validation action. In these situations, the validation approach taken by O'Brien & Gere is a conservative one; qualifiers are applied to sample data to indicate both major and minor excursions. In this way, data associated with any type of excursion are identified to the data user. Major excursions will result in data being rejected, indicating that the data are considered unusable for either quantitative or qualitative purposes. Minor excursions will result in sample data being qualified as approximate that are otherwise usable for quantitative or qualitative purposes. |
| | Excursions are subdivided into excursions that are within the laboratory's control and those that are out of the laboratory's control. Excursions involving laboratory control sample recovery, calibration response, method blank excursions, low or high spike recovery due to inaccurate spiking solutions or poor instrument response, holding times, interpretation errors, and quantitation errors are within the control of the laboratory. Excursions resulting from matrix spike recovery, serial dilution recovery, surrogate, and internal standard performance due to matrix interference from the matrix of the samples are examples of those excursions that are not within the laboratory's control if the laboratory has followed proper method control procedures, including performing appropriate cleanup techniques, where applicable. |
| **Parameter Type** | **Applying Data Validation Qualifiers Approach*** |
| Sample collection information-Cooler Temperature | Results for samples submitted for organic and inorganic analyses impacted by cooler temperatures of greater than 10°C are qualified as approximate (UJ, J). |
| Sample collection information-Percent Solids | Results for samples submitted for organic and inorganic analyses that are impacted by percent solids of 50 percent or less are qualified as approximate (UJ, J).<br>*Low Level 2008 - For non-aqueous samples, if the Percent Moisture is less the 70.0%, no qualification of the data is necessary. If the Percent Moisture is greater than or equal to 70.0% and less than 90.0%, qualify detects as "J" and non-detects as approximated "UJ". If the Percent Moisture is greater than or equal to 90.0%, qualify detects as "J" and non-detects as unusable "R".* |
| Holding times | Evaluation of organic and inorganic data for the holding time parameter is performed utilizing the method holding times from date of collection, in accordance with USEPA validation guidelines. |
| Calibration Data-SVOCs by USEPA Method 8270C | SVOC target analytes are evaluated using the criteria of 15 %RSD or correlation coefficient criteria of 0.990 for initial calibration curves. Calibration verifications are evaluated using a criterion of 20 %D for the target analytes. Initial calibrations and calibration verifications were also evaluated using the criterion of a RF value of greater than or equal to a value of 0.05 for the target analytes. |
| Organic Multi-results | When two results are reported, due to re-preparation or for dilution analyses, both sets of results are evaluated during the validation process. Based on the evaluation of the associated quality control data, the results reflecting the higher quality data are reported. |
| General Organic MS/MSD, LCS, Duplicate Data | Laboratory established control limits are used to assess duplicate, surrogate, MS/MSD, and LCS data. |
| | In the case that excursions are identified in more than one quality control sample of the same matrix within one sample delivery group, samples are batched according to sample preparation or analysis date and qualified accordingly. |
| | If percent recoveries are less than laboratory control limits but greater than ten percent, non-detected and detected results are qualified as approximate (UJ, J) to indicate minor excursions. |
| | If percent recoveries are greater than laboratory control limits, detected results are qualified as approximate (J) to indicate minor excursions. |
| | If percent recoveries are less than ten percent, detected results are qualified as approximate (J) and non-detected results are qualified as rejected (R) to indicate major excursions. |
| | If RPDs for MSDs or duplicates are outside of laboratory control limits, detected results are qualified as approximate (J) to indicate minor excursions. |
| Organic MS/MSD Data | Qualification of organic data for MS/MSD analyses is performed only when both MS and MSD percent recoveries are outside of laboratory control limits. |
| | Organic data are rejected (R) to indicate major excursions in the case that both MS/MSD recoveries are less than ten percent. |
| Sample dilution Data | Qualification of data is not performed if MS/MSD or surrogate recoveries are outside of laboratory control limits due to sample dilution. |
| General Inorganic | Laboratory established control limits are used to assess duplicate, MS/MSD, and LCS data. |

| | |
|---|---|
| MS/MSD, LCS, Duplicate Data | In the case that excursions are identified in more than one quality control sample of the same matrix within one sample delivery group, samples are batched according to sample preparation or analysis date and qualified accordingly. |
| | Qualification of inorganic data for MS/MSD analyses is performed when either MS or MSD percent recoveries are outside of laboratory control limits. |
| | For inorganic analyses, if RPDs for MS/MSDs, laboratory duplicates, or field duplicates are outside of laboratory control limits, associated detected and non-detected results are qualified as approximate (UJ, J). |
| | Detected sample results associated with recoveries that are greater than the laboratory control limits are qualified as approximate biased high ($J^{(+)}$). |
| | Detected sample results associated with recoveries that both are greater than the laboratory control limits and less than the laboratory control limits or with one recovery outside of laboratory control limits, are qualified as approximate (J). |
| | Detected sample results associated with recoveries that are less than the laboratory control limits are qualified as approximate biased low ($J^{(-)}$). |
| | Non-detected sample results associated with recoveries that are less than the laboratory control limits but greater than or equal to 30 percent are qualified as approximate (UJ). |
| | Non-detected sample results associated with recoveries that are less than 30 percent are qualified as rejected (R). |
| Organic MS/MSD and Field Duplicate Data | Qualification of data associated with MS/MSD or field duplicate excursions is limited to the un-spiked sample or the field duplicate pair, respectively. |
| Field Duplicate Data | Field duplicate data are evaluated against relative percent difference (RPD) criteria of less than 50 percent for aqueous samples and less than 100 percent for soils when results are greater than five times the QL. When sample results for field duplicate pairs are less than five times the QL, the data are evaluated using control limits of plus or minus two times the QL for soils. If RPDs for field duplicates are outside of laboratory control limits, detected and non-detected results are qualified as approximate (UJ, J) to indicate minor excursions. |
| Organic Blank Data | If methylene chloride, acetone or 2-butanone is detected in the sample at a concentration that is less than ten times the concentration in the associated blank, the sample result is qualified as "U". |
| | If other target analytes are detected in the sample at a concentration that is less than five times the concentration detected in the associated blank, the sample result is qualified as "U". |
| | Results greater than the MDL but less than QL and within the blank action level, are replaced with the QL and qualified as non-detected (U). |
| | Results greater than the QL are qualified as "U" at that concentration. |
| | The highest concentrations of the target analytes are used to evaluate the associated samples. |
| Internal Standard organic Data | Internal standard recoveries are evaluated using control limits of within 50% of the lower standard area and up to 100% of the upper standard area of the associated calibration verification standard. The results for target analytes associated with internal standard area recoveries 25% or greater but less than the lower standard area are qualified as approximate (J, UJ) to indicate minor internal standard recovery excursions. The non-detected results for target analytes associated with internal standard area recoveries less than 25% are rejected (R) to indicate major recovery excursions |
| Serial Dilution Data | Serial dilution results are evaluated by the laboratory for data with initial sample concentrations that are greater than 50 times the instrument detection limit (IDL), in accordance with the validation guidelines. Qualifiers are applied to data that exceeded the ten percent difference based on the laboratory evaluation summary form provided. |
| Inorganic Blank Data | Concentrations in the associated samples greater than the QL but f less than five times the associated blank concentration are qualified as undetected (U) when blank concentrations are less than the QL.<br>For concentrations in the samples below the QL, the concentration is replaced with the QL and qualified as undetected (U). |
| | Non-detected concentrations in the associated samples associated with a negative blank concentration are qualified as approximate (UJ). |
| | Concentrations in the associated samples of greater than the QL but less than ten times the method or calibration blank concentration, when the calibration or method blank concentration is greater than the QL, are rejected (R). |
| | If analytes are detected in equipment blanks, sample concentrations less than the QL are replaced with the QL and qualified as undetected (U). Sample concentrations greater than the QL and less than five times the equipment blank concentration are qualified as undetected (U). |
| * Indicates that data validation guidelines do not address this situation. Therefore, validation qualifiers are not applied to data. | |
| Source O'Brien & Gere | |

***Table 4. Laboratory QA/QC analyses definitions.***

| QA/QC Term | Definition |
|---|---|
| Quantitation limit | The level above which numerical results may be obtained with a specified degree of confidence; the minimum concentration of an analyte in a specific matrix that can be identified and quantified above the method detection limit and within specified limits of precision and bias during routine analytical operating conditions. |
| Method detection limit | The minimum concentration of an analyte that undergoes preparation similar to the environmental samples and can be reported with a stated level of confidence that the analyte concentration is greater than zero. |
| Instrument detection limit | The lowest concentration of a metal target analyte that, when directly inputted and processed on a specific analytical instrument, produces a signal/response that is statistically distinct from the signal/response arising from equipment "noise" alone. |
| Gas chromatography/mass spectrometry (GC/MS) instrument performance check | Performed to verify mass resolution, identification, and to some degree, instrument sensitivity. These criteria are not sample specific; conformance is determined using standard materials. |
| Calibration | Compliance requirements for satisfactory instrument calibration are established to verify that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of analysis and calibration verifications document satisfactory maintenance and adjustment of the instrument on a day-to-day basis. |
| Relative Response Factor | A measure of the relative mass spectral response of an analyte compared to its internal standard. Relative Response Factors are determined by analysis of standards and are used in the calculation of concentrations of analytes in samples. |
| Relative standard deviation | The standard deviation divided by the mean; a unit-free measure of variability. |
| Correlation coefficient | A measure of the strength of the relationship between two variables. |
| Relative Percent Difference | Used to compare two values; the relative percent difference is based on the mean of the two values, and is reported as an absolute value, i.e., always expressed as a positive number or zero. |
| Percent Difference | Used to compare two values; the percent difference indicates both the direction and the magnitude of the comparison, i.e., the percent difference may be either negative, positive, or zero. |
| Percent Recovery | The act of determining whether or not the methodology measures all of the target analytes contained in a sample. |
| Calibration blank | Consists of acids and reagent water used to prepare metal samples for analysis. This type of blank is analyzed to evaluate whether contamination is occurring during the preparation and analysis of the sample. |
| Method blank | A water or soil blank that undergoes the preparation procedures applied to a sample (i.e., extraction, digestion, clean-up). These samples are analyzed to examine whether sample preparation, clean-up, and analysis techniques result in sample contamination. |
| Field/equipment | Collected and submitted for laboratory analysis, where appropriate. Field/equipment blanks are handled in the same manner as environmental samples. Equipment/field blanks are analyzed to assess contamination introduced during field sampling procedures. |
| Trip blank | Consist of samples of analyte-free water that have undergone shipment from the sampling site to the laboratory in coolers with the environmental samples submitted for volatile organic compound (VOC) analysis. Trip blanks will be analyzed for VOCs to determine if contamination has taken place during sample handling and/or shipment. Trip blanks will be utilized at a frequency of one each per cooler sent to the laboratory for VOC analysis. |
| Internal standards performance | Compounds not found in environmental samples which are spiked into samples and quality control samples at the time of sample preparation for organic analyses. Internal standards must meet retention time and recovery criteria specified in the analytical method. Internal standards are used as the basis for quantitation of the target analytes. |
| Surrogate recovery | Compounds similar in nature to the target analytes but not expected to be detected in the environmental media which are spiked into environmental samples, blanks, and quality control samples prior to sample preparation for organic analyses. Surrogates are used to evaluate analytical efficiency by measuring recovery. |
| Laboratory control sample<br>Matrix spike blank analyses | Standard solutions that consist of known concentrations of the target analytes spiked into laboratory analyte-free water or sand. They are prepared or purchased from a certified manufacturer from a source independent from the calibration standards to provide an independent verification of the calibration procedure. They are prepared and analyzed following the same procedures employed for environmental sample analysis to assess method accuracy independently of sample matrix effects. |
| Laboratory duplicate | Two or more representative portions taken from one homogeneous sample by the analyst and analyzed in the same laboratory. |
| Matrix | The material of which the sample is composed or the substrate containing the analyte of interest, such as drinking water, waste water, air, soil/sediment, biological material. |
| Matrix Spike (MS) | An aliquot of a matrix (water or soil) fortified (spiked) with known quantities of specific target analytes and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery. |
| Matrix spike duplicate (MSD) | A second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method. |
| Retention time | The time a target analyte is retained on a GC column before elution. The identification of a target analyte is dependent on a target compound's retention time falling within the specified retention time window established for that compound. |
| Relative retention time | The ratio of the retention time of a compound to that of a standard. |

Source O'Brien & Gere

# MEMORANDUM

**TO:** C Yantz **cc:**
**FROM:** KA Storne
**RE:** North Bronson Industrial Area, Bronson, Michigan, Data Validation Report
**FILE:** 12716/41845.007.002
**DATE:** July 19, 2010

This report presents the results of data validation performed for sediment samples collected as part of the North Bronson Industrial Area (NBIA) Site in Bronson, Michigan. Sample collection activities were conducted by O'Brien & Gere in June 2010.

TestAmerica Laboratories, Inc. of Pittsburgh, Pennsylvania (TA Pittsburgh) performed the laboratory analyses for this sampling event. The laboratory packages generated contained summary forms for quality control analysis and supportive raw data.

Table 1 below summarizes the sample analyses submitted for data validation.

**Table 1.** *Analytical methods and references*

| Parameter | Method | Reference |
|---|---|---|
| Metals | USEPA Method 3050B/ 6010B | 1 |
| Mercury | USEPA Method 7471A | 1 |
| Percent solids | USEPA Method SM20 2540G | 2 |

Note:
1. United States Environmental Protection Agency (USEPA). 2004. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846,* 3rd Edition, Update IIIB. Washington D.C.
2. American Water Works Association (AWWA), American Public Health Association (APHA) and Water Environment Federation (WEF). 1998. *Standard Methods for the Examination of Water and Wastewater,* 20th Edition. Washington, D.C.

The samples submitted for data validation are summarized in the attached Table 2. Table 3 presents the specific data validation approach applied to data generated for this investigation. Table 4 presents the Laboratory QA/QC analyses definitions.

Full validation was performed on the sediment samples collected for this investigation. The analytical data generated for this investigation were evaluated by O'Brien & Gere using the quality assurance/quality control (QA/QC) criteria established in the following documents:

- O'Brien & Gere. 2008. *Field Sampling and Quality Assurance Plan, Revision 2, Addendum 4, North Bronson Industrial Area Operable Unit 1, Bronson, Michigan.* Farmington Hills, Michigan.
- USEPA. 2004. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846,* 3rd Edition, Update IIIB. Washington, D.C.

Data affected by excursions from criteria presented in the methods and the QAPP are qualified using guidance provided in the following document and professional judgment:

- USEPA. 2004. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540/R-04-004.* Washington D.C.

The application of these validation guidelines has been modified to reflect the requirements of the methods

and the QAPP.

The data validation included an evaluation of the following parameters, where applicable:

- Chain-of-custody records
- Documentation completeness
- Sample collection and preservation
- Percent solids
- Holding times
- Blank analysis
- Calibrations
- Matrix spike/matrix spike duplicate (MS/MSD) analysis
- Laboratory control sample (LCS) analysis
- Laboratory duplicate analysis
- Internal standards performance
- Field duplicate analysis
- ICP interference check analysis
- ICP serial dilution analysis
- Target analyte quantification and quantitation limits (QLs)

The following sections of this memorandum present the results of the comparison of the analytical data to the QA/QC criteria specified above.

Chain-of-custody record

The chain-of-custody records associated with samples collected 6/9/10 was incomplete. The courier and air bill numbers were not included on the record. However, a copy of the Federal Express tracking document was included in the data package.

Sample collection

An MS/MSD set was not collected for this sampling event. The impact of this sampling excursion is addressed in the following section.

Percent solids

The following soil sample was qualified as approximate (UJ, J) due to low percent solids: SD-42.

**METALS DATA EVALUATION SUMMARY**

The following QA/QC parameters were found to meet method and validation criteria or did not result in additional qualification of sample results:

- Documentation completeness
- Sample preservation
- Holding times
- Calibrations

- LCS analysis
- Laboratory duplicate analysis
- ICP interference check analysis

Excursions and additional observations are described below.

I. Blank analysis

Results in the following samples were qualified as non-detected (U) due to minor blank excursions:

- Beryllium in SD-40, SD-41, SD-42, SD-DUP-08 [SD-42], and SD-43

II. MS and MSD analysis

An MS/MSD set was not collected for this sampling event. Therefore the impact of sample matrix on the target analyte recovery could not be evaluated for this investigation.

III. ICP serial dilution analysis

An ICP serial dilution was not performed by TA Pittsburgh for this sample set. Therefore the impact of a chemical or physical interference on the sample matrix could not be evaluated for this investigation.

IV. Target analyte quantitation and QLs

Metal results reported by TA Pittsburgh were reported to the QL. Results that were less than the QL but greater that the MDL, were reported by the laboratory using the "B" flag, which was revised during data validation to a "J" flag to indicate that these values are approximate.

**DATA USABILITY**

Overall data usability with respect to completeness for the sample results reported is 100 percent considering the complete data set for the metal results. The data were identified as usable for qualitative and quantitative purposes. Based on the validation performed, the completeness goal of 95 percent was met for these analyses.

Table 2. Sample cross reference list

| Laboratory | Date Collected | Lab ID | Client ID | Matrix | Analysis Requested |
|---|---|---|---|---|---|
| TA Pittsburgh | 6/9/2010 | COF100528-001 | SD-40 | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 6/9/2010 | COF100528-002 | SD-41 | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 6/9/2010 | COF100528-003 | SD-42 | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 6/9/2010 | COF100528-004 | SD-DUP-08 [SD-42] | Sediment | Metals, Percent Solids |
| TA Pittsburgh | 6/9/2010 | COF100528-005 | SD-43 | Sediment | Metals, Percent Solids |

Note:
TA Pittsburgh indicates TestAmerica Pittsbugh in Pittsburgh, Pennsylvania.
DUP indicates field duplicate.
The sample identification utilized for the field duplicate location is listed in brackets.

| *Table 3. O'Brien & Gere Data validation approach using USEPA National Functional Guidelines* | |
|---|---|
| General Validation Approach | For certain parameters, USEPA guidance for data validation indicates that professional judgment is to be utilized to identify the appropriate validation action. In these situations, the validation approach taken by O'Brien & Gere is a conservative one; qualifiers are applied to sample data to indicate both major and minor excursions. In this way, data associated with any type of excursion are identified to the data user. Major excursions will result in data being rejected, indicating that the data are considered unusable for either quantitative or qualitative purposes. Minor excursions will result in sample data being qualified as approximate that are otherwise usable for quantitative or qualitative purposes. |
| | Excursions are subdivided into excursions that are within the laboratory's control and those that are out of the laboratory's control. Excursions involving laboratory control sample recovery, calibration response, method blank excursions, low or high spike recovery due to inaccurate spiking solutions or poor instrument response, holding times, interpretation errors, and quantitation errors are within the control of the laboratory. Excursions resulting from matrix spike recovery, serial dilution recovery, surrogate, and internal standard performance due to matrix interference from the matrix of the samples are examples of those excursions that are not within the laboratory's control if the laboratory has followed proper method control procedures, including performing appropriate cleanup techniques, where applicable. |
| **Parameter Type** | **Applying Data Validation Qualifiers Approach*** |
| Sample collection information-Cooler Temperature | Results for samples submitted for organic and inorganic analyses impacted by cooler temperatures of greater than 10°C are qualified as approximate (UJ, J). |
| Sample collection information-Percent Solids | Results for samples submitted for organic and inorganic analyses that are impacted by percent solids of 50 percent or less are qualified as approximate (UJ, J).<br>*Low Level 2008 - For non-aqueous samples, if the Percent Moisture is less the 70.0%, no qualification of the data is necessary. If the Percent Moisture is greater than or equal to 70.0% and less than 90.0%, qualify detects as "J" and non-detects as approximated "UJ". If the Percent Moisture is greater than or equal to 90.0%, qualify detects as "J" and non-detects as unusable "R".* |
| Holding times | Evaluation of organic and inorganic data for the holding time parameter is performed utilizing the method holding times from date of collection, in accordance with USEPA validation guidelines. |
| General Inorganic MS/MSD, LCS, Duplicate Data | Laboratory established control limits are used to assess duplicate, MS/MSD, and LCS data. |
| | In the case that excursions are identified in more than one quality control sample of the same matrix within one sample delivery group, samples are batched according to sample preparation or analysis date and qualified accordingly. |
| | Qualification of inorganic data for MS/MSD analyses is performed when either MS or MSD percent recoveries are outside of laboratory control limits. |
| | For inorganic analyses, if RPDs for MS/MSDs, laboratory duplicates, or field duplicates are outside of laboratory control limits, associated detected and non-detected results are qualified as approximate (UJ, J). |
| | Detected sample results associated with recoveries that are greater than the laboratory control limits are qualified as approximate biased high ($J^{(+)}$). |
| | Detected sample results associated with recoveries that both are greater than the laboratory control limits and less than the laboratory control limits or with one recovery outside of laboratory control limits, are qualified as approximate (J). |
| | Detected sample results associated with recoveries that are less than the laboratory control limits are qualified as approximate biased low ($J^{(-)}$). |
| | Non-detected sample results associated with recoveries that are less than the laboratory control limits but greater than or equal to 30 percent are qualified as approximate (UJ). |
| | Non-detected sample results associated with recoveries that are less than 30 percent are qualified as rejected (R). |
| Field Duplicate Data | Field duplicate data are evaluated against relative percent difference (RPD) criteria of less than 50 |

| | |
|---|---|
| | percent for aqueous samples and less than 100 percent for soils when results are greater than five times the QL. When sample results for field duplicate pairs are less than five times the QL, the data are evaluated using control limits of plus or minus two times the QL for soils. If RPDs for field duplicates are outside of laboratory control limits, detected and non-detected results are qualified as approximate (UJ, J) to indicate minor excursions. |
| Internal Standard organic Data | Internal standard recoveries are evaluated using control limits of within 50% of the lower standard area and up to 100% of the upper standard area of the associated calibration verification standard. The results for target analytes associated with internal standard area recoveries 25% or greater but less than the lower standard area are qualified as approximate (J, UJ) to indicate minor internal standard recovery excursions. The non-detected results for target analytes associated with internal standard area recoveries less than 25% are rejected (R) to indicate major recovery excursions |
| Serial Dilution Data | Serial dilution results are evaluated by the laboratory for data with initial sample concentrations that are greater than 50 times the instrument detection limit (IDL), in accordance with the validation guidelines. Qualifiers are applied to data that exceeded the ten percent difference based on the laboratory evaluation summary form provided. |
| Inorganic Blank Data | For calibration or method blanks, when blank concentrations are less than the QL, concentrations in the associated samples greater than the QL but less than five times the associated blank concentration are qualified as undetected (U).<br>For concentrations in the samples below the QL, the concentration is replaced with the QL and qualified as undetected (U). |
| | Non-detected concentrations in the associated samples associated with a negative blank concentration are qualified as approximate (UJ). |
| | When the calibration or method blank concentration is greater than the QL, concentrations in the associated samples of greater than the QL but less than ten times the method or calibration blank concentration are rejected (R). |
| | For equipment blanks, sample concentrations less than the QL are replaced with the QL and qualified as undetected (U). Sample concentrations greater than the QL and less than five times the equipment blank concentration are qualified as undetected (U). |
| * Indicates that data validation guidelines do not address this situation. Therefore, validation qualifiers are not applied to data. | |
| Source O'Brien & Gere | |

| *Table 4. Laboratory QA/QC analyses definitions.* | |
|---|---|
| **QA/QC Term** | **Definition** |
| Quantitation limit | The level above which numerical results may be obtained with a specified degree of confidence; the minimum concentration of an analyte in a specific matrix that can be identified and quantified above the method detection limit and within specified limits of precision and bias during routine analytical operating conditions. |
| Method detection limit | The minimum concentration of an analyte that undergoes preparation similar to the environmental samples and can be reported with a stated level of confidence that the analyte concentration is greater than zero. |
| Instrument detection limit | The lowest concentration of a metal target analyte that, when directly inputted and processed on a specific analytical instrument, produces a signal/response that is statistically distinct from the signal/response arising from equipment "noise" alone. |
| Gas chromatography/mass spectrometry (GC/MS) instrument performance check | Performed to verify mass resolution, identification, and to some degree, instrument sensitivity. These criteria are not sample specific; conformance is determined using standard materials. |
| Calibration | Compliance requirements for satisfactory instrument calibration are established to verify that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of analysis and calibration verifications document satisfactory maintenance and adjustment of the instrument on a day-to-day basis. |
| Relative Response Factor | A measure of the relative mass spectral response of an analyte compared to its internal standard. Relative Response Factors are determined by analysis of standards and are used in the calculation of concentrations of analytes in samples. |
| Relative standard deviation | The standard deviation divided by the mean; a unit-free measure of variability. |
| Correlation coefficient | A measure of the strength of the relationship between two variables. |
| Relative Percent Difference | Used to compare two values; the relative percent difference is based on the mean of the two values, and is reported as an absolute value, i.e., always expressed as a positive number or zero. |
| Percent Difference | Used to compare two values; the percent difference indicates both the direction and the magnitude of the comparison, i.e., the percent difference may be either negative, positive, or zero. |
| Percent Recovery | The act of determining whether or not the methodology measures all of the target analytes contained in a sample. |
| Calibration blank | Consists of acids and reagent water used to prepare metal samples for analysis. This type of blank is analyzed to evaluate whether contamination is occurring during the preparation and analysis of the sample. |
| Method blank | A water or soil blank that undergoes the preparation procedures applied to a sample (i.e., extraction, digestion, clean-up). These samples are analyzed to examine whether sample preparation, clean-up, and analysis techniques result in sample contamination. |
| Field/equipment | Collected and submitted for laboratory analysis, where appropriate. Field/equipment blanks are handled in the same manner as environmental samples. Equipment/field blanks are analyzed to assess contamination introduced during field sampling procedures. |
| Trip blank | Consist of samples of analyte-free water that have undergone shipment from the sampling site to the laboratory in coolers with the environmental samples submitted for volatile organic compound (VOC) analysis. Trip blanks will be analyzed for VOCs to determine if contamination has taken place during sample handling and/or shipment. Trip blanks will be utilized at a frequency of one each per cooler sent to the laboratory for VOC analysis. |
| Internal standards performance | Compounds not found in environmental samples which are spiked into samples and quality control samples at the time of sample preparation for organic analyses. Internal standards must meet retention time and recovery criteria specified in the analytical method. Internal standards are used as the basis for quantitation of the target analytes. |
| Surrogate recovery | Compounds similar in nature to the target analytes but not expected to be detected in the environmental media which are spiked into environmental samples, blanks, and quality control samples prior to sample preparation for organic analyses. Surrogates are used to evaluate analytical efficiency by measuring recovery. |
| Laboratory control sample Matrix spike blank analyses | Standard solutions that consist of known concentrations of the target analytes spiked into laboratory analyte-free water or sand. They are prepared or purchased from a certified manufacturer from a source independent from the calibration standards to provide an independent verification of the calibration procedure. They are prepared and analyzed following the same procedures employed for environmental sample analysis to assess method accuracy independently of sample matrix effects. |
| Laboratory duplicate | Two or more representative portions taken from one homogeneous sample by the analyst and analyzed |

| *Table 4. Laboratory QA/QC analyses definitions.* | |
|---|---|
| | in the same laboratory. |
| Serial dilution | Performed on a sample with a concentration minimally a factor of 50 times above the MDL in the original sample. The serial dilution (a five fold dilution) should agree within 10% of the original Original determination after correction for dilution. Otherwise a chemical or physical interference effect is suspected. |
| Matrix | The material of which the sample is composed or the substrate containing the analyte of interest, such as drinking water, waste water, air, soil/sediment, biological material. |
| Matrix Spike (MS) | Matrix spike allows for evaluation of the impact of the sample matrix (interference) on the target analytes in terms of accuracy and bias. An aliquot of a matrix (water or soil) fortified (spiked) with known quantities of specific target analytes and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery. |
| Matrix spike duplicate (MSD) | Matrix spike duplicate provides precision and accuracy data to evaluate the achievement of project quality objectives. A second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method. |
| Retention time | The time a target analyte is retained on a GC column before elution. The identification of a target analyte is dependent on a target compound's retention time falling within the specified retention time window established for that compound. |
| Relative retention time | The ratio of the retention time of a compound to that of a standard. |
| Source O'Brien & Gere | |

# *APPENDIX E*

# *STATISTICAL EVLAUATION OF BACKGROUND METALS CONCENTRATIONS IN SEDIMENT AND SPLP AND CORRESPONDING TOTAL METALS*

**Table E-1**
**Statistical Results* of Background (Upstream) Sediment Sampling**
**County Drain #30**
**NBIA Operable Unit 1, Bronson, Michigan**

| Constituent | Concentration by Sample Location | | | | | | | | | | Mean of Detected Samples | Median* | Standard Deviation of Detected Samples | Coefficient of Variance of Detected Samples | Skewness* | 95% UCL** | Distribution | UCL Statistic |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SD-35 | SD-36 | SD-37 | SD-38 | SD-39 | SD-40 | SD-41 | SD-42 | SD-42 (Dup-08)^ | SD-43 | | | | | | | | |
| ***Metals (mg/kg)*** | | | | | | | | | | | | | | | | | | |
| Aluminum | 8,950 | 5,170 | 4,360 | 5,450 | 4,780 | 3,260 | 4,880 | 4,100 | 4,720 | 2,530 | 4,316 | 4,570 | 993 | 0.23 | -0.88 | 4,981 | Data appear Normal and Lognormal | Student's-t UCL |
| Antimony | 1.6 U | 1.3 U | 1.3 U | 1.1 U | 0.7 U | 1.4 U | 1.9 U | 0.54 B | 0.31 B | 0.94 B | 0.74 | 1.30 | 0.28 | 0.38 | -0.01 | 0.96 | Data do not follow Discernible Distribution | KM (t) UCL |
| Arsenic | 3.4 | 3.6 | 5.7 | 9.2 | 1.0 | 5.2 | 5.2 | 3.6 | 5.6 | 2.8 | 3.8 | 3.6 | 1.5 | 0.40 | -0.59 | 4.8 | Data appear Normal | Student's-t UCL |
| Barium | 90.2 | 65.3 | 51.1 | 54.7 | 30.7 | 31.1 | 40.3 | 36.0 B | 44.5 | 25.9 B | 47.3 | 40.3 | 20.6 | 0.44 | 1.19 | 60.1 | Data appear Normal and Lognormal | Student's-t UCL |
| Beryllium | 0.63 U | 0.52 U | 0.54 U | 0.44 U | 0.28 U | 0.25 B,J | 0.30 B,J | 0.25 B,J | 0.32 B,J | 0.19 B,J | 0.25 | 0.30 | 0.05 | 0.18 | 0.47 | 0.28 | Data appear Normal and Lognormal | KM (t) UCL |
| Cadmium | 0.79 U | 0.65 U | 0.67 U | 0.54 U | 0.35 U | 0.057 B | 0.96 U | 0.16 B | 0.076 B | 0.75 U | 0.11 | 0.65 | 0.07 | 0.67 | -0.52 | 0.20 | Data do not follow Discernible Distribution | KM (t) UCL |
| Calcium | 18,800 | 9,310 | 18,900 | 50,700 | 1,910 | 80,500 J | 11,800 J | 47,100 J | 33,000 | 14,500 | 28,169 | 18,800 | 25,686 | 0.91 | 1.22 | 44,090 | Data appear Normal and Lognormal | Student's-t UCL |
| Chromium | 17.4 | 10.8 | 9.5 | 11.5 | 9.1 | 8.2 | 9.5 | 8.2 | 10.3 | 6.8 | 9.2 | 9.3 | 1.5 | 0.16 | 0.03 | 10.2 | Data appear Normal and Lognormal | Student's-t UCL |
| Cobalt | 7.9 U | 6.5 U | 6.7 U | 5.4 U | 3.5 U | 5.2 B | 5.4 B | 4.7 B | 6.2 | 3.1 B | 4.6 | 5.4 | 1.0 | 0.23 | 0.05 | 5.3 | Data appear Normal and Lognormal | KM (Percentile Bootstrap) UCL |
| Copper | 18 | 12.9 | 12.7 | 14.2 | 6 | 15.2 | 10 | 8.7 | 13.6 | 8.3 | 11.8 | 12.7 | 3.8 | 0.32 | 0.08 | 14.1 | Data appear Normal and Lognormal | Student's-t UCL |
| Iron | 14,100 | 11,400 | 12,000 | 16,600 | 3,840 | 11,600 | 11,200 | 9,450 | 13,200 | 7,970 | 10,907 | 11,400 | 3,628 | 0.33 | -0.55 | 13,155 | Data appear Normal and Lognormal | Student's-t UCL |
| Lead | 13.7 | 7.7 | 6.7 | 7.3 | 7.7 | 6.4 | 6.6 | 5.6 | 7.6 | 4.2 | 6.5 | 6.7 | 1.2 | 0.18 | -1.13 | 7.3 | Data appear Normal and Lognormal | Student's-t UCL |
| Magnesium | 6,810 | 2,800 | 6,680 | 12,900 | 1,150 | 28,100 | 3,490 | 21,000 | 7,340 | 3,900 | 9,648 | 6,680 | 9,266 | 0.96 | 1.29 | 15,391 | Data appear Normal and Lognormal | Student's-t UCL |
| Manganese | 275 | 176 | 211 | 219 | 46.6 | 160 | 237 | 144 | 201 | 62.0 | 170 | 176 | 77 | 0.45 | -0.54 | 218 | Data appear Normal and Lognormal | Student's-t UCL |
| Mercury | 0.052 U | 0.043 U | 0.045 U | 0.036 U | 0.023 U | 0.046 U | 0.064 U | 0.070 U | 0.061 U | 0.050 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Nickel | 15.5 | 11.7 | 9.7 | 12.2 | 5.7 | 12.2 | 10.5 | 8.1 B | 11.3 | 7.3 | 10.3 | 10.5 | 3.0 | 0.29 | 0.10 | 12.2 | Data appear Normal and Lognormal | Student's-t UCL |
| Potassium | 793 U | 649 U | 674 U | 545 U | 352 U | 429 B | 429 B | 366 B | 400 B | 241 B | 366 | 429 | 89 | 0.24 | 0.33 | 429 | Data appear Normal and Lognormal | KM (Percentile Bootstrap) UCL |
| Selenium | 2.4 | 3.3 | 2.5 | 1.7 | 0.5 | 0.70 U | 1.3 | 1.1 | 0.99 | 0.80 | 1.7 | 1.3 | 1.0 | 0.57 | 0.67 | 2.2 | Data appear Normal and Lognormal | KM (t) UCL |
| Silver | 0.79 U | 0.65 U | 0.67 U | 0.54 U | 0.35 U | 0.70 U | 0.96 U | 1.1 U | 0.92 U | 0.75 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Sodium | 793 U | 649 U | 674 U | 545 U | 352 U | 698 U | 963 U | 1,060 U | 921 U | 752 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Thallium | 1.6 U | 1.3 U | 1.3 U | 1.1 U | 0.7 U | 1.4 U | 1.9 U | 2.1 U | 1.8 U | 1.5 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Vanadium | 26.6 | 17.7 | 15.5 | 19.6 | 10.3 | 15.9 | 17.8 | 17.9 | 22.1 | 12.2 | 17.1 | 17.7 | 4.6 | 0.27 | 0.74 | 19.9 | Data appear Normal and Lognormal | Student's-t UCL |
| Zinc | 75.1 | 44.6 | 38.8 | 38.2 | 20.7 | 50.4 J | 34.2 J | 50.0 J | 58.7 J | 23.1 J | 41.7 | 38.8 | 16.3 | 0.39 | 0.83 | 51.8 | Data appear Normal and Lognormal | Student's-t UCL |
| ***Percent Solids (%)*** | 31.5 | 38.5 | 37.1 | 45.9 | 71 | 72 | 52 | 47 | 54 | 66 | NC | NC | NC | NC | NC | NC | NC | NC |

*Shading indicates that the value is an outlier for 5% significance level as conducted by Dixon's Outlier Test. Outlier Test was not conducted for Antimony and Cadmium, because sample size is insufficient. 95% UCL was derived following removal of outliers.*

*Based on both detect and non-detect samples after replacement of non-detect samples by reporting limit.

**Evaluation of data performed with USEPA ProUCL (V. 4) software (Available at: http://www.epa.gov/esd/tsc/software.htm). Outliers and duplicates were excluded.

^Duplicate sample was not utilized in analysis.

NC = Not Calculated

**Table E-2**
**Statistical Evaluation of SPLP Results**

| Constituent | MDEQ Res Drinking Water Criterion | MDNRE Res GSI Criterion | Concentration by Sample Location and Depth (ft-bgs) | | | | | | | | | | Mean of Detected Samples | Median* | Standard Deviation of Detected Samples | Coefficient of Variance of Detected Samples | Skew-ness* | 95% UCL** | Distribution | UCL Statistic |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SD-28-10N | SD-29-10N | SD-29-30N | SD-30-10N | SD-30-10N | SD-30-30N | SD-31-10N | SD-31-30N | SD-32-30N | SD-34-10N | | | | | | | | |
| | | | 1.0 to 1.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | | | | | | | | |
| ***Metals (ug/L)*** | | | | | | | | | | | | | | | | | | | | |
| Aluminum | | | **446 J** | **898 J** | **358 J** | **1270 J** | 200 U | 200 U | 200 U | **425 J** | **3610 J** | **3910 J** | 1,560 | 898 | 1,540 | 0.99 | 1.07 | 1,952 | Data appear Lognormal | KM (BCA) UCL |
| Antimony | | | 300 U | **1.9 J** | 300 U | 300 U | 300 U | 300 U | 300 U | 300 U | 300 U | 300 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Arsenic | 10 | 160 | 500 U | **7.8 J** | **3.6 J** | **5.6 J** | 500 U | 500 U | 500 U | 500 U | 12.6 J | 500 U | 7.4 | 6.7 | 3.9 | 0.52 | 0.92 | 11.0 | Data appear Normal and Lognormal | KM (t) UCL |
| Barium | 2,000 | 1,300 | 10,000 U | 10,000 U | 10,000 U | 10,000 U | 10,000 U | 10,000 U | 10,000 U | 10,000 U | 10,000 U | 10,000 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Beryllium | | | 5 U | 5 U | 5 U | 5 U | 5 U | 5 U | 5 U | 5 U | 5 U | 5 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Cadmium | 5.0 | 10 | 100 U | **4.5 J** | **0.98 J** | **2.1 J** | 100 U | 100 U | 100 U | **2.5 J** | 100 U | 100 U | 2.5 | 2.3 | 1.5 | 0.58 | 0.85 | 3.9 | Data appear Normal and Lognormal | KM (t) UCL |
| Calcium | | | 5,000 U | **11400** | **11700** | **12400** | **13500** | **14000** | **13200** | **12000** | 5,000 U | **7170** | 12,600 | 12,000 | 982 | 0.08 | -1.36 | 12,965 | Data appear Normal and Lognormal | KM (t) UCL |
| Chromium | | 260 | 500 U | **86.3 J** | **23.7 J** | **55.2 J** | 500 U | **14.7 J** | **7.9 J** | **40.9 J** | **6.5 J** | **49.8 J** | 35.6 | 32.3 | 27.7 | 0.78 | 0.75 | 53.6 | Data appear Normal and Lognormal | KM (t) UCL |
| Hexavalent Chromium | 11 | 12 | 20 U | 20 U | 20 U | 20 U | 20 U | 20 U | 20 U | 20 U | 20 U | 20 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Cobalt | | | 50 U | **2.9 J** | 50 U | 50 U | 50 U | 50 U | 50 U | 50 U | 50 U | 50 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Copper | 1,400 | 32 | 1000 U | **46.2** | **20.2 J** | **28.5 J** | **5.4 J** | **19.6 J** | **16.5 J** | **24.2 J** | 1000 U | **5.9 J** | 20.8 | 19.9 | 13.1 | 0.63 | 0.84 | 29.3 | Data appear Normal and Lognormal | KM (t) UCL |
| Iron | | | **301 J** | **1580 J** | **535 J** | **1190 J** | 100 U | 100 U | 100 U | **413 J** | **13300 J** | **3830 J** | 1,308 | 413 | 1,331 | 1.02 | 2.10 | 1,719 | Data appear Normal and Lognormal | KM (t) UCL |
| Lead | 4.0 | 140 | 500 U | 17.8 J | 4.3 J | **3.3 J** | 500 U | 500 U | 500 U | **2.2 J** | **2.8 J** | 6.3 J | 3.8 | 3.3 | 1.6 | 0.42 | 1.12 | 5.1 | Data appear Normal and Lognormal | KM (t) UCL |
| Magnesium | | | 5,000 U | 5,000 U | 5,000 U | 5,000 U | 5,000 U | 5,000 U | 5,000 U | 5,000 U | 5,000 U | 5,000 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Manganese* | 860 | 10,000 | 15 U | 15 U | 15 U | 15 U | 15 U | 15 U | 15 U | 15 U | **17.1** | **49.5** | 33.3 | 15.0 | 22.9 | 0.69 | 3.14 | 28.3 | Data do not follow Discernible Distribution | KM (t) UCL |
| Mercury | | | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Nickel | 100 | 140 | 40 U | **56.7** | **29.2 J** | **38.3 J** | 40 U | **33.4 J** | **20.3 J** | **36.4 J** | **3.7 J** | **15.3 J** | 29.2 | 31.3 | 16.2 | 0.55 | 0.10 | 38.2 | Data appear Normal and Lognormal | KM (t) UCL |
| Potassium | | | **126 J** | **2460 J** | **2020 J** | **856 J** | **94.2 J** | **5100** | **4930 J** | **1260 J** | **254 J** | **1190 J** | 1,829 | 1,225 | 1,851 | 1.01 | 1.09 | 3,965 | Data appear Lognormal and Gamma Distributed | Approximate Gamma UCL |
| Selenium | | | 250 U | 250 U | 250 U | 250 U | 250 U | 250 U | 250 U | 250 U | 250 U | 250 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Silver | 34 | 0.064 | 500 U | **5.5 J** | 500 U | 500 U | 500 U | 500 U | 500 U | 500 U | 500 U | 500 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Sodium* | | | 5,000 U | **20000 R** | **7220 R** | **23700 R** | 5,000 U | 5,000 U | 5,000 U | **1090 J** | **16300 R** | **20100** | 10,595 | 5,000 | 13,442 | 1.27 | 2.12 | 44,956 | Data do not follow Discernible Distribution | KM (Chebyshev) UCL |
| Thallium | 2.0 | 7.7 | 2000 U | 2000 U | 2000 U | 2000 U | 2000 U | 2000 U | 2000 U | 2000 U | 2000 U | 2000 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Vanadium | 4.5 | 13 | **1.7 J** | 5.9 J | **2.1 J** | 4.7 J | **1.7 J** | **1.6 J** | **2.9 J** | **3.3 J** | 11.8 J | 10 J | 4.6 | 3.1 | 3.6 | 0.80 | 1.28 | 7.4 | Data appear Lognormal and Gamma Distributed | Approximate Gamma UCL |
| Zinc | 2,400 | 600 | 1000 U | **71.3 J** | **22.9 J** | **19.1 J** | 1000 U | 1000 U | 1000 U | **10.8 J** | **7.6 J** | **20.7 J** | 16.2 | 19.1 | 6.6 | 0.41 | -0.55 | 21.8 | Data appear Normal and Lognormal | KM (t) UCL |
| ***Cyanide*** | | | | | | | | | | | | | | | | | | | | |
| DI Leachable Cyanide | 200 | | 10 U | 10 U | 10 U | 10 U | 10 U | 10 U | 10 U | 10 U | 10 U | 10 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Weak Acid Dissociable Cyanide | | 5.6 | 10 U | 10 U | 10 U | 10 U | 10 U | 10 U | 10 U | 10 U | 10 U | 10 U | NC | NC | NC | NC | NC | NC | NC | NC |

*See notes at end of table.*

*Shading or * indicates that the value is an outlier for 5% significance level as conducted by Dixon's Outlier Test. Outlier Test was not conducted for Manganese and Sodium, because sample size was insufficient. 95% UCL was derived following removal of outliers.*

*Based on both detect and non-detect samples after replacement of non-detect samples by reporting limit.

**Evaluation of data performed with USEPA ProUCL (V. 4) software (Available at: http://www.epa.gov/esd/tsc/software.htm). Outliers and rejected data were excluded. Analysis was not conducted for Antimony, Cobalt, or Silver, because sample size is insufficient for reliable statistics.

NC = Not Calculated

**Table E-3**
**Statistical Evaluation of SPLP Corresponding Non-Erodible Soils - Total Metals Results**

| Constituent | MDRE Statewide Default Background Criterion | MDEQ Res Drinking Water Protection Criterion | Res GSI Protection Criterion | SPLP Ratio (when higher than background or criterion) | Res Direct Contact Criterion | Concentration by Sample Location and Depth (ft-bgs) | | | | | | | | | | Mean of Detected Samples | Median* | Standard Deviation of Detected Samples | Coefficient of Variance of Detected Samples | Skew-ness* | 95% UCL** | Distribution | UCL Statistic |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SD-28-10N | SD-29-10N | SD-29-30N | SD-30-10N | | SD-30-30N | SD-31-10N | SD-31-30N | SD-32-30N | SD-34-10N | | | | | | | | |
| | | | | | | 1.0 to 1.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | 0.0 to 0.5 | 0.0 to 0.5 | 1.0 to 1.5 | 0.0 to 0.5 | | | | | | | | |
| ***Metals (mg/kg)*** | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | 6,900 | 1 | NA | | 5.0E+4 (DD) | 14,800 | 3,060 | 3,660 | 5,500 | 8,430 | 5,320 | 4,230 | 4,510 | 9,610 | 5,290 | 6,441 | 5,305 | 3,576 | 0.56 | 1.65 | 8,813 | Data appear Lognormal | Approximate Gamma UCL |
| Antimony | NA | 4.3 | 94 | | 180 | 0.608 U | 0.618 U | 0.608 U | 0.65 U | 0.774 U | 0.639 U | 0.628 U | 0.605 U | 0.635 U | 0.578 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Arsenic | 5.8 | 4.6 | 70 (X) | 23 | 7.6 | 5.32 | 7.68 | 8.17 | 11.7 | 13.1 | 13.4 | 9.63 | 8.56 | 23.2 | 4.77 | 9.15 | 8.56 | 3.12 | 0.34 | 0.06 | 11.08 | Data appear Normal and Lognormal | Student's-t UCL |
| Barium | 75 | 1,300 | 760 (G,X) | | 3.7E+04 | 255 | 48.2 | 54.7 | 79.2 | 135 | 76.3 | 62.3 | 55.3 | 91.3 | 60.1 | 73.6 | 62.3 | 26.9 | 0.37 | 1.69 | 90.3 | Data appear Normal and Lognormal | Student's-t UCL |
| Beryllium* | NA | 51 | 310 (G) | | 410 | 0.853 | 0.198 U | 0.195 U | 0.208 U | 0.553 | 0.205 U | 0.201 U | 0.194 U | 0.477 | 0.185 U | 0.628 | 0.203 | 0.199 | 0.317 | 1.708 | 0.602 | Data appear Normal and Lognormal | KM (t) UCL |
| Cadmium | 1.2 | 6 | 3 (G,X) | 155 | 550 | 1.53 J | 19.9 J | 18.3 J | 22.4 J | 2.04 J | 36.2 J | 37.1 J | 39.8 | 0.272 | 1.74 | 17.93 | 19.10 | 15.98 | 0.89 | 0.19 | 27.19 | Data appear Normal | Student's-t UCL |
| Calcium | | | NC | | NC | 6,330 | 28,800 | 31,500 | 22,800 | 20,500 | 55,500 | 35,900 | 41,700 | 3,840 | 6,250 | 25,312 | 25,800 | 16,854 | 0.67 | 0.28 | 35,082 | Data appear Normal and Lognormal | Student's-t UCL |
| Chromium | 18 | 1.0.E+06 (D) | 3.5E+06 (G,X) | | 7.9E+05 | 26.2 | 308 | 260 | 401 | 23.1 | 1060 | 508 | 574 | 16.3 | 234 | 341.1 | 284.0 | 321.0 | 0.94 | 1.22 | 527.1 | Data appear Normal and Lognormal | Student's-t UCL |
| Cobalt | 6.8 | 0.8 | 2 | | 2,600 | 6.37 | 4.38 | 4.73 | 5.28 | 3.54 | 7.05 | 4.69 | 4.98 | 3.19 | 5.26 | 4.95 | 4.86 | 1.16 | 0.24 | 0.34 | 5.62 | Data appear Normal and Lognormal | Student's-t UCL |
| Copper | 32 | 5,800 | 110 (G) | 557 | 2.E+04 | 58.2 | 976 * | 193 | 229 | 55.8 | 382 | 191 | 220 | 5 | 18.3 | 150.3 | 191.0 | 124.6 | 0.83 | 0.54 | 227.5 | Data appear Normal and Lognormal | Student's-t UCL |
| Iron | 12,000 | 6 | NA | | 160,000 | 14,300 | 8,700 | 10,200 | 11,600 | 10,700 | 13,500 | 11,400 | 9,280 | 32,600 | 14,100 | 11,531 | 11,400 | 2,053 | 0.18 | 0.16 | 12,803 | Data appear Normal and Lognormal | Student's-t UCL |
| Lead | 21 | 700 | 2,500 (G,X) | 58 | 400 | 16.6 | 109 | 93 | 31.2 | 14.2 | 44.8 | 28.2 | 26.8 | 10.2 | 27.2 | 40.1 | 27.7 | 33.8 | 0.84 | 1.48 | 65.7 | Data appear Lognormal and Gamma Distributed | Approximate Gamma UCL |
| Magnesium | NA | 8,000 | NA | | 1.0E+06 (D) | 3,800 J | 9,960 J | 9,060 J | 8,970 J | 3,920 J | 15,500 J | 11,600 J | 10,300 J | 1,950 J | 3,260 J | 7,832 | 9,015 | 4,390 | 0.56 | 0.18 | 10,377 | Data appear Normal and Lognormal | Student's-t UCL |
| Manganese | 440 | 1 | 72 (G,X) | | 2.5E+04 | 162 J | 128 J | 160 J | 179 J | 222 J | 229 J | 169 J | 264 | 91.6 | 498 * | 178.3 | 169.0 | 53.1 | 0.30 | 0.06 | 211.2 | Data appear Normal and Lognormal | Student's-t UCL |
| Mercury | 0.13 | 1.7 | 0.05 (M); 0.0012 | | 160 | 0.0504 J | 0.102 | 0.111 | 0.135 | 0.187 | 0.262 | 0.136 | 0.129 | 0.0649 J | 0.0199 J | 0.120 | 0.120 | 0.070 | 0.581 | 0.700 | 0.160 | Data appear Normal and Lognormal | Student's-t UCL |
| Nickel | 20 | 100 | 120 (G) | 809 | 4.0E+04 | 18.8 | 229 | 248 | 232 | 22 | 554 | 277 | 324 | 10.1 | 55 | 197 | 231 | 174 | 1 | 1 | 298 | Data appear Normal and Lognormal | Student's-t UCL |
| Potassium | | | NC | | NC | 486 U | 494 U | 487 U | 680 | 619 U | 644 | 503 U | 484 U | 508 U | 464 | 596 | 499 | 116 | 0 | 1 | 680 | Data appear Normal and Lognormal | KM (Percentile Bootstrap) UCL |
| Selenium | 0.41 | 4 | 400 | | 2,600 | 0.637 | 0.494 U | 0.598 | 1.08 | 2.83 | 1.23 | 1.25 | 0.795 | 0.508 U | 0.462 U | 0.93 | 0.94 | 0.29 | 0.31 | -0.04 | 1.02 | Data appear Normal and Lognormal | KM (Percentile Bootstrap) UCL |
| Silver | 1 | 4.5 | 0.1 (M); 0.027 | | 2,500 | 0.486 UR | 9.76 J | 13 J* | 9.11 J | 0.351 J | 20.5 J | 14 J | 14.1 | 0.508 U | 0.462 U | 11.55 | 9.76 | 6.18 | 0.54 | -0.06 | 14.05 | Data appear Normal | KM (Percentile Bootstrap) UCL |
| Sodium | NA | 2,500 | NA | | 1.0E+06 (D) | 97.2 U | 98.9 U | 97.3 U | 104 U | 124 U | 102 U | 101 U | 96.8 U | 102 U | 92.4 U | NC | NC | NC | NC | NC | NC | NC | NC |
| Thallium | NA | 2.3 | 4 (X) | | 35 | 0.972 U | 0.79 J | 0.973 U | 0.716 J | 0.988 J | 0.716 J | 0.757 J | 0.822 J | 1.02 U | 0.924 U | 0.760 | 0.757 | 0.046 | 0.061 | 0.374 | 0.799 | Data appear Normal and Lognormal | KM (t) UCL |
| Vanadium | NC | 72 | 190 | 18 | 750 (DD) | 28.6 | 9.83 | 12.1 | 17.7 | 34.3 | 17.4 | 16 | 15.4 | 28.1 | 20.1 | 20.0 | 17.6 | 7.9 | 0.40 | 0.69 | 24.5 | Data appear Normal and Lognormal | Student's-t UCL |
| Zinc | 47 | 2,400 | 250 (G) | 5,051 | 1.7E+05 | 113 | 380 | 306 | 146 | 47.5 | 198 | 231 | 159 J | 24.4 J | 52.7 J | 165.8 | 152.5 | 115.9 | 0.70 | 0.61 | 232.9 | Data appear Normal and Lognormal | Student's-t UCL |
| ***Percent Solids (%)*** | | | | | | 82.3 | 80.9 | 82.2 | 76.9 | 64.6 | 78.2 | 79.6 | 82.6 | 78.8 | 86.6 | NC | NC | NC | NC | NC | NC | NC | NC |

*See notes at end of table.*

*Shading or * indicates that the value is an outlier for 5% significance level as conducted by Dixon's Outlier Test. 95% UCL was derived following removal of outliers.*

*Based on both detect and non-detect samples after replacement of non-detect samples by reporting limit.

**Evaluation of data performed with USEPA ProUCL (V. 4) software (Available at: http://www.epa.gov/esd/tsc/software.htm). Outliers and rejected data were excluded

NC = Not Calculated

**Table E-3**
**Statistical Evaluation of SPLP Corresponding Non-Erodible Soils - Total Metals Results**

*Notes :*

1. *For soil sampling locations, see Figure 2.*
2. *Only constituents detected in one or more soil samples are listed in this table. See Appendix A for analytical reports and complete analytical results.*
3. *Inorganic Data Qualifiers :*

   *U - Constituent not detected at indicated Reporting Limit (RL)*

   *J - Estimated concentration detected above minimum detection limit (MDL), but below RL.*
4. *For clarity, all detections are shown in* ***bold-face*** *type.*
5. *Pale yellow shading indicates value is above the generic groundwater surface water interface (GSI) criteria.*
6. *Blue numerical values indicates value is above the generic drinking water criteria.*

# *APPENDIX F*

# *SUMMARY OF HISTORIC METALS CONCENTRATIONS IN SEDIMENTS AND NON-ERODIBLE SOILS ASSOCIATED WITH COUNTY DRAIN #30*

**Table F-1**
**Summary of Historic Metals Concentrations in County Drain #30 Sediments**

| Sediment Sample Number | Concentration (mg/kg) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Antimony | Arsenic | Barium | Cadmium | Chromium (total) | Copper | Lead | Manganese | Mercury | Nickel | Silver | Vanadium | Zinc |
| **Proposed Cleanup Goal** | **2.0** | **7.6** | **60** | **5.0** | **80** | **70** | **35** | **220** | **0.20** | **30** | **1.0** | **20** | **120** |
| **SD-01** | < 7.6 | 7.0 | 42.8 | **6.6** | **1,090** | **83.9** | **64.7** | 72.5 | < 0.1 | **233** | < 1.1 | 16.2 | 109 |
| **SD-02** | < 8.0 | 1.5 | 7.7 | **29.7** | **100** | 32.5 | 13.7 | 74.4 | < 0.2 | **127** | < 1.2 | 7.2 | 36.9 |
| **SD-03** | < 6.9 | 3.8 | 23.5 | **36.6** | **312** | **72.1** | **50.3** | 127 | < 0.1 | **275** | < 1.0 | 7.3 | 117 |
| **SD-04** | < 7.9 | 3.5 | 52.9 | **12.8** | 34.5 | **87.6** | 13.7 | 53.1 | < 0.2 | **46.8** | < 1.2 | 16.1 | 61.7 |
| SD-05 | < 6.7 | 2.5 | 8.8 | 2.4 | 42.8 | 13.5 | 4.8 | 166 | < 0.1 | 20.8 | < 0.99 | 5.3 | 17.7 |
| **SD-06** | < 7.4 | **9.7** | 53.7 | **17.7** | **393** | **89.9** | 22.7 | 192 | < 0.1 | **212** | **1.4** | 16.8 | 99.9 |
| **SD-07** | < 18 | **27.6** | **164** | **231** | **1,880** | **802** | **119** | **243** | < 0.3 | **1,180** | **29.9** | **22.9** | **763** |
| **SD-07 (dup)** | < 26 | **27.3** | **260** | **169** | **2,220** | **656** | **144** | **335** | < 0.5 | **1,310** | **19.3** | **27.7** | **671** |
| **SD-08** | < 43 | **22.4** | **228** | **58.4** | **714** | **415** | **601** | **605** | < 0.8 | **911** | **11.5** | **37.2** | **1,440** |
| SD-09 | < 6.7 | 4.2 | 10.4 | 1.1 | 25.1 | 10.0 | 4.0 | 147 | < 0.1 | 19.3 | < 0.99 | 8.4 | 31.4 |
| SD-10 | < 7.8 | 4.0 | 16.9 | 0.95 | 22.6 | 13.3 | 7.5 | **235** | < 0.1 | 10.6 | < 1.1 | 5.8 | 28.7 |
| SD-11 | < 3.1 | 1.3 | 10.4 | < 0.42 | 3.7 | < 6.9 | 5.5 | 96.5 | < 0.11 | 4.0 | < 1.1 | 5.4 | 14.1 |
| **SD-12** | **6.2** | 4.2 | **111** | **13.1** | 47.3 | 23.9 | 19.2 | **478** | < 0.18 | 29.1 | < 1.8 | **36.1** | 97.3 |
| **SD-13** | < 3.8 | 2.7 | 40.6 | < 2.3 | **206** | 21.5 | 27.3 | 104 | < 0.12 | **61.6** | < 1.4 | 15.7 | 56.5 |
| **SD-14** | < 10 | **19.4** | **205** | **38.4** | **1,300** | **214** | **152** | 189 | < 0.32 | **856** | < 3.6 | **33.0** | **331** |
| **SD-15** | < 11 | **22.9** | **133** | **34.7** | **534** | **145** | **53.4** | 173 | < 0.34 | **278** | < 3.8 | **30.5** | **220** |
| **SD-15 (dup)** | < 12 | **28.6** | **157** | **35.7** | **546** | **154** | **61.0** | 181 | < 0.34 | **288** | < 4.2 | 3.3 | **229** |
| **SD-16** | < 13 | **31.4** | **219** | **35.8** | **358** | **232** | **690** | **457** | < 0.43 | **231** | < 4.6 | **34.1** | **693** |
| **SD-17** | **6.4** | **8.0** | 46.2 | **13.7** | **163** | **722** | **58.6** | 146 | 0.19 | **63.7** | **3.4** | 12.0 | **165** |

*See notes at end of table.*

**Table F-1**
**Summary of Historic Metals Concentrations in County Drain #30 Sediments**

| Sediment Sample Number | Concentration (mg/kg) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Antimony | Arsenic | Barium | Cadmium | Chromium (total) | Copper | Lead | Manganese | Mercury | Nickel | Silver | Vanadium | Zinc |
| **Proposed Cleanup Goal** | **2.0** | **7.6** | **60** | **5.0** | **80** | **70** | **35** | **220** | **0.20** | **30** | **1.0** | **20** | **120** |
| **SD-18** | < 14 | 7.3 | **96.2** | 3.6 | **166** | **321** | **48.8** | **399** | 0.066 | **47.8** | < 2.4 | **28.2** | **261** |
| **SD-18 (dup)** | < 13 | 4.6 | 50.1 | 1.8 | 72.2 | **166** | 22.1 | **222** | 0.034 | **47.5** | < 2.1 | 14.9 | **123** |
| **SD-19** | < 17 | **28.3** | **119** | **32.4** | **973** | **577** | **55.2** | **760** | 0.091 | **590** | 0.46 | **33.9** | **917** |
| **SD-20** | < 24 | **41.8** | **373** | **45.8** | **884** | **470** | **79.4** | **1,810** | 0.200 | **121** | 0.73 | **37.1** | **1,520** |
| **SD-21** | < 28 | **22.5** | **254** | **44.6** | **1,580** | **364** | **90.7** | **725** | **0.250** | **400** | 0.80 | **39.1** | **738** |
| **SD-22** | < 31 | **21.9** | **290** | **47.4** | **900** | **395** | **110** | **667** | **0.380** | **204** | **4.7** | **41.2** | **728** |
| **SD-23** | < 8.7 | 5.2 | 32.8 | **8.3** | 43.1 | 36.3 | **201** | 129 | 0.019 | **33.6** | **1.1** | 13.8 | 119 |
| **SD-24** | < 7.9 | 2.8 | 14.9 | 2.4 | 21.1 | 20.4 | 9.4 | 171 | 0.015 | 10.2 | **1.6** | 8.2 | 51.8 |
| SD-25 | < 7.5 | 5.6 | 17.8 | 3.4 | 29.3 | 18.5 | 12.0 | 148 | 0.013 | 21.2 | 0.56 | 9.4 | 59.0 |
| SD-26 | < 7.1 | 2.2 | 7.7 | 0.92 | 11.8 | 20.2 | 4.2 | 124 | < 0.12 | 11.3 | < 1.2 | 7.2 | 27.7 |
| SD-27 | < 6.7 | 0.99 | 9.9 | 0.62 | 17.6 | 9.5 | 4.4 | 125 | < 0.11 | 11.1 | < 1.1 | 5.4 | 23.8 |
| Detections | 2 | 30 | 30 | 28 | 30 | 29 | 30 | 30 | 11 | 30 | 12 | 30 | 30 |
| Mean | ND | 12.5 | 102 | 31.1 | 490 | 206 | 91.7 | 312 | 0.20 | 255 | 3.68 | 19.3 | 325 |
| Median | ND | 6.3 | 51.5 | 13.4 | 186 | 88.8 | 49.6 | 177 | 0.12 | 92.4 | 1.30 | 15.9 | 118 |
| Geomean | ND | 7.5 | 53.5 | 10.3 | 163 | 85.6 | 35.1 | 216 | 0.13 | 90.0 | 1.92 | 15.0 | 141 |
| Maximum | 6.4 | 41.8 | 373 | 231 | 2,220 | 802 | 690 | 1,810 | 0.80 | 1,310 | 29.9 | 41.2 | 1,520 |

*See notes at end of table.*

**Table F-1**

**Summary of Historic Metals Concentrations in County Drain #30 Sediments**

*Notes:*

1. *SD-01 through SD-10 were collected as part of the RI sampling in September 1988. SD-11 through SD-17 were collected as part of the RI sampling in November 1991. SD-18 through SD-27 were PDI samples collected by Arcadis in March 2001.*
2. *Data Legend and Notes:*

   *"<" or "ND" indicates less than corresponding reporting limit.*

   *Values detected below the Reporting Limit but above the Minimum Detection Limit are estimated.*

   *See original data reports for data qualifiers.*

   *Values in **bold-face** type and highlighted in yellow exceed proposed cleanup goals.*

**Table F-2**
**Summary of CD #30 Non-Erodible Soil Data**
**From NBIA Site Operable Unit 1 Ground Water Delineation Study**

| Constituent | Proposed Cleanup Goal | Concentration by Boring Location and Depth (ft-bgs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | MW-6D | | | MW-42 | | | MW-43 | | |
| | | 0.0 to 0.5 | 2.0 to 3.0 | 4.0 to 5.0 | 0.0 to 0.5 | 3.0 to 4.0 | 5.0 to 6.0 | 0.0 to 0.5 | 3.0 to 4.0 | 4.0 to 5.0 |
| ***Metals (mg/kg)*** | | | | | | | | | | |
| Antimony | 85 | 0.605 U | 0.587 U | 0.563 U | 1.30 | 0.534 U | 0.634 U | 0.571 U | 0.553 U | 0.559 U |
| Arsenic | 8.9 | 3.40 | 3.02 | 6.57 | 6.88 | 3.35 | 9.01 | 5.94 | 11.3 | 3.99 |
| Barium | 37,000 | 104 B | 50.7 B | 5.67 B | 72.2 B | 18.7 B | 5.91 B | 55.8 B | 17.0 B | 8.40 B |
| Cadmium | 36 | 0.76 | 1.23 | 0.090 U | 26.5 | 0.14 | 0.11 | 3.16 | 0.23 | 0.0895 U |
| Chromium (total) | 2,500 | 15.3 | 19.6 | 3.55 | 98.5 | 9.50 | 4.81 | 25.6 | 4.06 | 4.93 |
| Copper | 230 | 21.1 | 12.4 | 3.92 | 102.0 | 6.20 | 5.98 | 28.1 | 4.56 | 5.26 |
| Lead | 49 | 6.13 | 7.26 | 2.92 | 31.9 | 4.96 | 3.19 | 12.0 | 2.65 | 2.88 |
| Manganese | 25,000 | 101 B | 62.5 B | 180 B | 221 | 88.6 | 173 | 145 | 488 | 200 |
| Mercury | 160 | 0.101 | 0.020 J | 0.090 U | 0.186 | 0.0855 U | 0.041 J | 0.082 J | 0.0884 U | 0.024 J |
| Nickel | 670 | 8.73 | 12.3 | 4.50 | 37.4 | 7.79 | 6.78 | 21.0 | 6.20 | 5.95 |
| Selenium | 2,600 | 0.545 | 0.469 U | 0.45 U | 0.463 B | 0.427 U | 0.507 U | 0.531 B | 0.442 U | 0.447 U |
| Silver | 2,500 | 0.484 U | 0.213 J | 0.45 U | 7.01 | 0.427 U | 0.507 U | 0.545 | 0.442 U | 0.447 U |
| Vanadium | 56 | 20.4 | 20.4 | 5.1 | 14.7 | 9.3 | 6.0 | 18.6 | 5.6 | 8.1 |
| Zinc | 6,100 | 26.8 | 34.8 | 14.5 | 132 | 40.5 | 20.0 | 57.5 | 15.1 | 18.0 |
| ***Cyanide (mg/kg)*** | | | | | | | | | | |
| Total | 12 | 0.605 U | 0.587 U | 0.563 U | 3.27 B | 0.534 U | 0.165 JB | 0.391 J | 0.155 B | 0.559 U |
| ***Percent Solids*** | -- | 82.6 | 85.2 | 88.9 | 86.8 | 93.6 | 78.9 | 87.6 | 90.5 | 89.4 |

*See notes at end of table.*

**Table F-2**
**Summary of CD #30 Non-Erodible Soil Data**
**From NBIA Site Operable Unit 1 Ground Water Delineation Study**

| Constituent | Proposed Cleanup Goal | Concentration by Boring Location and Depth (ft-bgs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MW-44S/D | | | | MW-45S/D | | | |
| | | 0.0 to 0.5 | 2.0 to 3.0 | 4.0 to 5.0 | 4.0 to 5.0 (dup) | 0.0 to 0.5 | 0.0 to 0.5 (dup) | 3.5 to 4.5 | 5.0 to 6.0 |
| ***Metals (mg/kg)*** | | | | | | | | | |
| Antimony | 85 | 0.560 B | 0.604 | 0.558 U | 0.567 U | 0.759 | 0.561 U | 0.558 U | 0.544 U |
| Arsenic | 8.9 | 7.64 | 3.49 | 3.09 | 18.1 | 5.38 | 6.62 | 15.5 | 5.17 |
| Barium | 37,000 | 91.3 B | 22.4 B | 5.07 B | 8.32 B | 48.5 B | 52.2 B | 15.1 B | 4.30 B |
| Cadmium | 36 | 12.1 | 0.921 | 0.0893 U | 0.0908 U | 1.05 | 2.62 | 0.0892 U | 0.0870 U |
| Chromium (total) | 2,500 | 111 | 28.7 | 13.4 | 5.68 | 8.94 | 10.4 | 7.47 | 6.14 |
| Copper | 230 | 88 | 8.68 | 6.50 | 7.76 | 15.0 | 26.0 | 8.19 | 5.37 |
| Lead | 49 | 14.7 | 5.74 | 3.60 | 3.61 | 7.21 | 9.31 | 3.96 | 2.54 |
| Manganese | 25,000 | 148 B | 154 B | 189 B | 230 B | 119 | 165 | 80.0 | 223 |
| Mercury | 160 | 0.131 | 0.018 J | 0.0893 U | 0.0908 U | 0.033 J | 0.047 J | 0.0892 U | 0.024 J |
| Nickel | 670 | 76.1 | 21.2 | 5.87 | 7.71 | 9.89 | 14.3 | 9.35 | 7.81 |
| Selenium | 2,600 | 0.770 | 0.473 U | 0.358 J | 0.454 U | 0.540 B | 0.652 B | 0.446 U | 0.435 U |
| Silver | 2,500 | 2.02 | 0.473 U | 0.446 U | 0.454 U | 0.364 J | 0.449 U | 0.446 U | 0.435 U |
| Vanadium | 56 | 19.8 | 17.4 | 7.63 | 6.77 | 13.8 | 13.4 | 10.6 | 5.83 |
| Zinc | 6,100 | 68.8 | 41.7 | 16.9 | 21.9 | 26.9 | 36.3 | 24.0 | 22.8 |
| ***Cyanide (mg/kg)*** | | | | | | | | | |
| Total | 12 | 0.229 B | 0.591 U | 0.558 U | 0.567 U | 0.591 U | 0.112 J | 0.558 U | 0.166 J |
| ***Percent Solids*** | -- | 76.6 | 84.6 | 89.6 | 88.1 | 84.6 | 89.1 | 89.7 | 91.9 |

*See notes at end of table.*

**Table F-2**
**Summary of CD #30 Non-Erodible Soil Data**
**From NBIA Site Operable Unit 1 Ground Water Delineation Study**

*Notes:*

1. *Samples collected by O'Brein & Gere in October 2008 as part of the NBIA Operable Unit 1 Groundwater Delienation Study.*
2. *Data were collected for characterization only and were not independently validated.*
3. *Inorganic Data Qualifiers:*
   *U - Constituent not detected at indicated Reporting Limit.*
   *J - Estimated concentration detected above minimum detection limit but below the Reporting Limit.*
   *B - Constituent detected in method blank at a reportable concentration.*
4. *For clarity, all detections are shown in* ***bold-face*** *type.*
5. *Values highlighted in yellow exceed proposed cleanup goals.*