Draft
2015 Soil, Groundwater, Surface Water, and Kuskokwim River Sediment Characterization

Supplement to Remedial Investigation Red Devil Mine, Alaska

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List of Abbreviations and Acronyms

µg/L	micrograms per liter
AAC	Alaska Administrative Code
bgs	below ground surface
BLM	Bureau of Land Management
BSAF	Biota-Sediment Accumulation Factor
BTEX	benzene, toluene, ethylbenzene, xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
DQO	data quality objective
DRO	diesel range organics
E & E	Ecology and Environment, Inc.
EPA	U.S. Environmental Protection Agency
Field Operations Plan	Field Operations Plan – 2014, Quantification of fish and aquatic insect tissue contaminants in the middle Kuskokwim River, Alaska
Field Sampling Plan	Final Field Sampling Plan for 2015 Soil, Groundwater, Surface Water, and Kuskokwim River Sediment Characterization, Supplement to Remedial Investigation, Red Devil Mine, Alaska
FS	Feasibility Study
GRO	gasoline range organics
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
ng/g	nanograms/gram
ng/L	nanograms per liter
NTCRA	non-time-critical removal action
NTU	nephelometric turbidity unit

List of Acronyms and Abbreviations (cont.)

OPMs	occurrences, prospects, or mines
Ppm	parts per million
RDM	Red Devil Mine
RI	Remedial Investigation
RI Supplement Work Plan	Final Work Plan for 2015 Soil, Groundwater, Surface Water, and Kuskokwim River Sediment Characterization, Supplement to Remedial Investigation, Red Devil Mine, Alaska
SSE	selective sequential extraction
SVOC	semivolatile organic compound
TAL	target analyte list
TOC	total organic carbon
XRF	X-ray fluorescence (spectroscopy)

1 Introduction

This document presents results of supplemental studies conducted to support the Remedial Investigation (RI) being performed at the Red Devil Mine (RDM), located in Red Devil, Alaska. The RDM consists of an abandoned mercury mine and ore processing facility located on public lands managed by the U.S. Department of the Interior Bureau of Land Management (BLM) in southwest Alaska (see Figure 1-1). The BLM initiated an RI/Feasibility Study (FS) at the RDM in 2009 pursuant to its delegated Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) lead agency authority. An RI was performed by Ecology and Environment, Inc. (E & E) on behalf of the BLM under Delivery Order Number L09PD02160 and General Services Administration Contract Number GS-10F-0160J. Results of the RI are presented in the Final Remedial Investigation Report, Red Devil Mine, Alaska (E & E 2014a). Results of the FS are presented in the Final Feasibility Study, Red Devil Mine, Alaska (E & E 2016).

Data collected during the RI were used to define the site physical setting, the nature and extent of contamination, and the fate and transport of contaminants. The RI results were used to assess risk to human health and the environment due to exposure to site contaminants. The FS addresses contaminated tailings/waste rock, soil, and Red Devil Creek sediments. Neither the RI nor FS fully evaluated possible site impacts to the adjacent Kuskokwim River. The FS did not address remedies for groundwater or Kuskokwim River sediments because the need for, and extent of, cleanup of these media have not yet been completely assessed. The RI Supplement is being performed to address data gaps associated with soil, groundwater, and Kuskokwim River sediments that were identified as part of the development of site-wide remedial alternatives during the preparation of the FS. The RI Supplement also addresses changes in the groundwater and surface water monitoring network and possible changes to the groundwater and surface water conditions at the RDM stemming from implementation of a non-time-critical removal action (NTCRA) performed by the BLM at the RDM during the summer of 2014. Lastly, data were collected and evaluated specifically to address questions regarding methylmercury bioaccumulation in the Kuskokwim River food chain, particularly in upper trophic level fish that may be consumed by local residents.

E & E is performing the RI Supplement on behalf of the BLM under Delivery Order Number L14PB00938 and BLM National Environmental Services Blanket Purchase Agreement Number L14PA00149. The RI Supplement is being performed per applicable CERCLA statutes, regulations, and guidance following the Final Work Plan for 2015 Soil, Groundwater, Surface Water, and Kuskokwim River Sediment Characterization, Supplement to Remedial Investigation, Red Devil Mine, Alaska (RI Supplement Work Plan; E & E 2015).

Historical mining activities at the RDM included underground and surface mining. Ore processing included crushing, retorting/furnacing, milling, and flotation. Historical mining operations left tailings and other remnants that have affected local soil, surface water, sediment, and groundwater. The final RI report provides detailed background information on the RDM and information on the regulatory framework for the RI/FS and supplemental RI work addressed in this document. That information is not repeated in this RI Supplement report. Existing data and information regarding the RDM pertinent to the RI Supplement activities are presented in the final RI report, RI Supplement Work Plan, and other documents.

1.1 Definition of the Site

The RDM encompasses the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of a response action. Historical mining operations left tailings and other remnants that have affected local soil, surface water, sediment, and groundwater. Based on the location of tailings and other features, the RI Supplement's objectives and associated data collection pertain to each of the following areas:

- The Main Processing Area.
- Red Devil Creek, extending from a reservoir upstream of the Main Processing Area to the creek's delta at its confluence with the Kuskokwim River.
- The area west of the Main Processing Area where historical surface exploration and mining occurred, referred to as the Surface Mined Area. The Surface Mined Area is underlain by the area of underground mine workings. The "Dolly Sluice" and "Rice Sluice" and their respective deltas on the bank of the Kuskokwim River are associated with the Surface Mined Area.
- Sediments in the Kuskokwim River.

Figure 1-2 illustrates the upland area encompassed by the RI and RI Supplement and the major features identified above based on aerial photographs taken in 2010 (Aero-Metric, Inc. 2010a) and 2001 (Aero-Metric, Inc. 2010b).

The Main Processing Area contains most of the former site structures and is where ore beneficiation and mineral processing were conducted. The area is split by Red Devil Creek. Underground mine openings (shafts, adits, and stopes to the surface) and ore processing and mine support facilities (housing, warehousing, and so forth) were located on the west side of Red Devil Creek until 1955. After 1955, all ore processing was conducted at structures and facilities on the east side of Red Devil Creek. The Main Processing Area includes three monofills. The monofills contain demolished mine structure debris and other material. Two monofills are unlined (Monofills #1 and #3). Monofill #2, on the east side of Red Devil Creek, is an engineered and lined containment structure for building debris and materials from the demolished Post-1955 Retort structure.

1.2 Purpose and Objectives

The purpose of this report is to describe the RI Supplement activities, procedures, and methods that were used to augment existing data for soil, groundwater, surface water, and Kuskokwim River sediment and biota. The objectives of the supplemental RI activities are generally to address data gaps identified during the development of the FS, identify possible changes to site conditions resulting from the NTCRA, and support the development of site-wide remedial alternatives at the RDM. Additionally, sediment toxicity testing was conducted on Kuskokwim River sediment to evaluate potential impacts to benthos near the RDM, and data on total mercury and methylmercury measured in Kuskokwim River periphyton and fish were used to evaluate methylmercury bioaccumulation in the Kuskokwim River food chain near the RDM. A summary of the RI and other pertinent studies is presented in Chapter 2 of the RI Supplement Work Plan. A detailed discussion of the data gaps and data quality objectives (DQOs) of the RI Supplement is presented in Chapter 3 of the RI Supplement Work Plan. Objectives of the supplemental RI activities also are briefly summarized in this report.

1.3 RI Supplement and BLM Kuskokwim River Investigation Activities

The RI Supplement field investigations were conducted over the course of three field events in 2015:

- June 17 to June 24, 2015 – Spring groundwater and surface water monitoring event.
- July 7 to August 12, 2015 – Soil boring installation and associated subsurface soil sampling and monitoring well installation.
- September 1 to September 11, 2015 – Fall groundwater and surface water monitoring event, well survey, and Kuskokwim River sediment sampling.

The RI Supplement field work was originally planned for two mobilizations, with the soil boring and well installation activities to be performed during the first mobilization immediately after the spring groundwater and surface water monitoring. E & E's subcontracted driller mobilized to the RDM on June 23, 2015, and the driller and E & E staff began preparing for the planned drilling activities. However, on June 25, an unplanned demobilization was necessary due to a wildfire encroaching upon the village of Red Devil and the RDM. The wildfire apparently started due to a lightning strike on June 24 and was first observed on the morning of June 25, as it was encroaching upon the village of Red Devil. For health and safety reasons, E & E staff, E & E's drilling subcontractor, and BLM staff demobilized from Red Devil early in the afternoon of June 25. On July 7, 2015, after the fire was suppressed, the E & E staff, E & E's drilling subcontractor, and BLM staff remobilized to the site and resumed drilling-related field activities.

The RI Supplement field activities were performed in accordance with the Final Field Sampling Plan for 2015 Soil, Groundwater, Surface Water, and Kuskokwim River Sediment Characterization, Supplement to Remedial Investigation, Red Devil Mine, Alaska (Field Sampling Plan; E & E 2015), included as Appendix A of the RI Supplement Work Plan, except as noted in the sections below.

RI Supplement results are integrated with RI results presented in the final RI report (E & E 2014a) in this section as applicable. Consistent with the final RI report, the analytes aluminum, calcium, iron, magnesium, potassium, and sodium are common earth crust elements. Based on EPA, Region 10 policy, these common earth crust elements are not discussed in this report; however, the sample results are presented in the Sections 2 through 5 data tables for reference. For organic analytes, all positive detections are considered to represent site-related "contamination" because there are no nearby offsite sources of organic contaminants that are expected to contribute to onsite contamination.

Analytical data generated from the RI Supplement samples were validated by an E & E chemist in accordance with following:

- Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA 2010).
- Contract Laboratory Program National Functional Guidelines for Organic Data Review (EPA 2008).
- Quality assurance guidelines in Standard Operating Procedure BR-0013 for mercury selective sequential extraction analyses (Brooks Rand 2010).

The results of laboratory analytical data validation are summarized in Data Review Memoranda for each laboratory data deliverable and are presented in Appendix B. In general, all data generated for the RI Supplement are considered usable, with qualifications, for evaluation of the nature and extent of contamination assessment of potential risk to human health and ecological receptors. Qualifications of data are described in the Data Review Memoranda. Beginning in 2010, the BLM began a study to examine mercury, methylmercury, and other metals in the Kuskokwim River basin. Those studies pertinent to the present evaluation of Kuskokwim River sediment near the RDM are summarized in Chapter 5.

1.4 Document Organization

As noted above, the RI Supplement and BLM Kuskokwim River investigations collectively are being performed to augment existing data to characterize soil, groundwater, surface water, and Kuskokwim River sediment. The RI Supplement Report is organized by each of these media. For each of these media, the RI Supplement report presents the objectives of the supplemental RI activities; descriptions of the numbers, types, locations, and analytical requirements of laboratory samples collected; the locations and methods used for field data and sample collection; deviations from the RI Supplement Work Plan; results of the RI Supplement and other pertinent investigations; and discussion and conclusions.

The RI Supplement Report is organized as follows:

- **Chapter 1, Introduction –** Describes the purpose and objectives of the RI Supplement activities and baseline monitoring.
- **Chapter 2, Soil Investigation**
- **Chapter 3, Groundwater Investigation**
- **Chapter 4, Surface Water Investigation**
- **Chapter 5, Kuskokwim River Investigations**
- **Chapter 6, References –** Lists the guidance documents and literature resources cited in this document.
- **Appendix A, Summary of Soil Boring Data**
- **Appendix B, Data Review Memoranda**
- **Appendix C, Sediment Toxicity Testing Report**

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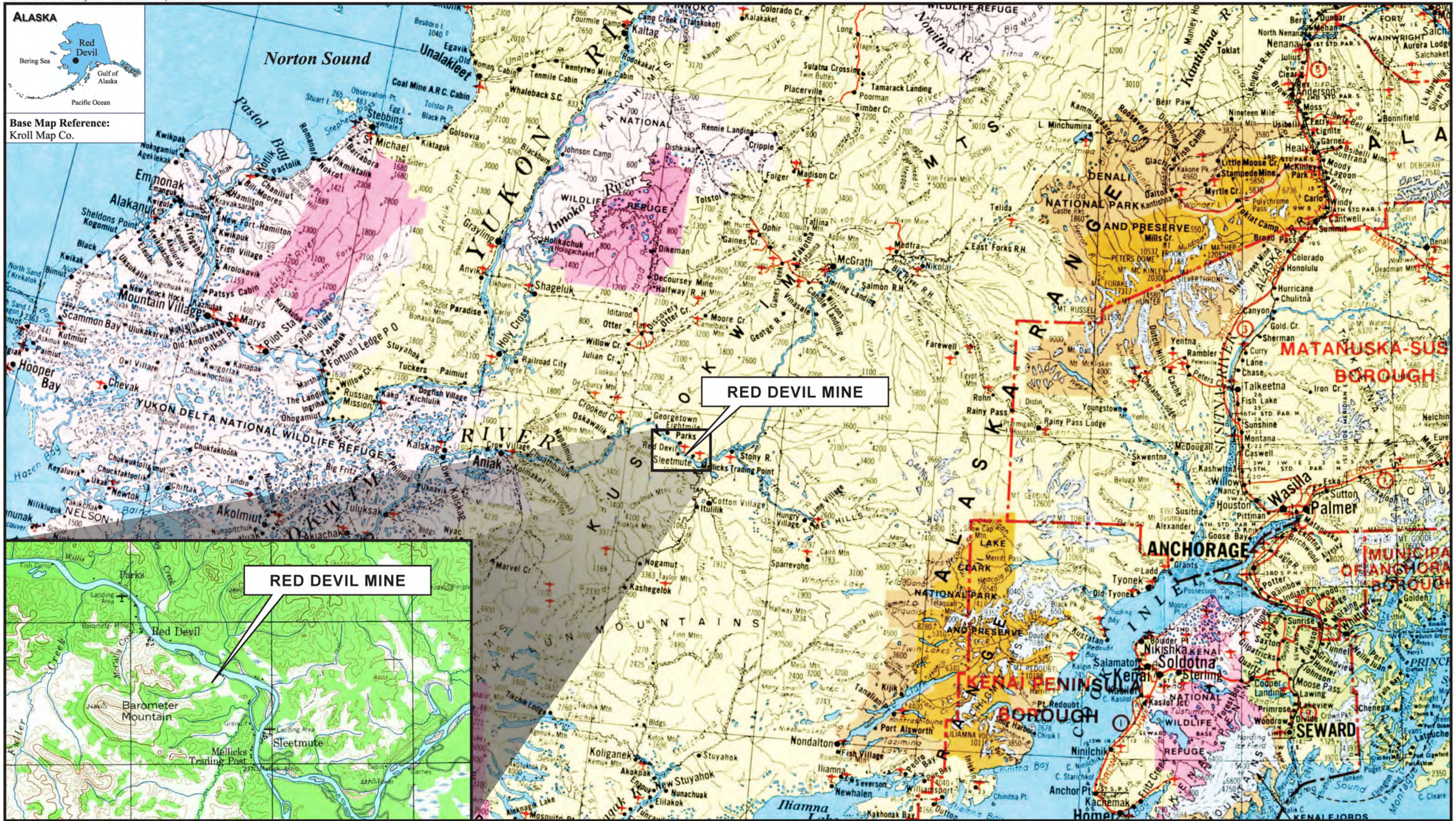

ecology and environment, inc.
International Specialists in the Environment
Seattle, Washington

0 40 80
Approximate Scale in Miles

RED DEVIL MINE
Red Devil, Alaska

Figure 1-1
SITE LOCATION MAP

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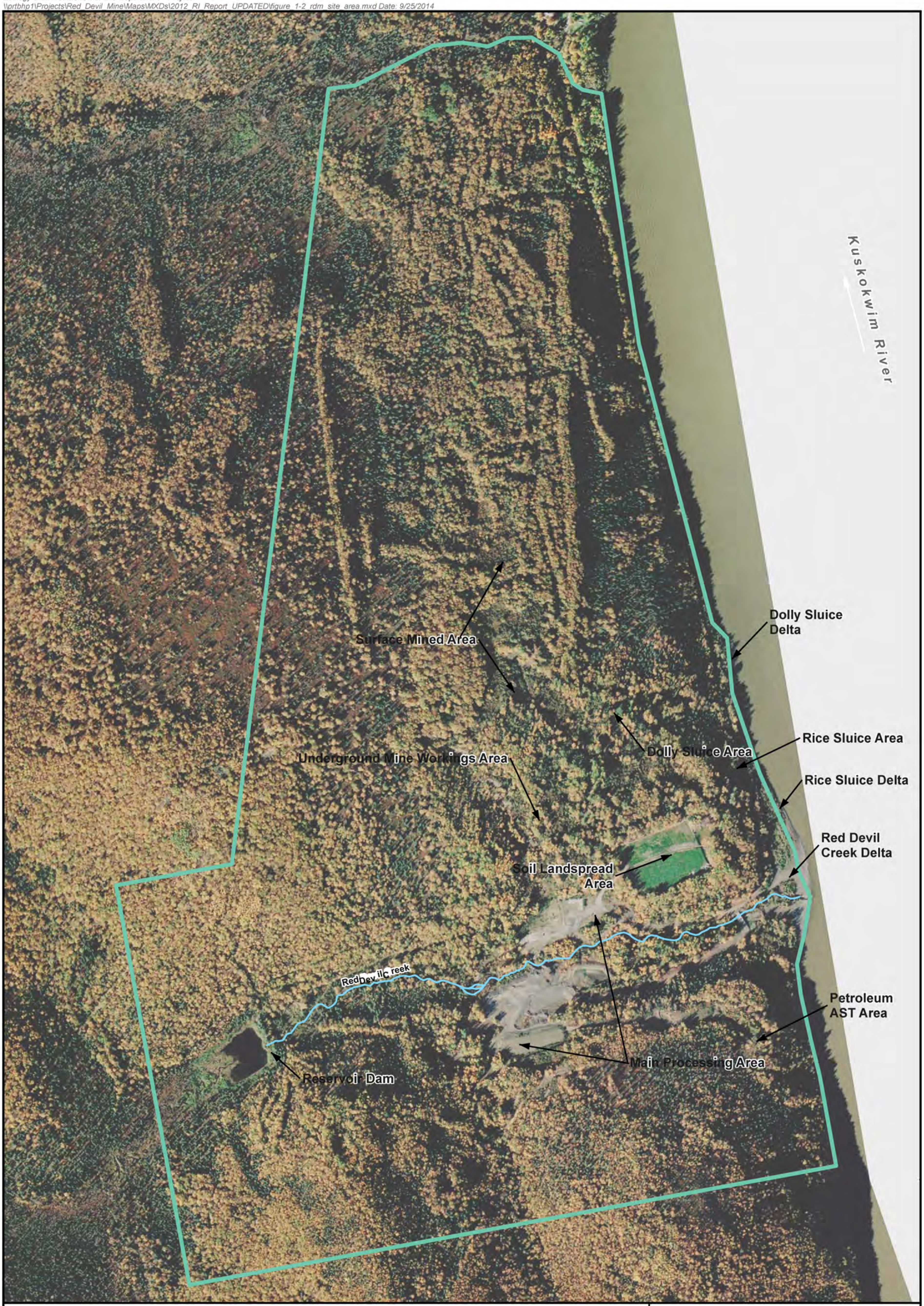

Upland Area Encompassed by Remedial Investigation

RED DEVIL MINE

Red Devil, Alaska

Figure 1-2
Upland Area Encompassed by Remedial Investigation

0 75 150 300 450 600 750
Feet
0 37.5 75 150 225
Meters
Scale 1:4,562

Image Source: Aero-Metric, Inc. 2010a

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2 Soil Investigation

2.1 Soil Investigation Activities

The RI Supplement soil characterization activities were performed from July 7 to August 12, 2015 and were designed to address data gaps associated with subsurface soil and bedrock. The soil characterization was performed to gather the types of additional information identified in Section 3.3 of the RI Supplement Work Plan. The supplemental RI soil characterization was designed to meet the following objectives:

- Assess lithological and mineralogical characteristics of subsurface soils and bedrock.
- Identify mine waste types and soil types.
- Determine thickness and inorganic element concentrations of tailings/waste rock where present.
- Determine concentrations of inorganic elements in tailings/waste rock where present.
- Identify and determine the thickness of types of native soil/alluvium.
- Determine concentrations of inorganic elements in soil/alluvium below tailings/waste rock from the base of tailings/waste rock to the top of bedrock to assess impacts on native soil/alluvium from deposition of inorganic elements leached from tailings/waste rock.
- Determine depth of bedrock.
- Visually assess whether the bedrock is naturally mineralized.
- Determine the presence, depth, and thickness of saturated interval(s).

Soil characterization included installing additional soil borings at the site, consisting of:

- Seven soil borings in the Main Processing Area;
- Three soil borings in the Red Devil Creek Area; and
- Four soil borings in the Surface Mined Area that were converted to monitoring wells.

The 2015 soil borings and a description of the locations of the soil borings relative to pertinent site features are presented in Table 2-1. The locations of the 2015 soil borings and monitoring wells are shown in Figure 2-1.

Actual drilling locations were refined from the locations proposed in the RI Supplement Work Plan during the investigation based on actual conditions encountered in the field. Sampling and other field procedures were performed in accordance with the Field Sampling Plan, except as noted below. A brief description of field sampling and other procedures is provided below.

2.1.1 Soil Boring Installation and Soil Sampling

Soil boring and monitoring well installation were performed using a drill rig operated by a subcontracted, Alaska-licensed driller. The driller used a track-mounted CME 850 drill rig outfitted to use direct push and hollow-stem auger equipment/method for drilling in unconsolidated material and some weathered bedrock, and air rotary/down-the-hole hammer equipment/method for drilling in bedrock. Soil borings were advanced to the total depths presented in Table 2-1.

A 2-foot-long split spoon sampler was used for subsurface soil sampling using direct-push and hollow-stem auger drilling methods. Soil cores were collected continuously with the split spoon samplers from the ground surface to the base of the unconsolidated materials. While drilling with air rotary/down-the-hole hammer in bedrock, drill cuttings were generally collected at a minimum frequency of every 5 feet, and typically every foot. At most drilling locations, occurrence of groundwater and saturated conditions was readily identifiable based on moisture content of the recovered soil in the split spoon samplers. While drilling in bedrock using air rotary/down-the-hole hammer method, saturated conditions were locally more difficult to identify because groundwater occurs primarily in fractures, and location, density, and orientations of the fractures are not well understood at the site. In comparatively less productive saturated zones, the drilling returns may not provide a clear indication of saturated conditions. If the fractures are not productive and/or if the clay-rich nature of the rock/cuttings (mixed with water) results in coating of the borehole wall and any fractures, any possible flow of water into the borehole would be impeded. Care was taken to observe and record drilling-related information, including rate of penetration, first occurrence of groundwater, water returns (presence and estimated flow rate based on airlift pumping rates), and borehole caving or sloughing, to aid in the identification of saturated intervals in bedrock.

After boreholes were successfully advanced, unless they were converted to monitoring wells, they were abandoned at the completion of sampling or the end of the day in accordance with State of Alaska regulations (18 Alaska Administrative Code [AAC] 75 and 18 AAC 78). Drill cuttings and other investigation-derived waste were managed in accordance with the Field Sampling Plan.

2.1.2 XRF Field Screening and Lithological Characterization

The soil material recovered was visually characterized and logged by the field geologist and field screened for total inorganic elements using X-ray fluorescence spectroscopy (XRF) following the procedures specified in the Field Sampling Plan. Logging and XRF field screening were typically performed at 1-foot intervals in both unconsolidated materials and in bedrock.

The following types of field observations of sampled soil and bedrock materials were made by the E & E field geologist if feasible:

- Soil type (consistent with soil type designations presented in the final RI report);
- Soil group classification (using United Soil Classification System);
- Color;
- Odor;
- Lithology and mineralogical characteristics and grain shape and size of clasts;
- Grain size range and distribution;
- Gradation;
- Soil particle lithology;
- Hardness;
- Plasticity;
- Bedding or sedimentary structures;
- Moisture content;
- Observations of gross contamination, including sheen and elemental mercury;
- Qualitative description of matrix porosity;
- Mineralization, including sulfides and iron staining;
- Weathering.
- Lithological and mineralogical characteristics of bedrock; and
- Bedrock fracture characteristics.

2.1.3 Soil Sampling for Laboratory Analysis

Selected samples of tailings/waste rock and native soil/alluvium were submitted to TestAmerica, Seattle, Washington, under subcontract to E & E, for laboratory analysis. TestAmerica performed analysis for total target analyte list (TAL) inorganics. Under sub-subcontract to TestAmerica, Brooks Rand Labs, Seattle, Washington, performed mercury selective sequential extraction (SSE) analysis on selected samples. Samples were selected for laboratory analyses using XRF field screening results and lithological observations following the criteria specified in the Field Sampling Plan. Soil sampling for laboratory analysis was performed following procedures described in the Field Sampling Plan. Subsurface soil samples submitted to the laboratory for these analyses are summarized in Table 2-1.

2.1.4 Deviations from the Field Sampling Plan

Two of the soil borings/monitoring wells that were originally planned for installation in the Main Processing Area (MP092/MW37 and MP093/MW38) were not installed. These two planned soil borings/monitoring wells were intended to replace RI monitoring wells MW16 and MW17. At the time of the development of the RI Supplement Work Plan, it was thought that wells MW16 and MW17 had been decommissioned as part of the NTCRA performed by BLM in 2014 (described in Section 2.3 of the RI Supplement Work Plan). The wells are located in the Main Processing Area near the edge of the area of tailings/waste rock regrading. During the spring 2015 groundwater and surface water monitoring event, it was determined that these two wells had not been decommissioned and they appeared to be in good condition. Therefore, soil borings/monitoring wells MP092/MW37 and MP093/MW38 were not installed.

Collection of soil samples and rock cuttings generally was performed at a frequency of one sample per foot. However, for several soil borings, the frequency was less over some intervals. Similarly, the frequency of XRF field screening was less than the planned frequency across some intervals in several boreholes. The actual frequency of soil and rock cuttings collection is shown in Appendix A.

A total of five new soil borings/monitoring wells were originally planned for installation in the Surface Mined Area. A total of eight boreholes were installed, including four boreholes that were abandoned and four boreholes in which monitoring wells were installed. Locations of the boreholes and monitoring wells are illustrated in Figure 2-1. Descriptions of the boreholes and monitoring wells are presented in Tables 2-1 and 3-1. Monitoring well installation is discussed in Section 3.1.1.

2.2 Soil Investigation Results

The supplemental RI soil characterization entailed installation of new soil borings at selected locations in the Main Processing Area, Red Devil Creek Area, and Surface Mined Area. Locations of RI Supplement soil borings are illustrated in Figure 2-1. The objectives of the soil investigation are listed in Section 2.1. Soil and bedrock characterization were performed using a combination of field observations, results of XRF field screening for total inorganic elements, and laboratory analysis for TAL inorganic elements and mercury SSE. Results of field characterization and laboratory sample analysis are summarized below.

2.2.1 Field Lithological and Mineralogical Characterization

Field observations of key soil and bedrock lithological and mineralogical characteristics, United Soil Classification System soil group classification, color, mineralization (including sulfide minerals, veins, and iron staining), and weathering, and moisture content are summarized in Table 2-2 and Appendix A.

2.2.2 XRF Field Screening

Field screening of soil samples for total metals using a field portable XRF was performed on soil and bedrock materials samples from boreholes. XRF results for the primary contaminants of concern (COCs) at the site—antimony, arsenic, and mercury—are presented in Table 2-2. The XRF results for all metals analyzed are presented in Appendix A.

2.2.3 Laboratory Soil Sample Results

2.2.3.1 Total Inorganic Elements

Laboratory analytical results for total inorganic elements are presented in Table 2-3. Results are used to support characterization of mine waste and soils, which are discussed in Sections 2.2.4 and 2.2.5.

2.2.3.2 Mercury Selective Sequential Extraction

As discussed in Chapter 5 of the final RI report, multiple interrelated factors affect the fate and transport of mercury in the environment. Chemical processes (redox, precipitation-dissolution, aqueous complexation, adsorption and desorption reactions, and formation and mobilization of colloids), and biogeochemical processes (methylation and demethylation) impact the mobility and toxicity of mercury. In addition, the various forms of mercury that these chemical and biogeochemical processes act upon also affect the fate and transport of mercury. For example, mercury in cinnabar—the mercury (II) sulfide that makes up the primary ore mineral at the RDM—is only minimally soluble under a broad range of conditions, whereas other forms of mercury (II) or elemental mercury [Hg(0)] are relatively more soluble and susceptible to methylation or volatilization. The form of mercury also controls how much mercury is bioavailable.

Historical information on operations at the RDM indicates that cinnabar is the dominant mercury ore mineral at the RDM. Cinnabar ore was subjected to thermal processing, either in retorts or furnaces at the mine, breaking down the cinnabar and allowing recovery of the resulting elemental mercury in a condenser system. No historical information on the specific chemical forms of mercury in RDM ore processing wastes (e.g., calcines) is available. However, at other mercury mine sites, extended X-ray adsorption fine structure spectroscopy studies indicate that the mercury species metacinnabar (m-HgS), corderoite ($Hg_3S_2Cl_2$), schuetteite ($HgSO_4$ -H_20), and mercury chlorides are likely to form during the roasting of mercury ores. Each of these species is more soluble than cinnabar (Rytuba 2002).

To better understand what forms of mercury are present in RDM site soils (including native soils and mine wastes) and sediment, a mercury SSE method was employed. Although the SSE technique does not identify specific minerals, chemical species, or oxidation states, it does differentiate between and quantify groups of mercury-containing materials based upon their solubility behavior. The results may be useful for inferring the mineralogical or chemical species present. The mercury SSE method distinguishes between water soluble, synthetic “stomach acid” (weak acid) soluble, organo-complexed, strong complexed, and mineral bound forms of mercury. Each sequential extraction step dissolves a less soluble fraction of mercury-containing material in the sample. A summary of the SSE steps and typical mercury species identified by each extraction step is provided below.

SSE Step	Extractant	Fraction Description	Typical Mercury Compounds
F0	De-ionized Water	Volatile	Hg_0 (vapor phase elemental mercury)
F1	De-ionized Water	Water soluble	$HgCl_2$, $HgSO_4$ (salts)
F2	pH 2 HCl/HOAc	Synthetic "stomach acid" soluble (weak acid)	HgO
F3	1 M KOH	Organo-complexed	Hg-humics, Hg_2Cl_2
F4	12 M HNO_3	Strong complexed	Mineral lattice, Hg_2Cl_2, Hg_0 (liquid phase elemental mercury)
F5	Aqua Regia (concentrated HCl and HNO_3)	Mineral bound	HgS, m-HgS, HgSe, HgAu

Key:
HCl = hydrogen chloride
HOAc = acetic acid
HNO_3 = nitric acid
KOH = potassium hydroxide
HgO = elemental mercury
Hg_2Cl_2 = mercury chloride
HgSe = mercury selenide
HgS = cinnabar
m-HgS = metacinnabar

Mercury SSE results for RDM soil and sediment samples collected during the RI are presented and discussed in Chapters 4 and 5 of the final RI report.

As part of the RI Supplement, additional sampling of subsurface soil for mercury SSE analysis was performed. Laboratory results for mercury SSE are presented in Table 2-3. Results are used to support characterization of mine waste and soils, which are discussed in Sections 2.2.4 and 2.2.5.

2.2.4 Identification and Characterization of Tailings/Waste Rock and Native Soil

As discussed in Chapter 3 of the final RI report, the distribution and arrangement of soils and mine and ore processing wastes at the site play a significant role in determining the nature and extent of contamination, as well as the fate and transport of contaminants at the RDM. This and other factors and processes that affect the nature and extent and fate and transport of inorganic elements at the RDM are discussed in Chapter 5 of the final RI.

Native soils at the RDM consist of loess, soils derived from Kuskokwim Group bedrock and alluvial deposits associated with the Kuskokwim River and Red

Devil Creek. Non-native materials at the site are comprised of various types of mining and ore processing wastes and fill. Mining-related waste consists of waste rock, dozed and sluiced overburden, flotation tailings, and tailings (thermally processed ore, also known as calcines, burnt ore, and retorted ore). Tailings and waste rock are typically mixed and are referred to as tailings/waste rock in the final RI report and this document. Native materials have been removed, disturbed, relocated, covered, and/or mixed with other native soils and/or mine waste and tailings and fill locally across the site. Some of the native soils are naturally mineralized. The presence and nature of naturally mineralized soils at the RDM is discussed in Section 4.1.7 of the final RI report and summarized in Section 2.2.5 below.

During the RI, multiple lines of evidence were used to identify the various mine wastes and soil types and to define their distribution. These lines of evidence are discussed below. In conjunction with other information, visual observations of the presence of red porous rock and rock fragments with a distinctive rust-colored rind are shown to be useful to identify the presence of tailings. Visual observations of the presence of primary ore minerals cinnabar (mercury sulfide) and stibnite (antimony sulfide), and related gangue minerals realgar and orpiment (arsenic sulfides), and calcite and quartz veins, combined with other information, are useful to identify waste rock and naturally mineralized bedrock and rock fragments within native soils. Combined with other information, results of mercury SSE analysis were used to identify the presence of cinnabar and other forms of mercury in soils. Results of the efforts to delineate the lateral and vertical extents of tailings/waste rock, other mine wastes, and site-specific soil types during the RI are presented in Chapter 3 of the final RI report.

The RI Supplement soil characterization built upon the results of the RI, and employed a similar approach to identify types of mine wastes and native soils, and to attempt to identify naturally-mineralized soils and soils impacted by contamination. Field lithological and mineralogical observations were used, in conjunction with XRF field screening data (see Section 2.2.2) and laboratory results for total inorganics and mercury SSE analyses (see Section 2.2.3), to identify mine waste and soil types.

As in the RI, each subsurface soil sample collected as part of the RI Supplement was assigned a site-specific soil type. The interpreted mine waste and soil types identified in the soil borings are presented in Table 2-2. Mine waste types observed in the soil borings include mixed tailings/waste rock and waste rock. Table 2-2 summarizes the thickness of these mine wastes at each borehole location where they were observed. The XRF field screening results for total antimony, arsenic, and mercury for the materials are presented in Table 2-2. The results of the total TAL inorganic analyses and mercury SSE analyses for selected samples are presented in Table 2-3.

For the RI Supplement, selected samples of subsurface soil, including tailings/waste rock and a variety of disturbed and undisturbed native soils and weathered bedrock were analyzed by mercury SSE. Mercury SSE results were evaluated by calculating the proportion of mercury represented by each SSE fraction as a percentage of the total mercury in the SSE samples. The total concentration of mercury was calculated by adding the concentration values for all the SSE fractions analyzed for a given sample (F0 through F5). The relative solubility of mercury under various conditions in tailings/waste rock and various soil types was evaluated by comparing the calculated percentages to total mercury by soil type. Key results are briefly discussed below.

The comparably less soluble SSE fraction F5, which includes cinnabar, generally comprised most of the mercury in samples with relatively higher concentrations of total mercury, including tailings/waste rock, mineralized native soil, and some weathered bedrock. This is consistent with visual observations in those samples with visible cinnabar. Where cinnabar is not visible in the samples, the mercury SSE results provide information on the likely presence of cinnabar as well as other forms of mercury. The more soluble SSE fractions F0 through F4 were detected in comparatively higher proportions relative to total mercury only in those samples that had relatively low total mercury concentrations.

The general tendency of various soil types at the RDM with higher total mercury concentrations to have lower proportions of the more soluble fractions F0 through F4 is illustrated in Figure 2-3.

Geologic cross sections illustrating the generalized distribution of mine wastes, soil types, bedrock, and other pertinent features are presented in Figures 2-4 through 2-6. A cross section reference map is presented in Figures 2-1 and 2-2.

2.2.5 Characterization of Bedrock

In parts of the RDM, including the Main Processing Area, Red Devil Creek Area, and Surface Mined Area, the depth to bedrock is not known. An objective of the RI Supplement soil characterization effort was to determine the depth to bedrock at the borehole locations. Depths to weathered bedrock and competent bedrock, where encountered, are presented in Table2-2.

Another objective of the RI Supplement soil characterization was to identify naturally occurring mineralization in bedrock. Such information may be used to evaluate the nature and extent and fate and transport of COCs at the RDM. Such information also was used to inform the decisions on drilling locations and well depths for new monitoring wells installed in the Surface Mined Area (see Section 3.2.1). Natural mineralization at the RDM comprises not only the discrete high grade mercury ore bodies targeted during mining, but also sub-ore grade zones peripheral to the ore bodies. This peripheral mineralization includes not only mercury and antimony sulfide minerals (primarily cinnabar and stibnite, respectively), but also arsenic sulfides (realgar and orpiment). Weathering of these natural sulfides, and possibly other minerals, results in naturally elevated levels of arsenic, mercury, and antimony in groundwater. Bedrock and soil in zones hydraulically downgradient of the mineralized zones also likely contain naturally elevated metals concentrations from deposition of the mobilized metals (e.g., oxidation of arsenic sulfide and adsorption of resulting arsenate onto clay particles or iron oxide/hydroxide). Migration of inorganic elements in groundwater at the RDM is complicated and is affected by multiple complex groundwater migration pathways and varied geochemical conditions present at any given time at any given location along those pathways. Available information and conclusions regarding these factors are discussed in Section 5.4 of the final RI report. Available information regarding the ore geology and peripheral mineralization is detailed in Section 4.1.7 in the final RI report and summarized below.

Ore Zone Geology

The Red Devil ore bodies are epithermal hydrothermal deposits (Gray et al. 2000). The ore minerals are cinnabar and stibnite sulfide. Other sulfide minerals locally present are realgar and orpiment (arsenic sulfides) and pyrite (iron sulfide). The mineral-laden hydrothermal solutions were derived from dehydration of hydrous minerals in the argillite/shale and mobilization of formation waters of the Kuskokwim Group host rock by heat from igneous plutons that locally intruded the host rock. The hydrothermal solutions migrated through permeable rocks and along fractures and faults (e.g., Gray et al. 2000). Such faults include the northwest-trending Red Devil fault and associated faults that run through the RDM area. Sulfide minerals and possibly other species, along with quartz, carbonate, and clay gangue, were deposited where the chemical and physical conditions favored their formation.

Concentrations of mercury in the RDM ore were typically 2 to 5 percent (20,000 to 50,000 parts per million [ppm]) and ranged as high as 30 percent (300,000 ppm). The richest ore mined at the RDM consisted of numerous discrete elongate bodies (ore shoots) that are mainly localized along and near intersections of several igneous dikes (average strike and dip of North 37° East, 63° Southeast) and numerous right lateral faults associated with the Red Devil fault (average strike and dip of North 40° West, 60° Southwest), which cut the dikes into segments. The intersections of the dikes and faults, and thus the main ore shoots, plunge on average approximately 39° on a bearing of South 10° East (Malone 1962). The main ore shoots that were mined are associated with two dikes: the Dolly dike and the “F” zone dike. The right lateral slip along the numerous faults that cut these dikes results in two arrays of ore shoots that comprise the ore zones that were targeted during mining: the zone associated with the Dolly and Rice ore shoots and the zone associated with the “F” ore zone shoots (Malone 1962). Stopes were driven along these ore shoots, and locally reached the surface or were terminated a short distance below the ground surface.

A map illustrating the configuration of the underground mine workings as of 1962 (based on Malone 1962 and MacKevett and Berg 1963) is presented on Figure 2-2. Information from a 1962 mine workings cross section (Alaska Mines and Minerals, Inc. and Decoursey Mountain Mining Co., Inc. 1962) is projected onto geologic cross section I-I’ (modified from RI Report Figure 3-4, Geologic Cross

Section B-B'), presented on Figure 2-6 of this document. Information on estimated elevations of key underground mine features is shown in Figures 2-2 and 2-6.

Stope surface openings and other mine openings generally mark the locations where the ore zones reached the top of the bedrock and illustrate the west-northwest-trending alignments of the two primary ore zones (see Figures 2-2 and 2-6). The surface expression of the "F" ore zone is approximated by the "F" Zone Shaft Collar, 325 Adit and 311 Adit Portals, the Main Shaft Collar, and intervening stope surface openings. The surface expression of the Dolly and Rice ore zone is approximated by the Dolly Shaft Collar, the Rice Shaft Collar, and intervening stope surface openings (MacKevett and Berg 1963; Malone 1962).

The extent of the ore-grade mineralization at the RDM is not clear. At a minimum, the extent of ore-grade mercury mineralization would be defined by the extent of mining; however, high concentrations of cinnabar (and other sulfide minerals as well as elevated concentrations of mercury, antimony, and arsenic that may not be present in the form of sulfides) that were not economically recoverable likely are present beyond the extent of mining. The most recent available maps of underground mine workings were based on the mine development that had taken place as of 1962 (MacKevett and Berg 1963; Malone 1962); these maps were used to develop Figure 2-2. However, underground mining occurred after 1962 (see final RI report Section 1.4.2.1). Therefore, the extent of ore zones illustrated in Figures 2-2 and 2-6 represents the minimum extent of the mercury ore zones.

The "F" ore zone extends to the southeast beyond the Main Shaft Collar at least as far as the center of the Main Processing Area, as evidenced by the stopes that branch off the 200 level and approach the surface beneath Red Devil Creek in the vicinity of the seep (see Figures 2-2 and 2-6). The ore shoots that these stopes followed were hypothesized to extend to the top of bedrock in the final RI report.

The elevation of Red Devil Creek where underground workings approach the surface beneath the creek (near the seep) is approximately 210 feet above mean sea level referenced to the North American Vertical Datum 1988. Results of a geophysical survey conducted by the U.S. Geological Survey at the RDM using surface-based, direct-current resistivity and electromagnetic induction methods support the presence of near-surface stopes. The resistivity results indicated the presence of several anomalies in the subsurface along Red Devil Creek in the Main Processing Area, including two anomalies that appear likely to be associated with underground mine workings. Anomaly D is interpreted to be an elongate conductive anomaly that underlies Red Devil Creek for a distance of at least approximately 200 feet. Anomaly E is interpreted to be a nearly vertical anomaly that extends to within approximately 6 feet of the surface. Anomaly E is in close proximity to the seep on the northwest bank of Red Devil Creek (Burton and Ball 2011). The approximate cross sectional positions of these resistivity anomalies are shown in Figures 2-4 and 2-6.

Mineralization Peripheral to the Ore Zones
Existing information on local geology and mine operations and RI soil data indicate the presence of mineralization associated with, but beyond the extent of, the mercury ore zones targeted by mining. The rich ore shoots exploited during mining grade along the northwest-trending faults and associated fractures into zones characterized by networks of closely spaced cinnabar-bearing veinlets, widely spaced veinlets that form protore containing less than 1 percent mercury, and more distally into a peripheral zone of "barren veinlets" and clay alteration (MacKevett and Berg 1963; Malone 1962). Sub-ore grade mineralization also extended some distance laterally (i.e., toward the northeast and southwest) from the ore zones. Such sub-ore grade mineralization is discussed further below.

For simplicity, the mercury ore zones and the associated zones of sub-ore grade mercury deposits and deposits of other sulfide minerals are collectively referred to as the "mineralized zone" in this report. The extent of the mineralized zone and the distribution of inorganic element concentrations within the zone are not well understood. Information on the extent and distribution of sub-ore grade mineralization at the RDM is limited. This is likely because during mine exploration and development little information was gathered regarding the extent of mineralization at levels below ore grade. Compounding the lack of historical information, the intensive surface mining and exploration activities that took place within the Surface Mined Area and the disposal of tailings and waste rock throughout the Main Processing Area make it difficult to characterize pre-mining conditions on the surface in these areas at the present time. Nonetheless, some information regarding the mineralized zone is available. Pertinent available information is summarized below.

Surface exploratory work performed by the United States Bureau of Mines in the 1940s includes mapping of target mineral concentrations in trenches arrayed across and roughly perpendicular to the ore zones. Sub-ore grade concentrations of mercury and antimony up to several hundred ppm were reported at locations more than 150 feet laterally away from the "F" ore zone. No information on arsenic sulfide concentrations is provided (Webber et al. 1947).

The presence of mineralization outside of the ore zones also is indicated by RI soil data. Such mineralization is presented in final RI report Sections 4.17 and 4.3 and summarized below.

RI Characterization of the Mineralized Zone
Collectively, the historical mining information and RI data indicate that the natural mineralized zone (including the mercury ore zones and associated sub-ore grade deposits of mercury and deposits of antimony and arsenic sulfides and other minerals) lies within an elongate area that trends approximately west-northwest, perpendicular to the Red Devil Creek valley. This mineralized zone underlies part of the Main Processing Area as well as the Surface Mined Area. Historical site information indicates that naturally mineralized Kuskokwim Group bedrock and

soils derived from it occurred locally at the surface prior to mine development. As evidenced by the incised nature of the Red Devil Creek valley, Red Devil Creek has eroded into the bedrock, exposing the ore and mineralized zones in the Main Processing Area and transporting eroded ore and other mineralized rock and soil downstream. This is indicated by reports on the early mine history—the mine was discovered when cinnabar float was found in the creek bed. The cinnabar float was followed upstream to the lode, described as being located approximately 1,000 feet up Red Devil Creek from the Kuskokwim River (Webber et al. 1947). This description corresponds to the location where the "F" ore zone intercepts the creek (see Figures 2-2 and 2-6). Cinnabar float in the Red Devil Creek alluvium and other soils in the area of the discovery, described as "detritus material in the vicinity of the lode" (interpreted here to be slope wash or other soils derived from mineralized Kuskokwim Group bedrock), were the source of cinnabar ore during the initial mining (Webber et al. 1947).

As a result of the exposure and erosion of the ore and mineralized zones, the alluvium adjacent to and downstream of the mineralized zone would contain higher natural concentrations of mineralization-related inorganic elements than alluvium found upstream of the ore and mineralized zones. Similarly, soils derived from mineralized Kuskokwim Group bedrock, including colluvium and slope wash transported downslope into Red Devil Creek valley, would contain higher natural concentrations of inorganic elements than Kuskokwim Group-derived soils from areas outside of the ore and mineralized zones. Naturally mineralized geologic materials, including mineralized Kuskokwim Group bedrock and soils and alluvium derived from it that underlie portions of the Main Processing Area and Surface Mined Area, pre-date mining activities. As such, the natural mineralization of these materials represents pre-mining "background" conditions for those areas that are mineralized. Historical mining and ore processing activities, including disposal of the tailings and waste rock, occurred within the Main Processing Area, coinciding with part of the area where the naturally mineralized zone is expected to be present in the shallow subsurface. The presence of tailings/waste rock throughout most of the Main Processing Area makes characterization of naturally mineralized soil conditions in this part of the site difficult because of elevated concentrations of inorganic elements in these mine waste materials, which may leach from the waste materials and be deposited in the native soils.

Within the Surface Mined Area, varying degrees of disturbance by exploration and mining activities have occurred. This disturbance makes it difficult to positively identify naturally mineralized conditions because potential impacts of mining-related disturbance on underlying soils cannot be ruled out, and available information does not readily facilitate differentiation between the natural mineralization and such mining-related impacts on inorganic element concentrations. Efforts to identify and characterize areas of natural mineralization in the Surface Mined Area during the RI are presented in Section 4.1.7 of the final RI report.

RI Supplement Bedrock Characterization

During the RI Supplement, as with soil, identification of natural mineralization included visual observations of the presence of cinnabar (see Photograph 1 inset), stibnite, realgar, orpiment (see Photograph 2 inset), calcite and quartz veins; XRF field screening results for antimony, arsenic, and mercury; and results for total TAL inorganics and mercury SSE analyses. The presence of these ore-related minerals and/or elevated concentrations of these COCs in bedrock suggest that the bedrock is naturally mineralized. Bedrock intervals in the RI Supplement boreholes that exhibit these features are shown in Table 2-2. Naturally mineralized bedrock was observed in most of the boreholes installed in the Surface Mined Area and, within the Main Processing Area, at borehole MP098. The mineralization observed at borehole MP098 is associated with the ore zones targeted by stopes stemming upward from the 150 Level / 200 Level of the underground mine workings (see discussion of Ore Zone Geology above and Figures 2-2 and 2-6).

Photograph 1
Weathered bedrock in split spoon sampler from depth interval 44 to 45 feet bgs, borehole MP098. Note cinnabar (red grains).

Photograph 2
Drill cuttings from borehole SM70b from depth interval 127 to 128 feet bgs. Note orpiment (bright orange grains).

2.2.6 Occurrence of Groundwater

An objective of the RI Supplement soil characterization was to identify saturated zones and depths to groundwater in the new boreholes. This information may be used to evaluate the nature and extent and fate and transport of COCs at the RDM. Such information also was used to inform the decisions on drilling locations and well depths for new monitoring wells installed in the Surface Mined Area (see Section 3.2.1). Observations of soil moisture content and first occurrence of groundwater at each new borehole are summarized in Table 2-2.

2.3 Soil Characterization Conclusions

The RI Supplement soil characterization activities were performed to address data gaps associated with subsurface soil and bedrock. The soil characterization was performed to gather the types of additional information identified in Section 3.3 of the RI Supplement Work Plan and meet the following objectives listed in Section 2.1. It is anticipated that data collected as part of the RI Supplement soil investigation will be used, in conjunction with the RI results, to refine the estimates of depth and volume of material to be remediated through action proposed in the FS.

Results of the soil investigation met the study objectives and are detailed in Section 2.2. The RI Supplement soil characterization built upon the results of the RI, and employed a similar approach to that used in the RI to identify types of mine wastes and native soils, and to attempt to identify naturally-mineralized soils and soils impacted by contamination. Field lithological and mineralogical observations were used, in conjunction with XRF field screening data and laboratory analytical results, to identify mine waste and soil types and their thicknesses. The interpreted mine waste and soil types identified in the soil borings are presented in Table 2-2. Concentrations of inorganic contaminants in mine waste (mixed tailings/waste rock and waste rock), native soils, and bedrock were determined using XRF field screening data and laboratory analytical results. Results are presented in Tables 2-2 and 2-3 and Appendix A. Depth to bedrock and information regarding occurrence of groundwater were gathered during drilling at each borehole. Naturally mineralized bedrock and native soils were identified using visual lithological and mineralogical observations were used and XRF field screening data. Mineralized zones associated with the underground mine workings were targeted during the borehole/monitoring well installation in the Surface Mined Area. Information on depths of bedrock mineralization was used in conjunction with information gathered during drilling regarding occurrence of groundwater to inform well construction decisions of newly installed monitoring wells in the Surface Mined Area. Results are detailed in Table 2-2 and Appendix A.

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Table 2-1 Soil Boring Installation and Soil Sample Collection

General Area	Soil Boring ID	Soil Boring Location Description and Notes	Soil Boring Total Depth (feet bgs)	Sample ID	Sample Depth Interval (feet bgs)		Sample Date	Sample Description	Sample Analyses and Methods	
					Top	Bottom			Total TAL Metals - EPA 6010B/6020A /7470A/7471A	Hg SSE (F0 - F5) with Total Hg
Post-1955 Main Processing Area	MP092 (not installed)	Not installed. Originally planned for location near MW16 and MW17.	NA	NA	NA	NA	NA	NA		
	MP093 (not installed)	Not installed. Originally planned for location near MW16 and MW17.	NA	NA	NA	NA	NA	NA		
	MP094	Near RI Soil Borings MP29 and MP30.	24	15MP094SB11	10	11	7/8/2015	Field Sample	X	X
				15MP094SB13	12	13	7/8/2015	Field Sample	X	
				15MP094SB17	16	17	7/8/2015	Field Sample	X	X
				15MP094SB19	18	19	7/8/2015	Field Sample	X	X
				15MP094SB20	19	20	7/8/2015	Field Sample	X	
				15MP200SB01	19	20	7/8/2015	Field Duplicate of 15MP094SB20	X	
	MP095	Near RI Soil Borings MP25 and MP29.	22	15MP095SB04	3	4	7/7/2015	Field Sample	X	X
				15MP095SB05	4	5	7/7/2015	Field Sample	X	X
				15MP095SB10	9	10	7/7/2015	Field Sample	X	X
				15MP095SB11	10	11	7/7/2015	Field Sample	X	
				15MP095SB13	12	13	7/7/2015	Field Sample	X	
				15MP200SB02	12	13	7/7/2015	Field Duplicate of 15MP095SB13	X	
	MP096	Near RI Soil Borings MP27 and MP28.	32	15MP096SB06	5	6	7/8/2015	Field Sample	X	X
				15MP096SB13	12	13	7/8/2015	Field Sample	X	X
				15MP096SB17	16	17	7/8/2015	Field Sample	X	X
				15MP096SB19	18	19	7/8/2015	Field Sample	X	
				15MP096SB26	25	26	7/8/2015	Field Sample	X	
				15MP200SB03	25	26	7/8/2015	Field Duplicate of 15MP096SB26	X	X
	MP097	Near Red Devil Creek Alignment and RI Soil Borings MP29 a	16	15MP097SB02	1	2	7/8/2015	Field Sample	X	X
				15MP097SB06	5	6	7/8/2015	Field Sample	X	X
				15MP097SB09	8	9	7/8/2015	Field Sample	X	
				15MP097SB11	10	11	7/8/2015	Field Sample	X	X
				15MP200SB04	10	11	7/8/2015	Field Duplicate of 15MP097SB11	X	X
				15MP097SB13	12	13	7/8/2015	Field Sample	X	
Pre-1955 Main Processing Area	MP098	Near RI Soil Borings MP45, MP46, MP47, MP48 and MP60.	46	15MP098SB20	19	20	7/9/2015	Field Sample	X	X
				15MP098SB26	25	26	7/9/2015	Field Sample	X	X
				15MP098SB33	32	33	7/9/2015	Field Sample	X	
				15MP098SB36	35	36	7/9/2015	Field Sample	X	
				15MP098SB38	37	38	7/9/2015	Field Sample	X	X
	MP099	Near RI Soil Boring MP53.	26	15MP099SB11	10	11	7/9/2015	Field Sample	X	X
				15MP099SB12	11	12	7/9/2015	Field Sample	X	
				15MP099SB13	12	13	7/9/2015	Field Sample	X	X
				15MP099SB17	16	17	7/9/2015	Field Sample	X	
				15MP099SB19	18	19	7/9/2015	Field Sample	X	X
				15MP200SB05	18	19	7/9/2015	Field Duplicate of 15MP099SB19	X	X
	MP100	Near RI Soil Borings MP57 and MP58.	37.5	15MP100SB09	8	9	7/10/2015	Field Sample	X	X
				15MP100SB11	10	11	7/10/2015	Field Sample	X	X
				15MP100SB17	16	17	7/10/2015	Field Sample	X	
				15MP100SB19	18	19	7/10/2015	Field Sample	X	X
				15MP100SB21	20	21	7/10/2015	Field Sample	X	
Near Red Devil Creek Alignment in Main Processing Area	MP101	Near Red Devil Creek Alignment and RI Soil Boring MP38.	17.5	15MP101SB11	10	11	7/10/2015	Field Sample	X	X
				15MP101SB13	12	13	7/10/2015	Field Sample	X	X
				15MP101SB14	13	14	7/10/2015	Field Sample	X	

Table 2-1 Soil Boring Installation and Soil Sample Collection

General Area	Soil Boring ID	Soil Boring Location Description and Notes	Soil Boring Total Depth (feet bgs)	Sample ID	Sample Depth Interval (feet bgs)		Sample Date	Sample Description	Sample Analyses and Methods	
					Top	Bottom			Total TAL Metals - EPA 6010B/6020A /7470A/7471A	Hg SSE (F0 - F5) with Total Hg
Near Red Devil Creek in Red Devil Creek Downstream Alluvial Area	RD21	Near Red Devil Creek Alignment and RI Soil Borings MP40 and RD07.	8	15RD21SB05	4	5	7/11/2015	Field Sample	X	X
	RD22	Near Red Devil Creek Alignment and RI Soil Borings RD07 and RD06.	20	15RD22SB01	0	1	7/11/2015	Field Sample	X	
				15RD22SB09	8	9	7/11/2015	Field Sample	X	X
Surface Mined Area	SM67	Northeast of Dolly Shaft and south and assumed downgradient of proposed repository location. Well MW39 installed (see Table 2-2).	90	None	NA	NA	NA	NA		
	SM68a	Near Dolly Shaft and 503 Crosscut and associated stopes. Encountered void at 37 feet bgs. Discontinued drilling and abandoned hole. Relocated to SM68b.	37	15SM68SB11	10	11	7/16/2015	Field Sample	X	
	SM68b	Near Dolly Shaft and 503 Crosscut and associated stopes. Drilled to 135 feet bgs. Hole dry. Hole abandoned. Relocated to SM68c.	135	None	NA	NA	NA	NA		
	SM68c	Near 507 Crosscut and Dolly No. 7 / 1280 Crosscut. Well MW40 installed (see Table 2-2).	155	None	NA	NA	NA	NA		
	SM69 (not installed)	NA. Not installed.	NA	NA	NA	NA	NA	NA		
	SM70a	Near 325 Adit and 150 Level / 200 Level. Hole dry. Hole abandoned. Relocated to SM70b.	96	15SM70SB02	1	2	7/18/2015	Field Sample	X	
	SM70b	Near 325 Adit and 150 Level / 200 Level. Well MW42 installed (see Table 2-2).	140	None	NA	NA	NA	NA		
	SM71a	Near 33 Level. Well installation attempted, but well damaged. Abandoned well. Relocated to SM71b.	99	15SM200SB02	11	12	7/21/2015	Field Duplicate of 15SM71SB12	X	
	SM71b	Near 33 Level. Well installed (see Table 2-2).	120	None	NA	NA	NA	NA		

Key:
bgs = Below ground surface
Hg SSE = Mercury Selective Sequential Extraction
NA = Not applicable
TAL = Target Analyte List

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
	0	1											NR	T/WR								Dry			
	1	2	X								X	Dark Gray	SP-SM	T/WR		19127	97	5416	42	135	10	Dry			
	2	3											NR	T/WR											
	3	4	X				X		X			Grayish Brown	SM	T/WR		24765	119	6826	51	112	10	Damp			
	4	5	X				X		X			Gray	SP-SM	T/WR		24560	117	5521	44	98	9	Damp			
	5	6										Brown	OL	DN		557	12	352	8	< LOD	5	Moist			
	6	7										Very Dark Brown	OL	DN		241	11	424	9	< LOD	5	Damp			
	7	8										Very Dark Brown	OL	DN		38	10	111	5	< LOD	5	Moist			
	8	9	X								X	Dark Gray	GM	T/WR		9836	56	2296	24	39	6	Moist			
	9	10										Yellowish Brown	ML	DN (KG)		3144	32	1010	20	20	7	Damp			
	10	11										Dark Grayish Brown	ML	DN (KG)	15MP094SB11	2914	29	1445	19	33	6	Moist			
MP094	11	12										Gray	ML	N		30	11	82	5	< LOD	6	Moist			
	12	13										Gray	GM	N	15MP094SB13	2872	27	734	13	26	5	Wet			
	13	14										Gray	ML	N		< LOD	17	10	3	< LOD	6	Moist			
	14	15										Brown	ML	N		229	12	98	5	< LOD	5	Saturated			
	15	16										Brown	ML	N		< LOD	18	273	9	< LOD	7	Wet			
	16	17									X	Grayish Brown	GM	N (KG)	15MP094SB17	3102	29	918	15	51	6	Moist			
	17	18										Brown	ML	N (KG)		< LOD	16	43	4	< LOD	6	Wet			
	18	19										Grayish Brown	ML	N (KG)	15MP094SB19	1403	20	547	11	12	5	Wet			
	19	20										Brown	ML	N (KG)	15MP094SB20	1028	21	52	5	< LOD	8	Moist			
	20	21										Brown	ML	WB		271	13	168	6	< LOD	5	Moist			
	21	22										Grayish Brown		WB								Wet			
	22	24										Dark Grayish Brown		WB								Wet			
	0	1	X						X		X	Dark Gray	GM	T/WR		13310	142	6284	68	631	18	Damp			
	1	2	X						X		X	Dark Gray	ML	T/WR		9501	97	3274	35	514	14	Damp			
	2	3									X	Dark Gray	SM	T/WR		764	21	283	5	29	4	Damp			
	3	4									X	Dark Gray	SM	T/WR	15MP095SB04	151	19	59	3	<LOD	8	Damp			
	4	5										Dark Gray	ML	N	15MP095SB05	1819	28	485	8	59	5	Moist			
	5	6									X	Dark Gray	ML	N								Moist			
	6	7										Brown	ML	N								Wet			
	7	8										Brown	ML	N		96	19	58	3	16	3	Moist			
	9	10										Brown	ML	N	15MP095SB10	1268	26	584	9	61	5	Moist			
MP095	10	11										Olive Brown	MH	N	15MP095SB11	310	20	108	4	11	3	Moist			
	11	12										Olive Brown	MH	N		905	22	430	7	56	4	Moist			
	12	13									X	Olive Brown	MH	N	15MP095SB13	122	18	59	3	14	3	Moist			
	13	14										Olive Brown	ML	N		<LOD	56	17	2	9	3	Moist			
	14	15										Olive Brown	MH	N		<LOD	50	79	3	<LOD	6	Moist			
	15	16										Dark Brown	ML	N		<LOD	52	24	2	<LOD	7	Damp			
	16	17												WB								Saturated			
	17	18										Dark Gray		WB		<LOD	57	142	4	<LOD	8	Saturated			
	18	19										Dark Grayish Brown		WB		<LOD	51	34	2	10	3	Wet			
	19	20										Dark Grayish Brown		WB		<LOD	56	30	2	<LOD	8	Wet			
	20	22										Dark Grayish Brown		WB								Wet			
	0	1	X		X						X	Brown	GM	T/WR		7034	77	3827	42	287	6	Dry			
	1	2	X		X						X	Grayish Brown	SM	T/WR		3036	37	3568	39	325	7	Dry			
	2	3	X		X				X		X	Grayish Brown	SM	T/WR		6024	70	5782	65	824	13	Damp			
	3	4	X		X				X		X	Grayish Brown	SM	T/WR		4404	57	9157	106	1098	17	Damp			
MP096	4	5	X		X				X		X	Dark Brown	SM	T/WR		5520	63	4396	49	843	13	Damp			
	5	6	X		X				X		X	Dark Grayish Brown	SM	T/WR	15MP096SB06	7976	88	5203	58	580	10	Damp			
	6	7										Yellowish Brown	ML	T/WR		2042	28	2282	26	151	4	Damp			
	7	8										Yellowish Brown	ML	DN		<LOD	33	30	2	4	1				
	8	9										Olive Brown	ML	DN		382	13	203	4	24	1	Moist			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
	9	10										Olive Brown	ML	DN		<LOD	32	6	1	<LOD	2	Damp			
	10	11										Olive Brown	ML	DN		341	13	228	5	27	2	Moist			
	11	12										Olive Brown	ML	DN		<LOD	45	7	2	<LOD	3	Moist			
	12	13										Olive Brown	ML	DN	15MP096SB13	453	16	261	6	26	2	Moist			
	13	14										Olive Brown	ML	DN		<LOD	32	10	2	<LOD	2	Moist			
	14	15										Grayish Brown	ML	DN		60	12	20	2	<LOD	2	Moist			
	15	16										Olive Brown	ML	DN		<LOD	34	12	2	<LOD	2	Moist			
	16	17									X	Grayish Brown	ML	DN (KG)	15MP096SB17	1407	21	941	12	122	4	Moist			
	17	18									X	Grayish Brown	GM	DN (KG)		61	12	15	2	<LOD	2	Moist			
	18	19									X	Olive Brown	GM	DN (KG)	15MP096SB19	140	12	418	6	4	1	Wet			
MP096	19	20										Olive Brown	GM	DN (KG)		<LOD	33	30	2	<LOD	2	Wet			
	20	21										Olive Brown	ML	N or DN		39	11	184	4	13	1	Wet			
	21	22										Dark Grayish Brown	ML	N or DN		<LOD	40	14	2	<LOD	3	Moist			
	22	23										Grayish Brown	ML	N		<LOD	35	11	2	<LOD	2	Wet			
	23	24										Olive Brown	ML	N		<LOD	38	15	2	<LOD	3	Moist			
	24	25										Gray	ML	N		<LOD	39	22	2	<LOD	3	Moist			
	25	26										Olive Brown	ML	N	15MP096SB26	133	13	165	4	7	1	Wet			
	26	27										Grayish Brown	GM	N		<LOD	38	23	2	<LOD	3	Moist			
	27	28										Brown	GM	N		<LOD	42	43	3	<LOD	3	Wet			
	28	30										Brown		WB								Wet			
	30	32										Dark Gray		WB								Moist			
	0	1										Dark Grayish Brown	NR	T/WR								Damp			
	1	2	X		X							Dark Grayish Brown	GM	T/WR	15MP097SB02	2799	27	1064	16	60	6	Damp			
	2	3										Dark Grayish Brown	NR	T/WR								Damp			
	3	4									X	Gray	ML	N or DN		759	17	432	10	15	4	Damp			
	4	5										Gray	ML	N or DN		1040	19	1738	20	36	5	Damp			
	5	6										Tan	ML	N or DN	15MP097SB06	45	12	51	5	< LOD	7	Damp			
	6	7										Gray	ML	N or DN		1475	20	497	11	22	4	Wet			
MP097	7	8										Gray	MH	N or DN		< LOD	16	24	3	< LOD	6	Moist			
	8	9										Brown	ML	N or DN	15MP097SB09	1795	22	464	10	21	4				
	9	10										Grayish Brown	ML	N or DN		54	11	39	4	< LOD	6	Wet			
	10	11										Olive Brown	ML	N or DN	15MP097SB11	856	17	719	13	47	5	Moist			
	11	12										Olive Brown	MH	N or DN		204	12	99	5	< LOD	6	Moist			
	12	13										Olive Brown	GM	N (KG)	15MP097SB13	1431	20	552	11	27	5	Saturated			
	13	14										Olive Brown	ML	N (KG)		374	13	296	8	18	4	Wet			
	14	15										Olive Brown		WB		180	12	175	6	< LOD	6	Saturated			
	15	16										Orange Brown		WB		63	15	42	5	< LOD	9	Damp			
	0	1										Brown	SM	T/WR		1239	18	755	13	85	6	Moist			
	1	2									X	Black	GP	T/WR		647	18	3743	36	92	9	Damp			
	2	3										Brown	GM	T/WR		94	13	761	16	25	6	Moist			
	3	4										Brown	ML	T/WR		290	14	692	14	14	5	Moist			
	4	5										Dark Gray	GM	T/WR		6412	44	1776	22	698	16	Damp			
	5	6								X	X	Gray	GM	T/WR		1393	23	1214	20	230	11	Damp			
MP098	6	7											NR	T/WR											
	7	8										Dark Gray	GM	T/WR								Damp			
	8	9							X			Dark Gray	GP-GM	T/WR								Damp			
	9	10							X			Dark Gray	GP-GM	T/WR								Damp			
	10	11		X						X		Dark Gray	GP	T/WR								Damp			
	11	12								X	X	Dark Gray	GP	T/WR								Dry			
	12	13										Dark Gray	NR	T/WR								Damp			
	13	14										Dark Gray	GP	T/WR								Damp			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
MP098	14	15										Dark Gray	GM	T/WR								Damp			
	15	16						X		X	X	Light Gray	GP-GM	T/WR		281	14	1951	23	41	6	Damp			
	16	18											NR	T/WR		188	12	282	8	< LOD	6				
	18	20										Dark Grayish Brown	SM	T/WR	15MP098SB20	339	15	1686	22	90	7	Moist			
	20	21											NR	WR		53	13	917	17	1213	21				
	21	22	X							X		Dark Grayish Brown	ML	WR		44	11	526	11	15	5	Damp			
	22	23								X		Brown	GM	WR		200	15	833	17	219	11	Damp			
	23	24										Brown	SM	DN (KG, MZ)		135	16	90	8	756	21	Damp			
	24	25								X		Brown	ML	DN (KG, MZ)		303	15	270	10	23	6	Damp			
	25	26								X	X	Gray	ML	N or DN (KG, MZ)	15MP098SB26	413	15	1083	17	241	10	Moist			
	26	27								X		Orange Brown	ML	N or DN (KG, MZ)		81	11	293	8	21	4	Damp			
	27	28								X		Orange Brown	GM	N or DN (KG, MZ)		101	11	223	7	16	4	Moist			
	28	29											NR	N (KG, MZ)											
	29	30								X		Orange Brown	ML	N (KG, MZ)		442	16	429	12	42	6	Wet			
	30	31										Yellowish Brown	GM	N (KG, MZ)		264	13	286	8	61	6	Saturated			
	31	32										Gray	ML	N (KG, MZ)		361	15	223	9	11	5	Wet			
	32	33										Brown	ML	N (KG, MZ)	15MP098SB33	418	15	433	11	135	7	Saturated			
	33	34									X	Dark Grayish Brown	ML	N (KG, MZ)		523	16	170	7	13	5	Moist			
	34	35										Gray	GP	N (KG, MZ)								Wet			
	35	36							X		X	Light Gray	GP-GM	WB	15MP098SB36	638	15	1729	20	60	6	Wet			
	36	37											NR	WB											
	37	38										Orange Brown	GM	WB	15MP098SB38	1747	24	2782	28	160	9	Saturated			
	38	39											NR	WB											
	39	40										Orange Brown	GW-GM	WB		1351	21	1857	22	68	6	Saturated			
	40	41											NR	WB											
	41	42								X		Orange Brown	GP-GM	WB		1279	21	2610	27	290	11	Saturated			
	42	44							X	X	X	Light Gray		WB								Wet			
	44	45							X	X	X	Light Gray		WB		1314	26	6243	53	949	24	Wet			
MP099	0	2										Dark Grayish Brown	SM	T/WR								Dry			
	2	4	X							X	X	Grayish Brown	SM	T/WR		6587	47	6264	44	606	16	Dry			
	4	6	X							X		Dark Grayish Brown	SM	T/WR		3139	31	2607	27	142	9	Damp			
	6	7	X								X			T/WR		10017	60	4569	38	133	9				
	7	8	X								X	Olive Brown	ML	DN		558	15	274	8	30	5	Damp			
	8	9	X		X						X			T/WR		2525	26	1601	21	185	9				
	9	10	X		X						X	Brown	ML	DN		63	12	76	5	< LOD	6	Moist			
	10	11			X						X			T/WR	15MP099SB11	11982	67	2450	28	659	17				
	11	12										Olive Brown	ML	DN	15MP099SB12	52	12	379	10	< LOD	7	Damp			
	12	13									X			DN	15MP099SB13	5805	41	4050	36	304	12				
	13	14										Gray	SM	DN		54	11	19	3	< LOD	6	Damp			
	14	15												DN (loess)		< LOD	17	20	3	< LOD	6				
	15	16										Gray	SM	DN		< LOD	16	16	3	< LOD	5	Moist			
	16	17												DN	15MP099SB17	828	16	431	10	25	5				
	17	18	X									Olive Brown	ML	T/WR		< LOD	17	14	3	< LOD	6	Moist			
	18	19												DN	15MP099SB19	258	14	286	9	33	6				
	19	20										Gray	ML	N or DN		< LOD	20	59	6	< LOD	8	Damp			
	20	21												N or DN		< LOD	17	129	6	8	5				
	21	22										Brown	SM	N or DN		< LOD	17	136	7	8	5	Damp			
	22	23												N or DN		< LOD	16	77	5	< LOD	6				
	23	24										Brown	ML	WB		< LOD	16	164	7	9	4	Moist			
	24	26										Brown		WB								Dry			
MP100	0	1	X								X			T/WR		642	16	2050	23	166	9				
	1	2	X								X	Dark Gray	SM	T/WR		809	18	2163	24	102	7	Damp			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
MP100	2	3						X	X		X			T/WR		126	13	2070	24	8	5				
	3	4						X	X		X	Dark Gray	SM	T/WR		569	15	2857	26	7	5	Damp			
	4	6								X	X	Dark Gray	SM	T/WR		255	14	1893	22	79	7	Damp			
	6	7									X			T/WR		115	13	1051	17	36	6				
	7	8									X	Dark Gray	GM	T/WR		559	16	1776	22	120	8	Damp			
	8	9									X			T/WR	15MP100SB09	241	14	1236	18	57	7				
	9	10									X	Brown	SM	DN (loess)		331	12	25	3	< LOD	5	Damp			
	10	11												DN (loess)	15MP100SB11	579	14	129	6	7	4				
	11	12										Gray	ML	N		157	12	4	2	< LOD	5	Moist			
	12	13												N		126	11	< LOD	4	< LOD	5				
	13	14										Gray	ML	N		51	11	29	3	< LOD	6	Moist			
	14	16										Grayish Brown	SM	N		< LOD	16	40	4	< LOD	5	Moist			
	16	17												N (loess)	15MP100SB17	30	11	41	4	< LOD	5				
	17	18										Brown	SP	N (loess)		< LOD	15	51	4	< LOD	5	Moist			
	18	19												N (loess)	15MP100SB19	138	12	73	5	< LOD	6				
	19	20								X		Gray	SP	N		< LOD	15	30	3	< LOD	5	Moist			
	20	21												N	15MP100SB21	27	10	56	4	< LOD	5				
	21	22										Gray	SM	N		< LOD	14	20	3	< LOD	5	Saturated			
	22	23												N		< LOD	16	30	3	< LOD	5				
	23	24										Gray	SP-SM	N		< LOD	15	29	3	< LOD	5	Saturated			
	24	25												N		< LOD	15	35	3	< LOD	5				
	25	26										Gray	ML	N		< LOD	15	23	3	< LOD	5	Moist			
	26	27												N		< LOD	15	33	3	< LOD	5				
	27	28									X	Brownish Yellow	ML	N (KG)		< LOD	17	21	3	< LOD	6	Wet			
	28	29									X			N (KG)		< LOD	17	13	3	< LOD	6				
	29	30										Brown	GM	N (KG)		< LOD	16	22	3	< LOD	5	Wet			
	30	31												N (KG)		< LOD	15	25	3	< LOD	5				
	31	32										Brown	SM	N (KG)		< LOD	23	42	6	< LOD	12	Wet			
	32	33												N (KG)		< LOD	15	26	3	< LOD	5				
	33	34										Brown	GM	N (KG)		< LOD	18	48	4	< LOD	7	Moist			
	34	35												WB		< LOD	16	47	4	< LOD	5				
	35	36										Brown	GM	WB		< LOD	18	110	6	< LOD	7	Wet			
	36	37										Brown		WB		< LOD	19	63	5	< LOD	7	Moist			
MP101	0	1	X								X	Dark Gray	GP	T/WR		836	17	2178	24	25	5	Wet			
	1	2										Dark Gray	GP	T/WR								Wet			
	2	4			X				X		X	Dark Gray	GP-GM	T/WR		6696	45	3175	29	1216	20	Wet			
	5	6										Gray	GP	T/WR		2097	22	1317	17	526	12	Saturated			
	6	8									X	Dark Gray	GP	T/WR		2565	26	1409	18	265	9	Saturated			
	8	10	X						X	X	X	Dark Gray	GP-GM	T/WR		630	22	614	18	77	10	Saturated			
	10	11	X						X	X	X			T/WR	15MP101SB11	2357	25	1353	18	329	10				
	11	12										Dark Gray	CH	N		80	12	98	6	< LOD	7	Moist			
	12	13												N	15MP101SB13	1582	21	915	15	162	8				
	13	14										Dark Gray	CH	N (KG)	15MP101SB14	201	13	267	9	12	5	Moist			
	14	15												WB		205	13	359	9	25	5				
	15	16										Dark Gray	GP-GC	WB		86	13	248	9	< LOD	7	Moist			
	16	17												WB		181	14	772	15	12	5				
	17	18										Brown		WB		97	12	415	10	< LOD	7	Damp			
RD21	1	2			X						X	Dark Grayish Brown	GP-GM	T/WR		1260	19	853	10	41	2	Wet			
	2	3			X						X			T/WR		1190	21	1105	14	30	2				
	3	4	X							X		Brown	GP-GC	T/WR		<LOD	44	16	2	<LOD	3	Wet			
	4	5												T/WR	15RD21SB05	1356	21	867	11	35	2				
	5	6	X							X		Brown	GP-GC	T/WR		56	14	19	2	4	1	Wet			

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	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
RD21	6	7												WB		1778	25	1774	20	24	2				
	7	8										Gray		WB		<LOD	42	9	2	3	1	Damp			
RD22	0	1										Brown	ML	N	15RD22SB01	47	11	21	3	< LOD	6	Damp			
	2	3												N		92	11	43	4	< LOD	6				
	3	4										Brown	ML	N		< LOD	16	26	3	< LOD	6	Moist			
	4	5												N		< LOD	15	19	3	< LOD	6				
	5	6										Brown	SM	N		< LOD	17	13	3	< LOD	7	Moist			
	6	7												N		< LOD	16	14	3	< LOD	5				
	7	8										Brown	ML	N (KG)		< LOD	16	10	3	< LOD	6	Moist			
	8	9												N (KG)	15RD22SB09	162	12	74	5	6	4				
	9	10										Grayish Brown	ML	N (KG)		< LOD	17	13	3	< LOD	6	Moist			
	10	11												N (KG)											
	11	12										Gray	GM	N (KG)		< LOD	15	21	3	< LOD	5	Wet			
	12	13												N (KG)											
	13	14										Grayish Brown	ML	N (KG)		< LOD	18	21	4	< LOD	7	Moist			
	14	15												N (KG)		< LOD	18	7	3	< LOD	7				
	15	16										Gray	GC	N (KG)		< LOD	17	6	3	< LOD	7	Moist			
	16	17												N (KG)		< LOD	15	27	3	< LOD	5				
	17	18										Gray	GP-GC	WB		< LOD	18	8	3	< LOD	7	Moist			
	18	19												WB		< LOD	16	21	3	< LOD	6				
	19	20										Gray		WB		< LOD	16	10	3	< LOD	6	Moist			
SM67	1	2										Olive Brown	ML	DN (KG and loess)		<LOD	39	61	3	<LOD	3	Damp			
	2	3												N (loess)		<LOD	95	<LOD	37	<LOD	20				
	3	4										Olive Brown	ML	N (loess)		<LOD	35	16	2	<LOD	2	Damp			
	4	5										Olive Brown	ML	N (loess)		<LOD	32	5	1	<LOD	2	Moist			
	6	7												N (loess)		<LOD	35	6	2	<LOD	2				
	7	8										Olive Brown	ML	N (loess)		<LOD	33	8	1	2	1	Moist			
	8	9												N (loess)		<LOD	41	122	4	4	1				
	9	10										Olive Brown	ML	WB		<LOD	38	111	4	4	1	Moist			
	10	11												WB		<LOD	39	116	4	4	1				
	11	12										Grayish Brown	GP	WB		<LOD	42	157	4	5	1	Dry			
	12	13												WB		<LOD	40	196	5	5	1				
	13	14										Grayish Brown		WB		<LOD	38	138	4	3	1	Damp			
	14	15												WB		<LOD	35	90	3	5	1				
	15	16										Gray		WB		<LOD	44	162	5	<LOD	4	Dry			
	16	17												WB		<LOD	40	103	4	5	1				
	17	18										Gray		WB		<LOD	33	13	1	3	1	Damp			
	18	19												WB		<LOD	44	119	4	<LOD	4				
	19	20										Gray		WB		<LOD	42	98	4	6	1	Damp			
	20	21										Gray		B		<LOD	38	55	3	4	1	Dry			
	21	22										Gray		B		<LOD	36	75	3	6	1	Damp			
	22	23										Gray		B		<LOD	38	78	3	4	1	Dry			
	23	24										Grayish Brown		B		<LOD	36	75	3	4	1	Dry			
	24	25										Grayish Brown		B		<LOD	36	44	2	3	1	Dry			
	25	26										Grayish Brown		B		<LOD	38	106	3	<LOD	3	Dry			
	26	27										Grayish Brown		B		<LOD	38	73	3	3	1	Dry			
	27	28										Grayish Brown		B		<LOD	39	93	3	5	1	Dry			
	28	29										Grayish Brown		B		<LOD	38	85	3	<LOD	3	Dry			
	29	30										Dark Gray		B		<LOD	39	79	3	4	1	Dry			
	30	31										Grayish Brown		B		<LOD	39	60	3	<LOD	3	Dry			
	31	32										Gray		B		<LOD	38	79	3	5	1	Dry			
	32	33										Brown		B		<LOD	37	89	3	5	1	Dry			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
SM67	33	34										Brown		B		<LOD	37	112	3	3	1	Dry			
	34	35										Grayish Brown		B		<LOD	37	77	3	4	1	Dry			
	35	36										Grayish Brown		B		<LOD	37	78	3	4	1	Dry			
	36	37										Grayish Brown		B		<LOD	36	67	3	<LOD	3	Dry			
	37	38										Dark Gray		B		<LOD	39	62	3	3	1	Dry			
	38	39										Dark Gray		B		<LOD	35	74	3	<LOD	3	Dry			
	39	40										Black		B		<LOD	36	91	3	5	1	Dry			
	40	41										Dark Gray		B		<LOD	38	92	3	4	1	Dry			
	41	42										Gray		B		<LOD	40	86	3	<LOD	3	Damp			
	42	43										Gray		B		<LOD	41	80	3	<LOD	3	Damp			
	43	44										Dark Gray		B		<LOD	38	95	3	3	1	Damp			
	44	45										Gray		B		<LOD	39	86	3	<LOD	3	Damp			
	45	46									X	Grayish Brown		B		<LOD	41	99	4	<LOD	3	Damp			
	46	47										Brown		B		<LOD	40	176	5	<LOD	3	Damp			
	47	48										Gray		B		<LOD	40	67	3	<LOD	3	Damp			
	48	49										Gray		B		<LOD	41	109	4	<LOD	3	Damp			
	49	50									X	Gray		B		<LOD	39	54	3	4	1	Dry			
	50	51										Dark Gray		B		<LOD	37	41	2	4	1	Dry			
	51	52										Dark Gray		B		<LOD	40	68	3	4	1	Dry			
	52	53										Gray		B		<LOD	38	54	3	<LOD	3	Dry			
	53	54										Gray		B		<LOD	40	60	3	3	1	Dry			
	54	55										Light Gray		B		<LOD	42	53	3	<LOD	3	Dry			
	55	56										Gray		B		<LOD	38	70	3	7	1	Damp			
	56	57										Black		B		<LOD	39	65	3	4	1	Dry			
	57	58										Gray		B		<LOD	42	69	3	<LOD	3	Damp			
	58	59										Gray		B		<LOD	40	64	3	4	1	Dry			
	59	60										Gray		B		<LOD	40	65	3	<LOD	3	Dry			
	60	61										Gray		B		<LOD	45	77	3	<LOD	3	Dry			
	61	62										Gray		B		<LOD	43	369	8	<LOD	4	Dry			
	62	63										Dark Gray		B		<LOD	42	97	4	<LOD	3	Damp			
	63	64										Dark Gray		B		<LOD	39	96	3	4	1	Damp	Dry	MW39	63 - 83
	64	65										Gray		B		<LOD	41	92	3	<LOD	3	Damp			
	65	66										Gray		B		<LOD	38	43	2	3	1	Dry			
	66	67										Gray		B		<LOD	39	59	3	<LOD	3	Dry			
	67	68										Gray		B		<LOD	40	67	3	<LOD	3	Dry			
	68	69										Gray		B		<LOD	40	46	3	<LOD	3	Damp			
	69	70										Light Gray		B		<LOD	39	40	2	4	1	Damp			
	70	71										Gray		B		<LOD	40	159	4	<LOD	3	Damp			
	71	72										Dark Gray		B		<LOD	38	77	3	4	1	Damp			
	72	73										Dark Gray		B		<LOD	39	79	3	3	1	Damp			
	73	74										Gray		B		<LOD	44	69	3	<LOD	3	Dry			
	74	75										Dark Gray		B		<LOD	41	54	3	<LOD	3	Damp			
	75	76										Dark Gray		B		<LOD	38	81	3	5	1	Damp			
	76	77										Dark Gray		B		<LOD	38	85	3	4	1	Damp			
	77	78										Dark Gray		B		<LOD	41	87	3	<LOD	3	Damp			
	78	79										Dark Gray		B		<LOD	39	116	4	3	1	Damp			
	79	80										Dark Gray		B		<LOD	38	93	3	<LOD	3	Damp			
	80	81										Gray		B		<LOD	42	52	3	<LOD	3	Damp			
	81	82										Gray		B		<LOD	38	41	2	<LOD	3	Dry			
	82	83										Light Gray		B		<LOD	42	44	3	4	1	Dry			
	83	84										Dark Gray		B		<LOD	39	93	3	4	1	Damp			
	84	85										Gray		B		<LOD	40	66	3	3	1	Damp			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
	85	86										Dark Gray		B		<LOD	38	83	3	5	1	Damp			
	86	87										Dark Gray		B		<LOD	40	50	3	<LOD	3	Damp			
SM67	87	88										Gray		B		<LOD	38	48	2	<LOD	3	Dry			
	88	89										Gray		B		<LOD	41	43	2	<LOD	3	Dry			
	89	90										Gray		B		<LOD	42	35	2	4	1	Dry			
	0	2											NR	DN (KG)											
	3	4										Brown	GP-GM	DN (KG)		137	18	187	6	7	2	Damp			
	4	5												DN (KG)		<LOD	68	120	6	<LOD	6				
	5	6											GP-GM	DN (KG)		<LOD	38	93	3	<LOD	3				
	6	7												DN (KG)		<LOD	45	122	4	4	1				
	7	8										Black		DN (KG)		<LOD	42	153	4	4	1	Moist			
	8	9												WB		<LOD	37	176	4	5	1				
	9	10							X		X	Dark Brown		WB		<LOD	41	132	4	<LOD	3	Damp			
	10	11												WB	15SM68SB11	147	13	226	5	<LOD	3				
	11	12										Gray		WB		<LOD	55	140	6	<LOD	4	Damp			
	12	13												WB		<LOD	43	94	4	<LOD	3				
	13	14										Grayish Brown		WB		<LOD	35	58	2	4	1	Damp			
	14	15												WB		<LOD	39	111	4	6	1				
	15	16										Grayish Brown		WB		<LOD	39	80	3	4	1	Dry			
	16	17												WB		71	20	104	6	<LOD	5				
	17	18										Dark Gray		WB		<LOD	51	34	3	<LOD	3	Dry			
	18	19												WB		<LOD	38	72	3	3	1				
SM68a	19	20										Gray		WB		<LOD	35	116	3	3	1	Dry			
	20	21												WB		<LOD	83	195	10	<LOD	7				
	21	22										Black		WB		327	17	735	12	<LOD	5	Dry			
	22	23												B		1313	29	1882	30	<LOD	7				
	23	24										Grayish Brown		B		188	13	715	10	5	1	Dry			
	24	25										Black		B		85	13	447	7	7	1	Damp			
	25	26									X	Brown		B		506	16	987	13	6	2	Damp			
	26	27										Brown		B		291	15	828	12	<LOD	4	Damp			
	27	28									X	Grayish Brown		B		151	14	472	8	6	1	Damp			
	28	29										Grayish Brown		B		78	13	423	7	6	1	Damp			
	29	30										Grayish Brown		B		47	13	400	7	<LOD	3	Damp			
	30	31										Dark Gray		B		<LOD	38	183	4	7	1	Damp			
	31	32										Dark Gray		B		<LOD	37	235	5	6	1	Damp			
	32	33										Black		B		<LOD	39	163	4	8	1	Damp			
	33	34										Brownish Yellow		B		<LOD	37	271	5	5	1	Damp			
	34	35										Very Dark Gray		B		<LOD	38	226	5	7	1	Damp			
	35	36									X	Grayish Brown		B		<LOD	39	386	7	8	1	Damp			
	36	37										Gray		B		94	13	620	9	7	1	Damp			
	0	25	See borehole SM68a interval 0-25 ft.																						
	25	26										Dark Gray		B		<LOD	39	82	3	4	1	Damp			
	26	27										Grayish Brown		B		<LOD	40	72	3	<LOD	3	Moist			
	27	28										Brown		B		<LOD	36	41	2	3	1	Damp			
	28	29										Brown		B		<LOD	38	41	2	3	1	Damp			
SM68b	29	30										Gray		B		<LOD	36	54	3	<LOD	3	Dry			
	30	31										Gray		B		<LOD	39	73	3	<LOD	3	Dry			
	31	32										Gray		B		<LOD	36	36	2	3	1	Damp			
	32	33										Gray		B		<LOD	37	36	2	<LOD	3	Damp			
	33	34										Gray		B		<LOD	36	47	2	4	1	Damp			
	34	35										Dark Gray		B		<LOD	35	92	3	3	1	Damp			
	35	36										Black		B		<LOD	36	57	3	<LOD	3	Damp			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
SM68b	36	37										Dark Gray		B		<LOD	37	67	3	<LOD	3	Damp			
	37	38										Dark Gray		B		<LOD	40	33	2	<LOD	3	Damp			
	38	39										Dark Gray		B		<LOD	40	69	3	<LOD	3	Damp			
	39	40										Gray		B		<LOD	37	54	2	4	1	Damp			
	40	41										Dark Gray		B		<LOD	39	47	3	4	1	Moist			
	41	42										Dark Brown		B		<LOD	35	38	2	<LOD	3	Damp			
	42	43										Dark Brown		B		<LOD	37	93	3	4	1	Damp			
	43	44										Black		B		<LOD	39	76	3	3	1	Damp			
	44	45										Black		B		<LOD	39	83	3	4	1	Damp			
	45	46										Black		B		<LOD	40	106	4	<LOD	3	Damp			
	46	47										Black		B		<LOD	38	64	3	<LOD	3	Damp			
	47	48										Black		B		<LOD	37	91	3	4	1	Damp			
	48	49										Black		B		<LOD	40	67	3	<LOD	3	Damp			
	49	50										Black		B		<LOD	38	93	3	<LOD	3	Moist			
	50	51										Dark Gray		B		<LOD	45	81	4	<LOD	4	Damp			
	51	52										Very Dark Gray		B		<LOD	41	85	3	5	1	Damp			
	52	53										Black		B		<LOD	38	123	4	5	1	Damp			
	53	54										Black		B		<LOD	40	116	4	6	1	Moist			
	54	55										Black		B		<LOD	39	135	4	4	1	Moist			
	55	56										Gray		B		<LOD	40	56	3	<LOD	3	Damp			
	56	57										Dark Gray		B		<LOD	38	110	3	4	1	Damp			
	57	58										Dark Gray		B		<LOD	38	86	3	3	1	Damp			
	58	59										Dark Gray		B		<LOD	38	80	3	<LOD	3	Damp			
	59	60							X			Dark Gray		B		<LOD	40	289	6	7	1	Damp			
	60	61										Dark Gray		B		<LOD	38	164	4	5	1	Damp			
	61	62							X			Dark Gray		B		<LOD	37	287	5	4	1	Dry			
	62	63										Very Dark Gray		B		48	13	444	8	13	2	Moist			
	63	64						X	X		X	Black		B		402	14	1788	20	19	2	Moist			
	64	65					X	X		X	X	Light Gray		B		5659	63	10672	110	16	4	Moist			
	65	66					X	X	X		X	Very Dark Gray		B		2145	26	2975	29	13	2	Damp			
	66	67						X	X		X	Black		B		218	15	12859	141	<LOD	14	Damp			
	67	68						X	X		X	Very Dark Gray		B		234	14	3791	40	36	3	Damp			
	68	69						X	X	X	X	Dark Gray		B		51	13	1633	18	60	3	Damp			
	69	70						X		X		Gray		B		111	13	2013	21	69	3	Damp			
	70	71						X			X	Very Dark Gray		B		83	12	2017	21	52	3	Damp			
	71	72						X	X	X	X	Dark Gray		B		91	13	2678	28	54	3	Damp			
	72	73						X	X			Dark Gray		B		203	15	6658	73	85	5	Damp			
	73	74						X			X	Dark Gray		B		65	13	3662	38	34	3	Damp			
	74	75						X	X					B		42	12	674	9	19	2				
	75	76						X			X	Black		B		45	13	920	12	10	2	Damp			
	76	77						X			X	Very Dark Gray		B		<LOD	37	247	5	4	1	Damp			
	77	78							X		X	Black		B		<LOD	37	156	4	6	1	Moist			
	78	79						X				Very Dark Gray		B		86	13	213	5	5	1	Damp			
	79	80						X			X	Dark Gray		B		<LOD	37	242	5	4	1	Damp			
	80	81									X	Very Dark Gray		B		<LOD	36	73	3	3	1	Moist			
	81	82										Black		B		<LOD	39	260	6	<LOD	3	Damp			
	82	83						X				Black		B		<LOD	36	117	3	4	1	Damp			
	83	84										Dark Gray		B		<LOD	40	190	5	4	1	Moist			
	84	85										Black		B		<LOD	39	120	4	<LOD	3	Moist			
	85	86										Black		B		<LOD	38	132	4	4	1	Moist			
	86	87										Black		B		<LOD	37	99	3	4	1	Damp			
	87	88										Black		B		<LOD	38	126	4	5	1	Damp			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
SM68b	88	89										Black		B		<LOD	41	106	4	3	1	Dry			
	89	90										Black		B		<LOD	46	164	5	<LOD	3	Moist			
	90	91										Black		B		<LOD	45	84	3	5	1	Damp			
	91	92										Black		B		<LOD	41	265	6	<LOD	3	Damp			
	92	93										Black		B		<LOD	39	140	4	4	1	Dry			
	93	94										Very Dark Gray		B		<LOD	40	137	4	<LOD	3	Dry			
	94	95										Very Dark Gray		B		<LOD	43	89	3	4	1	Dry			
	95	96									X	Dark Gray		B		<LOD	48	75	4	<LOD	3	Moist			
	96	97									X	Dark Gray		B		<LOD	56	82	4	<LOD	4	Moist			
	97	98									X	Dark Gray		B		<LOD	49	99	4	<LOD	4	Wet			
	98	99									X	Dark Gray		B		<LOD	45	219	6	<LOD	4	Wet			
	99	100										Dark Gray		B		<LOD	46	78	4	4	1	Wet			
	100	101										Dark Gray		B		<LOD	47	120	4	6	1	Wet			
	101	102										Dark Gray		B		<LOD	46	75	4	<LOD	3	Wet			
	102	103										Black		B		<LOD	46	100	4	<LOD	3	Wet			
	103	104										Gray		B		<LOD	47	61	3	<LOD	3	Wet			
	104	105									X	Gray		B		<LOD	47	61	3	<LOD	3	Wet			
	105	106									X	Gray		B		<LOD	45	68	3	4	1	Wet			
	106	107										Gray		B		<LOD	47	79	4	<LOD	4	Wet			
	107	108										Dark Gray		B		<LOD	48	96	4	6	1	Wet			
	108	109									X	Gray		B		<LOD	46	54	3	<LOD	3	Wet			
	109	110										Dark Gray		B		<LOD	49	58	3	<LOD	3	Wet			
	110	111										Dark Gray		B		<LOD	51	48	3	<LOD	4	Wet			
	111	112										Dark Gray		B		<LOD	49	52	3	<LOD	4	Wet			
	112	113										Dark Gray		B		<LOD	52	96	4	<LOD	4	Wet			
	113	114									X	Dark Gray		B		<LOD	47	78	4	<LOD	3	Wet			
	114	115									X	Dark Gray		B		<LOD	42	57	3	<LOD	3	Wet			
	115	116									X	Dark Gray		B		<LOD	45	65	3	<LOD	3	Wet			
	116	117										Black		B		<LOD	47	133	5	5	1	Wet			
	117	118									X	Dark Gray		B		<LOD	52	83	4	6	1	Damp			
	118	119									X	Gray		B		<LOD	48	85	4	<LOD	4	Damp			
	119	120									X	Gray		B		<LOD	50	95	4	<LOD	4	Dry			
	120	121									X	Gray		B		<LOD	48	100	4	4	1	Dry			
	121	122									X	Gray		B		<LOD	51	96	4	4	1	Dry			
	122	123									X	Gray		B		<LOD	53	136	5	<LOD	4	Dry			
	123	124										Gray		B								Dry			
	124	125									X	Gray		B								Damp			
	125	126										Dark Gray		B								Damp			
	126	127										Dark Gray		B								Dry			
	127	128										Gray		B								Dry			
	128	129										Gray		B								Dry			
	129	130										Gray		B								Dry			
	130	131										Gray		B								Dry			
	131	132										Gray		B								Dry			
	132	133												B											
	133	134										Gray		B								Dry			
	134	135										Gray		B								Dry			
SM68c	0	50	See borehole SM68a interval 0-25 ft and borehole SM68b interval 25-50 ft.																						
	50	51									X	Dark Brown		B		ND		116		4		Damp			
	51	53.5										Dark Reddish Brown		B		ND		254				Moist			
	53.5	55										Dark Gray		B		ND		136		5		Dry			
	55	57.5									X	Gray		B		ND		166		5		Dry			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs) Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein	Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm) Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Groundwater Observations Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well Insatallation Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
	57.5	60										Dark Gray		B		ND		106		ND		Dry			
	60	62.5										Dark Reddish Gray		B		ND		207		5		Dry			
	62.5	65										Gray		B		ND		98		ND		Dry			
	65	67.5										Gray		B		ND		78		ND		Dry			
	67.5	70										Gray		B		ND		85		ND		Dry			
	70	72.5										Gray		B		ND		92		5		Dry			
	72.5	75										Gray		B		ND		89		ND		Dry			
	75	77.5										Dark Gray		B		ND		75		ND		Dry			
	77.5	80									X	Gray		B		ND		69		ND		Dry			
	80	82.5									X	Gray		B		ND		81		6		Dry			
	82.5	85										Gray		B		ND		121		ND		Dry			
	85	87.5									X	Gray		B		ND		123		6		Dry			
	87.5	90									X	Gray		B		ND		101		5		Dry			
	90	92.5									X	Gray		B		ND		103		5		Dry			
	92.5	95									X	Gray		B		ND		74		6		Dry			
	95	97.5									X	Gray		B		ND		93		4		Dry			
	97.5	100									X	Gray		B		ND		253		10		Dry			
	100	102.5										Gray		B		ND		447		5		Dry			
	102.5	105						X	X		X	Gray		B		ND		4608		33		Dry			
	105	107.5						X	X		X	Gray		B		ND		359		7		Dry			
	107.5	110									X	Gray		B		ND		128		6		Dry			
	110	112.5										Dark Gray		B		ND		84		10		Dry			
	112.5	115										Gray		B		ND		221		5		Dry			
	115	117.5									X	Gray		B		ND		88		ND		Dry			
	117.5	120									X	Gray		B		ND		166		5		Dry			
SM68c	120	122										Gray		B		ND		79		ND		Dry			
	122	125									X	Gray		B		ND		71		5		Dry			
	125	127.5										Gray		B		ND		68		4		Dry			
	127.5	130									X	Gray		B		ND		84		4		Dry			
	130	132.5									X	Gray		B		ND		118		ND		Dry		MW40	119 - 139
	132.5	135									X	Gray		B		ND		94		6		Damp			
	135	136									X	Dark Gray		B		ND		71		ND		Wet	129.2		
	136	137									X	Dark Gray		B		ND		110		5		Wet			
	137	138									X	Dark Gray		B		ND		74		ND		Wet			
	138	139										Dark Gray		B		ND		79		4		Wet			
	139	140									X	Dark Gray		B		ND		81		4		Wet			
	140	141										Dark Gray		B		ND		75		ND		Wet			
	141	142										Dark Gray		B		ND		87		ND		Wet			
	142	143										Dark Gray		B		ND		95		ND		Wet			
	143	144										Dark Gray		B		ND		126		4		Wet			
	144	145										Black		B		ND		179		5		Wet			
	145	146										Black		B		ND		122		ND		Wet			
	146	147									X	Black		B		ND		99		ND		Wet			
	147	148										Dark Gray		B		ND		184		ND		Wet			
	148	149										Dark Gray		B		ND		112		5		Wet			
	149	150									X	Dark Gray		B		ND		83		4		Wet			
	150	151									X	Dark Gray		B		ND		81		ND		Wet			
	151	152									X	Dark Gray		B		ND		80		ND		Wet			
	152	153										Dark Gray		B		ND		79		ND		Wet			
	153	154										Dark Gray		B		ND		42		ND		Wet			
	154	155										Dark Gray		B		ND		58		ND		Wet			
SM70a	0	1						X			X			DN (KG, MZ)		50	13	334	6	10	1				

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
SM70a	1	2						X			X	Brown	GM	DN (KG, MZ)	15SM70SB02	<LOD	40	467	8	13	2	Moist			
	2	3						X						DN (KG, MZ)		<LOD	41	15	2	<LOD	3				
	3	4										Grayish Brown	ML	N (loess)		<LOD	35	14	2	<LOD	2	Damp			
	4	5												N (loess)		<LOD	36	35	2	<LOD	2				
	5	6										Yellowish Brown	SM	N		<LOD	38	7	2	<LOD	2	Dry			
	6	7												N (loess)		<LOD	59	<LOD	9	<LOD	5				
	7	8										Grayish Brown	ML	N (loess)		<LOD	36	8	2	<LOD	2	Damp			
	8	9												N (loess)		<LOD	36	7	2	<LOD	3				
	9	10										Grayish Brown	ML	N (loess)		<LOD	42	11	2	<LOD	3	Damp			
	10	11												N (loess)		<LOD	50	<LOD	7	<LOD	3				
	11	12										Gray	SM	N (loess)		<LOD	47	<LOD	7	<LOD	3	Moist			
	12	13												N (KG)		<LOD	36	21	2	3	1				
	13	14						X			X	Brown	GC	N (KG)		<LOD	38	155	4	4	1	Damp			
	14	15						X			X			WB		<LOD	55	313	8	<LOD	5				
	15	16						X			X	Grayish Brown		WB		<LOD	44	437	8	<LOD	4	Dry			
	16	17						X	X		X			WB		<LOD	40	1074	14	<LOD	5				
	17	18						X	X		X	Brown		WB		<LOD	42	234	5	4	1	Dry			
	18	20									X	Dark Gray		WB								Dry			
	20	22						X	X		X	Dark Gray		WB								Dry			
	22	24						X			X	Dark Grayish Brown		WB								Dry			
	24	26						X		X	X	Grayish Brown		WB								Dry			
	26	27						X				Brown		B		40		397		ND		Dry			
	27	28										Brown		B		48		427		ND		Dry			
	28	29						X				Brown		B		37		529		ND		Dry			
	29	30						X				Brown		B		44		1027		ND		Dry			
	30	31						X			X	Brown		B		ND		473		ND		Dry			
	31	32						X			X	Brown		B		ND		510		ND		Dry			
	32	33						X				Brown		B		<LOD	38	235	5	5	1	Damp			
	33	34						X				Grayish Brown		B		<LOD	36	186	4	4	1	Damp			
	34	35						X				Grayish Brown		B		<LOD	36	105	3	4	1	Dry			
	35	36						X				Reddish Brown		B		<LOD	37	199	4	<LOD	3	Damp			
	36	37						X				Brown		B		<LOD	39	126	4	5	1	Dry			
	37	38									X	Dark Gray		B		<LOD	38	151	4	5	1	Damp			
	38	39						X				Gray		B		51	14	636	10	<LOD	4	Damp			
	39	40						X				Dark Reddish Brown		B		108	15	967	14	<LOD	5	Damp			
	40	41						X				Dark Reddish Brown		B		41	12	444	7	6	1	Damp			
	41	42										Dark Brown		B		<LOD	38	247	5	5	1	Damp			
	42	43						X				Brown		B		41	13	314	6	4	1	Damp			
	43	44						X				Brown		B		<LOD	37	249	5	4	1	Damp			
	44	45						X				Brown		B		<LOD	38	299	6	5	1	Damp			
	45	46										Dark Gray		B		<LOD	37	168	4	5	1	Damp			
	46	47						X				Dark Gray		B		<LOD	38	197	5	5	1	Damp			
	47	48						X				Dark Grayish Brown		B		38	12	291	5	<LOD	3	Damp			
	48	49										Grayish Brown		B		41	12	222	5	5	1	Damp			
	49	50										Dark Grayish Brown		B		<LOD	37	225	5	5	1	Damp			
	50	51										Dark Grayish Brown		B		<LOD	37	206	5	5	1	Damp			
	51	52										Dark Grayish Brown		B		<LOD	38	123	4	4	1	Damp			
	52	53										Dark Grayish Brown		B		<LOD	39	145	4	4	1	Damp			
	53	54												B		<LOD	40	188	5	4	1				
	54	55										Grayish Brown		B		<LOD	36	164	4	4	1	Damp			
	55	56										Black		B		<LOD	42	82	3	<LOD	3	Damp			
	56	57										Black		B		<LOD	38	113	4	4	1	Damp			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
	57	58										Black		B		<LOD	39	129	4	3	1	Damp			
	58	59										Dark Gray		B		<LOD	37	113	3	4	1	Damp			
	59	60										Black		B		<LOD	38	145	4	4	1	Damp			
	60	61										Very Dark Gray		B		<LOD	42	118	4	<LOD	3	Damp			
	61	62										Black		B		<LOD	39	108	4	4	1	Damp			
	62	63										Very Dark Gray		B		<LOD	36	100	3	4	1	Damp			
	63	64										Black		B		<LOD	39	77	3	5	1	Damp			
	64	65										Dark Gray		B		<LOD	39	79	3	4	1	Damp			
	65	66										Gray		B		<LOD	38	109	3	5	1	Damp			
	66	67										Gray		B		<LOD	37	69	3	<LOD	3	Dry			
	67	68										Gray		B		<LOD	37	70	3	4	1	Damp			
	68	69										Dark Gray		B		<LOD	37	58	3	<LOD	3	Damp			
	69	70										Dark Gray		B		<LOD	39	45	2	4	1	Dry			
	70	71										Gray		B		<LOD	40	67	3	<LOD	3	Damp			
	71	72										Gray		B		<LOD	37	106	3	5	1	Damp			
	72	73										Black		B		65	13	91	3	7	1	Damp			
	73	74										Black		B		<LOD	39	99	3	4	1	Damp			
	74	75										Very Dark Gray		B		<LOD	38	72	3	5	1	Damp			
	75	76										Very Dark Gray		B		<LOD	39	110	4	4	1	Damp			
SM70a	76	77										Gray		B		<LOD	38	190	4	4	1	Damp			
	77	78										Gray		B		<LOD	38	108	3	3	1	Dry			
	78	79										Gray		B		<LOD	37	76	3	3	1	Dry			
	79	80										Gray		B		<LOD	38	73	3	3	1	Dry			
	80	81										Gray		B		<LOD	39	80	3	5	1	Dry			
	81	82										Gray		B		<LOD	38	181	4	3	1	Dry			
	82	83										Gray		B		63	13	372	6	4	1	Dry			
	83	84										Gray		B		<LOD	36	117	3	<LOD	3	Dry			
	84	85										Gray		B		82	13	385	7	4	1	Dry			
	85	86						X				Very Dark Gray		B		66	12	399	7	9	1	Damp			
	86	87						X						B		<LOD	38	475	8	8	1				
	87	88										Black		B		<LOD	39	419	7	14	2	Damp			
	88	89						X	X			Dark Gray		B		<LOD	40	2170	25	57	3	Dry			
	89	90						X	X	X	X	Dark Gray		B		51	14	3831	41	1531	19	Damp			
	90	91						X	X	X	X	Black		B		67	13	2351	24	300	6	Damp			
	91	92						X	X		X	Black		B		42	13	645	10	231	5	Damp			
	92	93						X	X		X	Black		B		70	13	279	6	33	2	Damp			
	93	94						X			X	Very Dark Gray		B		<LOD	43	162	5	12	2	Damp			
	94	95						X			X	Dark Gray		B		52	14	195	5	12	1	Damp			
	95	96						X				Black		B		<LOD	40	416	7	12	1	Damp			
	0	30	See borehole SM70a interval 0-30 ft.																						
	30	31						X				Brown		B		<LOD	41	350	7	4	1	Damp			
	31	32						X				Brown		B		<LOD	38	421	7	5	1	Damp			
	32	33										Black		B		<LOD	36	132	4	9	1	Damp			
	33	34										Very Dark Gray		B		<LOD	37	179	4	6	1	Damp			
	34	35						X				Very Dark Gray		B		<LOD	40	90	3	4	1	Damp			
SM70b	35	36										Very Dark Gray		B		<LOD	37	151	4	5	1	Damp			
	36	37						X				Very Dark Gray		B		<LOD	39	132	4	4	1	Damp			
	37	38										Very Dark Gray		B		<LOD	38	208	5	4	1	Damp			
	38	39										Dark Grayish Brown		B		<LOD	37	59	3	6	1	Damp			
	39	40										Dark Grayish Brown		B		<LOD	38	66	3	7	1	Damp			
	40	41										Dark Brown		B		<LOD	37	140	4	5	1	Damp			
	41	42										Dark Brown		B		<LOD	39	162	4	5	1	Damp			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
SM70b	42	43										Dark Grayish Brown		B		<LOD	35	76	3	4	1	Damp			
	43	44										Dark Grayish Brown		B		<LOD	38	69	3	5	1	Damp			
	44	45										Dark Grayish Brown		B		<LOD	37	138	4	5	1	Damp			
	45	46										Grayish Brown		B		<LOD	39	72	3	<LOD	3	Damp			
	46	47										Dark Grayish Brown		B		<LOD	37	80	3	5	1	Damp			
	47	48										Dark Grayish Brown		B		<LOD	38	71	3	5	1	Damp			
	48	49										Dark Grayish Brown		B		<LOD	35	102	3	3	1	Damp			
	49	50										Dark Grayish Brown		B		<LOD	36	297	5	4	1	Damp			
	50	51										Dark Grayish Brown		B		<LOD	38	149	4	8	1	Damp			
	51	52										Dark Grayish Brown		B		<LOD	36	72	3	5	1	Moist			
	52	53										Black		B		<LOD	38	81	3	5	1	Damp			
	53	54										Black		B		<LOD	37	81	3	4	1	Damp			
	54	55										Black		B		<LOD	41	92	3	5	1	Damp			
	55	56										Dark Grayish Brown		B		<LOD	40	84	3	4	1	Damp			
	56	57									X	Very Dark Gray		B		<LOD	36	139	4	6	1	Damp			
	57	58										Gray		B		<LOD	39	121	4	6	1	Damp			
	58	59										Grayish Brown		B		<LOD	41	414	7	4	1	Damp			
	59	60										Gray		B		<LOD	41	266	6	<LOD	4	Dry			
	60	61									X	Light Brownish Gray		B		<LOD	42	120	4	4	1	Dry			
	61	62										Gray		B		<LOD	41	128	4	5	1	Dry			
	62	63										Grayish Brown		B		<LOD	39	123	4	5	1	Damp			
	63	64										Gray		B		<LOD	39	43	3	5	1	Dry			
	64	65										Gray		B		<LOD	42	39	2	6	1	Dry			
	65	66					X					Gray		B		<LOD	40	95	3	<LOD	3	Dry			
	66	67										Dark Gray		B		<LOD	37	93	3	5	1	Damp			
	67	68										Black		B		<LOD	45	68	3	4	1	Damp			
	68	69										Black		B		<LOD	38	76	3	4	1	Damp			
	69	70										Black		B		<LOD	40	77	3	5	1	Dry			
	70	71										Black		B		<LOD	42	112	4	4	1	Moist			
	71	72										Black		B		<LOD	39	77	3	5	1	Moist			
	72	73										Black		B		<LOD	38	91	3	<LOD	3	Moist			
	73	74										Black		B		<LOD	40	74	3	3	1	Damp			
	74	75										Black		B		<LOD	41	98	4	5	1	Moist			
	75	76										Black		B		<LOD	41	247	6	4	1	Moist			
	76	77										Black		B		<LOD	43	82	4	<LOD	3	Moist			
	77	78										Black		B		<LOD	40	96	3	4	1	Moist			
	78	79										Black		B		<LOD	39	109	4	5	1	Damp			
	79	80									X	Dark Gray		B		<LOD	39	153	4	<LOD	3	Damp			
	80	81									X	Dark Gray		B		<LOD	48	117	4	5	1	Wet			
	81	82										Black		B		<LOD	44	85	4	<LOD	3	Saturated			
	82	83									X	Black		B		<LOD	47	102	4	5	1	Saturated			
	83	84									X	Black		B		<LOD	45	87	4	6	1	Saturated			
	84	85										Gray		B		<LOD	50	131	5	<LOD	4	Damp			
	85	86									X	Gray		B		<LOD	49	134	5	6	1	Damp			
	86	87									X	Gray		B		<LOD	52	160	5	<LOD	4	Damp			
	87	88									X	Light Gray		B		<LOD	48	167	5	<LOD	4	Dry			
	88	89									X	Light Gray		B		<LOD	48	96	4	<LOD	4	Dry			
	89	90										Light Gray		B		<LOD	47	105	4	5	1	Dry			
	90	91										Yellowish Brown		B		<LOD	47	163	5	6	1	Dry			
	91	92					X				X			B		<LOD	50	64	3	<LOD	3				
	92	93									X	Gray		B		<LOD	46	75	4	7	1	Damp			
	93	94									X	Gray		B		<LOD	50	225	6	6	2	Dry			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
SM70b	94	95									X	Gray		B		<LOD	46	317	7	6	2	Dry			
	95	96									X	Gray		B		<LOD	52	179	6	<LOD	4	Dry			
	96	97									X	Grayish Brown		B		<LOD	55	139	5	<LOD	4	Dry			
	97	98									X	Dark Reddish Brown		B		<LOD	49	105	4	5	1	Damp			
	98	99									X	Dark Grayish Brown		B		<LOD	44	112	4	<LOD	4	Moist			
	99	100									X	Dark Brown		B		<LOD	49	96	4	<LOD	4	Wet			
	100	101									X	Dark Gray		B		<LOD	47	111	4	<LOD	4	Wet			
	101	102									X	Dark Gray		B		<LOD	50	109	4	<LOD	4	Wet			
	102	103									X	Dark Gray		B		<LOD	47	115	4	6	1	Wet			
	103	104									X	Dark Gray		B		<LOD	49	113	4	5	1	Wet			
	104	105									X	Dark Gray		B		<LOD	50	56	3	<LOD	3	Wet			
	105	106										Black		B		<LOD	51	122	5	6	1	Wet			
	106	107									X	Dark Brownish Gray		B		<LOD	49	110	4	<LOD	4	Wet			
	107	108									X	Dark Brownish Gray		B		<LOD	48	151	5	5	1	Wet			
	108	109									X	Dark Gray		B		<LOD	47	139	5	<LOD	4	Wet			
	109	110									X	Black		B		<LOD	47	98	4	<LOD	4	Wet			
	110	111									X	Dark Gray		B		<LOD	46	124	4	<LOD	4	Moist			
	111	112									X	Dark Gray		B		<LOD	50	90	4	<LOD	4	Wet			
	112	113									X	Dark Gray		B		<LOD	48	112	4	<LOD	3	Wet			
	113	114										Gray		B		<LOD	47	96	4	<LOD	4	Wet			
	114	115										Dark Gray		B		<LOD	47	94	4	<LOD	3	Wet			
	115	116									X	Dark Gray		B		<LOD	47	78	4	<LOD	4	Wet			
	116	117									X	Gray		B		<LOD	46	90	4	5	1	Wet			
	117	118										Black		B		<LOD	50	115	5	<LOD	4	Wet			
	118	119									X	Black		B		<LOD	47	331	7	5	1	Wet			
	119	120									X	Dark Gray		B		<LOD	45	346	7	<LOD	4	Wet		MW42	119 - 139
	120	121									X	Dark Gray		B		<LOD	43	480	9	4	1	Wet			
	121	122									X	Dark Gray		B		<LOD	49	302	7	6	2	Wet			
	122	123									X	Dark Gray		B		84	16	1312	19	8	2	Wet			
	123	124									X	Dark Gray		B		<LOD	43	918	13	9	2	Wet			
	124	125					X				X	Dark Gray		B		<LOD	47	783	13	10	2	Wet			
	125	126									X	Dark Gray		B		<LOD	48	718	12	8	2	Wet			
	126	127									X	Dark Gray		B		<LOD	46	475	9	5	1	Wet	126.5		
	127	128							X		X	Dark Gray		B		<LOD	45	1713	22	8	2	Wet			
	128	129							X		X	Dark Gray		B		<LOD	47	828	13	11	2	Wet			
	129	130									X	Dark Gray		B		<LOD	46	1981	26	10	2	Wet			
	130	131									X	Dark Gray		B		<LOD	48	2223	30	12	3	Wet			
	131	132									X			B		<LOD	48	793	13	12	2				
	132	133										Black		B		<LOD	47	727	12	39	3	Wet			
	133	134									X	Dark Gray		B		<LOD	62	3133	51	<LOD	11	Wet			
	134	135										Dark Gray		B		<LOD	52	3458	48	16	3	Wet			
	135	136									X	Dark Gray		B		<LOD	48	475	9	11	2	Wet			
	136	137									X	Black		B		<LOD	47	370	8	7	2	Wet			
	137	138									X	Dark Gray		B		<LOD	46	371	8	8	2	Wet			
	138	139									X	Dark Gray		B		<LOD	45	555	10	9	2	Wet			
	139	140									X	Dark Gray		B								Wet			
SM71a	0	1						X						DN (KG and Loess)		<LOD	38	197	4	5	1				
	1	2						X				Brown	GM	DN (KG and Loess)		<LOD	41	253	6	6	1	Moist			
	2	3												DN (KG and Loess)		<LOD	44	208	5	7	1				
	3	4										Brown	GM	DN (KG and Loess)		<LOD	39	11	2	<LOD	3	Moist			
	4	5												DN (loess)		<LOD	35	11	2	<LOD	2				
	5	6										Grayish Brown	SP-SM	DN (loess)		<LOD	34	11	2	<LOD	2	Moist			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
SM71a	6	7						X						DN (KG and Loess)		<LOD	36	23	2	<LOD	2				
	7	8						X				Brown	GM	DN (KG and Loess)		<LOD	44	62	3	<LOD	3	Moist			
	8	9												DN (KG and Loess)		<LOD	36	49	2	<LOD	3				
	9	10										Grayish Brown	GM	DN (KG and Loess)		<LOD	40	153	4	<LOD	3	Moist			
	11	12						X				Grayish Brown	GP	DN (KG and Loess)	15SM71SB12	93	13	164	4	5	1	Damp			
	12	13												WB		<LOD	36	92	3	10	1				
	13	14										Grayish Brown	GP	WB		<LOD	65	123	7	<LOD	5	Dry			
	14	15						X						WB		<LOD	39	114	3	8	1				
	15	16						X				Dark Grayish Brown		WB		<LOD	45	130	5	6	1	Damp			
	16	17						X						WB		<LOD	49	109	4	5	1				
	17	18						X				Dark Grayish Brown		WB		<LOD	38	95	3	4	1	Dry			
	18	19						X						WB		<LOD	38	137	4	4	1				
	19	20						X				Grayish Brown		WB		<LOD	37	93	3	5	1	Damp			
	20	21												WB		<LOD	37	159	4	7	1				
	21	22						X				Dark Grayish Brown		WB		<LOD	41	236	6	8	1	Dry			
	22	23						X						WB		<LOD	42	112	4	4	1				
	23	24						X				Dark Grayish Brown		WB		<LOD	37	76	3	4	1	Dry			
	24	25						X				Brown		B		<LOD	37	81	3	5	1	Damp			
	25	26						X				Brown		B		<LOD	37	104	3	5	1	Damp			
	26	27						X				Brown		B		<LOD	39	123	4	5	1	Damp			
	27	28						X				Dark Grayish Brown		B		42	13	121	4	5	1	Damp			
	28	29										Dark Grayish Brown		B		<LOD	36	118	3	4	1	Damp			
	29	30										Brown		B		<LOD	36	149	4	5	1	Damp			
	30	31						X				Grayish Brown		B		<LOD	37	212	5	5	1	Damp			
	31	32						X				Brown		B		<LOD	38	189	4	5	1	Damp			
	32	33						X				Dark Grayish Brown		B		<LOD	37	247	5	6	1	Damp			
	33	34						X				Dark Grayish Brown		B		<LOD	39	217	5	4	1	Damp			
	34	35						X				Brown		B		<LOD	38	183	4	3	1	Damp			
	35	36										Grayish Brown		B		<LOD	37	142	4	4	1	Damp			
	36	37										Dark Brown		B		<LOD	35	86	3	5	1	Damp			
	37	38										Very Dark Grayish Brown		B		<LOD	38	117	4	4	1	Damp			
	38	39										Dark Brown		B		<LOD	38	145	4	5	1	Damp			
	39	40						X				Dark Grayish Brown		B		<LOD	40	400	7	<LOD	4	Damp			
	40	41						X				Dark Brown		B		<LOD	35	306	5	4	1	Damp			
	41	42						X				Dark Grayish Brown		B		<LOD	36	170	4	4	1	Damp			
	42	43						X				Dark Grayish Brown		B		<LOD	36	144	4	4	1	Damp			
	43	44										Dark Grayish Brown		B		<LOD	36	99	3	6	1	Damp			
	44	45						X				Very Dark Gray		B		<LOD	37	117	3	5	1	Damp			
	45	46										Dark Grayish Brown		B		<LOD	37	125	4	3	1	Damp			
	46	47										Dark Gray		B		<LOD	37	154	4	3	1	Damp			
	47	48										Dark Grayish Brown		B		<LOD	36	115	3	4	1	Damp			
	48	49										Dark Grayish Brown		B		<LOD	36	135	4	4	1	Damp			
	49	50										Dark Grayish Brown		B		<LOD	38	114	4	7	1	Damp			
	50	51										Very Dark Gray		B		<LOD	36	109	3	5	1	Damp			
	51	52										Very Dark Gray		B		<LOD	36	88	3	5	1	Damp			
	52	53										Black		B		<LOD	38	88	3	5	1	Damp			
	53	54										Very Dark Gray		B		<LOD	35	97	3	5	1	Damp			
	54	55										Black		B		<LOD	36	82	3	5	1	Damp			
	55	56										Black		B		<LOD	36	101	3	6	1	Damp			
	56	57										Dark Grayish Brown		B		<LOD	36	48	2	6	1	Damp			
	57	58										Dark Gray		B		<LOD	35	46	2	4	1	Damp			
	58	59										Very Dark Gray		B		<LOD	38	94	3	6	1	Damp			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
	59	60						X				Dark Grayish Brown		B		<LOD	37	72	3	5	1	Damp			
	60	61									X	Dark Gray		B		<LOD	37	62	3	3	1	Damp			
	61	62									X	Dark Gray		B		<LOD	36	52	2	5	1	Damp			
	62	63					X					Very Dark Gray		B		<LOD	36	92	3	7	1	Damp			
	63	64										Black		B		<LOD	38	90	3	4	1	Damp			
	64	65										Black		B		<LOD	40	96	3	<LOD	3	Moist			
	65	66										Black		B		<LOD	39	104	3	5	1	Moist			
	66	67										Dark Gray		B		<LOD	36	117	3	3	1	Damp			
	67	68										Very Dark Gray		B		<LOD	38	71	3	3	1	Damp			
	68	69										Very Dark Gray		B		<LOD	37	82	3	3	1	Damp			
	69	70										Very Dark Gray		B		<LOD	37	63	3	5	1	Damp			
	70	71										Very Dark Gray		B		<LOD	37	53	2	<LOD	3	Damp			
	71	72									X	Dark Gray		B		<LOD	39	54	3	3	1	Damp			
	72	73									X	Dark Gray		B		<LOD	37	69	3	<LOD	3	Damp			
	73	74									X	Dark Gray		B		<LOD	37	68	3	<LOD	3	Damp			
	74	75									X	Black		B		<LOD	38	113	4	6	1	Damp			
	75	76									X	Black		B		<LOD	38	99	3	8	1	Damp			
	76	77									X	Black		B		<LOD	38	133	4	8	1	Damp			
SM71a	77	78										Black		B		<LOD	39	129	4	6	1	Damp			
	78	79										Black		B		<LOD	40	94	3	9	1	Damp			
	79	80									X	Very Dark Gray		B		<LOD	38	51	2	<LOD	3	Damp			
	80	81										Very Dark Gray		B		<LOD	38	59	3	5	1	Damp			
	81	82										Very Dark Gray		B		<LOD	39	59	3	<LOD	3	Damp			
	82	83									X	Very Dark Gray		B		<LOD	37	52	2	3	1	Damp			
	83	84										Very Dark Gray		B		<LOD	37	74	3	5	1	Damp			
	84	85										Very Dark Gray		B		<LOD	38	78	3	4	1	Damp			
	85	86										Black		B		<LOD	38	80	3	5	1	Damp			
	86	87										Black		B		<LOD	40	84	3	5	1	Damp			
	87	88										Very Dark Gray		B		<LOD	44	62	3	5	1	Damp			
	88	89										Very Dark Gray		B		<LOD	36	113	3	3	1	Damp			
	89	90											NR	B											
	90	91										Very Dark Gray		B								Moist			
	91	92										Very Dark Gray		B		<LOD	37	87	3	4	1	Moist	87.5		
	92	93										Very Dark Gray		B		<LOD	42	106	4	5	1	Moist			
	93	94										Very Dark Gray		B		<LOD	54	100	5	6	2	Moist			
	94	95									X	Very Dark Gray		B		<LOD	39	129	4	5	1	Wet			
	95	96						X			X	Black		B		<LOD	39	180	4	4	1	Wet			

Table 2-2 Field Soil Characterization Summary

Soil Boring ID	Sample Depth Interval (feet bgs)		Mineralogical/Lithological Observations									Soil Color	USCS Symbol	Soil Type (based on Final RI report)	Laboratory Sample ID	XRF Field Screening Results (ppm)						Groundwater Observations		Monitoring Well Insatallation	
	Top	Bottom	Red Porous Rock	Vitreous "Slag"	Red Rind	Elemental Hg	Stibnite	Realgar	Orpiment	Cinnabar	White Vein					Total Antimony	XRF Error Antimony	Total Arsenic	XRF Error Arsenic	Total Mercury	XRF Error Mercury	Moisture observed in Soil Sample or Rock Cuttings	Static Water Level in Completed Well, September 10, 2015 (estimated, feet bgs)	Monitoring Well ID	Monitoring Well Screened Interval (feet bgs)
SM71a	96	97									X	Very Dark Gray		B		<LOD	39	107	3	8	1	Wet	87.5		
	97	98										Very Dark Gray		B		<LOD	32	69	3	<LOD	2	Wet			
	98	99										Black		B		<LOD	35	139	4	7	1	Wet			
SM71b	0	100	See borehole SM71a interval 0-100 ft.																						
	100	101										Black		B		<LOD	46	86	4	<LOD	4	Wet	87.5	MW43	98 - 118
	102	103										Dark Gray		B		<LOD	62	55	4	<LOD	5	Wet			
	103	104										Dark Gray		B		<LOD	45	125	4	4	1	Wet			
	104	105										Dark Gray		B		<LOD	47	182	5	<LOD	4	Wet			
	105	106									X	Dark Gray		B		<LOD	49	185	6	5	1	Wet			
	106	107									X	Dark Gray		B		<LOD	50	225	6	<LOD	4	Wet			
	107	108									X	Dark Gray		B		<LOD	48	248	7	<LOD	4	Wet			
	108	109									X	Dark Gray		B		<LOD	49	475	9	<LOD	5	Wet			
	109	110									X	Dark Gray		B		<LOD	49	1285	19	7	2	Wet			
	110	111									X	Dark Gray and White		B		<LOD	47	803	13	6	2	Wet			
	111	112									X	Dark Gray		B		<LOD	48	4026	51	<LOD	10	Wet			
	112	113									X	Dark Gray		B		<LOD	48	2880	36	11	3	Wet			
	113	114										Black		B		61	16	1150	18	7	2	Moist			
	114	115					X				X	Dark Gray		B		51	16	3397	44	<LOD	9	Wet			
	115	116					X				X	Gray		B		<LOD	52	6954	94	<LOD	13	Wet			
	116	117									X	Gray		B		<LOD	47	916	14	7	2	Wet			
	117	118										Dark Gray		B		<LOD	42	431	8	6	1	Wet			
	118	119										Dark Gray		B		<LOD	48	478	10	<LOD	5	Wet			
	119	120					X					Black		B		<LOD	47	363	8	5	1	Wet			
	120	121										Black		B		<LOD	49	212	6	6	1	Wet			

Key
<LOD = Less than level of detection
bgs = Below ground surface
ND = Not detected
NR = Not reported
ppm = Parts per million
XRF = X-ray fluoresence spectroscopy

RI Soil Type Descriptions
B = Bedrock of the Kuskokwim Group.
DN (KG and Loess) = Disturbed native soil that comprises a mixture of soil derived from Kuskokwim group bedrock and glacially-derived windblown silt and very fine sand.
DN (KG) = Disturbed native soil that is derived from Kuskokwim Group bedrock and contains clasts of the same.
DN (KG, MZ) = Disturbed native soil that is derived from mineralized Kuskokwim group bedrock.
DN (loess) = Glacially derived windblown silt and very fine sand that has been disturbed by anthropogenic activity.
DN = Native unconsolidated soil that do not appear to have been disturbed by anthropogenic activity.
N (KG) = Native soil that is derived from Kuskokwim group bedrock and contains clasts of the same.
N (KG, MZ) = Native soil that is derived from mineralized Kuskokwim group bedrock and contains clasts of the same.
N (loess) = Glacially-derived windblown silt and very fine sand that is undisturbed by anthropogenic activity.
N = Native unconsolidated soils not otherwise specified that are undisturbed by anthropogenic activity.
N or DN (KG, MZ) = Native soil that may or may not have been disturbed that is derived from mineralized Kuskokwim Group bedrock.
N or DN = Native soil not otherwise specified that may or may not have been disturbed.
T/WR = Mine waste that includes tailings (thermally processed or) and/or waste rock. May also contain vitreous material and furnace dusts.
WB = Weathered bedrock of the Kuskokwim Group.
WR = Waste rock.

Table 2-3 Subsurface Soil Sample Laboratory Results

Soil Boring ID	Sample Depth Interval (feet bgs)		Sample ID	Total Inorganic Elements (mg/kg)																							Mercury Selective Sequential Extraction (ng/g)						Total Mercury (ng/g)
	Top	Bottom		Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	F0	F1	F2	F3	F4	F5	Total Mercury
				SW846 6010B	SW846 6020A	SW846 6020A	SW846 6020A	SW846 6020A	SW846 6020A	SW846 6010B	SW846 6020A	SW846 6020A	SW846 6020A	SW846 6010B	SW846 6020A	SW846 6010B	SW846 6020A	SW846 7471A	SW846 6020A	SW846 6010B	SW846 6020A	SW846 6020A	SW846 6010B	SW846 6020A	SW846 6020A	SW846 6020A	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	EPA 1631 Appendix
MP094	10	11	15MP094SB11	6900	9600	2900	220	0.53	0.25	3900	33	12	49	27000	9.4	4500	360	89	45	870	1.4	0.14	6460 J	6460 J	32	95	8 U	611	7.39	32900	9270	36500	106000
	12	13	15MP094SB13	6800	3300	860	130	0.39	0.45	2100	25	11	33	20000	7.9	3300	260	37	34	520	2.2	0.11	63 J	0.096 J	32	75							
	16	17	15MP094SB17	6500	2300	1100 J+	190 J+	0.49	0.33	1900 J+	21 J+	14	43	25000	9	3400	380	120	44 J+	730 J+	1.4	0.11	72 J	0.14 J	30 J+	92	24.4	1780 J	3.07	294	10900 J	24100	45000
	18	19	15MP094SB19	7000	1500	700	150	0.47	0.33	1900	24	14	43	31000	9.1	3100	450	76	45	570	1.7	0.12	68	0.11 J	36	100	20.1	374	0.86	437	5820	9700	25500
	19	20	15MP094SB20	7300	410 J	37	110	0.55	0.66	1600	22	13	47	26000	12	2300	330	1.8	44	570	3.2	0.1	40 J	0.081 J	40	100							
MP095	3	4	15MP095SB04	6400	180	83	71	0.39	0.13	1200	21	9.3	17	23000	5.5	2500	180	2.5	32	390	1.1	0.049 J	42 U	0.075 U	31	70	8.07 U	46.4	0.46	1090	58.4	59.8	1280
	4	5	15MP095SB05	7200	630	370	120	0.43	0.16	1400	23	10	27	25000	8.1	2600	230	42	35	540	1.3	0.083 J	53 J	0.082 J	32	140	7.11 U	7.52	0.2 U	280	72.5	58.1	462
	9	10	15MP095SB10	6500	1200	590	150	0.55	0.31	3600	22	14	40	42000	9.9	2900	1800	45	41	660	1.5	0.086	90	0.099 J	31	120	36.7	829	0.41	479	6080	6870	22200
	10	11	15MP095SB11	7700	380	180	130	0.54	0.42	2700	29	13	45	34000	11	3000	850	18	43	640	1.7	0.097 J	59 J	0.085 J	37	120							
	12	13	15MP095SB13	9500	140 J	80 J	160	0.58	0.41	2000	26	13	49	19000	13	3200	530	29 J	45	590	1.7	0.14	61 J	0.11 J	39	110							
MP096	5	6	15MP096SB06	7100	13000	6800	550	0.69	0.34	4800	30	15	64	28000	11	4800	680	2100	44	2000	2	0.21	190	0.54	28	83	850	45800	6910	41500	63000	1310000	1730000
	12	13	15MP096SB13	9800	650	410	170	0.4	0.26	1200	24	8.2	25	15000	8.6	2900	290	77	25	510	1.7	0.088 J	77 J	0.12 J	39	66	44.1	819	11.8	1420	12000	29500	17100
	16	17	15MP096SB17	8000	1800	1200	190	0.41	0.16	2000	24	7.3	36	23000	12	3500	310	320	25	950	1.4	0.12	96	0.16 J	32	61	86.9	4170	2000	1740	12200	37300	326000
	18	19	15MP096SB19	5800	250	740	100	0.46	0.37	1900	19	17	39	19000	10	2600	670	4.2	32	570	1.4	0.1 J	41 U	0.073 U	29	84							
	25	26	15MP096SB26	7100	60 J	71 J	120	0.43	0.26	1800	24	13	31	23000	8	2800	310	19 J	36	510	1.6	0.093 J	78 J	0.072 U	38	84							
MP097	1	2	15MP097SB02	7400	4300	1700	270	0.56	0.3	2100	24	13	45	24000	11	3200	410	390	40	960	1.8	0.14	100	0.19	32	89	375	12000	113	2410	44500	474000	568000
	5	6	15MP097SB06	8400	710	770	150	0.52	0.39	1900	28	17	42	26000	11	3200	380	76	51	670	2	0.13	66 J	0.13 J	37	120	36	1390	5.05	1420	19000	52000	90100
	8	9	15MP097SB09	7800	1800	1100	180	0.51	0.37	2200	25	14	38	26000	9.3	3800	390	92	45	780	1.8	0.11	83 J	0.14 J	32	110							
	10	11	15MP097SB11	6700	650 J+	800 J+	160 J+	0.44 J+	0.36 J+	1800	24 J+	14 J+	36 J+	20000	9.9 J+	2900	330	110	40 J+	700 J+	1.5 J+	0.12 J+	87	0.13 J+	33 J+	93 J+	12.6	1510	1.52	638	11900	31200	45300
	12	13	15MP097SB13	9000	160	330	140	0.51	0.44	1500	26	18	41	23000	12	3200	390	22	51	630	1.7	0.13	61 J	0.11 J	39	110							
MP098	19	20	15MP098SB20	5400 J	220	1200	140	0.63	0.55	8000	23	17	57	32000	15	6200	1000	250	59	870	1.6	0.2	94	0.15 J	32	120	26.2	433	1.67	727	9410	40900	147000
	25	26	15MP098SB26	2400	120	590	100	0.62	0.29	1000	19	9.8	56	23000	11	1600	270	8900	42	740	1.3	0.26	61 J	0.27	23	90	16.2	159	4420	7040	8790	1200000	740000
	32	33	15MP098SB33	3400	200	630	130	0.72	0.61	1200	40	19	65	31000	14	1600	720	470	63	770	1.7	0.19	48 J	0.43	35	130							
	35	36	15MP098SB36	2100	480	4900	110	0.87	0.7	3700	44	26	74	40000	18	4800	490	200	110	700	4.4	0.16	39 U	0.85	35	110							
	37	38	15MP098SB38	2300	1600	4600	300	0.66	0.79	1500	83	28	61	63000	16	1500	700	470	110	410	4.7	0.21	40 U	0.21 J	37	120	102	5200	15.2	4300	32400	364000	243000
MP099	10	11	15MP099SB11	7500	10000	4000	430	0.68	0.44	5700	30	17	65	28000	14	5100	710	540	54	2000	1.6	0.23	190	0.37	30	98	143	4590	22.9	1330	22900	428000	656000
	11	12	15MP099SB12	5700 J	110	280	120	0.62	0.75	1900	23	14	45	38000	10	2000	410	35	48	500	1.2	0.14	63 J	0.093 J	35	120							
	12	13	15MP099SB13	6600	3400	3200	300	0.58	0.43	3300	22	16	52	28000	13	4000	500	640	40	1500	1.4	0.18	160	0.27	28	89	217	13900	34.2	4060	31200	565000	517000
	16	17	15MP099SB17	8900	380	590	140	0.57	0.29	1700	25	13	35	15000	9.6	2700	290	130	32	720	1.1	0.12	89 J	0.12 J	39	68							
	18	19	15MP099SB19	1400	25 J	200	120	0.52	1.2	890	14	14	53	37000	9.1	240	1900 J	16	46	540	1.2	0.12	39 U	0.11 J	21	150	50	1160	25.2	1310	7400	22500	23000
MP100	8	9	15MP100SB09	1300	430	2100	100	0.65	0.67	3600	11	23	63	33000	13	7600	880	160	66	720	1.5	0.24	35 U	0.087 J	20	130	16.8	347	0.19 U	1010	14000	5680000	260000
	10	11	15MP100SB11	7100	730	140	81	0.39	0.17	1300	21	6.8	22	14000	6.6	2300	130	6.3	25	370	0.85	0.074 J	49 J	0.071 J	37	59	7.52 U	212	0.96	11200	1590	67400	290000
	16	17	15MP100SB17	9900	63	110	86	0.32	0.16	1700	21	7.1	19	19000	6	4100	250	8.9	24	490	0.8	0.053 J	81	0.076 J	31	61							
	18	19	15MP100SB19	8000	220 J+	110 J+	87 J+	0.32 J+	0.21 J+	1700 J+	30 J+	8.1 J+	21 J+	22000	6.2 J+	3000	250	28	26 J+	550 J+	1.1 J+	0.061 J+	97 J	0.083 J+	37 J+	56 J+	7.9 U	294	1.03	418	3220 J	9960 J	17900
	20	21	15MP100SB21	7600	63	96	94	0.3	0.19	1700	19	8.5	16	10000	5.7	2500	130	13	21	410	0.86	0.079 J	96	0.088 J	30	49							
MP101	10	11	15MP101SB11	6100	2500	1700	220	0.59	0.5	1900	25	21	54	30000	13	2600	500	520	69	760	1.9	0.18	57 J	0.2	33	100	879	11800	48000	8800	163000	1440000	616000
	12	13	15MP101SB13	3500	870	840	140	0.66	0.35	2100	20	15	72	33000	14	2200	450	220	61	840	4.4	0.29	62 J	0.13 J	31	100	237	6310	1640	1010	31100	86300	148000
	13	14	15MP101SB14	1000	200	300	53	0.48	0.54	2000	17	18	43	39000	11	4000	770	21	63	470	4.7	0.21	39 U	0.065 U	32	110							
RD21	4	5	15RD21SB05	4900 J	740	1300	180	0.6	0.52	1700	23	18	70	36000	12	5200	1000	200	59	1100	1.8	0.22	90	0.17 J	30	110	21.3	777	168	1010	10200	91100	106000
RD22	0	1	15RD22SB01	9100	210	270	120	0.47	0.25	1400	24	12	32	24000	8.6	2900	370	20	34	520	1.1	0.098 J	64 J	0.11 J	40	76							
	8	9	15RD22SB09	6800	9.9	24 J+	74 J+	0.38	0.13	1700 J+	20 J+	9.4 J+	26 J+	16000	8.2 J+	2600 J+	170 J+	3.5	29 J+	470 J+	1	0.12 J+	59 J	0.065 U	30 J+	68 J+	7.66 U	17.6 J	0.21 U	381 J	54.6	138 J	3480
SM68	10	11	15SM68SB11	2100	9.1	260	190	0.87	0.95	1000	17	26	84	64000	18	310	1800	11	68	780	1.7	0.3	39 U	0.18 J	31	160							
SM70	1	2	15SM70SB02	2200	35	850	110	1	0.62	1600	13	20	75	38000	15	490	880	29	69	800	1.6	0.19	39 U	0.12 J	25	130							
SM71	11	12	15SM71SB12	1500	120	510	130	0.93	1.2	650	25	23	68	49000	14	180	1800	18	76	500	1.4	0.17	37 U	0.15 J	43	140							

Key:

Bold = Detected

Hg = Mercury

J = The analyte was detected. The associated result is estimated.

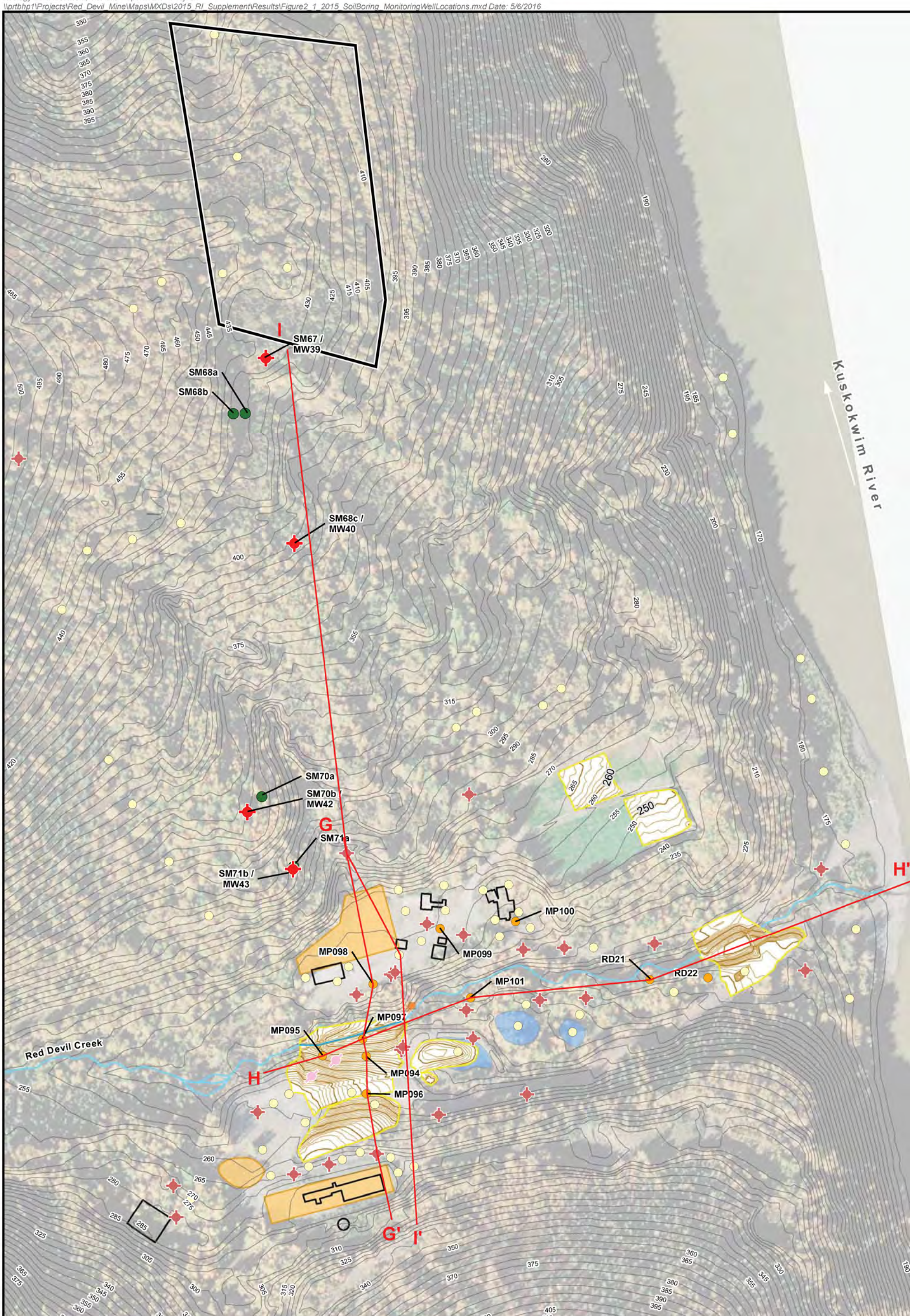
J+ = The analyte was detected. The associated result is estimated with a high bias.

mg/kg = Milligrams per kilogram

ng/g = Nanograms per gram

SSE = Selective Sequential Extraction

U = The analyte was analyzed for but not detected. The value provided is the method detection limit.



2015 Soil Boring
Soil Boring/Monitoring Well Location – Abandoned
2015 Soil Boring / Monitoring Well
Existing RI Monitoring Well Location
Decommissioned Well
Existing RI Soil Boring Location
2014 5-foot Contour
2014 1-foot Contour
Area of 2014 NTCRA Re-grading
2010 5-foot Contour
Post-NTCRA Stream Alignment
Red Devil Creek
Line of Geologic Cross Section
Settling Pond
Monofill
Historical Structure
Approximate Location of Proposed Repository Footprint
Seep Location

Digital 2010 5-foot topographic contours based on the aerial orthophotograph taken on September 21, 2010 (AeroMetric 2012)

Digital 2014 5-foot and 1-foot topographic contours based on Marsh Creek (2014)

RED DEVIL MINE

Red Devil, Alaska

Figure 2-1
2015 Soil Boring and Monitoring Well Locations

0 37.5 75 150 225 300
Feet
0 10 20 40 60 80 100
Meters
Scale 1:2,500

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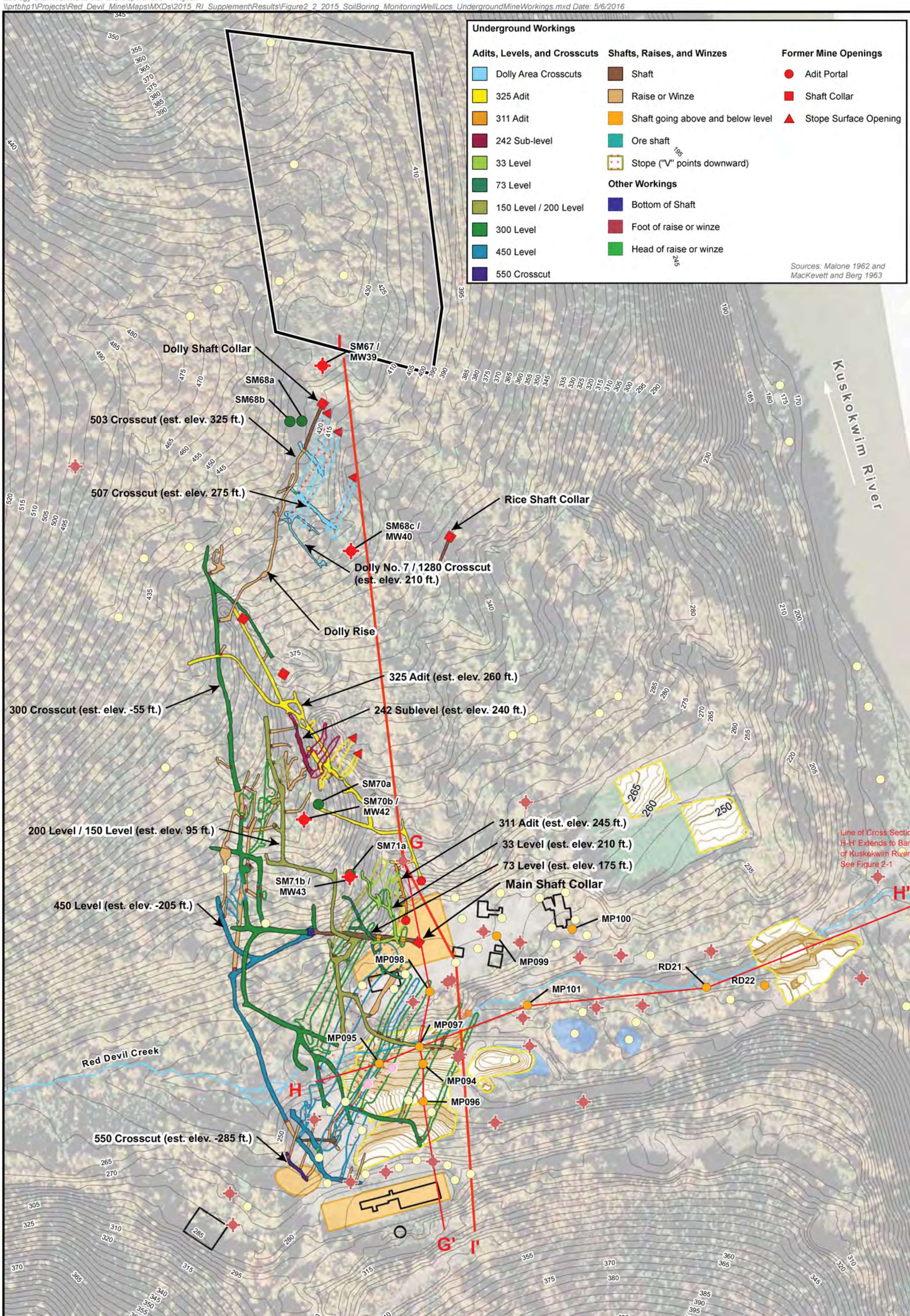
Ecology & Environment, Inc. GIS Department Project: \\prtbhp1\Projects\Red_Devil_Mine\Maps\MXDs\2015_RI_Supplement\Results\Figure2_2_2015_SoilBoring_MonitoringWellLocs_UndergroundMineWorkings.mxd Date: 5/6/2016



2015 Soil Boring	2014 5-foot Contour	Settling Pond
Soil Boring/Monitoring Well Location – Abandoned	2014 1-foot Contour	Monofill
2015 Soil Boring / Monitoring Well	Area of 2014 NTCRA Re-grading	Historical Structure
Existing RI Monitoring Well Location	2010 5-foot Contour	Approximate Location of Proposed Repository Footprint
Decommissioned Well	Post-NTCRA Stream Alignment	Seep Location
Existing RI Soil Boring Location	Red Devil Creek	
	Line of Geologic Cross Section	

Digital 2010 5-foot topographic contours based on the aerial orthophotograph taken on September 21, 2010 (AeroMetric 2012)

Digital 2014 5-foot and 1-foot topographic contours based on Marsh Creek (2014)

RED DEVIL MINE

Red Devil, Alaska

Figure 2-2
2015 Soil Boring and Monitoring Well Locations and Underground Mine Workings

0 37.5 75 150 225 300
Feet
0 10 20 40 60 80 100
Meters
Scale 1:2,500

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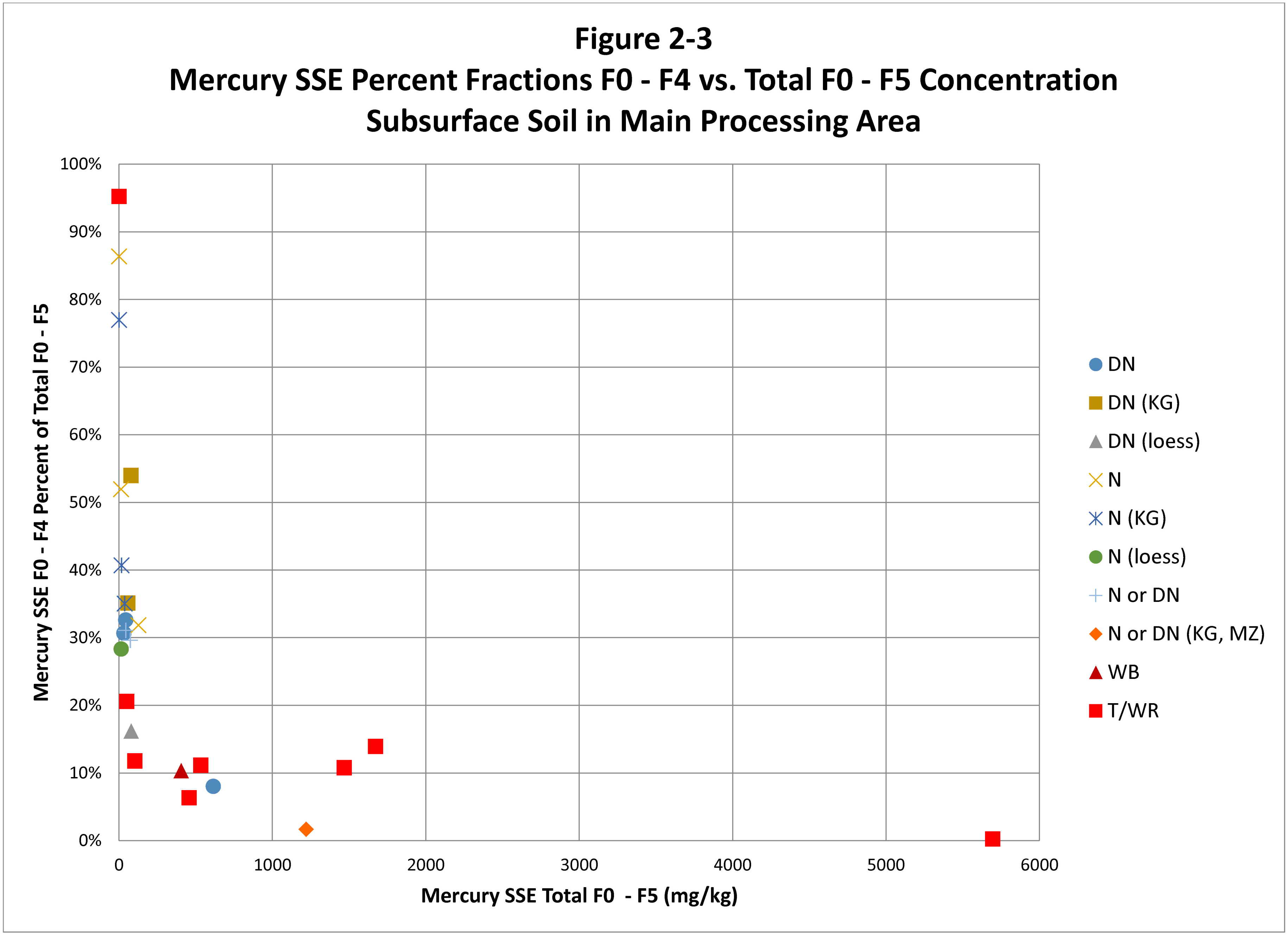
Figure 2-3
Mercury SSE Percent Fractions F0 - F4 vs. Total F0 - F5 Concentration
Subsurface Soil in Main Processing Area
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
1000
2000
3000
4000
5000
6000
Mercury SSE F0 - F4 Percent of Total F0 - F5
Mercury SSE Total F0 - F5 (mg/kg)
DN
DN (KG)
DN (loess)
N
N (KG)
N (loess)
N or DN
N or DN (KG, MZ)
WB
T/WR

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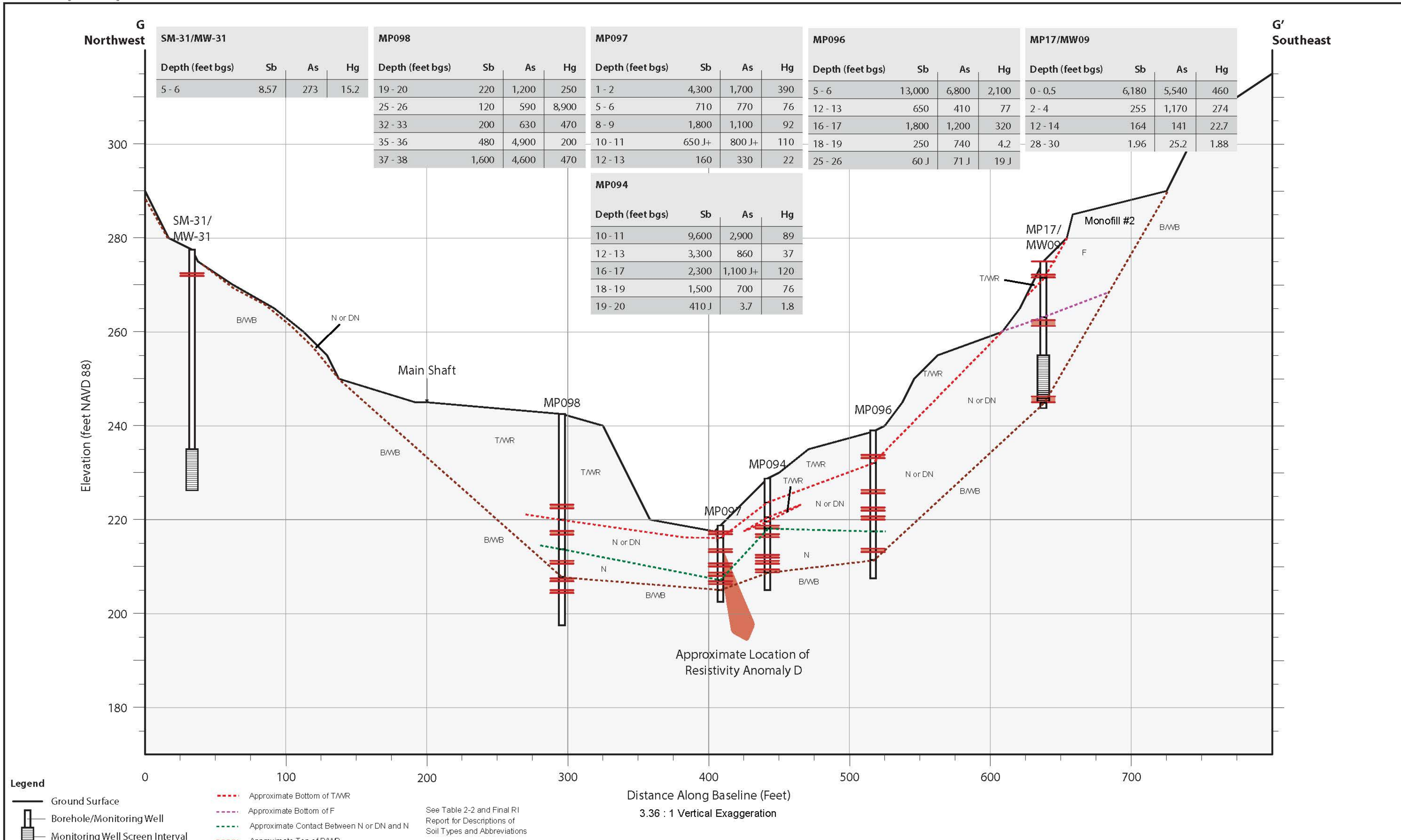

SM-31/MW-31

Depth (feet bgs)	Sb	As	Hg
5 - 6	8.57	273	15.2

MP098

Depth (feet bgs)	Sb	As	Hg
19 - 20	220	1,200	250
25 - 26	120	590	8,900
32 - 33	200	630	470
35 - 36	480	4,900	200
37 - 38	1,600	4,600	470

MP097

Depth (feet bgs)	Sb	As	Hg
1 - 2	4,300	1,700	390
5 - 6	710	770	76
8 - 9	1,800	1,100	92
10 - 11	650 J+	800 J+	110
12 - 13	160	330	22

MP094

Depth (feet bgs)	Sb	As	Hg
10 - 11	9,600	2,900	89
12 - 13	3,300	860	37
16 - 17	2,300	1,100 J+	120
18 - 19	1,500	700	76
19 - 20	410 J	3.7	1.8

MP096

Depth (feet bgs)	Sb	As	Hg
5 - 6	13,000	6,800	2,100
12 - 13	650	410	77
16 - 17	1,800	1,200	320
18 - 19	250	740	4.2
25 - 26	60 J	71 J	19 J

MP17/MW09

Depth (feet bgs)	Sb	As	Hg
0 - 0.5	6,180	5,540	460
2 - 4	255	1,170	274
12 - 14	164	141	22.7
28 - 30	1.96	25.2	1.88

Notes:

1. Surface topography is based on: 1) digital 2010 5-foot topographic contours based on the aerial orthograph taken on September 21, 2010 (Aerometric 2012); and 2) digital 2014 5-foot and 1-foot topographic contours based on Marsh Creek (2014).
2. Approximate resistivity anomaly locations based on USGS (2011).
3. Tabulated sample results are for laboratory total antimony (Sb), arsenic (As), and mercury (Hg) in soil.

Figure 2-4
Geologic Cross Section G-G'
Red Devil Mine
Red Devil, Alaska

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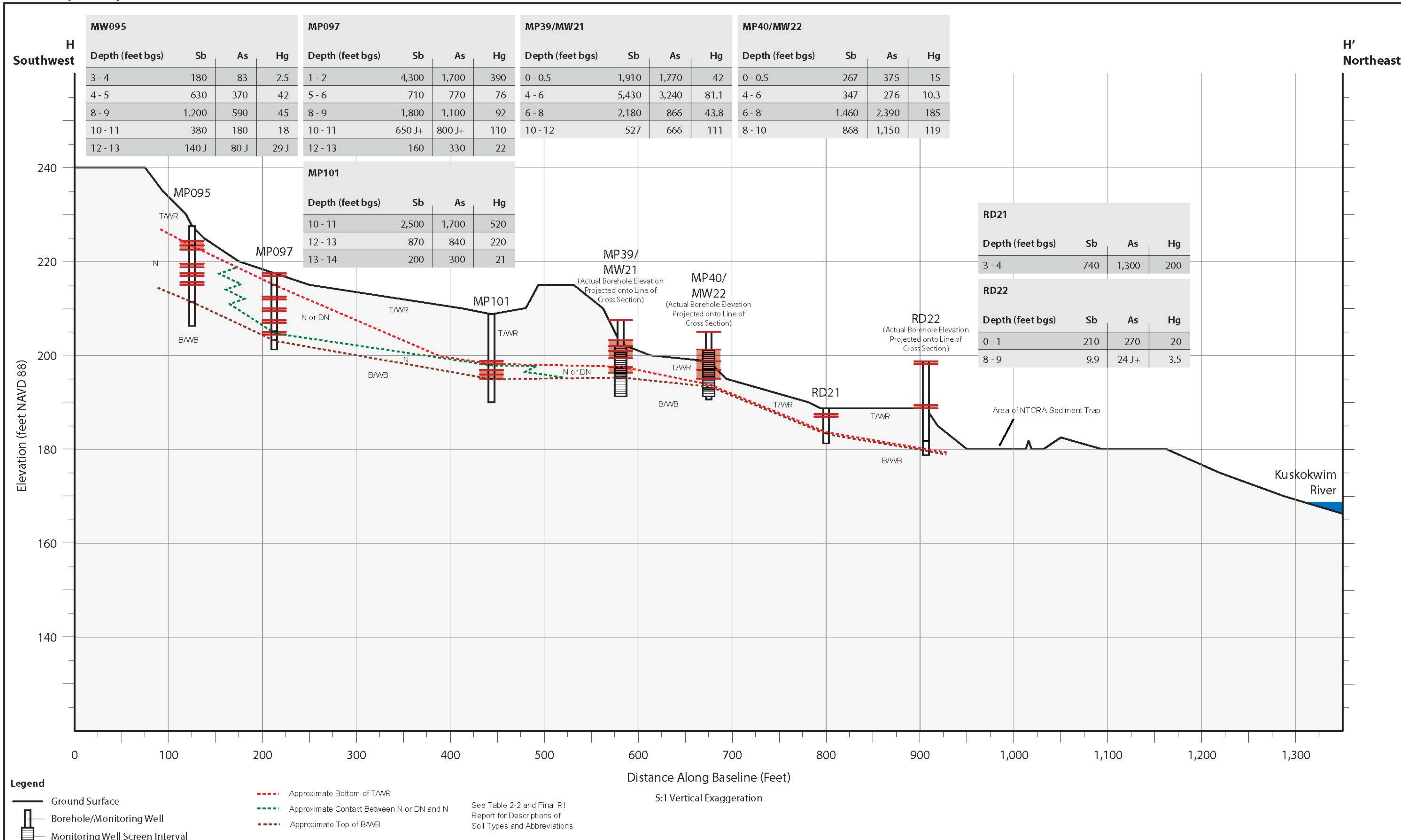

MW095

Depth (feet bgs)	Sb	As	Hg
3 - 4	180	83	2.5
4 - 5	630	370	42
8 - 9	1,200	590	45
10 - 11	380	180	18
12 - 13	140 J	80 J	29 J

MP097

Depth (feet bgs)	Sb	As	Hg
1 - 2	4,300	1,700	390
5 - 6	710	770	76
8 - 9	1,800	1,100	92
10 - 11	650 J+	800 J+	110
12 - 13	160	330	22

MP101

Depth (feet bgs)	Sb	As	Hg
10 - 11	2,500	1,700	520
12 - 13	870	840	220
13 - 14	200	300	21

MP39/MW21

Depth (feet bgs)	Sb	As	Hg
0 - 0.5	1,910	1,770	42
4 - 6	5,430	3,240	81.1
6 - 8	2,180	866	43.8
10 - 12	527	666	111

MP40/MW22

Depth (feet bgs)	Sb	As	Hg
0 - 0.5	267	375	15
4 - 6	347	276	10.3
6 - 8	1,460	2,390	185
8 - 10	868	1,150	119

RD21

Depth (feet bgs)	Sb	As	Hg
3 - 4	740	1,300	200

RD22

Depth (feet bgs)	Sb	As	Hg
0 - 1	210	270	20
8 - 9	9.9	24 J+	3.5

Notes:

1. Surface topography is based on: 1) digital 2010 5-foot topographic contours based on the aerial orthograph taken on September 21, 2010 (Aerometric 2012); and 2) digital 2014 5-foot and 1-foot topographic contours based on Marsh Creek (2014).
2. Tabulated sample results are for laboratory total antimony (Sb), arsenic (As), and mercury (Hg) in soil.

Figure 2-5
Geologic Cross Section H-H'
Red Devil Mine
Red Devil, Alaska

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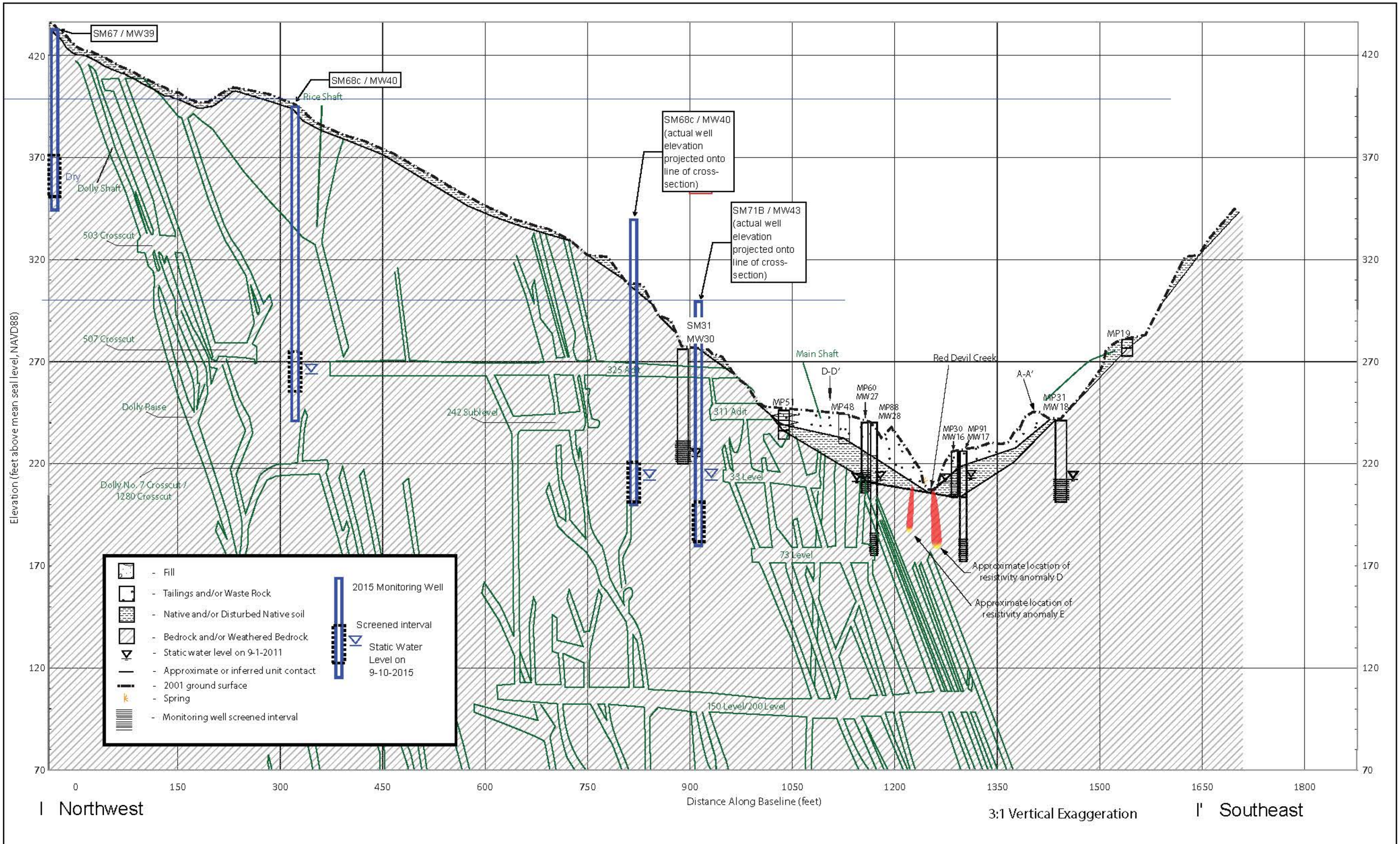

Notes: 1) Surface topography based on 5/27/2001 aerial photograph and topographic map (Aero-Metric, Inc. 2010)

2) Mine workings projected onto geological cross section based on March 1962 longitudinal projection (Alaska Mines and Minerals, Inc. and Decoursey Mountain Mining Co., Inc., 1962)

3) Approximate resistivity anomaly locations based on USGS (2011)

RED DEVIL MINE

Red Devil, Alaska

Figure 2-6
Geologic Cross Section I-I' and Underground Mine Workings

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3 Groundwater Investigation

3.1 Groundwater Investigations

The RI Supplement groundwater characterization activities were designed to address data gaps associated with groundwater in the Main Processing Area, the Red Devil Creek downstream alluvial area, and the Surface Mined Area. Additional groundwater characterization was performed to gather the types of additional information identified in Section 3.3 of the RI Supplement Work Plan. The supplemental RI groundwater characterization was designed to meet the following objectives:

- Assess groundwater occurrence, depth, and quality in the Surface Mined Area to better understand impacts of naturally mineralized bedrock and underground mine workings on groundwater flow paths and inorganic element concentrations.
- Assess groundwater occurrence, depth, and quality in the portions of the RDM affected by the 2014 NTCRA construction.
- Provide additional data on groundwater conditions in the area downgradient of Monofill #2.
- Assess groundwater concentrations of semivolatile organic compounds (SVOCs), diesel-range organics (DRO), gasoline range organics (GRO), and benzene, toluene, ethylbenzene, xylenes (BTEX) in selected wells located within and upgradient of part of the Main Processing Area.
- Provide additional information on baseline groundwater conditions at the site.

Although the wells installed in the Surface Mined Area are intended primarily to assess the potential influence of natural mineralization and mine workings on groundwater conditions upgradient of the Main Processing Area, the resulting data may also be useful for characterizing groundwater conditions downgradient of the proposed on-site repository considered as part of the FS.

Sampling and other field procedures were performed in accordance with the Field Sampling Plan, except as noted below. A brief description of field sampling and other procedures is provided below.

3.1.1 Monitoring Well Installation

Additional groundwater characterization included installation of additional monitoring wells at the site. Four new monitoring wells were installed in the Surface Mined Area. A description of the new monitoring wells and their locations relative to the underground mine workings features targeted by the well installation is presented in Table 3-1. The locations of the 2015 monitoring wells are shown in Figures 2-1, 2-2, and 3-1. Actual monitoring well locations were refined from the locations proposed in the RI Supplement Work Plan during the investigation based on actual conditions encountered in the field. A description of the monitoring well installation results is presented in Section 3.2.1.

Well installation, completion, and development were performed in accordance with the Field Sampling Plan, except as noted below. Monitoring well installation was performed using a drill rig operated by a subcontracted, Alaska-licensed driller. Soil borings installation and field soil characterization conducted as part of the monitoring well installation were performed as described in Section 2.1. Well construction details are provided in Table 3-1. Those boreholes that were not converted to monitoring wells were abandoned at the completion of drilling in accordance with State of Alaska regulations (18 AAC 75 and 18 AAC 78). Drill cuttings and other investigation-derived waste were managed in accordance with the Field Sampling Plan.

3.1.2 Well Survey

On September 11, 2015, the horizontal and vertical coordinates of new monitoring wells were surveyed by a subcontracted, Alaska-registered land surveyor. Vertical coordinates were surveyed to within the nearest 0.1 foot. Well elevation survey data are presented in Section 3.2.

3.1.3 Water Level Measurement

Water levels were measured in the monitoring wells over the course of three rounds in 2015. The locations of the 2015 and RI monitoring wells are shown in Figure 3-1. The 2015 measurements took place on:

- Spring groundwater and surface water monitoring event – June 17, June 18 (MW16 and MW17) and June 22, 2015 (MW31, MW34, MW35, and MW36).
- Following installation of monitoring wells (all wells except MW34, MW35, and MW36) – August 12, 2015.
- Fall groundwater and surface water monitoring event – September 2 and September 10, 2015.

3.1.4 Groundwater Sampling

Additional groundwater characterization included collecting groundwater data from new and selected existing monitoring wells. Additional groundwater characterization was performed using a combination of field data collection and the results of laboratory analysis for selected analytical parameters. Groundwater samples were collected during two sampling events in 2015—the spring event in June and the fall event in September.

Groundwater samples were collected from selected wells during each monitoring event. Wells sampled as part of the spring and fall 2015 groundwater monitoring events are listed in Tables 3-2 and 3-3, respectively. Locations of monitoring wells sampled are illustrated in Figure 3-1.

All groundwater samples were collected for field water quality parameters (pH, specific conductance, oxidation reduction potential, turbidity, dissolved oxygen, and temperature) and the following laboratory analyses: total TAL inorganic elements and low-level mercury; dissolved low-level mercury; inorganic ions (chloride, fluoride, and sulfate); nitrate-nitrite as N; total suspended solids; and alkalinity (as carbonate/ bicarbonate). In addition, samples from wells MW19 and MW22 were analyzed for SVOCs, DRO, GRO, and BTEX. Well MW19 is located upgradient of the Main Processing Area, and well MW22 is located downgradient of Settling Pond #3. Groundwater samples collected for the various laboratory analyses for the two monitoring events are listed in Tables 3-2 and 3-3. Groundwater samples were submitted to TestAmerica, Seattle, Washington, for laboratory analysis. TestAmerica performed all analyses except total and dissolved low-level mercury analyses, which were performed under sub-subcontract to TestAmerica by Brooks Rand Labs, Seattle, Washington.

3.1.5 Deviations from the Field Sampling Plan

As discussed in Section 2.1.4, two of the soil borings/monitoring wells that were originally planned for installation in the Main Processing Area (MP092/MW37 and MP093/MW38) were not installed. These borings/monitoring wells were intended to replace RI monitoring wells MW16 and MW17, which, at the time of the development of the RI Supplement Work Plan, were thought to have been decommissioned as part of the 2014 NTCRA. During the spring 2015 groundwater monitoring event, it was determined that these two wells had not been decommissioned and they appeared to be in good condition.

As discussed in Section 2.1.4, a total of five new soil borings and associated monitoring wells were originally planned for installation in the Surface Mined Area. However, only four new wells were installed. Over the course of the drilling effort in the Surface Mined Area, a total of eight boreholes were drilled, including the four boreholes in which monitoring wells were installed. Locations of the boreholes and monitoring wells are illustrated in Figures 2-1, 2-2, and 3-1. As described in Tables 2-1 and 3-1, it was necessary to abandon several of the boreholes originally planned for monitoring well installation because groundwater was not encountered at the targeted depths. Further discussion of monitoring well installation is provided in Section 3.2.1.

The initial sampling of the new monitoring wells was originally planned to be performed following their completion at the end of the soil boring/monitoring well installation event. However, because the wildfire demobilization/ remobilization resulted in an overall delay of the well installation activities, the new wells were not completed until mid-August. Since the new wells were planned for sampling in September as part of the planned fall 2015 field event, the initial sampling of the wells would have been performed only a few weeks before the September sampling, rendering the initial sampling essentially redundant.

Therefore, the BLM directed E & E to not perform the planned initial sampling of the wells in August. Well MW30 was not sampled in the June or September 2015 sampling events because the water levels were too low at the time of the sampling events.

Well MW09 was not sampled in June 2015 because the water level was too low at the time of the sampling event.

Newly installed well MW39 was not developed or sampled because the well was dry at the times these activities were attempted (see Section 3.2.1 for a description of well installation).

3.2 Groundwater Investigation Results

Additional groundwater characterization included installation of additional monitoring wells at the site and monitoring of the new wells and existing RI wells. The objectives of the groundwater investigation are listed in Section 3.1. Groundwater characterization was performed using a combination of field observations and results of laboratory analysis of groundwater samples. Results of groundwater characterization are summarized below.

3.2.1 Monitoring Well Installation

A primary objective of the new monitoring wells is to assess groundwater occurrence, depth, and quality in the Surface Mined Area to better understand impacts of naturally mineralized bedrock and underground mine workings on groundwater flow paths and inorganic element concentrations. Four new monitoring wells were installed in the Surface Mined Area. The new monitoring wells and a description of their locations relative to pertinent mine workings are presented in Table 3-1. The locations of the 2015 monitoring wells are shown in Figures 2-1, 2-2, and 3-1.

Monitoring well installation in the Surface Mined Area targeted the mineralized zone, if present, and associated network of underground mine workings. The nature of the mineralized zone at the RDM is discussed in Section 2.2.5. As stated in the RI report, the presence of an extensive network of underground mine workings at the site is expected to influence the groundwater flow patterns at the RDM. It was hypothesized that the mine workings provide a highly transmissive groundwater flow network that connects a large portion of the Surface Mined Area and the Main Processing Area and that, assuming the mine workings are not plugged, the mine workings and associated bedrock fractures would exert a draining effect where the mine workings lie below the water table within the host bedrock but above the nearby base level, which is the level of Red Devil Creek. The nature of groundwater flow and migration patterns in this area is presented in Section 2.1.2 of the RI Supplement Work Plan and summarized below.

The planned new monitoring wells were designed to characterize shallow groundwater conditions in the mineralized zone, if present, in the vicinity of the underground mine workings. Therefore, the planned well construction entailed installation of the wells with screen intervals that are within or close to the mineralized zone, if present, and straddle or are near the water table.

The planned monitoring well locations were selected to meet the following criteria: 1) the drilling location can be accessed with the drilling and support equipment; 2) the mineralized zone is expected to be present and at a generally shallow depth; and 3) the depth to groundwater is expected to be fairly close to the depth of the targeted mineralized zone.

As described in Section 2.2.5, the Red Devil ore zones consisted of multiple parallel linear ore shoots that plunge, on average, at an angle of approximately 39° from horizontal on a bearing of South 10° East. The three-dimensional location and configuration of the ore zone can thus be estimated based on the positions of the mapped underground mine workings (see Figures 2-2 and 2-6). The groups of parallel ore shoots thus collectively form several tabular-shaped zones that dip approximately 35° toward the southwest. Peripheral sub-ore grade mineralization was hypothesized to extend to some degree generally along the strike of the tabular bodies defined by the mined ore shoots. Such zones were the zones targeted by the RI Supplement drilling program.

Although the subsurface positions of the mineralized zones can be approximated, the depths to groundwater at the planned well locations were not known prior to drilling. If the mine workings and associated bedrock fractures exert a draining effect where the mine workings locally lie below the water table but above the nearby base level of Red Devil Creek, the depth to the water table would be expected to vary abruptly and significantly in the vicinity of the mine workings. This was found to be the case during the new well installation. As a result, multiple attempts were required to install several monitoring wells with screen intervals that are in close proximity (both laterally and vertically) to the mine workings and associated mineralized bedrock.

A total of eight soil borings were installed in the Surface Mined Area in the attempt to install the planned monitoring wells. A total of four new monitoring wells were installed. A summary of the soil boring and monitoring well installation are presented in Tables 2-1 and 3-1, respectively. Well construction details are provided in Table 3-1. Information regarding bedrock mineralized zones and occurrence of groundwater is presented in Table 2-2 and described for completed monitoring wells below:

- Well MW39 was installed in borehole SM67 near its originally planned location northwest of the Dolly Shaft and assumed downgradient of the proposed repository location (see Figures 2-2 and 2-6). No visual evidence of mineralization was observed in the borehole (see Table 2-2). During borehole drilling, evidence for groundwater was observed at several intervals as shallow as 63 feet bgs. As noted in Section 2.1.1, while drilling in bedrock using air rotary/down-the-hole hammer method, identification of saturated conditions was locally difficult because groundwater occurs primarily in fractures, and location, density, and orientations of the fractures are not well understood at the site. Further, in comparatively less productive saturated zones, the drilling returns may not provide a clear indication of saturated conditions. Such conditions appear to have been experienced during drilling of borehole SM67. Moisture mixed with the clayey cuttings resulted in a clayey coating of the borehole wall, which was suspected to have obscured and possibly limited flow of water into the borehole. Based on interpretation of available information made during drilling, a well was installed with a screen interval of 63 to 83 feet bgs.

- Well MW40 was installed in borehole SM68c, the third borehole drilled in the attempt to install the well. The well was installed near the 507 Crosscut and Dolly No. 7 / 1280 Crosscut (see Figures 2-2 and 2-6). Abundant visual evidence of mineralization (stibnite, realgar, orpiment, and cinnabar in cuttings) and comparatively high XRF field screening concentrations of antimony (up to 5,659 ppm) and arsenic (12, 859 ppm) were identified in boreholes SM68a and SM68b. In borehole SM68c, comparatively weak mineralization was identified. The well was installed in an area where the water table was relatively well defined. The screen interval straddled the water table within a zone of weak mineralization (see Table 2-2).
- Well MW42 was installed in borehole SM70b, the second borehole drilled in the attempt to install the well. The well was installed near the 325 Adit and 150 Level / 200 Level (see Figures 2-2 and 2-6). Indications of mineralization were identified in borehole SM70a. In borehole SM70b, some visual evidence of mineralization, consisting of thin intervals with orpiment (see Photograph 2 inset in Section 2.2.5) and stibnite and XRF field screening arsenic concentrations up to 3,458 ppm were identified within a zone ranging from approximately 120 to 140 feet below ground surface (bgs). The water table was observed at a depth of approximately 127 feet bgs on September 10, 2015. The well was installed with a screen interval of 119 to 139 feet bgs, straddling the water table and coinciding with the mineralized zone (see Table 2-2).
- Well MW43 was installed in borehole SM71b, the second borehole drilled in the attempt to install the well. The well was installed near the 33 Level (see Figures 2-2 and 2-6). Indications of mineralization, including visual observation of stibnite in two thin intervals and XRF field screening arsenic concentrations up to 6,954 ppm, were identified in the boreholes within a zone between approximately 108 and 120 feet bgs, about 20 feet below the water table (approximately 88 feet bgs on September 10, 2015). Installation of a well in borehole SM71a was attempted, but the well was damaged in the process. A well was successfully installed in borehole SM71b a short distance from SM71a, with a screen interval of 98 to 118 feet bgs (see Table 2-2).

3.2.2 Groundwater Levels and Gradients

Depth to groundwater measurements and calculated groundwater elevations for wells monitored during the spring 2015 and fall 2015 monitoring events are presented in Table 3-4. For comparison, water level data collected during previous monitoring events also are included in the table. Based on static water elevations and stream elevations along Red Devil Creek, groundwater potentiometric surface maps for the spring and fall monitoring events were generated and are presented in Figures 3-2 and 3-3, respectively.

During the spring and fall 2015 groundwater monitoring events, as observed during the RI and 2012 baseline monitoring events, groundwater at the site generally flowed toward Red Devil Creek, with groundwater elevations generally mimicking topography over much of the site (see final RI report). Of notable exception is the groundwater in the Surface Mined Area. As noted in Section 3.2.1 and the final RI report, the presence of underground mine workings was hypothesized to exert a draining effect where the mine workings lie below the water table within the host bedrock but above the nearby base level, which is the level of Red Devil Creek. This includes a part of the Surface Mined Area. During the fall 2015 monitoring event, the depths to groundwater in Surface Mined Area wells whose lateral positions and screened intervals are in close proximity to the mine workings—MW39, MW40, MW42, and MW43—were substantially lower than in other nearby wells installed in bedrock further away from the mine workings (e.g., MW31). The positions of these wells relative to the mine workings are illustrated in Figures 2-2, 2-6, and 3-3. Well MW39, located near the Dolly Shaft and downgradient of the proposed repository, was dry at the time of monitoring in the fall of 2015, indicating a depth to groundwater of greater than 83 feet bgs (the depth of the bottom of the screen interval). This corresponds to a groundwater elevation less than approximately 350 feet. The groundwater elevations in wells MW42 and MW43, located nearest to Red Devil Creek, were approximately 213 feet, nearly the same elevation as Red Devil Creek at its closest point (approximately 210 feet), indicating a highly transmissive hydraulic connection between the area of the wells and the creek. The water level data demonstrate that the mine workings efficiently drain part of the Surface Mined Area with a groundwater gradient toward the mine workings and eventually toward Red Devil Creek.

As indicated by the groundwater elevation contours in Figures 3-2 and 3-3, groundwater in the Main Processing Area and much of the Surface Mined Area and the area downstream of the Main Processing Area emerges into Red Devil Creek and enters the Kuskokwim River as surface water rather than as groundwater.

Groundwater elevations during both 2015 monitoring events were generally lower than during previous groundwater monitoring events at the RDM at similar times of the year. Groundwater elevations were lower during the fall 2015 event than during the spring 2015 event. Details are presented in Table 3-4, and comparisons of water elevations between the 2015 and previous monitoring events are summarized below:

- During the spring (June) 2015 monitoring event, groundwater elevations were lower than during the spring (May) 2012 monitoring event in all wells by a range of 0.64 to 11.44 feet and by an average of 4.08 feet.
- During the fall (September 10) 2015 monitoring event, groundwater elevations were lower than during the fall (September 10) 2012 monitoring event in all but one well. The water elevations were lower in 2015 than in 2012 by a range of 0.85 to 9.14 feet and by an average of 3.49 feet. The water elevation in MW25 was 1.42 feet higher in 2015 than in 2012.
- During the fall (September 10) 2015 monitoring event, groundwater elevations were lower than during the RI (September 1, 2011) monitoring event in all but one well. The water elevations were lower in 2015 than in 2011 by a range of 0.12 to 6.15 feet and by an average of 1.80 feet. The water elevation in well MW16 was 0.09 feet higher in September 2015 than in September 2011.
- During the fall (September 10) 2015 monitoring event, groundwater elevations were lower in all wells than during the spring (June) 2015 monitoring event by a range of 0.38 to 6.23 feet and by an average of 1.85 feet.

During the fall 2015 monitoring event, there was an upward gradient in the MW27/MW28 well pair, consistent with the direction observed during the RI and 2012 baseline monitoring events. The upward gradient during the fall 2015 monitoring event was 0.016, slightly lower than the gradients observed during the RI and 2012 baseline monitoring events, which ranged from 0.021 to 0.127. An upward gradient in the vicinity of wells MW27 and MW28 is consistent with the previous interpretation that groundwater in that part of the Main Processing Area emerges into Red Devil Creek (see Section 3.2 of the final RI report).

During the spring and fall 2015 monitoring events, there was a downward gradient in the MW16/MW17 well pair, consistent with the direction observed during the 2012 baseline monitoring events and all except one monitoring event (September 1, 2011) during the RI. The downward gradients observed in 2015 ranged from 0.044 to 0.149. The downward gradients observed during the RI and 2012 baseline monitoring events ranges from 0.020 to 0.048. The downward gradient observed during most of the monitoring events in the MW16/MW17 area may be attributable to losing conditions in that area such as those interpreted along Red Devil Creek in part of the Main Processing Area during the RI and 2012 baseline monitoring events (see Section 3.2.2 of the final RI report). Such losing conditions would result in a localized generally downward flow of surface water into the subsurface.

3.2.3 Groundwater Sample Results

Groundwater sampling was performed at selected RI wells and new wells to meet the RI Supplement objectives listed in Section 3.1 pertaining to groundwater quality. Laboratory results and field water quality measurements of groundwater sampling conducted during the spring and fall 2015 monitoring events are presented in Tables 3-5 and 3-6, respectively. Results for key constituents—total antimony, total arsenic, and total and dissolved mercury—are presented in Figures 3-4 through 3-6 for the spring 2015 event, and Figures 3-7 through 3-9 for the fall 2015 event. Results as they pertain to RI Supplement objectives are discussed below.

3.2.3.1 Surface Mined Area

To assess groundwater quality in the Surface Mined Area, groundwater monitoring was performed at existing (MW29 and MW30) during the spring and fall monitoring events, and at newly installed wells (MW39, MW40, MW42, and MW43) during the fall event.

RI Wells MW29 and MW30

Wells MW29 and MW30 are located in the Surface Mined Area but are not located in close proximity to known locations of underground mine workings. During both events, insufficient water was present to sample well MW30. For well MW29, the 2015 results are presented in Tables 3-5 and 3-6 and Figures 3-4 through 3-9. The 2015 sampling results for total antimony, total arsenic, total mercury, and dissolved mercury are compared to previous sampling results below.

Spring

In well MW29, total antimony was detected in the spring 2015 sample at a concentration 0.75 micrograms per liter (µg/L), similar to concentrations observed during previous RI or 2012 baseline monitoring samples. Total arsenic was detected at 75 µg/L in the spring 2015 sample, less than the concentration in the spring 2012 baseline sample (102 µg/L). Total mercury was detected at a concentration of 215 nanograms per liter (ng/L) in the spring 2015 sample, similar to the concentration in the RI sample (247 ng/L), and greater than in the spring 2012 baseline samples (6 ng/L). Dissolved mercury was detected at a concentration of 1.45 ng/L in the spring 2015 sample, similar to the concentration in the RI sample (0.71 ng/L, estimated) and the spring 2012 baseline sample (1 ng/L).

Fall

Total antimony was not detected in the fall 2105 sample from well MW29. Total arsenic was detected at 35 µg/L in the fall 2015 sample, slightly lower than the concentrations in the RI sample (36.9 µg/L) and fall 2012 baseline sample (44 µg/L). Total mercury was not detected in the fall 2015 sample; total mercury was detected at a concentration of 6 ng/L in the fall 2012 baseline sample. Dissolved mercury was detected at a concentration of 5.69 ng/L in the fall 2015 sample, greater than the concentration in the RI sample (0.71 ng/L, estimated) and similar to the fall 2012 baseline concentration (7 ng/L).

<u>New Wells MW39, MW40, MW42, and MW43</u>

New wells MW39, MW40, MW42, and MW43 were installed to better understand impacts of naturally mineralized bedrock and underground mine workings on groundwater flow paths and inorganic element concentrations. Samples were collected from the wells during the fall monitoring event. During the fall event, well MW39 was dry and no sample was collected. Results are presented in Table 3-6 and Figures 3-7 through 3-9 and summarized below.

Total antimony concentrations in the new wells ranged from 6.2 µg/L (MW40) to 250 µg/L (MW42). Total arsenic was detected at concentrations of 38 µg/L (MW38), 85 µg/L (MW40), and 610 µg/L (MW42). Total mercury concentrations were qualified nondetect. Dissolved mercury concentrations ranged from nondetect to 48.2 ng/L in MW42.

3.2.3.2 Area of NTCRA Regrading

Groundwater quality in the vicinity of the 2014 NTCRA regrading was evaluated by sampling wells MW16, MW17, MW27, MW28. Only wells MW27 and MW28 were sampled during the spring event. All four wells were sampled during the fall event. Results are presented in Tables 3-5 and 3-6 and Figures 3-4 through 3-9. Sampling results for total antimony, total arsenic, total mercury, and dissolved mercury were compared to previous sampling results. No obvious trends in concentrations of these analytes for the area as a whole were noted. A comparison of the 2015 sampling results to previous sampling results is described in detail below.

Spring 2015

<u>Well MW27</u>

In the spring 2015 sample from well MW27, total antimony was detected at 11 µg/L, similar to the 2011 RI result (9.16 µg/L, estimated) and the spring 2012 baseline result (12.7 µg/L). Total arsenic was detected at 29 µg/L, similar to the RI result (22.6 µg/L) and the spring 2012 baseline result (37 µg/L). Total mercury was detected at 663 ng/L, greater than the RI result (411 ng/L) and spring 2012 baseline result (140 ng/L). Dissolved mercury was detected at 131 ng/L, less than the RI result (277 ng/L) and spring 2012 baseline result (170 ng/L).

<u>Well MW28</u>

In the spring 2015 sample from well MW28, total antimony was detected at 7 µg/L, less than the 2011 RI result (19.3 µg/L, estimated) and the spring 2012 baseline result (13.2 µg/L). Total arsenic was detected at 75 µg/L, less than the RI result (32.8 µg/L) but greater than the spring 2012 baseline result (73 µg/L). Total mercury was detected at 1,890 ng/L, less than the RI result (4,000 ng/L) but greater than the spring 2012 baseline result (1,340 ng/L). Dissolved mercury was detected at 27.5 ng/L, greater than the RI result (10.9 ng/L) but less than the spring 2012 baseline result (38 ng/L).

Fall 2015

Well MW16

In the fall 2015 sample from well MW16, total antimony was detected at 570 µg/L, slightly less than the 2011 RI result (678 µg/L) and the fall 2012 baseline result (757 µg/L). Total arsenic was detected at 1,700 µg/L, greater than the RI result (1,020 µg/L) and the fall 2012 baseline result (830 µg/L). Total mercury was detected at 1,540 ng/L, greater than the RI result (1,210 ng/L) and fall 2012 baseline result (664 ng/L). Dissolved mercury was detected at 702 ng/L, greater than the RI result (285 ng/L) and fall 2012 baseline result (285 ng/L).

Well MW17

In the fall 2015 sample from well MW17, total antimony was detected at 9.3 µg/L, less than the 2011 RI result (53.9 µg/L) but greater than the fall 2012 baseline result (6.44 µg/L). Total arsenic was nondetect; the RI result was 28.5 µg/L and the fall 2012 baseline result was 3 µg/L). Total mercury was detected at 361 ng/L (estimated), less than the RI result (6,070 ng/L) and but greater than the fall 2012 baseline result (10 ng/L). Dissolved mercury was detected at 7.98 ng/L, similar to the RI result (9.49 ng/L). The fall 2012 baseline result was nondetect.

Well MW27

In the fall 2015 sample from well MW27, total antimony was detected at 8.3 µg/L, slightly less than the 2011 RI result (9.16 µg/L, estimated) and the fall 2012 baseline result (12.9 µg/L). Total arsenic was detected at 27 µg/L, somewhat greater than the RI result (22.6 µg/L) and less than the fall 2012 baseline result (31 µg/L). Total mercury was detected at 401 ng/L, similar to the RI result (411 ng/L) and less than the fall 2012 baseline result (112 ng/L). Dissolved mercury was detected at 253 ng/L, similar to the RI result (277 ng/L) and greater than the fall 2012 baseline result (60 ng/L).

Well MW28

In the fall 2015 sample from well MW28, total antimony was detected at 16 µg/L, similar to the 2011 RI result (19.3 µg/L, estimated) and the fall 2012 baseline result (17.4 µg/L). Total arsenic was detected at 130 µg/L, greater than the RI result (32.8 µg/L) and the fall 2012 baseline result (68 µg/L). Total mercury was detected at 1,320 ng/L (estimated), less than the RI result (4,000 ng/L) but greater than the fall 2012 baseline result (183 ng/L). Dissolved mercury was detected at 294 ng/L, greater than the RI result (10.9 ng/L) and the fall 2012 baseline result (26 ng/L).

3.2.3.3 Area Downgradient of Monofill #2

To provide additional data on groundwater conditions in the area downgradient of Monofill #2, groundwater was sampled from wells MW09 and MW10. During the spring sampling event a sample was collected from MW10; there was insufficient water recharge to collect a sample from MW09. Samples were collected from both wells during the fall sampling event. Results are presented in Tables 3-5 and 3-6 and Figures 3-4 through 3-9 Well MW09 had been sampled previously only during the fall 2012 baseline monitoring event. Sampling results for total antimony, total arsenic, total mercury, and dissolved mercury were compared to previous sampling results. No obvious trends in concentrations of these analytes for the area as a whole were noted. A comparison of the 2015 sampling results to previous sampling results is described in detail below.

Spring
Well MW10
In the spring 2015 sample from well MW10, total antimony was detected at 0.21 µg/L (estimated), less than the 2011 RI result (6.49 µg/L) and the spring 2012 baseline result (1.23 µg/L). Total arsenic was detected at 95 µg/L, similar to the RI result (96.9 µg/L) and less than the spring 2012 baseline result (148 µg/L). Total mercury was detected at 7.95 ng/L, less than the RI result (532 ng/L) and spring 2012 baseline result (32 ng/L). Dissolved mercury was detected at 2.32 ng/L, greater than the RI result (0.62 ng/L, estimated); the spring 2012 baseline result was nondetect.

Fall
Well MW09
In the fall 2015 sample from well MW09, total antimony was detected at 7.8 µg/L, less than the fall 2012 baseline result (11.7 µg/L). Total arsenic was nondetect; the fall 2012 baseline result was 13 µg/L. Total mercury was detected at 1,020 ng/L, greater than the fall 2012 baseline result (172 ng/L). Dissolved mercury was detected at 5.46 ng/L, less than the fall 2012 baseline (11 ng/L).

Well MW10
In the fall 2015 sample from well MW10, the total antimony result was nondetect; the 2011 RI result was 6.49 µg/L) and the fall 2012 baseline result was 2.65 µg/L. Total arsenic was detected at 100 µg/L (estimated), similar to the RI result (96.9 µg/L) and the fall 2012 baseline result (110 µg/L). The total mercury result was nondetect; the RI result was 532 ng/L and the fall 2012 baseline result was nondetect. Dissolved mercury was detected at 32.3 ng/L (estimated), greater than the RI result (0.62 ng/L, estimated); the fall 2012 baseline result was nondetect.

3.2.3.4 Organic Compounds in the Main Processing Area

Groundwater samples collected from wells MW19 and MW22 during the spring and fall 2015 monitoring events were analyzed for SVOCs, DRO, GRO, and BTEX. Well MW19 is located upgradient of the Main Processing Area and well MW22 is located downgradient of Settling Pond #3. Results for the spring and fall event are presented in Tables 3-5 and 3-6, respectively. The tables present only those SVOC analytes that were detected in one or more samples. Results are discussed below.

The following SVOCs were detected in one or more samples: butyl benzyl phthalate; benzoic acid; benzyl alcohol; diethyl phthalate; di-n-butyl phthalate; 2-fluorobiphenyl. All results at concentrations below federal drinking water maximum contaminant level (MCL) and/or Alaska groundwater cleanup levels (18 AAC 75.345 Table C), if applicable.

DRO was not detected in the samples from MW19, but was detected in samples from MW22 collected in the spring (0.063 milligrams per liter [mg/L], estimated) and fall (0.19 mg/L), below the Alaska groundwater cleanup level (1.5 mg/L).

GRO was detected only in the sample collected from MW19 in the fall event at a concentration of 0.055 mg/L, below the Alaska groundwater cleanup level (2.2 mg/L).

The only BTEX compound detected is toluene, which was detected at an estimated concentration of 0.054 µg/L in the sample collected from MW19 in the spring event. This concentration is below the MCL and Alaska groundwater cleanup level (1.0 mg/L).

3.2.3.5 Other Wells Sampled for Baseline Monitoring

In addition to the wells that were sampled to address objectives associated with specific site features and geographic areas (see Sections 3.2.3.1 through 3.2.3.4), other wells distributed across the RDM—MW01, MW26, MW06, MW19, MW22, MW32, and MW33— were sampled in 2015 to gather additional information on baseline groundwater conditions at the RDM. Sample results for these wells are presented in Tables 3-4 and 3-6 and Figures 3-4 through 3-9. The 2015 sampling results for total antimony, total arsenic, total mercury, and dissolved mercury were compared to previous sampling results. No obvious trends in concentrations were noted.

3.3 Groundwater Investigation Conclusions

The RI Supplement groundwater characterization activities were designed to address data gaps associated with groundwater in the Main Processing Area, the Red Devil Creek downstream alluvial area, and the Surface Mined Area. Additional groundwater characterization was performed to gather the types of additional information identified in Section 3.3 of the RI Supplement Work Plan and to meet the objectives listed in Section 3.1. Results of the RI Supplement groundwater investigation activities are detailed in Section 3.2. Key findings of the study are briefly summarized below. It is anticipated that results of the supplemental groundwater characterization will be used to support the development of site-wide remedial alternatives at the RDM.

3.3.1 Surface Mined Area

It was hypothesized in the final RI report (e.g., Section 5.4.2) that the system of underground mine workings at the RDM likely dominates groundwater flow pathways in bedrock within those parts of the Surface Mined Area and Main Processing Area where underground mining took place, and that the presence of the mine workings network in the Surface Mined Area exerts a draining effect where the mine workings lie below the water table within the host bedrock but above the nearby base level, which is the level of Red Devil Creek. The draining effect would serve to establish a hydraulic gradient toward such mine workings. It was further hypothesized that groundwater within the system likely eventually flows to the Red Devil Creek valley and emerges as surface water in Red Devil

Creek, and that flow within the mine workings and connected fracture systems likely results in impacts on groundwater chemistry due to the presence of naturally occurring mineralization. Such impacts were stated to be likely to impact local groundwater as well as surface water in Red Devil Creek (see final RI report Section 5.4.3.2).

New monitoring wells MW39, MW40, MW42, and MW43 were installed in the Surface Mined Area to provide additional information on groundwater conditions in the Surface Mined Area in the vicinity (laterally and vertically) of the underground mine workings. Detailed information on the well installation is presented in Section 3.2.1.

RI Supplement groundwater elevation results show that the depths to groundwater in the new Surface Mined Area wells were substantially greater than in other nearby wells installed in bedrock further away from the mine workings. The groundwater elevations in wells MW42 and MW43, located nearest to Red Devil Creek, were nearly the same as the elevation of Red Devil Creek at its closest point to the wells (approximately 210 feet). These results clearly demonstrate that the mine workings provide a highly transmissive hydraulic connection between the area of the wells and the creek that serves to depress the water table in portions of the Surface Mined Area where the mine workings lie below the water table but above the nearby base level of Red Devil Creek. The results support the conclusion that the mine workings provide a preferential flow pathway of groundwater in areas drained by the mine workings from the Surface Mined Area to the Red Devil Creek valley, where it emerges into Red Devil Creek and enters the Kuskokwim River as surface water rather than as groundwater.

It was further hypothesized in the RI (see Section 5.4.3 of the final RI report) that naturally mineralized bedrock such as that associated with the mine workings is a source of some of the arsenic, antimony, and mercury groundwater impacts at the RDM. RI Supplement groundwater sample results from the newly installed wells contained concentrations of total antimony and arsenic ranging up to 250 µg/L and 610 µg/L, respectively. Dissolved mercury concentrations in those samples ranged as high as 48.2 ng/L. These concentrations are significantly higher than observed previously in the groundwater samples collected elsewhere in the Surface Mined Area from wells not installed in close proximity to the underground mine workings. These results demonstrate that the groundwater that flows into the underground mine workings network is impacted by the natural mineralization associated with the Red Devil ore zones. As also hypothesized in the RI (see final RI report Section 5.4.3.2), such impacted groundwater is expected to emerge in Red Devil Creek along gaining reaches within the Main Processing Area where components of the mine workings system approach the surface. The RI and RI Supplement data collectively support this conclusion.

3.3.2 Area of NTCRA Regrading

Groundwater quality in the vicinity of the 2014 NTCRA regrading and stream realignment was evaluated by sampling wells MW16, MW17, MW27, and

MW28. Only wells MW27 and MW28 were sampled during the spring event. All four wells were sampled during the fall event. Sampling results for total antimony, total arsenic, total mercury, and dissolved mercury were compared to previous sampling results. No obvious trends in concentrations or changes in concentration of these analytes that could be positively attributed to the NTCRA regrading were noted.

During the fall 2015 monitoring event, there was an upward gradient in the MW27/MW28 well pair consistent with the direction observed during the RI and 2012 baseline monitoring events. An upward gradient in the vicinity of wells MW27 and MW28 is consistent with the previous interpretation that groundwater in that part of the Main Processing Area emerges into Red Devil Creek.

During the spring and fall 2015 monitoring events, there was a downward gradient in the MW16/MW17 well pair, consistent with the direction observed during all except one of the previous monitoring events in the MW16/MW17 well pair. The downward gradient appears to be localized and may be attributable to losing conditions in that area. Localized losing conditions in this area are consistent with the pre-NTCRA conditions interpreted along Red Devil Creek in that part of the Main Processing Area during the RI and 2012 baseline monitoring events.

3.3.3 Area Downgradient of Monofill #2

To provide additional data on groundwater conditions in the area downgradient of Monofill #2, groundwater was sampled from wells MW09 and MW10. During the spring sampling event a sample was collected from MW10; there was insufficient water recharge to collect a sample from MW09. Samples were collected from both wells during the fall sampling event. The 2015 sampling results for total antimony, total arsenic, total mercury, and dissolved mercury were compared to previous sampling results. No obvious trends in concentrations were noted.

3.3.4 Organic Compounds in the Main Processing Area

Groundwater samples collected from wells MW19 and MW22 during the spring and fall 2015 monitoring events were analyzed for SVOCs, DRO, GRO, and BTEX. The following SVOCs were detected in one or more samples: butyl benzyl phthalate; benzoic acid; benzyl alcohol; diethyl phthalate; di-n-butyl phthalate; 2-fluorobiphenyl. All detected SVOCs are at concentrations below federal MCLs and/or Alaska groundwater cleanup levels, if applicable. DRO was not detected in the samples from MW19, but was detected in samples from MW22 collected in the spring and fall at concentrations below the Alaska groundwater cleanup level (1.5 mg/L). GRO was detected only in the sample collected from MW19 in the fall event at a concentration below the Alaska groundwater cleanup level (2.2 mg/L). The only BTEX compound detected is toluene, which was detected at a concentration below the federal MCL and Alaska groundwater cleanup level (1.0 mg/L).

3.3.5 Baseline Monitoring

Groundwater monitoring was performed at selected wells to address specific objectives associated with various site features and geographic areas, discussed in Sections 3.3.1 to 3.3.4 above. In addition to those specific objectives, groundwater monitoring data was collected to from those wells to augment existing information on baseline groundwater conditions at the RDM. Any trends identified for these wells are discussed in the sections above.

Other wells distributed across the RDM—MW01, MW26, MW06, MW19, MW22, MW32, and MW33— also were monitored in 2015 to gather additional information on baseline groundwater conditions at the RDM. For these wells the 2015 sampling results for total antimony, total arsenic, total mercury, and dissolved mercury were compared to previous sampling results. No obvious trends in concentrations were noted.

In general, groundwater elevations at most of the wells across the RDM during the spring and fall 2015 monitoring events were lower than during previous groundwater monitoring events at the RDM at similar times of the year. During the spring and fall 2015 groundwater monitoring events, as observed during the RI and 2012 baseline monitoring events, groundwater at the site generally flowed toward Red Devil Creek, with groundwater elevations generally mimicking topography over much of the site. An important exception is the groundwater elevations in the surface Mined Area (see Section 3.3.1).

Table 3-1 Monitoring Well Installation Summary

General Area	Soil Boring ID	Monitoring Well ID	Description	Soil Boring Total Depth (feet bgs)	Monitoring Well Total Depth (feet bgs)	Monitoring Well Screened Interval (feet bgs)
Post-1955 Main Processing Area	MP092 (not installed)	MW37 (not installed)	Not installed. Originally planned for location near MW16 and MW17.	NA	NA	NA
	MP093 (not installed)	MW38 (not installed)	Not installed. Originally planned for location near MW16 and MW17.	NA	NA	NA
Surface Mined Area	SM67	MW39	Northeast of Dolly Shaft and south and assumed downgradient of proposed repository location. Well installed.	90	84	63 - 83
	SM68a (abandoned)	NA	Near Dolly Shaft and 503 Crosscut and associated stopes. Encountered void at 37 feet bgs. Discontinued drilling and abandoned hole. Relocated to SM68b.	37	NA	NA
	SM68b (abandoned)	NA	Near Dolly Shaft and 503 Crosscut and associated stopes. Drilled to 135 feet bgs. Hole dry. Hole abandoned. Relocated to SM68c.	135	NA	NA
	SM68c	MW40	Near 507 Crosscut and Dolly No. 7 / 1280 Crosscut. Well installed.	155	140	119 - 139
	SM69 (not installed)	MW41 (not installed)	Not installed. Originally planned for location near Dolly Area crosscuts.	NA	NA	NA
	SM70a (abandoned)	NA	Near 325 Adit and 150 Level / 200 Level. Hole dry. Hole abandoned. Relocated to SM70b.	96	NA	NA
	SM70b	MW42	Near 325 Adit and 150 Level / 200 Level. Well installed.	140	140	119 - 139
	SM71a (abandoned)	NA	Near 33 Level. Well installation attempted, but well damaged. Abandoned well. Relocated to SM71b.	99	NA	NA
Surface Mined Area	SM71b	MW43	Near 33 Level. Well installed.	120	118.5	98 - 118

Key:
bgs = below ground surface
NA = Not applicable

Table 3-2 Groundwater Sample Collection - Spring 2015

General Area	Monitoring Well ID	Sample ID	Sample Date	Sample Collection Equipment	Sample Description	Sample Analyses and Methods									
						Total TAL Metals	Total Low-Level Hg	Dissolved Low-Level Hg	Total Suspended Solids	Inorganic Ions	Nitrate Nitrite as N	Carbonate Alkalinity as CaCO3	SVOCs	BTEX/GRO	DRO
						EPA 6010B/6020 A /7470A	EPA 1631E	EPA 1631E	SM 2540D	MCAWW 300.0	MCAWW 353.2	SM 2320B	SW846 8270D	SW846 8260C / AK101	AK102
Post-1955 Main Processing Area	MW01	0615MW01GW	6/19/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			
	MW09	Not sampled. Insufficient water.	NA	NA	NA										
	MW10	0615MW10GW	6/20/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			
	MW22	0615MW22GW	6/23/2015	Peristaltic pump	Field Sample	X	X	X	X	X	X	X	X	X	X
		0615MW50GW	6/23/2015	Peristaltic pump	Field Duplicate of 0615MW22GW	X	X	X	X	X	X	X	X	X	X
Pre-1955 Main Processing Area	MW06	0615MW06GW	6/20/2015	Peristaltic pump	Field Sample	X	X	X	X	X	X	X			
	MW26	0615MW26GW	6/22/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			
	MW27	0615MW27GW	6/21/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			
	MW28	0615MW28GW	6/22/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			
Red Devil Creek Delta Area	MW32	0615MW32GW	6/21/2015	Peristaltic pump	Field Sample	X	X	X	X	X	X	X			
	MW33	0615MW33GW	6/21/2015	Peristaltic pump	Field Sample	X	X	X	X	X	X	X			
Surface Mined Area	MW29	0615MW29GW	6/23/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			
	MW30	Not sampled. Insufficient water.	NA	NA	NA										
Upgradient of Post-1955 Main Processing Area	MW08	0615MW08GW	6/20/2015	Peristaltic pump	Field Sample	X	X	X	X	X	X	X			
	MW19	0615MW19GW	6/23/2015	Peristaltic pump	Field Sample	X	X	X		X	X	X	X	X	X
		0615MW51GW	6/23/2015	Peristaltic pump	Field Duplicate of 0165MW19GW	X	X	X		X	X	X			
Upland Area West of Surface Mined Area	MW31	0615MW31GW	6/22/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			

Key:
BTEX = Benzene, toluene, ethylbenzene, and xylenes
DRO = Diesel range organics
EPA= Environmental Protection Agency
GRO =Gasoline range organics
Hg = Mercury
MCAWW = Methods for Chemical Analysis of Water and Wastes
NA = Not applicable
SVOCs = Semivolatile organic compounds
TAL = Target Analyte List

Table 3-3 Groundwater Sample Collection - Fall 2015

General Area	Monitoring Well ID	Sample ID	Sample Date	Sample Collection Equipment	Sample Description	Sample Analyses and Methods									
						Total TAL Metals EPA 6010B/6020 A /7470A	Total Low-Level Hg EPA 1631E	Dissolved Low-Level Hg EPA 1631E	Total Suspended Solids SM 2540D	Inorganic Ions MCAWW 300.0	Nitrate Nitrite as N MCAWW 353.2	Carbonate Alkalinity as CaCO3 SM 2320B	SVOCs SW846 8270D	BTEX/GRO SW846 8260C / AK101	DRO AK102
Post-1955 Main Processing Area	MW01	0915MW01GW	9/3/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			
	MW09	0915MW09GW	9/9/2015	Bladder pump	Field Sample	X	X	X	X	X	X	X			
	MW10	0915MW10GW	9/5/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			
		0915MW50GW	9/5/2015	Submersible pump	Field Duplicate of 0915MW10GW	X	X	X	X	X	X	X			
	MW16	0915MW16GW	9/5/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			
	MW17	0915MW17GW	9/5/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			
	MW22	0915MW22GW	9/9/2015	Peristaltic pump	Field Sample	X	X	X	X	X	X	X	X	X	X
		0915MW52GW	9/9/2015	Peristaltic pump	Field Duplicate of 0915MW22GW (organic analyses only)								X	X	X
Pre-1955 Main Processing Area	MW06	0915MW06GW	9/8/2015	Peristaltic pump	Field Sample	X	X	X	X	X	X	X			
	MW26	0915MW26GW	9/4/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			
	MW27	0915MW27GW	9/4/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			
	MW28	0915MW28GW	9/4/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			
Red Devil Creek Delta Area	MW32	0915MW32GW	9/8/2015	Peristaltic pump	Field Sample	X	X	X	X	X	X	X			
	MW33	0915MW33GW	9/8/2015	Peristaltic pump	Field Sample	X	X	X	X	X	X	X			
Surface Mined Area	MW29	0915MW29GW	9/7/2015	Bladder pump	Field Sample	X	X	X	X	X	X	X			
	MW30	Not sampled. Insufficient water.	NA	NA	NA										
	MW39	Not sampled. Dry.	NA	NA	NA										
	MW40	0915MW40GW	9/6/2015	Bladder pump	Field Sample	X	X	X	X	X	X	X			
	MW42	0915MW42GW	9/6/2015	Bladder pump	Field Sample	X	X	X	X	X	X	X			
	MW43	0915MW43GW	9/6/2015	Bladder pump	Field Sample	X	X	X	X	X	X	X			
		0915MW51GW	9/6/2015	Bladder pump	Field Duplicate of 0915MW43GW	X	X	X	X	X	X	X			
Upgradient of Post-1955 Main Processing Area	MW08	0915MW08GW	9/8/2015	Peristaltic pump	Field Sample	X	X	X	X	X	X	X			
Upgradient of Post-1955 Main Processing Area	MW19	0915MW19GW	9/8/2015	Peristaltic pump	Field Sample	X	X	X	X	X	X	X	X	X	X
Upland Area West of Surface Mined Area	MW31	0915MW31GW	9/6/2015	Submersible pump	Field Sample	X	X	X	X	X	X	X			

Key:
BTEX = Benzene, toluene, ethylbenzene, and xylenes
DRO = Diesel range organics
Environmental Protection Agency = EPA
GRO =Gasoline range organics
Hg = Mercury
MCAWW = Methods for Chemical Analysis of Water and Wastes
SVOCs = Semivolatile organic compounds
TAL = Target Analyte List

Table 3-4 Well Construction and Groundwater Depth Information

Monitoring Well ID	Soil Boring ID	Reported Well Total Depth As Constructed (feet bgs)	Reported Screened Interval (feet bgs)	Surveyed Ground Elevation (feet NAVD88)	Surveyed Top of Casing Elevation (feet NAVD88)	GW Encountered During Drilling (feet bgs)	Measured Well Total Depth (feet below TOC)	Static Water Level			Ground Water Elevation (feet NAVD88)
								Depth (feet below TOC)	Date	Time	
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD		21.72	8/14/2000	NR	235.79
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD		19.87	9/5/2007	13:15	237.64
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD		22.16	9/18/2008	13:28	235.35
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD		19.62	6/19/2009	NR	237.89
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD		22.27	10/6/2009	17:30	235.24
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD		20.04	9/20/2010	18:18	237.47
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD		19.46	8/24/2011	16:38	238.05
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD		19.55	9/1/2011	16:03	237.96
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD		17.56	5/26/2012	14:32	239.95
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD		18.62	9/9/2012	17:05	238.89
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD		19.43	6/17/2015	13:03	238.08
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD		20.80	8/12/2015	12:15	236.71
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD		21.03	9/2/2015	9:50	236.48
MW01	B01	29.5	19.0 - 29.0	254.51	257.51	17.8 - TD	29.82	20.36	9/10/2015	NR	237.15
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD		22.28	8/14/2000	NR	208.49
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD		20.68	9/5/2007	14:40	210.09
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD		22.57	9/18/2008	14:11	208.20
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD		19.51	6/19/2009	NR	211.26
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD		23.01	10/7/2009	13:20	207.76
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD		20.95	9/20/2010	19:50	209.82
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD		19.44	8/26/2011	10:18	211.33
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD		19.96	9/1/2011	15:41	210.81
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD		15.47	5/26/2012	15:17	215.30
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD		17.24	9/9/2012	17:10	213.53
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD		19.74	6/17/2015	10:54	211.03
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD		21.83	8/12/2015	12:33	208.94
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD		22.20	9/2/2015	9:45	208.57
MW03	B03	25.5	15.0 - 25.0	228.37	230.77	19.0 - TD	27.98	21.92	9/10/2015	NR	208.85
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD		27.77	8/14/2000	NR	214.35
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD		26.78	9/5/2007	12:25	215.34
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD		26.82	9/18/2008	12:32	215.30
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD		25.43	6/19/2009	NR	216.69
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD		27.77	10/6/2009	18:55	214.35
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD		26.79	9/20/2010	16:09	215.33
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD		25.24	8/22/2011	16:02	216.88
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD		25.99	9/1/2011	15:00	216.13
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD		21.72	5/26/2012	16:47	220.40
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD		23.72	9/10/2012	14:15	218.40
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD		26.95	6/17/2015	15:13	215.17

Table 3-4 Well Construction and Groundwater Depth Information

Monitoring Well ID	Soil Boring ID	Reported Well Total Depth As Constructed (feet bgs)	Reported Screened Interval (feet bgs)	Surveyed Ground Elevation (feet NAVD88)	Surveyed Top of Casing Elevation (feet NAVD88)	GW Encountered During Drilling (feet bgs)	Measured Well Total Depth (feet below TOC)	Static Water Level			Ground Water Elevation (feet NAVD88)
								Depth (feet below TOC)	Date	Time	
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD		NR	8/12/2015	NR	NR
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD		28.61	9/2/2015	11:40	213.51
MW04	B04	30.5	20.0 - 30.0	239.92	242.12	25.3 - TD	33.11	28.32	9/10/2015	NR	213.80
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD		19.29	8/14/2000	NR	198.20
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD		18.63	9/5/2007	15:30	198.86
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD		19.08	9/18/2008	11:35	198.41
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD		17.90	6/19/2009	NR	199.59
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD		19.29	10/7/2009	17:25	198.20
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD		19.03	9/20/2010	13:22	198.46
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD		18.78	8/24/2011	14:56	198.71
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD		18.70	9/1/2011	15:09	198.79
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD		16.25	5/26/2012	16:02	201.24
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD		18.29	9/9/2012	11:45	199.20
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD		18.24	6/17/2015	14:25	199.25
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD		19.17	8/12/2015	11:03	198.32
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD		19.20	9/2/2015	11:15	198.29
MW06	B06	23.5	13.0 - 23.0	214.99	217.49	20.0 - TD	26.19	19.18	9/10/2015	NR	198.31
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD		Dry	8/14/2000	NR	Dry (Water Elevation <257.4 ft bgs)
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD		20.42	9/5/2007	14:00	260.47
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD		Dry	9/18/2008	NR	Dry (Water Elevation <257.4 ft bgs)
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD		20.10	6/19/2009	NR	260.79
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD		Dry	10/7/2009	NR	Dry (Water Elevation <257.4 ft bgs)
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD		20.40	9/21/2010	10:20	260.49
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD		19.51	8/26/2011	9:12	261.38
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD		19.97	9/1/2011	16:14	260.92
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD		19.68	5/26/2012	13:36	261.21
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD		20.57	9/9/2012	16:45	260.32
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD		21.10	6/17/2015	12:25	259.79
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD		21.97	8/12/2015	11:54	258.92
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD		22.36	9/2/2015	10:50	258.53
MW07	B07	21.5	11.0 - 21.0	278.39	280.89	14.8 - TD	23.67	22.41	9/10/2015	NR	258.48
MW08	11MP01SB	16.0	5.0 - 15.0	328.92	331.32	2.5 - 4.0, 10.5 - TD		13.70	8/30/2011	9:21	317.62
MW08	11MP01SB	16.0	5.0 - 15.0	328.92	331.32	2.5 - 4.0, 10.5 - TD		13.65	9/1/2011	16:28	317.67
MW08	11MP01SB	16.0	5.0 - 15.0	328.92	331.32	2.5 - 4.0, 10.5 - TD		11.64	5/26/2012	13:23	319.68
MW08	11MP01SB	16.0	5.0 - 15.0	328.92	331.32	2.5 - 4.0, 10.5 - TD		12.74	9/9/2012	16:10	318.58
MW08	11MP01SB	16.0	5.0 - 15.0	328.92	331.32	2.5 - 4.0, 10.5 - TD		13.54	6/17/2015	12:41	317.78
MW08	11MP01SB	16.0	5.0 - 15.0	328.92	331.32	2.5 - 4.0, 10.5 - TD		14.87	8/12/2015	11:58	316.45
MW08	11MP01SB	16.0	5.0 - 15.0	328.92	331.32	2.5 - 4.0, 10.5 - TD		15.04	9/2/2015	10:35	316.28
MW08	11MP01SB	16.0	5.0 - 15.0	328.92	331.32	2.5 - 4.0, 10.5 - TD	17.61	14.89	9/10/2015	NR	316.43

Table 3-4 Well Construction and Groundwater Depth Information

Monitoring Well ID	Soil Boring ID	Reported Well Total Depth As Constructed (feet bgs)	Reported Screened Interval (feet bgs)	Surveyed Ground Elevation (feet NAVD88)	Surveyed Top of Casing Elevation (feet NAVD88)	GW Encountered During Drilling (feet bgs)	Measured Well Total Depth (feet below TOC)	Static Water Level			Ground Water Elevation (feet NAVD88)
								Depth (feet below TOC)	Date	Time	
MW09	11MP17SB	31.0	20.0 - 30.0	274.88	277.28	14.0 - 16.0, 31.0 - TD		>31.56	8/29/2011	18:21	--
MW09	11MP17SB	31.0	20.0 - 30.0	274.88	277.28	14.0 - 16.0, 31.0 - TD		28.11	9/1/2011	16:43	249.17
MW09	11MP17SB	31.0	20.0 - 30.0	274.88	277.28	14.0 - 16.0, 31.0 - TD		26.67	5/26/2012	14:04	250.61
MW09	11MP17SB	31.0	20.0 - 30.0	274.88	277.28	14.0 - 16.0, 31.0 - TD		27.88	9/9/2012	15:30	249.40
MW09	11MP17SB	31.0	20.0 - 30.0	274.88	277.28	14.0 - 16.0, 31.0 - TD		27.81	9/11/2012	11:20	249.47
MW09	11MP17SB	31.0	20.0 - 30.0	274.88	277.28	14.0 - 16.0, 31.0 - TD		27.60	6/17/2015	11:31	249.68
MW09	11MP17SB	31.0	20.0 - 30.0	274.88	277.28	14.0 - 16.0, 31.0 - TD		27.93	8/12/2015	12:04	249.35
MW09	11MP17SB	31.0	20.0 - 30.0	274.88	277.28	14.0 - 16.0, 31.0 - TD		28.30	9/2/2015	10:00	248.98
MW09	11MP17SB	31.0	20.0 - 30.0	274.88	277.28	14.0 - 16.0, 31.0 - TD	34.72	29.38	9/10/2015	NR	247.90
MW10	11MP14SB	61.0	50.0 - 60.0	274.31	276.21	48.0 - TD		30.60	8/29/2011	16:15	245.61
MW10	11MP14SB	61.0	50.0 - 60.0	274.31	276.21	48.0 - TD		29.17	9/1/2011	16:38	247.04
MW10	11MP14SB	61.0	50.0 - 60.0	274.31	276.21	48.0 - TD		25.62	5/26/2012	14:14	250.59
MW10	11MP14SB	61.0	50.0 - 60.0	274.31	276.21	48.0 - TD		26.39	9/9/2012	15:45	249.82
MW10	11MP14SB	61.0	50.0 - 60.0	274.31	276.21	48.0 - TD		26.88	9/10/2012	11:35	249.33
MW10	11MP14SB	61.0	50.0 - 60.0	274.31	276.21	48.0 - TD		28.98	6/17/2015	11:37	247.23
MW10	11MP14SB	61.0	50.0 - 60.0	274.31	276.21	48.0 - TD		32.90	8/12/2015	12:09	243.31
MW10	11MP14SB	61.0	50.0 - 60.0	274.31	276.21	48.0 - TD		33.52	9/2/2015	10:25	242.69
MW10	11MP14SB	61.0	50.0 - 60.0	274.31	276.21	48.0 - TD	63.54	31.02	9/10/2015	NR	245.19
MW11	11MP12SB	23.0	12.0 - 22.0	268.70	271.30	dry		Dry	8/29/2011	12:00	Dry (Water Elevation <246.7 ft bgs)
MW11	11MP12SB	23.0	12.0 - 22.0	268.70	271.30	dry		Dry	9/1/2011	16:34	Dry (Water Elevation <246.7 ft bgs)
MW11	11MP12SB	23.0	12.0 - 22.0	268.70	271.30	dry		22.60	5/26/2012	14:24	248.70
MW11	11MP12SB	23.0	12.0 - 22.0	268.70	271.30	dry		24.24	9/9/2012	16:00	Suspected Dry (Water Elevation <246.7 ft bgs)
MW11	11MP12SB	23.0	12.0 - 22.0	268.70	271.30	dry		23.69	6/17/2015	15:52	Suspected Dry (Water Elevation <246.7 ft bgs)
MW11	11MP12SB	23.0	12.0 - 22.0	268.70	271.30	dry		24.08	8/12/2015	12:11	Suspected Dry (Water Elevation <246.7 ft bgs)
MW11	11MP12SB	23.0	12.0 - 22.0	268.70	271.30	dry		24.36	9/2/2015	10:30	Suspected Dry (Water Elevation <246.7 ft bgs)
MW11	11MP12SB	23.0	12.0 - 22.0	268.70	271.30	dry	25.70	24.16	9/10/2015	NR	Suspected Dry (Water Elevation <246.7 ft bgs)
MW12	11RD13SB	15.0	4.0 - 14.0	263.22	265.62	1.0 - TD		3.72	8/31/2011	13:34	261.90
MW12	11RD13SB	15.0	4.0 - 14.0	263.22	265.62	1.0 - TD		3.70	9/1/2011	16:20	261.92
MW12	11RD13SB	15.0	4.0 - 14.0	263.22	265.62	1.0 - TD		2.46	5/26/2012	11:04	263.16
MW12	11RD13SB	15.0	4.0 - 14.0	263.22	265.62	1.0 - TD		3.30	9/9/2012	16:39	262.32
MW12	11RD13SB	15.0	4.0 - 14.0	263.22	265.62	1.0 - TD		5.02	6/17/2015	13:18	260.60
MW12	11RD13SB	15.0	4.0 - 14.0	263.22	265.62	1.0 - TD		6.80	8/12/2015	11:46	258.82
MW12	11RD13SB	15.0	4.0 - 14.0	263.22	265.62	1.0 - TD		6.98	9/2/2015	11:00	258.64
MW12	11RD13SB	15.0	4.0 - 14.0	263.22	265.62	1.0 - TD	17.68	5.97	9/10/2015	NR	259.65
MW13	11MP20SB	32.0	21.0 - 31.0	274.30	276.70	27.0 - TD		30.05	8/30/2011	18:04	246.65
MW13	11MP20SB	32.0	21.0 - 31.0	274.30	276.70	27.0 - TD		29.70	9/1/2011	16:09	247.00
MW13	11MP20SB	32.0	21.0 - 31.0	274.30	276.70	27.0 - TD		18.41	5/26/2012	13:45	258.29
MW13	11MP20SB	32.0	21.0 - 31.0	274.30	276.70	27.0 - TD		24.06	9/9/2012	16:50	252.64
MW13	11MP20SB	32.0	21.0 - 31.0	274.30	276.70	27.0 - TD		29.85	6/17/2015	12:13	246.85

Table 3-4 Well Construction and Groundwater Depth Information

Monitoring Well ID	Soil Boring ID	Reported Well Total Depth As Constructed (feet bgs)	Reported Screened Interval (feet bgs)	Surveyed Ground Elevation (feet NAVD88)	Surveyed Top of Casing Elevation (feet NAVD88)	GW Encountered During Drilling (feet bgs)	Measured Well Total Depth (feet below TOC)	Static Water Level			Ground Water Elevation (feet NAVD88)
								Depth (feet below TOC)	Date	Time	
MW13	11MP20SB	32.0	21.0 - 31.0	274.30	276.70	27.0 - TD		DRY	8/12/2015	11:51	Dry (Water Elevation <243.3 ft bgs)
MW13	11MP20SB	32.0	21.0 - 31.0	274.30	276.70	27.0 - TD		DRY	9/2/2015	10:45	Dry (Water Elevation <243.3 ft bgs)
MW13	11MP20SB	32.0	21.0 - 31.0	274.30	276.70	27.0 - TD	31.70	DRY	9/10/2015	NR	Dry (Water Elevation <243.3 ft bgs)
MW14	11MP25SB	36.0	25.0 - 35.0	246.71	249.01	25.7 - TD		30.51	8/31/2011	10:05	218.50
MW14	11MP25SB	36.0	25.0 - 35.0	246.71	249.01	25.7 - TD		30.01	9/1/2011	16:00	219.00
MW14	11MP25SB	36.0	25.0 - 35.0	246.71	249.01	25.7 - TD		24.40	5/26/2012	14:45	224.61
MW14	11MP25SB	36.0	25.0 - 35.0	246.71	249.01	25.7 - TD		27.34	9/10/2012	17:35	221.67
MW14	11MP25SB	36.0	25.0 - 35.0	246.71	249.01	25.7 - TD		--	--	--	Decommissioned in 2014 NTCRA
MW14	11MP25SB	36.0	25.0 - 35.0	246.71	249.01	25.7 - TD		--	--	--	Decommissioned in 2014 NTCRA
MW15	11MP29SB	26.0	15.0 - 25.0	242.63	244.93	16.2 - TD		19.64	8/30/2011	10:35	225.29
MW15	11MP29SB	26.0	15.0 - 25.0	242.63	244.93	16.2 - TD		19.59	9/1/2011	15:56	225.34
MW15	11MP29SB	26.0	15.0 - 25.0	242.63	244.93	16.2 - TD		18.33	5/26/2012	14:56	226.60
MW15	11MP29SB	26.0	15.0 - 25.0	242.63	244.93	16.2 - TD		18.3	9/8/2012	13:00	226.63
MW15	11MP29SB	26.0	15.0 - 25.0	242.63	244.93	16.2 - TD		--	--	--	Decommissioned in 2014 NTCRA
MW15	11MP29SB	26.0	15.0 - 25.0	242.63	244.93	16.2 - TD		--	--	--	Decommissioned in 2014 NTCRA
MW16	11MP30SB	22.0	11.0 - 21.0	226.09	228.09	16.0 - TD		13.84	8/30/2011	11:35	214.25
MW16	11MP30SB	22.0	11.0 - 21.0	226.09	228.09	16.0 - TD		14.90	9/1/2011	15:50	213.19
MW16	11MP30SB	22.0	11.0 - 21.0	226.09	228.09	16.0 - TD		6.17	5/26/2012	15:08	221.92
MW16	11MP30SB	22.0	11.0 - 21.0	226.09	228.09	16.0 - TD		8.88	9/8/2012	14:30	219.21
MW16	11MP30SB	22.0	11.0 - 21.0	226.09	228.09	16.0 - TD		13.13	6/18/2015	19:52	214.96
MW16	11MP30SB	22.0	11.0 - 21.0	226.09	228.09	16.0 - TD		14.80	8/12/2015	12:19	213.29
MW16	11MP30SB	22.0	11.0 - 21.0	226.09	228.09	16.0 - TD		15.19	9/2/2015	9:35	212.90
MW16	11MP30SB	22.0	11.0 - 21.0	226.09	228.09	16.0 - TD	24.14	14.81	9/10/2015	NR	213.28
MW17	11MP91SB	52.5	41.5 - 51.5	226.36	228.66	25.0 - 33.0, 33.0 - TD		15.00	8/30/2011	9:20	213.66
MW17	11MP91SB	52.5	41.5 - 51.5	226.36	228.66	25.0 - 33.0, 33.0 - TD		13.78	9/1/2011	15:52	214.88
MW17	11MP91SB	52.5	41.5 - 51.5	226.36	228.66	25.0 - 33.0, 33.0 - TD		8.20	5/26/2012	15:03	220.46
MW17	11MP91SB	52.5	41.5 - 51.5	226.36	228.66	25.0 - 33.0, 33.0 - TD		10.79	9/8/2012	16:20	217.87
MW17	11MP91SB	52.5	41.5 - 51.5	226.36	228.66	25.0 - 33.0, 33.0 - TD		15.03	6/18/2015	19:40	213.63
MW17	11MP91SB	52.5	41.5 - 51.5	226.36	228.66	25.0 - 33.0, 33.0 - TD		17.01	8/12/2015	12:18	211.65
MW17	11MP91SB	52.5	41.5 - 51.5	226.36	228.66	25.0 - 33.0, 33.0 - TD		17.28	9/2/2015	9:36	211.38
MW17	11MP91SB	52.5	41.5 - 51.5	226.36	228.66	25.0 - 33.0, 33.0 - TD	55.02	19.93	9/10/2015	NR	208.73
MW18	11MP31SB	40.0	29.0 - 39.0	241.33	243.83	38.0 - TD		29.66	8/31/2011	15:47	214.17
MW18	11MP31SB	40.0	29.0 - 39.0	241.33	243.83	38.0 - TD		29.87	9/1/2011	15:37	213.96
MW18	11MP31SB	40.0	29.0 - 39.0	241.33	243.83	38.0 - TD		21.82	5/26/2012	13:10	222.01
MW18	11MP31SB	40.0	29.0 - 39.0	241.33	243.83	38.0 - TD		24.83	9/9/2012	17:20	219.00
MW18	11MP31SB	40.0	29.0 - 39.0	241.33	243.83	38.0 - TD		29.17	6/17/2015	10:46	214.66
MW18	11MP31SB	40.0	29.0 - 39.0	241.33	243.83	38.0 - TD		31.43	8/12/2015	12:31	212.40
MW18	11MP31SB	40.0	29.0 - 39.0	241.33	243.83	38.0 - TD		31.65	9/2/2015	9:30	212.18
MW18	11MP31SB	40.0	29.0 - 39.0	241.33	243.83	38.0 - TD	41.57	31.20	9/10/2015	NR	212.63

Table 3-4 Well Construction and Groundwater Depth Information

Monitoring Well ID	Soil Boring ID	Reported Well Total Depth As Constructed (feet bgs)	Reported Screened Interval (feet bgs)	Surveyed Ground Elevation (feet NAVD88)	Surveyed Top of Casing Elevation (feet NAVD88)	GW Encountered During Drilling (feet bgs)	Measured Well Total Depth (feet below TOC)	Static Water Level			Ground Water Elevation (feet NAVD88)
								Depth (feet below TOC)	Date	Time	
MW19	11MP33SB	43.0	32.0 - 42.0	237.70	240.00	39.0 - TD		19.47	9/1/2011	15:32	220.53
MW19	11MP33SB	43.0	32.0 - 42.0	237.70	240.00	39.0 - TD		11.54	5/26/2012	12:59	228.46
MW19	11MP33SB	43.0	32.0 - 42.0	237.70	240.00	39.0 - TD		16.02	9/9/2012	17:25	223.98
MW19	11MP33SB	43.0	32.0 - 42.0	237.70	240.00	39.0 - TD		18.48	6/17/2015	10:31	221.52
MW19	11MP33SB	43.0	32.0 - 42.0	237.70	240.00	39.0 - TD		23.48	8/12/2015	12:33	216.52
MW19	11MP33SB	43.0	32.0 - 42.0	237.70	240.00	39.0 - TD		24.95	9/2/2015	9:20	215.05
MW19	11MP33SB	43.0	32.0 - 42.0	237.70	240.00	39.0 - TD	45.70	23.94	9/10/2015	NR	216.06
MW20	11MP38SB	15.5	4.5 - 14.5	212.90	215.20	6.5 - TD		6.89	8/31/2011	8:53	208.31
MW20	11MP38SB	15.5	4.5 - 14.5	212.90	215.20	6.5 - TD		6.97	9/1/2011	15:43	208.23
MW20	11MP38SB	15.5	4.5 - 14.5	212.90	215.20	6.5 - TD		4.82	5/26/2012	15:26	210.38
MW20	11MP38SB	15.5	4.5 - 14.5	212.90	215.20	6.5 - TD		5.53	9/9/2012	10:10	209.67
MW20	11MP38SB	15.5	4.5 - 14.5	212.90	215.20	6.5 - TD		7.11	6/17/2015	10:18	208.09
MW20	11MP38SB	15.5	4.5 - 14.5	212.90	215.20	6.5 - TD		7.92	8/12/2015	12:39	207.28
MW20	11MP38SB	15.5	4.5 - 14.5	212.90	215.20	6.5 - TD		8.12	9/2/2015	9:10	207.08
MW20	11MP38SB	15.5	4.5 - 14.5	212.90	215.20	6.5 - TD	17.70	7.96	9/10/2015	NR	207.24
MW21	11MP39SB	17.5	6.5 - 16.5	208.23	210.13	7.0 - TD		8.80	8/31/2011	10:16	201.33
MW21	11MP39SB	17.5	6.5 - 16.5	208.23	210.13	7.0 - TD		8.82	9/1/2011	17:10	201.31
MW21	11MP39SB	17.5	6.5 - 16.5	208.23	210.13	7.0 - TD		7.91	5/26/2012	15:36	202.22
MW21	11MP39SB	17.5	6.5 - 16.5	208.23	210.13	7.0 - TD		8.29	9/8/2012	17:35	201.84
MW21	11MP39SB	17.5	6.5 - 16.5	208.23	210.13	7.0 - TD		8.55	6/17/2015	10:08	201.58
MW21	11MP39SB	17.5	6.5 - 16.5	208.23	210.13	7.0 - TD		9.10	8/12/2015	12:39	201.03
MW21	11MP39SB	17.5	6.5 - 16.5	208.23	210.13	7.0 - TD		9.45	9/2/2015	9:00	200.68
MW21	11MP39SB	17.5	6.5 - 16.5	208.23	210.13	7.0 - TD	10.67	9.14	9/10/2015	NR	200.99
MW22	11MP40SB	15.5	4.5 - 14.5	203.10	205.10	7.8 - TD		8.20	8/31/2011	11:08	196.90
MW22	11MP40SB	15.5	4.5 - 14.5	203.10	205.10	7.8 - TD		8.48	9/1/2011	17:04	196.62
MW22	11MP40SB	15.5	4.5 - 14.5	203.10	205.10	7.8 - TD		5.55	5/26/2012	15:44	199.55
MW22	11MP40SB	15.5	4.5 - 14.5	203.10	205.10	7.8 - TD		7.77	9/9/2012	17:35	197.33
MW22	11MP40SB	15.5	4.5 - 14.5	203.10	205.10	7.8 - TD		8.47	6/17/2015	9:46	196.63
MW22	11MP40SB	15.5	4.5 - 14.5	203.10	205.10	7.8 - TD		10.01	8/12/2015	12:43	195.09
MW22	11MP40SB	15.5	4.5 - 14.5	203.10	205.10	7.8 - TD		10.33	9/2/2015	8:50	194.77
MW22	11MP40SB	15.5	4.5 - 14.5	203.10	205.10	7.8 - TD	17.74	10.19	9/10/2015	NR	194.91
MW23	11MP66SB	29.0	18.0 - 28.0	201.96	204.16	20.0 - TD		16.02	8/30/2011	16:31	188.14
MW23	11MP66SB	29.0	18.0 - 28.0	201.96	204.16	20.0 - TD		16.01	9/1/2011	15:14	188.15
MW23	11MP66SB	29.0	18.0 - 28.0	201.96	204.16	20.0 - TD		14.60	5/26/2012	15:56	189.56
MW23	11MP66SB	29.0	18.0 - 28.0	201.96	204.16	20.0 - TD		15.56	9/9/2012	17:47	188.60
MW23	11MP66SB	29.0	18.0 - 28.0	201.96	204.16	20.0 - TD		15.88	6/17/2015	14:15	188.28
MW23	11MP66SB	29.0	18.0 - 28.0	201.96	204.16	20.0 - TD		16.92	8/12/2015	11:06	187.24
MW23	11MP66SB	29.0	18.0 - 28.0	201.96	204.16	20.0 - TD		16.63	9/2/2015	11:10	187.53
MW23	11MP66SB	29.0	18.0 - 28.0	201.96	204.16	20.0 - TD	30.95	16.54	9/10/2015	NR	187.62

Table 3-4 Well Construction and Groundwater Depth Information

Monitoring Well ID	Soil Boring ID	Reported Well Total Depth As Constructed (feet bgs)	Reported Screened Interval (feet bgs)	Surveyed Ground Elevation (feet NAVD88)	Surveyed Top of Casing Elevation (feet NAVD88)	GW Encountered During Drilling (feet bgs)	Measured Well Total Depth (feet below TOC)	Static Water Level			Ground Water Elevation (feet NAVD88)
								Depth (feet below TOC)	Date	Time	
MW24	11MP62SB	30.0	19.0 - 29.0	221.41	223.51	20.0 - TD		17.70	8/30/2011	14:51	205.81
MW24	11MP62SB	30.0	19.0 - 29.0	221.41	223.51	20.0 - TD		17.61	9/1/2011	15:06	205.90
MW24	11MP62SB	30.0	19.0 - 29.0	221.41	223.51	20.0 - TD		14.59	5/26/2012	16:15	208.92
MW24	11MP62SB	30.0	19.0 - 29.0	221.41	223.51	20.0 - TD		16.45	9/9/2012	14:00	207.06
MW24	11MP62SB	30.0	19.0 - 29.0	221.41	223.51	20.0 - TD		16.89	6/17/2015	14:31	206.62
MW24	11MP62SB	30.0	19.0 - 29.0	221.41	223.51	20.0 - TD		17.88	8/12/2015	10:58	205.63
MW24	11MP62SB	30.0	19.0 - 29.0	221.41	223.51	20.0 - TD		19.02	9/2/2015	11:12	204.49
MW24	11MP62SB	30.0	19.0 - 29.0	221.41	223.51	20.0 - TD	32.30	17.88	9/10/2015	NR	205.63
MW25	11MP89SB	42.0	31.0 - 41.0	237.56	239.76	32.0 - TD		31.85	8/30/2011	18:02	207.91
MW25	11MP89SB	42.0	31.0 - 41.0	237.56	239.76	32.0 - TD		31.88	9/1/2011	14:50	207.88
MW25	11MP89SB	42.0	31.0 - 41.0	237.56	239.76	32.0 - TD		29.74	5/26/2012	16:22	210.02
MW25	11MP89SB	42.0	31.0 - 41.0	237.56	239.76	32.0 - TD		33.87	9/9/2012	10:30	205.89
MW25	11MP89SB	42.0	31.0 - 41.0	237.56	239.76	32.0 - TD		31.81	6/17/2015	14:40	207.95
MW25	11MP89SB	42.0	31.0 - 41.0	237.56	239.76	32.0 - TD		32.48	8/12/2015	10:56	207.28
MW25	11MP89SB	42.0	31.0 - 41.0	237.56	239.76	32.0 - TD		32.60	9/2/2015	11:20	207.16
MW25	11MP89SB	42.0	31.0 - 41.0	237.56	239.76	32.0 - TD	44.43	32.45	9/10/2015	NR	207.31
MW26	11MP52SB	43.0	32.0 - 42.0	244.03	245.93	34.0 - TD		36.25	8/30/2011	11:35	209.68
MW26	11MP52SB	43.0	32.0 - 42.0	244.03	245.93	34.0 - TD		36.30	9/1/2011	14:47	209.63
MW26	11MP52SB	43.0	32.0 - 42.0	244.03	245.93	34.0 - TD		32.76	5/26/2012	16:30	213.17
MW26	11MP52SB	43.0	32.0 - 42.0	244.03	245.93	34.0 - TD		34.01	9/9/2012	17:55	211.92
MW26	11MP52SB	43.0	32.0 - 42.0	244.03	245.93	34.0 - TD		36.04	6/17/2015	14:48	209.89
MW26	11MP52SB	43.0	32.0 - 42.0	244.03	245.93	34.0 - TD		36.98	8/12/2015	10:50	208.95
MW26	11MP52SB	43.0	32.0 - 42.0	244.03	245.93	34.0 - TD		37.24	9/2/2015	11:25	208.69
MW26	11MP52SB	43.0	32.0 - 42.0	244.03	245.93	34.0 - TD	45.13	36.42	9/10/2015	NR	209.51
MW27	11MP60SB	34.0	23.0 - 33.0	241.04	242.94	29.0 - TD		30.30	8/30/2011	16:50	212.64
MW27	11MP60SB	34.0	23.0 - 33.0	241.04	242.94	29.0 - TD		30.37	9/1/2011	14:58	212.57
MW27	11MP60SB	34.0	23.0 - 33.0	241.04	242.94	29.0 - TD		26.28	5/26/2012	16:38	216.66
MW27	11MP60SB	34.0	23.0 - 33.0	241.04	242.94	29.0 - TD		28.64	9/9/2012	12:50	214.30
MW27	11MP60SB	34.0	23.0 - 33.0	241.04	242.94	29.0 - TD		34.41	6/17/2015	14:58	Suspected Dry (Water Elevation <208.4 ft)
MW27	11MP60SB	34.0	23.0 - 33.0	241.04	242.94	29.0 - TD		NR	8/12/2015	NR	--
MW27	11MP60SB	34.0	23.0 - 33.0	241.04	242.94	29.0 - TD		31.42	9/2/2015	22:30	211.52
MW27	11MP60SB	34.0	23.0 - 33.0	241.04	242.94	29.0 - TD	35.77	31.24	9/10/2015	NR	211.52
MW28	11MP88SB	64.0	53.0 - 63.0	239.94	241.94	49.0 - TD		25.50	8/30/2011	14:57	216.44
MW28	11MP88SB	64.0	53.0 - 63.0	239.94	241.94	49.0 - TD		28.61	9/1/2011	14:53	213.33
MW28	11MP88SB	64.0	53.0 - 63.0	239.94	241.94	49.0 - TD		24.19	5/26/2012	16:41	217.75
MW28	11MP88SB	64.0	53.0 - 63.0	239.94	241.94	49.0 - TD		27.01	9/10/2012	15:43	214.93
MW28	11MP88SB	64.0	53.0 - 63.0	239.94	241.94	49.0 - TD		28.90	6/17/2015	15:08	213.04
MW28	11MP88SB	64.0	53.0 - 63.0	239.94	241.94	49.0 - TD		29.88	8/12/2015	10:46	212.06
MW28	11MP88SB	64.0	53.0 - 63.0	239.94	241.94	49.0 - TD		30.10	9/2/2015	11:35	211.84

Table 3-4 Well Construction and Groundwater Depth Information

Monitoring Well ID	Soil Boring ID	Reported Well Total Depth As Constructed (feet bgs)	Reported Screened Interval (feet bgs)	Surveyed Ground Elevation (feet NAVD88)	Surveyed Top of Casing Elevation (feet NAVD88)	GW Encountered During Drilling (feet bgs)	Measured Well Total Depth (feet below TOC)	Static Water Level			Ground Water Elevation (feet NAVD88)
								Depth (feet below TOC)	Date	Time	
MW28	11MP88SB	64.0	53.0 - 63.0	239.94	241.94	49.0 - TD	65.87	29.95	9/10/2015	NR	211.99
MW29	11MP41SB	70.0	59.0 - 69.0	280.35	282.25	61.0 - TD		63.21	9/1/2011	13:20	219.04
MW29	11MP41SB	70.0	59.0 - 69.0	280.35	282.25	61.0 - TD		52.65	5/26/2012	17:09	229.60
MW29	11MP41SB	70.0	59.0 - 69.0	280.35	282.25	61.0 - TD		61.20	9/9/2012	16:22	221.05
MW29	11MP41SB	70.0	59.0 - 69.0	280.35	282.25	61.0 - TD		64.08	6/17/2015	15:41	218.17
MW29	11MP41SB	70.0	59.0 - 69.0	280.35	282.25	61.0 - TD		66.60	8/12/2015	11:12	215.65
MW29	11MP41SB	70.0	59.0 - 69.0	280.35	282.25	61.0 - TD		66.89	9/2/2015	12:11	215.36
MW29	11MP41SB	70.0	59.0 - 69.0	280.35	282.25	61.0 - TD	71.75	66.81	9/10/2015	NR	215.44
MW30	11SM31SB	53.0	42.0 - 52.0	275.71	277.41	45.0 - TD		53.53	9/1/2011	14:35	Suspected Dry (Water Elevation <223.7 ft)
MW30	11SM31SB	53.0	42.0 - 52.0	275.71	277.41	45.0 - TD		52.63	5/26/2012	16:58	Suspected Dry (Water Elevation <223.7 ft)
MW30	11SM31SB	53.0	42.0 - 52.0	275.71	277.41	45.0 - TD		NR	9/9/2012	NR	Suspected Dry (Water Elevation <223.7 ft)
MW30	11SM31SB	53.0	42.0 - 52.0	275.71	277.41	45.0 - TD		54.25	6/17/2015	19:33	Suspected Dry (Water Elevation <223.7 ft)
MW30	11SM31SB	53.0	42.0 - 52.0	275.71	277.41	45.0 - TD		54.28	8/12/2015	11:19	Suspected Dry (Water Elevation <223.7 ft)
MW30	11SM31SB	53.0	42.0 - 52.0	275.71	277.41	45.0 - TD		54.32	9/2/2015	12:15	Suspected Dry (Water Elevation <223.7 ft)
MW30	11SM31SB	53.0	42.0 - 52.0	275.71	277.41	45.0 - TD	55.63	54.45	9/10/2015	NR	Suspected Dry (Water Elevation <223.7 ft)
MW31	11UP11SB	44.8	33.8 - 43.8	495.79	497.99	34.0 - TD		37.75	8/29/2011	13:51	460.24
MW31	11UP11SB	44.8	33.8 - 43.8	495.79	497.99	34.0 - TD		37.51	9/1/2011	14:05	460.48
MW31	11UP11SB	44.8	33.8 - 43.8	495.79	497.99	34.0 - TD		34.12	5/26/2012	10:10	463.87
MW31	11UP11SB	44.8	33.8 - 43.8	495.79	497.99	34.0 - TD		36.29	9/9/2012	18:10	461.70
MW31	11UP11SB	44.8	33.8 - 43.8	495.79	497.99	34.0 - TD		39.31	6/22/2015	19:09	458.68
MW31	11UP11SB	44.8	33.8 - 43.8	495.79	497.99	34.0 - TD		42.25	8/12/2015	11:31	455.74
MW31	11UP11SB	44.8	33.8 - 43.8	495.79	497.99	34.0 - TD		43.07	9/2/2015	12:45	454.92
MW31	11UP11SB	44.8	33.8 - 43.8	495.79	497.99	34.0 - TD	47.10	41.75	9/10/2015	NR	456.24
MW32	11RD05SB	25.0	14.0 - 24.0	194.38	196.58	16.5 - TD		18.90	8/31/2011	15:55	177.68
MW32	11RD05SB	25.0	14.0 - 24.0	194.38	196.58	16.5 - TD		18.86	9/1/2011	15:26	177.72
MW32	11RD05SB	25.0	14.0 - 24.0	194.38	196.58	16.5 - TD		16.71	5/26/2012	12:45	179.87
MW32	11RD05SB	25.0	14.0 - 24.0	194.38	196.58	16.5 - TD		17.21	9/8/2012	15:40	179.37
MW32	11RD05SB	25.0	14.0 - 24.0	194.38	196.58	16.5 - TD		19.03	6/17/2015	9:30	177.55
MW32	11RD05SB	25.0	14.0 - 24.0	194.38	196.58	16.5 - TD		19.49	8/12/2015	12:47	177.09
MW32	11RD05SB	25.0	14.0 - 24.0	194.38	196.58	16.5 - TD		20.17	9/2/2015	12:45	176.41
MW32	11RD05SB	25.0	14.0 - 24.0	194.38	196.58	16.5 - TD	26.73	20.05	9/10/2015	NR	176.53
MW33	11RD20SB	23.0	12.0 - 22.0	176.62	178.92	10.5 - TD		8.14	8/31/2011	17:57	170.78
MW33	11RD20SB	23.0	12.0 - 22.0	176.62	178.92	10.5 - TD		8.19	9/1/2011	15:20	170.73
MW33	11RD20SB	23.0	12.0 - 22.0	176.62	178.92	10.5 - TD		3.98	5/26/2012	12:33	174.94
MW33	11RD20SB	23.0	12.0 - 22.0	176.62	178.92	10.5 - TD		5.97	9/8/2012	12:30	172.95
MW33	11RD20SB	23.0	12.0 - 22.0	176.62	178.92	10.5 - TD		8.50	6/17/2015	14:04	170.42
MW33	11RD20SB	23.0	12.0 - 22.0	176.62	178.92	10.5 - TD		9.05	8/12/2015	11:09	169.87
MW33	11RD20SB	23.0	12.0 - 22.0	176.62	178.92	10.5 - TD		9.23	9/2/2015	8:40	169.69
MW33	11RD20SB	23.0	12.0 - 22.0	176.62	178.92	10.5 - TD	24.26	9.12	9/10/2015	NR	169.80

Table 3-4 Well Construction and Groundwater Depth Information

Monitoring Well ID	Soil Boring ID	Reported Well Total Depth As Constructed (feet bgs)	Reported Screened Interval (feet bgs)	Surveyed Ground Elevation (feet NAVD88)	Surveyed Top of Casing Elevation (feet NAVD88)	GW Encountrered During Drilling (feet bgs)	Measured Well Total Depth (feet below TOC)	Static Water Level			Ground Water Elevation (feet NAVD88)
								Depth (feet below TOC)	Date	Time	
MW34	AST5 MW1	NR	NR	290.95	294.25			15.57	9/1/2011	16:49	278.68
MW34	AST5 MW1	NR	NR	290.95	294.25			15.82	6/22/2015	11:54	278.43
MW34	AST5 MW1	NR	NR	290.95	294.25			17.11	9/2/2015	10:20	277.14
MW34	AST5 MW1	NR	NR	290.95	294.25		22.80	16.38	9/10/2015	NE	277.87
MW35	AST5 MW2	NR	NR	285.76	289.26			41.97	9/1/2011	16:55	247.29
MW35	AST5 MW2	NR	NR	285.76	289.26			40.01	6/22/2015	11:58	249.25
MW35	AST5 MW2	NR	NR	285.76	289.26			44.94	9/2/2015	10:15	244.32
MW35	AST5 MW2	NR	NR	285.76	289.26		55.30	44.42	9/10/2015	NR	244.84
MW36	AST5 MW3	NR	NR	286.33	290.03			35.81	9/1/2011	16:57	254.22
MW36	AST5 MW3	NR	NR	286.33	290.03			33.16	6/22/2015	12:08	256.87
MW36	AST5 MW3	NR	NR	286.33	290.03			40.89	9/2/2015	10:10	249.14
MW36	AST5 MW3	NR	NR	286.33	290.03		65.38	39.39	9/10/2015	NR	250.64
MW39	SM67	84.0	63 - 83	432.83	435.26			85.11	8/3/2015	9:00	Suspected Dry (Water Elevation <349.8 ft)
MW39	SM67	84.0	63 - 83	432.83	435.26			Dry (>84)	8/12/2015	11:25	Dry (Water Elevation <349.8 ft)
MW39	SM67	84.0	63 - 83	432.83	435.26			Dry (>84)	9/2/2015	12:35	Dry (Water Elevation <349.8 ft)
MW39	SM67	84.0	63 - 83	432.83	435.26		86.02	Dry (>84)	9/10/2015	NR	Dry (Water Elevation <349.8 ft)
MW40	SM68c	140.0	119 - 139	392.86	395.18	135		131.11	8/12/2015	11:37	264.07
MW40	SM68c	140.0	119 - 139	392.86	395.18	135		131.49	9/2/2015	12:25	263.69
MW40	SM68c	140.0	119 - 139	392.86	395.18	135	142.45	131.60	9/10/2015	NR	263.58
MW42	SM70b	140.0	119 - 139	339.85	342.34	99		NR	8/12/2015	NR	
MW42	SM70b	140.0	119 - 139	339.85	342.34	99		129.10	9/2/2015	11:50	213.24
MW42	SM70b	140.0	119 - 139	339.85	342.34	99	142.97	129.01	9/10/2015	NR	213.33
MW43	SM71b	118.5	98 - 118	300.87	303.69	94		90.25	8/12/2015	10:33	213.44
MW43	SM71b	118.5	98 - 118	300.87	303.69	94		90.42	9/2/2015	12:00	213.27
MW43	SM71b	118.5	98 - 118	300.87	303.69	94	121.13	90.34	9/10/2015	NR	213.35

Notes

Elevation datum: NAVD88 calculated using GEOID09.

Top of casing (TOC) refers to the top of PVC inner casing.

Key

NR	Not Recorded
TD	Total depth
TOC	Top of Casing
bgs	Below ground surface

Table 3-5 Groundwater Sample Results, Spring 2015

Analyte	Station ID		Units	MW08	MW19	MW10	MW01	MW22	MW26	MW27	MW28	MW06	MW32	MW33	MW29	MW31
	Geographic Area			Post-1955 MPA					Pre-1955 MPA				Red Devil Creek Downstream Alluvial Area and Delta		Surface Mined Area	Upland Area West of Surface Mined Area
	Sample ID Method			0615MW08GW	0615MW19GW	0615MW10GW	0615MW01GW	0615MW22GW	0615MW26GW	0615MW27GW	0615MW28GW	0615MW06GW	0615MW32GW	0615MW33GW	0615MW29GW	0615MW31GW
Total Inorganic Elements																
Aluminum	Metals (ICP)	SW846 6010B	µg/L	190 U	190 U	190 U	**1300 J**	190 U	190 U	190 U	**350 J**	190 U	190 U	**840 J**	**720 J**	**3900**
Antimony	Metals (ICP/MS)	SW846 6020A	µg/L	**0.24 J**	**0.21 J**	**0.21 J**	**11**	**340**	**37**	**11**	**7**	**6.1**	**1.2**	**430**	**0.75 J**	**0.36 J**
Arsenic	Metals (ICP/MS)	SW846 6020A	µg/L	**0.27 J**	**0.55 J**	**95**	**130**	**59**	**1300**	**29**	**75**	**34**	**0.65 J**	**23**	**75**	**4.1**
Barium	Metals (ICP/MS)	SW846 6020A	µg/L	**38**	**46**	**88**	**200**	**46**	**610**	**40**	**54**	**80**	**14**	**39**	**250**	**94**
Beryllium	Metals (ICP/MS)	SW846 6020A	µg/L	0.1 U	0.1 U	0.1 U	**0.21 J**	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	**0.19 J**
Cadmium	Metals (ICP/MS)	SW846 6020A	µg/L	0.028 U	0.028 U	0.028 U	**0.19 J**	0.028 U	0.028 U	**0.091 J**	0.028 U	0.028 U	0.028 U	0.028 U	0.028 U	**0.036 J**
Calcium	Metals (ICP)	SW846 6010B	µg/L	**11000**	**18000**	**21000**	**18000**	**14000**	**66000**	**86000**	**40000**	**31000**	**11000**	**15000**	**53000**	**7800**
Chromium	Metals (ICP/MS)	SW846 6020A	µg/L	**0.33 J**	**0.2 J**	**1.5**	**30**	**0.31 J**	1.9 U	**16**	**8.6**	0.14 U	**0.43**	**2**	**20**	**56**
Cobalt	Metals (ICP/MS)	SW846 6020A	µg/L	0.032 U	**0.045 J**	**0.98**	**1.5**	**0.032 J**	**12**	**2.7 J**	**4.7**	**1.1**	**0.13 J**	**0.44**	**1.9**	**5.1**
Copper	Metals (ICP/MS)	SW846 6020A	µg/L	0.6 U	0.6 U	0.6 U	7.2 U	**0.7 J**	**1.1 J**	4 U	**1.6 J**	0.6 U	**0.79 J**	**2.4**	2.9 U	11 U
Iron	Metals (ICP)	SW846 6010B	µg/L	180 U	180 U	**930**	**56000**	180 U	**56000**	**740**	**1400**	**2100**	180 U	**1100**	**3900**	**6800**
Lead	Metals (ICP/MS)	SW846 6020A	µg/L	0.034 U	0.034 U	0.034 U	**2.8**	0.034 U	**0.065 J**	**0.1 J**	**0.38 J**	0.034 U	**0.041 J**	**1.3**	**0.71**	**3.9**
Magnesium	Metals (ICP)	SW846 6010B	µg/L	**8400**	**13000**	**32000**	**12000**	**11000**	**40000**	**53000**	**30000**	**30000**	**9100**	**11000**	**52000**	**5800**
Manganese	Metals (ICP/MS)	SW846 6020A	µg/L	0.35 U	**6.7 J**	**110**	**220**	**2 J**	**6300**	**750**	**890**	**550**	**12**	**37**	**450**	**220**
Mercury	Mercury (CVAA)	SW846 7470A	µg/L	0.041 U	0.041 U	0.041 U	**0.76**	**0.057 J**	**0.4**	**0.14 J**	**0.92**	0.041 U	0.041 U	**0.42**	**0.19 J**	**0.34**
Nickel	Metals (ICP/MS)	SW846 6020A	µg/L	**0.73 J**	0.4 U	**1.7 J**	**23**	**1.2 J**	**8.3 J**	**41**	**14 J**	**1.8 J**	**5**	**2.2 J**	**18**	**44**
Potassium	Metals (ICP)	SW846 6010B	µg/L	**410 J**	**290 J**	**1000 J**	**760 J**	**360 J**	**3400**	**1400 J**	**990 J**	**760 J**	**360 J**	**840 J**	**1100 J**	**1700 J**
Selenium	Metals (ICP/MS)	SW846 6020A	µg/L	**0.58 J**	**0.91 J**	0.3 U	**2**	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	**0.92 J**	**0.47 J**	0.3 U	**0.67 J**
Silver	Metals (ICP/MS)	SW846 6020A	µg/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	**0.23 J**
Sodium	Metals (ICP)	SW846 6010B	µg/L	**1300 J**	**2400**	**3500**	**2500**	**2600**	**6300**	**16000**	**11000**	**4300**	**1600 J**	**4100**	**2400**	**1500 J**
Thallium	Metals (ICP/MS)	SW846 6020A	µg/L	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Vanadium	Metals (ICP/MS)	SW846 6020A	µg/L	0.98 U	0.98 U	0.98 U	**16**	0.98 U	0.98 U	0.98 U	**1.2 J**	0.98 U	0.98 U	**3.3 J**	**2.9 J**	**11**
Zinc	Metals (ICP/MS)	SW846 6020A	µg/L	1.9 U	**1.9 J**	1.9 U	**15**	1.9 U	**4.9 J**	**16 J**	**2.8 J**	1.9 U	**11**	**6.9 J**	**5.6 J**	**21 J**
Total Low Level Mercury																
Mercury	Total Mercury by EPA 1631	EPA 1631	ng/L	**2.35**	2.01 U	**7.95**	**532**	**246**	**483**	**663**	**1890**	**4**	**47.9**	**745**	**215**	**376**
Dissolved Low Level Mercury																
Mercury	Dissolved Mercury by EPA 1631	EPA 1631	ng/L	**1.48**	**0.91**	**2.32**	**4.52**	**108**	**32.4**	**131**	**27.5**	**0.51**	**18.5**	**5.84**	**1.45**	**14.5**
Semivolatile Organic Compounds																
Benzoic acid	Semivolatile Organic Compounds (GC/MS)	SW846 8270D	µg/L		**0.82 J**			**0.75 J**								
Benzyl alcohol	Semivolatile Organic Compounds (GC/MS)	SW846 8270D	µg/L		0.095 U			**0.1 J**								
Butyl benzyl phthalate	Semivolatile Organic Compounds (GC/MS)	SW846 8270D	µg/L		0.19 U			**0.19 J**								
Diethyl phthalate	Semivolatile Organic Compounds (GC/MS)	SW846 8270D	µg/L		**0.2 J**			**0.2 J**								
2-Fluorobiphenyl	Semivolatile Organic Compounds (GC/MS)	SW846 8270D	µg/L		**86**			**80**								
Benzene, Toluene, Ethylbenzene, and Xylenes																
Benzene	Volatile Organic Compounds (GC/MS)	SW846 8260C	µg/L		0.025 U			0.025 U								
Toluene	Volatile Organic Compounds (GC/MS)	SW846 8260C	µg/L		0.025 U			**0.054 J**								
Ethylbenzene	Volatile Organic Compounds (GC/MS)	SW846 8260C	µg/L		0.03 U			0.03 U								
m-Xylene & p-Xylene	Volatile Organic Compounds (GC/MS)	SW846 8260C	µg/L		0.05 U			0.05 U								
o-Xylene	Volatile Organic Compounds (GC/MS)	SW846 8260C	µg/L		0.06 U			0.06 U								
Gasoline Range Organics and Diesel Range Organics																
Gasoline Range Organics (GRO)-C6-C10	Alaska - Gasoline Range Organics (GC)	ADEC AK101	mg/L		0.015 U			0.015 U								
DRO (nC10-<nC25)	Alaska - Diesel Range Organics & Residual Range Organics (GC)	ADEC AK102 & 103	mg/L		0.022 UJ-			**0.063 J**								
General Chemistry																
Total Suspended Solids	Solids, Total Suspended (TSS)	SM 2540D	mg/L	2 UJ		2 UJ	**180 J**	2 U	**98**	**2.8 J**	**20**	**2.8 J**	2 UJ	**20 J**	**64**	35 U
Chloride	Anions, Ion Chromatography	MCAWW 300.0	mg/L	**0.7 J**	**0.49 J**	**0.66 J**	**0.7 J**	**0.42 J**	**0.82 J**	**1.2**	**0.78 J**	**0.71 J**	**0.46 J**	**0.65 J**	**0.62 J**	**0.5 J**
Fluoride	Anions, Ion Chromatography	MCAWW 300.0	mg/L	**0.12**	**0.13**	**0.17**	**0.11**	**0.12**	**0.29**	**0.16**	**0.18**	**0.17**	**0.06 J**	**0.07 J**	**0.14**	**0.07 J**
Sulfate	Anions, Ion Chromatography	MCAWW 300.0	mg/L	**4.2**	**5.6**	8.9 U	11 U	**5.3**	70 U	170 U	40 U	**20**	**11**	**14**	32 U	1 U
Carbonate Alkalinity as CaCO3	Alkalinity	SM 2320B	mg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bicarbonate Alkalinity as CaCO3	Alkalinity	SM 2320B	mg/L	**57**	**110**	**180**	**81**	**78**	**280**	**270**	**200**	**180**	**52**	**99**	**310**	**40**
Hydroxide Alkalinity as CaCO3	Alkalinity	SM 2320B	mg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Alkalinity	Alkalinity	SM 2320B	mg/L	**57**	**110**	**180**	**81**	**78**	**280**	**270**	**200**	**180**	**52**	**99**	**310**	**40**
Nitrate Nitrite as N	Nitrogen, Nitrate-Nitrite	MCAWW 353.2	mg/L	**0.35**	**0.12**	0.005 U	**0.054**	**0.02 J**	0.005 U	**0.069**	0.005 U	0.005 U	**1.2**	**0.17**	**0.012 J**	**0.038 J**
Field Water Quality Parameters																
Temperature	Field Measurement		Deg C	4.45	7.35	13.64	13.9	15.5	18.16	19.58	17.74	11.26	19.58	9.31	12.67	10.86
pH	Field Measurement		pH Units	6.25	6.91	7.65	6.28	6.21	6.78	6.32	7.13	6.31	5.73	6.35	6.47	5.99
Conductivity	Field Measurement		mS/cm	0.138	0.206	0.367	0.185	0.169	0.832	0.874	0.466	0.39	0.153	0.192	0.647	0.09
Turbidity	Field Measurement		NTU	0	0	0	171	0	0	21.4	7.9	12.9	0	12.3	40.6	6.7
Dissolved Oxygen	Field Measurement		mg/L	0	0	0	0	0	0	0	0	0	1.142	0	0	2.54
Oxidation-Reduction Potential	Field Measurement		mV	207	49	-115	60	91	-142	49	-84	-46	174	123	-29	119

Key
µg/L = Micrograms per liter
ADEC = Alaska Department of Environmental Conservation
Bold = Detected
Deg C = Degrees Celsius.
EPA = United States Environmental Protection Agency
GC/MS = Gas Chromatography/Mass Spectrometry
ICP/ MS = Inductively coupled plasma/mass spectrometry
J = The analyte was detected. The associated result is estimated.
mg/L = milligrams per liter
mS/cm = Millisiemens per centimeter
mV = Millivolts
ng/L = Nanograms per liter
NTU = Nephelometric turbidity units
U = The analyte was analyzed for but not detected. The value provided is the method detection limit.
UJ- = The analyte was analyzed for but not detected. The associated reporting limit is estimated with a low bias.
UJ = The analyte was analyzed for but not detected. The associated reporting limit is estimated.

Table 3-6 Groundwater Sample Results, Fall 2015

Analyte	Station ID		Units	MW08	MW09	MW19	MW10	MW01	MW16	MW17	MW22	MW26	MW27	MW28	MW06	MW32	MW33	MW40	MW42	MW43	MW29	MW31
	Geographic Area			Post-1955 MPA								Pre-1955 MPA				Red Devil Creek Downstream Alluvial Area and Delta		Surface Mined Area				Upland Area West of Surface Mined Area
	Sample ID / Method			0915MW08GW	0915MW09GW	0915MW19GW	0915MW10GW	0915MW01GW	0915MW16GW	0915MW17GW	0915MW22GW	0915MW26GW	0915MW27GW	0915MW28GW	0915MW06GW	0915MW32GW	0915MW33GW	0915MW40GW	0915MW42GW	0915MW43GW	0915MW29GW	0915MW31GW
Total Inorganic Elements																						
Aluminum	Metals (ICP)	SW846 6010B	µg/L	190 U	190 U	190 U	190 U	190 U	**380 J**	190 U	190 U	190 U	190 U	**940 J**	190 U	190 U	190 U	190 U	**230 J**	190 U	190 U	**1200 J**
Antimony	Metals (ICP/MS)	SW846 6020A	µg/L	**0.44**	**7.8**	**0.33 J**	0.56 U	1.8 U	**570**	**9.3**	**280**	**28**	**8.3**	**16**	**7.3**	**1.9**	**460**	**6.2**	**250**	**9.2**	0.23 U	0.14 U
Arsenic	Metals (ICP/MS)	SW846 6020A	µg/L	**0.39 J**	7.6 U	**0.62 J**	**100 J**	6.8 U	**1700**	5.3 U	**61**	**490**	**27**	**130**	**48**	**1**	**25**	**85**	**610**	**38**	**35**	0.82 U
Barium	Metals (ICP/MS)	SW846 6020A	µg/L	**47**	**510**	**49**	**86**	**82**	**72**	**49**	**55**	**560**	**44**	**69**	**80**	**21**	**28**	**110**	**95**	**86**	**250**	**25**
Beryllium	Metals (ICP/MS)	SW846 6020A	µg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	Metals (ICP/MS)	SW846 6020A	µg/L	**0.045 J**	**0.34 J**	**0.1 J**	0.037 U	0.2 U	0.5 U	0.13 U	**0.092 J**	0.076 U	0.13 UJ	0.03 U	**0.11 J**	**0.13 J**	**0.56**	**0.71**	**0.68**	**0.3 J**	0.028 U	0.028 UJ
Calcium	Metals (ICP)	SW846 6010B	µg/L	**13000**	**29000**	**19000**	**21000**	**21000**	**37000**	**26000**	**18000**	**62000**	**90000**	**41000**	**31000**	**17000**	**17000**	**44000**	**40000**	**22000**	**59000**	**8000**
Chromium	Metals (ICP/MS)	SW846 6020A	µg/L	**0.41**	0.47 U	**0.21 J**	0.17 U	1.2 U	1.2 U	0.53 U	**0.17 J**	0.8 U	0.68 UJ	3.3 U	**0.14 J**	**2**	**0.39 J**	0.37 U	1.6 U	1.3 U	0.32 U	2.8 U
Cobalt	Metals (ICP/MS)	SW846 6020A	µg/L	**0.037 J**	**2.5**	**0.055 J**	**0.079 J**	**1.4**	**10**	**0.18 J**	0.032 U	**12**	**2.5**	**3.5**	**1.2**	**0.19 J**	**0.035 J**	**31**	**8.1**	**33**	**0.67**	**0.31 J**
Copper	Metals (ICP/MS)	SW846 6020A	µg/L	0.6 U	1.7 U	0.6 U	0.6 U	2.9 U	1.6 U	0.6 U	0.6 U	0.87 U	0.6 U	1.8 U	0.6 U	**0.94 J**	**0.96 J**	0.6 U	1.4 U	0.75 U	0.6 U	**0.93 J**
Iron	Metals (ICP)	SW846 6010B	µg/L	180 U	**890**	180 U	**1000**	**14000**	**20000**	180 U	180 U	**40000**	180 U	**2900**	**2400**	180 U	180 U	180 U	**330 J**	**990**	**2200**	**690**
Lead	Metals (ICP/MS)	SW846 6020A	µg/L	**0.098 J**	**0.86**	**0.057 J**	0.11 U	0.39 U	0.34 U	0.33 U	**0.051 J**	0.11 U	0.034 U	0.45 U	**0.055 J**	**0.078 J**	**0.074 J**	0.075 U	0.18 U	0.1 U	0.034 U	0.33 U
Magnesium	Metals (ICP)	SW846 6010B	µg/L	**11000**	**21000**	**14000**	**32000**	**14000**	**66000**	**19000**	**15000**	**41000**	**56000**	**31000**	**31000**	**15000**	**13000**	**46000**	**31000**	**17000**	**59000**	**5900**
Manganese	Metals (ICP/MS)	SW846 6020A	µg/L	**1.2 J**	**5400**	**12 J**	**130**	**530**	**8300**	**16**	**2 J**	**6100**	**2300**	**940**	**580**	**32 J**	**2.3**	**340**	**730**	**2500 J**	**460**	**13**
Mercury	Mercury (CVAA)	SW846 7470A	µg/L	0.041 U	**0.32**	0.041 U	0.041 U	0.041 U	**1.7**	**0.19 J**	**0.1 J**	**0.067 J**	**0.075 J**	**0.41**	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Nickel	Metals (ICP/MS)	SW846 6020A	µg/L	**0.85 J**	**3.7**	0.4 U	0.4 U	4.2 U	**4.7**	0.56 U	**0.8 J**	**11**	**52**	10 U	**2 J**	**8.4**	**0.89 J**	**120**	**37**	**100**	**2.1 J**	1.4 U
Potassium	Metals (ICP)	SW846 6010B	µg/L	**480 J**	**540 J**	**300 J**	**940 J**	**440 J**	**2400 J**	**390 J**	**360 J**	**3400**	**1300 J**	**1200 J**	**770 J**	**480 J**	**630 J**	**840 J**	**1000 J**	**510 J**	**1000 J**	**510 J**
Selenium	Metals (ICP/MS)	SW846 6020A	µg/L	**0.65 J**	0.3 U	**1.1**	0.3 U	**0.87 J**	0.3 U	**0.76 J**	**1.2**	0.3 U	0.3 U	0.3 U	0.3 U	**1.3**	**0.47 J**	0.3 U	**0.49 J**	0.3 U	0.3 U	**0.37 J**
Silver	Metals (ICP/MS)	SW846 6020A	µg/L	0.03 U	0.03 U	**0.05 J**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	**0.048**	0.03 U	**0.06 J**	**0.05 J**	0.03 U	0.03 U
Sodium	Metals (ICP)	SW846 6010B	µg/L	**1600 J**	**2700**	**2600**	**3300**	**3600**	**6100**	**3100**	**2800**	**7000**	**17000**	**11000**	**4400**	**2000**	**4200**	**1900 J**	**2700**	**5300**	**2200**	**1300 J**
Thallium	Metals (ICP/MS)	SW846 6020A	µg/L	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Vanadium	Metals (ICP/MS)	SW846 6020A	µg/L	0.98 U	**1.2 J**	0.98 U	0.98 U	**1.6 J**	**2 J**	0.98 U	0.98 U	0.98 U	0.98 U	**4**	0.98 U	0.98 U	**1.1 J**	**1.2 J**	**2.5 J**	**0.99 J**	0.98 U	**4.3**
Zinc	Metals (ICP/MS)	SW846 6020A	µg/L	1.9 U	5.3 U	**2.5 J**	1.9 U	16 U	7.7 U	2.4 U	**1.9 J**	4.2 U	22 UJ	5.1 U	**2.8 J**	**25**	**2.5 J**	5 U	12 U	6 U	2.2 U	3.5 U
Total Low Level Mercury																						
Mercury	Total Mercury by EPA 1631	EPA 1631	ng/L	**8.49**	**1020**	**3.29**	26.1 U	16.9 U	**1540**	**361 J**	**401**	**216**	**401**	**1320 J**	**12.9**	**114**	**8.21**	30.9 U	259 U	74.3 U	11.7 U	35.5 U
Dissolved Low Level Mercury																						
Mercury	Dissolved Mercury by EPA 1631	EPA 1631	ng/L	0.45 U	**5.46**	1.15 U	**32.3 J**	**53.8**	**702**	**7.98**	**323**	**34.7**	**253**	**294**	**0.19**	**35.9**	**3.02**	1.87 U	**48.2**	**7.55 J**	**5.69**	1.12 U
Semivolatile Organic Compounds																						
Butyl benzyl phthalate	Semivolatile Organic Compounds (GC/MS)	SW846 8270D	µg/L			0.19 UJ-					**0.21 J**											
Di-n-butyl phthalate	Semivolatile Organic Compounds (GC/MS)	SW846 8270D	µg/L			**0.14 J**					**0.15 J**											
2-Fluorobiphenyl	Semivolatile Organic Compounds (GC/MS)	SW846 8270D	µg/L			**72**					**65**											
Benzene, Toluene, Ethylbenzene, and Xylenes																						
Benzene	Volatile Organic Compounds (GC/MS)	SW846 8260C	µg/L			0.025 U					0.025 U											
Toluene	Volatile Organic Compounds (GC/MS)	SW846 8260C	µg/L			0.025 U					0.025 U											
Ethylbenzene	Volatile Organic Compounds (GC/MS)	SW846 8260C	µg/L			0.03 U					0.03 U											
m-Xylene & p-Xylene	Volatile Organic Compounds (GC/MS)	SW846 8260C	µg/L			0.05 U					0.05 U											
o-Xylene	Volatile Organic Compounds (GC/MS)	SW846 8260C	µg/L			0.06 U					0.06 U											
Gasoline Range Organics and Diesel Range Organics																						
Gasoline Range Organics (GRO)-C6-C10	Alaska - Gasoline Range Organics (GC)	ADEC AK101	mg/L			**0.055**					0.015 U											
DRO (nC10-<nC25)	Alaska - Diesel Range Organics & Residual Range Organics (GC)	ADEC AK102 & 103	mg/L			0.052 UJ-					**0.19**											
General Chemistry																						
Total Suspended Solids	Solids, Total Suspended (TSS)	SM 2540D	mg/L	2 U	**2.4**	2 U	**2.4**	**5.2**	**42**	**4.4**	2 U	**70**	2 U	**22**	**3.4**	2 U	2 U	2 U	**6.2**	**3.2**	**5**	**4.8**
Chloride	Anions, Ion Chromatography	MCAWW 300.0	mg/L	**0.77**	**0.81**	**0.59 J+**	**0.76**	**0.75**	**0.82**	**0.72**	**0.61**	**0.75**	**1.1**	**0.82**	**0.77**	**0.44 J**	**0.55**	**0.8**	**1**	**1.3**	**0.68**	**0.62**
Fluoride	Anions, Ion Chromatography	MCAWW 300.0	mg/L	**0.12 J**	0.1 U	**0.13 J+**	**0.16 J**	0.13 U	**0.3**	0.12 U	**0.11 J**	**0.35**	**0.16 J**	**0.17 J**	**0.17 J**	**0.08 J**	**0.09 J**	0.23 U	0.16 U	0.19 U	0.14 U	0.09 U
Sulfate	Anions, Ion Chromatography	MCAWW 300.0	mg/L	**4.3**	6.9 U	**4.8 J+**	7.9 U	10 U	220 U	7.1 U	**6.5**	45 U	**170 J**	37 U	**20**	**12**	**11**	9.3 U	17 U	15 U	32 U	0.78 U
Carbonate Alkalinity as $CaCO_3$	Alkalinity	SM 2320B	mg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bicarbonate Alkalinity as $CaCO_3$	Alkalinity	SM 2320B	mg/L	**66**	**150**	**110**	**170**	**110**	**130**	**130**	**97**	**270**	**280**	**200**	**170**	**76**	**86**	**280**	**210**	**120**	**340**	**42**
Hydroxide Alkalinity as $CaCO_3$	Alkalinity	SM 2320B	mg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Alkalinity	Alkalinity	SM 2320B	mg/L	**66**	**150**	**110**	**170**	**110**	**130**	**130**	**97**	**270**	**280**	**200**	**170**	**76**	**86**	**280**	**210**	**120**	**340**	**42**
Nitrate Nitrite as N	Nitrogen, Nitrate-Nitrite	MCAWW 353.2	mg/L	**0.44**	0.005 U	**0.082**	0.005 U	0.005 U	0.005 U	**0.057**	**1.4**	0.005 U	0.005 U	0.005 U	0.005 U	**1.1**	**0.088**	0.005 U	**330**	0.005 U	0.005 U	**0.066**
Field Water Quality Parameters																						
Temperature	Field Measurement		Deg C	5.5	9.06	7.20		10.21	8.1	5.73	7.43	8.59	7.87	6.49	7.45	8.76	9.91				6.37	
pH	Field Measurement		pH Units	6.41	6.88	7.28		6.04	6.56	7.28	6.07	6.76	6.42	7.06	6.9	5.98	6.57				6.67	
Conductivity	Field Measurement		mS/cm	0.164	0.221	0.227		0.173	0.736	0.293	0.233	0.456	0.567	0.315	0.407	0.201	0.199				0.501	
Turbidity	Field Measurement		NTU	0	3.9	0		6.3	12.2	0	0	0	0	28.9	0	0	0				0.1	
Dissolved Oxygen	Field Measurement		mg/L	0	0	0		0	0	0	0	0	0	0	0	0	0				0	
Oxidation-Reduction Potential	Field Measurement		mV	2.91	-71	88		-26	-81	27	164	-111	71	-63	-73	213	8.9				-45	

Key
µg/L = Micrograms per liter
ADEC = Alaska Department of Environmental Conservation
Bold = Detected
Deg C = Degrees Celsius.
EPA = United States Environmental Protection Agency
GC/MS = Gas Chromatography/Mass Spectrometry
ICP/ MS = Inductively coupled plasma/mass spectrometry
J = The analyte was detected. The associated result is estimated.
mg/L = milligrams per liter
mS/cm = Millisiemens per centimeter
mV = Millivolts
ng/L = Nanograms per liter
NTU = Nephelometric turbidity units
U = The analyte was analyzed for but not detected. The value provided is the method detection limit.
UJ+ = The analyte was analyzed for but not detected. The associated reporting limit is estimated with a high bias.
UJ- = The analyte was analyzed for but not detected. The associated reporting limit is estimated with a low bias.
UJ = The analyte was analyzed for but not detected. The associated reporting limit is estimated.

Ecology & Environment, Inc. GIS Department Project:
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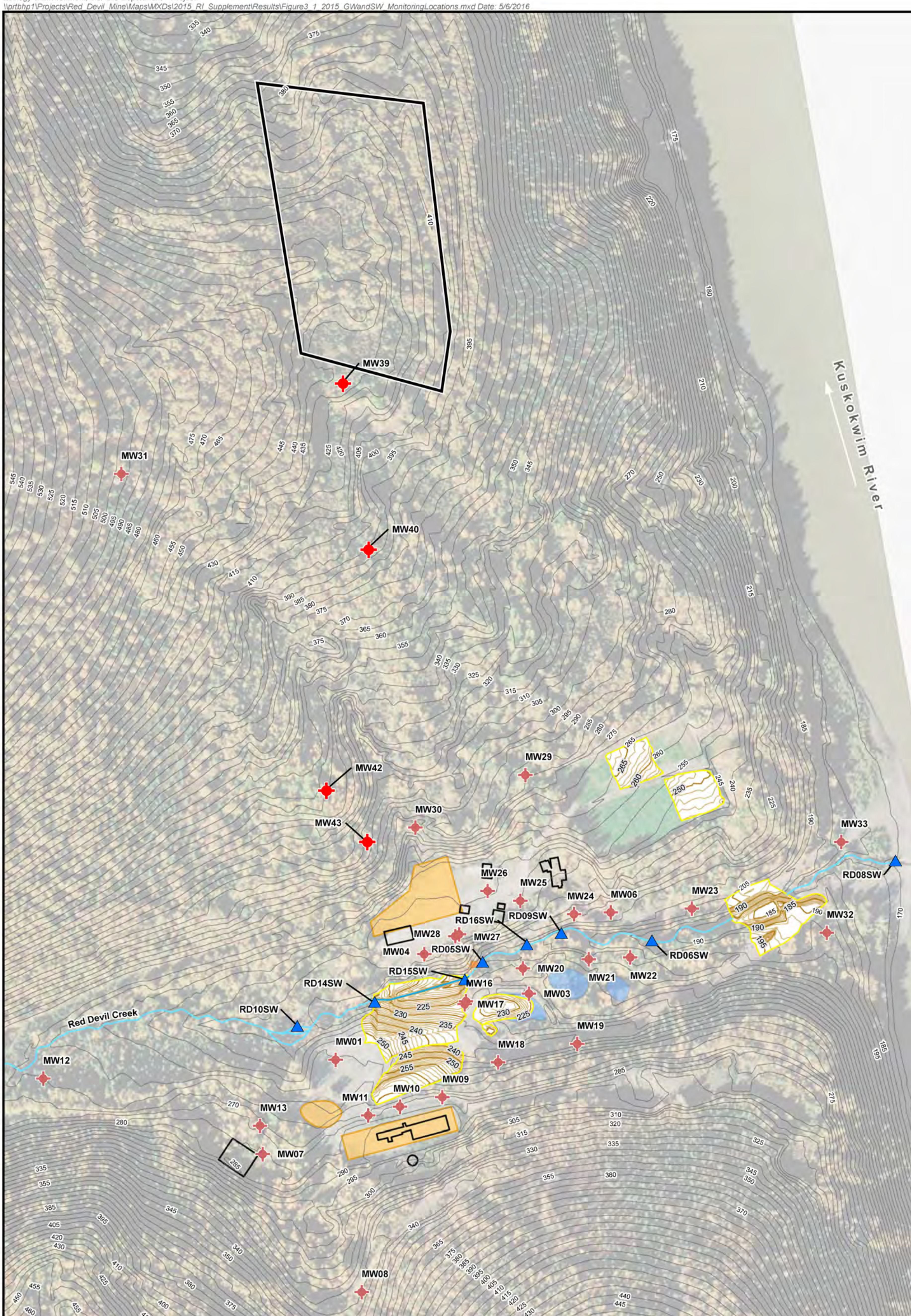

2015 Monitoring Locations

- New 2015 Monitoring Well
- Existing RI Monitoring Well
- Surface Water

- 2014 5-foot Contour
- 2014 1-foot Contour
- Area of 2014 NTCRA Re-grading
- 2010 5-foot Contour
- Post-NTCRA Stream Alignment
- Red Devil Creek

- Settling Pond
- Monofill
- Historical Structure
- Approximate Location of Proposed Repository Footprint
- Seep Location

Digital 2010 5-foot topographic contours based on the aerial orthophotograph taken on September 21, 2010 (AeroMetric 2012)

Digital 2014 5-foot and 1-foot topographic contours based on Marsh Creek (2014)

RED DEVIL MINE

Red Devil, Alaska

Figure 3-1
2015 Groundwater and Surface Water Monitoring Locations

0 50 100 200 300 400 Feet

0 12.5 25 50 75 100 125 Meters

Scale 1:2,500

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Ecology & Environment, Inc. GIS Department Project:
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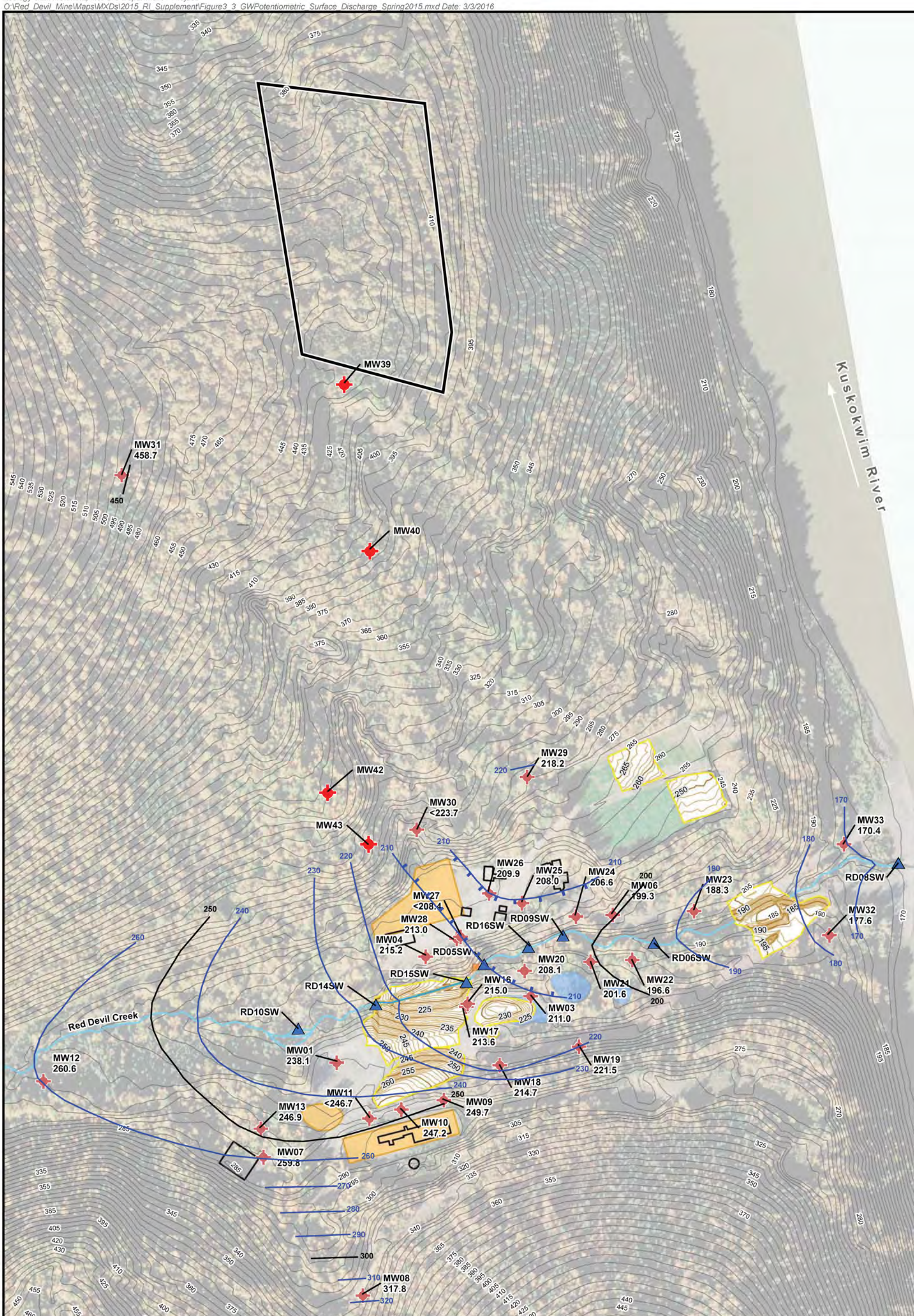

2015 Monitoring Locations		
New 2015 Monitoring Well	2014 5-foot Contour	Settling Pond
Existing RI Monitoring Well Spring 2015 Groundwater Elevation	2014 1-foot Contour	Monofill
Surface Water	Area of 2014 NTCRA Re-grading	Historical Structure
210 Groundwater Potentiometric Surface Elevation Contour (hatch mark on downgradient side)	2010 5-foot Contour	Approximate Location of Proposed Repository Footprint
	Post-NTCRA Stream Alignment	Seep Location
	Red Devil Creek	

Digital 2010 5-foot topographic contours based on the aerial orthophotograph taken on September 21, 2010 (AeroMetric 2012)

Digital 2014 5-foot and 1-foot topographic contours based on Marsh Creek (2014)

RED DEVIL MINE

Red Devil, Alaska

Figure 3-2
Groundwater Potentiometric Surface, Spring 2015

0 50 100 200 300 400 Feet
0 12.5 25 50 75 100 125 Meters
Scale 1:2,500

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Ecology & Environment, Inc. GIS Department Project:
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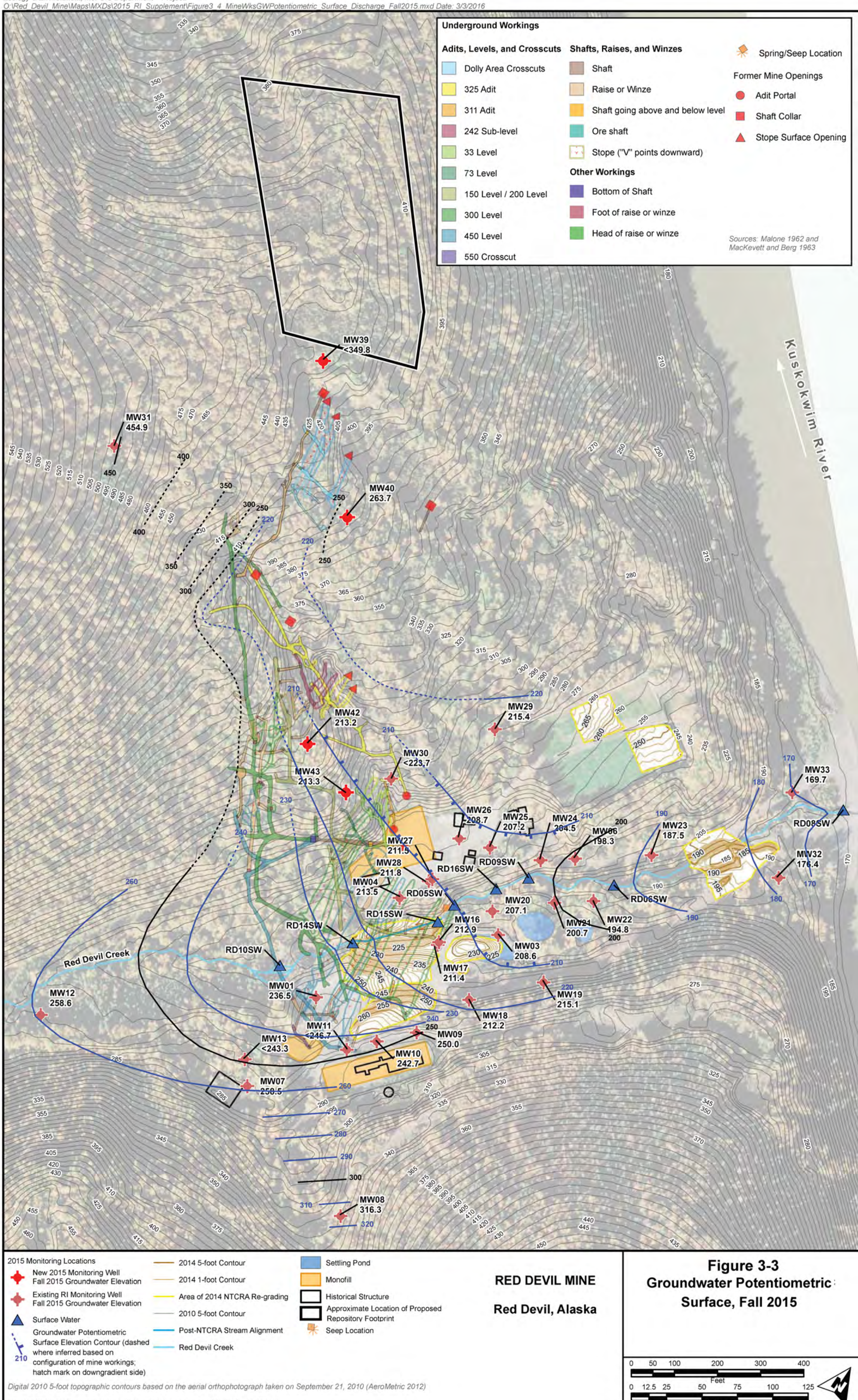

Figure 3-3 Groundwater Potentiometric Surface, Fall 2015

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Ecology & Environment, Inc. GIS Department Project:
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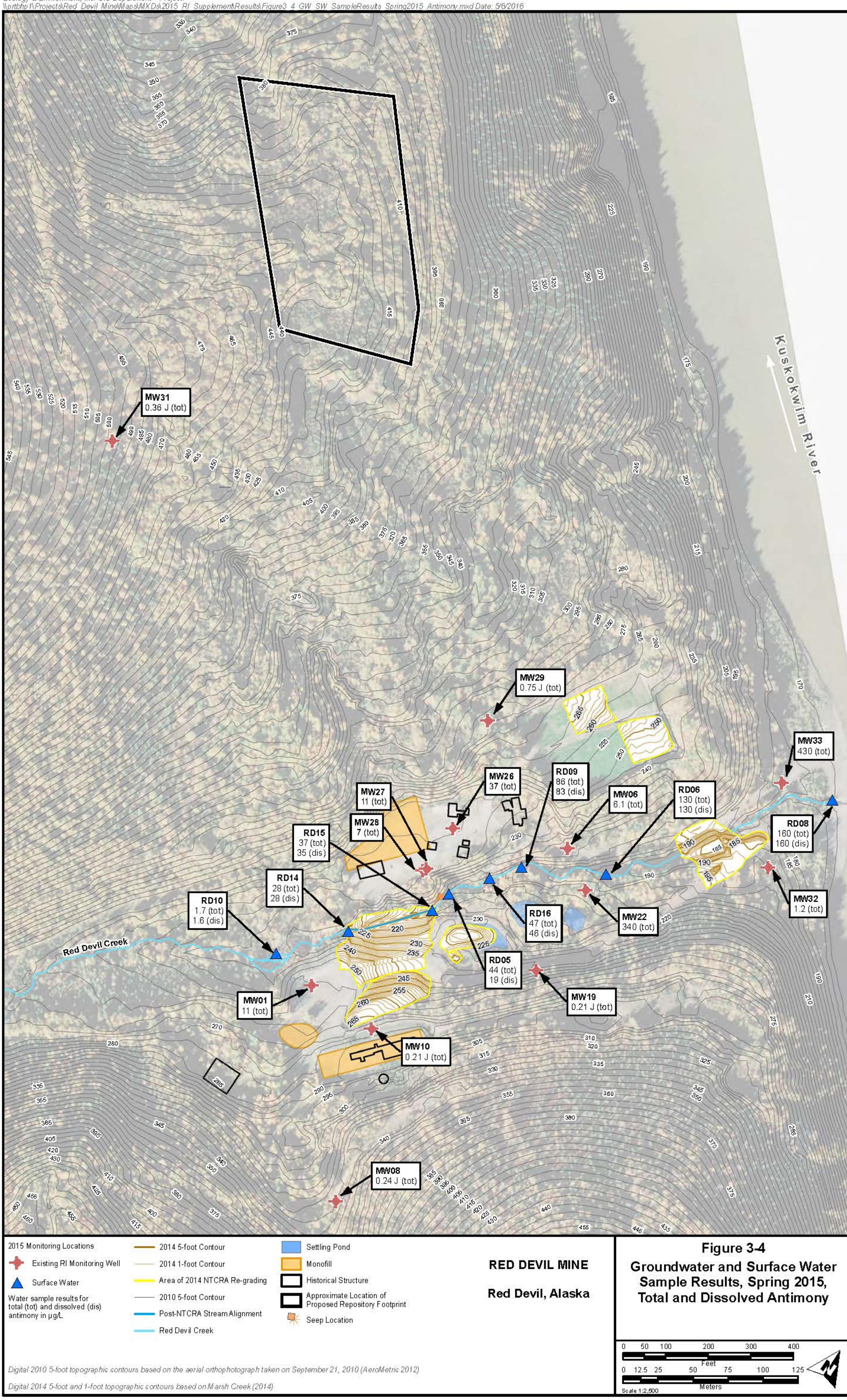

RED DEVIL MINE

Red Devil, Alaska

Figure 3-4
Groundwater and Surface Water Sample Results, Spring 2015, Total and Dissolved Antimony

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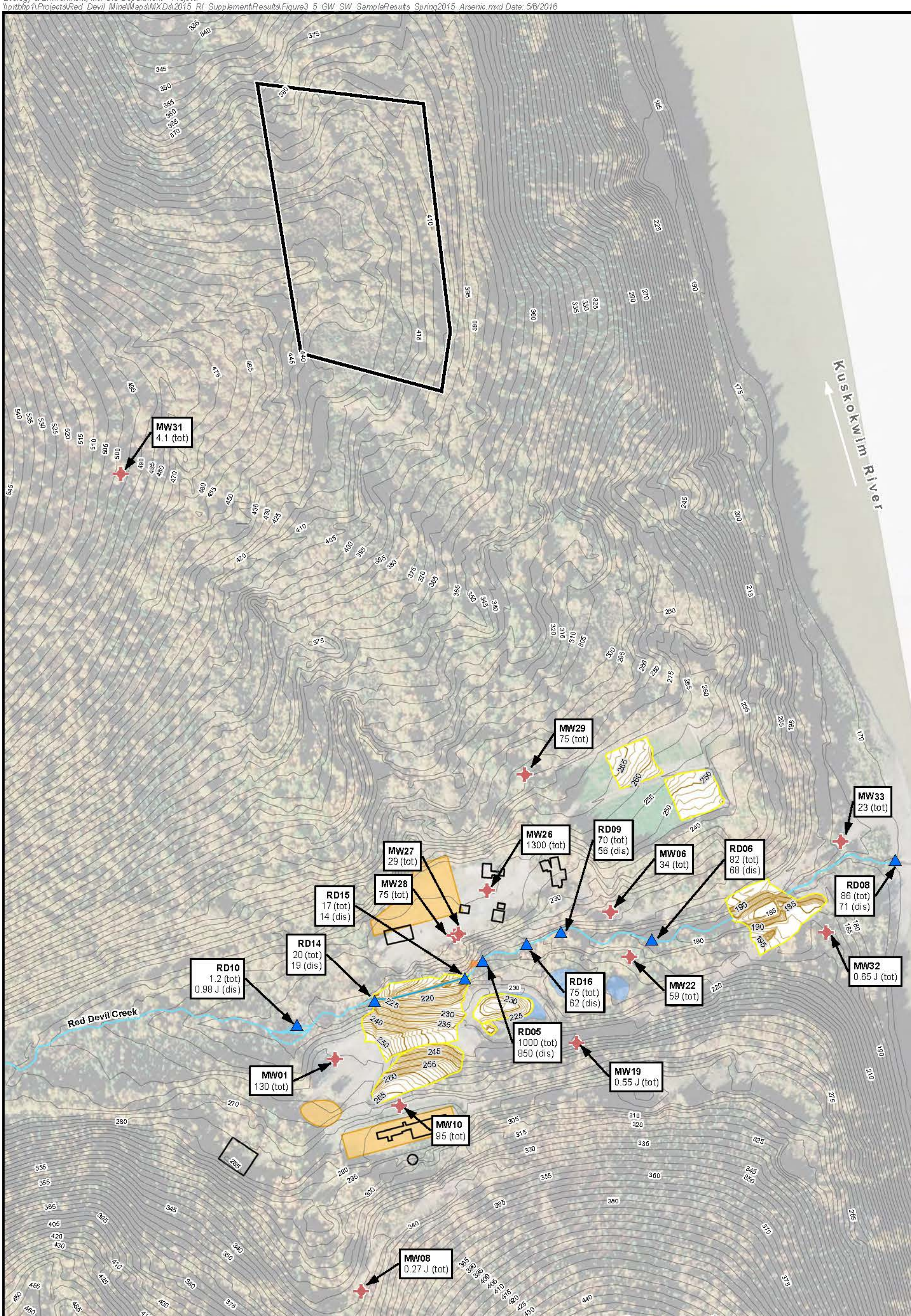

2015 Monitoring Locations

- Existing RI Monitoring Well
- Surface Water

Water sample results for total (tot) and dissolved (dis) arsenic in µg/L.

- 2014 5-foot Contour
- 2014 1-foot Contour
- Area of 2014 NTCRA Re-grading
- 2010 5-foot Contour
- Post-NTCRA Stream Alignment
- Red Devil Creek
- Settling Pond
- Monofill
- Historical Structure
- Approximate Location of Proposed Repository Footprint
- Seep Location

RED DEVIL MINE

Red Devil, Alaska

Figure 3-5
Groundwater and Surface Water Sample Results, Spring 2015, Total and Dissolved Arsenic

0 50 100 200 300 400 Feet
0 12.5 25 50 75 100 125 Meters
Scale 1:2,500

Digital 2010 5-foot topographic contours based on the aerial orthophotograph taken on September 21, 2010 (AeroMetric 2012)

Digital 2014 5-foot and 1-foot topographic contours based on Marsh Creek (2014)

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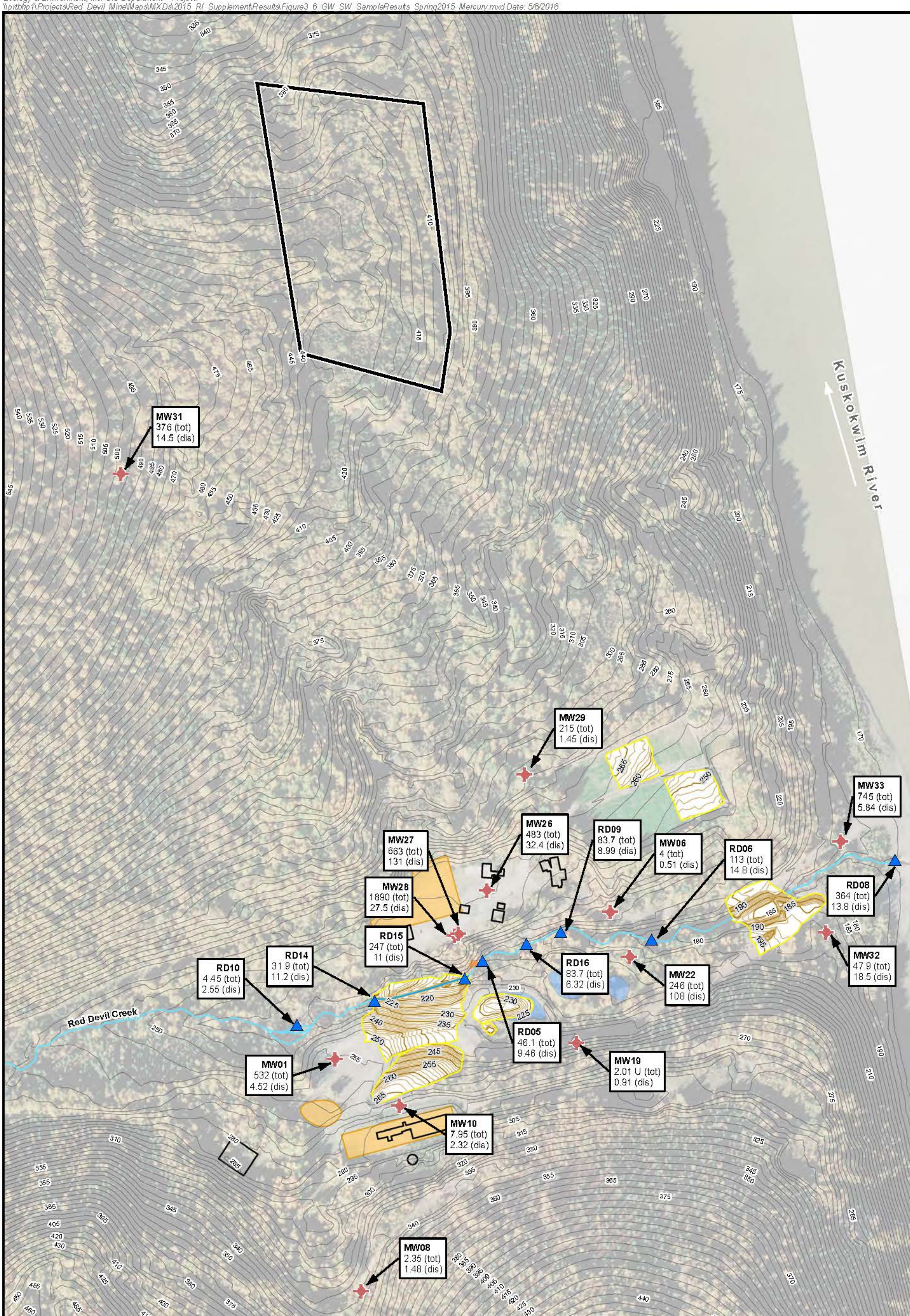

2015 Monitoring Locations

- Existing RI Monitoring Well
- Surface Water

Water sample results for total (tot) and dissolved (dis) mercury in ng/L

- 2014 5-foot Contour
- 2014 1-foot Contour
- Area of 2014 NTCRA Re-grading
- 2010 5-foot Contour
- Post-NTCRA Stream Alignment
- Red Devil Creek
- Settling Pond
- Monofill
- Historical Structure
- Approximate Location of Proposed Repository Footprint
- Seep Location

Digital 2010 5-foot topographic contours based on the aerial orthophotograph taken on September 21, 2010 (AeroMetric 2012)

Digital 2014 5-foot and 1-foot topographic contours based on Marsh Creek (2014)

RED DEVIL MINE

Red Devil, Alaska

Figure 3-6
Groundwater and Surface Water Sample Results, Spring 2015, Total and Dissolved Mercury

0 50 100 200 300 400 Feet
0 12.5 25 50 75 100 125 Meters
Scale 1:2,500

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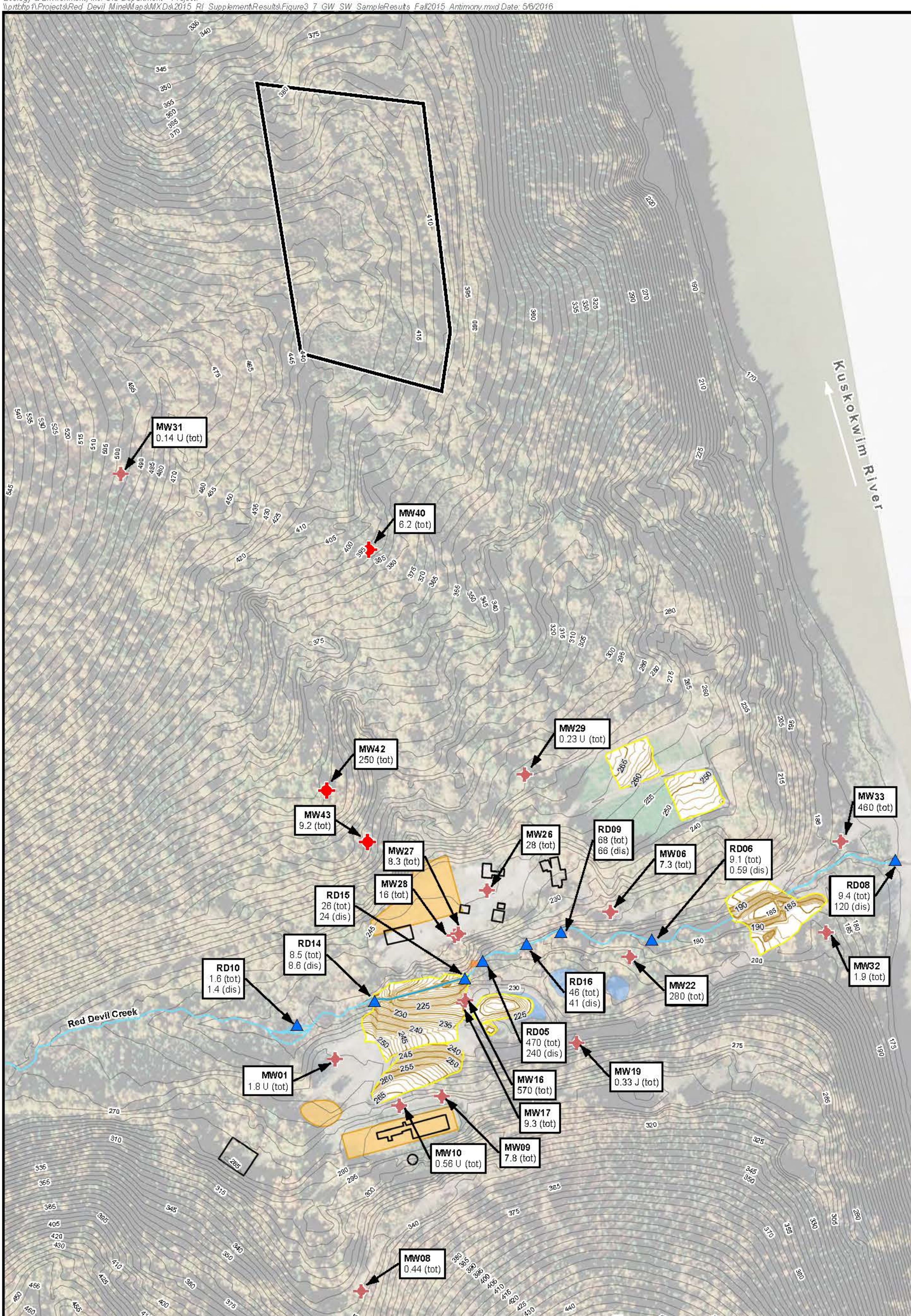

2015 Monitoring Locations
- New 2015 Monitoring Well
- Existing RI Monitoring Well
- Surface Water

Water sample results for total (tot) and dissolved (dis) antimony in µg/L.

- 2014 5-foot Contour
- 2014 1-foot Contour
- Area of 2014 NTCRA Re-grading
- 2010 5-foot Contour
- Post-NTCRA Stream Alignment
- Red Devil Creek
- Settling Pond
- Monofill
- Historical Structure
- Approximate Location of Proposed Repository Footprint
- Seep Location

Digital 2010 5-foot topographic contours based on the aerial orthophotograph taken on September 21, 2010 (AeroMetric 2012)

Digital 2014 5-foot and 1-foot topographic contours based on Marsh Creek (2014)

RED DEVIL MINE

Red Devil, Alaska

Figure 3-7
Groundwater and Surface Water Sample Results, Fall 2015, Total and Dissolved Antimony

0 50 100 200 300 400
Feet
0 12.5 25 50 75 100 125
Meters
Scale 1:2,500

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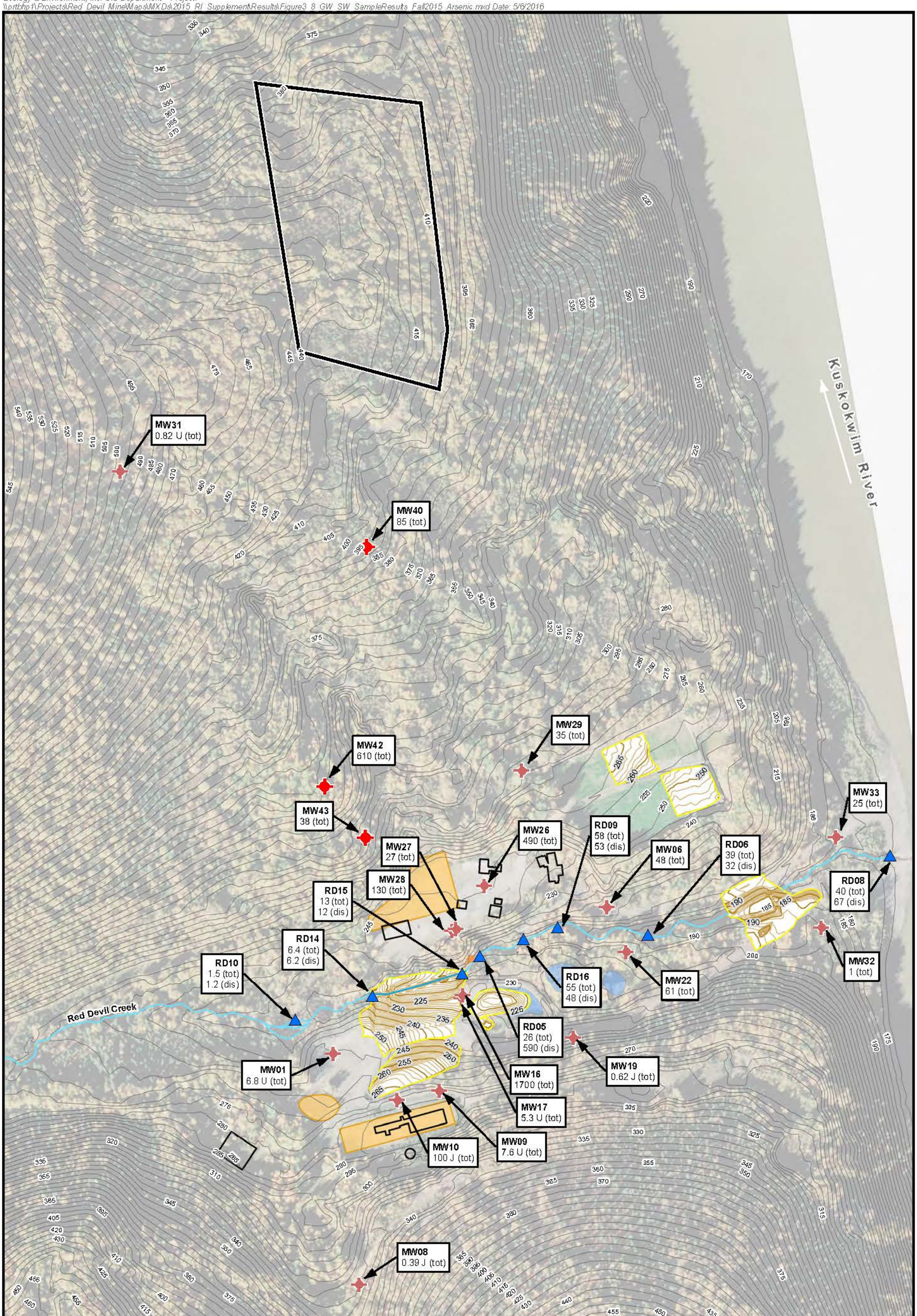

2015 Monitoring Locations
- New 2015 Monitoring Well
- Existing RI Monitoring Well
- Surface Water

Water sample results for total (tot) and dissolved (dis) arsenic in µg/L

- 2014 5-foot Contour
- 2014 1-foot Contour
- Area of 2014 NTCRA Re-grading
- 2010 5-foot Contour
- Post-NTCRA Stream Alignment
- Red Devil Creek
- Settling Pond
- Monofill
- Historical Structure
- Approximate Location of Proposed Repository Footprint
- Seep Location

Digital 2010 5-foot topographic contours based on the aerial orthophotograph taken on September 21, 2010 (AeroMetric 2012)

Digital 2014 5-foot and 1-foot topographic contours based on Marsh Creek (2014)

RED DEVIL MINE

Red Devil, Alaska

Figure 3-8
Groundwater and Surface Water Sample Results, Fall 2015, Total and Dissolved Arsenic

0 50 100 200 300 400 Feet
0 12.5 25 50 75 100 125 Meters
Scale 1:2,500

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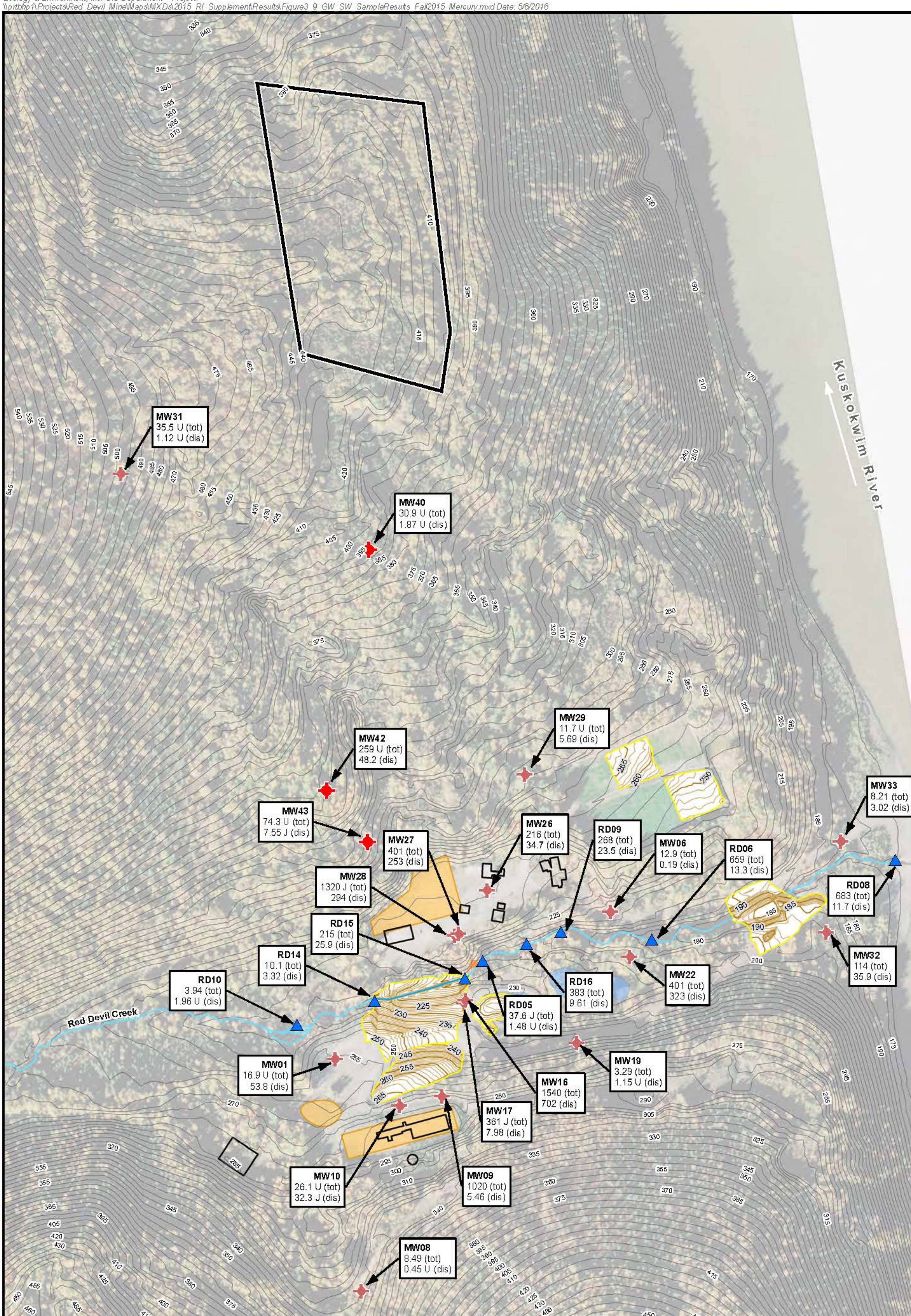

2015 Monitoring Locations
- New 2015 Monitoring Well
- Existing RI Monitoring Well
- Surface Water

Water sample results for total (tot) and dissolved (dis) mercury in ng/L

- 2014 5-foot Contour
- 2014 1-foot Contour
- Area of 2014 NTCRA Re-grading
- 2010 5-foot Contour
- Post-NTCRA Stream Alignment
- Red Devil Creek
- Settling Pond
- Monofill
- Historical Structure
- Approximate Location of Proposed Repository Footprint
- Seep Location

Digital 2010 5-foot topographic contours based on the aerial orthophotograph taken on September 21, 2010 (AeroMetric 2012)

Digital 2014 5-foot and 1-foot topographic contours based on Marsh Creek (2014)

RED DEVIL MINE

Red Devil, Alaska

Figure 3-9
Groundwater and Surface Water Sample Results, Fall 2015, Total and Dissolved Mercury

0 50 100 200 300 400 Feet
0 12.5 25 50 75 100 125 Meters
Scale 1:2,500

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4 Surface Water Investigation

4.1 Surface Water Investigations

The RI Supplement surface water characterization activities were designed to address data gaps associated with surface water in Red Devil Creek and a seep located on the northwest bank of the creek. Additional surface water characterization was performed to gather the types of additional information identified in Section 3.3 of the RI Supplement Work Plan. The supplemental RI surface water characterization was designed to meet the following objectives:

- Assess potential impacts on surface water quality and flow rate by flow of groundwater that is impacted by naturally mineralized bedrock and underground mine workings in the Surface Mined Area.
- Assess groundwater quality and flow rate in the area affected by the 2014 NTCRA construction.
- Provide additional information on baseline surface water conditions at the site.

Additional surface water characterization was performed using a combination of field data collection and the results of laboratory analysis for selected analytical parameters. Surface water monitoring was performed during two sampling events in 2015—the spring event in June and the fall event in September at the locations listed in Tables 4-1 and 4-2, respectively. Surface water monitoring locations are shown in Figure 3-1.

Sampling and other field procedures were performed in accordance with the Field Sampling Plan, except as noted below. A brief description of field sampling and other procedures is provided below.

4.1.1 Stream Gaging

At the selected surface water monitoring locations along Red Devil Creek and the seep, discharge rates were measured during the spring and fall 2015 field events on June 19 and September 2, 2015, respectively.

4.1.2 Surface Water Sampling

At the selected surface water monitoring locations along Red Devil Creek and the seep, surface water was sampled for field and laboratory water quality parameters. Surface water samples were collected for field water quality parameters (pH, specific conductance, oxidation reduction potential, turbidity, dissolved oxygen, and temperature) and the following laboratory analyses: total TAL inorganic elements and low-level mercury; dissolved TAL inorganic elements and low-level mercury; total organic carbon (TOC); total suspended solids; total dissolved solids; inorganic ions (chloride, fluoride, and sulfate); nitrate-nitrite as N; and alkalinity (as carbonate/bicarbonate). Surface water samples collected for the various laboratory analyses for the two monitoring events are listed in Tables 4-1 and 4-2. Surface water samples were submitted to TestAmerica, Seattle, Washington, for laboratory analysis. TestAmerica performed analysis for all analyses except total and dissolved low-level mercury analyses, which were performed under sub-subcontract to TestAmerica by Brooks Rand Labs, Seattle, Washington.

4.1.3 Deviations from the Field Sampling Plan

There were no deviations from the Field Sampling Plan for the surface water monitoring.

4.2 Surface Water Investigation Results

The RI Supplement surface water characterization was performed using a combination of field data collection and the results of laboratory analysis for selected analytical parameters. The objectives of the groundwater investigation are listed in Section 4.1. Results of surface water characterization are summarized below.

4.2.1 Stream Discharge

Estimated surface water discharge calculations for Red Devil Creek surface water stations monitored during the spring and fall 2015 surface water monitoring events are presented in Table 4-3. For comparison, stream gaging data collected previously also are presented in Table 4-3.

Estimated Red Devil Creek surface water discharge ranged from 1.3 to 1.9 cubic feet per second on June 19, 2015, and from 0.48 to 0.81 cubic feet per second on September 2, 2015. During each monitoring event, the stream discharge generally increased from upstream to downstream, consistent with gaining conditions and the conclusion that groundwater in the Main Processing Area and part of the Surface Mines Area emerges as surface water in the creek (see Section 3.2.2).

The estimated discharge rates during both the spring and fall 2015 monitoring events were substantially lower than during all previous monitoring events, consisting of the RI event (August 18, 2011), spring 2012 baseline event (May 26, 2012), and fall 2012 baseline event (September 12, 2012). Such lower discharge is consistent with the lower groundwater elevations observed during the spring and fall 2015 groundwater monitoring (see Section 3.2.2).

4.2.2 Surface Water Sample Results

At the selected surface water monitoring locations along Red Devil Creek and the seep, surface water was sampled for field and laboratory water quality parameters. Laboratory results and field water quality measurements of surface water sampling conducted during the spring and fall 2015 monitoring events are presented in Tables 4-4 and 4-5, respectively. Results for key constituents—total and dissolved antimony, total and dissolved arsenic, and total and dissolved mercury—are presented in Figures 3-4 through 3-6, for the spring 2015 event, and Figures 3-7 through 3-9 for the fall 2015 event and are discussed below.

Surface water results for spring and fall 2015 sampling indicate generally increasing total and dissolved antimony, arsenic, and mercury concentrations along Red Devil Creek moving downstream beginning at approximately station RD10, located near the upstream end of the Main Processing Area. Overall, the trends of increasing concentrations along Red Devil Creek in spring and fall 2015 surface water samples are similar to those documented in the RI and 2012 baseline monitoring events, although the magnitude of the increases varied. Concentrations trends were evaluated by comparing the 2015 and historical results for the same stations, as discussed below.

Spring

Concentrations of total and dissolved antimony in samples from Red Devil Creek and the seep were lower in the spring 2015 samples than in the spring 2012 samples. Total arsenic concentrations in samples from Red Devil Creek and the seep were lower in the spring 2015 samples than in the spring 2012 samples. Dissolved arsenic concentrations in samples from Red Devil Creek were lower in the spring 2015 samples than in the spring 2012 samples, but the concentration in the sample from the seep was higher. Total and dissolved mercury concentrations in samples from Red Devil Creek were lower in the spring 2015 samples than in the spring 2012 samples, but the concentrations in the sample from the seep were higher.

Fall

Concentrations of total and dissolved antimony in samples from Red Devil Creek were lower in the fall 2015 samples than in the 2011 RI and fall 2012 samples, but the concentrations in the sample from the seep were higher than in the 2011 RI and fall 2012 samples. For samples downstream of station RD10, concentrations of total and dissolved arsenic in samples from Red Devil Creek and the seep were lower in the fall 2015 samples than in the 2011 RI and fall 2012 samples. For samples downstream of station RD10, concentrations of total mercury in samples from Red Devil Creek and the seep were higher in the fall 2015 samples than in fall 2012 samples. The 2015 total mercury concentrations were higher than those in two of the 2011 RI Red Devil Creek samples but lower in the other two creek samples and the seep sample. The dissolved mercury concentrations were higher in most of the fall 2015 samples than in the 2011 RI and fall 2012 samples from the same stations.

4.3 Surface Water Investigation Conclusions

The RI Supplement surface water characterization activities were designed to address data gaps associated with surface water in Red Devil Creek and a seep located on the northwest bank of the creek. Additional surface water characterization was performed to gather the types of additional information identified in Section 3.3 of the RI Supplement Work Plan and meet the objectives listed in Section 4.1. Results of surface water characterization are detailed in Section 4.2. Key findings are summarized below.

4.3.1 Stream Discharge

Estimated Red Devil Creek surface water discharge ranged from 1.3 to 1.9 cubic feet per second on June 19, 2015, and from 0.48 to 0.81 cubic feet per second on September 2, 2015. During each monitoring event, the stream discharge generally increased from upstream to downstream, consistent with overall gaining conditions and the conclusion that groundwater in the Main Processing Area and part of the Surface Mines Area emerges as surface water in the creek.

The estimated discharge rates during both the spring and fall 2015 monitoring events were substantially lower than during all previous monitoring events. Such lower discharge is consistent with the comparatively lower groundwater elevations observed during the spring and fall 2015 groundwater monitoring.

4.3.2 Surface Water Sample Results

Surface water results for spring and fall 2015 sampling indicate generally increasing total and dissolved antimony, arsenic, and mercury concentrations along Red Devil Creek moving downstream beginning at approximately station RD10, located near the upstream end of the Main Processing Area. Overall, the trends of increasing concentrations along Red Devil Creek in spring and fall 2015 surface water samples are similar to those documented in the RI and 2012 baseline monitoring events, although the magnitudes varied. The spring 2015 concentrations in Red Devil Creek were generally lower than concentrations seen in previous sampling events. This may be attributable to lower groundwater elevations observed in the spring 2015. The fall 2015 concentrations of antimony and arsenic in Red Devil Creek and the seep were generally lower than concentrations seen in previous sampling events. As suggested for the spring 2015 sample results, this may be attributable to lower groundwater elevations observed in the spring 2015. The total and dissolved mercury results did not exhibit an obvious trend relative to previous results. No obvious trends that could be attributed to the 2014 NTCRA regrading were noted.

4.3.3 Surface Water Contaminant Transport

The RI Supplement results and RI results show that transport of contaminants in surface water is occurring presently at the RDM. Contaminant loading (e.g., antimony, arsenic, mercury, and methylmercury) along Red Devil Creek as it flows through the Main Processing Area is attributable to groundwater migration into the stream along gaining reaches and erosion and entrainment of particulates. Groundwater emerges to surface water as baseflow within the Main Processing Area as well as at a seep located adjacent to the creek in the Main Processing Area.

Sources of inorganics in groundwater include leaching from mine wastes, as well as naturally mineralized bedrock and native soils. Based on results of the Surface

Mined Area groundwater evaluation (see Section 3.3.1), groundwater impacted by flow through mineralized bedrock and the underground mine workings emerges into Red Devil Creek within the Main Processing Area and is a source of impacts to Red Devil Creek.

Surface water loading along the creek also is attributable to entrainment of contaminants within or adsorbed to particulates and dissolution/desorption of contaminants from bed and suspended sediment. The 2014 NTCRA was undertaken to address the active erosion of tailings/waste rock along Red Devil Creek and transport of those materials to the Kuskokwim River. It is noted that no post-NTCRA sampling was performed to determine if all tailings/waste rock material in the NTCRA area was removed.

During RI and 2012 baseline monitoring, total concentrations of antimony and arsenic were typically only slightly higher than the dissolved concentrations at each sample location throughout most of Red Devil Creek. This was interpreted in the final RI report to indicate that transport of antimony and arsenic in Red Devil Creek surface water was dominated by dissolved phase transport at the times of monitoring. This is further evidenced by field measurements of turbidity and laboratory analysis of total suspended solids, which indicate low turbidity and total suspended solids concentrations at the times of sampling. Such dissolved phase transport also was concluded to be the dominant transport mechanism at the times of sampling for the RI and 2012 baseline monitoring events. Additional data collected during the spring and fall 2015 monitoring show similar trends. It is concluded that transport of antimony and arsenic was dominated by dissolved transport at the times of sampling in 2015.

During the RI and 2012 baseline monitoring events, total concentrations of mercury were substantially higher (up to more than an order of magnitude) than the dissolved concentrations at each surface water sample location within and downstream of the Main Processing Area. As was concluded in the RI (see final RI report Section 5.6.2.1), this is interpreted to indicate that mercury transport in surface water in Red Devil Creek included substantial transport by particulate phases that are larger than 0.45 micometers (the pore size of the filters used to collect the dissolved phase aliquots) at the times of sampling. It also was concluded in the final RI that colloidal transport of mercury occurs in groundwater at the RDM (see final RI report Section 5.4.4). These conclusions are supported by several related lines of evidence discussed in final RI report sections 5.3.1, 5.4.1, 5.4.4, 5.6.1, and 5.6.2. Additional data collected during the spring and fall 2015 surface water and groundwater monitoring show similar trends. It is concluded that transport of mercury included substantial transport as particulates, including mobile colloids, at the times of sampling in 2015.

Table 4-1 Surface Water Sample Collection - Spring 2015

Sample Location ID	Sample ID	Location Description	Sample Date	Sample Description	Sample Analyses and Methods									
					Total TAL Metals EPA 6010B/6020 A/ 7470A	Dissolved TAL Metals EPA 6010B/6020 A/7470A	Total Low Level Hg EPA 1631E	Dissolved Low Level Hg EPA 1631E	Total Organic Carbon SW846 9060	Total Suspended Solids SM 2540D	Total Dissolved Solids SM 2540C	Inorganic Ions MCAWW 300.0	Nitrate Nitrite as N MCAWW 353.2	Carbonate Alkalinity as CaCO3 SM 2320B
RD10	0615RD10SW	Red Devil Creek, near upstream end of the Main Processing Area	6/18/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
RD14	0615RD14SW	Red Devil Creek, new station immediately upstream of the newly aligned section (post-NTCRA) of Red Devil Creek, near former station RD04SW	6/18/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
RD15	0615RD15SW	Red Devil Creek, new station immediately downstream of the newly aligned section (post-NTCRA) of Red Devil Creek, near former baseline monitoring station RD13SW	6/18/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
	0615RD50SW		6/18/2015	Field Duplicate of 0615RD15SW	X	X	X	X	X	X	X	X	X	X
RD05	0615RD05SW	Seep on left bank of Red Devil Creek	6/18/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
RD16	0615RD16SW	Red Devil Creek, new station downstream of seep area between RD12 and RD09	6/18/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
RD09	0615RD09SW	Red Devil Creek, near Settling Pond #2	6/18/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
RD06	0615RD06SW	Red Devil Creek, near Settling Pond #3	6/17/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
RD08	0615RD08SW	Red Devil Creek, near confluence of Red Devil Creek and Kuskokwim River, downstream of sediment trap constructed during NTCRA	6/17/2015	Field Sample	X	X	X	X	X	X	X	X	X	X

Key:
EPA = Environmental Protection Agency
Hg = Mercury
MCAWW = Methods for Chemical Analysis of Water and Wastes
TAL = Target Analyte List

Table 4-2 Surface Water Sample Collection - Fall 2015

Sample Location ID	Sample ID	Location Description	Sample Date	Sample Description	Sample Analyses and Methods									
					Total TAL Metals EPA 6010B/6020 A/ 7470A	Dissolved TAL Metals EPA 6010B/6020 A/7470A	Total Low Level Hg EPA 1631E	Dissolved Low Level Hg EPA 1631E	Total Organic Carbon SW846 9060	Total Suspended Solids SM 2540D	Total Dissolved Solids SM 2540C	Inorganic Ions MCAWW 300.0	Nitrate Nitrite as N MCAWW 353.2	Carbonate Alkalinity as CaCO3 SM 2320B
RD10SW	0915RD10SW	Red Devil Creek, near upstream end of the Main Processing Area	9/9/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
RD14SW	0915RD14SW	Red Devil Creek, new station immediately upstream of the newly aligned section (post-NTCRA) of Red Devil Creek, near former station RD04SW	9/9/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
	0915RD25SW		9/9/2015	Field Duplicate of 0915RD14SW	X	X	X	X	X	X	X	X	X	X
RD15SW	0915RD15SW	Red Devil Creek, new station immediately downstream of the newly aligned section (post-NTCRA) of Red Devil Creek, near former baseline monitoring station RD13SW	9/9/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
RD05SW	0915RD05SW	Seep on left bank of Red Devil Creek	9/9/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
RD16SW	0915RD16SW	Red Devil Creek, new station downstream of seep area between RD12 and RD09	9/9/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
RD09SW	0915RD09SW	Red Devil Creek, near Settling Pond #2	9/9/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
RD06SW	0915RD06SW	Red Devil Creek, near Settling Pond #3	9/9/2015	Field Sample	X	X	X	X	X	X	X	X	X	X
RD08SW	0915RD08SW	Red Devil Creek, near confluence of Red Devil Creek and Kuskokwim River, downstream of sediment trap constructed during NTCRA	9/9/2015	Field Sample	X	X	X	X	X	X	X	X	X	X

Key:
EPA = Environmental Protection Agency
Hg = Mercury
MCAWW = Methods for Chemical Analysis of Water and Wastes
TAL = Target Analyte List

Table 4-3 Red Devil Creek and Seep Discharge

Monitoring Location	Estimated Discharge (cfs)				
	August 18, 2011	May 26, 2012	September 12, 2012	June 19, 2015	September 2, 2015
RD10	5.5	12.2	4.6	1.3	0.48
RD014	Station not established	Station not established	Station not established	1.4	0.67
RD04	5.9	12.7	3.5	Station not monitored	Station not monitored
RD05 (seep)	0.18	Station not monitored	0.16	0.23	0.19
RD13	Station not established	10.5	3.8	Station not monitored	Station not monitored
RD15	Station not established	Station not established	Station not established	1.4	0.54
RD12	8.2	Station not monitored	Station not monitored	Station not monitored	Station not monitored
RD16	Station not established	Station not established	Station not established	1.6	0.60
RD09	6.0	13.4	3.4	1.4	0.78
RD06	6.8	14.5	3.8	1.5	0.79
RD08	7.2	14.2	3.1	1.9	0.81

Key:

cfs = Cubic feet per second

Table 4-4 Surface Water Sample Results, Spring 2015

Analyte	Station ID		Units	RD10	RD14	RD15	RD05	RD16	RD09	RD06	RD08
	Geographic Area			Red Devil Creek	Red Devil Creek	Red Devil Creek	Seep	Red Devil Creek	Red Devil Creek	Red Devil Creek	Red Devil Creek
	Sample ID			0615RD10SW	0615RD14SW	0615RD15SW	0615RD05SW	0615RD16SW	0615RD09SW	0615RD06SW	0615RD08SW
	Method										
Total Inorganic Elements											
Aluminum	Metals (ICP)	SW846 6010B	µg/L	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
Antimony	Metals (ICP/MS)	SW846 6020A	µg/L	**1.7**	**28**	**37**	**44**	**47**	**86**	**130**	**160**
Arsenic	Metals (ICP/MS)	SW846 6020A	µg/L	**1.2**	**20**	**17**	**1000**	**75**	**70**	**82**	**86**
Barium	Metals (ICP/MS)	SW846 6020A	µg/L	**22**	**23**	**23**	**96**	**27**	**26**	**27**	**29**
Beryllium	Metals (ICP/MS)	SW846 6020A	µg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	Metals (ICP/MS)	SW846 6020A	µg/L	**0.038 J**	0.028 U	0.028 U	0.028 U	0.028 U	0.028 U	0.028 U	0.028 U
Calcium	Metals (ICP)	SW846 6010B	µg/L	**16000**	**16000**	**16000**	**37000**	**17000**	**17000**	**16000**	**17000**
Chromium	Metals (ICP/MS)	SW846 6020A	µg/L	**0.32 J**	**0.46**	**0.34 J**	**0.26 J**	**0.28 J**	**0.3 J**	**0.3 J**	**0.31 J**
Cobalt	Metals (ICP/MS)	SW846 6020A	µg/L	**0.045 J**	**0.046 J**	**0.081 J**	**4.5**	**0.31 J**	**0.24 J**	**0.26 J**	**0.23 J**
Copper	Metals (ICP/MS)	SW846 6020A	µg/L	0.6 U	0.6 U	0.6 U	0.6 U	**1.2 J**	0.6 U	**0.61 J**	0.6 U
Iron	Metals (ICP)	SW846 6010B	µg/L	180 U	**180 J**	180 U	**2200**	**230 J**	**190 J**	**200 J**	**200 J**
Lead	Metals (ICP/MS)	SW846 6020A	µg/L	**0.071 J**	**0.07 J**	**0.065 J**	**0.11 J**	**0.072 J**	**0.061 J**	**0.062 J**	**0.078 J**
Magnesium	Metals (ICP)	SW846 6010B	µg/L	**8800**	**8400**	**8500**	**38000**	**10000**	**10000**	**9900**	**10000**
Manganese	Metals (ICP/MS)	SW846 6020A	µg/L	**8.8**	**13**	**17**	**300**	**38**	**30**	**35**	**28**
Mercury	Mercury (CVAA)	SW846 7470A	µg/L	0.041 U	0.041 U	**0.07 J**	0.041 U	**0.053 J**	**0.056 J**	**0.43**	**0.17 J**
Nickel	Metals (ICP/MS)	SW846 6020A	µg/L	**0.42 J**	**0.48 J**	**0.57 J**	**17**	**1.6 J**	**1.2 J**	**1.3 J**	**1.3 J**
Potassium	Metals (ICP)	SW846 6010B	µg/L	**240 J**	**260 J**	**250 J**	**1200 J**	**290 J**	**310 J**	**330 J**	**320 J**
Selenium	Metals (ICP/MS)	SW846 6020A	µg/L	0.3 U	**0.3 J**	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Silver	Metals (ICP/MS)	SW846 6020A	µg/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Sodium	Metals (ICP)	SW846 6010B	µg/L	**1800 J**	**1700 J**	**1700 J**	**11000**	**2300**	**2200**	**2300**	**2400**
Thallium	Metals (ICP/MS)	SW846 6020A	µg/L	**0.16 J**	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Vanadium	Metals (ICP/MS)	SW846 6020A	µg/L	**0.99 J**	0.98 U	**0.98 J**	0.98 U	0.98 U	0.98 U	0.98 U	**1 J**
Zinc	Metals (ICP/MS)	SW846 6020A	µg/L	1.9 U	**2.3 J**	**6.8 J**	**2.9 J**	**5.1 J**	**5.4 J**	**4.7 J**	**7.1**
Total Low Level Mercury											
Mercury	Total Mercury by EPA 1631	EPA 1631	ng/L	**4.45**	**31.9**	**247**	**46.1**	**83.7**	**83.7**	**113**	**364**
Dissolved Inorganic Elements											
Aluminum	Metals (ICP) (DISSOLVED)	SW846 6010B	µg/L	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
Antimony	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	**1.6**	**28**	**35**	**19**	**46**	**83**	**130**	**160**
Arsenic	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	**0.98 J**	**19**	**14**	**850**	**62**	**56**	**68**	**71**
Barium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	**22**	**24**	**22**	**100**	**28**	**26**	**28**	**29**
Beryllium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.028 U	0.028 U	0.028 U	0.028 U	0.028 U	0.028 U	0.028 U	0.028 U
Calcium	Metals (ICP) (DISSOLVED)	SW846 6010B	µg/L	**16000**	**17000**	**16000**	**39000**	**18000**	**17000**	**18000**	**18000**
Chromium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	**0.17 J**	**0.2 J**	**0.15 J**	0.14 U	**0.16 J**	**0.15 J**	**0.16 J**	**0.15 J**
Cobalt	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.032 U	0.032 U	0.032 U	**3.2**	**0.23 J**	**0.15 J**	**0.16 J**	**0.13 J**
Copper	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U
Iron	Metals (ICP) (DISSOLVED)	SW846 6010B	µg/L	180 U	180 U	180 U	**2000**	180 U	180 U	180 U	180 U
Lead	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.034 U	0.034 U	0.034 U	0.034 U	0.034 U	0.034 U	0.034 U	0.034 U
Magnesium	Metals (ICP) (DISSOLVED)	SW846 6010B	µg/L	**8900**	**9300**	**8800**	**42000**	**11000**	**11000**	**11000**	**11000**
Manganese	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	**3.1**	**6.5**	**11**	**300**	**32**	**24**	**28**	**22**
Mercury	Mercury (CVAA) (DISSOLVED)	SW846 7470A	µg/L	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Nickel	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.4 U	0.4 U	0.4 U	**13**	**1.1 J**	**0.81 J**	**0.91 J**	**0.83 J**
Potassium	Metals (ICP) (DISSOLVED)	SW846 6010B	µg/L	**240 J**	**290 J**	**260 J**	**1200 J**	**330 J**	**310 J**	**350 J**	**360 J**
Selenium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	**0.63 J**	**0.51 J**	**0.48 J**	0.3 U	**0.54 J**	**0.36 J**	**0.49 J**	**0.44 J**
Silver	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Sodium	Metals (ICP) (DISSOLVED)	SW846 6010B	µg/L	**1600 J**	**1700 J**	**1600 J**	**11000**	**2300**	**2100**	**2300**	**2300**
Thallium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Vanadium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U
Zinc	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	1.9 U	1.9 U	**5.7 J**	1.9 U	**5.1 J**	**4 J**	**4.6 J**	**5.5 J**
Dissolved Low Level Mercury											
Mercury	Dissolved Mercury by EPA 1631	EPA 1631	ng/L	**2.55**	**11.2**	**11**	**9.46**	**6.32**	**8.99**	**14.8**	**13.8**
General Chemistry											
Total Organic Carbon	Organic Carbon, Total (TOC)	SW846 9060	mg/L	**1.9**	**1.5**	**1.5**	**1.2**	**1.4**	**1.6**	**1.7**	**1.6**
Total Dissolved Solids	Solids, Total Dissolved (TDS)	SM 2540C	mg/L	**73 J**	**79 J**	**79 J**	**270 J**	**94 J**	**110 J**	**120 J**	**120 J**
Total Suspended Solids	Solids, Total Suspended (TSS)	SM 2540D	mg/L	**2 J**	2 UJ	2 UJ	2 UJ	2 UJ	**2 J**	2 UJ	**40 J**
Chloride	Anions, Ion Chromatography	MCAWW 300.0	mg/L	**0.41 J**	**0.4 J**	**0.39 J**	**0.68 J**	**0.39 J**	**0.41 J**	**0.41 J**	**0.45 J**
Fluoride	Anions, Ion Chromatography	MCAWW 300.0	mg/L	**0.05 J**	**0.05 J**	**0.05 J**	**0.14**	**0.06 J**	**0.05 J**	**0.06 J**	**0.06 J**
Sulfate	Anions, Ion Chromatography	MCAWW 300.0	mg/L	**8**	**8.3**	**8.4**	**29**	**9.8**	**9.6**	**9.8**	**10**
Carbonate Alkalinity as CaCO3	Alkalinity	SM 2320B	mg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bicarbonate Alkalinity as CaCO3	Alkalinity	SM 2320B	mg/L	**76**	**70**	**69**	**250**	**100**	**81**	**79**	**79**
Hydroxide Alkalinity as CaCO3	Alkalinity	SM 2320B	mg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Alkalinity	Alkalinity	SM 2320B	mg/L	**76**	**70**	**69**	**250**	**100**	**81**	**79**	**79**
Nitrate Nitrite as N	Nitrogen, Nitrate-Nitrite	MCAWW 353.2	mg/L	**0.12**	**0.13**	**0.13**	0.005 U	**0.12**	**0.13**	**0.12**	**0.17**

Table 4-4 Surface Water Sample Results, Spring 2015

Analyte	Station ID / Geographic Area / Sample ID / Method		Units	RD10 Red Devil Creek 0615RD10SW	RD14 Red Devil Creek 0615RD14SW	RD15 Red Devil Creek 0615RD15SW	RD05 Seep 0615RD05SW	RD16 Red Devil Creek 0615RD16SW	RD09 Red Devil Creek 0615RD09SW	RD06 Red Devil Creek 0615RD06SW	RD08 Red Devil Creek 0615RD08SW
Field Water Quality Parameters											
Temperature	Field Measurement		Deg C	9.61	9.18	8.29	2.7	6.96	6.34	9.63	10.31
pH	Field Measurement		pH Units	7.94	7.8	7.99	7.13	7.63	7.4	6.04	7.6
Conductivity	Field Measurement		mS/cm	0.16	0.16	0.162	0.547	0.186	0.181	0.171	0.076
Turbidity	Field Measurement		NTU	0	0	0	0.3	0.1	0.1	0	0
Dissolved Oxygen	Field Measurement		mg/L	10.83	9.85	11.27	0	8.55	9.24	12.16	8.63
Oxidation-Reduction Potential	Field Measurement		mV	71	75	80	-93	78	151	67	183

Key
µg/L = Micrograms per liter
ADEC = Alaska Department of Environmental Conservation
Bold = Detected
Deg C = Degrees Celsius.
EPA = United States Environmental Protection Agency
GC/MS = Gas Chromatography/Mass Spectrometry
ICP/ MS = Inductively coupled plasma/mass spectrometry
J = The analyte was detected. The associated result is estimated.
mg/L = milligrams per liter
mS/cm = Millisiemens per centimeter
mV = Millivolts
ng/L = Nanograms per liter
NTU = Nephelometric turbidity units
U = The analyte was analyzed for but not detected. The value provided is the method detection limit.
UJ = The analyte was analyzed for but not detected. The associated reporting limit is estimated.

Table 4-5 Surface Water Sample Results, Fall 2015

Analyte	Station ID		Units	RD10	RD14	RD15	RD05	RD16	RD09	RD06	RD08
	Geographic Area			Red Devil Creek	Red Devil Creek	Red Devil Creek	Seep	Red Devil Creek	Red Devil Creek	Red Devil Creek	Red Devil Creek
	Sample ID			0915RD10SW	0915RD14SW	0915RD15SW	0915RD05SW	0915RD16SW	0915RD09SW	0915RD06SW	0915RD08SW
	Method										
Total Inorganic Elements											
Aluminum	Metals (ICP)	SW846 6010B	µg/L	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
Antimony	Metals (ICP/MS)	SW846 6020A	µg/L	**1.6**	**8.5**	**26**	**470**	**46**	**68**	**9.1**	**9.4**
Arsenic	Metals (ICP/MS)	SW846 6020A	µg/L	**1.5**	**6.4**	**13**	**26**	**55**	**58**	**39**	**40**
Barium	Metals (ICP/MS)	SW846 6020A	µg/L	**27**	**25**	**27**	**28**	**30**	**30**	**84**	**88**
Beryllium	Metals (ICP/MS)	SW846 6020A	µg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	Metals (ICP/MS)	SW846 6020A	µg/L	**0.051 J**	0.028 U	0.028 U	**0.33 J**	0.028 U	**0.1 J**	**0.08 J**	**0.14 J**
Calcium	Metals (ICP)	SW846 6010B	µg/L	**20000**	**20000**	**21000**	**40000**	**21000**	**21000**	**20000**	**21000**
Chromium	Metals (ICP/MS)	SW846 6020A	µg/L	**0.27 J**	**0.83**	**0.38 J**	**0.34 J**	**0.28 J**	**0.23 J**	**1.3**	**0.31 J**
Cobalt	Metals (ICP/MS)	SW846 6020A	µg/L	**0.045 J**	**0.057 J**	**0.069 J**	0.032 U	**0.24 J**	**0.21 J**	**32**	**33**
Copper	Metals (ICP/MS)	SW846 6020A	µg/L	0.6 U	0.6 U	0.6 U	**0.66 J**	0.6 U	0.6 U	0.6 U	0.6 U
Iron	Metals (ICP)	SW846 6010B	µg/L	**270 J**	**300 J**	**300 J**	**3200**	**390 J**	**320 J**	**330 J**	**320 J**
Lead	Metals (ICP/MS)	SW846 6020A	µg/L	0.034 U	0.034 U	0.034 U	**0.066 J**	0.034 U	0.034 U	**0.074 J**	**0.077 J**
Magnesium	Metals (ICP)	SW846 6010B	µg/L	**11000**	**11000**	**12000**	**43000**	**12000**	**13000**	**12000**	**13000**
Manganese	Metals (ICP/MS)	SW846 6020A	µg/L	**20**	**20**	**24**	**2.3**	**40**	**38**	**2600**	**2600**
Mercury	Mercury (CVAA)	SW846 7470A	µg/L	0.041 U	0.041 U	**0.056 J**	0.041 U	**0.12 J**	0.041 U	**0.054 J**	0.041 U
Nickel	Metals (ICP/MS)	SW846 6020A	µg/L	0.4 U	0.4 U	0.4 U	**0.9 J**	**1 J**	**0.97 J**	**100**	**100**
Potassium	Metals (ICP)	SW846 6010B	µg/L	**290 J**	**280 J**	**320 J**	**1200 J**	**330 J**	**360 J**	**380 J**	**370 J**
Selenium	Metals (ICP/MS)	SW846 6020A	µg/L	**0.46 J**	**0.44 J**	**0.46 J**	**0.33 J**	**0.39 J**	**0.43 J**	0.3 U	0.3 U
Silver	Metals (ICP/MS)	SW846 6020A	µg/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Sodium	Metals (ICP)	SW846 6010B	µg/L	**1600 J**	**1700 J**	**1800 J**	**13000**	**2100**	**2100**	**2300**	**2300**
Thallium	Metals (ICP/MS)	SW846 6020A	µg/L	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Vanadium	Metals (ICP/MS)	SW846 6020A	µg/L	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U
Zinc	Metals (ICP/MS)	SW846 6020A	µg/L	1.9 U	1.9 U	**6.2 J**	**2.4 J**	**6.4 J**	**6.1 J**	**5.7 J**	**6.1 J**
Total Low Level Mercury											
Mercury	Total Mercury by EPA 1631	EPA 1631	ng/L	**3.94**	**10.1**	**215**	**37.6 J**	**383**	**268**	**659**	**683**
Dissolved Inorganic Elements											
Aluminum	Metals (ICP) (DISSOLVED)	SW846 6010B	µg/L	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
Antimony	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	**1.4**	**8.6**	**24**	**240**	**41**	**66**	**0.59**	**120**
Arsenic	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	**1.2**	**6.2**	**12**	**590**	**48**	**53**	**32**	**67**
Barium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	**25**	**26**	**25**	**88**	**28**	**29**	**84**	**30**
Beryllium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	**0.043 J**	0.028 U	0.028 U	**0.47**	**0.3 J**	0.028 U	**0.28 J**	**0.32 J**
Calcium	Metals (ICP) (DISSOLVED)	SW846 6010B	µg/L	**20000**	**20000**	**20000**	**39000**	**20000**	**21000**	**21000**	**21000**
Chromium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	**0.32 J**	**0.32 J**	**0.17 J**	**1.3**	**0.18 J**	**0.19 J**	**0.19 J**	**0.2 J**
Cobalt	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.032 U	**0.056 J**	**0.047 J**	**7.6**	**0.16 J**	**0.15 J**	**0.071 J**	**0.14 J**
Copper	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.6 U	0.6 U	0.6 U	**1.2 J**	0.6 U	0.6 U	0.6 U	0.6 U
Iron	Metals (ICP) (DISSOLVED)	SW846 6010B	µg/L	180 U	180 U	**200 J**	**2600**	**240 J**	**250 J**	**200 J**	180 U
Lead	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.034 U	0.034 U	0.034 U	**0.15 J**	**0.047 J**	0.034 U	**0.054 J**	0.034 U
Magnesium	Metals (ICP) (DISSOLVED)	SW846 6010B	µg/L	**11000**	**11000**	**11000**	**42000**	**12000**	**13000**	**13000**	**13000**
Manganese	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	**8.7**	**15**	**18**	**740**	**33 J**	**33**	**130**	**30**
Mercury	Mercury (CVAA) (DISSOLVED)	SW846 7470A	µg/L	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Nickel	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.4 U	0.4 U	0.4 U	**35**	**0.83 J**	**0.82 J**	0.4 U	**0.92 J**
Potassium	Metals (ICP) (DISSOLVED)	SW846 6010B	µg/L	**260 J**	**270 J**	**300 J**	**1200 J**	**330 J**	**350 J**	**340 J**	**370 J**
Selenium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	**0.38 J**	**0.42 J**	**0.41 J**	**0.59 J**	**0.36 J**	**0.47 J**	0.3 U	**0.44 J**
Silver	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Sodium	Metals (ICP) (DISSOLVED)	SW846 6010B	µg/L	**1600 J**	**1700 J**	**1700 J**	**13000**	**2000**	**2100**	**2300**	**2400**
Thallium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Vanadium	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	0.98 U	0.98 U	0.98 U	**1.7 J**	0.98 U	0.98 U	0.98 U	0.98 U
Zinc	Metals (ICP/MS) (DISSOLVED)	SW846 6020A	µg/L	1.9 U	1.9 U	**5.4 J**	**11**	**5.9 J**	**5.2 J**	1.9 U	**7.8**
Dissolved Low Level Mercury											
Mercury	Dissolved Mercury by EPA 1631	EPA 1631	ng/L	1.96 U	**3.32**	**25.9**	1.48 U	**9.61**	**23.5**	**13.3**	**11.7**
General Chemistry											
Total Organic Carbon	Organic Carbon, Total (TOC)	SW846 9060	mg/L	**2.3**	**2.4**	**2.4**	**1.2**	**2.5**	**2.4**	**2.4**	**2.4**
Total Dissolved Solids	Solids, Total Dissolved (TDS)	SM 2540C	mg/L	**98**	**120**	**110**	**290**	**130**	**130**	**120**	**110**
Total Suspended Solids	Solids, Total Suspended (TSS)	SM 2540D	mg/L	2 U	2 U	2 U	**5.4**	2 U	2 U	2 U	2 U
Chloride	Anions, Ion Chromatography	MCAWW 300.0	mg/L	**0.55**	**0.57**	**0.5**	**0.72**	**0.56**	**0.58**	**0.57**	**0.55**
Fluoride	Anions, Ion Chromatography	MCAWW 300.0	mg/L	**0.05 J**	**0.05 J**	**0.05 J**	**0.14 J**	**0.05 J**	**0.07 J**	**0.05 J**	**0.07 J**
Sulfate	Anions, Ion Chromatography	MCAWW 300.0	mg/L	**8.1**	**8.4**	**8.7**	**26**	**9.6**	**9.8**	**10**	**10**
Carbonate Alkalinity as CaCO3	Alkalinity	SM 2320B	mg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bicarbonate Alkalinity as CaCO3	Alkalinity	SM 2320B	mg/L	**87**	**86**	**81**	**250**	**87**	**89**	**91**	**110**
Hydroxide Alkalinity as CaCO3	Alkalinity	SM 2320B	mg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Alkalinity	Alkalinity	SM 2320B	mg/L	**87**	**86**	**81**	**250**	**87**	**89**	**91**	**110**
Nitrate Nitrite as N	Nitrogen, Nitrate-Nitrite	MCAWW 353.2	mg/L	**0.14**	**0.14**	**0.14**	0.005 U	**0.13**	**0.13**	**0.12**	**0.12**
Field Water Quality Parameters											
Temperature	Field Measurement		Deg C	8.22	7.95	8.04	4.09	7.96	8.01	7.94	8.46
pH	Field Measurement		pH Units	7.63	7.74	7.78	7.35	7.67	7.58	7.57	7.19
Conductivity	Field Measurement		mS/cm	0.212	0.213	0.213	0.594	0.231	0.229	0.235	0.231
Turbidity	Field Measurement		NTU	0	0	0	1.5	0	0	0	0
Dissolved Oxygen	Field Measurement		mg/L	17.15	24.44	4.44	0	5.4	12.3	31.07	29.01
Oxidation-Reduction Potential	Field Measurement		mV	3	-77	-88	-69	-56	-23	-1	45

Table 4-5 Surface Water Sample Results, Fall 2015

Analyte	Station ID	Units	RD10	RD14	RD15	RD05	RD16	RD09	RD06	RD08
	Geographic Area		Red Devil Creek	Red Devil Creek	Red Devil Creek	Seep	Red Devil Creek	Red Devil Creek	Red Devil Creek	Red Devil Creek
	Sample ID		0915RD10SW	0915RD14SW	0915RD15SW	0915RD05SW	0915RD16SW	0915RD09SW	0915RD06SW	0915RD08SW
	Method									

Key

µg/L = Micrograms per liter
ADEC = Alaska Department of Environmental Conservation
Bold = Detected
Deg C = Degrees Celsius.
EPA = United States Environmental Protection Agency
GC/MS = Gas Chromatography/Mass Spectrometry
ICP/ MS = Inductively coupled plasma/mass spectrometry
J = The analyte was detected. The associated result is estimated.
mg/L = milligrams per liter
mS/cm = Millisiemens per centimeter
mV = Millivolts
ng/L = Nanograms per liter
NTU = Nephelometric turbidity units
U = The analyte was analyzed for but not detected. The value provided is the method detection limit.
UJ = The analyte was analyzed for but not detected. The associated reporting limit is estimated.

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5 Kuskokwim River Investigations

This chapter discusses the results and conclusions derived from sediment characterization performed as part of the RI Supplement and RI as well as BLM studies addressing Kuskokwim River biota. Project-specific data were used to assess contaminant transport into and between media in Red Devil Creek, the Kuskokwim River, and other contaminant source areas. As previously noted, the project area lies within a larger mineralized region, which locally contributes to naturally high concentrations of mercury and other metals in the environment. Where possible, multiple lines of evidence were used to address critical questions and maximize use of existing data. Of particular interest is the question of whether methylmercury is bioaccumulating in the Kuskokwim River food chain, particularly in upper trophic-level fish that may be consumed by local residents.

5.1 Kuskokwim River Sediment RI Supplement Investigations

The RI Supplement sediment characterization activities were designed to address data gaps associated with sediment in the Kuskokwim River near and downriver of Red Devil Creek. Additional sediment characterization was performed to gather the types of additional information identified in Section 3.3 of the RI Supplement Work Plan. The supplemental RI sediment characterization was designed to meet the following objectives:

- Assess the cross-river and downriver extents of contamination in Kuskokwim River sediment.
- Assess the turbidity of Kuskokwim River water.
- Assess the toxicity of sediments to benthic macroinvertebrates.
- Assess the potential for methylation and bioaccumulation of mercury.

Data collected to meet these objectives, in conjunction with data collected during the RI and BLM Kuskokwim River investigations, are used to inform site-wide remedial decision making.

Additional sediment characterization was performed using a combination of field data collection and the results of laboratory analysis for selected analytical parameters of sediment samples collected at offshore sediment sample locations in the Kuskokwim River. The sediment sampling and laboratory analysis included the following:

- Twelve sediment samples were collected from the area upriver of, in the vicinity of, and downriver of Red Devil Creek delta. These samples were analyzed for total TAL inorganic elements, TOC, and grain size distribution. These samples also were analyzed for toxicity using a *Hyallela azteca* 28-day test. Six of the samples also were analyzed for methylmercury and mercury SSE.
- Twelve sediment samples were collected from locations cross-river and downriver from the areas of elevated concentrations of antimony, arsenic, and mercury documented during the RI. Each of these samples was analyzed for total TAL inorganic elements, TOC, and grain size distribution. In addition, eight of these samples also were analyzed for methylmercury.
- Four sediment samples were collected from locations near the northeast bank of the Kuskokwim River along two previously defined RI sample transects near the Red Devil Creek delta. Two samples were collected from one transect located upstream of Red Devil Creek, and two samples were collected from one transect located a short distance downstream of Red Devil Creek. Along each transect, one sample was collected from shallow water near the shore approximately 10 to 20 feet from the northeast bank, and a second sample was collected approximately 50 feet from the northeast bank. All four samples were analyzed for TAL inorganic elements only.

In addition to collection of sediment samples, the water column at all sampling locations was analyzed in the field for turbidity.

5.1.1 RI Supplement Sediment Sampling

Sediment samples were collected during the September 2015 RI Supplement field event. The locations of the samples are described in Table 5-1 and shown in Figures 5-1 and 5-2. As described in the RI Supplement Work Plan, selection of planned sample locations was based in part on results of previous RI sediment samples, collected in 2010, 2011, and 2012, and locations and BLM periphyton samples collected in 2014 (see Section 5.2.2). Locations of RI sediment samples are illustrated in Figures 5-1 and 5-2. A summary of laboratory analytical results for the 2010, 2011, and 2012 RI Kuskokwim River sediment samples is presented in Table 4-33 of the final RI report and Table 4-1 of the final RI Supplement Work Plan. RI sediment sample results also are discussed in Section 5.3. Locations of BLM 2014 periphyton samples that are within the area of the 2015 RI Supplement sediment sampling are shown in Figures 5-1 and 5-2. Locations of all of the BLM 2014 periphyton samples, including those within the extent of the RI Supplement sampling as well as those collected further upriver and downriver, are shown in Figure 5-3. It is noted that the provided periphyton sample location data that were used to generate figures in the RI Supplement Work Plan contained several errors; the corrected location information is represented in Figures 5-1 through 5-3. Collection of the 2014 periphyton samples is described in Section 5.2.2.

The sampling team attempted to collect each sediment sample at the location identified in the RI Supplement Work Plan. For some samples, the actual sample locations varied from planned locations due to conditions encountered at the time of sampling. Significant deviations in the sample locations are discussed in Section 5.1.3.

Sediment sampling and other field procedures were performed in accordance with the Field Sampling Plan, except as noted below. Samples were collected from a flat-bottomed vessel outfitted with an A-frame and electric winch, fathometer, and Global Positioning System. The vessel and sampling equipment were operated by operators under subcontract to E & E. The vessel was positioned over the sampling stations by either anchoring or live-boating. Sediment samples were collected with a hand-auger; van Veen sampler; or clean, dedicated plastic scoop. As necessary, multiple grabs were collected to obtain adequate sample volume for the planned laboratory analyses. The type of sampling equipment used for each sample is identified in Table 5-1. E & E staff collected the samples for the laboratory analyses listed in Table 5-1. Sediment samples were submitted to TestAmerica, Seattle, Washington, for laboratory analysis. TestAmerica performed analysis for total TAL inorganic elements, TOC, and grain size distribution. Brooks Rand Labs, Seattle, Washington, under sub-subcontract to TestAmerica, performed analyses for methylmercury and mercury SSE. Northwestern Aquatic Sciences, Newport, Oregon, under sub-subcontract to TestAmerica performed sediment toxicity testing.

5.1.2 River Turbidity Measurement

At each RI Supplement sediment sample location the turbidity of river water was measured with a calibrated field water quality meter. At each sample location the water quality probe was lowered to approximately mid-depth and turbidity was measured in situ.

5.1.3 Deviations from the Field Sampling Plan

The sediment sample from location KR086 was collected at a location approximately 150 feet from the planned location, which was co-located with RI sample location KR54. The proposed sampling location KR086 was located near the downstream end of the Red Devil Creek delta in an area of relatively swift current. This current had apparently resulted in relatively heavy armoring of the river bottom (i.e., very gravelly/cobbly conditions). More than 12 attempts were made to collect a sample at this location. Subsequently, sampling was attempted at three alternate nearby locations. The attempts at the first three alternate locations also were unsuccessful due to swift current and armoring. A sample was eventually collected at a fifth location in a relatively calm and shallow eddy downriver of the Red Devil Creek delta.

The sediment toxicity sample planned for collection at location KR101, located on the northeast bank downriver of the RDM, was not collected at that location. At location KR101, the current was relatively swift and the bottom was relatively heavily armored (i.e., very gravelly/cobbly conditions), with little finer-grained sediment. Although it was feasible to collect enough sediment at KR101 for the other analyses (see Table 5-1), it was not feasible to collect adequate sediment volume for the toxicity test. Therefore, a sample for toxicity testing was collected at alternate location KR099, which is also located on the northeast bank downriver of the RDM. Location KR099 is the next location upriver from KR101, and is situated on the inside of the river bend in a lower energy environment with more abundant, finer-grained sediment. Collection of the toxicity sample at location KR100 also was considered prior to toxicity sample collection at location KR99. However, location KR100 is situated near a landing for small watercraft, and petroleum odors and sheens were observed at that location at the time of sampling. Due to the concern that such petroleum impacts could potentially affect the toxicity testing results, location KR100 was not selected for collection of the toxicity test sample.

5.2 BLM Kuskokwim River Investigations

Beginning in 2010, BLM began a study to comprehensively examine mercury, methylmercury, and other metals in the Kuskokwim River basin in proximity to the Red Devil Mine. Those studies pertinent to the present evaluation of Kuskokwim River sediment near the RDM are summarized below.

5.2.1 Fish Movement and Tissue Sampling

In 2010 and 2011, the BLM in cooperation with the United States Fish and Wildlife Service and Alaska Department of Fish and Game measured mercury concentrations in small muscle biopsies from norther pike (*Esox lucius*) and burbot (*Lota lota*) equipped with radio transmitters, and related the concentrations to fish location and movements in the middle Kuskokwim River region.

The study design and methods are described in Matz et al. (2015). Matz et al. (2015) divided the mainstream Kuskokwim River and major tributaries within the study area into eight watersheds or reaches (see Figure 5-4). These watersheds or reaches are:

1) Kusko-Aniak: Mainstem Kuskokwim River from Aniak to George River, including Aniak and Oskawalik Rivers;

2) George: George River, including East and South Forks;

3) Kusko above George: Mainstem Kuskokwim River upstream of George River to Sleetmute, Alaska (the reach that includes the RDM);

4) Holitna: Holitna and Hoholitna Rivers;

5) Kusko-Stony: Mainstem Kuskokwim River from Holitna River to Stony River and including Stony River and Moose Creek;

6) Kusko above Sleetmute: Mainstem Kuskokwim River from Stony River to Selatna River, including Swift and Tatlawiksuk Rivers;

7) Kusko above Selatna: Mainstem Kuskokwim River from Selatna River to North Fork of Kuskokwim River; and

8) Takotna: The Takotna River including the Nixon Fork.

Matz et al. (2015) collected small muscle biopsy samples from and put radio tags in northern pike and burbot from these watersheds during several sampling events in June to October 2011 and June to November 2012. Northern pike ranged in length from 510 to 1068 millimeters (20 to 42 inches) and burbot ranged in length from 500 to 870 millimeters (19 to 34 inches). The number of fish sampled and tagged per watershed and basic watershed characteristics are listed in Table 5-2.

Radio-tagged fish were located using a combination of four ground-based tracking stations and aerial surveys. Ground stations were located on the mainstem Kuskokwim River near Aniak, the mouth of the George River, on the mainstem Kuskokwim River 5 kilometers downstream from the Stoney River, and on the Holitna River 1.5 kilometers upstream from its mouth. Ground tracking stations were operational from mid-March to mid-November. Tracking flights were conducted between late October 2011 and February 2014 with a fixed wing aircraft equipped with a Lotek SRX600 receiver with internal Global Positioning System that recorded time and location data. Flights were timed before and after periods of major movements during freeze-up and break-up.

Muscle biopsy samples were analyzed for total mercury by Physis Environmental Laboratories, Anaheim, California and Frontier Global Science, Seattle, Washington following U.S. Environmental Protection Agency (EPA) methods. Analytical chemistry results underwent a third-party quality assurance review using EPA Validation Level IV criteria. All data were considered valid based on the quality assurance review.

5.2.2 Periphyton Sampling

In 2014, the BLM collected periphyton samples from the Kuskokwim River for analysis for metals and methylmercury to assess the potential bioaccumulation of these constituents in river and stream biota. Periphyton may be used as a surrogate for benthic macroinvertebrates (see Section 5.2.3) since periphyton are sedentary and can be a food source for benthic macroinvertebrates in the littoral zone. Thirteen samples were collected both upstream and downstream from the Red Devil Creek delta. One sample also was collected from Red Devil Creek. Sample locations over the entire periphyton sampling area are shown on Figure 5-3. The periphyton samples collected within the area of the Red Devil RI and RI Supplement sediment sampling are shown in Figures 5-1 and 5-2.

Sampling methods are discussed in the Field Operations Plan – 2014, Quantification of fish and aquatic insect tissue contaminants in the Middle

Kuskokwim River, Alaska (Field Operations Plan; BLM 2014). In brief, the periphyton samples were collected by brushing the upper surface of cobbles and other substrate within the littoral zone near shore. At each site, a clean nylon brush was used to dislodge periphyton from the substrate, and stream water was used to wash the dislodged periphyton into a clean plastic pan. The resulting slurry was transferred to a pre-cleaned sample container, labeled, and placed on ice. Two composite samples were collected at each site; each sample was composed of periphyton from 5 to 10 individual pieces of substrate. The periphyton samples were analyzed for 20 metals, methylmercury, inorganic arsenic, and percent solids. A list of analytes and analytical methods is shown below.

Total Inorganic Elements	
Aluminum	EPA 6020
Antimony	EPA 6020
Arsenic	EPA 6020
Barium	EPA 6020
Beryllium	EPA 6020
Boron	EPA 6020
Cadmium	EPA 6020
Chromium	EPA 6020
Copper	EPA 6020
Iron	EPA 6020
Lead	EPA 6020
Magnesium	EPA 6020
Manganese	EPA 6020
Mercury	EPA 245.7
Molybdenum	EPA 6020
Nickel	EPA 6020
Selenium	EPA 6020
Strontium	EPA 6020
Vanadium	EPA 6020
Zinc	EPA 6020
Percent Solids	
Percent Solids	SM 2540 B
Methylmercury	
Methylmercury (as Mercury)	EPA 1630 Mod/FGS-070
Inorganic Arsenic	
Inorganic Arsenic	EPA 1632

5.2.3 Benthic Macroinvertebrate Sampling

In 2014, the BLM attempted to collect benthic macroinvertebrates from the Kuskokwim River from five locations both upstream and downstream from the RDM, but was unsuccessful. The intent of the sampling was to provide benthic macroinvertebrate samples for chemical analysis and analysis of community composition. Sampling methods were described in the Field Operations Plan (BLM 2014) and were similar to those used successfully in Red Devil Creek and other small tributary creeks to the Kuskokwim River in prior years. Some benthic macroinvertebrates were collected from the Kuskokwim River during the 2014 sampling event at a few locations after extensive sampling effort, but the total biomass and number of organisms was insufficient for analysis, and the larger effort was abandoned. The BLM suggested that the scarcity of benthic macroinvertebrates in the near-shore environment of the Kuskokwim River may be due to excessive turbidity. BLM also collected periphyton samples in 2014 (see Section 5.2.2). Periphyton may be used as a surrogate for benthic macroinvertebrates since periphyton are sedentary and can be a food source for benthic macroinvertebrates in the littoral zone.

During the 2015 RI Supplement sediment sampling event (see Section 5.1), field turbidity measurements of Kuskokwim River water were made to assess river turbidity at those locations at the time of sampling (see Section 5.1.2). Results are presented in Section 5.3.6 and briefly summarized below. In situ turbidity averaged 328 nephelometric turbidity units (NTU; range 14 to 575 NTU) in the near-shore environment of the Kuskokwim River. In contrast, field turbidity in Red Devil Creek typically was undetectable or in the low single digit NTU range. Habitat quality in the near-shore zone of the Kuskokwim River also may be affected by ice scour and seasonal changes in water level. For these reasons, it is not surprising that a diverse and abundant benthic macroinvertebrate community is not present in the near-shore zone of the Kuskokwim River.

5.3 Kuskokwim River Investigation Results

The RI Supplement Kuskokwim River sediment characterization was performed using a combination of field data collection and the results of laboratory analysis for selected analytical parameters. The objectives of the sediment investigation are listed in Section 5.1. The RI Supplement sediment characterization built upon sediment investigations performed as part of the RI. Results of the RI Supplement and RI Kuskokwim River investigation activities are presented below.

5.3.1 Total Inorganic Elements in Sediment

In Kuskokwim River sediment samples collected during the RI (in 2010, 2011, and 2012), antimony, arsenic, and mercury concentrations were the COCs most highly elevated above background values. The RI background sediment concentrations for these COCs are: total antimony, 0.446 milligrams per kilogram (mg/kg); arsenic, 15 mg/kg; and mercury, 0.144 mg/kg. Concentrations of antimony, arsenic, and mercury in RI samples generally decreased downriver from the mouth of Red Devil Creek. Locations of RI sediment samples are illustrated in Figure 5-1. The total antimony, arsenic, and mercury concentrations for the RI sediment samples are presented in Table 4-22 and illustrated in Figures 4-41 and 4-42 of the final RI report. These results also are presented graphically in Figures 5-5 through 5-10 and Figures 5-13a through 5-13c of this report. The samples in Figures 5-13a through 5-13c are arranged generally from upriver (left) to downriver (right). Sediment sample location KR15, located near the upriver end of the Red Devil Creek delta, is indicated on each figure. Upriver locations (including RI background locations KR01, KR18, KR19, KR20, KR21, KR22, KR12, KR23, KR24, KR25, KR26, KR27, and KR13, and KR14) are shown to the left of KR15. Downriver sample locations are shown to the right of KR15. The samples collected from some of the RI sample locations furthest downriver and distant from the shore exceeded one or more of the background values for antimony, arsenic, and mercury. The extent of antimony, arsenic, and mercury contamination (defined as exceeding background levels) in river sediments thus was not defined by RI sampling in the downriver and/or the cross-river directions.

As part of the 2015 RI Supplement, additional sediment sampling for total inorganic elements was performed to further assess the cross-river and downriver extents of contamination in Kuskokwim River sediment. Laboratory results of sediment samples collected in 2015 are presented in Table 5-3. Locations of the 2015 sediment samples, as well as the RI samples, are illustrated in Figures 5-1 and 5-2. The total antimony, arsenic, and mercury results of the 2015 RI Supplement and 2010, 2011, and 2012 RI sediment samples are illustrated in Figures 5-5 thru 5-10. The results for total antimony, arsenic, and mercury for the 2015 sediment samples also are presented graphically in Figures 5-14a through 5-14c. The 2015 results for other inorganic elements are illustrated in Figures 5-14e through 5-14n. The samples in Figures 5-14a through 5-14n are arranged generally from upriver (left) to downriver (right). Sediment sample location KR084, located near the upriver end of the Red Devil Creek delta, is indicated on each figure. Upriver locations (KR082 and KR083) are shown left of KR084. Downriver sample locations are shown to the right of KR084. Sample locations KR106, KR107, KR108, and KR109, which are located near the northeast bank across the river from the Red Devil Creek delta area, are shown to the left of location KR084.

The 2015 sediment sample results show that concentrations of total antimony, arsenic, and mercury further decrease with distance from the southwest bank, as indicated by results for samples from locations KR094 and KR095 (see Table 5-3 and Figures 5-5, 5-7, and 5-9. Concentrations in these samples are below the RI background sediment concentrations for total antimony, arsenic, and mercury.

Concentrations of total antimony, arsenic, and mercury generally decrease with distance downriver from the Red Devil Creek delta area (see Table 5-3 and Figures 5-5 through 5-10 and 5-14a through 5-14c). Concentrations of total arsenic and mercury are generally near or slightly above background levels in the downriver samples. Concentrations of total antimony are above the background level at most of the downriver sample locations.

5.3.2 Methylmercury in Sediment

During the RI, 26 bed sediment samples collected in 2010, 2011, and 2012 were analyzed for methylmercury (see final RI report Section 5.3.6). Locations of RI sediment samples are illustrated in Figure 5-1. RI results are presented in Table 4-22 and illustrated in Figures 4-41 and 4-42 of the final RI report. These results are also presented graphically in Figures 5-11, 5-12, and 5-13d of this report. Methylmercury was detected in RI samples at concentrations ranging from 0.15 to 3.73 nanograms per gram (ng/g), and was detected above the background level of 0.49 ng/g in 14 of the 26 samples.

As part of the RI Supplement effort to further evaluate the potential for methylation of mercury in sediment, additional samples were analyzed directly for methylmercury. A total of 15 RI Supplement samples were analyzed for methylmercury. Locations of all 2015 sediment samples are illustrated in Figures 5-1 and 5-2. The samples selected for methylmercury analysis are identified in Table 5-1. Laboratory results of methylmercury analyses of 2015 sediment samples are presented in Table 5-3. The methylmercury concentrations for the 2015 sediment samples are graphically represented in Figures 5-11, 5-12, and 5-14d. For the 2015 sediment samples, methylmercury concentrations were below the method detection limit in six samples. Only the samples from KR084 (0.788 ng/g, estimated), KR092 (0.605 ng/g, estimated), and KR104 (0.667 ng/g, estimated) were greater than the RI background level of 0.49 ng/g for methylmercury.

5.3.3 Mercury Selective Sequential Extraction in Sediment

Several approaches were taken during the RI to evaluate the potential for methylation of mercury in Kuskokwim River sediments. Several types of data were collected to evaluate the amount of mercury that is soluble and bioavailable. Several Kuskokwim River RI sediment samples were collected for mercury SSE analysis. A general discussion of mercury SSE analysis is presented in Sections 5.3.5.1 and 5.3.5.2 of the final RI report, and in Section 2.2.3.2 of this report.

As part of the RI Supplement effort to further evaluate the potential for methylation of mercury in Kuskokwim River sediment, seven samples were collected for mercury SSE analysis. Results of the mercury SSE analysis are presented in Table 5-3. Interpretation of these results is presented in Section 5.3.7.3.

5.3.4 Grain Size and Total Organic Carbon in Sediment

RI Supplement sediment samples were analyzed for grain size and TOC to provide additional information on the physical and chemical characteristics of the sediment and to support the interpretation of the sediment toxicity testing results (see Section 5.3.5). Laboratory results of grain size and TOC analyses of 2015 sediment samples are presented in Table 5-3.

5.3.5 Sediment Toxicity Testing

In September 2015, sediment samples for toxicity testing were collected from 12 locations in the Kuskokwim River near the RDM, including:

- Nine locations at or downstream from the Red Devil Creek delta (KR084, KR085, and KR087 to KR093);

- One location downstream from the Red Devil Creek delta on the opposite back of the river (KR099); and
- Two (reference) locations upstream from the Red Devil Creek delta (KR082 and KR083).

Sample locations are shown in Figures 5-1 and 5-2. The samples were sent to Northwestern Aquatic Sciences, Newport, Oregon, where a 28-day growth and survival tests with *Hyalella azteca* (amphipod) was conducted with each sample following EPA Method 100.4. The full Northwestern Aquatic Sciences testing report is provided in Appendix C. This section provides a summary and interpretation of the testing results.

5.3.5.1 Survival Effects

Hyalella survival results are summarized in Table 5-4. Seven of 10 samples collected downstream from the Red Devil Creek delta showed no effects on survival compared with the upstream reference samples or laboratory control sample. In these seven samples, survival ranged from 89 to 93%. In the remaining three samples, *Hyalella* survival was reduced by 10 to 30% compared with the reference samples and laboratory control.

5.3.5.2 Growth Effects

Table 5-4 also summarizes the *Hyalella* growth results. No effect on growth was observed in nine of 10 samples collected downstream from the Red Devil Creek delta. In one downstream sample, growth was reduced by about 20% compared with the upstream reference samples and laboratory control.

5.3.5.3 Relationships between Sediment Chemistry and Toxicity

The sediment chemistry and *Hyalella* survival data were examined to identify sediment constituents negatively correlated with survival. Such constituents could be possible causative agents of the observed toxicity. This was done by calculating Pearson's and Spearman's correlation coefficients for *Hyalella* survival versus concentrations of total inorganic elements and other parameters in sediment. The Spearman correlation coefficient is a nonparametric analog of the usual correlation coefficient and is calculated by replacing the data values with their ranks and calculating the correlation coefficient of the ranks. *Hyalella* survival was not significantly correlated with antimony, arsenic, mercury, or methylmercury levels in sediment (see Tables 5-5 and 5-6 for Pearson and Spearman correlations, respectively, and significant levels). Furthermore, the sediment sample (15KR085SD) with the greatest levels of antimony (3,100 mg/kg), arsenic (2,100 mg/kg), and mercury (310 mg/kg) had the greatest survival (93%) of samples collected downstream from the delta. These results suggest that reduced survival of *Hyalella* in Kuskokwim River sediment samples collected downstream from the Red Devil Creek delta was not due to antimony, arsenic, mercury, or methylmercury, the principal COCs at the site.

Tables 5-5 and 5-6 list sediment constituents that were negatively correlated with *Hyalella* survival. These constituents include physical parameters associated with sediment texture (% medium sand, % silt, and % clay), TOC, two major elements (magnesium and sodium), and 10 metals (cadmium, cobalt, copper, iron, manganese, nickel, selenium, silver, vanadium, and zinc). The correlations do not prove cause and effect; they simply indicate that there is a negative association between these parameters and *Hyalella* survival. There is more than one possible interpretation for these results.

One interpretation is that *Hyalella* survival was affected by one or more of the 10 metals (cadmium, cobalt, copper, iron, manganese, nickel, selenium, silver, vanadium, and zinc) that were negatively correlated with survival. To explore this possibility, the concentrations of these 10 metals in samples 15KR089SD, KR15091SD, and KR15093SD were compared to the screening levels for effects on freshwater benthos, identified in Table 6-45 of the final RI report. Table 5-7 shows that seven of these metals (cadmium, cobalt, copper, selenium, silver, vanadium, and zinc) do not exceed their screening levels in these samples and therefore are unlikely to have affected *Hyalella* survival. In contrast, the concentrations of iron, manganese, and nickel in these samples did exceed their screening levels. However, one reference sample (15KR082SD) also contained iron, manganese, and nickel above the screening levels, suggesting that these metals may be naturally elevated in Kuskokwim River sediment. Furthermore, the 2015 sediment metals results discussed in Section 5.3.1 provide no indication that the site is a significant source or iron, manganese, or nickel to the Kuskokwim River. Based on results of a Mann-Whitney U-test (non-parametric equivalent of two sample t-test), sediment concentrations of iron, manganese, or nickel are not greater in samples collected downstream from the Red Devil Creek delta compared with upstream samples.

Another interpretation is that *Hyalella* survival was affected by TOC and/or sediment texture rather than metals concentrations. The three samples with significantly reduced *Hyalella* survival had higher TOC and less gravel than the two upstream reference samples (see Table 5-3). Further, the two samples with the lowest survival (15KR089SD and 15KR091SD) had the greatest TOC levels (see Table 5-3). The mechanism(s) by which sediment texture and/or TOC may have affected *Hyalella* survival is uncertain; however, it is known that sediment texture and TOC can affect toxicity-testing results and that reference samples and site samples should be similar for these parameters. For this study, they were matched as closely as possible given existing information and river conditions near the site, but nonetheless differed.

In summary, it is likely that reduced survival of *Hyalella* in samples 15KR089SD, KR15091SD, and KR15093SD compared with upstream reference samples was the result of differences in sediment texture and/or TOC content between the site and reference samples, and/or the result of non-site-related metals that appear to be naturally elevated in Kuskokwim River sediment.

5.3.6 River Turbidity Measurement

In situ measurements of Kuskokwim River water turbidity are presented in Table 5-3. In situ river water turbidity averaged 328 NTU and ranged from 14 to 575 NTU.

5.3.7 BLM 2014 Periphyton Tissue Sampling

This section presents the results of the periphyton sampling performed by the BLM in 2014 (see Section 5.2.2).

5.3.7.1 Spatial Distribution of Metals in Periphyton

The periphyton analytical results are presented in Table 5-8. To evaluate the spatial distribution of inorganic elements in periphyton, the sample results were plotted from upstream to downstream with the sample collected in Red Devil Creek located at the center of each figure (see Figures 5-15a to 5-15p). Antimony, arsenic, and mercury in the periphyton sample from Red Devil Creek were noticeably greater than in samples from the Kuskokwim River (see Figures 5-15a through 5-15d and Figures 5-15g and 5-15h). These results are not unexpected given the nature of contamination at the RDM. Selenium and zinc in the Red Devil Creek periphyton sample also were elevated compared with the Kuskokwim River samples (see Figures 5-15n and 5-15p).

The Mann-Whitney U-test was used to test for differences in metals concentrations between periphyton samples collected upstream and downstream from the Red Devil Creek delta. Total antimony, arsenic, and mercury (but not selenium and zinc) were significantly elevated ($p < 0.05$) in periphyton samples collected downstream from the Red Devil Creek delta compared with upstream samples (see Table 5-9). The greatest difference was for total mercury, which was 20 times greater on average in periphyton samples collected downstream from the Red Devil Creek delta compared with upstream samples (see Table 5-9). In contrast, the average difference in total arsenic levels between downstream and upstream periphyton samples was only 20% (see Table 5-9). In contrast to total arsenic, inorganic arsenic was not elevated in samples collected downstream from the Red Devil Creek delta (see Table 5-9 and Figures 5-15e and 5-15f).

5.3.7.2 Methylmercury in Periphyton

Methylmercury was not detected (< 0.5 ng/g wet weight) in the periphyton samples (see Table 5-8). Hence, despite the fact the total mercury levels were greater in periphyton samples collected downstream from the Red Devil Creek delta compared with upstream samples, there is no indication that this pattern of total mercury contamination resulted in greater methylmercury levels at the base of the aquatic food web. This result is not unexpected given that methylmercury production occurs in anoxic sediment environments, not in the aerobic environment from which the periphyton samples were collected.

5.3.7.3 Metals Bioavailability

Three parameters that were analyzed in Kuskokwim River samples collected in 2014 or 2015 are relevant for understanding contaminant bioavailability at the base of the aquatic food web. These parameters are: (1) methylmercury in periphyton; (2) inorganic arsenic in periphyton; and (3) mercury SSE results for sediment. These parameters are discussed in turn below.

Methylmercury in Periphyton

As noted above, methylmercury was not detected in periphyton samples collected from the Kuskokwim River by the BLM in 2014 (see Table 5-8). These results suggest that mercury releases from the RDM have not resulted in greater methylmercury levels at the base of the aquatic food web in the Kuskokwim River.

Inorganic Arsenic in Periphyton

In general, inorganic arsenic compounds are more toxic than organic arsenic compounds. In the Kuskokwim River, inorganic arsenic was not elevated in periphyton samples collected downstream from the Red Devil Creek delta compared with upstream samples (see Table 5-8 and Figures 5-15e and 5-15f). In fact, inorganic arsenic levels in periphyton were significantly lower in samples collected downstream from the Red Devil Creek delta than in upstream samples ($p < 0.0406$, Mann-Whitney U-test).

Mercury SSE Results for Sediment

Several approaches were taken during the RI to evaluate the potential for methylation of mercury in Kuskokwim River sediments. Several types of data were collected that indicate that a large fraction of total mercury in site soil and sediment is sparingly soluble. For example, mercury SSE data indicate that a small fraction of total mercury in site soil (see final RI report Section 5.3.5.1) and sediment derived in part from site soil (see final RI report Section 5.3.5.2) is water soluble (F1) or stomach acid soluble (F2) and that the proportion of these soluble fractions relative to the total mercury decreases with increasing total mercury concentration. Similarly, synthetic precipitation leaching procedure data suggest that a small fraction of the total mercury concentration in site soil samples is soluble under slightly acidic conditions procedure (see final RI report Section 5.3.4.1). The soluble portion of the total mercury pool is the portion subject to methylation.

For the RI Supplement, additional sampling and analysis of Kuskokwim River sediment for mercury SSE was performed to gather additional information on the potential for methylation of mercury in Kuskokwim River sediments. Seven sediment samples were analyzed for mercury SSE. Sample results are presented in Table 5-3 and 5-10. Table 5-10 uses the mercury SSE results for the RI Supplement sediment samples to estimate the fraction of total mercury in Kuskokwim River sediment that is readily bioavailable. The sums of the F0, F1, and F2 mercury SSE fractions were used to represent readily bioavailable mercury in each sample. These SSE fractions represent mercury forms that are soluble in water (F0 and F1) or weak acid (F2). These are the mercury forms most likely to be subject to microbial methylation in the environment.

Kuskokwim River sediment samples collected at or within 800 meters of the Red Devil Creek delta contained elevated levels of total mercury (740 to 17,000 ng/g or 0.74 to 17 mg/kg); however, the percentage of readily bioavailable mercury in the samples was low—typically less than 1% of total mercury (see Table 5-10). These results are consistent with mercury SSE results for sediment, soil, and mine wastes presented in Sections 5.3.5.1 and 5.3.5.2 of the final RI report. Those results showed that mercury in site soils and mine waste was largely present as cinnabar or other comparably less soluble mercury forms. Such mercury forms are sparingly bioavailable.
In contrast, the Kuskokwim River sediment sample collected at downriver location KR097 contained low total mercury (18 ng/g or 0.018 mg/kg) and a greater percentage of bioavailable mercury compared with the six samples collected near the RDM (see Table 5-10).

5.3.8 BLM Fish Movement and Tissue Sampling

This section discusses results from Matz et al. (2015) as they related to understanding the potential for the RDM to affect mercury levels in game fish of harvestable size from the middle Kuskokwim River region.

5.3.8.1 Comparison of Mercury Levels in Fish among Watersheds

Average total mercury levels in northern pike and burbot from the Kuskokwim River reaches studied by Matz et al. (2015) are presented in Table 5-11. The average total mercury levels in pike and burbot from the Kuskokwim River reach that includes the RDM (Kusko above George) were among the lowest measured. These results suggest that the releases of mine wastes from the RDM have not negatively affected mercury levels in Kuskokwim River pike.

The greatest average total mercury concentration in pike was found in the Takotna watershed (see Table 5-11), which is well upriver from the RDM (see Figure 5-4). The greatest total mercury concentration in burbot was found in the George River watershed (see Table 5-11), a tributary to the Kuskokwim River not affected by releases from the RDM. The George River watershed also had a high average total mercury concentration in pike, as did the Holitna River watershed (see Table 5-11).

High total mercury levels in pike from the Takotna, Holitna, and George River watersheds likely are the result of the physical and biological characteristics of these watersheds. All three watersheds have extensive areas of oxbows with abundant wetland habitat, ideal habitat for pike and other fish and important sites for mercury methylation.

5.3.8.2 Fish Movement
According to Matz et al. (2015), most pike (78 to 100%) captured in the George River, Holitna, Kusko-Stony, Kusko-above-Selatna, and Takotna watersheds stayed in the watershed where they were captured. Hence, mercury exposure for pike in these watersheds comes from their native watershed. In contrast, only about 40% of northern pike captured in the Kuskokwim River reach that includes the RDM (Kusko above George) stayed in that river reach. The movement of pike out of this river reach has the effect of reducing their exposure to mercury from the RDM. This behavior may explain why mercury levels in northern pike from this reach showed no effect from the RDM.

Low fidelity of pike to the Kusko-above-George reach may be due to the physical and biological characteristics of this reach. This reach is characterized by linear shorelines, strong current, high turbidity, and low density of shoreline wetlands. These characteristics make the reach unattractive to pike, and few pike were captured in this river reach (see Table 5-2). As a result, residents of nearby villages prefer fishing for pike in other river reaches where better pike habitat and more pike occur. This situation reduces the potential for human exposure to mercury and other contaminants from the RDM via the fish consumption pathway.

Information regarding burbot movement is available for three Kuskokwim River reaches (Kusko-Aniak, Kusko-above-George, and Kusko-Stoney). Eighty percent (80%) of burbot that were captured in the Kusko-Aniak reach (the most downstream reach included in the study) stayed in that reach. In contrast, only about 10% of burbot captured in the Kusko-above-George reach (where the RDM is located) and the Kusko-Stoney reach stayed in those reaches. Movement of burbot out of the reach where the RDM is located has the effect of minimizing burbot exposure to mercury from the RDM.

5.4 Kuskokwim River Investigation Conclusions
The RI Supplement sediment characterization activities were designed to address data gaps associated with sediment in the Kuskokwim River near and downriver of Red Devil Creek. The resulting data were used in conjunction with results of the BLM Kuskokwim River investigations to evaluate potential impacts of RDM-related contamination on Kuskokwim River sediment, fish, and other potential receptors. Collectively, these data represent multiple lines of evidence that can be used to understand potential impacts on the Kuskokwim River environment, as illustrated in Figure 5-16. The results of this evaluation will be used to support the development of site-wide remedial alternatives at the RDM.

5.4.1 Cross-River and Downriver Extent of Sediment Contamination
As part of the RI Supplement, sediment sampling and analysis for total inorganic elements was performed as part of the RI Supplement to assess the cross-river and downriver extents of contamination in Kuskokwim River sediment. Concentrations of total antimony, arsenic, and mercury decrease with distance

away from the riverbank near the Red Devil Mine, and with distance downriver from the Red Devil Creek delta. Concentrations of total arsenic and mercury are generally near or slightly above background levels in the downriver samples. Concentrations of total antimony are above the background level at most of the downriver sample locations.

5.4.2 Sediment Toxicity

A 28-day growth and survival test with *Hyalella azteca* (freshwater amphipod) was conducted with sediment from 10 locations in the Kuskokwim River downstream from the Red Devil Creek delta and from two upstream reference samples. The following results are noteworthy:

- Seven of 10 samples collected downstream from the Red Devil Creek delta showed no effects on survival compared with the upstream reference samples or laboratory control sample. In these seven samples, survival ranged from 89 to 93%. In the remaining three samples, *Hyalella* survival was reduced by 10 to 30% compared with the reference samples and laboratory control.
- No effect on growth was observed in nine of 10 samples collected downstream from the Red Devil Creek delta. In one downstream sample, growth was reduced by about 20% compared with the upstream reference samples and laboratory control.
- There was no correlation between *Hyalella* survival and sediment concentrations of antimony, arsenic, mercury, or methylmercury.
- Reduced survival of *Hyalella* in some downstream samples appears to be the result of differences in sediment texture and/or TOC content between the downstream samples and upstream reference samples, and/or the result of metals (iron, manganese, and nickel) that are naturally elevated in Kuskokwim River sediment.

5.4.3 Kuskokwim River Periphyton

In 2014, the BLM collected periphyton samples from the near-shore environment of the Kuskokwim River at 13 locations downstream from the Red Devil Creek delta and 13 locations upstream form the Red Devil Creek delta. Sampling methods are discussed in the BLM Field Operations Plan (BLM 2014). The samples were analyzed for metals, methylmercury, inorganic arsenic, and percent solids. The following results are noteworthy:

- Antimony, arsenic, and mercury were elevated in periphyton samples collected downstream from the Red Devil Creek delta compared with upstream samples. The greatest difference was for mercury, which was about 20 times greater on average in periphyton samples collected downstream from the Red Devil Creek delta compared with upstream samples. In contrast, the average difference in total arsenic levels between downstream and upstream periphyton samples was 20%. Inorganic arsenic was not elevated in samples collected downstream from the Red Devil Creek delta.

- Methylmercury was not detected in the periphyton samples. Hence, despite the fact the total mercury levels were elevated in periphyton samples collected downstream from the Red Devil Creek delta, there is no indication that this pattern of total mercury contamination resulted in greater methylmercury levels at the base of the aquatic food web.

5.4.4 Kuskokwim River Fish

Between 2011 and 2014, the BLM Alaska State Office, in cooperation with the United States Fish and Wildlife Service and Alaska Department of Fish and Game, measured mercury concentrations in small muscle biopsies from northern pike and burbot equipped with radio transmitters, and related the concentrations to fish location and movements in the middle Kuskokwim River region. The study design and methods are described in Matz et al. (2015). Matz et al. (2015) divided the mainstream Kuskokwim River and major tributaries within the study area into eight watersheds or reaches for their investigation. The following results are noteworthy:

- Total mercury levels in pike and burbot from the Kuskokwim River reach that includes the RDM were among the lowest measured in the study. These results suggest that releases of mining wastes from the RDM have not negatively affected mercury levels in Kuskokwim River game fish.
- Only about 10% of burbot and 40% of pike captured in the Kuskokwim River reach that includes the RDM remained in that river reach. Low fidelity of burbot and pike to this reach has the effect of reducing their exposure to mercury and other contaminants from the RDM.
- Low fidelity of pike to the Kuskokwim River reach near the RDM likely is due to the physical and biological characteristics of the reach. The reach is characterized by strong current, high turbidity, linear shorelines, and low density of shoreline wetlands. These characteristics make the reach unattractive to pike. As a result, residents of nearby villages prefer fishing for pike in other river reaches where better pike habitat and more pike are present. This situation limits potential human exposure to mercury and other contaminants from the RDM via the fish consumption pathway.
- The greatest total mercury levels in pike were found in the Takotna, Holitna, and George River watersheds. All three watersheds have extensive areas of oxbows with abundant wetland habitat, ideal habitat for pike and other fish, and important sites for mercury methylation.
- Regression analysis was used to determine if a relationship exists between the average total mercury level in pike from a given watershed (dependent variable) and the number of mercury OPMs in that watershed (independent variable). No relationship between pike total mercury and the number of OPMs in a given watershed was evident ($R = 0.1878$, $p = 0.6560$, $n = 8$). The value of R-squared, the proportion of the variation in pike total mercury that can be accounted for by variation in OPMs, is 0.0353 (3.5%). This result suggests that other factors, such as wetland area (a measure of watershed methylation potential), should be investigated to

understand controls on mercury levels in game fish from the middle Kuskokwim River region.

5.4.5 Kuskokwim River Impacts

The following lines of evidence suggest that potential impacts to people and the environment from the RDM-related substances in the Kuskokwim River likely are minimal and, specifically, that mercury releases from the RDM are not contributing to unacceptable levels of methylmercury exposure for people catching and eating edible size game fish from the Kuskokwim River:

- Mercury levels in northern pike and burbot from the Kuskokwim River reach that includes the RDM were among the lowest measured in these fish species in the middle Kuskokwim River region by Matz et al. (2015). These results suggest that the RDM has not negatively affected mercury levels in game fish in the Kuskokwim River.
- Average total mercury levels reported by Matz et al. (2015) for pike (0.2 mg/kg wet weight) and burbot (0.09 mg/kg wet weight) in the section of the Kuskokwim River that includes the RDM are less than the average statewide levels reported by ADEC for 2001 to 2015, which are 0.41 and 0.33 mg/kg wet weight for pike and burbot fillet samples, respectively (http://dec.alaska.gov/eh/docs/vet/Fish/MetalsResults/TotalMercuryInAlaskanFish.pdf). This comparison suggests that the RDM has not negatively affected mercury levels in game fish in the Kuskokwim River.
- Methylmercury was not detected in Kuskokwim River periphyton samples collected downstream from the Red Devil Creek delta. This finding suggests that mercury releases from the RDM are not resulting in greater levels of methylmercury at the base of the aquatic food web in the river.
- Methylmercury in Kuskokwim River sediment was detected in 2015 samples collected downriver of the RDM at concentrations greater than the RI background concentration (0.49 ng/g) in only two of the 14 samples analyzed.
- Mercury SSE results for sediment samples collected downstream from the Red Devil Creek delta show that only a small fraction (typically less than 1%) of total mercury in sediment is in a form that is soluble in water or weak acid, the forms most likely to be subject to microbial methylation in the environment. Hence, most mercury in Kuskokwim River sediment downstream from the Red Devil Creek delta is in a form that would not be expected to adversely impact people or the environment, a finding that is consistent with the above-mentioned results for game fish, periphyton, and sediment toxicity.

- Although reduced survival of *Hyalella azteca* (amphipod) was found in sediment bioassays with three of 10 Kuskokwim River sediment samples collected downstream from the Red Devil Creek delta, the reduced survival was not the result of antimony, arsenic, mercury, or methylmercury. Instead, the effects appear to be due to differences in sediment texture and/or TOC content between the downstream samples and upstream reference samples, and/or the result of other metals (iron, manganese, and nickel) that are naturally elevated above sediment benchmarks in Kuskokwim River sediment.

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Table 5-1 Kuskokwim River Sediment Sample Collection

General Location	Sample Location ID	Sample ID	Sample Location Description	Sample Date	Sample Collection Equipment	Sample Description	Sample Analyses and Methods					
							Total TAL Metals	Methylmercury	Mercury SSE	Grain Size	Total Organic Carbon	Toxicity Hyalella Azteca (28 day)
							EPA 6010B/6020A 7471A	EPA 1630 Modified	Hg SSE (F0 F5) with Total Hg	ASTM D422	9060	EPA 100.4 Chronic
Upriver of Red Devi Creek Delta	KR082	15KR082SD	Near BLM periphyton sample location Kusko-14-PERI-1	9/2/2015	Hand auger	Field Sample	X			X	X	X
	KR083	15KR083SD	Near RI sediment sample location KR26	9/2/2015	Van Veen	Field Sample	X			X	X	X
Near Right Bank of Kuskokwim River Across from Red Devil Mine Area	KR106	15KR106SD	Approximately 50 feet from right bank opposite area of RI sample location KR29 upriver from Red Devil Creek	9/4/2015	Hand auger	Field Sample	X					
	KR107	15KR107SD	Approximately 10 to 20 feet from right bank opposite area of RI sample location KR29 upriver from Red Devil Creek	9/4/2015	Hand auger	Field Sample	X					
	KR108	15KR108SD	Approximately 50 feet from right bank opposite area of RI sample location KR54 downriver from Red Devil Creek	9/4/2015	Scoop	Field Sample	X					
	KR109	15KR109SD	Approximately 10 to 20 feet from right bank opposite area of RI sample location KR54 downriver from Red Devil Creek	9/4/2015	Hand auger	Field Sample	X					
Red Devil Creek Delta Area	KR084	15KR084SD	Near RI sediment sample locations KR29 and KR28	9/5/2015	Hand auger	Field Sample	X	X	X	X	X	X
		15KR202SD		9/5/2015	Hand auger	Field Duplicate of 15KR084SD	X	X	X	X	X	
	KR085	15KR085SD	Near RI sediment sample location KR02	9/2/2015	Hand auger	Field Sample	X			X	X	X
	KR086	15KR086SD	Near RI sediment sample locations KR34 and KR35 (deviation)	9/6/2015	Hand auger	Field Sample	X			X	X	
Downriver of Red Devil Creek Delta	KR087	15KR087SD	Near RI sediment sample location KR37	9/2/2015	Van Veen	Field Sample	X			X	X	X
	KR088	15KR088SD	Near BLM periphyton sample location Kusko-14-PERI-13	9/2/2015	Hand auger	Field Sample	X	X	X	X	X	X
	KR089	15KR089SD	Near RI sediment sample location KR43	9/6/2015	Hand auger	Field Sample	X	X	X	X	X	X
	KR090	15KR090SD	Near RI sediment sample locations KR45 and KR44	9/3/2015	Hand auger	Field Sample	X			X	X	X
	KR091	15KR091SD	Near RI sediment sample location KR60	9/6/2015	Hand auger	Field Sample	X	X	X	X	X	X
	KR092	15KR092SD	Near BLM periphyton sample location Kusko-14-PERI-14	9/3/2015	Hand auger	Field Sample	X	X	X	X	X	X
	KR093	15KR093SD	Near RI sediment sample location KR72	9/6/2015	Hand auger	Field Sample	X	X	X	X	X	X
	KR094	15KR094SD	Outboard of RI sediment sample locations, near locations KR55 and KR56	9/3/2015	Hand auger	Field Sample	X			X	X	
	KR095	15KR095SD	Outboard of RI sediment sample locations, near location KR73	9/3/2015	Hand auger	Field Sample	X			X	X	
	KR096	15KR096SD	Downriver of RI sediment sample locations, near BLM periphyton sample location Kusko-14-PERI-15	9/3/2015	Hand auger	Field Sample	X	X		X	X	
	KR097	15KR097SD	Downriver of RI sediment sample locations, near right bank	9/4/2015	Hand auger	Field Sample	X	X	X	X	X	
	KR098	15KR098SD	Downriver of RI sediment sample locations, near BLM periphyton sample location Kusko-14-PERI-16	9/4/2015	Hand auger	Field Sample	X	X		X	X	
		15KR200SD		9/4/2015	Hand auger	Field Duplicate of 15KR098SD	X	X		X	X	
	KR099	15KR099SD	Downriver of RI sediment sample locations, near right bank	9/5/2015	Hand auger	Field Sample	X			X	X	X (Originally planned for location KR101)
		15KR201SD		9/5/2015	Hand auger	Field Duplicate of 15KR099SD	X			X	X	

Table 5-1 Kuskokwim River Sediment Sample Collection

General Location	Sample Location ID	Sample ID	Sample Location Description	Sample Date	Sample Collection Equipment	Sample Description	Sample Analyses and Methods					
							Total TAL Metals	Methylmercury	Mercury SSE	Grain Size	Total Organic Carbon	Toxicity Hyalella Azteca (28 day)
							EPA 6010B/6020A 7471A	EPA 1630 Modified	Hg SSE (F0 F5) with Total Hg	ASTM D422	9060	EPA 100.4 Chronic
	KR100	15KR100SD	Downriver of RI sediment sample locations, near BLM periphyton sample location Kusko-14-PERI-18	9/4/2015	Hand auger	Field Sample	X	X		X	X	
	KR101	15KR101SD	Downriver of RI sediment sample locations, near right bank	9/4/2015	Hand auger	Field Sample	X	X		X	X	Not collected at this location; collected at KR099.
	KR102	15KR102SD	Downriver of RI sediment sample locations, near BLM periphyton sample location Kusko-14-PERI-21	9/5/2015	Hand auger	Field Sample	X	X		X	X	
	KR103	15KR103SD	Downriver of RI sediment sample locations, near right bank	9/5/2015	Hand auger	Field Sample	X			X	X	
	KR104	15KR104SD	Downriver of RI sediment sample locations, near BLM periphyton sample location Kusko-14-PERI-25	9/5/2015	Hand auger	Field Sample	X	X		X	X	
	KR105	15KR105SD	Downriver of RI sediment sample locations, near right bank	9/5/2015	Hand auger	Field Sample	X	X		X	X	

Key:
EPA = United States Environmental Protection Agency
Hg SSE = Mercury Selective Sequential Extraction
TAL = Target Analyte List

Table 5-2 Watershed Characteristics and Number of Fish Sampled per Watershed in the Middle Kuskokwim River Region, Alaska, by Matz et al. (2015)

Watershed or Reach Name[(a)]	Watershed or Reach Number[(a)]	Number of Northern Pike Sampled[(a)]	Number of Burbot Sampled[(a)]	Watershed Area (acres)[(a)]	Number of Mercury Occurrences, Prospects, or Mines[(a)]	Number of Mercury Mines[(b)]
Kusko-Aniak	1	0	20	2,895,369	28	9
George River	2	23	0	879,551	14	4
Kusko above George River[(c)]	3[(c)]	7	21	233,184	15	4
Holitna	4	104	0	4,094,943	10	2
Kusko-Stony	5	18	22	2,431,133	1	0
Kusko above Sleetmute	6	0	0	2,577,740	6	0
Kusko above Selatna	7	26	0	964,871	6	0
Takotna	8	32	0	1,425,213	8	3

Notes:

(a) = From Table 1 from Matz et al. (2015).

(b) = From Figure 8 from Matz et al. (2015).

(c) = Includes Red Devil Mine site.

Table 5-3 Kuskokwim River Sediment Sample Results, Fall 2015

Analyte	Sample Location ID / General Location Description / Sample ID / Method		Units	KR082	KR083	KR106	KR107	KR108	KR109	KR084	KR085	KR086	KR087	KR088	KR089
				Upriver of Red	Upriver of Red	Near Right Bank	Near Right Bank	Near Right Bank	Near Right Bank	Red Devil Creek	Red Devil Creek	Red Devil Creek	Downriver of	Downriver of Red	Downriver of Red
				15KR082SD	15KR083SD	15KR106SD	15KR107SD	15KR108SD	15KR109SD	15KR084SD	15KR085SD	15KR086SD	15KR087SD	15KR088SD	15KR089SD
Total Inorganic Elements															
Aluminum	Metals (ICP)	SW846 6010B	mg/kg dry	7900	5500	6900	6200	6900	6000	5200	6600	7700	6300	3900	8600
Antimony	Metals (ICP/MS)	SW846 6020A	mg/kg dry	0.79	0.27	2.1	0.58	1.1	0.43	920	3100	120	40	100	19 J+
Arsenic	Metals (ICP/MS)	SW846 6020A	mg/kg dry	9.8	6.9	36	11	21	8.5	510	2100	100	40	230	31 J+
Barium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	150	61	300	88	160	85	120	520	160	120	82	110 J+
Beryllium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	0.45	0.2	0.79	0.24	0.4	0.2	0.29	0.64	0.41	0.44	0.58	0.59
Cadmium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	0.47	0.12	0.91	0.19	0.42	0.14	0.18	0.34	0.34	0.2	0.35	0.39
Calcium	Metals (ICP)	SW846 6010B	mg/kg dry	1800	2200	5600	5500	11000	2400	1600	3300	3800	3600	1600	3300
Chromium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	29	14	49	16	24	15	19	35	27	23	17	27 J+
Cobalt	Metals (ICP/MS)	SW846 6020A	mg/kg dry	15	6.9	18	6.3	9.1	5.6	8	15	10	8.8	15	19
Copper	Metals (ICP/MS)	SW846 6020A	mg/kg dry	50	16	57	16	25	12	19	51	26	17	45	46 J+
Iron	Metals (ICP)	SW846 6010B	mg/kg dry	29000	15000	17000	16000	18000	15000	19000	27000	20000	16000	37000	66000
Lead	Metals (ICP/MS)	SW846 6020A	mg/kg dry	12	2.7	19	5	9.8	3.7	6.7	11	8.7	6	9.8	10
Magnesium	Metals (ICP)	SW846 6010B	mg/kg dry	4000	2800	3900	3700	4200	3500	2500	4200	3600	3000	1300	6600
Manganese	Metals (ICP/MS)	SW846 6020A	mg/kg dry	1200	380	590	310	510	300	350	580	460	470	590	3800
Mercury	Mercury (CVAA)	SW846 7471A	mg/kg dry	0.098 J	0.016 J	0.054	0.021	0.041	0.01 J	31	310	1.4	2.9	9.9	2.1
Nickel	Metals (ICP/MS)	SW846 6020A	mg/kg dry	51	20	59	20	28	18	27	55	31	28	41	55 J+
Potassium	Metals (ICP)	SW846 6010B	mg/kg dry	590	420	870	730	1000	610	590	1600	690	480	490	720
Selenium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	1.9	0.69	4.2	0.98	1.6	0.88	0.88	1.7	1.6	1.2	1.6	2.9
Silver	Metals (ICP/MS)	SW846 6020A	mg/kg dry	0.14	0.0078 J	0.33	0.081 J	0.17	0.072 J	0.038 J	0.15	0.11	0.049	0.098 J	0.2
Sodium	Metals (ICP)	SW846 6010B	mg/kg dry	70 J	110	130	100	150	89 J	65 J	140	110	79	41 UJ	65 J
Thallium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	0.098 J	0.056 U	0.29 J	0.089 J	0.16	0.07 U	0.12 J	0.33	0.14	0.099	0.086 J	0.066 UJ
Vanadium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	33	22	68	23	33	25	23	29	35	31	29	40 J+
Zinc	Metals (ICP/MS)	SW846 6020A	mg/kg dry	110	41	170	51	83	44	54	85	87	71	93	100 J+
Methylmercury															
Methylmercury	Total Mercury by EPA 1631	EPA 1630 Modified	ng/g dry							0.788 J				0.01 UJ	0.01 UJ-
Mercury Selective Sequential Extraction															
F0	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	ng/g dry							4.77 UJ				9.28 J	4.63 UJ
F1	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	ng/g dry							271 J				58.5 UJ	2.37 UJ
F2	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	ng/g dry							1.16 UJ				12.1 J	1.13 UJ
F3	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	ng/g dry							1680 J				528 J	30.8 J
F4	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	ng/g dry							6000 J				1530 J	605 J
F5	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	ng/g dry							9140 J				4410 J	6810 J
Total Mercury	Low Level Mercury	EPA 1631 Appendix	ng/g dry							18700 J				63200 J	4250 J
Grain Size															
Gravel	Grain Size	ASTM D422	%	60.9	76.5					48.3	61.5	5.3	0.2	37.3	30.3
Coarse Sand	Grain Size	ASTM D422	%	13	14.7					9.1	16.1	1.8	0	18.1	17.5
Medium Sand	Grain Size	ASTM D422	%	6.1	5.1					10.4	13.5	2.3	1.1	13.3	16.4
Fine Sand	Grain Size	ASTM D422	%	10.6	3.5					25.3	6.3	31	73.5	20.2	11.6
Silt	Grain Size	ASTM D422	%	8.3	0.1					5.5	2.2	50.4	20.7	9.5	19.5
Clay	Grain Size	ASTM D422	%	1.1	0.1					1.5	0.4	9.2	4.4	1.6	4.6
Total Organic Carbon															
Total Organic Carbon	Organic Carbon, Total (TOC)	SW846 9060	mg/kg	8700	7600					4500	7000	15000	6500	4300	17000
Sediment Toxicity															
Toxicity - *Hyalella Azteca* (28 day)	Percent Survival (Mean +/- SD)	EPA 100.4 Chronic	%	81.3 ± 15.5	96.3 ± 5.2					92.5 ± 10.4	92.5 ± 8.9		90.0 ± 14.1	88.8 ± 12.5	61.3 ± 17.3
Toxicity - *Hyalella Azteca* (28 day)	Average Dry Weight/Amphipod (Mean +/- SD)	EPA 100.4 Chronic	mg	0.26 ± 0.06	0.25 ± 0.04					0.24 ± 0.02	0.28 ± 0.04		0.23 ± 0.05	0.28 ± 0.03	0.23 ± 0.03
Field Parameters															
Turbidity, Kuskokwim River Water	In situ field measurement		NTU	495	575	468	453	404	449	134	309	125	497	493	135

Table 5-3 Kuskokwim River Sediment Sample Results, Fall 2015

Analyte	Sample Location ID		Units	KR090	KR091	KR092	KR093	KR094	KR095	KR096	KR097	KR098	KR099	KR100	KR101	KR102	KR103	KR104	KR105
	General Location Description			Downriver of	Downriver of	Downriver of Red	Downriver of Red	Downriver of	Downriver of	Downriver of Red	Downriver of Red	Downriver of Red	Downriver of	Downriver of	Downriver of	Downriver of	Downriver of	Downriver of	Downriver of
	Sample ID			15KR090SD	15KR091SD	15KR092SD	15KR093SD	15KR094SD	15KR095SD	15KR096SD	15KR097SD	15KR098SD	15KR099SD	15KR100SD	15KR101SD	15KR102SD	15KR103SD	15KR104SD	15KR105SD
	Method																		
Total Inorganic Elements																			
Aluminum	Metals (ICP)	SW846 6010B	mg/kg dry	5700	5000	7000	5600	3700	3400	6500	4700	3700	5300	4400	11000	4800	5100	3800	7400
Antimony	Metals (ICP/MS)	SW846 6020A	mg/kg dry	75	16	30	3.8	0.21	0.2	4.2	0.39	0.85	0.51	2	0.53	1.2	55	2.6	1.5
Arsenic	Metals (ICP/MS)	SW846 6020A	mg/kg dry	57	24	47	16	5.8	4.5	23	8.1	8.6	8.4	9.8	9.1	7.5	46	21	24
Barium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	100	92	140	57	50	50	82	74 J+	58	70	60	66	96	480	330	260
Beryllium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	0.33	0.46	0.44	0.32	0.13	0.15	0.32	0.17	0.14	0.25	0.18	0.41	0.17	0.7	0.6	0.57
Cadmium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	0.26	0.46	0.38	0.43	0.13	0.12	0.16	0.15	0.14	0.14 J	0.13	2.8	0.16	0.82	0.51	0.54
Calcium	Metals (ICP)	SW846 6010B	mg/kg dry	3200	4600	2500	2300	1800	1100	1700	2400 J+	1000	1700	1600	2200	1500	2800	1500	4300
Chromium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	20	23	26	18	9.3	9.5	17	15 J+	12	17	15	25	13	64	30	40
Cobalt	Metals (ICP/MS)	SW846 6020A	mg/kg dry	10	15	12	12	4.3	3.7	9.9	5.7	4.8	6.7	5.4	14	5.2	24	13	14
Copper	Metals (ICP/MS)	SW846 6020A	mg/kg dry	26	58	28	30	6.9	5.2	23	9.3 J+	7	12	12	64	7.3	45	30	34
Iron	Metals (ICP)	SW846 6010B	mg/kg dry	20000	41000	22000	20000	9300	8000	21000	12000	9800	12000	11000	24000	12000	22000	8500	18000
Lead	Metals (ICP/MS)	SW846 6020A	mg/kg dry	7.1	11	9.8	7	2.2	1.9	6.6	3.4	2.6	4.6	3	9.9	2.6	14	10	12
Magnesium	Metals (ICP)	SW846 6010B	mg/kg dry	3000	6600	3300	3600	2200	1900	3000	2800 J+	2100	3000	2300	5100	2600	2900	1300	4100
Manganese	Metals (ICP/MS)	SW846 6020A	mg/kg dry	510	1800	570	420	300	330	510	340	310	180	250	420	600	1400	560	1200
Mercury	Mercury (CVAA)	SW846 7471A	mg/kg dry	5.1	1.3	0.41	2	0.0064 U	0.0073 J	0.15	0.012 J	0.37	0.011 J	0.24	0.18	0.14	1.7	0.26	0.025
Nickel	Metals (ICP/MS)	SW846 6020A	mg/kg dry	31	56	38	40	12	11	26	18 J+	15	22	15	43	17	66	36	49
Potassium	Metals (ICP)	SW846 6010B	mg/kg dry	540	820	560	670	450	400	420	480 J+	410	510	420	540	520	600	260	780
Selenium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	1.2	2	1.8	2.8	0.58	0.46 J	0.99	0.8	0.49 J	0.89	0.56	1.3	0.59	2.8	2.7	2
Silver	Metals (ICP/MS)	SW846 6020A	mg/kg dry	0.062	0.15	0.089 J	0.093 J	0.022 J	0.023 J	0.082 J	0.042 J	0.022 J	0.051 J	0.034 J	0.14	0.033 J	0.15 J	0.15 J	0.19 J
Sodium	Metals (ICP)	SW846 6010B	mg/kg dry	84	52 J	94	42 J	44 J	43 J	39 UJ	67 J	39 UJ	72 J	120	37 UJ	65 J	85 J	39 UJ	120
Thallium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	0.094	0.076 J	0.12 J	0.069 J	0.066 U	0.067 U	0.068 U	0.071 U	0.072 U	0.082 U	0.068 U	0.072 J	0.069 U	0.19 J	0.25 U	0.2 J
Vanadium	Metals (ICP/MS)	SW846 6020A	mg/kg dry	30	38	37	29	15	13	24	22 J+	17	24	18	37	18	67	47	58
Zinc	Metals (ICP/MS)	SW846 6020A	mg/kg dry	85	100	90	82	27	25	56	40	29	52	30	110	36	150	95	120
Methylmercury																			
Methylmercury	Total Mercury by EPA 1631	EPA 1630 Modified	ng/g dry		0.135 J	0.605 J	0.078 J			0.053 J	0.01 UJ	0.01 UJ		0.019 J	0.01 UJ	0.01 UJ		0.667 J	0.016 J
Mercury Selective Sequential Extraction																			
F0	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	ng/g dry		4.68 UJ	5.64 UJ	4.63 UJ				4.66 UJ								
F1	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	ng/g dry		12 UJ	14.5 UJ	61.8 J				2.39 UJ								
F2	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	ng/g dry		1.14 UJ	1.37 UJ	1.13 UJ				1.14 UJ								
F3	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	ng/g dry		45.2 J	446 J	98.3 J				5.55 J								
F4	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	ng/g dry		817 J	2190 J	299 J				4.94 J								
F5	Hg SSE (F0 - F5) with Total Hg	Hg SSE (F0 - F5) with Total Hg	ng/g dry		145 J	829 J	279 J				3.62 J								
Total Mercury	Low Level Mercury	EPA 1631 Appendix	ng/g dry		1270 J	923 J	776 J				13.4 J								
Grain Size																			
Gravel	Grain Size	ASTM D422	%	53.8	41.1	4.7	31.7	67.4	75.1	71.3	38.3	43.2	10.4	61	42.1	56.3	54.3	0.7	57.4
Coarse Sand	Grain Size	ASTM D422	%	6.6	11.5	3	16.2	12.6	12.1	6.4	15.2	15.1	3.5	6.6	25.2	7.1	8.1	1.1	6.2
Medium Sand	Grain Size	ASTM D422	%	3	14.9	5.3	19.9	7.8	4.8	5	14.5	17.1	4.6	14.9	15	15.6	10.2	4.9	11.4
Fine Sand	Grain Size	ASTM D422	%	27.5	9	53.8	12.5	12.3	8.1	15.9	28.4	23.1	73.4	15.5	10.4	20.2	21.3	52.4	18.2
Silt	Grain Size	ASTM D422	%	8.8	19.3	28.4	15.7	-0.1	0	1.4	2.1	1.1	4.5	1.7	6.7	0.8	5.8	35.4	6.3
Clay	Grain Size	ASTM D422	%	0.4	4.2	4.8	4.1	0	0	0	1.6	0.4	3.6	0.3	0.6	0	0.3	5.4	0.6
Total Organic Carbon																			
Total Organic Carbon	Organic Carbon, Total (TOC)	SW846 9060	mg/kg	5400	17000	9300	9000	1300 J	1200 J	4900	2900	2400	4200	2200	5500	1800 J	4700	41000	3100
Sediment Toxicity																			
Toxicity - *Hyalella Azteca* (28 day)	Percent Survival (Mean +/- SD)	EPA 100.4 Chronic	%	92.5 ± 17.5	61.3 ± 12.5	90.0 ± 12.0	70.0 ± 26.2						90.0 ± 10.7						
Toxicity - *Hyalella Azteca* (28 day)	Average Dry Weight/Amphipod (Mean +/- SD)	EPA 100.4 Chronic	mg	0.22 ± 0.04	0.24 ± 0.04	0.23 ± 0.02	0.20 ± 0.03						0.28 ± 0.04						
Field Parameters																			
Turbidity, Kuskokwim River Water	In situ field measurement		NTU	300	125	286	97	543	564	262	561	226	562	316	304	102	176	14	198

Key:
% = Percent
Bold = Detected
Hg = Mercury
ICP/ MS = Inductively coupled plasma/mass spectrometry
J = The analyte was detected. The associated result is estimated.
J+ = The analyte was detected. The associated result is estimated with a high bias.
mg = Milligrams
mg/kg = Milligrams per kilogram
ng/g = Nanograms per gram
NTU = Nephelometric turbidity units
SSE = Selective Sequential Extraction
U = The analyte was analyzed for but not detected. The value provided is the method detection limit.
UJ- = The analyte was analyzed for but not detected. The associated reporting limit is estimated with a low bias.
UJ = The analyte was analyzed for but not detected. The associated reporting limit is estimated.

Table 5-4 Survival and Growth Results for *Hyalella azteca* 28-day Sediment Toxicity Tests

Sample Location	Sample Location Description	Sample Number	Survival (%) (Mean ± SD)	Growth (mg) (average dry wt/amphipod) (Mean ± SD)
--	Lab control	Comtrol	93.8 ± 9.2	0.26 ± 0.05
KR082	Upstream reference	15KR082SD	81.3 ± 15.5§	0.26 ± 0.06
KR083	Upstream reference	15KR0823D	96.3 ± 5.2	0.25 ± 0.04
KR084	Downstream from RDC delta	15KR084SD	92.5 ± 10.4	0.24 ± 0.02
KR085	Downstream from RDC delta	15KR085SD	92.5 ± 8.9	0.28 ± 0.04
KR087	Downstream from RDC delta	15KR087SD	90.0 ± 14.1	0.23 ± 0.05
KR088	Downstream from RDC delta	15KR088SD	88.8 ± 12.5	0.28 ± 0.03
KR089	Downstream from RDC delta	15KR089SD	61.3 ± 17.3*‡§†	0.23 ± 0.03
KR090	Downstream from RDC delta	15KR090SD	92.5 ± 17.5	0.22 ± 0.04
KR091	Downstream from RDC delta	15KR091SD	61.3 ± 12.5*‡§†	0.24 ± 0.04
KR092	Downstream from RDC delta	15KR092SD	90.0 ± 12.0	0.23 ± 0.02
KR093	Downstream from RDC delta	15KR093SD	70.0 ± 26.2*§†	0.20 ± 0.03*‡§†
KR099	Other side of KR, downstream from delta	15KR099SD	90.0 ± 10.7	0.28 ± 0.04

Notes:

* Significant difference from control sediment (p<0.05)

‡ Significant difference from reference sediment 15KR082SD (p<0.05)

§ Significant difference from reference sediment 15KR083SD (p<0.05)

† Significant difference from pooled data for reference samples 15KR082SD and 15KR083SD (p<0.05)

Key:

mg = milligram

RDC = Red Devil Creek

SD = standard deviation

Site sample that differs from reference samples or lab control (see Notes)

Table 5-5 Pearson Correlations and Significance Levels Between *Hyalella* Survival and Constituents in Kuskokwim River Sediment Samples Collected in Fall 2015

Constituent	*Hyalella* Survival		Significant Relationship ($p < .05$)
	Correlation (R)[a]	Probability (p)[a]	
Principal Site Contaminants			
Antimony	0.2846	0.3700	No
Arsenic	0.2821	0.3743	No
Mercury	0.2415	0.4496	No
Methylmercury	0.6759	0.1405	No
Physical Parameters			
Medium Sand (%)	-0.6835	0.0143	Yes
Clay	-0.5865	0.0450	Yes
TOC	-0.8718	0.0002	Yes
Major Elements			
Iron	-0.7323	0.0068	Yes
Magnesium	-0.8189	0.0011	Yes
Other Metals			
Cadmium	-0.6942	0.0122	Yes
Cobalt	-0.6647	0.0184	Yes
Copper	-0.5864	0.0451	Yes
Manganese	-0.7713	0.0033	Yes
Nickel	-0.6718	0.0167	Yes
Selenium	-0.8279	0.0009	Yes
Silver	-0.7253	0.0076	Yes
Vanadium	-0.6982	0.0116	Yes
Zinc	-0.5835	0.0464	Yes

Note:

(a) = Based on 10 site samples and two upstream reference samples.

Table 5-6 Spearman Correlations and Significance Levels Between *Hyalella* Survival and Constituents in Kuskokwim River Sediment Samples Collected in Fall 2015

Constituent	*Hyalella* Survival		Significant Relationship ($p < .05$)
	Correlation (R)[a]	Probability (*p*)[a]	
Principal Site Contaminants			
Antimony	0.2451	0.4425	No
Arsenic	0.2451	0.4425	No
Mercury	0.1847	0.5654	No
Methylmercury	0.6323	0.1779	No
Physical Parameters			
Medium Sand (%)	-0.6004	0.0390	Yes
Silt	-0.6075	0.0361	Yes
Clay	-0.6549	0.0208	Yes
TOC	-0.5517	0.0630	Yes
Major Elements			
Iron	-0.6691	0.0173	Yes
Magnesium	-0.5914	0.0428	Yes
Sodium	0.7207	0.0082	Yes
Other Metals			
Cadmium	-0.8101	0.0014	Yes
Cobalt	-0.6540	0.0211	Yes
Copper	-0.5720	0.0520	Yes
Manganese	-0.6289	0.0285	Yes
Nickel	-0.6780	0.0154	Yes
Selenium	-0.8506	0.0005	Yes
Silver	-0.6994	0.0114	Yes
Vanadium	-0.6977	0.0116	Yes
Zinc	-0.6952	0.0121	Yes

Note:

(a) = Based on 10 site samples and two upstream reference samples.

Table 5-7 Comparison of Metals Concentrations in 2015 Kuskokwim River Sediment Samples Showing Reduced Growth of *Hyalella* with Sediment Screening Levels and Reference Concentrations

Analyte[a]	Units	Sample ID						BERA Screening Level	2015 Reference Sample Range[b]
		15KR089SD		15KR091SD		15KR093SD			
		Result		Result		Result			
Cadmium	mg/Kg	0.39		0.46		0.43		3.5	0.12 - 0.47
Cobalt	mg/Kg	19		15		12		50	6.9 - 15
Copper	mg/Kg	46	J+	58		30		197	16 - 50
Iron	mg/Kg	**66000**[d]		**41000**[d]		20000		21200	15000 - **29000**[c]
Manganese	mg/Kg	**3800**[d]		**1800**[d]		420		460	380 - **1200**[c]
Nickel	mg/Kg	**55**[d]	J+	**56**[d]		**40**[c]		36	20 - **51**[c]
Selenium	mg/Kg	2.9		2		2.8		5	0.69 - 1.9
Silver	mg/Kg	0.2		0.15		0.093	J	1.7	0.008 - 0.14
Thallium	mg/Kg	0.066	UJ	0.076	J	0.069	J	0.24	ND - 0.098
Vanadium	mg/Kg	40	J+	38		29		57	22 - 33
Zinc	mg/Kg	100	J+	100		82		315	41 - 110
Hyalella Survival	%	61.3		61.3		70		--	81 - 96
Hyalella Growth	mg	0.23		0.24		0.2		--	0.25 - 0.26

Key:

-- (double dash) = not applicable

BERA = Baseline Ecological Risk Assessment

Notes:

(a) = Metals that were sigificantly negatively correlated with survival in Tables CM-2 and CM-3 are listed.

(b) = Range for samples 15KR082SD and 15KR083SD

(c) = Red, bold result denotes a value that exceeds BERA screening level

(d) = Red, bold result in gray shaded cell denotes a value that exceeds BERA screening level and range for reference samples

Table 5-8 Periphyton Sample Results, BLM 2014

Analyte	Sample Location ID	Units	Kusko 14-PERI 27		Kusko 14-PERI 12		Kusko 14-PERI 11		Kusko 14-PERI 10		Kusko 14-PERI 9		Kusko 14-PERI 8		Kusko 14-PERI 7		Kusko 14-PERI 6		Kusko 14-PERI 5		Kusko 1
	General Location Description		Upriver of Red Devil Creek Delta		Upriver of Red Devil Creek Delta		Upriver of Red Devil Creek Delta		Upriver of Red Devil Creek Delta		Upriver of Red Devil Creek Delta		Upriver of Red Devil Creek Delta		Upriver of Red Devil Creek Delta		Upriver of Red Devil Creek Delta		Upriver of Red Devil Creek Delta		Upriver of Re De
	Nearby RI Supplement Sediment Sample Location																				
	Sample ID		Kusko 14-PERI 27A	Kusko 14-PERI 27B	Kusko 14-PERI 12A	Kusko 14-PERI 12B	Kusko 14-PERI 11A	Kusko 14-PERI 11B	Kusko 14-PERI 10A	Kusko 14-PERI 10B	Kusko 14-PERI 9A	Kusko 14-PERI 9B	Kusko 14-PERI 8A	Kusko 14-PERI 8B	Kusko 14-PERI 7A	Kusko 14-PERI 7B	Kusko 14-PERI 6A	Kusko 14-PERI 6B	Kusko 14-PERI 5A	Kusko 14-PERI 5B	Kusko 14-PERI 4A
	Method																				
Total Inorganic Elements																					
Aluminum	EPA 6020	µg/g dry	**30907**		**22703**		**23697**	**30781**	**32708**	**9587**	**36258**	**13345**	**35519**	**37973**	**24663**	**31040**	**34537**	**29596**	**31431**	**15281**	**26820**
Antimony	EPA 6020	µg/g dry	**1.5**		**1.2**		**1.7**	**3.7**	**1.6**	**0.7**	**1.7**	**1.0**	**1.3**	**1.4**	**1.0**	**1.4**	**1.5**	**1.2**	**1.6**	**0.7**	**1.2**
Arsenic	EPA 6020	µg/g dry	**23.4**		**22.0**		**24.0**	**33.3**	**23.8**	**12.5**	**23.0**	**18.2**	**22.2**	**22.8**	**15.8**	**18.3**	**25.5**	**19.0**	**23.7**	**11.0**	**24.3**
Barium	EPA 6020	µg/g dry	**434.0**		**357.6**		**311.7**	**443.2**	**477.4**	**138.1**	**519.3**	**233.7**	**562.0**	**657.7**	**355.1**	**440.7**	**523.8**	**422.7**	**494.5**	**226.9**	**401.6**
Beryllium	EPA 6020	µg/g dry	**0.9**		**0.8**		**0.8**	**1.1**	**1.0**	**0.4**	**1.0**	**0.6**	**1.2**	**1.1**	**0.8**	**0.9**	**1.0**	**0.9**	**0.9**	**0.5**	**0.8**
Boron	EPA 6020	µg/g dry	**21.4**		**14.6**		**13.8**	**20.2**	**23.3**	**3.6**	**28.6**	**6.6**	**27.3**	**29.3**	**19.0**	**23.3**	**24.5**	**21.8**	**24.7**	**14.2**	**20.6**
Cadmium	EPA 6020	µg/g dry	**0.5**		**0.4**		**0.4**	**0.8**	**0.3**	**0.2**	**0.4**	**0.3**	**0.4**	**0.4**	**0.2**	**0.3**	**0.5**	**0.3**	**0.4**	**0.18 J**	**0.4**
Chromium	EPA 6020	µg/g dry	**47.7**		**41.1**		**45.4**	**54.9**	**50.2**	**18.7**	**57.2**	**27.2**	**62.4**	**59.9**	**39.9**	**47.6**	**55.0**	**47.8**	**52.7**	**24.6**	**47.7**
Copper	EPA 6020	µg/g dry	**29.4**		**28.1**		**28.1**	**45.5**	**28.1**	**16.2**	**32.5**	**25.3**	**28.9**	**30.7**	**20.8**	**21.6**	**30.1**	**23.0**	**26.6**	**13.0**	**22.5**
Iron	EPA 6020	µg/g dry	**32052**		**29002**		**32780**	**44167**	**34699**	**18396**	**38544**	**25446**	**35060**	**35178**	**23889**	**29874**	**35449**	**30348**	**35211**	**16343**	**32124**
Lead	EPA 6020	µg/g dry	**11.2**		**8.7**		**9.4**	**15.5**	**10.5**	**5.2**	**16.1**	**8.1**	**9.7**	**10.5**	**7.9**	**8.3**	**10.3**	**7.8**	**10.5**	**5.0**	**8.1**
Magnesium	EPA 6020	µg/g dry	**7870**		**7431**		**7535**	**9541**	**8137**	**4289**	**8875**	**5711**	**8595**	**8788**	**5883**	**7205**	**8690**	**7391**	**8200**	**3741**	**7265**
Manganese	EPA 6020	µg/g dry	**551.0**		**672.3**		**544.1**	**792.1**	**610.4**	**361.2**	**794.7**	**511.4**	**882.3**	**829.8**	**431.8**	**527.2**	**688.7**	**557.6**	**708.5**	**316.1**	**650.6**
Mercury	EPA 245.7	µg/g dry	**0.07**		**0.04**		**0.08**	**0.17**	**0.06**	**0.03**	**0.08**	**0.04**	**0.04**	**0.04**	**0.04**	**0.06**	**0.12**	**0.03**	**0.07**	**0.04**	**0.04**
Molybdenum	EPA 6020	µg/g dry	**1.2**		**1.1**		**1.2**	**1.6**	**1.2**	**0.6**	**1.3**	**1.1**	**1.1**	**1.3**	**0.9**	**0.9**	**1.3**	**1.0**	**1.4**	**0.6**	**1.0**
Nickel	EPA 6020	µg/g dry	**30.6**		**32.4**		**32.8**	**44.5**	**32.5**	**19.0**	**36.1**	**27.4**	**36.3**	**35.9**	**22.3**	**28.1**	**33.4**	**29.6**	**30.5**	**14.4**	**29.2**
Selenium	EPA 6020	µg/g dry	**0.7**		**0.5**		**0.6**	**0.9**	**0.6**	**0.3**	**0.5**	**0.5**	**0.4**	**0.5**	**0.4**	**0.5**	**0.6**	**0.4**	**0.4**	**0.3**	**0.3**
Strontium	EPA 6020	µg/g dry	**62.5**		**75.7**		**54.3**	**75.2**	**59.0**	**33.2**	**71.9**	**45.3**	**87.4**	**85.3**	**47.5**	**57.1**	**96.3**	**76.5**	**76.4**	**31.4**	**65.8**
Vanadium	EPA 6020	µg/g dry	**78.0**		**69.1**		**71.2**	**88.9**	**88.2**	**28.4**	**106.0**	**44.8**	**102.9**	**104.9**	**69.2**	**82.5**	**96.6**	**85.3**	**93.3**	**41.9**	**83.5**
Zinc	EPA 6020	µg/g dry	**96.6**		**89.9**		**98.3**	**149.8**	**97.1**	**55.1**	**104.0**	**77.4**	**96.1**	**96.6**	**67.4**	**82.6**	**96.7**	**85.2**	**93.0**	**43.2**	**85.6**
Percent Solids																					
Percent Solids	SM 2540 B	% Dry	**17.1**	**15**	**54.7**	**18.9**	**19.4**	**7.8**	**28.9**	**35.2**	**35.9**	**39.2**	**49.5**	**45.1**	**22.1**	**23.2**	**24.1**	**32.4**	**21.1**	**19.6**	**24.6**
Methylmercury																					
Methylmercury (as Mercury)	EPA 1630 Mod/FGS-070	ng/g wet	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.4 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Inorganic Arsenic																					
Inorganic Arsenic	EPA 1632	mg/kg wet	**4.23**	**3.24**	**6.53**	**2.07**	**2.94**	**1.67**	**2.19**	**7.26**	**1.69**	**3.12**	**8.15**	**4.48**	**1.03**	**2.1**	**2.58**	**3.1**	**1.5**	**0.723**	**2.77**

Table 5-8 Periphyton Sample Results, BLM 2014

Analyte	Sample Location ID	Units	4-PERI-4	Kusko 14-PERI 3		Kusko 14-PERI 2		Kusko 14-PERI 1		RD-14-PERI-1		Kusko 14-PERI 13		Kusko 14-PERI 14		Kusko 14-PERI 15		Kusko 14-PERI 16		Kusko 14-PERI 26	
	General Location Description		d Devil Creek lta	Upriver of Red Devil Creek Delta		Upriver of Red Devil Creek Delta		Upriver of Red Devil Creek Delta		Red Devil Creek		Downriver of Red Devil Creek Delta		Downriver of Red Devil Creek Delta		Downriver of Red Devil Creek Delta		Downriver of Red Devil Creek Delta		Downriver of Red Devil Creek Delta	
	Nearby RI Supplement Sediment Sample Location							KR082				KR088		KR092		KR096		KR098			
	Sample ID		Kusko 14-PERI 4B	Kusko 14-PERI 3A	Kusko 14-PERI 3B	Kusko 14-PERI 2A	Kusko 14-PERI 2B	Kusko 14-PERI 1A	Kusko 14-PERI 1B	RD-14 PERI 1A	RD-14 PERI 1B	Kusko 14-PERI 13A	Kusko 14-PERI 13B	Kusko 14-PERI 14A	Kusko 14-PERI 14B	Kusko 14-PERI 15A	Kusko 14-PERI 15B	Kusko 14-PERI 16A	Kusko 14-PERI 16B	Kusko 14-PERI 26A	Kusko 14-PERI 26B
	Method																				
Total Inorganic Elements																					
Aluminum	EPA 6020	µg/g dry	38410	30280	32989	27857	23814	36763	37328	17384	21114	22753	15290	22941	16629		19708	16406	17043	23988	44024
Antimony	EPA 6020	µg/g dry	1.8	0.7	1.2	1.4	2.3	1.3	1.4	1267.7	1570.7	13.9	13.7	3.3	4.5		57.9	3.1	3.2	2.6	3.1
Arsenic	EPA 6020	µg/g dry	27.4	14.9	19.2	23.8	35.5	19.0	20.8	1637.1	1570.5	35.7	26.0	26.8	23.0		34.1	24.3	22.2	38.2	37.7
Barium	EPA 6020	µg/g dry	568.7	439.9	485.9	421.5	640.7	524.9	536.2	298.0	348.3	308.1	230.1	326.5	228.6		273.2	231.9	237.0	351.6	683.4
Beryllium	EPA 6020	µg/g dry	1.1	0.8	1.0	0.9	1.4	1.0	1.0	0.7 U	0.7 U	0.9	0.6	0.9	0.6		0.8	0.6	0.6	0.9	1.4
Boron	EPA 6020	µg/g dry	31.1	22.0	23.9	22.6	33.3	26.5	25.9	25.2	31.2	10.9	7.9	12.8	7.8		10.2	6.4	7.4	10.1	33.3
Cadmium	EPA 6020	µg/g dry	0.4	0.2	0.3	0.5	0.6	0.4	0.4	0.7 U	0.7 U	0.5	0.4	0.4	0.4		0.3	0.4	0.4	0.6	0.6
Chromium	EPA 6020	µg/g dry	60.7	49.5	53.4	44.1	68.2	59.0	57.0	31.3	38.9	43.2	32.6	45.7	33.9		39.6	35.2	34.2	50.1	76.2
Copper	EPA 6020	µg/g dry	44.3	17.5	23.1	30.7	73.2	27.1	26.9	45.0	45.3	32.9	25.5	30.9	27.0		32.2	31.2	25.2	44.0	45.5
Iron	EPA 6020	µg/g dry	39836	27425	31780	30157	26778	34253	34146	27563	27134	35081	27875	33621	27419		31926	31925	27740	43206	45073
Lead	EPA 6020	µg/g dry	12.0	5.9	8.3	10.3	15.8	9.2	10.0	11.8	13.2	11.3	8.3	10.0	9.0		10.1	10.0	8.3	14.8	16.1
Magnesium	EPA 6020	µg/g dry	9464	6931	7992	7546	6611	8516	8644	3434	3786	8600	6459	8471	6782		7619	7438	6843	10690	11795
Manganese	EPA 6020	µg/g dry	806.8	501.3	636.6	575.2	894.8	613.8	789.8	362.5	418.2	646.3	514.0	616.6	493.4		575.5	516.9	485.1	930.6	1013.8
Mercury	EPA 245.7	µg/g dry	0.06	0.04	0.03	0.04	0.03	0.04	0.05	181.79	225.06	5.99	6.87	0.25	0.19		4.56	0.40	0.47	0.14	0.16
Molybdenum	EPA 6020	µg/g dry	1.4	0.6	1.3	1.6	1.7	1.0	1.0	0.92 J	0.77 J	1.4	1.0	1.3	1.1		1.2	1.4	1.0	1.7	1.8
Nickel	EPA 6020	µg/g dry	36.7	27.0	30.6	29.4	48.9	33.9	34.4	29.6	35.4	37.2	29.0	36.3	31.1		34.2	32.5	29.1	46.7	46.8
Selenium	EPA 6020	µg/g dry	0.4	0.3	0.5	0.35 J	0.8	0.6	0.7	2.7	2.4	0.6	0.5	0.6	0.5		0.4	0.5	0.4	0.9	0.9
Strontium	EPA 6020	µg/g dry	80.6	67.5	70.3	72.1	127.6	73.9	72.5	46.2	47.5	90.6	60.2	80.0	67.2		64.0	70.1	76.6	88.9	93.0
Vanadium	EPA 6020	µg/g dry	104.6	84.7	93.5	77.3	118.5	104.5	100.8	48.0	57.4	65.6	49.2	71.5	50.4		60.8	50.3	52.0	75.7	125.3
Zinc	EPA 6020	µg/g dry	115.6	72.9	89.2	96.5	147.0	107.9	101.5	215.7	202.0	109.2	83.1	107.5	89.6		98.3	96.5	84.5	139.7	140.6
Percent Solids																					
Percent Solids	SM 2540 B	% Dry	13.1	71.8	46.6	12.8	20.5	36.1	41.9	3.8	3.5	34.4	33.6	34.6	38	19.3	24.9	37.8	50	41.6	24.7
Methylmercury																					
Methylmercury (as Mercury)	EPA 1630 Mod/FGS-070	ng/g wet	0.5 U	0.5 U	0.5 U	0.4 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Inorganic Arsenic																					
Inorganic Arsenic	EPA 1632	mg/kg wet	1.42	8.16	3.69	2.84	0.641	4.67	5.7	66.6	70.4	2.82	2.59	4.65	2.05	4.21	3.15	4.58	3.69	4.37	1.76

Table 5-8 Periphyton Sample Results, BLM 2014

Analyte	Sample Location ID	Units	Kusko 14-PERI 18		Kusko 14-PERI 19		Kusko 14-PERI 20		Kusko 14-PERI 21		Kusko 14-PERI 22		Kusko 14-PERI 23		Kusko 14-PERI 24		Kusko 14-PERI 25	
	General Location Description		Downriver of Red Devil Creek Delta		Downriver of Red Devil Creek Delta		Downriver of Red Devil Creek Delta		Downriver of Red Devil Creek Delta		Downriver of Red Devil Creek Delta		Downriver of Red Devil Creek Delta		Downriver of Red Devil Creek Delta		Downriver of Red Devil Creek Delta	
	Nearby RI Supplement Sediment Sample Location		KR100						KR102								KR104	
	Sample ID		Kusko 14-PERI 18A	Kusko 14-PERI 18B	Kusko 14-PERI 19A	Kusko 14-PERI 19B	Kusko 14-PERI 20A	Kusko 14-PERI 20B	Kusko 14-PERI 21A	Kusko 14-PERI 21B	Kusko 14-PERI 22A	Kusko 14-PERI 22B	Kusko 14-PERI 23A	Kusko 14-PERI 23B	Kusko 14-PERI 24A	Kusko 14-PERI 24B	Kusko 14-PERI 25A	Kusko 14-PERI 25B
	Method																	
Total Inorganic Elements																		
Aluminum	EPA 6020	µg/g dry	**20691**	**29048**	**13718**	**19853**	**15136**	**32103**	**33489**	**39784**	**36391**	**38221**	**29009**	**37141**	**29586**	**37859**		**24269**
Antimony	EPA 6020	µg/g dry	**2.2**	**2.3**	**1.9**	**1.6**	**2.2**	**2.3**	**2.2**	**2.7**	**2.8**	**2.5**	**2.1**	**2.7**	**2.1**	**2.5**		**1.0**
Arsenic	EPA 6020	µg/g dry	**30.9**	**26.4**	**15.7**	**17.3**	**22.2**	**22.8**	**21.8**	**27.7**	**26.8**	**30.7**	**27.0**	**28.3**	**26.7**	**32.9**		**11.6**
Barium	EPA 6020	µg/g dry	**299.8**	**451.2**	**190.3**	**276.2**	**199.8**	**446.6**	**484.8**	**557.7**	**511.7**	**555.1**	**422.2**	**544.8**	**427.8**	**547.5**		**334.3**
Beryllium	EPA 6020	µg/g dry	**0.8**	**1.0**	**0.4**	**0.7**	**0.5**	**0.9**	**1.0**	**1.1**	**1.1**	**1.1**	**0.9**	**1.2**	**0.9**	**1.1**		**0.7**
Boron	EPA 6020	µg/g dry	**8.9**	**21.0**	**8.5**	**13.6**	**6.0**	**23.2**	**25.1**	**28.1**	**27.9**	**27.4**	**19.7**	**26.5**	**20.4**	**26.4**		**15.4**
Cadmium	EPA 6020	µg/g dry	**0.5**	**0.4**	**0.2**	**0.3**	**0.3**	**0.4**	**0.3**	**0.4**	**0.3**	**0.5**	**0.5**	**0.5**	**0.4**	**0.4**		**0.188 J**
Chromium	EPA 6020	µg/g dry	**39.8**	**52.3**	**25.8**	**34.8**	**30.0**	**52.8**	**53.8**	**65.3**	**59.2**	**63.5**	**48.4**	**61.2**	**49.4**	**60.3**		**36.9**
Copper	EPA 6020	µg/g dry	**34.7**	**31.9**	**18.0**	**21.2**	**26.3**	**26.1**	**24.5**	**30.6**	**26.0**	**36.5**	**31.0**	**34.5**	**27.8**	**29.7**		**14.7**
Iron	EPA 6020	µg/g dry	**35277**	**32999**	**18971**	**25417**	**27888**	**31458**	**32023**	**39272**	**35602**	**39535**	**33100**	**37823**	**32684**	**37957**		**25524**
Lead	EPA 6020	µg/g dry	**11.5**	**11.6**	**6.2**	**7.6**	**8.8**	**9.3**	**9.2**	**11.9**	**10.0**	**13.6**	**11.2**	**12.4**	**9.6**	**10.7**		**6.3**
Magnesium	EPA 6020	µg/g dry	**8622**	**8293**	**4463**	**6064**	**6554**	**7761**	**7890**	**9566**	**8527**	**10252**	**8330**	**9667**	**8008**	**9391**		**5030**
Manganese	EPA 6020	µg/g dry	**730.8**	**633.6**	**338.9**	**489.9**	**447.6**	**541.8**	**545.7**	**661.1**	**647.7**	**709.1**	**653.3**	**688.4**	**608.6**	**721.6**		**514.9**
Mercury	EPA 245.7	µg/g dry	**0.23**	**0.15**	**0.21**	**0.11**	**0.22**	**0.13**	**0.09**	**0.12**	**0.12**	**0.12**	**0.09**	**0.14**	**0.11**	**0.14**		**0.10**
Molybdenum	EPA 6020	µg/g dry	**1.3**	**1.4**	**1.0**	**0.9**	**1.0**	**1.0**	**1.1**	**1.4**	**1.2**	**1.5**	**1.3**	**1.4**	**1.1**	**1.1**		**0.7**
Nickel	EPA 6020	µg/g dry	**36.9**	**32.8**	**19.0**	**24.8**	**29.0**	**31.0**	**30.4**	**37.3**	**32.0**	**39.8**	**32.7**	**37.2**	**32.3**	**36.1**		**20.9**
Selenium	EPA 6020	µg/g dry	**0.7**	**0.4**	**0.4**	**0.5**	**0.5**	**0.6**	**0.5**	**0.5**	**0.7**	**0.8**	**0.6**	**0.6**	**0.5**	**0.5**		**0.3**
Strontium	EPA 6020	µg/g dry	**72.9**	**73.0**	**26.9**	**45.1**	**42.3**	**62.4**	**70.0**	**70.7**	**64.7**	**85.1**	**67.7**	**83.4**	**69.3**	**83.4**		**49.1**
Vanadium	EPA 6020	µg/g dry	**63.3**	**84.8**	**39.8**	**58.1**	**44.0**	**88.0**	**92.2**	**106.0**	**97.0**	**102.0**	**80.8**	**100.4**	**82.7**	**102.8**		**65.3**
Zinc	EPA 6020	µg/g dry	**110.6**	**101.3**	**59.8**	**71.8**	**86.7**	**91.1**	**90.2**	**108.9**	**98.2**	**119.4**	**100.1**	**111.6**	**95.6**	**104.4**		**61.4**
Percent Solids																		
Percent Solids	SM 2540 B	% Dry	**36.1**	**28.7**	**36**	**39.7**	**32.2**	**41.4**	**40.6**	**33.4**	**32.3**	**22.5**	**23.3**	**31.1**	**40.4**	**41.7**	**20.4**	**25.5**
Methylmercury																		
Methylmercury (as Mercury)	EPA 1630 Mod/FGS-070	ng/g wet	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.4 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Inorganic Arsenic																		
Inorganic Arsenic	EPA 1632	mg/kg wet	**2.2**	**2.28**	**3.53**	**2.63**	**2.64**	**1.72**	**3.78**	**3.35**	**4.43**	**2.48**	**1.2**	**2.91**	**2.56**	**2**	**1.46**	**3.3**

Key:
EPA = Environmental Protection Agency
µg/g =
micrograms
per kilogram
mg/kg = miligrams per kilogram
% = percent

Table 5-9 Comparison of Metals Concentrations in Periphyton from the Kuskokwim River Upstream and Downstream from the Red Devil Creek Delta

Analyte	Upstream Periphyton Concentration (µg/g dry weight)			Downstream Periphyton Concentration (µg/g dry weight)			Is Downstream Significnalty Greater than Upstream (*p* < 0.05)?*	
	Mean	SD	Median	Mean	SD	Median	(Yes/No)	*p* value
Antimony	1.42	0.44	1.32	7.6	15.5	2.43	Yes	0.0005
Arsenic (total)	21.9	4.2	22	26.3	7.0	27.7	Yes	0.0241
Inorganic Arsenic	12.1	5.2	11.9	9.1	2.4	8.8	No	0.9637
Mercury	0.057	0.024	0.051	0.99	2.03	0.16	Yes	0.00002
Cadmium	0.39	0.10	0.38	0.39	0.11	0.39	No	0.4388
Copper	28.9	8.6	28.1	29.0	7.1	29.0	No	0.3598
Iron	31307	3966	31995	32571	5520	31926	No	0.2691
Manganese	634	111	653	608	137	580	No	0.7475
Nickel	31.5	5.0	31.7	32.7	6.4	33.8	No	0.2364
Selenium	0.51	0.14	0.48	0.54	0.14	0.53	No	0.2691
Vanadium	83	14	80	74	19	66	No	0.9244
Zinc	94	17	91	97	19	99	No	0.2525

Notes:

* Mann-Whitney U-test for difference in medians.

Key:

p = probability

SD = standard deviation

Table 5-10 Summary of Mercury Selective Sequential Extraction (SSE) Results for 2015 Kuskokwim River Sediment Samples

Analyte / SSE Fraction	SSE Extractant	SSE Fraction Description	Units	Sample Location and Number													
				KR084 Red Devil Creek (RDC) Delta Area 15KR084SD		KR088 300 m Downriver of RDC Delta 15KR088SD		KR089 360 m Downriver of RDC Delta 15KR089SD		KR091 510 m Downriver of RDC Delta 15KR091SD		KR092 775 m Downriver of RDC Delta 15KR092SD		KR093 800 m Downriver of RDC Delta 15KR093SD		KR097 1,300 m Downriver of RDC Delta (other bank) 15KR097SD	
Mercury SSE Results																	
Fraction 0 (F0)	De-ionized Water	Volatile	ng/g dry	4.77	UJ	9.28	J	4.63	UJ	4.68	UJ	5.64	UJ	4.63	UJ	4.66	UJ
Fraction 1 (F1)	De-ionized Water	Water soluble	ng/g dry	271	J	58.5	UJ	2.37	UJ	12	UJ	14.5	UJ	61.8	J	2.39	UJ
Fraction 2 (F2)	pH 2 Stomach Acid	Weak Acid Soluble	ng/g dry	1.16	UJ	12.1	J	1.13	UJ	1.14	UJ	1.37	UJ	1.13	UJ	1.14	UJ
Fraction 3 (F3)	I Molar KOH	Organic Complexed	ng/g dry	1680	J	528	J	30.8	J	45.2	J	446	J	98.3	J	5.55	J
Fraction 4 (F4)	12 Molar HNO_3	Strongly Complexed	ng/g dry	6000	J	1530	J	605	J	817	J	2190	J	299	J	4.94	J
Fraction 5 (F5)	Aqua Regia	Cinnabar	ng/g dry	9140	J	4410	J	6810	J	145	J	829	J	279	J	3.62	J
Sum F0 to F5 (ND= 0.5DL)	see above	Total Mercury	ng/g dry	17,094		6,519		7,450		1,016		3,476		741		18	
Bioavailable Fraction Estimate																	
Sum F0 to F2 (ND=0.5DL)	see above	Readily Bioavailable	ng/g dry	274		51		4.1		8.9		11		65		4.1	
% F0 to F2 of F0 to F5	see above	Readily Bioavailable	%	1.6%		0.8%		0.1%		0.9%		0.3%		8.7%		22%	

Key:

DL = detection limit

ND = non-detect

RDC = Red Devil Creek

SSE = Selective Sequential Extraction

Table 5-11 Northern Pike and Burbot Total Mercury Concentrations for Watersheds in the Middle Kuskokwim River Region, Alaska

Watershed or Reach Name[(a)]	Watershed or Reach Number[(a)]	Mean Pike Total Mercury (mg/kg wet wt)[(b)]	Mean Burbot Total Mercury (mg/kg wet wt)[(b)]
Kusko-Aniak	1	0.35	0.10
George River	2	0.54	0.21
Kusko above George River[(d)]	3[(d)]	0.2	0.09
Holitna	4	0.45	0.09
Kusko-Stony	5	0.17	0.12
Kusko above Sleetmute	6	0.11	0.15
Kusko above Selatna	7	0.25	0.10
Takotna	8	0.72	--

Notes:

(a) = From Table 1 from Matz et al. (2015).

(b) = From Figure 7 from Matz et al. (2015).

(c) = From Figure 8 from Matz et al. (2015).

(d) = Includes Red Devil Mine site.

Key:

-- = not available

Wet wt = wet weight

Ecology & Environment, Inc. GIS Department Project:
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2015 Sediment Sample Location
2014 BLM Periphyton Sample Location
2012 RI Sediment Sample Location
2011 RI Sediment Sample Location
2010 RI Sediment Sample Location
Bathymetric contour (feet)

Settling Pond
Monofill
Historical Structure

Bathymetric contours represent approximate depths below river surface on September 25, 2011

RED DEVIL MINE

Red Devil, Alaska

Figure 5-1
Kuskokwim River Sediment and Periphyton Sample Locations - Near Red Devil Mine Site

0 75 150 300 450 600
Feet
0 15 30 60 90 120 150
Meters
Scale 1:2,500

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2015 Sediment Sample Locations
2014 BLM Periphyton Sample Locations
2012 RI Sediment Sample Locaiton
2011 RI Sediment Sample Location
2010 RI Sediment Sample Location

RED DEVIL MINE

Red Devil, Alaska

Figure 5-2
Kuskokwim River Sediment and Periphyton Sample Locations - Near Red Devil Mine Site and Downriver

0 0.075 0.15 0.3 0.45 0.6
Miles
0 0.125 0.25 0.5 0.75 1
Kilometers
Scale 1:2,500

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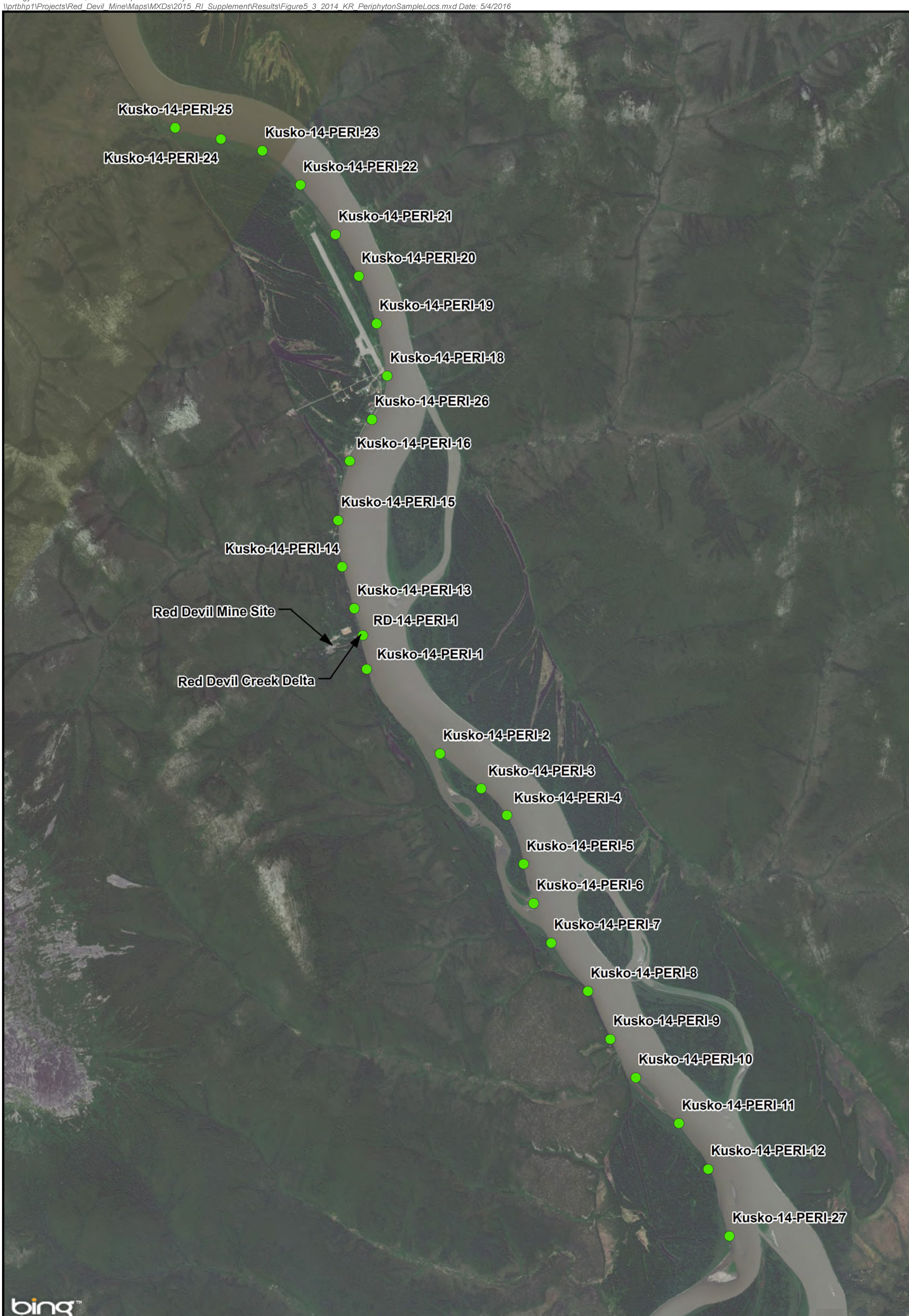
Ecology & Environment, Inc. GIS Department Project: \\prtbhp1\Projects\Red_Devil_Mine\Maps\MXDs\2015_RI_Supplement\Results\Figure5_3_2014_KR_PeriphytonSampleLocs.mxd Date: 5/4/2016



2014 BLM Periphyton Sample Location

RED DEVIL MINE

Red Devil, Alaska

Figure 5-3
2014 Kuskokwim River Periphyton Sample Locations

0 0.25 0.5 0.75 1 Miles

0 0.25 0.5 0.75 1 1.25 Kilometers

Scale 1:2,500

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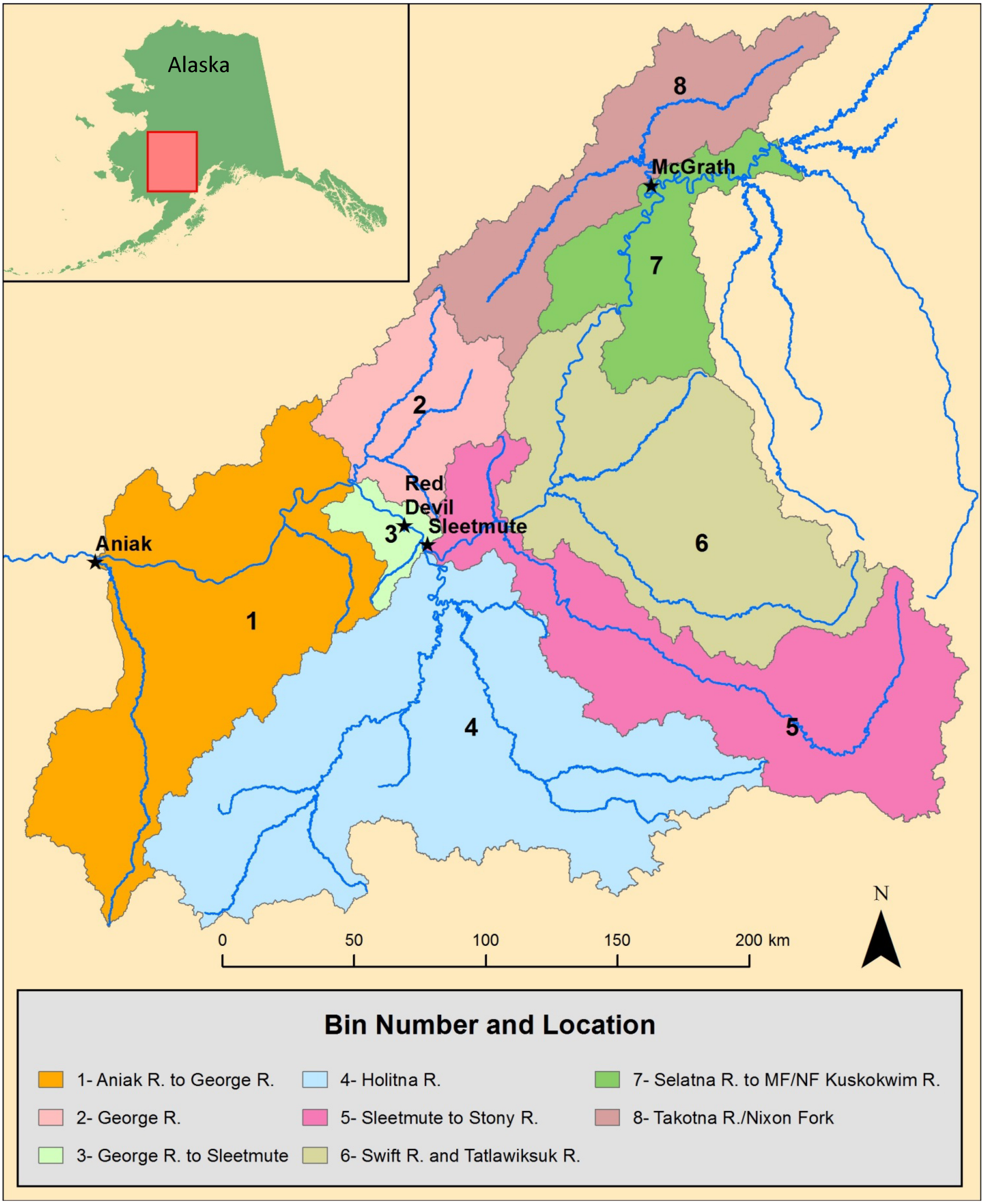

Figure 5-4. Watersheds in the Mid-Kuskokwim River Region Used to Compare Mercury Concentrations to Fish Movements Among Watersheds

Adapted from Matz et al. (2015)
Watershed boundaries based on U.S. Geological Survey Hydrologic Unit Codes for Alaska

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2010 Total Antimony (mg/kg)	2011 Total Antimony (mg/kg)	2012 Total Antimony (mg/kg)	2015 Total Antimony (mg/kg)
> 150	> 150	> 150	> 150
50 to 150	50 to 150	50 to 150	50 to 150
15 to 50	15 to 50	15 to 50	15 to 50
5 to 15	5 to 15	5 to 15	5 to 15
1 to 5	1 to 5	1 to 5	1 to 5
0.446 to 1	0.446 to 1	0.446 to 1	0.446 to 1
≤ 0.446 background	≤ 0.446 background	≤ 0.446 background	≤ 0.446 background

RED DEVIL MINE

Red Devil, Alaska

Bathymetric contour (feet)
Settling Pond
Monofill
Historical Structure

Figure 5-5

Total Antimony in Sediment, RI (2010-2012) and RI Supplement (2015) – Near Red Devil Mine Site

0 75 150 300 450 600
Feet
0 15 30 60 90 120 150
Meters
Scale 1:2,500

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Ecology & Environment, Inc. GIS Department Project:
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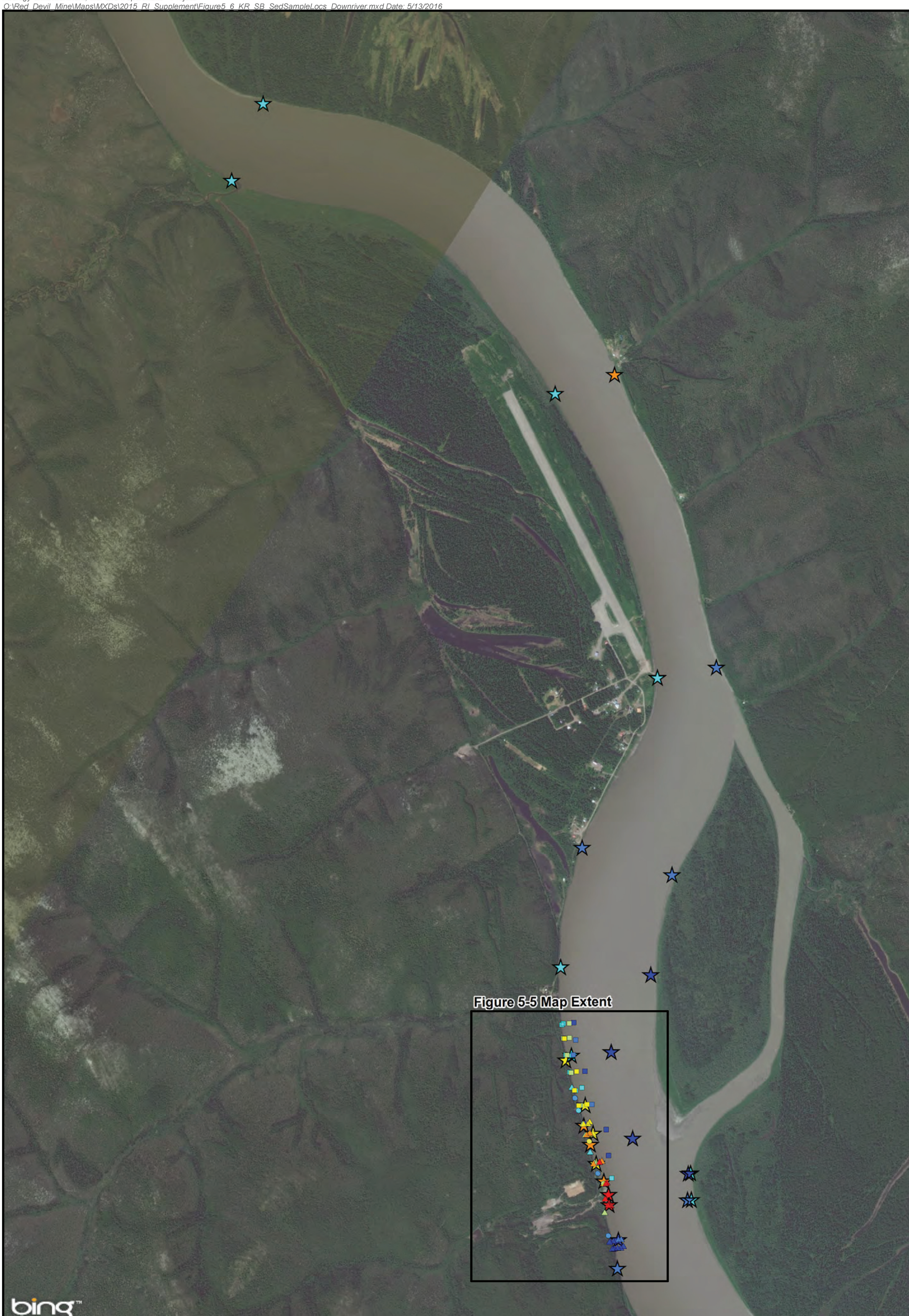

2010 Total Antimony (mg/kg)	2011 Total Antimony (mg/kg)	2012 Total Antimony (mg/kg)	2015 Total Antimony (mg/kg)
> 150	> 150	> 150	> 150
50 to 150	50 to 150	50 to 150	50 to 150
15 to 50	15 to 50	15 to 50	15 to 50
5 to 15	5 to 15	5 to 15	5 to 15
1 to 5	1 to 5	1 to 5	1 to 5
0.446 to 1	0.446 to 1	0.446 to 1	0.446 to 1
≤ 0.446 background	≤ 0.446 background	≤ 0.446 background	≤ 0.446 background

RED DEVIL MINE

Red Devil, Alaska

Figure 5-6

Total Antimony in Sediment, RI (2010-2012) and RI Supplement (2015) – Near Red Devil Mine Site and Downriver

0 0.075 0.15 0.3 0.45 0.6
Miles
0 0.125 0.25 0.5 0.75 1
Kilometers
Scale 1:2,500

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Ecology & Environment, Inc. GIS Department Project:
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Figure 5-7
Total Arsenic in Sediment, RI (2010-2012) and RI Supplement (2015) – Near Red Devil Mine Site

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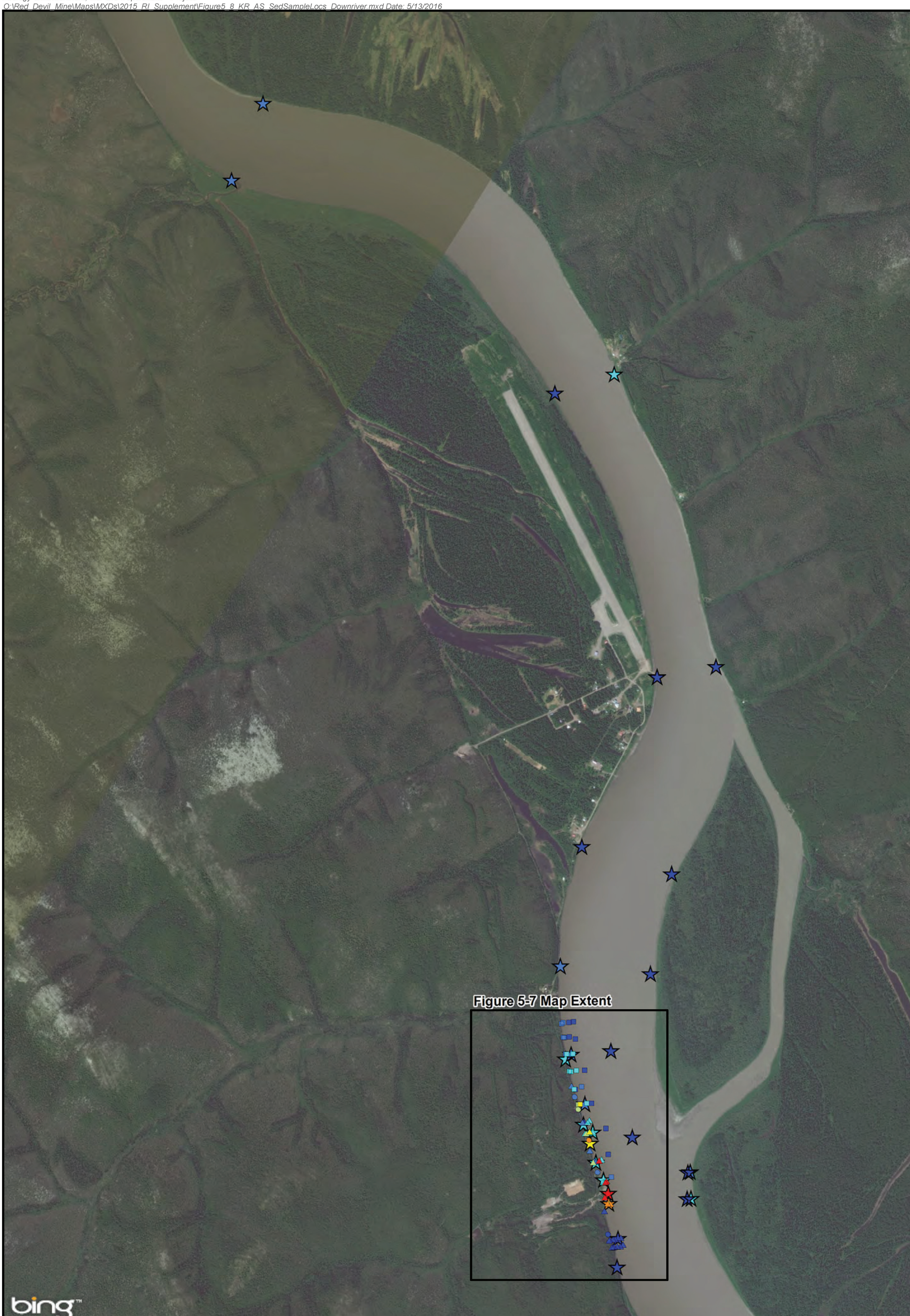

2010 Total Arsenic (mg/kg)	2011 Total Arsenic (mg/kg)	2012 Total Arsenic (mg/kg)	2015 Total Arsenic (mg/kg)
> 800	> 800	> 800	> 800
400 to 800	400 to 800	400 to 800	400 to 800
200 to 400	200 to 400	200 to 400	200 to 400
100 to 200	100 to 200	100 to 200	100 to 200
30 to 100	30 to 100	30 to 100	30 to 100
15 to 30	15 to 30	15 to 30	15 to 30
≤ 15 background	≤ 15 background	≤ 15 background	≤ 15 background

RED DEVIL MINE

Red Devil, Alaska

Figure 5-8

Total Arsenic in Sediment, RI (2010-2012) and RI Supplement (2015) – Near Red Devil Mine Site and Downriver

0 0.075 0.15 0.3 0.45 0.6
Miles
0 0.125 0.25 0.5 0.75 1
Kilometers
Scale 1:2,500

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Ecology & Environment, Inc. GIS Department Project:
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2010 Total Mercury (mg/kg)	2011 Total Mercury (mg/kg)	2012 Total Mercury (mg/kg)	2015 Total Mercury (mg/kg)
> 300	> 300	> 300	> 300
100 to 300	100 to 300	100 to 300	100 to 300
25 to 100	25 to 100	25 to 100	25 to 100
5 to 25	5 to 25	5 to 25	5 to 25
1 to 5	1 to 5	1 to 5	1 to 5
.144 to 1	.144 to 1	.144 to 1	.144 to 1
≤ .144 background	≤ .144 background	≤ .144 background	≤ .144 background

RED DEVIL MINE

Red Devil, Alaska

Bathymetric contour (feet)
Settling Pond
Monofill
Historical Structure

Figure 5-9

Total Mercury in Sediment, RI (2010-2012) and RI Supplement (2015) – Near Red Devil Mine Site

0 75 150 300 450 600 Feet
0 15 30 60 90 120 150 Meters
Scale 1:2,500

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Ecology & Environment, Inc. GIS Department Project:
O:\Red_Devil_Mine\Maps\MXDs\2015_RI_Supplement\Figure5_10_KR_HG_SedSampleLocs_Downriver.mxd Date: 5/13/2016

2010 Total Mercury (mg/kg)	2011 Total Mercury (mg/kg)	2012 Total Mercury (mg/kg)	2015 Total Mercury (mg/kg)
> 300	> 300	> 300	> 300
100 to 300	100 to 300	100 to 300	100 to 300
25 to 100	25 to 100	25 to 100	25 to 100
5 to 25	5 to 25	5 to 25	5 to 25
1 to 5	1 to 5	1 to 5	1 to 5
.144 to 1	.144 to 1	.144 to 1	.144 to 1
≤ .144 background	≤ .144 background	≤ .144 background	≤ .144 background

RED DEVIL MINE

Red Devil, Alaska

Figure 5-10

Total Mercury in Sediment, RI (2010-2012) and RI Supplement (2015) – Near Red Devil Mine Site and Downriver

0 0.075 0.15 0.3 0.45 0.6
Miles
0 0.125 0.25 0.5 0.75 1
Kilometers
Scale 1:2,500

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Ecology & Environment, Inc. GIS Department Project:
O:\Red_Devil_Mine\Maps\MXDs\2015_RI_Supplement\Figure5_11_KR_MM_SedSampleLoc.mxd Date: 5/13/2016

2010 Methylmercury (ng/g)	2011 Methylmercury (ng/g)	2012 Methylmercury (ng/g)	2015 Methylmercury (ng/g)
> 3.0	> 3.0	> 3.0	> 3.0
2.5 to 3.0	2.5 to 3.0	2.5 to 3.0	2.5 to 3.0
2.0 to 2.5	2.0 to 2.5	2.0 to 2.5	2.0 to 2.5
1.5 to 2.0	1.5 to 2.0	1.5 to 2.0	1.5 to 2.0
1.0 to 1.5	1.0 to 1.5	1.0 to 1.5	1.0 to 1.5
0.49 to 1.0	0.49 to 1.0	0.49 to 1.0	0.49 to 1.0
≤ 0.49 background	≤ 0.49 background	≤ 0.49 background	≤ 0.49 background

RED DEVIL MINE

Red Devil, Alaska

Bathymetric contour (feet)
Settling Pond
Monofill
Historical Structure

Figure 5-11

Methylmercury in Sediment, RI (2010-2012) and RI Supplement (2015) – Near Red Devil Mine Site

0 75 150 300 450 600
Feet
0 15 30 60 90 120 150
Meters
Scale 1:2,500

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Ecology & Environment, Inc. GIS Department Project:
O:\Red_Devil_Mine\Maps\MXDs\2015_RI_Supplement\Figure5_12_KR_MM_SedSampleLocs_Downriver.mxd Date: 5/13/2016

2010 Methylmercury (ng/g)	2011 Methylmercury (ng/g)	2012 Methylmercury (ng/g)	2015 Methylmercury (ng/g)
> 3.0	> 3.0	> 3.0	> 3.0
2.5 to 3.0	2.5 to 3.0	2.5 to 3.0	2.5 to 3.0
2.0 to 2.5	2.0 to 2.5	2.0 to 2.5	2.0 to 2.5
1.5 to 2.0	1.5 to 2.0	1.5 to 2.0	1.5 to 2.0
1.0 to 1.5	1.0 to 1.5	1.0 to 1.5	1.0 to 1.5
0.49 to 1.0	0.49 to 1.0	0.49 to 1.0	0.49 to 1.0
≤ 0.49 background	≤ 0.49 background	≤ 0.49 background	≤ 0.49 background

RED DEVIL MINE

Red Devil, Alaska

Figure 5-12

Methylmercury in Sediment, RI (2010-2012) and RI Supplement (2015) – Near Red Devil Mine Site and Downriver

0 0.075 0.15 0.3 0.45 0.6
Miles
0 0.125 0.25 0.5 0.75 1
Kilometers
Scale 1:2,500

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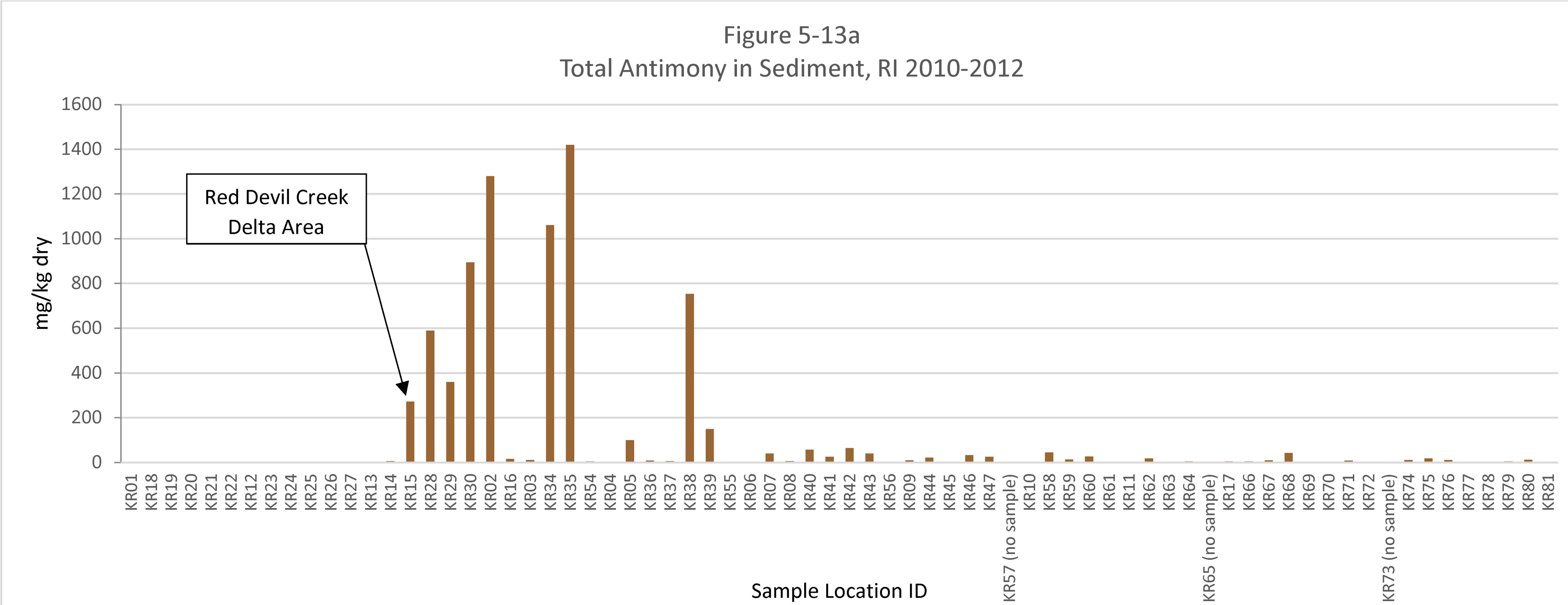

Figure 5-13a
Total Antimony in Sediment, RI 2010-2012
mg/kg dry
Red Devil Creek Delta Area
Sample Location ID
KR57 (no sample)
KR65 (no sample)
KR73 (no sample)

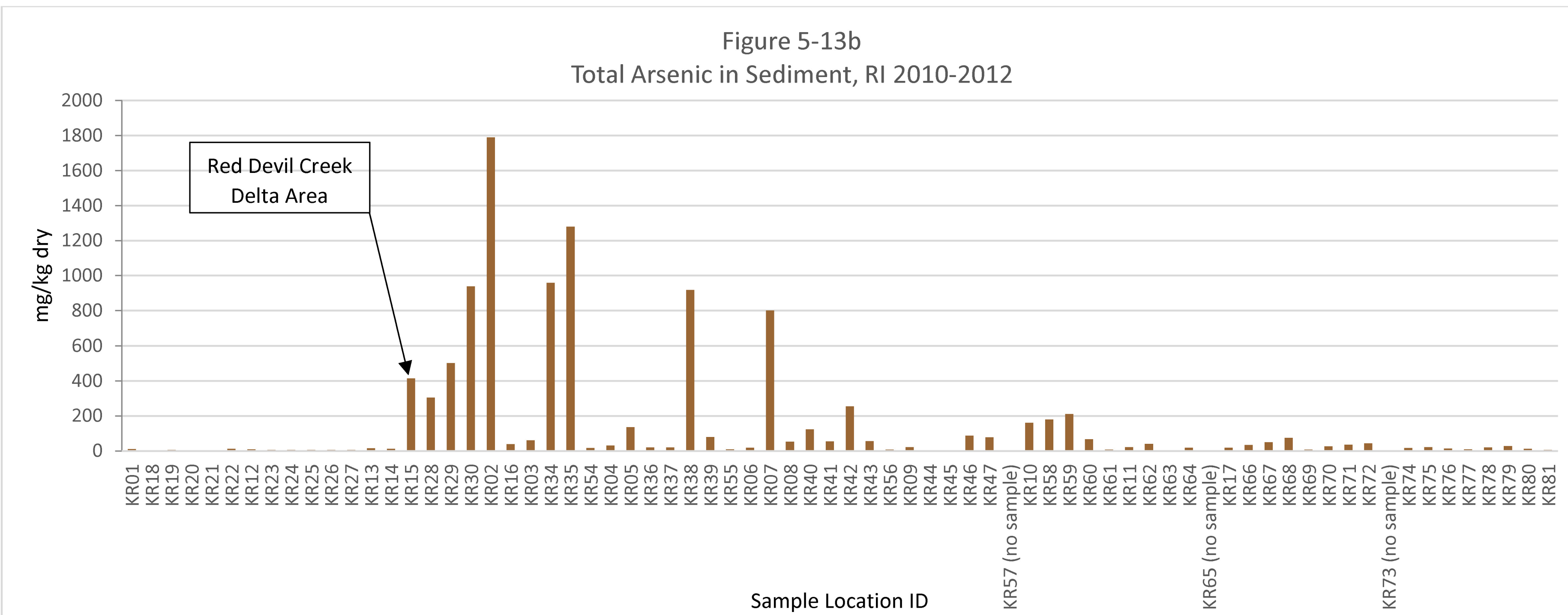

Figure 5-13b
Total Arsenic in Sediment, RI 2010-2012
mg/kg dry
Red Devil Creek Delta Area
Sample Location ID
KR57 (no sample)
KR65 (no sample)
KR73 (no sample)

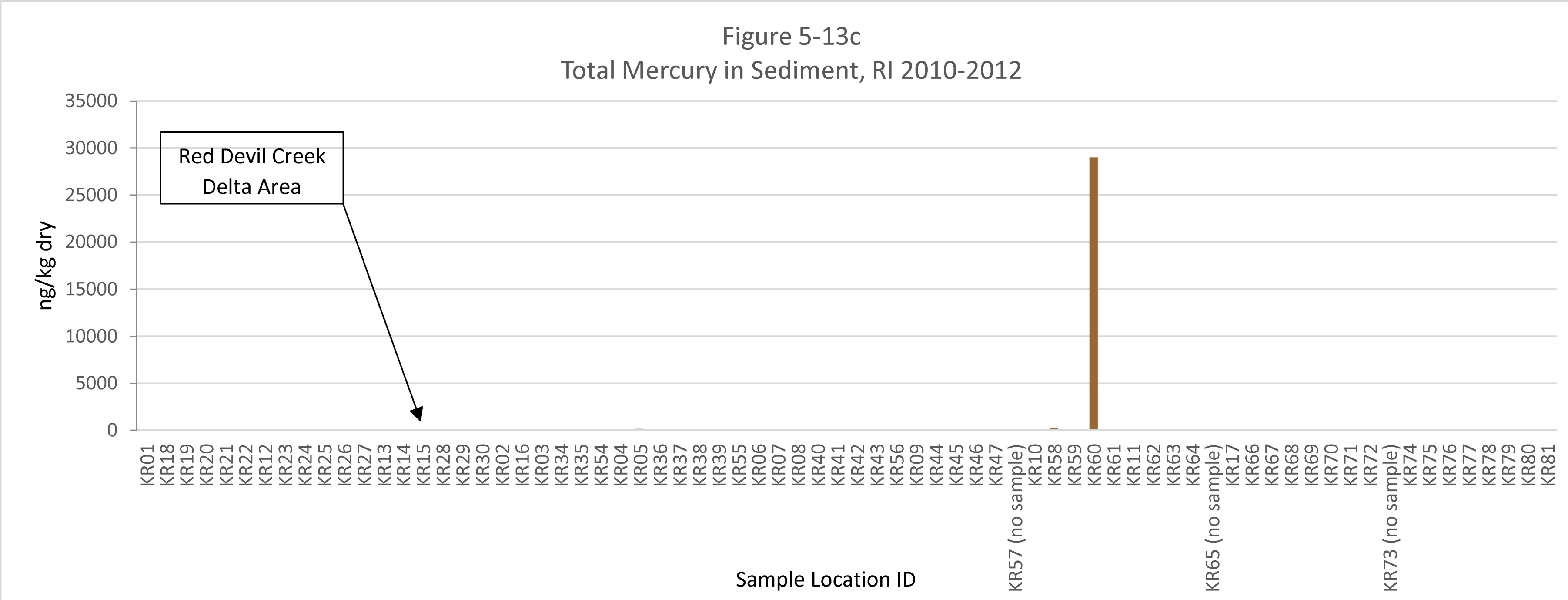
Figure 5-13c
Total Mercury in Sediment, RI 2010-2012
ng/kg dry
35000
30000
25000
20000
15000
10000
5000
0
Red Devil Creek Delta Area
Sample Location ID
KR01 KR18 KR19 KR20 KR21 KR22 KR12 KR23 KR24 KR25 KR26 KR27 KR13 KR14 KR15 KR28 KR29 KR30 KR02 KR16 KR03 KR34 KR35 KR54 KR04 KR05 KR36 KR37 KR38 KR39 KR55 KR06 KR07 KR08 KR40 KR41 KR42 KR43 KR56 KR09 KR44 KR45 KR46 KR47 KR57 (no sample) KR10 KR58 KR59 KR60 KR61 KR11 KR62 KR63 KR64 KR65 (no sample) KR17 KR66 KR67 KR68 KR69 KR70 KR71 KR72 KR73 (no sample) KR74 KR75 KR76 KR77 KR78 KR79 KR80 KR81

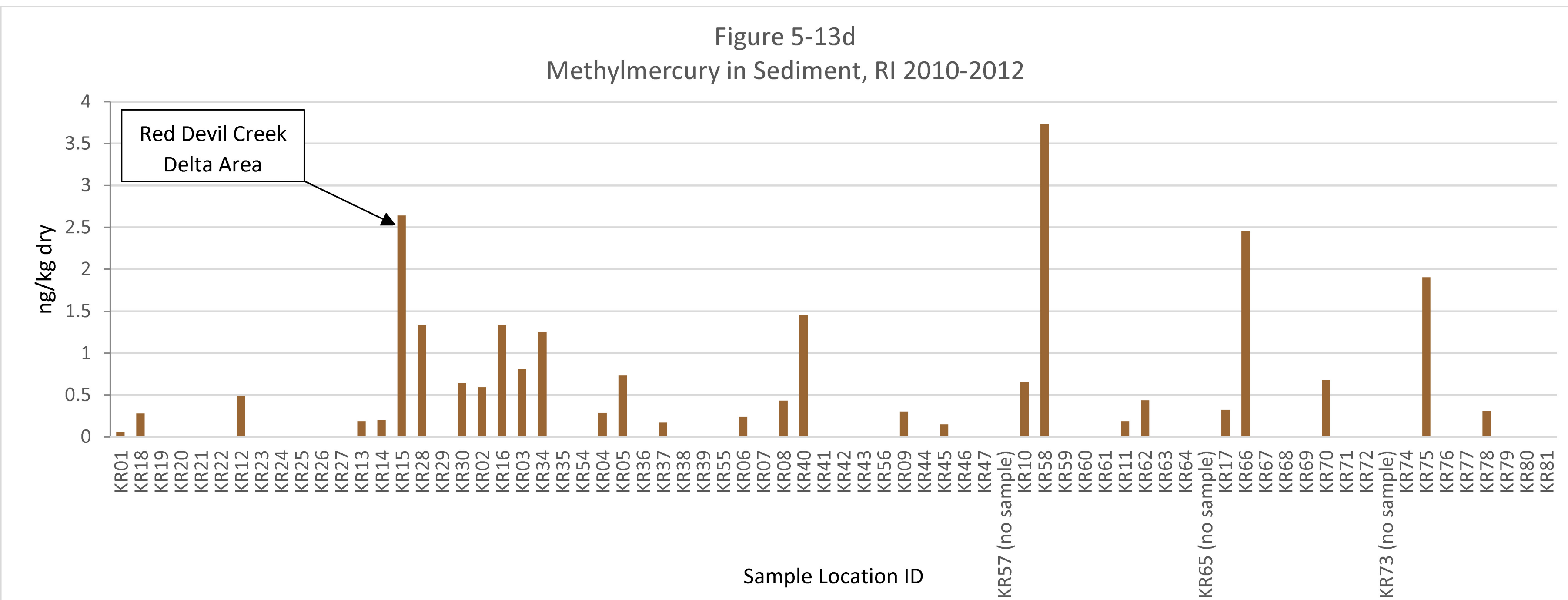
Figure 5-13d
Methylmercury in Sediment, RI 2010-2012
ng/kg dry
4
3.5
3
2.5
2
1.5
1
0.5
0
Red Devil Creek Delta Area
Sample Location ID
KR01 KR18 KR19 KR20 KR21 KR22 KR12 KR23 KR24 KR25 KR26 KR27 KR13 KR14 KR15 KR28 KR29 KR30 KR02 KR16 KR03 KR34 KR35 KR54 KR04 KR05 KR36 KR37 KR38 KR39 KR55 KR06 KR07 KR08 KR40 KR41 KR42 KR43 KR56 KR09 KR44 KR45 KR46 KR47 KR57 (no sample) KR10 KR58 KR59 KR60 KR61 KR11 KR62 KR63 KR64 KR65 (no sample) KR17 KR66 KR67 KR68 KR69 KR70 KR71 KR72 KR73 (no sample) KR74 KR75 KR76 KR77 KR78 KR79 KR80 KR81

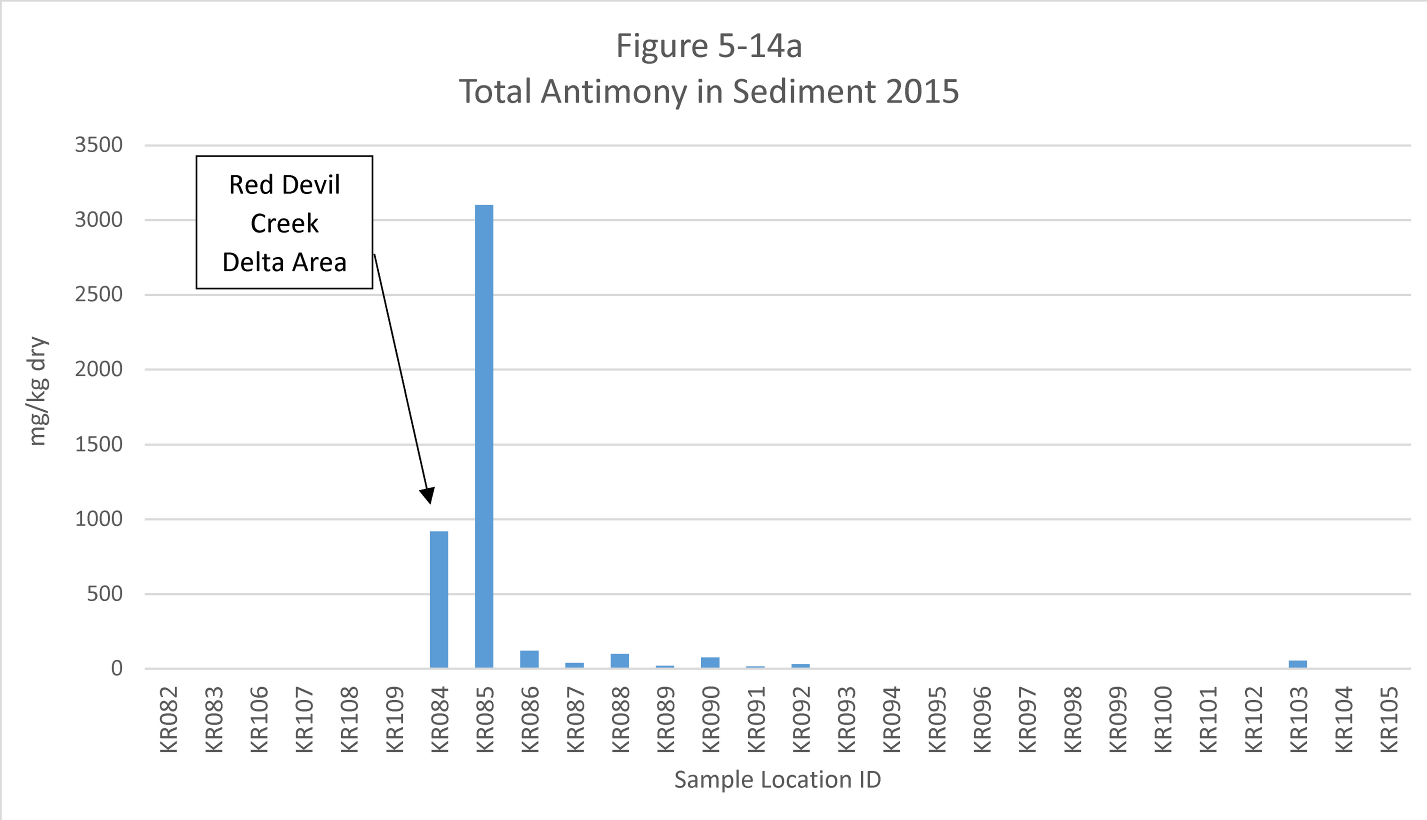
Figure 5-14a
Total Antimony in Sediment 2015
3500
3000
2500
2000
1500
1000
500
0
mg/kg dry
Red Devil Creek Delta Area
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105
Sample Location ID

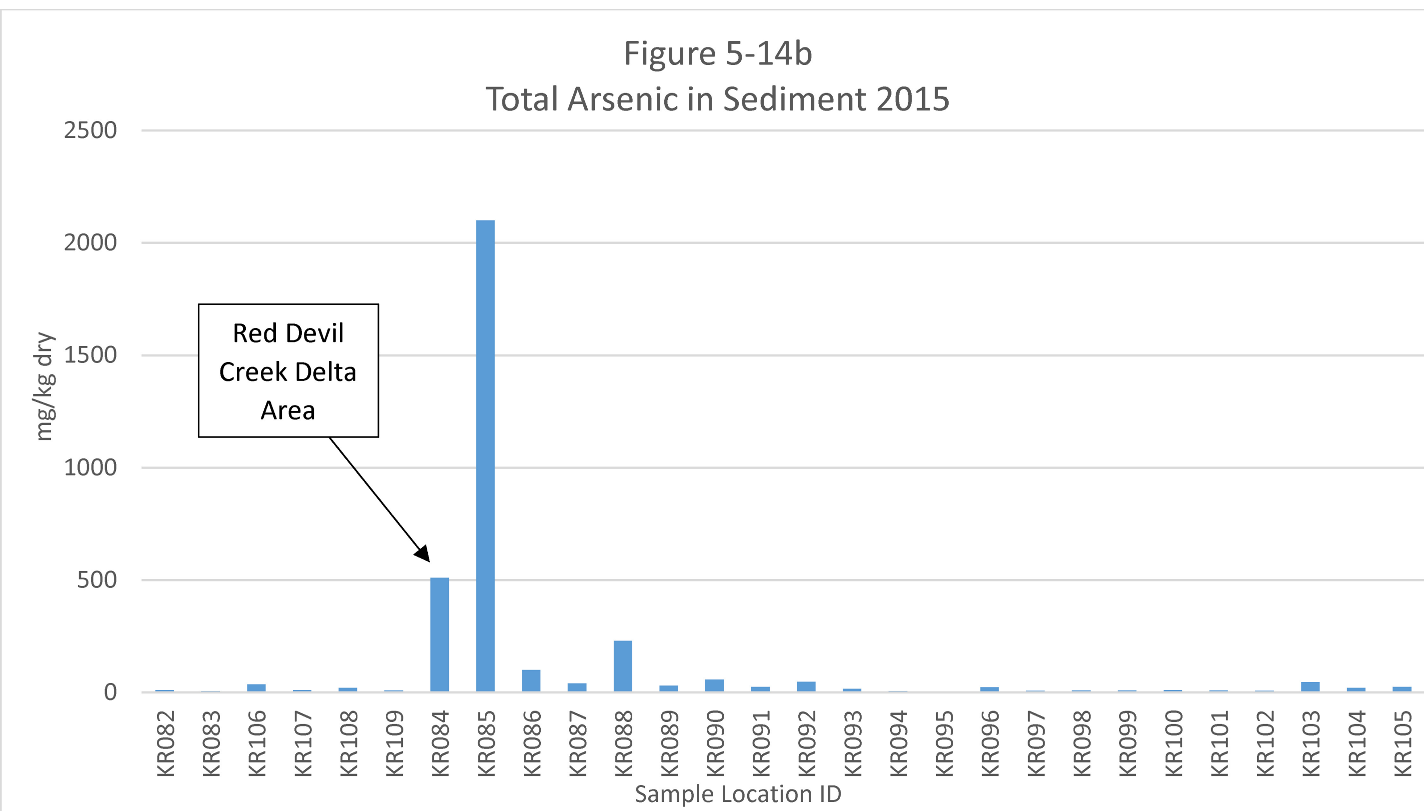
Figure 5-14b
Total Arsenic in Sediment 2015
2500
2000
1500
1000
500
0
mg/kg dry
Red Devil Creek Delta Area
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105
Sample Location ID

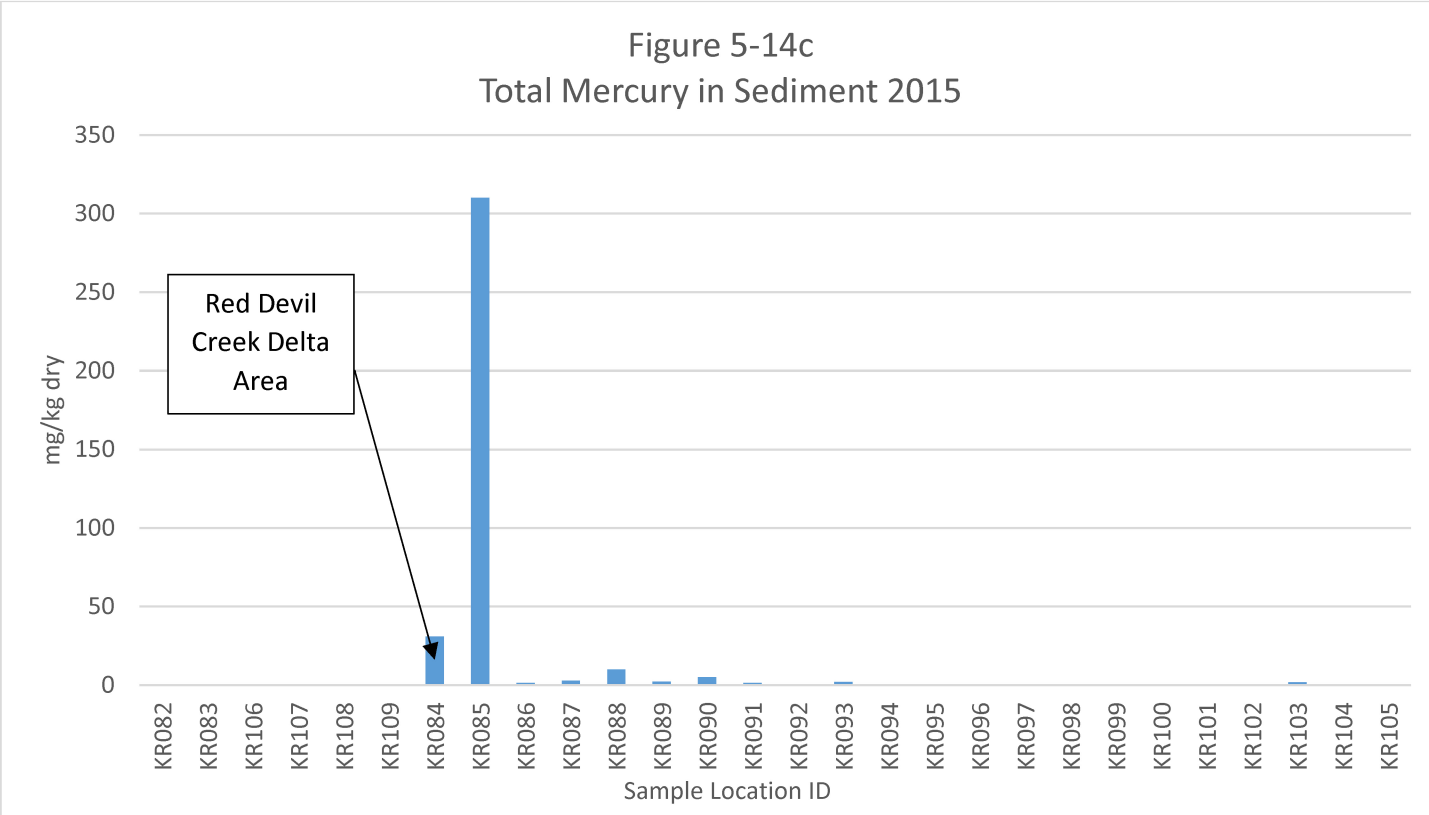

Figure 5-14c
Total Mercury in Sediment 2015
350
300
250
200
150
100
50
0
mg/kg dry
Red Devil Creek Delta Area
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105
Sample Location ID

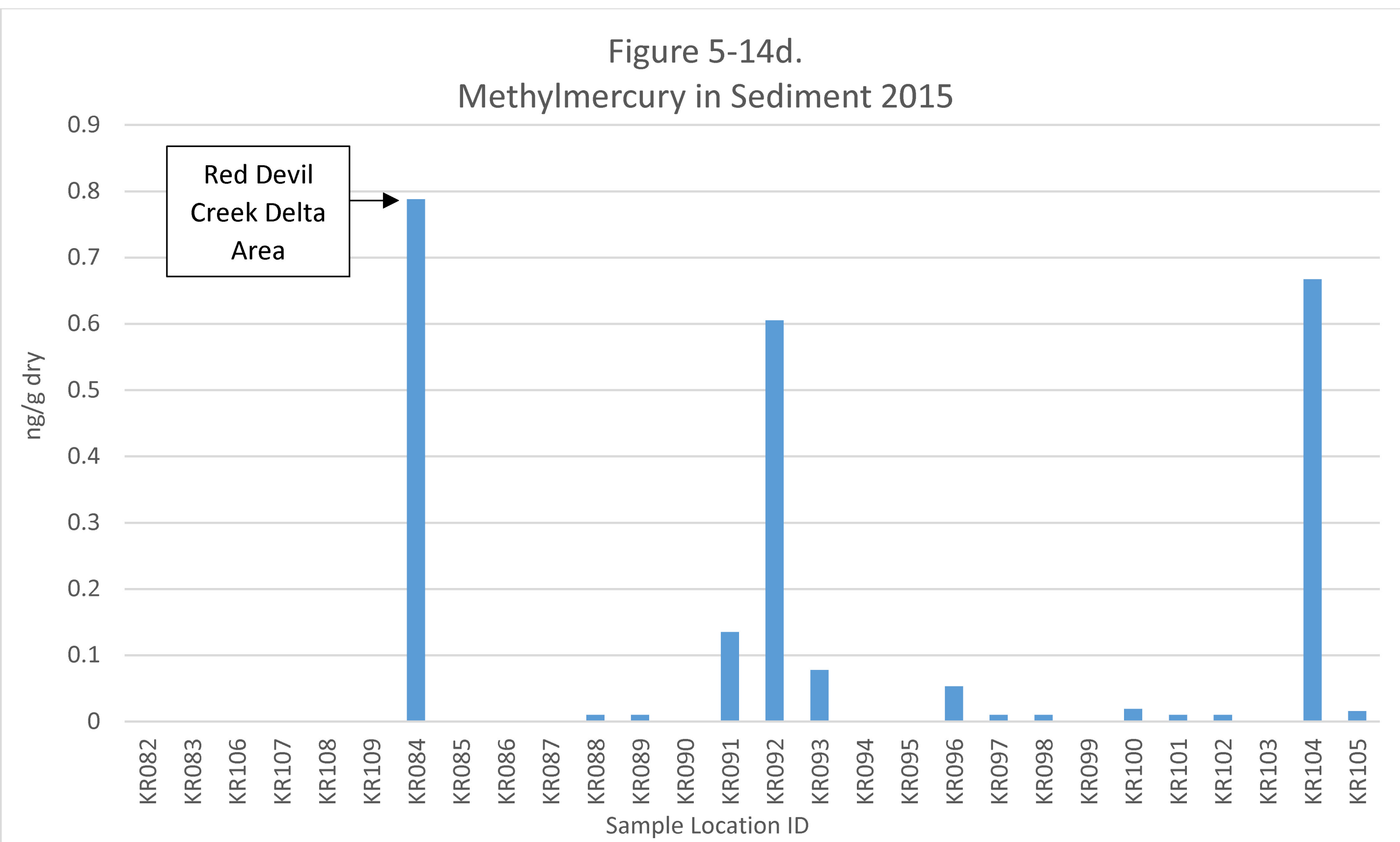

Figure 5-14d.
Methylmercury in Sediment 2015
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
ng/g dry
Red Devil Creek Delta Area
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105
Sample Location ID

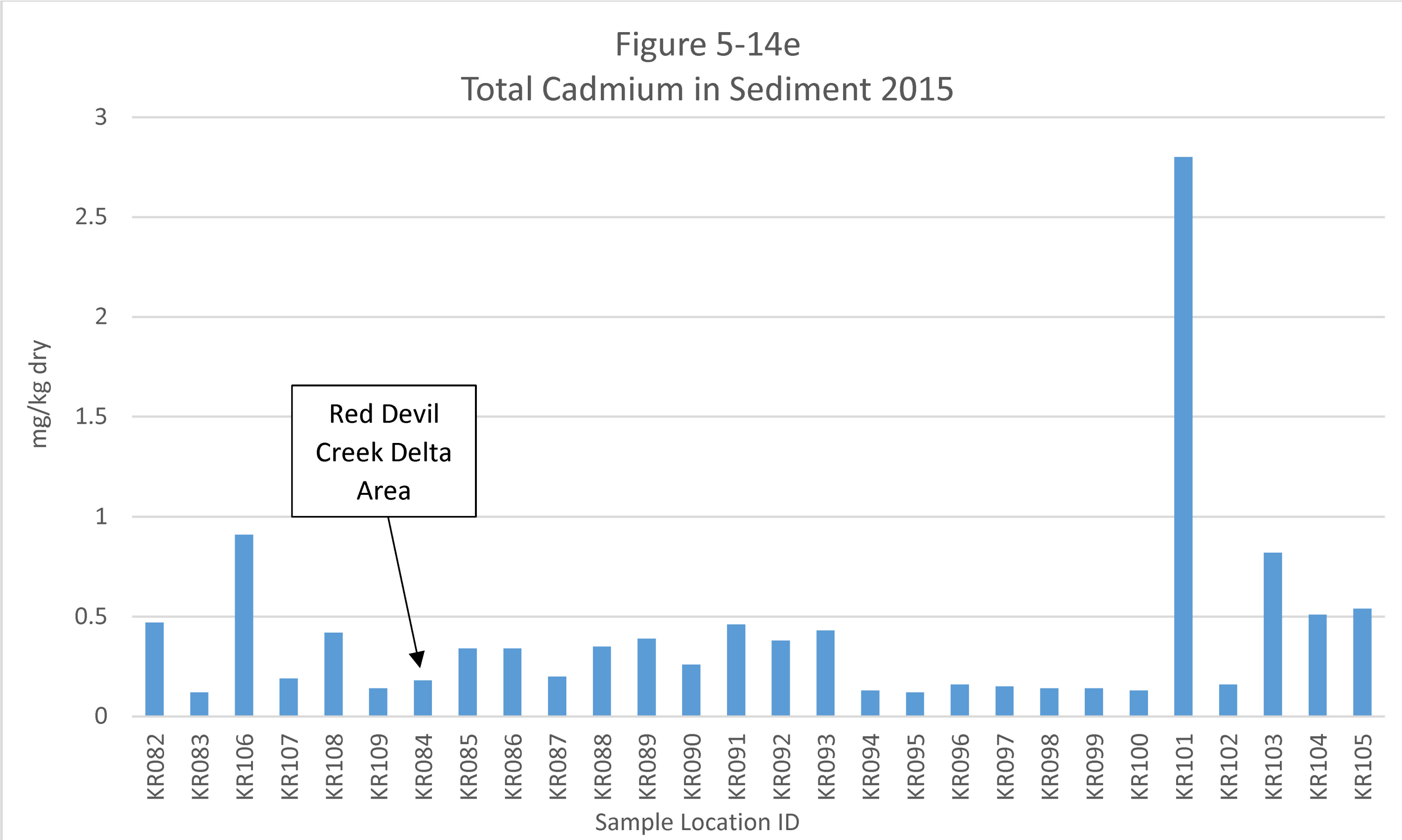
Figure 5-14e
Total Cadmium in Sediment 2015
mg/kg dry
3
2.5
2
1.5
1
0.5
0
Red Devil Creek Delta Area
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105
Sample Location ID

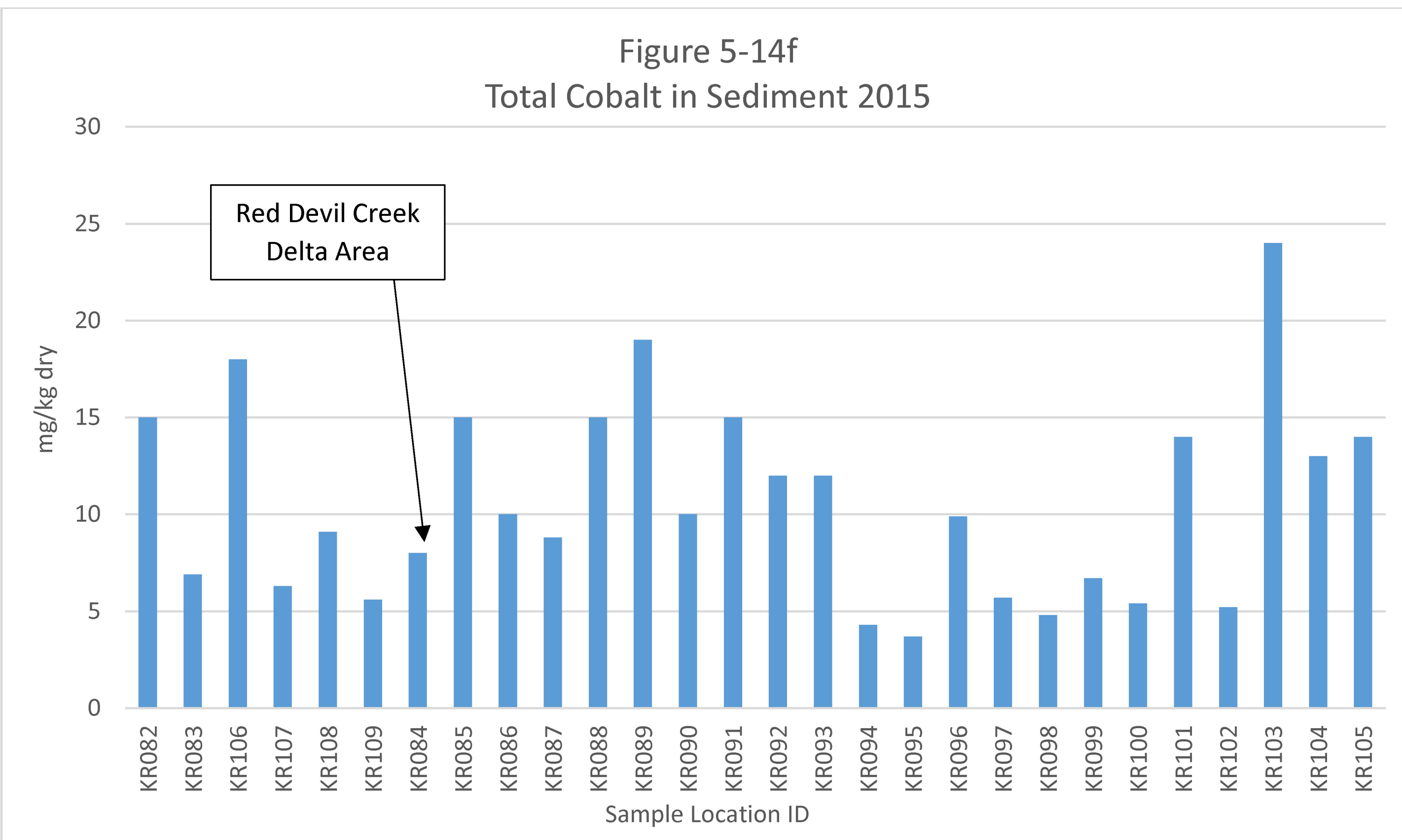
Figure 5-14f
Total Cobalt in Sediment 2015
mg/kg dry
30
25
20
15
10
5
0
Red Devil Creek Delta Area
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105
Sample Location ID

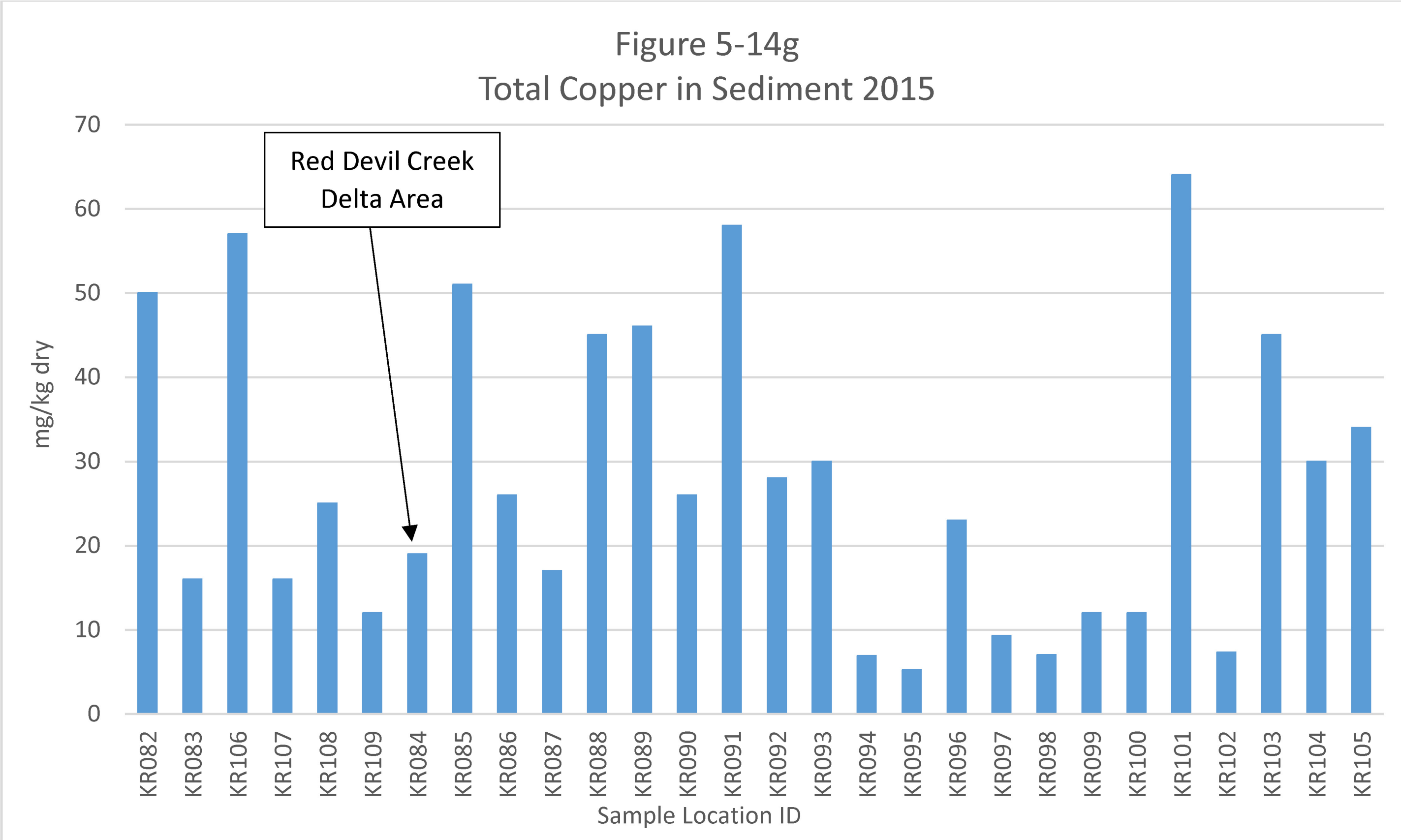

Figure 5-14g
Total Copper in Sediment 2015
Red Devil Creek Delta Area
mg/kg dry
70
60
50
40
30
20
10
0
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105
Sample Location ID

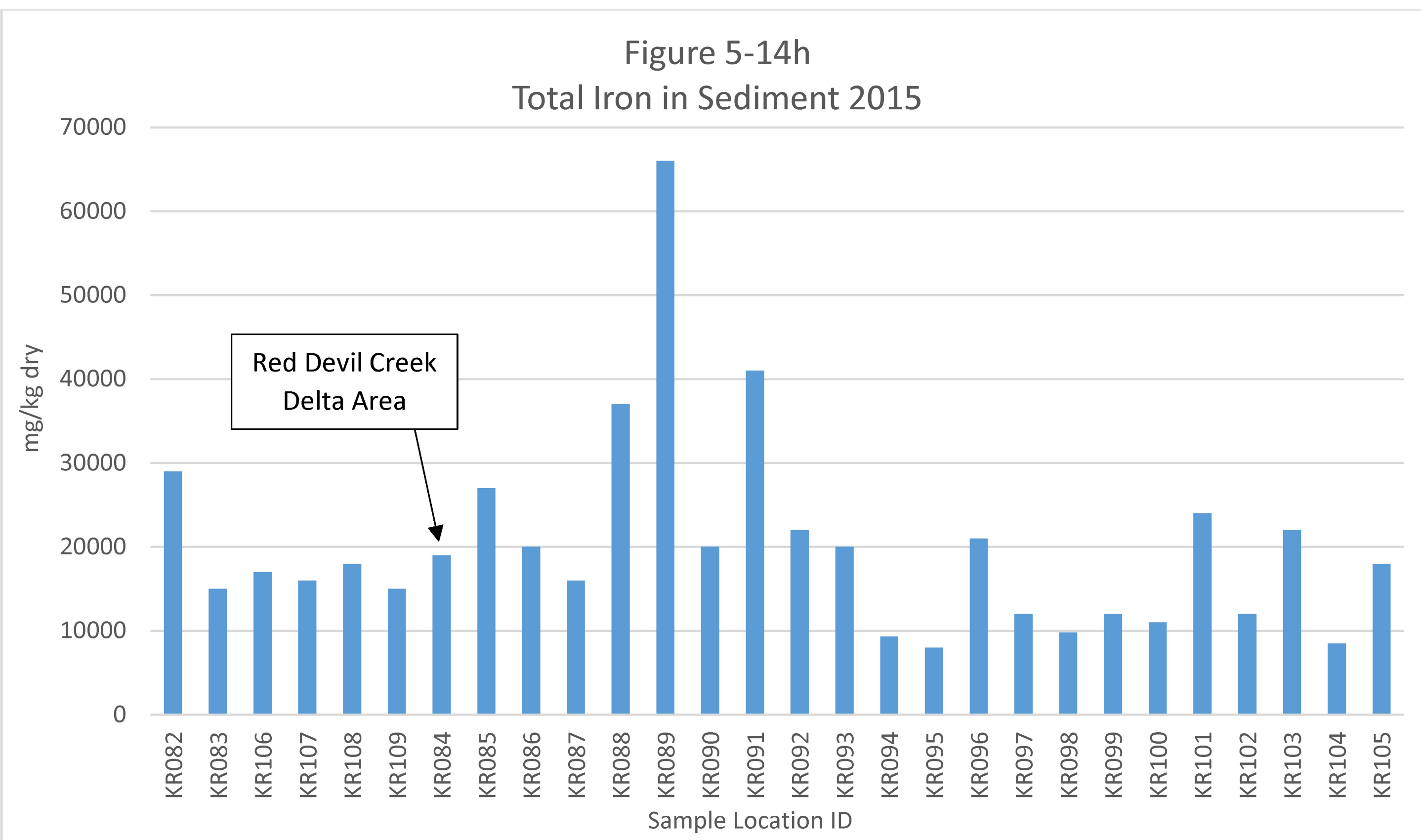

Figure 5-14h
Total Iron in Sediment 2015
Red Devil Creek Delta Area
mg/kg dry
70000
60000
50000
40000
30000
20000
10000
0
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105
Sample Location ID

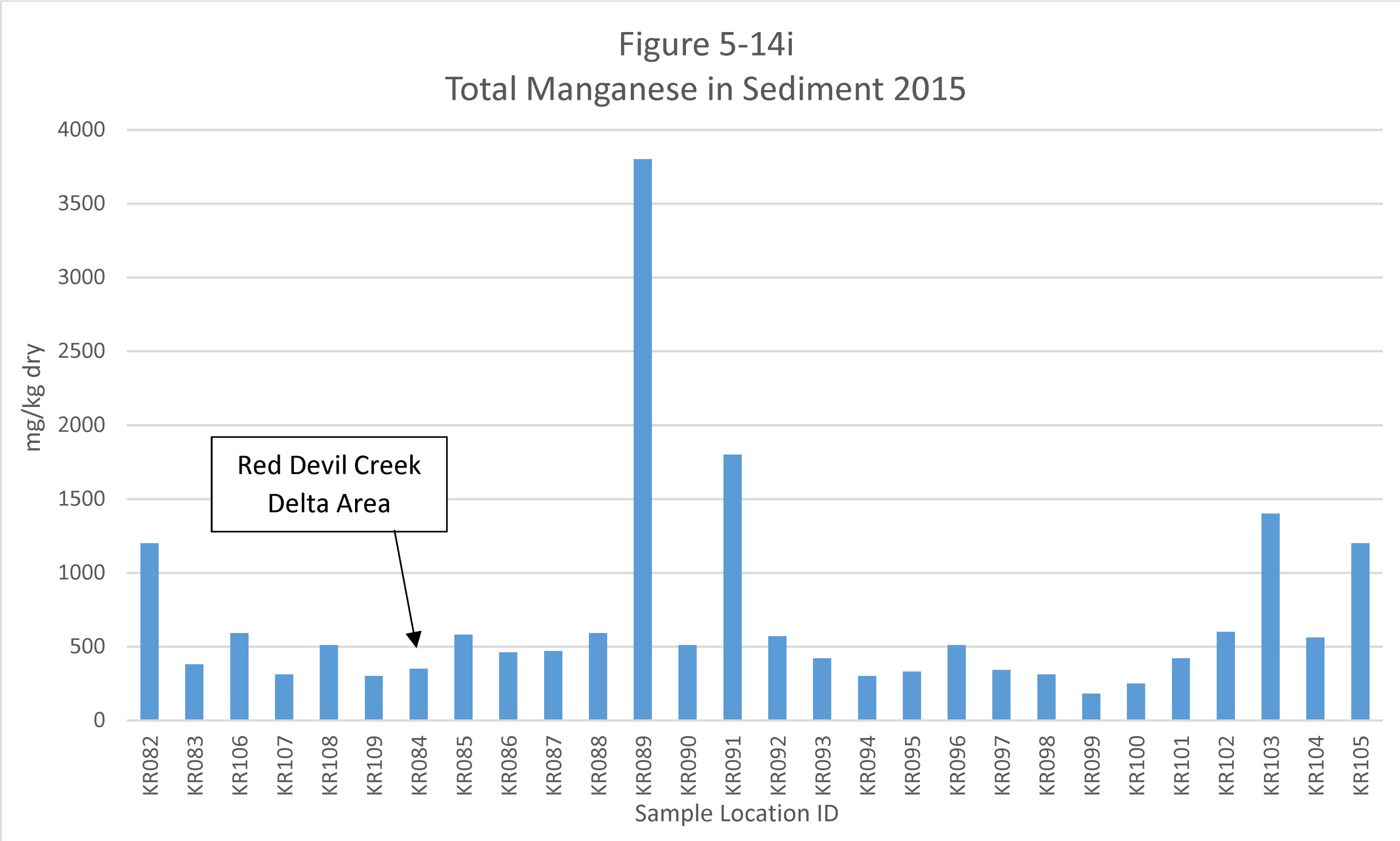

Figure 5-14i
Total Manganese in Sediment 2015
mg/kg dry
4000
3500
3000
2500
2000
1500
1000
500
0
Red Devil Creek Delta Area
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105
Sample Location ID

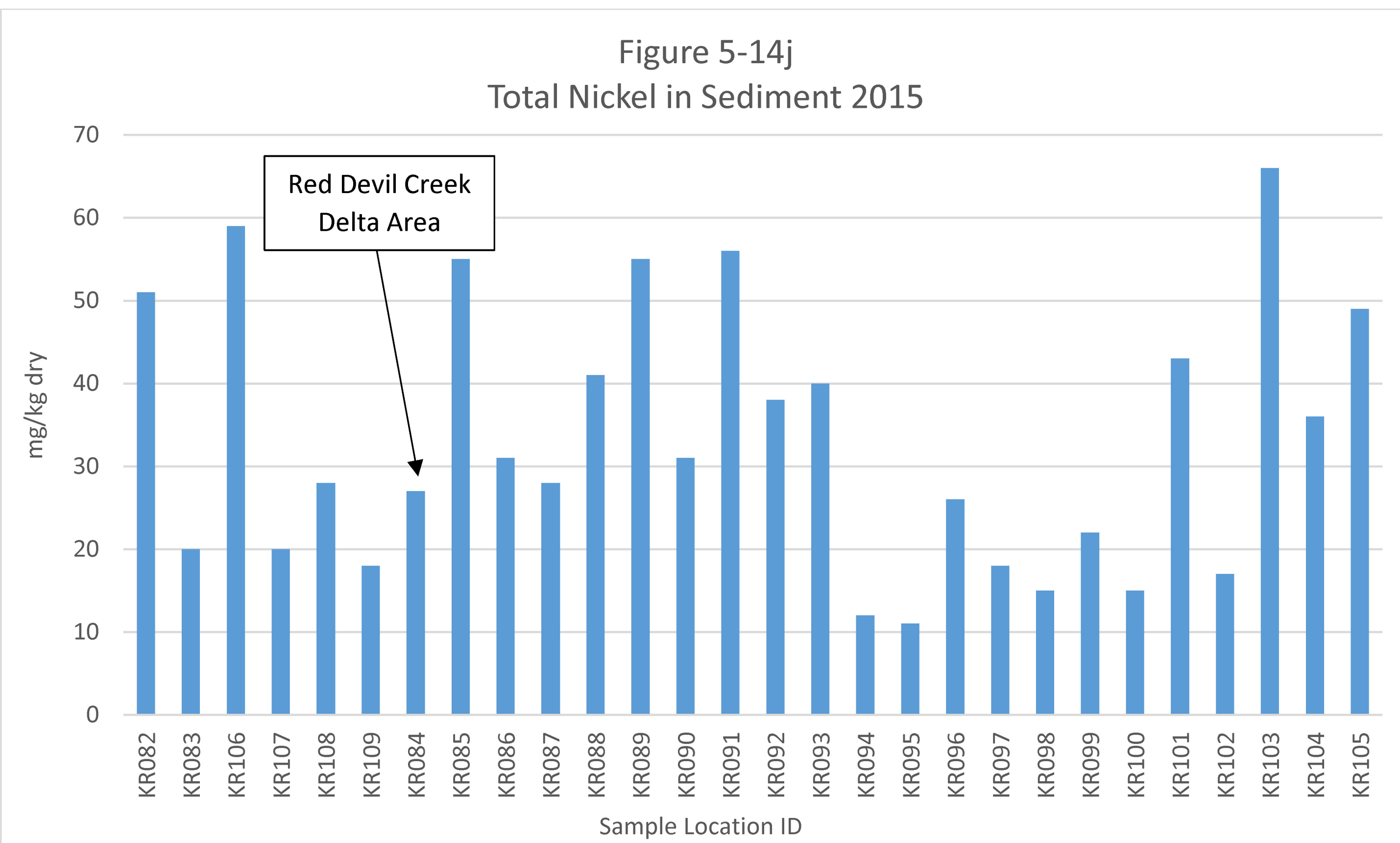

Figure 5-14j
Total Nickel in Sediment 2015
mg/kg dry
70
60
50
40
30
20
10
0
Red Devil Creek Delta Area
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105
Sample Location ID

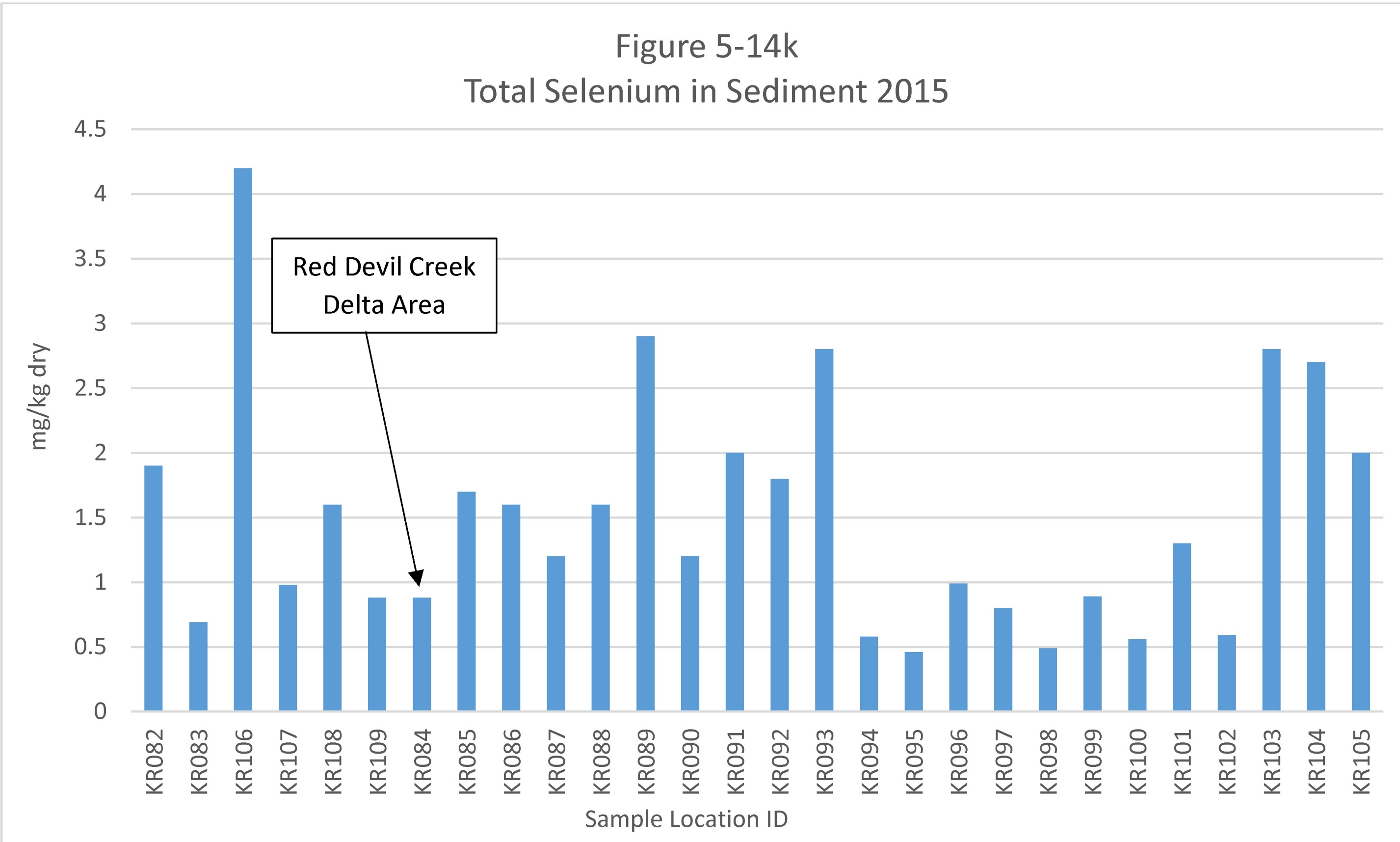
Figure 5-14k
Total Selenium in Sediment 2015
mg/kg dry
Red Devil Creek
Delta Area
Sample Location ID
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105

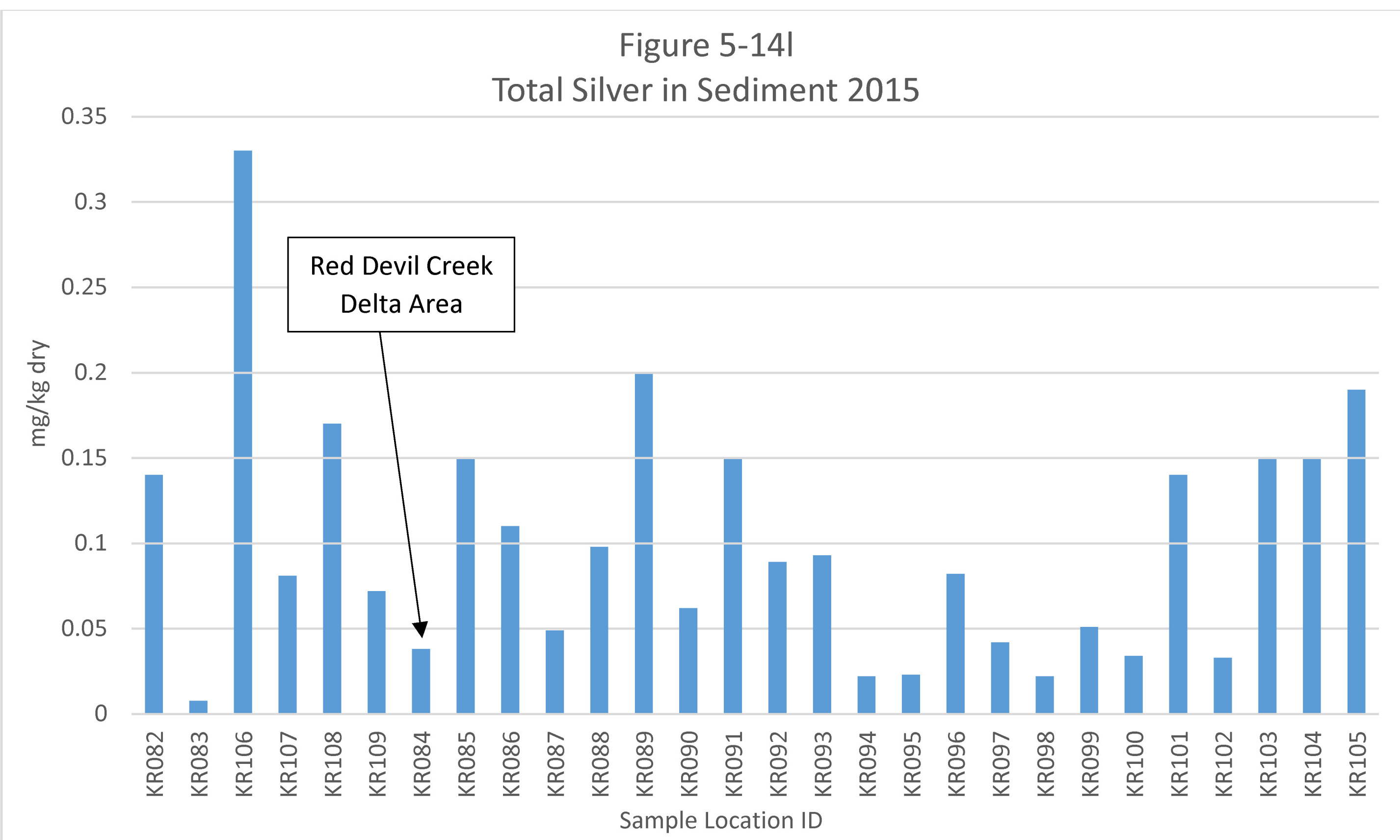
Figure 5-14l
Total Silver in Sediment 2015
mg/kg dry
Red Devil Creek
Delta Area
Sample Location ID
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105

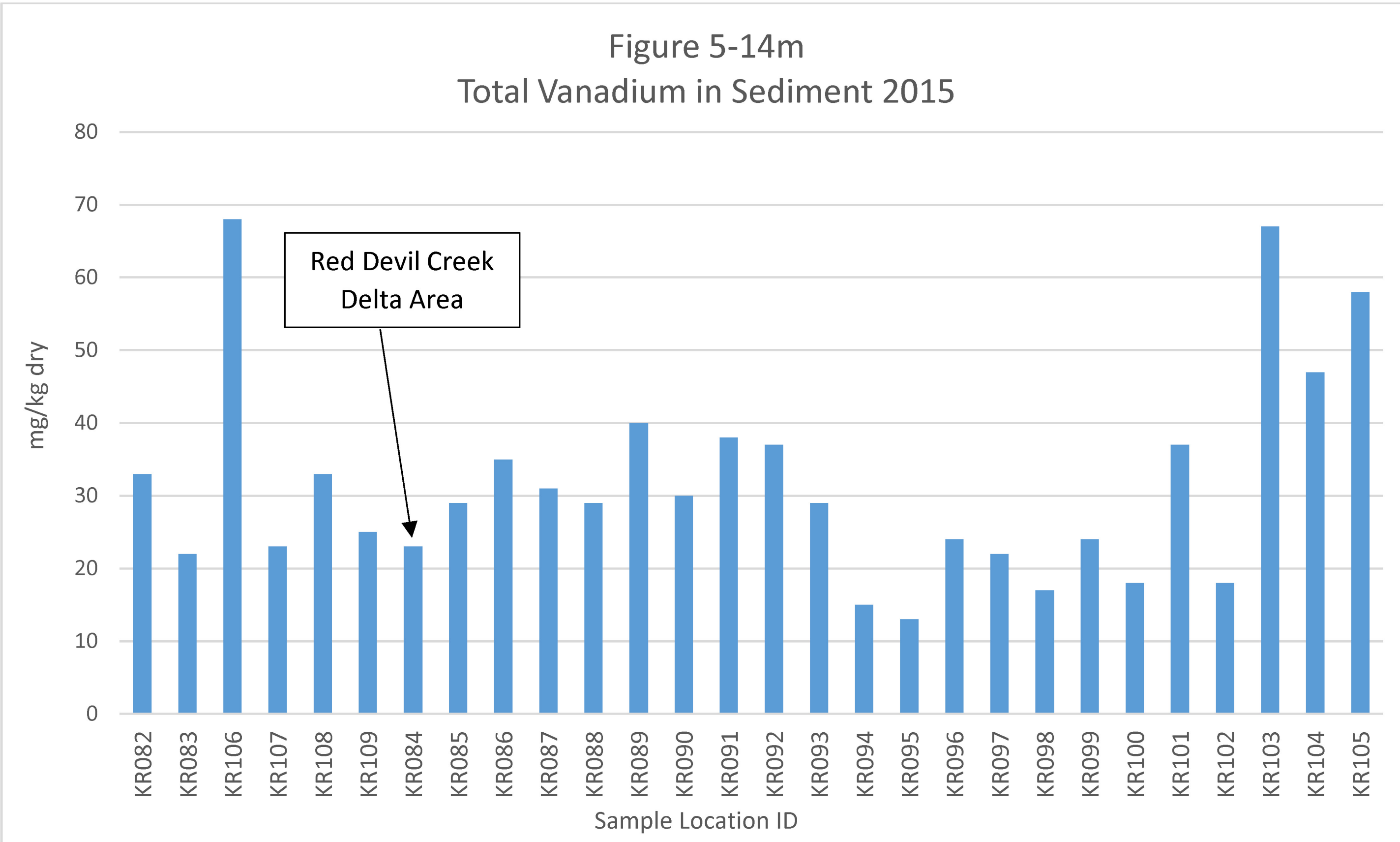
Figure 5-14m
Total Vanadium in Sediment 2015
80
70
60
50
40
30
20
10
0
mg/kg dry
Red Devil Creek
Delta Area
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105
Sample Location ID

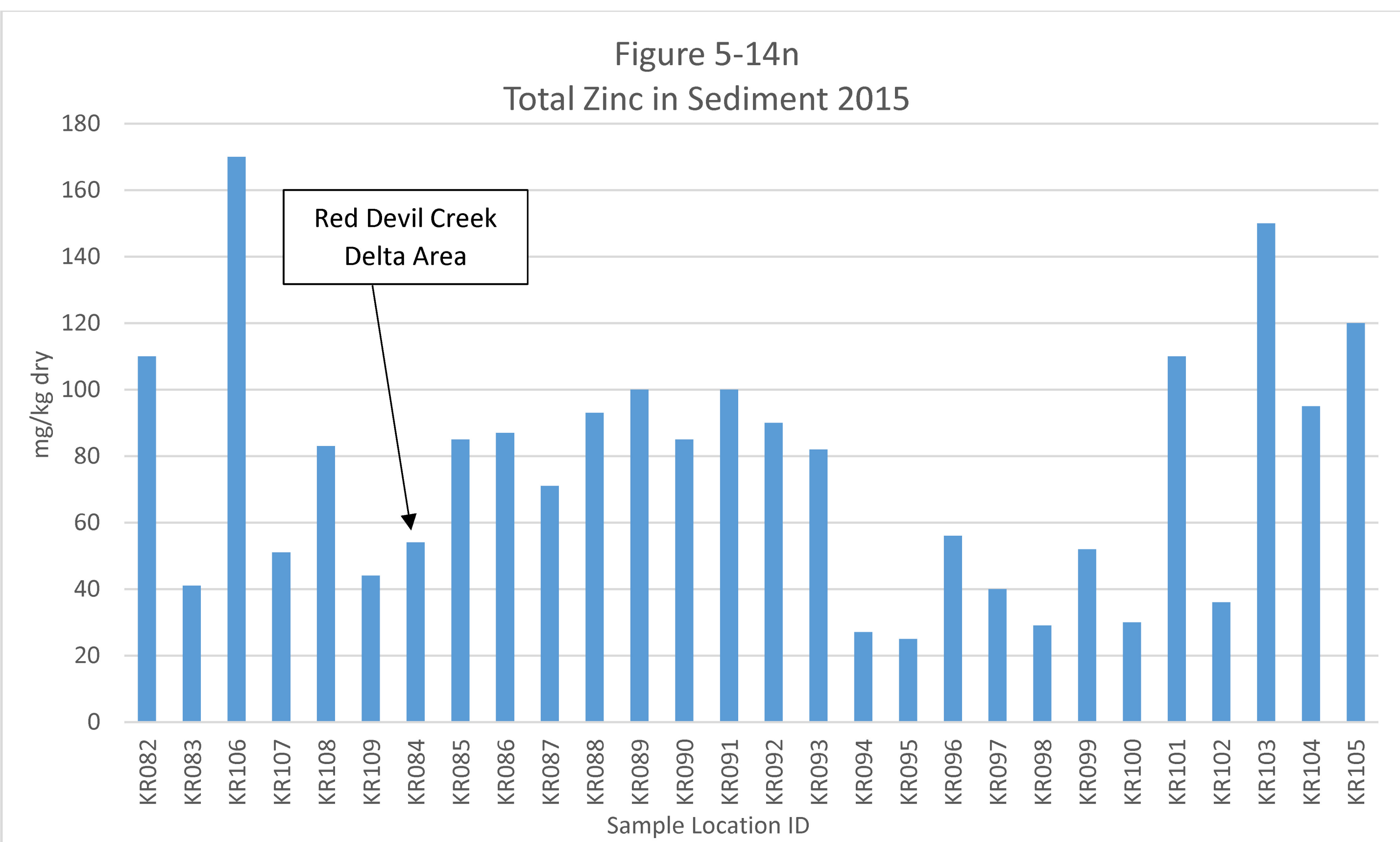
Figure 5-14n
Total Zinc in Sediment 2015
180
160
140
120
100
80
60
40
20
0
mg/kg dry
Red Devil Creek
Delta Area
KR082
KR083
KR106
KR107
KR108
KR109
KR084
KR085
KR086
KR087
KR088
KR089
KR090
KR091
KR092
KR093
KR094
KR095
KR096
KR097
KR098
KR099
KR100
KR101
KR102
KR103
KR104
KR105
Sample Location ID

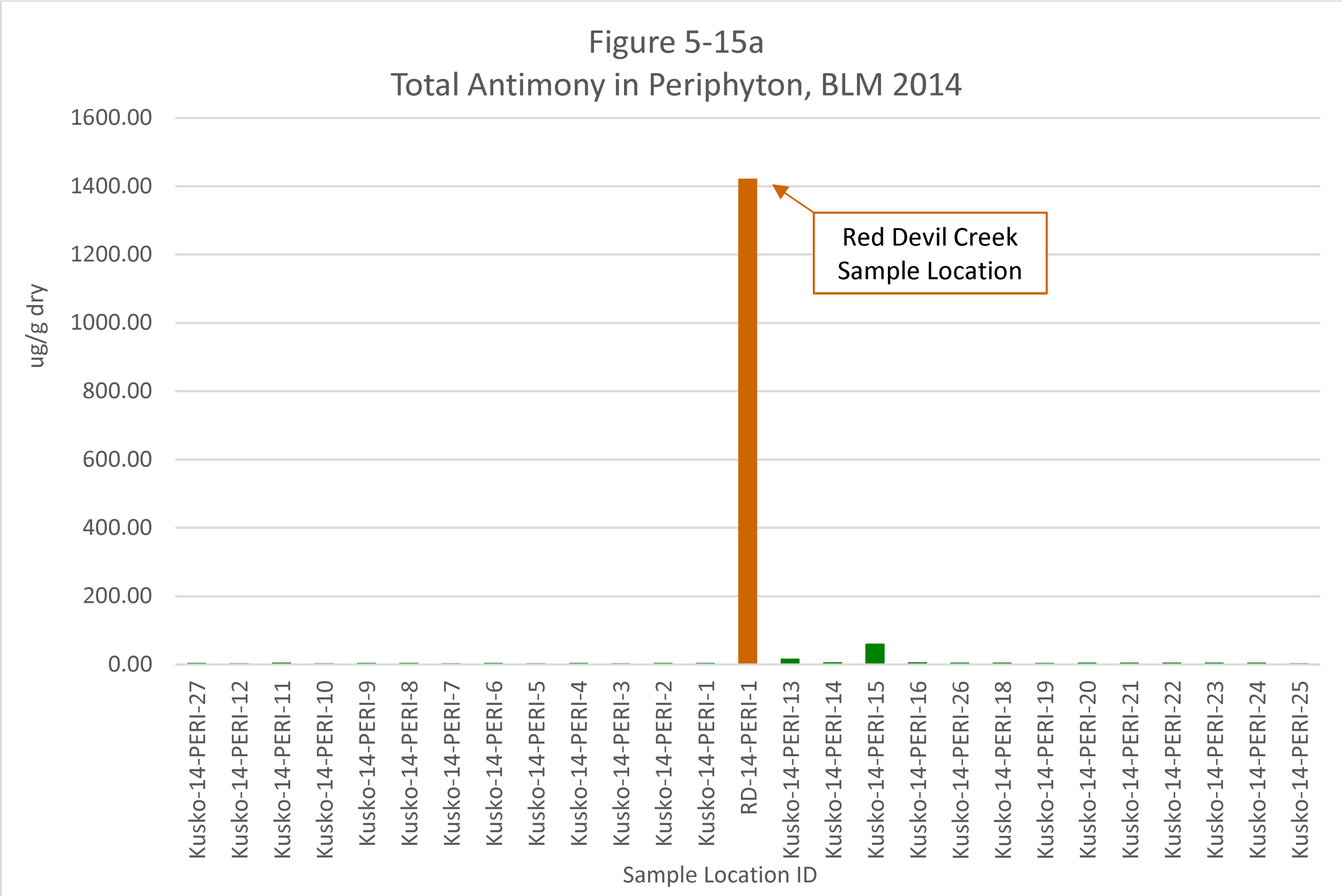
Figure 5-15a
Total Antimony in Periphyton, BLM 2014
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
ug/g dry
Red Devil Creek
Sample Location
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

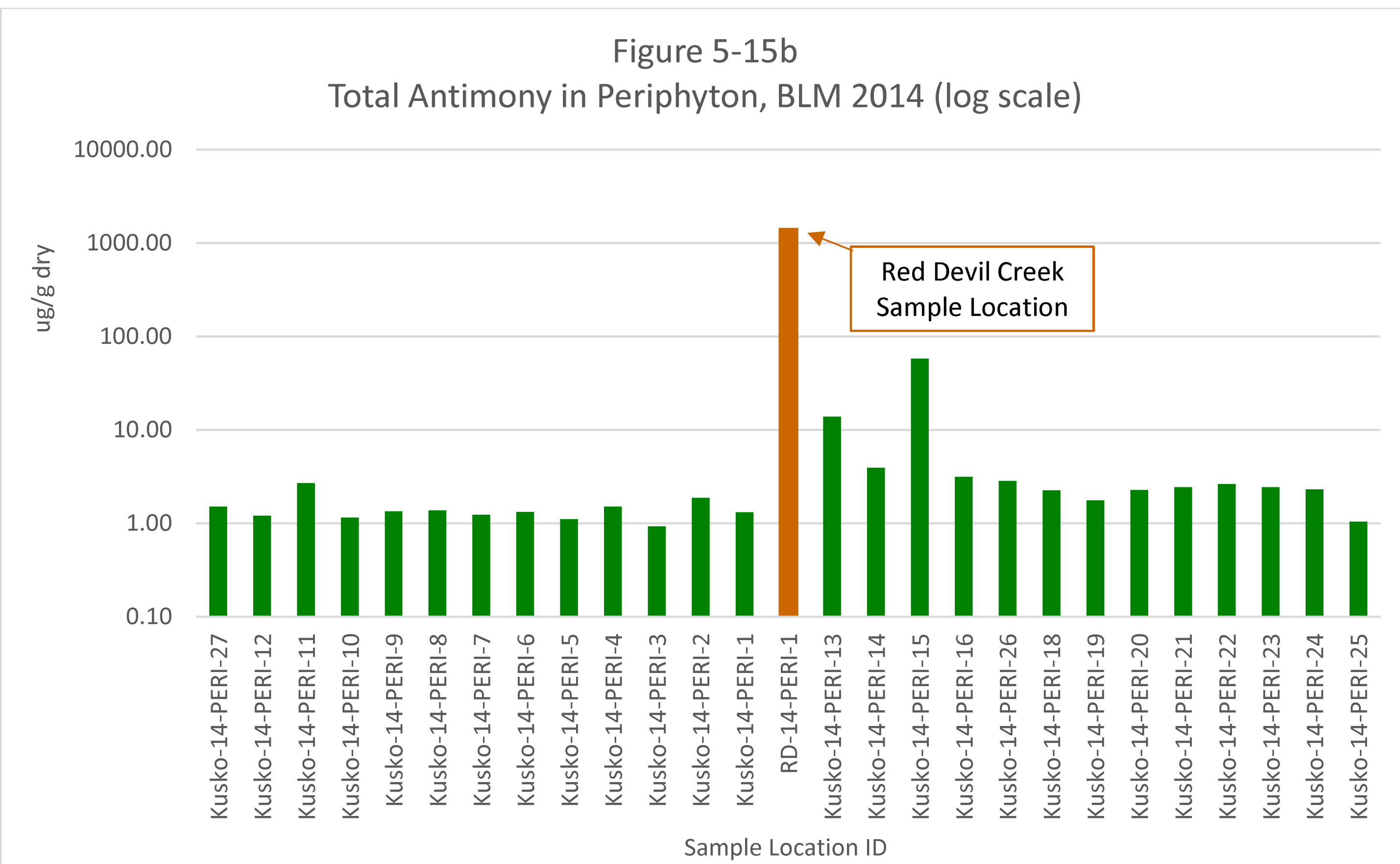
Figure 5-15b
Total Antimony in Periphyton, BLM 2014 (log scale)
10000.00
1000.00
100.00
10.00
1.00
0.10
ug/g dry
Red Devil Creek
Sample Location
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

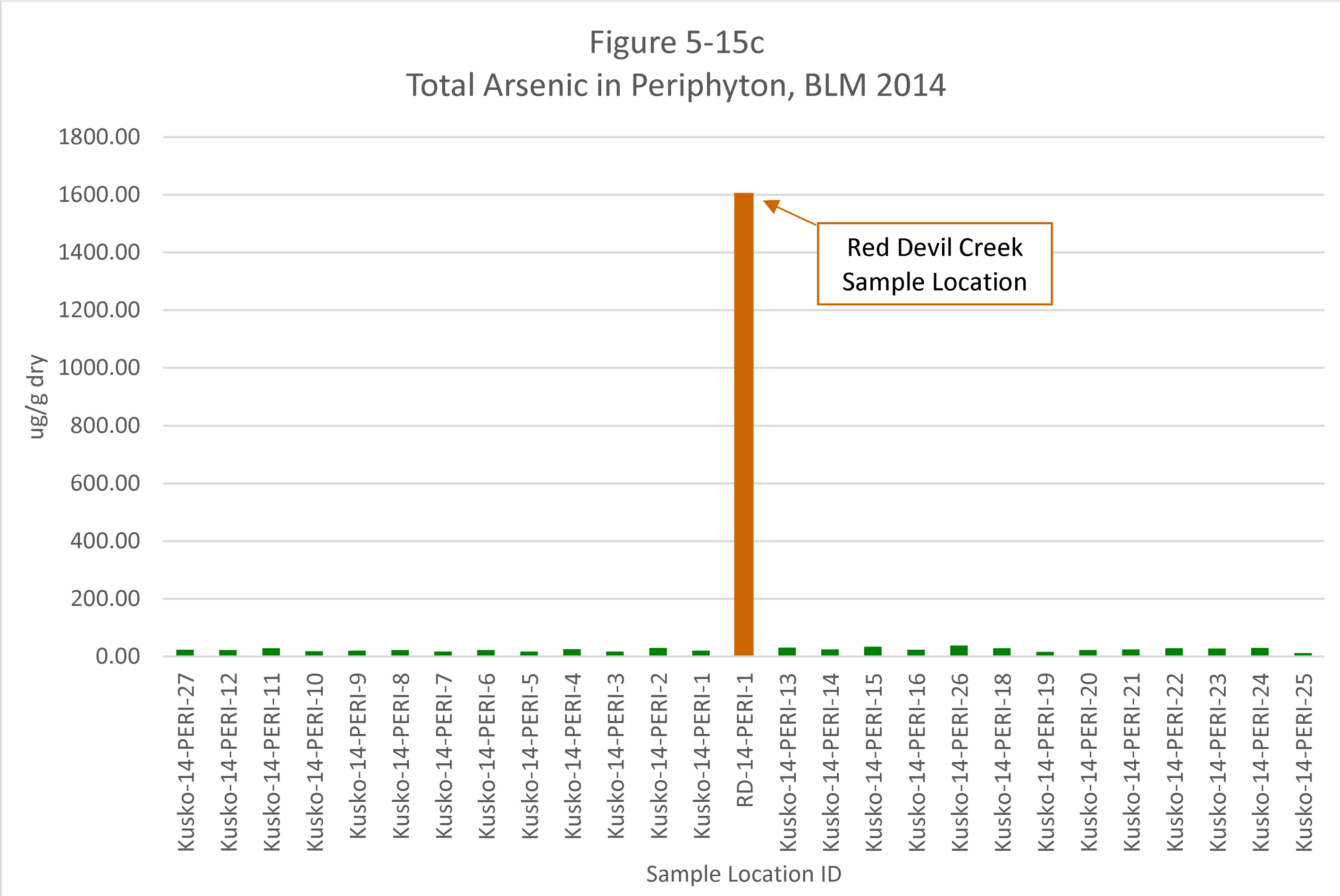
Figure 5-15c
Total Arsenic in Periphyton, BLM 2014
1800.00
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
ug/g dry
Red Devil Creek Sample Location
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

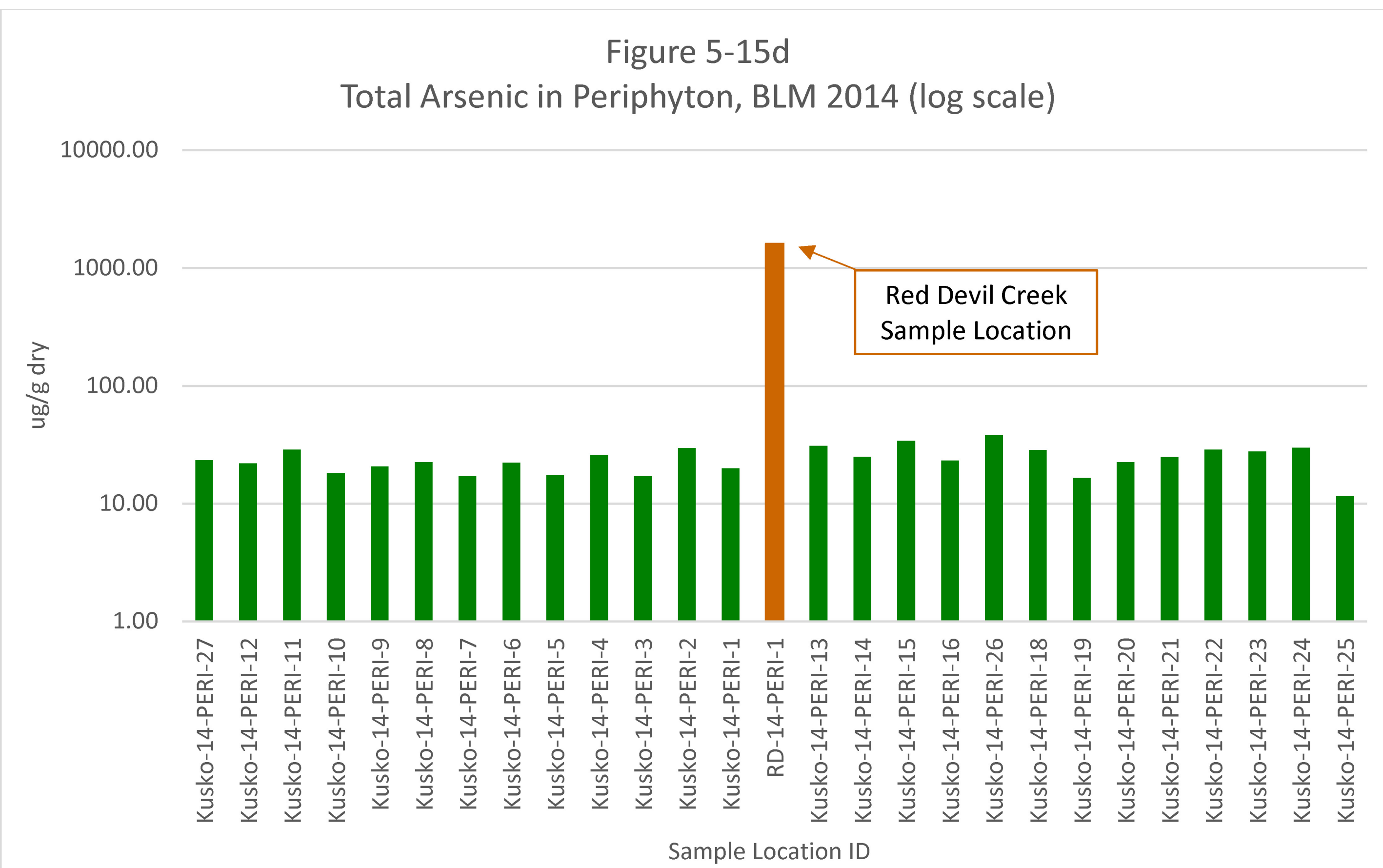
Figure 5-15d
Total Arsenic in Periphyton, BLM 2014 (log scale)
10000.00
1000.00
100.00
10.00
1.00
ug/g dry
Red Devil Creek Sample Location
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
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Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

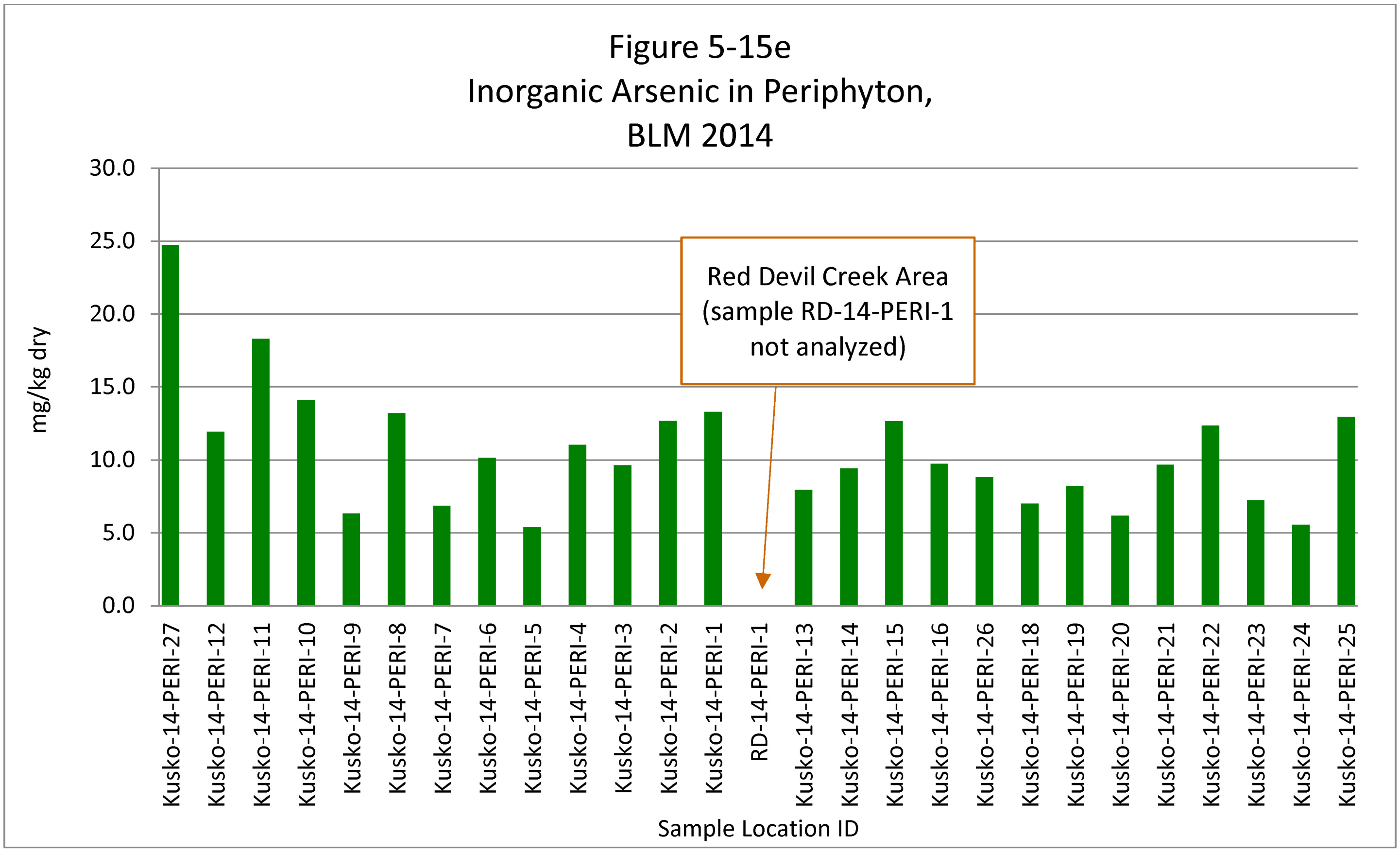


Figure 5-15e
Inorganic Arsenic in Periphyton,
BLM 2014
30.0
25.0
20.0
15.0
10.0
5.0
0.0
mg/kg dry
Red Devil Creek Area
(sample RD-14-PERI-1
not analyzed)
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

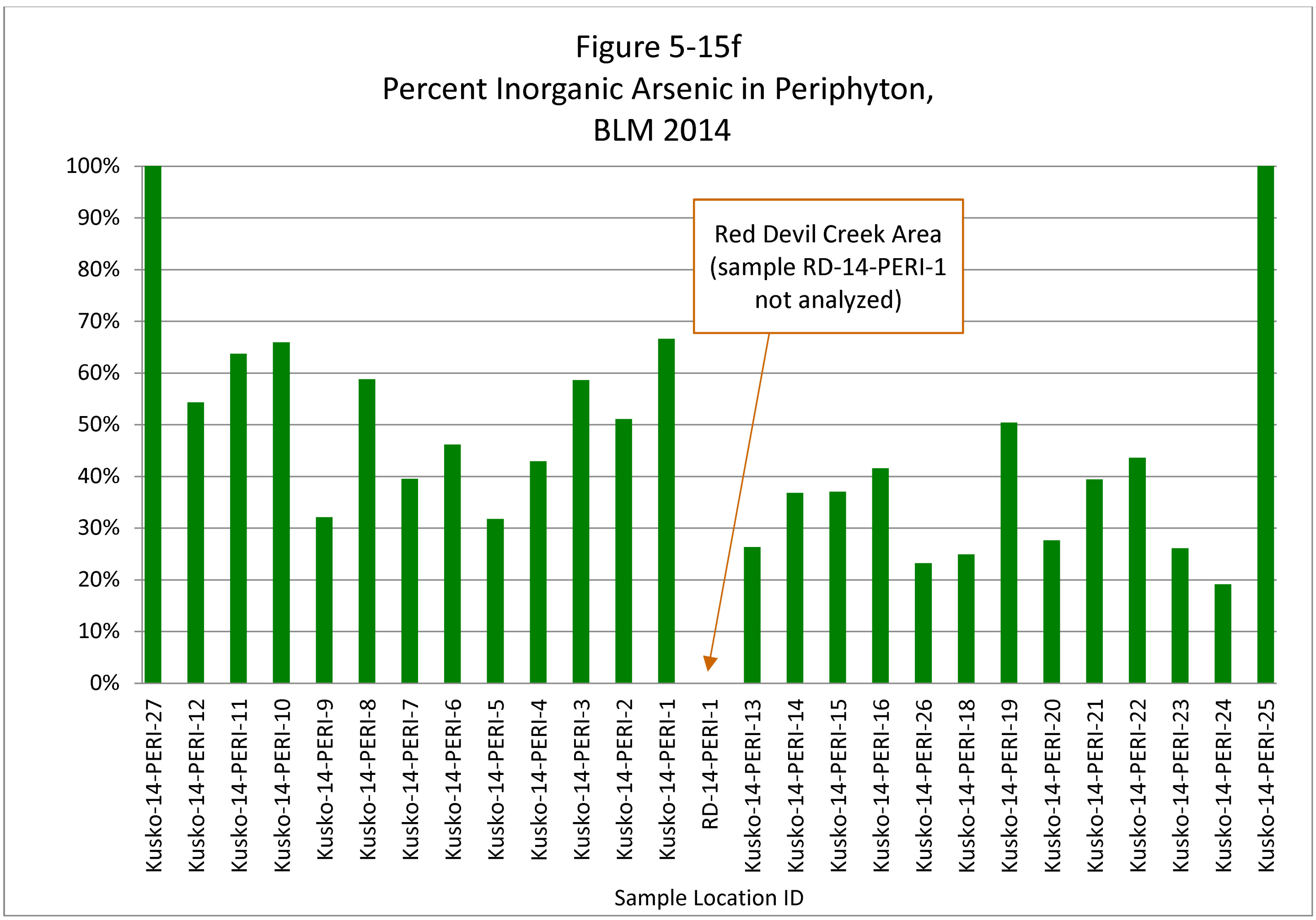


Figure 5-15f
Percent Inorganic Arsenic in Periphyton,
BLM 2014
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Red Devil Creek Area
(sample RD-14-PERI-1
not analyzed)
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

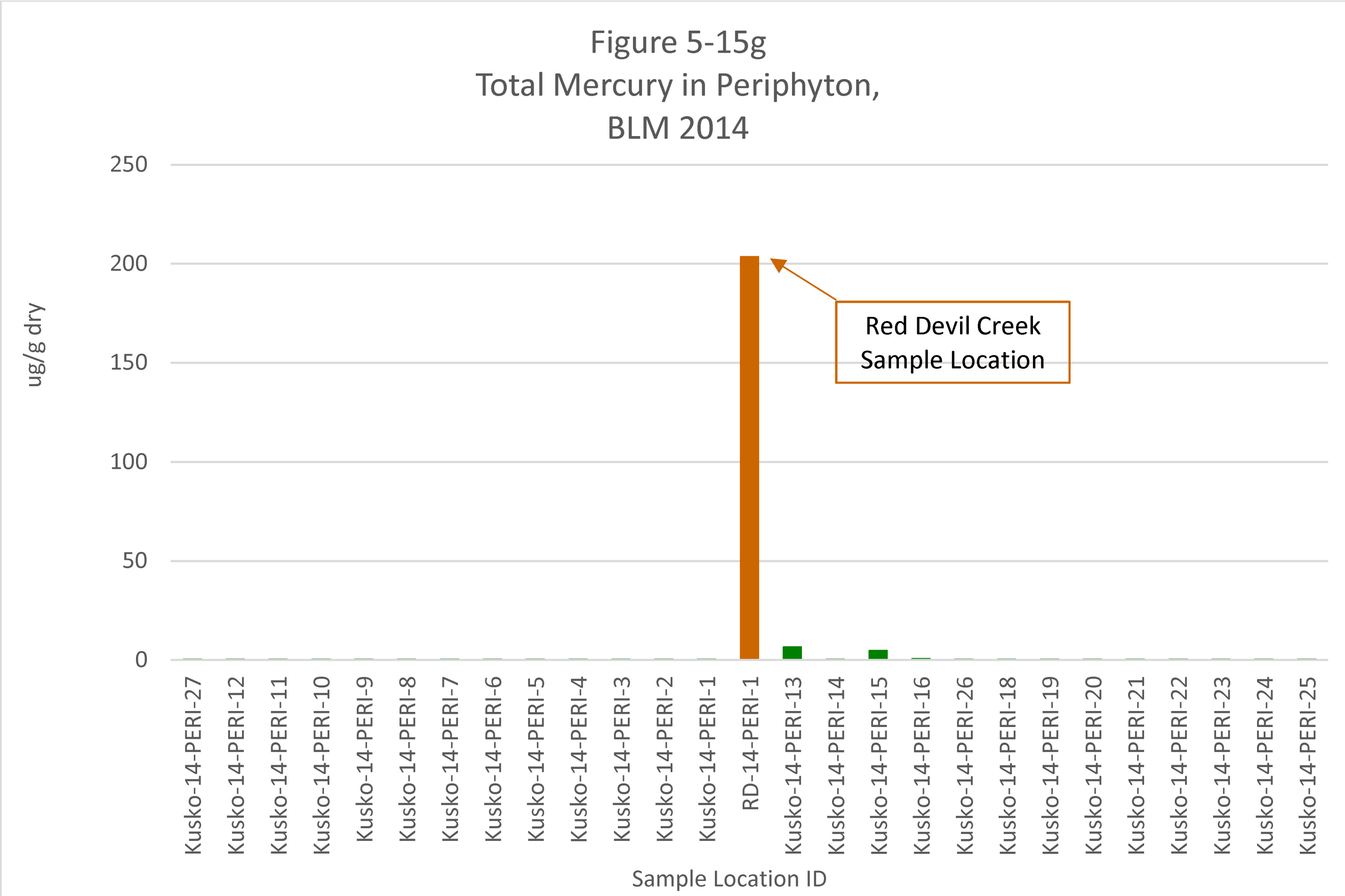


Figure 5-15g
Total Mercury in Periphyton,
BLM 2014
250
200
150
100
50
0
ug/g dry
Red Devil Creek
Sample Location
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

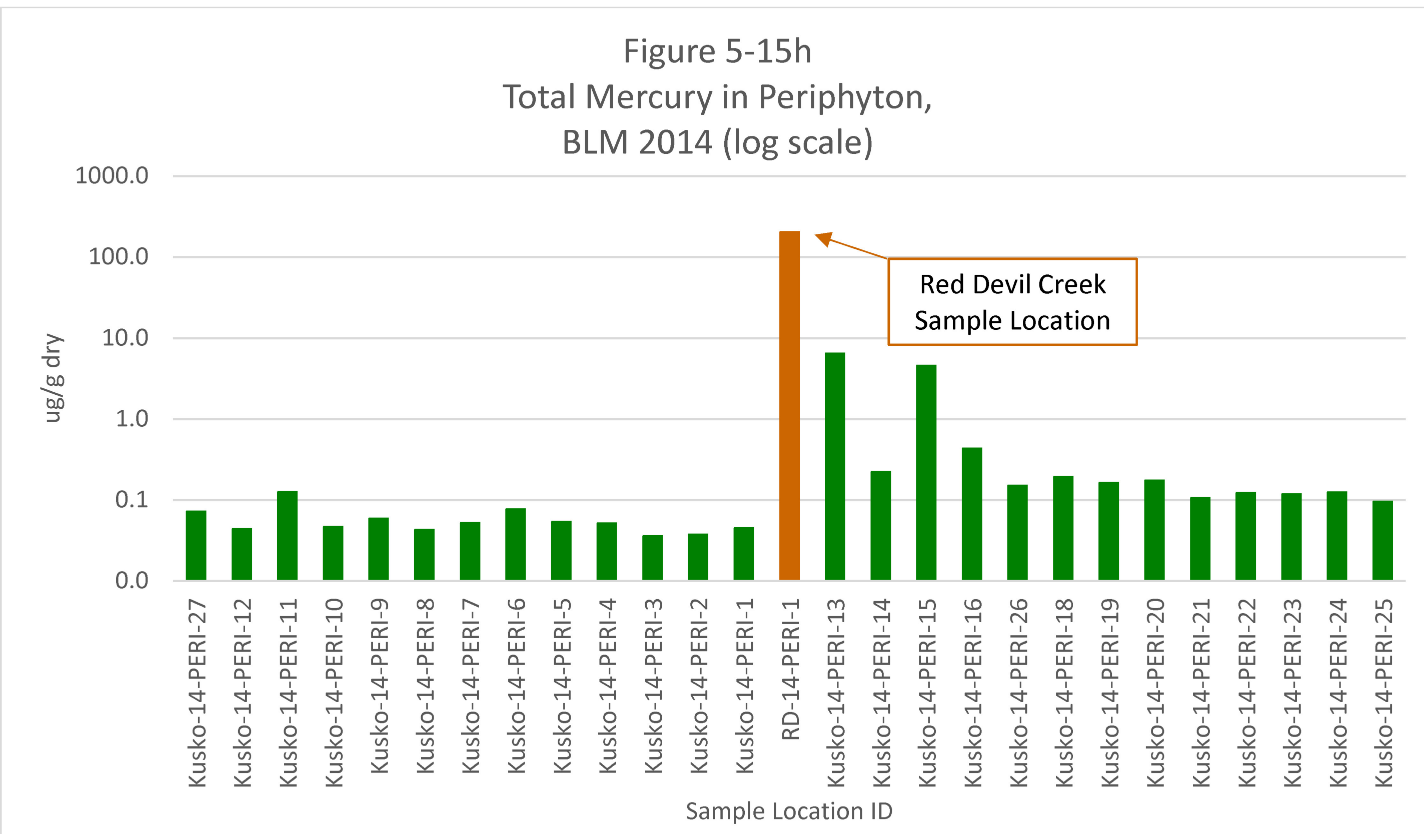


Figure 5-15h
Total Mercury in Periphyton,
BLM 2014 (log scale)
1000.0
100.0
10.0
1.0
0.1
0.0
ug/g dry
Red Devil Creek
Sample Location
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

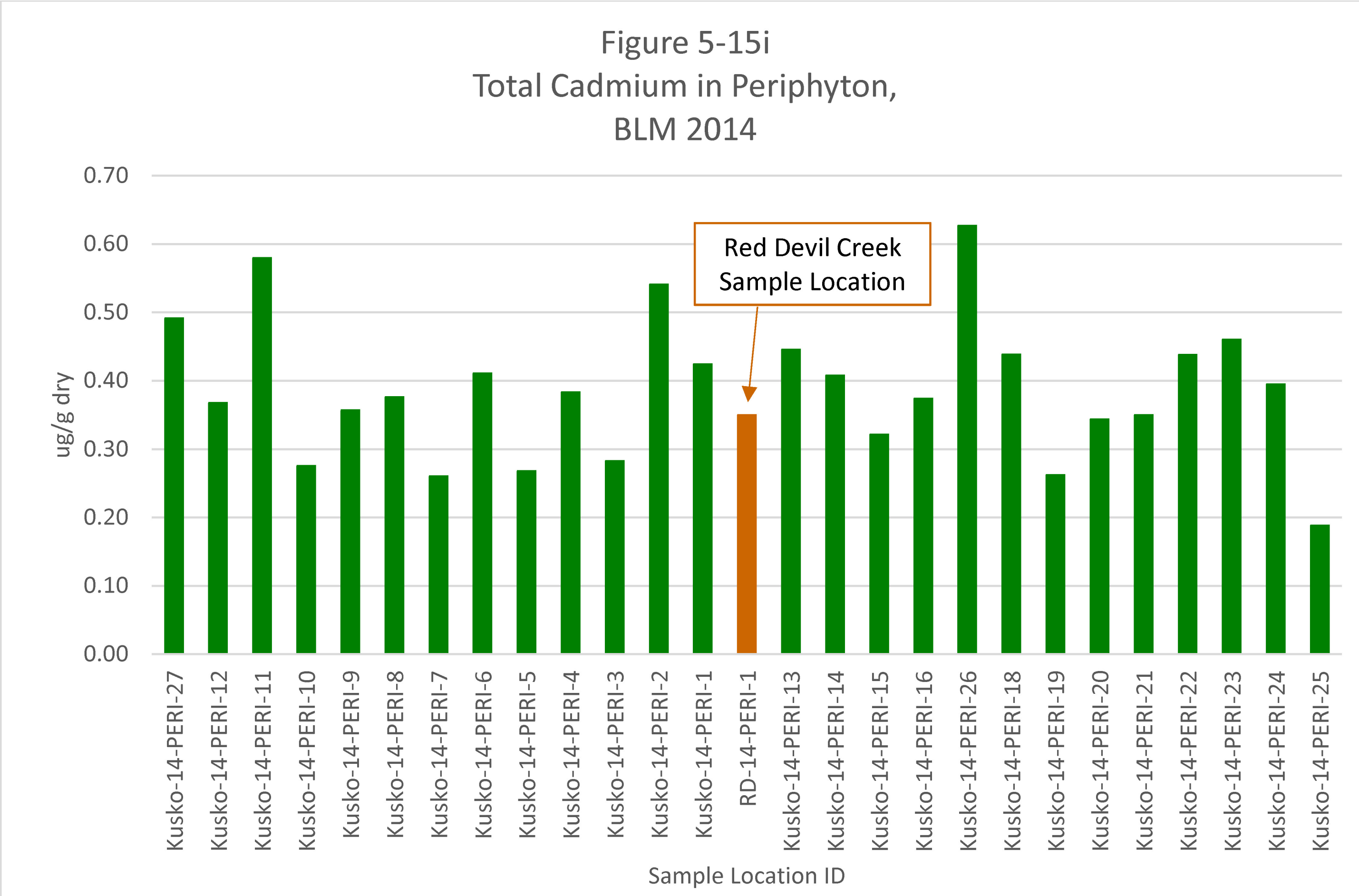


Figure 5-15i
Total Cadmium in Periphyton,
BLM 2014
Red Devil Creek
Sample Location
ug/g dry
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

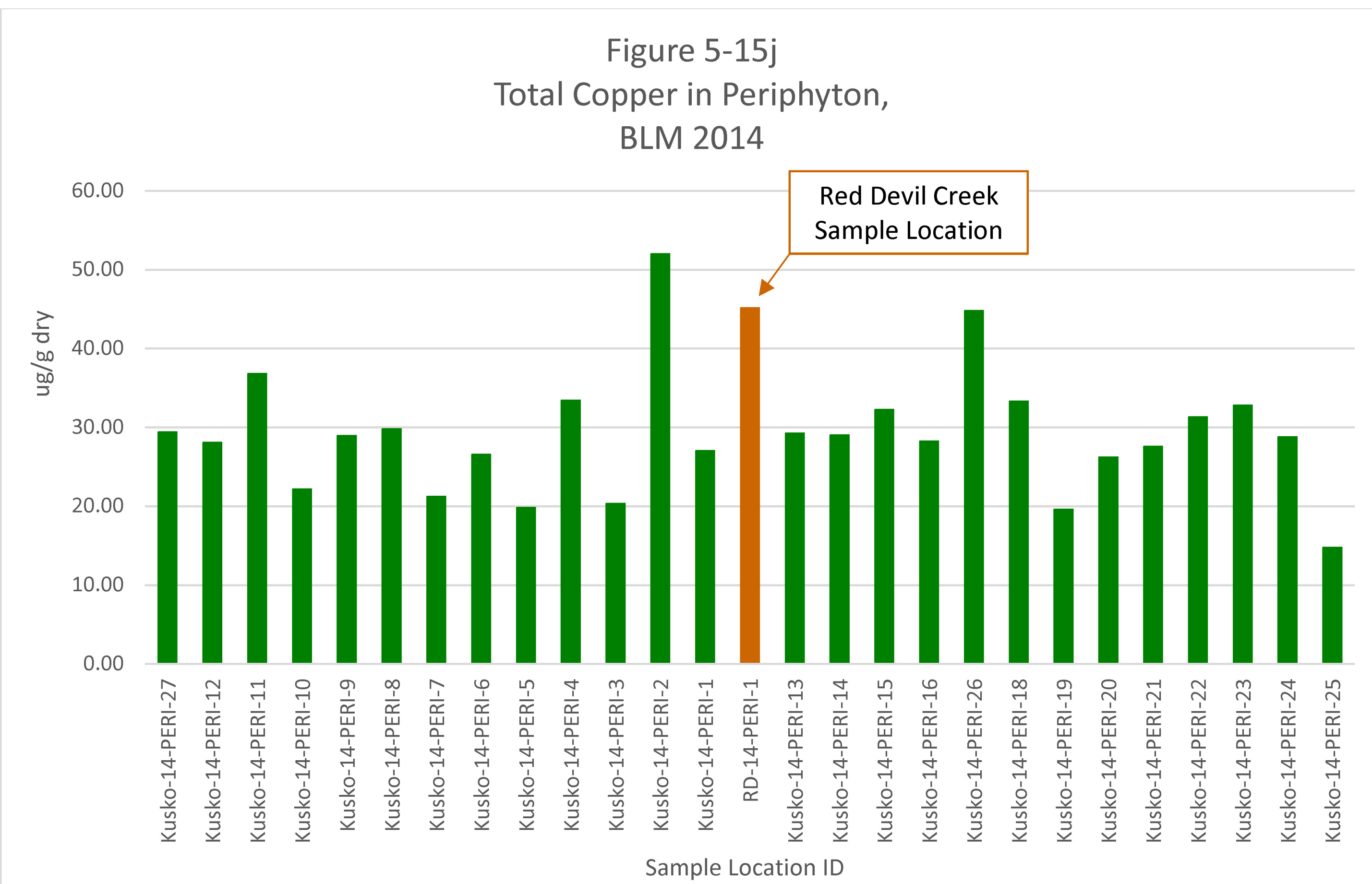


Figure 5-15j
Total Copper in Periphyton,
BLM 2014
Red Devil Creek
Sample Location
ug/g dry
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

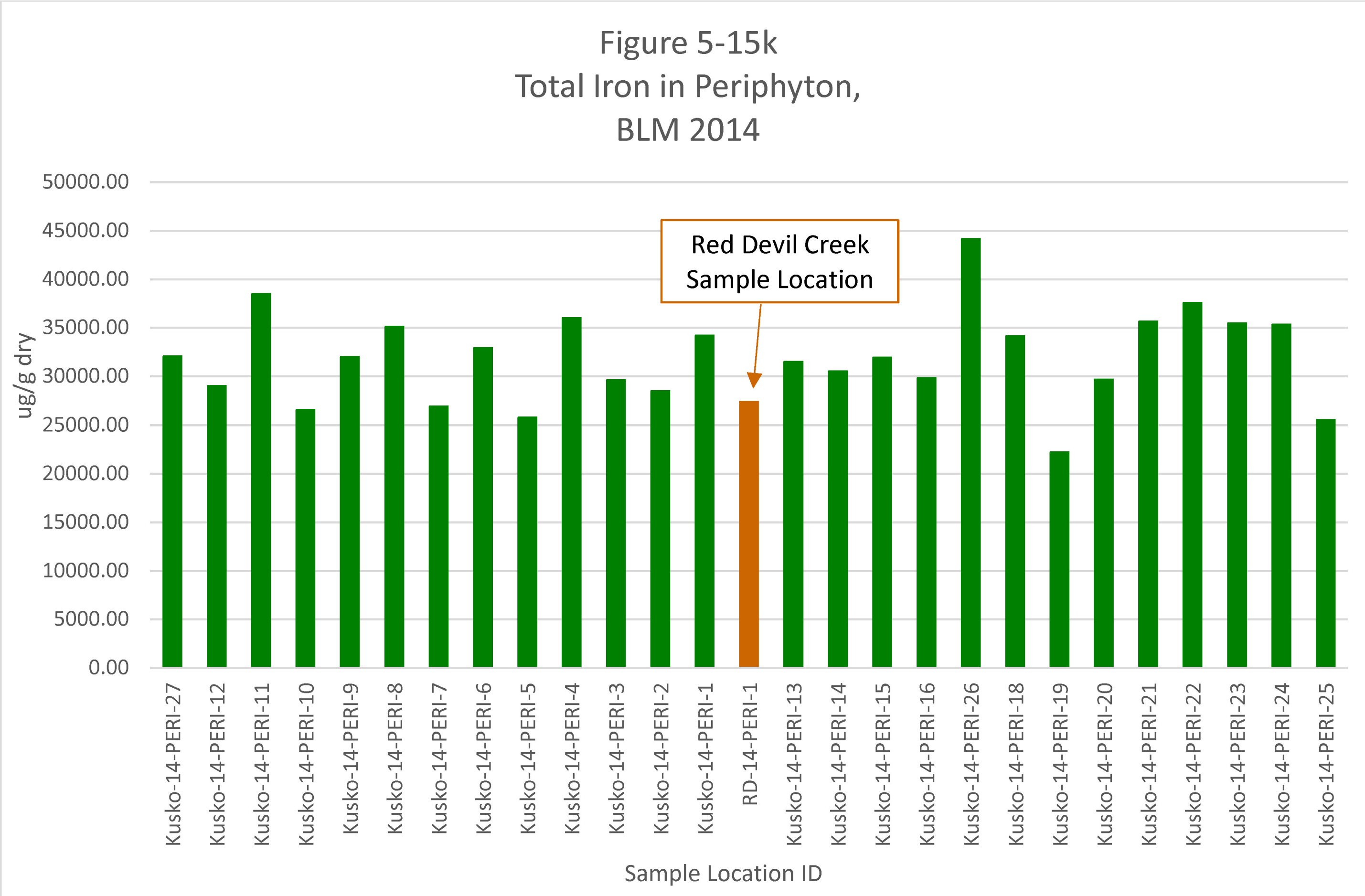


Figure 5-15k
Total Iron in Periphyton,
BLM 2014
50000.00
45000.00
40000.00
35000.00
30000.00
25000.00
20000.00
15000.00
10000.00
5000.00
0.00
ug/g dry
Red Devil Creek
Sample Location
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

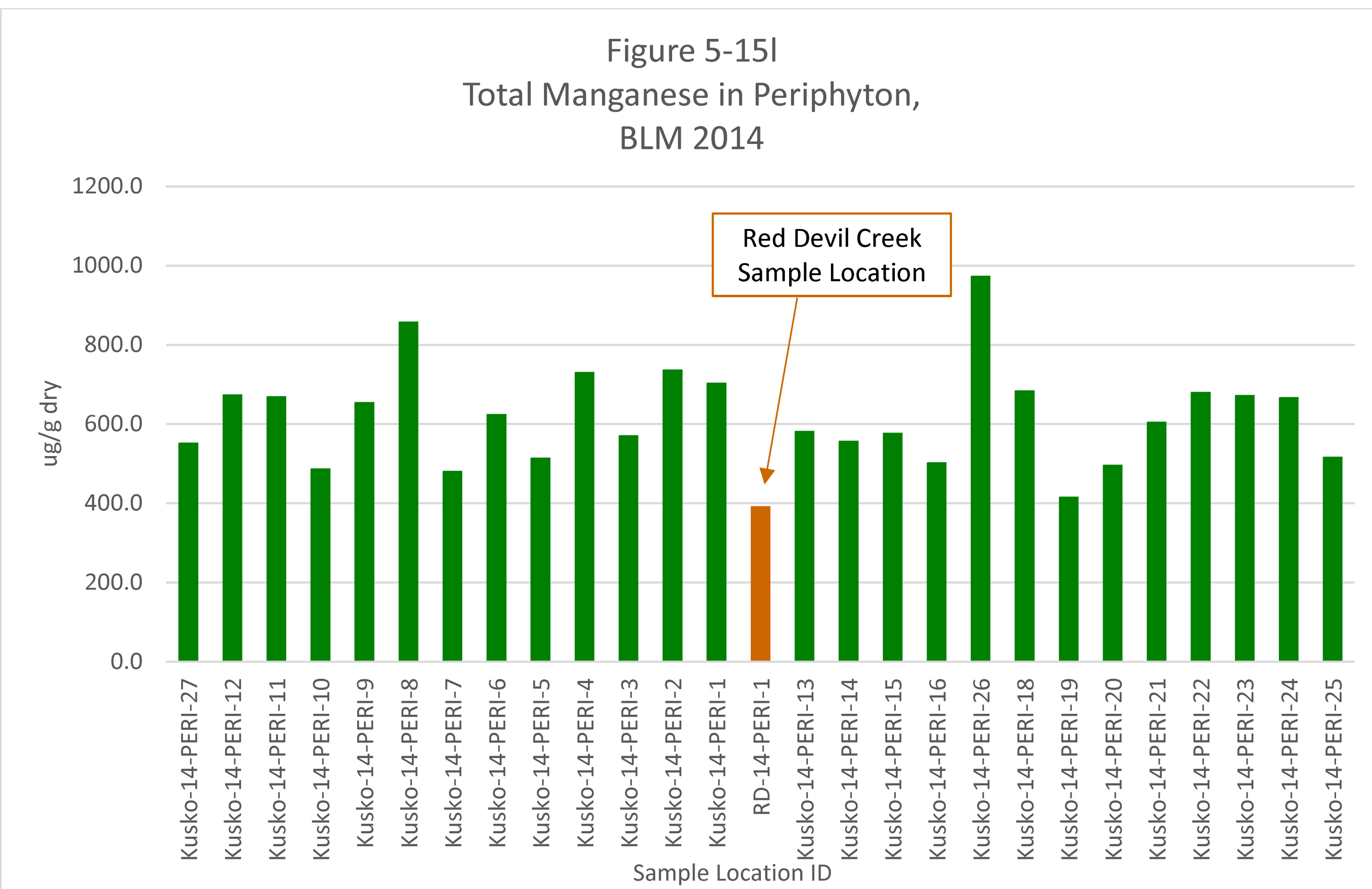


Figure 5-15l
Total Manganese in Periphyton,
BLM 2014
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
ug/g dry
Red Devil Creek
Sample Location
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

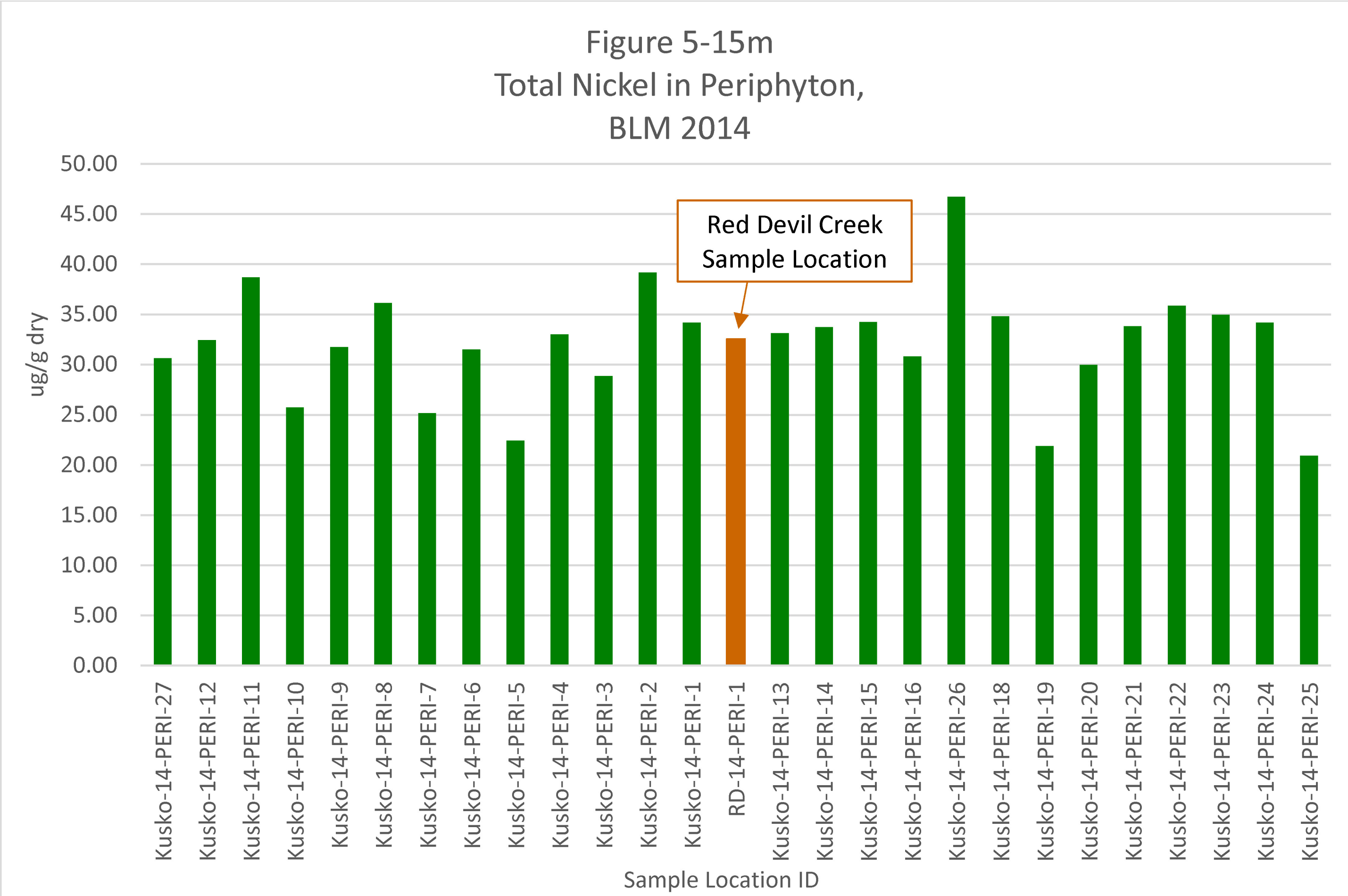


Figure 5-15m
Total Nickel in Periphyton,
BLM 2014
ug/g dry
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Red Devil Creek
Sample Location
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

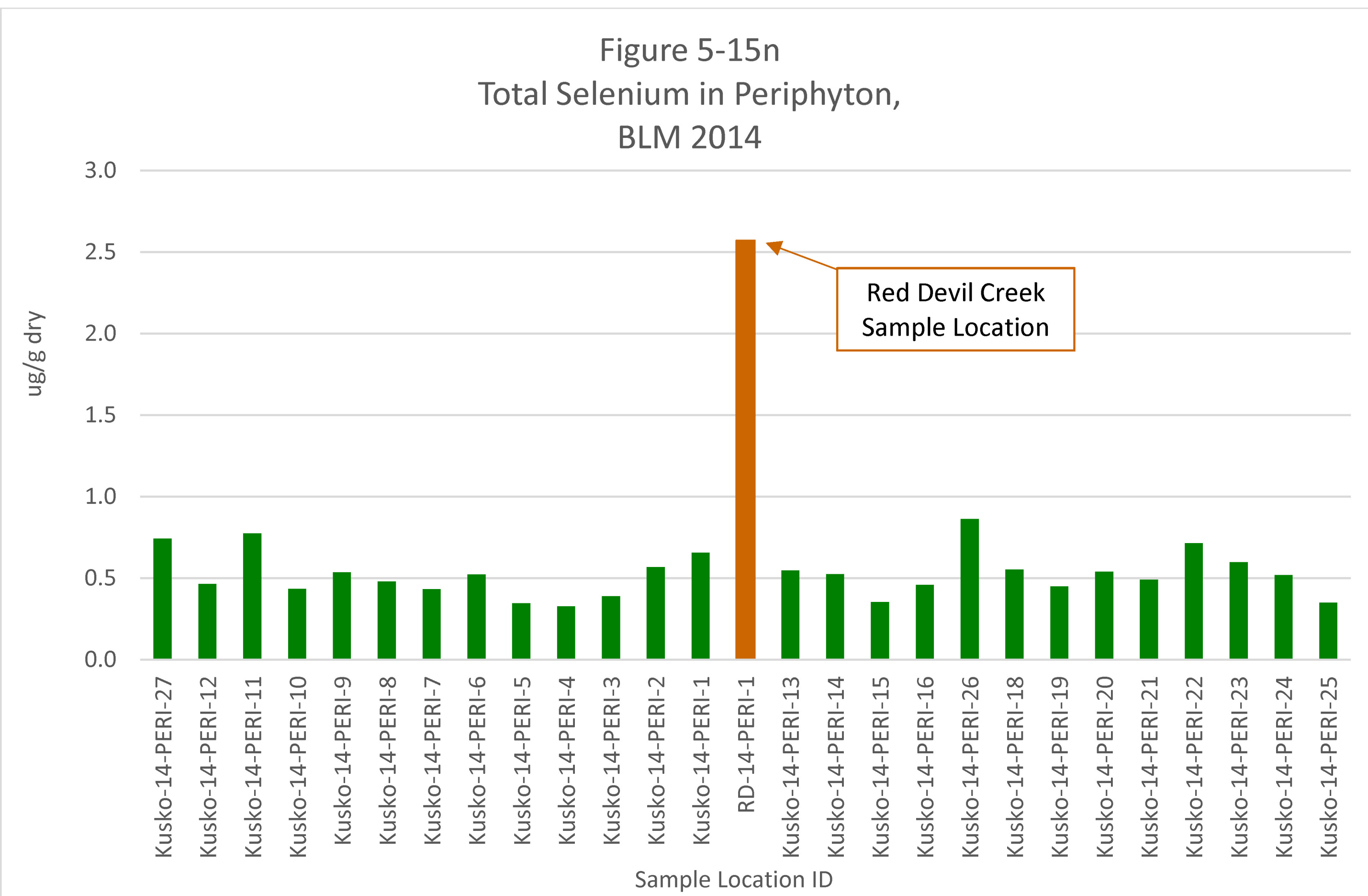


Figure 5-15n
Total Selenium in Periphyton,
BLM 2014
ug/g dry
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Red Devil Creek
Sample Location
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

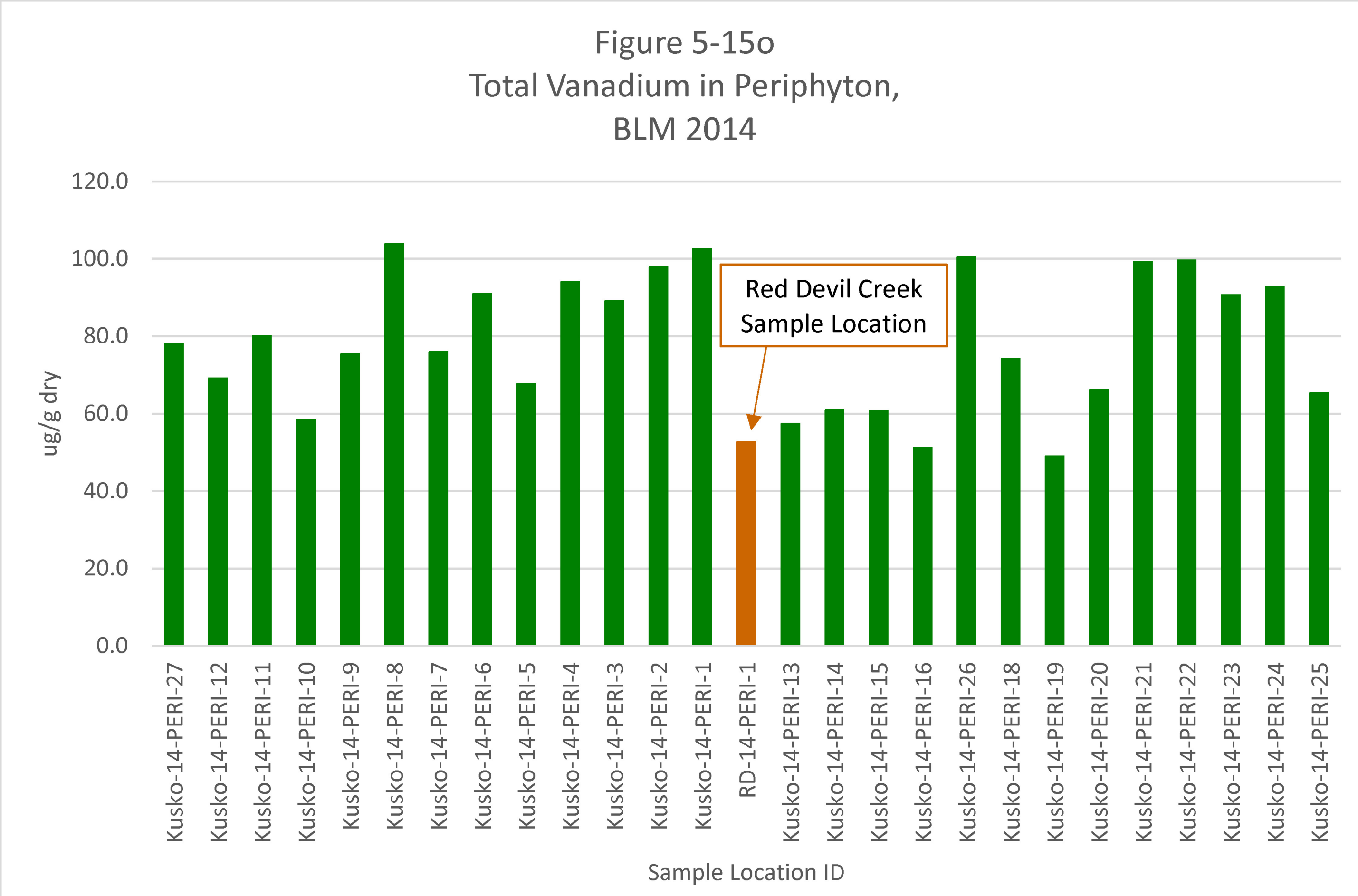


Figure 5-15o
Total Vanadium in Periphyton,
BLM 2014
120.0
100.0
80.0
60.0
40.0
20.0
0.0
ug/g dry
Red Devil Creek
Sample Location
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID

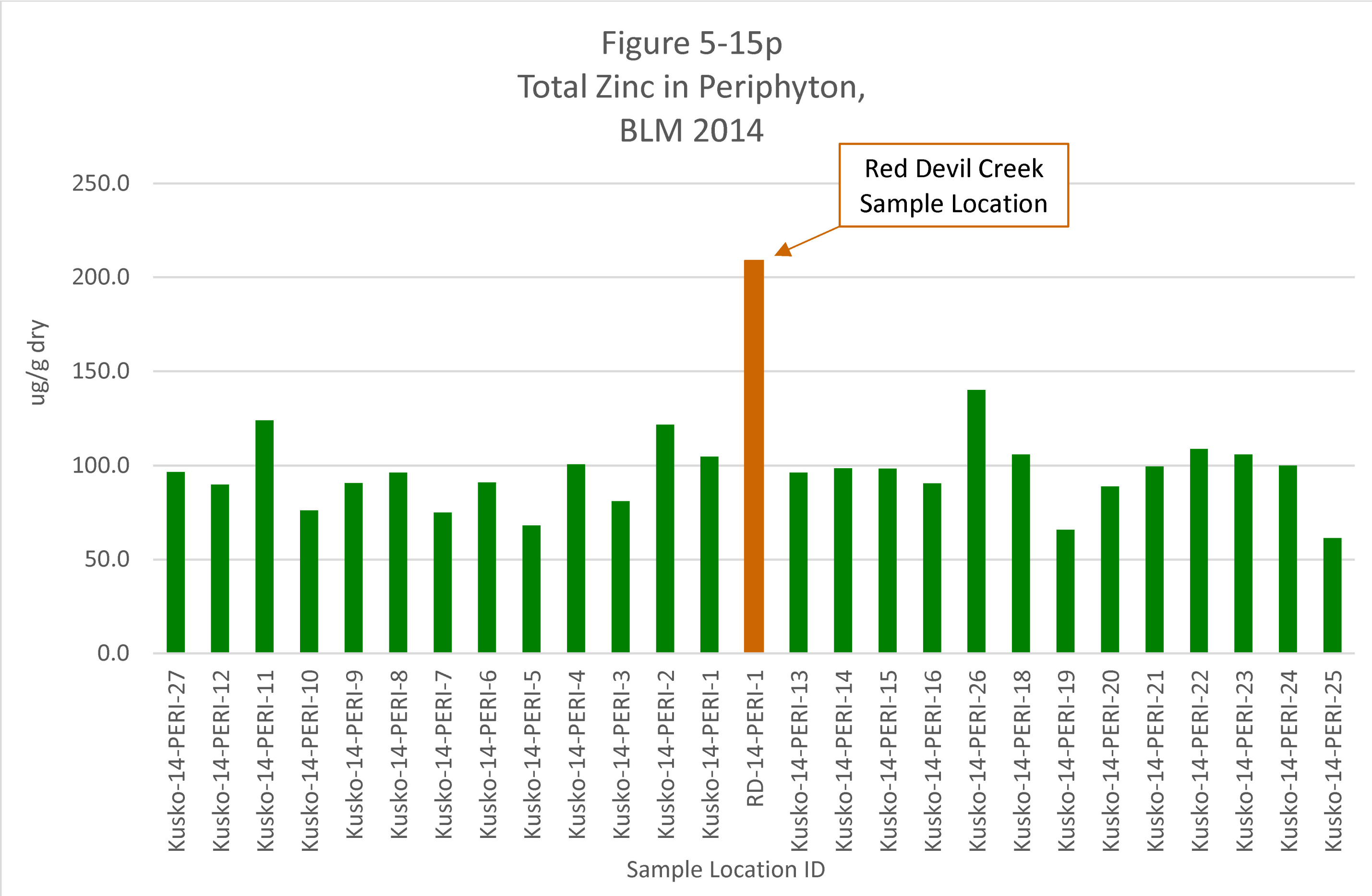
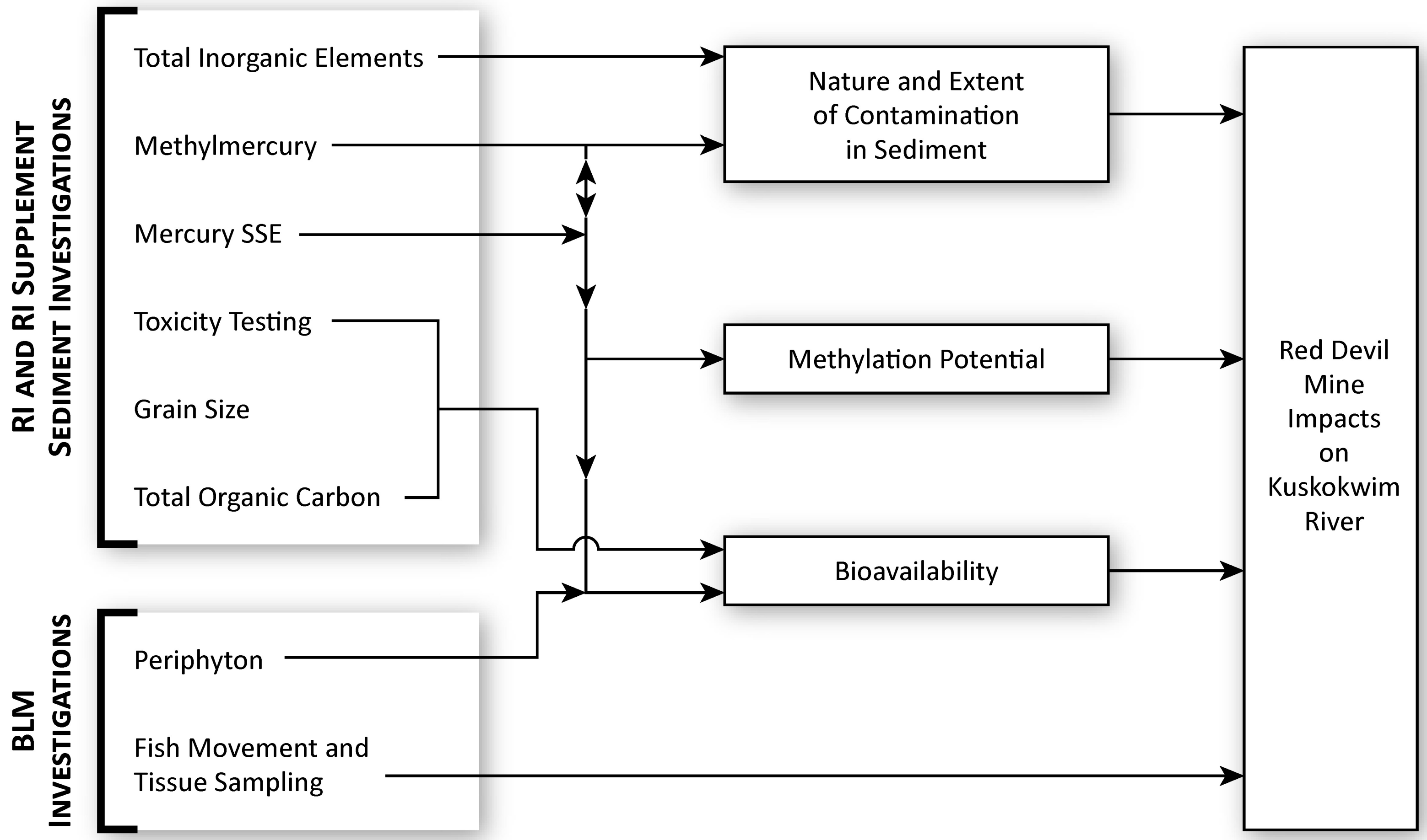


Figure 5-15p
Total Zinc in Periphyton,
BLM 2014
Red Devil Creek
Sample Location
250.0
200.0
150.0
100.0
50.0
0.0
ug/g dry
Kusko-14-PERI-27
Kusko-14-PERI-12
Kusko-14-PERI-11
Kusko-14-PERI-10
Kusko-14-PERI-9
Kusko-14-PERI-8
Kusko-14-PERI-7
Kusko-14-PERI-6
Kusko-14-PERI-5
Kusko-14-PERI-4
Kusko-14-PERI-3
Kusko-14-PERI-2
Kusko-14-PERI-1
RD-14-PERI-1
Kusko-14-PERI-13
Kusko-14-PERI-14
Kusko-14-PERI-15
Kusko-14-PERI-16
Kusko-14-PERI-26
Kusko-14-PERI-18
Kusko-14-PERI-19
Kusko-14-PERI-20
Kusko-14-PERI-21
Kusko-14-PERI-22
Kusko-14-PERI-23
Kusko-14-PERI-24
Kusko-14-PERI-25
Sample Location ID



RED DEVIL MINE

Red Devil, Alaska

Figure 5-16
Kuskokwim River Impacts Lines of Evidence

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