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Written Submission from Orano Canada Inc.

Mémoire d' Orano Canada Inc.

In the matter of

À l'égard d'

Orano Canada Inc.

Orano Canada Inc.

Application to renew the McClean Lake Operating Licence for 2-year term

Demande pour le renouvellement du permis d'exploitation de McClean Lake pour une période de deux ans

Hearing in writing based on written submissions

Audience par écrit fondée sur des mémoires

September 2026

Septembre 2026

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Orano Canada Inc.

McClean Lake Operation

Waste Rock Management

Technical Information Document

Version 3 Revision 1

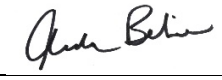
January 2023

Orano Canada Inc.

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History of Revisions

Version	Date	Details of Revision
Version 01 Revision 00	September 23, 2003	Initial submission to CNSC (Rowson to Forbes)
Version 01 Revision 01	March 2004	Response to comments from the CNSC (Flowelle to Rowson, December 2003)
Version 02 Revision 00	June 2013	Submission of updated TID to CNSC and SMOE (Huffman to Gunning and Bourhis, June 28, 2013)
Version 03 Revision 00	November 2021	Submission of updated TID to CNSC and SMOE (Laniece to Akhter and Merkowsky, November 2021)
Version 03 Revision 01	January 2023	Response to comments from the CNSC (Received June 27, 2022) and SMOE (Received November 8, 2022)

Plain Language Summary

Waste Rock Management

Waste materials are generated as part of the mining and milling of uranium. In 1991 - prior to the commencement of mining and milling of uranium at the McClean Lake Operation – an environmental assessment of the predicted waste volume, contaminant concentrations, and modelled impacts on adjacent water bodies was prepared by Orano Canada Inc. This document, the Environmental Impact Statement, was reviewed and approved by government regulatory bodies. Orano conducts periodic validations of these assessments as part of the Waste Rock Management Technical Information Document (Waste Rock TID). The Waste Rock TID is intended to confirm that the impacts of waste management activities match the initial predictions made prior to start-up of the site remain valid. The Waste Rock TID is submitted to government regulatory bodies for review and comment. Waste Rock TIDs were provided by Orano in 2004 and 2013. The Waste Rock TIDs show that the environment is protected and the water quality in nearby lakes remains within acceptable concentrations for aquatic life.

There are several constituents of potential concern (COPCs) in mining waste that without careful management have the potential to impact adjacent water bodies. The primary COPC at the McClean Lake Operation is arsenic. Arsenic is of primary importance due to its abundance in the waste rock and mine waste; its transport properties in groundwater; and its potential adverse effect on human health, aquatic life, and wildlife.

The 2021 Waste Rock TID is a two-part document: Part A is a description and, when possible, a recalibration of the waste materials comparing it to environmental assessment predictions. Part B presents the predicted environmental effects based on current and future activities, utilizing a groundwater flow model to predict future contaminant concentrations at adjacent water bodies of a number of possible waste rock management scenarios. The document contains updated information on waste currently present or expected to be placed at the McClean Lake site as well as updated waste rock characterization data to better understand and confirm expected contaminant concentrations in the waste rock.

In the 2021 Waste Rock TID Orano assessed the approved waste management scenario and six other waste management scenarios that are being considered to support current and future mining needs at the McClean Lake Operation. Contaminant transport models have been developed to predict impacts of the waste rock placement scenarios on adjacent water bodies. The predicted impact of all of the waste rock placement scenarios on the water quality in adjacent water bodies are consistent with those presented in the 1991 Environmental Impact Statement (EIS) and the concentrations COPCs are below the required regulatory guidelines.

Water quality monitoring programs are on-going at the McClean Lake Operation and data from these programs will continue informing future updates.

Executive Summary

Waste Rock Management

Much of the material excavated during mining of any mineral, including uranium, is of no commercial value and is considered a waste product of the mining process. This waste rock, when not properly managed from the outset, can be problematic. Though the material may not contain enough of the mineral of interest to be of commercial value, it may contain trace quantities of the mineral, or other minerals, which have the potential to have an effect on the environment. Mine waste rock management plans are therefore developed and the potential effects on the environment are considered during environmental assessment and licensing phases. Mine waste rock management plans include strategies to segregate benign from potentially problematic mine waste rock.

The 2021 Waste Rock Management Technical Information Document (WR TID) describes waste rock management at the McClean Lake Operation, documents performance, and updates predictions of operational and long-term environmental effects. Multiple alternative scenarios for waste rock management scenarios are evaluated and each alternative concludes that the environment will be protected over the long term. The WR TID is used to facilitate discussion on decommissioning strategies, licensing actions, and environmental assessments in support of activities at the McClean Lake Operation.

The WR TID is presented in two parts.

PART A – Summary of Current Waste Rock Management Practice

Part A of the WR TID provides a description of the waste rock management practices and facilities, a summary of operations to date, and comparison of overall performance to previous environmental assessment predictions.

Since the submission of the 2013 Waste Rock TID, additional programs and projects have taken place that inform this update to the TID. The programs and projects include:

- Additional monitoring data for pore water samples from the JEB, Sue C, and Sue E clean waste rock stockpiles as well as pit water samples for Sue C/A, Sue E and Sue B;
- An updated geochemical characterization of potentially reactive waste rock from the Cigar Lake mine, which is approved to be placed in the Sue C/A pit;
- Characterization and source term development for the McClean, Caribou and Sue D Underground Projects waste rock;
- Evaluation of scenarios with significant reductions in mining waste volumes for McClean and Midwest ore bodies based on ongoing research and development of the Surface Access Borehole Resource Extraction (SABRE) mining method;
- Changes in the clean waste rock stockpile volumes as a result of construction activities and relocation of the contaminated landfill from the JEB TMF to the Sue C/A pit; and

- Evaluation of placement options for operational process waste, which are currently stored on the JEB and Sue ore pads as well as in the CX pond, to the contaminated landfill in Sue C/A pit.

The results of the operational performance assessment in Part A were used to update the solids content and source term used in the modelling for Part B of this TID.

PART B – Modelling and Sensitivity Studies

Part B of the WR TID presents the prediction of potential environmental effects based on current and future activities at the site. Predictive modelling is completed for a number of alternative waste rock management scenarios.

The scenarios are described below:

Scenario 1: Update to Approved Case for Sue Pits – This scenario considers the waste rock placement plan presented in the most recently assessed and approved EIS for the Sue area, the 2009 Caribou EIS.

Scenario 2: The 2013 Waste Rock TID included a Scenario 2 but the Scenario was considered to be no longer relevant for the 2021 WR TID and was therefore eliminated. The numbering of the scenarios remains the same in order to facilitate comparison to the 2013 Waste Rock TID.

Scenario 3: Future Projects Case for Sue Pits – This scenario considers a modification of Scenario 1 to reflect currently proposed changes to the mine plan as well as waste rock management strategy for the McClean Lake Operation.

Scenario 3A: Operational Process Waste in Sue C/A Pit– This scenario is same as Scenario 3, but contaminant transport sources include operational process wastes (mostly sludges) proposed for permanent placement in the Sue C Contaminated Landfill.

Scenario 3B: Operational Process Waste and Midwest SABRE Special Waste Rock in Sue C/A Pit – This scenario includes the same contaminants sources in Sue C/A pit as in Scenario 3A and also includes 13,300 m^3 of future special waste rock from SABRE mining of the Midwest ore.

Scenario 3C: Pit Lakes Water Treated– Scenario 3C is the same as Scenario 3B except that the Sue C/A, Sue E, and Sue B pit lakes water has been *in situ* treated post-placement of the waste materials to meet the Saskatchewan Environmental Quality Guideline (SEQG) for surface water for these pit lakes.

Scenario 4: Fully Backfilled Sue C/A Pit –This scenario is identical to Scenario 3 but considers a fully backfilled Sue C/A pit to 453 mASL. The waste rock elevation of 453 mASL was derived for the fully backfilled case in the Sue E EIS. The additional waste rock is assumed to have the mean properties of JEB, Sue C, and Sue E clean waste rock stockpiles.

Scenario 5: Midwest – This scenario considers Midwest as an open pit mining project. Therefore, the incremental effects on Collins Creek from the Midwest pit partially backfilled with special waste rock are considered. This waste rock management scenario reflects the one described in the 2011 Midwest EIS, and modelling is completed using a sub-model extracted from the 2011 regional groundwater model.

Incremental Effects

Incremental impacts from each of the contaminant sources (individual pits and waste rock stockpiles) were calculated and then combined to consider cumulative effects for each of the seven scenarios.

Arsenic is used as a representative COPC because arsenic source terms and predicted peak arsenic values are the highest among the COPCs (although well below the SEQG surface water value of 5 µg/L). All other COPCs are predicted to be substantially below SEQG values. Figure 1 show modelled results for time-dependent incremental COPC concentrations profiles for the key COPCs in Collins Creek for "Future Projects Case" (Scenario 3). The comparison of the relative concentration for each COPC (i.e. concentration of COPC divided by guideline value for COPC) illustrate why arsenic (even though significantly lower than the SEQG for surface water value of 5 µg/L at peak concentration) is identified as more important for modelling relative to the other COPCs from a potential risk to the environment perspective.

The effects of placed special waste rock, contaminated pit lakes, and clean waste rock stockpiles was analysed in terms of each of the seven scenarios.

In all scenarios, peak arsenic concentrations remain well below SEQG in all receptors.

Conclusions

Results from the 2021 Waste Rock TID are summarized below:

- Monitoring results for the clean waste rock stockpiles indicate that the piles are performing as predicted and have low potential for acid generation.
- Contaminant transport modelling from the clean waste rock piles and the pits lake water sources was completed to predict incremental concentrations of key COPCs in Collins Creek. Arsenic was identified as the most important indicator for evaluating potential impacts to the environment.
- Based on the measured and predicted waste rock data the waste rock management practices at the McClean Lake Operation are effective.
- The current approved decommissioning plan for MLO waste rock management is protective of the water quality in Collins Creek and adjacent surface water bodies. In addition, six other waste management scenarios were effective at limiting potential impacts at Collins Creek and the adjacent surface water bodies to COPC concentrations below the SEQG.

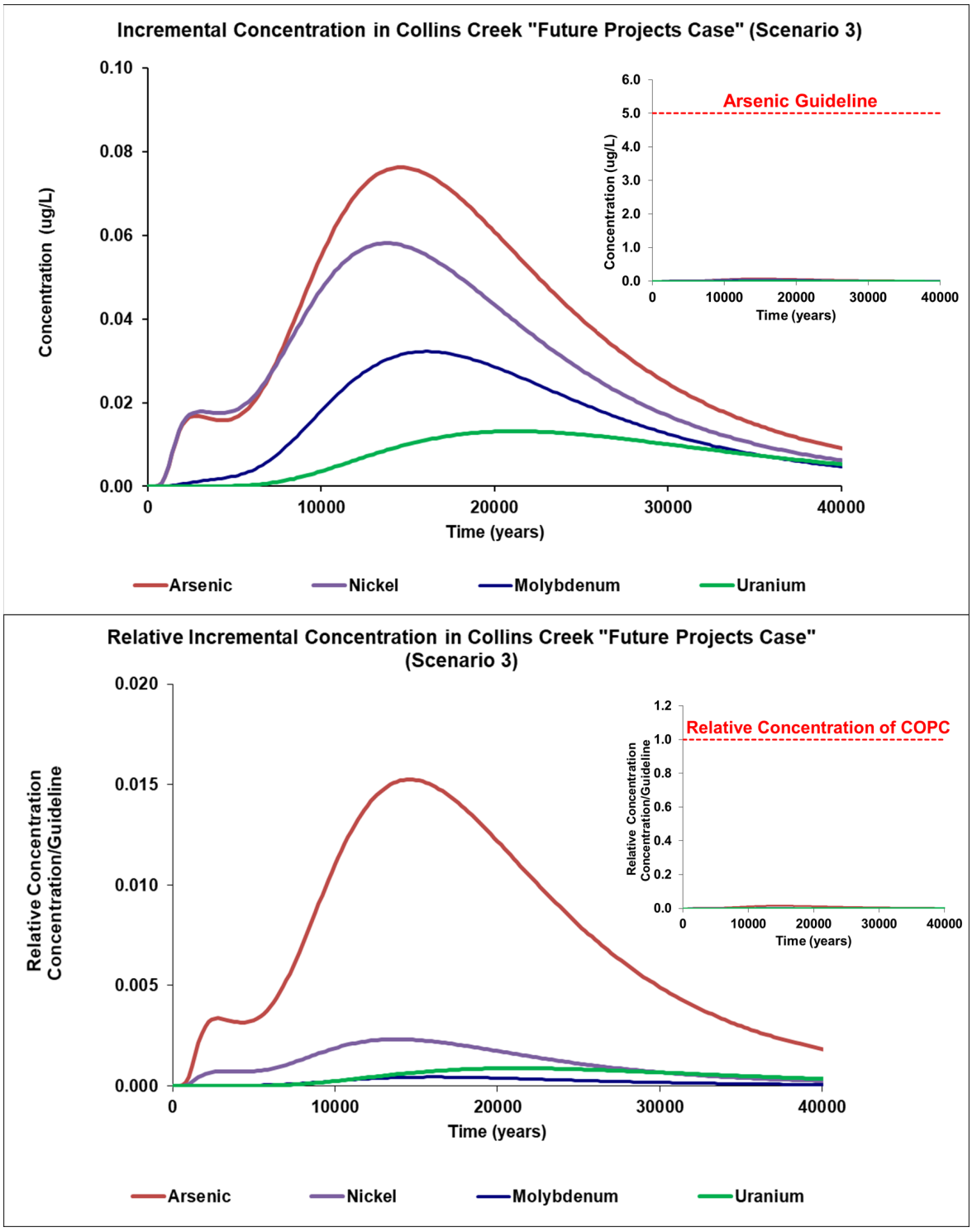


Figure 1: A time-dependant incremental COPC concentrations compared with SEQG for arsenic (5 µg/L) and relative concentrations for each COPC (i.e. Concentration of COPC divided by Guideline Value for COPC) in Collins Creek for the "Future Projects Case" (Scenario 3). A relative concentration of a COPC >1 would signify a modelled concentration above the guideline for that COPC in Collins Creek.

Orano Canada Inc.

McClean Lake Operation

Waste Rock Management
Technical Information Document

Part A: Summary of Current Waste Rock Management Practice

Version 3 Revision 1

January 2023

Orano Canada Inc.

orano

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1 Introduction

1.1 Purpose and Document History

Orano Canada Inc. (Orano) is the majority owner and operator of the McClean Lake Operation, a uranium mine and mill located in northern Saskatchewan, Canada. The McClean Lake Operation has had a long exploration, environmental assessment, and licensing history. Exploration activities commenced in the late 1970's, followed by environmental assessment in the 1990s and the initiation of mining and milling operations in 1995 and 1999, respectively. The initial environmental assessment for the McClean Lake Operation was completed in 1991. Since this time, there have been substantial changes in environmental legislation, continued evolution in environmental assessment methodology, and advances in waste rock management procedures.

In order to provide a comprehensive, current understanding of waste rock management and operational performance at the McClean Lake Operation, Orano undertook the initiative to compile and summarize the relevant waste rock studies into a Waste Rock Management Technical Information Document (Waste Rock TID). The Waste Rock TID is intended to support current and future licence applications, environmental assessments, the interpretation of environmental effects, and to meet internal Orano objectives. The Waste Rock Management TID (submitted 2021 and updated in 2022 in response to technical comments) provides a comprehensive, current understanding of waste rock management at the McClean Lake Operation and operational performance to date.

The Waste Rock TID was first compiled and submitted to regulators in 2004 (COGEMA 2004) and focused on the management of potentially problematic waste rock, or special waste. The Waste Rock TID was updated in 2013 (AREVA 2013) to include a number of waste rock characterization and placement programs that took place between 2004 and 2013. The 2013 update (AREVA 2013) included the characterization and placement of waste rock generated during the mining of the Sue A, B, and E orebodies. Since the submission of the 2013 Waste Rock TID, additional programs and projects have taken place that relate to the waste rock and associated storage facilities at the McClean Lake Operation which have necessitated an update to the Waste Rock TID: The programs and projects include:

- Additional monitoring data for pore water samples from the JEB, Sue C, and Sue E clean waste rock stockpiles as well as pit water quality for Sue C/A, Sue E and Sue B pits;
- An updated geochemical characterization of potentially reactive waste rock from the Cigar Lake mine, which is approved to be placed in the Sue C/A pit and;
- Characterization and source term development for the McClean pod, Caribou and Sue D projects waste rock;
- Evaluation of scenarios with significant reductions in mining waste volumes for McClean and Midwest ore bodies based on ongoing research and development of the Surface Access Borehole Resource Extraction (SABRE) mining method;

- Changes in the clean waste rock stockpiles inventory as result of construction activities; relocation of the contaminated landfill from the JEB TMF to the Sue C/A pit; and

- Evaluation for potential final placement of operational process waste, which are temporally stored on the JEB and Sue ore pads as well as in the CX pond, and in the contaminated landfill in Sue C/A pit.

Predicted operational and long-term effects, as well as mitigation and contingency measures related to waste rock management at the McClean Lake Operation (including the Midwest Project) are presented herein. Operational effects related to water management are also briefly discussed in this TID. Hydrogeological modelling is presented in detail in the Hydrogeology and Groundwater Modelling of Collins Creek Basin TID, updated in December 2011 (AREVA 2011c). The significance of predicted effects is assessed in the Environmental Performance TID Volume 1 and Volume 2, updated in May 2016 and September 2016 (AREVA 2016a), respectively (a draft update to Volume 1 submit in September 2022, which is under technical review)where ecological risk assessment for the McClean Lake Operation is presented.

The Waste Rock TID will be updated periodically in order to incorporate new performance information and update effects predictions. Periodic updating of the Waste Rock TID will improve the communication of information to regulatory agencies and allow the document to support Orano's current activities and future projects.

1.2 Scope of Document

The Waste Rock TID is structured in two sections, Part A and Part B.

The objectives of each part are as follows:

- Part A summarizes the waste rock management practice to date at the McClean Lake Operation and compares the overall performance to predictions made in previous environmental assessments; and
- Part B presents predictive modelling for various waste rock management scenarios.

Similar to the 2013 version (AREVA 2013), this version also incorporates data and modelling for the Midwest Project as it is included in the licensing for the McClean Lake Operation. The Midwest Project was not included in the original Waste Rock TID (COGEMA 2004).

1.3 General Background

1.3.1 Site Description

The McClean Lake Operation is a uranium mine and mill facility consisting of three main sites: the Sue site consisting of the mined-out Sue A, B, C, and E pits, the undeveloped Sue D, Caribou, and McClean underground pods; the JEB site where the milling facility and the JEB Tailings Management Facility (TMF;

previously JEB pit) are located; and the Midwest site where the undeveloped Midwest ore body is located. The JEB and Sue sites are connected by a 12 km haul road. There are also various support facilities for water treatment and waste management, and site infrastructure such as roads, electricity distribution, and camp facilities.

The following waste rock management facilities are included:

- at the JEB site: the organics stockpile, overburden and JEB clean waste rock stockpiles, and special waste pad (Figure 2-1); and,
- at the Sue site: the Sue C and Sue E overburden stockpiles, the Sue C and Sue E clean waste rock stockpiles, the mined-out Sue C/A, Sue B, and Sue E pits, contaminated landfill (within Sue C/A pit) and the Sue Water Treatment Plant (WTP) and associated facilities (Figure 2-2).

Currently approved activities include the following:

- storage, handling, and management of waste rock that was produced from the JEB, Sue A, Sue B, Sue C, and Sue E pits;
- deposition of special waste rock from JEB, Sue C, Sue A, Sue E, Caribou, and Cigar Lake in mined-out Sue C pit and special waste from Sue B and McClean pod in mined-out Sue E pit;
- operation of contaminated landfill in the Sue C pit; and
- supporting activities such as water treatment and environmental monitoring.

1.3.2 Types of Waste Rock

Waste rock is produced during mining, as overlying and surrounding material is excavated to access uranium ore. Three types of waste rock are typically produced:

- Overburden: which consists of organics and till, is surficial soil and rock material that must first be stripped to expose the underlying bedrock;
- clean waste rock: which is benign bedrock material, predominantly sandstone but occasionally basement rock as well, that is excavated and disposed of on surface stockpiles; and
- special waste rock: which is mineralized sandstone and basement rock in the vicinity of the ore body, which requires special consideration due to its potential to adversely affect the environment if stockpiled on surface.

1.3.3 Waste Rock Management Standard

Orano published a Waste Rock Management Standard with three key components: characterization, prediction and management, and verification and follow-up (AREVA 2012b). This standard is consistent with Global Acid Rock Drainage Guide, or GARDGuide (INAP 2014), which deals with the prediction,

prevention, and management of acid rock drainage (ARD) produced from sulphide mineral oxidation. A flowchart showing an overview of the waste rock management standard is shown in Figure 1-1. The standard is also consistent with REGDOC-2.11.1, Waste Management, Volume II: Management of Uranium Mine Waste Rock and Mill Tailings (CNSC 2018)

Each component of the Waste Rock Management Standard was applied to this study, as described further below.

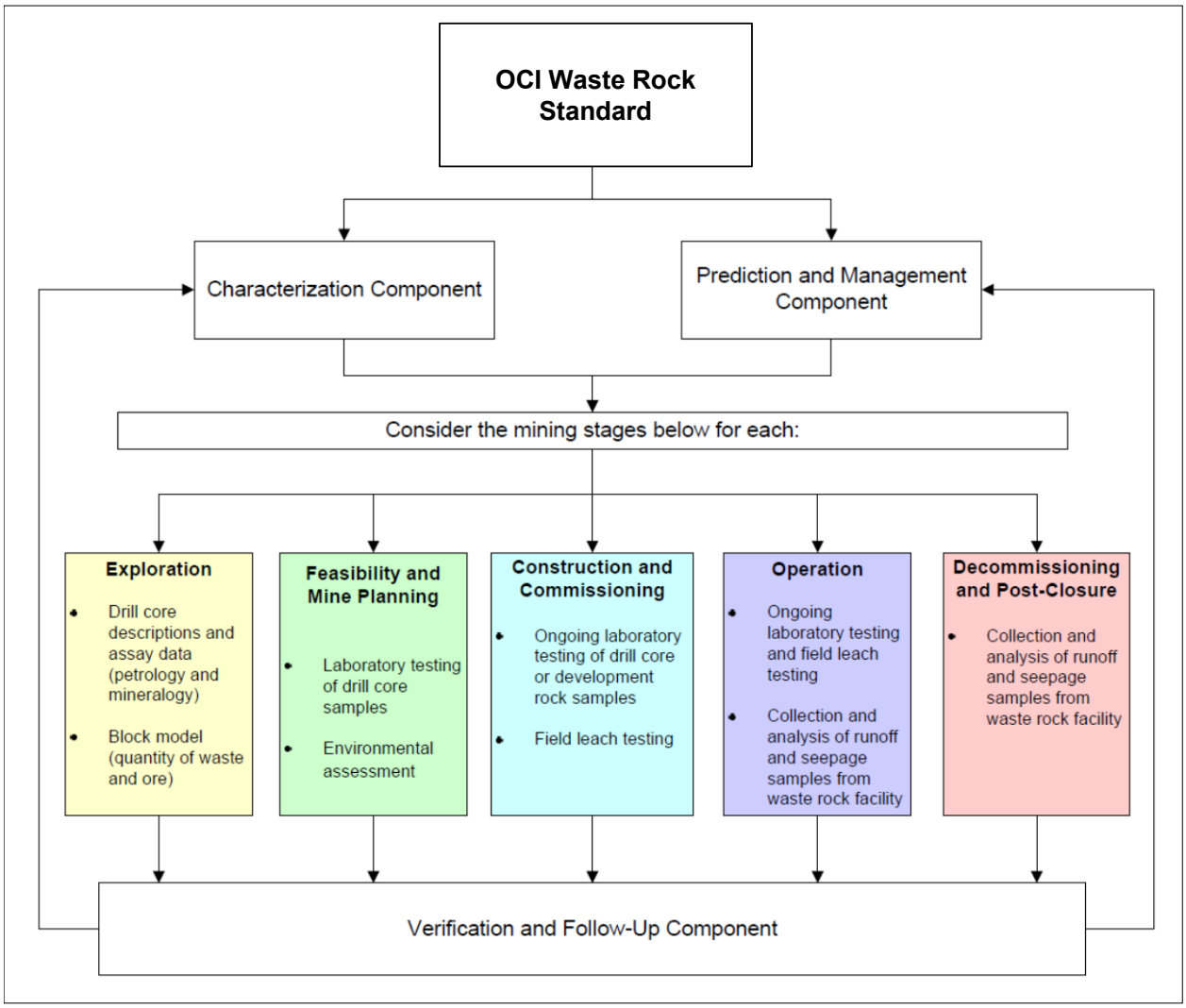


Figure 1-1: Overview of Orano Waste Rock Management Standard

1.3.3.1 Characterization

Waste rock characterization begins at the early stages of a project, in order to prepare for future environmental assessments and management of waste rock during mining. Consideration of waste rock

characterization requirements should begin as early as the exploration stages of a project. Characterization takes place in the lab, in the field, and through periodic site assessments.

The classification and characterization process for different waste rock types involves the collection and analysis of samples that are representative of waste rock in the field. The samples are tested for acid generating and metal leaching potentials. Column leaching tests, commonly referred to as kinetic tests, are conducted to confirm the relevant geochemical behaviours under conditions that simulate long-term management options (*e.g.*, exposed to air and water in a surface stockpile or underwater disposal).

In this and previous versions of the Waste Rock TID, the results of waste rock characterization focused on quantifying the rate of release of constituents of potential concern (COPC) for different sources of waste rock in various management scenarios.

1.3.3.2 Prediction and Management

The objective of the waste rock prediction and management component is to use the waste rock characterization data to anticipate and manage potential water quality issues originating from the waste rock. Predictions on downstream water quality are developed with the use of groundwater and contaminant transport models. The source terms used in the modelling are developed from testing completed in the characterization component.

In this study, selected waste rock management approaches were evaluated to assess interactions with the receiving environment. The assessment involved:

- characterizing the groundwater flow;
- identifying pathways and the media through which constituents from the waste rock may migrate; and
- determining the loadings to the receiving surface water bodies.

The potential effects to the environment are expressed as predictions of surface water quality concentrations that can be compared to regulatory guidelines to gauge acceptability of each waste rock management scenario.

An overall waste rock management plan has been included in the previous versions of the Waste Rock TID (COGEMA 2004; AREVA 2013) and various environmental impact assessments. Section 4, Appendix AI of this document and Appendix AII of this document include an assessment and evaluation of the overall waste rock management strategy to date.

1.3.3.3 Verification and Follow-Up

The prediction of environmental effects provides the basis for the site monitoring and follow-up programs that are used to evaluate the performance of the waste rock management facilities. The characterization of waste rock, evaluation of management options, and monitoring of management facilities is an iterative

process requiring an ongoing assessment during operation. This iterative process reflects the key components of the McClean Lake Operation Integrated Approach to Environmental Protection. This approach is identified in the Environmental Performance TID (AREVA 2016a) and encompasses three main processes: environmental assessment, adaptive management, and continual improvement.

1.4 Report Organization

An overall executive summary for Parts A and B is provided at the start of this document.

Part A of the Waste Rock TID contains a summary of waste rock management practice to date, and is composed of four sections:

- **Section 1 – Introduction:** describes the purpose, history, and organization of the Waste Rock TID, scope of the document, and a description of the Waste Rock Management Standard (AREVA 2012c);
- **Section 2 – Facilities Description:** describes the locations, history, and current status of key waste rock management facilities at the McClean Lake Operation;
- **Section 3 – Operations to Date:** provides a brief overview of waste rock segregation criteria and methodology, material inventories, waste rock placement, and pit water quality;
- **Section 4 – Evaluation of Current Practice to Date:** compares measured waste rock solids content and pore water quality data to predictions from previous environmental assessments; and
- **Section 5 – References:** provides a list of the references used in the compilation of Part A of this document.

Part B of the Waste Rock TID contains predictive modelling for future waste rock management scenarios, and is composed of nine sections:

- **Section 1 – Introduction:** describes the purpose and scope of the modelling completed for this study, as well as the history of local groundwater models and waste rock studies for the McClean Lake Operation;
- **Section 2 – Description of Decommissioned State:** describes the waste rock placement strategy assumed for the time of decommissioning (including waste rock types, elevations, and till caps) based on the history of environmental assessment at the McClean Lake Operation and current data;
- **Section 3 – Description of Modelling Scenarios:** introduces the various waste rock management scenarios considered in this document, and the assumptions made for each;
- **Section 4 – Flow Models:** outlines the regional flow models, boundary conditions, groundwater recharge values, and hydraulic conductivity values used in this study;
- **Section 5 – Contaminant Transport:** summarizes the source terms, flow rates, and other modelling inputs used in the contaminant transport analyses of each scenario;

- **Section 6 – Surface Water Quality Predictions:** presents the results of contaminant transport modelling, including the loading of constituents of concern to surface water receptors and the resulting surface water concentrations for each scenario;
- **Section 7 – Bounding and Sensitivity Cases:** identifies parameters that are considered to have a significant impact on calculated loadings, and considers the effects of varying those parameters;
- **Section 8 – Monitoring and Follow-Up:** describes monitoring and follow-up programs and initiatives specific to waste rock management;
- **Section 9 – Contingency Measures:** considers possible contingencies that could be implemented in the event that the assumptions and predicted long-term effects are found to be incorrect based on operational monitoring and follow-up program results;
- **Section 10 – Conclusions:** provides conclusions and recommendations from Parts A and B; and
- **Section 11 – References:** provides a list of the references used in the compilation of Part B of this document.

2 Facilities Description

Section 2 provides a brief overview of the relevant facilities at the McClean Lake Operation. The key facilities related to the management of waste rock at the McClean Lake Operation include stockpiles at the JEB and the Sue sites, the mined-out Sue C/A and E pits, and the Sue WTP and associated facilities.

The locations of facilities related to waste rock management are shown in Figure 2-1 for the JEB site, and Figure 2-2 for the Sue site. Both figures are from the McClean Lake Operation 2020 Annual Report (Orano 2021). Waste material produced from the mining of open pits at the McClean Lake Operation was segregated as follows:

- **JEB, Sue C, and Sue E pits:** waste material was segregated into organics, till overburden, clean waste rock, and special waste rock.
- **Sue A:** overburden and waste rock was treated as special waste.
- **Sue B:** overburden was removed and stockpiled, but all waste rock was treated as special waste.

Organics, overburden, and clean waste rock are stockpiled on surface, while special waste is disposed of in either the Sue C/A or Sue E pits.

2.1 Overburden and Clean Waste Rock Stockpiles

Both overburden and clean waste rock can be stockpiled on surface. Overburden includes both peaty organic material and boulder-rich till material. Available information from exploration diamond drill holes and mining experiences to date indicate that the till overburden is unmineralized; therefore, overburden material does not require special handling or long-term management and can be safely stockpiled on surface for later use. Stockpiled overburden will be used during future site decommissioning and reclamation activities.

Clean waste rock consists predominantly of unaltered sandstone that contains less than 250 ppm uranium, less than 75 ppm arsenic, low acid generating potential, and insignificant metal leaching potential (refer to Section 3.1.1). Clean waste rock in surface waste stockpiles has been placed using waste rock segregation procedures (Section 3.1.1), eliminating the possibility of special waste or ore being placed within these stockpiles. Clean waste rock is suitable for purposes such as on-site construction and future decommissioning activities, such as backfill and the construction of the JEB TMF cover; however, only a small portion will be used for this purpose. Clean waste stockpiles are considered permanent, and their reclamation is considered within the scope of future site decommissioning activities. There are currently three clean waste stockpiles at the McClean Lake Operation; the JEB, Sue C, and Sue E clean waste rock stockpiles.

The overburden and waste stockpile sites are located away from watercourses that could erode the toes of the stockpile embankments. The base of these stockpiles was constructed from the initial till overburden

material removed from the JEB and Sue C pits. Material was placed in layers of approximately 10 m in height. A gradient of 1.5% from the center of the stockpile area was constructed to allow for drainage. The final slope design of the waste stockpiles was set to an angle of approximately 35° for each 10 m lift. Between each successive lift, a 10 m wide catchment bench was constructed. Diversion and collection of runoff waters around the stockpiles was achieved by construction of containment ditches and berms where required. Containment ditches facilitate water collection and discharge to respective containment areas. Piezometers are installed in proximity to the stockpiles for routine groundwater monitoring, and piezometers are also installed in the stockpiles as described in Section 2.1.3.

2.1.1 Stockpiles at the JEB Site

At the JEB site, the upper layer of overburden removed prior to mining consisted of organic materials which have been stockpiled separately for future site construction projects or use in decommissioning activities. Approximately 128,369 bank cubic metres (bcm) or 82,541 tonnes of organic material is stockpiled in the JEB organics stockpile, located in a separate well-drained area southeast of the JEB TMF. Bank cubic metres (bcm) refer to the *in-situ* volume prior to excavation. The organic material will be used throughout the life of the operation and at decommissioning for the revegetation of disturbed areas. The organics stockpile covers an area of approximately 2.9 hectares (ha).

Till overburden from the open pit mining of the JEB ore was not separately stockpiled. A small portion of the till overburden was used to build roads leading to the special waste pad and the JEB clean waste rock stockpile. The remainder was used to build a base for the JEB clean waste rock stockpile that ranged in thickness from approximately 2 to 4 m.

The JEB clean waste rock stockpile area is located east of the JEB TMF. JEB clean waste rock is permanently stockpiled in this area. The JEB clean waste stockpile covers an area of approximately 31 ha with a final elevation of 490 mASL. Prior to its use in construction activities related to the JEB TMF Optimization Project, the stockpile contained approximately 4,445,884 bcm or 10,803,498 tonnes of material, using a conversion factor of 2.43 tonnes/bcm. Inventory as of December 31, 2020 was 4,406,993 bcm (10,708,993 tonnes).

Throughout the last decade some material from the JEB clean waste rock stockpile has been crushed and used in the JEB TMF Optimization and Expansion Projects and other smaller projects on site. In summer 2021, the JEB clean waste rock stockpile was used for construction of TMF Expansion embankment. The clean waste rock will continue to be utilized for future projects at the McClean Lake Operation, including the JEB TMF Expansion Project and the eventually decommissioning of the JEB TMF in the construction of the cover. Approximately 24,437 bcm was used between 2012 and 2017. An estimated 166,000 bcm of the stockpile is expected to be used between 2018 and 2026 for a variety of construction projects, including JEB TMF optimization and expansion to 457.5 mASL (~125,000 bcm), as well as road repairs (~41,000 bcm). In addition to this, future planned construction activities will include the use of the clean waste rock stockpile to backfill and cover areas around JEB during final decommissioning. This waste will be removed from the currently un-contoured side; which will then be contoured and revegetated. The approximate JEB clean waste rock stockpile volume at the start of decommissioning is estimated to be 3,580,000 bcm.

During mining, special waste was also temporarily stockpiled on the JEB special waste pad. This special waste was backhauled to the Sue C special waste management facility in 2002 and eventually placed in the Sue C/A pit.

The locations of stockpiles at the JEB site are shown in Figure 2-1.

2.1.2 Stockpiles at the Sue Site

At the Sue site, the organics layer is very thin; therefore, due to minimal quantity of material, the organics were not stockpiled separately.

There are two overburden stockpiles at the Sue site. The first contains Sue B and Sue C overburden and is located east of the Sue C pit. The second contains overburden from Sue E and is located east of the Sue E pit. Overburden from Sue A was disposed of in the Sue C/A pit, as the Sue A area had previously been used as a temporary storage area for special waste from the mining of Sue C. The Sue B and C overburden stockpile covers an area of approximately 2.5 ha and contains approximately 298,513 bcm or 656,729 tonnes of material, while the Sue E overburden stockpile covers an area of approximately 4.5 ha and contains approximately 697,664 bcm or 1,534,861 tonnes of material. The conversion factor used to convert overburden in bcm to tonnes was 2.20 tonnes/bcm. The overburden stockpile will be used as backfill and clean cover during decommissioning of the JEB and Sue areas. Remaining overburden will be contoured and revegetated.

Clean waste rock stockpiles from the mining of Sue C and Sue E pits are present at the Sue site. The clean waste rock from the Sue pits predominantly consists of unaltered sandstone with some minor amount of basement rock, both with low concentrations of COPC.

The Sue C clean waste rock is stockpiled at the north end of the Sue site, and currently covers an area of approximately 67 ha. The material in the stockpile was placed in 10 m lifts to a final elevation of 495 mASL. The Sue C stockpile contains clean waste rock originating from both the sandstone and basement, as the waste rock material was segregated throughout the entire mining depth of the pit. The current inventory of the Sue C stockpile is 10,006,102 bcm or 24,314,828 tonnes using a conversion factor of 2.43 tonnes/bcm. Approximately 56,345 bcm of the Sue C clean waste rock stockpile was used prior to 2017 and an estimated 9,000 bcm is anticipated to be used between 2018 and 2026 for a variety of construction projects including road repairs.

Sue E clean waste rock is stockpiled southwest of the Sue C/A pit, and currently covers an area of approximately 35.6 ha. The material in the stockpile was placed in 10 m lifts to a final elevation of 477 mASL. The Sue E stockpile contains waste rock originating from the sandstone only, as a cutoff elevation above the basement at 406 mASL was established. Below this elevation, waste rock was conservatively treated as special waste. The approximate volume of the Sue E clean waste rock stockpile is 4,587,836 bcm or 11,148,441 tonnes using a conversion factor of 2.43 tonnes/bcm. An estimated 5,500 m^3 and 2,600 m^3 of the Sue E clean waste rock stockpile was used respectively in 2018 and 2019 for the SABRE pad extensions on the McClean pods.

Sue C and Sue E clean waste rock stockpile material will be used as backfill throughout the Sue area during decommissioning and final slopes of the remaining material of the respective stockpiles will then be re-contoured to less than 3H:1V and revegetated.

Clean waste rock was not stored on surface for Sue A and Sue B, as all material was treated as special waste and was disposed of in-pit.

The locations of stockpiles at the Sue site are shown in Figure 2-2.



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 2022-11-17 Scale: 1:10,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

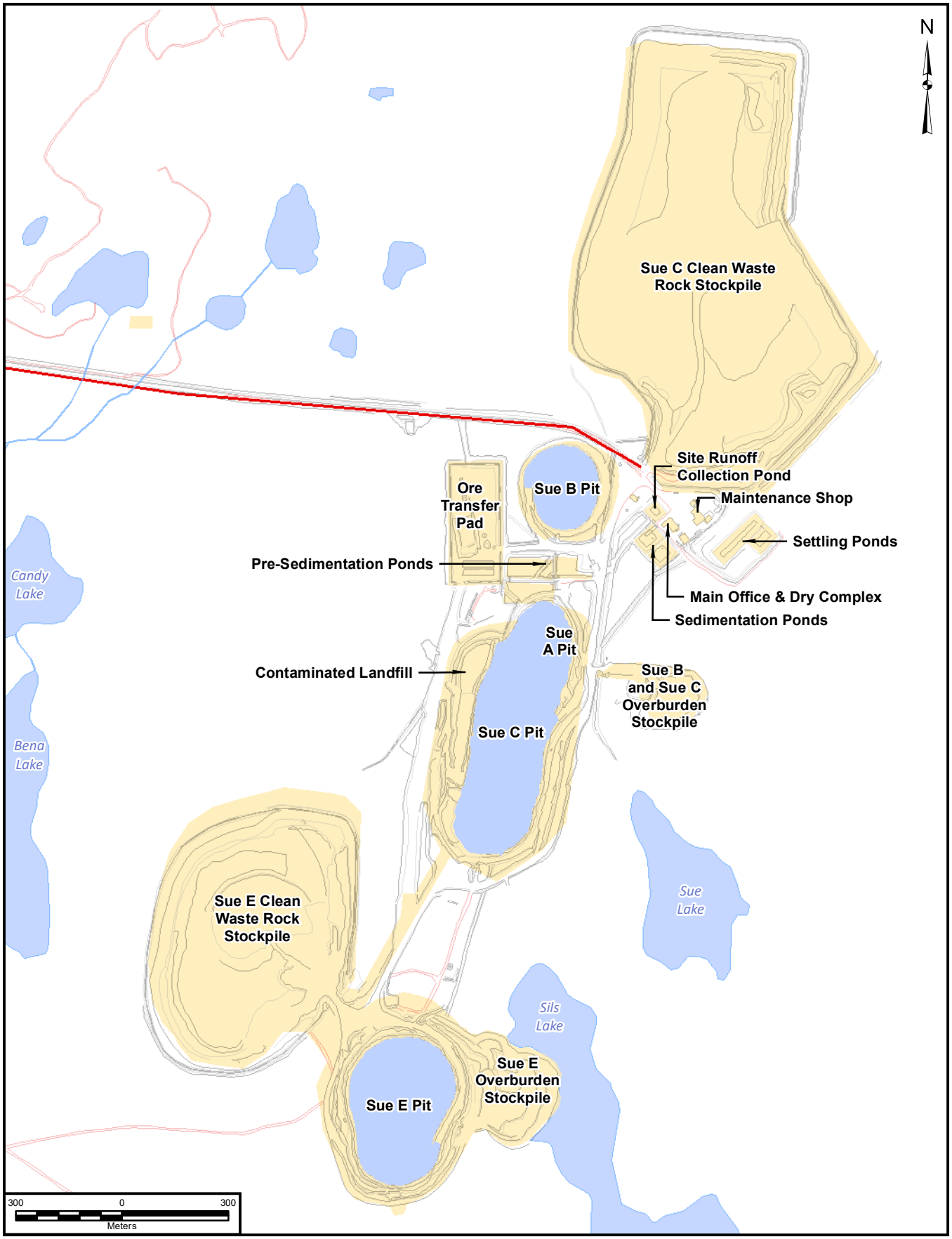
McCLEAN LAKE OPERATION

FIGURE 2-1
JEB SITE LAYOUT

WASTE ROCK MANAGEMENT
TECHNICAL INFORMATION DOCUMENT

orano

File: \\ocskfile\teamdata\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Figure 2-1 - JEB Layout.mxd



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 4/7/2021 Scale: 1:15,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 2-2
SUE SITE LAYOUT

WASTE ROCK MANAGEMENT
TECHNICAL INFORMATION DOCUMENT

orano

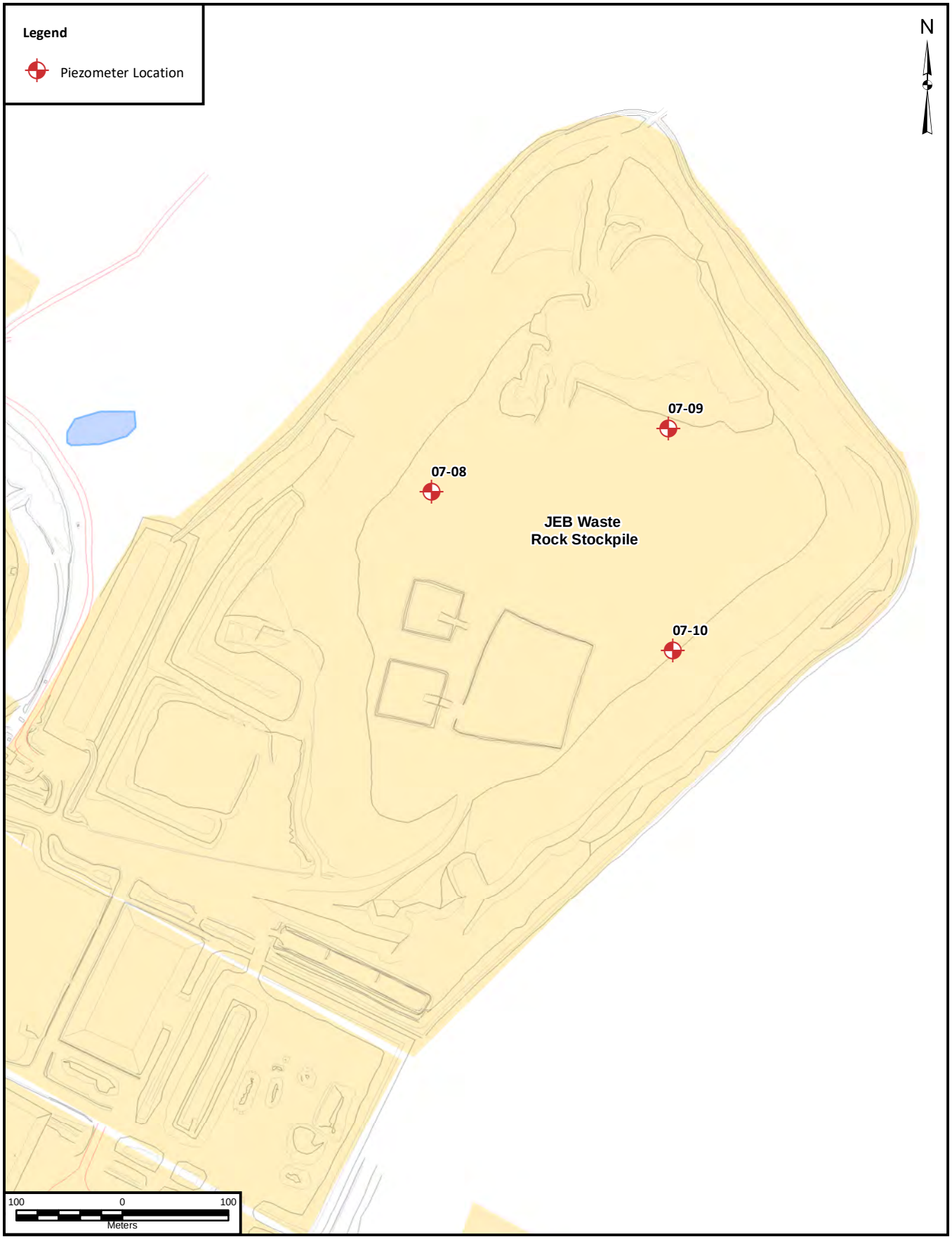
File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Figure 2-2 - Sue Site Layout.mxd

2.1.3 Clean Waste Rock Stockpile Monitoring

During operation, seepage and runoff from the waste rock stockpiles are collected in ditches and directed to the containment areas located at each of the JEB and Sue sites. Water from these containment areas is directed to the water treatment plants and represents significant contribution to the water treatment requirements during the operational life of the McClean Lake Operation.

Between 1998 and 2005, efforts were made to sample seepage from the JEB and Sue C clean waste rock stockpiles. Seepage sample results were presented in the 2004 Waste Rock TID (COGEMA 2004). In 2005, seepage samples were removed from the monitoring program due to difficulties in their collection. Samples were only available following major storm events, collecting sufficient samples was difficult, and consistent sampling locations could not be established. Additionally, it was noted that the samples provided only a snapshot of seepage water quality for a specific area of the waste rock pile and were most likely not representative of overall waste rock pore water quality. In order to establish consistent sampling locations, Orano installed clean waste rock piezometers in all three stockpiles in 2007. The completion zones of these piezometers were targeted to intercept the water table underneath the stockpiles, in order to collect representative samples of water that has infiltrated through the stockpiles. Annual sampling of these piezometers replaced the seepage sampling. The locations of the JEB, Sue C, and Sue E clean waste rock pile piezometers are shown in Figure 2-3, Figure 2-4, and Figure 2-5, respectively.

A summary of the piezometer data is included in Section 4.2.5.2, and described in detail in Appendix AI.6 of this document.



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman
Drawn: T.Lohman
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Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

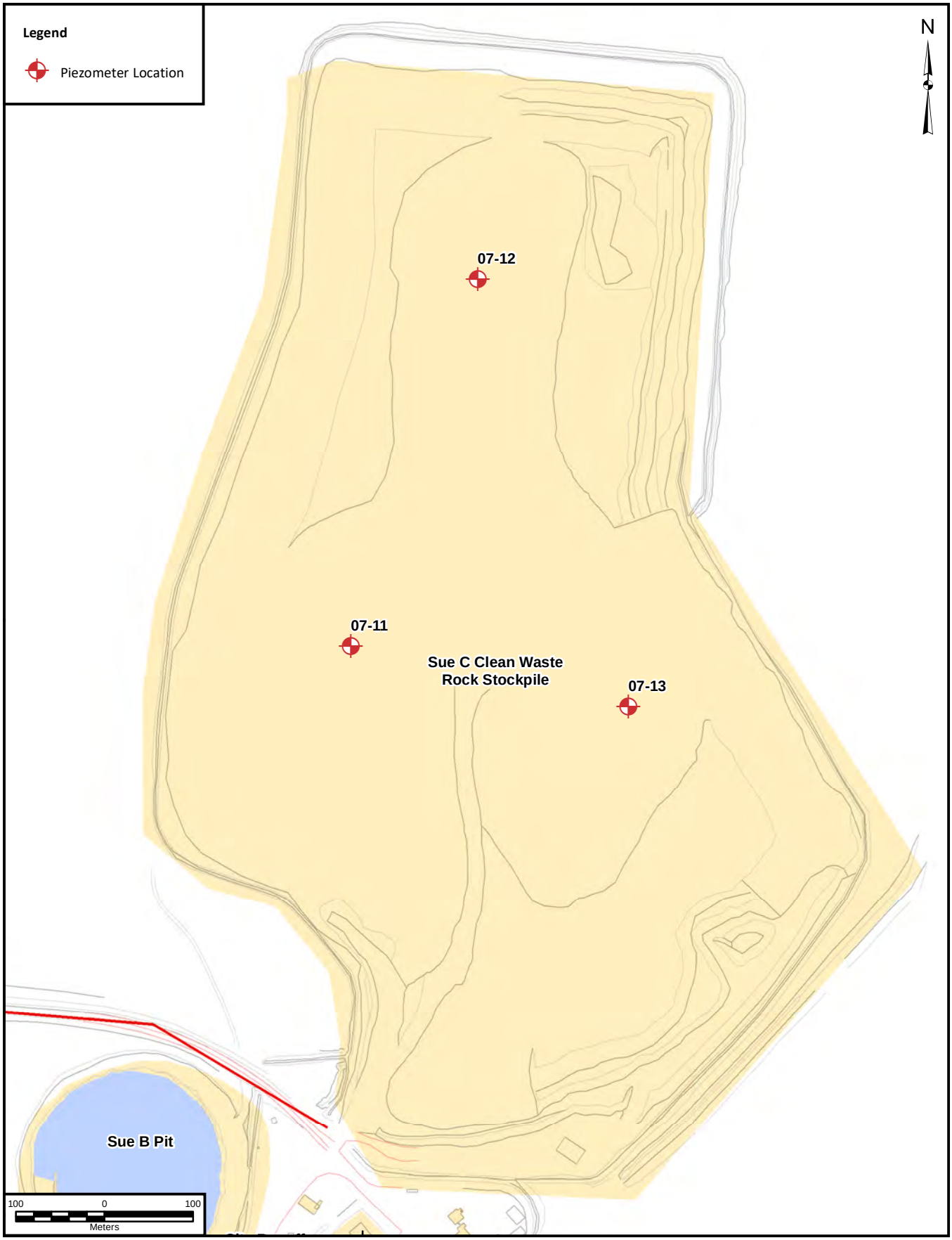
McCLEAN LAKE OPERATION

FIGURE 2-3
LOCATIONS OF JEB WASTE ROCK PILE PIEZOMETERS

WASTE ROCK MANAGEMENT
TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Figure 2-3 - JEB WRP Piezos.mxd



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
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Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

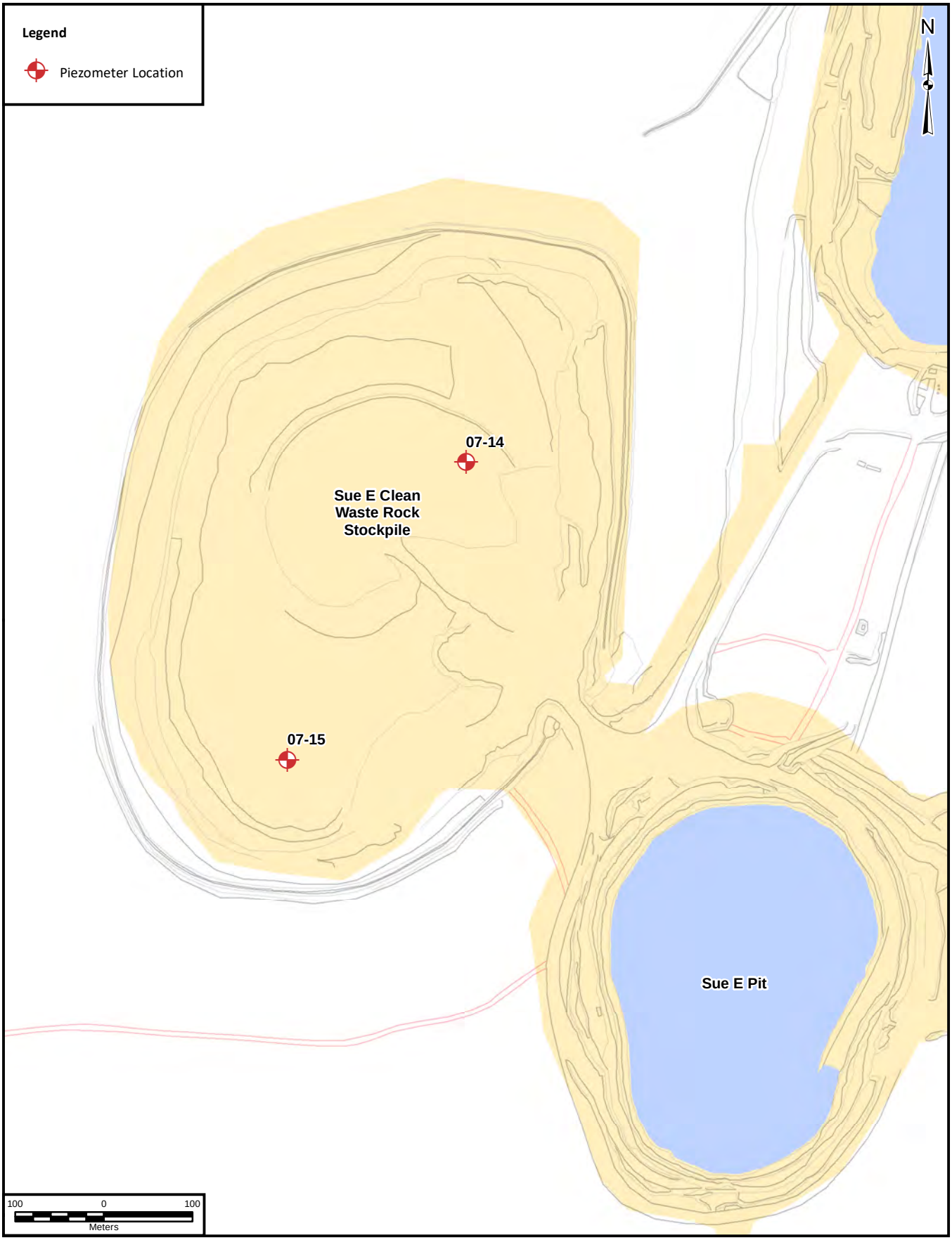
McCLEAN LAKE OPERATION

FIGURE 2-4
LOCATIONS OF SUE C CLEAN WASTE ROCK PIEZOMETERS

WASTE ROCK MANAGEMENT
TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Figure 2-4 - Locations of Sue C CWRP Piezo.mxd



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman
Drawn: T.Lohman
Date: 2/10/2021
Scale: 1:6,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 2-5
LOCATIONS OF SUE E CLEAN WASTE ROCK PIEZOMETERS

WASTE ROCK MANAGEMENT
TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Figure 2-5 - Locations of Se E CWRP Piezo.mxd

2.2 Temporary Special Waste Pads

Special waste is defined as any material having a uranium content of 0.025% (250 ppm) or greater, but less than 0.085% (850 ppm). This material is typically associated with elevated metal contents (i.e. arsenic > 75 mg/kg), and frequently with acid-generating or metal-leaching potential (i.e. acid base accounting, elevated sulphur content) (see Section 3.1.1). Laboratory testing results have indicated that this material may be problematic if left indefinitely on surface exposed to atmospheric conditions.

This section describes the temporary placement of special waste at the McClean Lake Operation during mining.

2.2.1 Temporary Special Waste Stockpile at the JEB Site

The temporary JEB special waste pad is a lined facility with an area of approximately two hectares, located adjacent to the clean waste stockpile as shown in Figure 2-1. Approximately 27,796 bcm of special waste material was excavated from JEB pit and placed on the temporary JEB special waste pad. The backhauling of this special waste to the Sue C pit was completed on April 25, 2002 (COGEMA 2003). The temporary JEB special waste pad has since been repurposed for the temporary storage of contaminated and hazardous materials.

2.2.2 Temporary Special Waste Stockpile at the Sue Site

A temporary special waste pad with an area of approximately 2.4 hectares was constructed over the undeveloped Sue A pit. Approximately 273,024 bcm of Sue C special waste was temporarily stockpiled within this facility. The backhauling of this special waste to the Sue C pit was completed on April 25, 2002 (COGEMA 2003).

During the development of the Sue A pit, the area underlying the former special waste pad was excavated and placed in the Sue C pit. Following this, all Sue A, Sue B, and Sue E special waste material was immediately hauled to the pits for disposal and a temporary special waste pad was not required at the Sue site.

2.3 Existing Pits in the JEB Area

The JEB pit is shown on Figure 2-1. Mining of the JEB pit was completed on July 12, 1997, and the pit has been converted into the McClean Lake Tailings Management Facility (TMF). The JEB pit contains no waste rock. Clean waste rock is stockpiled at the JEB site as described in Section 2.1.1.

2.4 Existing Pits in the Sue Area

2.4.1 Sue C/A Pits

The mining of the Sue C pit began in May 1997 and was completed on February 4, 2002 (COGEMA 2003). At the completion of Sue C mining, the pit was approximately 138 m in depth, with the pit crest at approximately 460 mASL and the bottom of the pit at 322 mASL. The total volume of the fully mined-out pit is approximately 11.1 million m^3. The Sue A pit was mined from July 2005 to March 31, 2006 (AREVA 2007a). This pit is located immediately north of Sue C. Upon completion of mining, the Sue A pit intersected Sue C to form one large pit. The base of the Sue A pit is at approximately 380 mASL; while the base of Sue C varies from 322-345 mASL. All special waste is currently disposed of in the Sue C area of the pit, and no special waste has been placed in Sue A to date.

2.4.2 Sue E Pit

Mining of the Sue E pit began with the removal of overburden in September 2005 and was completed on March 15, 2008 (AREVA 2009d). The total volume of the fully mined-out pit is approximately 8.0 million m^3.

The Sue E pit design includes bench back slopes in rock at 76º, and in the till materials at 27º. In order to enhance the stability of the slopes within the pit, safety berms of 6 m in width were constructed. These safety berms provide catchment plateau for possible falling material. The haulage roads within the pit were of a spiral design, 22 m in width, and at approximately a 10% gradient. The Sue E pit design is shown in Figure 2-6.



McClean Lake Operation

LEGEND Crest ——— Toe - - - - - -

343 bench moved up to 346 elevation

NOTES: 6.2-10% - 22m ramp, to 334, 15m below backslopes vary, 1.5:1 in overburden (>442) 6m benches to 334, based on 30m mining width around 235C110A. Pit Area - 155,033 m2

* - Excel rounded nos.

orano

SCALE:	As Shown	DATE
DESIGNED:	M. Eaid	09/04/06
DRAWN:	M. Eaid	09/04/06
CHECKED:	L. Rowson	14/04/06
APPROVED:	B. Dodds	25/04/06
REF. DWGS	pit_desn_fnl17; 235C110	
REV. A:	S. PIERCE	31/10/07
REV. B:	L. ROWSON	21/01/08
DIR:	G:\Engineer\Drawing\235	

FIGURE 2-6

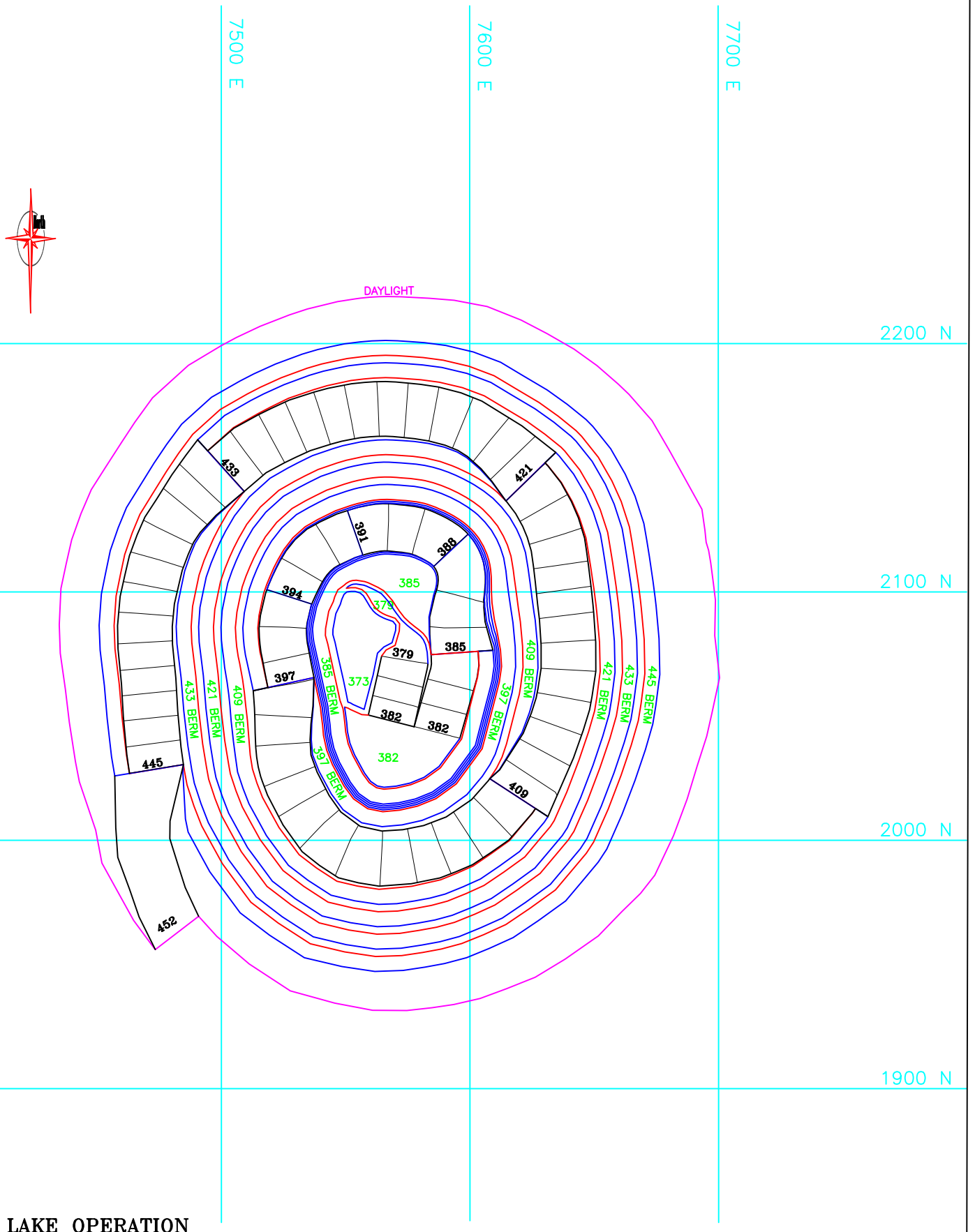
SUE E
PHASE II PIT

DWG NO.: 235C111b REV. NO.: 0

2.4.3 Sue B Pit

The removal of overburden at Sue B occurred in the summer of 2007. The pit was mined from March 24, 2008 to November 26, 2008 (AREVA 2009b). The total volume of the fully mined-out pit is approximately 1.7 million m^3.

The Sue B pit design includes bench back slopes in rock at 76º, and in the till materials at 21º. In order to enhance the stability of the slopes within the pit, safety berms of 6 m in width were constructed. These safety berms provide catchment plateau for possible falling material. The haulage roads within the pit were of a spiral design, 22 m in width, and at approximately a 10% gradient. The Sue B pit design is shown in Figure 2-7.



McCLEAN LAKE OPERATION

LEGEND
TOE
CREST
RAMP

NOTE: FIGURE NUMBER ADDED FOR WRTID (TL)

orano

SCALE:	N.T.S.	DATE
DESIGNED:		
DRAWN:	S.P.	14/11/08
CHECKED:		
APPROVED:		
REF. DWGS		
REVISIONS:		
REVISIONS:		
DIR:	G:\ENGINEER\DRAWING\232	

FIGURE 2-7

Sue B Pit Design
Revised 373 Toe

DWG NO.: 232C076 REV. NO.: A

2.5 Water Management and Treatment Facilities

2.5.1 JEB Site

At the JEB site, the ore pad, the special waste pad, the waste rock pile, and the mill terrace each have an independent set of ditches and/or berms designed to capture all runoff from those sources (Figure 2-8). Originally the mill terrace site runoff pond was separated from other runoff sources so that the water could potentially be released to the environment without treatment. However, until the ore pad Probable Max Precipitation (PMP) holding pond was constructed in 2016, the ore pad runoff ditch water was pumped to the site runoff pond when the ditch was approaching bank full. Since 2017 the ore pad ditch overflows to the ore pad PMP pond.

If the special waste runoff collection ditch overflowed it would report to the clean waste rock runoff collection pond. The clean waste rock runoff collection pond overflow reports to the JEB TMF. The JEB Dewatering Well System (DWS) was designed to reduce water treatment requirements and assist in controlling water levels within the JEB TMF by intercepting groundwater prior to any interaction with tailings porewater, and to maintain hydraulic containment of the tailings by ensuring a downward hydraulic gradient towards the JEB TMF. Previously the system consisted of thirty-six dewatering wells installed around the perimeter of the JEB TMF. The use of the dewatering well system was discontinued in June 2014, and all but three of the wells have been completely decommissioned. All dewatering wells associated with the JEB TMF will be decommissioned prior to the expansion of the JEB TMF to 468 mASL. Presently groundwater intrusion into, and hydraulic containment of the JEB TMF is managed by the base drain at the bottom of the JEB TMF connected to a Raise Well (CM05) Water management of the JEB TMF is discussed in section 3 of the Tailings Management TID (Orano 2020).

The JEB WTP receives water from various sources at the JEB site. It removes COPCs and suspended solids and uses three stages in the treatment of waste water: hydroxide precipitation of heavy metals, ferric adsorption of transition metals (e.g., arsenic and molybdenum) at pH 4, and radium removal by pH adjustment. Precipitated sludges from each stage are pumped directly to the tailings preparation circuit in the mill for treatment and disposal within the JEB TMF (AREVA 2016b).

All treated water from the McClean Lake Operation, which includes water from the JEB and Sue water treatment plants is released to the Sink Reservoir which is part of the Sink/Vulture Treated Effluent Management System (S/V TEMS).

2.5.2 Sue Site

Water management at the Sue site has been designed to collect and contain contaminated or potentially contaminated waters that may result from mining activities (Figure 2-9). Water from the Sue ore transfer pad ditch reports to the Sue C/A pit. The site runoff containment pond, pre-sedimentation ponds, clean waste rock pile containment ditch and, Sue open pits are designed to collect all Sue site surface runoff. Diversion and collection ditches around the Sue site are designed such that surface runoff from clean areas is directed to avoid the mining area while runoff from contaminated areas is directed to a containment pond or pit.

Although the Sue WTP was originally a two-stage plant designed largely to remove TSS from mining, in 2011 it was reconfigured to a three-stage treatment process (Figure 2-10), similar to the JEB WTP (AREVA 2016b). Water removed from the Sue C/A pit for treatment is pumped via the lime addition tank to the pre-sedimentation pond to settle out fines and act as a hydroxide precipitation stage. The water from the pre-sedimentation pond is then pumped to the first reaction tank inside the Sue WTP for ferric adsorption of transition metals (e.g., arsenic and molybdenum) at pH 4. From the first reaction tank, effluent is pumped to the sedimentation ponds for settling. From the sedimentation ponds the effluent is directed to the second reaction tank for radium removal by pH adjustment. The water is then pumped to two settling/monitoring ponds for final settling. The first settling/monitoring pond also acts as a confined volume that can be recycled through the reaction tanks if radium and arsenic treatment was insufficient to meet the discharge limits. Finally, the second settling/monitoring pond discharge feeds sand filters to reduce the residual suspended solids in the treated water before discharge to SV/TEMS.

For more information on the S/V TEMS and effluent management related topics, please refer to the McClean Lake Operation Environmental Performance TID (AREVA 2016).

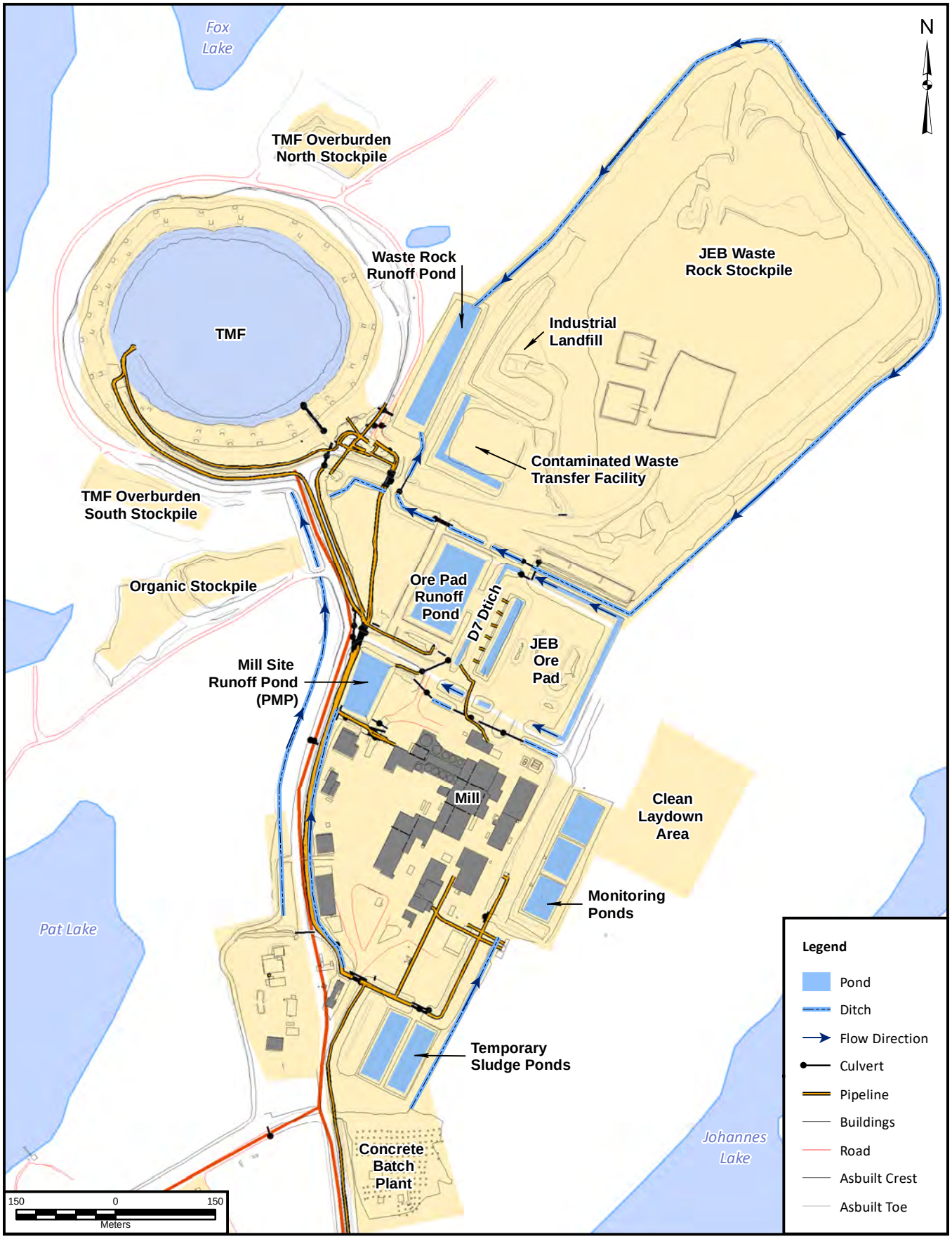
2.6 Sue C/A Contaminated Landfill

In early 2017, Orano submitted McClean Lake Operation - Contaminated Waste Management Notification/Application (Huffmann to Adilman and Akhter, Feb 24, 2017) to relocate the contaminated waste from the existing temporary contaminated landfill (TCL) at the JEB TMF to the new permanent Sue C/A Contaminated Landfill constructed in the Sue C/A Pit. The project included the decommissioning of the TCL and the construction and operation of the permanent Sue C/A Contaminated Landfill. Approval to construct, Alter or Extend pollutant control facilities PC17-032 was issued by SMOE (Adilman to Laniece, April 24, 2017) and acceptance of the notification/application was received from CNSC (Akhter to Laniece, May 31, 2017). The construction of the permanent Sue C/A Contaminated Landfill and the activities associated with the relocation of the waste from the existing TCL was completed in September 2017. The permanent contaminated landfill was constructed on the platform previously created by the placement of Sue E special waste (see section 3.2.1.1) on the western side of the Sue C/A pit (Figure 2-2) at an elevation of approximately 437 mASL (AREVA 2017 & AREVA 2018). The Sue C/A Contaminated Landfill has a relatively large surface area at approximately 400 m long with a width varying from 30 m to 60 m. The available capacity within the Sue C/A Contaminated Landfill is sufficient for handling the waste that had been placed into the TCL, and for managing ongoing waste material generated during operations in the future at a rate of approximately 1,500 m^3/year (un-compacted waste).

As a part of decommissioning the TCL, as of September 2017 approximately 18,391 m^3 of contaminated material from the TCL was excavated and backfilled into the Sue C/A Contaminated Landfill. The total volume incorporates sand that was used to cover materials on each load, preventing windblown debris. From 2018 to 2020, approximately 4,583 m^3 of waste has been placed in the Sue C/A Contaminated Landfill. Waste placed in the Sue C/A Contaminated Landfill consists of both non-process waste and process waste. The non-process waste includes used PPE, paper towel, metal, wood, concrete and waste that are placed into contaminated roll off bins prior to transport to the landfill. Process waste originates from the McClean Lake mill, the SABRE project, as well as the JEB and Sue WTPs and includes scales from reaction tanks, leach tanks and clarifiers as well as both regenerated and non-regenerative spent filter materials. Whereas non-process waste is not expected to produce any COPC source terms, process

wastes have the potential to add COPC source terms to the Sue C/A pit. Measured quantities, solid content and inventory of process waste placed in the Sue C/A Contaminated Landfill is presented in section 4.2.6.

The Sue C/A Contaminated Landfill is currently being considered as a potential site for the future placement of industrial wastes along with the contaminated waste. The industrial wastes are non-hazardous and non-contaminated materials including tires, screening, drill steel, welding tips and flux, waste metal vehicle parts, insulation, siding, furniture, industrial plastic as well as other materials not suitable for recovery, reuse, or recycling. Similar to the contaminated non-process waste currently being placed in the Contaminated Landfill, the industrial wastes are not expected to produce any COPC source terms to the Sue C/A pit.



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/12/2021 Scale: 1:8,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

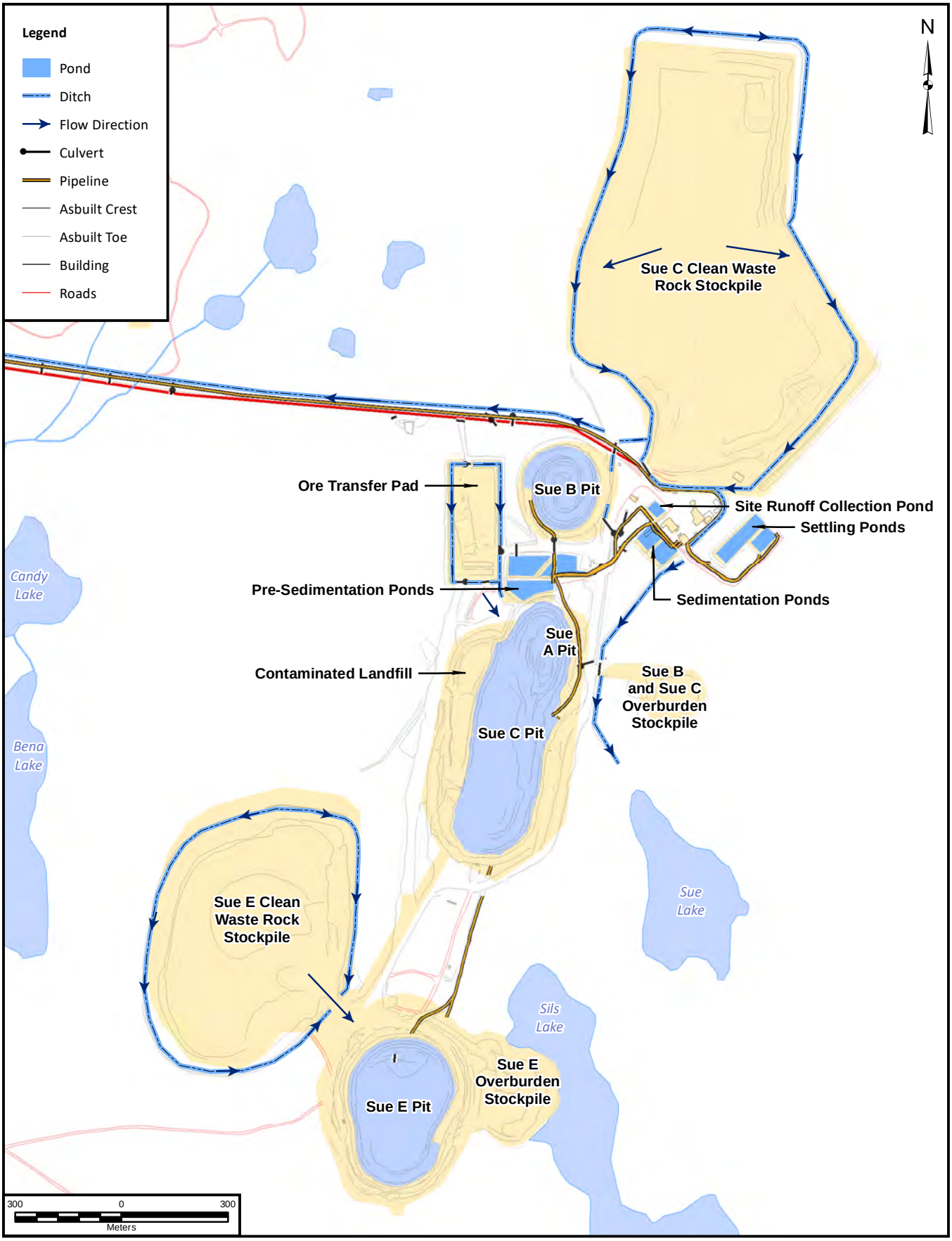
McCLEAN LAKE OPERATION

FIGURE 2-8
JEB SITE PONDS AND DITCHES

WASTE ROCK MANAGEMENT
TECHNICAL INFORMATION DOCUMENT

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Figure 2-8 - JEB Site Ponds and Ditches.mxd



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/12/2021 Scale: 1:15,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

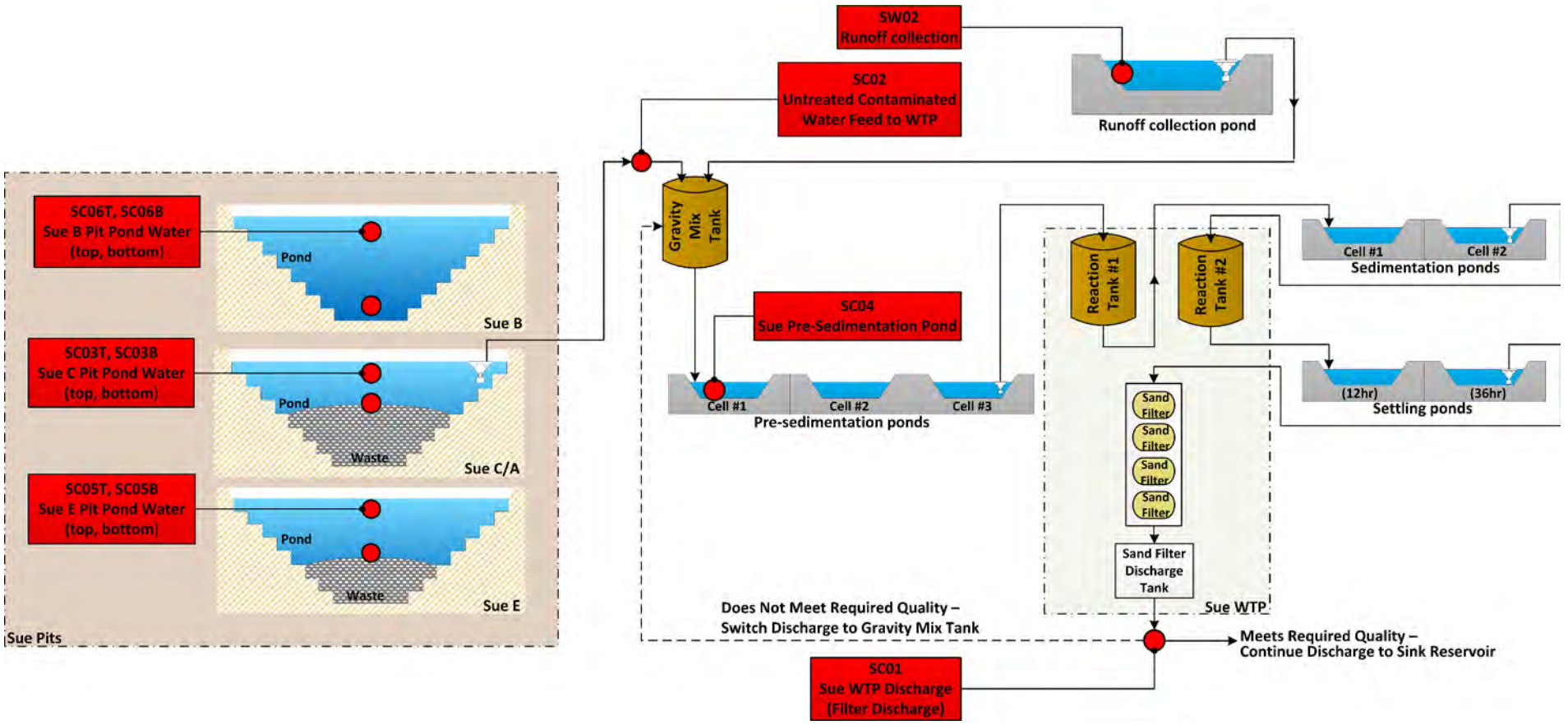
McCLEAN LAKE OPERATION

FIGURE 2-9
SUE SITE PONDS AND DITCHES

WASTE ROCK MANAGEMENT
TECHNICAL INFORMATION DOCUMENT

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\FIgure 2-9 - Sue Site Ponds and Ditches.mxd



Projection: NA
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/12/2021
Scale:
Data Sources:

McCLEAN LAKE OPERATION

FIGURE 2-10
SUE WATER TREATMENT PLANT SCHEMATIC

WASTE ROCK MANAGEMENT
TECHNICAL INFORMATION DOCUMENT

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Figure 2-10 - Sue WTP Schematic.mxd

3 Operations to Date

This section provides a brief overview of waste rock segregation criteria and methodology, materials inventories, waste rock placement, and pit water quality.

Open pit mining produces waste rock material that must be excavated to access the uranium ore. During mining of the JEB, Sue C, and Sue E pits, mined waste material was carefully segregated into different categories (organics, till overburden, clean waste rock, and special waste) and placed within the designated facilities described in section 2.

Segregation of mined waste material for the Sue A and B pits was limited to the removal of overburden (organics and till) and waste rock. Due to the complex geology of the Sue A and Sue B pits, all waste rock was treated as special waste and designated for in-pit disposal in the facilities described in Section 2.

The discussion on waste rock segregation criteria and related operational procedure is presented as historical information.

3.1 Waste Rock Production

In this section, the segregation criteria, operational segregation procedures, and current inventory are discussed for each deposit that has been mined to date at the McClean Lake Operation. This information is presented as historical information and is intended to be used as a reference for future mining at the McClean Lake Operation and the Midwest Project. Suggestions for continual improvement are also provided.

3.1.1 Segregation Criteria

The criteria traditionally applied in the uranium mining industry to segregate clean waste from special waste and ore is based on the uranium content. Orano applies the following segregation criteria, which also considers arsenic content:

- clean waste is material that contains less than 250 mg/kg uranium, has low acid generating potential, and contains less than 75 mg/kg arsenic;
- special waste is material that contains between 250 mg/kg and 850 mg/kg uranium, or has been identified as having acid generating potential, or contains greater than 75 mg/kg arsenic; and,
- ore is material that contains more than 850 mg/kg uranium.

Prior to the 2007 Midwest EIS (AREVA 2007b), the typical arsenic cut-off between clean and special waste was 200 mg/kg. During the mining of Sue A, Sue E, and Sue B, X-ray fluorescence (XRF) technology was applied and evaluated as a segregation tool. The results of this study were included in the Midwest EIS

(AREVA 2007b). The study showed that application of this technology allowed for the lowering of the arsenic segregation limit to 75 mg/kg due to its low detection limit. The XRF has since been incorporated into the operational segregation procedures for the McClean Lake Operation and is described further in Section 3.1.2.2.

Specific segregation methodologies are developed on a project by project basis. The segregation methodology for each project to date is presented below.

3.1.1.1 JEB and Sue C

The applicability of the general classification presented in Section 3.1.1 was confirmed during the 1991 test program for JEB and Sue C. This test program quantified waste rock in terms of acid generating potential and concentrations of arsenic, nickel, and other key COPCs (Minatco 1991b). The study was based on the knowledge that mineralization events which introduce uranium also introduce sulphide minerals into the deposit, resulting in acid generating potential and the potential to release heavy metals. Therefore, it was expected that a correlation could be made between uranium and other constituents such as arsenic and nickel. If the uranium content was found to be low, then the content of sulphide minerals (and acid generating potential) was also expected to be low.

It was concluded, based on the 1991 test program, that JEB and Sue C waste rock could be segregated during mining into clean waste and special waste based on uranium analysis alone (Minatco 1991b). This was further confirmed during mining of the JEB pit by comparing uranium levels (probing/scanning results) in the blast hole cutting samples collected during mining to those of other key elements/metals (geochemical analysis). A total of 1,221 blast hole cutting samples (clean waste rock, special waste, and ore) were analyzed, with the focus on arsenic which was identified as one of the key constituents. The relationship between arsenic and uranium was examined using a scatter plot, as shown in Figure 3-1, which demonstrates a high correlation between these two elements (r^2 = 0.88). Typically, it was observed that cutting samples with uranium content above the special waste cut-off level (250 mg/kg) also had an arsenic content above the special waste cut-off level (200 mg/kg at the time). A very small percentage of samples did not conform to this relationship. Based on these results, the approach to segregating special waste from clean waste during mining of the Sue C pit was based on uranium content (i.e. radiometric probing/scanning results).

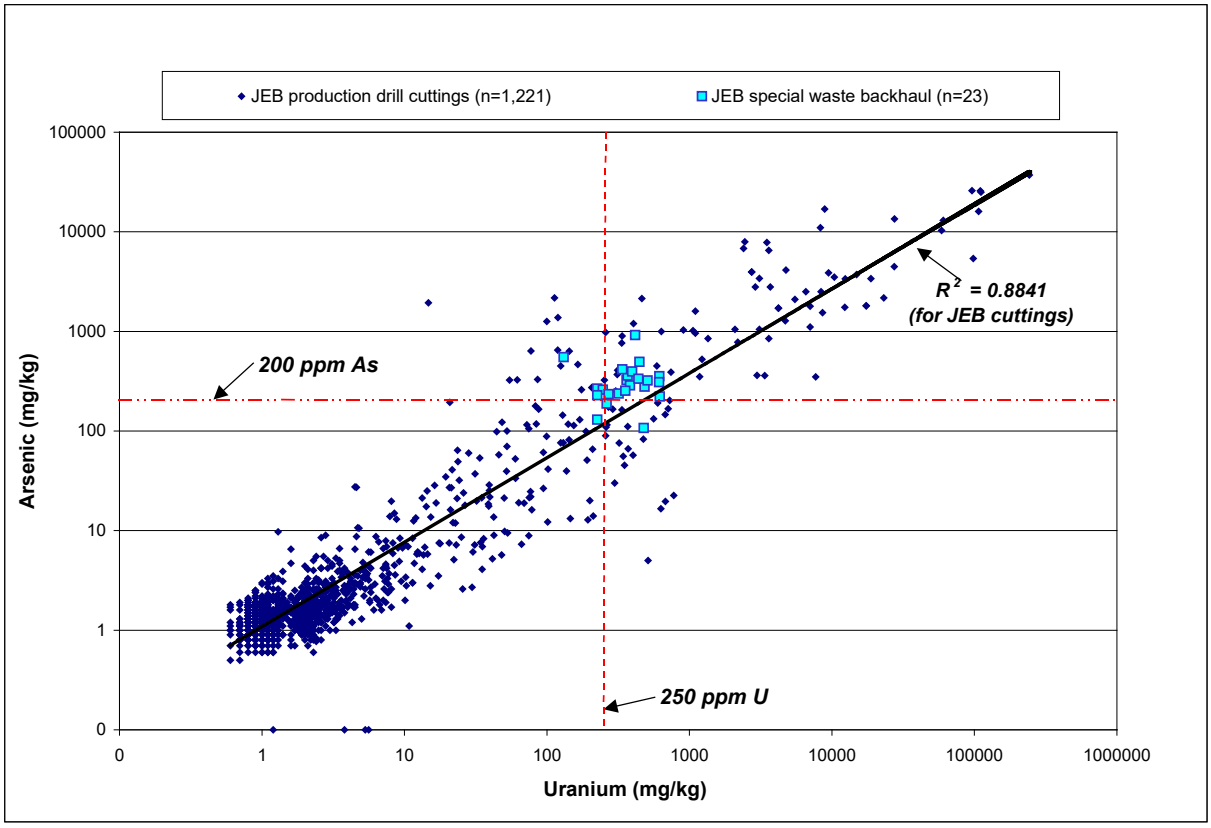


Figure 3-1: Uranium Content vs. Arsenic Content Relationship for JEB Pit

3.1.1.2 Sue A and Sue B

Studies (Minatco 1991b) prior to mining suggested that segregation of clean and special waste for Sue A and Sue B may not be possible due to the complex geology of the Sue A and B deposits. Therefore, the expectation prior to mining was that all waste rock may need to be treated as special waste which was confirmed during mining, and segregation did not occur. For Sue B, overburden was separated and stockpiled, but all waste rock was treated as special waste. For Sue A, all overburden and waste rock material were treated as special waste.

3.1.1.3 Sue E

For Sue E, waste rock characterization studies suggested that there was a clear cut-off of elevated arsenic concentrations above 410 mASL in the open pit. Therefore, it was expected that waste rock above an elevation of 410 mASL could be segregated and that the clean waste was expected to have virtually no acid generating potential. Below this elevation, it was recommended that all waste rock be treated as special waste to be conservative. In the field, this cut-off elevation was redefined as 406 mASL based on field measurements. Therefore, it was possible to segregate waste recovered during the mining of Sue E into overburden, clean waste, and special waste.

3.1.2 Operational Procedures for Waste Rock Segregation

Operational procedures have been developed in order to ensure that special waste and clean waste rock are effectively categorized, separated, and transported to the appropriate disposal area. These procedures are described in detail below.

3.1.2.1 Radiometric Techniques and Drill Cutting Assays

The uranium content of waste rock is estimated in the field by radiometric techniques. The uranium content is subsequently confirmed with assay results. This has been the main segregation procedure used at the McClean Lake Operation to date. The following methods are used:

- systematic radiometric scanning of blast hole cuttings in clean waste zones to detect anomalous activity levels;
- radiometric probing of blast holes in ore zones to define ore/waste boundaries;
- radiometric scanning of working faces during excavation to confirm blast hole scanning/probing results;
- overhead scanning of waste rock in the proximity of special waste or ore once loaded onto trucks;
- daily scanning of the clean waste rock disposal area to ensure that no special waste or ore was inadvertently placed; and
- systematic sampling to assess acid generation potential of placed clean waste rock.

The effectiveness of this waste rock segregation method was assessed for Sue E in the Sue E Follow-Up Program Report (AREVA 2012a). The follow-up program verified that the above methods, in conjunction with XRF analysis, were used to successfully segregate clean and special waste for the Sue E Project.

3.1.2.2 X-Ray Fluorescence (XRF) Analysis

While radiometric techniques have proven reliable for estimating the uranium content of waste rock, the need for also estimating the arsenic content was identified prior to the mining of Sue A. Arsenic is a key constituent of concern at the McClean Lake Operation and the Midwest Project, and therefore a reliable field technique is required to estimate the arsenic content to improve identification of potentially problematic waste rock. X-ray fluorescence (XRF) technology was selected as the best tool to achieve this goal.

During XRF analysis, sediment samples are irradiated with high energy X-rays. For arsenic detection, a sealed ^{109}Cd radioisotope source is used. After the sample is irradiated, atoms of certain elements in the sample may absorb the X-ray energy, which results in a dislodging of electrons from the inner shell of the atoms. In this process, known as the photoelectric effect, the resulting vacancy is filled by an electron that cascades in from outer electron shells. This rearrangement of electrons results in the emission of X-ray characteristics of each atom, which is termed X-ray fluorescence.

The basic components of the XRF equipment are high performance detectors and multi-channel analyzers. These are used to measure characteristic X-ray energies, which identify elements, and to measure the intensity of these X-rays to estimate the concentration of the elements. The XRF technique provides a non-destructive means of multi-element analysis.

An evaluation program for the XRF was initiated in 2004, followed by a field evaluation during the mining of Sue A. As mentioned above, it was expected that all Sue A waste rock would be treated as special waste, and therefore a waste rock segregation methodology was not required. However, Sue A provided the opportunity for a field test where the XRF could be evaluated under actual mining conditions. Full details of this field test can be found in Appendix X of the 2007 Midwest EIS (AREVA 2007b). Upon completion of this initial field test, the XRF was further evaluated during the mining of Sue E and Sue B.

The XRF unit used at the McClean Lake Operation was a small, handheld bulk sample analyzer with a 0.35 keV resolution Si PIN detector. The XRF is used in systematic sampling of blast hole cuttings throughout mining. The purpose of blast hole sampling is to provide systematic geochemical data to identify and properly classify waste rock material excavated from the pit. Composite grab samples from each blast pattern are taken from the blast hole cuttings, dried at 80°C, and screened to remove particles that are greater than 1 mm in diameter. The samples are then placed in the XRF sample cup for analysis. The XRF can detect a variety of elements; however, the primary COPCs analyzed by XRF at the McClean Lake Operation are arsenic, uranium, lead, and nickel.

The analytical performance of the XRF technique is limited by several factors, which range from atomic structure to instrument design to sample properties. The most significant effect at the atomic level is the interference from overlapping energy spectrums and absorption of X-rays by other elements. These effects can be partially corrected by calibration using certified standards and site-specific samples. Several

procedures were developed in association with the use of XRF technology for waste rock segregation purposes at the McClean Lake Operation, and these procedures were applied during the mining of Sue A, Sue B, and Sue E.

A subset of the composite samples subjected to XRF analyses are routinely sent to SRC Analytical Laboratories (SRC). The purpose of these analyses is to determine constituent concentrations to validate results obtained by the XRF. A composite sample is prepared by combining small samples from each of the individual blast hole samples. Samples for Sue A, Sue B, and Sue E were analyzed for arsenic, uranium, lead, and nickel at SRC, as these were the key constituents of concern measured by the XRF.

3.2 Special Waste Rock Placement and Water Management

3.2.1 Special Waste Rock Placement in the Sue Pits

This section describes the current as-built conditions of each pit, and the methods of placing special waste rock in the Sue special waste rock management facilities (Sue C and Sue E pits).

3.2.1.1 Sue C Pit

The Sue C pit is the largest of the Sue pits, as shown in Figure 2-2. Due to its size and depth, this pit was proposed as a special waste management facility for the McClean Lake Operation during environmental assessment and licensing through the 1991 McClean EIS (Minatco 1991b). The Sue C pit was approved for the disposal of special waste and currently contains special waste rock from Sue C, Sue E, and JEB, as well as all waste rock from Sue A. Special waste rock from the Cigar Lake, McClean Underground, Caribou, and Sue D ore bodies are also planned for disposal in the Sue C pit.

The current placement of special waste rock is shown in the Sue C pit as-built and corresponding cross-sections,

Figure 3-4, and Figure 3-5, respectively.

JEB, Sue C, and Sue A Special Waste Rock Placement in Sue C Pit

Backhauling of JEB and Sue C special waste rock into the Sue C pit was completed on April 25, 2002 (COGEMA 2004). The placement of JEB and Sue C special waste rock was carried out in a single lift off a working platform established at about 355 mASL. Special waste rock was hauled down the pit ramp using 100-ton haulage trucks and dumped onto a working platform. A bulldozer was used to push the material over the working face into ponded water, progressively extending the platform across the pit in a single lift. The placement initially followed the west pit wall, and then was extended to the east wall with a perimeter ditch being left between the fill and the pit wall. The special waste rock fill was then extended in both a north and south direction.

During special waste rock placement, the pit water levels were maintained at a minimum of 5 m below the working platform to ensure the stability of the waste rock slopes during placement. Pit inflow water was pumped from a sump located at the opposite end of the pit from the special waste rock placement. This approach minimized the suspended solids in the water being removed for treatment. The top of the JEB and Sue C special waste rock was placed at approximately 350 mASL.

Sue A special waste rock was placed in Sue C concurrently with the mining of the Sue A ore. The top elevation of Sue A special waste rock varies from 330-410 mASL depending on the location in the Sue C pit.

Sue E Placement in Sue C Pit

Special waste rock from the Sue E project was hauled and temporarily placed on the west edge of the Sue C/A pit resulting in a decrease in Sue C/A pit water quality, which is further described in Section 3.2.4.1. From July 3 to September 17, 2009, the special waste rock was pushed down into the Sue C/A pit (AREVA 2010). Due to the water level in the pit at this time, it was not possible to place the Sue E special waste rock in an even layer at the base of the pit. Rather, the special waste rock was pushed down as far as possible from the west side of the pit, and the pit was allowed to reflood naturally over the waste rock.

During the time that the Sue E special waste rock was pushed down, four piezometers were installed in the special waste rock for the purpose of verifying Sue E special waste rock pore water source terms for the Sue E Follow-Up Program (AREVA 2012a). One of the piezometers also intersected Sue A special waste rock, allowing for the collection of Sue A pore water quality data. The results from these piezometers are summarized in Section 4.2.2.2 and Section 4.2.4.2 for Sue A and Sue E, respectively. The data can be found in Appendix AII of this document. After the completion of the Follow-Up Program, the piezometers were allowed to flood and are no longer accessible.

The top elevation of Sue E special waste rock varies from 370-430 mASL based on the location in the Sue C pit. The current placement of Sue E special waste rock is shown in the Sue C pit as-built and corresponding cross-sections, Figure 3-4 and Figure 3-5, respectively.

3.2.1.2 Sue E Pit

The Sue E pit was assessed and approved as a special waste rock management facility for Sue B special waste rock by SMOE and CNSC through the Sue E and Caribou EIS's (AREVA 2004; AREVA 2009a).

At the end of 2008, the Sue E pit was filled to the 400 mASL level with 1,441,350 bcm or 3,502,481 tonnes of Sue B special waste rock. The special waste rock was covered with a minimum 2 m compacted till cap. A radiation survey, topographic survey, photographic record, and a series of density tests were completed before the dewatering pumps were removed and the pit was allowed to reflood naturally (AREVA 2009b). The placement of Sue B special waste rock is shown in the Sue E pit as built cross-sections, Figure 3-6 and Figure 3-7, respectively.

3.2.1.3 Sue B Pit

The Sue B pit was not used as a special waste rock management facility. At the end of 2008, a minimum 1 m compacted till cap was placed over the bottom horizon of the pit. A radiation survey, topographic survey, photographic record, and a series of density tests were completed before the dewatering pumps were removed and the pit was allowed to reflood naturally (AREVA 2009b). The as-built flooded pit is shown in Figure 3-2.

7500 E

7600 E

7700 E

North

2300 N

2200 N

2100 N

2000 N

1900 N

B

C'

SUE B

WATER ELEVATION ~451.9 masl

A

A'

C

B'

McClean Lake Operation

LEGEND

CREST

TOE

PIT WATER

SECTION LINE A——A'

NOTES: FIGURE NUMBER ADDED FOR WRTID (TL)

LOCAL MINE COORDINATES

WATER ELEVATION RECORED 16/12/20

orano

SCALE:	AS SHOWN	DATE
DESIGNED:		
DRAWN:	M.S.	10/01/21
CHECKED:	D.H.	13/01/21
APPROVED:	S.P.	15/01/21
REF. DWGS	232C106	
REV. A:		
REV. B:		
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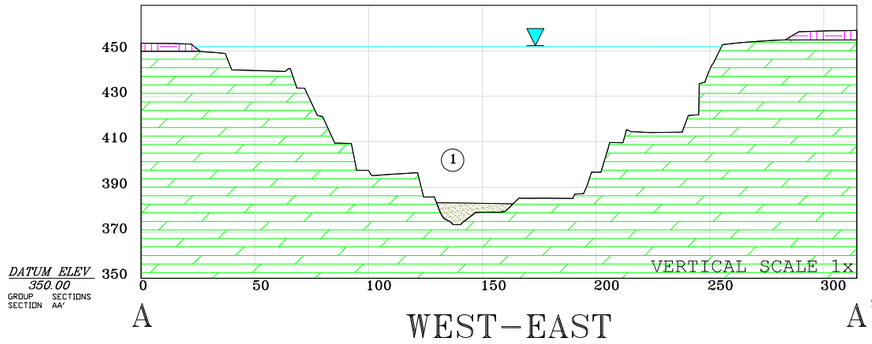
FIGURE 3-2

SUE B PIT

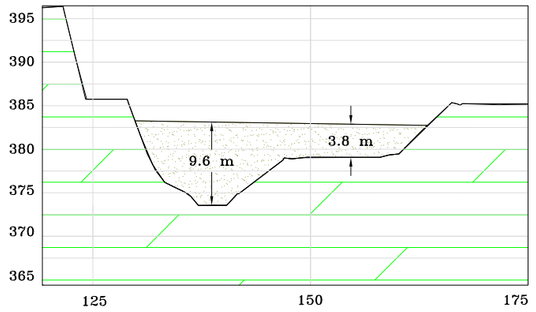
AS-BUILT DRAWING

DECEMBER 31, 2020

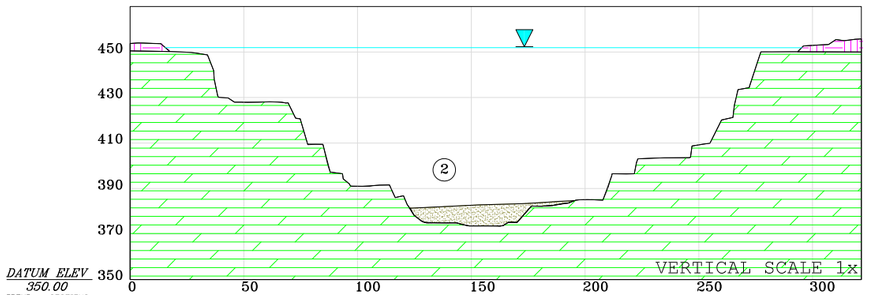
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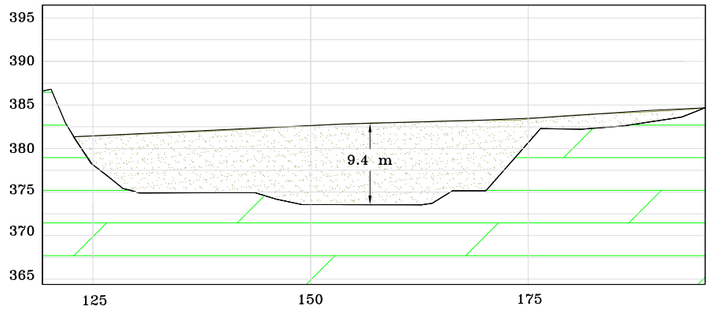
A WEST–EAST A'



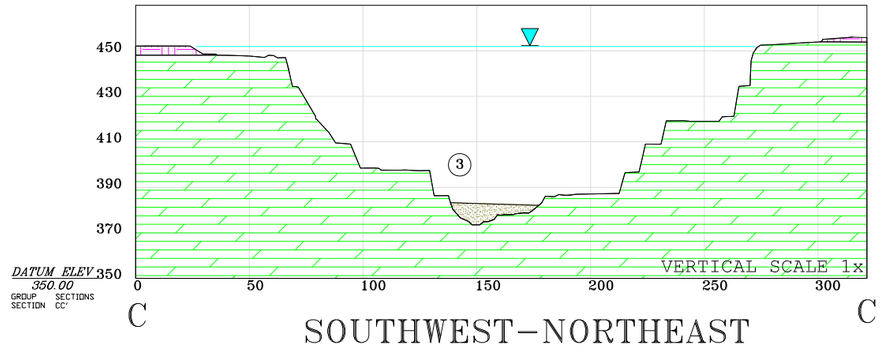
DETAIL (1)



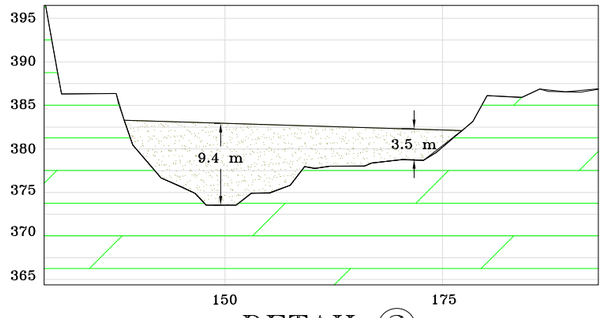
B NORTH–SOUTH B'



DETAIL (2)



C SOUTHWEST–NORTHEAST C'



DETAIL (3)

LEGEND

WATER LEVEL
OVERBURDEN
BEDROCK
OVERBURDEN CAP

McClean Lake Operation

NOTES: FIGURE NUMBER ADDED FOR WRTID (TL)
PIT WATER ELEVATION 451.9 masl ON 16/12/20

orano

SCALE:	AS SHOWN	DATE
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CHECKED:	D.H.	13/01/21
APPROVED:	S.P.	15/01/21
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FIGURE 3-3

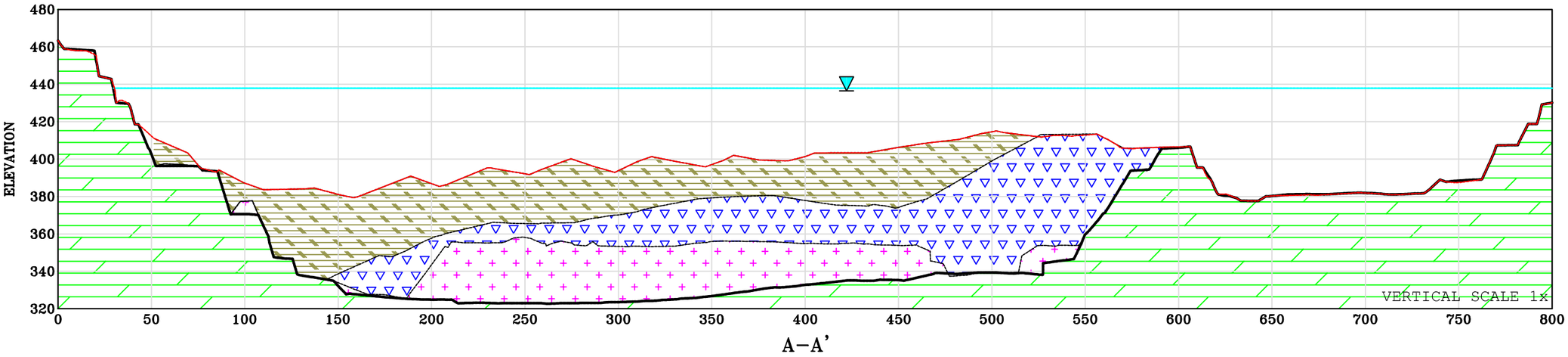
SUE B PIT
AS-BUILT CROSS-SECTIONS
DECEMBER 31, 2020

DWG NO.: 232C106 REV. NO.: 0

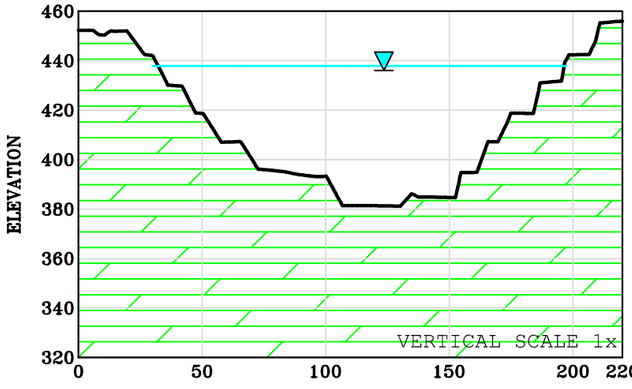
7200 E
7400 E
7600 E
1800 N
1600 N
1400 N
1200 N
1000 N
North
A
A'
B
B'
C
C'
D
D'
E
E'
SUE C/A
WATER ELEVATION ~437.2 masl
PIT WATER
CREST
TOE
SECTION LINE A——A'
LEGEND
McClean Lake Operation
NOTES: FIGURE NUMBER ADDED FOR WRTID (TL)
LOCAL MINE COORDINATES
WATER ELEVATION RECORDED 16/12/20
orano

SCALE:	AS SHOWN	DATE
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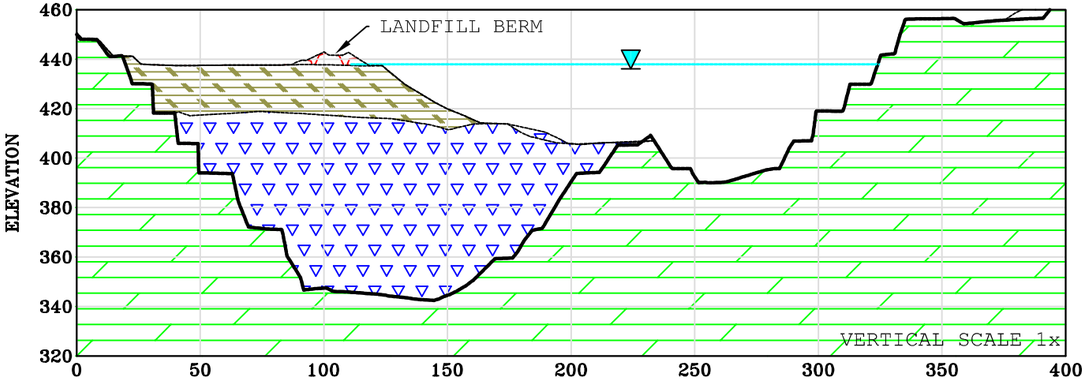
FIGURE 3-4
SUE C/A PIT
AS-BUILT DRAWING
DECEMBER 31, 2020
DWG NO.: 233C290 | REV. NO.: 0



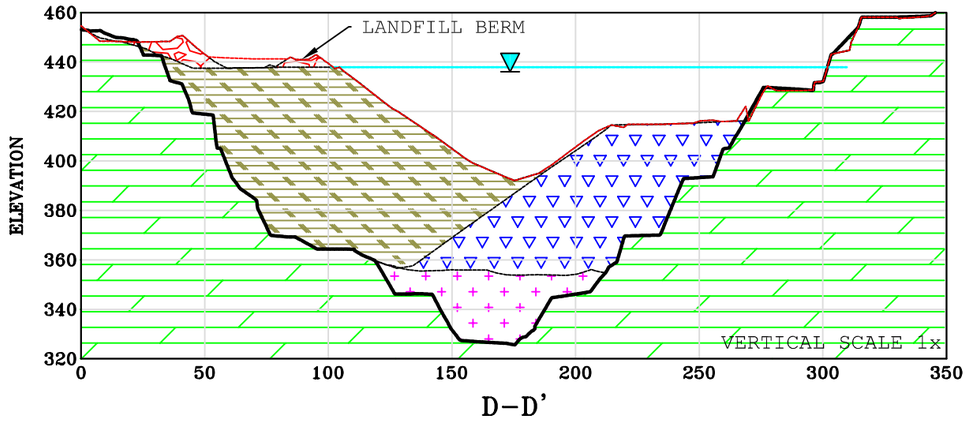
A–A’



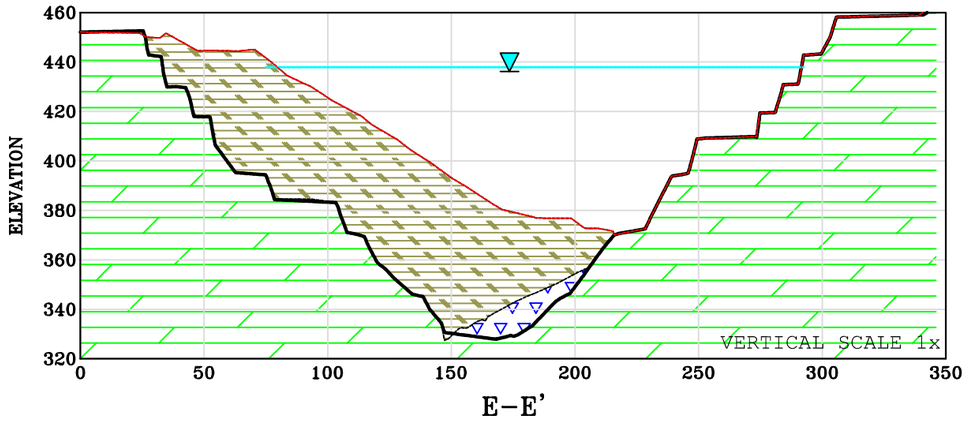
B–B’



C–C’



D–D’



E–E’

McClean Lake Operation

LEGEND

- SUE E SPECIAL WASTE
- SUE A SPECIAL WASTE
- JEB AND SUE C SPECIAL WASTE
- BEDROCK
- SUE E WASTE ROCK
- WATER LEVEL

NOTES: FIGURE NUMBER ADDED FOR WRTID (TL)

PIT WATER ELEVATION 437.2 masl ON DECEMBER 16, 2020

orano

SCALE:	AS SHOWN	DATE
DESIGNED:		
DRAWN:	M.S.	10/01/21
CHECKED:	D.H.	13/01/21
APPROVED:	S.P.	15/01/21
REF. DWGS	233C290	
REV. A:		
REV. B:		
DIR:	G:\Site Services\...\Drawing	

FIGURE 3–5

SUE C/A PIT
AS–BUILT CROSS–SECTIONS
DECEMBER 31, 2020

DWG NO.: 233C291 | REV. NO.: 0

6900 E
7000 E
7100 E
7200 E
600 N
500 N
400 N
300 N
200 N
100 N
North
B
C'
A
A'
C
B'
SUE E
WATER ELEVATION ~449.2 masl

McClean Lake Operation

LEGEND
CREST
TOE
SECTION LINE A——A'
PIT WATER

NOTES: FIGURE NUMBER ADDED FOR WR TID (TL)
LOCAL MINE COORDINATES
WATER ELEVATION RECORDED 16/12/20

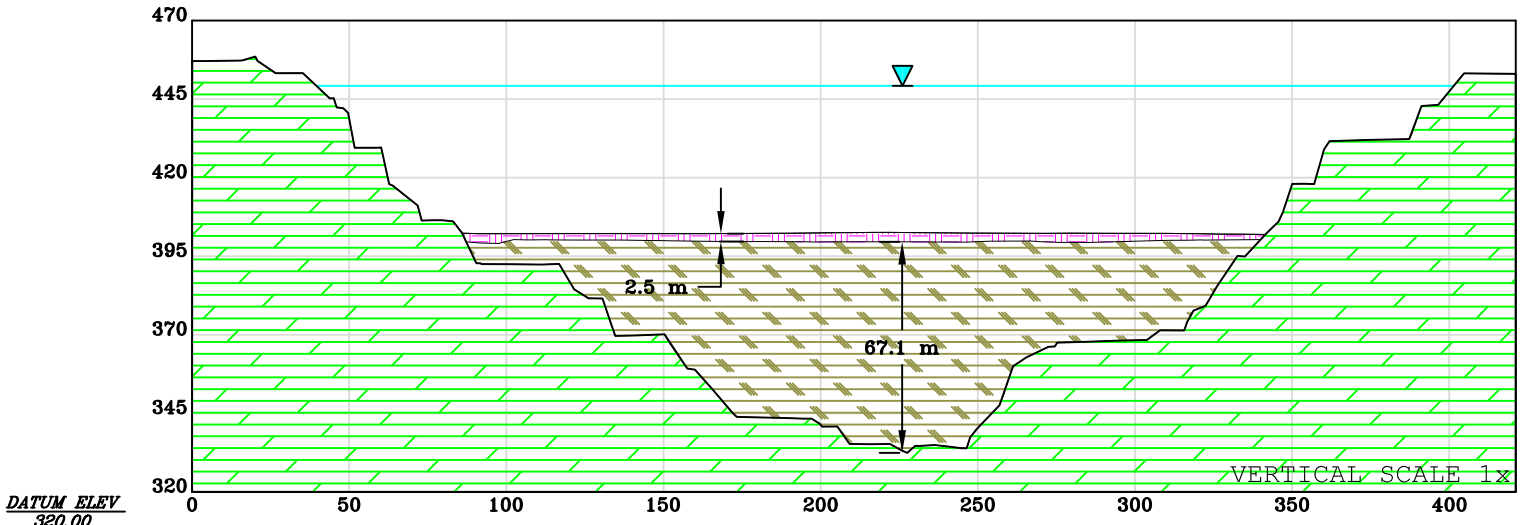
orano

SCALE:	AS SHOWN	DATE
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APPROVED:	S.P.	15/01/21
REF. DWGS	235C181	
REV. A:		
REV. B:		
DIR:	G:\Site Services\Drawing	

FIGURE 3-6

SUE E PIT
AS-BUILT DRAWING
DECEMBER 31, 2020

DWG NO.: 235C180 | REV. NO.: 0

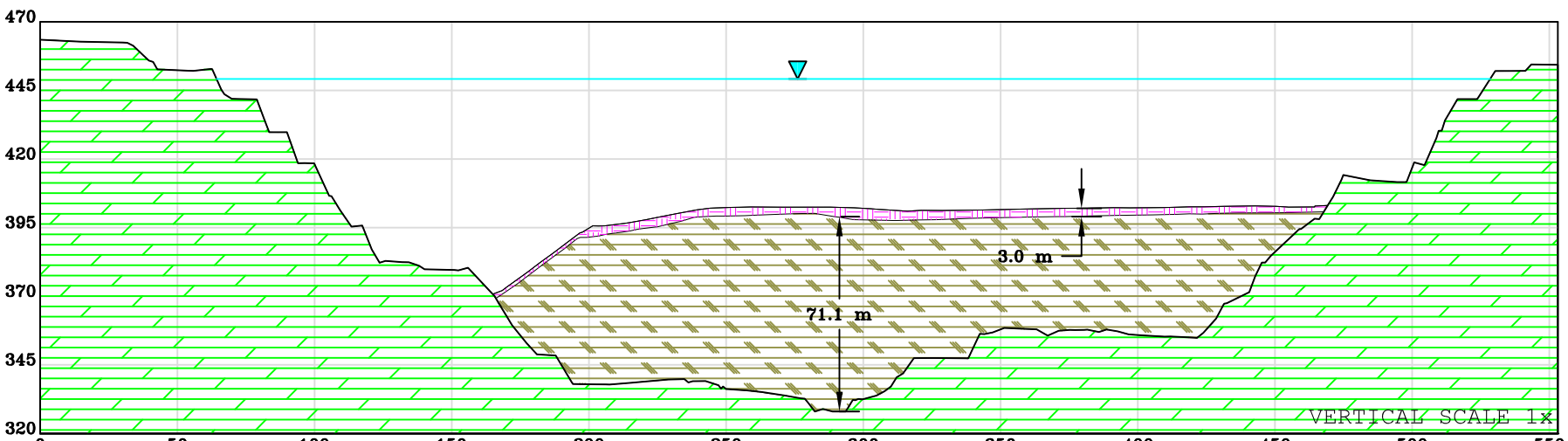


DATUM ELEV
320.00
GROUP SECTIONS
SECTION AA'

A

WEST–EAST

A'

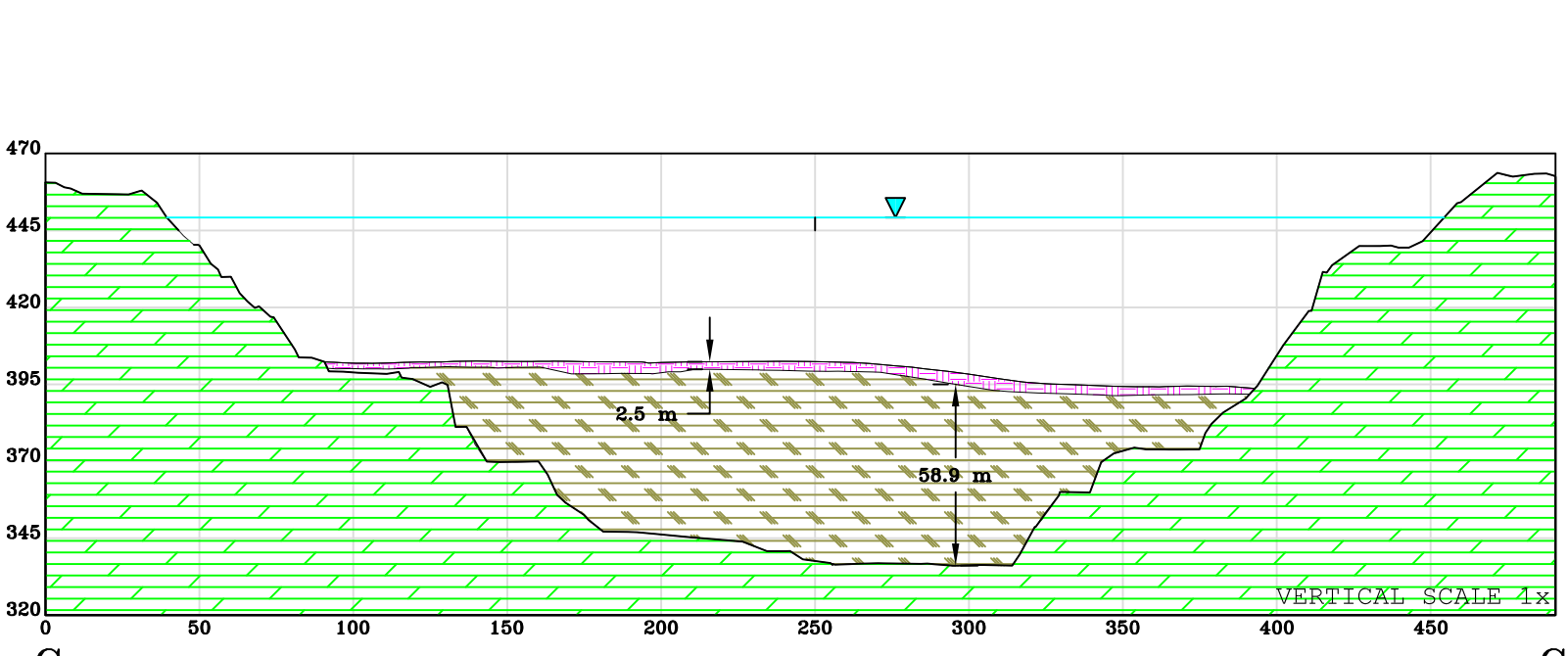


DATUM ELEV
320.00
GROUP SECTIONS
SECTION BB'

B

NORTH–SOUTH

B'



DATUM ELEV
320.00
GROUP SECTIONS
SECTION CC'

C

SOUTHWEST–NORTHEAST

C'

McClean Lake Operation

LEGEND

SUE B SPECIAL WASTE
OVERBURDEN
BEDROCK
WATER LEVEL

NOTES:FIGURE NUMBER ADDED FOR WR TID (TL)
LOCAL MINE COORDINATES
WATER ELEVATION 449.2 m ON 16/12/20

orano

SCALE:	AS SHOWN	DATE
DESIGNED:		
DRAWN:	M.S.	10/01/21
CHECKED:	D.H.	13/01/21
APPROVED:	S.P.	15/01/21
REF. DWGS	235C180	
REV. A:		
REV. B:		
DIR:	G:\Site Services\...\Drawing	

FIGURE 3–7

SUE E PIT
AS–BUILT CROSS SECTIONS
DECEMBER 31, 2020

DWG NO.: 235C181 | REV. NO.: 0

3.2.2 Estimate of Waste Rock from Future Projects

3.2.2.1 McClean Underground, Caribou, and Sue D

In 2011, the McClean Underground project was revised to include the underground mining of Caribou and Sue D (AREVA 2011b). It is estimated that 804,180 tonnes of total waste rock will be produced from this project. This quantity represents the maximum amount of special waste rock that would require disposal and includes the entirety of the basement rock from the ramp access. During mining however, it is anticipated that attempts will be made to segregate the problematic waste rock from the ramp access. It is expected that the quantity of special waste rock will be reduced using segregation methods. As a worst-case scenario, the full quantity of 804,180 tonnes will be assessed for in-pit disposal in this Waste Rock TID.

In the Caribou EIS (AREVA 2009a), McClean Underground special waste rock was assessed and approved for disposal in the Sue E pit. As Sue B special waste rock has already been placed and capped in the Sue E pit, and the pit has been allowed to reflood, the current proposal is to place McClean Underground special waste in the Sue C/A pit. The effects of this will be assessed in Part B of this Waste Rock TID. Special waste rock from the open pit mining of Caribou has been assessed and approved for placement in Sue C/A, while waste rock placement from Sue D has not been assessed and approved to date.

As the amount of Caribou special waste rock planned for deposition in Sue C/A will be significantly reduced by using underground mining techniques, it is expected that this overall change in special waste rock placement will result in negligible changes to predicted effects.

3.2.2.2 Cigar Lake

Cigar Lake special waste rock will be deposited in the Sue C/A pit in two phases. The Phase I quantity is currently estimated to be 439,200 m^3 (i.e. the mined in Stockpile Cigar Lake as of December 2020 = 385,600 m^3 and unmined Cigar Lake Phase I = 53,600 m^3), while the Phase 2 quantity is estimated at 175,000 m^3. Placement of Cigar Lake Phase 1 special waste rock was initially assessed and approved in the 2001 Disposal of Cigar Lake Waste Rock EIA (COGEMA and CLMC 2001). In 2017, geochemical assessment was conducted on Potentially Reactive Waste Rock (PRWR) at the Cigar Lake mine to provide an expanded geochemical data on, PRWR on Stockpile C, unmined Cigar Lake Phase I and Phase II for Orano to reassess the risk associated with deposition of the PRWR in the Sue C/A pit. Details of the result of the 2017 geochemical assessment are provided as Appendix AII of this document. The updated 2017 geochemical assessment resulted in COPC source terms generally consistent, or lower than, the 2001 Disposal of Cigar Lake Waste Rock EIA (Section 4.3.2). Placement of the Cigar Lake Phase I special waste rock in the Sue C/A pit will occur in approximately 2030, while Phase 2 will occur in approximately 2052.

3.2.2.3 Midwest

For the Midwest project, special waste rock will be placed in the mined-out Midwest pit, while clean waste rock will be deposited in two proposed surface stockpiles. Stockpile A will be located to the north of the Midwest pit and cover an area of approximately 100 ha, while Stockpile B will be located south of the pit and cover an area of approximately 75 ha.

Placement of Midwest special waste rock in a proposed Midwest pit was assessed and approved in the Midwest EIS (AREVA 2007b; AREVA 2011a). The Surface Access Borehole Resource Extraction (SABRE) Technology is currently being considered by Orano for the mining of the Midwest ore and this has the potential to significantly reduce the volume of waste rock that will be produced from the Midwest project. Midwest will be considered in Part B of this study in predictive waste rock modelling scenarios. The incremental effects from Midwest Project will be combined with effects of the Sue Mining Area in order to consider cumulative effects on Collins Creek.

3.2.3 Summary of Current and Predicted Inventory

Table 3-1 presents the current inventory and management location of waste rock from each completed project. The estimated future quantities of Cigar Lake, Sue D, Caribou, and McClean Underground waste rock are also included and are described further in the following section. For Part B of this study, waste rock quantities in tonnes will be used. Conversion factors for converting quantities in lcm and bcm to tonnes are provided in the footnotes of Table 3-1.

Table 3-1: Current Waste Rock Inventory and Expected Future Production

Pit	Material Type	Location	Volume (bcm)[1]	Mass (tonnes)[2]	Status
JEB	Organic Overburden	JEB Organics Stockpile	128,369	82,541	Current Inventory
	Till Overburden and Clean Waste Rock[3]	JEB Clean Waste Rock Stockpile	4,406,993	10,708,993	
	Special Waste Rock	Sue C Pit	27,796	67,544	
Sue C	Overburden	Sue C Overburden Stockpile	98,003	215,607	
	Overburden and Clean Waste Rock	Sue C Clean Waste Rock Stockpile	10,006,102	24,314,828	
	Special Waste Rock	Sue C Pit	273,024	663,448	
Sue A	Overburden	Sue C Pit	124,580	274,076	
	Special Waste Rock	Sue C Pit	1,448,841	3,520,684	
Sue B	Overburden	Sue C Overburden Stockpile	200,510	441,122	
	Special Waste Rock	Sue E Pit	1,441,350	3,502,481	
Sue E	Overburden	Sue E Overburden Stockpile	697,664	1,534,861	
	Clean Waste Rock	Sue E Clean Waste Rock Stockpile	4,587,836	11,148,441	
	Special Waste Rock	Sue C Pit	2,437,822	5,923,907	
McClean, Sue D, Caribou[4]	Total Waste Rock Quantity	Sue C Waste Rock Stockpile/Sue C/A Pit	330,938	804,180	Future Production
Cigar Lake[5]	Special Waste Rock	Sue C/A Pit	614,200	1,492,506	
Midwest[6]	Clean Waste Rock	Proposed Stockpiles A and B	35,000,000	85,050,000	
	Special Waste Rock	Proposed Midwest Pit	2,500,000	6,000,000	

[1] For current inventory, the McClean Lake Operation generally reports in bank cubic metres (bcm). This is the in-situ volume prior to excavation. Volume estimates for current inventory are based on site records from the McClean Lake Surface Department.

[2] Conversion factors are as follows:

Organics: bcm to tonnes = 0.643

Overburden: bcm to tonnes = 2.20

Clean and Special Waste: bcm to tonnes = 2.43

[3] Quantities in bcm of till overburden and clean waste rock were not separated, so an overall tonnage was calculated using the waste rock conversion factor of 2.43. The quantity in bcm is considered to be the most reliable measurement. The value of 4,406,993bcm is the volume prior to the start of TMF Optimization and Expansion activities. Future planned construction activities in the TMF are expected to result in a stockpile volume of approximately 3,580,000 bcm at decommissioning. Please see Section 2.1.1 for more details and an estimate of current and planned quantities.

[4] The volume in tonnes is the estimated total waste rock volume from McClean, Caribou, and Sue D using an underground development mining method and based on internal estimates available at the time of preparation of this TID. This volume was converted to bcm using a factor of 2.43 tonnes/bcm. This total amount of waste rock will be segregated into clean and special waste. Therefore, using the total volume represents a worst-case scenario (i.e. a scenario where waste rock cannot be segregated)

[5] Cigar Lake Waste Rock Volume of 614,200 in bcm was taken from Cigar Lake 2017 Potentially Acid Generating Waste Geochemical Update (appendix AII of this document)

[6] Estimates of clean and special waste rock quantity in bcm were taken from the Midwest EIS (AREVA 2011a) and converted to tonnes using a factor of 2.43 tonnes/bcm. Special waste rock was estimated to fall between 925,000 and 1,400,000 bcm in the Midwest EIS. However, as a conservative approach, the volume of special waste rock requiring in pit disposal has been taken as 2,500,000 m^3 (bcm) or 6,000,000 tonnes, for the purpose of the current Midwest assessment.

3.2.4 Pit Water Quality

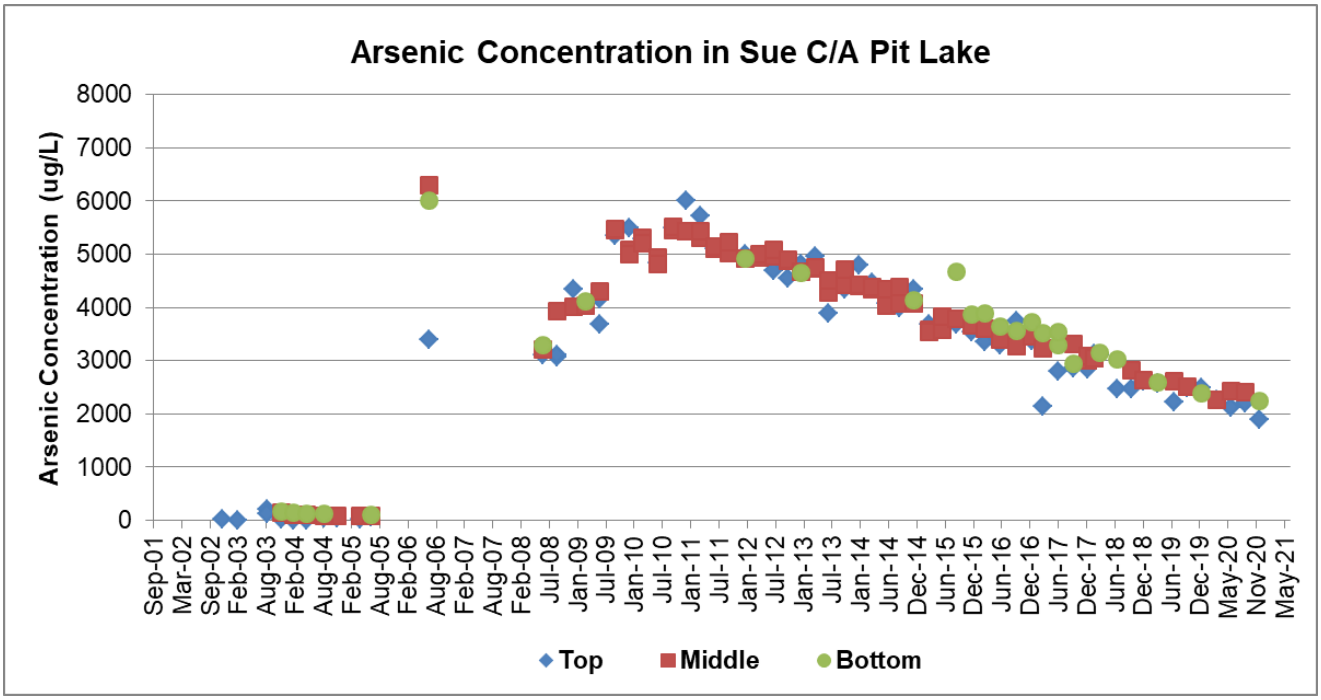
The monitoring of the pit water quality of Sue C/A, Sue E and Sue B began in 2002, 2009 and 2009 respectively. The monitoring program is to assess the extent to which special waste rock respectively placed in the pits affect the evolution of the pit water quality and the potential effect on the receiving environment. The current pit water quality values presented and discussed in the subsections below, do not meet Saskatchewan Environmental Quality Guidelines (SEQG) values and so the water is contained in the respective pits. The Sue C/A pit water which has relatively higher concentrations of COPC is pumped and treated through the Sue WTP as discussed in section 2.5.2 above. Future plans are under consideration for the decommissioning of the pits have been assessed through decommissioning scenarios and are presented in Part B of this document.

3.2.4.1 Sue C/A Pit

Sue C/A pit water quality monitoring began in the summer of 2002. Samples were collected at three depths in the pit and categorized as top (0.5 m), middle (0.5 to < 30 m), and bottom (≥ 30m) samples. Sampling was stopped at the end of July 2005 due to mining activity. One set of samples is available for mid-2007 and full sampling resumed in 2008. Efforts are made to collect from the same location each time; however, it is known that the boat drifts even when anchored, depending on wind direction and strength.

Sue C/A pit water concentrations are shown in Figure 3 8 and Figure 3 9 for arsenic, nickel, radium-226, and uranium, indicating the change in contaminant concentration since the placement of Sue E special waste rock in the Sue C/A pit in 2008. With the exception of temporally decreasing arsenic concentrations, concentrations of COPCs appear to have reached equilibrium and have been generally stable for the last 5 years. Table 3-2 compares average pit water concentrations to average values derived from measurements of the Sue A and Sue E special waste rock pore water. For the pit water, the average is taken over the period of 2018 – 2020 when concentrations have generally stabilized.

The significant COPCs are bolded in Table 3-2.



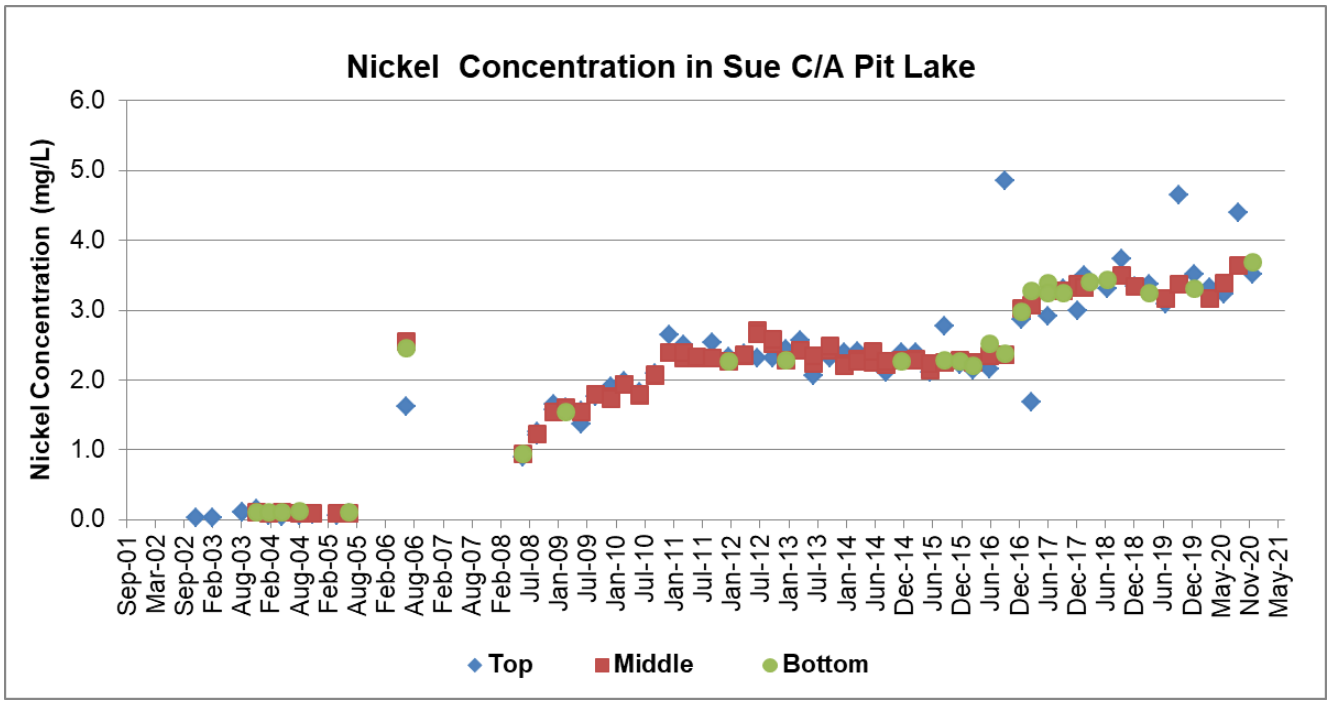
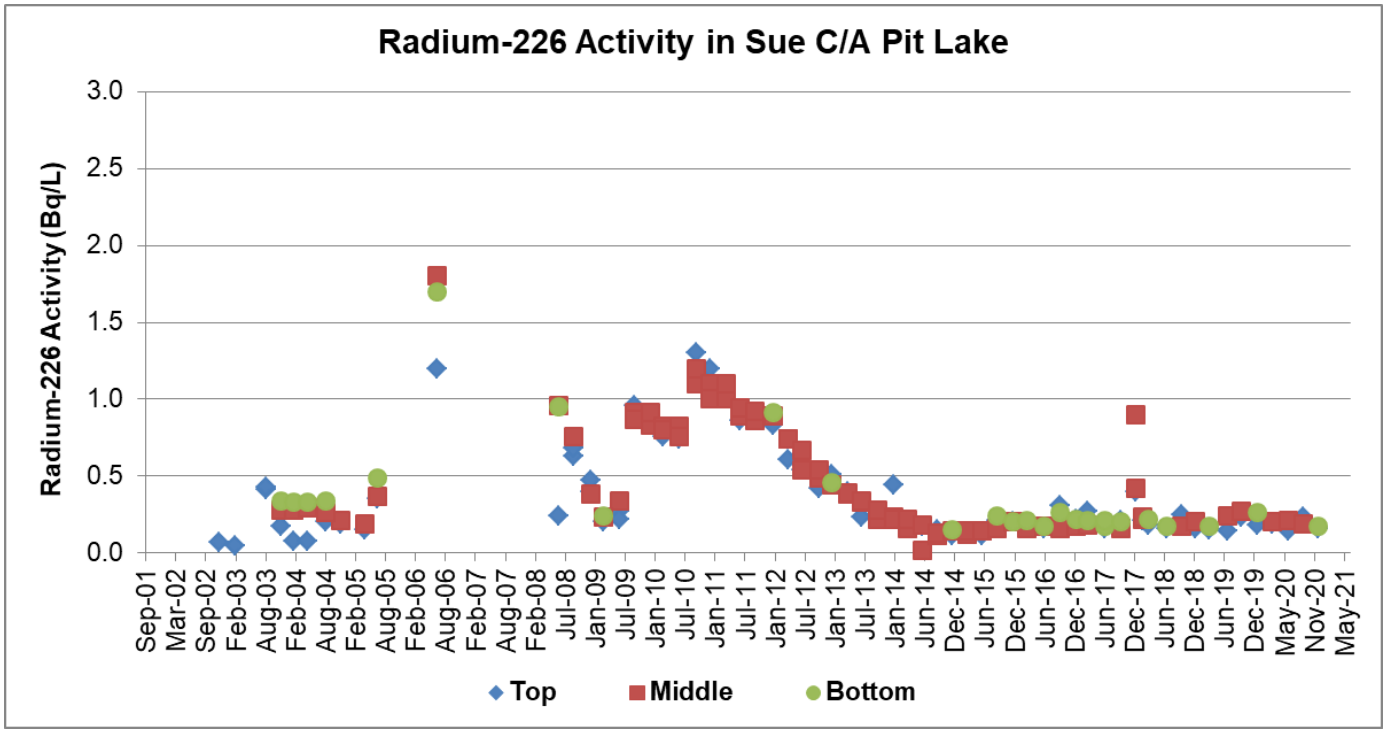


Figure 3-8: Arsenic and Nickel Concentrations in Sue C/A Pit



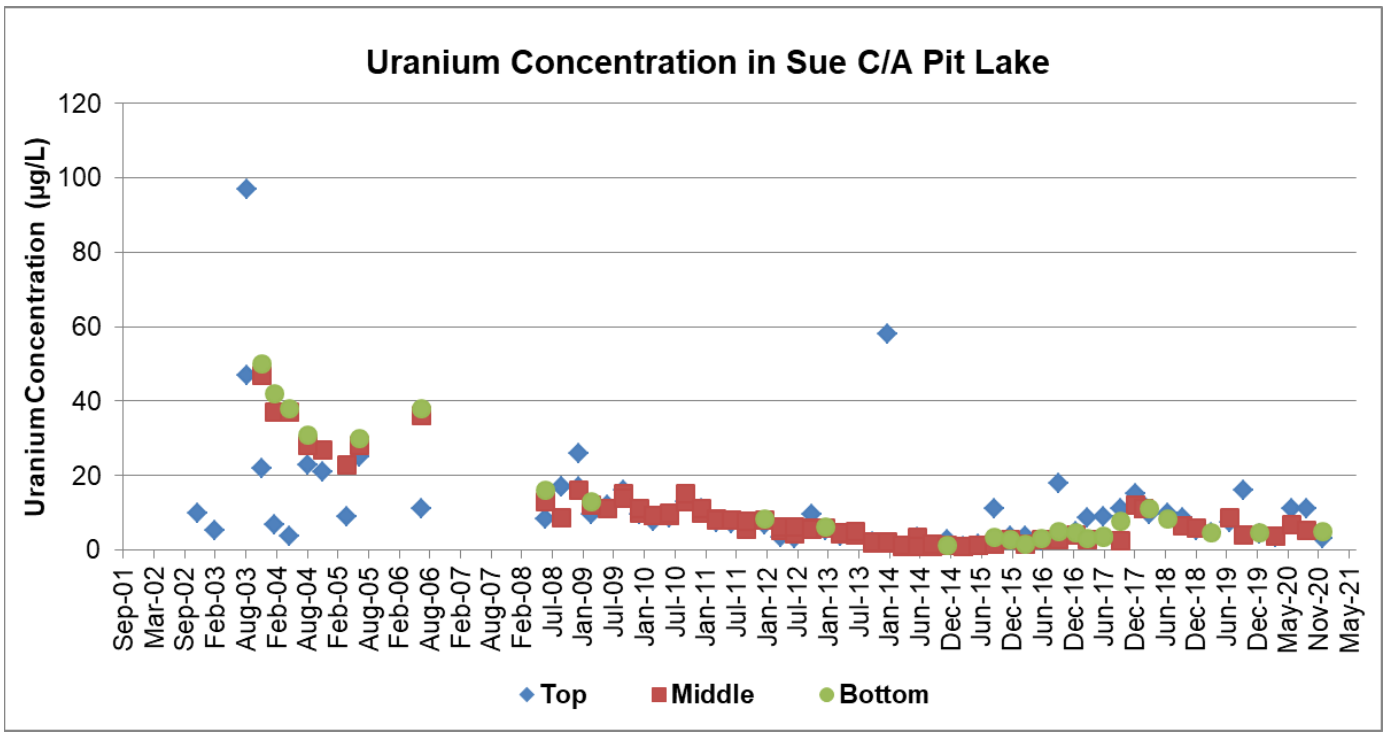


Figure 3-9: Radium-226 and Uranium Concentrations in Sue C/A Pit

Table 3-2: Sue C/A Pit Water Quality vs. Sue A/E Waste Rock Pore Water Quality

Analyte	Units	Sue C/A Pit Water	Sue A Waste Rock Pore Water[1]	Sue E Waste Rock Pore Water[2]
		2018 -2020 Average	(Averaged Over 2009-2013)	(Averaged Over 2009-2013)
Alkalinity (as CaCO3)	mg/L	19.8	36.5	27.0
Aluminum	mg/L	0.05	0.01	0.03
Antimony	mg/L	0.004	0.007	0.002
Arsenic	**µg/L**	**2560**	**4400**	**1300**
Barium	mg/L	0.03	0.15	0.09
Beryllium	mg/L	0.0001	0.0002	0.0003
Bicarbonate (as HCO3)	mg/L	24.2	44.6	33.0
Boron	mg/L	0.119	0.15	0.37
Cadmium	**mg/L**	**0.00005**	**0.0001**	**0.0004**
Calcium	mg/L	15.5	26.7	48.3
Carbonate (as CO3)	mg/L	1	1	1
Chloride	**mg/L**	**3.2**	**5.1**	**9.0**
Chromium	mg/L	0.0005	0.001	0.001
Cobalt	**mg/L**	**0.062**	0.21	0.12
Copper	**mg/L**	**0.00095**	**0.0013**	**0.0019**
Fluoride	mg/L	0.09	0.12	0.10
Hardness, Total	mg/L	61.0	101.1	225.0
Hydroxide	mg/L	1	1	1
Iron	mg/L	0.089	0.03	0.43
Lead	**mg/L**	**0.0003**	**0.0006**	**0.0003**
Lead-210	**Bq/L**	**0.033**	**0.04**	**0.06**
Magnesium	mg/L	5.46	5.0	25.5
Manganese	mg/L	0.58	1.6	2.8
Molybdenum	**mg/L**	**0.50**	**0.40**	**0.80**
Nickel	**mg/L**	**3.47**	**3.4**	**1.7**
Nitrate	mg/L	32.4	8.0	7.9
pH	pH units	7.2	7.3	6.8
pH, Field	pH units	6.9	6.3	5.9
Polonium-210	**Bq/L**	**0.022**	**0.01**	**0.01**
Potassium	mg/L	6.3	9.1	20.1
Radium-226	**Bq/L**	**0.196**	**0.49**	**0.81**
Selenium	**mg/L**	**0.0012**	**0.0017**	**0.0128**
Silver	mg/L	0.00005	0.00005	0.00004
Sodium	mg/L	4.5	6.7	14.3
Specific Conductivity	µS/cm	194	368.8	637.9
Specific Conductivity, Field	µS/cm	195	384.1	783.0
Strontium	mg/L	0.184	0.2	0.8
Sulfate	**mg/L**	**35.0**	**47.8**	**140.3**
Sum of Ions	mg/L	127	234.3	457.3
Thallium	mg/L	0.0002	0.0004	0.0004
Thorium-230	**Bq/L**	**0.02**	**0.02**	**0.02**
Tin	mg/L	0.0001	0.00025	0.00024
Titanium	mg/L	0.0023	0.0004	0.0014
Total Dissolved Solids	mg/L	141	239.8	422.2
Uranium	**µg/L**	**7.5**	**9.0**	**54.5**
Vanadium	**mg/L**	**0.0029**	**0.004**	**0.001**
Zinc	**mg/L**	**0.024**	**0.08**	**0.09**

[1] EQuIS Database, Locations 09-07 (MP03to MP14 only)
[2] EQuIS Database, Locations 09-07 (MP15 to MP17 only), 09-08, 09-09, 09-10 (excluding MP03, see Appendix A-1.7 of 2013 Waste Rock TID)

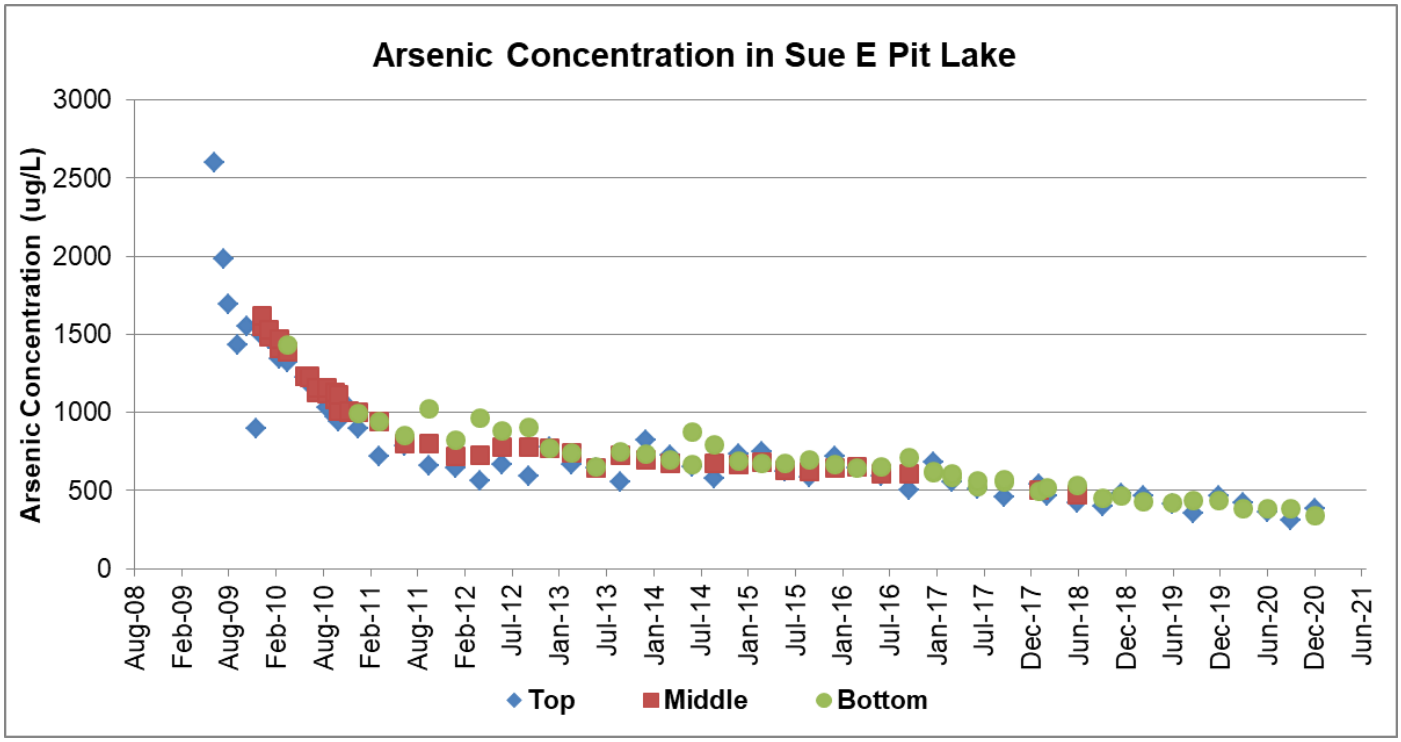
3.2.4.2 Sue E Pit

Sue B special waste rock was placed in the Sue E pit and covered with a till cap in December 2008. Sue E pit water monitoring began in June of 2009. Samples were collected at three depths in the pit and categorized as top (0.5 to <10 m), middle (10 to < 40 m), and bottom (≥ 40 m) samples. Since 2018 top samples are collected monthly and a bottom sample is also collected quarterly.

The updated Sue E pit water concentrations are shown in Figure 3-10 and Figure 3-11 for arsenic, nickel, radium-226, and uranium. These figures illustrate the change in contaminant concentration since the placement of the till cap in December 2008. The figures indicate that concentrations of COPCs have generally stabilized or have been decreasing since 2011.

Table 3-3 shows the 2018 – 2020 average pit water concentrations for analytes measured. Table 3-3 also gives the predicted pore water concentrations for Sue B waste rock taken from the Caribou EIS (AREVA 2009a, Table 4-6, Appendix VIIIB of the 2013 Waste Rock TID), for all significant COPCs except arsenic. The pore water concentrations in the Caribou EIS were based on sequential leach test results for all COPCs except arsenic The predicted arsenic pore water concentration in Sue B waste rock shown in Table 3-3 was developed using the arsenic solids content from Table 8 of Appendix AI.4 of this document together with the correlation relating solids content to concentration which was developed for the Caribou EIS (AREVA 2009a, Figure 3.6, Appendix VIIIA of the of the 2013 Waste Rock TID).

The measured Sue E pit concentrations are lower than the predicted values for all COPCs except nickel. The predicted arsenic concentration is considerably higher than the measured arsenic concentration in the Sue E pit water.



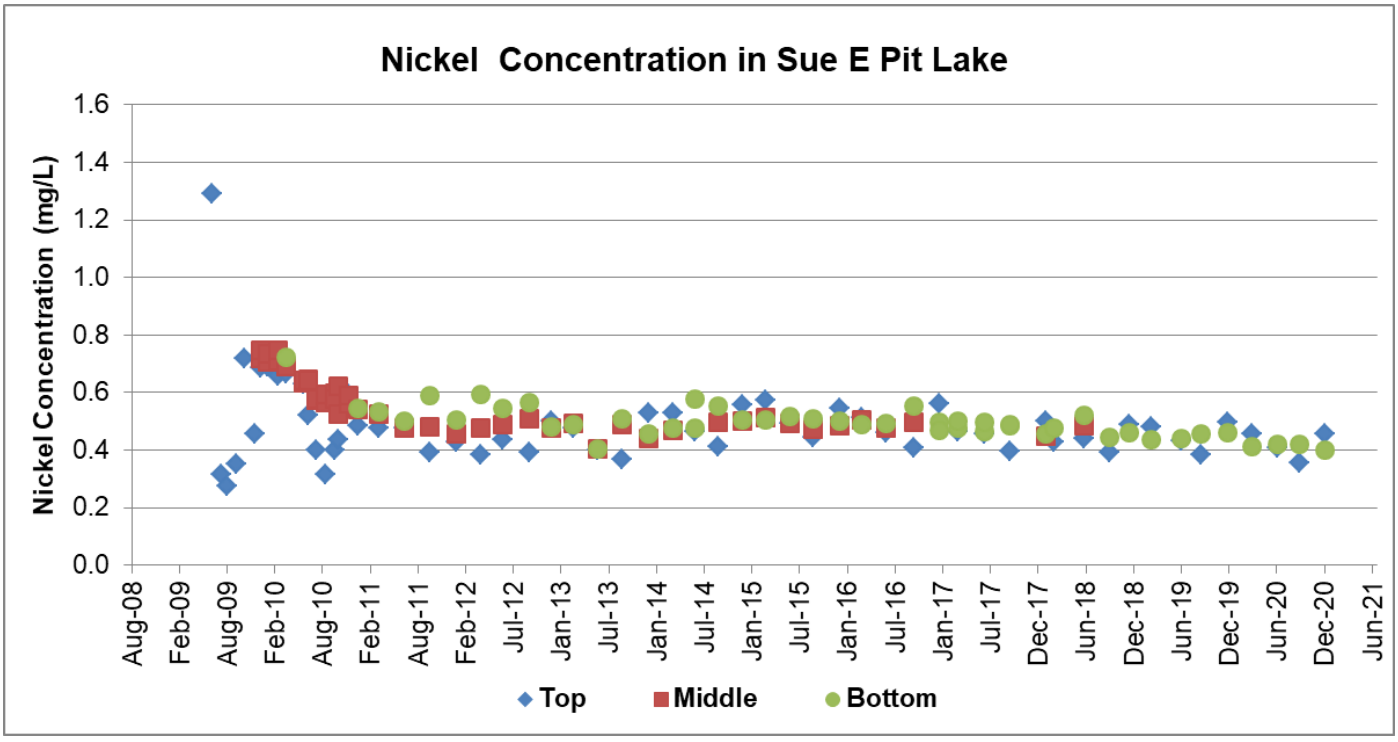
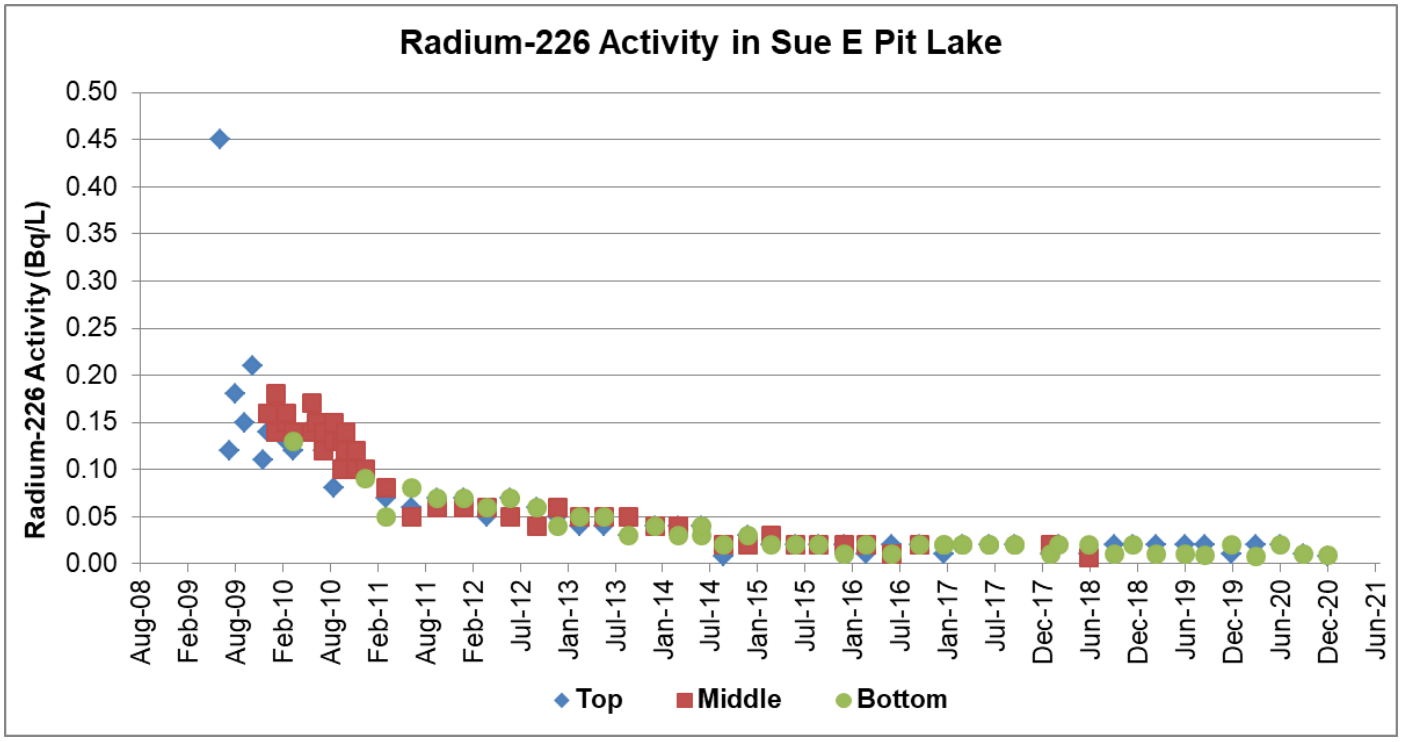


Figure 3-10: Arsenic and Nickel Concentrations in Sue E Pit



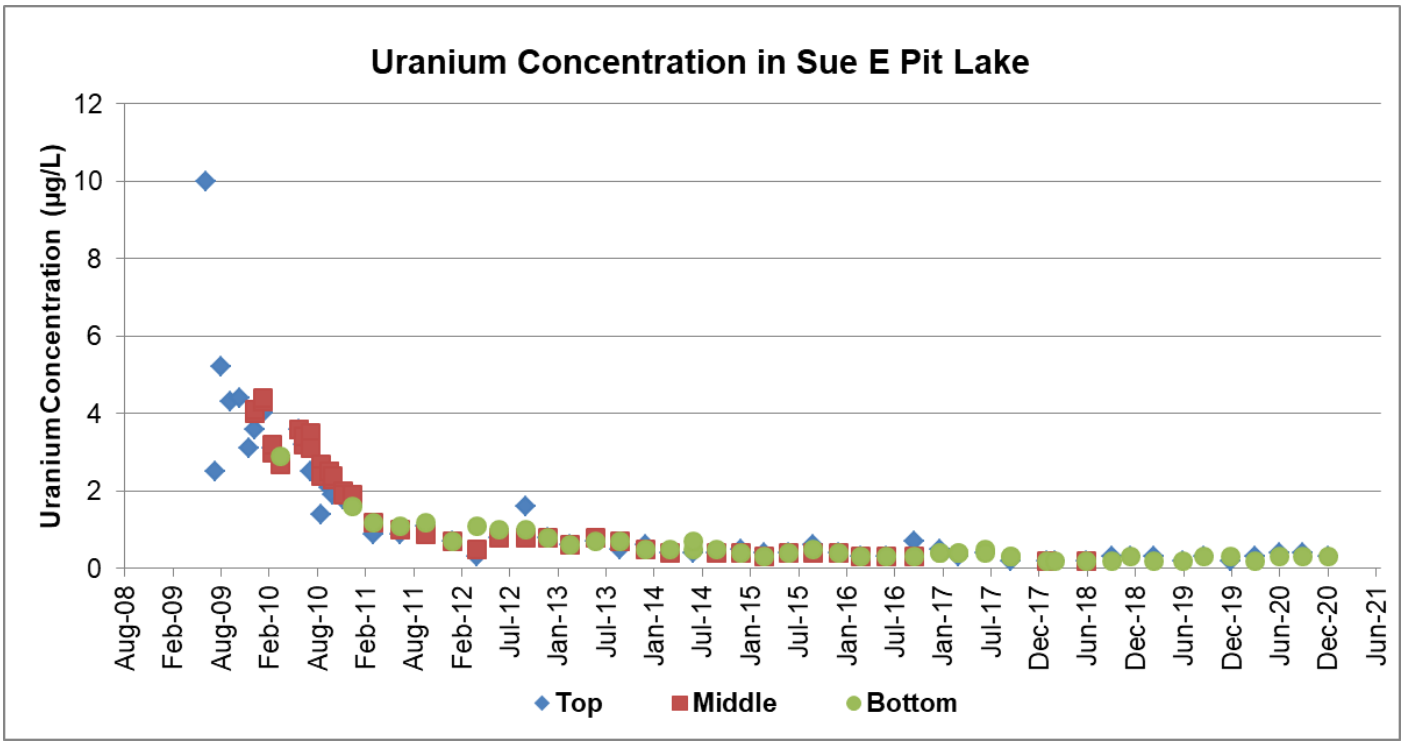


Figure 3-11: Radium-226 and Uranium Concentrations in Sue E Pit

Table 3-3: Sue E Pit Water Quality vs. Predicted Sue B Waste Rock Pore Water Quality

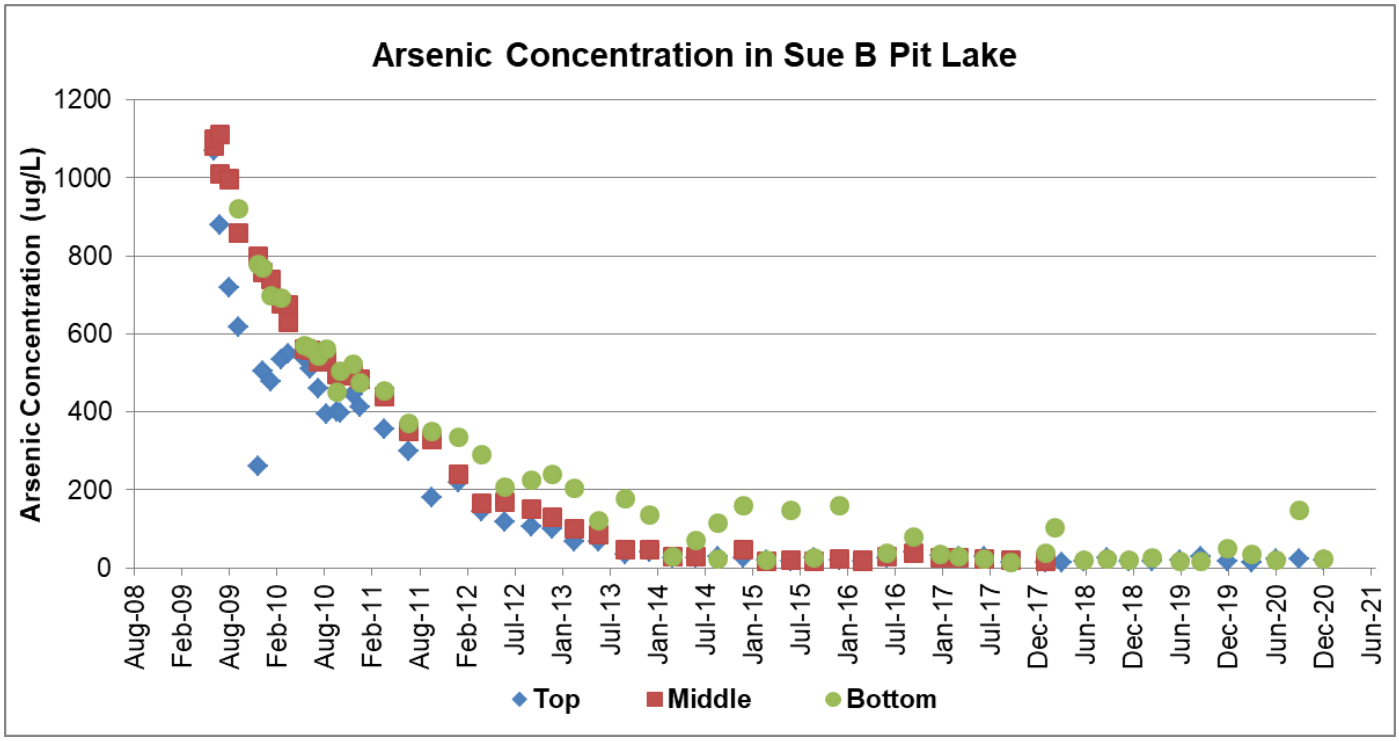
Analyte	Units	Sue E Pit Water 2018 -2020 Average	Predicted Sue B Waste Rock Pore Water Concentration
Alkalinity (as CaCO3)	mg/L	13.7	-
Aluminum	mg/L	0.04	-
Antimony	mg/L	0.003	-
Arsenic	**µg/L**	**430**	**2390** [1]
Barium	mg/L	0.01	-
Beryllium	mg/L	0.0001	-
Bicarbonate (as HCO3)	mg/L	16.8	-
Boron	mg/L	0.019	-
Cadmium	**mg/L**	**0.00001**	**-**
Calcium	mg/L	4.80	-
Carbonate (as CO3)	mg/L	1	-
Chloride	**mg/L**	**1.8**	**-**
Chromium	mg/L	0.0005	-
Cobalt	**mg/L**	**0.0018**	**0.5** [2]
Copper	**mg/L**	**0.00045**	**0.5** [2]
Fluoride	mg/L	0.08	-
Hardness, Total	mg/L	19.0	-
Hydroxide	mg/L	1	-
Iron	mg/L	0.043	-
Lead	**mg/L**	**0.0001**	**0.005** [2]
Lead-210	**Bq/L**	**0.023**	**0.03** [2]
Magnesium	mg/L	1.71	-
Manganese	mg/L	0.094	-
Molybdenum	**mg/L**	**0.013**	**1.2** [2]
Nickel	**mg/L**	**0.44**	**0.20** [2]
Nitrate	mg/L	9.7	-
pH	pH units	7.1	-
pH, Field	pH units	6.6	-
Polonium-210	**Bq/L**	**0.006**	**-**
Potassium	mg/L	1.4	-
Radium-226	**Bq/L**	**0.015**	**1.2** [2]
Selenium	**mg/L**	**0.0001**	**0.05** [2]
Silver	mg/L	0.00009	-
Sodium	mg/L	2.5	-
Specific Conductivity	µS/cm	58.0	-
Specific Conductivity, Field	µS/cm	62.4	-
Strontium	mg/L	0.044	-
Sulfate	**mg/L**	**6.3**	**-**
Sum of Ions	mg/L	44.7	-
Thallium	mg/L	0.0002	-
Thorium-230	**Bq/L**	**0.01**	**0.04** [2]
Tin	mg/L	0.0001	-
Titanium	mg/L	0.0008	-
Total Dissolved Solids	mg/L	59.1	-
Uranium	**µg/L**	**0.26**	**350** [2]
Vanadium	**mg/L**	**0.0008**	**-**
Zinc	**mg/L**	**0.0030**	**1.35** [2]

[1] **Arsenic** solids content taken from Table 8, Appendix 1-D; leachable fraction as per Figure 3.6, Appendix VIIIA of the of the 2013 Waste Rock TID, Caribou EIS (AREVA 2009a)
[2] Table 4.6, Appendix VIIIB of the of the 2013 Waste Rock TID, Caribou EIS (AREVA 2009a)

3.2.4.3 Sue B Pit

Sue B pit water monitoring began in June of 2009. Samples were collected at three depths in the pit and categorized as top (0.5 to <10 m), middle (10 to < 40 m), and bottom (≥ 40 m) samples. Since 2018, sampling includes monthly top samples and quarterly bottom samples.

Updated pit water concentrations are shown in Figure 3-12 and Figure 3-13 for arsenic, nickel, radium-226, and uranium. These figures illustrate the change in contaminant concentration since reflooding began at the end of 2008. The figures show that the concentration of COPCs has generally stabilized or is decreasing trend.



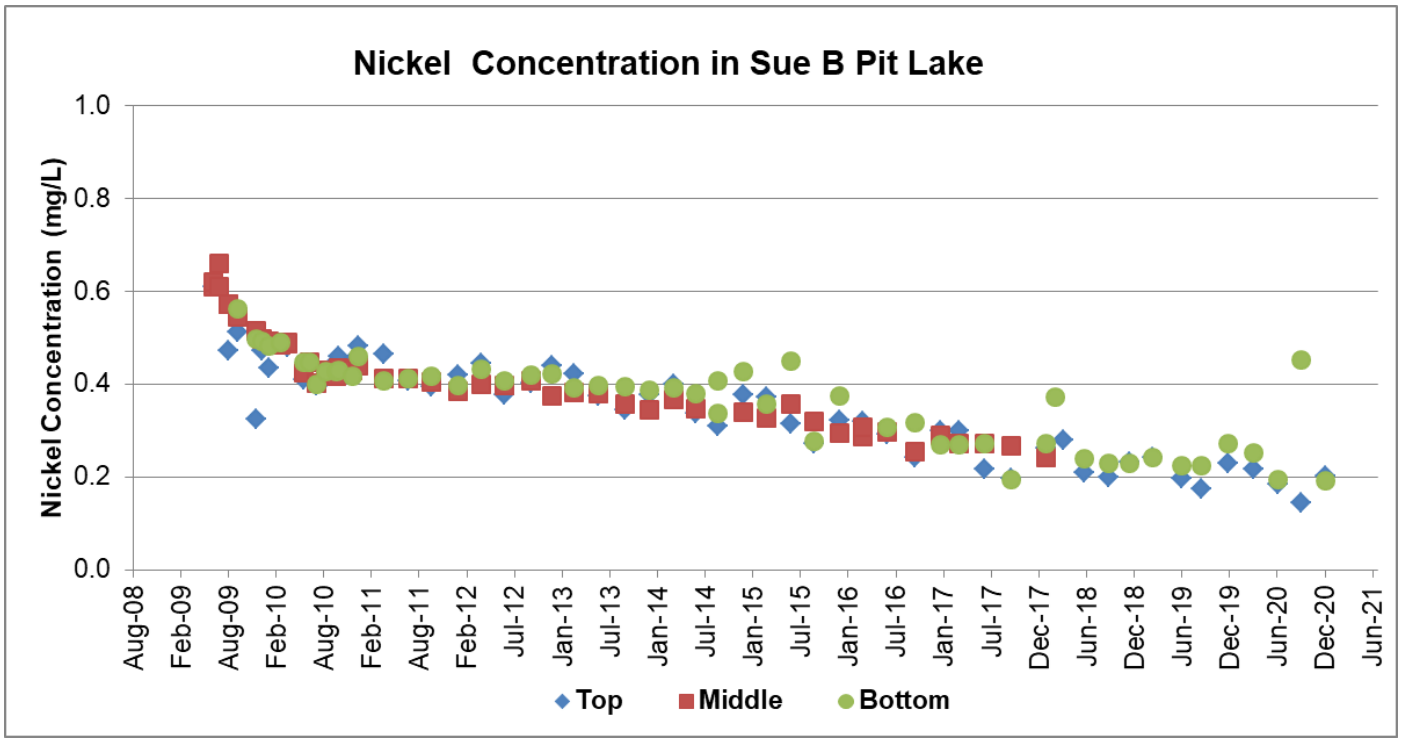


Figure 3-12: Arsenic and Nickel Concentrations in Sue B Pit

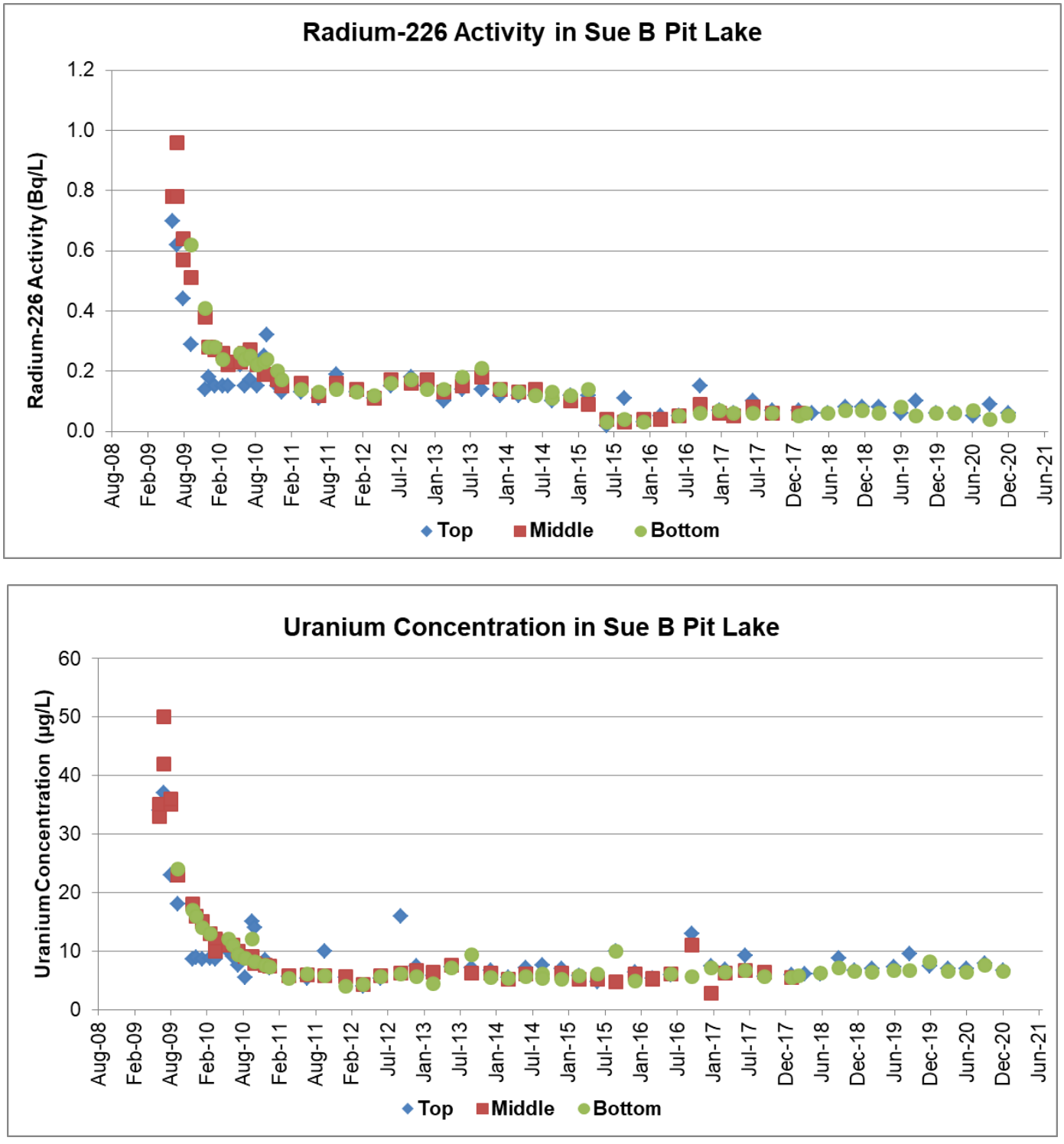


Figure 3-13: Radium-226 and Uranium Concentrations in Sue B Pit

Table 3-4: Sue B Pit Water Quality

Analyte	Units	Sue B Pit Water		
		2018 Average	2019 Average	2020 Average
Alkalinity (as CaCO3)	mg/L	15.8	16.0	14.3
Aluminum	mg/L	0.029	0.038	0.038
Antimony	mg/L	0.003	0.002	0.002
Arsenic	**µg/L**	**27**	**23**	**37**
Barium	mg/L	0.025	0.027	0.027
Beryllium	mg/L	0.0001	0.0001	0.0001
Bicarbonate (as HCO3)	mg/L	19.4	19.8	17.6
Boron	mg/L	0.025	0.024	0.025
Cadmium	**mg/L**	**0.00002**	**0.00002**	**0.00003**
Calcium	mg/L	8.1	8.1	8.0
Carbonate (as CO3)	mg/L	1.0	1.0	1.0
Chloride	mg/L	2.7	2.8	3.2
Chromium	mg/L	0.0005	0.0005	0.0005
Cobalt	**mg/L**	**0.0007**	**0.0005**	**0.0007**
Copper	**mg/L**	**0.0007**	**0.0009**	**0.0008**
Fluoride	mg/L	0.078	0.063	0.038
Hardness, Total	mg/L	33.4	33.4	33.1
Hydroxide	mg/L	1.0	1.0	1.0
Iron	mg/L	0.167	0.194	0.166
Lead	**mg/L**	**0.0002**	**0.0004**	**0.0003**
Lead-210	**Bq/L**	**0.030**	**0.030**	**0.031**
Magnesium	mg/L	3.21	3.19	3.19
Manganese	mg/L	0.215	0.185	0.239
Molybdenum	mg/L	0.003	0.002	0.004
Nickel	**mg/L**	**0.25**	**0.23**	**0.23**
Nitrate	mg/L	21.7	20.0	18.8
pH	pH units	7.1	7.2	6.8
pH, Field	pH units	6.5	6.6	6.5
Polonium-210	**Bq/L**	**0.017**	**0.022**	**0.024**
Potassium	mg/L	1.8	1.8	1.8
Radium-226	**Bq/L**	**0.065**	**0.069**	**0.060**
Selenium	**mg/L**	**0.0005**	**0.0005**	**0.0005**
Silver	mg/L	0.00005	0.00005	0.00005
Sodium	mg/L	2.8	2.8	2.8
Specific Conductivity	µS/cm	96.0	92.9	93.1
Specific Conductivity, Field	µS/cm	102	93	113
Strontium	mg/L	0.089	0.089	0.089
Sulfate	**mg/L**	**9.7**	**9.9**	**10.2**
Sum of Ions	mg/L	69.5	68.6	65.6
Thallium	mg/L	0.0002	0.0002	0.0002
Thorium-230	**Bq/L**	**0.0155**	**0.0138**	**0.0163**
Tin	mg/L	0.0001	0.0001	0.0001
Titanium	mg/L	0.0005	0.0005	0.0006
Total Dissolved Solids	mg/L	76.8	79.8	77.0
Uranium	**µg/L**	**6.4**	**7.3**	**6.9**
Vanadium	**mg/L**	**0.0002**	**0.0002**	**0.0002**
Zinc	**mg/L**	**0.0039**	**0.0067**	**0.0063**

3.2.4.4 Summary of Current Pit Water Quality

Table 3-5 provides a summary of the 2018 - 2020 average concentrations for Sue C/A, Sue E, and Sue B pits. The summary illustrates that contaminant concentrations are highest in almost all cases in the Sue C/A pit, which is expected since the special waste rock placed in the pit has not been capped.

Table 3-5: Summary of Sue C/A, Sue E, and Sue B Pit Water Quality

Analyte	Units	Sue C/A Pit Water 2018-2020 Average	Sue E Pit Lake 2018-2020 Average	Sue B Pit Lake 2018-2020 Average
Alkalinity (as CaCO3)	mg/L	19.8	13.7	15.4
Aluminum	mg/L	0.05	0.04	0.03
Antimony	mg/L	0.004	0.003	0.003
Arsenic	**µg/L**	**2560**	**430**	**30**
Barium	mg/L	0.03	0.01	0.03
Beryllium	mg/L	0.0001	0.0001	0.0001
Bicarbonate (as HCO3)	mg/L	24.2	16.8	19.0
Boron	mg/L	0.119	0.019	0.024
Cadmium	**mg/L**	**0.00005**	**0.00001**	**0.00002**
Calcium	mg/L	15.5	4.80	8.09
Carbonate (as CO3)	mg/L	1	1	1
Chloride	**mg/L**	**3.2**	**1.8**	**2.9**
Chromium	mg/L	0.0005	0.0005	0.0005
Cobalt	**mg/L**	**0.062**	**0.0018**	**0.0006**
Copper	**mg/L**	**0.00095**	**0.00045**	**0.00081**
Fluoride	mg/L	0.09	0.08	0.06
Hardness, Total	mg/L	61.0	19.0	33.3
Hydroxide	mg/L	1	1	1
Iron	mg/L	0.089	0.043	0.175
Lead	**mg/L**	**0.0003**	**0.0001**	**0.0003**
Lead-210	**Bq/L**	**0.033**	**0.023**	**0.030**
Magnesium	mg/L	5.46	1.71	3.20
Manganese	mg/L	0.58	0.094	0.213
Molybdenum	**mg/L**	**0.50**	**0.013**	**0.003**
Nickel	**mg/L**	**3.47**	**0.44**	**0.24**
Nitrate	mg/L	32.4	9.7	20.3
pH	pH units	7.2	7.1	7.0
pH, Field	pH units	6.9	6.6	6.5
Polonium-210	**Bq/L**	**0.022**	**0.006**	**0.021**
Potassium	mg/L	6.3	1.4	1.8
Radium-226	**Bq/L**	**0.196**	**0.015**	**0.065**
Selenium	**mg/L**	**0.0012**	**0.0001**	**0.0005**
Silver	mg/L	0.00005	0.00009	0.00005
Sodium	mg/L	4.5	2.5	2.8
Specific Conductivity	µS/cm	194	58.0	94.2
Specific Conductivity, Field	µS/cm	195	62.4	101.6
Strontium	mg/L	0.184	0.044	0.089
Sulfate	**mg/L**	**35.0**	**6.3**	**9.9**
Sum of Ions	mg/L	127	44.7	68.1
Thallium	mg/L	0.0002	0.0002	0.0002
Thorium-230	**Bq/L**	**0.02**	**0.01**	**0.02**
Tin	mg/L	0.0001	0.0001	0.0001
Titanium	mg/L	0.0023	0.0008	0.0005
Total Dissolved Solids	mg/L	141	59.1	77.7
Uranium	**µg/L**	**7.5**	**0.26**	**6.8**
Vanadium	**mg/L**	**0.0029**	**0.0008**	**0.0002**
Zinc	**mg/L**	**0.024**	**0.0030**	**0.0054**

4 Evaluation of Current Practice to Date

In this section, available mining and post-mining data from completed projects will be compared to predictions made in previous environmental assessments for each project. The goal of this comparison is to verify the waste rock solids content and pore water source terms used in waste rock modelling to date. Based on the results of this comparison and the measured data, updates will be made to the pore water source terms and solids contents. The updated pore water source terms and solids contents will be used in the modelling in Part B of this document.

Completed mining projects to date include JEB, Sue A, Sue B, Sue C, and Sue E. The performance of the JEB, Sue C, and Sue E clean waste rock stockpiles will also be evaluated in this section.

4.1 Assessment Methodology

As per Section 3.1.1 of this study, waste rock characterization has been carried out for the orebodies mined to date and has been used to develop source terms for the modelling of effects from waste rock management. Typically, both solids content and pore water predictions are developed. Pre-mining studies include elemental content analysis, acid base accounting, humidity cell testing, and column testing.

During mining, clean and special waste sampling occurred as part of the waste rock segregation practice. Additional solids samples have also been collected during post-mining activities. Monitoring wells have been installed in all three clean waste rock stockpiles, as well as in-pit special waste rock when possible, in order to collect additional pore water data for verification of source term predictions made in environmental impact assessments. The information in this section is presented as follows:

- Section 4.1.1: Summary of characterization, operational, and post-mining waste rock data collected to date is presented.
- Section 4.2: Predictions from environmental impact assessments are compared to measured data on a project by project basis. Detailed comparisons and raw data are in Appendix AI of this document.
- Section 4.3: Available waste rock characterization data for future projects is discussed.
- Section 4.4: Waste rock quantities pore water source terms, and solids content predictions will be updated to reflect the measured data, new characterization data, and the results of this analysis.

4.1.1 Summary of Waste Rock Testing to Date

Special waste rock, as the term is used for this assessment, consists of primarily altered basement rock, waste rock (either sandstone or basement) adjacent to ore bodies, and any waste rock that could not be effectively segregated (segregation criteria are discussed in section 3.1.1). Special waste rock may contain minerals that, when excavated and left exposed to atmospheric conditions over the long term, are likely to

react and release chemical elements. The reactions that special waste may undergo are highly varied, but can include oxidation of iron sulphide minerals, such as pyrite or pyrrhotite, in the presence of water and oxygen. These reactions release acidity in addition to other key elements. Other potential reactions include simple leaching where no acidity is produced but key elements could still be released at significant rates.

The assessment of metal leaching from the waste rock requires knowledge of the maximum possible concentrations of dissolved constituents associated with the special waste rock and how concentrations may change with time. This concentration behaviour is known as the source term. The source term is typically evaluated through extensive characterization of the solids, as well as through studies that evaluate the interactions between water and waste rock solids. The constituents dissolved from the waste rock into the water are referred to as the contaminant mass.

At the McClean Lake Operation, waste rock testing is undertaken to evaluate the long-term behaviour of waste rock under various disposal/storage conditions, and to define the source terms associated with the waste rock. The history of testing for waste rock disposed of at the McClean Lake Operation is presented in detail in Table 4-1 and an overview is as follows:

- 1991: A series of laboratory tests were undertaken to support the McClean Lake EIS (Minatco 1991a) which includes the Jeb, Sue C, Sue A and Sue B deposits.
- 2001: Laboratory testing to support the Disposal of Cigar Lake Waste Rock EIS (COGEMA and CLMC 2001).
- 2004: Waste rock characterization of the Sue E deposit for the Sue E EIS (AREVA 2004) and
- 2009: Waste rock characterization of the Caribou deposit in support of the Caribou EIS (AREVA 2009a).

Additional operational data has also been collected as follows:

- Data has been collected during mining of the JEB, Sue A, Sue B, Sue C, and Sue E pits.
- Additional waste rock samples were collected and tested during other activities such as the backhaul of JEB and Sue C special waste rock to the Sue C pit.
- In 2017, a geochemical assessment of the Cigar Lake mine Potentially Reactive Waste Rock (PRWR). Details of the assessment are presented in the 2017 Cigar Lake Potentially Acid Generating Waste Geochemical Update and presented in Appendix AII of this document.

Table 4-1 provides a brief overview of waste rock testing to date, and an outline of the relevant operational and post-mining data that has been collected. Of the various results available for source term determination, those that have been deemed most representative are also noted in the table.

Table 4-1: Summary of Waste Rock Testing to Date

Year	Project or Study	References	Program Objectives	Data Used for Source Term Predictions
1991	Test Program for McClean Lake Project Waste Rock (McClean EIS)	Minatco 1991a, COGEMA 2004	Identify and categorize material as either clean or special waste rock using drill core sample test results and estimate respective volumes on the basis of lithology and U_3O_8 assay results. Laboratory analysis to determine acid generating potential and metal leaching.	The predicted McClean Underground solids content used in all EIS documents to date is based on the solids analysis of the composite sample for McClean Underground (Table 2.2, Supporting Document IV, Minatco 1991a). Further data collection is recommended and is being carried out in a current waste rock characterization program for McClean Underground, Caribou, and Sue D, explained further below. This testing data is compiled in Appendix II of the 2004 Waste Rock TID (COGEMA 2004).
1991	Additional Test Program for McClean Lake Project Waste Rock (McClean EIS)	Minatco 1991b, COGEMA 2004	Completed testing to simulate two waste management options: in-pit disposal (saturated column testing) and surface disposal (humidity cell testing). Assessment included waste rock from JEB, Sue C, Sue A, and Sue B. Assessment concluded that JEB and Sue C could be segregated, while the complex geology of Sue A and Sue B would likely cause difficulties in segregation.	Predicted Sue A and B clean and special waste solids contents in all assessments to date have been based on the solids analysis from the composite sample testing (Table 4, Appendix A, Minatco 1991b). The radionuclide predictions (Th-230, Ra-226, Pb-210) for JEB and Sue C special waste used in all assessments to date is based on the results of the composite sample solids analysis (Table 4, Appendix A, Minatco 1991b). All other COPCs for JEB and Sue C in recent assessments are based on field samples from backhauling of the waste rock, detailed further below. The results of saturated column testing (Appendix A, Minatco 1991b), combined with test results from the 2001 Cigar Lake Waste Rock Study (Appendix I, COGEMA and CLMC 2001), were used to establish the relationship between arsenic pore water concentration and arsenic solids content. Results of saturated column testing have been used to establish initial source term concentrations for constituents other than arsenic are compiled in Appendix II of the 2004 Waste Rock TID (COGEMA 2004).
1996-1997	JEB Mining	COGEMA 2004	45 production drill cutting samples of JEB special waste were collected and analyzed in order to confirm previous predictions of solids content.	Results of cuttings analysis has been used to develop the JEB solids content used in the previous Waste Rock TID and all assessments since the 1991 McClean EIS. This field data is compiled in Appendix AI.1 of this document.

Table 4-1: Summary of Waste Rock Testing to Date (Continued)

Year	Project or Study	Reference	Program Objectives	Data Used for Source Term Predictions
2001	Test Program in Support of Cigar Lake Waste Rock EIS	COGEMA and CLMC 2001, COGEMA 2004	Conducted column testing to determine the leaching characteristics of waste rock under conditions similar to the Sue C pit (e.g. longer pore water residence time, co-disposal of McClean Lake and Cigar Lake waste rock). Test results indicated that the previous predictions of arsenic in waste rock pore waters were underestimated, in particular for the Cigar Lake waste rock, due to the high flush rate used in the 1991 (Minatco 1991b) and 1995 (CLMC 1995) test procedures. Sequential leach testing to determine the fraction of constituents in solids that is leachable by water that will be released over time in the Sue C pit (% leachable). Assessed the effects of temporary surface storage at Cigar Lake on the leachable fraction of constituents. Results indicated little effect on the leachable inventory.	The column test results were used to establish the relationship between arsenic pore water concentration and arsenic solids content. Results of saturated column testing have been used to establish initial source term concentrations for constituents other than arsenic. The leachable fraction for all constituents of concern, including arsenic, has been used in previous assessments such as the previous Waste Rock TID (COGEMA 2004), the Sue E EIS (AREVA 2004a), and the Caribou EIS (AREVA 2009a). The Cigar Lake waste rock data is compiled in Appendix II of the 2004 Waste Rock TID (COGEMA 2004).
2002	Backhauling of JEB and Sue C Special Waste to the Sue C Pit	COGEMA 2003, COGEMA 2004	23 samples of JEB special waste and 18 samples of Sue C special waste were collected and analyzed to verify the predicted solids content.	The results of the sample analysis have been used in every assessment since the 1991 EIS to define the JEB and Sue C solids contents, with the exception of radionuclides (Ra-226, Pb-210, and Th-230), which were not analyzed. Radionuclide results were taken from the composite samples in the 1991 EIS (Minatco 1991b). This field data is compiled in Appendix AI.1 for JEB and Appendix AI.2 for Sue C this document.

Table 4-1: Summary of Waste Rock Testing to Date (Continued)

Year	Project or Study	Reference	Program Objectives	Data Used for Source Term Predictions
2004	Sue E EIS	AREVA 2004	Sue E special waste rock samples were collected in 1992, 2001, and 2004 drilling campaigns for the purpose of further characterizing Sue E waste rock. EcoMetrix Inc. completed a waste rock characterization study using these samples (AREVA 2013). Underwater column testing to simulate in-pit disposal was completed for both high arsenic and low arsenic samples. Sequential leach testing was completed to determine the total inventory of soluble metals in the solids. Clean waste samples from the 1992, 2001, and 2004 drilling campaigns were collected and sent to EcoMetrix for characterization. Surface disposal was assessed using ABA analysis, solids content analysis, and modified humidity cell testing.	Characterization data was used to develop solids content predictions for Sue E clean and special waste rock, as well as pore water source terms for Sue E special waste in the Sue E EIS (AREVA 2004a). Analysis of Sue E clean waste suggested that there was virtually no risk of acid generating potential. Therefore, clean waste rock pore water source terms for Sue E were not developed. A copy of the Sue E waste rock characterization program is included in Appendix A-II.1 of the 2013 Waste Rock TID (AREVA 2013).
2005-2006	Sue A Mining	AREVA 2006, AREVA 2007a	Radiometric and XRF scanning of blast hole samples, composite samples sent to SRC for calibration of XRF. Elements analyzed include As, Ni, Pb, and U.	Data has not been used to date in EIS documents, but it is recommended to update As, Ni, Pb, and U results with this data for this study and future assessments. The data is summarized in Appendix AI.3 of this document.
2005-2008	Sue E Mining	AREVA 2009d, AREVA 2012a	Radiometric and XRF scanning of blast hole samples, composite samples sent to SRC for calibration of XRF. Elements analyzed include As, Ni, Pb, and U.	Data was used in the Sue E Follow-Up Program to verify solids content predictions made in the Sue E EIS. It is recommended to update As, Ni, Pb, and U solids results with this data for this study and future assessments. The data is summarized in Appendix AI.5 of this document.

Table 4-1: Summary of Waste Rock Testing to Date (Continued)

Year	Project or Study	Reference	Program Objectives	Data Used for Source Term Predictions
2007-2008	Waste Rock Follow-Up Program	AREVA 2009c, AREVA 2012a	Installation of piezometers in the JEB, Sue C, and Sue E clean waste rock stockpiles for the purpose of monitoring pore water quality. These piezometers replaced toe seepage sampling at McClean Lake.	A summary of the clean waste rock pore water data can be found in Appendix A-I.6 of the 2013 Waste Rock TID (AREVA 2013b).
2008	Sue B Mining	AREVA 2009d	Radiometric and XRF scanning of blast hole samples, composite samples sent to SRC for calibration of XRF. Elements analyzed include As, Ni, Pb, and U.	Data has not been used to date in EIS documents, but it is recommended to update As, Ni, Pb, and U results with this data for this study and future assessments. The data is summarized in Appendix AI.4 of this document.
2009	Caribou EIS	AREVA 2009a	Caribou special waste rock samples were collected through various drilling campaigns for the purpose of further characterizing Caribou waste rock. EcoMetrix Inc. completed a waste rock characterization study using these samples (AREVA 2013b). Underwater column testing to simulate in-pit disposal was completed. Sequential leach testing was completed to determine the total inventory of soluble metals in the solids. Clean waste samples were also sent to EcoMetrix for characterization. Surface disposal was assessed using ABA analysis, solids content analysis, and modified humidity cell testing.	Characterization data was used to develop solids content predictions for Caribou clean and special waste rock, as well as pore water source terms for Caribou special waste rock. This data considers mining of Caribou as an open pit. A copy of the Caribou waste rock characterization program is included in Appendix A-II.2 of the 2013 Waste Rock TID (AREVA 2013b).

Table 4-1: Summary of Waste Rock Testing to Date (Continued)

Year	Project or Study	Reference	Program Objectives	Data Used for Source Term Predictions
2009	Sue E Special Waste Piezometer Installations	AREVA 2012a	Four multi-level piezometers were installed in the Sue E special waste rock for the purpose of verifying Sue E special waste rock pore water source terms from the Sue E EIS. As one of the piezometers intersected Sue A special waste, data is also available for Sue A.	Sue E data was used in the Sue E Follow-Up Program to verify special waste rock pore water predictions made in the Sue E EIS. It is recommended to update the pore water source terms for Sue A and E with this data for this study and future assessments. Special waste pore water data has been summarized in Appendix AI.7 of this document.
2013	Waste Rock Characterization and Source Term Development McClean Underground, Caribou, and Sue D Projects	EcoMetrix 2013 (Appendix AIII of this document)	Samples from recent drilling programs have been submitted to EcoMetrix and SRC for ABA analysis, solids analysis, and sequential leach testing. Results show that this waste rock behaves similarly to other samples from the Sue area. Therefore, underwater column testing was not performed, and arsenic pore water parameters were derived from existing relationships. Humidity cell testing was completed in 2013 This testing was to determine whether clean segregated basement rock could be disposed of in a surface stockpile.	Results from this study will be used to update the waste rock quantities, solids content, and leachable fractions for modelling an underground mining scenario for Caribou, Sue D, and McClean Underground in Part B of this TID document. A copy of the waste rock characterization program results is included in Appendix AIII of this document.

Table 4-1: Summary of Waste Rock Testing to Date (Continued)

Year	Project or Study	Reference	Program Objectives	Data Used for Source Term Predictions
2018	Geochemical Characterization of Potentially Reactive Waste Rock (PRWR) at Cigar Lake Operation of Cameco	2017 Potentially Acid Generating Waste Geochemical Update (Appendix AII of this document)	The objective of this work was to provide an update to the Cigar Lake Joint Venture, specifically Orano, on the geochemical nature of the material on Stockpile C at the Cigar Lake mine. Furthermore, this work was intended to expand the source terms of COPCs to include production related waste rock remaining in the Cigar Lake Phase I ore deposit and characterize the material expected for Cigar Lake Phase II ore to allow for future waste rock management purposes. The results of this assessment showed that generally, with very minor exceptions, the geochemical limits of the PRWR agreement is sound for existing rock on Stockpile C. Excursions are observed for remaining unmined Phase I development Potential Acid Generating (PAG) material, primarily due to the rock expected for development in the future. This waste rock is primarily in areas containing more sulphide mineralization and graphitic alteration. Waste rock expected from Phase II is outside the mean and upper bound ranges of the PRWR for a number of elements.	The data and information provided in this document is to be used to reassess the risk associated with deposition of this PRWR in Sue C pit, considering potential changes to rock geochemistry on Stockpile C at Cigar Lake mine since 2001 as well as changes to the operation of the Sue C in-pit waste rock disposal facility at McClean Lake Operation, primarily being a flooded pit already containing special waste rock. A copy of the 2017 Cigar Lake Potentially Acid Generating Waste Geochemical Update is included as Appendix AII of this document.

4.2 Comparison of Effects to EIS Predictions

For JEB, Sue C, Sue A, and Sue B, predictions of solids content were initially made in the 1991 McClean EIS (Minatco 1991a, 1991b), and generally carried through subsequent assessments including the Sue E EIS (AREVA 2004) and the Caribou EIS (AREVA 2009a). For Sue E, predictions of solids content were initially made in the Sue E EIS (AREVA 2004) and these predictions were updated in the Caribou EIS with measured values from mining.

The most recent predictions of pore water quality for JEB, Sue C, Sue A, Sue B, and Sue E were made in the Caribou EIS (AREVA 2009a). The pore water quality predictions are based on a number of waste rock characterization programs that were conducted for the 1991 McClean EIS, 2001 Disposal of Cigar Lake Waste Rock EIS, Sue E EIS, and Caribou EIS. In this testing, the leachable fractions of various COPCs were determined from laboratory leach testing. In the Caribou EIS, the combined results of this leach testing were considered along with the predicted solids contents to develop pore water source term predictions for key COPCs.

In this section, predictions of waste rock solids content and pore water quality from environmental impact assessments will be compared to actual measured data on a project by project basis. The results of each comparison are described generally in the subsequent sections, and detailed information and calculations can be found in Appendix AI of this document. The primary COPCs considered in this comparison are:

- Arsenic;
- Copper;
- Cobalt;
- Nickel;
- Molybdenum;
- Lead;
- Selenium;
- Uranium;
- Zinc;
- radium-226;
- lead-210; and
- thorium-230.

This list is consistent with those identified for various other TIDs such as the Environmental Performance TID (AREVA 2016a). In general, arsenic is identified as the primary COPCs for the McClean Lake Operation, and thus is one of the key focuses of this assessment.

A summary of the recommended solids content and pore water quality values will be presented in Section 4.4. These values will be used as modelling inputs presented in Part B of this document.

Clean waste rock deposited on surface will be assessed by reviewing the measured pore water quality from piezometers installed in the JEB, Sue C, and Sue E clean waste rock piles. Discussion of clean waste rock solids content is also included in the data summaries in Appendix AI of this document. Recommended source terms for each clean waste rock stockpile are presented in Section 4.4.1.3, and are based on recent piezometer data (Appendix AI.6 of this document).

4.2.1 JEB and Sue C

4.2.1.1 Solids Content

During development stages of the JEB and Sue C pits, mined material was routinely monitored to ensure that clean waste rock, special waste rock, and ore were effectively segregated and transported to appropriate stockpile areas. Detailed description of segregation techniques is presented in Section 3.1.1. A total of 1,221 samples were collected from the JEB pit and 3,101 samples were collected from the Sue C pit. A detailed summary of the analysis of the clean cuttings data is shown in Appendix AI.1 for JEB and Appendix AI.2 for Sue C in this document.

For JEB special waste, 55 samples were collected during operation in order to define the solids content of the special waste. When the JEB waste was hauled to the Sue C pit in 2002, an additional 23 samples of special waste were collected. These samples were used to define the JEB solids content, which is shown in Table 4-2 along with the predicted solids content from the 1991 EIS (Minatco 1991b). The detail evaluation of the solids content is shown in Appendix AI.1 of this document.

For Sue C special waste, 18 samples were collected during the backhauling of the special waste to the Sue C pit in 2002. These samples were used to define the Sue C solids content, which is shown in Table 4-2 along with the predicted solids content from the 1991 McClean EIS (Minatco 1991b). The evaluation of the solids content is shown in Appendix AI.2 of this document.

Table 4-2: JEB and Sue C Predicted vs. Measured Special Waste Solids Content

COPC	Unit	JEB		Sue C	
		Predicted Solids Content in 1991 EIS	Measured Solids Content	Predicted Solids Content in 1991 EIS	Measured Solids Content
As	mg/kg	420.0	338.9	420.0	148.0
Co	mg/kg	11.6	14.8	44.0	5.0
Cu	mg/kg	25.0	30.7	33.0	9.0
Mo	mg/kg	166.3	19.4	25.0	31.0
Ni	mg/kg	270.0	286.3	390.0	138.0
Pb	mg/kg	94.0	31.8	19.0	26.0
Se	mg/kg	361.5	1.3	355.0	1.0
U	mg/kg	420.0	344.5	430.0	317.0
Zn	mg/kg	26.0	14.3	56.0	7.0

For both JEB and Sue C, measured clean and special waste rock solids contents were generally consistent with or below what was predicted in the 1991 McClean EIS (Minatco 1991a, 1991b). Predictions of JEB and Sue C special waste rock solids contents in the 2004 Waste Rock TID (COGEMA 2004), the Sue E EIS (AREVA 2004), and the Caribou EIS (AREVA 2009a) have all been based on the measured field data. These values will be used in Part B of this document.

The 2002 measured data for JEB and Sue C special waste rock did not include radionuclide analysis. The radionuclide values presented in the Caribou EIS are based on waste rock characterization studies from the 1991 McClean EIS (Minatco 1991b).

4.2.1.2 Pore Water Quality

The pore water quality predictions for JEB and Sue C are presented in Tables 4.5 and 4.6 in Appendix VIIIB of the Caribou EIS (AREVA 2009a). The pore water quality predictions were derived from a combination of the measured solids content and laboratory leach testing results from studies in both the 1991 McClean EIS (Minatco 1991a, 1991b) and the Disposal of Cigar Lake Waste Rock EIS (COGEMA and CLMC 2001).

A comparison could not be made between predicted and measured pore water quality for JEB and Sue C, as JEB and Sue C pore water quality could not be measured in the field. Upon completion of the backhauling of JEB and Sue C special waste rock to the Sue C pit in April 2002, there was an attempt to install a pore water collection system in the placed special waste rock. The system consisted of shallow piezometers with small diameter tubes installed in each piezometer. The small diameter tubes were run inside of a larger diameter pipe in order to protect the tubing. The tubing and pipes were extended to the edges of the pit, where they could be safely accessed and pumped to recover samples. The base of the pit and the placed pipe was then covered with special waste rock. Despite numerous attempts, pumping of the tubing was unsuccessful and a pore water sample could not be obtained from any of the piezometers.

Therefore, in the absence of measured pore water data, the pore water quality predictions from the Caribou EIS are used in the modelling scenarios in Part B of this document. Modelling the pore water source terms with predicted values in the absence measured pore water data is a conservative approach considering the fact that predicted solid COPC values are significantly higher than the measured values (Table 4-2)

4.2.2 Sue A

4.2.2.1 Solids Content

During the mining of Sue A, segregation did not occur. All overburden and waste rock was treated as special waste and disposed of in the Sue C pit. In addition to the radiometric methods used for Sue C and JEB, Sue A provided an opportunity for the first field trial of XRF technology. Throughout mining, blast hole cuttings were scanned with the XRF handheld unit and analyzed for arsenic, nickel, lead, and uranium content. Composite samples were collected and sent to SRC Analytical (SRC) in Saskatoon to verify the XRF results.

The full analysis of the XRF and SRC data for Sue A is presented in Appendix AI.3 of this document and summarized here (Table 4-3). Typically, it is expected that XRF and SRC results will have a high degree of correlation, particularly for arsenic and lead. The XRF is typically conservative in nickel and uranium measurements when compared to SRC results, due to XRF detection limit handling for these elements. For Sue A, the XRF and SRC results did not correlate for arsenic. The SRC results showed a higher concentration of arsenic than the XRF. As Sue A was the first mining test application for the XRF, a possible explanation is that operational procedures were still being tested and developed for the XRF. Once operational procedures were finalized, a much stronger correlation between XRF and SRC arsenic results has been observed. This is shown in the Sue B and Sue E XRF and SRC data analyses, located in Appendices AI.4 and AI.5, respectively. Due to uncertainty in the XRF measurements, the SRC results are considered to be the most accurate representation of Sue A waste rock solids content.

The predicted quantity of Sue A waste rock in the Caribou EIS (AREVA 2009a) was substantially less (1,929,422 tonnes), than the actual placed quantity (3,520,684 tonnes) (Appendix AI.3 of this document). Investigation into this difference indicated that the Caribou EIS predicted volume was based on a volume estimate from the 2004 Waste Rock TID (COGEMA 2004). At the time of preparation of the 2004 Waste Rock TID, Sue A had not yet been mined and the estimated quantity was based on older pit designs. In May 2005, a decision was made to redesign the Sue A pit based on improved economic conditions (AREVA 2005). This resulted in a larger volume of excavated waste rock material. The quantities for Sue A presented in the 2004 Waste Rock TID were carried through to the Caribou EIS and were not updated with actual mined quantities. The inventory for all analyzed elements is higher than anticipated due to the larger quantity of placed waste rock.

Table 4-3 shows a comparison of the predicted and measured solids content, quantities, and inventory for Sue A. The quantity of 4,223,921 tonnes shown in Table 4-3 is the sum of the design bench quantities from the final Sue A pit design. Design bench quantities were used to calculate weighted average solids content for Sue A special waste, as XRF and SRC quantities were collected on a per bench basis and actual mined quantities per bench were not available for this analysis. As the design quantities were greater than the

mined quantities and therefore, the calculations are conservative. More information on these calculations can be found in Appendix AI.3 of this document.

Table 4-3: Sue A Waste Predicted vs. Measured Quantities, Solids Content, and Inventory

Result	Quantity (tonnes)	Solids Content (mg/kg)				Average Inventory (tonnes)			
		As	Ni	Pb	U	As	Ni	Pb	U
Sue A Predicted in Caribou EIS	1,929,422 (Clean and Special)	148	31.0	239	16.0	286	59.8	461	30.9
Sue A XRF Weighted Average	4,223,921	156	91.4	184	21.1	660	386	776	89.0
Sue A SRC Weighted Average	4,223,921	278	169	204	21.8	1174	712	863	92.1
Actual Placed Quantity	3,520,684	278	169	204	21.8	979	595	718	77.5

The Sue A solids parameters used for modelling in Part B of this TID are as follows:

- Waste rock quantity used for modelling is the actual placed quantity of 3,520,684 tonnes
- SRC measured values are used for: arsenic, nickel, lead, and uranium
- Weighted average waste rock and special waste rock solids contents from the Caribou EIS are used for all other COPCs and radionuclides as XRF and SRC results are not available.

4.2.2.2 Pore Water Quality

The pore water quality predictions for Sue A used in the Caribou EIS are presented in Tables 4.5 and 4.6 in Appendix VIIIB of the Caribou EIS (AREVA 2009a). The Sue A values were derived from a combination of the measured solids content and laboratory leach testing results from studies in both the 1991 McClean EIS (Minatco 1991a, 1991b) and the Disposal of Cigar Lake Waste Rock EIS (COGEMA and CLMC 2001).

Four multi-level piezometers were installed in the Sue E special waste rock in the Sue C pit in 2009. The deepest piezometer had a number of ports that intersected Sue A special waste rock. Therefore, pore water quality data for Sue A special waste rock could be collected.

The detailed data for Sue A special waste rock pore water is presented in Appendix AI.7 of this document and summarized here. A total of 20 pore water samples were collected from the Sue A special waste rock from 2009-2013. In 2010, the piezometers became submerged by the pit water and it was no longer possible to safely access them for a period of time. In March 2013, the water level was low enough to allow access to the piezometers and a number of ports were resampled.

Table 4-4 shows the minimum, maximum, and average results from the 20 samples for the COPCs modelled in the Caribou EIS. The measured results are generally consistent with the Caribou EIS predictions, with the exception of nickel.

Table 4-4: Measured vs. Predicted Sue A Pore Water Quality

Constituent of Concern	Minimum	Maximum	Average	Caribou EIS Prediction
Arsenic (µg/L)	129	10,800	4,371	91,000
Chloride (mg/L)	4.0	7.0	5.1	-
Cobalt (mg/L)	0.0006	1.1	0.2	0.5
Copper (mg/L)	0.0002	0.011	0.0013	0.5
Lead (mg/L)	0.0001	0.0023	0.0006	0.005
Lead-210 (Bq/L)	0.02	0.04	0.04	0.03
Molybdenum (mg/L)	0.1	0.9	0.40	1.2
Nickel (mg/L)	0.01	46.5	3.4	0.2
Radium-226 (Bq/L)	0.04	0.96	0.49	1.2
Selenium (mg/L)	0.0004	0.013	0.002	0.05
Thorium-230 (Bq/L)	0.01	0.02	0.02	0.04
Uranium (µg/L)	0.2	71	9.4	350
Zinc (mg/L)	0.0012	0.28	0.075	0.035

The average measured results for Sue A pore water is used in the modelling in Part B of this document.

4.2.3 Sue B

4.2.3.1 Solids Content

During the mining of Sue B, segregation did not occur beyond separating overburden from waste rock. All waste rock was treated as special waste and disposed of in the Sue E pit. In addition to radiometric methods, XRF technology was used in the segregation procedures for Sue B. Throughout mining, blast hole cuttings were scanned with the XRF handheld unit and analyzed for arsenic, nickel, lead, and uranium content. Composite samples were collected and sent to SRC to verify the XRF results.

The full analysis of the XRF and SRC analyses for Sue B are presented in Appendix AI.4 of this document and summarized here. The XRF and SRC results for Sue B showed a high degree of correlation for arsenic and lead. This indicates that the XRF unit was calibrated and performing well for field measurements. XRF measurements for nickel and uranium were higher than SRC results, due to XRF detection limit handling for these elements. Therefore, the XRF is conservative in the field for nickel and uranium measurements.

The mined quantity of Sue B special waste was 3,502,481 tonnes, which is 20% greater than the predicted quantity of 2,882,933 tonnes in the Caribou EIS. The larger quantity can be attributed to the fact that Sue B waste rock could not be segregated, and all waste rock was treated as special waste rock.

Table 4-5 shows a comparison of the predicted and measured special waste rock solids content, quantities, and inventory for Sue B. Although a good correlation can be observed between the XRF and SRC results, the SRC results are considered to be the most representative values due to the greater accuracy of laboratory testing. The measured field concentrations are generally lower than Caribou EIS predictions. When combined with the increased waste rock quantity, the overall inventory is generally consistent with Caribou EIS predictions. The quantity of 3,547,815 tonnes shown in Table 4-5 is the sum of the design bench quantities. Design bench quantities were used to calculate weighted average solids content for Sue B special waste rock, as XRF and SRC quantities were collected on a per bench basis and actual mined quantities per bench were not available for this analysis. As the design quantities were greater than the mined quantities, the calculations are conservative. More information on these calculations can be found in Appendix AI.4 Appendix AI.3 of this document.

Table 4-5: Sue B Special Waste Predicted vs. Measured Quantities, Solids Content, and Inventory

Result	Quantity (tonnes)	Solids Content (mg/kg)				Average Inventory (tonnes)			
		As	Ni	Pb	U	As	Ni	Pb	U
Sue B Predicted in Caribou EIS	2,882,933 (Clean and Special)	173	98.0	172	15.0	499	283	496	43.2
Sue B XRF Weighted Average	3,547,815	71.8	106	77.5	27.0	255	374	275	95.8
Sue B SRC Weighted Average	3,547,815	62.3	48.7	59.9	14.1	221	173	213	50.0
Actual Placed Quantity	3,502,481	62.3	48.7	59.9	14.1	218	171	210	49.4

The Sue B waste rock solids parameters used for modelling in Part B of this TID are as follows:

- Waste rock quantity used for modelling is the actual placed quantity of 3,502,481 tonnes;
- SRC measured values are used for: arsenic, nickel, lead, and uranium; and
- Weighted average waste rock and special waste rock solids contents from the Caribou EIS are used for all other COPCs and radionuclides as XRF and SRC results are not available.

4.2.3.2 Pore Water Quality

The pore water quality predictions for Sue B used in the Caribou EIS are presented in Tables 4.5 and 4.6 in Appendix VIIIB of the Caribou EIS (AREVA 2009a). The values were derived from a combination of the measured solids content and laboratory leach testing results from studies in both the 1991 McClean EIS (Minatco 1991a, 1991b) and the Disposal of Cigar Lake Waste Rock EIS (COGEMA and CLMC 2001).

A comparison could not be made between predicted and measured pore water quality for Sue B as pore water quality was not measured in the field. Therefore, in the absence of measured pore water data, the

pore water quality predictions from the Caribou EIS are used in the modelling scenarios in Part B of this document.

4.2.4 Sue E

4.2.4.1 Solids Content

During the mining of Sue E, waste rock was segregated into clean and special waste. All special waste rock was disposed of in the Sue C pit, while clean waste rock was stockpiled on surface. In addition to radiometric methods, XRF technology was used in the segregation procedures for Sue E. Throughout mining, blast hole cuttings were scanned with the XRF handheld unit and analyzed for arsenic, nickel, lead, and uranium content. Composite samples were collected and sent to SRC to verify the XRF results.

The full analysis of the XRF and SRC analyses for Sue E are presented in Appendix AI.5 of of this document and summarized here. The XRF and SRC results for Sue E showed a high degree of correlation for arsenic, uranium, and lead; indicating that the XRF unit was calibrated well and shows further improvement of the XRF from Sue A mining. XRF measurements for nickel were higher than SRC results, due to XRF detection limit handling for this element. Therefore, the XRF was conservative in the field for nickel measurements.

The mined quantity of Sue E special waste rock was 5,923,907 tonnes, which is 24% less than the predicted quantity of 7,798,436 tonnes in the Sue E EIS (AREVA 2004a). The segregated quantity of clean waste rock was 11,224,245 tonnes, which was more than the 7,180,640 tonnes predicted in the Sue E EIS.

Table 4-6 shows a comparison of the predicted and measured special waste rock solids content, quantities, and inventory for Sue E. Although a good correlation can be observed between the XRF and SRC results, the SRC results are considered to be the most representative values due to the greater accuracy of laboratory testing. The measured field concentrations and inventories are generally consistent with Sue E EIS predictions. The quantity of 6,369,254 tonnes shown in Table 4-6 is the sum of the design bench quantities. Design bench quantities were used to calculate weighted average solids content for Sue E special waste, as XRF and SRC quantities were collected on a per bench basis and actual mined quantities per bench were not available for this analysis. As the design quantities were greater than the mined quantities, the calculations are conservative. More information on these calculations can be found in Appendix AI.5.

Table 4-6: Sue E Special Waste Predicted vs. Measured Quantities, Solids Content, and Inventory

Result	Special Waste Quantity (tonnes)	Solids Content (mg/kg)				Average Inventory (tonnes)			
		As	Ni	Pb	U	As	Ni	Pb	U
Sue E Predicted in Sue E EIS	7,798,436	57.2	28.0	39.1	41.9	446	218	305	327
Sue E XRF Weighted Average	6,369,254	32.0	62.6	18.1	34.3	204	399	115.	219
Sue E SRC Weighted Average	6,369,254	32.1	48.3	14.9	36.2	205	308	94.9	231
Actual Placed Quantity	5,923,907	32.1	48.3	14.9	36.2	190	286	88.3	214

The Sue E special waste rock solids content for arsenic, nickel, lead and uranium is updated with the Sue E SRC measured average for the modelling scenarios in Part B of this document. XRF and SRC results are not available for the other COPCs and radionuclides. Therefore, the solids content used in the Sue E EIS and Caribou EIS for these analytes are used in Part B of this document. The waste rock quantity used for modelling is the actual placed quantity of 5,923,907 tonnes.

4.2.4.2 Pore Water Quality

The pore water quality predictions for Sue E used in the Caribou EIS are presented in Tables 4.5 and 4.6 in Appendix VIIIB of the Caribou EIS (AREVA 2009a). The Sue E values presented in these tables were derived from laboratory waste rock characterization program completed for the Sue E EIS (AREVA 2004a).

Four multi-level piezometers were installed in the Sue E special waste rock in the Sue C pit in 2009 (AREVA 2012a). A total of 28 pore water samples were collected from these piezometers between 2009 and 2013. The piezometers were submerged and inaccessible from 2010 to March 2013. Sampling from the piezometers ended in 2013. Detailed data for Sue E special waste rock pore water is presented in Appendix AI.7 of this document and summarized here

Table 4-7 shows the minimum, maximum, and average results from the 28 samples for the COPCs modelled in the Caribou EIS. The measured results are generally consistent with the Caribou EIS predictions, with the exception of arsenic.

Table 4-7: Measured vs. Predicted Sue E Pore Water Quality

Constituent of Potential Concern	Minimum	Maximum	Average	Caribou EIS Predictions
Arsenic (µg/L)	9.0	6,060	1,318	800
Chloride (mg/L)	2.6	22	9.0	-
Cobalt (mg/L)	0.012	0.34	0.1	0.51
Copper (mg/L)	0.0002	0.01	0.002	0.47
Lead (mg/L)	0.0001	0.002	0.0003	0.47
Lead-210 (Bq/L)	0.02	0.13	0.1	0.03
Molybdenum (mg/L)	0.083	8.0	0.8	0.68
Nickel (mg/L)	0.21	5.81	1.7	1.3
Radium-226 (Bq/L)	0.35	2.2	0.8	1.2
Selenium (mg/L)	0.0003	0.15	0.013	0.1
Thorium-230 (Bq/L)	0.01	0.04	0.020	0.04
Uranium (µg/L)	1.3	512	55	1100
Zinc (mg/L)	0.0052	0.46	0.090	0.48

The average measured results for Sue E pore water are used in the modelling in Part B of this document.

4.2.5 Clean Waste Rock Stockpiles

4.2.5.1 Solids Content

Assessment results for the solids contents of the JEB, Sue C, and Sue E clean waste rock piles (CWRP) were presented in Appendices AI.1, AI.2, and AI.5 of this document, respectively, and detailed calculations can be found in these appendices. For JEB, solids content data was available for arsenic, uranium and lead. For Sue C and Sue E, solids content data was available for arsenic, uranium and lead. Laboratory analysis was limited to these key constituents of concern and other constituents of concern (cobalt, copper, molybdenum, selenium, zinc, radium-226, lead-210, and thorium-230) were not analyzed. Solids content predictions from the Caribou EIS (AREVA 2009b) will be used for the constituents of concern without measured data.

The clean waste rock solids content for each stockpile is presented below in Table 4-8. For Sue E, SRC results are presented as the XRF unit tends to overestimate nickel and uranium due to detection limit handling for these elements. More information on the XRF and SRC analyses for Sue E can be found in Appendix AI.5 of this document.

Table 4-8: Clean Waste Rock Solids Content for JEB, Sue C, and Sue E Stockpiles

Stockpile	Weighted Average Solids Content			
	As (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	U (mg/kg)
JEB[1]	9.0	N/A	2.1	7.1
Sue C[2]	9.5	11.9	21.9	6.4
Sue E[3]	2.6	3.3	10.0	4.4

[1] Weighted average of 1,112 blasthole drill cutting results collected throughout JEB mining (Appendix AI.1)

[2] Weighted average of 3,101 blasthole drill cutting results collected throughout Sue C mining (Appendix AI.2)

[3] Weighted average of 62 samples collected throughout Sue E mining and sent to SRC Analytical for the purpose of verifying field XRF results (Appendix AI.5)

Table 4-8 shows that all three stockpiles have low concentrations for each of the COPC, indicating that the clean waste rock was effectively segregated from the special waste rock during mining. JEB and Sue C waste rock was segregated using radiometric techniques. For Sue E, an extensive waste rock characterization program was undertaken for the Sue E EIS (AREVA 2004). A copy of this study can be found in Appendix A-II.1 of the 2013 Waste Rock TID (AREVA 2013). This study, in conjunction with the continued use of radiometric field segregation methods and the introduction of XRF technology, further improved the segregation methodology used at the McClean Lake Operation.

4.2.5.2 Pore Water Quality

In 2007, a field program was initiated to provide site specific water chemistry and water level data for the existing clean waste rock piles. The field program consisted of drilling and installing piezometers in each of the CWRP. The locations of these piezometers are shown in Section 2.1.3 of this document.

The piezometers were developed, purged, and sampled for the first time in the spring of 2008. Sampling has generally occurred on a yearly basis, or every second year, since 2008. The piezometers were not sampled in 2020 because of limited on-site staff resources due to Covid-19 related restrictions. The samples from these piezometers were evaluated in terms of pH, specific conductivity, source term COPCs, and major ion analysis. The details of this analysis can be found in Appendix AI.6 of this document and the results are discussed generally below.

The JEB clean waste rock pile has been consistently neutral in pH since 2008 and specific conductivity is low (Table 2 in Appendix AI.6 of this document). In Sue C, the pH is slightly acidic (2019 average pH is 4.3); however, the pH appears to be stabilizing based on recent measurements. Specific conductivity is generally low and stabilizing over time. For Sue E, the observed pH is just below neutral (2019 average pH is 5.4) and stabilizing based on recent measurements, while specific conductivity results are generally low. Overall, the measured pH and specific conductivity for three clean waste rock piles indicate that the clean waste rock has low acid generating potential.

Data of samples collected from 2009-2019 (Table 3 in Appendix AI of this document) from the CWRP piezometers were evaluated in terms of source term COPC. These include arsenic, cobalt, copper, lead, molybdenum, nickel, selenium, uranium, zinc, lead-210, radium-226, and thorium-230. Source terms were not developed for the JEB CWRP. However, source terms for the Sue C CWRP were developed in the 2004 Waste Rock TID (COGEMA 2004) using the seepage samples collected from the Sue C CWRP prior to June 2005. Source terms were also not developed for Sue E as the waste rock characterization program from the Sue E EIS (AREVA 2004) concluded that the clean waste rock had virtually no acid generating potential. For the purpose of this evaluation, the Sue C CWRP source terms are used as a comparison for piezometer results collected from 2009-2019 from all three CWRP. Figures 2 to 25 in Appendix AI of this document shows hydrochemical trend of the source term parameters. The trend charts illustrate the temporal metals concentration in comparison to the predicted value for Sue C CWRP. Individual hydrochemical trend charts were reviewed for each source term parameter concentration at each of the piezometer locations. Temporal concentrations were assessed on a visual basis to identify whether the predicted source term concentration still represented a suitable trending long-term upper limit concentration. Where no longer representative, a revised source term concentration has been provided in Tables 4, 5 and 6 for JEB, Sue C and Sue E CWRP respectively in Appendix AI.6 of this document. The final revised source term concentration is based on a visually estimate of the maximum value based on trending concentrations from piezometer porewater samples. A summary of the updated CWRP source terms is presented in Table 4-14. Summary comparisons of piezometer pore water data to Sue C source term data (Table 4-14) are as follows:

- JEB clean waste rock pile pore water samples are generally consistent with or below the Sue C source term for all COPCs.
- Sue C results for cobalt, copper, lead-210, nickel, and zinc are slightly elevated above source term. These results may be due to the placement of some basement rock on the Sue C CWRP, which may not have been anticipated when the original source terms were developed. Overall, the metals concentrations in the Sue C CWRP are low and appear to be stabilizing over time.
- Sue E results show that lead-210 and copper are elevated above the Sue C source term. Overall, the Sue E waste rock pile is generally consistent with or below the Sue C source term.

Overall, the analysis of the source term parameters for the clean waste rock piles indicates that low concentrations have been observed for all constituents of concern, and acid generating potential appears to be low. The stockpiles were also evaluated in terms of major ion chemistry using piper plot analysis. (Appendix AI.6 of this document). The results showed that the stockpiles are performing similarly in terms of cation chemistry. Samples from the three stockpiles showed calcium as the dominant cation. For anion chemistry, the Sue C CWRP has a greater sulphate concentration due to the presence of basement rock on the stockpile. The Sue E and JEB CWRP contain greater concentrations of bicarbonate which is typical of sandstone. The presence of nitrate and nitrite in all of the samples can be attributed to the residual blasting agents used during mining.

Based on the pH and specific conductivity data, analysis of source term parameters, and major ion chemistry, the clean waste rock piles at the McClean Lake Operation are confirmed to be clean. The data suggests that clean waste rock was effectively segregated from special waste rock, and the potential for acid generation from the placed waste rock appears to be low. Sampling of the clean waste rock pile piezometers will continue to occur on an annual basis.

4.2.6 Operational Process Waste in Sue C Contaminated Landfill

In early 2018, a program was implemented to sample and analyze new operational process wastes prior to placement in the Sue C contaminated landfill. Inventory measured quantities and solid content of process waste placed in the Sue C contaminated landfill is presented in Table 4-9. The resulting weighted COPC content of the process wastes that have been placed in the Sue C contaminated landfill by December 2020 is included in Table 4-11 and 4-12 to account for the source terms contribution of the contaminated landfill to the Sue C pit in the contaminant transport modelling presented in Part B of this document.

The Sue C Contaminated Landfill is currently considered as the disposal site for the future placement of operational process wastes that are temporary stored in the CX pond as well as on the JEB and Sure ore pads respectively. The wastes in the CX pond are mostly CX solution and waste sludge from JWTP before the TMF was completed whereas the waste on JEB and Sure ore pads are waste sludges from pre-sedimentation and sedimentation ponds of the Sue WTP. The inventory measured quantities and content of the waste sludges being considered for future placement in the Sue C Contaminated Landfill is presented in Table 4-9. The potential effect of the placement of the waste sludges in the Sue C Contaminated Landfill on the environment has been determined through contaminant transport modelling presented in Section 6.2.3 of Part B of this document.

Table 4-9 Current and Future Sue C Contaminated Landfill Operational Process Waste Inventory, Measured Quantities and Solid Content

Current Operational Process Waste	Quantity (tonnes)	Solid Concentration (µg/g)												
		As	Co	Cu	Fe	Mo	Ni	Pb	S	Se	U	V	Zn	NH_3
SABRE Drill Cuttings	369.2	232.5	4.1	3.2	1937	67.5	68.6	57.2	38.8	2.9	1148.2	118.8	5.8	-
Tailings Rejects	11.25	3410	-	1850	27800	290	1430	5290	-	70	470	-	50	-
Tails Neut Tank Scale	20	7735	-	3470	53100	260	5170	5030	-	50	1825	-	70	-
Leach Tank Scale	3.2	6150	-	2720	10500	1570	210	9190	-	140	29700	-	10	-
Filter Media	2.5	200	-	20	76300	150	10	20	-	10	130	-	10	-
Sum	406													
Weighted Values		736	4	247	5698	95	358	519	35	8	1381	108	10	-
Operational Process Waste for Future Placement														
CX Pond Sludge	1113	1289	9	16	10619	67	295	65	66024	2	313	66	30	18180
JEB Ore Pad Sludge	4762	3463	100	200	16600	47	3660	450	-	-	993	-	50	-
Sue Ore Pad Sludge	214	15810	690	415	13695	80	52700	410	-	-	1600	-	85	-
Sum	6089													
Weighted Values		3500	104	174	15404	51	4768	378	12073	0.33	890	12	48	3325

4.3 Future Projects

4.3.1 McClean Underground Project

The McClean Underground project was initially assessed and approved as part of the 1991 McClean EIS (Minatco 1991a, 1991b). Since the time that the 1991 McClean EIS was prepared, a number of changes have been proposed to the McClean Underground project. These changes include the addition of Caribou and Sue D pods to the proposed underground mining project, as well as a ramp access from the Sue B pit.

4.3.1.1 McClean Lake Underground Deposit

In the Caribou EIS (AREVA 2009a), special waste rock from the McClean Underground project was assessed and approved for placement in the Sue E pit. Currently, it is proposed that the McClean Underground waste rock will be segregated with clean waste being placed on Sue C clean waste rock pile and special waste rock being placed in the Sue C/A pit. More information on the quantities of waste rock expected and the proposed placement can be found in Section 3.2.2.1.

The solids content values for McClean Underground used in the Caribou EIS are based on the results of composite sampling conducted for the 1991 McClean EIS (Minatco 1991a, 1991b). The pore water source term for arsenic was developed using the correlation relating arsenic solids content to concentration which was developed for the Caribou EIS (AREVA 2009a, Figure 3.6, Appendix VIIIA). Pore water source terms for other constituents were developed from laboratory leach testing results from studies in both the 1991 EIS (Minatco 1991a, 1991b) and the Disposal of Cigar Lake Waste Rock EIS (COGEMA and CLMC 2001).

4.3.1.2 Caribou Deposit

The solids content values for Caribou presented in the Caribou EIS are based on the results of block model and waste rock characterization studies prepared for the Caribou EIS (AREVA 2009a). Copies of the relevant documents are provided in Appendix A-II.2 of the 2013 Waste Rock TID (AREVA 2013b). Arsenic, nickel, and uranium solids contents are based on a mean geostatistical estimate from exploration block models. The remaining constituents of concern are estimated from an average of all geochemical samples from the Orano exploration database that were identified as Caribou special waste rock. The pore water source term for arsenic was developed using the arsenic solids content and existing source term relationship for arsenic, shown in Figure 3.6 of the Caribou waste rock characterization study (Appendix A-II.2 of the 2013 Waste Rock TID (AREVA 2013b). Pore water source terms for other COPCs were developed using an average of the equilibrium concentration results from four column tests, also conducted as part of the Caribou waste rock characterization study.

4.3.1.3 Additional Waste Rock Characterization Studies

In 2012, a waste rock characterization program was initiated to support the McClean Underground (including McClean, Caribou and Sue D pods) project. A total of 54 core samples were selected from the Moffat Exploration Core Storage Area at the McClean Lake Operation. The samples were submitted to SRC and EcoMetrix Inc. for geochemical analyses and leach testing. Samples were selected from areas

representative of McClean Underground, Caribou, and Sue D waste rock. Efforts were made to select recent samples whenever possible, as older core samples can oxidize on surface and become unrepresentative of mined waste rock. Approximately half of the samples collected originated from exploration drilling programs in the 2009-2012 seasons.

Sequential leach testing and geochemical analyses for the McClean Underground project waste rock were completed in 2012. As waste rock from McClean Underground, Caribou, and Sue D is primarily basement rock, the testing was focused on the characterization of basement rock samples.

The results showed that special waste rock originating from McClean Underground, Caribou, and Sue D correlates to special waste rock from other deposits in the Sue area. Therefore, underwater column testing was not completed and previously determined source term relationships for the Sue site were used to estimate pore water source terms.

As discussed in Section 3.2.2.1, attempts will be made to segregate the waste rock from the ramp access to the McClean Underground project. As the majority of the ramp is in basement rock, humidity cell testing was conducted to assess the condition of stockpiling clean segregated basement waste rock on surface. This testing was completed in December 2013 and is presented in appendix AIII of this document.

The solids contents and arsenic pore water source terms for McClean Underground project waste rock has been updated with the results of the humidity cell testing results. The remaining pore water source term parameters are taken from the Caribou EIS (AREVA 2009a).

4.3.2 Cigar Lake Special Waste

The currently assessed and approved decommissioning plan is to haul the Cigar Lake special waste rock for disposal in Sue C pit during two campaign hauls, one at the conclusion of Cigar Lake Phase 1 mining and one at the conclusion of Cigar Lake Phase 2 mining. As of the end of 2020, the Cigar Lake Phase I special waste rock quantity is estimated to be 439,200 m^3 (i.e. the mined and deposited in Stockpile C at Cigar Lake = 385,600m^3 and unmined Cigar Lake Phase I = 53,600 m^3). Phase II at Cigar Lake is expected to produce an additional 175,000 m^3 of special waste rock.

The reactivity and geochemical characteristics of the Cigar Lake special waste rock have been assessed a number of times and the data for the Cigar Lake special waste presented in the 2013 Waste Rock TID (AREVA 2013b) was derived from studies completed for the Disposal of Cigar Lake Waste Rock EIS (COGEMA and CLMC 2001). At the time of the 2001 McClean EIS assessment, a limited volume of rock had been placed on the waste rock facility at the Cigar Lake mine and the majority of the geochemical assessment was based on core samples.

Since the 2001 McClean EIS, more waste rock has been placed on the lined Stockpile C facility at the Cigar Lake mine which included:

- all development basement rock from underground, (including non-potential acid generating (PAG) basement rock) and,

- slimes from production and post-flooding mine remediation activities.

A number of significant changes at the Cigar Lake mine and McClean Lake Operation, as well as additional waste rock studies have occurred since 2001 as outlined below:

- Cigar Lake
    - Disposal of slimes on Stockpile C at Cigar Lake
    - Lower than anticipated volumes of waste rock production

- McClean Lake
    - Placement of the Sue C, Sue A and Sue E special waste rock in Sue C pit
    - Flooding of the Sue C pit
    - Pumping and treatment of Sue C/A pit water at SWTP

- Additional Studies
    - Detailed planning for Phase II of Cigar Lake to develop the understanding of the waste rock associated with that portion of the Cigar Lake deposit.
    - A full geochemical and geotechnical reassessment was completed on the Stockpile C rock utilizing data from previous waste rock assessments and the 2017 Stockpile C drilling program occurred.
    - A thorough assessment of the remaining unmined Cigar Lake Phase I as well as Phase II development special waste rock was conducted as part of the 2017 assessment program. The Phase II rock was assessed both from exploration and resource evaluation data as well from core collected in 2017.

The primary intent of the 2017 assessment program was to update and expand on saturated in-pit disposal source terms within Sue C pit at the McLean Lake Operation for Cigar Lake Stockpile C, remaining Phase I and Phase II special waste rock. Results from the assessment summarizing the solids content, leachable mass, and source terms for modelling are presented in Table 4-10. Details of the 2017 assessment program are presented in the 2017 Cigar Lake Potentially Acid Generating Waste Geochemical Update, which is included in Appendix AII of this document.

4.3.2.1 Cigar Lake Stockpile C Waste Rock

A full geochemical source term reassessment was completed on Cigar Lake Stockpile C waste rock utilizing data from previous waste rock assessments and data from the 2017 Cigar Lake Stockpile C drilling campaign test work program. The 2017 assessment of the Cigar Lake Stockpile C waste rock resulted in source terms generally consistent, or lower than, the 2001 McClean EIS. Most significant were results for arsenic and molybdenum (Table 4-10):

- The measured arsenic solids content has been lowered from 200 to 100 µg/g, and the percent leachable of this COPC is estimated to be much lower than previously assessed. The results also indicate a lower porewater arsenic concentration, down from 21 mg/L to 9.6 mg/L.
- Molybdenum, a soluble parameter within waste rock, has measured solids content down from an estimated 15 µg/g to 6.5 µg/g, percent leachable is down from 55% to 12.3%, and porewater concentrations are down from 11 mg/L to 3.3 mg/L.

4.3.2.2 Phase I Unmined Waste Rock

A thorough assessment of the remaining unmined Cigar Lake Phase I special waste rock was conducted as part of the 2017 of the Cigar Lake Stockpile C waste rock assessment. The results are summarized in Table 4-10.

Significant changes are arsenic contents estimated at 280 µg/g up from 100 µg/g, molybdenum concentrations at 23 µg/g up from 6.5 µg/g, and nickel concentrations at 217 µg/g up from 90 µg/g. Expected pore water concentration are correspondingly higher.

4.3.2.3 Phase II Deposit

Cigar Lake Phase II waste rock was assessed both from exploration and resource evaluation data as well from core collected in 2017. This data is well constrained in terms of expected development areas and results from the assessment show increased solids content over those in Cigar Lake Phase I:

- Arsenic, radium-226 and vanadium are similar or lower than remaining Cigar Lake Phase I waste rock, but higher than what is currently on Stockpile C.
- Molybdenum, nickel, selenium and uranium are similar to current Stockpile C rock and lower than remaining Cigar Lake Phase I waste rock.
- Cobalt, copper and lead concentrations are notably higher then observed for overall Cigar Lake Phase I waste rock.

Table 4-10: Summary of source term update predictions for Cigar Lake Stockpile C, remaining Cigar Lake Phase I and Phase II waste rock

COPC	Solids Content				Percent Leachable (all)			Porewater Concentration			
	2001 McClean EIS	Stockpile C	Phase I Remaining	Phase II	2001 McClean EIS	Stockpile C	Phase II	2001 McClean EIS	Stockpile C	Phase I Remaining	Phase II
	µg/g	µg/g	µg/g	µg/g	%	%	%	mg/L	mg/L	mg/L	mg/L
Arsenic	*200*	100	277	203	*20*	4.34	5.5	*21*	9.6	18.1	15.1
Cadmium	--	0.14	0.14[1]	0.15[2]	--	n/a	n/a	--	0.0087	0.0087	0.0089
Cobalt	*84*	47	24.6	33	*1*	1.35	0.056	*0.3*	0.4	0.3	0.35
Copper	*25*	30	21.9	48.8[2]	*0.2*	0.63	0.063	*0.003*	0.04	0.026	0.058
Molybdenum	*15*	6.5	22.6	7	*55*	12.3	16.3	*11*	3.3	11.5	3.6
Nickel	*111*	90	217	104	*1.5*	0.86	0.076	*0.25*	0.2	0.9	0.2
Lead	*23*	23	30	81[2]	*0.3*	0.76	0.047	*0.004*	0.07	0.091	0.24
Radium-226	--	0.18(Bq/g)	0.86(Bq/g)	0.52[2](Bq/g)	--	0.26	0.17	--	1.2(Bq/L)	5.8(Bq/L)	3.5(Bq/L)
Selenium	--	1	7	2.2	--	4.75	5.25	--	0.18	1.2	0.39
Uranium	*9*	10	17	10.4	--	0.21	0.27	*0.5*	0.43	0.73	0.45
Vanadium	--	29	254	55	--	0.39	0.06	--	0.046	0.14	0.031
Zinc	*40*	29	38.1	19.4[2]	*1*	3.97	1.73	*0.006*	0.092	0.12	0.061

Note: Data for the 2001 EIS is provided for comparison.

[1] Assumed similar to Stockpile C

[2] Values from limited 2017 drilling data

4.3.3 Midwest

The solids content values and initial pore water concentrations presented in Table 4-11, Table 4-12 and Table 4-13 respectively, are from Appendices VIII and IX of the most recent updates to the Midwest EIS (AREVA 2011a). With the exception of uranium, arsenic, and lead-210, solids content values were derived from an average of all solids contents from special waste characterization in 1981, 1995, and 2001. For uranium and arsenic, average calculations were determined from block model estimates. The block model was constructed using exploration drilling data within the area of the proposed Midwest pit. The model was comprised of 4,707 geochemical results and sorted into ore and special waste using a range of uranium cut-off value scenarios. The resulting arsenic concentration in the special waste ranged from 980 μg/g to 1,200 μg/g, while uranium concentrations ranged from 190 μg/g to 330 μg/g. The average result of 1,100 μg/g and 260 μg/g were used for arsenic and uranium, respectively.

For lead-210, a solids content analysis and source term prediction was not included in the most recent EIS. A value of 1.5 Bq/g was selected for this study, as it was equivalent to the value selected for radium-226, similar to the ratio noted for McClean Lake Operation waste rock.

Special waste rock quantities ranged from 930,000 bcm to 1,400,000 bcm. The maximum value of 1,400,000 bcm, shown in Table 3-1, was selected for this study in order to be conservative.

Pore water source terms were developed for the Midwest waste rock using the results of a number of laboratory characterization programs which are summarized in the Midwest EIS (AREVA 2011a).

The waste rock characterization appendix from the 2011 Midwest EIS (AREVA 2011a) is included in Appendix A-III of the 2013 Waste Rock TID (AREVA 2013b) as a reference.

On-going research and development of Surface Access Borehole Resource Extraction (SABRE) is demonstrating the practicality of more advanced mining techniques to significantly reduce the mining waste generated. Implementation of the SARBE technique and the corresponding reductions in mining waste volumes for the Midwest Project are assessed in Part B of this document.

4.4 Recommended Waste Rock Modelling Parameters

4.4.1 Source Term Characterization

4.4.1.1 Additional Constituents of Concern

For the 2021 Waste Rock TID, six additional COPCs were added to the modelling in addition to the ones identified in the overall evaluation of waste rock performance (ammonia, cadmium, chloride, polonium-210, sulfate, and vanadium). These constituents were added to align with the 2016 Environmental Performance TID (AREVA 2016a) and Tailings Optimization and Validation Program (Orano, 2020). Data for these constituents is limited; however, the data available is summarized in Appendix A-I.8 of 2013 Waste Rock TID (AREVA 2013) and included in the recommended parameters below. Future waste rock characterization will include these additional constituents of concern.

4.4.1.2 Submerged Waste Rock

Table 4-11 and 4-12 provide the calculated tonnage and average solids content for the various types of waste rock to be disposed of within the Sue C/A, Sue E, and Midwest pits. The quantities used in this table are based on the current and future inventories summarized in Table 3-1. Solids content values for completed projects are chosen based on the analyses in Appendix AI and Section 4.2 of this document. For future projects, the most recent solids content values from waste rock characterization studies have been used, as outlined in Section 4.3 of this document. The source of each data set is indicated in footnotes below the table.

The approximate quantities of waste rock planned for disposal in the Sue C/A, Sue E, and Midwest pits are 12.5 million tonnes, 3.5 million tonnes, and 6.0 million tonnes, respectively.

Table 4-11: Updated Solids Content for the Waste Rock Disposed and to be Disposed of into the Sue C/A, Sue E, and Midwest Pits

Source	Status	Mass (tonnes)	Cd (µg/g)	Co (µg/g)	Cu (µg/g)	Mo (µg/g)	Ni (µg/g)	Pb (µg/g)	Se (µg/g)	U (µg/g)	V (µg/g)	Zn (µg/g)	^{226}Ra (Bq/g)	^{210}Pb (Bq/g)	^{210}Po (Bq/g)	^{230}Th (Bq/g)	Cl (µg/g)	SO_4 (µg/g)	NH_3 (µg/g)
Sue C/A Pit																			
JEB [a]	Completed	67,544	9.1	15	31	19	286	32	1.3	345	288	14	8.5	9.0	--	6.0	107	20	--
Sue C [b]		663,448	10	5	9	31	138	26	1.0	317	208	7.0	10	9.0	--	7.0	300	20	--
Sue A [c]		3,520,684	3.2	7.3	42	16	169	204	77	22	85	10	0.36	0.38	--	0.28	114	20	--
Sue E [d]		5,923,907	--	9.3	59	7.9	48	15	7.4	36	--	13	0.69	0.69	--	0.62	--	--	--
Sue C Contaminated Landfill [e]		406	--	3.7	247	96	358	519	8.2	1381	108	10	--	--	--	--	--	105	--
McClean Underground, Caribou, Sue D [f]	Future Project	804,180	0.095	60	12	4.6	89	11	0.80	48	48	10	0.90	0.90	--	0.80	--	8367	--
Cigar Lake [g]		1,492,506	0.14	40	34	8.7	110	40	2.1	11	65	27	0.36	0.1	--	0.10	--	-	--
Weighted Average:		***12,472,675***	***0.29***	***16***	***45***	***11***	***98***	***72***	***26***	***47***	***47***	***14***	***1.1***	***1.0***	--	***0.84***	***143***	***1348***	--
Sue E Pit																			
Sue B [h]	Completed	3,502,481	1.5	11	42	46	49	60	104	14	72	15	0.33	0.33	--	0.27	107	20	--
Midwest Pit																			
Midwest [i]	Future Project	6,000,000	--	403	692	23	621	347	0.2	260	--	735	1.5	--	--	0.9	--	--	--

[a] JEB solids content is based on 23 backhaul drill cutting and 55 production cutting assay results, except for Ra-226, Pb-210, and Th-230, which are based on 1991 composite sample results (Minatco 1991b). Appendix I-A (AREVA 2013b). and Section 4.2.1.1 of this document for more information.

[b] Sue C solids content is based on 18 backhaul composite sample assay results, except for Ra-226, Pb-210, and Th-230, which are based on 1991 composite sample results (Minatco 1991b). Appendix I-B (AREVA 2013b). and Section 4.2.1.1 of this document for more information.

[c] Sue A As, Ni, U, and Pb solids contents are based on 96 SRC composite samples collected for XRF verification during mining. Solids contents for other COPC are based on 1991 composite sample results (Minatco 1991b). Appendix I-C (AREVA 2013b) and Section 4.2.2.1 of this document for more information.

[d] Sue E As, Ni, U, and Pb solids contents are based on 114 SRC composite samples collected for XRF verification during mining. Solids contents for other COPC are based on values presented in AREVA 2009a, Table 4.4, Appendix VIIIB (AREVA 2013b). Appendix I-E (AREVA 2013b) and Section 4.2.4.1 of this document for more information.

[e] Sue C Contaminated Landfill; based on composite sample assay results of process waste placed in contaminated landfill in Sue C pit

[f] McClean Underground, Caribou, and Sue D solids content is based on a recent 2012 waste rock characterization study performed by EcoMetrix, Inc. and included in Appendix AIII of this document

[g] Cigar Lake solids content is based on Cigar Lake 2017 PAG Waste Geochemical Update (Appendix AII of this document).

[h] Sue B As, Ni, U, and Pb solids contents are based on 40 SRC composite samples collected for XRF verification during mining. Solids contents for other COPC are based on 1991 composite sample results (Minatco 1991b). Appendix I-D (AREVA 2013b) and Section 4.2.3.1 of this document for more information.

[i] Midwest solids content is based on studies presented in Appendices VIII and IX of the most recent Midwest EIS (AREVA 2011), with the exception of Pb-210, which was not analyzed in the Midwest EIS. Pb-210 was assigned the same value as Ra-226, similar to the ratio noted for McClean Lake Operation waste rock. Appendix III (AREVA 2013b) and Section 4.3.3 of this document for more information.

Leaching of Arsenic

Two key parameters are required to simulate the leaching of arsenic from placed waste rock: (1) the initial arsenic pore water concentration; and (2) the arsenic leachable mass. Interpretation of column test results for waste rock from various McClean Lake projects indicates that there is a relationship between the arsenic pore water concentration and total arsenic solids content, as given by:

$C_0 = 0.0096S^{1.2911}$

Where:

C_0 = the initial pore water concentration (mg/L)

S = solids content (µg/g)

The above relationship was used in the Caribou EIS (AREVA 2009a) to determine initial arsenic pore water concentrations representative of waste rock to be placed in the Sue C/A and Sue E pits.

This relationship has also been used for this study, with the exception of waste rock with measured pore water quality data (i.e. Sue A and Sue E) and Midwest. For Midwest, $C_0 = 0.123S^{0.935}$ was used as this was the relationship established in Midwest waste rock characterization studies (AREVA 2011a).

The change in waste rock arsenic pore water concentrations with time is constrained by the total leachable mass of constituents (i.e. mass available for release) in the waste rock. Interpretation of a number of sequential leach tests for arsenic indicates that there is a relationship between the water leachable arsenic fraction and the total arsenic solids content, as given by:

$S_L = 0.00831S^{1.36955}$

Where:

S_L = leachable fraction (µg/g)

S = solids content (µg/g)

This relationship was used in the Caribou EIS to determine the arsenic leachable fraction and the total leachable mass representative of waste rock to be disposed of into the Sue C/A and Sue E pits. This relationship has been reviewed and new data has been incorporated for this study. Based on the review of the data, the relationship was updated to be $S_L = 0.0108S^{1.2654}$ (more information can be found in Part B of this study, in Appendix B-I) and this value was used for JEB, Sue A, Sue B, Sue C, McClean Underground, Caribou, Sue D, and Cigar Lake. Midwest is the exception and a relationship of $S_L = 0.0168S^{1.2763}$ was used as described in the Midwest EIS (AREVA 2011a). The updated arsenic solids contents presented in Table 4-12 were used for the calculations in this study.

Leaching of Other Constituents

For other constituents, the Caribou EIS source term predictions were replaced with known, measured values if available. Measured pore water quality data is available for Sue A and Sue E special waste rock. For other waste rock sources, source term values from the Caribou EIS were used for the other constituents.

The values presented in the Caribou EIS were developed from an assumed pulse-type source function, which is characterized by a constant source concentration over the duration required to deplete the leachable inventory. The two parameters required to define the source function for each constituent are: (1) the source concentration; and (2) the duration of the pulse. The source concentration was determined for each constituent based on the results of laboratory-scale submerged column tests. Equilibrium pore water concentrations determined by the column tests are presented in Table 4-13 for waste rock sources that do not have measured data available.

4.4.1.3 Surface Waste Rock Stockpiles

Source terms were previously developed for the Sue C CWRP using seepage results collected from the pile (COGEMA 2004). For this study, source term predictions for each stockpile were updated using the average of the six most recent samples collected from the piezometers in the JEB, Sue C, and Sue E CWRP (Appendix AI.6 of this document). Separate source terms were assigned to each CWRP, as shown in Table 4-14.

Table 4-12: Updated Arsenic Source Term Parameters

Source	Status	Mass (tonnes)	Arsenic Content (µg/g)	Arsenic Leachable Mass (tonnes) [a]	Initial Arsenic Pore Water Concentration (mg/L) [b]
Sue A/C Pit					
JEB	Completed	67,544	339	1.2	18
Sue C		663,448	148	4.0	6.1
Sue A		3,520,684	278	47	4.4
Sue E		5,923,907	32	5.2	1.3
Sue C Contaminated Landfill		406	736	0.30	11
McClean Underground, Caribou, Sue D	Future Project	804,180	204	7.3	9.2
Cigar Lake		1,492,506	152	9.3	12
Weighted Average:		***12,472,675***	***135***	***74***	***4.3***
Sue E Pit					
Sue B	Completed	3,502,481	62	7.1	2.0
Midwest Pit					
Midwest	Future Project	6,000,000	1100	768	86

[a] JEB, Sue A, Sue B, Sue C, Sue E, McClean Underground, Caribou, Sue D, Cigar Lake: Calculated using relationship $S_L = 0.0108S^{1.2654}$ (AREVA 2013b, Appendix B-I)
Midwest: Calculated using relationship $S_L = 0.0168S^{1.2763}$ (AREVA 2011, Appendix VIII)

[b] Sue A and Sue E: Based on average of field measurements (AREVA 2013b, Appendix I-G)
Cigar Lake: Based on average of field measurements (Appendix … of this document)
JEB, Sue B, Sue C, McClean Underground, Caribou, Sue D: Calculated using relationship $C_0 = 0.0096S^{1.2911}$ (AREVA 2009a)
Midwest: Calculated using relationship $C_0 = 0.123S^{0.935}$ (AREVA 2011)

Table 4-13: Updated Initial Pore Water Concentrations

Source [(a)]	Status	Mass (tonnes)	Cd (mg/L)	Co (mg/L)	Cu (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Se (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)	^{226}Ra (Bq/L)	^{210}Pb (Bq/L)	^{210}Po (Bq/L)	^{230}Th (Bq/L)	Cl (mg/L)	SO_4 (mg/L)	NH_3 (mg/L)
Sue A/C Pit																			
JEB	Completed	67,544	0.0056	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.0007	0.035	1.2	0.03	--	0.04	0.9	4.0	--
Sue C		663,448	0.0019	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.0020	0.035	1.2	0.03	--	0.04	0.9	4.0	--
Sue A		3,520,684	0.00012	0.21	0.0013	0.40	3.4	0.00060	0.0017	0.0094	0.0039	0.075	0.49	0.039	0.01	0.019	5.1	46	--
Sue E		5,923,907	0.00038	0.12	0.0019	0.80	1.7	0.00032	0.013	0.055	0.0012	0.09	0.81	0.056	0.015	0.020	9.0	127	--
Sue C Contaminated Landfill		406		0.06	3.7	1.4	5.3	7.7	0.12	20	1.6	0.15						6.9	
McClean Underground, Caribou, Sue D	Future Project	804,180	0.008	2.3	0.45	0.28	42	0.075	0.38	0.64	0.076	0.91	1.2	0.03	--	0.04	--	--	--
Cigar Lake		1,492,506	0.0088	0.37	0.043	4.4	0.29	0.12	0.37	0.47	0.054	0.087	2.4	0.03	--	0.04	--	--	--
Weighted Average:		***12,472,269***	***0.0019***	***0.34***	***0.065***	***1.1***	***4.6***	***0.020***	***0.078***	***0.15***	***0.013***	***0.014***	***0.96***	***0.045***	***0.014***	***0.025***	***7.1***	***90***	***--***
Sue E Pit																			
Sue B	Completed	3,502,481	0.0017	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.014	0.035	1.2	0.03	--	0.04	1.0	2.0	--
Midwest Pit																			
Midwest	Future Project	6,000,000	0.001	73	0.40	7.3	115	0.10	0.30	0.30	0.0068	2.7	1.2	0.03	--	0.04	--	20	--

(a) Sue A and Sue E: Initial pore water concentrations are based on an average of measured field data (AREVA 2013b, Appendix I-G)
JEB, Sue B, Sue C, Cigar Lake, McClean Underground Caribou, Sue D: Initial pore water concentrations derived from Caribou EIS (AREVA 2009a)
Cigar Lake: Updated pore water concentrations derived from Appendix AII of this document
Midwest: Initial pore water concentrations derived from Midwest EIS (AREVA 2011)
Pore water concentration for the Sue C Contaminated Landfill is based on the ratio of leachable concentration to the Arsenic leachable concentration (see Appendix BII, Section 1.5).

Table 4-14: Updated Clean Waste Rock Stockpile Source Terms

Constituent of Potential Concern	Units	Revised Source Term [2]		
		JEB[(a)]	Sue C[(b)]	Sue E[(c)]
Arsenic	mg/L	0.0001	0.001	0.0002
Cadmium	mg/L	0.000013	0.00067	0.0003
Cobalt	mg/L	0.0005	0.014	0.0093
Copper	mg/L	0.001	0.008	0.0058
Lead	mg/L	0.00017	0.00077	0.00012
Molybdenum	mg/L	0.0001	0.0001	0.0004
Nickel	mg/L	0.0015	0.14	0.033
Selenium	mg/L	0.0001	0.0078	0.0001
Uranium	mg/L	0.00065	0.00092	0.00017
Vanadium	mg/L	0.00047	0.00010	0.00011
Zinc	mg/L	0.002	0.021	0.012
Lead-210	Bq/L	0.024	0.045	0.048
Polonium-210	Bq/L	0.0051	0.0070	0.0060
Radium-226	Bq/L	0.016	0.29	0.52
Thorium-230	Bq/L	0.013	0.01	0.015
Ammonia	mg/L	0.054	2.7	1.8
Chloride	mg/L	2.1	3.2	2.1
Sulphate	mg/L	8.5	49.8	0.45

Notes:
[(a)] Based on average of the six most recent samples to date of this assessment, collected from piezometers 07-08, 07-09, and 07-10.
[(b)] Based on average of the six most recent samples to date of this assessment, collected from piezometers 07-11, 07-12, and 07-13.
[(c)] Based on average of the six most recent samples to date of this assessment, collected from piezometers 07-14 and 07-15.

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Appendix AI.1: Evaluation of JEB Waste Rock Solids Content

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1 JEB Waste Rock Characterization Data

In the addendum to the 1991 McClean EIS (Minatco 1991b), waste management strategies and test work were developed for the JEB, Sue C, Sue A, and Sue B pits in order to support the 1991 EIS submission. The test work consisted of humidity cell testing and underwater column testing to characterize clean waste rock and special waste rock, respectively. Full results of this study can be found in Appendix II of the 2004 Waste Rock TID (COGEMA 2004) or the 1991 EIS (Minatco 1991a and 1991b).

2 JEB Pit Operational Data

During mining of the JEB pit, a total of 1,221 blasthole drill cutting samples were routinely collected for rock analysis (solids content). In the 2004 Waste Rock TID (COGEMA 2004), it was described that 1,112 samples were collected in clean waste rock, while 45 were collected in special waste and 64 were collected in ore. During the preparation of this TID, a slight error was found in calculations from the previous TID. 10 special waste samples from Bench 347 of the JEB pit were classified as ore in the previous special waste calculations. The classification was changed back to special waste and incorporated into the special waste calculations in this document. Therefore, for this analysis, 1,112 samples were collected in clean waste rock, 55 were collected in special waste, and 54 were collected in ore. The results for clean waste rock and special waste have been summarized by mining bench in this document.

Blast hole samples were also collected for acid base accounting (ABA). A total of 96 composite samples, for overburden and clean waste rock, were collected from the JEB pit, and the results are presented in this document.

During backhauling of JEB special waste into the Sue C pit, samples were collected to complement the blasthole drill cutting samples that were collected during mining. In defining the solids content of JEB special waste, both sets of data were combined, as presented in this document.

2.1 JEB Clean Waste Rock by Bench

Table 1 below summarized the operational clean waste rock sampling data per bench. Measured analytes included lead, uranium, arsenic, and boron.

Table 1: JEB Clean Waste Rock Sampling Summary by Bench

Bench	Number of Samples	Pb (mg/kg)	U (mg/kg)	B (mg/kg)	As (mg/kg)
433	95	1.7	0.9	3.4	1.6
421	177	1.5	1.2	3.2	1.5
409	241	1.3	1.4	6.2	1.3
397	216	1.3	2.4	17.2	2.0
385	167	1.4	3.2	25.3	2.8
373	65	1.9	5.0	29.5	3.5
367	77	7.0	43.0	53.6	56.4
363	28	6.1	26.0	39.0	27.2
359	32	6.3	43.0	72.5	69.8
355	14	6.3	31.8	273.6	58.5
Overall Average	**1112**	**2.1**	**7.1**	**21.2**	**9.0**

2.2 JEB Pit Acid Base Accounting (ABA) Analysis

The acid generating potential of JEB waste rock was assessed through periodic sampling and acid base accounting (ABA) analysis. The results are summarized in Table 2 below.

Table 2: Summary of JEB ABA Data

Date	Sampler	Location	Material	Sample	Acid Generation Potential (g CaCO3)
11/26/1995	BK	448 ELV, WEST SIDE OF PIT	OVB	ABA 1	-1.7
11/26/1995	BK	446 ELV, SE END OF PIT	OVB	ABA 2	-2.4
12/4/1995	DS	451, SW END, 448, S END	OVB	ABA 3	-2.5
12/10/1995	BK	449, SW END	OVB	ABA 5	-2.2
12/10/1995	BK	445, S END	OVB	ABA 6	-0.2
12/18/1995	DS	445, CENTRE-W	OVB	ABA 7	0.3
12/23/1995	BK	450, N-CEN TO NW	OVB	ABA 8	-1.2
1/1/1996	DS	449, SW & CEN-E	OVB	ABA 9	0.3
1/7/1996	BK	450, CEN-E TO E END	OVB	ABA 10	-0.2
1/14/1996	DS	443, SW & 451, NE	OVB	ABA 11	-1.7
1/21/1996	BK	452-25	OVB	ABA 12	-2.2
1/28/1996	DS	452-32	OVB	ABA 13	-1.7
2/4/1996	BK	452-40	OVB	ABA 14	-2.1
2/12/1996	DS	452-49	OVB	ABA 15	-1.5
2/18/1996	BK	440-2	OVB	ABA 16	-2.2
2/26/1996	DS	440-5	OVB	ABA 17	-2.5
3/3/1996	BK	440-9	OVB	ABA 18	-2.3
3/11/1996	DS	440-13	OVB	ABA 19	-0.7
3/17/1996	BK	440-19	OVB	ABA 20	-2.4
3/24/1996	DS	440-22	OVB	ABA 21	-3.1
3/31/1996	BK	440-25, 452-52,53	OVB	ABA 22	-2.4
4/7/1996	DS	440-30	OVB	ABA 23	-3.4
4/14/1996	BK	440-33	OVB	ABA 24	-2.8
4/21/1996	RF		OVB	ABA 25	-3.4
4/28/1996	BK		OVB	ABA 26	-2.6
5/5/1996	DS	440- CENTRE	OVB	ABA 27	-3.0
5/12/1996	BK	433-WF	OVB	ABA 28	-2.9
5/20/1996	DS	433-WF	OVB	ABA 29	-3.5
5/26/1996	BK	433-WF	OVB	ABA 30	-2.4
6/3/1996	DS	433-WF	OVB	ABA 31	-4.0
6/9/1996	KS	433-WF	OVB	ABA 32	-1.9
6/23/1996	BK	440-WF	OVB	ABA 34	-5.4
6/30/1996	DS	440 -NE SIDE OF PIT	OVB	ABA 36	-3.9
7/7/1996	BK	Area around 5320E,11150N	OVB	ABA 38	-4.4
7/14/1996	DS	NEAR 5460E,11220N	OVB	ABA 40	-4.2
7/22/1996	BK	NEAR 5460E,11220N	OVB	ABA 42	-4.6
7/28/1996	DS	5470,11240-5430,11180,440 BENCH	OVB	ABA 44	-3.9
8/11/1996	DS	5470,11110-5280,11080,440 BENCH	OVB	ABA 47	-4.3

Date	Sampler	Location	Material	Sample	Acid Generation Potential (g CaCO3)
8/18/1996	JG		OVB	ABA 52A	-4.7
8/25/1996	DS		OVB	ABA 53A	-3.9
9/1/1996	JG		OVB	ABA 55	-5.1
9/16/1996	LM	433-WF	OVB	ABA 33	-2.8
4/12/1996	BK	433-5,6,7	SS	CUTTING S 1	-0.4
4/21/1996	RF	433-8,9	SS	CUTTING S 2	-1.1
4/26/1996	BK	433-10,11,12,13,14	SS	CUTTING S 3	-1.7
5/3/1996	DS	433-15,16,17,18,19,20	SS	CUTTING S 4	-2.2
5/10/1996	BK	433-15A,21,22,23,24,25	SS	CUTTING S 5	-1.0
5/17/1996	DS	433-26,27,28, 421-01	SS	CUTTING S 6	-1.0
5/24/1996	BK	421-01S,02,03	SS	CUTTING S 7	-1.3
6/21/1996	BK	421-12,13	SS	ABA 35	-0.5
6/28/1996	DS	421-14,16,409-01	SS	ABA 37	-0.7
7/5/1996	BK	409-01,421-15	SS	ABA 39	-1.0
7/12/1996	DS	433-31,32,409-03	SS	ABA 41	-1.0
7/19/1996	BK	421-17,18,19,409-04,	SS	ABA 43	-0.6
7/26/1996	DS	421-19,20,433-33,34(half)	SS	ABA 45	0.0
8/2/1996	BK	409-05,421-21,421-22,433-34	SS	ABA 46	-1.2
8/16/1996	JG/DS	421-22,23,24	SS	ABA 48	-0.9
8/16/1996	JG	421-24	SS	ABA 49	-1.0
8/18/1996	JG	433-35	SS	ABA 50	-0.8
8/18/1996	JG	433-35	SS	ABA 51	-1.5
8/21/1996	JG	409-6	SS	ABA 52	-0.6
8/21/1996	JG	409-6	SS	ABA 53	-0.7
8/28/1996	DS	409-07,421-26	SS	ABA 54A	-0.6
8/30/1996	DS	433-36,409-08	SS	ABA 54	-0.5
9/1/1996	JG	433-37	SS	ABA 56	-0.5
9/5/1996	JG	409-09,433-38	SS	ABA 57	-0.6
9/9/1996	DS/BK	433-38,409-10,421-27	SS	ABA 58	-0.6
9/14/1996	JG	409-11,421-28	SS	ABA 59	0.0
9/18/1996	JG/BK	421-28,397-01	SS	ABA 60	-0.7
9/25/1996	JG/DS	421-29,409-12,421-30	SS	ABA 61	-1.0
10/4/1996	JG	409-13,14,15	SS	ABA 62	-0.5
10/9/1996	DS	409-16,397-02	SS	ABA 63	-1.5
10/14/1996	JG	409-17,409-18,409-19	SS	ABA 64	-1.4
10/18/1996	JG	397-03,397-04	SS	ABA 65	-1.6
10/20/1996	BK	409-20,409-21,397-05	SS	ABA 66	-1.7
10/27/1996	DS	409-22,409-23,397-06	SS	ABA66A	-1.6
10/30/1996	BK/DS	397-07,397-08	SS	ABA 67	-2.2
11/9/1996	JG	397-09,385-01	SS	ABA 68	-1.6

Date	Sampler	Location	Material	Sample	Acid Generation Potential (g CaCO3)
11/12/1996	JG	397-10,397-11,385-02	SS	ABA 69	-1.7
11/14/1996	JG/DS	397-12,397-13,385-03	SS	ABA 70	-2.2
11/23/1996	JG	397-14,385-04	SS	ABA 71	-1.4
11/25/1996	JG/DS	397-15,397-16	SS	ABA72A	-1.7
12/2/1996	DS	385-06,385-07,397-17	SS	ABA72	0.0
12/7/1996	JG/DS	397-18,385-08	SS	ABA 73	-1.4
12/12/1996	JG/DS	385-9,385-10,385-11,385,12	SS	ABA 74	-2.0
22/12/96	JG/DS	373-1,385-13,14,15	SS	ABA 75	0.0
04/01/97	JG/DS	385-15A,16-373-2,3	SS	ABA 76	-0.7
10/1/1997	JG/DS	385-17,373-4,5,6,7,8	SS	ABA 77	0.0
5/2/1997	JG	373-8,9,10,11,12,385-18	SS	ABA 78	0.0
28/02/97	LD	373-15,16,17	SS	ABA 79	-1.0
12/3/1997	MP/RW	373-18,19,367-1,3,363-1	SS	ABA 80	0.0
7/4/1997	MP	367-4,5,6,7	SS	ABA 81	-1.0
17/04/97	WS	367-9,10	SS	ABA 82	-6.7
3/5/1997	RW/DS	363-2	SS	ABA 83	-6.0
20/05/97	RW/DS	363-3,5,355-01	SS	ABA 84	0.0
3/6/1997	RW/DS	363-6,7,355-02	SS	ABA 85	0.0
				Average	-1.8
				Minimum	-6.7
				Maximum	0.3

2.3 JEB Special Waste Production Cutting Sampling Results

During mining, a total of 45 special waste cuttings samples were collected. The chemistry results are presented in Table 3.

Table 3: JEB Special Waste Production Cuttings Samples

Bench	Blast	As (mg/kg)	Pb (mg/kg)	U (mg/kg)
367	2	17	48	630
	2	20	43	677
	2	5	28	513
	2	23	27	776
	2	30	60	299
	4	111	11	369
	9	45	24	350
363	2	109	29	260
	7	83	62	475
359	2	390	174	742
	2	450	29	590
	3	166	17	290
	4	1000	120	634
	5	57	20	402

Bench	Blast	As (mg/kg)	Pb (mg/kg)	U (mg/kg)
	8	76	14	321
355	1	133	40	560
	1	977	11	258
	3	174	9	270
	3	274	11	372
	3	361	26	615
	3	1200	9	405
	5	66	32	371
	6	146	16	677
	6	191	26	598
351	1	25	3	77
	1	82	10	143
	1	130	6	170
	1	766	33	335
	1	449	4	125
	3	2140	49	464
	4	21	4	35
	4	70	5	52
	4	166	28	87
	4	409	39	313
	4	370	74	311
	4	56	19	343
	5	203	56	727
	5	167	26	710
	5	632	26	144
	6	118	8	84
	6	61	4	94
347	1	1940	127	15
	1	194	5	21
	1	116	6	72
	1	99	18	188
	2	163	58	336
	2	324	20	253
	3	900	26	337
	3	252	65	304
	3	115	8	264
	3	90	21	259
	3	273	23	206
	3	29	6	39
	3	326	6	62
	3	2170	19	113

2.4 JEB Special Waste Backhaul Sampling Results

In 2002, JEB special waste was backhauled to the Sue C pit. 23 samples of special waste were collected and analyzed during this process. The results are presented in Table 4.

Table 4: JEB Special Waste Samples Collected During Backhauling in 2002

Sample Name	As (mg/kg)	Co (mg/kg)	Cu (mg/kg)	Mo (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Se (mg/kg)	U (mg/kg)	Zn (mg/kg)
JEB 1	355	9	14	18	246	42	1	615	18
JEB 2	238	8	15	20	287	35	1	319	16
JEB 3	325	13	10	22	344	25	1	362	13
JEB 4	287	14	15	17	379	32	1	383	15
JEB 5	278	11	11	20	340	34	1	484	13
JEB 6	494	14	11	18	410	35	1	446	15
JEB 7	267	7	8	22	244	22	1	226	14
JEB 8	322	7	11	19	250	33	1	508	12
JEB 9	550	31	105	23	370	27	4	131	15
JEB 10	919	49	117	24	601	43	3	417	17
JEB 11	130	8	15	17	117	24	1	226	11
JEB 12	222	11	29	18	186	39	1	619	20
JEB 13	361	25	76	24	266	40	1	369	16
JEB 14	309	18	29	19	263	63	1	613	15
JEB 15	396	12	35	18	338	40	1	396	15
JEB 16	107	4	8	18	84	40	1	478	9
JEB 17	334	22	56	22	256	54	3	439	20
JEB 18	260	12	11	19	246	21	1	247	11
JEB 19	188	10	9	16	204	24	1	263	12
JEB 20	228	13	25	24	201	21	1	226	12
JEB 21	254	9	15	18	224	30	1	355	11
JEB 22	234	12	11	15	300	22	1	271	14
JEB 23	415	22	69	16	429	44	1	338	14

3 Comparison of Predicted vs. Measured JEB Solids Content

The JEB predicted clean and special waste solids contents were compared to operational field data in order to verify EIS predictions. The results are shown below.

3.1 JEB Clean Waste Comparison

Table 5 and Figure 1 compares the JEB clean waste predicted solids content from the 1991 EIS (Table 4, Addendum Appendix A, Minatco 1991b) to measured field data. The full waste rock characterization study can be found in the 1991 EIS (Minatco 1991a and 1991b) or the 2004 Waste Rock TID (COGEMA 2004).

The results show that the clean waste solids content is generally consistent with EIS predictions.

Table 5: Comparison of Predicted vs. Actual Clean Waste Solids Content

Bench	Number of Samples	Pb (mg/kg)	U (mg/kg)	As (mg/kg)
433	95	1.7	0.9	1.6
421	177	1.5	1.2	1.5
409	241	1.3	1.5	1.4
397	217	1.3	2.2	2.0
385	166	1.4	3.2	2.7
373	65	2.0	5.2	3.5
367	77	7.0	43.1	56.4
363	28	6.2	26.1	27.4
359	32	6.3	43.7	70.2
355	14	7.4	65.0	105.9
Overall Clean Waste Rock Weighted Average		**2.1**	**7.1**	**9.0**
EIS Predictions[1]		**7.7**	**3.2**	**26.0**

[1]Reference: Table 4, Appendix A, Addendum to 1991 EIS (Minatco 1991b)

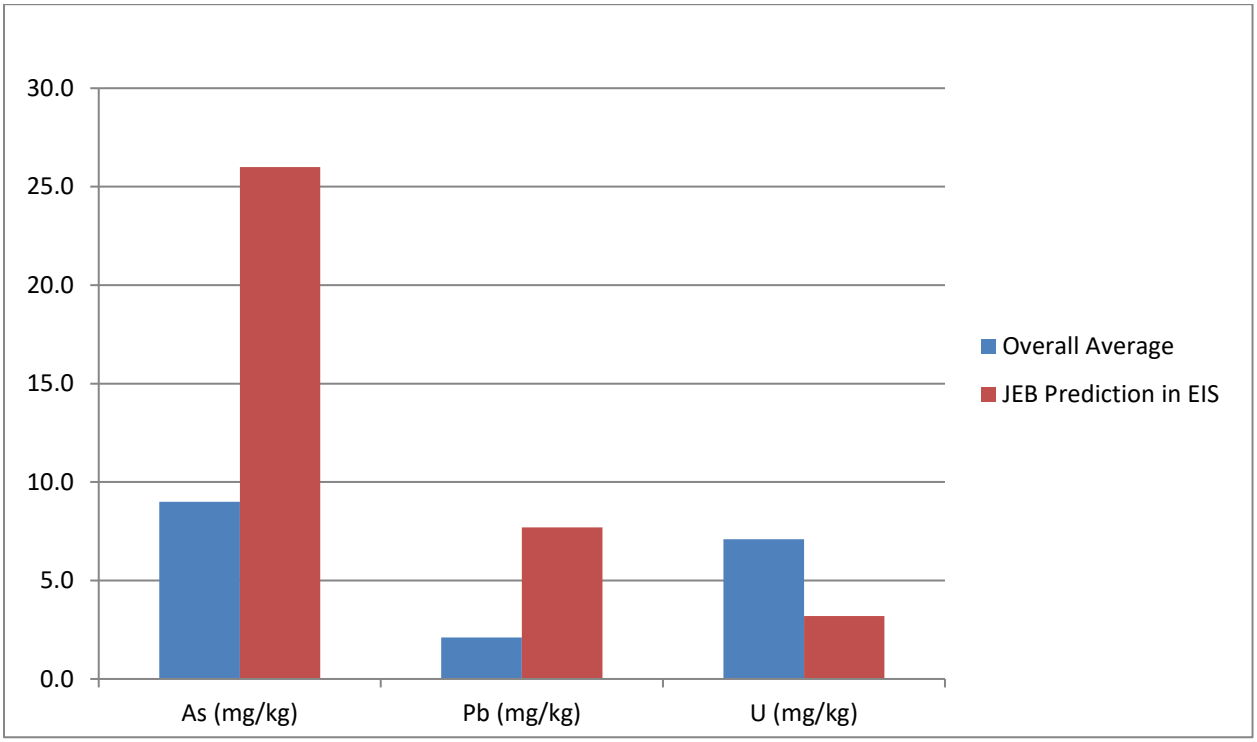


Figure 1: JEB Predicted vs. Actual Clean Waste Solids Content

3.2 JEB Special Waste Comparison

Table 6 and Figure 2 compares the JEB special waste predicted solids content from the 1991 EIS (Table 4, Addendum Appendix A, Minatco 1991b) to measured field data. The full waste rock characterization study can be found in the 1991 EIS (Minatco 1991a and 1991b) or the 2004 Waste Rock TID (COGEMA 2004).

Prior to this comparison, the backhaul and production cuttings data from JEB were combined to develop an average measured result for each analyte. This is also shown in Table 6.

The results show that the special waste solids content is generally consistent with EIS predictions. In subsequent assessments, such as the Sue E EIS, Caribou EIS, and 2004 Waste Rock TID, the average solids content presented in Table 6 has been used with the exception of radionuclide values. As radionuclides were not analyzed during operation, the Pb-210, Ra-266, and Th-230 predictions from the 1991 EIS (Table 4, Appendix A, Addendum, Minatco 1991b) have been used in subsequent assessments. It should be noted that the average solids content in Table 6 differs slightly from the previous Waste Rock TID (AREVA 2004), as well as the subsequent Sue E and Caribou EIS documents. This is due to the addition of ten extra special waste samples which were incorrectly classified in the previous TID as ore.

Table 6: Average JEB Special Waste Concentration

Sample Name	Sampling Campaign	As (mg/kg)	Co (mg/kg)	Cu (mg/kg)	Mo (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Se (mg/kg)	U (mg/kg)	Zn (mg/kg)
JEB 1	Backhaul	355	9	14	18	246	42	1	615	18
JEB 2		238	8	15	20	287	35	1	319	16
JEB 3		325	13	10	22	344	25	1	362	13
JEB 4		287	14	15	17	379	32	1	383	15
JEB 5		278	11	11	20	340	34	1	484	13
JEB 6		494	14	11	18	410	35	1	446	15
JEB 7		267	7	8	22	244	22	1	226	14
JEB 8		322	7	11	19	250	33	1	508	12
JEB 9		550	31	105	23	370	27	4	131	15
JEB 10		919	49	117	24	601	43	3	417	17
JEB 11		130	8	15	17	117	24	1	226	11
JEB 12		222	11	29	18	186	39	1	619	20
JEB 13		361	25	76	24	266	40	1	369	16
JEB 14		309	18	29	19	263	63	1	613	15
JEB 15		396	12	35	18	338	40	1	396	15
JEB 16		107	4	8	18	84	40	1	478	9
JEB 17		334	22	56	22	256	54	3	439	20
JEB 18		260	12	11	19	246	21	1	247	11
JEB 19		188	10	9	16	204	24	1	263	12
JEB 20		228	13	25	24	201	21	1	226	12
JEB 21		254	9	15	18	224	30	1	355	11
JEB 22		234	12	11	15	300	22	1	271	14
JEB 23		415	22	69	16	429	44	1	338	14
Bench 367, Blast 2	Production	17	Not Analyzed				48	Not Analyzed	630	Not Analyzed
		20					43		677	
		5					28		513	
		23					27		776	
		30					60		299	
Bench 367, Blast 4		111					11		369	
Bench 367, Blast 9		45					24		350	
Bench 363, Blast 2		109					29		260	
Bench 363, Blast 7		83					62		475	
Bench 359, Blast 2		390					174		742	
		450					29		590	
Bench 359, Blast 3		166					17		290	
Bench 359, Blast 4		1000					120		634	
Bench 359, Blast 5		57					20		402	
Bench 359, Blast 8		76					14		321	
Bench 355, Blast 1		133					40		560	
		977					11		258	
Bench 355, Blast 3		174					9		270	
		274					11		372	
		361					26		615	
		1200					9		405	
Bench 355, Blast 5		66					32		371	
Bench 355, Blast 6		146					16		677	
		191					26		598	
Bench 351, Blast 1	Production	25	Not Analyzed				3	Not Analyzed	77	Not Analyzed
		82					10		143	
		130					6		170	
		766					33		335	
		449					4		125	
Bench 351, Blast 3		2140					49		464	
Bench 351, Blast 4		21					4		35	
		70					5		52	
		166					28		87	
		409					39		313	
		370					74		311	
		56					19		343	
Bench 351, Blast 5		203					56		727	
		167					26		710	

Appendix AI.2: Evaluation of Sue C Waste Rock Solids Content

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1 Sue C Waste Rock Characterization Data

In the addendum to the 1991 McClean EIS (Minatco 1991b), waste management strategies and test work were developed for the JEB, Sue C, Sue A, and Sue B pits in order to support the 1991 EIS submission. The test work consisted of humidity cell testing and underwater column testing to characterize clean waste rock and special waste rock, respectively. Full results of this study can be found in Appendix II of the 2004 Waste Rock TID (COGEMA 2004) or the 1991 EIS (Minatco 1991a and 1991b).

2 Sue C Pit Operational Data

During mining of the Sue C pit, a total of 3,101 blasthole drill cutting samples were routinely collected for geochemical analysis (solids content). The samples were collected from every third blasthole (fourth in upper benches), representing about 15 by 18 m spacing. The samples were analyzed for uranium, arsenic, and nickel. The result of this sampling program for Sue clean waste rock has been summarized by mining bench and provided in this document.

Blast hole samples were also collected for acid base accounting (ABA). Each ABA sample was a composite (of about 75 holes), representing 60,000 m3 of material on average. A total of 174 overburden and clean waste rock samples were collected from the Sue C pit, and the results are presented in this document.

During backhauling of Sue C special waste, samples were collected to define solids content. A total of 18 composite samples were prepared from 38 drill cutting samples and 49 grab samples, as provided in this document. These backhaul samples have been used to define the Sue C special waste solids content in subsequent environmental assessments.

3 Sue C Clean Waste Blast Cutting Results

Table 1 below summarizes the blast hole clean waste cuttings results from Sue C.

Table 1: Blast Cutting Results for Sue C Mining

Bench	Statistic	Pb	As	U	Ni
442	Number	627	627	627	177
	Maximum	2800.0	111.9	101.6	10.4
	Minimum	0.6	0.5	0.8	2.9
	Average	19.1	2.9	2.9	6.2
	Stan. Dev.	121.3	6.4	4.5	1.3
	Variance	14743.0	41.5	20.7	1.8
430	Number	530	530	530	157
	Maximum	3230.0	123.0	12.7	9.5
	Minimum	0.6	0.3	1.1	2.4
	Average	29.9	2.7	2.8	6.1
	Stan. Dev.	196.3	5.7	1.4	1.4
	Variance	38608.6	32.0	1.9	1.9
418	Number	455	455	455	351
	Maximum	2590.0	363.0	16.2	11.1
	Minimum	0.8	0.6	1.2	2.2
	Average	34.2	4.8	3.3	6.1
	Stan. Dev.	186.3	21.6	1.9	1.6
	Variance	34771.2	466.9	3.5	2.4
406	Number	407	407	407	407
	Maximum	1320.0	666.0	144.0	19.5
	Minimum	0.9	0.5	1.1	3.0
	Average	29.8	6.8	4.5	6.7
	Stan. Dev.	120.6	38.1	7.5	1.5
	Variance	14570.5	1452.9	55.9	2.3
394	Number	370	370	370	370
	Maximum	780.0	128.0	62.4	325.0
	Minimum	1.2	0.2	0.6	2.3
	Average	15.6	3.6	5.1	7.0
	Stan. Dev.	47.1	7.8	5.1	16.6
	Variance	2226.9	60.4	26.2	277.8
382	Number	268	268	268	268
	Maximum	188.0	44.7	114.0	104.0
	Minimum	0.7	0.1	0.7	2.7
	Average	13.4	3.8	7.0	7.7
	Stan. Dev.	21.9	5.0	8.5	8.9
	Variance	479.9	25.5	73.0	79.8
370	Number	196	196	196	196
	Maximum	62.3	1520.0	215.0	1120.0
	Minimum	0.4	0.2	0.9	2.2
	Average	6.7	18.1	11.1	25.8
	Stan. Dev.	8.2	116.4	22.9	88.0
	Variance	67.7	13616.9	528.9	7778.6
358	Number	131	131	131	131
	Maximum	98.2	1010.0	770.0	594.0
	Minimum	0.4	0.2	1.0	2.3

Bench	Statistic	Pb	As	U	Ni
	Average	8.2	53.2	31.2	44.7
	Stan. Dev.	14.0	157.5	83.6	99.4
	Variance	198.7	24992.7	7036.9	9961.0
346	Number	82	82	82	82
	Maximum	21.0	1940.0	126.0	1460.0
	Minimum	0.1	0.2	1.6	1.8
	Average	4.3	67.4	17.0	71.4
	Stan. Dev.	4.7	266.2	23.8	224.6
	Variance	22.3	71746.8	575.4	51088.8
334	Number	20	20	20	20
	Maximum	45.7	361.0	168.0	403.0
	Minimum	0.5	1.0	4.1	4.0
	Average	6.1	42.7	28.2	61.5
	Stan. Dev.	10.3	95.8	38.4	103.4
	Variance	112.0	9652.8	1554.3	11257.8
322	Number	15	15	15	15
	Maximum	16.8	687.0	599.0	612.0
	Minimum	1.1	1.6	9.2	7.3
	Average	4.0	120.3	91.2	118.3
	Stan. Dev.	4.3	189.8	144.2	162.5
	Variance	19.6	38601.0	22276.5	28277.6

4 Sue C Pit Acid Base Accounting (ABA) Analysis

The acid generating potential of Sue C waste rock was assessed through periodic sampling and acid base accounting (ABA) analysis. The results are summarized in Table 2 below.

Table 2: Summary of Sue C ABA Data

ABA #	Period	Blast Number	Date Blasted	Net Acid Generation (g $CaCO_3$)	Lift
1	Aug 10/97	o/b	n/a	-3.7	1st Lift
2		o/b	n/a	-2.6	1st Lift
3		o/b	n/a	-2.5	1st Lift
4		o/b	n/a	-1.5	1st Lift
5		o/b	n/a	-2.7	1st Lift
6	Aug 10-17/97	o/b	n/a	-2.7	1st Lift
7		o/b	n/a	-2.3	1st Lift
8	Aug 17-Sept 5/97	o/b	n/a	-4.0	1st Lift
9		442-03	Aug 31/97	-4.1	1st Lift
10	Sept 5-Sept 20/97	442-04	Sept 7/97	-1.4	1st Lift
11		o/b	n/a	-1.6	1st Lift
12		442-05&06	Sept 10/97	-0.8	1st Lift
13		442-07&08	Sept 14&18/97	-0.6	1st Lift
14		442-09	Sept 19/97	-0.5	1st Lift
14	Sept 20-Oct 18/97	442-10	Sept 22/97	-0.5	1st Lift
15		442-11	Sept 25/97	-0.7	1st Lift
16		442-12&13	Sept 28&30/97	-0.8	1st Lift
17		442-14A&B	Oct 3/97	-0.4	1st Lift
18		442-15&16	Oct 12&9/97	-0.5	1st Lift
19		442-17&18	Oct 12&17/97	-0.3	1st Lift
20		442-19	Oct 15/97	-1.3	1st Lift
20	Oct 18-Nov 2/97	442-20	Oct 31/97	-1.3	1st Lift
21		442-21&22	Oct 23&26/97	-0.8	1st Lift
22		442-23	Oct 31/97	-0.7	1st Lift
23		442-24&25	Nov 1&4/97	-1.0	1st Lift
23	Nov 2-Nov 15/97	442-24&25	Nov 1&4/97	-1.0	1st Lift
24		442-26&27	Nov 6&12/97	-0.9	1st Lift
25	Nov 15-Nov 30/97	442-28	Nov17/97	-0.7	1st Lift
26		430-01	Nov 22&27/97	-1.3	1st Lift
27		442-29&31	Nov 20&21/97	-0.8	1st Lift
28	Nov 30/97-Jan25/98	442-32&33	Dec 1/97	-0.5	1st Lift
29		430-01&02	Dec 1&4/97	-0.9	1st Lift
30		442-34,430-3&4	Dec 11&13/97	-5.8	1st Lift
31		442-36,37&38	Dec 15&17/97	-2.2	1st Lift
32		430-5,6&7	Jan 4,6&8/98	-1.0	1st Lift
33		442-39,430-9&10	Jan 12,14&17/98	<0.5	1st Lift
34		430-11	Jan 19/98	-1.1	1st Lift
34	Jan 25-Feb 9/98	430-12	Jan 22/98	-1.1	1st Lift
35		430-13&14	Jan 25&28/98	-0.6	1st Lift
36		o/b	n/a	-2.5	1st Lift
37		o/b	n/a	-2.2	1st Lift
38		430-15&16	Feb 1&6/98	0.3	1st Lift

ABA #	Period	Blast Number	Date Blasted	Net Acid Generation	Lift
39		442-40&41	Feb 2&5/98	-0.6	1st Lift
40		442-42&43	Feb 8&11/98	-0.8	1st Lift
41	Feb 9-23/98	442-44,430-17	Feb 14&16/98	<0.5	1st Lift
42		442-46,49	Feb 20&22/98	-0.6	1st Lift
43		442-47,50,51	Feb 25,27&Mar 1/98	-0.5	1st Lift
44		442-52,430-18,20	Mar 2, 3&9/98	-1.2	1st Lift
45		442-53	Mar 5/98	-0.7	1st Lift
46	Feb 23-Mar 22/98	418-01,02	Mar 7&9/98	-0.8	1st Lift
47		418-03,430-21,23	Mar 11&16/98	-0.7	1st Lift
48		430-19	Mar 15/98	-1.6	1st Lift
49		430-22,24	Mar 18&21/98	-0.6	1st Lift
50	Mar 22-Apr 4/98	418-04,430-25,26	Mar 23&25/98	<.5	1st Lift
51		430-27,418-05	Mar 30&31/98	-0.6	1st Lift
52		430-28	Apr 5/98	-0.7	2nd Lift
53	Apr 4-17/98	430-30,418-06	Apr 18&4/98	<0.5	2nd Lift
55		430-29	Apr 12/98	<0.5	2nd Lift
53		430-30,418-06	Apr 18&4/98	<0.5	2nd Lift
54		430-31,418-07	Apr 22&19/98	<0.5	2nd Lift
56		430-33,34	Apr 25&28/98	0.5	2nd Lift
57	Apr 17-May 17/98	418-08	Apr 24/98	0.6	2nd Lift
58		418-09,10	May 1/98	-0.7	2nd Lift
59		430-35,418-11	May 2&5/98	0.0	2nd Lift
60		418-12,13,430-36	May 9,11&14/98	0.6	2nd Lift
61		430-37,418-14,15	May 14,16&20/98	0.6	2nd Lift
62		418-16,18,20	May 17, 18, 31/98	0.6	2nd Lift
63		430-39	May 25/98	0.6	2nd Lift
64		418-17,18	May 27, 28/98	0.6	2nd Lift
65		418-19, 25	June 4, 18/98	0.6	2nd Lift
66	May 17-June 28/98	418- 21, 24	June 6, 9/98	0.6	2nd Lift
67		406-2, 406-3	June 13, 17/98	0.6	2nd Lift
68		418-23	June 18/98	0.6	2nd Lift
69		418-26, 27, 28	June 20, 25, 27/98	0.9	2nd Lift
70		406-4	June 23/98	0.9	2nd Lift
71		418-29	June 29/98	0.9	2nd Lift
72		418-30, 31	July 2/98	0.9	2nd Lift
73		406-06,418-33	July 11/98	0.9	2nd Lift
74	June 28-Aug 5/98	418-32, 35	July 8, July 16/98	0.9	2nd Lift
75		406-07	July 18/98	-1.4	2nd Lift
76		418-34	July 18/98	-0.6	2nd Lift
77		418-36	July 22/98	-0.9	2nd Lift
78		406-8	July 25/98	-2.6	2nd Lift
78		406-9,10	Aug 5/98	-2.6	2nd Lift
79		406-11,12	Aug 13,10/98	-1.1	2nd Lift
80		406-13,15	Aug 16,17/98	-0.5	2nd Lift
81	Aug 5-Sept 2/98	406-16,17	Aug 21/98	-1.1	2nd Lift
82		394-1,2	Aug 23,27/98	<0.5	2nd Lift
83		406-18,19	Aug 25,29/98	<0.5	2nd Lift
84		406-20	Aug 29/98	-1	2nd Lift
84		406-21,22	Sept 2/98	-1.0	2nd Lift
85	Sept 2-17/98	394-3,4	Sept 4,11/98	-1.1	2nd Lift
86		406-23,24	Sept 7/98	-0.6	2nd Lift
87		406-26	Sept 15/98	<0.5	2nd Lift
86	Sept 17-Oct 10/98	406-25	Sept 18/98	-0.6	2nd Lift
87		406-14,27	Sept 19,28/98	<0.5	2nd Lift

ABA #	Period	Blast Number	Date Blasted	Net Acid Generation	Lift
88		406-28,29,30	Sept 21,26,28/98	-0.8	2nd Lift
89		394-5,6,7,8,9	Sept 17,17,24,27,Oct 1/98	-0.9	2nd Lift
90		394-10,12	Oct 3,8/98	<0.5	2nd Lift
88		406-31,32	Oct 11,11/98	-0.8	2nd Lift
90		394-11	Oct 16/98	<0.5	2nd Lift
91		394-13,14,15	Oct 13,20,23/98	-0.8	2nd Lift
92	Oct 10-Nov 8/98	382-02,03,04	Oct 26,28, Nov 1/98	-1.8	2nd Lift
93		406-33,34	Oct 16,29/98	-1.1	2nd Lift
94		394-16,17	Nov 1,4/98	-0.8	2nd Lift
96		382-05	Nov 7/98	-0.8	2nd Lift
88		406-31,32	Oct 11,11/98	-0.8	2nd Lift
90		394-11	Oct 16/98	<0.5	2nd Lift
91		394-13,14,15	Oct 13,20,23/98	-0.8	2nd Lift
92	Oct 10-Nov 8/98	382-02,03,04	Oct 26,28, Nov 1/98	-1.8	2nd Lift
93		406-33,34	Oct 16,29/98	-1.1	2nd Lift
94		394-16,17	Nov 1,4/98	-0.8	2nd Lift
96		382-05	Nov 7/98	-0.8	2nd Lift
93		406-35	Nov 10/98	-1.1	2nd Lift
94		394-18	Nov 12/98	-0.8	2nd Lift
95	Nov 9-Dec 1/98	394-19,20,21	Nov 19,21,23/98	-1.6	2nd Lift
96		382-06,07	Nov 12,17/98	-0.8	2nd Lift
97		394-22,23,24	Nov 26,25,29/98	2.0	2nd Lift
98		382-08,09	Dec 1,4/98	1.7	2nd Lift
99	Dec 1-22/98	382-10,11,12,13	Dec 3,21,22/98	<0.5	2nd Lift
100		394-21,25,25	Dec 10,12,13,17/98	<0.5	2nd Lift
101	Nov 2/99	Old sed pond	n/a	-38.9	
102	Nov 3/99	Old sed pond	n/a	-1.1	
103	Nov 4/99	Old sed pond	n/a	-1.3	
104	Nov 5/99	Old sed pond	n/a	-2.8	
107	Nov 1/99	Old sed pond	n/a	-11.1	
98		382-08,09	Dec 1,4/98	1.7	3rd Lift
99		382-10,11,12,13	Dec 3,21,22/98	<0.5	3rd Lift
105		442-55,56	Nov 1,10/99	-1.0	3rd Lift
106		442-57	Nov 12/99	-0.5	3rd Lift
108		442-58,59	Nov 15,16/99	<0.5	3rd Lift
109		442-60	Nov 18/99	<0.5	3rd Lift
110	Oct 17-Dec 31/99	442-61,62	Nov 20/99	<0.5	3rd Lift
111		442-63	Nov 23/99	<0.5	3rd Lift
112		442-64	Nov 28/99	<0.5	3rd Lift
113		442-65,66	Dec 3,5/99	-1.0	3rd Lift
114		430-40,41	Dec 8,10/99	<.5	3rd Lift
117		382-16,17	Dec 13,15/99	<.5	3rd Lift
115		430-42,43	Jan 8,18/00	<.5	3rd Lift
116	Dec 31/99-Feb 27/00	370-01,03,05	Jan 10,20,24/00	<.5	3rd Lift
118		430-44,45,46	Feb 2,9,12/00	<.05	3rd Lift
119		370-06,07,08	Jan 24,Feb 2/00	<.05	3rd Lift
120		370-09,10	Feb 25, Mar 6/00	-2.9	3rd Lift
121	Feb 27-Apr 28/00	358-03,04,05	Mar 20,24, Apr 1/00	0.5	3rd Lift
122		430-48,49,50	April 11, 21, 26/00	-1.5	3rd Lift
123	Apr 28-Jun 5/00	430-51,52	May 4,15/00	<0.5	3rd Lift
124		358-02,06	Mar 16, Apr 04/00	-1.4	3rd Lift
125		418-37	June 12/00	0.6	3rd Lift
126	June 5-Aug 3/00	418-38,39	June 26,14/00	0.7	3rd Lift
127		418-40,41	July 5,12/00	<0.5	3rd Lift

ABA #	Period	Blast Number	Date Blasted	Net Acid Generation	Lift
128		418-42,43,44	July 15, 19 31	-0.3	3rd Lift
129	Aug 3-Aug 30/00	406-36,37,38	August 18, 21, 24	-0.5	3rd Lift
130		406-39,40	Aug 29, Sept 10/00	-1.0	3rd Lift
130	Aug 30-Oct 7/00	406-39,40	Aug 29, Sept 10/00	-1.0	3rd Lift
131		406-41,42	Sept 2,5/00	-0.8	3rd Lift
132		406-43,45	Sept 17, 30/00	-0.5	3rd Lift
133		406-44	Sept 23/00	-0.7	3rd Lift
134		382-18	Oct 1/00	-0.7	3rd Lift
135	Oct 11-Oct 14/00	394-28	Oct 11/00	1.0	3rd Lift
136		394-29	Oct 17/00	1.0	3rd Lift
137	Oct 30- Nov 15/00	394-33	Nov 12/00	<0.5	3rd Lift
138		394-31	Nov 5/00	<0.5	3rd Lift
139	Nov 15-Nov 30/00	394-33,34,36,36	Nov 12,18,20,24/00	<0.5	3rd Lift
140	Nov 30- Dec 8/00	382-19,20,21	Nov 30, Dec 6, 8/00	-2.7	3rd Lift
141	Dec 31-Jan 26/01	382-22,23	Jan 18,25/01	-1.3	3rd Lift
142	Jan 26-Mar 13/01	382-24,25	Jan 30, Feb 2/01	-1.0	4th Lift
143		382-26,27,29	Feb 7,11,16/01	-0.8	4th Lift
144		382-28	Feb 14/01	-0.9	4th Lift
145		370-12	Feb 20/01	-0.2	4th Lift
146		370-13	Feb 24,27/01	-1.3	4th Lift
147		370-14	Mar 10/01	-1.4	4th Lift
148	Mar 13-26/01	370-15	Mar 18/01	-0.8	4th Lift
149		370-16	Mar 25/01	-5.9	4th Lift
150	Mar 26-Apr 09/01	370-17	Mar 29/01	-5.2	4th Lift
151		370-18	April 9/01	-6.5	4th Lift
152	April 9-May 6/01	370-19	April 12/01	-5.2	4th Lift
153		370-20	April 17/01	-3.4	4th Lift
154		370-21	April 25/01	-2.3	4th Lift
155		442-67	April 27/01	<0.5	4th Lift
156		430-54	May 1/01	-0.6	4th Lift
157		370-22	May 3/01	-1.4	4th Lift
158	May 6-June 7/01	370-23	May 9/01	-3.1	4th Lift
159		418-47	May 13/01	-0.8	4th Lift
160		406-46	May 25/01	-0.7	4th Lift
161		358-09	May 22/01	-0.6	4th Lift
162		358-11,12,13	May 29,June 11,16/01	-3.3	4th Lift
162	June 7-July 6/01	358-11,12,13	May 29,June 11,16/01	-3.3	4th Lift
163		358-14,15,16	June 20,26,30/01	-9.0	4th Lift
164		370-24	July 3/01	-2.3	4th Lift
165	July 6-Aug 5/01	346-01,02	July 5+7/01	-2.8	4th Lift
166		346-03,04	July 16+19/01	-1.3	4th Lift
167		358-17,18,19	July 12,22,Aug 3/01	-6.0	4th Lift
168		358-20,21,22	Aug 13, 24, 28/01	-2.2	4th Lift
169		346-5,6,7	July 23,28,Aug 5/01	-5.8	4th Lift
170	Sept 2- Dec 1/01	346-10,11,16-19	Sept 2-Oct 27/01	-2.6	4th Lift
171		334-08	Nov 19/01	-2.1	4th Lift
172	Jan 6-Feb 4/02	322-03	Dec 15/01	-7.9	4th Lift
173		322-04	Jan 6/02	-2.4	4th Lift
174		322-05	Jan 13/02	-2.7	4th Lift

5 Sue C Special Waste Production Cutting Sampling Results

During mining, special waste cuttings samples were not collected. Cuttings samples were collected during the backhauling of Sue C special waste.

6 Sue C Special Waste Backhaul Sampling Results

In 2002, Sue C special waste was backhauled to the Sue C pit. During this process, 18 composite samples of special waste were prepared from cutting and grab samples from the special waste pile. The results are presented in Table 3.

Table 3: Sue C Special Waste Samples Collected During Backhauling in 2002

Composite Sample Name	Sample Type	Number of Samples Used in Composite	As (mg/kg)	Co (mg/kg)	Cu (mg/kg)	Mo (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Se (mg/kg)	U (mg/kg)	Zn (mg/kg)
SUE C 1	Cutting	6	97	5	17	12	124	12	<1	199	8
SUE C 2	Cutting	5	113	3	4	15	115	42	<1	306	4
SUE C 3	Cutting	6	146	5	8	26	142	32	<1	420	5
SUE C 4	Cutting	4	52	3	5	28	56	31	<1	364	6
SUE C 5	Cutting	4	154	4	3	29	142	29	<1	394	5
SUE C 6	Cutting	4	20	1	2	13	17	5	<1	31	3
SUE C 7	Cutting	3	31	3	3	13	41	5	<1	58	7
SUE C 8	Cutting	6	107	4	3	22	84	14	<1	225	8
F10 F14	Grab	5	309	9	7	50	284	21	1	423	7
F15 F19	Grab	5	138	4	51	54	137	67	<1	506	8
F20 F24	Grab	5	253	6	7	59	238	23	<1	350	7
F25 M1	Grab	5	219	12	13	60	180	19	<1	327	6
M2 M6	Grab	5	161	5	6	34	146	42	<1	524	7
M7 M11	Grab	5	229	5	5	26	176	18	<1	278	7
M13 M22	Grab	5	122	4	7	38	122	31	<1	459	8
M23 M27	Grab	5	133	4	5	35	132	27	<1	307	8
M28 A1	Grab	5	87	3	5	24	73	29	<1	354	6
A2 A5	Grab	4	289	2	5	28	283	17	<1	178	7
Average Solids Content			**148**	**5**	**9**	**31**	**138**	**26**	**1**	**317**	**7**

7 Comparison of Predicted vs. Measured Sue C Solids Content

The Sue C predicted clean and special waste solids contents were compared to operational field data in order to verify EIS predictions. The results are shown below

8 Sue C Clean Waste Comparison

Table 4 and Figure 1 compare the Sue C clean waste predicted solids content from the 1991 EIS (Table 4, Addendum Appendix A, Minatco 1991b) to measured field data. The full waste rock characterization study can be found in Appendix II of the 2004 Waste Rock TID (COGEMA 2004) or the 1991 EIS (Minatco 1991a and 1991b).

For Sue C, the raw clean waste rock data was not available. Rather, a summary of statistics per bench, as shown in Table 1, was taken from the previous Waste Rock TID (COGEMA 2004). This data was used to calculate a weighted average based on the average result per bench and the number of samples per bench. This value was compared to the clean waste rock predictions in the 1991 EIS, as shown in Table 4 below.

The results show that the clean waste solids content is generally consistent with EIS predictions.

Table 4: Comparison of Predicted vs. Actual Clean Waste Solids Content

Bench	# Samples	As (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	U (mg/kg)
442	627	2.9	6.2	19.1	2.9
430	530	2.7	6.1	29.9	2.8
418	455	4.8	6.1	34.2	3.3
406	407	6.8	6.7	29.8	4.5
394	370	3.6	7.0	15.6	5.1
382	268	3.8	7.7	13.4	7.0
370	196	18.1	25.8	6.7	11.1
358	131	53.2	44.7	8.2	31.2
346	82	67.4	71.4	4.3	17.0
334	20	42.7	61.5	6.1	28.2
322	15	120.3	118.3	4.0	91.2
Weighted Average	**3,101**	9.5	11.9	21.9	6.4
EIS Predictions	**-**	14.0	20.0	19.0	6.4

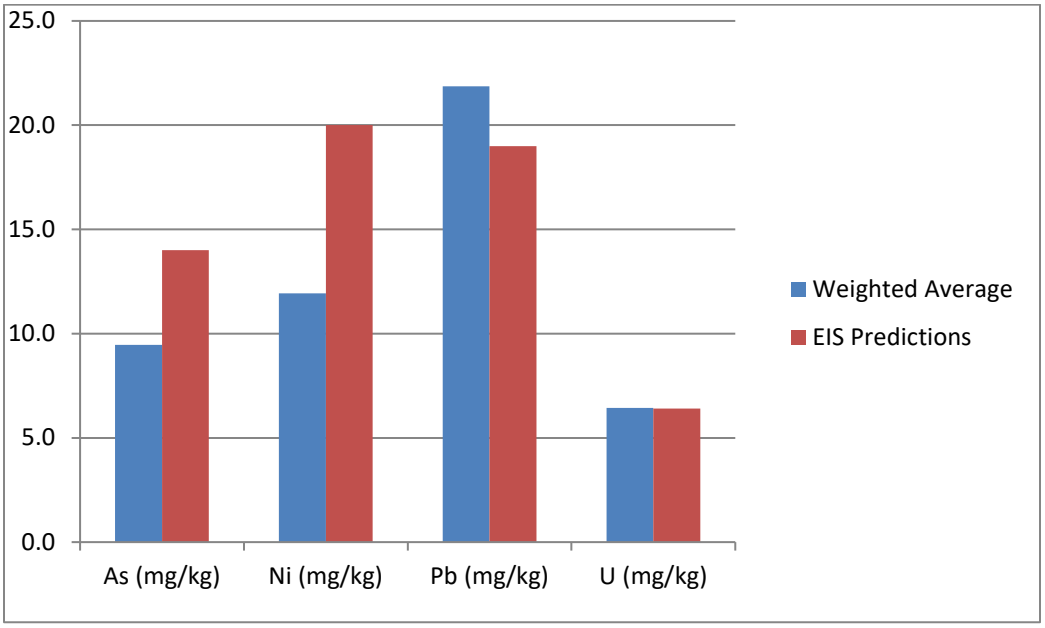


Figure 1: Sue C Predicted vs. Actual Clean Waste Solids Content

9 Sue C Special Waste Comparison

Table 5 and Figure 2 compares the Sue C special waste predicted solids content from the 1991 EIS (Table 4, Addendum Appendix A, Minatco 1991b) to the collected backhaul sample data. The full waste rock characterization study can be found in Appendix II of the 2004 Waste Rock TID (COGEMA 2004) or the 1991 EIS (Minatco 1991a and 1991b).

The results show that the special waste solids content is generally consistent with EIS predictions. In subsequent assessments, such as the Sue E EIS, Caribou EIS, and 2004 Waste Rock TID, the overall average solids content presented in Table 5 has been used with the exception of radionuclide values. Since radionuclides were not analyzed during operation, the Pb-210, Ra-226, and Th-230 predictions from the waste rock characterization in the 1991 EIS (Table 4, Appendix A, Addendum, Minatco 1991b) have been used in subsequent assessments.

Table 5: Comparison of Predicted vs. Actual Sue C Special Waste Solids Content

	As (mg/kg)	Co (mg/kg)	Cu (mg/kg)	Mo (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Se (mg/kg)	U (mg/kg)	Zn (mg/kg)
Overall Average	148	5	9	31	138	26	1	317	7
EIS Predictions	420	44	33	25	390	19	355	430	56

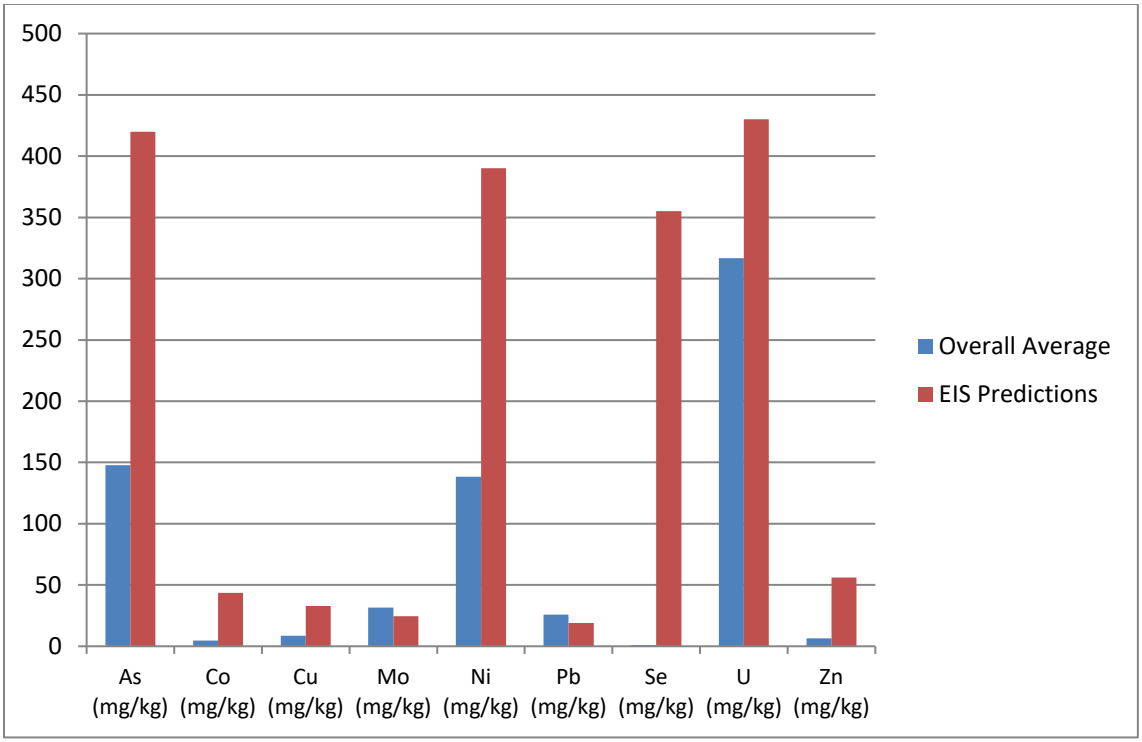


Figure 2: Sue C Predicted vs. Actual Special Waste Solids Content

Appendix AI.3: Evaluation of Sue A Waste Rock Solids Content

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1 Sue A Quantities

XRF and SRC samples were collected during the mining of Sue A from benches 442, 430, 418, 406, 394, and 382. Since data was collected on a per bench basis, the best method of calculating an overall geochemistry for the special waste rock from Sue A is to calculate a weighted average per bench. In order to do this, waste rock bench quantities are needed.

During mining, bench quantities of each waste type were not tracked. Rather, quantities of waste rock and ore were tracked by monthly totals. Design bench quantities are available for Sue A. A pit survey was also completed for Sue A after mining; however, as Sue A is an extension of Sue C, the volumes of Sue A could not be distinguished. Therefore, the design quantities were used for this analysis.

All waste rock in the mining of Sue A was treated as special waste. Therefore, the total design quantity per bench was used as an estimate for the amount of special waste per bench. The design quantity would have also included ore; however, the estimated amount of ore was not available per bench. In addition, the actual mined Sue A quantity was approximately 100,000 bcm less than the design quantity. Therefore, the use of the design quantities is conservative.

The design quantities are shown in Table 1.

Table 1: Design Bench Quantities for Sue A (from McClean Lake Mining Group)

Bench	Crest-Toe	Bench Volume (bcm)
442	Overburden - 442	505,456
430	442-430	341,117
418	430-418	301,086
406	418-406	276,267
394	406-394	192,948
382	394-382	97,527
376	382-376	20,164
373	376-373	3,675
Estimated Volume (bcm)		**1,738,239**

Reference: McClean Lake Mining Department, Drawing #231C033 – Sue A Ultimate Pit Design – September 10, 2005

2 Sue A XRF Data Summary

Table 2 shows the number of XRF readings per bench for the Sue A pit.

Table 2: Number of XRF Readings Per Bench

Waste Type	Bench	Number of Blasts	Number of XRF Results
Special Waste	442	9	542
	430	8	391
	418	10	322
	406	7	307
	394	7	228
	382	3	63
Total Number of XRF Analyses			**1853**

The XRF occasionally reports a result of "<LOD" for results that are below the detection limit of the instrument. This is primarily observed in uranium and nickel results. Table 3 shows the observed detection limit of the XRF for Sue A mining. The detection limits were determined by graphing the XRF results and observing the average cutoff. The detection limits observed for Sue A data were identical to those observed for Sue E and Sue B data.

Table 3: XRF Detection Limits Used in Sue A Data Calculations

Element	Detection Limit (mg/kg)	Half Detection Limit Subbed in for <LOD (mg/kg)
As	20.0	10.0
Ni	75.0	37.5
Pb	20.0	10.0
U	30.0	15.0

The XRF data was reviewed, and any results that fell below the Detection Limit in Table 3 were replaced with half of the detection limit. An example calculation is shown below for Bench 382. In this case, a total of three blasts occurred and 63 XRF results were available. The raw data is shown in Table 4.

In Table 4, any values that fell below the detection limits in Table 3, including "<LOD" values, were replaced with half of the detection limit for each element. The results and the average calculation are shown in Table 5.

Table 4: Raw Data for Bench 382

Bench	Blast	Hole	Uranium (mg/kg)	Lead (mg/kg)	Arsenic (mg/kg)	Nickel (mg/kg)
382	1	1	22.78	77.04	161.77	46.95
		2	<LOD	74.60	125.12	<LOD
		3	<LOD	17.61	64.49	<LOD
		4	<LOD	22.11	89.73	63.80
		5	24.47	40.12	158.73	40.05
		6	<LOD	60.16	201.67	59.22
		7	37.43	58.89	379.68	349.50
		8	<LOD	26.45	59.55	65.02
		9	189.57	51.50	1380.71	1551.56
		10	100.94	29.83	311.92	327.71
		11	99.45	49.49	753.51	767.04
		12	132.82	66.57	1179.81	2005.25
		13	69.50	74.56	670.14	641.69
		14	99.01	30.24	1398.16	1969.21
		15	189.39	24.45	2093.41	4795.46
		16	135.13	23.57	236.92	91.11
		17	16.85	27.67	64.05	34.12
		18	255.47	156.90	3556.93	2655.84
		19	203.67	53.98	1815.82	1584.15
		20	59.01	45.50	882.04	877.48
		21	37.79	81.93	364.55	104.54
		22	<LOD	36.28	73.54	43.78
		23	<LOD	54.20	307.00	306.71
		24	56.02	26.41	772.06	1153.49
		25	31.32	23.18	297.49	275.80
		26	23.18	49.52	103.19	53.87
		27	<LOD	31.43	50.33	<LOD
		28	<LOD	13.51	83.61	<LOD
		29	248.11	33.34	3830.94	5067.44
		30	65.17	85.47	368.80	538.47
		31	45.26	44.37	210.50	354.19
		32	75.49	36.77	257.24	125.79
		33	41.41	17.83	562.22	727.81
		34	<LOD	10.58	73.91	80.52
		35	102.99	26.58	413.91	447.30
		36	59.92	<LOD	290.07	92.79
		37	48.53	28.55	1524.42	2013.32
		38	255.16	38.65	6396.05	7526.16
		39	<LOD	33.17	128.78	81.15
		40	<LOD	24.93	113.19	110.88

Bench	Blast	Hole	Uranium (mg/kg)	Lead (mg/kg)	Arsenic (mg/kg)	Nickel (mg/kg)
	2	4	<LOD	33.07	142.55	<LOD
		5	21.94	13.54	79.96	<LOD
		6	<LOD	19.97	20.89	<LOD
		7	<LOD	42.10	82.81	<LOD
		10	23.36	23.45	101.43	62.76
		11	18.50	<LOD	69.70	98.81
		16	44.05	<LOD	190.34	349.06
	3	1	372.26	59.99	4240.70	3525.78
		2	<LOD	<LOD	36.42	48.75
		3	<LOD	10.51	54.97	36.58
		4	1368.02	77.56	4425.51	2633.00
		5	83.80	56.12	2861.99	<LOD
		7	33.98	18.32	405.56	68.97
		8	59.78	15.27	66.50	53.13
		9	59.83	29.80	164.33	64.00
		10	38.40	21.74	140.81	55.23
		11	109.37	17.17	270.80	205.39
		12	38.40	20.67	118.60	107.87
		13	39.50	<LOD	132.34	152.83
		14	22.64	16.38	347.11	452.86
		15	48.39	19.60	120.47	125.21
		16	129.87	<LOD	788.67	604.91
		17	217.97	26.64	717.46	787.38

Table 5: Average Concentrations for Uranium, Lead, Arsenic, and Nickel in Bench 382

Bench	Blast	Hole	Uranium (mg/kg)	Lead (mg/kg)	Arsenic (mg/kg)	Nickel (mg/kg)
382	1	1	15.00	77.04	161.77	37.50
		2	15.00	74.60	125.12	37.50
		3	15.00	10.00	64.49	37.50
		4	15.00	22.11	89.73	37.50
		5	15.00	40.12	158.73	37.50
		6	15.00	60.16	201.67	37.50
		7	37.43	58.89	379.68	349.50
		8	15.00	26.45	59.55	37.50
		9	189.57	51.50	1380.71	1551.56
		10	100.94	29.83	311.92	327.71
		11	99.45	49.49	753.51	767.04
		12	132.82	66.57	1179.81	2005.25
		13	69.50	74.56	670.14	641.69
		14	99.01	30.24	1398.16	1969.21
		15	189.39	24.45	2093.41	4795.46
		16	135.13	23.57	236.92	91.11
		17	15.00	27.67	64.05	37.50
		18	255.47	156.90	3556.93	2655.84
		19	203.67	53.98	1815.82	1584.15
		20	59.01	45.50	882.04	877.48
		21	37.79	81.93	364.55	104.54
		22	15.00	36.28	73.54	37.50
		23	15.00	54.20	307.00	306.71
		24	56.02	26.41	772.06	1153.49
		25	31.32	23.18	297.49	275.80
		26	15.00	49.52	103.19	37.50
		27	15.00	31.43	50.33	37.50
		28	15.00	10.00	83.61	37.50
		29	248.11	33.34	3830.94	5067.44
		30	65.17	85.47	368.80	538.47
		31	45.26	44.37	210.50	354.19
		32	75.49	36.77	257.24	125.79
		33	41.41	10.00	562.22	727.81
		34	15.00	10.00	73.91	80.52
		35	102.99	26.58	413.91	447.30
		36	59.92	10.00	290.07	92.79
		37	48.53	28.55	1524.42	2013.32
		38	255.16	38.65	6396.05	7526.16
		39	15.00	33.17	128.78	81.15
		40	15.00	24.93	113.19	110.88
	2	4	15.00	33.07	142.55	37.50
		5	15.00	10.00	79.96	37.50
		6	15.00	10.00	20.89	37.50
		7	15.00	42.10	82.81	37.50
		10	15.00	23.45	101.43	37.50
		11	15.00	10.00	69.70	98.81
		16	44.05	10.00	190.34	349.06
	3	1	372.26	59.99	4240.70	3525.78
		2	15.00	10.00	36.42	37.50
		3	15.00	10.00	54.97	37.50
		4	1368.02	77.56	4425.51	2633.00
		5	83.80	56.12	2861.99	37.50
		7	33.98	10.00	405.56	37.50
		8	59.78	10.00	66.50	37.50

Bench	Blast	Hole	Uranium (mg/kg)	Lead (mg/kg)	Arsenic (mg/kg)	Nickel (mg/kg)
		9	59.83	29.80	164.33	37.50
		10	38.40	21.74	140.81	37.50
		11	109.37	10.00	270.80	205.39
		12	38.40	20.67	118.60	107.87
		13	39.50	10.00	132.34	152.83
		14	15.00	10.00	347.11	452.86
		15	48.39	10.00	120.47	125.21
		16	129.87	10.00	788.67	604.91
		17	217.97	26.64	717.46	787.38
Overall Average (mg/kg)			**89.80**	**35.23**	**752.16**	**739.13**

An overall average of each As, Ni, Pb, and U result was then calculated for each bench. A weighted average solids content was then calculated using the average result per bench and the design bench volumes shown in Table 1. The results are shown in Table 6.

Table 6: Weighted Average Solids Content (XRF) for Sue A Special Waste

Bench	Bench Volume from Sue A Pit (bcm)	Mass of Waste[1] (tonnes)	Metal	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration[3] (mg/kg)	Average Inventory[4] (tonnes)
Bench 442	505,456	1,228,258	Arsenic	10.0	459.0	12.0	14.8
			Uranium	15.0	106.1	15.2	18.6
			Lead	10.0	1,112.5	40.5	49.7
			Nickel	37.5	105.9	37.8	46.4
Bench 430	341,117	828,914	Arsenic	10.0	528.4	13.8	11.4
			Uranium	15.0	15.0	15.0	12.4
			Lead	10.0	1,006.8	53.9	44.7
			Nickel	37.5	37.5	37.5	31.1
Bench 418	301,086	731,639	Arsenic	10.0	1,190.7	27.8	20.4
			Uranium	15.0	15.0	15.0	11.0
			Lead	10.0	2,789.1	105.6	77.2
			Nickel	37.5	37.5	37.5	27.4
Bench 406	276,267	671,329	Arsenic	10.0	9,513.6	142.4	95.6
			Uranium	15.0	209.3	16.0	10.8
			Lead	10.0	15,210.2	317.3	213.0
			Nickel	37.5	865.9	40.2	27.0
Bench 394	192,948	468,864	Arsenic	10.0	27,089.4	632.0	296.3
			Uranium	15.0	445.9	20.7	9.7
			Lead	10.0	29,352.2	812.7	381.0
			Nickel	37.5	5,084.2	77.1	36.1
Bench 382[2]	121,365	294,917	Arsenic	20.9	6,396.1	752.2	221.8
			Uranium	15.0	1,368.0	89.8	26.5
			Lead	10.0	156.9	35.2	10.4
			Nickel	37.5	7,526.2	739.1	218.0
Total[5]	1,738,239	4,223,921	Arsenic	10.0	27,089.4	156.3	660.3
			Uranium	15.0	1,368.0	21.1	89.0
			Lead	10.0	29,352.2	183.7	776.1
			Nickel	37.5	7,526.2	91.4	386.0

Notes:

[1] Based on a dry bulk density of 2.43 tonnes/m^3
[2] Quantity includes Benches 382, 376, and 373
[3] Represents average concentrations calculated using half of the detection limit for <LOD results and values below detection limit.
[4] Calculated as follows: (Averaged Concentration * Mass of Waste) / (1,000,000 mg / 1 kg)
[5] Metal concentrations represent the weighted average based on the volume of each bench

2.1 Sue A SRC Data Summary

During the mining of Sue A, composite samples from each blast were collected for comparison to the XRF results. As XRF analyses were performed on multiple holes within the blast pattern, and the SRC sample was a composite of blast holes, there are fewer SRC results than XRF results. For Bench 406, sampling was more intensive and also included individual blast holes.

The XRF unit was used for systematic sampling of waste rock throughout mining. The purpose of the SRC analyses was to verify the performance of the XRF and calibrate the unit, as well as develop correlations for arsenic, nickel, lead, and uranium.

Composite samples were not collected from all blasts within each bench. Ore blasts were not sampled.

Table 7 summarizes the number of SRC samples available.

Table 7: Number of SRC Results Per Bench

Waste Type	Bench	Number of Blasts	Number of SRC Results
Special Waste	442	9	17
	430	8	8
	418	10	3
	406	7	59
	394	7	6
	382	3	3
Total Number of XRF Analyses			**96**

Table 8 shows the raw SRC data for all of Sue A, and the average result for each bench. In the sample name, the bench and blast numbers are shown. For example, sample B382-01 denotes the composite sample from Blast 1 on Bench 382. Sampling on Bench 406 was more intensive and included individual blast holes. For example, sample B406-01-01 denotes the sample from Blast Hole 1, Blast 1, on Bench 406. Samples with “R” after the name are repeat samples.

Table 8: Summary of SRC Data from Sue A

Bench	Sample	U (ppm)	As (ppm)	Ni (ppm)	Pb (ppm)
382	B382-01	38.9	2034.0	1720.0	24.9
	B382-02	17.6	88.6	117.0	13.1
	B382-03	555.0	5650.0	4850.0	26.8
	Bench Average	**203.8**	**2590.9**	**2229.0**	**21.6**
	Bench Maximum	**555.0**	**5650.0**	**4850.0**	**26.8**
	Bench Minimum	**17.6**	**88.6**	**117.0**	**13.1**
394	B394-01	9.1	1450.0	5.9	2440.0
	B394-02	6.4	47.6	11.8	127.0
	B394-03	16.2	111.0	70.6	63.6
	B394-04	15.8	319.0	168.0	196.0
	B394-05	3.0	4.3	3.5	5.4
	B394-06	12.6	23.4	7.1	25.4
	Bench Average	**10.5**	**325.9**	**44.5**	**476.2**
	Bench Maximum	**16.2**	**1450.0**	**168.0**	**2440.0**
	Bench Minimum	**3.0**	**4.3**	**3.5**	**5.4**
406	B406-01	6.6	529.0	5.7	904.0
	B406-01-01	5.5	25.2	4.3	625.0
	B406-01-02	3.5	15.3	5.4	205.0
	B406-01-03	3.8	19.7	3.2	376.0
	B406-01-04	4.3	31.3	3.4	423.0
	B406-01-05	5.2	338.0	5.0	987.0
	B406-01-06	7.2	689.0	4.6	2380.0
	B406-01-07	5.0	744.0	4.3	1630.0
	B406-01-08	4.4	58.2	4.1	478.0
	B406-01-09	4.3	19.0	4.3	366.0
	B406-01-10	3.5	50.2	4.6	274.0
	B406-01-11	4.0	33.6	5.3	238.0
	B406-01-12	4.5	36.4	4.5	400.0
	B406-01-13	5.6	243.0	5.5	922.0
	B406-01-14	9.0	1570.0	6.0	4600.0
	B406-01-15	4.1	85.7	3.2	249.0
	B406-01-16	6.6	150.0	6.4	727.0
	B406-01-17	4.0	34.1	4.4	326.0
	B406-01-18	6.4	91.8	5.6	335.0
	B406-01-19	3.9	45.3	4.7	278.0
	B406-01-20	5.1	151.0	3.7	431.0
	B406-01-21	24.7	2780.0	18.4	5380.0
	B406-01-22	10.8	300.0	39.6	615.0
	B406-01-23	3.2	68.3	4.2	162.0
	B406-01-24	23.3	1310.0	27.8	2270.0
	B406-01-25	21.0	2210.0	23.5	3980.0
	B406-01-26	5.9	168.0	5.5	550.0
	B406-01-27	53.2	4890.0	13.9	8840.0
	B406-01-28	13.2	1110.0	26.1	2820.0

Bench	Sample	U (ppm)	As (ppm)	Ni (ppm)	Pb (ppm)
	B406-01-29	4.6	197.0	5.7	616.0
	B406-01-30	6.7	147.0	11.3	476.0
	B406-01-31	7.9	121.0	19.6	619.0
	B406-01-32	7.0	500.0	5.9	1150.0
	B406-01-33	4.3	34.6	5.2	163.0
	B406-01-34	5.3	57.9	9.7	192.0
	B406-01-35	3.9	19.7	4.7	81.0
	B406-01-36	3.4	42.2	4.4	140.0
	B406-01-37	5.6	180.0	9.6	614.0
	B406-01-37 R	5.7	177.0	9.5	614.0
	B406-01-38	3.1	19.8	3.9	55.3
	B406-01-39	7.1	42.5	8.8	163.0
406 (Continued)	B406-01-40	4.7	20.9	5.5	184.0
	B406-01-41	6.9	123.0	13.7	572.0
	B406-01-42	3.8	17.1	4.2	95.1
	B406-01-43	3.6	20.3	4.4	40.0
	B406-01-44	4.0	20.0	4.2	57.3
	B406-01-45	5.1	35.1	5.0	32.8
	B406-01-46	4.5	22.9	4.7	53.2
	B406-01-47	5.7	35.7	9.1	228.0
	B406-01-48	4.8	42.4	4.6	98.7
	B406-01-49	5.3	50.0	4.6	80.2
	B406-01-50	6.0	28.6	6.3	78.1
	B406-01-50 R	6.3	27.9	6.1	76.9
	B406-01-51	14.6	54.8	7.2	73.8
	B406-02	4.8	232.0	5.2	508.0
	B406-04	13.0	127.0	25.6	348.0
	B406-05	8.1	22.6	9.2	42.3
	B406-06	3.2	9.7	3.7	62.5
	B406-07	4.1	6.6	3.4	10.4
	Bench Average	**7.4**	**342.9**	**8.2**	**835.5**
	Bench Maximum	**53.2**	**4890.0**	**39.6**	**8840.0**
	Bench Minimum	**3.1**	**6.6**	**3.2**	**10.4**
418	B406-01	3.5	9.4	3.4	24.9
	B418-10	3.3	5.8	3.1	9.1
	B418-10 R	3.5	5.8	3.0	9.0
	Bench Average	**3.4**	**7.0**	**3.2**	**14.3**
	Bench Maximum	**3.5**	**9.4**	**3.4**	**24.9**
	Bench Minimum	**3.3**	**5.8**	**3.0**	**9.0**
430	B430-02	3.2	10.8	2.2	162.0
	B430-03	4.2	11.7	2.0	52.8
	B430-04	2.5	2.9	2.5	47.5
	B430-05	3.2	4.1	2.1	38.4
	B430-06	2.6	2.7	1.4	50.7
	B430-07	3.7	5.4	5.1	4.1
	B430-07 R	3.6	5.5	5.1	3.8

Bench	Sample	U (ppm)	As (ppm)	Ni (ppm)	Pb (ppm)
	B430-08	3.2	3.5	1.4	3.7
	Bench Average	**3.3**	**5.8**	**2.7**	**45.4**
	Bench Maximum	**4.2**	**11.7**	**5.1**	**162.0**
	Bench Minimum	**2.5**	**2.7**	**1.4**	**3.7**
442	B442-01E	2.3	6.2	7.9	5.9
	B442-02E	5.4	4.4	3.5	15.5
	B442-03-41-01	39.2	31.1	48.7	51.2
	B442-03-41-02	38.7	30.8	47.4	50.5
	B442-03-41-03	38.8	32.2	49.4	53.8
	B442-03-41-04	37.4	32.4	49.1	52.5
	B442-03-41-05	39.8	33.6	49.0	52.8
	B442-03E	2.4	3.0	4.8	7.2
	B442-05E	5.0	6.7	11.0	9.9
	B442-07E	1.8	2.2	3.9	4.2
	B442-08E	4.1	5.2	4.4	10.3
	B442-09E	3.9	24.9	24.7	4.7
	B442-12E	2.7	2.6	4.9	4.5
	B442-13E	2.6	5.7	6.9	4.2
	B442-15E	3.9	4.5	2.8	7.8
	B442-16E	2.5	2.5	3.5	4.8
	B442-16E R	2.5	2.3	3.3	4.7
	Bench Average	**13.7**	**13.5**	**19.1**	**20.3**
	Bench Maximum	**39.8**	**33.6**	**49.4**	**53.8**
	Bench Minimum	**1.8**	**2.2**	**2.8**	**4.2**

SRC results from all benches were compiled and a bench average was calculated for each. Once completed, a weighted average solids content for Sue A special waste was calculated using the bench results and design volumes from Table 1. The results are presented in Table 9.

Table 9: Weighted Average Solids Content (SRC) for Sue A Special Waste

Bench	Bench Volume from Sue A Pit (bcm)	Mass of Waste[1] (tonnes)	Metal	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration[3] (mg/kg)	Average Inventory[4] (tonnes)
Bench 442	505,456	1,228,258	Arsenic	2.2	33.6	13.5	16.6
			Uranium	1.8	39.8	13.7	16.8
			Lead	4.2	53.8	20.3	24.9
			Nickel	2.8	49.4	19.1	23.5
Bench 430	341,117	828,914	Arsenic	2.7	11.7	5.8	4.8
			Uranium	2.5	4.2	3.3	2.7
			Lead	3.7	162.0	45.4	37.6
			Nickel	1.4	5.1	2.7	2.3
Bench 418	301,086	731,639	Arsenic	5.8	9.4	7.0	5.1
			Uranium	3.3	3.5	3.4	2.5
			Lead	9.0	24.9	14.3	10.5
			Nickel	3.0	3.4	3.2	2.3
Bench 406	276,267	671,329	Arsenic	6.6	4,890.0	342.9	230.2
			Uranium	3.1	53.2	7.4	4.9
			Lead	10.4	8,840.0	835.5	560.9
			Nickel	3.2	39.6	8.2	5.5
Bench 394	192,948	468,864	Arsenic	4.3	1,450.0	325.9	152.8
			Uranium	3.0	16.2	10.5	4.9
			Lead	5.4	2,440.0	476.2	223.3
			Nickel	3.5	168.0	44.5	20.9
Bench 382[2]	121,365	294,917	Arsenic	88.6	5,650.0	2,590.9	764.1
			Uranium	17.6	555.0	203.8	60.1
			Lead	13.1	26.8	21.6	6.4
			Nickel	117.0	4,850.0	2,229.0	657.4
Total[5]	1,738,239	4,223,921	Arsenic	2.2	5,650.0	277.9	1,173.7
			Uranium	1.8	555.0	21.8	92.1
			Lead	3.7	8,840.0	204.4	863.5
			Nickel	1.4	4,850.0	168.5	711.8

Notes:

[1] Based on a dry bulk density of 2.43 tonnes/m^3

[2] Quantity includes Benches 382, 376, and 373

[3] Represents average concentrations calculated using half of the detection limit for <LOD results

[4] Calculated as follows: (Averaged Concentration * Mass of Waste) / (1,000,000 mg / 1 kg)

[5] Metal concentrations represent the weighted average based on the volume of each bench

2.2 Comparison of Predicted vs. Actual Sue A Solids Content and Inventory

The SRC and XRF results for Sue A were compared to solids content predictions made in the Caribou EIS for arsenic, nickel, lead, and uranium. The inventory of metals was also compared.

In the Caribou EIS, it was assumed that Sue A waste rock would be segregated into clean and special waste. However, during mining, all waste rock was treated as special waste. Therefore, for the purposes of this comparison, a weighted average predicted solids content was calculated based on Caribou EIS predicted values for clean and special waste. The solids contents used in the Caribou EIS originated from a waste rock characterization program for Sue A from the 1991 EIS. The weighted average predicted solids content is shown in Table 10.

Table 10: Weighted Average Predicted Solids Content Based on Caribou EIS Values

Analyte	Unit	Clean Waste Predicted	Special Waste Predicted	Weighted Average
Quantity	tonnes	1,896,554	32,868	1,929,422
As	mg/kg	130	1200	148
Ni	mg/kg	21	620	31
Pb	mg/kg	240	160	239
U	mg/kg	12	240	16

References: Caribou EIS (AREVA 2009a) - Appendix VIIIB - Table 4.4, and 1991 McClean Lake EIS (Minatco 1991b) - Addendum - Table 4.

The design quantity of special waste was 4,223,921 tonnes. The actual mined quantity of special waste was 1,621,325 bcm or 3,939,820 tonnes based on a conversion factor of 2.43. This is twice as much waste rock as the quantity estimated for the Caribou EIS modeling (1,929,422 tonnes). Table 11 shows a comparison of the measured solids content and average inventory to what was predicted in the Caribou EIS. This is also shown in Figures 1 and 2. The design quantities were used for Table 11 and the figures in order to be conservative.

Table 11: Comparison of Predicted vs. Actual Solids Content and Inventory for Sue A Special Waste

Result	Quantity (tonnes)	Solids Content (mg/kg)				Average Inventory (tonnes)			
		As	Ni	Pb	U	As	Ni	Pb	U
Sue A Predicted in Caribou EIS	1,929,422 (Clean and Special)	148.0	31.0	239.0	16.0	285.6	59.8	461.1	30.9
Sue A XRF Weighted Average	4,223,921	156.3	91.4	183.7	21.1	660.3	386.0	776.1	89.0
Sue A SRC Weighted Average	4,223,921	277.9	168.5	204.4	21.8	1173.7	711.8	863.5	92.1

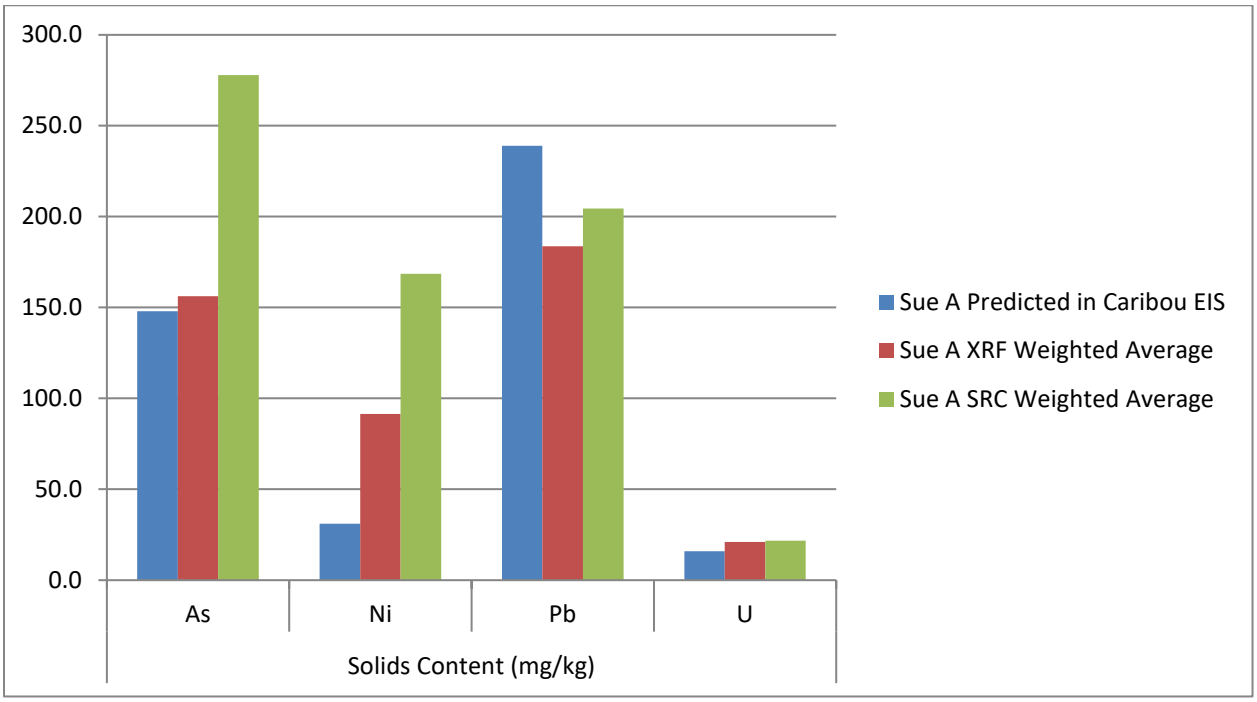


Figure 1: Comparison of Predicted vs. Actual Sue A Solids Content

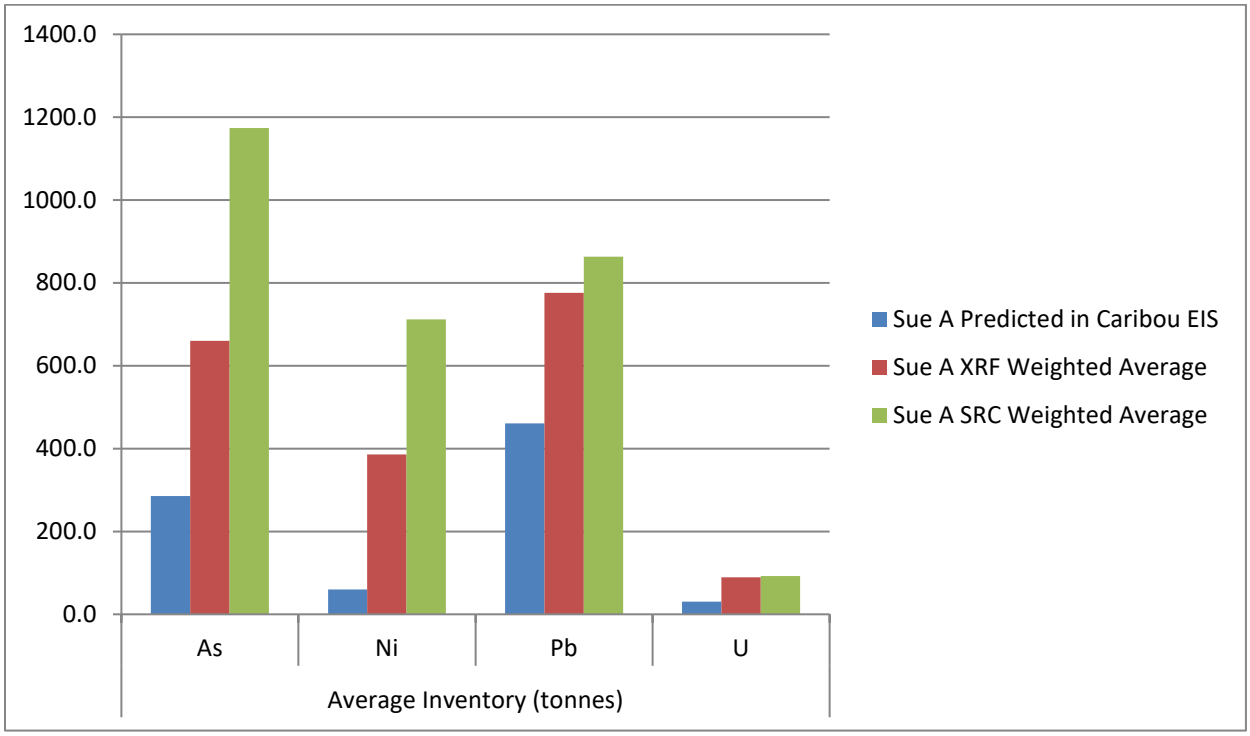


Figure 2: Comparison of Predicted vs. Actual Sue A Inventory

Typically, the XRF results should be conservative when compared to the SRC results. However, this was not the case for Sue A. In particular, higher values of arsenic and nickel were measured using the SRC results. Ideally, the XRF and SRC results for arsenic should correspond closely, indicating a high degree of accuracy in the XRF calibration for arsenic. As Sue A was the first mining test application for the XRF, a possible explanation is that operational procedures were still being tested and developed for the XRF. Once operational procedures were finalized, a much stronger correlation between XRF and SRC arsenic results has been observed. This is shown in the Sue B and Sue E data summaries located in this appendix. The SRC results are considered to be the most accurate representation of waste rock data

Table 11 shows a large difference in the predicted volume in the Caribou EIS when compared to the actual mined quantities. Investigation into this issue showed that the predicted volume was based on a volume estimate from the previous Waste Rock TID (COGEMA 2004). At the time of preparation of the last Waste Rock TID, Sue A had not yet been mined and the estimated quantity was based on pit designs older than the design shown in Table 1. In May 2005, a decision was made to redesign the Sue A pit based on improved economic conditions (AREVA 2005). This resulted in a larger volume of mined material. While the Sue A solids content was generally consistent with EIS predictions with the exception of nickel, the inventory is higher than anticipated due to the larger quantity of placed waste rock. The solids content and waste rock quantities will be updated accordingly in the modeling to reflect this change.

Appendix AI.4: Evaluation of Sue B Waste Rock Solids Content

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1 Introduction

XRF and SRC samples were collected during the mining of Sue B from benches 433, 421, 409, 397, and 385. Since data was collected on a per bench basis, the best method of calculating an overall geochemistry for the special waste rock from Sue B is to calculate a weighted average per bench. In order to do this, waste rock bench quantities are needed.

During mining, bench quantities of each waste type were not tracked. Rather, quantities of waste rock and ore were tracked by monthly totals. There are two ways of estimating bench quantities: 1) by using bench volumes from the final pit design, and 2) by calculating the bench volumes from the final surveyed pit.

As all waste rock in the mining of Sue B was treated as special waste, an estimate of waste quantities per bench can be determined by subtracting the amount of ore per bench from the total quantity of material per bench.

2 Sue B Quantities

2.1 Sue B Design Quantities

Prior to the mining of Sue B, a final pit design was prepared in Surpac. The in-place quantities of material per bench were calculated, along with an approximate tonnage of ore per bench. The quantities are shown below in Table 1. All benches have XRF and SRC data with the exception of the overburden and Bench 445.

Table 1: Sue B Pit Ultimate Design – November 18/08 (Drawing 232C076, provided by Shaun Pierce)

Bench	Toe/Crest	Crest Area (m^2)	Toe Area (m^2)	Bench Area	Height (m)	Bench Volume (bcm)	Ore (tonnes)	Ore[1] (bcm)
Overburden		-		-	-	202,916	-	-
445	445-Overburden	-	44,642	-	-	230,319	-	-
433	433-445	40,336	35,289	37,813	12	453,750	1,018	737
421	421-433	31,461	26,541	29,001	12	348,012	35,565	25,734
409	409-421	23,248	18,640	20,944	12	251,328	35,172	25,450
397	397-409	15,855	11,223	13,539	12	162,468	6,747	4,882
385	385-397	9,070	5,053	7,061	12	85,448	27,028	19,557
382	382-385	3,370	2,550	2,960	3	8,876	7,761	5,615
379	379-382	1,708	1,091	1,400	3	4,269	4,958	3,588
373	373-379	874	690	782	6	4,682	4,952	3,583
					TOTAL	**1,752,068**	**123,200**	**89,146**

[1]Based on a conversion factor of 1.382
Reference: McClean Lake Mining Department, Drawing #232C076 – November 18, 2008

2.2 Sue B Actual Bench Quantities

The actual bench quantities from the mining of Sue B can be calculated from the pit survey data. It is important to note that this method does not differentiate between waste rock and ore, but rather calculates a total in-place material volume. This total surveyed volume was compared to the total volume predicted in the pit design, and this data is shown in the Table 2 below.

Table 2: Comparison of Pit Survey Data (provided by Shaun Pierce) to Sue B Ultimate Design

Bench	Toe/Crest	Bench Height (m)	Surveyed Bench Volume (bcm)	Design Bench Volume (bcm)	Difference (Surveyed-Design)	% Difference
445	445-459[1]	14	385,822	433,235[2]	-47,413	-11.6%
433	433-445	12	448,088	453,750	-5,662	-1.3%
421	421-433	12	352,192	348,012	4,180	1.2%
409	409-421	12	256,234	251,328	4,906	1.9%
397	397-409	12	160,868	162,468	-1,600	-1.0%
385	385-397	12	84,291	85,448	-1,157	-1.4%
382	382-385	3	8,451	8,876	-425	-4.9%
379	379-382	3	4,202	4,269	-67	-1.6%
373	373-379	6	2,634	4,682	-2,048	-56.0%

Bench	Toe/Crest	Bench Height (m)	Surveyed Bench Volume (bcm)	Design Bench Volume (bcm)	Difference (Surveyed-Design)	% Difference
		TOTAL	1,702,782	1,752,068	-49,286	-2.9%

[1]Top of Overburden
[2]Bench volume is a sum of the Overburden and 445-Overburden layers in Table 1
Reference: McClean Lake Mining Department

This data shows that the design and final pit quantities were very comparable, with the total volume differing by 2.9%.

2.3 Quantities Used in XRF and SRC Calculations

For the purpose of calculating weighted averages per bench for XRF and SRC data, the design quantities were used since ore quantities were also available. The estimated special waste quantities, based on pit design data, are shown below in Table 3.

Table 3: Estimated Special Waste Quantities for Sue B

Bench	Toe/Crest	Height (m)	Bench Volume (bcm)	Overburden (bcm)	Ore (tonnes)	Ore (bcm)	Special Waste (bcm)
Overburden	Overburden	-	202,916	202,916	0	0	0
445	445-Overburden	-	230,319	0	0	0	230,319
433	433-445	12	453,750	0	1,018	737	453,013
421	421-433	12	348,012	0	35,565	25,734	322,278
409	409-421	12	251,328	0	35,172	25,450	225,878
397	397-409	12	162,468	0	6,747	4,882	157,586
385	385-397	12	85,448	0	27,028	19,557	65,891
382	382-385	3	8,876	0	7,761	5,615	3,261
379	379-382	3	4,269	0	4,958	3,588	681
373	373-379	6	4,682	0	4,952	3,583	1,099
		TOTAL	**1,752,068**	**202,916**	**123,200**	**89,146**	**1,460,006**

The totals in Table 3 were compared to the Sue B Pit production history, obtained from the McClean Lake Mining Department. In the production history, the total amount of waste rock and ore is prepared by tracking monthly quantities. In this total, the amount of overburden is reported as 202,916 bcm, the amount of special waste is reported as 1,441,350 bcm, and the amount of ore is reported as 58,528 bcm. The actual tracked quantity of special waste is very comparable to the total using design bench quantities. Therefore, the special waste quantities shown in Table 3 will be used to calculate weighted average concentrations for XRF and SRC data.

During the actual mining of Sue B, the total volume for Bench 433 was reported as everything from 433 masl to the base of the overburden. Bench 445 was the estimated elevation of the sandstone-overburden contact. Bench 385 is the last bench with XRF data available. The special waste volumes in Benches 382, 379, and 373 are minimal. Therefore, for the purpose of calculating a weighted average solids content, the following assumptions were made:

- the bench volumes for Bench 433 and Bench 445 in Table 3 above were combined for a total of 683,332 bcm, and identified as “Bench 433” in the XRF calculations; and
- the volume used for “Bench 385” in the XRF calculations includes the volumes from Benches 385, 382, 379, and 373, for a total of 70,932 bcm.

3 Sue B XRF Data Summary

Table 4 below shows the number of XRF readings per bench for the Sue B pit.

Table 4: Number of XRF Readings Per Bench

Waste Type	Bench	Number of Blasts	Number of XRF Results
Special Waste	433	9	606
	421	10	454
	409	10	284
	397	7	166
	385	4	56
Total Number of XRF Analyses			**1,566**

The XRF occasionally reports a result of "<LOD" for results that are below the detection limit of the instrument. This is primarily observed in uranium and nickel results. Table 5 shows the observed detection limit of the XRF for Sue B mining. The detection limits were determined by graphing the XRF results and observing the average cutoff. The detection limits observed for Sue B data were identical to those observed for Sue E.

Table 5: XRF Detection Limits Used in Sue B Data Calculations

Element	Detection Limit (mg/kg)	Half Detection Limit Subbed in for <LOD (mg/kg)
As	20.0	10.0
Ni	75.0	37.5
Pb	20.0	10.0
U	30.0	15.0

The XRF data was reviewed, and any results that fell below the Detection Limit in Table 5 were replaced with half of the detection limit. An example calculation is shown below for Bench 385. In this case, a total of four blasts occurred and 56 XRF results were available. The raw data is shown in Table 6.

In Table 6, any values that fell below the detection limits in Table 5, including "<LOD" values, were replaced with half of the detection limit for each element. The results and the average calculation are shown in Table 7.

Table 6: Raw Data for Bench 385

Bench	Blast	Hole	Uranium (mg/kg)	Lead (mg/kg)	Arsenic (mg/kg)	Nickel (mg/kg)
385	1	1	< LOD	104.35	185.28	51.50
		2	< LOD	154.09	63.20	< LOD
		3	< LOD	269.57	94.99	< LOD
		4	< LOD	295.88	58.91	< LOD
		5	< LOD	543.70	148.12	< LOD
		6	< LOD	124.94	92.90	< LOD
		7	< LOD	221.60	137.82	51.51

Bench	Blast	Hole	Uranium (mg/kg)	Lead (mg/kg)	Arsenic (mg/kg)	Nickel (mg/kg)
		8	< LOD	284.16	110.20	< LOD
		9	68.81	221.66	305.88	< LOD
		10	28.79	296.16	229.85	52.99
		11	73.60	1172.59	230.01	133.91
		12	37.35	199.76	100.52	61.24
		13	67.90	214.38	159.20	99.35
		14	41.33	49.01	633.27	622.37
		15	61.41	489.26	429.65	158.46
		16	38.53	60.58	884.05	2312.33
		17	23.32	200.70	63.48	< LOD
		18	103.35	117.02	460.97	2238.81
		19	115.04	635.14	433.31	172.31
		20	109.29	49.28	515.90	322.88
		21	209.63	1069.34	2533.17	2760.63
		22	90.08	53.25	500.77	907.81
		23	121.79	77.32	363.49	167.38
		24	45.58	20.22	202.23	710.74
		25	240.30	55.33	4809.23	8695.05
	2	1	< LOD	21.65	90.90	132.80
		2	25.15	29.49	134.14	257.40
		3	< LOD	< LOD	70.28	112.60
		4	< LOD	< LOD	99.01	128.77
		5	85.60	52.86	172.74	95.89
		6	35.60	33.24	149.44	205.74
		7	47.99	38.10	199.76	230.64
		8	239.00	59.09	2258.94	4486.80
		9	57.66	58.04	498.41	267.62
		10	182.77	57.46	1750.99	1406.76
		11	45.27	12.29	241.40	387.21
		12	50.69	27.47	337.42	554.28
		13	25.76	16.71	221.51	186.08
		14	23.19	24.99	236.87	151.14
		15	597.54	24.27	3860.13	7784.55
		16	346.23	39.48	1857.97	3476.28
		17	29.39	< LOD	561.88	997.46
		18	58.68	18.63	522.23	294.95
		19	< LOD	< LOD	224.93	473.42
	3	1	77.35	< LOD	567.36	722.80
		2	< LOD	< LOD	43.78	68.55
		3	< LOD	< LOD	25.86	< LOD
		4	< LOD	17.17	36.76	< LOD
		5	< LOD	< LOD	21.78	84.86
		6	< LOD	< LOD	38.96	67.16
	4	1	< LOD	261.46	42.36	< LOD
		2	41.28	930.49	76.73	74.12
		3	52.29	291.98	173.96	< LOD
		4	< LOD	626.28	60.45	69.09
		5	119.28	34.75	206.20	247.16
		6	< LOD	< LOD	15.40	< LOD

Table 7: Average Concentrations for Uranium, Arsenic, Lead, and Nickel in Bench 385

Bench	Blast	Hole	Uranium (mg/kg)	Lead (mg/kg)	Arsenic (mg/kg)	Nickel (mg/kg)
385	1	1	15.00	104.35	185.28	37.50
		2	15.00	154.09	63.20	37.50
		3	15.00	269.57	94.99	37.50
		4	15.00	295.88	58.91	37.50
		5	15.00	543.70	148.12	37.50
		6	15.00	124.94	92.90	37.50
		7	15.00	221.60	137.82	37.50
		8	15.00	284.16	110.20	37.50
		9	68.81	221.66	305.88	37.50
		10	15.00	296.16	229.85	37.50
		11	73.60	1172.59	230.01	133.91
		12	37.35	199.76	100.52	37.50
		13	67.90	214.38	159.20	99.35
		14	41.33	49.01	633.27	622.37
		15	61.41	489.26	429.65	158.46
		16	38.53	60.58	884.05	2312.33
		17	15.00	200.70	63.48	37.50
		18	103.35	117.02	460.97	2238.81
		19	115.04	635.14	433.31	172.31
		20	109.29	49.28	515.90	322.88
		21	209.63	1069.34	2533.17	2760.63
		22	90.08	53.25	500.77	907.81
		23	121.79	77.32	363.49	167.38
		24	45.58	20.22	202.23	710.74
		25	240.30	55.33	4809.23	8695.05
	2	1	15.00	21.65	90.90	132.80
		2	15.00	29.49	134.14	257.40
		3	15.00	10.00	70.28	112.60
		4	15.00	10.00	99.01	128.77
		5	85.60	52.86	172.74	95.89
		6	35.60	33.24	149.44	205.74
		7	47.99	38.10	199.76	230.64
		8	239.00	59.09	2258.94	4486.80
		9	57.66	58.04	498.41	267.62
		10	182.77	57.46	1750.99	1406.76
		11	45.27	10.00	241.40	387.21
		12	50.69	27.47	337.42	554.28
		13	15.00	10.00	221.51	186.08
		14	15.00	24.99	236.87	151.14
		15	597.54	24.27	3860.13	7784.55
		16	346.23	39.48	1857.97	3476.28
		17	15.00	10.00	561.88	997.46
		18	58.68	10.00	522.23	294.95
		19	15.00	10.00	224.93	473.42
	3	1	77.35	10.00	567.36	722.80
		2	15.00	10.00	43.78	37.50
		3	15.00	10.00	25.86	37.50
		4	15.00	10.00	36.76	37.50
		5	15.00	10.00	21.78	84.86
		6	15.00	10.00	38.96	37.50
	4	1	15.00	261.46	42.36	37.50
		2	41.28	930.49	76.73	37.50
		3	52.29	291.98	173.96	37.50
		4	15.00	626.28	60.45	37.50
		5	119.28	34.75	206.20	247.16
		6	15.00	10.00	10.00	37.50
Overall Average (mg/kg)			**68.77**	**173.76**	**509.63**	**763.83**

An overall average of each As, Ni, Pb, and U result was then calculated for each bench. A weighted average solids content was then calculated using the average result per bench and the special waste volumes shown in Table 3. The results are shown in Table 8.

Table 8: Weighted Average Solids Content (XRF) for Sue B Special Waste

Bench	Bench Volume from Sue B Pit (bcm)	Mass of Waste[1] (tonnes)	Metal	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration[4] (mg/kg)	Average Inventory[5] (tonnes)
Bench 433[2]	683,332	1,660,497	Arsenic	10.0	18,516.0	59.8	99.2
			Uranium	15.0	8,243.3	32.0	53.1
			Lead	10.0	2,332.7	71.4	118.5
			Nickel	37.5	34,572.0	103.3	171.6
Bench 421	322,278	783,136	Arsenic	10.0	1,726.7	19.3	15.1
			Uranium	21.5	79.4	15.2	11.9
			Lead	11.5	3,602.6	48.3	37.9
			Nickel	41.6	161.6	38.0	29.8
Bench 409	225,878	548,884	Arsenic	10.0	1,261.4	47.3	26.0
			Uranium	22.4	207.0	18.3	10.0
			Lead	11.9	1,643.1	80.1	43.9
			Nickel	41.1	290.9	44.3	24.3
Bench 397	157,586	382,934	Arsenic	10.1	803.5	69.6	26.7
			Uranium	22.8	818.7	22.9	8.8
			Lead	12.0	2,174.6	116.8	44.7
			Nickel	42.9	260.3	43.8	16.8
Bench 385[3]	70,932	172,365	Arsenic	15.4	4,809.2	509.6	87.8
			Uranium	23.2	597.5	68.8	11.9
			Lead	12.3	1,172.6	173.8	29.9
			Nickel	51.5	8,695.1	763.8	131.7
Total[6]	1,460,006	3,547,815	Arsenic	6.7	18,516.0	71.8	254.8
			Uranium	11.7	8,243.3	27.0	95.7
			Lead	9.6	3,602.6	77.5	275.0
			Nickel	35.9	34,572.0	105.5	374.1

[1] Based on a dry bulk density of 2.43 tonnes/m^3

[2] Bench Volume includes everything from 433 masl to the base of the overburden

[3] Bench Volume includes Benches 385, 382, 379, and 373

[4] Represents average concentrations calculated using half of the detection limit for <LOD results

[5] Calculated as follows: (Average Concentration * Mass of Waste) / (1,000,000 mg / 1 kg)

[6] Metal concentrations represent the weighted average based on the volume of each bench

4 Sue B SRC Data Summary

During the mining of Sue B, composite samples from each blast were collected for comparison to the XRF results. As XRF analyses were performed on multiple holes within the blast pattern, and the SRC sample was a composite of blast holes, there are fewer SRC results than XRF results.

The XRF unit was used for systematic sampling of waste rock throughout mining. The purpose of the SRC analyses was to verify the performance of the XRF and calibrate the unit, as well as develop correlations for arsenic, nickel, lead, and uranium.

Composite samples were not collected from all blasts within each bench. Ore blasts were not sampled.

Table 9 summarizes the number of SRC samples available.

Table 9: Number of SRC Results per Bench

Waste Type	Bench	Number of Blasts	Number of SRC Results
Special Waste	433	9	10
	421	10	9
	409	10	11
	397	7	6
	385	4	4
Total Number of SRC Analyses			**40**

Table 10 shows the raw SRC data for all of Sue B, and the average result for each bench. In the sample name, the bench and blast numbers are shown. For example, sample B385-01 denotes the composite sample from Blast 1 on Bench 385. Samples with “R” after the name are repeat samples.

Table 10: Summary of SRC Data from Sue B

Bench	Sample Name	U (ppm)	As (ppm)	Ni (ppm)	Pb (ppm)
385	B385-01	52.7	742.0	781.0	255.0
	B385-02	103.0	1100.0	1280.0	24.5
	B385-03	20.4	210.0	240.0	8.0
	B385-04	32.8	131.0	95.3	275.0
	Bench Average	52.2	545.8	599.1	140.6
	Bench Maximum	103.0	1100.0	1280.0	275.0
	Bench Minimum	20.4	131.0	95.3	8.0
397	B397-01	9.4	25.0	13.6	50.0
	B397-02	19.5	192.0	43.4	322.0
	B397-05	19.6	144.0	36.3	254.0
	B397-06	10.8	73.9	37.5	18.0

Bench	Sample Name	U (ppm)	As (ppm)	Ni (ppm)	Pb (ppm)
	B397-07	27.4	46.1	18.5	57.2
	B397-07 R	28.8	47.1	19.0	56.7
	Bench Average	19.2	88.0	28.1	126.3
	Bench Maximum	28.8	192.0	43.4	322.0
	Bench Minimum	9.4	25.0	13.6	18.0
409	B409-01	15.0	66.2	48.3	7.1
	B409-02	3.0	16.1	9.5	5.4
	B409-03	8.9	9.0	4.3	24.5
	B409-04	7.3	18.0	10.5	52.0
	B409-05	7.8	9.0	7.8	22.8
	B409-06	5.0	20.0	12.7	54.1
	B409-07	4.4	32.0	19.7	13.8
	B409-08	43.8	323.0	77.1	409.0
	B409-09	8.7	53.0	17.4	176.0
	B409-10	8.0	33.0	10.2	81.9
	B409-10 R	7.9	34.0	10.7	80.0
	Bench Average	10.9	55.8	20.7	84.2
	Bench Maximum	43.8	323.0	77.1	409.0
	Bench Minimum	3.0	9.0	4.3	5.4
421	B421-01	2.6	5.1	3.2	19.0
	B421-02	6.8	41.4	11.1	75.7
	B421-03	3.0	28.0	10.5	11.9
	B421-05	1.8	5.2	6.0	3.7
	B421-06	3.0	10.7	7.1	19.0
	B421-07	1.6	5.0	4.3	7.6
	B421-08	7.1	19.1	7.3	11.9
	B421-09	2.5	4.8	3.8	21.4
	B421-10	4.7	20.3	4.8	89.1
	Bench Average	3.7	15.5	6.5	28.8
	Bench Maximum	7.1	41.4	11.1	89.1
	Bench Minimum	1.6	4.8	3.2	3.7
433	B433-02	118.0	226.0	204.0	46.7
	B433-03	6.1	13.3	6.2	119.0
	B433-04	7.8	37.7	7.5	154.0
	B433-05	3.8	5.3	7.6	22.2
	B433-06	3.5	5.3	4.4	42.4
	B433-07	2.0	3.4	5.7	3.8
	B433-07 R	2.1	3.2	5.4	4.0
	B433-08	1.7	2.9	5.3	5.1

Bench	Sample Name	U (ppm)	As (ppm)	Ni (ppm)	Pb (ppm)
	B433-09	2.3	3.6	4.0	16.0
	B433-09 R	2.2	3.3	4.3	14.8
	Bench Average	14.9	30.4	25.4	42.8
	Bench Maximum	118.0	226.0	204.0	154.0
	Bench Minimum	1.7	2.9	4.0	3.8

SRC results from all benches were compiled and a bench average was calculated for each. Once completed, a weighted average solids content for Sue B special waste was calculated using the bench results and design volumes from Table 3. The results are presented in Table 11.

Table 11: Weighted Average Solids Content (SRC) for Sue B Special Waste

Bench	Bench Volume from Sue B Pit (bcm)	Mass of Waste[1] (tonnes)	Metal	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration[4] (mg/kg)	Average Inventory[5] (tonnes)
Bench 433[2]	683,332	1,660,497	Arsenic	2.9	226.0	30.4	50.5
			Uranium	1.7	118.0	14.9	24.8
			Lead	3.8	154.0	42.8	71.1
			Nickel	4.0	204.0	25.4	42.2
Bench 421	322,278	783,136	Arsenic	4.8	41.4	15.5	12.1
			Uranium	1.6	7.1	3.7	2.9
			Lead	3.7	89.1	28.8	22.6
			Nickel	3.2	11.1	6.5	5.1
Bench 409	225,878	548,884	Arsenic	9.0	323.0	55.8	30.6
			Uranium	3.0	43.8	10.9	6.0
			Lead	5.4	409.0	84.2	46.2
			Nickel	4.3	77.1	20.7	11.4
Bench 397	157,586	382,934	Arsenic	25.0	192.0	88.0	33.7
			Uranium	9.4	28.8	19.2	7.4
			Lead	18.0	322.0	126.3	48.4
			Nickel	13.6	43.4	28.1	10.7
Bench 385[3]	70,932	172,365	Arsenic	131.0	1,100.0	545.8	94.1
			Uranium	20.4	103.0	52.2	9.0
			Lead	8.0	275.0	140.6	24.2
			Nickel	95.3	1,280.0	599.1	103.3
Total[6]	1,460,006	3,547,815	Arsenic	2.9	1,100.0	62.3	221.0
			Uranium	1.6	118.0	14.1	50.0
			Lead	3.7	409.0	59.9	212.5
			Nickel	3.2	1,280.0	48.7	172.7

[1] Based on a dry bulk density of 2.43 tonnes/m^3
[2] Bench Volume includes everything from 433 masl to the base of the overburden
[3] Bench Volume includes Benches 385, 382, 379, and 373
[4] Represents average concentrations calculated using available SRC results for each bench
[5] Calculated as follows: (Average Concentration * Mass of Waste) / (1,000,000 mg / 1 kg)
[6] Metal concentrations represent the weighted average based on the volume of each bench

A comparison of Tables 8 and 11 show that the XRF and SRC weighted average solids contents agree, with the XRF being conservative in nickel measurements. The XRF tends to be more conservative for both uranium and nickel due to detection limit handling. The results show that the XRF is an effective and conservative tool for measuring concentrations in the field, particularly for arsenic. When total average concentration is considered, the XRF is conservative for all four metals, as shown in Figure 1. It should be noted that the calibration of the XRF has improved considerably since the mining of Sue A. This can be attributed to the development of operational procedures for the XRF during Sue A mining.

5 Comparison of Predicted vs. Actual Sue B Solids Content and Inventory

The SRC and XRF results for Sue B were compared to solids content predictions made in the Caribou EIS for arsenic, nickel, lead, and uranium. The inventory of metals was also compared.

In the Caribou EIS, it was assumed that Sue B waste rock would be segregated into clean and special waste. However, during mining, all waste rock was treated as special waste. Therefore, for the purposes of this comparison, a weighted average predicted solids content was calculated based on Caribou EIS predicted values for clean and special waste (AREVA 2009, Appendix VIIIB, Table 4.4). The weighted average predicted solids content is shown in Table 12.

Table 12: Weighted Average Predicted Solids Content Based on Caribou EIS Values

Analyte	Unit	Clean Waste Predicted	Special Waste Predicted	Weighted Average
Quantity	tonnes	2,858,390	24,543	2,882,933
As	mg/kg	160	1700	173
Ni	mg/kg	87	1400	98
Pb	mg/kg	170	390	172
U	mg/kg	14	190	15

The design mass of special waste was 3,547,815 tonnes (from Table 3 using a swell factor of 2.43), while the actual mined quantity was 1,441,350 bcm or 3,502,481 tonnes based on a swell factor of 2.43. Table 13 shows that, despite the increase in waste rock quantity over what was predicted in the Caribou EIS, the measured solids content and average inventory are generally consistent with what was predicted in the Caribou EIS. This is also demonstrated in Figures 1 and 2. The design bench volumes were used for Table 13 and the figures in order to be conservative.

Figures 1 and 2 show that the XRF results tend to be conservative in comparison to the SRC results, particularly for nickel and uranium. There is a very good correlation between XRF and SRC results for arsenic and lead.

Table 13: Comparison of Predicted vs. Actual Solids Content and Inventory for Sue B Special Waste

Result	Quantity (tonnes)	Solids Content (mg/kg)				Average Inventory (tonnes)			
		As	Ni	Pb	U	As	Ni	Pb	U
Sue B Predicted in Caribou EIS	2,882,933 (Clean and Special)	173.0	98.0	172.0	15.0	498.7	282.5	495.9	43.2
Sue B XRF Weighted Average	3,547,815	71.8	105.5	77.5	27.0	254.8	374.1	275.0	95.7
Sue B SRC Weighted Average	3,547,815	62.3	48.7	59.9	14.1	221.0	172.7	212.5	50.0

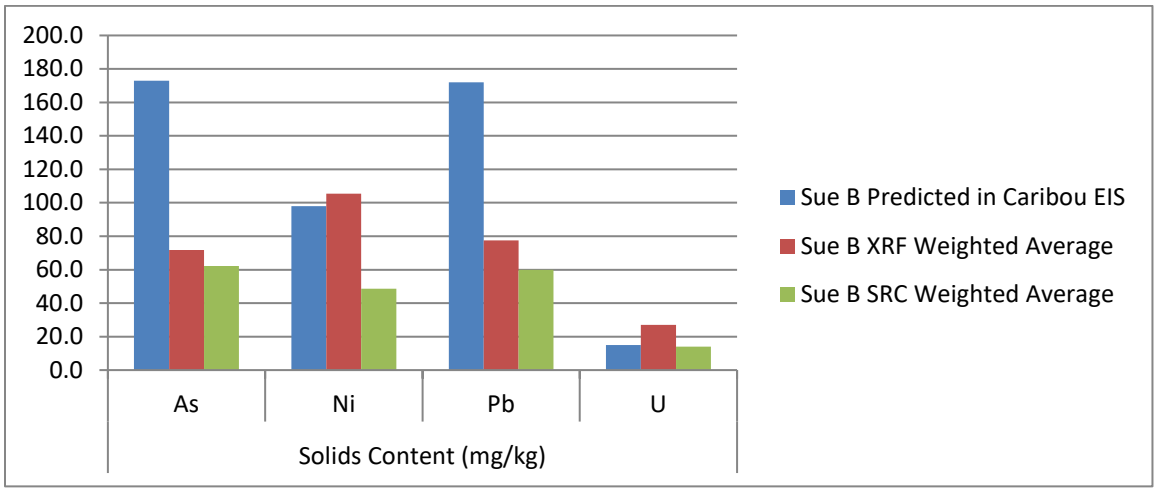


Figure 1: Comparison of Predicted vs. Actual Sue B Solids Content

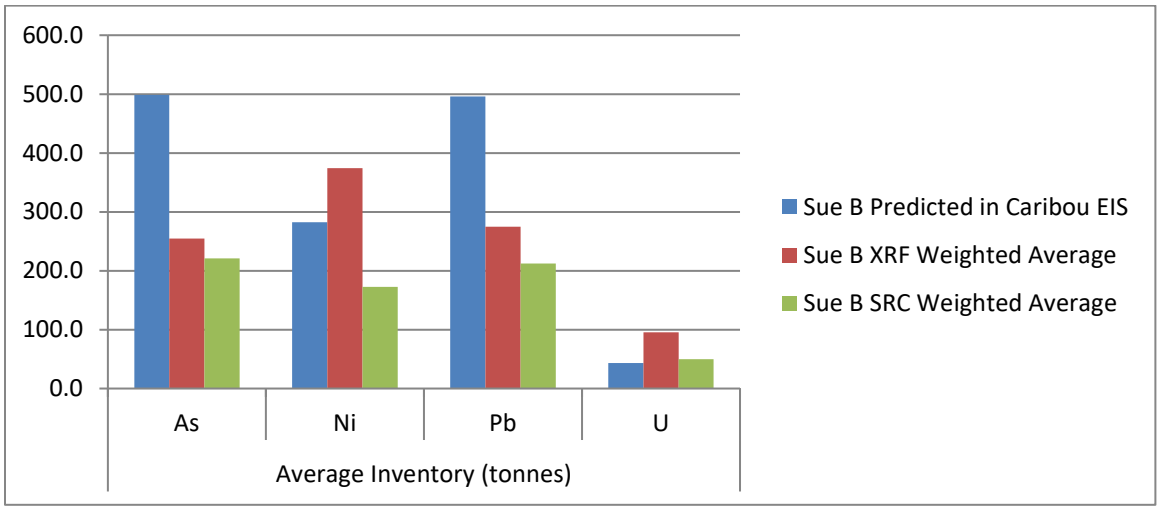


Figure 2: Comparison of Predicted vs. Actual Sue B Inventory

Appendix A-I.5: Evaluation of Sue E Waste Rock Solids Content

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1 Introduction

During the mining of Sue E, waste rock was segregated into clean and special waste. The XRF was one of the tools used for the segregation process. The cutoff between clean and special waste was determined to be Bench 406. Therefore, all waste rock below Bench 406 was treated as special waste and all waste rock above Bench 406 was treated as clean waste. XRF and SRC samples were collected throughout the mining of Sue E for Benches 442, 430, 418, and 406 for clean waste, and Benches 394, 382, 370, 358, 346, and 334 for special waste.

The XRF and SRC data were summarized in 2011 for the Sue E Follow-Up Program. A component of the Sue E Follow-Up Program was to validate predictions made in the 2004 Sue E Environmental Impact Study (EIS) with respect to Sue E waste rock solids content and pore water concentrations. The program determined that waste rock solids and pore water from Sue E waste rock was generally consistent with predictions made in the Sue E EIS. This appendix provides a summary of the calculations made for the Sue E Follow-Up Program.

In 2009, the Caribou EIS was approved. In the Caribou EIS, the solids content predictions for Sue E were developed based on the measured data from Sue E mining.

2 Sue E Quantities

As XRF and SRC data was collected on a per bench basis, the best method of calculating an overall geochemistry for the clean and special waste rock from Sue E is to calculate a weighted average per bench. In order to do this, waste rock bench quantities are needed.

During mining, bench quantities of each waste type were not tracked. Rather, quantities of waste rock and ore were tracked by monthly totals. Therefore, it was decided to use the design bench volume to calculate the weighted average solids content. It was not possible to estimate the quantity of ore removed per bench, so the entire bench volume was used in the calculation to be conservative. Using design bench quantities, the total volume was estimated to be 4,975,202 bcm for clean waste and 2,621,092 bcm for special waste. The actual mined quantities were 4,619,031 bcm for clean waste and 2,437,822 bcm for special waste. Therefore, the use of the design bench quantities is conservative.

3 Quantities Used in XRF and SRC Calculations

For the purpose of calculating weighted averages per bench for XRF and SRC data, the design quantities in Table 1 were used.

Table 1: Design Bench Quantities for Sue E

Waste Type	Bench	Toe/Crest	Height (m)	Bench Volume (bcm)
Overburden	454	465-454	Varies	697,664*
Clean Waste	442	454-442	12	1,486,902
	430	442-430	12	1,344,402
	418	430-418	12	1,158,777
	406	418-406	12	985,121
	Total Design Quantity (Clean Waste)			**4,975,202**
Special Waste	394	406-394	12	822,709
	382	394-382	12	667,802
	370	382-370	12	513,080
	358	370-358	12	341,577
	355	358-355	3	58,866
	349	355-349	6	100,068
	343	349-343	6	66,104
	337	343-337	6	36,316
	334	337-334	3	9,841
	331	331-334	3	4,729
	Total Design Quantity (Special Waste)			**2,621,091**

*Actual measured quantity during mining.

For special waste, XRF results were taken at larger bench intervals than shown in Table 1. XRF results are available for Benches 394, 382, 370, 358, 346, and 334. For the purpose of calculating a weighted average solids content, the following assumptions were made:

- the bench volumes for Benches 355, 349, and 343 were combined and identified as the volume for "Bench 346" in the calculations; and
- the bench volumes for Benches 337, 334, and 331 were combined and identified as the volume for "Bench 334" in the calculations.

3.1 Sue E XRF Data Summary

Table 2 below shows the number of XRF readings per bench for the Sue E pit.

Table 2: Number of XRF Readings Per Bench

Waste Type	Bench	Number of Blasts	Number of XRF Results
Clean Waste	442	42	2,841
	430	32	1,939
	418	33	1,591
	406	26	1,522
Special Waste	394	20	1,124
	382	20	562
	370	16	335
	358	7	260
	346	6	113
	334	1	39
Total Number of XRF Analyses			**10,326**

The XRF occasionally reports a result of "<LOD" for results that are below the detection limit of the instrument. This is primarily observed in uranium and nickel results. Table 3 shows the observed detection limit of the XRF for Sue E mining. The detection limits were determined by graphing the XRF results and observing the average cutoff.

Table 3: XRF Detection Limits Used in Sue E Data Calculations

Element	Detection Limit (mg/kg)	Half Detection Limit Subbed in for <LOD (mg/kg)
As	20.0	10.0
Ni	75.0	37.5
Pb	20.0	10.0
U	30.0	15.0

The XRF data was reviewed, and any results that fell below the Detection Limit in Table 3 were replaced with half of the detection limit. An example calculation is shown below for Bench 334. In this case, one blast occurred and 39 XRF results were available. The raw data is shown in Table 4.

In Table 4, any values that fell below the detection limits in Table 3, including "<LOD" values, were replaced with half of the detection limit for each element. The results and the average calculation are shown in Table 5.

Table 4: Raw Data for Bench 334

Bench	Blast	Hole	Uranium (mg/kg)	Lead (mg/kg)	Arsenic (mg/kg)	Nickel (mg/kg)
334	1	1	<LOD	<LOD	<LOD	<LOD
		2	<LOD	<LOD	<LOD	<LOD
		3	98.32	<LOD	41.87	<LOD
		4	342.51	<LOD	296.58	389.52
		5	<LOD	<LOD	<LOD	<LOD
		6	<LOD	<LOD	42.70	<LOD
		7	<LOD	<LOD	43.15	<LOD
		8	200.21	<LOD	23.91	<LOD
		9	117.51	<LOD	27.52	<LOD
		10	41.13	<LOD	<LOD	<LOD
		11	<LOD	<LOD	46.24	96.81
		12	<LOD	<LOD	<LOD	<LOD
		13	<LOD	<LOD	<LOD	90.08
		14	<LOD	<LOD	<LOD	80.94
		15	<LOD	<LOD	<LOD	90.24
		16	<LOD	<LOD	<LOD	76.29
		17	<LOD	<LOD	<LOD	<LOD
		18	<LOD	<LOD	<LOD	<LOD
		19	80.00	<LOD	21.85	76.88
		20	<LOD	<LOD	35.15	<LOD
		21	62.29	<LOD	111.74	<LOD
		22	148.72	<LOD	65.22	163.25
		23	<LOD	<LOD	59.21	132.07
		24	<LOD	<LOD	<LOD	<LOD
		25	44.52	23.78	137.86	485.37
		26	<LOD	<LOD	34.76	81.05
		27	<LOD	<LOD	20.35	<LOD
		28	<LOD	<LOD	<LOD	80.55
		29	<LOD	24.30	253.10	633.39
		30	79.40	<LOD	3093.45	7928.41
		31	<LOD	34.46	21.43	89.51
		32	<LOD	<LOD	<LOD	91.71
		33	<LOD	<LOD	<LOD	<LOD
		34	<LOD	<LOD	<LOD	<LOD
		35	<LOD	<LOD	<LOD	82.56
		36	<LOD	12.22	22.37	115.48
		37	<LOD	<LOD	<LOD	<LOD
		38	<LOD	<LOD	<LOD	<LOD
		39	<LOD	<LOD	<LOD	80.11

Table 5: Average Concentrations for Uranium, Lead, Arsenic, and Nickel in Bench 334

Bench	Blast	Hole	Uranium (mg/kg)	Lead (mg/kg)	Arsenic (mg/kg)	Nickel (mg/kg)
334	1	1	15.00	10.00	10.00	37.50
		2	15.00	10.00	10.00	37.50
		3	98.32	10.00	41.87	37.50
		4	342.51	10.00	296.58	389.52
		5	15.00	10.00	10.00	37.50
		6	15.00	10.00	42.70	37.50
		7	15.00	10.00	43.15	37.50
		8	200.21	10.00	23.91	37.50
		9	117.51	10.00	27.52	37.50
		10	41.13	10.00	10.00	37.50
		11	15.00	10.00	46.24	96.81
		12	15.00	10.00	10.00	37.50
		13	15.00	10.00	10.00	90.08
		14	15.00	10.00	10.00	80.94
		15	15.00	10.00	10.00	90.24
		16	15.00	10.00	10.00	76.29
		17	15.00	10.00	10.00	37.50
		18	15.00	10.00	10.00	37.50
		19	80.00	10.00	21.85	76.88
		20	15.00	10.00	35.15	37.50
		21	62.29	10.00	111.74	37.50
		22	148.72	10.00	65.22	163.25
		23	15.00	10.00	59.21	132.07
		24	15.00	10.00	10.00	37.50
		25	44.52	23.78	137.86	485.37
		26	15.00	10.00	34.76	81.05
		27	15.00	10.00	20.35	37.50
		28	15.00	10.00	10.00	80.55
		29	15.00	24.30	253.10	633.39
		30	79.40	10.00	3093.45	7928.41
		31	15.00	34.46	21.43	89.51
		32	15.00	10.00	10.00	91.71
		33	15.00	10.00	10.00	37.50
		34	15.00	10.00	10.00	37.50
		35	15.00	10.00	10.00	82.56
		36	15.00	12.22	22.37	115.48
		37	15.00	10.00	10.00	37.50
		38	15.00	10.00	10.00	37.50
		39	15.00	10.00	10.00	80.11
Overall Average			**42.30**	**11.35**	**117.91**	**297.80**

An overall average of each As, Ni, Pb, and U result was then calculated for each bench. A weighted average solids content was then calculated for clean and special waste using the average result per bench and the design volumes shown in Table 1. The clean waste results are shown in Table 6, and the special waste results are shown in Table 7.

Table 6: Weighted Average Solids Content (XRF) for Sue E Clean Waste

Bench	Bench Volume from Sue E Pit[1] (bcm)	Mass of Waste[2] (tonnes)	Metal	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration[3] (mg/kg)	Average Inventory[4] (tonnes)
Bench 442	1,486,902	3,613,172	Arsenic	10.0	358.7	10.4	37.6
			Uranium	15.0	169.6	15.1	54.5
			Lead	10.0	148.1	12.5	45.0
			Nickel	37.5	351.1	37.8	136.0
Bench 430	1,344,402	3,266,897	Arsenic	10.0	61.3	10.2	33.3
			Uranium	15.0	45.1	15.0	49.1
			Lead	10.0	419.8	15.0	49.1
			Nickel	37.5	77.5	37.5	123.0
Bench 418	1,158,777	2,815,828	Arsenic	10.0	115.6	10.4	29.2
			Uranium	15.0	63.0	15.0	42.4
			Lead	10.0	295.0	15.4	43.4
			Nickel	37.5	92.0	37.5	106.0
Bench 406	985,121	2,393,844	Arsenic	10.0	269.8	11.1	26.5
			Uranium	15.0	213.0	15.4	37.0
			Lead	10.0	332.3	24.8	59.2
			Nickel	37.5	37.5	37.5	89.8
Total[5]	4,975,202	12,089,741	Arsenic	10.0	358.7	10.5	127.0
			Uranium	15.0	213.0	15.1	183.0
			Lead	10.0	419.8	16.3	197.0
			Nickel	37.5	351.1	37.6	454.0

[1]Design bench quantities for Sue E pit

[2]Based on dry bulk density of 2.43 tonnes/m^3

[3]Represents average concentration per bench using half detection limits for samples below detection

[4]Calculated as follows: (Average Concentration*Mass of Waste) / (1,000,000 mg / 1 kg)

[5]Metals concentrations represent the weighted average based on design volumes of each bench

Table 7: Weighted Average Solids Content (XRF) for Sue E Special Waste

Bench	Bench Volume from Sue E Pit[1] (bcm)	Mass of Waste[2] (tonnes)	Metal	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration[3] (mg/kg)	Average Inventory[4] (tonnes)
Bench 394	822,709	1,999,183	Arsenic	10.0	1647.4	17.4	34.7
			Uranium	15.0	1150.3	28.7	57.3
			Lead	10.0	324.2	28.4	56.9
			Nickel	37.5	921.0	40.3	80.5
Bench 382	667,802	1,622,759	Arsenic	10.0	581.9	22.7	36.8
			Uranium	15.0	1018.2	33.4	54.2
			Lead	10.0	93.3	16.0	25.9
			Nickel	37.5	1053.8	50.1	81.2
Bench 370	513,080	1,246,784	Arsenic	10.0	4322.4	45.9	57.2
			Uranium	15.0	1578.9	39.0	48.6
			Lead	10.0	53.3	11.5	14.3
			Nickel	37.5	5687.8	82.6	103
Bench 358	341,577	830,032	Arsenic	10.0	1138.2	42.8	35.5
			Uranium	15.0	460.3	37.3	30.9
			Lead	10.0	143.2	12.4	10.3
			Nickel	37.5	847.6	75.5	62.7
Bench 346	225,038	546,842	Arsenic	10.0	442.2	46.1	25.2
			Uranium	15.0	324.2	40.8	22.3
			Lead	10.0	40.0	11.8	6.4
			Nickel	37.5	634.4	63.1	34.5
Bench 334	50,886	123,653	Arsenic	10.0	3093.5	118	14.6
			Uranium	15.0	342.5	42.3	5.2
			Lead	10.0	34.5	11.4	1.4
			Nickel	37.5	7928.4	298	36.8
Total[5]	2,621,092	6,369,254	Arsenic	10.0	4322.4	32.0	204.0
			Uranium	15.0	1578.9	34.3	218.0
			Lead	10.0	324.2	18.1	115.0
			Nickel	37.5	7928.4	62.6	399.0

[1]Design bench quantities for Sue E pit

[2]Based on dry bulk density of 2.43 tonnes/m^3

[3]Represents average concentration per bench using half detection limits for samples below detection

[4]Calculated as follows: (Average Concentration*Mass of Waste) / (1,000,000 mg / 1 kg)

[5]Metals concentrations represent the weighted average based on design volumes of each bench

3.2 Sue E SRC Data Summary

During the mining of Sue E, composite samples from each blast were collected for comparison to the XRF results. As XRF analyses were performed on multiple holes within the blast pattern, and the SRC sample was a composite of blast holes, there are fewer SRC results than XRF results.

The XRF unit was used for systematic sampling of waste rock throughout mining. The purpose of the SRC analyses was to verify the performance of the XRF unit and develop correlations for arsenic, nickel, lead, and uranium.

Composite samples were not collected from all blasts within each bench. Ore blasts were not sampled.

Table 8 summarizes the number of SRC samples available.

Table 8: Number of SRC Results per Bench

Waste Type	Bench	Number of Blasts	Number of SRC Results
Clean Waste	442	42	20
	430	32	12
	418	33	5
	406	26	25
Special Waste	394	20	24
	382	20	7
	370	16	6
	358	7	9
	346	6	5
	334	1	1
Total Number of SRC Analyses			**114**

Table 9 shows the raw SRC data for Bench 406, and the average result for that bench. In the sample name, the bench and blast numbers are shown. For example, sample B406-01 denotes the composite sample from Blast 1 on Bench 406. Samples with “R” after the name are repeat samples.

Table 9: Summary of SRC Data from Bench 406 of Sue E

Bench	Sample Name	Arsenic (ppm)	Uranium (ppm)	Lead (ppm)	Nickel (ppm)
406	B406-01	2.6	6.1	11.5	3.3
	B406-02	2.5	3.9	15.2	2.8
	B406-03	2.5	5.9	6.9	3.4
	B406-04	2.5	5.3	6.3	2.8
	B406-05	2.3	7.2	10.7	3.4
	B406-05 R	2.5	7.8	11.2	3.6
	B406-06	3.1	7.5	20.3	3.0
	B406-07	3.5	14.6	16.9	4.0
	B406-08	4.8	21.7	36.7	4.3
	B406-09	8.2	11.6	41.3	4.3
	B406-11	5.9	6.3	19.1	3.9
	B406-12	3.6	11.4	9.8	5.1
	B406-13	3.7	12.1	9.4	2.6
	B406-14	3.9	7.7	13.2	5.0
	B406-15	4.2	6.7	14.3	4.2
	B406-17	7.5	12.9	27.1	3.7
	B406-18	3.8	7.3	23.4	2.0
	B406-20	7.5	12.3	46.6	3.7
	B406-21	1.5	5.8	6.3	3.2
	B406-22	3.8	17.8	17.3	3.0
	B406-23	2.0	6.9	12.1	2.7
	B406-23 R	2.2	6.6	11.3	2.5
	B406-24	2.2	4.0	5.9	0.6
	B406-25	4.7	12.2	31.0	2.2
	B406-26	2.7	6.9	8.0	0.8
	Bench Average	**3.7**	**9.1**	**17.3**	**3.2**
	Bench Maximum	**8.2**	**21.7**	**46.6**	**5.1**
	Bench Minimum	**1.5**	**3.9**	**5.9**	**0.6**

SRC results from the remaining benches were compiled and a bench average was calculated for each. Once completed, a weighted average solids content for both Sue E clean and special waste was calculated using the bench design volumes from Table 1. The clean waste results are shown in Table 10 and the special waste results are shown in Table 11.

Table 10: Weighted Average Solids Content (SRC) for Sue E Clean Waste

Bench	Bench Volume from Sue E Pit[1] (bcm)	Mass of Waste[2] (tonnes)	Metal	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration[3] (mg/kg)	Average Inventory[4] (tonnes)
Bench 442	1,486,902	3,613,172	Arsenic	0.7	6.7	2.6	9.3
			Uranium	1.1	4.5	2.6	9.4
			Lead	3.4	13.5	7.4	26.9
			Nickel	2.3	5.4	3.5	12.5
Bench 430	1,344,402	3,266,897	Arsenic	1.0	7.1	2.1	6.9
			Uranium	0.8	10.2	2.9	9.6
			Lead	3.8	49.6	10.0	32.7
			Nickel	2.2	5.4	3.5	11.4
Bench 418	1,158,777	2,815,828	Arsenic	1.9	2.3	2.1	6.0
			Uranium	2.2	6.1	4.4	12.4
			Lead	4.8	9.1	7.0	19.6
			Nickel	1.9	3.9	3.1	8.7
Bench 406	985,121	2,393,844	Arsenic	1.5	8.2	3.7	9.0
			Uranium	3.9	21.7	9.1	21.9
			Lead	5.9	46.6	17.3	41.3
			Nickel	0.6	5.1	3.2	7.7
Total[5]	4,975,202	12,089,741	Arsenic	0.7	8.2	2.6	31.3
			Uranium	0.8	21.7	4.4	53.3
			Lead	3.4	49.6	10.0	121.0
			Nickel	0.6	5.4	3.3	40.3

[1]Design quantities for Sue E pit

[2]Based on dry bulk density of 2.43 tonnes/m^3

[3]Represents average concentration per bench using half detection limits for samples below detection

[4]Calculated as follows: (Average Concentration*Mass of Waste) / (1,000,000 mg / 1 kg)

[5]Metals concentrations represent the weighted average based on design volumes of each bench

Table 11: Weighted Average Solids Content (SRC) for Sue E Special Waste

Bench	Bench Volume from Sue E Pit[1] (bcm)	Mass of Waste[2] (tonnes)	Metal	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration[3] (mg/kg)	Average Inventory[4] (tonnes)
Bench 394	822,709	1,999,183	Arsenic	1.4	53.7	14.4	28.7
			Uranium	6.0	169.0	47.6	95.2
			Lead	6.2	172.0	35.4	70.8
			Nickel	124.0	124.0	16.3	32.5
Bench 382	667,802	1,622,759	Arsenic	1.3	10.2	4.3	7.0
			Uranium	2.2	15.7	9.1	14.8
			Lead	0.8	15.5	6.8	11.0
			Nickel	4.3	46.5	15.4	24.9
Bench 370	513,080	1,246,784	Arsenic	2.5	140.0	29.3	36.6
			Uranium	9.0	55.5	27.7	34.5
			Lead	0.5	7.6	3.1	3.9
			Nickel	13.6	170.0	58.8	73.3
Bench 358	341,577	830,032	Arsenic	8.9	201.0	59.9	49.7
			Uranium	22.4	119.0	54.4	45.2
			Lead	2.6	11.7	6.8	5.7
			Nickel	12.5	211.0	89.2	74.0
Bench 346	225,038	546,842	Arsenic	11.0	198.0	57.7	31.6
			Uranium	32.6	110.0	55.5	30.4
			Lead	3.5	6.1	4.4	2.4
			Nickel	26.7	235.0	75.3	41.2
Bench 334	50,886	123,653	Arsenic	412.0	412.0	412.0	50.9
			Uranium	83.1	83.1	83.1	10.3
			Lead	8.3	8.3	8.3	1.0
			Nickel	498.0	498.0	498.0	61.6
Total[5]	2,621,092	6,369,254	Arsenic	1.3	412.0	32.1	204.0
			Uranium	2.2	169.0	36.2	231.0
			Lead	0.5	172.0	14.9	94.7
			Nickel	4.3	498.0	48.3	308.0

1Design quantities for Sue E pit

2Based on dry bulk density of 2.43 tonnes/m3

3Represents average concentration per bench using half detection limits for samples below detection

4Calculated as follows: (Average Concentration*Mass of Waste) / (1,000,000 mg / 1 kg)

5Metals concentrations represent the weighted average based on design volumes of each bench

A comparison of Tables 6 and 10 for clean waste and Tables 7 and 11 for special waste show that the XRF and SRC weighted average solids contents agree, with the XRF being conservative in nickel measurements. The XRF tends to be more conservative for both uranium and nickel due to detection limit handling. The results show that the XRF is an effective and conservative tool for measuring concentrations in the field, particularly for arsenic.

4 Comparison of Predicted vs. Actual Sue E Solids Content and Inventory

The SRC and XRF results for Sue E were compared to solids content predictions made in the Sue E EIS for arsenic, nickel, lead, and uranium. The inventory of metals was also compared.

Option 1b of the Sue E EIS was chosen as the preferred waste rock management strategy. The total amount of clean waste to be placed on surface was estimated to be 7,180,640 tonnes. Under Option 1b, any waste rock originating below a cutoff elevation of 418 masl would be treated as special waste. This translated into an estimated 7,798,436 tonnes of waste rock that would be placed in in the Sue E pit. Of this quantity, 437,400 tonnes would be special waste and 7,361,036 tonnes would be clean waste that was not segregated. Based on these quantities and estimated solids contents from the Sue E EIS (Table 4.4, Sue E EIS, Appendix IX), a weighted average solids content can be calculated for Sue E special waste. Table 12 shows both the predicted clean waste and weighted average special waste solids contents.

Table 12: Predicted Clean and Special Waste Solids Contents in Sue E EIS

Analyte	Unit	Clean Waste Predicted	Special Waste Predicted	Weighted Average Special Waste
Quantity	tonnes	7,361,036	437,400	7,798,436
As	mg/kg	10.0	851.0	57.2
Ni	mg/kg	4.0	432.0	28.0
Pb	mg/kg	38.0	57.0	39.1
U	mg/kg	16.0	477.0	41.9

During mining, the cutoff elevation was established to be 406 masl. The result was a clean waste final volume of 11,224,245 tonnes and a special waste final volume to 5,923,907 tonnes. These are comparable to the design quantities of 12,089,741 tonnes and 6,369,253 tonnes for clean and special waste, respectively. For the XRF and SRC calculations, design quantities were used as design bench quantity estimates were available.

Table 13 shows the estimated and measured solids contents for Sue E clean waste. The results are also shown in Figures 1 and 2. For Sue E clean waste, numerous XRF results for nickel fell below detection and an average result could not be reliably calculated. The SRC result for nickel is considered to be the most representative value.

Table 13: Predicted and Measured Solids Content for Sue E Clean Waste

Result	Clean Waste Quantity (tonnes)	Solids Content (mg/kg)				Average Inventory (tonnes)			
		As	Ni	Pb	U	As	Ni	Pb	U
Sue E Predicted in Sue E EIS	7,180,640	10.0	4.0	38.0	16.0	71.8	28.7	272.9	114.9
Sue E XRF Weighted Average	12,089,741	10.5	N/A	16.3	15.1	126.9	N/A	197.1	182.6
Sue E SRC Weighted Average	12,089,741	2.6	3.3	10.0	4.4	31.4	39.9	120.9	53.2

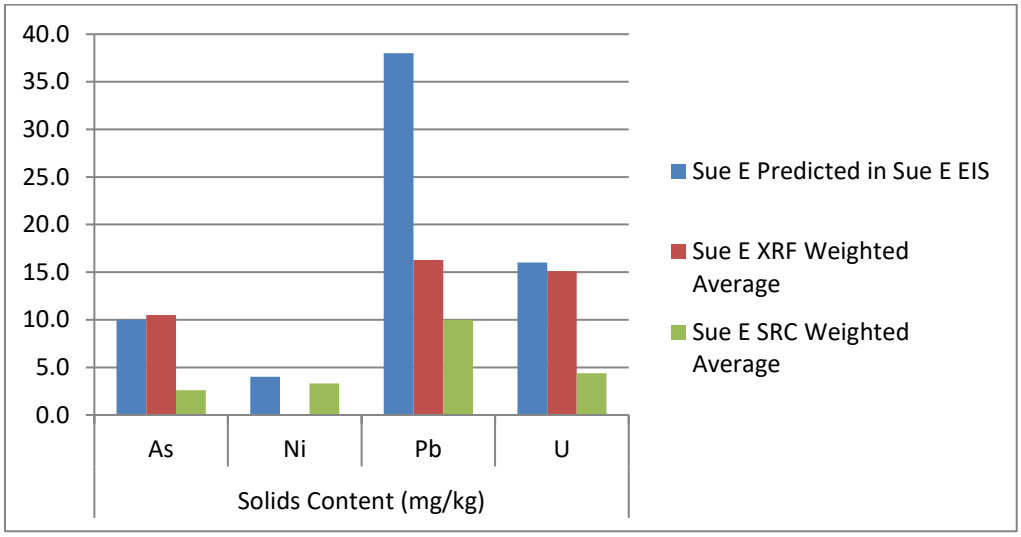


Figure 1: Comparison of Predicted vs. Actual Solids Content for Sue E Clean Waste

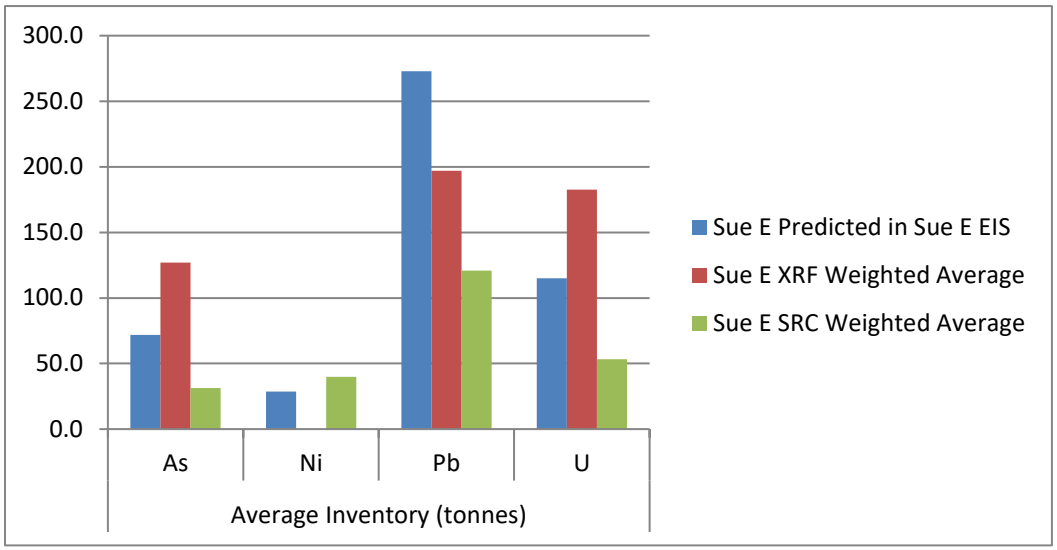


Figure 2: Comparison of Predicted vs. Actual Inventory for Sue E Clean Waste

The results show that the measured data is generally consistent with Sue E EIS predictions. The XRF is conservative in measuring arsenic, lead, and uranium.

Table 14 shows the estimated and measured solids contents for Sue E special waste. The results are also shown in Figures 3 and 4.

Table 14: Predicted and Measured Solids Content for Sue E Special Waste

Result	Special Waste Quantity (tonnes)	Solids Content (mg/kg)				Average Inventory (tonnes)			
		As	Ni	Pb	U	As	Ni	Pb	U
Sue E Predicted in Sue E EIS	7,798,436	57.2	28.0	39.1	41.9	446.1	218.4	304.9	326.8
Sue E XRF Weighted Average	6,369,254	32.0	62.6	18.1	34.3	203.8	398.7	115.3	218.5
Sue E SRC Weighted Average	6,369,254	32.1	48.3	14.9	36.2	204.5	307.6	94.9	230.6

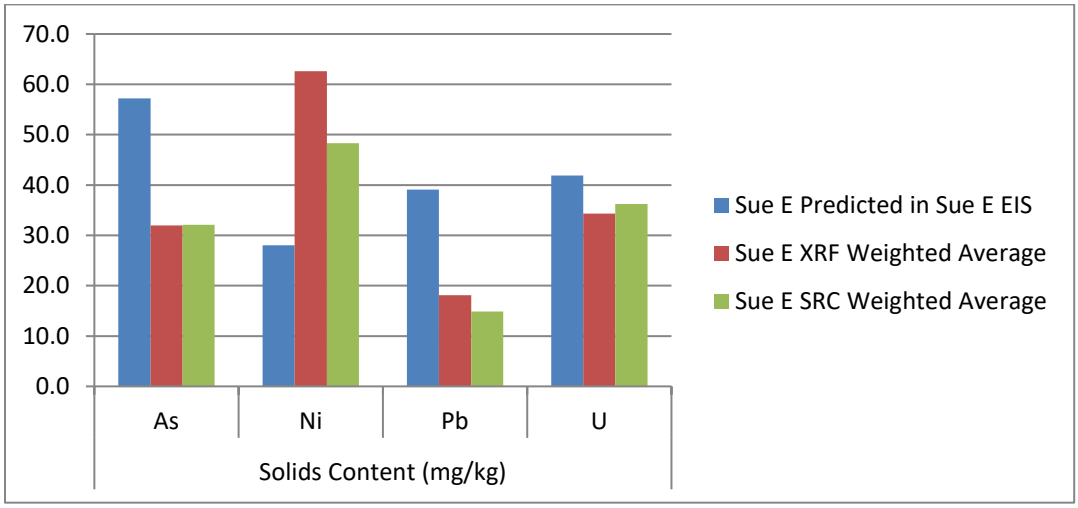


Figure 3: Comparison of Predicted vs. Actual Solids Content for Sue E Special Waste

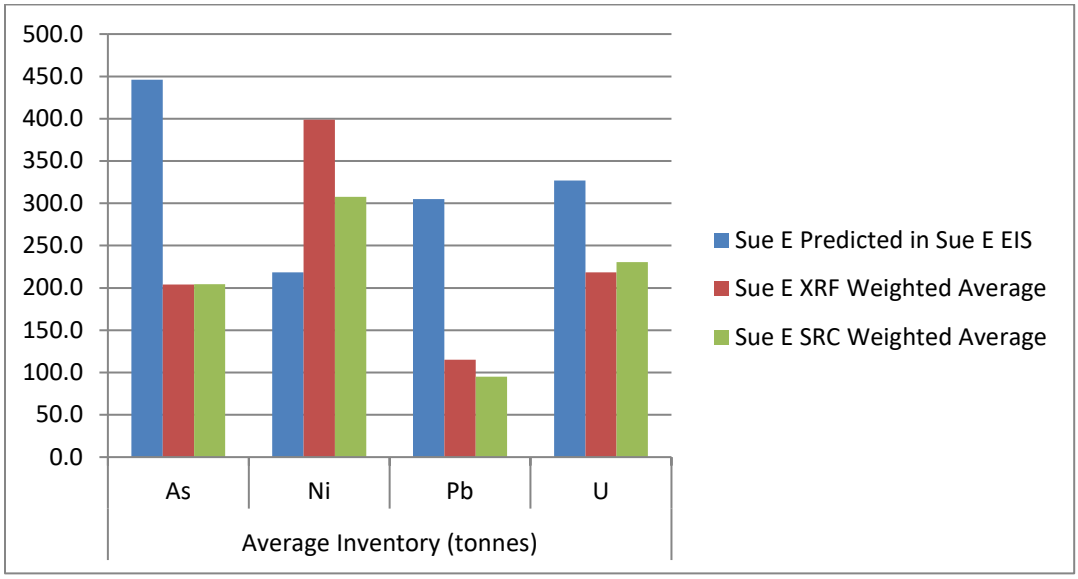


Figure 4: Comparison of Predicted vs. Actual Inventory for Sue E Special Waste

The results show that there is a strong correlation between the XRF and SRC results for arsenic, uranium, and lead in the special waste data. The XRF is conservative in measuring nickel results. Results were generally consistent to EIS predictions with the exception of nickel, which is slightly higher than predicted.

5 Sue E Predictions in the Caribou EIS

In the Caribou EIS, it was estimated that 6,369,254 tonnes of Sue E special waste would be placed in the Sue C pit. This quantity was based on design quantities as a final estimate of Sue E quantities was not available at the time the Caribou EIS was prepared. In the Caribou EIS, the Sue E XRF and SRC data was compiled and analyzed by EcoMetrix, Inc. in order to assess the geochemistry of Sue E clean and special waste. The weighted average solids content from Sue E XRF data (shown in Table 7) for special waste was used as the estimated solids content for arsenic, uranium, lead, and nickel in the Caribou EIS for Sue E special waste.

Sue E waste rock characterization studies concluded that the Sue E clean waste rock had virtually no acid generating potential. All Sue E clean waste was placed on the Sue E clean waste rock stockpile. As such, solids content and pore water source term estimates for clean waste were not included in the Caribou EIS.

Appendix AI.6: JEB, Sue C, and Sue E Clean Waste Rock Piezometer Data

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1 Introduction

As part of the 2004 Waste Rock TID a pore water source term for the Sue C clean waste rock stockpile was predicted based on observed stockpile seepage results and humidity cell testing (COGEMA 2004). The predicted source term parameter values are shown below in Table 1.

Table 1: Predicted Pore Water Source Term Parameters - Sue C Clean Waste Rock Stockpile

Analyte	Unit	Pore Water Source Term
Arsenic	mg/L	0.015
Cobalt	mg/L	0.004
Copper	mg/L	0.003
Lead	mg/L	0.013
Molybdenum	mg/L	0.070
Nickel	mg/L	0.029
Selenium	mg/L	0.058
Uranium	mg/L	0.019
Zinc	mg/L	0.018
Lead-210	Bq/L	0.02
Radium-226	Bq/L	1.00
Thorium-230	Bq/L	0.01

2 Clean Waste Rock Pile Field Program

There are currently three existing clean waste rock piles at the McClean Lake Operation:

- the JEB clean waste rock stockpile, located east of the JEB pit;
- the Sue C clean waste rock stockpile, located at the north end of the Sue site; and
- the Sue E clean waste rock stockpile, located southwest of the Sue C pit.

In 2007 dedicated piezometers were installed in each of the clean waste rock stockpile to assess the pore water quality:

- piezometers in the JEB waste rock pile,
- piezometers in the Sue C waste rock pile, and
- piezometers in the Sue E waste rock pile.

The piezometers locations are shown in Figures 2-3, 2-4, and 2-5 in Part A of this document. The piezometers were developed, purged, and sampled for the first time in the spring of 2008 and are generally sampled on a yearly basis since this time. The piezometers were not sampled in 2020 because of limited on-site staff resources due to Covid-19 related restrictions.

For the purpose of this evaluation, porewater quality analysis results for the clean waste rock stockpile dedicated piezometers are compared to the Sue C predicted source term parameter values. Current and historical water chemistry for the dedicated piezometers are presented in Tables 2 and 3.

3 Major Chemistry

Water samples were collected from the JEB, Sue C, and Sue E stockpile piezometers and analyzed for major ion parameters. The respective major ion chemistry of the most recently collected samples (July 2019; Table 2) were plotted on a piper plot (Figure 1) to determine the dominant cation, dominant anion, and water type..

For all of the stockpiles samples the water type was generally a calcium-magnesium-bicarbonate-sulphate type with a low level of mineralization as represented by TDS (<500 mg/L).

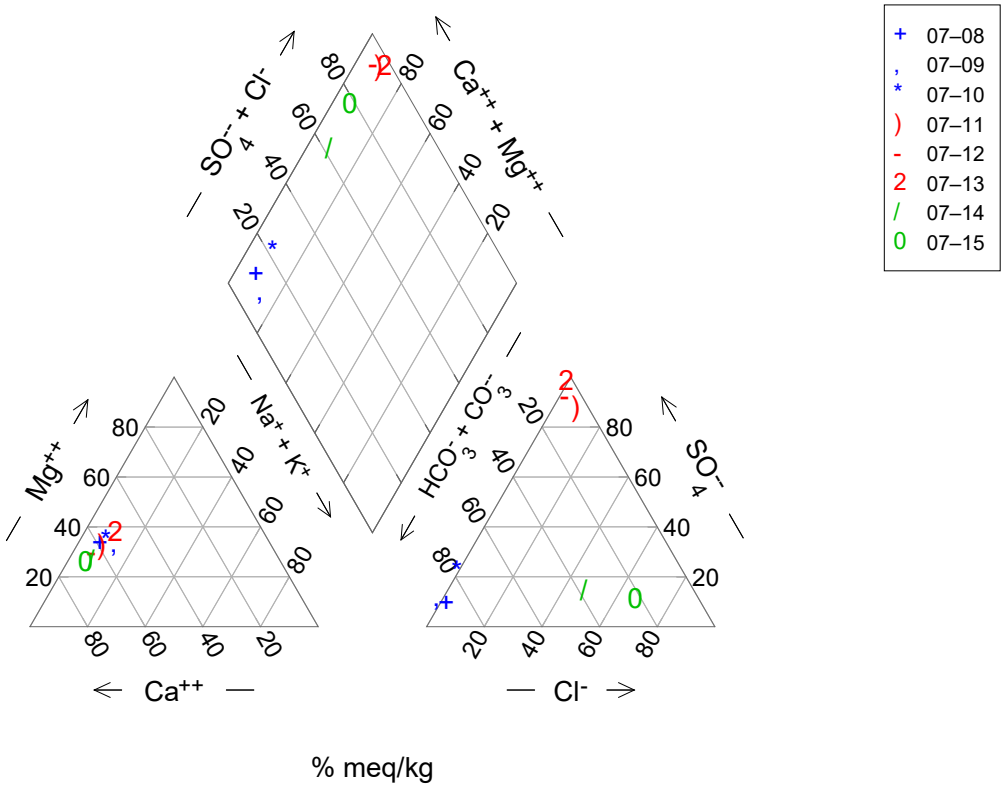


Figure 1: Piper Plot of Most Recent Clean Waste Rock Stockpile Piezometers Samples

The piper plot shows that samples collected from the JEB stockpile, plotted in blue, are of a calcium-magnesium-bicarbonate water type. The dominant cation is calcium and the dominant anion is bicarbonate. Samples collected from the Sue C stockpile, plotted in red, are a calcium-magnesium- sulfate water type with a dominant cation of calcium and a dominant anion of sulfate. Samples from the Sue E stockpile, plotted in green, are a calcium-magnesium water type with a dominant cation of calcium. There is no dominant anion for Sue E; it is split between chloride and bicarbonate with low concentrations of sulfate.

The stockpiles are performing similarly in terms of cation chemistry. For anion chemistry, the Sue C stockpile has a greater sulfate concentration due to the presence of basement rock on the stockpile. The Sue E and JEB stockpiles contain greater concentrations of bicarbonate which is typical of sandstone.

The presence of nitrate + nitrite in all of the samples can be attributed to the residual blasting agents used during mining.

4 Comparison to Source Term Parameters

Hydrochemical trend charts are shown for the source term parameters (Table 1). Temporal trend charts for each of the source term parameters are illustrated in Figures 2 to 25.

Individual hydrochemical trend charts were reviewed for each source term parameter concentration at each of the piezometer locations. The average concentration for each piezometer location was calculated based on the most recent 6 samples each sample location. For calculation of the average for each piezometer location, analytical results reported below the laboratory detection limits were assumed to equal the stated detection limit value. The Base Case Source Term value was the average of the piezometers concentrations for that waste rock pile. The Upper Bound Case Source Term value was the maximum of the piezometers concentrations for that waste rock pile.

Table 4: Revised Pore Water Source Term Parameters - JEB Clean Waste Rock Stockpile

Constituent of Potential Concern	Unit	Predicted Source Term [1]	2013 Source Term [2]	Average Concentration [3]			Base Case Source Term [4]	Upper Bound Case Source Term [5]
				7-08	7-09	7-10		
Arsenic	mg/L	0.015	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Cadmium	mg/L			0.00001	0.00001	0.00002	0.000013	0.00002
Cobalt	mg/L	0.004	0.0005	0.001	0.0003	0.0002	0.0005	0.001
Copper	mg/L	0.003	0.002	0.00043	0.0003	0.0024	0.001	0.0024
Lead	mg/L	0.013	0.0001	0.0001	0.0001	0.0003	0.00017	0.0003
Molybdenum	mg/L	0.07	0.0005	0.0001	0.0001	0.0001	0.0001	0.0001
Nickel	mg/L	0.029	0.003	0.0019	0.00075	0.0017	0.0015	0.0019
Selenium	mg/L	0.058	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Uranium	mg/L	0.019	0.0008	0.001	0.00017	0.00079	0.00065	0.001
Vanadium	mg/L			0.0003	0.00062	0.00048	0.00047	0.00062
Zinc	mg/L	0.018	0.003	0.0028	0.0013	0.0026	0.002	0.0028
Lead-210	Bq/L	0.02	0.023	0.02	0.021	0.03	0.024	0.03
Polonium-210	Bq/L			0.005	0.0052	0.005	0.0051	0.0052
Radium-226	Bq/L	1	0.017	0.009	0.017	0.023	0.016	0.023
Thorium-230	Bq/L	0.01	0.01	0.01	0.01	0.02	0.013	0.02
Ammonia	mg/L			0.042	0.073	0.047	0.054	0.073
Chloride	mg/L			2.8	0.7	2.7	2.1	2.8
Sulphate	mg/L			6.9	5.9	12.8	8.5	12.8

Notes:
[1]Source term concentration based on predicted value for Sue C clean waste rock stockpile (COGEMA 2004).
[2] 2013 source term concentration based on value used in the 2013 Waste Rock TID (Areva 2013).
[3] Average concentration is based on the most recent 6 samples for that piezometer location. For calculation of the average, analytical results reported below the laboratory detection limits were assumed to equal the stated detection limit value.
[4] Base Case source term concentration is the average concentration for the piezometers completed in that waste rock pile.
[5] Upper Bound Case source term concentration is the maximum concentration for the piezometers completed in that waste rock pile.

Table 5: Revised Pore Water Source Term Parameters - Sue C Clean Waste Rock Stockpile

Constituent of Potential Concern	Unit	Predicted Source Term [1]	2013 Source Term [2]	Average Concentration [3]			Base Case Source Term [4]	Upper Bound Case Source Term [5]
				7-11	7-12	7-13		
Arsenic	mg/L	0.015	0.001	0.0014	0.0007	0.0009	0.001	0.0014
Cadmium	mg/L			0.001	0.0004	0.0006	0.00067	0.001
Cobalt	mg/L	0.004	0.013	0.019	0.014	0.009	0.014	0.019
Copper	mg/L	0.003	0.005	0.0077	0.0085	0.0078	0.008	0.0085
Lead	mg/L	0.013	0.005	0.00065	0.0012	0.00045	0.00077	0.0012
Molybdenum	mg/L	0.07	0.0005	0.0001	0.0001	0.0001	0.0001	0.0001
Nickel	mg/L	0.029	0.003	0.081	0.091	0.24	0.14	0.24
Selenium	mg/L	0.058	0.0001	0.0062	0.0011	0.016	0.0078	0.016
Uranium	mg/L	0.019	0.00055	0.0014	0.00075	0.0006	0.00092	0.0014
Vanadium	mg/L			0.0001	0.0001	0.0001	0.00010	0.0001
Zinc	mg/L	0.018	0.016	0.026	0.021	0.016	0.021	0.026
Lead-210	Bq/L	0.02	0.02	0.037	0.062	0.035	0.045	0.062
Polonium-210	Bq/L			0.0058	0.01	0.0052	0.0070	0.01
Radium-226	Bq/L	1	0.45	0.37	0.16	0.34	0.29	0.37
Thorium-230	Bq/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ammonia	mg/L			6.7	1.3	0.07	2.7	6.7
Chloride	mg/L			5.2	1.7	2.8	3.2	5.2
Sulphate	mg/L			33	18.5	98	49.8	98

Notes:
[1]Source term concentration based on predicted value for Sue C clean waste rock stockpile (COGEMA 2004).
[2] 2013 source term concentration based on value used in the 2013 Waste Rock TID (Areva 2013).
[3] Average concentration is based on the most recent 6 samples for that piezometer location. For calculation of the average, analytical results reported below the laboratory detection limits were assumed to equal the stated detection limit value.
[4] Base Case source term concentration is the average concentration for the piezometers completed in that waste rock pile.
[5] Upper Bound Case source term concentration is the maximum concentration for the piezometers completed in that waste rock pile.

Table 6: Revised Pore Water Source Term Parameters - Sue E Clean Waste Rock Stockpile

Constituent of Potential Concern	Unit	Predicted Source Term [1]	2013 Source Term [2]	Average Concentration [3]		Base Case Source Term [4]	Upper Bound Case Source Term [5]
				7-14	7-15		
Arsenic	mg/L	0.015	0.0002	0.0002	0.0002	0.0002	0.0002
Cadmium	mg/L			0.0002	0.0004	0.0003	0.0004
Cobalt	mg/L	0.004	0.005	0.011	0.0076	0.0093	0.011
Copper	mg/L	0.003	0.014	0.011	0.0005	0.0058	0.011
Lead	mg/L	0.013	0.0003	0.00013	0.0001	0.00012	0.00013
Molybdenum	mg/L	0.07	0.0003	0.0007	0.0001	0.0004	0.0007
Nickel	mg/L	0.029	0.03	0.049	0.017	0.033	0.049
Selenium	mg/L	0.058	0.0001	0.0001	0.0001	0.0001	0.0001
Uranium	mg/L	0.019	0.0001	0.00015	0.00018	0.00017	0.00018
Vanadium	mg/L			0.0001	0.00011	0.00011	0.00011
Zinc	mg/L	0.018	0.009	0.013	0.011	0.012	0.013
Lead-210	Bq/L	0.02	0.03	0.048	0.047	0.048	0.048
Polonium-210	Bq/L			0.0052	0.0067	0.0060	0.0067
Radium-226	Bq/L	1	0.48	0.31	0.72	0.52	0.72
Thorium-230	Bq/L	0.01	0.01	0.01	0.02	0.015	0.02
Ammonia	mg/L			2.1	1.4	1.8	2.1
Chloride	mg/L			1.7	2.4	2.1	2.4
Sulphate	mg/L			0.5	0.4	0.45	0.5

Notes:
[1]Source term concentration based on predicted value for Sue C clean waste rock stockpile (COGEMA 2004).
[2] 2013 source term concentration based on value used in the 2013 Waste Rock TID (Areva 2013).
[3] Average concentration is based on the most recent 6 samples for that piezometer location. For calculation of the average, analytical results reported below the laboratory detection limits were assumed to equal the stated detection limit value.
[4] Base Case source term concentration is the average concentration for the piezometers completed in that waste rock pile.
[5] Upper Bound Case source term concentration is the maximum concentration for the piezometers completed in that waste rock pile.

Tables and Figures

Table 2: Water Analytical – Indicator Parameter Analyses

Sample Location	Date	Anions					Cations				General					Compounds
		Bicarbonate (as HCO3)	Carbonate (as CO3)	Chloride	Sulfate	Hydroxide	Calcium	Magnesium	Potassium	Sodium	Alkalinity (as CaCO3)	Specific Conductivity	Hardness, Total	pH	Total Dissolved Solids	Nitrate + Nitrite (as N)
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µS/cm	mg/L	pH units	mg/L	mg/L
JEB																
07-08	6/16/2010	94	< 1	2	5.6	< 1	33	12	2	6.5	77	307	132	7.03	205	---
	7/26/2011	111	< 1	2	3.8	< 1	37	13	2.4	6.8	91	334	146	6.96	216	---
	8/15/2012	143	< 1	3	7.2	< 1	48	19	2.8	7.4	117	430	198	7.1	288	27
	6/9/2013	129	< 1	3	5.5	< 1	47	17	2.8	7.4	106	424	187	6.94	299	24
	6/28/2014	132	< 1	3	5.1	< 1	44	16	2.2	7	108	414	176	7.53	284	25
	7/28/2015	100	< 1	2	6.1	< 1	33	12	2.1	5.7	82	323	132	6.76	262	20
	7/18/2016	104	< 1	2	7.4	< 1	39	14	2.5	6.4	85	364	155	6.99	246	23
	10/3/2017	106	< 1	3	7.2	< 1	42	15	2.6	6.6	87	405	166	7.69	273	24
	11/10/2018	137	< 1	4	8.5	< 1	51	18	2.8	7.7	112	493	201	7.62	336	29
	7/24/2019	94	< 1	3	7.1	< 1	38	13	2.4	6.4	77	343	148	6.85	251	22
07-09	8/30/2009	77	< 1	1.3	6	< 1	18	7.1	2	5.3	63	189	74	7.22	137	---
	6/11/2010	66	< 1	1.1	9.6	< 1	19	7.7	1.9	5.3	54	194	79	7.04	138	---
	7/24/2011	67	< 1	1	6.7	< 1	19	7.7	1.7	5.1	55	190	79	7	137	---
	8/15/2012	68	< 1	1.1	7.9	< 1	22	8.4	1.9	5.5	56	218	89	6.83	155	12
	9/9/2014	68	< 1	1.1	6.9	< 1	21	7.9	1.6	5.3	56	211	85	7.01	173	9.8
	7/24/2015	66	< 1	0.9	6.2	< 1	18	6.8	1.4	4.9	54	182	73	7.2	142	8.8
	7/17/2016	61	< 1	0.7	6.3	< 1	16	6.3	1.7	4.6	50	170	66	7.13	117	7
	12/20/2017	60	< 1	0.5	5.4	< 1	13	5.4	2	4.2	49	138	55	7.22	112	5.4
	11/12/2018	52	< 1	0.5	4.8	< 1	12	5.1	1.8	4.1	43	134	51	7.55	102	4.8
	7/25/2019	57	< 1	0.6	5.6	< 1	15	5.8	1.6	4.6	47	147	61	7.19	121	6.3
07-10	8/30/2009	92	< 1	6	37	< 1	46	16	3.4	9.1	75	450	181	6.95	336	---
	6/10/2010	110	< 1	4	20	< 1	44	16	2.9	8.6	90	425	176	6.77	306	---
	7/25/2011	117	< 1	3	8.7	< 1	44	16	2.8	8	96	406	176	6.9	281	---
	8/15/2012	104	< 1	5	8.6	< 1	40	15	2.8	7.6	85	383	161	6.78	270	22
	6/9/2013	85	< 1	1.9	6.3	< 1	28	11	2.4	6.2	70	268	115	6.85	199	16
	6/27/2014	112	< 1	1.8	5.6	< 1	29	11	2.3	6.1	92	267	118	7	169	11
	7/25/2015	95	< 1	2.5	16	< 1	29	11	1.9	6.4	78	282	118	7.19	193	13
	7/17/2016	100	< 1	2.2	16	< 1	30	11	2.4	6.4	82	283	120	7	185	11
	8/31/2019	111	< 1	2.7	24	< 1	32	12	2.5	7.2	91	283	129	6.74	206	8.8
Sue C																
07-11	9/8/2010	< 1	< 1	6	23	< 1	52	17	7.5	8	< 1	708	200	4.28	482	---
	7/27/2011	< 1	< 1	5	23	< 1	55	18	7.1	7.8	< 1	700	211	4.65	450	---
	8/16/2012	< 1	< 1	6	18	< 1	53	17	7.6	7.5	< 1	708	202	4.5	502	92
	7/29/2013	< 1	< 1	5	23	< 1	53	16	8.2	7.6	< 1	706	198	4.55	466	72
	6/29/2014	< 1	< 1	5	34	< 1	48	16	8	6.8	< 1	653	185	4.46	462	67
	7/29/2015	< 1	< 1	6	25	< 1	57	18	7.5	7.8	< 1	772	216	4.5	512	81
	7/18/2016	< 1	< 1	< 1	39	< 1	50	17	7.8	7.1	< 1	667	194	4.43	407	66
	9/19/2017	< 1	< 1	6	35	< 1	52	17	7.9	8	< 1	685	200	4.37	473	72
	7/21/2019	< 1	< 1	4	42	< 1	44	15	7.4	6.6	< 1	601	171	4.1	452	54
07-12	8/6/2010	< 1	< 1	5	16	< 1	48	15	6.6	7.6	< 1	603	181	5	432	---
	12/17/2011	< 1	< 1	4	55	< 1	64	21	5	7.1	< 1	757	246	3.7	450	---
	7/29/2012	< 1	< 1	1	17	< 1	32	9.6	2.8	3.3	< 1	399	119	3.85	340	38
	7/30/2013	< 1	< 1	2	18	< 1	46	13	4	5	< 1	600	168	3.68	392	54
	9/8/2014	< 1	< 1	3	18	< 1	58	16	3.7	6.3	< 1	720	210	3.74	497	71
	7/25/2015	< 1	< 1	1	14	< 1	34	9.8	2.6	3.8	< 1	456	125	3.78	299	52
	7/19/2016	< 1	< 1	1.1	12	< 1	23	6.8	2.1	2.8	< 1	300	85	4.01	206	27
	10/1/2017	< 1	< 1	2	26	< 1	32	9.6	3.5	3.9	< 1	416	119	3.5	272	39
	7/24/2019	< 1	< 1	1	23	< 1	30	8.6	2.8	4.1	< 1	364	110	3.83	295	33

Table 2: Water Analytical – Indicator Parameter Analyses (Cont'd)

Sample Location	Date	Anions					Cations				General					Compounds
		Bicarbonate (as HCO3)	Carbonate (as CO3)	Chloride	Sulfate	Hydroxide	Calcium	Magnesium	Potassium	Sodium	Alkalinity (as CaCO3)	Specific Conductivity	Hardness, Total	pH	Total Dissolved Solids	Nitrate + Nitrite (as N)
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µS/cm	mg/L	pH units	mg/L	mg/L
07-13	7/24/2010	< 1	< 1	6	57	< 1	56	22	9	9.8	< 1	679	230	4.52	520	---
	11/7/2011	< 1	< 1	5	79	< 1	53	19	8.7	9.1	< 1	630	210	4.51	414	---
	7/29/2012	< 1	< 1	4	74	< 1	53	20	8.9	8.7	< 1	622	214	4.44	506	50
	7/30/2013	< 1	< 1	4	77	< 1	48	18	8.7	8.4	< 1	564	194	4.43	435	42
	9/8/2014	1	< 1	3	76	< 1	41	16	7.2	7.5	1	503	168	4.93	394	40
	7/31/2015	< 1	< 1	3	86	< 1	41	16	7.8	7.1	< 1	484	168	4.66	305	34
	8/21/2016	< 1	< 1	3	110	< 1	43	16	8.4	7.6	< 1	471	173	4.56	312	24
	10/2/2017	< 1	< 1	2	110	< 1	36	15	7.7	6.7	< 1	416	151	4.37	291	22
	7/22/2019	1	< 1	2	130	< 1	40	18	8.6	7.4	1	470	174	4.73	348	20
Sue E																
07-14	9/1/2009	17	< 1	1.4	1.7	< 1	22	5	2.4	3.7	14	233	75	6.26	222	---
	10/4/2010	5	< 1	1.7	0.5	< 1	25	6	2.9	3.7	4	277	87	5.62	197	---
	6/13/2012	4	< 1	2	0.5	< 1	27	6.4	3.1	3.7	3	310	94	5.46	290	---
	6/10/2013	< 1	< 1	1.7	0.4	< 1	26	6.2	3.2	3.7	< 1	284	90	5.24	191	31
	6/29/2014	< 1	< 1	1.8	0.5	< 1	26	6.5	2.9	3.6	< 1	284	92	5.06	241	30
	7/31/2015	2	< 1	2	0.5	< 1	30	7.1	2.6	4.2	2	310	104	5.5	247	34
	7/18/2016	5	< 1	1.6	0.6	< 1	26	6.4	2.5	3.7	4	275	91	5.41	204	30
	9/17/2017	1	< 1	1.8	0.4	< 1	26	6.5	2.9	3.7	1	279	92	5.63	235	32
	10/12/2018	2	< 1	1.4	0.6	< 1	22	5.3	2.2	3.5	2	228	77	5.53	177	26
	7/20/2019	2	< 1	1.7	0.6	< 1	23	5.7	2.6	3.6	2	255	81	5.48	227	29
07-15	9/26/2010	28	< 1	2.2	0.3	< 1	21	5.2	2.1	2.5	23	215	74	5.92	196	---
	6/14/2012	4	< 1	2.3	0.3	< 1	30	7	2.7	2.8	3	286	104	5.24	260	---
	6/11/2013	5	< 1	2.4	0.2	< 1	28	6.7	3	2.5	4	280	97	4.6	223	27
	6/30/2014	5	< 1	2.7	0.3	< 1	30	7.1	3.3	2.6	4	291	104	5.61	270	31
	7/29/2015	< 1	< 1	3	0.3	< 1	30	7.1	3.2	2.7	< 1	306	104	5.16	276	36
	7/19/2016	< 1	< 1	2	0.3	< 1	32	7.5	3.7	2.6	< 1	324	111	5.22	265	38
	9/17/2017	2	< 1	2.3	0.5	< 1	30	7	3.8	2.5	2	298	104	5.85	242	37
	10/16/2018	4	< 1	2.2	0.5	< 1	27	6.6	3.8	2.4	3	299	94	5.58	247	34
	7/20/2019	< 1	< 1	2	0.4	< 1	30	6.9	3.8	2.5	< 1	299	103	5.29	276	34

Notes:

1) --- denotes no laboratory analysis results available for this parameter

Table 3: Water Analytical – Dissolved Metals, Trace Elements, and Radionuclides

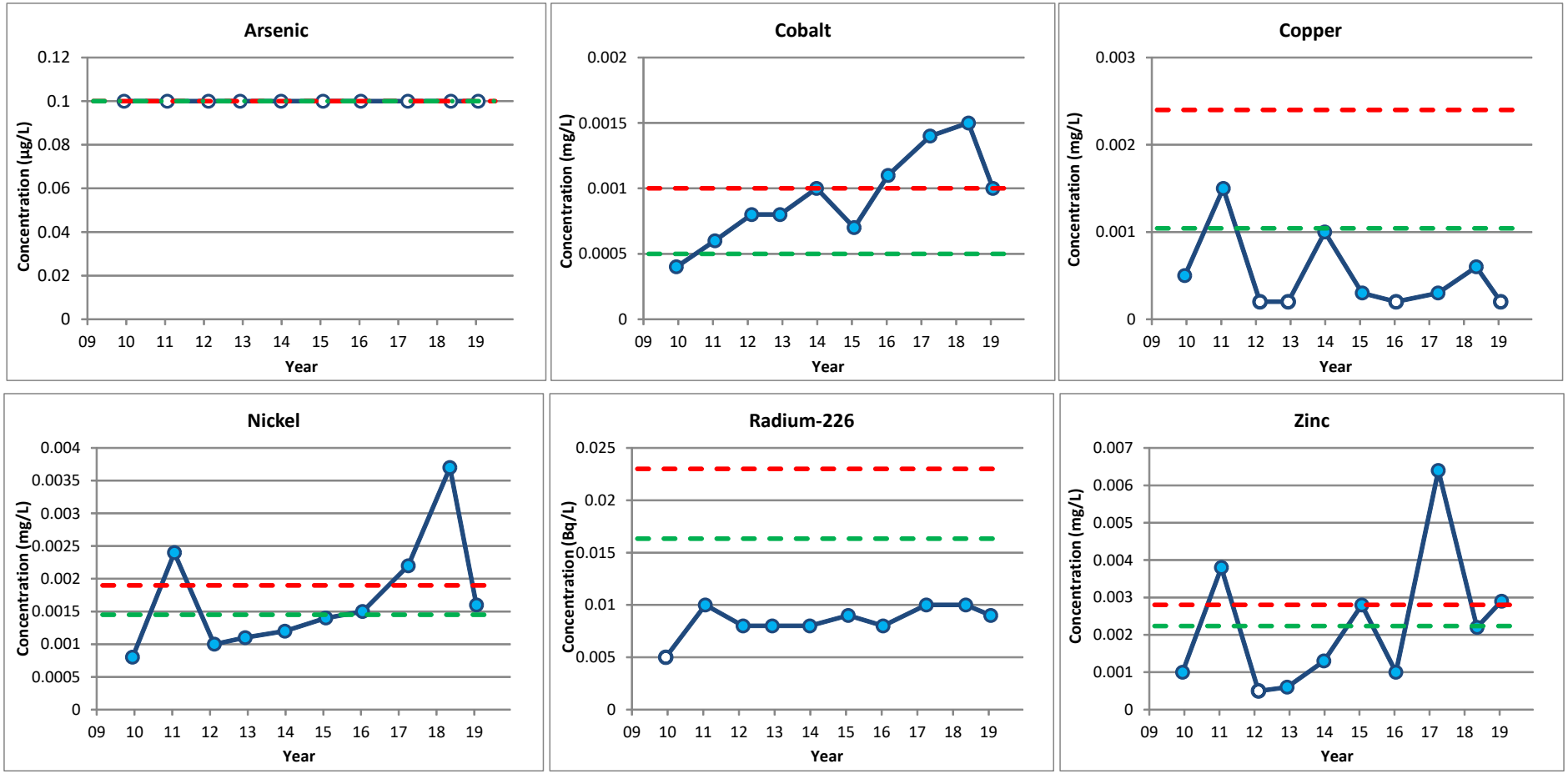
Sample Location	Date	Aluminum mg/L	Antimony mg/L	Arsenic µg/L	Barium mg/L	Beryllium mg/L	Boron mg/L	Cadmium mg/L	Chromium mg/L	Cobalt mg/L	Copper, mg/L	Lead mg/L	Lead-210 Bq/L	Molybdenum mg/L	Nickel mg/L	Radium-226 Bq/L	Selenium mg/L	Silver mg/L	Strontium mg/L	Thallium mg/L	Thorium-230 Bq/L	Uranium, µg/L	Vanadium mg/L	Zinc mg/L
JEB																								
07-08	6/16/2010	< 0.0005	< 0.0002	< 0.1	0.023	< 0.0001	< 0.01	0.00002	< 0.0005	0.0004	0.0005	< 0.0001	< 0.02	< 0.0001	0.0008	< 0.005	< 0.0001	< 0.00001	0.15	< 0.0002	< 0.01	0.8	0.0003	0.001
	7/26/2011	< 0.0005	< 0.0002	< 0.1	0.027	< 0.0001	< 0.01	< 0.00001	0.0009	0.0006	0.0015	< 0.0001	< 0.02	0.0004	0.0024	0.01	< 0.0001	< 0.00005	0.18	< 0.0002	< 0.01	1	0.0003	0.0038
	8/15/2012	< 0.0005	< 0.0002	< 0.1	0.033	< 0.0001	< 0.01	0.00001	0.0005	0.0008	< 0.0002	< 0.0001	0.03	< 0.0001	0.001	0.008	< 0.0001	< 0.00005	0.22	< 0.0002	< 0.01	2.8	0.0004	< 0.0005
	6/9/2013	< 0.0005	< 0.0002	< 0.1	0.032	< 0.0001	< 0.01	0.00001	< 0.0005	0.0008	< 0.0002	< 0.0001	< 0.02	< 0.0001	0.0011	0.008	< 0.0001	< 0.00005	0.22	< 0.0002	< 0.01	1.6	0.0004	0.0006
	6/28/2014	0.0011	< 0.0002	0.1	0.03	< 0.0001	< 0.01	0.00001	< 0.0005	0.001	0.001	< 0.0001	< 0.02	< 0.0001	0.0012	0.008	< 0.0001	< 0.00005	0.2	< 0.0002	< 0.01	1.2	0.0003	0.0013
	7/28/2015	0.0046	< 0.0002	< 0.1	0.025	< 0.0001	< 0.01	0.00001	< 0.0005	0.0007	0.0003	< 0.0001	< 0.02	< 0.0001	0.0014	0.009	< 0.0001	< 0.00005	0.16	< 0.0002	< 0.01	0.7	0.0003	0.0028
	7/18/2016	0.0006	< 0.0002	< 0.1	0.028	< 0.0001	< 0.01	< 0.00001	< 0.0005	0.0011	< 0.0002	< 0.0001	< 0.02	< 0.0001	0.0015	0.008	0.0001	< 0.00005	0.18	< 0.0002	< 0.01	0.7	0.0003	0.001
	10/3/2017	0.0064	< 0.0002	< 0.1	0.032	< 0.0001	< 0.01	0.00002	< 0.0005	0.0014	0.0003	0.0001	< 0.02	0.0001	0.0022	0.01	< 0.0001	< 0.00005	0.21	< 0.0002	< 0.01	1	0.0003	0.0064
	11/10/2018	0.0023	< 0.0002	< 0.1	0.035	< 0.0001	< 0.01	0.00001	0.0006	0.0015	0.0006	< 0.0001	< 0.02	< 0.0001	0.0037	0.01	0.0001	< 0.00005	0.24	< 0.0002	< 0.01	1.6	0.0003	0.0022
	7/24/2019	0.002	< 0.0002	< 0.1	0.028	< 0.0001	< 0.01	< 0.00001	< 0.0005	0.001	< 0.0002	< 0.0001	< 0.02	< 0.0001	0.0016	0.009	< 0.0001	< 0.00005	0.18	< 0.0002	< 0.01	0.6	0.0003	0.0029
07-09	8/30/2009	---	---	0.6	---	---	---	0.001	---	---	0.0039	0.0001	0.02	0.0004	0.0014	0.01	---	---	---	---	< 0.01	0.8	---	0.011
	6/11/2010	0.0008	< 0.0002	0.2	0.012	< 0.0001	< 0.01	< 0.00001	0.0012	0.0002	0.0024	< 0.0001	< 0.02	0.0003	0.0021	0.008	< 0.0001	0.00001	0.075	< 0.0002	< 0.01	0.2	0.0006	0.0038
	7/24/2011	< 0.0005	< 0.0002	0.1	0.013	< 0.0001	< 0.01	0.00002	0.0008	0.0002	0.0013	< 0.0001	0.03	0.0003	0.0013	0.02	< 0.0001	< 0.00005	0.083	< 0.0002	< 0.01	0.2	0.0006	0.0026
	8/15/2012	0.0012	< 0.0002	< 0.1	0.014	< 0.0001	< 0.01	0.00001	< 0.0005	0.0002	0.0004	< 0.0001	< 0.02	< 0.0001	0.0008	0.03	< 0.0001	< 0.00005	0.092	< 0.0002	< 0.01	0.2	0.0006	0.0016
	9/9/2014	0.038	< 0.0002	< 0.1	0.013	< 0.0001	< 0.01	< 0.00001	< 0.0005	0.0003	< 0.0002	< 0.0001	< 0.02	< 0.0001	0.0007	0.02	< 0.0001	< 0.00005	0.088	< 0.0002	< 0.01	0.2	0.0006	< 0.0005
	7/24/2015	0.025	< 0.0002	0.1	0.012	< 0.0001	< 0.01	0.00002	< 0.0005	0.0003	< 0.0002	< 0.0001	< 0.02	0.0001	0.0008	0.02	< 0.0001	< 0.00005	0.079	< 0.0002	< 0.01	0.2	0.0006	0.0013
	7/17/2016	0.0031	< 0.0002	0.1	0.011	< 0.0001	< 0.01	< 0.00001	< 0.0005	0.0006	0.0004	< 0.0001	< 0.02	< 0.0001	0.0008	0.01	< 0.0001	< 0.00005	0.071	< 0.0002	< 0.01	0.2	0.0006	0.0017
	12/20/2017	0.0094	0.0002	0.1	0.009	< 0.0001	< 0.01	0.00001	< 0.0005	0.0004	< 0.0002	< 0.0001	0.03	0.0001	0.0005	0.02	< 0.0001	< 0.00005	0.056	< 0.0002	< 0.01	0.1	0.0007	< 0.0005
	11/12/2018	0.0032	< 0.0002	< 0.1	0.0085	< 0.0001	< 0.01	0.00001	< 0.0005	0.0002	0.0006	< 0.0001	< 0.02	< 0.0001	0.0009	0.01	< 0.0001	< 0.00005	0.054	< 0.0002	< 0.01	0.1	0.0006	0.0011
	7/25/2019	0.0007	< 0.0002	0.1	0.01	< 0.0001	< 0.01	< 0.00001	< 0.0005	0.0002	0.0002	< 0.0001	< 0.02	< 0.0001	0.0008	0.02	< 0.0001	< 0.00005	0.064	< 0.0002	< 0.01	0.2	0.0006	0.0029
07-10	8/30/2009	---	---	0.6	---	---	---	0.0039	---	---	0.0079	0.0001	< 0.02	0.0004	0.0033	0.02	---	---	---	---	< 0.01	1	---	0.017
	6/10/2010	< 0.0005	0.0002	0.1	0.025	< 0.0001	0.02	0.00002	0.0012	0.001	0.006	< 0.0001	< 0.02	0.0008	0.008	0.02	< 0.0001	< 0.00001	0.19	< 0.0002	< 0.01	1.3	0.0004	0.014
	7/25/2011	< 0.0005	< 0.0002	< 0.1	0.025	< 0.0001	< 0.01	0.00001	0.0009	0.0008	0.004	< 0.0001	< 0.02	0.0007	0.0059	0.02	< 0.0001	0.00011	0.2	< 0.0002	< 0.01	1.1	0.0005	0.0027
	8/15/2012	0.0009	< 0.0002	0.1	0.022	< 0.0001	< 0.01	< 0.00001	< 0.0005	0.0003	0.0026	< 0.0001	0.06	< 0.0001	0.0019	0.02	< 0.0001	0.00009	0.18	< 0.0002	< 0.01	0.9	0.0005	0.0016
	6/9/2013	< 0.0005	< 0.0002	< 0.1	0.015	< 0.0001	< 0.01	0.00002	< 0.0005	0.0002	0.0025	< 0.0001	< 0.02	< 0.0001	0.0014	0.02	< 0.0001	< 0.00005	0.12	< 0.0002	< 0.01	0.5	0.0004	0.002
	6/27/2014	0.0021	< 0.0002	0.1	0.016	< 0.0001	< 0.01	0.00002	< 0.0005	0.0002	0.0025	< 0.0001	0.03	< 0.0001	0.0015	0.02	< 0.0001	< 0.00005	0.12	< 0.0002	< 0.01	0.8	0.0005	0.0017
	7/25/2015	0.0054	< 0.0002	0.1	0.018	< 0.0001	< 0.01	0.00003	< 0.0005	0.0002	0.0019	< 0.0001	< 0.02	< 0.0001	0.0018	0.03	< 0.0001	< 0.00005	0.13	< 0.0002	< 0.01	0.7	0.0005	0.004
	7/17/2016	0.0036	< 0.0002	0.1	0.018	< 0.0001	< 0.01	0.00002	< 0.0005	0.0002	0.002	< 0.0001	< 0.02	< 0.0001	0.0016	0.02	< 0.0001	< 0.00005	0.13	< 0.0002	< 0.01	0.8	0.0005	0.0022
	8/31/2019	0.0006	< 0.0002	0.1	0.019	< 0.0001	< 0.01	0.00002	< 0.0005	0.0002	0.0026	0.0003	0.03	< 0.0001	0.002	0.03	< 0.0001	0.00006	0.14	< 0.0002	0.02	1	0.0005	0.0043
Sue C																								
07-11	9/8/2010	3.47	< 0.0002	1.4	0.38	0.0028	0.09	0.0012	0.002	0.02	0.014	0.0011	0.12	0.0003	0.084	0.62	0.0078	< 0.00001	0.6	0.0005	< 0.01	1.1	< 0.0001	0.046
	7/27/2011	3.27	< 0.0002	1.1	0.32	0.0025	0.07	0.0011	0.0029	0.021	0.036	0.003	0.07	0.0004	0.079	0.53	0.0076	< 0.00005	0.68	0.0005	< 0.01	0.9	< 0.0001	0.11
	8/16/2012	3.97	< 0.0002	1.4	0.34	0.0027	0.07	0.0012	0.0007	0.019	0.016	0.0018	0.08	< 0.0001	0.056	0.65	0.0038	< 0.00005	0.61	0.0004	< 0.01	1.3	< 0.0001	0.032
	7/29/2013	4.06	< 0.0002	1.7	0.26	0.0024	0.07	0.0011	< 0.0005	0.02	0.0091	0.0005	0.03	< 0.0001	0.059	0.51	0.0047	< 0.00005	0.57	0.0005	< 0.01	1.3	< 0.0001	0.041
	6/29/2014	4.04	< 0.0002	1.3	0.22	0.0027	0.09	0.0011	0.0008	0.018	0.016	0.0007	0.05	< 0.0001	0.085	0.4	0.0064	< 0.00005	0.56	0.0004	< 0.01	1.3	< 0.0001	0.024
	7/29/2015	3.56	< 0.0002	1.2	0.23	0.0022	0.06	0.0012	0.0009	0.02	0.0072	0.0009	0.06	< 0.0001	0.058	0.44	0.0052	< 0.00005	0.65	0.0004	< 0.01	1.2	< 0.0001	0.029
	7/18/2016	3.45	< 0.0002	1	0.18	0.0026	0.1	0.001	0.0018	0.02	0.0018	0.0006	< 0.02	< 0.0001	0.102	0.27	0.0081	< 0.00005	0.61	0.0004	< 0.01	1.3	0.0001	0.023
	9/19/2017	4.02	< 0.0002	1.7	0.16	0.0024	0.08	0.00094	0.0006	0.019	0.0076	0.0005	< 0.02	< 0.0001	0.067	0.42	0.006	< 0.00005	0.53	0.0004	< 0.01	1.3	< 0.0001	0.018
	7/21/2019	4.16	< 0.0002	1.3	0.12	0.0026	0.11	0.00074	0.0024	0.015	0.0042	0.0007	0.04	< 0.0001	0.115	0.19	0.0067	< 0.00005	0.45	0.0003	< 0.01	1.5	< 0.0001	0.019

Table 3: Water Analytical – Dissolved Metals, Trace Elements, and Radionuclides (Cont'd)

Sample Location	Date	Aluminum mg/L	Antimony mg/L	Arsenic µg/L	Barium mg/L	Beryllium mg/L	Boron mg/L	Cadmium mg/L	Chromium mg/L	Cobalt mg/L	Copper, mg/L	Lead mg/L	Lead-210 Bq/L	Molybdenum mg/L	Nickel mg/L	Radium-226 Bq/L	Selenium mg/L	Silver mg/L	Strontium mg/L	Thallium mg/L	Thorium-230 Bq/L	Uranium, µg/L	Vanadium mg/L	Zinc mg/L
07-12	8/6/2010	2.62	< 0.0002	1	0.37	0.0024	0.07	0.0011	0.0017	0.02	0.015	0.0017	0.03	0.0008	0.087	---	0.0052	< 0.00001	0.5	0.0004	< 0.01	0.9	< 0.0001	0.049
	12/17/2011	2.81	< 0.0002	1	0.26	0.0025	0.09	0.00062	< 0.0005	0.029	0.0037	0.0007	0.03	< 0.0001	0.526	0.19	0.004	< 0.00005	0.74	< 0.0002	< 0.01	1.3	0.0001	0.023
	7/29/2012	2.08	< 0.0002	0.7	0.31	0.0021	0.05	0.00035	< 0.0005	0.011	0.0028	0.0088	< 0.02	< 0.0001	0.121	0.25	0.0011	< 0.00005	0.38	< 0.0002	< 0.01	0.6	< 0.0001	0.014
	7/30/2013	2.66	< 0.0002	1.1	0.39	0.0026	0.04	0.00046	< 0.0005	0.015	0.025	0.0019	< 0.02	< 0.0001	0.124	0.22	0.0011	< 0.00005	0.53	< 0.0002	< 0.01	0.9	< 0.0001	0.031
	9/8/2014	2.81	< 0.0002	1.1	0.43	0.0026	0.04	0.00054	0.0008	0.018	0.0051	0.002	0.05	< 0.0001	0.133	0.22	0.0012	< 0.00005	0.71	0.0002	< 0.01	1	< 0.0001	0.026
	7/25/2015	1.84	< 0.0002	0.5	0.29	0.002	0.03	0.00036	0.0008	0.015	0.0061	0.0013	0.02	< 0.0001	0.078	0.16	0.0009	< 0.00005	0.42	< 0.0002	< 0.01	0.8	< 0.0001	0.018
	7/19/2016	1.04	< 0.0002	0.3	0.2	0.0012	0.03	0.00023	0.0007	0.009	0.003	0.0006	< 0.02	< 0.0001	0.053	0.14	0.0011	< 0.00005	0.27	< 0.0002	< 0.01	0.4	< 0.0001	0.0097
	10/1/2017	2.09	< 0.0002	0.8	0.17	0.0018	0.07	0.00058	0.0041	0.014	0.0063	0.0007	0.22	0.0001	0.102	0.14	0.0014	< 0.00005	0.34	< 0.0002	< 0.01	0.8	< 0.0001	0.022
	7/24/2019	1.87	< 0.0002	0.6	0.15	0.0016	0.04	0.00031	0.002	0.013	0.0057	0.0004	0.04	< 0.0001	0.053	0.1	0.0008	< 0.00005	0.33	< 0.0002	< 0.01	0.6	< 0.0001	0.019
07-13	7/24/2010	2.1	0.0003	1.2	0.1	0.0019	0.18	0.0011	< 0.0005	0.019	0.022	0.0003	0.04	< 0.0001	0.215	---	0.014	0.00016	0.55	< 0.0002	< 0.01	0.4	< 0.0001	0.06
	11/7/2011	3.3	< 0.0002	1.3	0.094	0.002	0.2	0.00086	< 0.0005	0.015	0.0075	0.0002	0.05	< 0.0001	0.207	0.45	0.014	0.00005	0.58	< 0.0002	< 0.01	0.6	< 0.0001	0.014
	7/29/2012	2.89	< 0.0002	1.3	0.092	0.0021	0.21	0.00091	< 0.0005	0.014	0.0069	0.002	< 0.02	< 0.0001	0.242	0.65	0.016	0.00018	0.57	< 0.0002	< 0.01	0.5	< 0.0001	0.018
	7/30/2013	2.29	< 0.0002	1	0.072	0.0016	0.19	0.00077	< 0.0005	0.011	0.008	0.0009	0.02	< 0.0001	0.215	0.45	0.014	0.00011	0.49	< 0.0002	< 0.01	0.5	< 0.0001	0.015
	9/8/2014	1.92	< 0.0002	0.9	0.057	0.0017	0.2	0.00069	< 0.0005	0.0082	0.0049	0.0002	0.05	< 0.0001	0.19	0.29	0.014	0.00012	0.46	< 0.0002	< 0.01	0.6	< 0.0001	0.016
	7/31/2015	2.39	< 0.0002	0.9	0.06	0.0017	0.2	0.00067	< 0.0005	0.0096	0.0082	< 0.0001	< 0.02	< 0.0001	0.2	0.38	0.014	0.00009	0.44	< 0.0002	< 0.01	0.5	< 0.0001	0.0096
	8/21/2016	1.82	< 0.0002	0.6	0.054	0.0013	0.21	0.00061	0.0006	0.0078	0.012	0.0006	0.06	< 0.0001	0.211	0.35	0.017	0.00054	0.42	< 0.0002	< 0.01	0.5	< 0.0001	0.023
	10/2/2017	1.67	< 0.0002	1	0.047	0.0013	0.26	0.00056	< 0.0005	0.0087	0.01	0.0001	0.04	< 0.0001	0.302	0.29	0.017	< 0.00005	0.37	< 0.0002	< 0.01	1.1	< 0.0001	0.021
	7/22/2019	1.65	< 0.0002	0.9	0.04	0.0012	0.26	0.00051	0.0006	0.0081	0.0036	< 0.0001	< 0.02	< 0.0001	0.35	0.29	0.02	0.0002	0.41	< 0.0002	< 0.01	0.4	< 0.0001	0.012
Sue E																								
07-14	9/1/2009	---	---	1.2	---	---	---	0.001	---	---	0.034	0.0002	0.1	0.001	0.024	0.09	---	---	---	---	< 0.01	0.5	---	0.033
	10/4/2010	0.13	< 0.0002	0.3	0.32	0.0004	0.02	0.00036	< 0.0005	0.0049	0.023	0.0001	< 0.02	0.0005	0.045	0.29	< 0.0001	0.0016	0.27	< 0.0002	< 0.01	< 0.1	< 0.0001	0.014
	6/13/2012	0.25	< 0.0002	0.2	0.4	0.0009	0.02	0.00041	< 0.0005	0.007	0.026	0.0003	< 0.02	0.0005	0.05	0.44	< 0.0001	0.002	0.32	< 0.0002	< 0.01	0.1	< 0.0001	0.012
	6/10/2013	0.31	< 0.0002	0.2	0.36	0.0008	0.01	0.00032	< 0.0005	0.0071	0.017	0.0002	< 0.02	0.0007	0.04	0.29	< 0.0001	0.0013	0.28	< 0.0002	< 0.01	0.1	< 0.0001	0.01
	6/29/2014	0.23	< 0.0002	0.2	0.3	0.0006	0.02	0.00028	0.0005	0.0084	0.011	0.0002	0.06	0.0006	0.04	0.27	< 0.0001	0.00089	0.28	< 0.0002	< 0.01	0.2	< 0.0001	0.01
	7/31/2015	0.26	< 0.0002	0.2	0.15	0.0007	0.02	0.00032	< 0.0005	0.013	0.013	< 0.0001	0.03	0.0008	0.052	0.36	< 0.0001	0.00056	0.3	< 0.0002	< 0.01	0.1	< 0.0001	0.011
	7/18/2016	0.25	0.0003	0.2	0.28	0.0008	0.01	0.00029	< 0.0005	0.011	0.01	0.0002	0.04	0.0007	0.042	0.33	< 0.0001	0.00055	0.27	< 0.0002	< 0.01	0.2	< 0.0001	0.013
	9/17/2017	0.24	< 0.0002	0.2	0.34	0.0009	0.02	0.00028	< 0.0005	0.013	0.021	< 0.0001	0.04	0.0006	0.055	0.4	< 0.0001	0.00011	0.28	< 0.0002	< 0.01	0.1	< 0.0001	0.013
	10/12/2018	0.19	0.0008	0.3	0.2	0.0006	0.01	0.00021	< 0.0005	0.011	0.0068	< 0.0001	0.08	0.0009	0.038	0.27	< 0.0001	0.0001	0.18	< 0.0002	< 0.01	0.2	< 0.0001	0.017
	7/20/2019	0.36	< 0.0002	0.2	0.27	0.0007	0.01	0.00022	< 0.0005	0.01	0.0047	0.0001	0.04	0.0007	0.064	0.25	< 0.0001	< 0.00005	0.24	< 0.0002	< 0.01	0.1	< 0.0001	0.011
07-15	9/26/2010	0.044	< 0.0002	0.3	0.12	0.0002	0.01	0.00014	< 0.0005	0.001	0.0017	0.0002	< 0.02	0.0002	0.0044	---	< 0.0001	< 0.00001	0.19	< 0.0002	< 0.01	0.1	< 0.0001	0.0056
	6/14/2012	0.077	< 0.0002	0.2	0.19	0.0004	0.02	0.0003	< 0.0005	0.0025	0.0019	0.0003	0.04	< 0.0001	0.0085	0.51	< 0.0001	< 0.00005	0.27	< 0.0002	< 0.01	0.1	< 0.0001	0.0064
	6/11/2013	0.082	< 0.0002	0.2	0.21	0.0004	0.02	0.00032	< 0.0005	0.0035	0.0007	< 0.0001	0.04	< 0.0001	0.01	0.45	< 0.0001	< 0.00005	0.27	< 0.0002	< 0.01	0.2	< 0.0001	0.0072
	6/30/2014	0.099	< 0.0002	0.3	0.24	0.0006	0.02	0.00032	< 0.0005	0.0064	0.0004	0.0001	0.05	0.0001	0.014	0.54	< 0.0001	< 0.00005	0.29	< 0.0002	< 0.01	0.5	< 0.0001	0.011
	7/29/2015	0.13	< 0.0002	0.2	0.28	0.0006	0.02	0.00042	< 0.0005	0.0049	0.0007	0.0001	0.1	< 0.0001	0.015	0.67	< 0.0001	< 0.00005	0.32	< 0.0002	< 0.01	0.1	< 0.0001	0.0089
	7/19/2016	0.16	< 0.0002	0.2	0.35	0.0008	0.02	0.00054	< 0.0005	0.0072	0.0008	0.0001	0.02	< 0.0001	0.018	0.82	< 0.0001	< 0.00005	0.33	< 0.0002	< 0.01	0.1	< 0.0001	0.012
	9/17/2017	0.16	< 0.0002	0.2	0.33	0.0008	0.03	0.00048	< 0.0005	0.0078	0.0002	< 0.0001	0.02	< 0.0001	0.017	0.79	< 0.0001	< 0.00005	0.27	< 0.0002	< 0.01	< 0.1	< 0.0001	0.01
	10/16/2018	0.19	< 0.0002	0.2	0.34	0.0008	0.02	0.00035	< 0.0005	0.0093	0.0004	0.0001	0.02	< 0.0001	0.018	0.76	< 0.0001	< 0.00005	0.29	0.0002	< 0.01	0.2	0.0002	0.012
	7/20/2019	0.19	< 0.0002	0.1	0.33	0.0009	0.02	0.00047	< 0.0005	0.01	0.0007	< 0.0001	0.07	< 0.0001	0.021	0.75	< 0.0001	< 0.00005	0.3	0.0002	0.02	0.1	< 0.0001	0.013

Notes:

1) --- denotes no laboratory analysis results available for this parameter



Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Arsenic	Cobalt	Copper	Nickel	Radium-226	Zinc
Unit	µg/L	mg/L	mg/L	mg/L	Bq/L	mg/L
Base Case	0.1	0.0005	0.001	0.0015	0.016	0.002
Upper Bound Case	0.1	0.001	0.0024	0.0019	0.023	0.0028

Projection:N/A
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/26/2021
Scale:
Data Sources: EQUIS Database

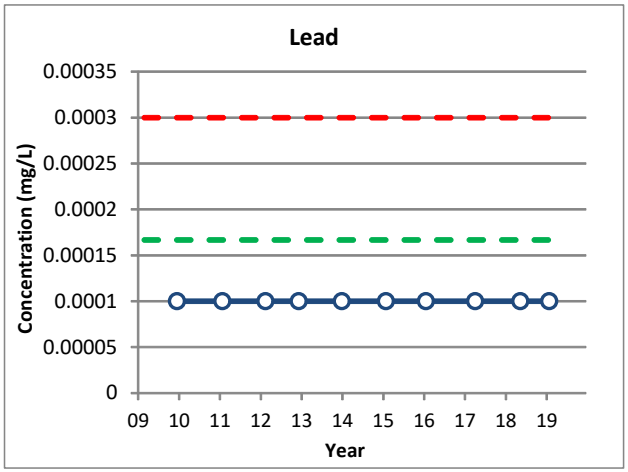
McCLEAN LAKE OPERATION

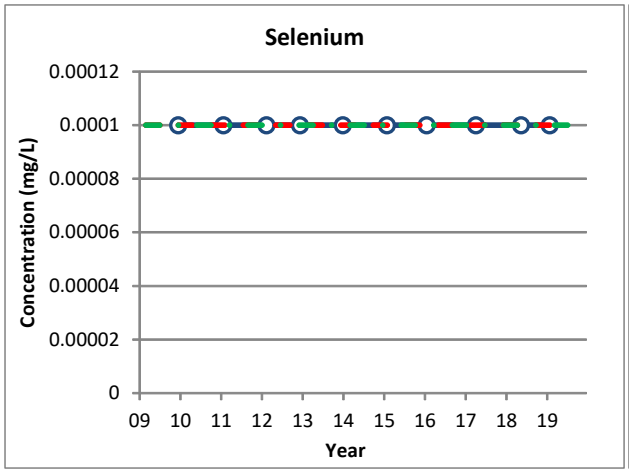
FIGURE 2
HYDROCHEMICAL TREND CHART FOR JEB CWRP: PIEZOMETER LOCATION 07-08

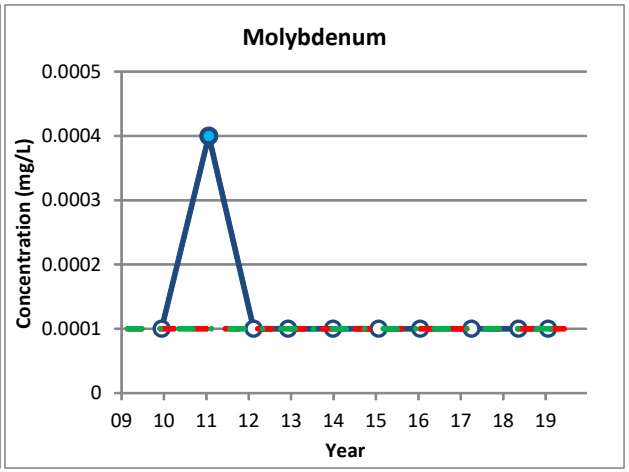
WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

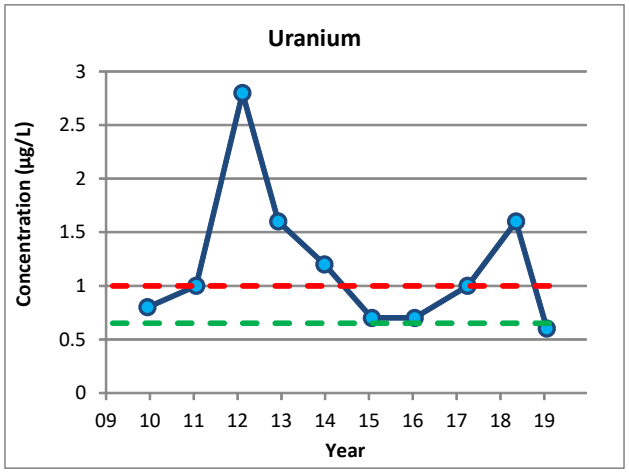
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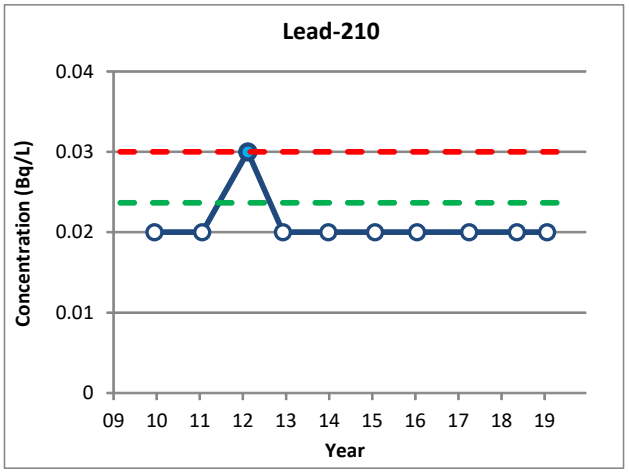
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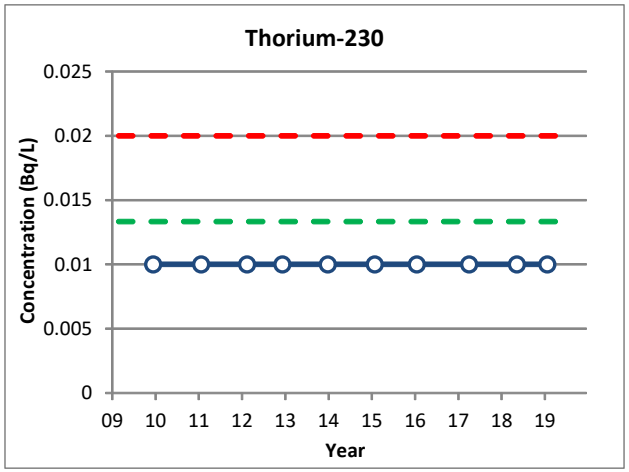












Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Lead	Selenium	Molybdenum	Uranium	Lead-210	Thorium-230
Unit	mg/L	mg/L	mg/L	µg/L	Bq/L	Bq/L
Base Case	0.00017	0.0001	0.0001	0.65	0.024	0.013
Upper Bound Case	0.0003	0.0001	0.0001	1	0.03	0.02

Projection:N/A
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/26/2021
Scale:
Data Sources: EQUIS Database

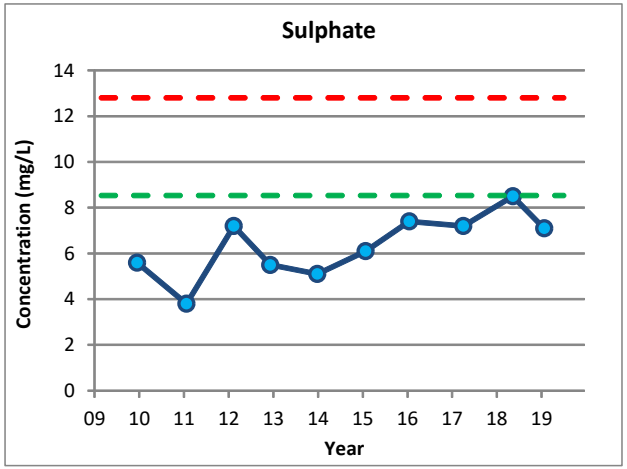
McCLEAN LAKE OPERATION

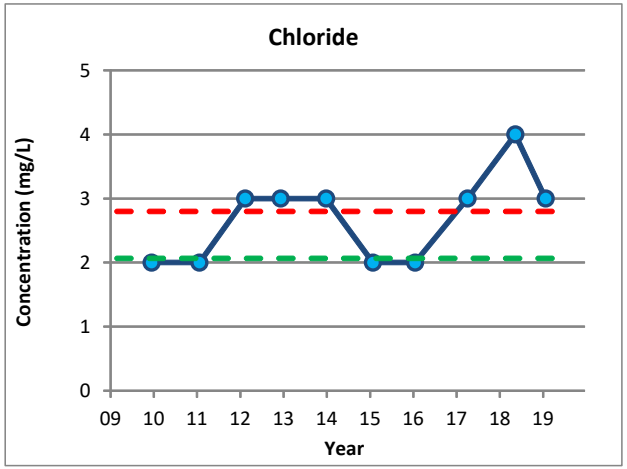
FIGURE 3
HYDROCHEMICAL TREND CHART FOR JEB CWRP: PIEZOMETER LOCATION 07-08

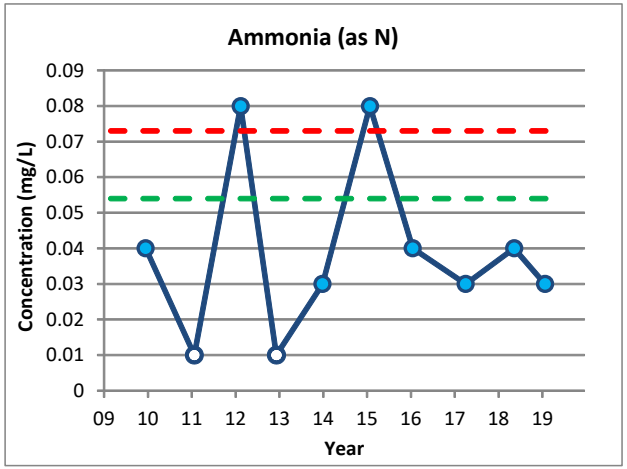
WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

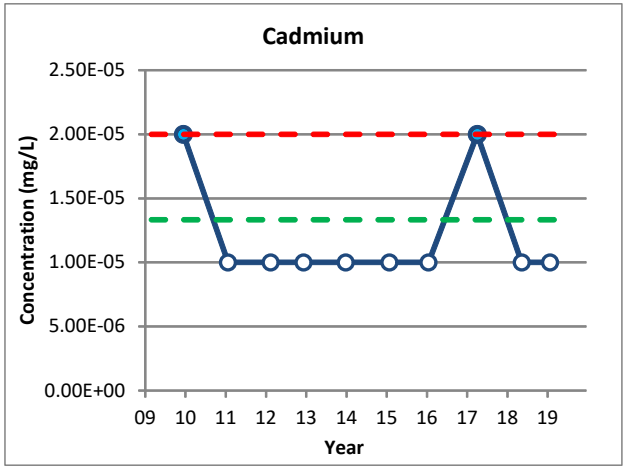
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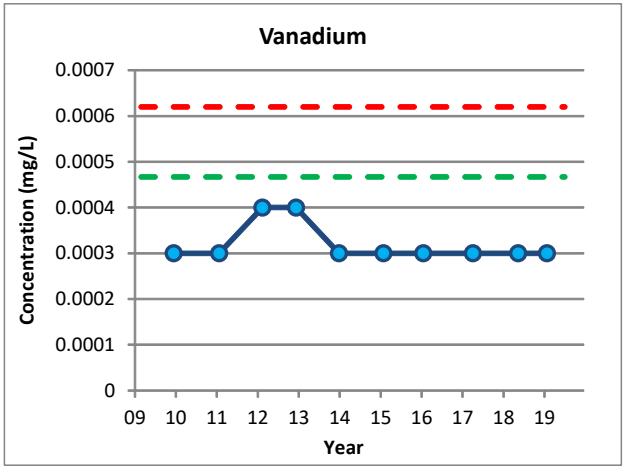
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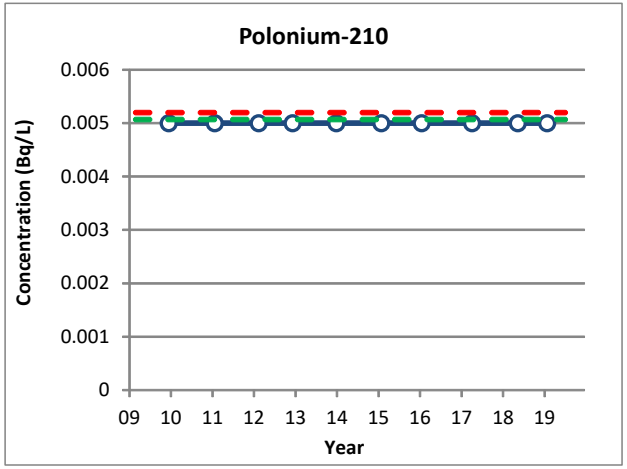












Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Sulphate	Chloride	Ammonia (as N)	Cadmium	Vanadium	Polonium-210
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	8.5	2.1	0.054	0.000013	0.00047	0.0051
Upper Bound Case	12.8	2.8	0.073	0.00002	0.00062	0.0052

Projection:N/A
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/26/2021
Scale:
Data Sources: EQUIS Database

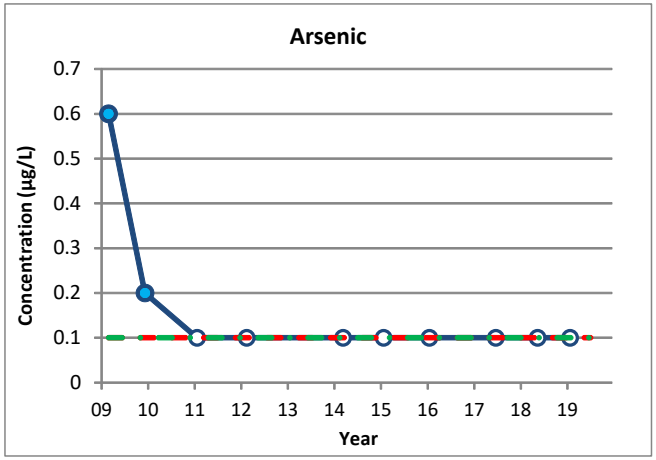
McCLEAN LAKE OPERATION

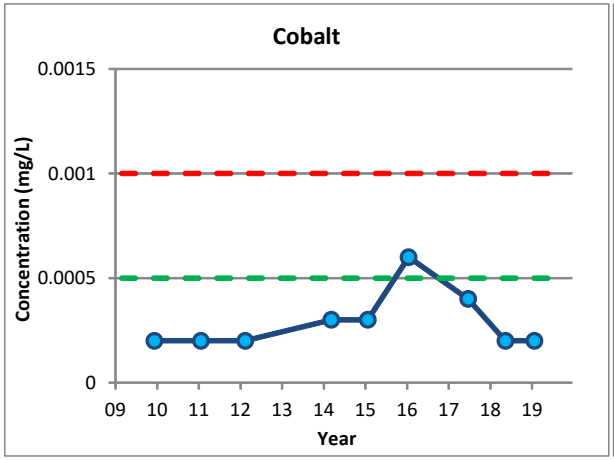
FIGURE 4
HYDROCHEMICAL TREND CHART FOR JEB CWRP: PIEZOMETER LOCATION 07-08

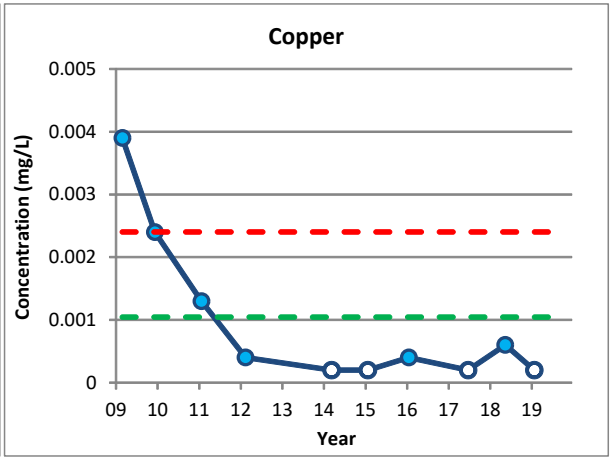
WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

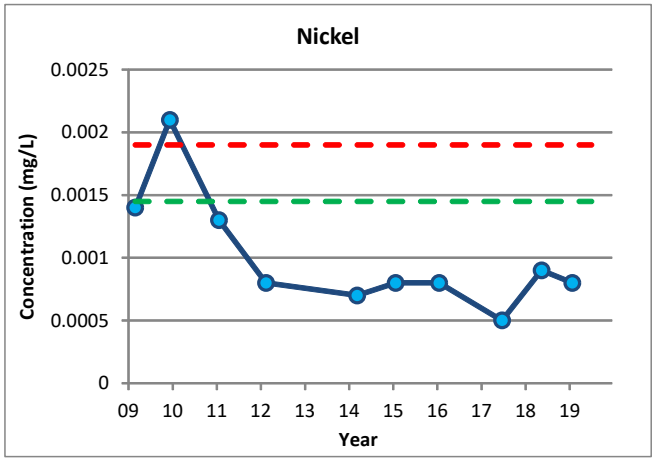
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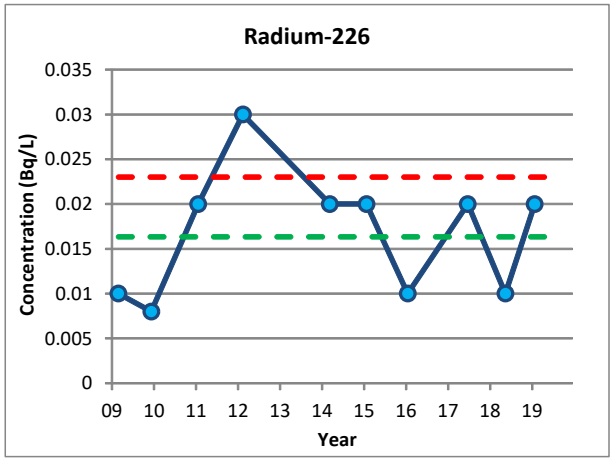
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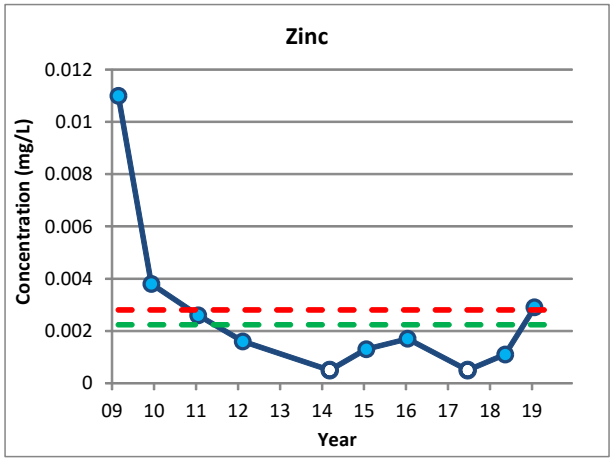












Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Arsenic	Cobalt	Copper	Nickel	Radium-226	Zinc
Unit	µg/L	mg/L	mg/L	mg/L	Bq/L	mg/L
Base Case	0.1	0.0005	0.001	0.0015	0.016	0.002
Upper Bound Case	0.1	0.001	0.0024	0.0019	0.023	0.0028

Projection:N/A
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/26/2021
Scale:
Data Sources: EQUIS Database

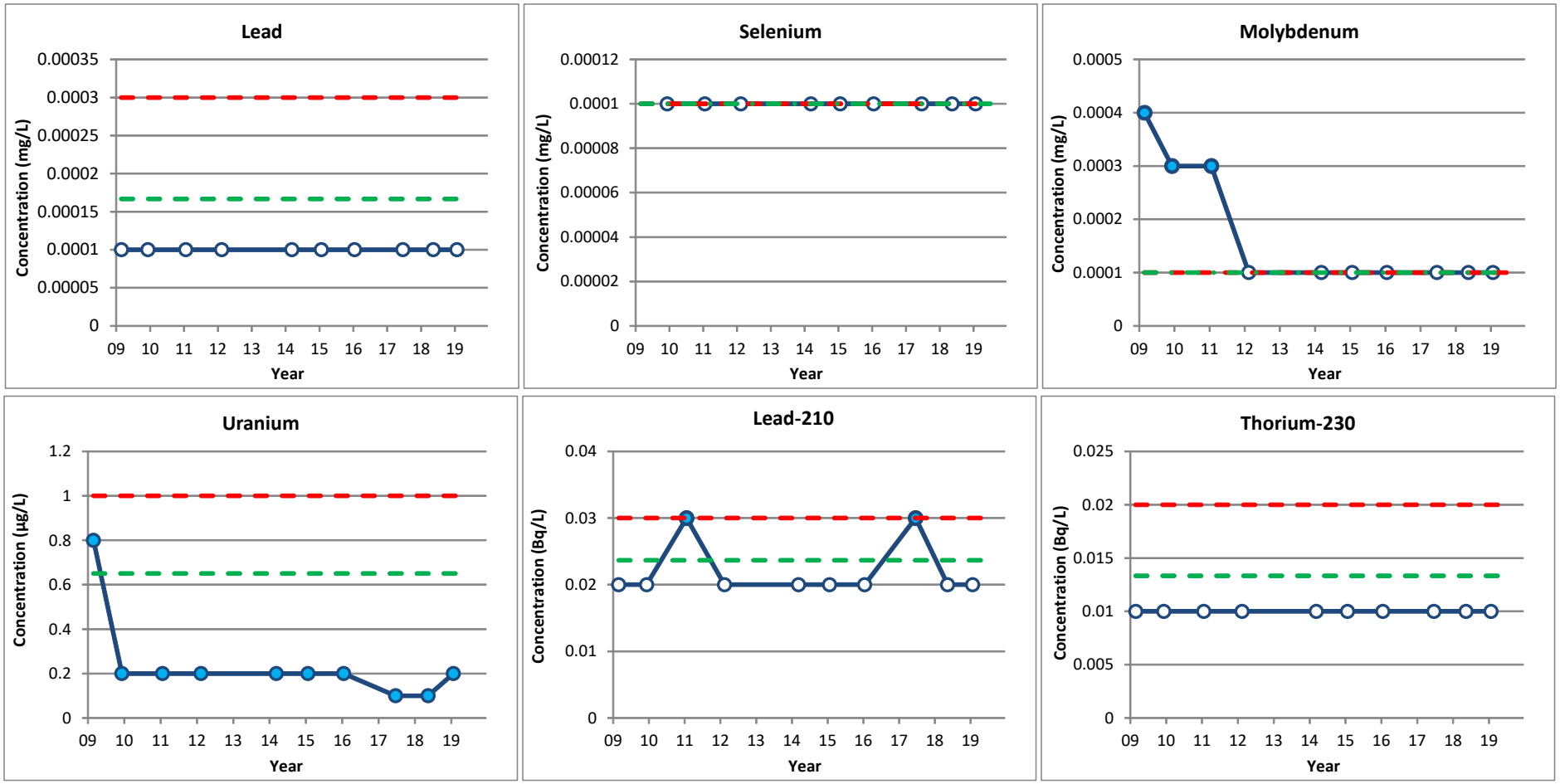
McCLEAN LAKE OPERATION

FIGURE 5
HYDROCHEMICAL TREND CHART FOR JEB CWRP: PIEZOMETER LOCATION 07-09

WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Appendix\Figure 5.mxd



Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Lead	Selenium	Molybdenum	Uranium	Lead-210	Thorium-230
Unit	mg/L	mg/L	mg/L	µg/L	Bq/L	Bq/L
Base Case	0.00017	0.0001	0.0001	0.65	0.024	0.013
Upper Bound Case	0.0003	0.0001	0.0001	1	0.03	0.02

Projection:N/A
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/26/2021
Scale:
Data Sources: EQUIS Database

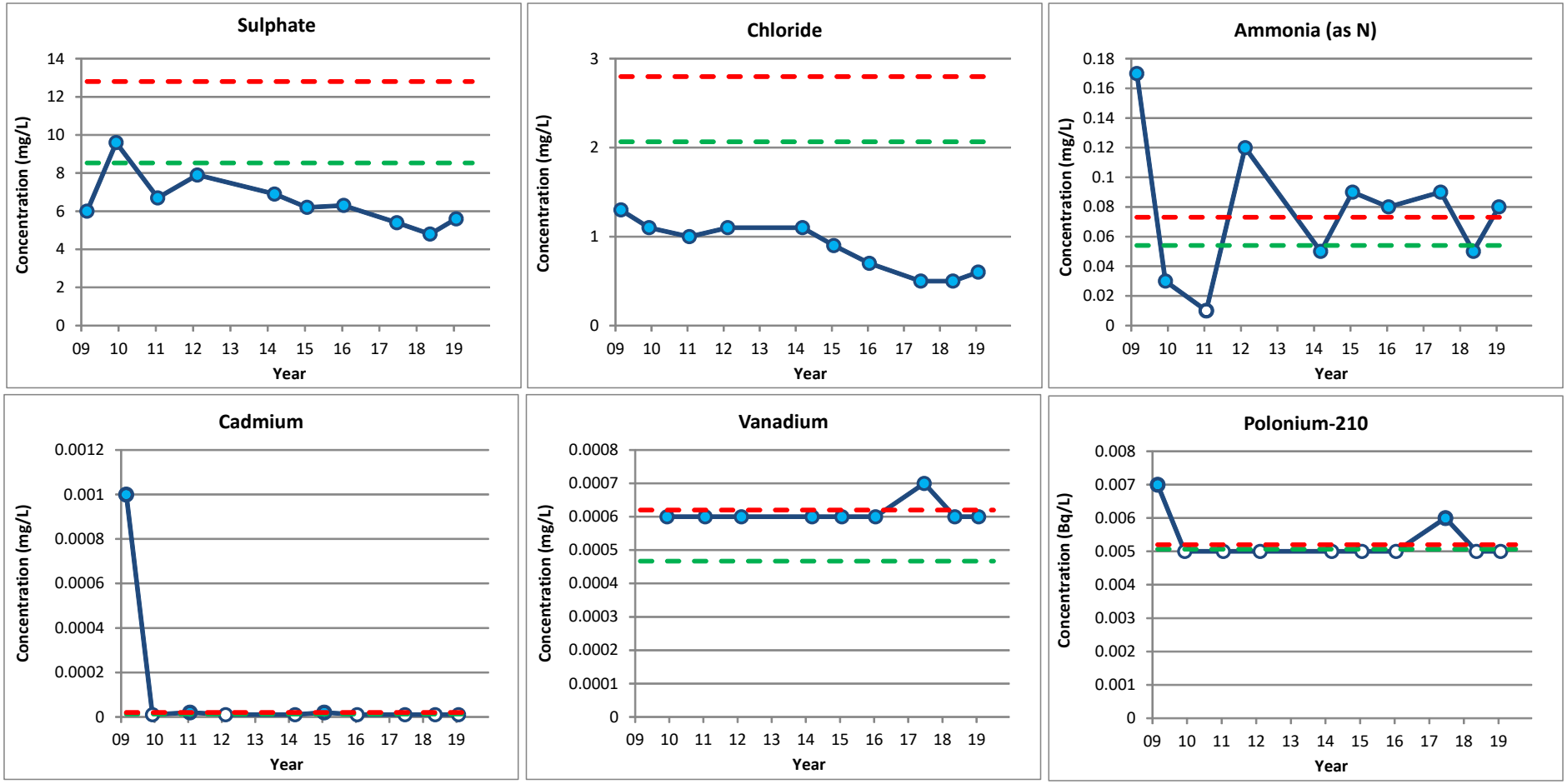
McCLEAN LAKE OPERATION

FIGURE 6
HYDROCHEMICAL TREND CHART FOR JEB CWRP: PIEZOMETER LOCATION 07-09

WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Appendix\Figure 6.mxd



Base Case Source Term

Upper Bound Case Source Term

Analyte	Sulphate	Chloride	Ammonia (as N)	Cadmium	Vanadium	Polonium-210
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	8.5	2.1	0.054	0.000013	0.00047	0.0051
Upper Bound Case	12.8	2.8	0.073	0.00002	0.00062	0.0052

Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Projection:N/A
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/26/2021 Scale:
Data Sources: EQUIS Database

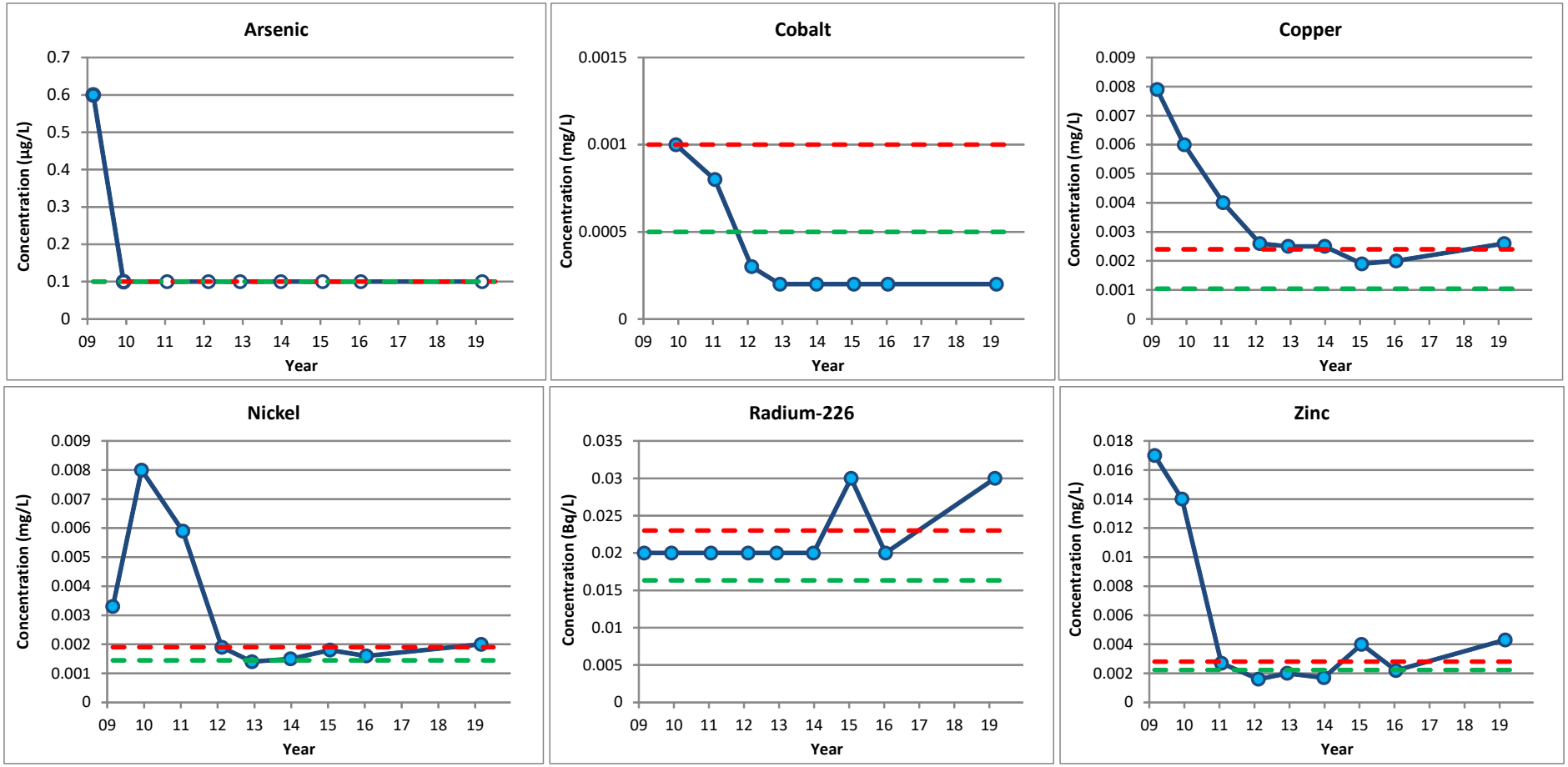
McCLEAN LAKE OPERATION

FIGURE 7
HYDROCHEMICAL TREND CHART FOR JEB CWRP: PIEZOMETER LOCATION 07-09

WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Appendix\Figure 7.mxd



Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Arsenic	Cobalt	Copper	Nickel	Radium-226	Zinc
Unit	µg/L	mg/L	mg/L	mg/L	Bq/L	mg/L
Base Case	0.1	0.0005	0.001	0.0015	0.016	0.002
Upper Bound Case	0.1	0.001	0.0024	0.0019	0.023	0.0028

Projection:N/A
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/26/2021
Scale:
Data Sources: EQUIS Database

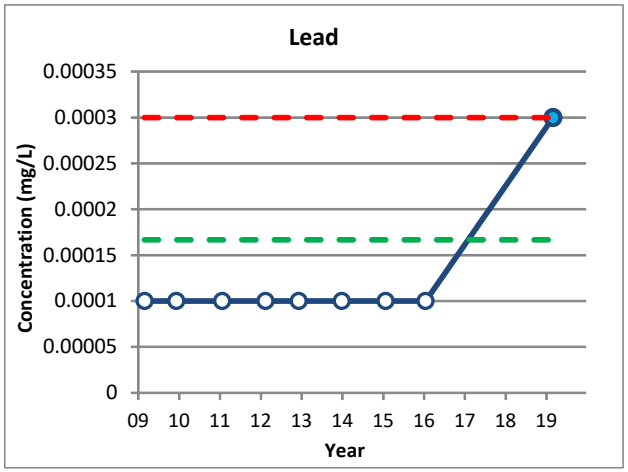
McCLEAN LAKE OPERATION

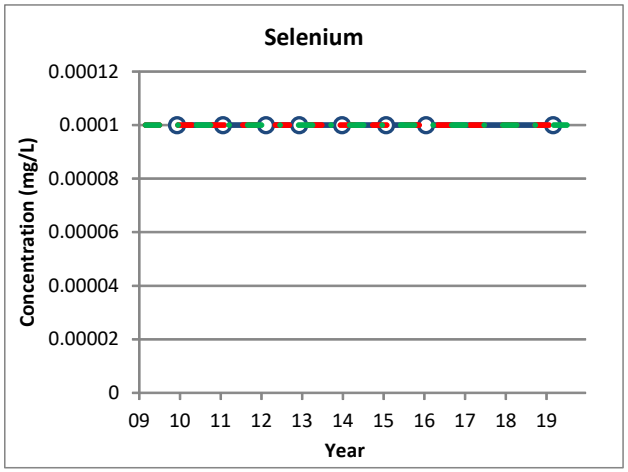
FIGURE 8
HYDROCHEMICAL TREND CHART FOR JEB CWRP: PIEZOMETER LOCATION 07-10

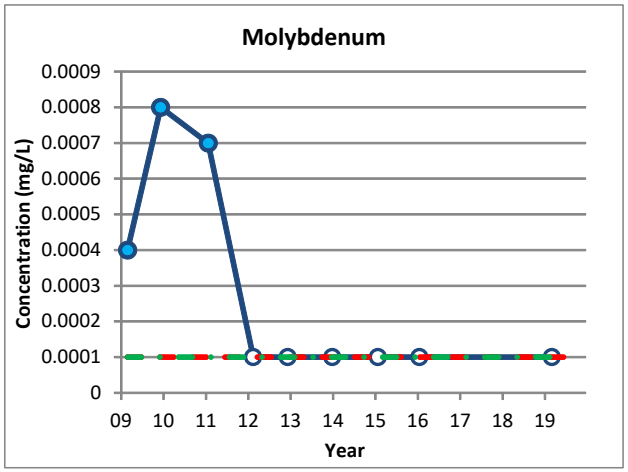
WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

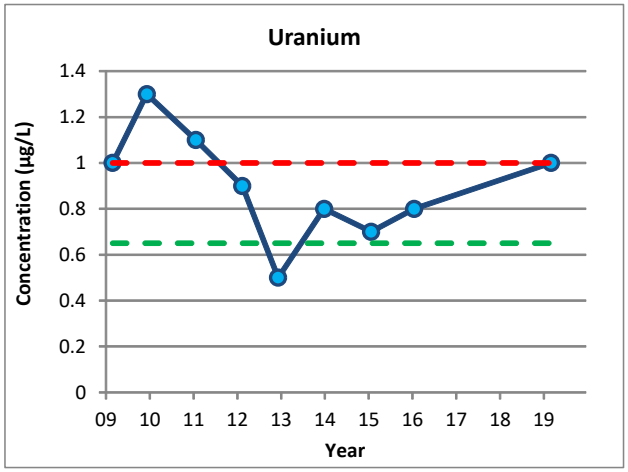
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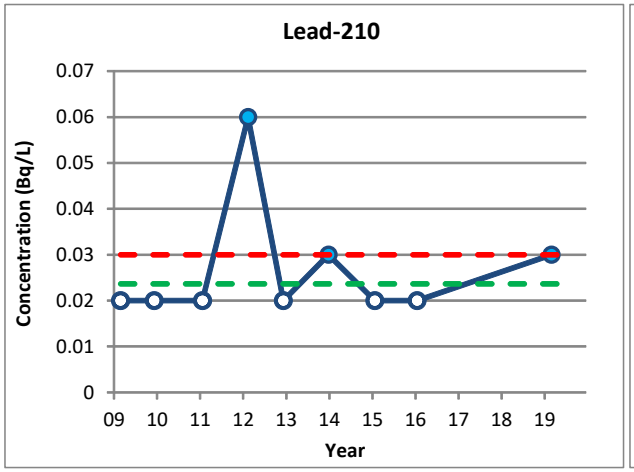
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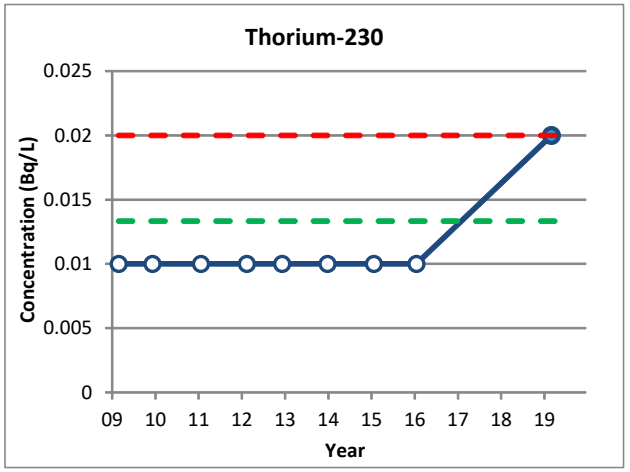












Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Lead	Selenium	Molybdenum	Uranium	Lead-210	Thorium-230
Unit	mg/L	mg/L	mg/L	µg/L	Bq/L	Bq/L
Base Case	0.00017	0.0001	0.0001	0.65	0.024	0.013
Upper Bound Case	0.0003	0.0001	0.0001	1	0.03	0.02

Projection:N/A
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/26/2021
Scale:
Data Sources: EQUIS Database

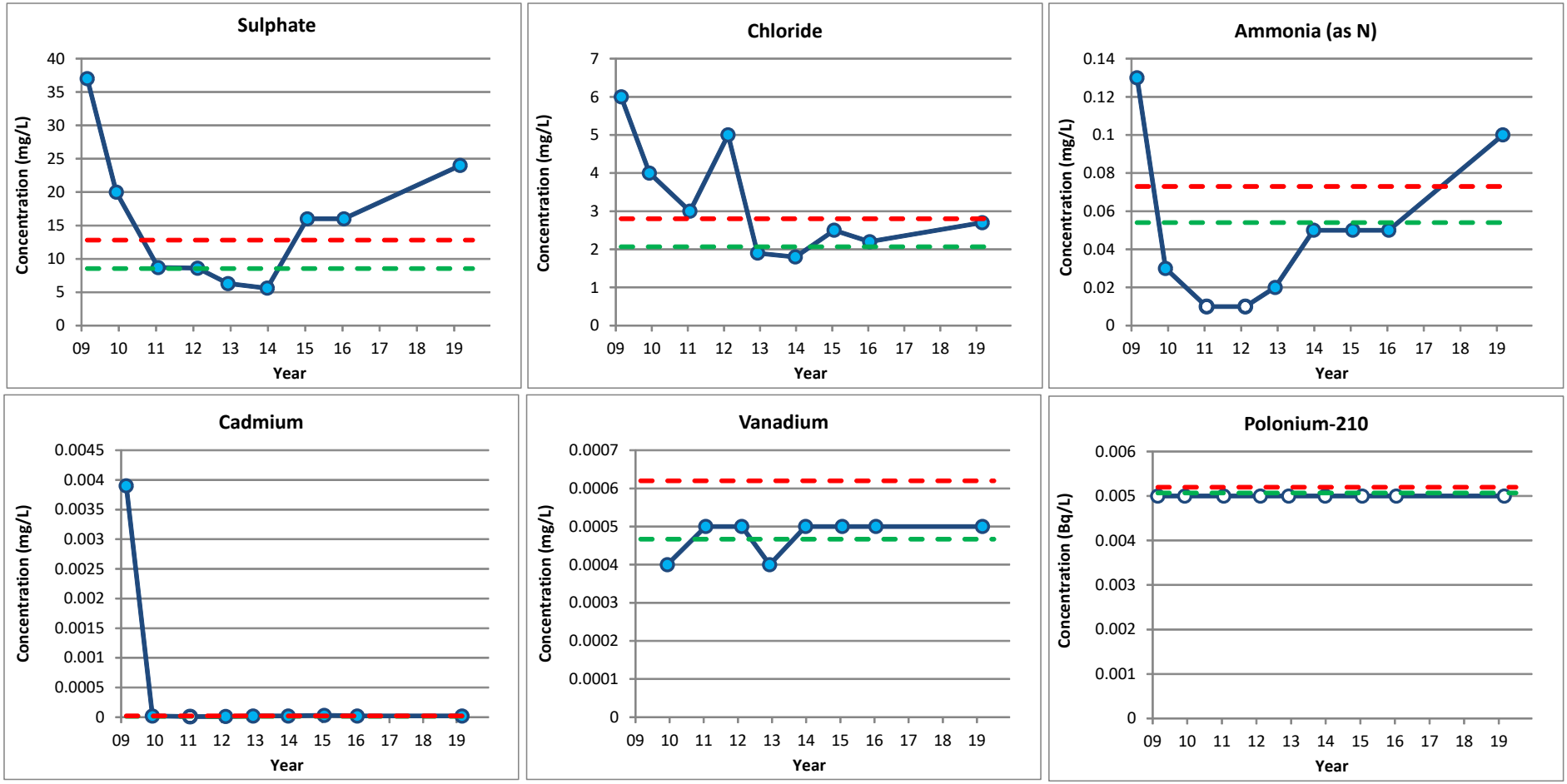
McCLEAN LAKE OPERATION

FIGURE 9
HYDROCHEMICAL TREND CHART FOR JEB CWRP: PIEZOMETER LOCATION 07-10

WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Appendix\Figure 9.mxd



Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Sulphate	Chloride	Ammonia (as N)	Cadmium	Vanadium	Polonium-210
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	8.5	2.1	0.054	0.000013	0.00047	0.0051
Upper Bound Case	12.8	2.8	0.073	0.00002	0.00062	0.0052

Projection:N/A
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/26/2021 Scale:
Data Sources: EQUIS Database

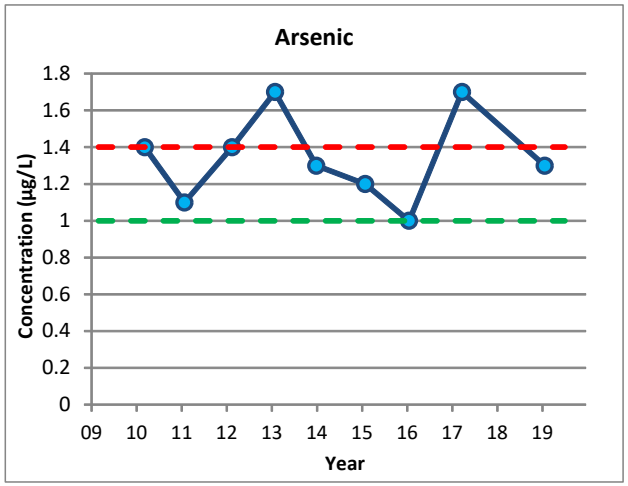
McCLEAN LAKE OPERATION

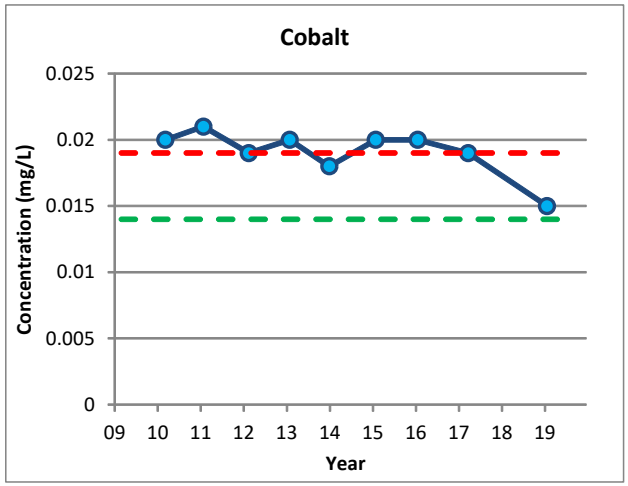
FIGURE 10
HYDROCHEMICAL TREND CHART FOR JEB CWRP: PIEZOMETER LOCATION 07-10

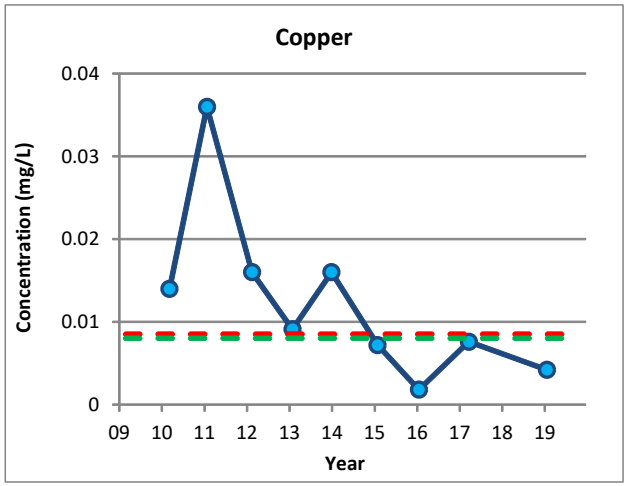
WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

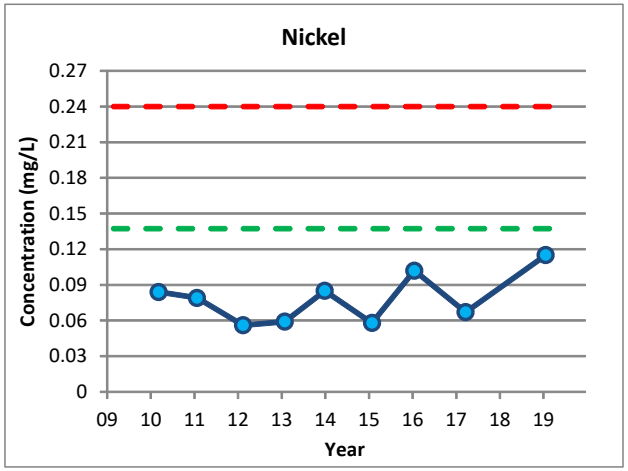
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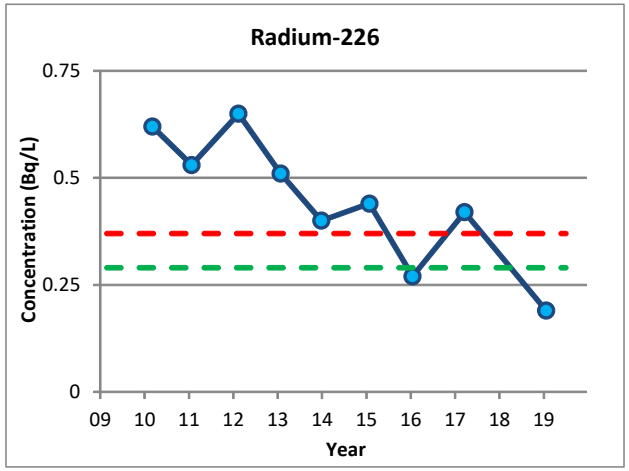
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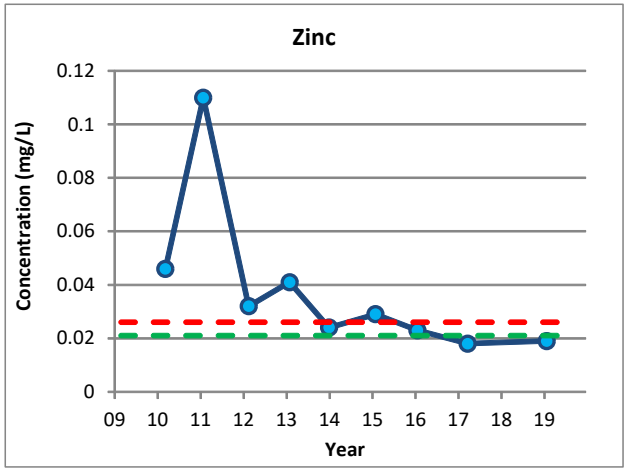












Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source

Analyte	Arsenic	Cobalt	Copper	Nickel	Radium-226	Zinc
Unit	µg/L	mg/L	mg/L	mg/L	Bq/L	mg/L
Base Case	1	0.014	0.008	0.14	0.29	0.021
Upper Bound Case	1.4	0.019	0.0085	0.24	0.37	0.026

Projection:N/A
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/26/2021
Scale:
Data Sources: EQUIS Database

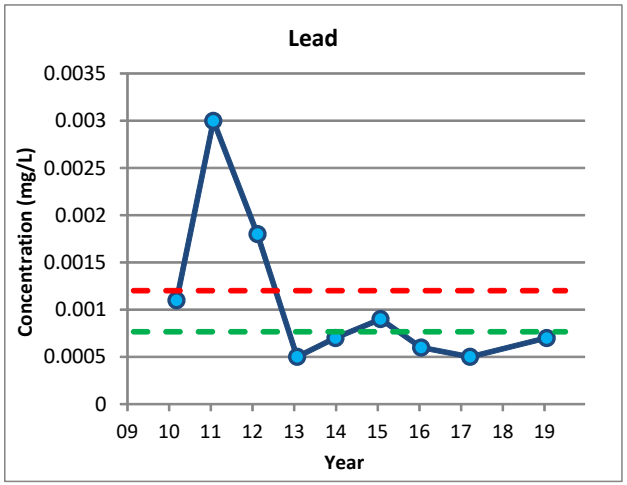
McCLEAN LAKE OPERATION

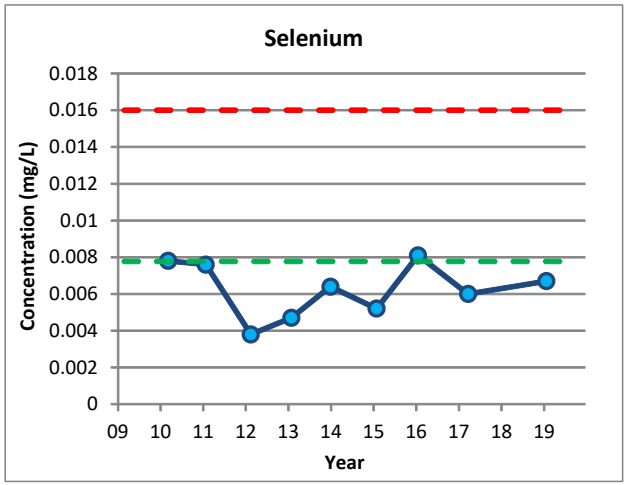
FIGURE 11
HYDROCHEMICAL TREND CHART FOR SUE C CWRP: PIEZOMETER LOCATION 07-11

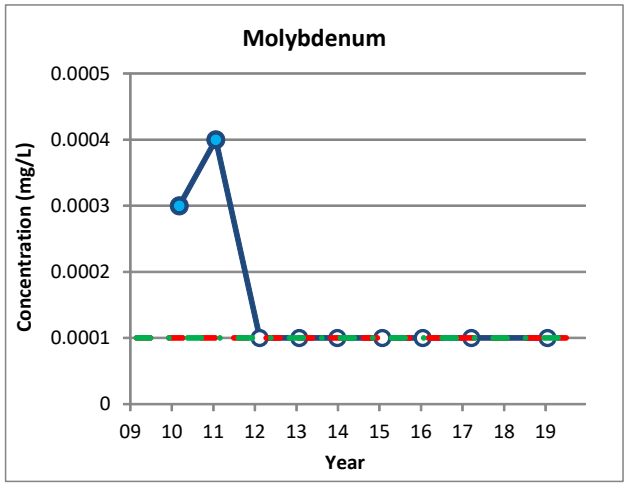
WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

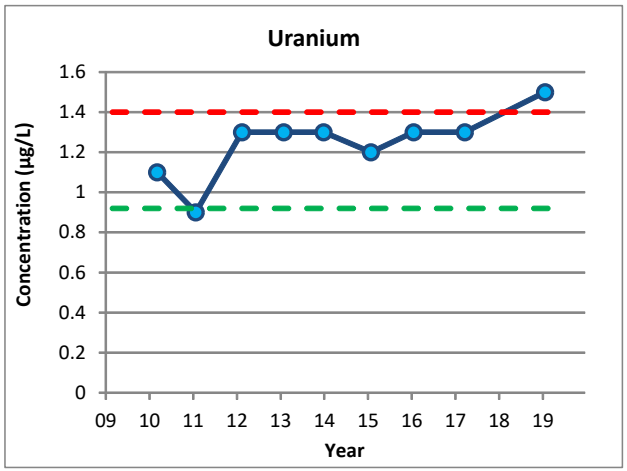
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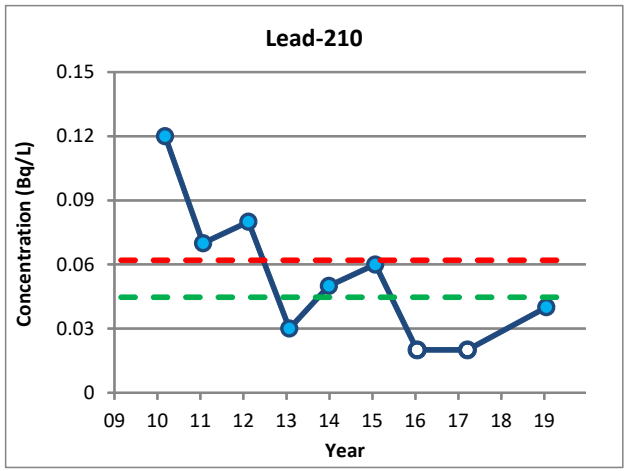
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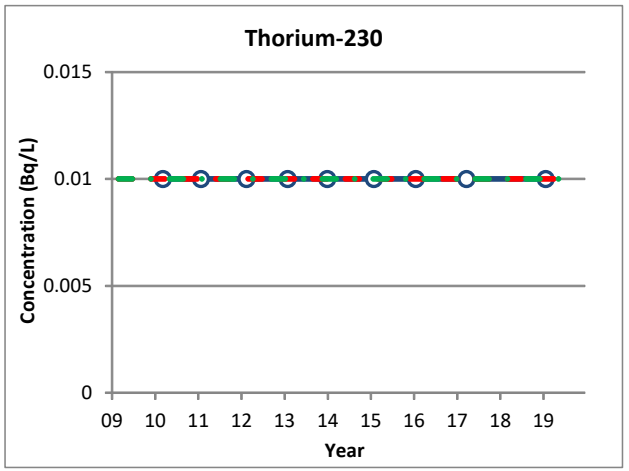












Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Lead	Selenium	Molybdenum	Uranium	Lead-210	Thorium-230
Unit	mg/L	mg/L	mg/L	µg/L	Bq/L	Bq/L
Base Case	0.00077	0.0078	0.0001	0.92	0.045	0.01
Upper Bound Case	0.0012	0.016	0.0001	1.4	0.062	0.01

Projection:N/A
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/26/2021 Scale:
Data Sources: EQUIS Database

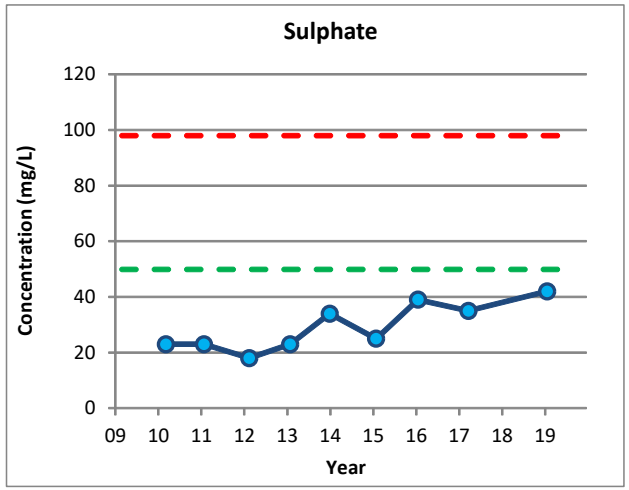
McCLEAN LAKE OPERATION

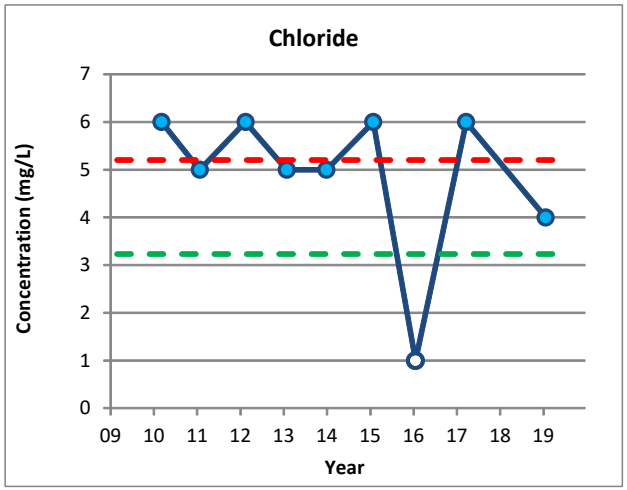
FIGURE 12
HYDROCHEMICAL TREND CHART FOR SUE C CWRP: PIEZOMETER LOCATION 07-11

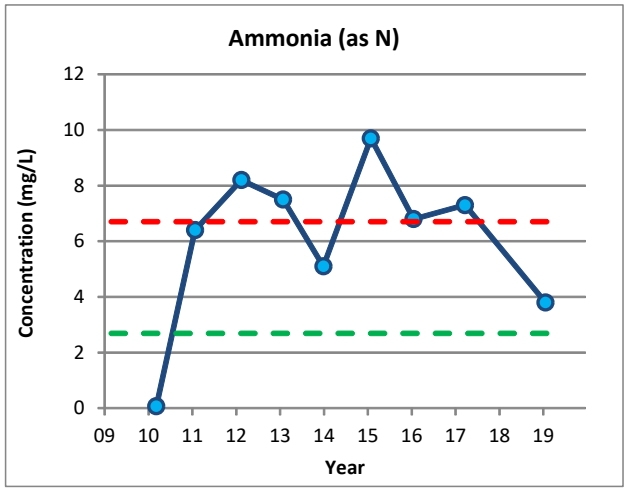
WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

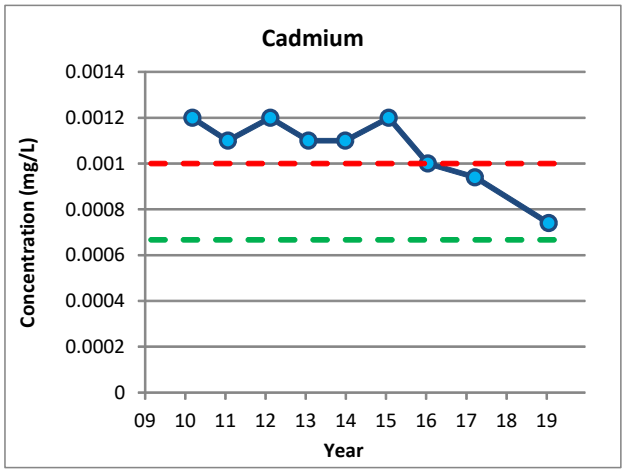
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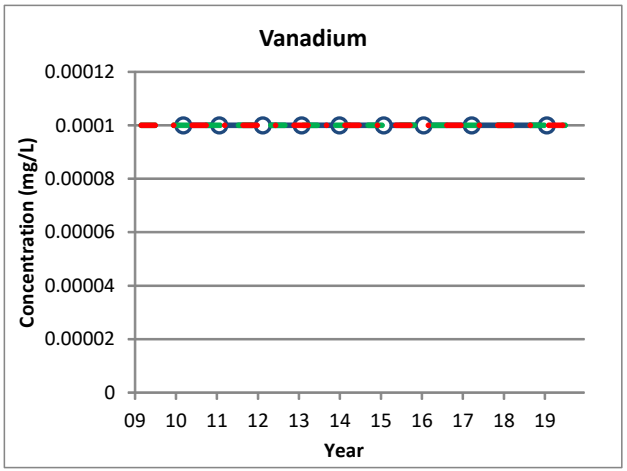
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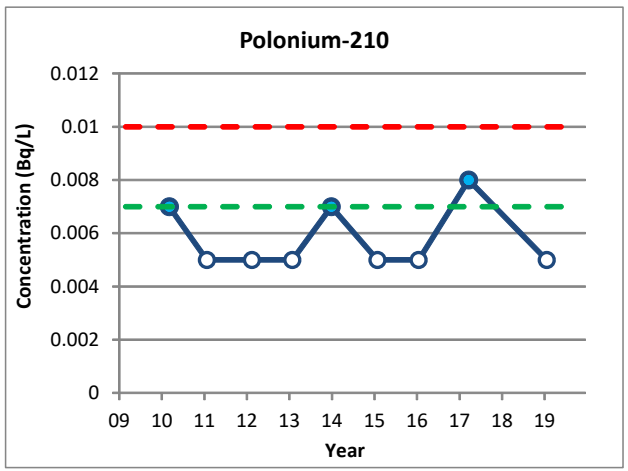












Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Sulphate	Chloride	Ammonia (as N)	Cadmium	Vanadium	Polonium-210
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	49.8	3.2	2.7	0.000667	0.0001	0.007
Upper Bound Case	98	5.2	6.7	0.001	0.0001	0.01

Projection:N/A
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/26/2021 Scale:
Data Sources: EQUIS Database

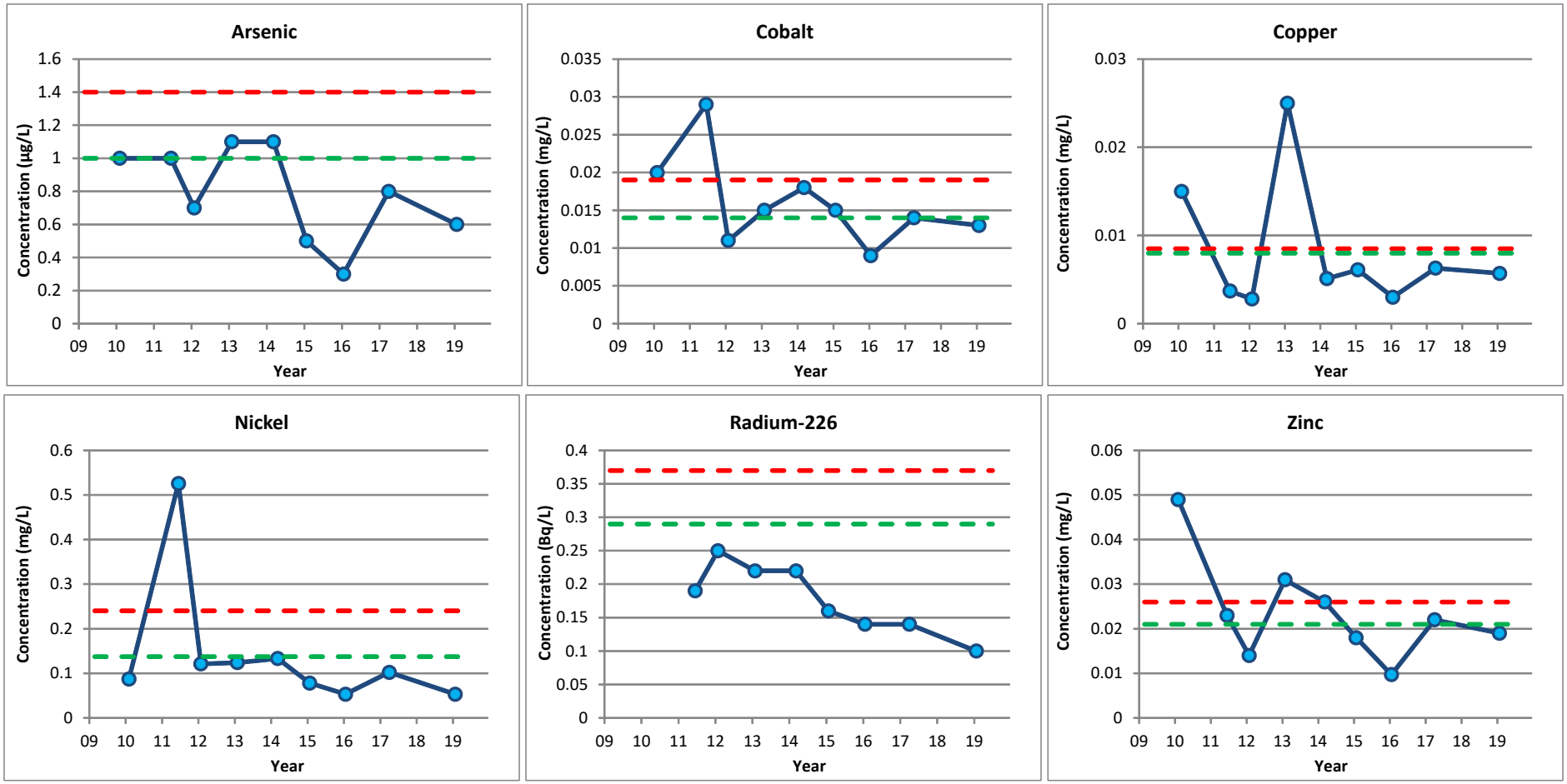
McCLEAN LAKE OPERATION

FIGURE 13
HYDROCHEMICAL TREND CHART FOR SUE C CWRP: PIEZOMETER LOCATION 07-11

WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Appendix\Figure 13.mxd



Base Case Source Term

Upper Bound Case Source

Analyte	Arsenic	Cobalt	Copper	Nickel	Radium-226	Zinc
Unit	µg/L	mg/L	mg/L	mg/L	Bq/L	mg/L
Base Case	1	0.014	0.008	0.14	0.29	0.021
Upper Bound Case	1.4	0.019	0.0085	0.24	0.37	0.026

Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Projection:N/A
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/26/2021 Scale:
Data Sources: EQUIS Database

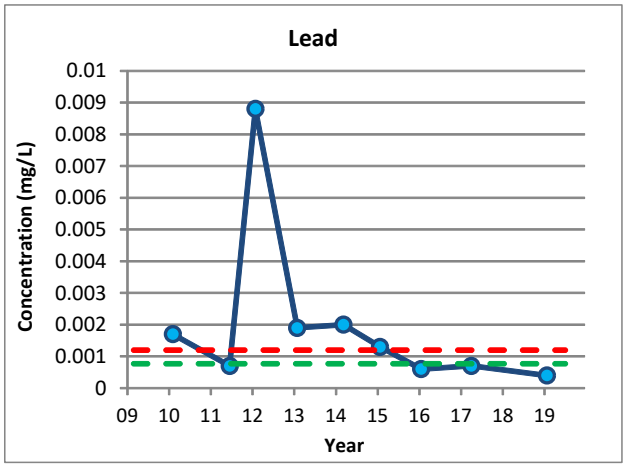
McCLEAN LAKE OPERATION

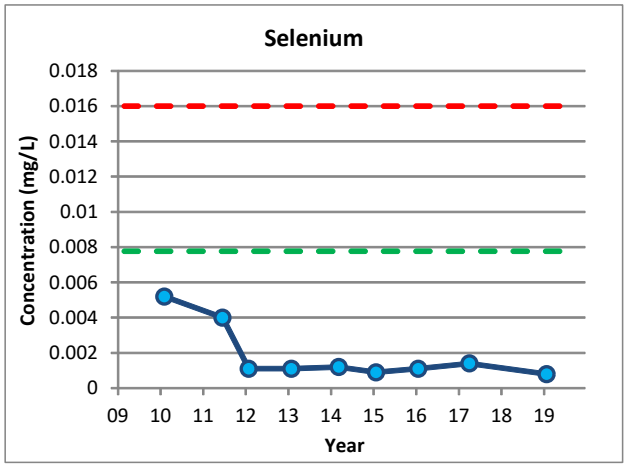
FIGURE 14
HYDROCHEMICAL TREND CHART FOR SUE C CWRP: PIEZOMETER LOCATION 07-12

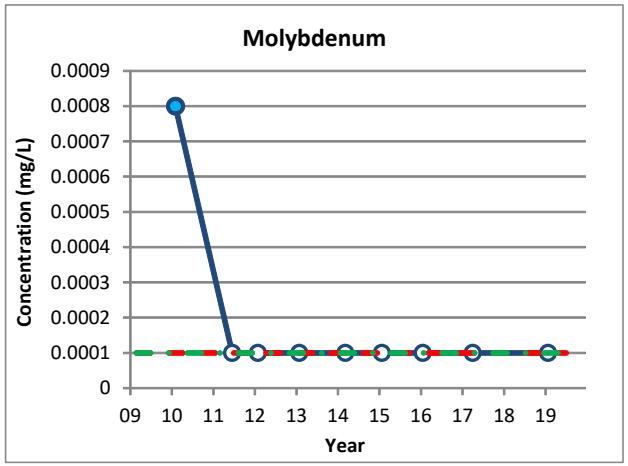
WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

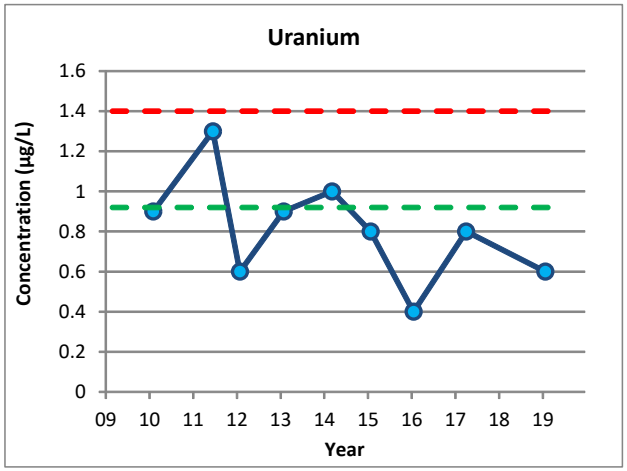
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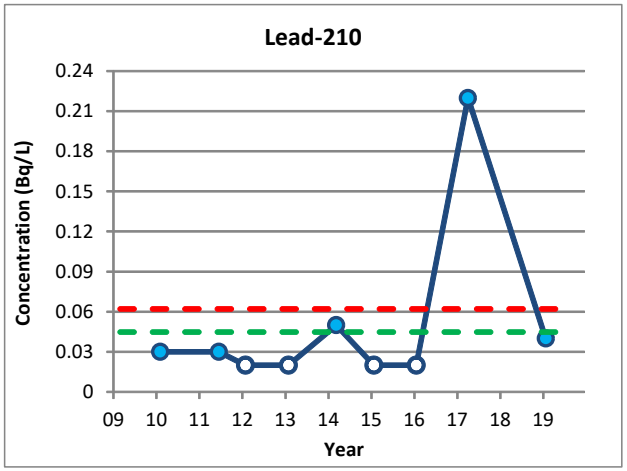
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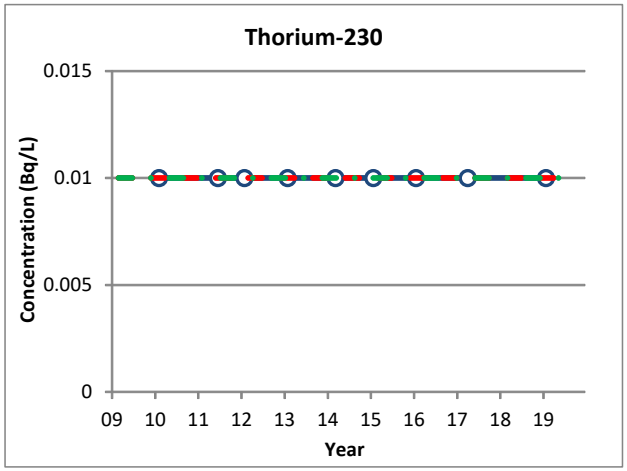












Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Lead	Selenium	Molybdenum	Uranium	Lead-210	Thorium-230
Unit	mg/L	mg/L	mg/L	µg/L	Bq/L	Bq/L
Base Case	0.00077	0.0078	0.0001	0.92	0.045	0.01
Upper Bound Case	0.0012	0.016	0.0001	1.4	0.062	0.01

Projection:N/A
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/26/2021 Scale:
Data Sources: EQUIS Database

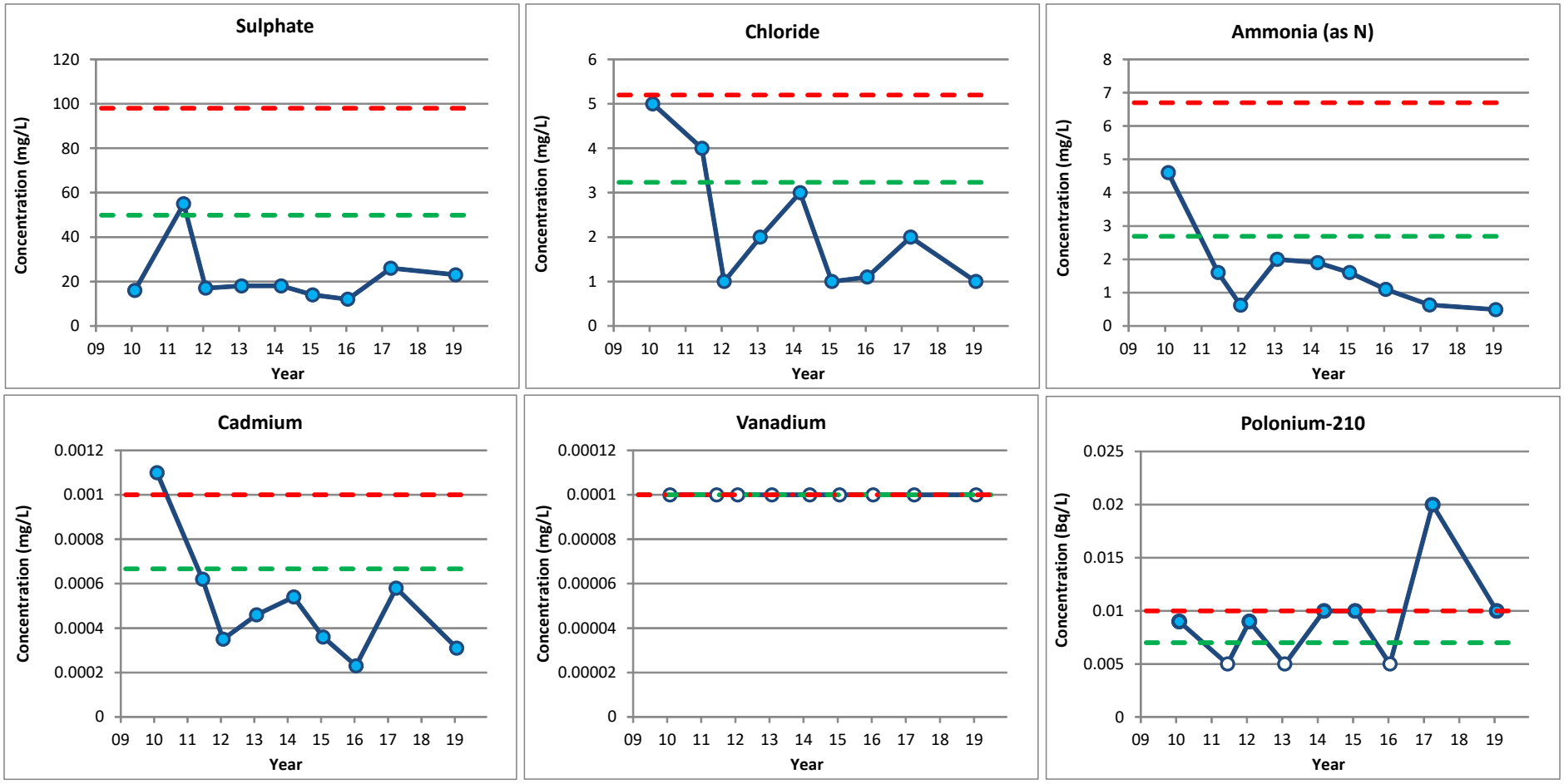
McCLEAN LAKE OPERATION

FIGURE 15
HYDROCHEMICAL TREND CHART FOR SUE C CWRP: PIEZOMETER LOCATION 07-12

WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Appendix\Figure 15.mxd



Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Sulphate	Chloride	Ammonia (as N)	Cadmium	Vanadium	Polonium-210
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	49.8	3.2	2.7	0.000667	0.0001	0.007
Upper Bound Case	98	5.2	6.7	0.001	0.0001	0.01

Projection:N/A
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/26/2021 Scale:
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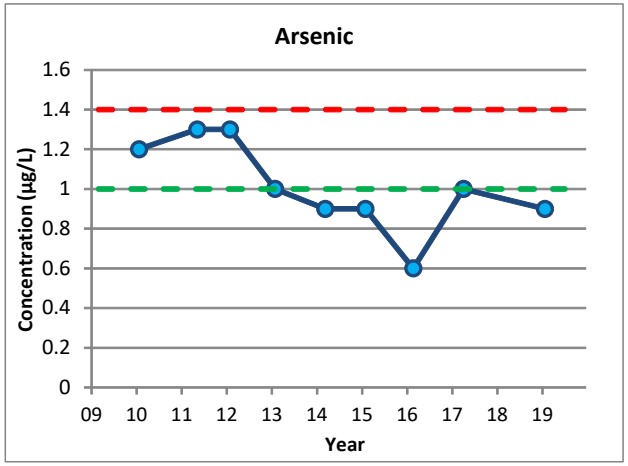
McCLEAN LAKE OPERATION

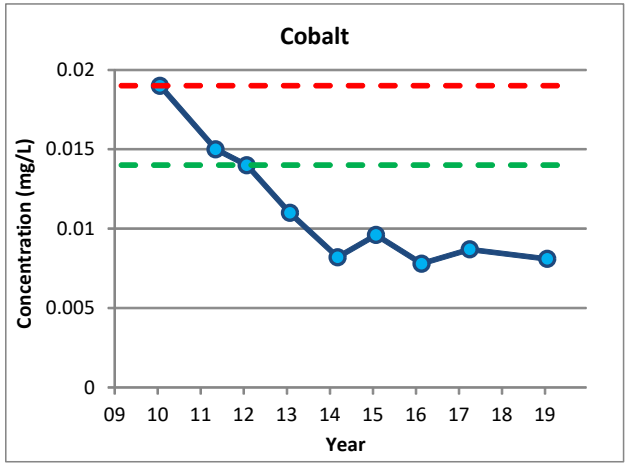
FIGURE 16
HYDROCHEMICAL TREND CHART FOR SUE C CWRP: PIEZOMETER LOCATION 07-12

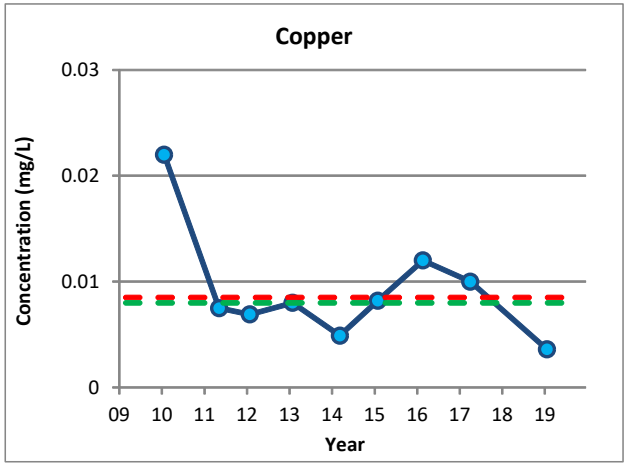
WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

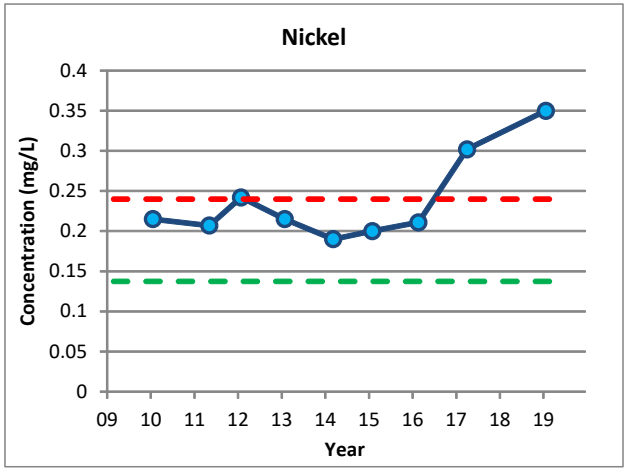
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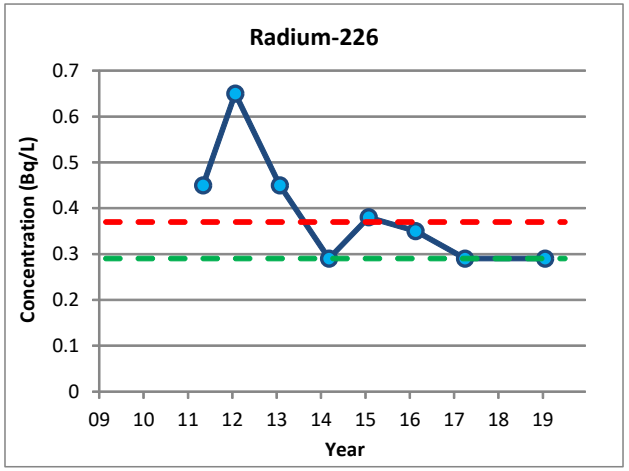
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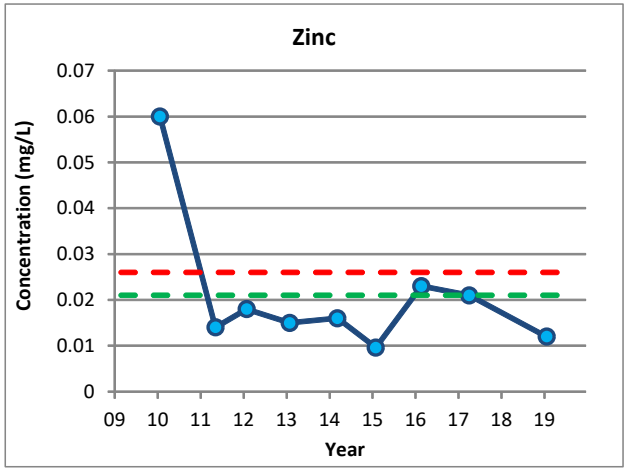












Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source

Analyte	Arsenic	Cobalt	Copper	Nickel	Radium-226	Zinc
Unit	µg/L	mg/L	mg/L	mg/L	Bq/L	mg/L
Base Case	1	0.014	0.008	0.14	0.29	0.021
Upper Bound Case	1.4	0.019	0.0085	0.24	0.37	0.026

Projection:N/A
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/26/2021
Scale:
Data Sources: EQUIS Database

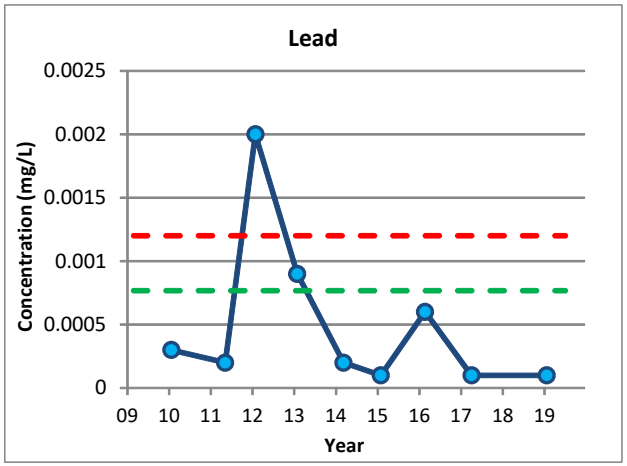
McCLEAN LAKE OPERATION

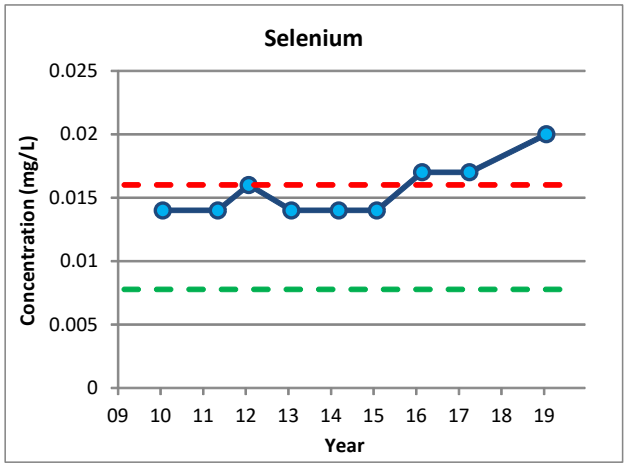
FIGURE 17
HYDROCHEMICAL TREND CHART FOR SUE C CWRP: PIEZOMETER LOCATION 07-13

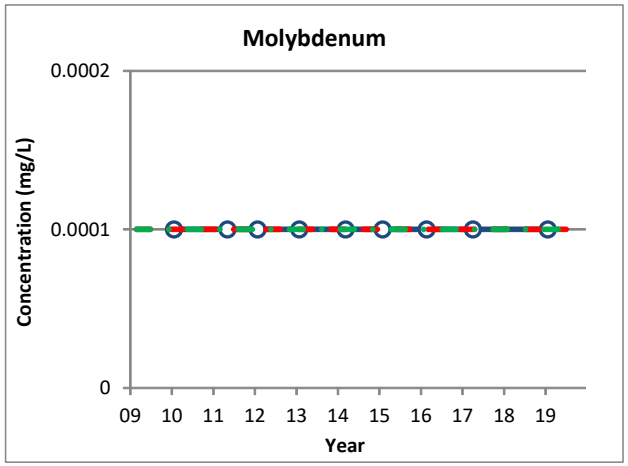
WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

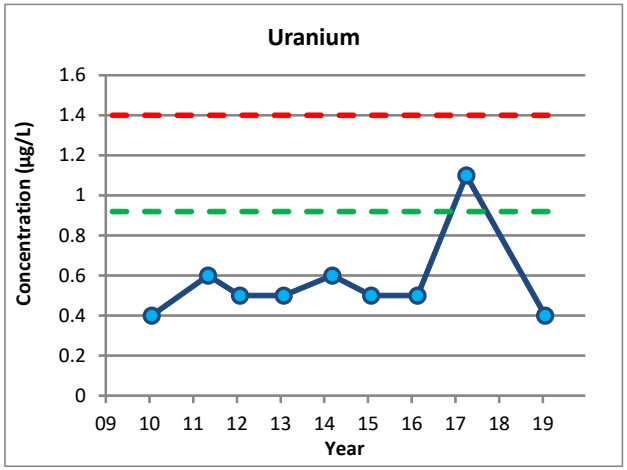
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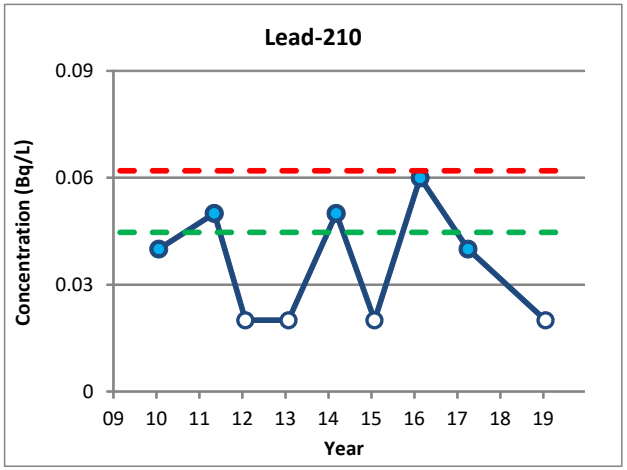
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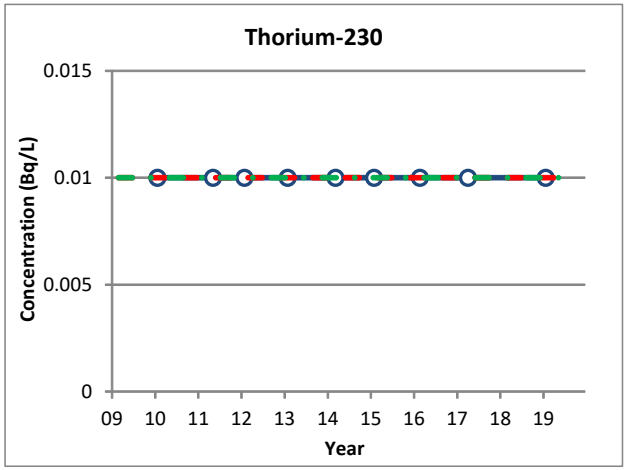












Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Lead	Selenium	Molybdenum	Uranium	Lead-210	Thorium-230
Unit	mg/L	mg/L	mg/L	µg/L	Bq/L	Bq/L
Base Case	0.00077	0.0078	0.0001	0.92	0.045	0.01
Upper Bound Case	0.0012	0.016	0.0001	1.4	0.062	0.01

Projection:N/A
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/26/2021 Scale:
Data Sources: EQUIS Database

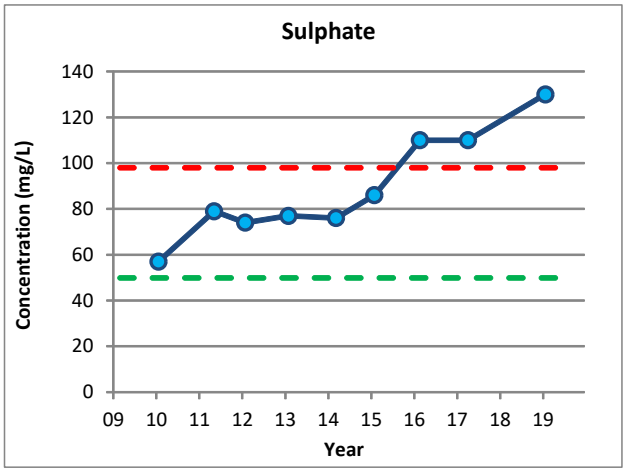
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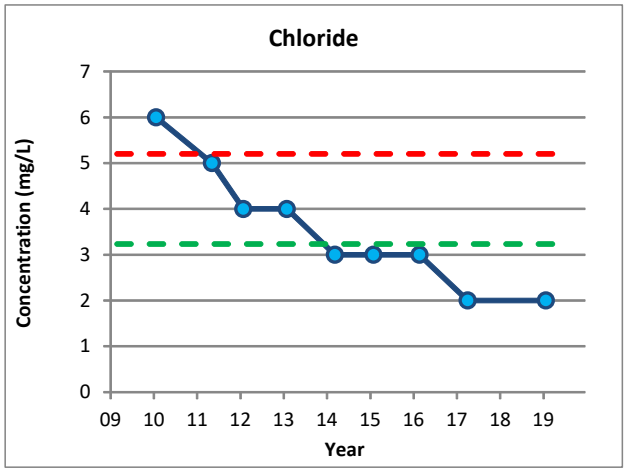
FIGURE 18
HYDROCHEMICAL TREND CHART FOR SUE C CWRP: PIEZOMETER LOCATION 07-13

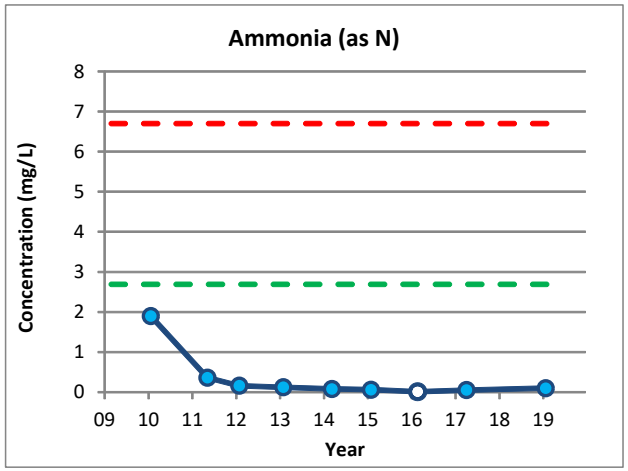
WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

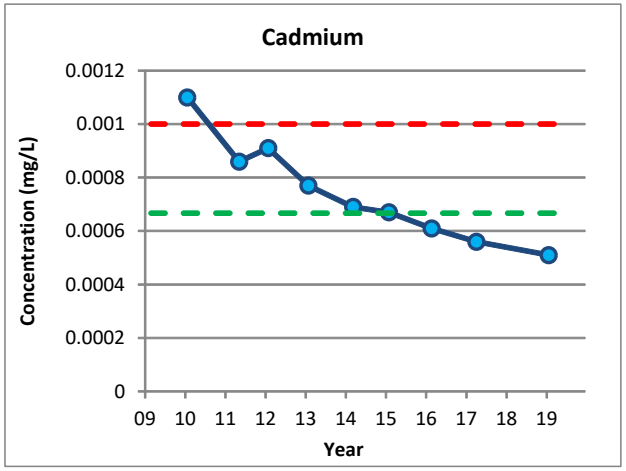
orano

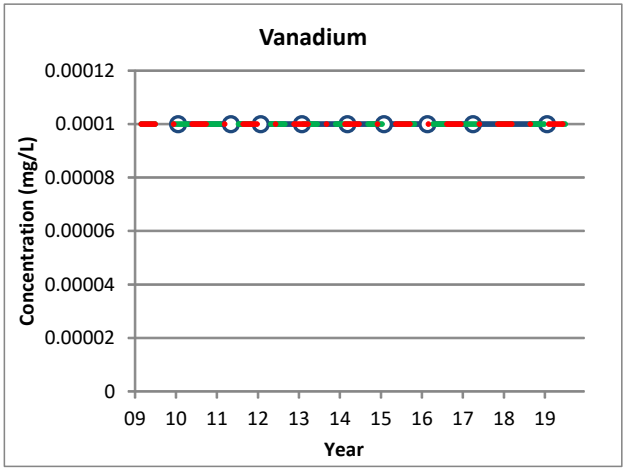
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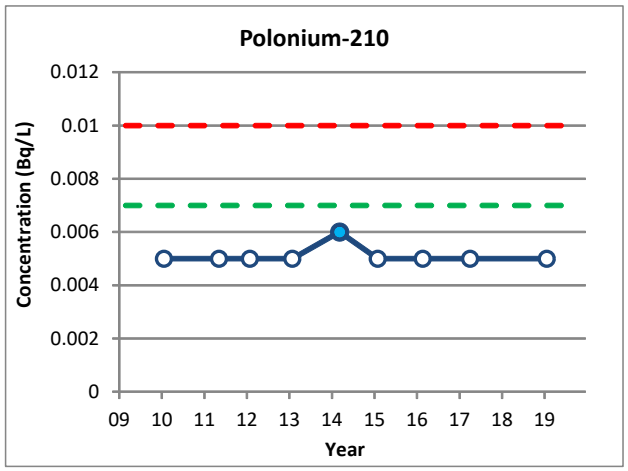












Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Sulphate	Chloride	Ammonia (as N)	Cadmium	Vanadium	Polonium-210
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	49.8	3.2	2.7	0.000667	0.0001	0.007
Upper Bound Case	98	5.2	6.7	0.001	0.0001	0.01

Projection:N/A
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/26/2021 Scale:
Data Sources: EQUIS Database

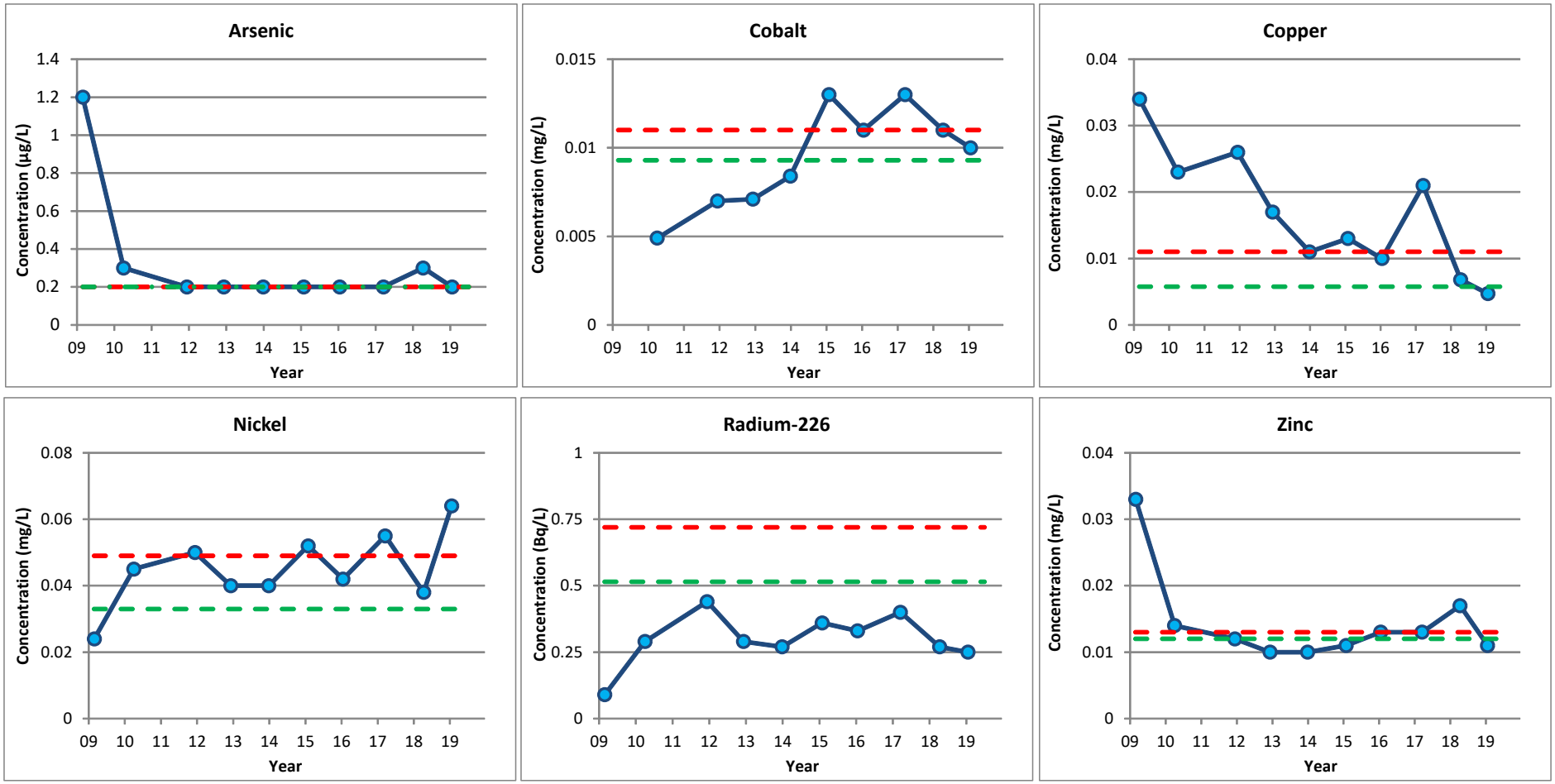
McCLEAN LAKE OPERATION

FIGURE 19
HYDROCHEMICAL TREND CHART FOR SUE C CWRP: PIEZOMETER LOCATION 07-13

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Appendix\Figure 19.mxd



Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Arsenic	Cobalt	Copper	Nickel	Radium-226	Zinc
Unit	µg/L	mg/L	mg/L	mg/L	Bq/L	mg/L
Base Case	0.2	0.0093	0.0058	0.033	0.52	0.012
Upper Bound Case	0.2	0.011	0.011	0.049	0.72	0.013

Projection:N/A
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/26/2021
Scale:
Data Sources: EQUIS Database

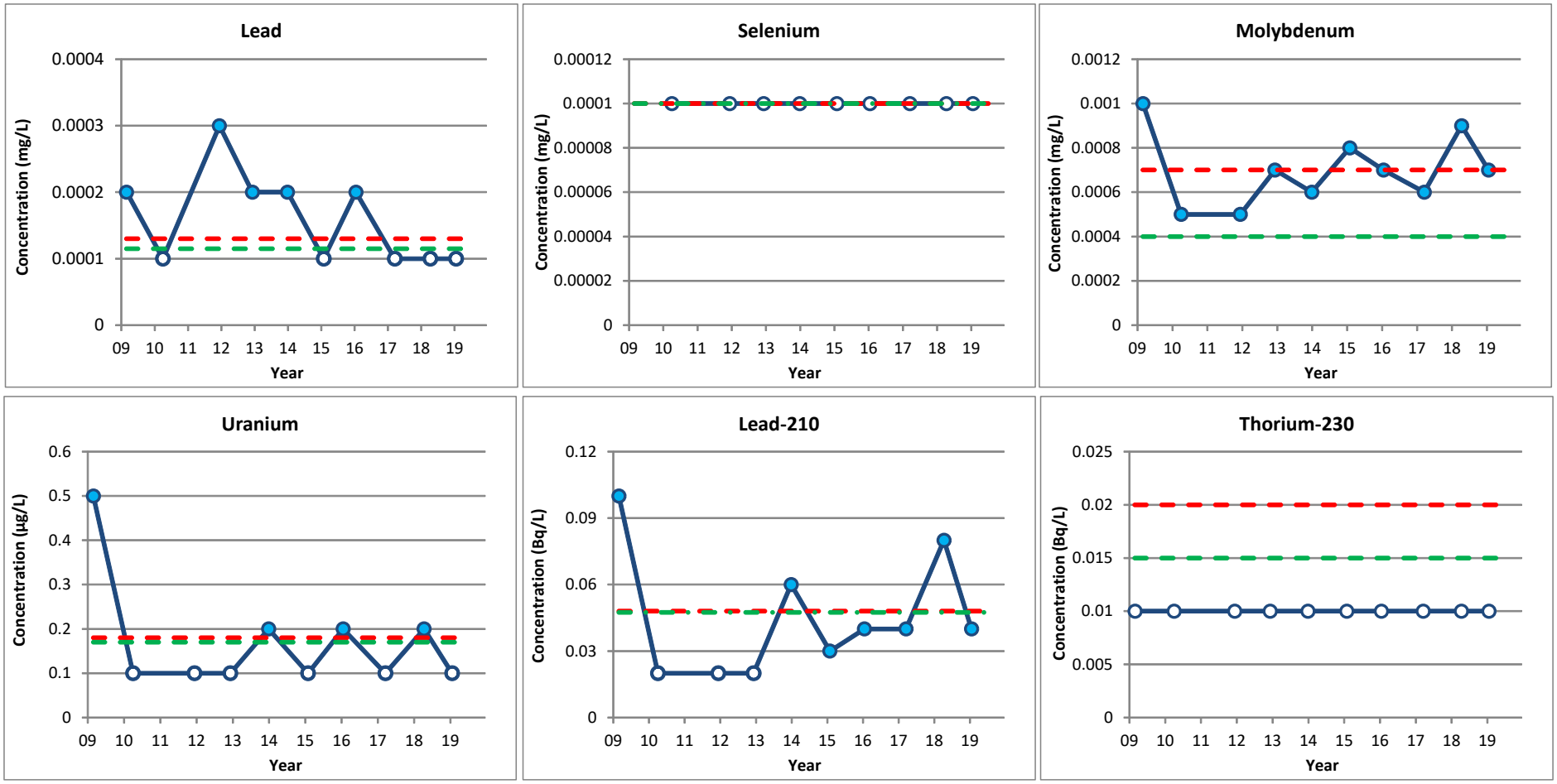
McCLEAN LAKE OPERATION

FIGURE 20
HYDROCHEMICAL TREND CHART FOR SUE E CWRP: PIEZOMETER LOCATION 07-14

WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Appendix\Figure 20.mxd



Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Lead	Selenium	Molybdenum	Uranium	Lead-210	Thorium-230
Unit	mg/L	mg/L	mg/L	µg/L	Bq/L	Bq/L
Base Case	0.00012	0.0001	0.0004	0.17	0.048	0.015
Upper Bound Case	0.00013	0.0001	0.0007	0.18	0.048	0.02

Projection:N/A
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/26/2021 Scale:
Data Sources: EQUIS Database

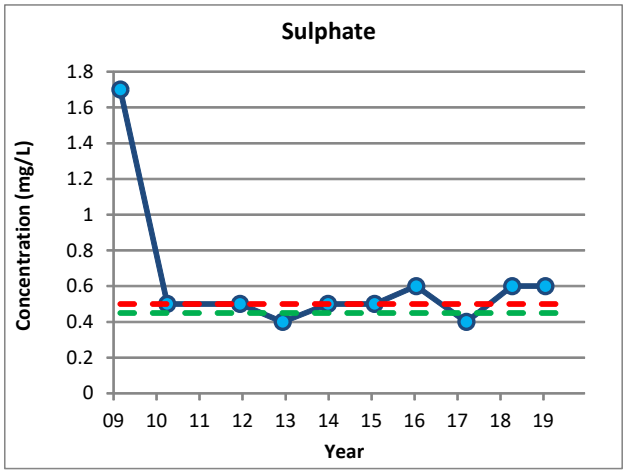
McCLEAN LAKE OPERATION

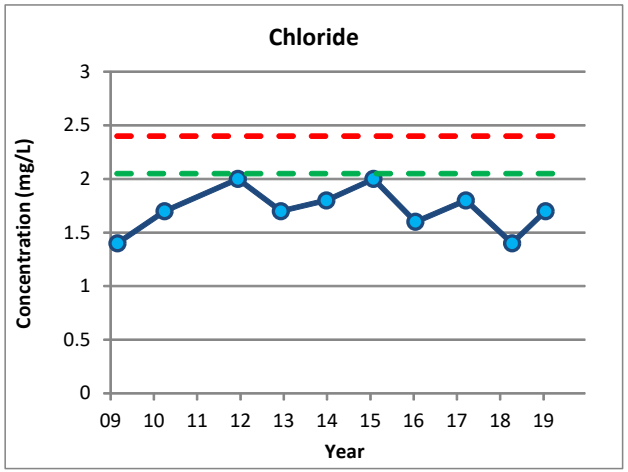
FIGURE 21
HYDROCHEMICAL TREND CHART FOR SUE E CWRP: PIEZOMETER LOCATION 07-14

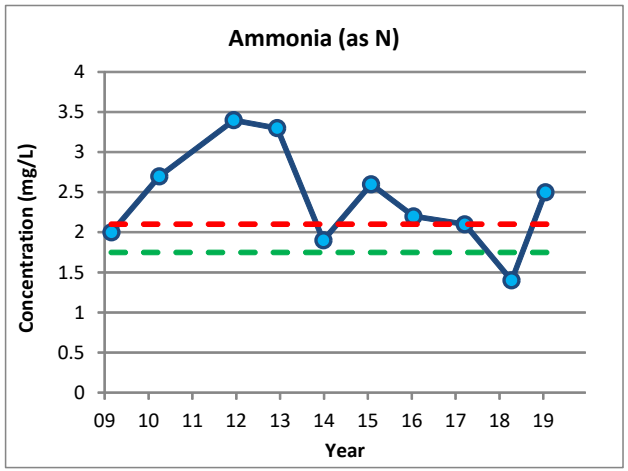
WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

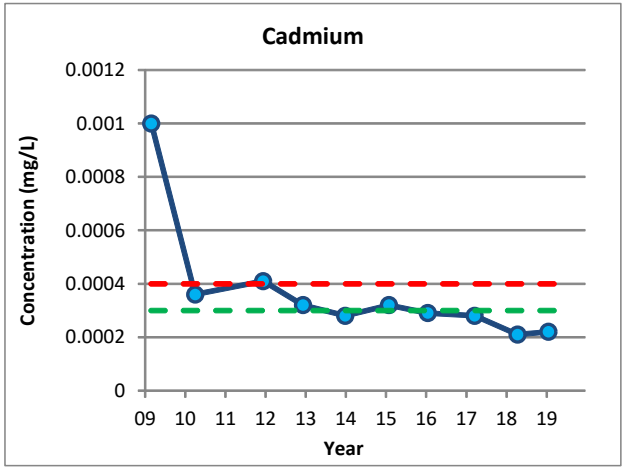
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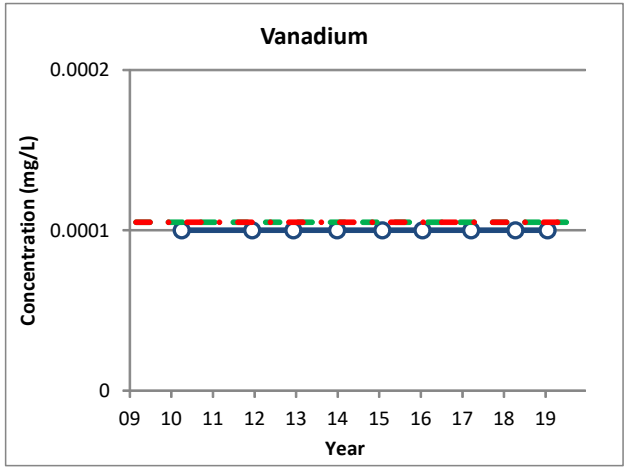
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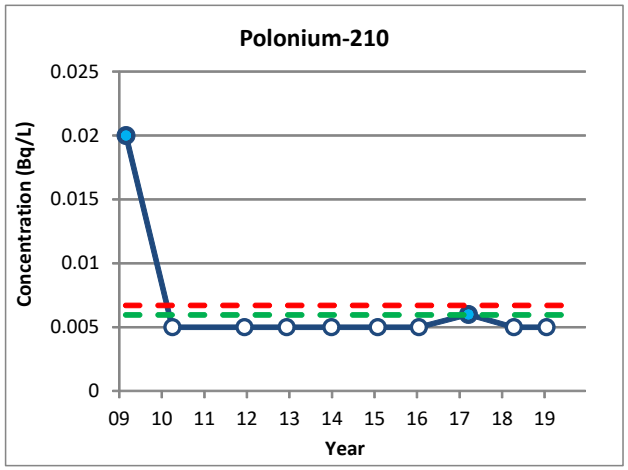












Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Sulphate	Chloride	Ammonia (as N)	Cadmium	Vanadium	Polonium-210
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	0.45	2.1	1.8	0.0003	0.00011	0.006
Upper Bound Case	0.5	2.4	2.1	0.0004	0.00011	0.0067

Projection:N/A
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/26/2021
Scale:
Data Sources: EQUIS Database

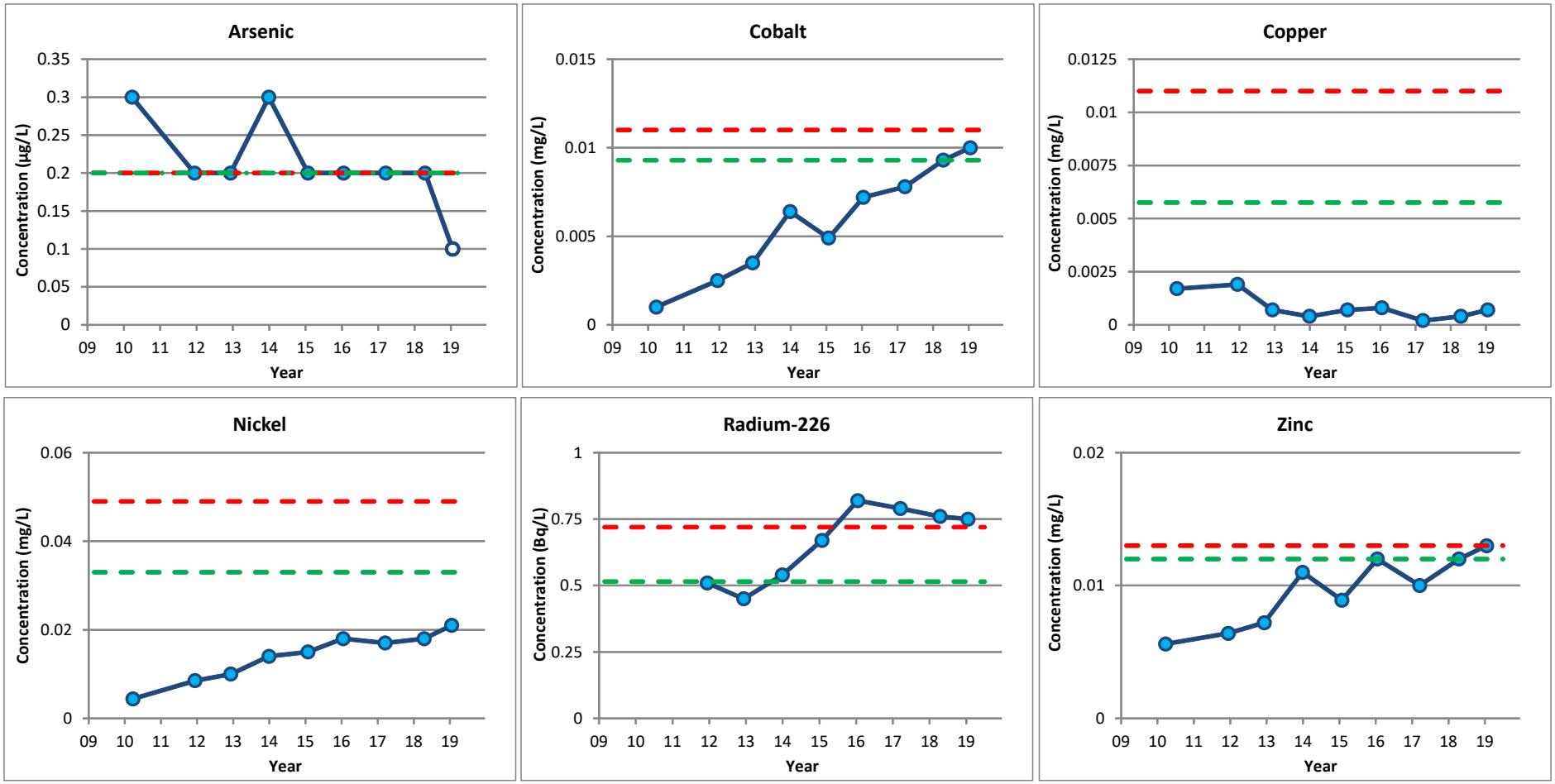
McCLEAN LAKE OPERATION

FIGURE 22
HYDROCHEMICAL TREND CHART FOR SUE E CWRP: PIEZOMETER LOCATION 07-14

WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Appendix\Figure 22.mxd



Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Arsenic	Cobalt	Copper	Nickel	Radium-226	Zinc
Unit	µg/L	mg/L	mg/L	mg/L	Bq/L	mg/L
Base Case	0.2	0.0093	0.0058	0.033	0.52	0.012
Upper Bound Case	0.2	0.011	0.011	0.049	0.72	0.013

Projection:N/A
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/26/2021
Scale:
Data Sources: EQUIS Database

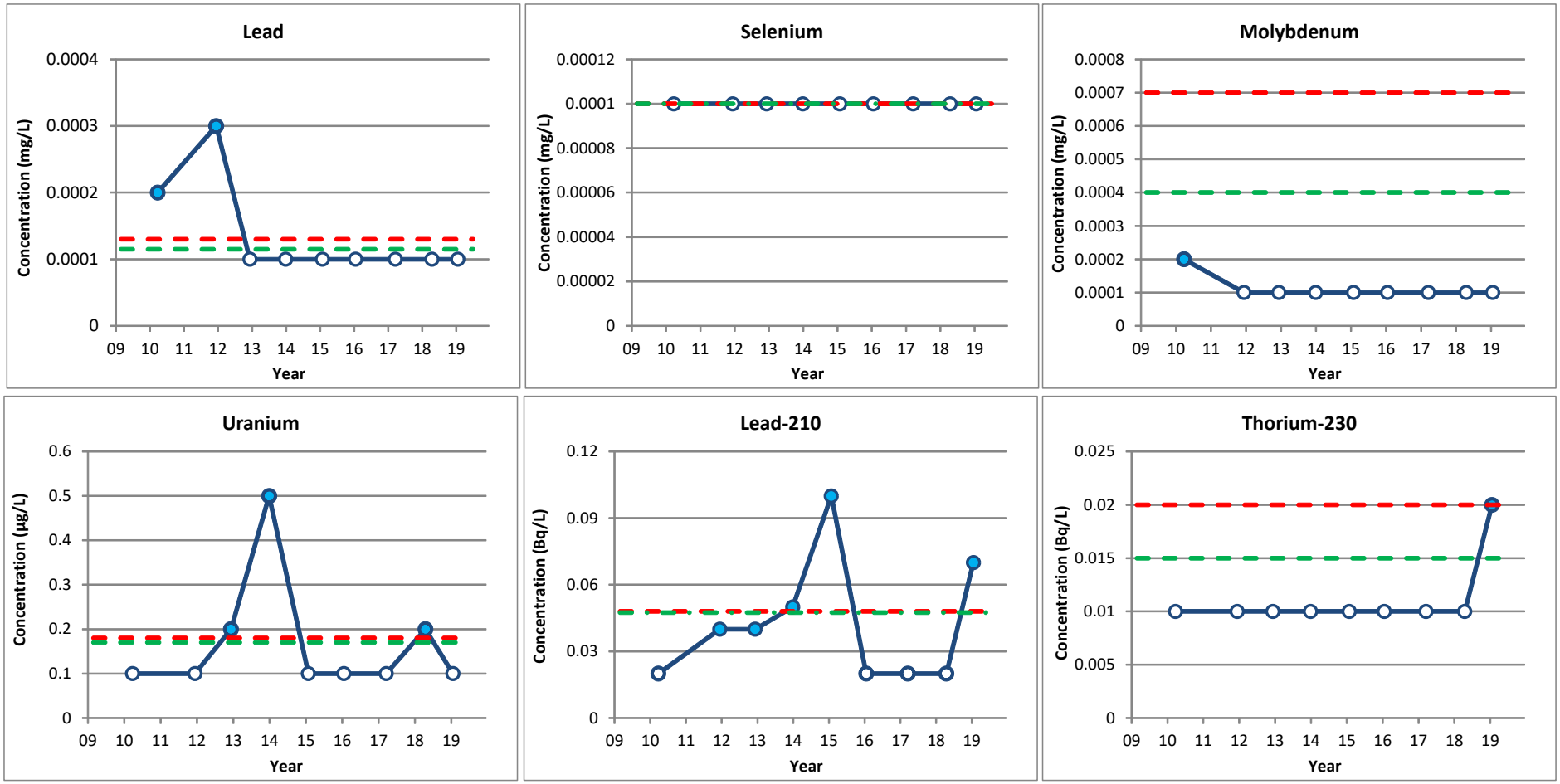
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FIGURE 23
HYDROCHEMICAL TREND CHART FOR SUE E CWRP: PIEZOMETER LOCATION 07-15

WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Appendix\Figure 23.mxd



Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Lead	Selenium	Molybdenum	Uranium	Lead-210	Thorium-230
Unit	mg/L	mg/L	mg/L	µg/L	Bq/L	Bq/L
Base Case	0.00012	0.0001	0.0004	0.17	0.048	0.015
Upper Bound Case	0.00013	0.0001	0.0007	0.18	0.048	0.02

Projection:N/A
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/26/2021 Scale:
Data Sources: EQUIS Database

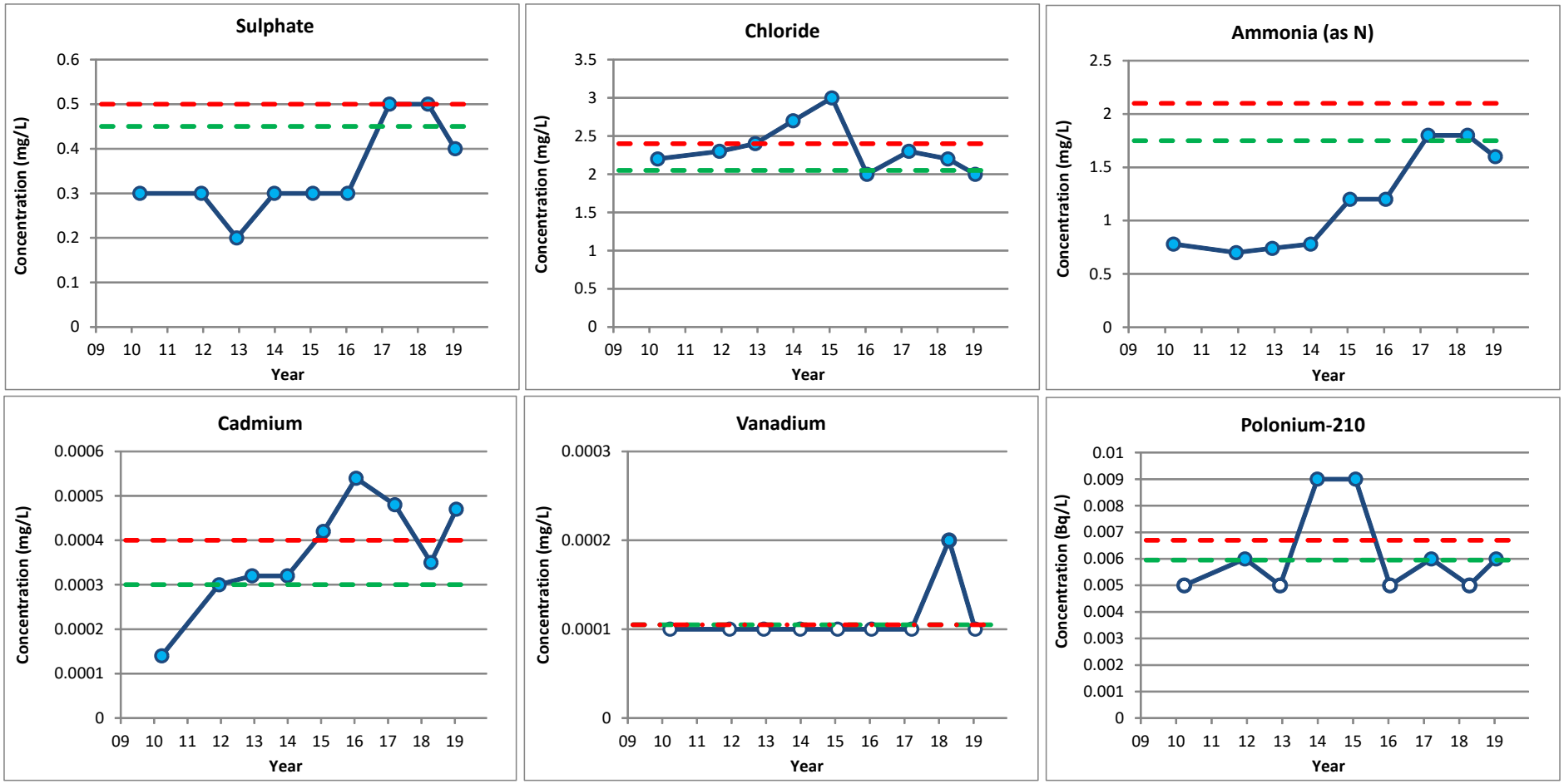
McCLEAN LAKE OPERATION

FIGURE 24
HYDROCHEMICAL TREND CHART FOR SUE E CWRP: PIEZOMETER LOCATION 07-15

WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Appendix\Figure 24.mxd



Note:
Filled symbols denote Sample Values
Unfilled symbols denote Values < Detection Limit(s)

Base Case Source Term
Upper Bound Case Source Term

Analyte	Sulphate	Chloride	Ammonia (as N)	Cadmium	Vanadium	Polonium-210
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	0.45	2.1	1.8	0.0003	0.00011	0.006
Upper Bound Case	0.5	2.4	2.1	0.0004	0.00011	0.0067

Projection:N/A
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/26/2021 Scale:
Data Sources: EQUIS Database

McCLEAN LAKE OPERATION

FIGURE 25
HYDROCHEMICAL TREND CHART FOR SUE E CWRP: PIEZOMETER LOCATION 07-15

WASTE ROCK MANAGEMENT TECHNICAL INFORMATION DOCUMENT

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File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Appendix\Figure 25.mxd

Appendix AI.7: Sue A and Sue E Special Waste Rock Piezometer Data

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1 Background

In October 2009, a small drilling and sampling program was conducted in the Sue C Pit. Four boreholes, completed as monitoring wells, were drilled in the Sue E special waste which had recently been pushed into the pit. The purpose of these monitoring wells was to validate the pore water source terms associated with Sue E special waste rock. Orano committed to the validation of these source terms as part of the Sue E Follow-Up Program.

Four monitoring wells were installed: 09-07, 09-08, 09-09, and 09-10. At the drilling location at 09-07, both Sue E and Sue A special waste were intersected so the opportunity was available to also collect some data in Sue A special waste.

Drilling was completed by Layne Christensen Company using an AP1000 DWPH hammer rig. A special type of piezometer, known as a Westbay, was installed in each borehole and backfilled with 10/20 silica sand to surface. Westbays are multi-level piezometers that use specialized ports and tools to allow for water sampling at various depths throughout the well.

Table 1 shows the wells, locations, and depths at installation. The wells were installed in Sue E special waste, but at the time of installation the pushing of Sue E special waste into the pit was not yet completed. After installation, pushing of waste rock continued and over time the elevation of the waste rock was lowered by 5-10 m around the new wells. The wells were cut off to an accessible height in November of 2010 and resurveyed. The shortening of the wells resulted in the loss of the top 1-2 sampling ports in each well. However, many of these ports were dry at installation so there was not a significant loss of monitoring data as a result of this activity. The resulting top of pipe elevations and well depths as of November 2010 are also presented in Table 1.

Well logs from the time of installation are also attached to the end of this data summary.

Table 1: Monitoring Well Locations and Details

Well	Easting	Northing	At Installation		As of November 2010		
			Top of Westbay Pipe Elevation (m)	Depth from Top of Westbay Pipe (m)	Top of Westbay Pipe Elevation (m)	Change in Top of Pipe Elevation (m)	Depth from Top of Westbay Pipe (m)
09-07	570092.61	6458242.51	441.632	83.50	438.288	3.34	80.16
09-08	570053.69	6458100.31	442.414	58.50	438.166	4.25	54.25
09-09	570024.44	6457982.91	445.378	27.10	438.316	7.06	20.04
09-10	570017.28	6457949.17	445.980	28.00	438.390	7.59	20.41

Each monitoring well contains a number of water sampling ports. Table 2 shows the port location names and the waste type at completion. The depths below the top of casing both at installation and as of November 2010 are also shown.

Table 2: Monitoring Port Depths

Well	Completion	Location Name in EQuIS	Number of Samples	Sampling Depth (m btoc) at Installation	Sampling Depth (m btoc) as of November 2010
09-07	Sue E	09-07_MP18	0	0.9	Removed
		09-07_MP17	1	7.0	3.7
		09-07_MP16	1	13.1	9.8
		09-07_MP15	1	19.2	15.9
	Sue A	09-07_MP14	1	25.3	21.9
		09-07_MP13	2	28.3	25.0
		09-07_MP12	1	34.4	31.1
		09-07_MP11	2	37.5	34.1
		09-07_MP10	1	43.5	40.2
		09-07_MP09	3	46.6	43.2
		09-07_MP08	1	52.7	49.3
		09-07_MP07	2	55.7	52.4
		09-07_MP06	1	61.8	58.4
		09-07_MP05	2	64.8	61.5
		09-07_MP04	1	70.9	67.6
		09-07_MP03	3	74.0	70.6
		09-07_MP02	0	80.0	76.7
		09-07_MP01	0	83.1	79.7
09-08	Sue E	09-08_MP12	1	6.8	2.6
		09-08_MP11	2	9.9	5.6
		09-08_MP10	1	15.9	11.7
		09-08_MP09	1	19.0	14.7
		09-08_MP08	1	25.1	20.8
		09-08_MP07	0	28.1	23.9
		09-08_MP06	0	34.2	29.9
		09-08_MP05	0	37.2	33.0
		09-08_MP04	0	43.3	39.1
		09-08_MP03	1	46.4	42.1
		09-08_MP02	1	52.4	48.2
		09-08_MP01	0	55.5	51.2
09-09	Sue E	09-09_MP05	0	3.8	Removed
		09-09_MP04	1	8.9	1.8
		09-09_MP03	3	15.0	7.9
		09-09_MP02	3	21.0	14.0
		09-09_MP01	2	24.1	17.0
09-10	Sue E	09-10_MP05	0	3.7	Removed
		09-10_MP04	1	9.8	2.2
		09-10_MP03	2	15.9	8.3
		09-10_MP02	2	21.9	14.4
		09-10_MP01	3	25.0	17.4

2 Sue A Pore Water Results

The pore water sample results for Sue A are presented in Table 3. A maximum, minimum, and average are calculated for each analyte. The results were compared to the pore water source terms for Sue A special waste that were used in the Caribou EIS, and the results are shown in Figures 1, 2, and 3. The results show that the measured pore water concentrations for Sue A special waste are generally consistent with what was predicted in the Caribou EIS, with the exception of an elevated measurement of nickel.

It should be noted that the sample from MP11 on July 22, 2010, has a nickel result of 46.5 mg/L. This is considerably higher than the results from other ports, which range from 0.01 mg/L to 2.41 mg/L. This port was resampled in March 2013 and was found to be 2.05 mg/L. The July 22, 2010 result from MP11 does not appear to be representative of the Sue A waste rock and has a strong influence on the average concentration. Without the July 22, 2010 result from MP11, the average for nickel would be 1.17 mg/L.

Table 3: Sue A Pore Water Results (from Orano EQuIS Database)

Analyte	09-07																				Min	Max	Average	Caribou EIS
	MP03			MP04	MP05		MP06	MP07		MP08	MP09			MP10	MP11		MP12	MP13		MP14				
	10/19/2009	7/21/2010	3/2/2013	7/21/2010	7/21/2010	3/2/2013	7/22/2010	7/22/2010	3/2/2013	7/22/2010	10/18/2009	7/22/2010	3/2/2013	7/22/2010	7/22/2010	3/3/2013	7/22/2010	7/21/2010	3/2/2013	7/20/2010				
Ammonia (mg/L)		1.58		1.49	1.62		29.75	6.74		3.61		4.66		4.41	16.25		30.5	2.79		1.58	1.49	30.5	8.7	
Arsenic (µg/L)	7140	10700	10800	10500	10200	1040	129	133	4550	4450	350	2990	2260	1940	2770	8360	3710	3710	1220	458	129	10800	4371	91000
Cadmium (mg/L)	0.00034	0.00013	0.0002	0.00011	0.00008	0.00003	0.00003	0.00001	0.00006	0.00005	0.00013	0.00009	0.00006	0.00007	0.0006	0.00007	0.00005	0.0001	0.00001	0.00024	0.00001	0.0006	0.00012	
Chloride (mg/L)	5.1	5.5	5	5.3	4.5	5	6	6	5	5	6	4.9	5	5	7	4	4	4.6	4	5	4	7	5.1	
Cobalt (mg/L)	0.481	0.3	0.24	0.28	0.72	0.028	0.0043	0.0023	0.17	0.17	0.0076	0.093	0.081	0.034	1.1	0.17	0.067	0.32	0.0027	0.0006	0.0006	1.1	0.2	0.5
Copper (mg/L)	0.0016	0.0002	0.011	0.0003	0.0002	0.0002	0.0004	0.0009	0.0002	0.0003	0.0004	0.0003	0.0002	0.0002	0.007	0.0002	0.0002	0.0002	0.0002	0.0026	0.0002	0.011	0.0013	0.5
Lead (mg/L)	0.0011	0.0001	0.001	0.0004	0.0023	0.0012	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.002	0.0001	0.001	0.0016	0.0001	0.0001	0.0001	0.0001	0.0001	0.0023	0.0006	0.005
Lead-210 (Bq/L)	0.02	0.04	0.04	0.04	0.04		0.04	0.04		0.04		0.04		0.04	0.04		0.04	0.04		0.04	0.02	0.04	0.04	0.03
Molybdenum (mg/L)	0.404	0.671	0.9	0.668	0.435	0.414	0.252	0.357	0.5	0.352	0.189	0.25	0.322	0.229	0.1	0.516	0.28	0.291	0.614	0.331	0.1	0.9	0.40	1.2
Nickel (mg/L)	1.68	2.27	3.28	2.41	1.81	0.094	0.017	0.034	1.7	1.14	0.092	0.865	1.16	0.738	46.5	2.05	0.847	1.88	0.201	0.01	0.01	46.5	3.4	0.2
Polonium-210 (Bq/L)	0.007	0.02	0.01	0.03	0.01		0.01	0.01		0.01		0.01		0.01	0.01		0.01	0.01		0.01	0.007	0.03	0.01	
Radium-226 (Bq/L)	0.68	0.96	0.72	0.66	0.7		0.04	0.18		0.31		0.15		0.08	0.93		0.57	0.78		0.06	0.04	0.96	0.49	1.2
Selenium (mg/L)	0.0013	0.0014	0.002	0.0019	0.0011	0.0005	0.0004	0.0006	0.0017	0.001	0.0011	0.0009	0.001	0.0007	0.013	0.0018	0.0008	0.0013	0.0004	0.0014	0.0004	0.013	0.002	0.05
Sulfate (mg/L)	23	37.5	57	36	31	40	25.5	25.5	43	25.5	23	20.5	39	22	255	49	36.5	39.5	44	51.5	20.5	255	46.2	
Thorium-230 (Bq/L)	0.01	0.02	0.02	0.02	0.02		0.02	0.02		0.02		0.02		0.02	0.02		0.02	0.02		0.02	0.01	0.02	0.02	0.04
Uranium (µg/L)	0.4	71	1	0.7	0.7	10	14	30	0.4	0.5	1.9	0.4	0.2	0.4	1	5.9	40	4.1	1.1	4.2	0.2	71	9.4	350
Vanadium (mg/L)	0.0077	0.0086	0.009	0.0089	0.0064	0.001	0.0004	0.0004	0.0065	0.0056	0.0004	0.0039	0.0012	0.0009	0.005	0.0053	0.0012	0.0046	0.0005	0.0003	0.0003	0.009	0.004	
Zinc (mg/L)	0.089	0.039	0.13	0.034	0.021	0.14	0.0013	0.0012	0.15	0.017	0.028	0.06	0.21	0.012	0.15	0.28	0.012	0.02	0.1	0.011	0.0012	0.28	0.075	0.035

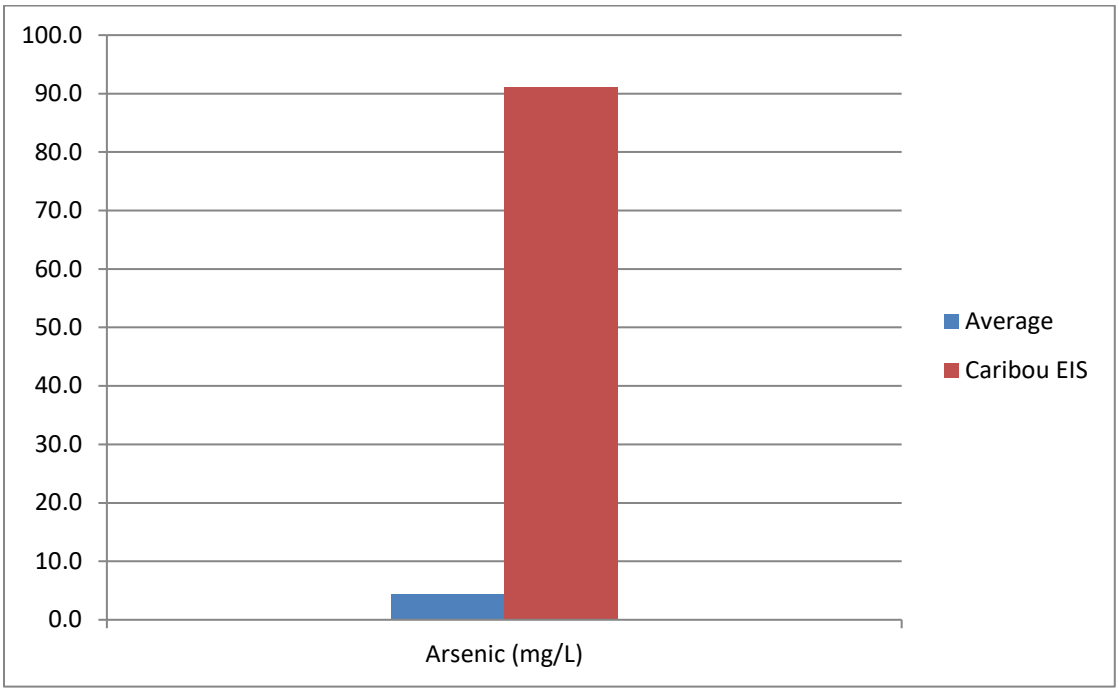


Figure 1: Sue A Pore Water Results for Arsenic

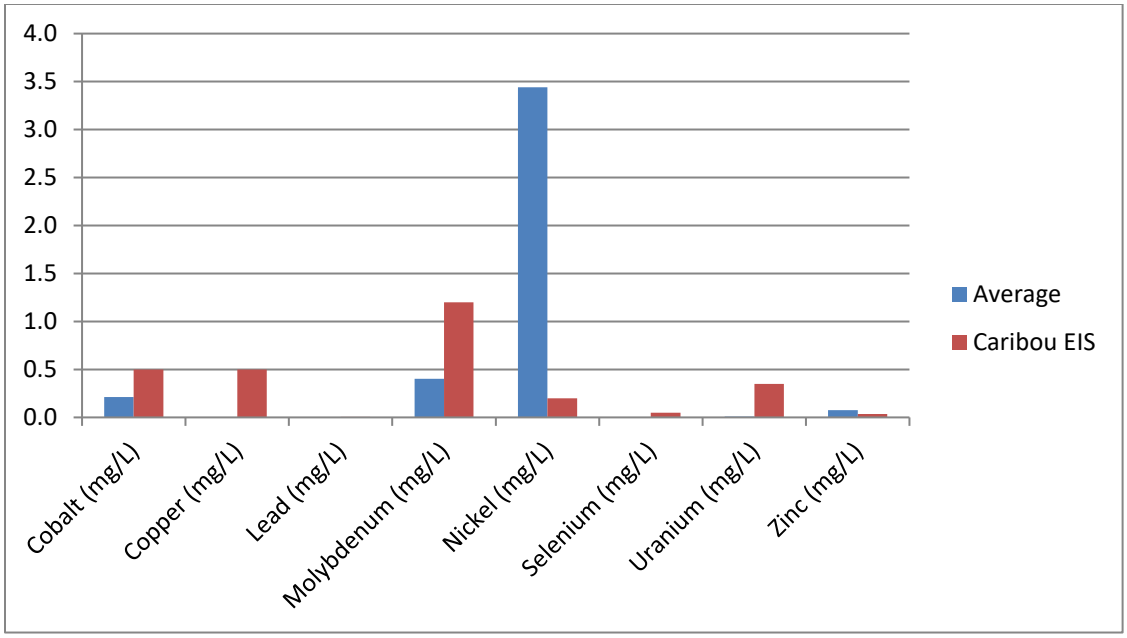


Figure 2: Sue A Pore Water Results for Remaining Metals

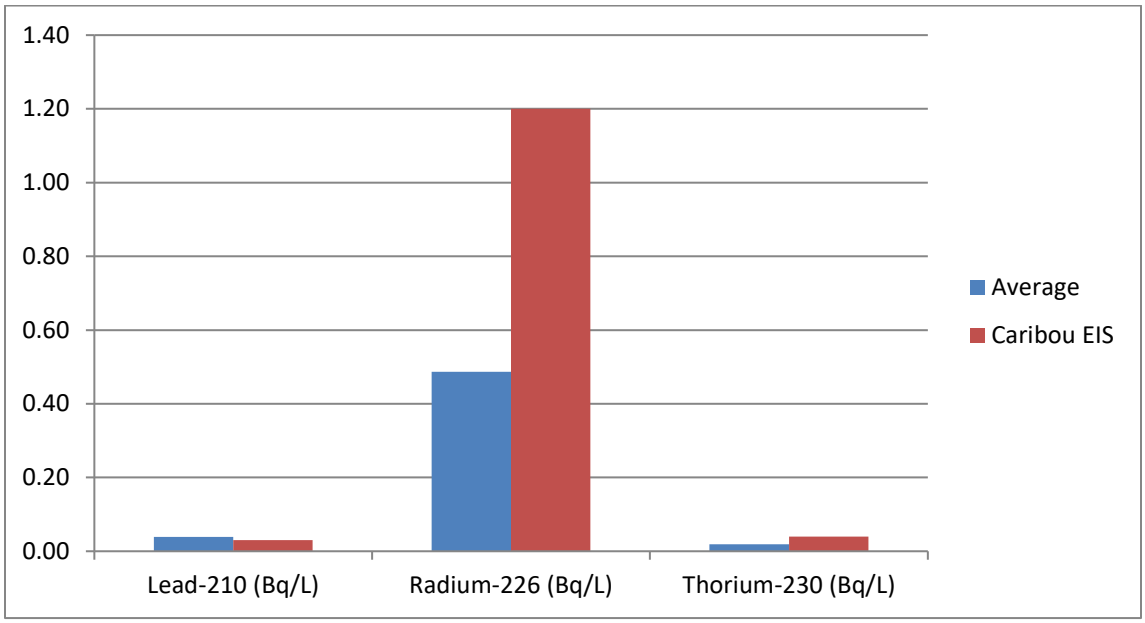


Figure 3: Sue A Pore Water Results for Radionuclides

3 Sue E Pore Water Results

The pore water sample results for Sue E were summarized and presented in the Sue E Follow-Up Program (AREVA 2012). In the Follow-Up Program Report, the pore water sample results were compared to the source terms used in the Sue E EIS. The results showed that the actual measured pore water data was generally consistent with predictions made in the Sue E EIS.

The pore water sample results for Sue E special waste are shown in Table 4. For the purposes of this study, the pore water results were compared to the source terms used in the Caribou EIS, as this is the most recently assessed and approved EIS. This comparison is shown in Figures 4, 5, and 6. The results show that the measured pore water geochemistry is generally consistent with what was predicted in the Caribou EIS.

The result from 09-10_MP03 on October 13, 2010, shown in Table 4, was considered to be an outlier and was removed from the data set. The extremely high pore water concentration for arsenic (250,000 μg/L) was likely established by a "nugget effect" in which a small amount of highly enriched arsenic mineralization within the waste rock was placed in close proximity to the sampling port at that elevation. The waste rock is well consolidated with a low liquid to solid ratio. Oxidized products from the "nugget" may have dissolved into a small volume of water, creating elevated concentrations. As there is no mixing other than molecular diffusion, the footprint in the pore water arsenic concentration is of limited spatial and possibly temporal extent and was therefore considered to be not representative of pore water quality in contact with the general waste rock. The port was resampled twice in March of 2013, and the elevated arsenic result was confirmed. All sample results from the 09-10_MP03 were removed from the data set.

Table 4: Sue E Pore Water Results (from Orano EQuIS Database)

Analyte	09-07			09-08								09-09								
	MP15	MP16	MP17	MP02	MP03	MP08	MP09	MP10	MP11	MP11	MP12	MP01	MP01	MP02	MP02	MP02	MP03	MP03	MP03	MP04
	7/6/2010	7/21/2010	7/21/2010	10/17/2009	10/18/2009	10/17/2009	10/18/2009	7/23/2010	10/18/2009	7/23/2010	7/23/2010	7/24/2010	2/27/2013	10/17/2009	7/24/2010	2/27/2013	10/17/2009	7/23/2010	3/1/2013	3/1/2013
Ammonia (mg/L)	1.49	1.31	1.29					8.33		4.33	4.24	4.94			3.03			12.32		
Arsenic (µg/L)	706	3230	3900	40	9	1870	76	257	226	1010	2360	113	185	1300	803	1020	610	880	210	6060
Cadmium (mg/L)	0.00018	0.00009	0.00005	0.00053	0.00027	0.00049	0.00021	0.00001	0.00059	0.00016	0.00036	0.0002	0.0005	0.00066	0.00052	0.00053	0.00079	0.0009	0.0007	0.0004
Chloride (mg/L)	4.1	2.6	2.8	8.5	4.6	4.3	14	22	22	16	21	3	3	7	4		15	14	11	
Cobalt (mg/L)	0.039	0.028	0.041	0.065	0.097	0.15	0.012	0.024	0.034	0.017	0.028	0.057	0.075	0.163	0.23	0.18	0.17	0.29	0.17	0.073
Copper (mg/L)	0.0014	0.0002	0.0006	0.0031	0.0007	0.0018	0.003	0.0003	0.0027	0.0004	0.001	0.0002	0.0015	0.0021	0.0034	0.0023	0.0024	0.002	0.01	0.0007
Lead (mg/L)	0.0001	0.0001	0.0001	0.0013	0.0001	0.0001	0.0007	0.0001	0.002	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.001	0.001	0.0002
Lead-210 (Bq/L)	0.04	0.11	0.04		0.02			0.04		0.05	0.08	0.04	0.04	0.04	0.07			0.05		
Molybdenum (mg/L)	0.176	0.389	0.38	0.368	0.186	0.323	0.244	1.77	0.885	2.78	8	0.083	0.09	0.309	0.201	0.359	0.635	0.35	0.12	1.4
Nickel (mg/L)	0.71	0.859	0.941	0.635	0.625	1.79	0.211	0.457	0.754	0.889	3.71	0.542	0.839	1.38	1.76	1.92	3.71	5.81	4.07	2.16
Polonium-210 (Bq/L)	0.01	0.02	0.01		0.006			0.01		0.01	0.02	0.01	0.01	0.005	0.01			0.01		
Radium-226 (Bq/L)	0.53	0.64	0.36		0.35			1.1		0.54	0.65	0.52	0.36	0.68	0.76			2		
Selenium (mg/L)	0.0007	0.0033	0.0013	0.0003	0.0004	0.002	0.0014	0.0046	0.0093	0.0086	0.062	0.0012	0.0008	0.0021	0.0016	0.0008	0.027	0.15	0.031	0.002
Sulfate (mg/L)	30.5	38	27.5	27	16	30	37	160	160	170	480	35.5	41	58	49.5		240	555	460	
Thorium-230 (Bq/L)	0.02	0.02	0.02		0.01			0.02		0.02	0.02	0.02	0.02	0.01	0.02			0.02		
Uranium (µg/L)	2.9	3.3	1.4	26	2.9	1.3	86	43	204	376	512	3.3	1.6	2.2	8.5	8.5	36	12	20	3.4
Vanadium (mg/L)	0.0012	0.002	0.0028	0.0006	0.0001	0.0023	0.0008	0.0001	0.001	0.0009	0.0014	0.0005	0.0005	0.0013	0.0012	0.0006	0.0005	0.001	0.001	0.0027
Zinc (mg/L)	0.098	0.027	0.022	0.03	0.049	0.059	0.0083	0.0052	0.0093	0.0054	0.015	0.019	0.055	0.068	0.084	0.21	0.077	0.079	0.46	0.29

Analyte	09-10								Min	Max	Average	Caribou EIS
	MP01	MP01	MP01	MP02	MP02	MP03*	MP03*	MP04				
	11/3/2009	10/13/2010	3/4/2013	10/13/2010	3/4/2013	10/13/2010	3/4/2013	3/4/2013				
Ammonia (mg/L)									1.29	12.32	4.6	
Arsenic (µg/L)	707	3040	972	1690	619	250000	135000	2370	9	6060	1318	800
Cadmium (mg/L)	0.00043	0.00029	0.00021	0.00025	0.0002	0.001	0.001	0.00039	0.00001	0.0009	0.0004	
Chloride (mg/L)	5	5	3.8	5		15	12		2.6	22	9.0	
Cobalt (mg/L)	0.12	0.34	0.19	0.17	0.16	0.67	0.36	0.095	0.012	0.34	0.1	0.51
Copper (mg/L)	0.0036	0.0022	0.001	0.0008	0.0004	0.02	0.02	0.0005	0.0002	0.01	0.002	0.47
Lead (mg/L)	0.0001	0.0001	0.0002	0.0001	0.0001	0.01	0.01	0.0001	0.0001	0.002	0.0003	0.47
Lead-210 (Bq/L)		0.05	0.04	0.13		0.56			0.02	0.13	0.1	0.03
Molybdenum (mg/L)	0.261	0.278	0.225	0.228	0.216	8.6	9.1	0.6	0.083	8	0.8	0.68
Nickel (mg/L)	1.24	2.23	1.86	1.71	1.8	18.7	14.2	2.7	0.211	5.81	1.7	1.3
Polonium-210 (Bq/L)		0.01	0.07	0.01		0.05			0.005	0.07	0.015	
Radium-226 (Bq/L)		0.74	0.79	2.2		6.1			0.35	2.2	0.8	1.2
Selenium (mg/L)	0.0013	0.0021	0.0011	0.0018	0.0009	0.04	0.01	0.016	0.0003	0.15	0.013	0.1
Sulfate (mg/L)	42	40	48	58		730	740		16	555	127	
Thorium-230 (Bq/L)		0.02	0.04	0.02		0.03			0.01	0.04	0.020	0.04
Uranium (µg/L)	18	3.7	8.8	16	13	70	70	3.6	1.3	512	54.5	1100
Vanadium (mg/L)	0.001	0.0022	0.0017	0.0013	0.0012	0.01	0.01	0.0012	0.0001	0.0028	0.001	
Zinc (mg/L)	0.1	0.098	0.14	0.083	0.19	0.32	0.06	0.065	0.0052	0.46	0.090	0.48

*Result was removed from the data set as per explanation in Appendix B of the Sue E Follow-Up Program, which is attached to this appendix.

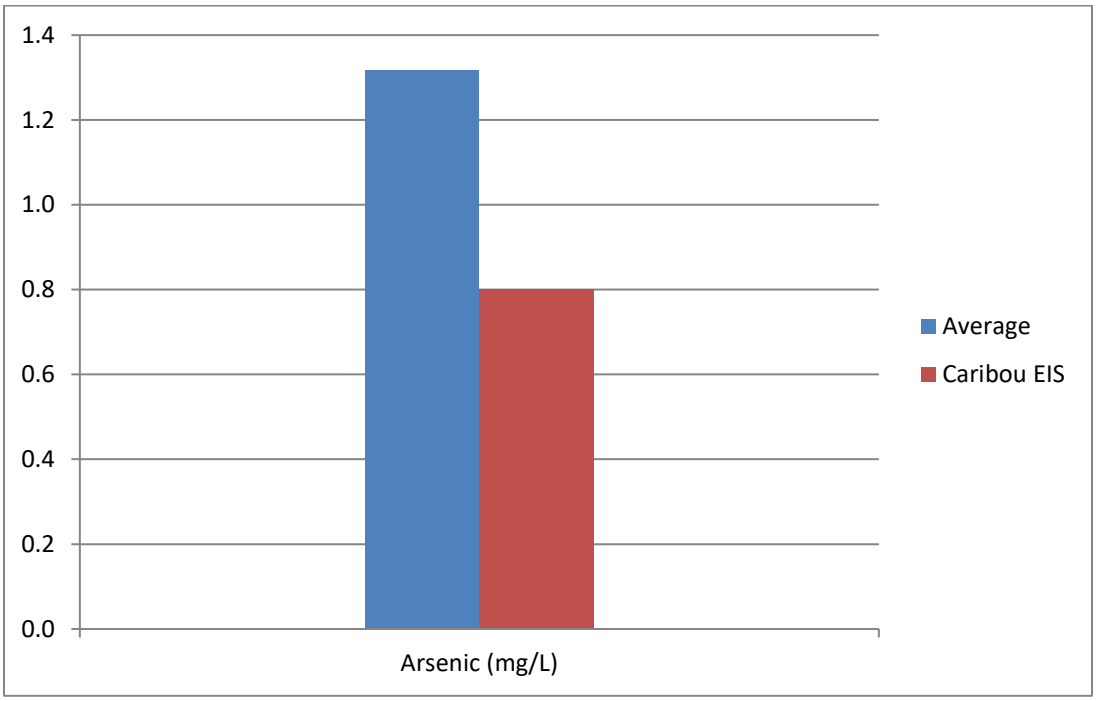


Figure 4: Sue E Pore Water Results for Arsenic

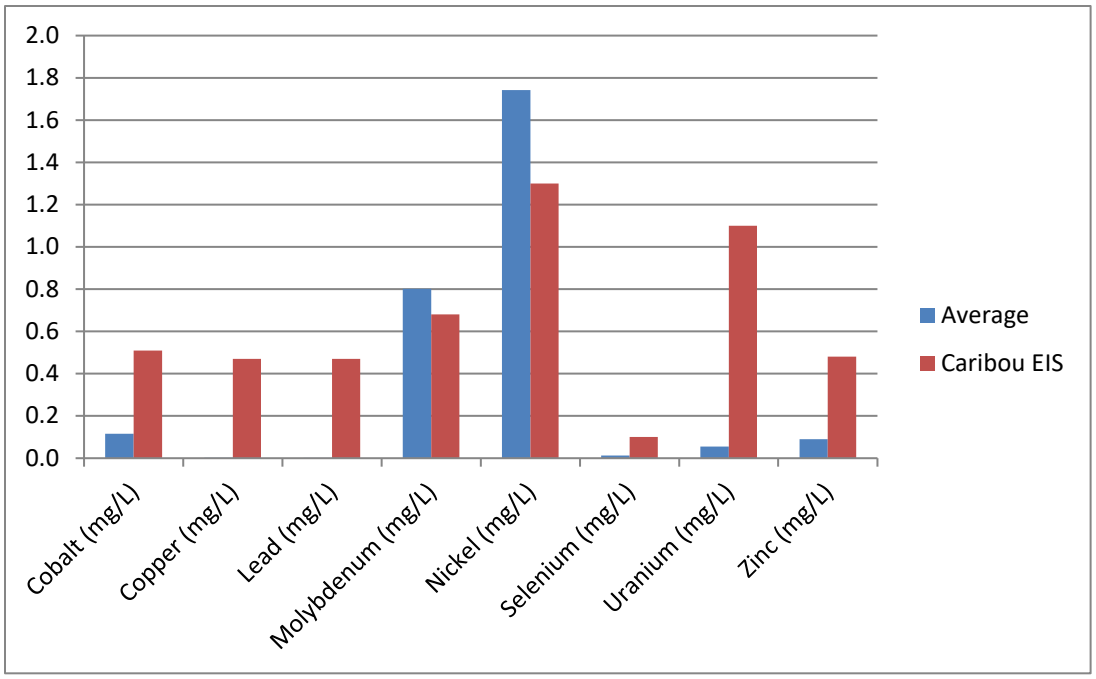


Figure 5: Sue E Pore Water Results for Remaining Metals

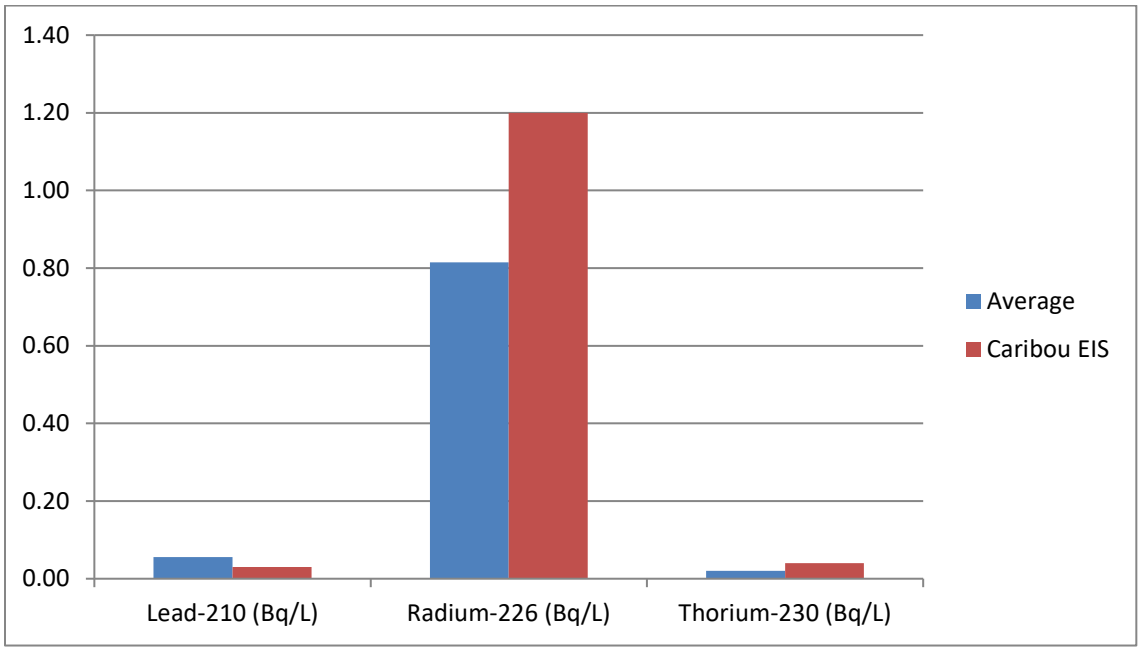


Figure 6: Sue E Pore Water Results for Radionuclides

4 Sue A/E Cuttings Results

During the drilling program, cuttings were also collected at 1.5 m intervals. Cuttings corresponding to each monitoring port were analyzed and the results were compared to the predicted solids content in the Caribou EIS. The results are shown in Table 5. The samples were analyzed for metals only, radionuclides were not included.

A comparison of the results to the Caribou EIS predictions is shown for Sue A and Sue E in Figures 7 and 8, respectively.

The results show that the cuttings geochemistry for Sue A is generally consistent with what was predicted in the Caribou EIS. The cuttings results for Sue E are slightly elevated above predictions for arsenic, nickel, and uranium.

Table 5: Sue A and Sue E Cuttings Geochemistry (from SRC Analytical Laboratory Results)

Well	Waste Type	Depth From (m)	Depth To (m)	Aluminum (ug/g)	Antimony (ug/g)	Arsenic (ug/g)	Barium (ug/g)	Beryllium (ug/g)	Boron (ug/g)	Cadmium (ug/g)	Chromium (ug/g)	Cobalt (ug/g)	Copper (ug/g)	Iron (ug/g)	Lead (ug/g)	Manganese (ug/g)	Molybdenum (ug/g)	Nickel (ug/g)	Selenium (ug/g)	Silver (ug/g)	Strontium (ug/g)	Thallium (ug/g)	Tin (ug/g)	Titanium (ug/g)	Uranium (ug/g)	Vanadium (ug/g)	Zinc (ug/g)
09-07	Sue E	0.0	1.2	54400	0.20	454	46	2.3	29	0.1	8.5	9.6	5	6200	24	89	16	276	0.4	0.1	260	0.3	0.1	160	144	237	15
		5.8	7.3	69600	0.20	696	36	2.7	66	0.1	7.8	12	19	7100	20	75	29	597	0.7	0.2	150	0.5	0.1	140	135	248	15
		11.9	13.4	32500	0.20	32	25	1	1	0.1	5.6	4.7	1.4	11600	3.3	25	0.9	25	0.1	0.1	100	0.4	0.1	610	21	97	31
		18.0	19.5	27400	0.20	35	21	0.9	1	0.1	1.7	2.2	1.4	7200	6.6	57	0.9	26	0.1	0.1	130	0.2	0.1	140	31	40	4.1
		24.1	25.6	48200	0.20	31	25	1.4	1	0.1	0.5	4.6	1.5	8900	4.6	53	0.7	38	0.1	0.1	69	0.2	0.1	260	14	27	15
09-07	Sue A	27.1	28.6	8100	0.20	340	12	0.3	1	0.1	2.5	28	7.6	2500	61	100	2.6	196	0.6	0.1	44	0.2	0.1	35	772	61	16
		33.2	34.7	3000	0.60	739	37	0.1	1	0.1	2.5	0.5	1.1	800	1200	11	3.2	3.8	0.1	0.1	96	0.2	0.1	20	8.8	9.7	3.2
		36.3	37.8	4700	0.20	65	15	0.2	1	0.1	3.9	0.4	2.2	760	100	12	0.7	10	0.1	0.1	91	0.2	0.1	37	7.1	46	1.4
		42.4	43.9	2900	0.20	68	36	0.2	1	0.1	5.5	0.7	1.5	1400	106	34	0.6	2.8	0.1	0.1	200	0.2	0.1	41	3.6	8.4	0.5
		45.4	46.9	1300	0.20	12	28	0.1	1	0.1	2.8	0.2	0.8	930	7.8	23	0.3	1.4	0.1	0.1	100	0.2	0.1	17	1.4	4	14
		51.5	53.0	1160	0.20	9.9	11	0.1	1	0.1	1.3	0.3	0.8	520	44	3.6	0.3	1.3	0.1	0.1	61	0.2	0.1	5	1.1	3	28
		54.6	56.1	1230	0.20	14	17	0.1	1	0.1	2.3	0.2	1.5	750	20	11	0.3	1.5	0.1	0.1	71	0.2	0.1	11	1.6	4.8	33
		60.7	62.2	2100	0.20	56	20	0.1	1	0.1	4	2.5	1.5	670	35	11	0.4	3.7	0.1	0.1	60	0.2	0.1	8.5	5.3	25	0.5
		63.7	65.2	1100	0.40	1800	9.9	0.1	1	0.1	1.5	550	29	710	386	53	6.8	411	0.2	0.3	42	0.2	0.1	11	16	7.2	0.5
		69.8	71.3	2200	0.20	554	16	0.1	1	0.1	1.7	120	20	810	419	51	1.1	83	0.1	0.1	91	0.2	0.1	13	7	7.1	10
		72.8	74.4	2900	0.20	42	12	0.2	1	0.1	1.2	1.3	1.1	430	44	5.2	0.4	3.8	0.1	0.1	100	0.2	0.1	16	2.3	7.1	0.5
		78.9	80.5	5700	0.20	109	20	0.4	1	0.1	4.9	12	5.6	880	85	13	1.4	33	0.2	0.1	170	0.2	0.1	16	20	29	0.5
		82.0	83.5	3000	0.20	112	14	0.2	1	0.1	2.2	26	4.2	580	87	8.4	0.9	21	0.1	0.1	120	0.2	0.1	18	8.4	13	1.9
09-08	Sue E	7.3	8.8	33200	0.20	202	31	1.4	1	0.1	0.5	4.4	4.5	5400	79	130	7.2	159	0.5	0.1	90	0.2	0.1	81	554	153	9.8
		10.4	11.9	33000	0.20	32	61	2.4	79	0.1	1.3	7.6	4.3	19800	6.9	100	1.8	52	0.2	0.1	150	0.8	0.1	1200	40	101	57
		16.5	18.0	20400	0.20	124	20	1.2	1	0.1	17	4.3	4	3000	10	33	7	109	0.2	0.1	170	0.2	0.1	6.1	155	81	8.3
		19.5	21.0	35600	0.20	280	35	1.9	1	0.1	19	9.5	5.7	6300	19	94	8	282	0.3	0.1	300	0.2	0.1	82	233	141	16
		25.6	27.1	11400	0.20	51	16	0.7	1	0.1	19	6.5	2.5	5800	6.2	52	2.7	56	0.1	0.1	73	0.2	0.1	21	159	33	160
		28.6	30.2	5400	0.20	12	21	0.4	1	0.1	7.1	1.1	2.8	1900	7.5	41	0.9	9	0.1	0.1	170	0.2	0.1	36	18	17	7.8
		34.7	36.3	8300	0.20	14	25	0.8	1	0.1	21	3.3	7.3	4000	9.1	61	0.6	20	0.1	0.1	120	0.2	0.1	17	12	20	6.3
		37.8	39.3	5500	0.20	8.2	13	0.3	1	0.1	6.3	1.3	3.2	1080	7.7	19	0.3	7.2	0.1	0.1	83	0.2	0.1	5.4	5.4	11	2.5
		42.4	43.9	5400	0.20	28	17	0.4	1	0.1	9.6	2.6	2.8	840	24	10	1.2	12	0.1	0.1	160	0.2	0.2	11	22	21	11
		46.9	48.5	3200	0.20	12	14	0.2	1	0.1	6.7	0.6	1.3	560	9.1	4.9	0.7	2.8	0.1	0.1	110	0.2	0.1	26	4.9	6.7	5.6
		53.0	54.6	2480	0.20	2.4	3.7	0.1	1	0.1	0.5	0.2	1.6	220	4.4	1.6	0.2	0.6	0.1	0.1	51	0.2	0.1	1.7	1	2.1	4.3
		57.6	58.5	7900	0.20	7.4	5.9	0.6	1	0.1	0.6	0.8	4.1	1000	3.8	4.9	0.2	11	0.1	0.1	26	0.2	0.1	4.4	12	3	3.8
09-09	Sue E	2.7	4.3	22900	0.20	130	18	0.8	1	0.1	0.5	2.5	9.5	3600	14	25	2.6	78	0.1	0.1	370	0.2	0.1	25	85	32	18
		8.8	10.4	58500	0.20	124	56	2.4	70	0.1	5.9	5.6	6	4300	14	52	8.8	99	1.2	0.1	190	0.2	0.1	140	68	192	16
		14.9	16.5	20400	0.20	63	33	0.9	1	0.1	7.7	2.8	6.9	6100	7	63	2.7	62	0.1	0.1	130	0.2	0.1	40	35	42	6.7
		21.0	22.6	66700	0.20	60	56	1.9	6	0.1	5	8.1	5.3	8700	8.1	70	1.8	76	0.1	0.1	160	0.7	0.1	480	31	62	50
		24.1	25.6	57200	0.20	28	60	1.8	1	0.1	0.5	4	4.5	5800	16	62	1.1	32	0.1	0.1	220	0.2	0.1	190	81	69	17
09-10	Sue E	2.7	4.3	45900	0.20	184	32	1.9	35	0.1	18	5	6	4100	17	71	9.4	165	0.4	0.1	430	0.2	0.1	36	184	180	8.5
		8.8	10.4	63600	0.20	98	74	2.2	70	0.1	2.1	4.4	7.5	5320	16	47	5	78	0.6	0.1	240	0.2	0.1	110	125	188	16
		14.9	16.5	25200	0.20	78	25	1	1	0.1	4.7	4.1	10	4500	16	42	3.8	50	0.2	0.1	300	0.2	0.1	39	191	66	12
		21.0	22.6	22700	0.20	212	32	1.3	1	0.1	14	5.2	6.7	5100	14	83	5.3	157	0.2	0.1	180	0.2	0.1	31	205	70	7.9
		24.1	25.6	16600	0.20	164	28	1.1	1	0.1	23	6.3	4.2	1700	18	22	9.9	146	0.3	0.1	200	0.2	0.1	8.4	125	82	15
Sue A Minimum				1100	0.20	9.9	9.9	0.1	1	0.1	1.2	0.2	0.8	430	7.8	3.6	0.3	1.3	0.1	0.1	42	0.2	0.1	5	1.1	3	0.5
Sue A Maximum				8100	0.60	1800	37	0.4	1	0.1	5.5	550	29	2500	1200	100	6.8	411	0.6	0.3	200	0.2	0.1	41	772	61	33
Sue A Average				3030	0.25	302	19	0.2	1	0.1	2.8	**57**	5.9	903	**199.6**	26	1.5	59	0.2	0.1	96	0.2	0.1	19	66	17	8.5
Sue A - Caribou EIS Prediction				-	-	1200	-	-	-	-	-	22	1200	-	160	-	78	620	177	-	-	-	-	-	240	-	25
Sue E Minimum				2480	0.20	2.4	3.7	0.1	1.0	0.1	0.5	0.2	1.3	220	3.3	1.6	0.2	0.6	0.1	0.1	26	0.2	0.1	1.7	1.0	2.1	2.5
Sue E Maximum				69600	0.20	696	74	2.7	79	0.1	23	12	19	19800	79	130	29	597	1.2	0.2	430	0.8	0.2	1200	554	248	160
Sue E Average				29762	0.20	**117**	31	1.3	14	0.1	7.9	4.6	5.1	5190	14	51	4.8	**97**	0.2	0.1	172	0.3	0.1	144	**100**	82	**20**
Sue E - Caribou EIS Prediction				-	-	32	-	-	-	-	-	9.0	59	-	18	-	8.0	63	7.0	-	-	-	-	-	34	-	13

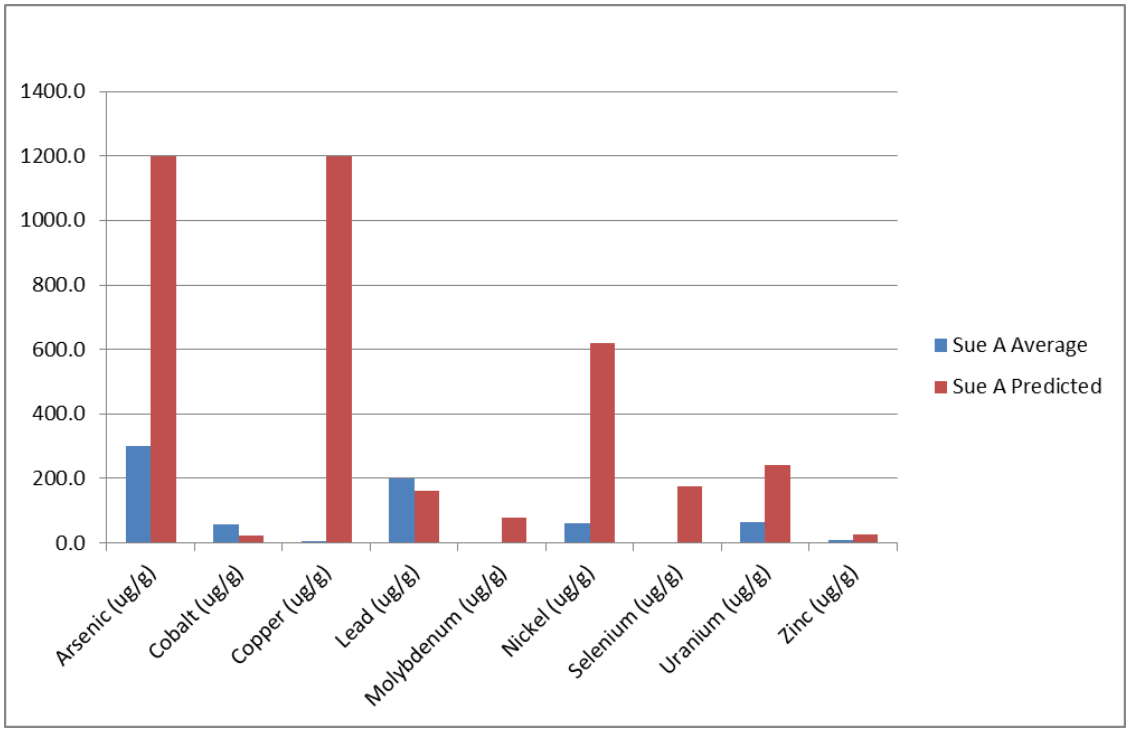


Figure 7: Sue A Cuttings Geochemistry Results

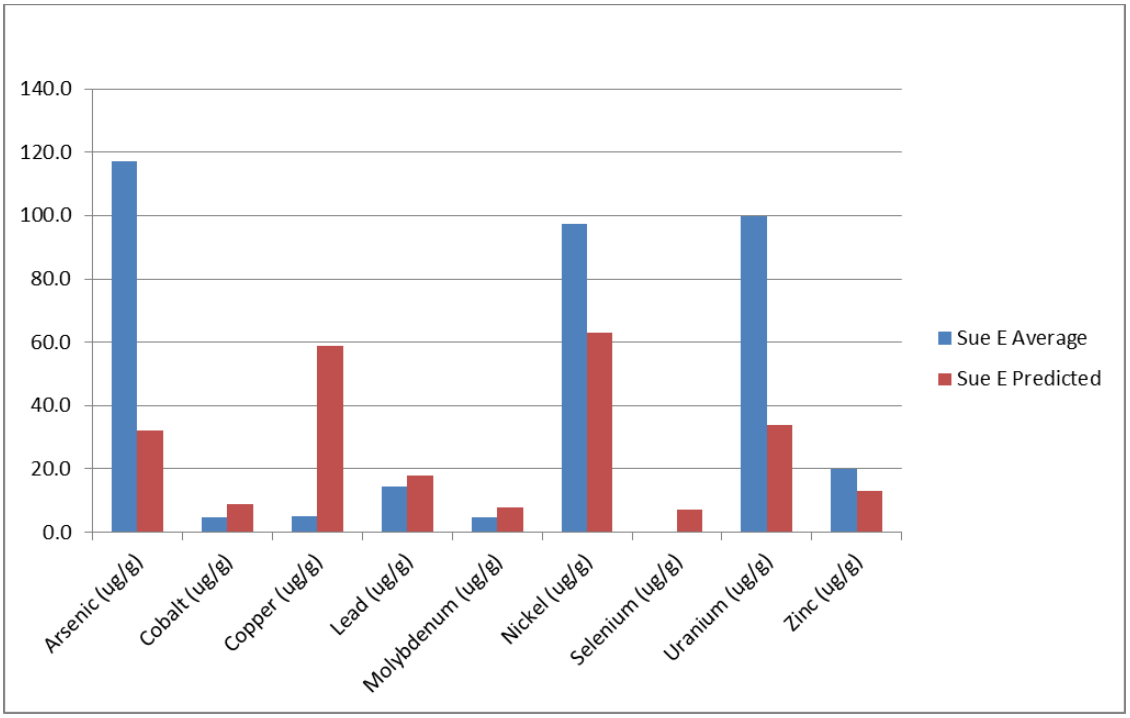


Figure 8: Sue E Cuttings Geochemistry Results

Appendix AII: Cigar Lake Operation 2017 PAG Waste Geochemical Update

CIGAR LAKE OPERATION

Cameco

Cigar Lake Operation

2017 Potentially Acid Generating Waste Geochemical Update

May 9, 2018

Prepared by:
Geo-Environmental Engineering, SHEQ

EXECUTIVE SUMMARY

Cigar Lake produces Potentially Acid Generating Waste (PAG) during development and mining activities. This waste rock has the potential for acidification in the future and also contains elevated contents of constituents of potential concern (COPCs) compared to clean waste rock. The currently assessed and approved decommissioning plan for the Stockpile C facility is to haul all of the stockpiled PAG material for disposal in Sue C Pit at Orano Canada Inc.'s McLean Lake Operation during two campaign hauls, one at the conclusion of Phase 1 mining and one at the conclusion of Phase 2 mining, and remediate and reclaim the Stockpile C facility. As of the end of 2017, the Stockpile C facility contained 361,000 m^3 rock, with an additional 78,000 m^3 expected to be produced through the life of Phase I operation. Phase II at Cigar Lake is expected to produce an additional 175,000 m^3 PAG waste rock.

The reactivity and geochemical characteristics of this material was assessed a number of times, most recently in the 2001 Disposal of Cigar Lake Waste Rock Environmental Impact Statement (EIS) produced by COGEMA Resources Inc. and Cigar Lake Mining Corporation (the 2001 EIS). At the time of the assessment, a limited volume of rock had been placed on the facility and the majority of the geochemical assessment was based on core samples. The approval of the 2001 EIS, including the main document and associated addendums, resulted in the drafting of an agreement between parties which outlined the acceptable criteria for rock chemistry, based on both the expected geochemical nature of the rock as well as an environmental risk assessment of the impacts of disposing the rock into Sue C pit (the Potentially Reactive Waste Rock Agreement).

Since the 2001 EIS, waste rock has been placed on the lined Stockpile C facility. This included all development basement rock from underground, including non-PAG basement rock, and slimes from production and post-flooding mine remediation activities. A number of significant changes at both Cigar Lake and McClean Lake have occurred since 2001, including; disposal of slimes on Stockpile C, higher than anticipated volumes of waste rock production from the Cigar Lake Mine, and flooding of the Sue C pit. No further waste rock assessment has occurred since 2001, therefore the geotechnical and geochemical characteristics of the material on Stockpile C was unknown. Additionally, more detailed planning for Phase II of Cigar Lake is underway, and little was known about the waste rock associated with that portion of the Cigar Lake deposit.

The goal of this work was to provide an update to the Cigar Lake Joint Venture, specifically Orano, on the geochemical nature of the material on Stockpile C. Furthermore, this work was intended to expand the source term to include production related waste rock remaining in the Phase I deposit and characterize the material expected for Phase II to allow for future waste rock management purposes. It is Orano's intent to utilize the information provided in this document to reassess the risk associated with deposition of this rock in Sue C pit, considering potential changes to rock geochemistry since 2001 as well as changes to the operation of the in-pit waste rock disposal facility, primarily being the rock already contained in that facility as well as flooding of the facility.

Questions raised by both Orano and Cameco in the past several years have included:

- Are predicted / previously assessed and approved solids concentrations from the 2001 EIS still valid?
- Is there a greater fines content (slimes) within certain sections of the pile and does this affect the overall flooded source term?
- If there is a greater fines content due to entrained slimes, does this contain more readily leachable elements than the bulk of the rock?
- Is the Potentially Reactive Waste Rock (PRWR) agreement between Orano and Cameco still valid and does this need to get reassessed?
- The 2001 EIS focussed on sulphate and arsenic, is there data available for other elements and COPCs?
- What are the effects on the water treatment facility of dumping fine waste rock into an already flooded pit, are there differences to the original plan of dry deposition then flooding?
- What information do we have and what do we require to assess waste rock management for the Cigar Lake Phase II deposit?

The results of this assessment showed that generally, with very minor exceptions, the geochemical limits of the PRWR agreement is sound for existing rock on Stockpile C. Excursions are observed for remaining unmined Phase I development PAG material, primarily due to the rock expected for development in the future is primarily in areas containing more sulphide mineralization and graphitic alteration. Rock expected from Phase II is outside the mean and upper bound ranges of the PRWR for a number of elements.

Fine grained waste rock deposited on Stockpile C from mine rehabilitation post flooding has not affected the overall characteristics of waste rock contained on Stockpile C. Both production methods and clay content of the deposit result in a very high fines content and overall fine grained waste rock, therefore the slimes entrained in waste rock were not discernable from the overall rock on the facility. Geochemically there was no marked difference in waste rock characteristics due to slimes placement, both from a solids and leaching perspective. This assessment concludes that slimes will not negatively affect the source terms from the facility. Orano will need to assess the impacts on their water treatment plant using the data obtained during this work.

A full geochemical source term reassessment was completed on Stockpile C rock utilizing data from previous waste rock assessments and the 2017 Stockpile C drilling campaign test work program. The current assessment resulted in source terms generally consistent, or lower than, the 2001 EIS. Most significant were results for arsenic and molybdenum. The measured arsenic solids content has been lowered from 200 to 100 µg/g, and the percent leachable of this COPC is estimated to be much lower than previously assessed. This results in a lower porewater As concentration, down from 21 mg/L to 9.6 mg/L. Molybdenum, a soluble parameter within waste rock, has measured solids content down from an estimated 15 µg/g to 6.5 µg/g, percent leachable is down from 55% to 12.3%, and porewater concentrations are anticipated to 3.3 mg/L, down from 11 mg/L. This decrease is due to a number of factors, primarily the access to significant amounts Stockpile C rock for

assessment, a more thorough use of historical data from a previous waste rock assessment, and the increased clean rock deposited on the facility than previously anticipated.

A thorough assessment of available remaining unmined Phase I development PAG waste rock was conducted as part of this assessment. Due to only PAG being assessed for deposition, and development primarily being in areas with more graphitic alteration and sulphide mineralization, expected solids COPC contents are higher than that those already on Stockpile C. Significant changes are arsenic contents estimated at 280 µg/g up from 100 µg/g, molybdenum concentrations at 23 µg/g up from 6.5 µg/g, and nickel concentrations at 217 µg/g up from 90 µg/g. Expected porewater concentration are correspondingly higher. Full results are summarized in Table 6-1.

Phase II rock was assessed both from exploration and resource evaluation data as well from core collected in 2017. This data are well constrained in terms of expected development areas and results show increased solids content over those in Phase I. Arsenic, radium-226 and vanadium are similar or lower than remaining Phase I rock, but higher than what is currently on the stockpile. Molybdenum, nickel, selenium and uranium are similar to current Stockpile C rock and lower than remaining Phase I rock. Cobalt, copper and lead concentrations are notably higher then observed for overall Phase I rock.

An assessment of acid base characteristics of the stockpile suggests that the pile is currently stable, with little oxidation occurring within the inner portions of the pile. Underdrain water quality seems to contradict this, however this was attributed to oxidation of the outer core of the pile, leading to some acidic waters in runoff. The pile is currently draining (from deposition) and little water is infiltrating into the rock itself due to the fine grained nature of the material. Currently all of the potentially acid generating rock on the pile has neutral to alkaline pH, and sufficient buffering capacity available to maintain these conditions.

It had been the intent of this work to complete a confirmatory waste rock assessment, however after examining all available data and the previous work completed, it was deemed necessary to provide an expanded and revised assessment and new source terms for waste rock from Cigar. Data is provided in a format similar to what Orano has utilized in their previous Sue C modelling work, and consistent with the 2001 EIS. Additionally, detailed particle size data on existing Stockpile C rock is provided for an assessment of fines impact on Sue C pit water treatment.

This document should provide all necessary data to evaluate waste management strategies for Stockpile C, remaining Phase I development rock as well as Phase II rock from a geochemical source term perspective.

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1.0 BACKGROUND

At Cigar Lake potentially acid generating (PAG) waste rock is produced during underground development in the immediate vicinity of the ore body. Rock is mainly from beneath the deposit in basement. During development and mining of the Phase I ore body it was anticipated that approximately 440,000 m^3 of waste rock would be produced and stored on Stockpile C. An additional 175,000 m^3 PAG waste rock would be associated with mining the Phase II ore body. PAG rock is typically composed of basement rock, concrete backfill, and shotcrete.

PAG waste rock is skipped to the surface and stockpiled on the stockpile. The currently assessed and approved decommissioning plan for the Stockpile C facility is to haul all of the stockpiled PAG material for disposal in Sue C Pit at Orano Canada Inc.'s McLean Lake Operation during two campaign hauls, one at the conclusion of Phase 1 mining and one at the conclusion of Phase 2 mining, and remediate and reclaim the Stockpile C facility. The assessed volume of rock that had been assessed for disposal in 2001 was 910,000 m^3, the currently anticipated volume is approximately 430,000 m^3.

The initial plan in 2001 had been dry placement of PAG into Sue C; this has changed to depositing through the current pit lake.

PAG waste rock at Cigar Lake has been assessed several times, the most recent being the Disposal of Cigar Lake Waste Rock EIS completed in 2001. From this point forward monitoring of the pile focused on volume and pile management, as well as underdrain seepage collection; no further geochemical assessment has been done on Stockpile C waste rock. Slimes (fine grained waste rock) have been entrained within regular PAG rock and been placed onto Stockpile C.

There have been a number of questions regarding Stockpile C over the past several years, notable are:

- Are predicted / previously assessed solids concentrations from the 2001 EIS still valid?
- Is there a greater fines content (slimes) within certain sections of the pile and does this affect the overall flooded source term?
- If there is a greater fines content due to entrained slimes, does this contain more readily leachable elements than the bulk of the rock?
- Is the Potentially Reactive Waste Rock (PRWR) agreement between Orano and Cameco still valid and does this need to get reassessed?
- The 2001 EIS assessment focussed on sulphate and arsenic, is there data available for other elements and COPCs?
- What are the effects on the water treatment facility of dumping fine waste rock into an already flooded pit, are there differences to the original plan of dry deposition then flooding?
- What information do we have and what do we require to assess waste rock management for the Cigar Lake Phase II deposit?

To that end Cameco initiated a geochemical program in early 2017. This covered both a reassessment and familiarization of previous test work and assessments, the examination of available geochemistry and drill core from within Stockpile C which could be classified as potentially acid generating (PAG), extensive drilling and sampling of Stockpile C, sampling of Phase II rock, geochemical and geotechnical laboratory test work, and an assessment of the data.

This program was designed and intended to answer the aforementioned questions. The geochemical characterization was staged to enable a comparison to be made on the previous geochemical data available for the stockpile. It was intended to confirm whether the material on Stockpile C matches previous predictions and, if required, to generate an updated source term. Previous EIS analysis programs were very thorough, methodologies were sound as was the assessment of the source terms. The current program was designed to follow previous analytical and assessment methodologies as close as possible and was not designed to develop an entirely new source term. Rather, the source term for all previously assessed and some additional COPCs have been updated, using methodologies similar to previous work.

1.1 Stockpile C History/Development

Stockpile C is an HDPE lined and bermed facility, intended for temporary storage of waste rock generated from the mining of the Cigar Lake orebody. The facility has undergone three expansions: Extension 1 and Extension 2 increased the overall design capacity to 99,000 m^3; and a final expansion, referred to as the Expansion Area (completed in 2006), and resulted in a total design storage volume of 390,000 m^3 for the stockpile. Each area is shown in Figure 2-3. Space has been optimized on the pile and the current capacity of the pile is approximately 425,000 $m^{3.}$

The original pad received rock from test mining, boxhole boring, and jet boring tests in the mid-1990s. By year 2000 there was approximately 70,000 m^3 present on the original pad and extensions. At this point the pile was filled to approximate design height (similar to the current conformation), up to the narrowest point in the saddle (the Extension). Cameco became mine operator in 2002 and, after the care and maintenance period through the early 2000s, began construction to bring the site into full production in 2005, resulting in waste rock being placed on the pile again.

The final expansion was completed in 2006 with some underground development rock placed over the extension/expansion boundary this same year. Approximately 23,000 m^3 of underground development rock was placed from 2005-2007 bringing waste rock volume up to approximately 101,000 m^3.

In 2008 an uncontrolled inflow occurred halting development. At this point only surface drilling rock was received on the pile. The pile contained approximately 103,000 m^3 through 2010. Re-entry into the mine workings and mine restoration led to major deposition of mine slimes, surface drilling cuttings, and underground development waste rock between 2011 and 2015 (90,500 m^3 in 2011 alone). The pile contained approximately 330,000 m^3 rock at end of 2016.

Reference drawings are provided to give an indication of the main operational phases on each area in the pad and the potential rock that was placed in each area. Drawings include:

- May 2000 (2001 EIS Drill Program),
- September 2006 (Expansion complete),
- December 2009 (prior to mine remediation),
- December 2011,
- December 2014, and
- December 2017 (see Figure 2-1, 2017 drill program locations).

The Stockpile C pad is drained by three sumps which collect surface runoff and water from the underdrain system. The first sump is located in the Original pad (Station 2.4-2), the second at the northern intersection of the Extension and Expansion (Station 2.4-3), and the third at the northwestern end of the Extension (Station 2.4-4). Sumps and pile operational phases are shown on Figure 2-3. The foundation of each portion of the pile is graded towards the respective sumps (to the northwest), with a drainage layer located between the liner and waste rock. Additionally, it is important to note that surface runoff from each portion of the pile runs around the perimeter of the pile and flows into the sumps. Runoff from the southern slopes flows around the entire facility into the sump on the Extension. The runoff from the northern slope flows east and discharges to each respective sump as it flows downgradient. Culverts through the berms separating the various sections of the pile allow flow around the entire pile. The sumps are sampled in the spring when there is sufficient water.

1.2 Cigar Lake PAG Criteria

The current Cigar Lake PAG criteria is defined in WST-303-03-A1, specifying that "All basement core (contains fine sulfides), or any core with sulfide mineralization. - scans less than 1.35 μSv /hr (0.03% U_3O_8) using the Automess gamma meter." Ideally the PAG criteria would be based on a total S content of the rock.

In this assessment, PAG waste rock was evaluated based on the McArthur River Mine PAG (and waste rock management) criteria of:

- Mineralized waste rock has a uranium content equal or greater than 254 micrograms per gram (>0.03%).
- Clean waste rock has a sulphur content of less than 0.2%.
- If waste rock has a sulphur content greater than 0.2%, the ratio of acid neutralizing potential to acid generating potential (NP/AP) is considered. If NP/AP is greater than 3, the sample is classified as clean; if less than 3, the sample is classified as Potentially Acid Generating (PAG).

1.3 Previous Geochemical Investigations and Summary of Historical Work

There have been a number of investigations specifically targeting PAG waste rock from the Cigar Lake operation. The aim of these were to predict the concentrations of key chemical parameters in porewater/groundwater after deposition into Bizarre Lake or Sue C pit and the total mass of key elements from this waste rock. The results of these past studies have

been presented as supporting documents to the EISs for the 1995 Cigar Lake Project (*Golder 1995* and *SENES 1995*) and the subsequent 2001 Disposal of Cigar Lake Waste Rock (*Beak 2001b*).

Previous investigations conducted both static and kinetic tests to predict the source terms under saturated and anoxic conditions to determine the leaching properties of the COPCs from waste rock (for submerged waste rock). Investigations in the 1995 EIS utilized fresh and weathered Phase I drill core samples. Studies were phased and work was completed in both 1993 and 1994. The 2001 EIS included both fresh/slightly weathered Phase I core samples as well as Stockpile C core samples, with work completed in 2000/2001. Detailed column and bulk leach testing were conducted as part of the 1993/1994 and 2000/2001 investigations. These studies were detailed, with the 2000 program mainly focused on the leaching behaviour of arsenic, which was defined as the key constituent of potential concern (COPC). Each varied slightly in study design, however overall results were generally comparable across studies.

1.3.1 1993/1994 Testing

The 1993 and 1994 programs were conducted on waste rock samples selected from exploration drill core. The 1993 program examined leaching of slightly weathered core samples representing a range of rock types present around the ore body. The 1994 test program then utilized fresher core samples on graphitic metapelite. Graphitic metapelite is the most reactive waste rock type and represents the majority of the waste rock that requires management on Stockpile C. Both testing programs were a comprehensive look at solids chemistry, humidity cell, saturated column leaching chemistry, and acid generating potential of the rock.

1.3.2 1994 Bulk Leach Test (Bizarre Lake Bulk Leach)

A field scale bulk leach test was conducted on a blend of fresh core samples from Phase I basement rock. A large tank was filled with the bulked sample and it was flushed with Bizarre Lake water. Both porewater and surface water were monitored through the testing period.

1.3.3 Summary of 1995 EIS Work

The EIS waste rock testing programs outlined in Sections 1.3.1 and 1.3.2 resulted in a number of conclusions. As summarized in the 1995 EIS supporting documents, the main takeaways were:

- The mine rock has the potential to produce acidic drainage.
- Unflooded (oxidized) rock has the potential to leach arsenic, cobalt and nickel.
- Graphitic metapelite samples with >0.5% S produced poor quality leachate.
- Oxidized high sulphide samples displayed increased initial flush leachate concentrations, which decreased to lower values after some time in the column work.
- Initial flushing of aged clean rock (low sulphur concentrations) also displayed an initially higher flush of COPCs which declined over time, however these concentrations were below surface water criteria.

- Flooded (unoxidized) rock has the potential to leach arsenic, radium and uranium.
- Flooded disposal of the mine rock greatly reduces the solubility of elements by limiting oxidation.

1.3.4 2000/2001 EIS Program

In 2000, an additional waste rock characterization program was conducted to support the 2001 EIS and refine estimates of As concentration in submerged waste rock and to confirm estimates of other key elements. This work stated that previous source terms presented in the 1995 EIS with respect to As leaching were underestimated.

The 2000 program examined fresh core samples as well as samples from Stockpile C. This program assessed solids chemistry, effects of different leachates, effects of sequential leaches, and kinetic saturated column studies. The primary intent of the work was to examine As in more detail within the reactive waste rock.

The results of this study showed that:

- The anticipated concentrations of most COPCs in the Cigar Lake waste rock were low, and comparable to previous studies.
- Arsenic concentrations were higher than previously anticipated.
- Arsenic concentrations in the porewater depend on the arsenic concentrations in the solids.
- Arsenic concentrations in Cigar Lake Phase I PAG waste rock were anticipated to be 200 µg/g.
- All other COPC concentrations did not exceed relevant water quality guidelines.
- The water based leach test was determined to be the most representative estimate of expected leaching rate resulting in 15% leachable As. The EIS assumed 20% leaching of As as a conservative estimate.
- Aged/weathered samples had little to no change in leachability compared to fresh samples, therefore it was concluded that there would be impact to As leaching behaviour by temporary storage waste rock on surface.

1.3.5 Phase I Core Sampling Program

In 2014 a program was initiated by the Cigar Lake geology department to obtain a comprehensive geochemical dataset on remaining Phase I waste rock. The intent was to characterize the potential COPC concentrations that may be expected in the remaining portion of the Phase I deposit and some previously mined core samples. Analytical work was conducted in 2014 and 2015 on 255 core samples. Analysis included acid-base accounting (ABA) procedures, total metals, oxide analysis, and select ^{226}Ra analysis. Phase I core sampling results are presented in Appendix A.

All rock characterization into areas and mining development zones was completed with the assistance of Cameco's Mineral Resource Management team and the Mining Group. Phase I was sorted as being only development rock, then split into two areas, the south development in cleaner biotitic metasedimentary rock, and along strike or trend of the

deposit (called Phase I north), which directly underlies the deposit. For Phase I mined rock all basement rock from development areas was considered, both clean and PAG, consistent with historical rock handling methodologies. These samples were compared directly with Stockpile C solids to determine if in-situ core sample solids content is representative of what we can expect on Stockpile C, if acceptable, solids data from both remaining Phase I and expected Phase II will be assessed directly using existing Stockpile C source term methodology.

1.3.6 Phase II Core Dataset

A dataset containing all available exploration geochemical data from drilling was examined to evaluate Phase II waste rock. This data were assessed and sorted to only development level rock, both vertically and horizontally constrained. Results were filtered to include PAG samples only. All samples and data utilized in the assessment are included in Appendix B.

All rock characterization into areas and mining development zones was completed with the assistance of Cameco's Mineral Resource Management team and the Mining Group. Core samples included only rock within the lateral extents of development and to a minimum elevation of 970 and maximum elevation of 1010 (mine grid elevation), which eliminated any samples within the deposit itself. The rock was sorted into two types, cleaner PAG corresponds to east/west development drifts not directly beneath the deposit, and is constrained by eastings from 9050 – 9900 and northings from 10002 to 10114. Altered PAG from directly beneath the deposit is mainly north/south development drifts and constrained to eastings from 9050 – 9900 and northings from 9904 – 10002. The majority of sample data was from altered PAG due to resource drilling locations. Total Phase II rock volumes are anticipated to be 93,467 m^3 cleaner PAG and 53,544 m^3 altered PAG. Overall Phase II rock results are statistically weighted by overall rock volume and sample density.

Additional rock was collected in 2017 from the altered PAG zones of the deposit. No cleaner unaltered rock was tested due to a lack of reliable fresh samples from this zone.

1.4 Slimes Management

During mine flooding a considerable amount of fine grained waste rock (referred to as slimes) was washed into the underground workings. During mine rehabilitation in 2010, and again in 2013-2016, these slimes were removed along with other waste rock and skipped to surface and disposed of on the expansion area of Stockpile C.

Some slimes from production activities were also placed in tote bags and temporarily stored on Stockpile C due to slimes pond storage issues; these tote bags have since been removed.

Currently, slimes produced during drilling and jet boring are managed within lined holding ponds on surface (slimes ponds) and no slimes are placed on Stockpile C. Slimes are defined as the fines produced during drilling and jet boring. However, waste rock contains a high proportion of fines due to the clays in the deposit, and the waste rock contained on Stockpile C is very fine. From a geochemical perspective, slimes are the same mineralogy as the waste rock itself, only theoretically finer (at least contain less coarse fraction of

rock). Underground muck and direct slimes from rehabilitation was placed on the expansion area on Stockpile C.

1.5 Potentially Reactive Waste Rock Agreement

The decommissioning plan for Cigar Lake PAG waste rock, as identified in the 2001 EIS, is to dispose of this material within Orano's Sue C pit at the McClean Lake site. A legal agreement was put together outlining terms and conditions for delivery of Potentially Reactive Waste Rock (PRWR) from Cigar Lake to McLean for disposal into Sue C pit. This agreement assumed a certain volume of rock with expected concentrations of COPCs (assuming that leaching and source terms developed for the rock were consistent to previous estimates). The agreement specifies both average and maximum concentration in the solids.

1.6 Constituents of Potential Concern

The main COPCs that are to be discussed in this report include those in the list below. This list is a compilation of the main Cigar Lake COPCs as well as those outlined in Orano's TID assessment of waste rock and what is included in the PRWR agreement. Where applicable or of interest, data from other elements are included, however not discussed in detail.

- Arsenic
- Cadmium
- Cobalt
- Copper
- Lead
- Molybdenum
- Nickel
- Radium-226
- Selenium
- Uranium
- Vanadium
- Zinc

2.0 2017 DRILLING AND SAMPLE COLLECTION

In 2017 a field program was conducted on Stockpile C. This program included borehole drilling, logging and sampling of stockpile C and core sampling of existing exploration core from the Phase II deposit.

Drilling was completed using Rabbit Lake Operation's SDC-390 sonic drill rig. Drill core was extracted using an 8.9 cm outer diameter core barrel providing a 5.7 cm inner diameter core sample. Outer casing was used for borehole stability with an outer diameter of 13.97 cm. Core was extruded into core bags in two meter intervals. All boreholes were drilled without the use of drilling fluids. At each drill location, two holes were drilled approximately one meter apart.

All borehole logging was completed in accordance with established Cameco Geo-Environmental Engineering Group (GEE) work instructions. A detailed drilling report was produced as part of this program (*Cameco 2018*).

2.1 Stockpile C Drill Program

Fifteen locations were drilled from May 09 to June 29, 2017. The program was run concurrently with other site drilling projects allowing flexibility to accommodate access issues. The boreholes were cored, logged, photographed, and sampled in pairs (designated "A" and "B" hole) approximately one meter apart. The samples were stored in core bags and then placed side by side for logging purposes. The "A" core was logged and sampled, while the "B" was visually confirmed to having the same, or very similar, lithology as the "A" core. The hole pairs were drilled to ensure enough core was available for planned and future, if required, testing and analysis. Figure 2-1 shows the drilling locations from both 2000 and 2017. Figure 2-2 is a cross section of the pile showing waste rock thickness above the liner and the depths of boreholes. In 2000 4 holes were drilled in the original pad and three in the expansion. In 2017 1 duplicate hole (compared to the 2000 drilling) was drilling in the original pad, 6 in the extension and 8 in the expansion.

A total of 94 geotechnical and 93 geochemical samples were collected. The samples were field screened through a 19.1 mm box screen to ensure coarse material was excluded from the samples. The geotechnical samples were placed in one liter sample pails and sealed with a lid. The geochemical samples were placed in 4.5 litre pails and sealed with lids. The lids for both pails were taped shut following sample collection.

2.2 Phase II Core Collection

Potentially acid generating exploration core from the Phase II area was identified for waste rock characterization. 2.5 meter samples were composited from core lengths ranging from 3.2 to 55.5 meters. The samples were, in most cases, small fragments of the core that was already loose and not a whole section of the core. When larger sections of core were taken identifiers on the core box were noted to indicate a sample interval.

A total of 18 samples were collected and shipped to SRC in sealed 4.5 liter pails.

3.0 2017 LABORATORY ANALYSIS

A matrix showing the geotechnical and geochemical test work that was completed for the project is outlined in Table 3-1. The test work was phased to allow appropriate compositing and testing on materials of interest.

In total, 92 samples were shipped to SRC labs in approximately 2 m lengths. A coarse crush was performed on these each sample, they were well mixed and following an analytical crush and grind was completed on each sample.

3.1 Particle Size Distribution and Moisture Content

Particle size distribution test work was focused on obtaining information on the fines content and variability within the pile. Conventional sieve analysis cannot differentiate material less the 37 microns. To provide a more detailed characterization of the fines light scattering test was completed on all material less than 4 mm. Material larger than 4 mm was weighed. Light scattering results on 48 samples collected from Stockpile C are provided in Appendix C.

Moisture contents were obtained from sub-samples sent for geotechnical test work. These samples were shipped in a separate sample bag from field composited section of the core. Raw results are included in Appendix C.

3.2 Solids Geochemistry

Stockpile C core samples were submitted to SRC analytical labs for elemental analysis of the solids. A total digestion (aqua-regia/hydrofluoric acid/perchloric acid) was performed on the crushed and ground samples, followed by ICP-MS analysis for trace elements.

Radium-226 analysis was performed on approximately half the samples submitted using the same preparation procedures as ICP samples.

Raw results are included in Appendix D.

3.3 Acid Base Accounting

Acid base accounting was performed on the, and included paste pH and electrical conductivity, acid neutralization capacity (AN), Acid generating potential (AP), calculated net acid generating potential (NAG), LECO Sulphide, total sulphur, and acid soluble sulphate. Raw results are included in Appendix D.

3.4 Leach Testing

Leach testing was initiated after solids geochemistry had been completed and reviewed. As the sample lithology was not apparent from visual logging, samples were chosen based on solids chemistry and locale. Sample selection ensured the results would be spatially and geochemically representative across the pile and cover the range in concentrations present in Stockpile C. In total 48 samples were selected for leach testing.

Leach testing was performed on crushed samples using a 48-hour Toxicity characteristic leach procedure (TCLP), followed by analysis of pH, conductivity, major ions, and trace elements by ICP-MS, and ^{226}Ra. Raw results are included in Appendix E.

4.0 RESULTS

This section will present a reassessment and reinterpretation of previous waste rock geochemistry programs as well as provide an interpretation of the 2017 characterization program.

4.1 Particle Size Assessment

The particle size analysis was completed to both characterize the current grain size distribution of Stockpile C and assess the impact of slimes placement on the grain size distribution within the expansion area, relative to the rest of the pile. Historical data collected in year 2000 was not utilized in this assessment.

Visual logging of the 2017 core samples could not identify slimes present in the samples, as the waste rock is degraded to a point that the majority of the matrix is silt and clay. Therefore, particle size analysis was used to determine whether more fines are present in parts of the pile where slimes had been placed.

The results from the light scattering analysis was fit into standard sizing fractions, with particular attention paid to finer material which may be more problematic for deposition into a flooded pit. Table 4-1 presents the grain size data as well as summary statistics for each sample. Figure 4-1 shows measured grain size distribution curves grouped by section of the pile and the averages for each section of the pile (the Original pad, Expansion and Extension).

Figure 4-2 shows the distribution of the samples on a trilinear graph as an alternate way to compare overall sample variability. The trilinear plots included all data within the clay/silt/sand fractions with the “undersize”, below typical clay particle sizing, added to the clay fraction (<0.001 mm).

Figure 4-1 shows the average grain size distribution between the individual areas is consistent, indicating the slimes placement expansion area has not impacted the overall grain size distribution of the waste rock.

With respect to the overall variability between individual samples it was noted that there are significant variations in oversize materials, (>4mm), particularly in the expansion area (ranges from 12.7-46.8%). The majority of samples are in the range of 31-47% oversize with the only three sampling having less than 31% and none with more the 47%. The individual graphs also show more variability between samples in the expansion area. The most consistent results appear to be from the original pad, however there are only three samples therefore this is likely only due to sample size. The trilinear graph (Figure 4-2) supports visual observation that the three pad areas have similar grain size distributions.

Focussing on the fines, the average d10 (10^{th} percentile of diameter), is highest in the Expansion area (0.0178 mm), followed by the Original (0.0103 mm), with the Extension being finest from that perspective (0.0085 mm). The average d50 is highest in the extension and expansion areas (16.1 and 15.7 mm respectively), with the Extension significantly lower (10.1 mm). The average d90 is similar between the Expansion and Extension areas (59.4 mm and 57.4 mm respectively), and lower in the Original pad (51.8

mm). The interquartile range is lowest in the original pad, followed by the Extension and Expansion. This suggests there is slightly less grain size variability in the samples collected from the original pad.

If we look at the sum of all particles less than 0.0625 mm (silt and clay fractions) we see similar results from each pad area, but with greater variability in the Expansion. The Original pad has an average of 24% (ranging from 19-31%), the Extension an average of 33% (ranging from 18-40%), and the Expansion an average of 34% (ranging from 12-54%).

A number of observations were made when assessing the particle sizes:

- The Expansion area appears to have a greater variability in the distribution of particle sizes, slightly finer overall than the other two areas, however also contains the most oversize fractions.
- The Extension area appears to be the coarsest overall out of all three areas.
- The Original pad appears to contain the most consistent range in particle sizes.
- Overall, the variability between each pile area appears to be insignificant.

It should be noted that the observations made regarding overall greater variability and oversize within the Expansion area are most likely due to the greater number of samples collected from this area.

4.2 Solids Geochemistry

The assessment of solids geochemistry in this document included results from all previous waste rock programs, including an examination of data from core samples from future development areas in Phase I, core from expected development areas in Phase II, and previous drilling programs completed in Stockpile C.

The previous source term assessment presented in the 2001 EIS document assumed a bulk (averaged) solids content in the pile and utilized the bulk solids content to calculate an initial flush and long term source for the pile.

The current assessment included re-drilling the location of a year 2000 borehole on Stockpile C to determine whether changes could be observed in overall COPC concentrations in that location over time. The remainder of the pile was drilled to assess variability in solids geochemistry through the life of mine. A composite assessment of the COPC concentrations was completed by utilizing both the 2000 and 2017 solids geochemistry.

A statistical comparison of all solids chemistry is provided in Table 4-2, and box and whisker plots in Figure 4-3 (Stockpile C alone) and Figure 4-4 (all rock).

Each element of interest is discussed as a comparison between the 2017 Stockpile C results and the year 2000 results (where results are available). The 2017 Stockpile C drilling is further broken up into stockpile phases (Original pad, Extension, and Expansion areas) to assess potential geochemical changes as mining progressed. A comparison between the re-drilled hole (2000 vs 2017) is presented to assess overall changes to rock chemistry by

leaching. A brief comparison between the remaining Phase I core (core from unmined Phase I areas) and Phase II core is also presented. It should be noted that the Phase I and II core samples are an indication of solids content of in-situ rock, however may not be representative of what will be placed on Stockpile C due to leaching of initially soluble elements that occurs during mining prior to placement on the stockpile. This is discussed in later sections.

Finally, overall summary statistics of all solids data for the entire stockpile are presented for use in ERA modelling and assessing the previous source term (Figure 4-4 and Table 4-2). The overall summary statistics were calculated using a volume to sample density weighting (for each pile area) to give a more representative overall source term. Volumes for weighting were based on pile areas, the Original pad has a surveyed 18,500 m^3 (5.5% of total rock), the Saddle/Extension 70,800 m^3 (20.8% of total rock), and the current pad/Expansion Area 250,800 m^3 (73.7% of total rock). Volumes were based on 2016 and 2017 surveys.

The previous EIS presented statistical information on the 15 solids samples utilized in leach testing (*Beak 2001b*). There were, however, additional samples that only contained general solids geochemical data (total = 39). In the current assessment, the entire EIS dataset available from Stockpile C was utilized to assess the overall solids geochemistry.

Similarly, for the 2017 program, 92 samples were submitted for solids test work, of these approximately half were submitted for leach test work. Solids results presented below includes the full dataset of 92 samples.

The data presented in Table 8.2 of 2001 EIS is the summary of expected PAG waste rock for source term assessment. This data are a summary of core sample solids concentrations from column studies (9 in total). The leaching behaviour and long term column results are representative of waste rock, however the addition of actual Stockpile C waste rock solids data would more fully and accurately characterize the expected solids content of this rock.

Mean solids values presented in the 2001 EIS and the PRWR agreement are higher than mean concentrations calculated using the full data set from 2001 for a number of elements which have a high variability between samples. The bias high mean concentrations are likely due, in part, to the small dataset utilized in calculating the mean concentrations.

Given the high variability that can occur in individual samples, it was perhaps more indicative of variability between samples to compare median values. The discussion below, therefore, focuses on median values when comparing different datasets, evaluating the overall changes between the pile in 2000 and 2017, and comparing different pile areas for 2017 data (Original/Extension/Expansion). Figure 4-3 shows the differences in distribution, for example Ca has a more normal distribution while As exhibits a positive skew on the distribution.

An overall estimate of solids chemistry within Stockpile C presents both median and mean to remain consistent with the 2001 EIS. Utilizing the mean values to estimate the overall loads for ERA modelling provides a conservative assessment for impact predictions.

The discussion on solids data within this section is mainly limited to providing an overview of the data, an overall discussion of each element as a whole is provided in later sections in the document.

Aluminum

Aluminum is not considered a COPC, however, it is useful to evaluate clay stability within the pile. The Cigar Lake deposit has a high clay content, typically Mg-chlorite (sudoite and clinochlore) and Mg- and Fe-rich illite, and the clay stability is pertinent in the overall discussion of acid-base chemistry further in the document.

The 2017 results had a median Al content of 54,300 µg/g for the entire stockpile compared to 75,683 µg/g for the holes drilled in 2000.

The hole drilled to assess pile evolution and weathering showed a median value of 53,500 µg/g vs 80,181 µg/g in 2000. Aluminum concentrations are significantly lower in the duplicate borehole, suggesting some weathering of primary minerals or breakdown of clay structure.

With respect to current spatial variability, rock on the original pad has an overall median of 53,500 µg/g, the extension 52,450 µg/g and the expansion 56,000 µg/g. The entire dataset (including the year 2000 chemistry), resulted in a median Al concentration of 56,100 µg/g and a mean of 56,512 µg/g. The newer and older portions of the pile have very consistent concentrations.

The potential waste rock characteristics for future development areas of the mine were assessed using drill core (2015 drilling dataset). Significantly higher Al concentrations were seen in this rock (median of 90,034 µg/g). Phase II historical core showed a median of 88,385 µg/g Al and 2017 core sampling resulted in a median of 78,872 µg/g. Overall, the results are very consistent in all phases of development.

Arsenic

The 2017 results had a median As content of 31 µg/g for the entire stockpile compared to 33 µg/g for the holes drilled in 2000. In comparison to the 2001 EIS a mean As concentration of 224 µg/g for a limited Stockpile C dataset was presented in Table 6-2, and an overall Cigar Lake estimate of 200 µg/g (column testing, Table 8.2 of the 2001 EIS), whereas in this re-assessment utilizing the full solids data set collected in 2001, a mean As concentration of 180 µg/g is calculated for all 2001 Stockpile C data.

The hole drilled to assess pile evolution and weathering showed a median value of 47 µg/g in 2017 versus 350 µg/g in 2000. This does not necessarily constitute a significant change due potential variability in drill hole locations between programs and overall variability down hole, however the bulk rock evaluated should be the same, therefore this may suggest some As leaching has occurred. With respect to current spatial variability, rock on the original pad had an overall median As concentration of 58 µg/g, the extension 23 µg/g and the expansion 39 µg/g. This suggests that As concentrations are not becoming worse as mining progresses, and that areas of the pile that likely contain more slimes do not have a higher As content. The entire dataset (including the year 2000 chemistry), resulted in a median As concentration of 28 µg/g and a mean of 100 µg/g for the overall pile.

The remainder of the Phase I deposit was assessed using drill core (2015 drilling dataset). Significantly higher As was seen in this rock (median of 125 µg/g). Phase II historical core showed a median of 90 µg/g As and 2017 core sampling resulted in a median of 156 µg/g. These values suggest that the remainder of Phase I has higher As content in waste and Phase II is significantly different however neither deposit's mean values are outside the range observed on Stockpile C. The increased As in Phase I unmined areas is due to these areas being higher in graphite alteration with is strongly associated with elevated As and sulphides.

Calcium

Calcium is not considered a COPC, however, it can be utilized to evaluate the readily soluble neutralization capacity. Shotcrete and backfill concrete are included (entrained) into waste rock during mining and mucking as a result a large proportion of neutralization capacity of the waste rock typically comes from the entrained concrete. A discussion of acid-base chemistry is included in Section 4.6 of this report.

The 2017 results had a median Ca concentration of 10,500 µg/g for the entire stockpile compared to 10,077 µg/g for the holes drilled in 2000. The hole drilled to assess pile evolution and weathering showed a median value of 12,850 µg/g in 2017 vs 15,062 µg/g in 2000. Calcium concentrations are only slightly lower in the duplicate borehole, suggesting only minor consumption/flushing of readily soluble neutralization capacity. Based on the 2017 data to evaluate the current spatial variability, rock on the original pad has an overall median of 11,000 µg/g, the extension 10,500 µg/g and the expansion 6,500 µg/g. The entire dataset (including the year 2000 chemistry), resulted in a median Ca concentration of 10,400 µg/g and a mean of 11,964 µg/g.

A discussion of Ca concentrations in core material is not representative of anything that may be encountered on Stockpile C, however concentrations in Phase I and Phase II unmined rock does serve to show the amount of soluble/available neutralization capacity added to the rock post mining. Remaining Phase I core has a median Ca concentration of 1,179 µg/g, Phase II historical of 1,072 µg/g and 2017 Phase II samples of 1,600 µg/g.

Cadmium

Cadmium concentrations in the 2017 sampling had a median concentrations of 0.1 µg/g for the entire stockpile consistent with 0.1 µg/g for the holes drilled in 2000. A large proportion of the values were below the detection limit. The maximum Cd concentration observed in all Stockpile C samples was 0.4 µg/g. Given the very low concentrations, no further discussion of Cd solids concentrations is warranted.

Cadmium was not analysed in PI core samples in the 2014/15 program. Phase II historical core also had a limited dataset which could not be utilized for this assessment, 2017 core sampling resulted in a maximum of 0.2 µg/g, similar to Stockpile C results.

Cobalt

The 2017 results had a median Co concentration of 28 µg/g for the entire stockpile compared to 54 µg/g for the holes drilled in 2000. In comparison, the 2001 EIS utilized a mean concentration of 84 µg/g for a limited dataset, whereas, in this re-assessment

utilizing all available solids data from 2000a mean concentration of 42 µg/g was calculated for Stockpile C rock.

The hole drilled to assess pile evolution and weathering showed a median concentration of 32 µg/g vs a median concentration of 113 µg/g in 2000. The decrease is significant suggesting some leaching of Co may have occurred.

With respect to current spatial variability, rock on the original pad had an overall median concentration of 32 µg/g, the extension 22 µg/g and the expansion 45 µg/g. Utilizing the entire dataset (including the year 2000 chemistry), resulted in a median Co concentration of 28 µg/g and a mean of 47 µg/g.

The remainder of the deposit was assessed using drill core (2015 drilling dataset). Co concentrations were seen in this rock (median of 20 µg/g) are similar to the concentrations seen in the Stockpile C rock. Phase II historical core showed a median of 11 µg/g Co, 2017 core sampling resulted in a median of 83 µg/g.

Chromium

The 2017 results had a median Cr concentration of 150 µg/g for the entire stockpile compared to 114 µg/g for the holes drilled in 2000 (Cr concentrations were not presented in the 2001 EIS for comparison).

The hole drilled to assess pile evolution and weathering showed a median value of 150 µg/g vs 119 µg/g in 2000.

With respect to current spatial variability, rock on the original pad had an overall median of 150 µg/g, the extension 150 µg/g and the expansion 140 µg/g. The entire dataset (including the year 2000 chemistry), resulted in a median Cr concentration of 140 µg/g and a mean of 145 µg/g.

No Cr data was available from the remainder of PI core. Phase II historical core had a very limited dataset and could not be utilized in this assessment, 2017 core sampling resulted in a median of 170 µg/g.

Cr data observed in all areas of the Stockpile and unmined data shows very consistent values.

Copper

The 2017 results had a median Cu concentration of 21 µg/g for the entire stockpile compared to 45 µg/g for the holes drilled in 2000. For comparison EIS utilized a mean of 25 µg/g for a limited dataset, in this re-assessment a mean of 48 µg/g was calculated for 2001 Stockpile C rock.

The hole drilled to assess pile evolution and weathering showed a median value of 39 µg/g vs 48 µg/g in 2000.

With respect to current spatial variability, rock on the original pad had an overall median of 33.5 µg/g, the extension 20.5 µg/g and the expansion 21 µg/g. The entire dataset

(including the year 2000 chemistry), resulted in a median Cu concentration of 32 µg/g and a mean of 31.5 µg/g.

The remainder of the deposit was assessed using drill core (2015 drilling dataset) and resulted in a mean Cu concentration of 10 µg/g. Phase II historical core had a very limited dataset that could not be used in this assessment, however 2017 core sampling resulted in a median of 32 µg/g.

Molybdenum

The 2017 results had a median Mo of 3.9 µg/g for the entire stockpile compared to 6.0 µg/g for the holes drilled in 2000. For comparison the 2001 EIS utilized a mean of 15 µg/g for a limited dataset, in this re-assessment a mean of 12.5 µg/g was calculated for Stockpile C rock.

The hole drilled to assess pile evolution and weathering showed a median value of 8 µg/g vs 26 µg/g in 2000. This is a significant change and may suggest some leaching of Mo has taken place since 2000.

With respect to current spatial variability, rock on the original pad had an overall median of 8.0 µg/g, the extension 3.1 µg/g and the expansion 4.3 µg/g. The entire dataset (including the year 2000 chemistry), resulted in a median Mo concentration of 3.9 µg/g and a mean of 6.5 µg/g.

The remainder of the deposit was assessed using drill core (2015 drilling dataset) and resulted in a mean Mo concentration of 20 µg/g. Phase II historical core showed a median of 4.4 µg/g Mo, 2017 core sampling resulted in a median of 21.5 µg/g.

Nickel

The 2017 results had a median Ni concentration of 60 µg/g for the entire stockpile compared to 86 µg/g for the holes drilled in 2000. For comparison, the 2001 EIS utilized a mean of 111 µg/g for a limited dataset, in this re-assessment of the 2000 data mean of 202 µg/g was calculated for the Stockpile C rock.

The hole drilled to assess pile evolution and weathering showed a median value of 61 µg/g vs 170 µg/g in 2000. This is a significant change and may suggest some leaching of Ni has taken place since 2000.

With respect to current spatial variability, rock on the original pad had an overall median of 61 µg/g, the extension 52 µg/g and the expansion 70 µg/g. The entire dataset (including the year 2000 chemistry), resulted in a median Ni concentration of 61 µg/g and a mean of 90 µg/g.

The remainder of the deposit was assessed using drill core (2015 drilling dataset) and resulted in a mean Ni concentration of 135 µg/g. Phase II historical core showed a median of 46 µg/g Ni, 2017 core sampling resulted in a median of 169 µg/g.

Lead

The 2017 results had a median Pb concentration of 17 µg/g for the entire stockpile compared to 17 µg/g for the holes drilled in 2000. For comparison, the 2001 EIS utilized a mean of 23 µg/g for a limited dataset, in this re-assessment a mean of 30 µg/g was calculated for the Stockpile C rock.

The hole drilled to assess pile evolution and weathering showed a median value of 12 µg/g vs 26 µg/g in 2000. This is a significant change and may suggest some leaching of Pb has taken place since 2000.

With respect to current spatial variability, rock on the original pad had an overall median of 14 µg/g, the extension 18 µg/g and the expansion 15 µg/g. The entire dataset (including the year 2000 chemistry), resulted in a median Pb concentration of 17 µg/g and a mean of 23 µg/g.

The remainder of the deposit was assessed using drill core (2015 drilling dataset) and resulted in a mean Pb concentration of 20 µg/g. Phase II historical core did not have a large enough sample set to assess however 2017 core sampling resulted in a median of 20 µg/g.

pH

Paste pH results are included to support the discussion on acid-base accounting and pile evolution. The 2017 results had a median pH of 9.8 for the entire stockpile. No paste pH data was available for year 2000 drill program. With respect to current spatial variability, rock on the original pad had an overall median of 10.6, the extension 10.0 and the expansion 8.6. There does not appear to be a lower pH in older areas of the pile. The lowest paste pH measured was 7 within the expansion area.

The pH of the drill core shows the amount of neutralization capacity added after mining and mucking. PI remaining rock has a median pH of 7.8. Phase II historical core has no results and 2017 PII core sampling resulted in a median of 7.6.

Radium-226

The 2017 results had a median ^{226}Ra activity of 0.12 Bq/g for the entire stockpile. Radium-226 data was not available in the 2000 assessment.

With respect to current spatial variability, rock on the original pad had an overall median of 0.14 Bq/g, the extension 0.11 Bq/g and the expansion 0.11 Bq/g. The entire dataset, resulted in a median ^{226}Ra concentration of 0.12 Bq/g and a mean of 0.18 Bq/g. Unlike some of the other COPCs, ^{226}Ra was only analyzed on samples where leach testing was conducted.

The remainder of the deposit was assessed using drill core (2015 drilling dataset) and resulted in a mean ^{226}Ra concentration of 0.18 Bq/g. Phase II historical core did not include any analyses for ^{226}Ra, 2017 core sampling resulted in a median of 0.15 Bq/g.

Total Sulphur

Sulphur is not considered a COPC, however it is evaluated with respect to acid base accounting in the pile (and PRWR criteria).

The 2017 results had a median S of 5,900 µg/g for the entire stockpile compared to 8,850 µg/g for the holes drilled in 2000.

The hole drilled to assess pile evolution and weathering showed a median value of 12,750 µg/g vs 11,475 µg/g in 2000. Sulphur concentrations are similar (higher) in the duplicate borehole, confirming that no major oxidation of primary sulphide minerals is occurring within the pile.

With respect to current spatial variability, rock on the original pad has an overall median of 10,300 µg/g, the extension 3,400 µg/g and the expansion 8,600 µg/g, which is a significant variation. The entire dataset (including the year 2000 chemistry), resulted in a median S concentration of 5,900 µg/g and a mean of 6,500 µg/g (0.59% / 0.65%, respectively)

Sulphur concentrations in remaining PI core is higher at a median of 15,800 µg/g, PII historical of 5,300 µg/g and 2017 PII samples of 18,800 µg/g. Sulphur concentration are quite comparable between different phases of the deposit.

Selenium

Selenium has not been identified as a COPC for Stockpile C/Sue C assessments, however this element has been of interest in newer assessments of waste rock and tailings in northern Saskatchewan and, therefore the data is discussed.

The 2017 results had a median Se concentration of 0.9 µg/g for the entire stockpile compared to 0.9 µg/g for the holes drilled in 2000.

The hole drilled to assess pile evolution and weathering showed a median value of 1.8 µg/g vs 0.4 µg/g in 2000. Given the difference, and that there is no physical mechanism for the concentration to increase, this difference suggests there may be enough variability in the waste rock between the two adjacent holes to negate assessing the evolution of the pile using this methodology.

With respect to current spatial variability, rock on the original pad had an overall median of 1.8 µg/g, the extension 0.8 µg/g and the expansion 1.1 µg/g. The entire dataset (including the year 2000 chemistry), resulted in a median Se concentration of 0.8 µg/g and a mean of 1.0 µg/g.

The remainder of the deposit was assessed using drill core (2015 drilling dataset) and resulted in a greater mean Se concentration at 6.5 µg/g. Phase II historical core showed a median of 2.1 µg/g Se, 2017 core sampling resulted in a median of 4.1 µg/g. Se shows a large variation in core samples, likely the result of leaching after deposition.

Uranium

The 2017 results had a median U concentration of 6 µg/g for the entire stockpile compared to 8 µg/g for the holes drilled in 2000. For comparison, the 2001 EIS utilized a mean of 9

µg/g for a limited dataset, in this re-assessment a mean of 24 µg/g was calculated for the Stockpile C rock.

The hole drilled to assess pile evolution and weathering showed a median value of 5.9 µg/g vs 6.6 µg/g in 2000.

With respect to current spatial variability, rock on the original pad had an overall median of 5.9 µg/g, the extension 5.5 µg/g and the expansion 5.6 µg/g. The entire dataset (including the year 2000 chemistry), resulted in a median U concentration of 6.0 µg/g and a mean of 10 µg/g. Uranium concentrations are quite consistent in waste rock however this should not be surprising as we have segregated the majority of high grade ore for mining.

The remainder of the deposit was assessed using drill core (2015 drilling dataset) and resulted in a mean U concentration of 4.2 µg/g. Phase II historical core showed a median of 8.5 µg/g U, 2017 core sampling resulted in a median of 8.4 µg/g.

Vanadium

The 2017 results had a median V concentration of 89 µg/g for the entire stockpile compared to 55 µg/g for the holes drilled in 2000.

The hole drilled to assess pile evolution and weathering showed a median value of 106 µg/g vs 64 µg/g in 2000.

With respect to current spatial variability, rock on the original pad had an overall median of 106 µg/g, the extension 83 µg/g and the expansion 94 µg/g. The entire dataset (including the year 2000 chemistry), resulted in a median V concentration of 78 µg/g and a mean of 82 µg/g.

The remainder of the deposit was assessed using drill core (2015 drilling dataset) and resulted in a mean V concentration of 240 µg/g. Phase II historical core showed a median of 51 µg/g V, 2017 core sampling resulted in a median of 220 µg/g.

Zinc

The 2017 results had a median Zn concentration of 26 µg/g for the entire stockpile compared to 36 µg/g for the holes drilled in 2000. For comparison, the 2001 EIS utilized a mean of Zn concentration of 40 µg/g for a limited dataset, in this re-assessment a mean concentration of 36 µg/g was calculated for the Stockpile C rock.

The hole drilled to assess pile evolution and weathering showed a median value of 14 µg/g vs 41 µg/g in 2000.

With respect to current spatial variability, rock on the original pad had an overall median of 14 µg/g, the extension 29 µg/g and the expansion 17 µg/g. The entire dataset (including the year 2000 chemistry), resulted in a median Zn concentration of 27 µg/g and a mean of 29 µg/g.

The remainder of the deposit was assessed using drill core (2015 drilling dataset) and resulted in a mean Zn concentration of 10 µg/g. Phase II historical core did not have a large

enough database to discuss in this assessment however 2017 core sampling resulted in a median of 17 µg/g.

Note on the 2001 EIS methodology for Data Analysis and Source Term Development

The 2001 EIS interpretation of source terms utilized the mean solids concentrations from rock utilized for column studies (*Beak 2001b, Table 8.2*). The issue with this method is that this assessment did not include all columns completed in the 1993/1994 assessment (as discussed below), and is not representative of the rock contained on Stockpile C. The use of columns gives an indication of the potential relationship of various solids and the resultant porewaters once deposited in a saturated environment. However, when using this relationship a representative value of mean or median solids content for the rock of interest should have been used (in this case Stockpile C results). It is suggested that the solids results presented in the current assessment are more representative of rock to be deposited in Sue C than that within the 2001 EIS.

4.3 Comparison of Stockpile C Solids to Historically Mined areas.

The source term assessment contained in this document was based on the analysis of rock already placed on Stockpile C. This is applicable when one considers grain size of the material, potential changes to the rock during mining and handling, the entrainment of lime and any potential weathering of the rock once placed.

An assessment of future rock from core samples also needs to be made, this included both remaining Phase I rock and Phase II rock. Only core samples were available in these zones therefore the applicability of using the solids analysis from core samples needed to be examined. The main uncertainty was the applicability of core sample analyses in terms of representativeness once placed on Stockpile C. Both core samples from historical drilling campaigns and the current work was examined. This included current (n=18) and historical (n≈320) Phase II samples, previously mined Phase I core (n≈110) and remaining unmined Phase I core (n≈110).

All rock characterization into areas and mining development zones was completed with the assistance of Cameco's Mineral Resource Management team and the Mining Group. With respect to further sample categorization, mined Phase I was sorted as being only development rock, then split into two areas, the south development which was in cleaner biotitic metasedimentary rock, and along strike or trend of the deposit (called Phase I north), which directly underlies the deposit and contains more graphitic meta-sedimentary rock with higher COPC concentrations. For Phase I mined rock all basement rock from development areas was considered, both clean and PAG, consistent with historical rock handling methodologies. These samples were compared directly with Stockpile C solids to determine if in-situ core sample solids content is representative of what we can expect on Stockpile C, if acceptable, solids data from both remaining Phase I and expected Phase II will be assessed directly using existing Stockpile C source term methodology.

Unmined Phase I rock, mainly from areas with more graphitic alteration than had previously been mined, only includes PAG. This is consistent with planned rock segregation moving forward.

Figure 4-3 and Table 4-2 show the results of the rock characterization. With respect to Stockpile C rock already in place, it was not possible to directly determine all material on the pile. Rock segregation has changed through the pile history, however the rock is some mix of “south” and “north” development rock. Comparing these to the weighted average of Stockpile C (Table 4-2), we see that the majority of COPCs fall between north and south Phase I mined rock. Lead, Se and V in Stockpile C are lower than the mined core, Se significantly. This will be discussed in more detail in later sections of the document, however the majority of COPCs from core samples can be said to be representative of what we may expect as stockpiled on surface. From a solids perspective the variations between zones is due to presence of graphitic alteration and sulphide mineralization. The data examined suggests that core solids concentrations should be representative of the expected future PAG waste rock.

4.4 Solids Correlations

Correlations between datasets were completed to provide some discussion points in further sections on leach and column work. These correlations should provide some context to geochemical variability observed in various samples analyzed. The correlation coefficient is a number between -1 and 1 that determines whether two sets of data are related. The closer to 1 we are more confident a positive linear correlation exists and -1 more confident a negative relationship exists. The significance of the correlation depends on the number of data points in the group. The p-value is the probability between 0 and 1 that the correlation is significant. In this analysis we discuss both a significance at the 0.05 and 0.01 level. The correlations are an attempt to assess whether certain elements are associated with one another, with this we can examine expected mineralogical associations and potentially COPC stability or make predictions on the observed trends. For Phase I unmined and Phase II rock, correlations were completed as a comparison to that rock on Stockpile C therefore included all samples, both PAG and clean.

Pearson correlations were completed on selected elements by splitting the dataset into Stockpile C, Phase I core (mined and unmined) and Phase II core. Correlation results are presented in Table 4-3A (Stockpile C rock), Table 4-3B (previously mined Phase I core) and Table 4-3C (future Phase I core), Table 4-3D (Historical Phase II core) and Table 4-3E (2017 Phase II Core). Correlations are highlighted yellow for noticeable (p-value<0.05) and blue for strong (p-value<0.01).

Correlations are generally consistent between previously mined and unmined Phase I datasets.

There were very few elements which correlated well in the full historical Phase II core dataset. Additionally a number of parameters analyzed was limited. As a result, discussed are only 2017 data, excluding CL-540 which is classified as mineralized (U > 254 µg/g).

For core samples the correlations should represent in-situ trends of mineralogical associations, whereas Stockpile C samples are potentially oxidized and have encountered leaching in addition to secondary precipitation of soluble elements.

Aluminum correlates to As, Co, Ni, Pb and V in both Phase I and II core datasets, and additionally to Ca, Se, Zn and S in Phase I. In Stockpile C we see a correlation to As, Co, Cu, Fe, Mo, Ni, Se and S.

Arsenic correlates to Al, Co, Mo, Ni, Pb and V in both Phase I and II core datasets. Additionally As correlates to Se and S in Phase I. For Stockpile C we see a good correlation to Al, Co, Mo, Ni, Se, V and S. The core sample correlations are consistent with Ni-Co arsenides, sulpharsenides and sulphides found in the ore deposit, most dominantly with gersdorffite (NiAsS), niccolite (NiAs) and cobaltite (CoAsS) (*Kaczowka 2017*). It appears that this primary mineralogy is consistent in Stockpile C, however the strong correlation between As and Mo is not readily apparent.

Total S correlates to the majority of elements in Phase I and Stockpile C, however total S only correlates well to Se in Phase II samples.

Co most strongly correlates to As and Ni in both PI and PII deposits, and in Stockpile C we see very good correlations between Co and a number of elements including most strongly to Mo and Ni.

Iron and Cu are present in the deposit as sulphides, within the periphery of the Phase I deposit in waste rock correlations suggest this is generally consistent. If waste rock is consistent to the ore zones Cu would be present as chalcopyrite ($CuFeS_2$) and bornite (Cu_5FeS_4). Fe is likely present as chalcopyrite, pyrite (FeS_2) and pyrrhotite ($Fe_{(1-x)}S$). Stockpile C shows similarities to core samples, with Fe most strongly correlated to U, Co, Cu and S, and also very strongly with Ni and Pb and Zn. The observed differences are likely in part, due to oxidation of a portion of the primary sulphides and re-precipitation as iron oxides and oxy-hydroxides, which would sorb and co-precipitate with a number of the other COPCs examined. Primarily it appears that most elements still correlate very well with S in Stockpile C suggesting that primary sulphides are still the dominant COPC attenuation mechanism and little oxidation is occurring within the pile.

Molybdenum is highly correlated to Ca, Pb, U and V in Phase II. In Phase I core we see correlations to Al, As, Co, Ni, V and S. Surprisingly no correlation between Mo and U was observed in Phase I. In the Phase I deposit, Heinrich et al 2010 found that Mo is primarily present as molybdenite (MoS_2) and jordisite (amorphous MoS_2), typically in association with U, V, As or Cu. The correlation Mo with Pb can be interpreted as the presence of galena (PbS) which is associated with higher grade ore in Cigar Lake and the product of uranium decay since initial mineralization. Molybdenite and galena are not directly associated with respect to mineralogy, rather present as separate minerals, both related to higher grade mineralization. In Stockpile C Mo is associated with Al, As, Co, Ni, S, V and S, very similar to Phase I core samples. It appears little alteration to primary mineralogy has occurred with the pile when examining Mo.

Arsenic is perfectly correlated to Co and Ni in the Phase II core samples, and highly correlated to Pb, V and S. Similarly As is very well correlated to Co, Mo and Ni in Phase I core samples. In Stockpile C there is a very good correlation between As with Ni, Co and Mo. This similarities between core samples and what is observed on Stockpile C suggests little change in primary mineralogy.

In Phase II, good correlation to Se is observed for S only. Correlations with Se are observed for Ca, Pb, V, Zn and S in Phase I (most strongly with S). In Stockpile C, Se correlates well to Al, As, Cu, Mo, V and S (most strongly to S). Whether the difference between Phase I and II is function of different mineralogical controls between the two deposits is unknown, however within the Phase I deposit Se is typically related to sulphides and sulpharsenides and associations are observed to a variety of COPCs (*Heinrich et al 2010, Kaczowka 2018*). The similarity of Phase I and Stockpile C again supports that little mineralogical variation since deposition. Se also shows a good correlation with high grade ore within the deposit, however that relationship is not observed in the waste rock examined.

Nickel in Phase II shows excellent correlations to Al, As, Co (nearly perfect correlation) and well to V and S. In Phase I, Ni is very well correlated to Al, As, Co, Mo, V and S. As discussed above these associations reflect primary ore zone mineralogy (gersdorffitte and cobaltite for Ni and Co). In Stockpile C we observe Ni associated with Al, As, Co, Cu, Fe, Mo, Pb, U, V, Zn, and S. The major change observed in Stockpile C is the good correlation to Fe, whereas, very poor relationships between Fe and Ni were observed in core samples. This again suggests some secondary precipitates are forming in the pile following the dissolution of primary mineralogy.

Very good correlations are observed between U and ^{226}Ra in all rocks examined.

There is a distinct difference in Phase I and II correlations, the correlations observed in Phase II, where they exist, are better typically than in Phase I. Almost perfect correlations are observed for expected mineralogy, for instance between Ni, Co and As, suggesting mineralogy as a nickel cobalt arsenides and sulpharsenides (gersdorffite, niccolite and cobaltite). However correlations are more limited between other elements when compared to Phase I core. This is most likely due to the sample set and variability in core examined for Phase II. The Phase I core dataset was much more variable and larger, introducing the potential for more mineralogical variability.

Phase I (both mined and unmined rock) and Stockpile C show very similar correlations, which suggests the primary mineralogy within the Stockpile is intact and adds weight to the assumption and other observations that significant oxidation has not occurred with this pile. The major difference observed in Stockpile C is that there is significantly better correlations to Fe for a large number of COPC. This suggests that any mobile phases are now associated with an iron phase within the pile. The iron phases in a dominantly oxic pile would likely be as iron oxides and oxyhydroxides, which would serve to co-precipitate and sorb a number of these elements.

4.5 Leach Testing

Leach testing was completed on these rocks to determine the amount of leachable COPC load that may be released from waste rock. The aim of these tests is to examine the amount of readily leachable COPC load under conditions that are not solubility controlled (high liquid to solid ratio). The advantage to using leach testing is that it is a relatively rapid test, can be performed on a large volume of samples, and gives a good indication of the total loads that may be released from the rock.

Detailed scoping level leach tests were conducted for the 2001 EIS to determine the leach solution most appropriate for As specific leaching. Scoping level leach testing was completed to evaluate the effect of different lixiviants run separately (hydroxylamine hydrochloride, acetic acid and deionized water) on a standard 48-hour test timeframes. Following this sequential leaching using the above lixiviants were performed on a more limited sample set, on varying time scales and rinsing with hydroxylamine hydrochloride.

The results of the sequential leach tests were used to calculate an averaged overall total leachable mass of each COPC (As, Cu, Co, Ni, Mo, Pb, Zn and U), which are presented in the 2001 EIS. While raw results for the sequential leach tests were available, due to a lack of detail in calculation methodology the results presented in the 2001 EIS could not be duplicated from the raw data.

To compare and compliment the current leaching dataset, the 2001 EIS scoping level test results recalculated as percent leachable for each individual lixiviants. The assessment of the historical test work is limited to only results from scoping level work. However, where available, the total leachable value calculated from sequential leaches as presented in the 2001 EIS are included in the discussion below (for As, Cu, Co, Ni, Mo, Pb, Zn and U).

The overall leachable mass of each parameter was calculated for each sample, then the leachable mass was used to calculate the percent leachable from each of these samples. In several cases, the calculated average leachable percentage in scoping tests was higher than the reported total leachable percentage in the 2001 EIS from sequential leaches.

A discussion of leach results for each element outlines previous leach test work from the on Stockpile C waste rock, was 2001 EIS, and add to that the current leach testing results.

The 2017 leach testing was completed at a 20:1 water to rock ratio. These results were recalculated in the current assessment to determine concentrations at a 1:1 water to rock ratio. The total amount of leached element from solids is presented. This methodology to convert leach test results collected at a 20:1 water to rock ratio to a 1:1 water to rock ratio is consistent with the approach used in the Orano TID and 2001 EIS documentation. The leachable percentage of total solids was calculated using the data discussed in Section 4.2. Raw data is presented in Table 4-4, the percentage leachable for different programs in Table 4-5. Leachability of elements as a percentage of total solids is discussed in the sections below.

As with the discussion on solids results, it is believed to be more appropriate to compare median values between pile areas as variations are more evident and less dependent on high values in datasets causing a positive skew to their distribution. Mean values are utilized for results (source terms and, where relevant, for a comparative discussion). Only the relevant COPCs are discussed in the sections below, discussion on other elements are introduced later where appropriate.

A graph of total leachable As versus solids As is presented in the 2001 EIS in Table 8.2. This data were the averaged results of the sequential leach results completed for the 2001 EIS. Orano presents this data as water leachable As and total leachable As (*AREVA 2013, Figure 2-1 and 2-2*). As mentioned earlier, 2001 EIS presents total leachable amount using

sequential leach testing, however these values could not be duplicated from the raw 2001 EIS data.

Results from individual scoping level leach tests (Acetic Acid, De-Ionized Water and Phosphoric Acid) were calculated and compared to the leach tests conducted in 2017. Where available, total leachable percentages from sequential leaches as presented in the 2001 EIS are stated below.

The 2000 test work included leach testing optimized to assess As solubility in the rock. In the 2017 test work no attempt was made to duplicate this work as the focus was on assessing the entire suite of COPCs.

Graphs for each COPC of interest are presented in Figure 4-5.

Aluminum

Aluminum is not considered an EOPC but is utilized to evaluate of clay stability within the pile.

The 2017 results had a median leachable Al of 0.05% for the entire stockpile compared to 0.0009 - 0.014% for various leaches completed for the 2001 EIS.

With respect to current spatial variability, rock on the original pad has an overall median of 0.006%, the expansion 0.005% and the extension 0.055%.

The entire dataset (including the year 2000 chemistry), resulted in a median leachable Al of 0.015% and a mean of 0.031%.

These results indicate that newer portions of the pile have a higher leachable Al.

The PII deposit was assessed using drill core (2015 drilling dataset). Similar to the Stockpile C results leachable Al was approximately 0.0012%.

Arsenic

The 2017 results had a median leachable As of 1.5% for the entire stockpile compared to 0.90 – 10.9% for various leaches completed for the 2001 EIS. Sequential leaches conducted for the 2001 EIS showed that 20% of As was leachable (*Beak 2001b, Table 8.2*).

With respect to current spatial variability within the pile, rock on the original pad has an overall median of 1.84%, the extension 13.8% and the expansion 1.36%. The entire dataset (including the year 2000 chemistry), resulted in a median leachable As of 1.81% and a mean of 4.34% (individual samples were weighted by pile and volume).

The PII deposit was assessed using drill core (2015 drilling dataset). Leachable As was 4.79%.

The relationship between leachable vs solids As in Stockpile C was very similar to those observed in 2000. Figure 4-5 shows the leachable As (recalculated to µg/g) vs solids As.

The total leachable percentage from all weighted data was significantly lower than the reported EIS sequential leach percentage (mean of 4.34% vs 20%, respectively).

Cadmium

Cadmium was below detection limit in all leach tests. The lack of Cd is directly related to the very low solids Cd content of the rock.

Cobalt

The 2017 results had a median leachable Co of 0.02 % for the entire stockpile compared to 1.3 – 2.0 % for various leaches completed for the 2001 EIS. Sequential leaches conducted for the 2001 EIS showed that 1.0% of Co was leachable (*Beak 2001b, Table 8.2*).

With respect to current spatial variability, rock on the original pad has an overall median of 0.03%, the extension 0.02%, and the expansion 0.01%. The entire dataset including the year 2000 chemistry, resulted in a median leachable Co of 0.90% and a mean of 1.35%.

The PII deposit was assessed using drill core (2015 drilling dataset). Leachable Co was 0.05%.

The relationship between leachable vs solids Co for the 2001 EIS scoping tests in Stockpile C were significantly lower than results observed in 2000. Figure 4-5 shows the leachable Co (recalculated to µg/g) vs solids Co. The reason for this discrepancy is unknown, however this is also observed for Ni and Zn. The percent leachable compared to the scoping tests cannot be attributed to the lixiviants differences. One explanation could be the hydroxylamine hydrochloride rinse utilized in the 2001 EIS leach testing. This is a moderately aggressive solution and has commonly used to extract ferromanganese and carbonate bound minerals in addition to adsorbed trace elements. As these are all not readily leachable elements, it is unlikely that this percentage of the total mineral has already been leached from the Stockpile. The total leachable percentage from all weighted data was similar to the reported EIS sequential leach percentage (mean of 1.4% vs 1.0%, respectively).

Copper

The 2017 results had a median leachable Cu of 0.096% for the entire stockpile compared to 0.59 – 0.89% for various leaches completed for the 2001 EIS. Sequential leaches conducted for the 2001 EIS showed that 0.20% of Zn was leachable (*Beak 2001b, Table 8.2*).

With respect to current spatial variability, rock on the original pad has an overall median of 0.095%, the extension 0.096% and the expansion 0.107%. The entire dataset (including the year 2000 chemistry), resulted in a median leachable Cu of 0.381% and a mean of 0.631%.

The PII deposit was assessed using drill core (2015 drilling dataset). Leachable Cu was 0.001%.

The relationship between leachable vs solids Cu in Stockpile C were significantly lower than results observed in 2000. Figure 4-5 shows the leachable Cu (recalculated to µg/g) vs solids Cu. The total leachable percentage from all weighted data was higher than the reported EIS sequential leach percentage (mean of 0.63% vs 0.20%, respectively).

Molybdenum

Previous test work showed an overall low Mo concentration in the solids, however leachability was elevated. Similarly, the 2017 results had a median leachable Mo of 12.4% for the entire stockpile compared to 4.5 – 7.9% for various leaches completed for the 2001 EIS. The sequential leaches conducted for the 2001 EIS showed that 55% of Mo was leachable.

With respect to current spatial variability, rock on the original pad has an overall median of 11.5%, the extension 12.4% and the expansion 9.0%. The entire dataset (including the year 2000 chemistry), resulted in a median leachable Mo of 8.7% and a mean of 12.3%.

The PII deposit was assessed using drill core (2015 drilling dataset). Leachable Mo was 16.2%.

The relationship between leachable vs solids Mo in Stockpile C were slightly greater but similar to results observed in 2000. Figure 4-5 shows the leachable Mo (recalculated to µg/g) vs solids Mo. The total leachable percentage from all weighted data was higher than the reported EIS sequential leach percentage (mean of 12.3% vs 55%, respectively).

Nickel

The 2017 results had a median leachable Ni of 0.01% for the entire stockpile compared to 0.93 – 1.25% for various leaches completed for the 2001 EIS. The sequential leaches conducted for the 2001 EIS showed that 1.5% of Ni was leachable.

With respect to current spatial variability, rock on the original pad has an overall median of 0.03%, the extension 0.01% and the expansion 0.01%. The entire dataset (including the year 2000 chemistry), resulted in a median leachable Ni of 0.4 % and a mean of 0.86%.

The PII deposit was assessed using drill core (2015 drilling dataset). Leachable Ni was 0.03%.

The relationship between leachable vs solids Ni in Stockpile C were significantly lower in 2017 than results observed in 2000. Figure 4-5 shows the leachable Ni (recalculated to µg/g) vs solids Ni. The total leachable percentage from all weighted data was lower than the reported EIS sequential leach percentage (mean of 0.86% vs 1.5%, respectively).

Lead

Leachable lead in the 2017 results was below detection in all but one sample. The result presented is likely meaningless. With the exception of the DI water leach, EIS results were also below detection. Sequential leach results showed an overall leachable Pb of 0.1% of total mass in the rock.

The PII deposit was assessed using drill core (2015 drilling dataset). Leachable Pb was 0.05%.

The correlation between leachable vs solids Pb in Stockpile C against results observed in 2000 could not be made due to the lack of samples greater than detection limit. Figure 4-5 shows the leachable Pb (recalculated to µg/g) vs solids Pb (EIS Results). The total

leachable percentage from all weighted data (entirely skewed to the 2001 data) was higher than the reported EIS sequential leach percentage (mean of 0.76% vs 0.30%, respectively). It is recommended to utilize the previous values from the 2001 EIS for any estimates of leachable percentage in risk assessment modelling.

The lower Pb solids concentrations observed in Stockpile C compared with previously mined rock cannot be correlated to a decrease due to leaching as there is not sufficient data to support this.

Radium-226

The 2017 results had a median leachable ^{226}Ra of 0.19% for the entire stockpile. No results were available from the 2001 EIS dataset.

With respect to current spatial variability, rock on the original pad has an overall median of 0.27%, the extension 0.18% and the expansion 0.18%. The entire 2017 dataset resulted in a median leachable ^{226}Ra of 0.19% and a mean of 0.26%.

The PII deposit was assessed using drill core (2015 drilling dataset). Leachable ^{226}Ra was 0.15%.

The relationship between leachable vs solids ^{226}Ra in Stockpile C for 2017 is presented in Figure 4-5.

Sulphate

Sulfate is not a COPC however presented here to identify whether significant changes to the pile are occurring with respect to oxidation of sulphides. Additionally the leachable inventory may assist in management strategies for the rock in Sue C Pit. The 2017 results had a median leachable SO_4 of 33.9% for the entire stockpile (comparing leached SO_4 to total rock S concentration).

With respect to current spatial variability, rock on the original pad has an overall median of 46.7%, the extension 34.6% and the expansion 17.1%. The entire dataset (including the year 2000 chemistry), resulted in a median leachable SO_4 of 18% and a mean of 28.8%.

The PII deposit was assessed using drill core (2015 drilling dataset). Leachable SO_4 was 3.9%.

The relationship between leachable vs solids SO_4 in Stockpile C were significantly lower in 2017 than results observed in 2000. Figure 4-5 shows the leachable SO_4 (recalculated to µg/g) vs total solids S. It is possible the discrepancy is due to the methodology utilized to calculate soluble SO_4 within the rock was different between analytical programs.

Selenium

The 2017 results had a median leachable Se of 4% for the entire stockpile. No Se results were available for the 2001 EIS test work.

With respect to current spatial variability, rock on the original pad has an overall median of 3.05%, the extension 4.00% and the expansion 2.76%. The entire dataset (including the year 2000 chemistry), resulted in a median leachable Se of 4.00% and a mean of 4.75%.

The PII deposit was assessed using drill core (2015 drilling dataset). Leachable Se was 2.79%.

The relationship between leachable vs solids Se in Stockpile C for the 2017 program is presented in Figure 4-5.

Selenium leachable percentage is quite high compared with the majority of other COPCs. However the large discrepancy in Se observed in Stockpile C compared to previously mined Phase II rock cannot be attributed to a rapid loss in Se post mining.

Uranium

A large proportion of samples had leachable U below detection. No data was available from the 2001 EIS. The 2017 results had a median leachable U of 0.11% for the entire stockpile. With respect to current spatial variability, rock on the original pad has an overall median of 0.17%, the extension 0.06% and the expansion 0.09%. The entire 2017 dataset resulted in a median leachable U of 0.11% and a mean of 0.21%.

The PII deposit was assessed using drill core (2015 drilling dataset). Leachable U was 0.16%.

The limited data for leachable vs solids U in Stockpile C for 2017 is presented in Figure 4-5.

Vanadium

The 2017 results had a median leachable V of 0.29% for the entire stockpile compared to 0.38 - 0.59% for various leaches completed for the 2001 EIS. Sequential leach results were not presented in the 2001 EIS.

With respect to current spatial variability, rock on the original pad has an overall median of 0.09%, the extension 0.32% and the expansion 0.27%. The entire dataset (including the year 2000 chemistry), resulted in a median leachable V of 0.35% and a mean of 0.39%.

The PII deposit was assessed using drill core (2015 drilling dataset). Leachable V was 0.06%.

The relationship between leachable vs solids V in Stockpile C were slightly lower in 2017 than results observed in 2000. Figure 4-5 shows the leachable V (recalculated to µg/g) vs solids V. There does not appear to be any significant relationship within this dataset, either for historical or current results.

Vanadium leachable percentage is very low, the discrepancy observed in Section 3.4 of Stockpile C V being lower than previously mined Phase I rock cannot be attributed to a loss (or leaching) after mining and deposition.

Zinc

A large proportion of the 2017 results had leachable Zn below detection. For the results that were obtaining, a median leachable Zn of 0.08% was observed for the entire stockpile compared to 2.55 - 4.22% for various leaches completed for the 2001 EIS. The sequential leaches conducted for the 2001 EIS showed that 1.0% of Zn was leachable.

With respect to current spatial variability, rock on the original pad has an overall median of 0.09%, the extension 0.07% and the expansion below detect. The entire dataset (including the year 2000 chemistry), resulted in a median leachable Zn of 3.35% and a mean of 3.97%.

The PII deposit was assessed using drill core (2015 drilling dataset). Leachable Zn was 1.61%.

The relationship between leachable vs solids Zn in Stockpile C is lower in 2017 than results observed in 2000. Figure 4-5 shows the leachable Zn (recalculated to µg/g) vs solids Zn.

Note on 2001 EIS Data Analysis

The 2000 EIS only presented leach results for As, although results for other elements were also available as raw data. In the current assessment, the data from leach tests conducted in 2000 were utilized to recalculate the leachable mass for all elements were data was available. During this process a miscalculation was observed in the 2000 EIS leach results, and several discrepancies were observed. The first discrepancy was in the water to solids ratio recalculation, where results for As could not be reproduced. Current recalculated leachable amounts for the scoping tests (HAH/acetic acid, de-ionized water and phosphoric acid) from EIS data were significantly lower than those presented in the text. The recalculation of laboratory derived concentrations on leaches involves multiplying the ratio of leach to solids (in this case 20:1) to calculate the values in mg/kg (or µg/g). To replicate EIS results the presented values were back-calculated to the original raw leach values. The ratio required to back-calculate the test results ranged from 30 to 266 (ratio should be consistently 20), suggesting that the leach testing water to rock ratio was between 30:1 and 266:1, however the 2001 EIS write-up clearly states that leaching was conducted on a 20:1 water to rock ratio.

The 2001 EIS data also showed inconsistencies in the leach solution to solids ratio between the same samples leached with HAH/acetic acid, de-ionized water, and phosphoric acid.

Leach to solids ratios needed to be determined for all COPCs of interest from the raw EIS dataset to develop source terms. For this assessment, all raw EIS data was used, assuming a 20:1 water to rock ratio to calculate the leach to solids ratio, including the data presented herein for As.

A similar situation was encountered when attempting to recalculate the sequential leach results from raw data, however in addition to calculation inconsistencies the methodology used for these test was not outlined within the report text. Therefore it was not possible to determine which of the many tests and time steps were utilized for the actual calculations

of the soluble fraction of COPCs within the waste rock as shown in Table 8.2 of the 2001 EIS.

The inconsistencies in calculations stated above are likely why the 2001 EIS leachable percentages as presented in Table 8.2 do not match what was recalculated from historical data in this assessment. That being said, the raw data from the 2001 EIS is sound, and therefore the recalculated data in addition to the 2017 dataset forms the basis for a good foundation to assess rock performance.

4.6 Historical Column Testing and Implications for Source Terms

No column tests were completed as part of the current study, however column testing was completed a number of times on Cigar Lake waste rock in the past. This information can be used to predict porewater concentrations for both surface and subaqueous disposal methods.

In this assessment all historical column tests were evaluated and relevant data was used to determine source term relationships for COPCs that had previously not been shown in detail.

The column testing used were from:

- 1993 test program on a variety of potential waste rock types (*Golder 1995*)
- 1994 test program on fresh graphitic metapelite (*Golder 1995*)
- Bulk leach test conducted on a blend of materials from site (*SENES 1995*)
- 2000/2001 test program on relatively fresh graphitic metapelite (*Beak 2001a*)

To determine expected porewater concentrations for As, the 2001 EIS used recalculated expected porewater concentrations compared to solids concentrations from the fits determined by column test results. This relationship was then used in conjunction with overall rock solids content to produce expected porewater concentrations for waste rock stored under saturated conditions. Data and a relationship was only presented for As in the 2001 EIS, therefore an attempt was made to utilize the raw data and obtain a relationship for all pertinent COPCs using this historical dataset.

4.6.1 Summary of Column Test Results

Both the 1993 and 1994 tests were similar in terms of methodology and set-up. Tests were completed over a 70 and 105 day period (respectively) with weekly sampling. Porewater exchanges through the test were high and the residence time for solution was low. This methodology was questioned by Beak in the 2001 EIS. It was thought the results would not be representative of actual porewater concentrations in a disposal scenario due to the low residence time in the tests.

The 1993 column results are presented in Figure 4-6. The current assessment used all rock tested which had potentially elevated COPCs, not only the selected graphitic metapelites as used for the 2001 EIS. The additional samples included sample numbers CW-93-4B through CW-93-11B. The rock types including one (1) altered meta-arkose, two (2) augen

metapelites, and five (5) graphitic metapelites. This approach was utilized as it is believed that the range in rock types would be more indicative of range of material on Stockpile C.

The 1994 column results are presented in Figure 4-7. These tests were completed on a graphitic metapelite waste rock composite representing a large portion of the deposit. The samples examined were all saturated columns (Samples S1 – S4).

The Bizarre Lake Bulk Leach experiment was a large scale tank experiment examining underwater disposal. This test was conducted using crushed core composed of a variety of rock types expected to be encountered during mining. Results are presented in Figure 4-8.

A greater mass of leachable COPCs were observed from tests completed on graphitic metapelite samples (CW-93-9B, -10B, and -11B). Solids As concentrations in these samples ranged from 350 – 708 µg/g, far greater than the median or mean solids concentrations in Stockpile C. Testing in 1993 was conducted on 1-2 year old core materials which was stated to have higher soluble COPC load than anticipated due to flushing of soluble constituents. These results may be representative of oxidation and flushing which is currently occurring during surface storage in Stockpile C. Therefore, results from these tests should be applicable to the current waste rock management practices.

Testing on 1994 samples was conducted on fresh rock, therefore these results would be representative of fresh rock directly disposed into an existing pit.

Waste rock management strategies outlined in the 1995 EIS were focussed on developing a source term for rock placement under water cover in Bizarre Lake, immediately after mining.

Conversely the placement of rock on Stockpile C and eventual transport to Sue C Pit changed the potential for oxidation, compared to immediate disposal below water.

The column tests results from both programs are applicable. In both scenarios, the overall total leachable COPC load from the rock needs to be accounted for, either as a long-term slowly released load, or an initial flush from immediately available oxidation product.

The overall trends in the 1993/1994 data show that pH remains constant through the time period of the test work, soluble sulphate is initially high and rapidly decreases, the majority of COPCs that are higher than detection limit in the sampling (Co, Mo, Ni, U, and Zn) are flushed from samples and little additional leaching occurs after the initial flush cycles.

Samples analyzed for the 2001 EIS had longer porewater residence times and more sampling cycles (Figure 4-9) than those completed previously. These showed that after the initial decrease of readily soluble constituents, the concentrations of some parameters either remained steady or slowly increased, suggesting a long term constant source. Selenium, Zn, and V showed slow increases in concentration over time, whereas Co, Mo, and Ni appeared to continue to decrease. As and Cd showed increases in concentrations with time. Both Mo and As had higher release rates compared to other COPCs.

Comparing different column studies, As showed a very inconsistent maximum observed concentrations, however within the 2001 EIS, this is attributed to solubility control issue

and differences in experimental setup. Results for the bulk leach test using Bizarre Lake water showed trends that were somewhat inconsistent with column work. In the bulk leach test a large proportion of parameters exhibited a fairly constant release of COPCs with time.

Comparing the 1993 and 1994 test work, completed on aged and fresh core, both showed very consistent trends, with varying initial solute release. The 1994 tests completed on fresh core showed an initially suppressed concentration of solutes (smaller initial release). This is attributed to fewer initially soluble COPCs present in the sample. The exception is with Mo, which showed a much higher initial release in the fresh samples. This could be due, in part, to a higher solids Mo concentration, and also due to the readily soluble nature of Mo in these samples. A large proportion of Mo is readily released as observed in leach tests (see Section 4.5).

4.6.2 2001 EIS Calculation Methodology

Determining methodology used to interpret column results for the 2001 EIS (*Beak 2001b*), was problematic. There were a number of inconsistencies, which will be discussed later in this section.

Arsenic was the focus of this work and therefore calculation results were shown to some degree. The 2001 EIS documentation stated that the results obtained from the 2001 test work were representative of porewater conditions, and for these samples the maximum leach concentrations were utilized as a solids to porewater comparison. It stated that if the residence times for the previous column studies were longer the porewater concentrations would have been higher than observed. As a results they stated that porewater concentrations could be calculated by summing the total mass of arsenic released from the waste rock then dividing the volume by the resident porewater. In draft EIS reports to Cigar Lake Mining Corporation the calculations of resident porewater and the data utilized to make these assumptions (porosity/solids density) are presented (*Beak 2001a* and *Rinker et. al. 2002*). It is not clear if these same methods were also utilized on the Bizarre Lake large scale leach test.

4.6.3 Current Column Interpretation Methodology

In this assessment two methods were used to interpret historical column results. Both the “total load released” (the method suggested by Beak), and a simple porewater to flush ratio recalculation completed using the maximum observed column concentration is presented. As each column had varying flush rates and porewater cycles it was thought the second method would normalize the data to some degree. Additionally, residence times were considered, whereby the porewater residence time stated by Beak to be appropriate were used to recalculate the other column data completed previously. Recalculating the data in this manner gave very unreasonably high concentrations, did not improve correlation between samples, and therefore were not included in this report.

To obtain the total load released value the raw solute concentration for each column analysis was recalculated to a mass released using the porewater flushed in that cycle. All cumulative masses for the entire column residence time were summed to a total mass of an

element flushed from the column during the column test. This mass was then divided by expected porewater volume within each column. This method was utilized for the columns completed in 1993 and 1994. The Bizarre Lake Bulk Leach results became unreasonably high when data was manipulated using this method, therefore results were utilized as-is, similar to the data treatment for the 2001 EIS columns. Where values below detection limit were encountered, they were assumed to be at detection limit, which provides a conservative assessment. For the 1993 and 1994 test work there were a number of solutes which had fewer analysis cycles completed (weeks 5, 10 and 15 for Se and ^{226}Ra for instance). For these it was assumed that porewater concentrations were similar in the preceding weeks where analysis was skipped. As mentioned above, more columns were examined in this assessment over what was chosen as representative in the 2001 EIS.

The porewater to flush ratio identified the flush cycle showing the maximum concentration and recalculating that with the specific flush volume for that cycle.

Both the total load and porewater recalculation for each element is presented. Additionally due to the lack of good fit for a number of the elements between the various studies, both a power function and linear fit is provided for this data. Figures 4-10A to 4-10C show the expected porewater concentrations vs solids content relationships developed for each parameter of interest (with various curve fits) and Table 4-6 shows the summary of results for each COPC. It should be noted that the total load method provides a very conservative estimate of porewater concentrations.

When comparing the current calculations to historically calculated 2001 EIS values, As was used as this was the only parameter with data presented.

4.6.4 Column Testing Results

In the following section, column test results are discussed briefly for each COPC, with a brief attempt at explaining geochemical mechanisms controlling COPC release from the rock. These discussions are added to provide potential reasons for the variability observed. Ultimately, the geochemical mechanisms are not relevant to a large degree, only the correlations between solids and expected porewater concentrations are required to develop expected porewater concentrations for the rock.

Arsenic

Arsenic examined in all column testing showed variable porewater concentrations. The work completed in 2001 specifically was tailored to refine As porewater concentrations and long term release rates. The graphs provided in the Figures 4-6 through 4-9 show raw leach results and demonstrate the variability in concentrations that resulted from different test work methodologies. The data and calculations in Table 4-6 shows the shows the results of the solids to porewater relationships.

When comparing results it should be noted that the resultant relationship determined in the current study predicts a lower porewater concentration than that determined by Beak in 2001 when using their methodology, even when the using same solids dataset (when extra 2001 samples are removed). The methodology used in the data calculation was based on a description in the 2001 EIS, however, a number of attempts to recreate these results

presented in the 2001 EIS were unsuccessful. However, assuming the total load released from the 1993 and 1994 test results are accurate, and we include a larger dataset of both solids concentrations in Stockpile C and include additional column from 1993, we obtain a reasonable (likely very conservative) estimate of porewater concentration for As. Arsenic porewater concentrations obtained here are compared with independent data from pile seepage in a later portion of the document and all indications are that the presented values will be in the range expected.

The power function was determined to be the most accurate estimate of measured data for porewater concentrations.

Cadmium

Cadmium was examined in column tests, however both solids and leach Cd concentrations were below detect in most samples. Analysis of the columns assumed concentrations below detect were at the detection limit. For solids the detection limit gives values of 0.5 and 1.0 and for porewaters recalculation of detection limit values using flush concentrations gave a range in concentrations (which is why variability is present in the graph). Nevertheless, Cd concentrations are presented as an expected porewater concentration in Table 4-6.

Cobalt

Cobalt is present in low concentrations in waste rock samples. For the 1993/1994 testing Co behaved quite similarly for all columns, with an initially higher concentration and steady decrease with time. Both the bulk leach and 2001 column work showed a consistent, and low, Co concentration with time. Figures 4-10A to 4-10C show a significant differences in column studies for samples with higher solids Co concentrations (1993/1994 test work).

To determine what controls on Co are in the samples, correlations in solids between Co and other elements were examined in the Phase I and Phase II rock. Good correlation were observed with Ni and As. Cobalt has been shown to substitute Ni in gersdorffite in the ore zones, therefore the correlation to Ni and As is not surprising (*Heinrich, et al 2000*).

Cobaltite is present within the deposit in high amounts within in ore zones and therefore may be present within the surrounding waste rock. When looking at correlations within Stockpile C rock, Co is highly correlated to a number of elements, most strongly with Fe, Ni, Pb and Se, however also with Al, As, Cu, S and U. The correlation to Fe in Stockpile C is likely tied to dissolution of primary minerals and co-precipitation / sorption with Fe-oxides. This would also explain correlations to other COPCs in Stockpile C not observed within core samples.

Both a linear and power function curves were fit to the column and solids data (Figures 4-10A to 4-10C), however, neither produced a good fit. The linear fit gives an unreasonable skew towards the outlying higher concentration samples examined in 1993/1994, and the power function fit is significantly lower than the bulk of the data examined at these concentrations. Therefore source term concentration chosen was from a visual examination of this data. Porewaters could range from 0.01 up to 0.4 mg/L from leach testing at that

solids content from both total load and porewater recalculation. It is proposed to utilize 0.4 mg/L to be conservative.

Copper

Copper is present at moderate concentrations in the Cigar Lake deposit. As with other presumably primary sulphides in the waste rock, we see an initially higher Cu concentration followed by a decrease to very low values rapidly in the testing. An early spike can be seen in the 2001 columns for both samples, which is likely due to the initial release of soluble oxidized load in the columns. Cu is correlated with a number of other elements in Stockpile C, and correlated to Fe in Phase I core. Leachability is very low in all Stockpile C samples (below 1%). Recalculated column studies (Figures 4-10A to 4-10C) showed a fair correlation.

The linear fit is the best representation of the data.

Iron

Iron was examined in light of a high amount of solids correlation to a number of COPCs. Iron is present in high concentrations in the waste rock core samples and in Stockpile C (mean of 19,500 µg/g). The correlations to iron in Stockpile C suggests that iron oxide minerals are a dominant attenuation mechanism for COPCs which have been released by oxidation of primary minerals, therefore it is important to briefly discuss the stability of this element in the pile. Leach testing suggests that the iron in the pile is quite stable, with only very minor total release of this element. Iron in column studies shows a very low release rate, especially considering the amount of iron present in the pile. The data suggests that the initial flush is at highest concentration followed by a gradual decrease with time. This suggests that there is some soluble iron load that exists in this rock, after this initial flush little further production of iron is observed.

Molybdenum

Molybdenum concentrations were significantly higher in leachate from 1994 column work which cannot be directly related to an initially higher sample solids concentration in those samples. If oxidation of 1993 (aged) core had an effect on releasing Mo, a higher initial flush of Mo would have been present in 1993 test work over 1994. This is not the case, rather a large variability is seen between samples in different column tests. This is consistent with leach testing, which showed at lower concentrations leachable Mo ranged by over one order of magnitude (Figures 4-10A to 4-10C). Potentially this large variability in porewater concentrations could be due to variability in deposit mineralogy for Mo (refer to Section 4.3). Surprisingly there was no difference observed in Mo concentrations in the 2001 test work which comparing limed vs un-limed columns. Mineral controls in the limed Ca-rich sample should have stabilized Mo as powellite ($CaMoO_4$). Low grade ores have a very strong correlation between Mo and Pb (*Heinrich et al. 2010*). However, very poor correlations to Pb in all depositional environments suggests that wulfenite ($PbMoO_4$) is likely not present to a large degree. Jordisite (MoS_2) is common in reducing environments, and is highly reactive. Another potential mineral control in waste rock could be phyllosilicates (notably chlorite and biotitie) which have been shown to contain a large proportion of Mo in the Cigar Lake ore zones (*Heinrich et al. 2010*).

The rapid and large percentage of leaching and different behaviour of Mo (compared to other COPCs likely present as primary sulphides) suggests that Mo is present partially as a very soluble or unstable species, perhaps one remobilized and deposited during a post-ore alteration stage, however more likely as a reactive sulphide. Section 5.0 of this report outlines an attempt at correlating Mo observed in Stockpile C drainage to other elements which may further assist in elucidating what other elements are related to Mo release. For conservatism the total load, linear fit is recommended as the preferred relationship to estimate porewater concentrations.

Nickel

Nickel results from column test work show very similar results to that observed for Co. The highest solids concentration samples appear to have much greater Ni release in column work. This is consistent with leach testing for both Ni and Co. The majority of 2017 leach testing results for Stockpile C show consistent solids vs leachable Ni and Co. The outlier observed in 2017 leach tests had the greatest solids concentrations out of all samples (at 640 µg/g Ni and 330 µg/g Co) and were outliers in terms of the total mass leached, both outliers are from the same sample. The column tests also show similar results with Ni and Co. Both CW-93-9B/10B columns showed the highest porewater concentrations out of all column tests and had the highest solids content. Mineralogy in these samples is likely somewhat different than other samples.

Neither curve fit gave an appropriate estimation of Ni porewater concentrations. It is proposed a value of 0.2 mg/L be utilized for a source term, being a maximum conservative visual fit to this data.

Lead

Lead results from column test work show very low concentrations (below detection for most analysis results). The comparison of all column work porewater to solids contents (Figures 4-10A to 4-10C), shows very poor correlations due to the number of samples below the detection limit. No initial increased Pb concentration is observed, likely due to detection limits masking this data. The concentration of Pb in solids is low, overall leachability of this element is very low and column studies show low concentrations in porewater.

It is recommended to utilize the linear curve fit using the total soluble load calculation.

Radium-226

Radium-226 concentrations observed in column tests (where available) show an initially higher concentration followed by a decrease with time. No ^{226}Ra concentrations were measured for the 2001 EIS work. Predicted porewater and solids ^{226}Ra concentrations correlated poorly to one another. Overall ^{226}Ra concentrations in test work are low, and total leachability measured on Stockpile C rock are also low (below 1% of total solids).

To maintain a level of conservatism, it is recommended to utilize the linear fit porewater relationship. Calculated porewater concentrations will be higher than the power fit, however not unreasonable when examined to the bulk of the data.

Selenium

Se is present in low concentrations in all waste rock samples and the overall mass leached in Stockpile C rock is moderate (up to 4.5% of total Se load). In the column tests the initial flush of Se was moderate, and a decrease is seen in all tests. 2001 column tests run over a long time frame showed a slight increase in Se after 200 days, similar to what was observed with Pb, Mo, Zn and V, however nothing significant. Selenium, a chalcophile element is typically contained in sulphides, could be present as elemental Se or ferriselite (FeS_2). In more oxidized environments Se may be associated with iron hydroxides. Selenium also substitutes strongly for S in the Cigar Lake deposit (*Heinrich et al. 2010*). Se is likely present as a primary sulphide within both waste rock and Stockpile C.

The highest concentration sample had slightly elevated porewater results compared to the other column tests however not unreasonable considering the rest of the data. It is recommended to utilize the linear fit for Se in making porewater predictions.

Uranium

Uranium concentrations in column tests showed a decreasing U concentration with time for the 1993 and 1994 column work, and a fairly steady state concentration in the Bizarre Bulk and 2001 column tests. Uranium was affected by addition of lime in the 2001 tests, with an approximately order of magnitude higher concentration measured in barren core and core with lime addition. This is somewhat of a surprise as addition of lime typically results in U(IV) to be present as soluble uranyl carbonate species. A reasonable correlation was observed for U in the recalculated column samples, however these results are somewhat biased by samples that were below analytic detection limit. One sample (containing a low solids content) showed a comparatively high porewater concentration. Uranium in solids correlates well with Co, Cu, Fe, Ni and Pb in Stockpile C, however no correlations are observed within the waste rock core samples.

Uranium is not expected to be of concern from this waste rock. The solids content is low and the overall leachable mass of U is low (below 1% of total solids). It is expected the linear fit will be representative in calculating a porewater concentration for U.

Vanadium

Vanadium concentrations in column tests is dominated by below detection limit analytical results. Vanadium porewater concentrations predicted in Table 4-6 reflect this detection limit calculation. Overall leachability of V is very low (below 1% of total solids), and V is not expected to be a concern.

A conservative approach would be to utilize the linear fit for V for modelling purposes.

Zinc

Zinc in all column studies shows an initially higher concentration with a decrease through time. Overall concentrations of resultant leachate are low. The 2001 columns showed an increase in long term Zn release, consistent with other elements likely associated with primary sulphides. Overall porewater concentrations are predicted to be very low, and total

leaching of is also low. In core samples Zn correlates well to Al and Ca and in Stockpile C only to Cu. Overall the risk of impacts from Zn from Stockpile C is very low.

Correlations between column test samples is very poor however due to the detection limit calculations the linear fit of data is recommended and should be a conservative estimate of Stockpile C rock.

Note on 2001 EIS Data Analysis

The methodology described in all Beak reports was followed in the current assessment. Unfortunately, matching the Beak calculation could not be done for As, despite the calculation steps (results) were shown. Several other inconsistencies and errors were observed when examining the results that were provided in the reassessment of 1993/1994 results. These are outlined below:

- The solids content reported for leach tests were incorrect for several of the samples, maximum reported porewater concentrations do not match raw data.
- The porewater volumes contained in columns were incorrect when recalculated using the report stated operational parameters (rock mass/density and porosity).
- The porewater to flush ratios utilized were very inconsistent between similar samples.
- Table 3.5 in the Beak (*2001a*) report shows a number of column tests were used; however in Figure 3.6 only select ones were plotted, and these are inconsistent with tabulated values.
- Only selected column tests were utilized from 1993 testing, and no explanation is given why all PAG (nor all graphitic metapelite samples) were used in the porewater calculations.
- The raw results presented in the 2001 EIS for 2001 samples (CW-00 columns) do not match raw data.
- When recalculating the Bizarre Lake Bulk Leach data using Beak methodology an unreasonable porewater concentration is obtained, however it is suggested in the reporting that these results were treated similarly to 1993/1994 columns.

4.7 Acid Base Accounting on Stockpile C

It was prudent to examine all core obtained in 2017 using standard acid base accounting (ABA) procedures. Column results from 1993/1994 suggested that significant oxidation of the pile would occur over a longer storage period. Additionally pile seepage in monitoring Station 2.4-2 (original pad) shows increased solute concentrations and significantly decreased pH. The original pad shows oxidation products on the waste rock surface.

Rock stored for longer periods on Stockpile C needs to be examined in the light of i) the potential for increased oxidation of primary sulphides in the rock and ii) the potential that the expected mineralogy and speciation of COPCs changes during the storage period. The concern for Stockpile C is not that it is acid forming, it is the magnitude of oxidation on Stockpile C and whether this waste rock material will become acidic prior to deposition in Sue C.

Conversely, there may be benefits to long term storage on surface by decreasing the soluble mass of some COPCs on the pile. This is certainly true for Mo, which does not appear to show an increased load due to oxidation of primary sulphides, rather is present in the rock, at least partially, as a reactive phase. Flushing of solutes on the pile would decrease overall environmental loading as the load contained within the seepage while being stored on surface is being collected and treated.

The current stockpile was characterized using ABA procedures to look at the current progression of acidification. Seepage beneath the pile can indicate, to a certain extent, the rate of production of the soluble load within the pile, however this may be compounded by dilution from runoff and selective flushing of certain parts of the pile. ABA test work and a comparison of the total leachable COPC load within the pile will be used to evaluate the rate of oxidation in the pile itself compared to standard ABA test work in the main deposit (remaining Phase I rock from 2015 test work).

Examination of core samples is not without complications, core is undisturbed rock which shows in-situ concentrations of metals, whereas the rock that is of concern is that which has been mined, mixed with lime from shotcrete and concrete, and hypothetically speaking has had a certain amount of readily soluble COPCs flushed from the rock (taken up in mine water and through water treatment). A direct comparison of historical ABA test work or that completed on core recently from the remainder of the deposit will not provide information on evolution of the rock in terms of available acidity and oxidation of sulphides since placement. The only pertinent data available which can be compared with respect to pile evolution is the total sulphur/sulphide content of the historical test work to that remaining in the pile. If the pile is statistically lower in sulphur content the inference can potentially be made that the pile is currently oxidizing.

4.7.1 ABA Discussion

The paste pH measured in all portions of the pile are presented in Appendix D. All samples measured showed pH values greater to or equal to 7, the lowest value of 7 was measured in the expansion area. Mean pH was highest in the original pad, followed by the extension then the expansion. The overall Stockpile C weighted mean pH was 9.8.

Phase I and Phase II PAG core also had relatively high paste pH, 7.6 and 7.5, respectively. Minimum values observed for these core samples were 5.6 and 5.8.

Comparing Acid Neutralization Potential (NP) vs Acid Generating Potential (AP) is a quick method to examine the potential for acidification. Potentially acid forming is defined by an NP/AP ratio, or neutralization potential ratio (NPR) less than 1, uncertain between 1 and 2 and non-acid forming above 2. The NP vs AP is plotted in Figure 4-11. It can be seen that, the majority of Stockpile C falls into the non-acid forming category, some is classified as uncertain and some is potentially acid forming. Phase 1 is, for the most part, all potentially acid forming, as is the 2017 Phase II core. The historical dataset for Phase II is a mix of a variety of categories, suggesting that it is likely these samples are often times distal to the deposit and likely would not be representative of any rock encountered during mining.

Figure 4-12 shows percent sulphide in rock plotted against the NPR for all samples. Here we can see that, after deposition on Stockpile C, waste rock with a sulphide of 0.5% and less would remain non-acid forming, at least in the short term (NPR>2). Comparing this one step further, current rock examined on NPR vs paste pH, we see that even Stockpile C rock which has a relatively low NPR is remaining at above neutral pH. It is evident from these tests that no acidification has taken place, at least in the core of the Stockpile. Sufficient neutralization capacity from entrained lime and shotcrete remains in the entire stockpile to keep acidification from occurring. This is true for all areas of the pile, including the originally deposited rock.

5.0 STOCKPILE C DRAINAGE AND FLUSHING

5.1 Underdrain Water Quality

Stockpile C underdrain water quality represents the geochemical current state of the pile and shows some indication of weathering to date. There are three sumps on the facility and these collect both surface runoff and seepage directly from the pile. Underdrain water quality for the three sumps in the pile is provided in Appendix F. There is some ambiguity as to the source of the water represented in each of sumps historically. Water quality from 1998 - 2002 may be combined Stockpile B and C seepage and runoff (as reported in the annual report), however these combined data were reported as Station 2.4-4 in 2002 (this station is currently defined as the sump in expansion, which did not exist in 2002). The 2004 Annual Report states 2004 Stockpile C sampling was conducted on Station 2.4-1 (Stockpile B) and 2.4-2 (Stockpile C original pad) separately (data confirmed as separate stations in our SAP-EC database). In 2005 water quality for three stations was reported. Data prior to 2002 is questionable as there is some naming confusion. Another challenge in interpreting the underdrain water quality is that the sumps are connected by perimeter ditches and culverts, and therefore each consecutive sump receives surface water runoff from the upstream sump. Data for 2.4-4 from 1993 to 2005 likely represents a mixed Stockpile B and C water, collected at a point in the piping after the two sources mixed. Some changes to station names likely occurred in the past, post 2006 Station 2.4-4 is clearly stated and reported as Expansion data. Data for 2.4-1 and 2.4-2 are individual underdrain waters for Stockpile B and C, respectively, back through the dataset (1991 to present). The collection well in the Extension (2.4-3) has data from 2002 to present and is also likely valid data for that sump alone. Despite these questions regarding source and mixing, the data are presented as a general indication of trends for the waste rock piles with no specific discussions regarding individual construction phases of the stockpile.

The steady decrease in underdrain pH observed in 2.4.2 in recent years was a concern as it could be an indication of sulphide oxidation. The 2001 EIS concluded that temporary storage of the waste rock at surface was acceptable, however decreasing pH in seepage water as reported for Station 2.4.2 contradicted those predictions as they indicate oxidation and acidification of the pile. Figures 5-1A and B shows time series evolution of underdrain water quality on the pile. pH in the underdrains is initially high (in the range of 8-12) however a slow but steady decrease is seen over time , currently pH is 3-4 at station 2.4.2, suggesting acidification is ongoing. Sulphate is increasing, and parameters that are pH controlled (Ni, U, Zn) are increasing. Similar trends of decreasing pH are observed in the Extension portion of the pile (Station 2.4.3) to a lesser extent. This is resulting in similar increasing metal concentrations. Surprisingly, Mo is decreasing in all cases, suggesting Mo is not controlled predominantly by sulphide oxidation.

To examine pH/oxidation controls on metals to a further degree, the pH vs metal COPC were plotted (Figures 5-2A and B). These plots shows that Cu, Fe, Ni, SO_4, U, and Zn are increasing with acidification, further supporting that active sulphide oxidation is occurring. Mo, As, Cd, Se, V and ^{226}Ra have decreasing trends with decreasing pH. This suggests that as primary mineralogy is degraded by oxidation a release of these latter elements is observed at near-neutral pH conditions, at lower pH these are becoming secondary

oxyanions. However, this decrease is not definitively due to any direct geochemical control (secondary oxyanion formation) on these elements, it may also be that the soluble load within the rock has been reduced by flushing prior to the onset of acidification.

The data observed in the sumps can be taken generally as an indication of flushed and oxidized pile performance, but does provide information on actual leachate water and chemistry should the pile remain in an oxic state.

Seepage water quality was examined by completing Pearson correlations (methodology described in Section 4.3). The water quality observed at these stations may not necessarily be representative of actual seepage water concentrations due to the dilution from runoff, however correlations between parameters should remain generally consistent regardless of the amount of dilution. For Station 2.4-2, correlations were split between high and low pH water and for 2.4-4 the correlations included only samples collected after 2005 (Tables 5-1A, B, C, and D).

The intent of this section is not to go through each element in detail, it is to briefly touch on and support some of the assumptions and statements earlier in the document.

Aluminum

Underdrain water quality results show an increase in Al release from the pile directly related to pH. As pH becomes lower due to sulphide oxidation and the buffering capacity of carbonates is exhausted we see aluminosilicate/clay buffering, which holds the pH at around 4. Directly in relation to the Al and pH control we see an increase in Mg. This is in agreement with clay types surrounding the deposits and we observe dissolution of Mg rich clays at these lower pH conditions (Mg-chlorite, Mg- and Fe-rich illite).

Al is stable in clay form from pH 5 up to about 10, below 5 Al^{3+} is soluble and above pH 10 $Al(OH)_4^-$ is soluble. The presence of Al is important as its release at lower pH suggests the affected acidified portions of the pile are now being buffered by clays as the carbonate system was exhausted.

Arsenic

Graph 4-13A shows an initially low As content followed by a large increase and gradual decline to low concentrations. When looking at As in comparison to pH, in all cases we see a higher As concentration in circumneutral pH ranges, a decrease can be seen at lower pH. As correlates well to Mo, and fairly well to Se. Within acidic pH ranges (<7) we observe a good correlation to Fe. If simple sulphide oxidation and dissolution of primary As species is occurring we would expect to see increased As at lower pH along with increases in Cu, Fe, Ni and U.

Molybdenum

The important thing to note with respect to Mo concentrations in the underdrain samples is the rapid decrease of Mo with time. It appears that Mo (irrespective of pH), flushes rapidly from the samples at relatively high concentrations. If long term loadings from Mo are a concern, an understanding of the flushing characteristics will be useful for when selecting a management practice and predicting an appropriate source term. Mo correlates well to As,

Pb and Se. Fair correlations are observed for Fe and U (negative) and for U (positive). In lower pH samples Mo correlates very well with Ca, Se, Zn and SO_4.

Sulphide Oxidation and Sulphate

Sulphate concentrations show steady concentrations with time except for the case of the samples which have been oxidized and are becoming acidic. Ca, Al, Cu, Fe, Ni, Se, U and Zn follow the same trends as seen for sulphate. For long term management this suggests long term release of the COPCs is controlled directly by sulphide oxidation rates. If pit lake storage can effectively eliminate sulphide oxidation, the release of these COPCs will be limited.

Radium-226

Radium-226 activities in the underdrain samples do not correlate consistently well in any one sump sample. Radium-226 not appear to be pH controlled to any degree, and activities noted in the underdrain samples appear to decrease slightly with time. Activities observed in the column and bulk leach tests are consistent with observed values in the sumps, with an initially elevated value followed by a decrease.

5.1.1 In-Situ Water Contents

To examine the degree of fresh water infiltration into the pile the available water contents were assessed. Currently two datasets of pile water contents exist, the 2001 drilling program and the current results from 2017. It was assumed that water contents on deposition were high. The amount of water remaining in the pile should indicate whether the pile is mainly draining remnant porewaters or has a significant amount of water infiltration.

Gravimetric water contents from the 2017 drilling program are provided in Table 4-1 and results from the 2001 program are included in the Waste Rock EIS. Summary statistics are shown in Table 5-2. The water content in 2001 ranged from 3.8% - 18.2%, with a mean of 10.7%, the extension holes from 6.2% - 23.7% with a mean of 10.1%. 2017 results showed the original pad with a range of 4.1% - 6.3% and a mean of 5.4%, the extension with a range of 3.4% - 9.5% and a mean of 6.3 and the expansion area with a range of 4.3% - 15.2% and a mean of 8.3%.

The comparison from 2001 to 2017 clearly shows that the waste rock is draining after deposition, with significant decreases in overall water content observed for all parts of the pile. Additionally both data sets show that the newest deposition has higher water contents (the extension in 2001 and the expansion in 2017). Both datasets show a high variability in water contents for freshly deposited material which decreases as the pile ages.

These results support the fact that the initial porewater entrained in the fine waste rock drains from the pile and suggests that less infiltration than draining is occurring.

The results seen in the underdrain represent initial flush water quality from the pile (diluted with runoff). Waste rock is placed at saturated conditions, and this freshly placed material drains to optimal field conditions after placement. Due to the fine nature of this material it is likely there is not a high degree of water infiltration in the pile, however that may be

variable depending on the slopes and propensity for ponding to occur. A low infiltration rate and high runoff likely results in less flushing of waste rock. The underdrain results are assumed to be dominated by surficial runoff and flushing of the solutes and oxidation products in the pile rim, and not representative of bulk pile geochemistry.

A certain amount of drainage will occur from the pile center, however it is likely that the majority of water seen at the toe of the facility is due to runoff.

5.1.2 Correlation to Acid Base Accounting Results

The majority of the pile is non-acid forming, some is uncertain, and a small proportion is potentially acid forming. pH results from core sampling indicated no currently acidic portions of the pile exist. All paste pH results were above 7 influenced by the large amount of shotcrete/concrete skipped to surface with waste rock.

Drilling indicated that no portions of the pile are currently acidic, it is likely that the higher flushing rates near the surface of the pile are removing soluble lime/neutralization capacity in these areas. Consequently the areas of the pile which are contributing to the loading observed in the sumps are representative of the pile crust and initial porewater drain down. The majority of the pile has remained neutral and unaffected by acidification. It is anticipated that in the near term no significant acidification of the pile will occur other than on the outer crust. The steady decrease in pH and geochemical trends observed in the underdrain water quality suggests that the pile is reactive, however due to the limited amount of seepage water expected from the pile core, the suggestion from water content data that the pile is still actively draining and high pH observed in the 2017 core sampling, all point towards this data being from the outer (active) portion of the pile.

6.0 SUMMARY OF RESULTS

The primary intent of this program was to update and expand on saturated in-pit disposal source terms within Sue C Pit at McLean Lake for Stockpile C, remaining Phase I and Phase II PAG waste rock.

These results are summarized below.

6.1 Stockpile C Waste Rock

A summary of solids content, leachable mass, and source terms for modelling are presented in Table 6-1. The overall recommended values for Stockpile C rock from this assessment are significantly lower than from the 2001 EIS in regards to As and Mo.

Each COPC is discussed below with regards to the appropriateness of the data compared to previous predictions. Ultimately, to remain conservative, Orano could utilize the 2001 EIS porewater predictions with new solids concentrations for both Mo and As, however these values seem unreasonable considering the updated assessment.

For all comparisons and summaries provided below it should be noted that the underdrain water quality is likely reflective of mainly oxidized runoff water and the majority of column tests had solids concentrations far exceeding expected Stockpile C concentrations.

Arsenic

Arsenic concentrations for porewater are significantly lower than those recommended in the 2001 EIS, 9.6 mg/L vs 21 mg/L. There are a number of reasons for this, primarily being that As solids concentrations in Stockpile C are significantly lower than determined in EIS work (mean of 100 µg/g vs 200 µg/g). Additionally more column data was utilized in this assessment and several calculation discrepancies were removed from the 2001 EIS data analysis, resulting in a lower porewater to solids relationship. The previous prediction of 21 mg/L for As is not reasonable for this rock due to both the solids content utilized and expected porewater concentration relationship developed for this work.

In terms of representativeness, both column results and underdrain water quality support the updated predictions. Underdrain concentration are a maximum of 2 mg/L. 1993 column testing showed maximum concentrations of 10 mg/L, 1994 columns up to 8.5 mg/L, bulk leach up to 2.5 mg/L. The 2001 EIS test work was an exception, with concentrations of up to 80 mg/L encountered. The 2017 leach testing, while not representative of in situ conditions showed a mean leach of 0.275 mg/L and a maximum of 4.4 mg/L. Even including the high 2001 column work, and recalculating the other column tests to total load, we obtain a relationship suggesting 9.6 mg/L porewater concentration.

Leachability of the rock is consistent with historical work, and percent leachable has been dropped to values more in line with experimental data (previous estimates were overly conservative).

Cadmium

Cadmium data is included in Table 6-2; however this data cannot be readily interpreted due to the majority being lower than detection limit. A worst case porewater value is provided. Values observed in underdrain water are below 0.001 mg/L. Several of the columns showed higher recalculated Cd values, however these also had significantly higher Cd concentrations in solids.

Cobalt

Cobalt solids concentrations are significantly lower in this assessment over the 2001 EIS predictions (47 mg/L versus 84 mg/L). The percent leachable in the current assessment is similar to what had been proposed earlier (1.35%). The porewater concentrations were estimated as a worst case visual fit of the combined column tests as a calculated fit could not be obtained.

With respect to representativeness, 1993 column data showed that the majority of tests were within 0.02 to 0.2 mg/L maximum leachate, with two outliers at 40 mg/L. 1994 columns had a maximum cobalt at 1 mg/L, bulk leach at 0.02 mg/L, and 2001 columns at 0.5 mg/L. Underdrain water quality is limited; however results for all three sumps have maximum recorded concentration of 0.06 mg/L. All available evidence points to the porewater value shown as being worst case. Correlations suggests cobalt is present primarily as a primary sulphide associated with Ni and As. There is an initial flush of soluble Co from the samples followed by a steady decrease in the absence of oxidation.

Copper

Copper solids concentrations were slightly higher than previously estimated (30 mg/L versus 25 mg/L), as was the percent leachable (0.2% versus 0.63%). The porewater concentrations for this material reflects this change, currently at 0.04 mg/L, the 2001 EIS suggested a value of 0.003 mg/L.

With respect to representativeness of the porewater estimation, we observe maximum column testing Cu concentrations of 0.01 mg/L (1993), 0.024 mg/L (1994), 0.035 mg/L (bulk leach), and 0.095 mg/L (2001). Underdrain water quality is a maximum of 0.1 mg/L and 2017 leach testing gave a maximum of 0.0023 mg/L. All evidence points to the value of 30 mg/L porewater concentration as being very conservative. Column testing suggests that Cu will have an initial flush of soluble/available mass followed by a rapid decrease in concentration.

Molybdenum

Molybdenum solids concentrations are lower than previously estimated in the 2001 EIS. Molybdenum concentrations will be initially high, however these are almost certainly going to drop significantly over time. The Mo concentration of 3.3 mg/L is the suggested initial flush concentration. Comparing to column results this appears somewhat low, however overall solids concentrations are on the lower end in Stockpile C compared to those examined in the column studies. This is also consistent with underdrain water quality observed as first flush on the original pad. Overall leachable Mo has been decreased from

the 2001 EIS results due to consistency in results between the current leach tests and those completed in 2001.

Molybdenum is likely present, at least partially, as a soluble species, resulting in an initial flush and decrease in concentration with time. Molybdenum is highly leachable from the rock (12.3%).

Nickel

Nickel solids concentrations are slightly lower than previously estimated, as is the total leachable percentage within the rock. As was the case for Co, neither curve fit gave an appropriate estimation of Ni porewater concentrations. It is proposed a value of 0.2 mg/L is utilized for a source term, being a maximum conservative visual fit to this data.

Lead concentrations were similar to those estimated previously. Percent leachable was higher than the proposed EIS values, due to values being below detect for the majority of 2017 leach tests this was obtained from a recalculation of the 2001 dataset. No distinct correlation for lead was observed in column data. It is proposed using a value of 0.07 mg/L for porewater concentrations. The graphs show that this may be somewhat low considering the total load column recalculation, however none of the column results, the leach tests, or the underdrain show higher concentrations. The value proposed is conservative.

Radium-226

Radium-226 was not included in the 2001 EIS analytical program or discussion. The proposed value for porewater from this assessment is 1.2 Bq/L. This value is considered conservative and reasonable considering all available data.

From underdrain sump sampling we do not see any discernable pH control on ^{226}Ra, and activities noted in the underdrain samples appear to decrease slightly with time (range from 0.005 – 1.8 Bq/L). Activities observed in the column and bulk leach tests are consistent with observed values in the sumps, with an initially elevated values followed by a decrease (range from 0.03 - 1.4 Bq/L for 1993 testing, up to 3.5 Bq/L in 1994 testing, up to 0.025 Bq/L in bulk leach). Values from 2017 leach testing are significantly lower than the values stated above (mean of 0.002 Bq/L) and overall leachability of this radionuclide is very low. From data it appears that ^{226}Ra has an initially slightly elevated concentration in samples, however after flushing this soluble load production should be limited, even if pile acidification should occur. The porewater value selected was from the total load of column testing and as stated earlier is considered an upper bound, conservative porewater concentration/activity for COPCs.

Selenium

Selenium was not included in the 2001 EIS discussion. Solids concentrations for 2017 Stockpile C are the same as for the 2001 program at 1.1 µg/g, resulting in a weighted average for the pile of 1.0 µg/g.

The proposed value for porewater is 0.18 mg/L. This value is considered reasonable taking into account column studies and underdrain water quality. Column work showed a maximum concentration of 0.47 mg/L (1993), 0.014 mg/L (1994), 0.01 mg/L (bulk leach),

and 0.15 mg/L (2001). Underdrain water had a maximum concentration of 0.65 mg/L and 2017 leach testing showed a maximum concentration of 0.009 mg/L. All available evidence suggests the selected porewater value is representative and conservative.

Selenium percent leachable is relatively high compared to other COPCs at 4.75% total rock mass.

Uranium

Uranium was not considered for discussion in the 2001 EIS in terms of percent leachable. Mean solids concentrations determined from the 2017 program are 10 µg/g, similar to the suggested 2001 value of 9 µg/g (2001 Stockpile C results were a mean of 24 µg/g).

2017 porewater concentrations are similar to those proposed in the 2001 EIS (0.43 vs 0.50 mg/L, respectively). Porewater values are considered representative. Column testing results showed a maximum concentration of 1.5 mg/L (1993), 1.05 mg/L (1994), .054 (bulk leach) and 0.17 mg/L (2001, with cement added). Underdrain water quality has water quality below 0.5 mg/L (higher values in oxidized runoff water), and 2017 Stockpile C leach results showed a maximum of 0.0044 mg/L.

Vanadium

Vanadium was not included in the 2001 EIS analytical program or discussion. The proposed value for porewater is 0.05 mg/L. Solids concentrations for Stockpile C are a weighted mean of 29 µg/g with a percent leachable of that mass at 0.39%.

This value is considered reasonable considering column studies and underdrain water quality. Column testing showed maximum concentrations of 0.06 mg/L (1993), 0.1 mg/L (1994), 0.002 mg/L (bulk leach), and 0.05 mg/L (2001). Underdrain water quality showed a maximum concentration of 0.025 mg/L and 2017 leach testing showed a maximum leach concentration of 0.021 mg/L. Vanadium release is likely a fairly steady state (constant) or slowly decreasing in the absence of oxidation.

Zinc

Zinc solids concentrations are slightly lower than those estimated for the 2001 EIS (29 µg/g vs 40 µg/g). Percent leachable was higher than previous estimates and is based on current work and a recalculation of historical data. The porewater concentrations of 0.09 mg/L are higher than previously proposed 0.006 mg/L.

Zinc porewater concentrations are considered reasonable when all available data is assessed. Column studies showed maximum Zn concentrations of 0.3 mg/L (1993), 0.065 mg/L (1994), 0.80 mg/L (bulk leach), and 0.2 mg/L (2001). 2017 leach testing showed a maximum Zn concentration of 0.004 mg/L and underdrain water quality is below 1 mg/L (for oxidized drainage).

6.2 PRWR Agreement

Table 6-2 shows the results of both drilling campaigns on the pile and a volume weighted overall solids content in the pile compared to the PRWR agreement values. It should be

noted that data presented in this table is a compilation of all available solids analysis, not just the select values included in the 2001 EIS.

All data from the current and 2001 Stockpile C assessments meet PRWR maximum allowable concentrations (approximately 130 samples). Overall average concentrations from the combined data sets exceeded the average values in the PRWR agreement for Cu, ^{226}Ra and U; however values are not significantly higher than the average PRWR values. Both Cu and U were statistically lower in the 2017 assessment than the 2001 dataset. Radium-226 was not measured in the previous assessment and it was not clear on how ^{226}Ra was obtained for the PRWR agreement.

6.3 Phase I Unmined Waste Rock

Phase I unmined rock was assessed through a geochemical program in 2014 and 2015. This included the majority of unmined rock in the deposit expected to be received on Stockpile C. An assessment of the data in historical core data (mined rock) showed a good correlation to material already on Stockpile C. It was expected that the geochemical behaviour of future Phase I material will be similar once deposited, therefore a direct comparison of solids data was a valid interpretation method.

Comparing remaining Phase I solids to existing Stockpile C rock, higher concentrations of As, Co, Mo, Se, and V content, and similar concentrations of Co, Nu, Ni, Pb, U, ^{226}Ra and Zn concentrations were measured in Phase I core samples. The variation to what is observed on Stockpile C can be attributed to two factors, the first is that only PAG rock was considered in remaining Phase I, secondly mining is progressing into areas with a higher degree of graphitic alteration, which correlates well with elevated As and other COPC concentrations. Additionally a significant area (Phase I south development rock) of mining included cleaner rock than development directly beneath the trend of the deposit.

Percent leachable and porewater concentrations will follow the same trends as observed for the rock currently on the stockpile due to mineralogical associations remaining the same. Outside of amending the mean solids content of this material, the source term assessment was similar to Stockpile C. No variations are expected from this methodology. Results for the source term assessment for this material is provided in Table 6-1.

6.4 Phase II Deposit

Two datasets were evaluated for Phase II. The first was a historical database containing information from geology programs. The first was development rock from historical and current exploration and resource evaluation programs, which was constrained in elevation and laterally to be in the bounds of development areas. The additional core samples collected in 2017 were evaluated in the same manner as Stockpile C material. These rocks were similar in mineralogy however fresh rock was only available from more elevated COPC areas. Consequently solids contents of those samples had elevated COPC concentrations. Element correlations were similar to Phase I rock. Percent leachable of a number of COPCs within these rocks were significantly lower than that observed in Stockpile C (Co, Cu, Ni, Pb, V and Zn). This is not attributed to a variation in mineralogy of the material, this is likely due to changes in rock behaviour post mining. Several reasons for this variation could be due to the interaction with jet boring solutions with the rock

during mining, and variations in particle size of crushed core in leach testing vs as-deposited fine waste rock on Stockpile C. Due to the uncertainty in the core testing it is recommended to apply percent leachable of Stockpile C to all rock assessed.

As with remaining Phase I rock, the source term assessment utilized the same methodology as applied to Stockpile C rock, varying the solids content of the material to appropriate concentrations, results are presented in Table 6-1.

6.5 Slimes Chemistry and Content

The effect of slimes in Stockpile C was not clearly evident. Particle size results did not show a distinct difference between areas of the pile that received more slimes. As such it was decided that the overall pile geochemical performance would be evaluated equally as a source, with no consideration of particle size. Theoretically slimes are fine waste rock, the waste rock contained on Stockpile C is very fine already, and therefore differences will be minimal. With respect to performance of fines when dumped into Sue C pit, data is included that will allow Orano to evaluate the effects on their water treatment plant.

6.6 Assessment of PAG

Rock that had been stored on Stockpile C included all basement materials. It is not clear on the proportion of these that were originally PAG vs clean basement material, however drilling on Stockpile C shows the majority of the rock is either in the uncertain or clean category currently. New development rock and Phase II rock slated to be stored on the stockpile will be PAG, however there is a large degree of neutralization during the mining process which alters in in-situ neutralization capacity. A significant amount of concrete/shotcrete is entrained in the waste rock. Currently the rock stored on the pile is not acidifying, and has sufficient neutralization capacity to remain stable for some time. There was no indication of sulphide oxidation occurring within the pile, suggesting that little waster infiltration and lack of oxygen due to the fine grained nature of the pile is limiting these reactions.

Some oxidation of the pile can be observed on the crust, specifically noted on the original pile, which has had more opportunity to weather. This crust results in underdrain water quality showing acidifying pH, and increasing COPC concentrations, however from the drilling assessment it was concluded that is limited to the outside of the pile. Samples were bulked from 2 m increments, even the upper two meter samples did not show any deviation from the remainder of the pile, suggesting oxidation and reactions are limited to the very outside crust of the facility.

The mechanisms controlling oxygen and water migration though the pile and more specific oxidation investigations are the subject of future work. Given that this is a lined facility that collects the minor seepage and runoff water from the facility, there is presently no risk to having this material remain at surface for a longer period of time.

7.0 CLOSURE

This report *2017 Potentially Acid Generating Waste Geochemical Update* has been prepared by Cameco Corporation.



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Lead Geoscientist

Geo-Environmental Engineering
SHEQ, Geo-Environmental Engineering

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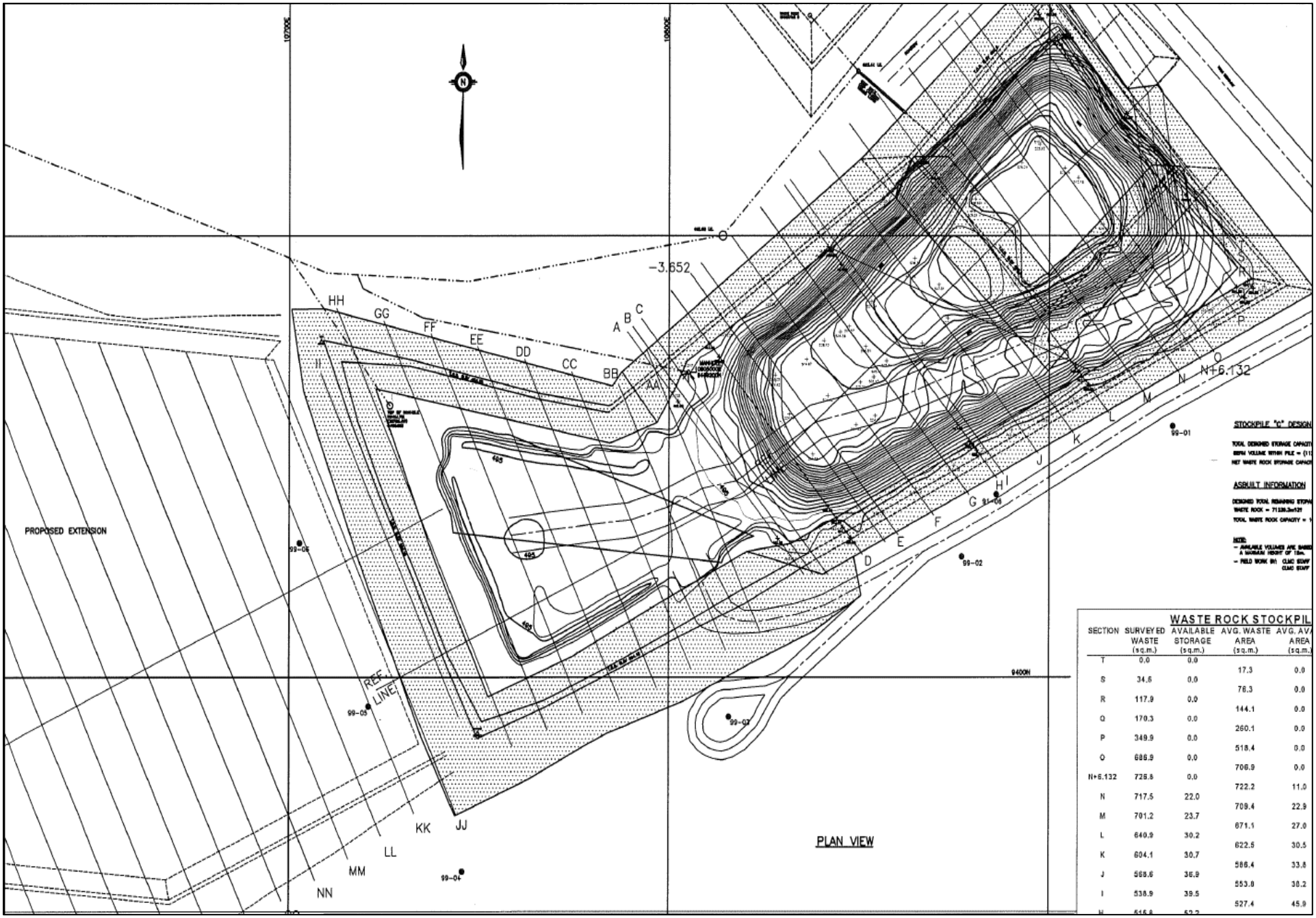
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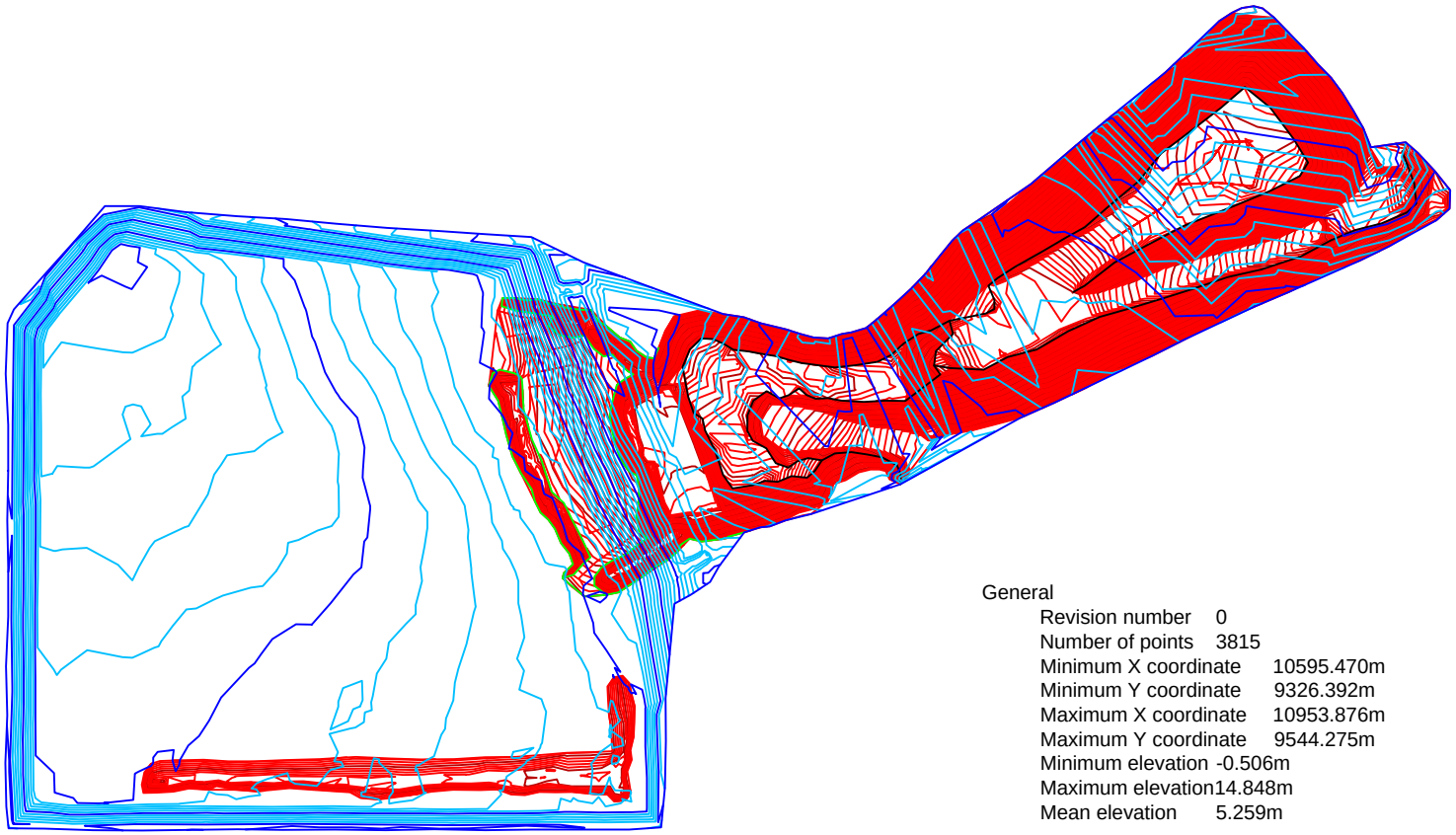
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REFERENCE DRAWINGS

REFERENCE DRAWINGS



Reference Drawing 1: May 2000 Stockpile C Survey



General

Revision number	0
Number of points	3815
Minimum X coordinate	10595.470m
Minimum Y coordinate	9326.392m
Maximum X coordinate	10953.876m
Maximum Y coordinate	9544.275m
Minimum elevation	-0.506m
Maximum elevation	14.848m
Mean elevation	5.259m

TIN

Number of triangles	7362
Maximum triangle area	83.99sq.m
Minimum triangle area	0.00sq.m
Minimum triangle length	0.000m
Maximum triangle length	19.832m

Volume

Base Surface	Prelim XML
Comparison Surface	Final Surface
Cut volume (unadjusted)	3.39 Cu. M.
Fill volume (unadjusted)	87084.60 Cu. M.
Net volume (unadjusted)	87081.21 Cu. M.<Fill>

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Note:

MAJOR CONTOURS 1.0m
MINOR CONTOURS 0.2m
BLUE PRELIM
GREEN SUBGRADE
ORANGE WASTE
RED FINAL

SURVEY FILES USED:
pujuly2c.txt
PrelimCompileC-PileJuly3c.xml

DRAWING ISSUE

NO	DATE	DESCRIPTION	BY
5			
4			
3			
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1			

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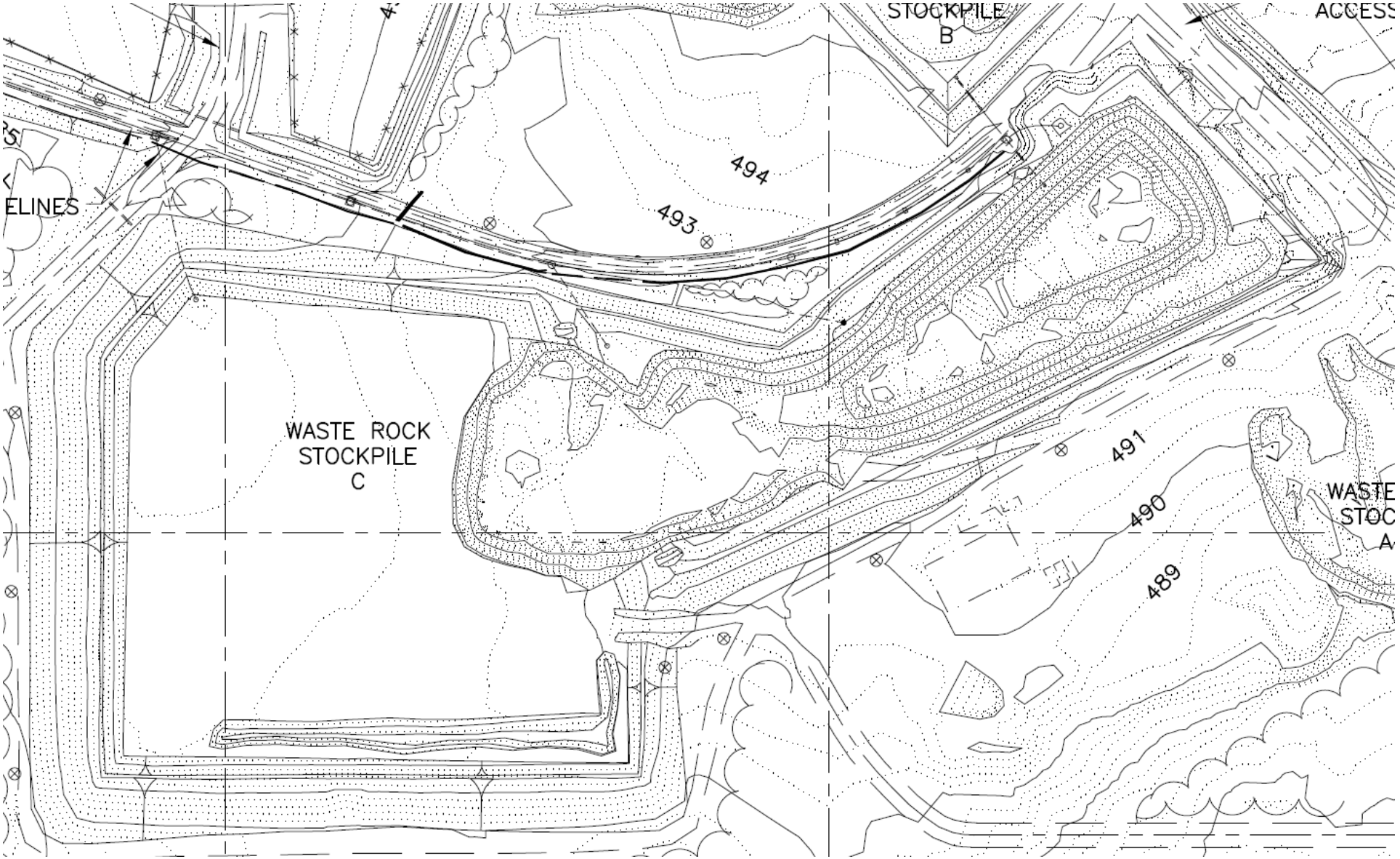
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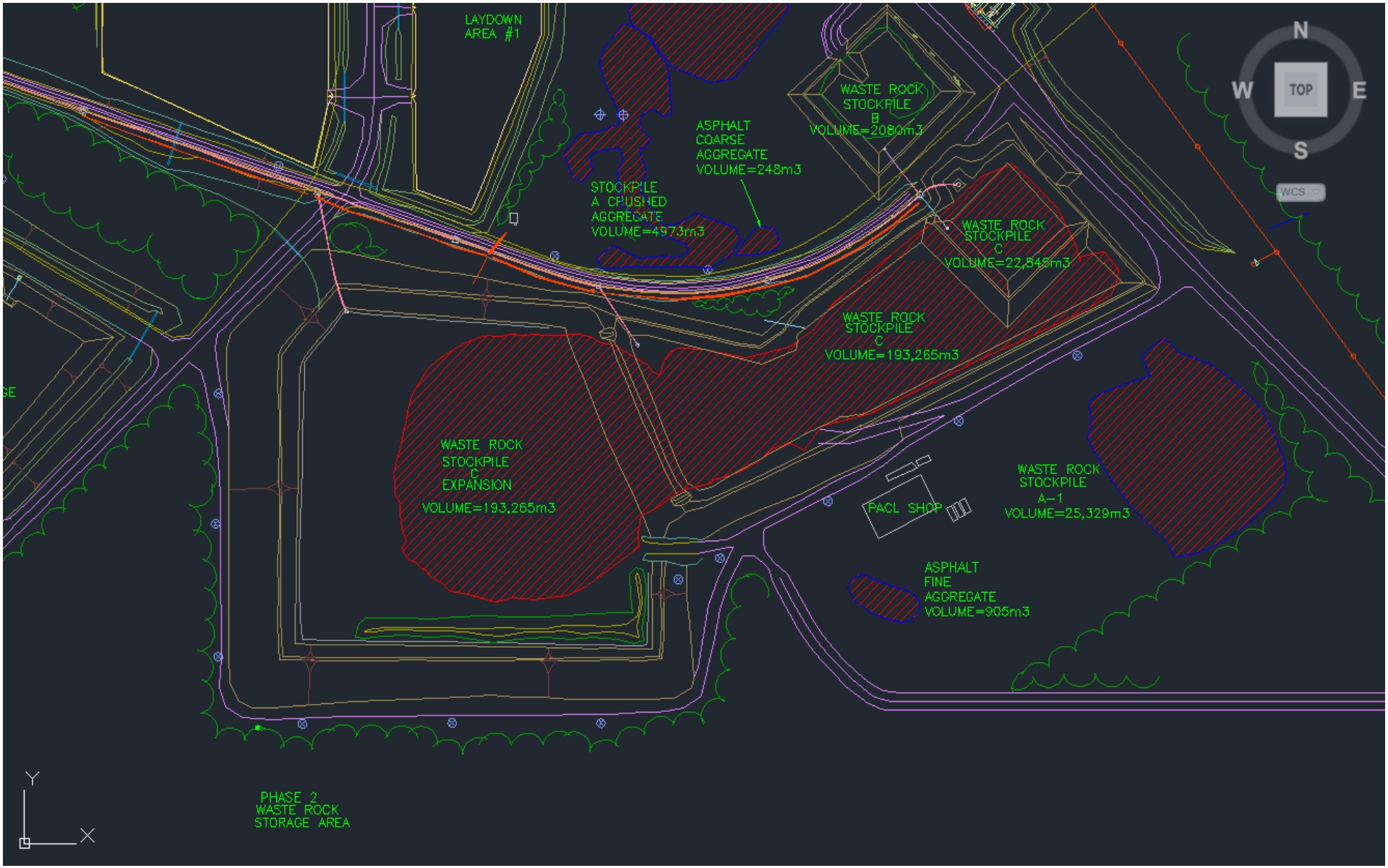
Reference Drawing 2: September 2006 Stockpile C Survey

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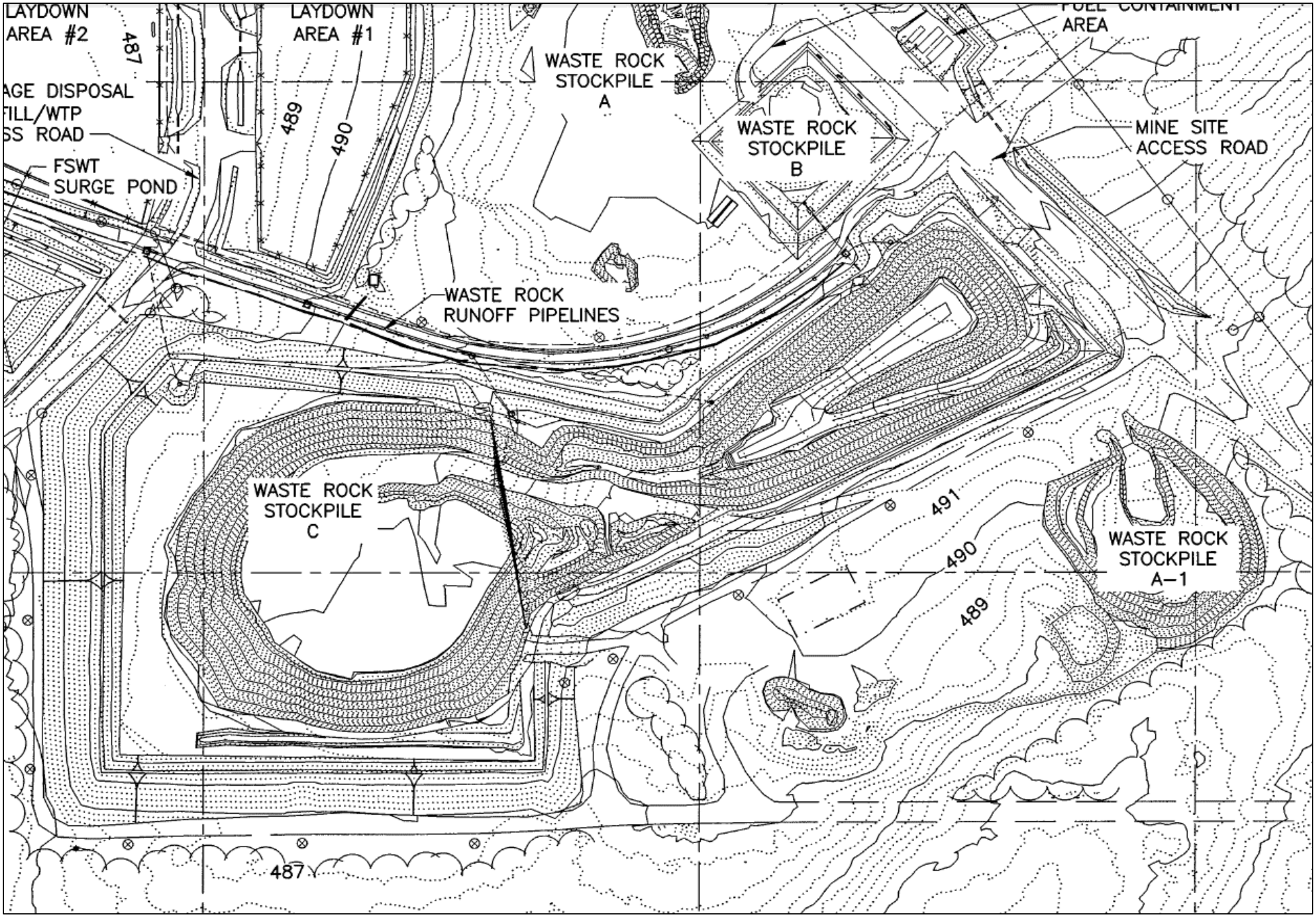
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Reference Drawing 3: December 2009 Stockpile C Survey



Reference Drawing 4: December 11 Stockpile C Survey



Reference Drawing 5: December 2014 Stockpile C Survey

TABLES

TABLES

Table 3-1
Sampling and Analytical Test work completed during the 2017 field program for Stockpile C and Phase II

Sample Name	Sample ID	Depth (m BG)		Sample Date	# of Pails	Particle Size Distribution		^{226}Radium		Solids/ABA		Leach Testing	
		From	To			SRC group	SRC Sample #	SRC group	SRC Sample #	SRC group	SRC Sample #	SRC group	SRC Sample #
17-BH-01A	GC-01 + MC-01	0.0	2.0	28-Jun-17	2	2017-7858	28713	2017-7858	28713	2017-7858	26677	2017-10605	35868
17-BH-01A	GC-02 + MC-02	2.0	4.0	28-Jun-17	2					2017-7858	26679		
17-BH-01A	GC-03 + MC-03	4.0	6.0	28-Jun-17	2	2017-7858	28631	2017-7858	28631	2017-7858	26681	2017-10605	35869
17-BH-01A	GC-04 + MC-04	6.0	8.0	28-Jun-17	2					2017-7858	28628		
17-BH-01A	GC-05 + MC-05	8.0	10.0	28-Jun-17	2	2017-7858	28632	2017-7858	28632	2017-7858	28629	2017-10605	35870
17-BH-01A	GC-06 + MC-06	10.0	12.0	28-Jun-17	2					2017-7858	28630		
17-BH-01A	GC-07 + MC-07	12.0	12.5	28-Jun-17	2	Sample not analyzed.							
17-BH-02A	GC-01 + MC-01	0.0	2.0	09-May-17	2	2017-7858	26512	2017-7858	26512	2017-7858	26605	2017-10605	35871
17-BH-02A	GC-02 + MC-02	2.0	4.0	09-May-17	2					2017-7858	26606		
17-BH-02A	GC-03 + MC-03	4.0	6.0	09-May-17	2	2017-7858	26514	2017-7858	26514	2017-7858	26607	2017-10605	35872
17-BH-02A	GC-04 + MC-04	6.0	8.0	09-May-17	2					2017-7858	26608		
17-BH-02A	GC-05 + MC-05	8.0	10.0	09-May-17	2	2017-7858	26516	2017-7858	26516	2017-7858	26609	2017-10605	35873
17-BH-02A	GC-06 + MC-06	10.0	11.0	09-May-17	2					2017-7858	26610		
17-BH-03A	GC-01 + MC-01	0.0	2.0	18-May-17	2	2017-7858	26518	2017-7858	26518	2017-7858	26611	2017-10605	35874
17-BH-03A	GC-02 + MC-02	2.0	4.0	18-May-17	2					2017-7858	26612		
17-BH-03A	GC-03 + MC-03	4.0	6.0	18-May-17	2	2017-7858	26520	2017-7858	26520	2017-7858	26613	2017-10605	35875
17-BH-03A	GC-04 + MC-04	6.0	8.0	18-May-17	2					2017-7858	26614		
17-BH-03A	GC-05 + MC-05	8.0	10.0	18-May-17	2	2017-7858	26522	2017-7858	26522	2017-7858	26615	2017-10605	35876
17-BH-03A	GC-06 + MC-06	10.0	12.0	18-May-17	2					2017-7858	26616		
17-BH-04A	GC-01 + MC-01	0.0	2.0	18-May-17	2	2017-7858	26524	2017-7858	26524	2017-7858	26617	2017-10605	35877
17-BH-04A	GC-02 + MC-02	2.0	4.0	18-May-17	2					2017-7858	26618		
17-BH-04A	GC-03 + MC-03	4.0	6.0	18-May-17	2	2017-7858	26526	2017-7858	26526	2017-7858	26619	2017-10605	35878
17-BH-04A	GC-04 + MC-04	6.0	8.0	18-May-17	2					2017-7858	26620		
17-BH-04A	GC-05 + MC-05	8.0	10.0	18-May-17	2	2017-7858	26528	2017-7858	26528	2017-7858	26621	2017-10605	35879
17-BH-04A	GC-06 + MC-06	10.0	12.0	18-May-17	2					2017-7858	26622		
17-BH-04A	GC-07 + MC-07	12.0	14.0	18-May-17	2	2017-7858	26530	2017-7858	26530	2017-7858	26623	2017-10605	35880
17-BH-04A	GC-08 + MC-08	14.0	15.0	18-May-17	2					2017-7858	26624		
17-BH-05A	GC-01 + MC-01	0.0	2.0	02-Jun-17	2	2017-7858	26576	2017-7858	26576	2017-7858	26669	2017-10605	35881
17-BH-05A	GC-02 + MC-02	2.0	4.0	02-Jun-17	2					2017-7858	26670		
17-BH-05A	GC-03 + MC-03	4.0	6.0	02-Jun-17	2	2017-7858	26578	2017-7858	26578	2017-7858	26671	2017-10605	35882
17-BH-05A	GC-04 + MC-04	6.0	8.0	02-Jun-17	2					2017-7858	26672		
17-BH-05A	GC-05 + MC-05	8.0	10.0	02-Jun-17	2	2017-7858	26580	2017-7858	26580	2017-7858	26673	2017-10605	35883
17-BH-05A	GC-06 + MC-06	10.0	12.0	02-Jun-17	2					2017-7858	26674		
17-BH-05A	GC-07 + MC-07	12.0	14.0	02-Jun-17	2	2017-7858	26582	2017-7858	26582	2017-7858	26675	2017-10605	35884
17-BH-05A	GC-08 + MC-08	14.0	16.1	02-Jun-17	2					2017-7858	26676		
17-BH-06A	GC-01 + MC-01	0.0	2.0	07-May-17	2	2017-7858	26497	2017-7858	26497	2017-7858	26590	2017-10605	35885
17-BH-06A	GC-02 + MC-02	2.0	4.0	07-May-17	2					2017-7858	26591		

Sample Name	Sample ID	Depth (m BG)		Sample Date	# of Pails	Particle Size Distribution		^{226}Radium		Solids/ABA		Leach Testing	
		From	To			SRC group	SRC Sample #	SRC group	SRC Sample #	SRC group	SRC Sample #	SRC group	SRC Sample #
17-BH-06A	GC-03 + MC-03	4.0	6.0	07-May-17	2	2017-7858	26499	2017-7858	26499	2017-7858	26592	2017-10605	35886
17-BH-06A	GC-04 + MC-04	6.0	8.0	07-May-17	2					2017-7858	26593		
17-BH-06A	GC-05 + MC-05	8.0	10.0	07-May-17	2	2017-7858	26501	2017-7858	26501	2017-7858	26594	2017-10605	35887
17-BH-06A	GC-06 + MC-06	10.0	12.0	07-May-17	2					2017-7858	26595		
17-BH-06A	GC-07 + MC-07	12.0	14.0	07-May-17	2	2017-7858	26503	2017-7858	26503	2017-7858	26596	2017-10605	35888
17-BH-06A	GC-08 + MC-08	14.0	16.0	07-May-17	2					2017-7858	26597		
17-BH-06A	GC-09 + MC-09	16.0	18.0	07-May-17	2	2017-7858	26505	2017-7858	26505	2017-7858	26598	2017-10605	35889
17-BH-06A	MC-10	18.0	20.0	07-May-17	1	Sample not analyzed.							
17-BH-07A	GC-01 + MC-01	0.0	2.0	31-May-17	2	2017-7858	26532	2017-7858	26532	2017-7858	26625	2017-10605	35890
17-BH-07A	GC-02 + MC-02	2.0	4.0	31-May-17	2					2017-7858	26626		
17-BH-07A	GC-03 + MC-03	4.0	6.0	31-May-17	2	2017-7858	26534	2017-7858	26534	2017-7858	26627	2017-10605	35891
17-BH-07A	GC-04 + MC-04	6.0	8.0	31-May-17	2					2017-7858	26628		
17-BH-07A	GC-05 + MC-05	8.0	10.0	31-May-17	2	2017-7858	26536	2017-7858	26536	2017-7858	26629	2017-10605	35892
17-BH-07A	GC-06 + MC-06	10.0	12.0	31-May-17	2					2017-7858	26630		
17-BH-07A	GC-07 + MC-07	12.0	14.0	31-May-17	2	2017-7858	26538	2017-7858	26538	2017-7858	26631	2017-10605	35893
17-BH-07A	GC-08 + MC-08	14.0	16.0	31-May-17	2					2017-7858	26632		
17-BH-07A	GC-09 + MC-09	16.0	18.0	31-May-17	2	2017-7858	26540	2017-7858	26540	2017-7858	26633	2017-10605	35894
17-BH-07A	GC-10 + MC-10	18.0	20.0	31-May-17	2					2017-7858	26634		
17-BH-08A	GC-01 + MC-01	0.0	2.0	31-May-17	2	2017-7858	26542	2017-7858	26542	2017-7858	26635	2017-10605	35895
17-BH-08A	GC-02 + MC-02	2.0	4.0	31-May-17	2					2017-7858	26636		
17-BH-08A	GC-03 + MC-03	4.0	6.0	31-May-17	2	2017-7858	26544	2017-7858	26544	2017-7858	26637	2017-10605	35896
17-BH-08A	GC-04 + MC-04	6.0	8.0	31-May-17	2					2017-7858	26638		
17-BH-08A	GC-05 + MC-05	8.0	10.0	31-May-17	2	2017-7858	26546	2017-7858	26546	2017-7858	26639	2017-10605	35897
17-BH-08A	GC-06 + MC-06	10.0	12.0	31-May-17	2					2017-7858	26640		
17-BH-08A	GC-07 + MC-07	12.0	14.0	31-May-17	2	2017-7858	26548	2017-7858	26548	2017-7858	26641	2017-10605	35898
17-BH-08A	GC-08 + MC-08	14.0	16.0	31-May-17	2					2017-7858	26642		
17-BH-08A	GC-09 + MC-09	16.0	18.0	31-May-17	2	2017-7858	26550	2017-7858	26550	2017-7858	26643	2017-10605	35899
17-BH-08A	GC-10 + MC-10	18.0	20.0	31-May-17	2					2017-7858	26644		
17-BH-09A	GC-01 + MC-01	0.0	2.0	01-Jun-17	2	2017-7858	26552	2017-7858	26552	2017-7858	26645	2017-10605	35900
17-BH-09A	GC-02 + MC-02	2.0	4.0	01-Jun-17	2					2017-7858	26646		
17-BH-09A	GC-03 + MC-03	4.0	6.0	01-Jun-17	2	2017-7858	26554	2017-7858	26554	2017-7858	26647	2017-10605	35901
17-BH-09A	GC-04 + MC-04	6.0	8.0	01-Jun-17	2					2017-7858	26648		
17-BH-09A	GC-05 + MC-05	8.0	10.0	01-Jun-17	2	2017-7858	26556	2017-7858	26556	2017-7858	26649	2017-10605	35902
17-BH-09A	GC-06 + MC-06	10.0	12.0	01-Jun-17	2					2017-7858	26650		
17-BH-09A	GC-07 + MC-07	12.0	14.0	01-Jun-17	2	2017-7858	26558	2017-7858	26558	2017-7858	26651	2017-10605	35903
17-BH-09A	GC-08 + MC-08	14.0	16.0	01-Jun-17	2					2017-7858	26652		
17-BH-09A	GC-09 + MC-09	16.0	18.0	01-Jun-17	2	2017-7858	26560	2017-7858	26560	2017-7858	26653	2017-10605	35904
17-BH-09A	GC-10 + MC-10	18.0	20.0	01-Jun-17	2					2017-7858	26654		
17-BH-09A	GC-11 + MC-11	20.0	21.0	01-Jun-17	2	2017-7858	26562	2017-7858	26562	2017-7858	26655	2017-10605	35905

Sample Name	Sample ID	Depth (m BG)		Sample Date	# of Pails	Particle Size Distribution		^{226}Radium		Solids/ABA		Leach Testing	
		From	To			SRC group	SRC Sample #	SRC group	SRC Sample #	SRC group	SRC Sample #	SRC group	SRC Sample #
17-BH-10A	GC-01 + MC-01	0.0	2.0	08-May-17	2	2017-7858	26507	2017-7858	26507	2017-7858	26600	2017-10605	35906
17-BH-10A	GC-02 + MC-02	2.0	4.0	08-May-17	2					2017-7858	26601		
17-BH-10A	GC-03 + MC-03	4.0	6.0	08-May-17	2	2017-7858	26509	2017-7858	26509	2017-7858	26602	2017-10605	35911
17-BH-10A	GC-04 + MC-04	6.0	8.0	08-May-17	2					2017-7858	26603		
17-BH-10A	GC-05 + MC-05	8.0	10.0	08-May-17	2	2017-7858	26511	2017-7858	26511	2017-7858	26604	2017-10605	35912
17-BH-11A	GC-01 + MC-01	0.0	2.0	01-Jun-17	2	2017-7858	26564	2017-7858	26564	2017-7858	26656	2017-10605	35913
17-BH-11A	GC-02 + MC-02	2.0	3.8	01-Jun-17	2			2017-10605	35858	2017-7858	26657	2017-10605	35914
17-BH-12A	GC-01 + MC-01	0.0	2.0	01-Jun-17	2	2017-7858	26565	2017-7858	26565	2017-7858	26658	2017-10605	35915
17-BH-12A	GC-02 + MC-02	2.0	4.0	01-Jun-17	2					2017-7858	26659		
17-BH-12A	GC-03 + MC-03	4.0	6.0	01-Jun-17	2	2017-7858	26567	2017-7858	26567	2017-7858	26660	2017-10605	35917
17-BH-12A	GC-04 + MC-04	6.0	6.7	01-Jun-17	2					2017-7858	26661		
17-BH-13A	GC-01 + MC-01	0.0	2.0	02-Jun-17	2	2017-7858	26572	2017-7858	26572	2017-7858	26662	2017-10605	35918
17-BH-13A	GC-02 + MC-02	2.0	2.5	02-Jun-17	2					2017-7858	26663		
17-BH-14A	GC-01 + MC-01	0.0	2.0	02-Jun-17	2	2017-7858	26574	2017-7858	26574	2017-7858	26664	2017-10605	35919
17-BH-14A	GC-02 + MC-02	2.0	2.5	02-Jun-17	2					2017-7858	26665		
17-BH-15A	GC-01 + MC-01	0.0	2.0	01-Jun-17	2	2017-7858	26569	2017-7858	26569	2017-7858	26666	2017-10605	35920
17-BH-15A	GC-02 + MC-02	2.0	4.0	01-Jun-17	2					2017-7858	26667		
17-BH-15A	GC-03 + MC-03	4.0	5.5	01-Jun-17	2	2017-7858	26571	2017-7858	26571	2017-7858	26668	2017-10605	35921
CL-505		474.0	495.0	23-May-17	1			2017-7457	26479	2017-7457	26479	2017-11343	38606
CL-508A		454.5	510.0	23-May-17	1			2017-7457	26480	2017-7457	26480		
CL-509		516.4	521.0	23-May-17	1			2017-7457	26481	2017-7457	26481	2017-11343	38607
CL-525_1		445.0	500.0	23-May-17	1			2017-7457	26482	2017-7457	26482		
CL-526_3		473.0	509.0	23-May-17	1			2017-7457	26483	2017-7457	26483	2017-11343	38608
CL-531_1		440.0	464.4	23-May-17	1			2017-7457	26484	2017-7457	26484		
CL-539_1		436.9	440.3	23-May-17	1			2017-7457	26485	2017-7457	26485	2017-11343	38609
CL-540		433	436.2	03-Jun-17	1			2017-7457	26486	2017-7457	26486	2017-11343	38610
CL-541_1		446.2	455.0	03-Jun-17	1			2017-7457	26487	2017-7457	26487	2017-11343	38611
CL-543_1		461	482.1	03-Jun-17	1			2017-7457	26488	2017-7457	26488		
CL-545		478.3	518.6	03-Jun-17	1			2017-7457	26489	2017-7457	26489		
CL-546A		461.6	506	03-Jun-17	1			2017-7457	26490	2017-7457	26490		
CL-549A		447.5	479.0	03-Jun-17	1			2017-7457	26491	2017-7457	26491		
CL-551A_1		443.6	450.1	03-Jun-17	1			2017-7457	26492	2017-7457	26492		
CL-554		473.3	485	03-Jun-17	1			2017-7457	26493	2017-7457	26493	2017-11343	38612
CL-557_1		451	515	03-Jun-17	1			2017-7457	26494	2017-7457	26494		
CL-564		466.5	473.2	03-Jun-17	1			2017-7457	26495	2017-7457	26495	2017-11343	38613
CL-565_1		462.0	496.6	03-Jun-17	1			2017-7457	26496	2017-7457	26496	2017-11343	38614

Table 4-1
Particle size distribution for Stockpile C samples collected in 2017

	Sample Name	SRC #	<0.001	Clay	Very Fine Silt	Fine Silt	Medium Silt	Coarse Silt	Very Fine Sand	Fine Sand	Medium Sand	Coarse Sand	Very Coarse Sand	Oversize	Mean	Median	Standard Deviation	d10	d50	d90	IQR (Q3 - Q1)[1]	Moisture Content
	From	From	0.00004	0.001	0.004	0.008	0.016	0.03125	0.06250	0.10	0.25	0.50	1.00	>2								%
		To	0.001	0.004	0.008	0.016	0.03125	0.06250	0.10	0.25	0.50	1.00	2.00								
Original	17-BH-01A 0-2	28713a	1.47	4.23	2.65	3.01	3.20	4.54	3.36	10.82	11.22	10.47	2.48	42.50	15.7	8.55	18.0	0.0220	8.5	49.0	23.70	4.10
	17-BH-01A 4-6	28631	1.47	4.30	2.79	3.56	4.18	5.65	4.12	10.37	7.74	8.14	5.20	42.49	16.3	8.78	18.0	0.0027	8.8	47.5	27.66	6.34
	17-BH-01A 8-10	28632	2.25	6.40	4.08	4.88	5.55	7.57	5.74	12.75	7.13	4.56	0.10	39.00	21.3	13.04	21.9	0.0063	13.0	58.8	38.48	5.74
Extension	17-BH-10A 0-2	26507	2.86	7.51	4.15	4.69	5.06	6.55	4.66	11.00	7.05	3.76	0.84	41.87	21.1	14.84	20.5	0.0108	14.8	55.5	36.63	7.26
	17-BH-10A 4-6	26509	3.64	10.87	5.72	6.13	6.25	7.32	4.96	9.81	4.35	1.19	0.07	39.70	25.2	20.64	22.7	0.0023	20.6	59.8	45.82	4.84
	17-BH-10A 8-10	26511	3.41	10.29	5.71	6.24	6.41	8.09	5.54	11.60	5.14	1.50	0.00	36.07	25.8	19.83	24.0	0.0032	19.8	63.5	47.13	7.31
	17-BH-11A 0-2	26564	3.48	9.48	4.54	4.66	4.71	6.14	4.34	10.89	7.01	1.94	0.01	42.80	22.4	17.82	20.7	0.0038	17.8	56.6	38.17	3.43
	17-BH-12A 0-2	26565	3.24	9.80	5.31	6.03	6.55	8.35	5.40	10.50	4.02	0.44	0.00	40.37	24.6	18.74	22.8	0.0039	18.7	59.6	45.97	6.47
	17-BH-12A 4-6	26567	2.58	7.89	3.96	4.39	4.52	5.65	3.59	8.95	7.36	5.76	0.50	44.85	19.7	14.72	19.0	0.0001	14.7	51.8	33.53	5.74
	17-BH-13A 0-2	26572	0.95	3.87	2.82	3.15	3.26	4.16	2.91	7.41	7.48	12.89	10.16	40.93	14.1	7.86	16.2	0.0066	7.9	40.3	22.31	5.67
	17-BH-14A 0-2	26574	2.51	9.42	6.41	6.84	6.36	6.98	4.25	9.20	6.56	3.27	0.04	38.15	24.2	18.83	22.8	0.0067	18.8	60.6	43.84	5.97
	17-BH-15A 0-2	26569	2.13	6.55	4.20	4.79	4.72	6.11	4.59	15.57	13.49	4.85	0.02	32.97	21.7	13.21	23.3	0.0147	13.2	65.4	35.00	9.54
	17-BH-15A 4-5	26571	1.94	6.67	5.07	5.75	5.61	7.16	5.34	13.71	8.41	1.45	0.01	38.91	22.0	14.07	22.5	0.0330	14.1	60.9	39.62	7.01
Expansion	17-BH-02A 0-2	26512	2.74	9.23	5.69	6.24	6.41	7.96	5.40	10.31	3.87	1.12	0.00	41.03	24.0	18.09	22.5	0.0069	18.1	58.6	45.27	6.76
	17-BH-02A 4-6	26514	2.44	7.66	4.60	5.30	5.92	8.34	6.23	13.99	4.87	1.01	0.03	39.60	22.9	15.06	22.7	0.0052	15.1	60.0	42.94	5.42
	17-BH-02A 8-10	26516	2.82	11.30	6.62	6.65	6.24	7.67	5.27	10.73	2.51	0.18	0.00	40.01	25.6	21.21	23.4	0.0018	21.2	60.0	48.13	6.11
	17-BH-03A 0-2	26518	2.78	9.27	5.14	5.50	5.74	7.56	5.11	10.49	4.48	1.89	0.04	41.99	23.1	17.57	21.7	0.0048	17.6	57.1	42.61	7.93
	17-BH-03A 4-6	26520	1.29	4.19	2.74	3.37	4.03	6.14	4.92	12.96	9.41	10.20	3.88	36.87	17.4	8.44	20.1	0.0052	8.4	53.1	28.99	13.28
	17-BH-03A 8-10	26522	2.38	7.91	5.46	5.87	5.56	6.88	5.14	13.83	8.35	1.47	0.00	37.15	22.9	15.75	22.9	0.0309	15.7	62.3	40.48	7.87
	17-BH-04A 0-2	26524	2.15	7.20	4.87	5.68	5.97	7.07	4.53	9.67	7.39	7.21	1.49	36.78	21.7	14.60	21.8	0.0101	14.6	57.8	38.78	8.33
	17-BH-04A 4-6	26526	1.77	7.12	5.53	5.72	5.37	6.54	4.49	12.28	13.87	10.69	0.21	26.41	23.2	14.84	24.7	0.0654	14.8	68.6	38.02	14.94
	17-BH-04A 8-10	26528	2.06	7.33	5.04	5.78	5.71	6.83	4.47	9.96	5.99	3.07	0.19	43.57	21.1	14.82	20.7	0.0017	14.8	54.9	38.70	7.40
	17-BH-04A 12-14	26530	0.87	2.94	1.88	2.09	2.12	2.77	2.19	8.34	13.20	17.06	3.12	43.41	12.6	5.84	16.5	0.0076	5.8	43.7	15.85	6.13
	17-BH-05A 0-2	26576	1.92	7.83	5.60	6.32	6.24	7.56	5.08	11.71	6.26	1.58	0.00	39.89	22.8	15.79	22.5	0.0073	15.8	59.7	42.54	8.35
	17-BH-05A 4-6	26578	1.87	6.31	4.88	6.40	7.50	9.25	5.80	12.41	5.92	2.21	0.02	37.42	23.0	13.47	23.6	0.0276	13.5	61.7	44.11	14.84
	17-BH-05A 8-10	26580	1.36	4.60	3.09	3.36	3.36	4.14	3.24	9.51	9.66	10.94	5.51	41.22	15.7	9.29	17.6	0.0159	9.3	46.8	24.38	6.28
	17-BH-05A 12-14	26582	2.13	6.13	3.96	5.02	5.88	8.00	5.79	14.33	10.77	9.85	1.71	26.42	22.8	12.54	24.7	0.0046	12.5	66.4	39.14	15.20
	17-BH-06A 0-2	26497	2.39	9.38	6.54	7.52	7.42	7.97	4.80	10.69	5.39	3.06	0.01	34.83	25.6	18.82	24.4	0.0041	18.8	63.9	47.50	11.95
	17-BH-06A 4-6	26499	2.35	8.77	5.38	6.39	7.15	8.86	5.99	12.33	4.74	0.94	0.00	37.09	24.3	16.50	23.9	0.0010	16.5	62.5	46.62	7.24
	17-BH-06A 8-10	26501	2.15	7.24	5.05	5.57	5.49	6.24	3.74	7.98	6.15	8.23	7.14	35.00	20.8	14.83	20.4	0.0255	14.8	52.2	36.31	8.52
	17-BH-06A 12-14	26503	3.30	9.73	5.72	6.50	6.85	8.67	5.94	12.57	4.26	0.68	0.00	35.79	25.9	19.18	24.5	0.0029	19.2	64.1	48.34	4.26
	17-BH-06A 16-18	26505	2.29	7.95	5.00	5.70	6.34	8.88	6.54	12.99	3.20	0.47	0.02	40.63	23.3	15.63	22.9	0.0044	15.6	59.2	45.20	4.54
	17-BH-07A 0-2	26532	2.10	4.70	6.49	8.63	6.84	8.38	5.55	10.88	7.83	6.72	0.55	31.34	23.8	13.88	24.6	0.1528	13.9	64.9	43.90	10.35
	17-BH-07A 4-6	26534	1.47	5.72	3.60	4.03	4.31	5.80	4.30	10.09	7.53	5.73	0.61	46.80	17.6	11.06	18.4	0.0022	11.1	49.6	31.03	5.50
	17-BH-07A 8-10	26536	1.67	6.43	4.95	4.99	5.06	6.46	4.38	10.36	9.14	8.15	1.15	37.27	20.5	13.42	21.2	0.0690	13.4	57.3	35.25	9.90
	17-BH-07A 12-14	26538	2.20	7.75	4.15	4.63	4.90	6.24	4.44	11.38	9.20	7.04	0.15	37.93	21.1	14.41	21.4	0.0002	14.4	58.5	35.83	8.40

	Sample Name	SRC #	<0.001	Clay	Very Fine Silt	Fine Silt	Medium Silt	Coarse Silt	Very Fine Sand	Fine Sand	Medium Sand	Coarse Sand	Very Coarse Sand	Oversize	Mean	Median	Standard Deviation	d10	d50	d90	IQR (Q3 - Q1)[1]	Moisture Content
	From	From	0.00004	0.001	0.004	0.008	0.016	0.03125	0.06250	0.10	0.25	0.50	1.00	>2								%
		To	0.001	0.004	0.008	0.016	0.03125	0.06250	0.10	0.25	0.50	1.00	2.00									
	17-BH-07A 16-18	26540	1.78	3.15	1.32	1.35	1.48	2.83	4.24	26.76	27.49	15.64	1.24	12.71	19.3	6.34	28.2	0.0597	6.3	78.6	18.87	5.77
	17-BH-08A 0-2	26542	2.87	9.71	6.25	6.94	6.61	7.55	4.91	9.55	4.48	3.43	0.09	37.59	24.9	19.32	23.2	0.0020	19.3	60.4	45.94	7.71
	17-BH-08A 4-6	26544	2.54	9.09	5.31	5.97	6.38	8.41	5.99	12.70	5.14	2.04	0.02	36.43	24.5	17.34	23.8	0.0027	17.3	62.8	45.80	6.38
	17-BH-08A 8-10	26546	1.73	7.27	5.98	7.15	7.63	8.93	5.17	8.59	5.23	5.95	3.00	33.36	23.6	15.47	23.6	0.0408	15.5	60.2	45.32	13.22
	17-BH-08A 12-14	26548	3.17	11.76	7.21	6.77	5.92	6.76	4.42	9.70	4.45	1.21	0.06	38.58	25.9	22.64	23.3	0.0130	22.6	60.8	46.85	5.81
	17-BH-08A 16-18	26550	3.12	11.59	7.57	7.24	6.46	6.95	4.50	9.03	3.31	1.26	0.00	38.97	26.2	22.82	23.5	0.0140	22.8	60.7	48.13	7.99
	17-BH-09A 0-2	26552	4.49	17.28	10.01	8.95	6.84	6.57	3.30	6.24	2.54	1.06	0.01	32.70	31.8	32.46	26.7	0.0023	32.5	66.9	57.21	7.76
	17-BH-09A 4-6	26554	2.18	8.12	5.30	6.08	6.60	8.42	5.62	11.72	4.61	1.39	0.00	39.96	23.3	16.01	22.8	0.0122	16.0	59.6	44.32	9.43
	17-BH-09A 8-10	26556	2.29	8.76	5.76	6.49	6.85	8.00	5.20	10.33	3.69	1.34	0.07	41.21	23.6	17.27	22.5	0.0010	17.3	58.1	45.08	7.78
	17-BH-09A 12-14	26558	3.00	9.41	5.62	5.95	5.80	7.28	5.00	9.50	2.65	0.28	0.01	45.52	23.0	18.45	21.1	0.0042	18.5	54.4	43.33	4.57
	17-BH-09A 16-18	26560	2.23	8.60	5.44	5.93	5.91	7.36	5.07	12.57	7.67	3.83	0.09	35.29	23.7	16.69	23.4	0.0014	16.7	62.9	42.47	9.48
	17-BH-09A 20-21	26562	1.12	4.23	2.87	2.97	2.54	2.88	2.26	10.10	16.24	12.27	2.11	40.42	15.1	8.44	18.3	0.0115	8.4	51.2	19.81	6.01

Note: Results are sorted into USCS particle size ranges and summary statistics are provided.
All results in mm
[1] IQR - Interquartile Range

Table 4-2
Summary statistics for solids samples assessed in this work

		Stockpile C								Phase I Core Samples					Phase II Core Samples				
		Stockpile C (2017)	**Stockpile C (2000)**	**2017 Hole 1**	**2000 Hole 2**	**Original Pad (2017)**	**Extension (2017)**	**Expansion (2017)**	**Stockpile C (All) (weighted)**	**P1 (Mined) (all core)**	**P1 (Mined) (south)**	**P1 (Mined) (north)**	**P1 Unmined (All Core)**	**P1 Unmined (PAG Core)**	**P2 (Historical) (All Core)**	**P2 (Historical) (Clean Dev't)**	**P2 (Historical) (Altered Dev't)**	**P2 (Historical) (weighted)**	**P2 New (2017 Core)**
Aluminum (µg/g)	N total	92	39	6	4	6	68	18	131	110	26	84	154	86	323	10	158	168	18
	Mean	**53,271**	**76,293**	**51,533**	**78,991**	**51,533**	**52,324**	**57,428**	**56,512**	**98,311**	**91,011**	**100,570**	**87,958**	**90,034**	**89,115**	**95,503**	**89,037**	**93,148**	**76,872**
	Std. Dev.	9,636	6,185	9,710	7,576	9,710	9,270	10,374	12,392	23,020	20,648	23,359	15,532	14,958	17,537	21,276	16,501	5,777	13,726
	Min	21,500	65,098	38,200	69,861	38,200	21,500	41,800	21,500	68,273	68,273	69,861	47,580	68,273	31,438	73,195	50,173	50,173	62,800
	Median	**54,300**	**75,683**	**53,500**	**80,181**	**53,500**	**52,450**	**56,750**	**56,100**	**90,502**	**88,650**	**92,884**	**86,797**	**87,062**	**88,385**	**86,824**	**88,147**	**88,385**	**73,000**
	Max	86,700	87,856	62,100	85,739	62,100	69,200	86,700	87,856	165,126	159,834	165,126	149,249	149,249	150,837	126,491	150,837	150,837	116,000
	P90	64,100	85,739	62,100	85,739	62,100	64,200	73,600	74,624	133,424	114,847	139,405	109,396	109,820	113,260	125,962	111,143	125,432	96,400
	P95	66,300	86,797	62,100	85,739	62,100	66,100	86,700	79,917	148,111	130,063	149,222	116,091	121,198	120,140	126,491	120,140	126,491	116,000
Arsenic (µg/g)	N total	92	39	6	4	23	68	40	131	110	26	84	154	86	285	9	147	156	18
	Mean	**100**	**180**	**176**	**355**	**160**	**66**	**202**	**100**	**357**	**54**	**451**	**178**	**277**	**270**	**97**	**388**	**203**	**741**
	Std. Dev.	256	338	324	317	232	144	436	245	905	30	1,019	494	644	957	47	1,318	2,393	1,374
	Min	4	7	31	69	21	4	7	4	20	20	40	5	5	30	60	40	40	20
	Median	**31**	**33**	**47**	**350**	**58**	**23**	**39**	**28**	**80**	**50**	**135**	**80**	**125**	**170**	**80**	**220**	**90**	**156**
	Max	2,020	1,590	838	652	838	1,090	2,020	2,020	7,900	180	7,900	4,940	4,940	15,840	210	15,840	15,840	4,500
	P90	187	652	838	652	606	174	623	189	779	70	931	327	455	376	210	450	310	3,930
	P95	373	1,170	838	652	652	251	1,380	373	1,361	78	1,657	460	638	520	210	770	400	4,500
Calcium (µg/g)	N total	74	39	6	4	6	68	18	131	110	26	84	154	86	320	10	158	168	18
	Mean	**12,446**	**13,482**	**12,850**	**15,062**	**12,850**	**12,410**	**6,950**	**11,964**	**2,242**	**1,891**	**2,350**	**2,021**	**2,251**	**3,996**	**2,501**	**3,141**	**2,734**	**2,965**
	Std. Dev.	6,290	8,370	8,877	10,461	8,877	6,100	2,451	6,294	3,360	869	3,814	3,015	3,994	13,415	4,601	10,422	2,164	3,688
	Min	2,800	5,217	2,800	6,003	2,800	4,300	4,000	2,800	429	1,001	429	357	500	0	71	71	71	840
	Median	**10,500**	**10,077**	**11,000**	**14,294**	**11,000**	**10,500**	**6,500**	**10,400**	**1,394**	**1,644**	**1,286**	**1,394**	**1,179**	**1,001**	**1,144**	**1,001**	**1,072**	**1,600**
	Max	42,700	42,382	24,500	25,658	24,500	42,700	12,800	42,700	25,443	4,717	25,443	29,732	29,732	135,078	15,366	78,403	78,403	15,800
	P90	21,000	25,658	24,500	25,658	24,500	20,000	11,500	20,000	3,466	2,609	3,681	2,623	3,538	6,011	9,220	3,359	3,359	8,300
	P95	23,000	30,089	24,500	25,658	24,500	22,500	12,800	23,000	5,114	3,502	5,389	4,135	6,021	12,665	15,366	7,933	15,366	15,800
Cadmium (µg/g)	N total	61	39	6	4	6	68	18	100	0	0	0	0	0	0	0	0	0	5
	Mean	**0.146**	**0.103**	**0.050**	**0.100**	**0.050**	**0.109**	**0.067**	**0.140**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**0.150**
	Std. Dev.	0.070	0.016	0.084	0.000	0.084	0.094	0.059	0.066	--	--	--	--	--	--	--	--	--	0.084
	Min	0.100	0.100	0.000	0.100	0.000	0.000	0.000	0.100	--	--	--	--	--	--	--	--	--	0.100
	Median	**0.100**	**0.100**	**0.000**	**0.100**	**0.000**	**0.100**	**0.100**	**0.100**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**0.200**
	Max	0.400	0.200	0.200	0.100	0.200	0.400	0.200	0.400	--	--	--	--	--	--	--	--	--	0.300
	P90	0.200	0.100	0.200	0.100	0.200	0.200	0.100	0.200	--	--	--	--	--	--	--	--	--	0.300
	P95	0.200	0.100	0.200	0.100	0.200	0.200	0.200	0.200	--	--	--	--	--	--	--	--	--	0.300
Cobalt (µg/g)	N total	92	39	6	4	6	68	18	131	110	26	84	154	26	285	9	147	156	18
	Mean	**42**	**112**	**45**	**128**	**45**	**35**	**68**	**47**	**180**	**25**	**228**	**65**	**25**	**45**	**14**	**65**	**33**	**336**
	Std. Dev.	50	152	37	95	37	42	73	68	486	9	548	79	9	68	12	84	17	606
	Min	4	22	20	46	20	4	18	4	10	10	10	5	10	1	5	3	3	23
	Median	**28**	**54**	**32**	**113**	**32**	**22**	**45**	**28**	**40**	**20**	**65**	**40**	**20**	**26**	**10**	**41**	**11**	**83**
	Max	330	655	120	241	120	300	330	655	4,380	50	4,380	600	50	561	45	561	561	2,000
	P90	90	241	120	241	120	67	140	93	433	40	467	154	40	93	45	115	61	1,800
	P95	120	577	120	241	120	93	330	140	635	40	680	237	40	133	45	244	102	2,000

		Stockpile C								Phase I Core Samples					Phase II Core Samples				
		Stockpile C (2017)	Stockpile C (2000)	2017 Hole 1	2000 Hole 2	Original Pad (2017)	Extension (2017)	Expansion (2017)	Stockpile C (All) (weighted)	P1 (Mined) (all core)	P1 (Mined) (south)	P1 (Mined) (north)	P1 Unmined (All Core)	P1 Unmined (PAG Core)	P2 (Historical) (All Core)	P2 (Historical) (Clean Dev't)	P2 (Historical) (Altered Dev't)	P2 (Historical) (weighted)	P2 New (2017 Core)
Chromium (µg/g)	N total	92	39	6	4	6	68	18	131	0	0	0			0	0	0	0	18
	Mean	**150**	**115**	**152**	**123**	**152**	**153**	**138**	**145**	--	--	--			--	--	--	--	**168**
	Std. Dev.	26	16	12	16	12	26	27	28	--	--	--			--	--	--	--	30
	Min	94	79	140	110	140	110	94	79	--	--	--			--	--	--	--	130
	Median	**150**	**114**	**150**	**119**	**150**	**150**	**140**	**140**	--	--	--			--	--	--	--	**170**
	Max	250	148	170	144	170	250	180	250	--	--	--			--	--	--	--	240
	P90	180	132	170	144	170	180	170	180	--	--	--			--	--	--	--	220
	P95	190	147	170	144	170	200	180	190	--	--	--			--	--	--	--	240
Copper (µg/g)	N total	92	39	6	4	6	68	18	131	110	26	84	154	26	0	0	0	0	18
	Mean	**27.6**	**48.1**	**39.3**	**47.5**	**39.3**	**27.6**	**23.9**	**29.5**	**53.9**	**21.9**	**63.8**	**24.8**	**21.9**	--	--	--	--	**48.8**
	Std. Dev.	22.2	28.4	29.7	11.2	29.7	23.6	10.9	23.7	76.3	29.8	83.4	31.5	29.8	--	--	--	--	39.9
	Min	5.3	8.4	9.9	36.7	9.9	5.3	5.3	5.3	10.0	10.0	10.0	10.0	10.0	--	--	--	--	9.1
	Median	**21.0**	**45.2**	**33.5**	**47.7**	**33.5**	**20.5**	**21.0**	**22.0**	**20.0**	**10.0**	**20.0**	**10.0**	**10.0**	--	--	--	--	**31.5**
	Max	130.0	115.0	76.0	58.0	76.0	130.0	50.0	130.0	410.0	140.0	410.0	230.0	140.0	--	--	--	--	150.0
	P90	51.0	95.6	76.0	58.0	76.0	61.0	47.0	61.0	152.0	60.0	177.0	50.0	60.0	--	--	--	--	100.0
	P95	73.0	108.0	76.0	58.0	76.0	65.0	50.0	73.0	235.5	70.0	257.0	80.5	70.0	--	--	--	--	150.0
Iron (µg/g)	N total	92	39	6	4	6	68	18	131	110	26	84	154	86	320	10	158	168	18
	Mean	**18,287**	**27,900**	**20,217**	**24,952**	**20,217**	**17,984**	**18,789**	**19,451**	**26,676**	**16,130**	**29,940**	**24,547**	**26,104**	**33,170**	**19,696**	**30,609**	**23,671**	**23,872**
	Std. Dev.	4,127	8,278	4,821	4,879	4,821	4,219	3,497	5,607	14,450	4,860	14,882	10,787	9,748	17,122	9,048	13,096	3,522	6,637
	Min	10,800	19,934	16,600	19,934	16,600	10,800	13,100	10,800	9,372	9,512	9,372	6,854	10,002	2,448	5,176	2,448	2,448	13,900
	Median	**17,400**	**26,229**	**18,350**	**25,005**	**18,350**	**17,100**	**18,900**	**17,600**	**26,439**	**15,108**	**27,802**	**22,697**	**24,200**	**32,244**	**20,179**	**30,845**	**23,081**	**22,950**
	Max	33,900	57,423	29,600	29,866	29,600	33,900	25,800	57,423	122,401	27,488	122,401	70,643	70,643	200,038	30,565	72,251	72,251	40,000
	P90	23,700	37,909	29,600	29,866	29,600	23,700	25,600	26,579	37,084	24,515	42,008	35,951	35,566	50,408	30,495	46,163	37,629	33,200
	P95	25,800	50,919	29,600	29,866	29,600	24,400	25,800	28,800	47,219	25,215	52,940	40,724	39,168	57,588	30,565	52,457	43,085	40,000
Potassium (µg/g)	N total	92	39	6	4	6	68	18	131	110	26	84	154	86	323	10	158	168	18
	Mean	**14,546**	**23,317**	**13,000**	**25,502**	**13,000**	**14,428**	**15,506**	**15,893**	**22,901**	**20,680**	**23,589**	**22,236**	**20,899**	**25,586**	**22,887**	**22,042**	**22,579**	**21,506**
	Std. Dev.	2,526	3,599	2,275	1,225	2,275	2,424	2,756	4,129	7,863	9,979	7,013	7,387	6,153	11,744	9,993	8,673	2,772	5,842
	Min	7,900	13,301	10,000	24,102	10,000	7,900	10,300	7,900	4,815	4,815	9,796	3,155	10,792	249	10,792	249	249	11,900
	Median	**14,450**	**23,502**	**13,200**	**25,552**	**13,200**	**14,400**	**15,550**	**14,800**	**22,871**	**21,833**	**22,995**	**21,459**	**20,380**	**23,576**	**20,505**	**21,750**	**20,837**	**20,000**
	Max	22,300	29,202	16,800	26,802	16,800	20,400	22,300	29,202	46,986	42,005	46,986	52,216	40,179	86,335	44,247	46,405	46,405	39,900
	P90	17,400	26,802	16,800	26,802	16,800	17,300	19,300	22,702	33,538	33,953	32,940	30,026	28,972	38,967	39,598	33,289	34,949	29,100
	P95	18,100	27,902	16,800	26,802	16,800	18,000	22,300	25,202	35,597	34,430	35,995	34,414	30,383	46,405	44,247	37,938	44,247	39,900
Magnesium (µg/g)	N total	92	39	6	4	6	68	18	131	110	26	84	154	86	320	10	158	168	18
	Mean	**34,025**	**45,135**	**29,767**	**40,705**	**29,767**	**33,784**	**36,356**	**35,588**	**42,793**	**57,838**	**38,136**	**40,245**	**33,626**	**40,092**	**35,416**	**38,353**	**22,579**	**28,333**
	Std. Dev.	7,720	9,787	3,991	4,339	3,991	7,741	8,113	8,719	15,927	21,939	9,764	15,454	6,425	21,830	9,520	21,164	2,772	4,635
	Min	14,000	34,313	24,800	36,363	24,800	14,000	23,000	14,000	16,101	33,227	16,101	18,091	18,091	6,151	23,760	12,603	249	19,200
	Median	**33,300**	**42,695**	**29,300**	**40,102**	**29,300**	**33,300**	**37,400**	**35,400**	**39,318**	**50,263**	**36,695**	**35,881**	**33,589**	**34,524**	**32,805**	**33,046**	**20,837**	**27,650**
	Max	51,900	75,380	36,200	46,253	36,200	51,900	50,700	75,380	115,783	115,783	68,746	116,386	60,907	167,041	56,022	167,041	46,405	38,700
	P90	44,200	60,304	36,200	46,253	36,200	44,200	48,000	46,253	62,897	89,249	51,584	60,907	39,439	68,203	50,022	63,922	34,949	35,900
	P95	48,000	72,967	36,200	46,253	36,200	46,800	50,700	49,811	69,409	102,516	54,409	72,183	42,831	77,195	56,022	77,189	44,247	38,700
Manganese (µg/g)	N total	92	39	6	4	6	68	18	131	110	26	84	154	86	0	0	0	0	18
	Mean	**135**	**103**	**83**	**93**	**83**	**146**	**111**	**135**	**103**	**80**	**111**	**142**	**113**	--	--	--	--	**113**
	Std. Dev.	97	16	16	6	16	104	72	94	67	15	75	233	72	--	--	--	--	52
	Min	59	70	66	85	66	62	59	59	77	77	77	77	77	--	--	--	--	30
	Median	**110**	**101**	**83**	**93**	**83**	**120**	**100**	**110**	**77**	**77**	**77**	**77**	**77**	--	--	--	--	**108**
	Max	810	139	100	101	100	810	390	810	542	155	542	2,168	465	--	--	--	--	210
	P90	210	132	100	101	100	220	120	210	155	77	155	209	155	--	--	--	--	200
	P95	350	132	100	101	100	350	390	290	197	77	232	310	232	--	--	--	--	210

		Stockpile C								Phase I Core Samples					Phase II Core Samples				
		Stockpile C (2017)	Stockpile C (2000)	2017 Hole 1	2000 Hole 2	Original Pad (2017)	Extension (2017)	Expansion (2017)	Stockpile C (All) (weighted)	P1 (Mined) (all core)	P1 (Mined) (south)	P1 (Mined) (north)	P1 Unmined (All Core)	P1 Unmined (PAG Core)	P2 (Historical) (All Core)	P2 (Historical) (Clean Dev't)	P2 (Historical) (Altered Dev't)	P2 (Historical) (weighted)	P2 New (2017 Core)
Molybdenum (µg/g)	N total	92	39	6	4	6	68	18	131	110	26	84	154	86	289	9	147	156	18
	Mean	**6.5**	**12.5**	**10.2**	**28.5**	**10.2**	**4.7**	**12.0**	**6.5**	**11.0**	**5.0**	**12.8**	**15.4**	**22.6**	**11.1**	**3.4**	**13.3**	**7.0**	**40.0**
	Std. Dev.	12.4	16.5	10.4	28.7	10.4	4.5	25.8	11.0	12.4	--	13.7	34.0	44.0	11.5	3.0	11.3	2.5	59.2
	Min	0.7	0.5	1.9	4.0	1.9	0.9	0.7	0.5	5.0	5.0	5.0	5.0	5.0	0.4	1.0	0.7	0.7	4.5
	Median	**3.9**	**6.0**	**8.0**	**25.5**	**8.0**	**3.1**	**4.3**	**3.9**	**5.0**	**5.0**	**5.0**	**5.0**	**20.0**	**9.4**	**2.0**	**11.8**	**4.4**	**21.5**
	Max	111.0	59.0	30.0	59.0	30.0	25.0	111.0	111.0	100.0	5.0	100.0	380.0	380.0	110.0	9.0	94.1	94.1	260.0
	P90	9.9	51.0	30.0	59.0	30.0	8.8	34.0	10.0	20.0	5.0	27.0	20.0	30.0	22.0	9.0	24.7	17.0	84.0
	P95	18.0	53.0	30.0	59.0	30.0	16.0	111.0	18.0	30.0	5.0	30.0	40.0	57.5	27.5	9.0	33.0	22.1	260.0
Sodium (µg/g)	N total	92	39	6	4	6	69	17	131	110	26	84	154	86	318	9	158	167	18
	Mean	**285**	**2,068**	**242**	**1,632**	**242**	**296**	**254**	**554**	**374**	**388**	**370**	**335**	**310**	**2,940**	**190**	**2,211**	**976**	**302**
	Std. Dev.	96	1,146	66	699	66	86	130	741	267	518	113	259	88	8,274	268	8,243	1,528	99
	Min	130	964	140	964	140	160	130	130	148	148	148	148	148	0	74	74	74	90
	Median	**270**	**1,780**	**235**	**1,595**	**235**	**290**	**200**	**300**	**297**	**297**	**371**	**297**	**297**	**297**	**74**	**260**	**148**	**290**
	Max	680	4,896	340	2,374	340	680	540	4,896	2,893	2,893	668	2,596	593	45,624	890	43,770	43,770	550
	P90	380	4,525	340	2,374	340	380	520	1,484	519	445	519	445	445	7,678	890	593	890	470
	P95	520	4,822	340	2,374	340	460	540	2,003	593	501	593	593	445	18,201	890	28,413	890	550
Nickel (µg/g)	N total	92	39	6	4	6	68	18	131	110	26	84	154	86	294	9	147	156	18
	Mean	**77**	**202**	**73**	**172**	**73**	**64**	**125**	**90**	**181**	**76**	**214**	**152**	**217**	**140**	**42**	**211**	**104**	**329**
	Std. Dev.	85	262	37	113	37	61	144	134	250	28	278	341	445	742	22	1,044	188	438
	Min	17	42	43	69	43	17	52	17	30	40	30	20	20	1	23	8	8	42
	Median	**60**	**86**	**61**	**170**	**61**	**52**	**70**	**61**	**100**	**70**	**120**	**90**	**135**	**80**	**33**	**107**	**46**	**169**
	Max	638	1,220	144	278	144	497	638	1,220	1,790	150	1,790	3,400	3,400	12,600	92	12,600	12,600	1,610
	P90	125	651	144	278	144	101	319	129	317	110	427	210	270	172	92	196	136	1,120
	P95	161	791	144	278	144	125	638	261	550	120	768	270	370	235	92	288	186	1,610
Lead (µg/g)	N total	92	39	6	4	17	68	18	131	110	26	84	154	86	0	0	0	0	18
	Mean	**21**	**30**	**13**	**29**	**16**	**23**	**17**	**23**	**33**	**29**	**34**	**26**	**30**	**--**	**--**	**--**	**--**	**81**
	Std. Dev.	18	42	4	20	12	19	12	21	65	34	73	30	37	--	--	--	--	228
	Min	4	7	9	11	4	7	4	4	10	10	10	10	10	--	--	--	--	5
	Median	**17**	**17**	**12**	**26**	**14**	**18**	**15**	**17**	**20**	**15**	**20**	**20**	**20**	**--**	**--**	**--**	**--**	**20**
	Max	130	254	20	53	59	130	59	254	630	140	630	230	230	--	--	--	--	990
	P90	29	53	20	53	23	32	26	32	61	65	60	50	60	--	--	--	--	100
	P95	59	107	20	53	59	60	59	60	131	108	131	80	88	--	--	--	--	990
pH paste	N total	92	0	6	0	6	68	18	92	110	26	84	154	86	0	0	0	0	18
	Mean	**9.7**	**--**	**10.3**	**--**	**10.3**	**10.0**	**8.6**	**9.8**	**7.6**	**8.1**	**7.4**	**7.9**	**7.7**	**--**	**--**	**--**	**--**	**7.5**
	Std. Dev.	0.9	--	1.4	--	1.4	0.7	0.9	0.9	0.7	0.3	0.6	0.4	0.4	--	--	--	--	0.6
	Min	7.0	--	7.8	--	7.8	8.9	7.0	7.0	5.6	7.5	5.6	5.8	5.8	--	--	--	--	5.8
	Median	**9.8**	**--**	**10.6**	**--**	**10.6**	**10.0**	**8.6**	**9.9**	**7.7**	**8.2**	**7.6**	**7.9**	**7.8**	**--**	**--**	**--**	**--**	**7.6**
	Max	11.8	--	11.8	--	11.8	11.7	10.1	11.8	8.9	8.9	8.4	9.0	8.6	--	--	--	--	8.3
	P90	11.0	--	11.8	--	11.8	11.0	10.0	11.0	8.3	8.4	8.1	8.4	8.1	--	--	--	--	8.2
	P95	11.2	--	11.8	--	11.8	11.1	10.1	11.1	8.3	8.4	8.2	8.5	8.2	--	--	--	--	8.3
Radium-226 (Bq/g)	N total	47	0	3	0	3	35	10	47	4	1	3	17	11	0	0	0	0	18
	Mean	**0.179**	**--**	**0.137**	**--**	**0.137**	**0.182**	**0.161**	**0.181**	**0.270**	**0.100**	**0.327**	**0.587**	**0.859**	**--**	**--**	**--**	**--**	**0.519**
	Std. Dev.	0.159	--	0.015	--	0.015	0.170	0.149	0.181	0.272	--	0.302	1.596	1.960	--	--	--	--	1.169
	Min	0.010	--	0.120	--	0.120	0.010	0.000	0.010	0.070	--	0.070	0.020	0.080	--	--	--	--	0.080
	Median	**0.120**	**--**	**0.140**	**--**	**0.140**	**0.110**	**0.110**	**0.120**	**0.175**	**--**	**0.250**	**0.140**	**0.180**	**--**	**--**	**--**	**--**	**0.145**
	Max	0.830	--	0.150	--	0.150	0.830	0.500	0.830	0.660	--	0.660	6.700	6.700	--	--	--	--	5.100
	P90	0.340	--	0.150	--	0.150	0.330	0.420	0.330	0.537	--	0.578	0.740	1.100	--	--	--	--	0.980
	P95	0.500	--	0.150	--	0.150	0.640	0.500	0.640	0.599	--	0.619	2.220	3.900	--	--	--	--	5.100

		Stockpile C								Phase I Core Samples					Phase II Core Samples				
		Stockpile C (2017)	**Stockpile C (2000)**	**2017 Hole 1**	**2000 Hole 2**	**Original Pad (2017)**	**Extension (2017)**	**Expansion (2017)**	**Stockpile C (All) (weighted)**	**P1 (Mined) (all core)**	**P1 (Mined) (south)**	**P1 (Mined) (north)**	**P1 Unmined (All Core)**	**P1 Unmined (PAG Core)**	**P2 (Historical) (All Core)**	**P2 (Historical) (Clean Dev't)**	**P2 (Historical) (Altered Dev't)**	**P2 (Historical) (weighted)**	**P2 New (2017 Core)**
Total Sulphur (µg/g)	N total	92	38	6	4	6	68	18	130	110	26	84	154	86	159	10	50	60	18
	Mean	**6,702**	**9,850**	**12,750**	**11,475**	**12,750**	**5,618**	**8,783**	**6,501**	**14,175**	**258**	**18,482**	**9,517**	**16,784**	**11,607**	**4,746**	**15,764**	**8,759**	**17,950**
	Std. Dev.	5,851	5,879	8,876	5,362	8,876	5,017	6,219	5,424	14,812	422	14,444	10,250	8,241	12,246	5,406	15,119	5,499	7,549
	Min	400	1,300	2,800	6,900	2,800	400	500	400	100	100	100	100	3,500	50	960	300	300	6,700
	Median	**5,950**	**8,850**	**10,300**	**10,650**	**10,300**	**3,400**	**8,600**	**5,900**	**14,500**	**100**	**16,750**	**9,300**	**15,800**	**9,600**	**1,500**	**12,900**	**5,300**	**18,800**
	Max	29,000	23,100	29,000	17,700	29,000	21,800	22,000	29,000	103,000	1,800	103,000	55,500	55,500	78,400	17,100	78,400	78,400	31,300
	P90	13,300	18,900	29,000	17,700	29,000	11,800	21,100	13,300	26,020	400	31,380	21,170	25,500	25,500	13,700	29,750	18,500	31,100
	P95	20,300	20,700	29,000	17,700	29,000	13,700	22,000	17,000	34,005	1,225	36,880	25,605	27,725	36,590	17,100	46,600	27,900	31,300
Sulphide (µg/g)	N total	92	0	6	0	6	68	18	92	110	26	84	154	86	0	0	0	0	18
	Mean	**5,928**	**--**	**11,650**	**--**	**11,650**	**4,947**	**7,728**	**5,368**	**13,966**	**262**	**18,208**	**9,434**	**16,640**	**--**	**--**	**--**	**--**	**17,667**
	Std. Dev.	5,515	--	8,786	--	8,786	4,699	5,853	5,524	14,739	441	14,428	10,180	8,209	--	--	--	--	7,465
	Min	200	--	2,000	--	2,000	200	400	200	100	100	100	100	3,500	--	--	--	--	6,300
	Median	**5,200**	**--**	**8,850**	**--**	**8,850**	**2,650**	**7,250**	**3,500**	**14,350**	**100**	**16,250**	**8,950**	**15,750**	**--**	**--**	**--**	**--**	**18,450**
	Max	27,800	--	27,800	--	27,800	20,200	20,500	27,800	103,000	2,000	103,000	55,000	55,000	--	--	--	--	31,000
	P90	12,300	--	27,800	--	27,800	11,100	18,900	12,300	26,000	400	30,970	21,000	25,350	--	--	--	--	30,100
	P95	18,900	--	27,800	--	27,800	12,900	20,500	14,900	33,595	1,150	36,635	25,470	27,850	--	--	--	--	31,000
Selenium (µg/g)	N total	92	39	6	4	6	68	18	131	109	26	83	86	50	169	0	119	119	18
	Mean	**1.1**	**1.1**	**1.9**	**0.4**	**1.9**	**0.9**	**1.2**	**1.0**	**4.9**	**3.4**	**5.3**	**4.8**	**7.0**	**2.0**	**--**	**2.2**	**2.2**	**4.4**
	Std. Dev.	0.8	0.8	1.1	0.1	1.1	0.7	0.6	0.7	5.2	5.7	5.0	5.1	5.4	1.4	--	1.5	1.5	3.2
	Min	0.1	0.1	0.6	0.2	0.6	0.1	0.4	0.1	0.5	0.5	0.5	0.5	0.5	0.1	--	0.1	0.1	1.3
	Median	**0.9**	**0.9**	**1.8**	**0.4**	**1.8**	**0.8**	**1.1**	**0.8**	**3.0**	**1.0**	**3.0**	**2.0**	**6.5**	**1.8**	**--**	**2.1**	**2.1**	**4.1**
	Max	3.4	3.3	3.4	0.5	3.4	3.3	2.7	3.4	28.0	28.0	17.0	19.0	19.0	10.1	--	10.1	10.1	16.0
	P90	2.2	2.5	3.4	0.5	3.4	2.1	2.2	2.1	12.0	8.0	12.0	12.0	15.0	3.7	--	4.0	4.0	5.8
	P95	2.7	2.9	3.4	0.5	3.4	2.4	2.7	2.5	15.0	8.8	15.0	15.0	15.0	4.4	--	5.1	5.1	16.0
Strontium (µg/g)	N total	92	39	6	4	6	68	18	131	0	0	0			0	0	0	0	18
	Mean	**49**	**76**	**51**	**78**	**51**	**50**	**45**	**54**	**--**	**--**	**--**			**--**	**--**	**--**	**--**	**66**
	Std. Dev.	17	18	10	16	10	18	13	20	--	--	--			--	--	--	--	25
	Min	27	50	34	63	34	27	34	27	--	--	--			--	--	--	--	20
	Median	**46**	**73**	**51**	**78**	**51**	**47**	**42**	**50**	--	--	--			--	--	--	--	**65**
	Max	120	129	64	92	64	120	90	129	--	--	--			--	--	--	--	120
	P90	67	96	64	92	64	72	58	79	--	--	--			--	--	--	--	98
	P95	79	113	64	92	64	79	90	91	--	--	--			--	--	--	--	120
Uranium (µg/g)	N total	92	39	6	4	6	68	18	131	48	7	41	141	86	287.0	7.0	126.0	133.0	18
	Mean	**8.4**	**24.0**	**5.9**	**6.3**	**5.9**	**8.9**	**6.9**	**10.0**	**8.1**	**6.1**	**8.5**	**15.0**	**17.0**	**16.5**	**10.9**	**9.6**	**10.4**	**32.8**
	Std. Dev.	7.7	62.5	1.7	1.0	1.7	8.7	3.9	20.8	6.8	4.8	7.1	55.5	70.7	82.6	6.4	3.8	1.5	80.4
	Min	3.0	1.9	4.1	5.0	4.1	2.5	4.1	2.0	4.2	4.2	4.2	4.2	4.2	0.0	8.5	8.5	8.5	4.1
	Median	**6.0**	**8.0**	**5.9**	**6.6**	**5.9**	**5.5**	**5.6**	**6.0**	**4.2**	**4.2**	**4.2**	**4.2**	**4.2**	**8.5**	**8.5**	**8.5**	**8.5**	**8.4**
	Max	51.0	340.0	7.9	7.1	7.9	51.0	19.0	340.0	33.9	17.0	33.9	653.0	653.0	1204.2	25.4	33.9	33.9	350.0
	P90	15.0	12.0	7.9	7.1	7.9	18.0	15.0	15.0	17.0	9.3	17.0	25.4	25.4	17.0	25.4	17.0	17.0	52.0
	P95	24.0	176.0	7.9	7.1	7.9	27.0	19.0	27.0	22.5	13.1	25.4	33.9	46.6	17.0	25.4	17.0	25.4	350.0

		Stockpile C								Phase I Core Samples					Phase II Core Samples				
		Stockpile C (2017)	**Stockpile C (2000)**	**2017 Hole 1**	**2000 Hole 2**	**Original Pad (2017)**	**Extension (2017)**	**Expansion (2017)**	**Stockpile C (All) (weighted)**	**P1 (Mined) (all core)**	**P1 (Mined) (south)**	**P1 (Mined) (north)**	**P1 Unmined (All Core)**	**P1 Unmined (PAG Core)**	**P2 (Historical) (All Core)**	**P2 (Historical) (Clean Dev't)**	**P2 (Historical) (Altered Dev't)**	**P2 (Historical) (weighted)**	**P2 New (2017 Core)**
Vanadium (µg/g)	N total	92	39	6	4	6	68	18	131	110	26	84	154	86	169	0	119	119	18
	Mean	**89**	**58**	**99**	**63**	**99**	**85**	**101**	**82**	**228**	**129**	**259**	**207**	**254**	**58**	**--**	**55**	**55**	**248**
	Std. Dev.	29	24	38	19	38	25	37	29	114	77	106	108	92	36	--	36	36	135
	Min	34	25	44	45	44	36	34	25	40	40	70	30	40	0	--	1	1	110
	Median	**89**	**55**	**106**	**64**	**106**	**83**	**94**	**78**	**215**	**125**	**260**	**200**	**240**	**56**	**--**	**51**	**51**	**220**
	Max	210	132	140	82	140	150	210	210	600	380	600	660	660	152	--	142	142	700
	P90	130	94	140	82	140	120	140	120	380	190	390	347	350	106	--	106	106	370
	P95	140	120	140	82	140	130	210	130	400	258	443	400	423	126	--	127	127	700
Zinc (µg/g)	N total	92	39	6	4	6	68	18	131	110	26	84	154	86	0	0	0	0	18
	Mean	**27**	**36**	**14**	**40**	**14**	**30**	**18**	**29**	**32**	**15**	**38**	**30**	**38**	**--**	**--**	**--**	**--**	**19**
	Std. Dev.	12	19	2	3	2	11	7	12	73	13	82	97	128	--	--	--	--	9
	Min	10	11	10	35	10	10	10	10	5	5	5	5	5	--	--	--	--	7
	Median	**26**	**36**	**14**	**41**	**14**	**29**	**17**	**27**	**10**	**10**	**20**	**10**	**10**	**--**	**--**	**--**	**--**	**17**
	Max	73	89	16	43	16	73	30	89	570	50	570	1,140	1,140	--	--	--	--	37
	P90	41	65	16	43	16	43	27	43	51	35	60	40	40	--	--	--	--	33
	P95	48	78	16	43	16	48	30	48	80	40	88	70	135	--	--	--	--	37

Table 4-3A
Pearson correlations for Stockpile C solids data

	N		Ca	Al	As	Co	Cu	Fe	Mo	Ni	Pb	Se	U	V	Zn	^{226}Ra	S
Ca	131	Pearson Corr.	1.00														
		p-value	--														
Al	131	Pearson Corr.	-0.05	1.00													
		p-value	0.605	--													
As	131	Pearson Corr.	-0.15	0.29	1.00												
		p-value	0.093	6.63E-04	--												
Co	131	Pearson Corr.	-0.15	0.28	0.41	1.00											
		p-value	0.093	0.001	1.14E-06	--											
Cu	131	Pearson Corr.	0.09	0.38	0.10	0.44	1.00										
		p-value	0.327	7.94E-06	0.274	1.51E-07	--										
Fe	131	Pearson Corr.	-0.10	0.59	0.15	0.74	0.58	1.00									
		p-value	0.250	8.66E-14	0.079	3.87E-24	5.50E-13	--									
Mo	131	Pearson Corr.	-0.13	0.37	0.86	0.38	0.19	0.21	1.00								
		p-value	0.134	1.73E-05	8.56E-39	1.02E-05	0.029	0.017	--								
Ni	131	Pearson Corr.	-0.14	0.36	0.73	0.76	0.36	0.56	0.56	1.00							
		p-value	0.103	2.72E-05	3.12E-23	5.14E-26	2.26E-05	5.91E-12	4.58E-12	--							
Pb	131	Pearson Corr.	-0.12	0.09	0.09	0.70	0.32	0.51	0.13	0.47	1.00						
		p-value	0.158	0.288	0.307	3.17E-20	1.65E-04	5.24E-10	0.141	2.13E-08	--						
Se	131	Pearson Corr.	0.07	0.26	0.25	0.09	0.32	0.17	0.28	0.13	-0.06	1.00					
		p-value	0.451	2.40E-03	3.97E-03	0.295	1.59E-04	0.050	1.45E-03	0.136	0.510	--					
U	131	Pearson Corr.	-0.02	0.08	-0.02	0.81	0.45	0.67	-0.02	0.52	0.81	0.00	1.00				
		p-value	0.864	0.374	0.839	1.09E-31	9.34E-08	4.09E-18	0.783	2.16E-10	2.62E-31	0.991	--				
V	131	Pearson Corr.	-0.24	-0.03	0.37	0.35	0.21	0.13	0.38	0.28	0.21	0.49	0.24	1.00			
		p-value	5.49E-03	0.720	1.73E-05	4.70E-05	0.015	0.141	9.22E-06	1.15E-03	0.015	3.67E-09	5.54E-03	--			
Zn	131	Pearson Corr.	0.39	0.13	0.08	0.28	0.47	0.27	0.16	0.23	0.33	-0.01	0.31	-0.08	1.00		
		p-value	4.55E-06	0.137	0.344	1.05E-03	1.48E-08	2.07E-03	0.067	9.75E-03	9.97E-05	0.868	2.70E-04	0.357	--		
^{226}Ra	47	Pearson Corr.	0.43	0.12	0.07	0.11	0.38	0.15	0.13	0.24	0.12	0.20	0.84	0.32	0.29	1.00	
		p-value	2.31E-03	0.406	0.630	0.463	8.46E-03	0.312	0.387	0.103	0.424	0.181	1.17E-13	0.030	0.051	--	
S	130	Pearson Corr.	-0.13	0.49	0.39	0.56	0.52	0.62	0.41	0.46	0.29	0.51	0.38	0.56	0.19	0.32	1.00
		p-value	0.130	2.38E-09	3.86E-06	3.15E-12	2.96E-10	3.36E-15	1.15E-06	4.04E-08	9.31E-04	3.99E-10	9.20E-06	2.84E-12	0.029	0.030	--

Table 4-3B
Pearson correlations for core samples from previously mined Phase I development rock

	N		Ca	Al	As	Co	Cu	Fe	Mo	Ni	Pb	Se	U	V	Zn	^{226}Ra	S
Ca	110	Pearson Corr.	1.00														
		p-value	--														
Al	110	Pearson Corr.	0.27	1.00													
		p-value	3.90E-03	--													
As	110	Pearson Corr.	0.31	0.43	1.00												
		p-value	1.01E-03	2.42E-06	--												
Co	110	Pearson Corr.	0.36	0.42	0.99	1.00											
		p-value	1.30E-04	0.000	0.000	--											
Cu	110	Pearson Corr.	0.28	0.11	-0.03	-0.01	1.00										
		p-value	2.60E-03	0.272	0.795	0.947	--										
Fe	110	Pearson Corr.	0.33	0.06	0.16	0.15	0.50	1.00									
		p-value	3.56E-04	0.559	0.100	0.118	0.000	--									
Mo	110	Pearson Corr.	0.05	0.33	0.76	0.73	0.02	0.35	1.00								
		p-value	0.587	3.95E-04	1.26E-21	3.23E-19	0.858	1.65E-04	--								
Ni	110	Pearson Corr.	0.31	0.54	0.92	0.87	0.01	0.29	0.77	1.00							
		p-value	9.40E-04	1.33E-09	2.24E-46	2.66E-34	0.951	0.002	4.35E-23	--							
Pb	110	Pearson Corr.	0.11	0.26	0.14	0.15	0.02	0.20	0.34	0.13	1.00						
		p-value	0.238	6.18E-03	0.152	0.121	0.854	0.041	2.32E-04	0.190	--						
Se	109	Pearson Corr.	0.27	0.40	0.37	0.34	-0.12	0.21	0.42	0.48	0.32	1.00					
		p-value	5.19E-03	1.86E-05	9.24E-05	2.46E-04	0.234	0.029	5.47E-06	9.92E-08	7.66E-04	--					
U	48	Pearson Corr.	0.02	0.39	-0.02	-0.01	0.14	-0.07	0.01	0.02	0.11	-0.07	1.00				
		p-value	0.901	6.25E-03	0.885	0.922	0.353	0.638	0.967	0.901	0.453	0.646	--				
V	110	Pearson Corr.	0.09	0.66	0.40	0.37	0.11	0.24	0.49	0.54	0.09	0.33	0.13	1.00			
		p-value	0.340	3.48E-15	1.32E-05	8.57E-05	0.248	0.012	5.21E-08	1.46E-09	0.360	5.63E-04	0.377	--			
Zn	110	Pearson Corr.	0.40	0.51	0.11	0.15	0.23	0.01	0.02	0.11	0.25	0.23	0.41	0.20	1.00		
		p-value	1.15E-05	1.62E-08	0.234	0.127	0.016	0.939	0.803	0.244	9.80E-03	0.017	3.72E-03	0.033	--		
^{226}Ra	4	Pearson Corr.	0.93	0.92	-0.06	0.01	0.96	-0.16	0.24	-0.02	0.99	0.57	0.94	0.54	0.96	1.00	
		p-value	0.074	0.078	0.941	0.992	0.039	0.839	0.760	0.979	0.011	0.430	0.214	0.460	0.037	--	
S	110	Pearson Corr.	0.35	0.12	0.24	0.23	0.46	0.93	0.41	0.37	0.21	0.30	-0.04	0.29	0.05	0.11	1.00
		p-value	2.17E-04	0.225	0.012	0.016	5.34E-07	1.26E-49	1.08E-05	6.53E-05	0.029	1.41E-03	0.775	1.83E-03	0.575	0.889	--

Table 4-3C
Pearson correlations for core samples from unmined Phase I future development rock

	N		Ca	Al	As	Co	Cu	Fe	Mo	Ni	Pb	Se	U	V	Zn	^{226}Ra	S
Ca	154	Pearson Corr.	1.00														
		p-value	--														
Al	154	Pearson Corr.	0.28	1.00													
		p-value	4.70E-04	--													
As	154	Pearson Corr.	0.01	0.32	1.00												
		p-value	0.885	6.10E-05	--												
Co	154	Pearson Corr.	0.16	0.37	0.71	1.00											
		p-value	0.048	3.00E-06	1.26E-24	--											
Cu	154	Pearson Corr.	0.22	0.06	0.20	0.11	1.00										
		p-value	5.65E-03	0.450	0.015	0.193	--										
Fe	154	Pearson Corr.	0.29	-0.13	0.02	0.15	0.12	1.00									
		p-value	2.52E-04	0.109	0.806	0.062	0.152	--									
Mo	154	Pearson Corr.	0.01	0.33	0.77	0.71	0.08	0.02	1.00								
		p-value	0.911	3.86E-05	1.85E-31	3.87E-25	0.327	0.786	--								
Ni	154	Pearson Corr.	0.02	0.34	0.99	0.65	0.21	0.01	0.74	1.00							
		p-value	0.845	1.84E-05	2.57E-122	1.10E-19	0.011	0.913	3.48E-28	--							
Pb	154	Pearson Corr.	0.65	0.22	0.15	0.30	0.20	0.21	0.18	0.16	1.00						
		p-value	6.49E-20	5.04E-03	0.061	1.87E-04	0.012	0.010	0.029	0.046	--						
Se	86	Pearson Corr.	0.33	0.17	0.01	0.17	0.17	0.18	0.09	0.03	0.33	1.00					
		p-value	2.08E-03	0.110	0.932	0.125	0.127	0.091	0.435	0.759	1.65E-03	--					
U	141	Pearson Corr.	0.09	0.09	0.06	0.03	0.04	-0.05	0.08	0.07	0.27	0.05	1.00				
		p-value	0.287	0.275	0.497	0.701	0.640	0.533	0.351	0.421	1.06E-03	0.646	--				
V	154	Pearson Corr.	0.07	0.54	0.37	0.56	0.08	-0.12	0.52	0.39	0.26	0.32	0.20	1.00			
		p-value	0.363	2.98E-13	1.67E-06	7.25E-14	0.323	0.148	7.33E-12	5.25E-07	1.31E-03	2.63E-03	0.020	--			
Zn	154	Pearson Corr.	0.80	0.32	0.01	0.10	0.15	0.30	0.04	0.02	0.44	0.33	0.21	0.15	1.00		
		p-value	2.25E-35	6.66E-05	0.872	0.226	0.055	1.88E-04	0.592	0.819	1.01E-08	1.79E-03	0.013	0.068	--		
^{226}Ra	17	Pearson Corr.	-0.03	0.05	-0.03	0.04	0.01	-0.23	0.34	0.05	0.33	0.09	0.99	0.60	0.42	1.00	
		p-value	0.918	0.860	0.898	0.877	0.970	0.382	0.184	0.852	0.203	0.784	1.25E-15	0.011	0.095	--	
S	154	Pearson Corr.	0.31	0.15	0.24	0.52	0.27	0.46	0.25	0.23	0.40	0.55	0.00	0.40	0.34	0.06	1.00
		p-value	9.60E-05	0.065	2.67E-03	5.49E-12	7.10E-04	1.29E-09	1.71E-03	3.40E-03	2.40E-07	5.62E-08	0.957	3.23E-07	1.73E-05	0.806	--

Table 4-3D
Pearson correlations for core samples from entire Phase II data on development rock (excluding 2017 samples)

	N		Ca	Al	As	Co	Cu	Fe	Mo	Ni	Pb	Se	U	V	Zn	^{226}Ra	S
Ca	320	Pearson Corr.	1.00														
		p-value	--														
Al	323	Pearson Corr.	-0.32	1.00													
		p-value	4.06E-09	--													
As	285	Pearson Corr.	-0.04	0.22	1.00												
		p-value	0.544	1.79E-04	--												
Co	285	Pearson Corr.	-0.08	0.07	0.50	1.00											
		p-value	0.182	0.219	8.31E-20	--											
Cu	0	Pearson Corr.	1.00	1.00	1.00	1.00	1.00										
		p-value	--	--	--	--	--										
Fe	320	Pearson Corr.	-0.10	0.15	-0.01	0.07	1.00	1.00									
		p-value	0.069	9.02E-03	0.919	0.217	--	--									
Mo	289	Pearson Corr.	-0.11	0.16	0.50	0.44	1.00	0.14	1.00								
		p-value	0.064	6.92E-03	1.93E-19	7.66E-15	--	0.016	--								
Ni	294	Pearson Corr.	-0.03	0.22	0.99	0.41	1.00	-0.01	0.47	1.00							
		p-value	0.631	1.41E-04	5.74E-273	9.54E-13	--	0.831	1.15E-17	--							
Pb	0	Pearson Corr.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00						
		p-value	--	--	--	--	--	--	--	--	--						
Se	169	Pearson Corr.	-0.13	0.16	0.10	0.33	1.00	0.49	0.33	0.07	1.00	1.00					
		p-value	0.092	3.65E-02	0.187	1.20E-05	--	1.18E-11	1.21E-05	0.377	--	--					
U	287	Pearson Corr.	-0.08	-0.26	0.03	0.07	1.00	-0.10	0.17	0.02	1.00	0.02	1.00				
		p-value	0.188	9.04E-06	0.676	0.221	--	0.080	3.30E-03	0.771	--	0.834	--				
V	169	Pearson Corr.	-0.02	0.15	-0.05	-0.10	1.00	0.67	0.21	-0.04	1.00	0.27	-0.20	1.00			
		p-value	0.773	0.059	0.527	0.188	--	2.60E-23	6.19E-03	0.611	--	4.80E-04	9.42E-03	--			
Zn	0	Pearson Corr.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
		p-value	--	--	--	--	--	--	--	--	--	--	--	--	--		
^{226}Ra	0	Pearson Corr.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
		p-value	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
S	159	Pearson Corr.	-0.17	0.27	0.71	0.57	1.00	0.54	0.45	0.74	1.00	0.95	-0.04	0.25	1.00	1.00	1.00
		p-value	0.029	5.72E-04	1.07E-22	9.35E-14	--	2.54E-13	8.39E-09	4.93E-27	--	6.65E-18	0.595	0.153	--	--	--

Table 4-3E
Pearson correlations for core samples from 2017 Phase II sampling program

	N		Ca	Al	As	Co	Cu	Fe	Mo	Ni	Pb	Se	U	V	Zn	^{226}Ra	S
Ca	17	Pearson Corr.	1.00														
		p-value	--														
Al	17	Pearson Corr.	0.35	1.00													
		p-value	0.166	--													
As	17	Pearson Corr.	0.30	0.90	1.00												
		p-value	0.235	9.67E-07	--												
Co	17	Pearson Corr.	0.29	0.90	1.00	1.00											
		p-value	0.255	7.47E-07	4.05E-21	--											
Cu	17	Pearson Corr.	-0.27	0.06	0.09	0.10	1.00										
		p-value	0.296	0.817	0.727	0.695	--										
Fe	17	Pearson Corr.	-0.50	-0.19	0.04	0.03	0.42	1.00									
		p-value	0.043	0.458	0.882	0.901	0.094	--									
Mo	17	Pearson Corr.	0.88	0.50	0.40	0.40	-0.21	-0.38	1.00								
		p-value	2.93E-06	0.040	0.111	0.114	0.417	0.135	--								
Ni	17	Pearson Corr.	0.35	0.92	0.99	0.99	0.08	0.01	0.45	1.00							
		p-value	0.174	1.88E-07	6.22E-16	1.52E-14	0.769	0.981	0.072	--							
Pb	17	Pearson Corr.	0.72	0.67	0.55	0.55	-0.21	-0.38	0.87	0.58	1.00						
		p-value	1.00E-03	3.40E-03	0.023	0.022	0.429	0.135	5.29E-06	0.014	--						
Se	17	Pearson Corr.	0.08	0.40	0.37	0.38	0.34	0.29	0.19	0.40	0.18	1.00					
		p-value	0.763	0.111	0.140	0.128	0.177	0.254	0.468	0.111	0.490	--					
U	17	Pearson Corr.	0.50	0.32	0.27	0.28	0.05	-0.22	0.63	0.29	0.61	0.05	1.00				
		p-value	0.040	0.218	0.301	0.283	0.862	0.405	6.64E-03	0.267	8.76E-03	0.834	--				
V	17	Pearson Corr.	0.64	0.66	0.55	0.55	0.03	-0.25	0.66	0.58	0.51	0.59	0.27	1.00			
		p-value	5.72E-03	4.13E-03	0.022	0.022	0.904	0.333	3.66E-03	0.014	0.035	0.012	0.296	--			
Zn	17	Pearson Corr.	-0.24	-0.27	-0.35	-0.36	-0.01	0.37	-0.11	-0.36	-0.11	-0.08	0.11	-0.20	1.00		
		p-value	0.356	0.290	0.165	0.153	0.959	0.145	0.685	0.162	0.669	0.771	0.670	0.443	--		
^{226}Ra	17	Pearson Corr.	0.33	0.28	0.24	0.26	0.14	-0.14	0.48	0.25	0.46	0.10	0.96	0.25	0.15	1.00	
		p-value	0.191	0.269	0.348	0.321	0.590	0.580	0.053	0.324	0.063	0.704	7.19E-10	0.325	0.571	--	
S	17	Pearson Corr.	-0.08	0.43	0.49	0.48	0.16	0.59	0.06	0.49	0.16	0.69	-0.12	0.33	0.05	-0.08	1.00
		p-value	0.769	0.085	0.048	0.050	0.528	0.013	0.832	0.044	0.543	2.37E-03	0.650	0.194	0.847	0.754	--

Table 4-4: Leach testing summary statistics for both 2001 EIS scoping level test work and 2017 test work

		2000 AA/HAH Raw Leach	2000 AA/HAH Recalculated	2000 DI Raw Leach	2000 DI Recalculated	2000 PA Raw Leach	2000 PA Recalculated	2017 TCLP Raw Leach	2017 TCLP Recalculated	2017 PII Raw Leach	2017 - PII Recalculated
Aluminum (µg/g)	N total	14	14	17	17	10	10	49	49	9	9
	Mean	0.053	1.1	0.63	12.7	0.26	5.3	25.0	1.3	0.09	1.7
	Std. Dev.	0.068	1.4	0.39	7.8	0.59	11.8	18.8	0.9	0.09	1.9
	Min	0.006	0.1	0.14	2.8	0.01	0.1	0.0	0.0	0.01	0.2
	Median	**0.037**	**0.7**	**0.54**	**10.8**	**0.06**	**1.2**	**26.0**	**1.3**	**0.04**	**0.8**
	Max	0.270	5.4	1.92	38.5	1.93	38.5	68.0	3.4	0.26	5.2
	P90	0.100	2.0	1.05	21.0	1.08	21.6	51.0	2.6	0.26	5.2
	P95	**0.270**	**5.4**	**1.92**	**38.5**	**1.93**	**38.5**	**57.2**	**2.9**	**0.26**	**5.2**
Arsenic (µg/g)	N total	17	17	17	17	17	17	49	49	9	9
	Mean	**160**	**3.2**	**229**	**4.6**	**506**	**10.1**	**275**	**6**	**1,887**	**38**
	Std. Dev.	336	6.7	495	9.9	463	9.3	792	16	2,715	54
	Min	4	0.1	3	0.1	64	1.3	2.0	0.0	12	0.2
	Median	**19**	**0.4**	**32**	**0.6**	**280**	**5.6**	**21**	**0**	**367**	**7**
	Max	1,090	21.8	1,765	35.3	1,370	27.4	4,350	87	7,340	147
	P90	990	19.8	1,238	24.8	1,220	24.4	917	18	7,340	147
	P95	**1,090**	**21.8**	**1,765**	**35.3**	**1,370**	**27.4**	**946**	**19**	**7,340**	**147**
Calcium (µg/g)	N total	17	17	17	17	17	17	49	49	9	9
	Mean	154.2	3,083.5	85.0	1,701.0	108.0	2,160.1	57.5	1,150.0	10.7	213.6
	Std. Dev.	76.9	1,538.3	40.5	809.7	46.9	937.7	38.1	761.1	11.1	222.6
	Min	62.5	1,250.0	17.9	358.5	27.5	550.0	6.6	132.0	0.7	14.0
	Median	**120.0**	**2,400.0**	**71.0**	**1,420.0**	**105.0**	**2,100.0**	**46.0**	**920.0**	**5.7**	**114.0**
	Max	300.0	6,000.0	179.8	3,595.0	190.0	3,800.0	184.0	3,680.0	30.0	600.0
	P90	290.0	5,800.0	139.0	2,780.0	170.0	3,400.0	98.0	1,960.0	30.0	600.0
	P95	**300.0**	**6,000.0**	**179.8**	**3,595.0**	**190.0**	**3,800.0**	**160.0**	**3,200.0**	**30.0**	**600.0**
Cadmium (µg/g)	N total	0	0	0	0	0	0	0	0	0	0
	Mean	--	--	--	--	--	--	--	--	--	--
	Std. Dev.	--	--	--	--	--	--	--	--	--	--
	Min	--	--	--	--	--	--	--	--	--	--
	Median	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
	Max	--	--	--	--	--	--	--	--	--	--
	P90	--	--	--	--	--	--	--	--	--	--
	P95	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

		2000 AA/HAH Raw Leach	2000 AA/HAH Recalculated	2000 DI Raw Leach	2000 DI Recalculated	2000 PA Raw Leach	2000 PA Recalculated	2017 TCLP Raw Leach	2017 TCLP Recalculated	2017 PII Raw Leach	2017 - PII Recalculated
Cobalt (µg/g)	N total	17	17	17	17	17	17	33	33	9	9
	Mean	0.1	2.3	0.1	1.4	0.1	1.6	0.0	0.2	0.0	0.2
	Std. Dev.	0.2	3.8	0.1	1.6	0.1	2.1	0.1	1.1	0.0	0.4
	Min	0.0	0.2	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0
	Median	**0.0**	**0.9**	**0.0**	**0.8**	**0.0**	**0.7**	**0.0**	**0.0**	**0.0**	**0.0**
	Max	0.8	15.3	0.3	6.8	0.4	8.5	0.3	6.4	0.1	1.2
	P90	0.4	8.0	0.1	2.9	0.2	3.7	0.0	0.0	0.1	1.2
	P95	**0.8**	**15.3**	**0.3**	**6.8**	**0.4**	**8.5**	**0.0**	**0.1**	**0.1**	**1.2**
Chromium (µg/g)	N total	9	9	15	15	15	15	44	44	2	2
	Mean	**0.002**	**0.037**	**0.002**	**0.041**	**0.003**	**0.054**	**0.007**	**0.134**	**0.001**	**0.023**
	Std. Dev.	0.001	0.021	0.001	0.024	0.001	0.023	0.004	0.087	0.000	0.010
	Min	0.001	0.015	0.001	0.015	0.001	0.015	0.001	0.014	0.001	0.016
	Median	**0.002**	**0.030**	**0.002**	**0.040**	**0.003**	**0.050**	**0.006**	**0.116**	**0.001**	**0.023**
	Max	0.004	0.070	0.005	0.108	0.005	0.106	0.019	0.380	0.002	0.030
	P90	0.004	0.070	0.003	0.063	0.004	0.085	0.012	0.240	0.002	0.030
	P95	**0.004**	**0.070**	**0.005**	**0.108**	**0.005**	**0.106**	**0.016**	**0.320**	**0.002**	**0.030**
Copper (µg/g)	N total	17	17	17	17	17	17	27	27	8	8
	Mean	**0.025**	**0.497**	**0.028**	**0.561**	**0.021**	**0.417**	**0.0010**	**0.0193**	**0.0008**	**0.0155**
	Std. Dev.	0.025	0.504	0.032	0.642	0.035	0.700	0.0005	0.0107	0.0007	0.0147
	Min	0.001	0.015	0.001	0.018	0.001	0.025	0.0003	0.0060	0.0002	0.0040
	Median	**0.018**	**0.355**	**0.020**	**0.408**	**0.012**	**0.240**	**0.0009**	**0.0180**	**0.0004**	**0.0080**
	Max	0.073	1.450	0.117	2.344	0.152	3.033	0.0023	0.0460	0.0020	0.0400
	P90	0.071	1.410	0.085	1.693	0.038	0.750	0.0015	0.0300	0.0020	0.0400
	P95	**0.073**	**1.450**	**0.117**	**2.344**	**0.152**	**3.033**	**0.0023**	**0.0460**	**0.0020**	**0.0400**
Iron (µg/g)	N total	17	17	17	17	17	17	36	38	9	9
	Mean	**1.0**	**19.6**	**1.5**	**30.1**	**0.4**	**8.4**	**0.0**	**0.4**	**0.0**	**0.7**
	Std. Dev.	0.4	8.0	0.8	16.3	1.2	23.3	0.1	1.5	0.0	0.9
	Min	0.5	10.0	0.7	13.2	0.0	0.3	0.0	0.0	0.0	0.0
	Median	**0.9**	**18.0**	**1.5**	**29.2**	**0.2**	**3.6**	**0.0**	**0.1**	**0.0**	**0.3**
	Max	2.1	41.3	4.3	85.3	4.9	98.5	0.5	9.6	0.1	2.6
	P90	1.5	29.5	1.9	37.8	0.3	6.3	0.0	0.4	0.1	2.6
	P95	**2.1**	**41.3**	**4.3**	**85.3**	**4.9**	**98.5**	**0.1**	**1.1**	**0.1**	**2.6**

		2000 AA/HAH Raw Leach	2000 AA/HAH Recalculated	2000 DI Raw Leach	2000 DI Recalculated	2000 PA Raw Leach	2000 PA Recalculated	2017 TCLP Raw Leach	2017 TCLP Recalculated	2017 PII Raw Leach	2017 - PII Recalculated
Potassium (µg/g)	N total	17	17	17	17	17	17	16	14	9	9
	Mean	8.3	166.8	4.1	81.1	6.8	135.9	3.7	84.3	6.5	130.0
	Std. Dev.	1.7	33.6	1.0	20.4	2.7	54.3	6.8	143.7	1.2	23.9
	Min	6.3	125.0	2.4	47.3	2.4	47.1	0.1	2.0	4.6	92.0
	Median	**8.4**	**167.0**	**4.0**	**79.5**	**7.6**	**152.0**	**0.3**	**6.0**	**6.4**	**128.0**
	Max	12.8	256.0	5.8	115.0	10.0	200.0	23.0	460.0	8.0	160.0
	P90	10.9	218.0	5.7	114.0	9.6	191.0	17.0	340.0	8.0	160.0
	P95	**12.8**	**256.0**	**5.8**	**115.0**	**10.0**	**200.0**	**23.0**	**460.0**	**8.0**	**160.0**
Magnesium (µg/g)	N total	17	17	17	17	17	17	16	14	9	9
	Mean	5.5	109.1	7.3	145.8	6.2	123.2	3.7	84.3	4.5	89.3
	Std. Dev.	1.0	19.3	14.7	294.3	1.6	32.2	6.8	143.7	3.0	59.1
	Min	3.9	77.0	1.4	27.0	3.0	60.0	0.1	2.0	0.9	18.0
	Median	**5.7**	**113.0**	**3.9**	**78.5**	**6.6**	**132.0**	**0.3**	**6.0**	**3.5**	**70.0**
	Max	7.2	144.0	64.3	1,285.0	8.3	166.0	23.0	460.0	10.0	200.0
	P90	7.2	143.0	6.0	119.9	8.2	163.0	17.0	340.0	10.0	200.0
	P95	**7.2**	**144.0**	**64.3**	**1,285.0**	**8.3**	**166.0**	**23.0**	**460.0**	**10.0**	**200.0**
Manganese (µg/g)	N total	17	17	17	17	17	17	4	4	7	7
	Mean	0.1	2.0	0.1	1.7	0.1	1.5	0.0	0.5	0.0	0.1
	Std. Dev.	0.0	0.3	0.0	0.5	0.0	0.5	0.0	0.8	0.0	0.1
	Min	0.1	1.5	0.0	0.6	0.0	0.7	0.0	0.0	0.0	0.0
	Median	**0.1**	**2.0**	**0.1**	**1.9**	**0.1**	**1.5**	**0.0**	**0.1**	**0.0**	**0.0**
	Max	0.1	2.6	0.1	2.4	0.1	2.6	0.1	1.7	0.0	0.2
	P90	0.1	2.6	0.1	2.2	0.1	2.1	0.1	1.7	0.0	0.2
	P95	**0.1**	**2.6**	**0.1**	**2.4**	**0.1**	**2.6**	**0.1**	**1.7**	**0.0**	**0.2**
Molybdenum (µg/g)	N total	17	17	17	17	17	17	49	49	9	9
	Mean	0.1	1.2	0.0	0.8	0.0	0.8	0.1	1.6	0.6	12.1
	Std. Dev.	0.1	2.0	0.1	1.5	0.0	0.8	0.2	3.4	1.0	20.0
	Min	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.2
	Median	**0.0**	**0.3**	**0.0**	**0.2**	**0.0**	**0.4**	**0.0**	**0.5**	**0.2**	**4.0**
	Max	0.4	7.8	0.3	6.0	0.1	2.2	0.9	17.2	3.0	60.2
	P90	0.2	3.7	0.1	2.5	0.1	2.0	0.2	3.9	3.0	60.2
	P95	**0.4**	**7.8**	**0.3**	**6.0**	**0.1**	**2.2**	**0.6**	**11.7**	**3.0**	**60.2**

		2000 AA/HAH Raw Leach	2000 AA/HAH Recalculated	2000 DI Raw Leach	2000 DI Recalculated	2000 PA Raw Leach	2000 PA Recalculated	2017 TCLP Raw Leach	2017 TCLP Recalculated	2017 PII Raw Leach	2017 - PII Recalculated
Sodium (µg/g)	N total	17	17	17	17	17	17	49	49	9	9
	Mean	4.9	98.8	4.0	80.6	5.8	116.4	6.2	124.9	6.1	121.1
	Std. Dev.	1.6	31.3	6.6	132.1	7.7	154.0	2.4	48.2	6.1	122.6
	Min	2.4	48.5	1.6	32.3	1.5	30.0	2.2	44.0	2.0	40.0
	Median	**4.4**	**88.0**	**2.3**	**46.5**	**4.0**	**80.0**	**6.1**	**122.0**	**3.2**	**64.0**
	Max	8.5	170.0	29.5	590.4	35.1	702.6	15.0	300.0	21.0	420.0
	P90	7.1	142.0	4.3	86.5	7.7	154.0	8.8	176.0	21.0	420.0
	P95	**8.5**	**170.0**	**29.5**	**590.4**	**35.1**	**702.6**	**9.0**	**180.0**	**21.0**	**420.0**
Nickel (µg/g)	N total	17	17	17	17	17	17	40	40	9	9
	Mean	0.1	2.9	0.1	1.8	0.1	2.3	0.0	0.4	0.0	0.4
	Std. Dev.	0.2	4.8	0.1	2.2	0.1	2.5	0.1	2.6	0.0	0.6
	Min	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
	Median	**0.1**	**1.1**	**0.0**	**0.9**	**0.0**	**1.0**	**0.0**	**0.0**	**0.0**	**0.0**
	Max	0.8	16.2	0.4	8.1	0.4	8.6	0.8	16.3	0.1	1.7
	P90	0.7	14.6	0.3	5.2	0.3	6.5	0.0	0.1	0.1	1.7
	P95	**0.8**	**16.2**	**0.4**	**8.1**	**0.4**	**8.6**	**0.0**	**0.1**	**0.1**	**1.7**
Lead (µg/g)	N total	8	8	15	15	1	1	1	1	3	3
	Mean	0.004	0.076	0.017	0.334	0.088	1.766	0.0003	0.006	0.0002	0.004
	Std. Dev.	0.002	0.047	0.043	0.867	--	--	--	--	0.0000	0.000
	Min	0.002	0.030	0.001	0.025	0.088	1.766	0.0003	0.006	0.0002	0.004
	Median	**0.004**	**0.070**	**0.004**	**0.070**	**0.088**	**1.766**	**0.0003**	**0.006**	**0.0002**	**0.004**
	Max	0.009	0.180	0.172	3.444	0.088	1.766	0.0003	0.006	0.0002	0.004
	P90	0.009	0.180	0.018	0.355	--	--	--	--	0.0002	0.004
	P95	**0.009**	**0.180**	**0.172**	**3.444**	**--**	**--**	**--**	**--**	**0.0002**	**0.004**
pH	N total	0	0	0	0	0	0	49	49	9	9
	Mean	--	--	--	--	--	--	9.9	9.7	7.3	7.6
	Std. Dev.	--	--	--	--	--	--	1.2	1.0	0.6	0.3
	Min	--	--	--	--	--	--	6.7	7.3	6.2	7.1
	Median	**--**	**--**	**--**	**--**	**--**	**--**	**10.2**	**9.8**	**7.5**	**7.6**
	Max	--	--	--	--	--	--	11.7	11.6	8.0	8.3
	P90	--	--	--	--	--	--	11.1	11.0	8.0	8.3
	P95	**--**	**--**	**--**	**--**	**--**	**--**	**11.1**	**11.1**	**8.0**	**8.3**

		2000 AA/HAH Raw Leach	2000 AA/HAH Recalculated	2000 DI Raw Leach	2000 DI Recalculated	2000 PA Raw Leach	2000 PA Recalculated	2017 TCLP Raw Leach	2017 TCLP Recalculated	2017 PII Raw Leach	2017 - PII Recalculated
Conductivity	N total	0	0	0	0	0	0	49	49	9	9
	Mean	--	--	--	--	--	--	441	1,368	145	822
	Std. Dev.	--	--	--	--	--	--	318	439	74	360
	Min	--	--	--	--	--	--	90	480	42	400
	Median	--	--	--	--	--	--	**354**	**1,340**	**126**	**800**
	Max	--	--	--	--	--	--	1,980	2,300	279	1,600
	P90	--	--	--	--	--	--	753	1,900	279	1,600
	P95	--	--	--	--	--	--	**1,000**	**2,200**	**279**	**1,600**
226Ra (Bq/g)	N total	0	0	0	0	0	0	38	38	9	9
	Mean	--	--	--	--	--	--	0.0181	0.0004	0.0387	0.0008
	Std. Dev.	--	--	--	--	--	--	0.0179	0.0004	0.0650	0.0013
	Min	--	--	--	--	--	--	0.0050	0.0001	0.0080	0.0002
	Median	--	--	--	--	--	--	**0.0100**	**0.0002**	**0.0200**	**0.0004**
	Max	--	--	--	--	--	--	0.0900	0.0018	0.2100	0.0042
	P90	--	--	--	--	--	--	0.0300	0.0006	0.2100	0.0042
	P95	--	--	--	--	--	--	**0.0800**	**0.0016**	**0.2100**	**0.0042**
Sulphate (µg/g)	N total	17	17	17	17	17	17	49	49	9	9
	Mean	35	707	20	398	31	623	100	2,001	40	793
	Std. Dev.	17	331	11	212	21	419	80	1,608	22	430
	Min	21	415	10	208	5	99	13	260	14	280
	Median	**29**	**580**	**17**	**332**	**27**	**530**	**84**	**1,680**	**36**	**720**
	Max	87	1,730	50	990	82	1,640	490	9,800	81	1,620
	P90	60	1,200	40	800	75	1,490	160	3,200	81	1,620
	P95	**87**	**1,730**	**50**	**990**	**82**	**1,640**	**260**	**5,200**	**81**	**1,620**
Selenium (µg/g)	N total	0	0	0	0	0	0	49	49	9	9
	Mean	--	--	--	--	--	--	0.002	0.039	0.014	0.278
	Std. Dev.	--	--	--	--	--	--	0.002	0.035	0.017	0.347
	Min	--	--	--	--	--	--	0.000	0.004	0.001	0.012
	Median	--	--	--	--	--	--	**0.002**	**0.030**	**0.007**	**0.136**
	Max	--	--	--	--	--	--	0.009	0.188	0.054	1.080
	P90	--	--	--	--	--	--	0.003	0.068	0.054	1.080
	P95	--	--	--	--	--	--	**0.007**	**0.132**	**0.054**	**1.080**

		2000 AA/HAH Raw Leach	2000 AA/HAH Recalculated	2000 DI Raw Leach	2000 DI Recalculated	2000 PA Raw Leach	2000 PA Recalculated	2017 TCLP Raw Leach	2017 TCLP Recalculated	2017 PII Raw Leach	2017 - PII Recalculated
Strontium (µg/g)	N total	17	17	17	17	17	17	49	49	9	9
	Mean	0.5	9.4	0.2	4.7	0.3	6.2	0.2	4.8	0.1	1.8
	Std. Dev.	0.1	1.7	0.1	1.3	0.1	2.2	0.1	2.8	0.1	1.5
	Min	0.4	7.5	0.1	2.1	0.1	2.4	0.0	0.8	0.0	0.2
	Median	**0.4**	**8.9**	**0.3**	**5.0**	**0.3**	**6.9**	**0.2**	**4.4**	**0.1**	**1.8**
	Max	0.6	12.8	0.4	7.4	0.5	9.0	0.9	17.2	0.2	4.6
	P90	0.6	12.6	0.3	6.0	0.4	8.8	0.4	7.8	0.2	4.6
	P95	**0.6**	**12.8**	**0.4**	**7.4**	**0.5**	**9.0**	**0.5**	**10.4**	**0.2**	**4.6**
Uranium (µg/g)	N total	0	0	0	0	0	0	10	10	4	4
	Mean	--	--	--	--	--	--	0.97	0.02	32.6	0.7
	Std. Dev.	--	--	--	--	--	--	1.43	0.03	61.0	1.2
	Min	--	--	--	--	--	--	0.10	0.00	0.4	0.0
	Median	**--**	**--**	**--**	**--**	**--**	**--**	**0.40**	**0.01**	**3.1**	**0.1**
	Max	--	--	--	--	--	--	4.40	0.09	124.0	2.5
	P90	--	--	--	--	--	--	3.55	0.07	124.0	2.5
	P95	**--**	**--**	**--**	**--**	**--**	**--**	**4.40**	**0.09**	**124.0**	**2.5**
Vanadium (µg/g)	N total	17	17	17	17	17	17	49	49	9	9
	Mean	0.01	0.30	0.01	0.23	0.01	0.20	0.011	0.229	0.01	0.23
	Std. Dev.	0.00	0.07	0.00	0.08	0.00	0.10	0.005	0.107	0.02	0.33
	Min	0.01	0.18	0.00	0.08	0.00	0.06	0.0002	0.004	0.00	0.02
	Median	**0.01**	**0.29**	**0.01**	**0.23**	**0.01**	**0.19**	**0.013**	**0.260**	**0.01**	**0.13**
	Max	0.02	0.48	0.02	0.41	0.02	0.40	0.021	0.420	0.05	1.08
	P90	0.02	0.38	0.02	0.34	0.02	0.33	0.018	0.360	0.05	1.08
	P95	**0.02**	**0.48**	**0.02**	**0.41**	**0.02**	**0.40**	**0.020**	**0.400**	**0.05**	**1.08**
Zinc (µg/g)	N total	17	17	17	17	17	17	8	8	7	7
	Mean	0.12	2.35	0.08	1.66	0.06	1.17	0.001	0.024	0.016	0.317
	Std. Dev.	0.11	2.15	0.05	1.05	0.06	1.21	0.001	0.025	0.010	0.202
	Min	0.02	0.32	0.02	0.45	0.01	0.19	0.001	0.010	0.001	0.020
	Median	**0.07**	**1.48**	**0.08**	**1.53**	**0.04**	**0.76**	**0.001**	**0.016**	**0.014**	**0.280**
	Max	0.36	7.20	0.21	4.18	0.24	4.83	0.004	0.086	0.032	0.640
	P90	0.36	7.10	0.17	3.30	0.15	3.06	0.004	0.086	0.032	0.640
	P95	**0.36**	**7.20**	**0.21**	**4.18**	**0.24**	**4.83**	**0.004**	**0.086**	**0.032**	**0.640**

Table 4-5
Leach testing summary statistics shown as percentage of rock solids content for both 2001 EIS scoping level test work and 2017 test work

		2000 Stockpile C Acetic Acid / HAH	2000 Stockpile C De-Ionized Water	2000 Stockpile C Phosphoric Acid	2017 Stockpile C	2017 Stockpile C Original Pad	2017 Stockpile C Extension	2017 Stockpile C Expansion	Stockpile C All	2017 PII Core
Aluminum (%)	N total	14	17	10	49	10	4	35	90	9
	Mean	**0.0013**	**0.0160**	**0.0064**	**0.0501**	**0.029**	**0.008**	**0.061**	**0.0312**	**0.0025**
	Std. Dev.	0.0016	0.0094	0.0139	0.0393	0.041	0.009	0.036	0.0363	0.0029
	Min	0.0002	0.0032	0.0002	0.0000	0.000	0.001	0.007	0.0000	0.0002
	Median	**0.0009**	**0.0142**	**0.0014**	**0.0504**	**0.006**	**0.005**	**0.055**	**0.0151**	**0.0012**
	Max	0.0064	0.0454	0.0455	0.1676	0.103	0.021	0.168	0.1676	0.0083
	P90	0.0024	0.0267	0.0256	0.0929	0.091	0.021	0.093	0.0809	0.0083
	P95	**0.0064**	**0.0454**	**0.0455**	**0.1109**	**0.103**	**0.021**	**0.159**	**0.0929**	**0.0083**
Arsenic (%)	N total	17	17	17	49	10	4	35	100	9
	Mean	**1.35**	**1.97**	**11.93**	**3.56**	**2.72**	**15.42**	**2.45**	**4.34**	**5.50**
	Std. Dev.	1.22	2.18	8.39	5.59	2.97	10.00	3.86	6.34	3.33
	Min	0.22	0.19	1.72	0.04	0.19	5.76	0.04	0.04	1.20
	Median	**0.90**	**1.21**	**10.88**	**1.50**	**1.84**	**13.80**	**1.36**	**1.81**	**4.79**
	Max	4.88	8.69	33.42	28.31	9.89	28.31	23.32	33.42	9.92
	P90	3.60	4.09	25.00	9.59	7.53	28.31	3.75	11.92	9.92
	P95	**4.88**	**8.69**	**33.42**	**18.02**	**9.89**	**28.31**	**6.36**	**19.74**	**9.92**
Barium (%)	N total	17	17	17	49	10	2	35	100	9
	Mean	**1.41**	**1.01**	**0.36**	**0.28**	**0.25**	**0.07**	**0.26**	**0.61**	**4.84**
	Std. Dev.	0.49	0.44	0.18	0.27	0.22	0.03	0.22	0.56	7.82
	Min	0.49	0.13	0.10	0.02	0.02	0.05	0.06	0.02	0.01
	Median	**1.44**	**0.89**	**0.36**	**0.21**	**0.23**	**0.07**	**0.21**	**0.36**	**1.37**
	Max	2.41	1.91	0.71	1.42	0.70	0.09	1.13	2.41	18.57
	P90	2.18	1.75	0.68	0.53	0.60	0.09	0.53	1.45	18.57
	P95	**2.41**	**1.91**	**0.71**	**0.87**	**0.70**	**0.09**	**0.87**	**1.77**	**18.57**

		2000 Stockpile C Acetic Acid / HAH	2000 Stockpile C De-Ionized Water	2000 Stockpile C Phosphoric Acid	2017 Stockpile C	2017 Stockpile C Original Pad	2017 Stockpile C Extension	2017 Stockpile C Expansion	Stockpile C All	2017 PII Core
Calcium (%)	N total	17	17	17	49	10	4	35	100	9
	Mean	**21.55**	**12.29**	**16.18**	**11.43**	**19.5**	**9.1**	**9.4**	**14.10**	**5.45**
	Std. Dev.	3.94	3.93	6.43	8.84	16.1	2.3	4.2	7.99	3.97
	Min	13.38	6.17	6.55	2.54	2.5	5.7	4.7	2.54	1.67
	Median	**22.61**	**12.75**	**15.26**	**9.57**	**13.9**	**9.8**	**9.2**	**12.20**	**4.67**
	Max	26.65	18.46	26.69	50.59	50.6	11.0	28.7	50.59	14.44
	P90	25.88	16.70	23.88	18.78	46.0	11.0	12.6	23.85	14.44
	P95	**26.65**	**18.46**	**26.69**	**30.14**	**50.6**	**11.0**	**13.5**	**26.67**	**14.44**
Cobalt (%)	N total	17	17	17	33	8	4	21	84	9
	Mean	**2.58**	**1.95**	**2.01**	**0.08**	**0.27**	**0.01**	**0.03**	**1.35**	**0.06**
	Std. Dev.	2.24	1.28	1.61	0.33	0.68	0.00	0.02	1.71	0.04
	Min	0.27	0.33	0.28	0.00	0.00	0.00	0.00	0.00	0.02
	Median	**2.04**	**1.58**	**1.30**	**0.02**	**0.03**	**0.01**	**0.02**	**0.90**	**0.05**
	Max	8.95	5.69	4.96	1.94	1.94	0.01	0.08	8.95	0.13
	P90	5.71	3.99	4.87	0.06	1.94	0.01	0.06	3.99	0.13
	P95	**8.95**	**5.69**	**4.96**	**0.08**	**1.94**	**0.01**	**0.07**	**4.96**	**0.13**
Chromium (%)	N total	9	15	15	44	5	4	35	83	2
	Mean	**0.036**	**0.037**	**0.050**	**0.092**	**0.093**	**0.059**	**0.096**	**0.068**	**0.014**
	Std. Dev.	0.024	0.021	0.023	0.061	0.094	0.035	0.058	0.053	0.005
	Min	0.012	0.013	0.013	0.012	0.012	0.023	0.017	0.012	0.010
	Median	**0.025**	**0.033**	**0.048**	**0.079**	**0.060**	**0.058**	**0.083**	**0.057**	**0.014**
	Max	0.076	0.086	0.108	0.243	0.229	0.098	0.243	0.243	0.018
	P90	0.076	0.062	0.085	0.167	0.229	0.098	0.167	0.142	0.018
	P95	**0.076**	**0.086**	**0.108**	**0.224**	**0.229**	**0.098**	**0.224**	**0.167**	**0.018**
Copper (%)	N total	17	17	17	27	10	2	14	78	8
	Mean	**0.894**	**1.028**	**0.801**	**0.107**	**0.121**	**0.107**	**0.098**	**0.631**	**0.063**
	Std. Dev.	0.638	0.961	1.163	0.084	0.113	0.000	0.071	0.844	0.042
	Min	0.078	0.091	0.130	0.008	0.008	0.107	0.015	0.008	0.013
	Median	**0.748**	**0.888**	**0.590**	**0.096**	**0.095**	**0.107**	**0.068**	**0.381**	**0.045**
	Max	2.224	4.042	5.229	0.377	0.377	0.107	0.219	5.229	0.129
	P90	1.945	2.334	0.903	0.219	0.309	0.107	0.200	1.343	0.129
	P95	**2.224**	**4.042**	**5.229**	**0.240**	**0.377**	**0.107**	**0.219**	**2.224**	**0.129**

		2000 Stockpile C Acetic Acid / HAH	2000 Stockpile C De-Ionized Water	2000 Stockpile C Phosphoric Acid	2017 Stockpile C	2017 Stockpile C Original Pad	2017 Stockpile C Extension	2017 Stockpile C Expansion	Stockpile C All	2017 PII Core
Iron (%)	N total	17	17	17	38	8	3	27	89	9
	Mean	**0.075**	**0.117**	**0.030**	**0.002**	**0.0067**	**0.00010**	**0.001**	**0.043**	**0.003**
	Std. Dev.	0.026	0.059	0.082	0.008	0.0173	0.00007	0.001	0.063	0.003
	Min	0.044	0.036	0.001	0.000	0.0001	0.00006	0.000	0.000	0.000
	Median	**0.068**	**0.108**	**0.013**	**0.001**	**0.0004**	**0.00006**	**0.001**	**0.012**	**0.001**
	Max	0.146	0.301	0.348	0.049	0.0495	0.00018	0.007	0.348	0.009
	P90	0.112	0.163	0.021	0.002	0.0495	0.00018	0.002	0.131	0.009
	P95	**0.146**	**0.301**	**0.348**	**0.007**	**0.049**	**0.00018**	**0.003**	**0.146**	**0.009**
Potassium (%)	N total	17	17	17	49	10	35	4	65	9
	Mean	**0.818**	**0.396**	**0.674**	**1.556**	**1.404**	**1.655**	**1.075**	**0.541**	**0.647**
	Std. Dev.	0.168	0.091	0.284	0.634	0.780	0.601	0.131	0.326	0.148
	Min	0.625	0.222	0.225	0.508	0.508	1.190	0.880	0.006	0.481
	Median	**0.776**	**0.418**	**0.779**	**1.379**	**1.169**	**1.587**	**1.127**	**0.509**	**0.623**
	Max	1.324	0.539	1.085	4.706	3.200	4.706	1.164	1.324	0.958
	P90	1.022	0.509	0.951	2.087	2.643	1.982	1.164	0.916	0.958
	P95	**1.324**	**0.539**	**1.085**	**2.333**	**3.200**	**2.333**	**1.164**	**1.022**	**0.958**
Magnesium (%)	N total	17	17	17	14	9	3	2	65	9
	Mean	**0.251**	**0.914**	**0.283**	**0.220**	**0.334**	**0.018**	**0.007**	**0.426**	**0.314**
	Std. Dev.	0.046	3.051	0.073	0.343	0.388	0.010	0.001	1.562	0.177
	Min	0.187	0.063	0.147	0.006	0.008	0.007	0.006	0.006	0.067
	Median	**0.246**	**0.172**	**0.305**	**0.021**	**0.277**	**0.021**	**0.007**	**0.230**	**0.333**
	Max	0.354	12.751	0.417	1.141	1.141	0.026	0.008	12.751	0.639
	P90	0.326	0.286	0.346	0.671	1.141	0.026	0.008	0.354	0.639
	P95	**0.354**	**12.751**	**0.417**	**1.141**	**1.141**	**0.026**	**0.008**	**0.441**	**0.639**
Manganese (%)	N total	17	17	17	4	4	0	0	55	7
	Mean	**2.000**	**1.733**	**1.488**	**0.468**	**0.468**	**--**	**--**	**1.647**	**0.094**
	Std. Dev.	0.401	0.552	0.605	0.822	0.822	--	--	0.661	0.094
	Min	1.283	0.429	0.547	0.033	0.033	--	--	0.033	0.009
	Median	**1.927**	**1.877**	**1.490**	**0.070**	**0.070**	**--**	**--**	**1.738**	**0.075**
	Max	3.005	2.558	2.765	1.700	1.700	--	--	3.005	0.256
	P90	2.550	2.397	2.136	1.700	1.700	--	--	2.336	0.256
	P95	**3.005**	**2.558**	**2.765**	**1.700**	**1.700**	**--**	**--**	**2.558**	**0.256**

		2000 Stockpile C Acetic Acid / HAH	2000 Stockpile C De-Ionized Water	2000 Stockpile C Phosphoric Acid	2017 Stockpile C	2017 Stockpile C Original Pad	2017 Stockpile C Extension	2017 Stockpile C Expansion	Stockpile C All	2017 PII Core
Molybdenum (%)	N total	17	17	17	49	10	4	35	100	9
	Mean	**8.5**	**5.9**	**13.0**	**15.5**	**12.9**	**12.1**	**16.7**	**12.3**	**16.3**
	Std. Dev.	5.4	3.6	15.7	9.8	9.4	8.1	10.1	10.4	9.3
	Min	2.2	1.9	1.3	2.3	2.3	6.5	5.5	1.3	1.8
	Median	**6.7**	**4.5**	**7.9**	**12.4**	**11.5**	**9.0**	**12.4**	**8.7**	**16.2**
	Max	18.8	13.8	64.9	47.0	35.9	23.9	47.0	64.9	33.3
	P90	17.5	13.2	37.5	29.0	27.3	23.9	29.0	23.6	33.3
	P95	**18.8**	**13.8**	**64.9**	**35.9**	**35.9**	**23.9**	**44.5**	**33.2**	**33.3**
Sodium (%)	N total	17	17	17	49	10	4	35	100	9
	Mean	**5.1**	**5.9**	**7.9**	**47.6**	**40.1**	**41.8**	**50.4**	**26.5**	**512**
	Std. Dev.	2.3	14.3	16.8	15.2	26.0	8.9	10.6	24.9	570
	Min	1.6	1.0	1.7	8.5	8.5	34.3	30.3	1.0	98
	Median	**4.6**	**2.4**	**4.0**	**47.3**	**32.3**	**39.2**	**50.3**	**18.5**	**387**
	Max	10.8	61.2	72.8	104.6	104.6	54.3	90.0	104.6	1,909
	P90	9.0	4.2	7.0	61.7	80.9	54.3	61.7	56.4	1,909
	P95	**10.8**	**61.2**	**72.8**	**64.4**	**104.6**	**54.3**	**64.4**	**62.7**	**1,909**
Nickel (%)	N total	17	17	17	40	10	4	26	91	9
	Mean	**1.68**	**1.19**	**1.52**	**0.09**	**0.28**	**0.01**	**0.02**	**0.86**	**0.071**
	Std. Dev.	1.59	0.93	1.10	0.40	0.80	0.00	0.06	1.18	0.076
	Min	0.27	0.25	0.28	0.00	0.00	0.00	0.00	0.00	0.014
	Median	**1.18**	**0.93**	**1.25**	**0.01**	**0.03**	**0.01**	**0.01**	**0.43**	**0.030**
	Max	5.83	3.77	3.52	2.55	2.55	0.01	0.29	5.83	0.22
	P90	4.88	2.91	3.32	0.06	1.31	0.01	0.03	2.55	0.22
	P95	**5.83**	**3.77**	**3.52**	**0.18**	**2.55**	**0.01**	**0.04**	**3.32**	**0.22**
Lead (%)	N total	8	15	1	1	0	0	1	25	3
	Mean	**0.28**	**0.89**	**3.40**	**0.02**	**--**	**--**	**0.021**	**0.76**	**0.047**
	Std. Dev.	0.12	1.65	--	--	--	--	--	1.41	0.026
	Min	0.15	0.08	3.40	0.02	--	--	0.021	0.02	0.022
	Median	**0.27**	**0.35**	**3.40**	**0.02**	**--**	**--**	**0.021**	**0.35**	**0.046**
	Max	0.45	6.62	3.40	0.02	--	--	0.021	6.62	0.074
	P90	0.45	1.78	--	--	--	--	--	1.78	0.074
	P95	**0.45**	**6.62**	--	--	**--**	**--**	--	**3.40**	**0.074**

		2000 Stockpile C Acetic Acid / HAH	2000 Stockpile C De-Ionized Water	2000 Stockpile C Phosphoric Acid	2017 Stockpile C	2017 Stockpile C Original Pad	2017 Stockpile C Extension	2017 Stockpile C Expansion	Stockpile C All	2017 PII Core
226Ra (%)	N total	0	0	0	38	9	2	27	38	9
	Mean	--	--	--	**0.26**	**0.39**	**0.18**	**0.23**	**0.26**	**0.17**
	Std. Dev.	--	--	--	0.25	0.39	0.06	0.19	0.25	0.10
	Min	--	--	--	0.04	0.06	0.14	0.04	0.04	0.041
	Median	--	--	--	**0.19**	**0.27**	**0.18**	**0.18**	**0.19**	**0.15**
	Max	--	--	--	1.29	1.29	0.23	1.00	1.29	0.31
	P90	--	--	--	0.55	1.29	0.23	0.44	0.55	0.31
	P95	--	--	--	**1.00**	**1.29**	**0.23**	**0.55**	**1.00**	**0.31**
Sulphate (%)	N total	17	17	17	49	10	4	35	100	9
	Mean	**12.0**	**6.5**	**10.8**	**48.5**	**52.3**	**16.7**	**51.1**	**28.8**	**6.6**
	Std. Dev.	10.9	5.2	9.9	33.8	37.5	6.3	33.3	31.3	5.6
	Min	3.0	1.3	0.7	9.2	11.0	9.2	14.0	0.7	2.3
	Median	**7.8**	**4.6**	**7.5**	**33.9**	**46.7**	**17.1**	**34.6**	**18.0**	**3.9**
	Max	44.6	18.1	32.9	134.8	134.8	23.2	125.0	134.8	20.0
	P90	29.6	17.6	32.2	105.0	106.4	23.2	105.0	80.5	20.0
	P95	**44.6**	**18.1**	**32.9**	**122.2**	**134.8**	**23.2**	**122.2**	**100.0**	**20.0**
Selenium (%)	N total	0	0	0	49	10	4	35	49	9
	Mean	--	--	--	**4.75**	**3.50**	**3.09**	**5.29**	**4.75**	**5.25**
	Std. Dev.	--	--	--	3.33	3.24	0.86	3.42	3.33	3.89
	Min	--	--	--	0.50	0.50	2.50	1.25	0.50	0.92
	Median	--	--	--	**4.00**	**3.05**	**2.76**	**4.00**	**4.00**	**4.65**
	Max	--	--	--	17.00	12.00	4.36	17.00	17.00	10.46
	P90	--	--	--	9.00	8.17	4.36	9.00	9.00	10.46
	P95	--	--	--	**12.00**	**12.00**	**4.36**	**13.43**	**12.00**	**10.46**
Strontium (%)	N total	17	17	17	49	10	4	35	100	9
	Mean	**12.13**	**6.05**	**7.98**	**9.80**	**11.50**	**6.43**	**9.70**	**9.25**	**2.85**
	Std. Dev.	2.18	1.65	3.14	4.31	7.75	1.38	2.82	3.93	2.05
	Min	6.74	3.70	2.61	2.11	2.11	5.11	2.50	2.11	0.40
	Median	**12.36**	**6.20**	**8.93**	**9.11**	**9.06**	**6.12**	**9.52**	**9.06**	**2.79**
	Max	15.56	8.13	12.19	27.37	27.37	8.37	16.47	27.37	7.08
	P90	14.26	8.06	11.89	15.64	24.36	8.37	13.75	13.83	7.08
	P95	**15.56**	**8.13**	**12.19**	**16.47**	**27.37**	**8.37**	**15.64**	**15.60**	**7.08**

		2000 Stockpile C Acetic Acid / HAH	2000 Stockpile C De-Ionized Water	2000 Stockpile C Phosphoric Acid	2017 Stockpile C	2017 Stockpile C Original Pad	2017 Stockpile C Extension	2017 Stockpile C Expansion	Stockpile C All	2017 PII Core
Uranium (%)	N total	0	0	0	10	6	2	2	10	4
	Mean	--	--	--	**0.213**	**0.305**	**0.090**	**0.057**	**0.213**	**0.267**
	Std. Dev.	--	--	--	0.277	0.333	0.023	0.064	0.277	0.300
	Min	--	--	--	0.012	0.047	0.074	0.012	0.012	0.046
	Median	--	--	--	**0.105**	**0.166**	**0.090**	**0.057**	**0.105**	**0.157**
	Max	--	--	--	0.915	0.915	0.107	0.103	0.915	0.709
	P90	--	--	--	0.689	0.915	0.107	0.103	0.689	0.709
	P95	--	--	--	**0.915**	**0.915**	**0.107**	**0.103**	**0.915**	**0.709**
Vanadium (%)	N total	17	17	17	49	10	4	35	100	9
	Mean	**0.60**	**0.47**	**0.40**	**0.29**	**0.15**	**0.27**	**0.33**	**0.39**	**0.060**
	Std. Dev.	0.29	0.25	0.27	0.16	0.17	0.13	0.15	0.25	0.042
	Min	0.24	0.09	0.09	0.00	0.00	0.13	0.03	0.0046	0.018
	Median	**0.59**	**0.39**	**0.38**	**0.29**	**0.09**	**0.27**	**0.32**	**0.35**	**0.056**
	Max	1.27	1.05	1.23	0.78	0.51	0.40	0.78	1.27	0.15
	P90	1.10	0.86	0.60	0.49	0.41	0.40	0.49	0.69	0.15
	P95	**1.27**	**1.05**	**1.23**	**0.51**	**0.51**	**0.40**	**0.68**	**0.85**	**0.15**
Zinc (%)	N total	17	17	17	8	4	0	4	59	7
	Mean	**5.88**	**4.61**	**3.23**	**0.10**	**0.10**	**--**	**0.11**	**3.97**	**1.73**
	Std. Dev.	4.42	2.16	3.01	0.07	0.02	--	0.11	3.55	1.14
	Min	2.23	2.49	0.60	0.05	0.08	--	0.045	0.045	0.065
	Median	**4.12**	**4.26**	**2.55**	**0.08**	**0.09**	**--**	**0.07**	**3.35**	**1.61**
	Max	20.17	11.88	13.73	0.27	0.13	--	0.27	20.17	3.76
	P90	9.70	6.62	5.43	0.27	0.13	--	0.27	8.06	3.76
	P95	**20.17**	**11.88**	**13.73**	**0.27**	**0.13**	**--**	**0.27**	**11.88**	**3.76**

Table 4-6
Porewater predictions for Stockpile C, remaining Phase I and Phase II waste rock

Parameter	Data Analysis Method	Mean Solids Concentration			Porewater Concentration - Linear Fitting (y = 0 + b*x)					Porewater Concentration - Power Fitting (y = a*x^b)				
		Stockpile C	Phase I	Phase II	Equation	R2	Stockpile C	Phase I	Phase II	Equation	R2	Stockpile C	Phase I	Phase II
		(µg/g) / (Bq/g)	(µg/g) / (Bq/g)	(µg/g) / (Bq/g)			(mg/L) / (Bq/L)	(mg/L) / (Bq/L)	(mg/L) / (Bq/L)			(mg/L) / (Bq/L)	(mg/L) / (Bq/L)	(mg/L) / (Bq/L)
As	Total Load Summary	99.6	277	203	y=0.0494x	0.458	4.92	13.68	10.03	y=0.694x^0.58	10.009	9.55	18.11	15.13
	P/W Recalculation				y=0.00893x	0.862	0.890	2.474	1.813	y=0.000835x^1.38	0.478	0.480	1.960	1.277
Cd	Total Load Summary	0.14	0.14	0.15	y=0.0203x	0.743	2.84E-03	2.84E-03	3.05E-03	y=0.0177x^0.363	0.051	8.67E-03	8.67E-03	8.89E-03
	P/W Recalculation				y=0.0217x	0.625	3.04E-03	3.04E-03	3.26E-03	y=0.0245x^1.83	0.339	6.71E-04	6.71E-04	7.61E-04
Co	Total Load Summary	47.0	24.6	33.0	y=0.0901x	0.513	4.23	2.22	2.97	y=9.06E-17x^7.02	0.951	5.03E-05	5.33E-07	4.20E-06
	P/W Recalculation				y=0.0469x	0.515	2.20	1.15	1.55	y=6.18E-18x^7.37	0.960	1.31E-05	1.11E-07	9.67E-07
Cu	Total Load Summary	29.5	21.9	48.8	y=0.00119x	0.864	0.0351	0.0261	0.0581	y=0.00199x^0.862	0.491	0.0368	0.0291	0.0571
	P/W Recalculation				y=0.000206x	0.580	6.08E-03	4.51E-03	1.01E-02	y=0.0216x^-0.263	0.055	8.87E-03	9.59E-03	7.77E-03
Mo	Total Load Summary	6.5	22.6	7.0	y=0.508x	0.554	3.30	11.47	3.55	y=0.318x^1.16	0.231	2.79	11.84	3.04
	P/W Recalculation				y=0.367x	0.187	2.39	8.29	2.57	y=1.77x^0.467	0.023	4.23	7.57	4.38
Ni	Total Load Summary	90.0	217	104	y=0.0555x	0.256	5.00	12.04	5.77	y=7.26E-18x^7.54	0.218	3.94E-03	3.00	0.01
	P/W Recalculation				y=0.0282x	0.252	2.54	6.12	2.93	y=9.22E-23x^9.42	0.264	2.36E-04	0.94	0.00
Pb	Total Load Summary	22.7	30	81	y=0.00302x	0.533	0.0695	0.0906	0.245	y=0.165x^-0.0404	0.001	0.145	0.144	0.138
	P/W Recalculation				y=0.000822x	0.661	0.0189	0.0247	0.067	y=0.00595x^0.503	0.073	0.0288	0.0329	0.054
^{226}Ra	Total Load Summary	0.181	0.86	0.52	y=6.76x	0.630	1.22	5.81	3.52	y=129x^3.78	0.737	0.202	72.94	10.89
	P/W Recalculation				y=2.25x	0.315	0.407	1.935	1.170	y=0.359x^-0.368	0.005	0.673	0.379	0.457
Se	Total Load Summary	1.00	7.0	2.2	y=0.176x	0.350	0.177	1.225	0.387	y=4.21E-7x^11.1	0.698	4.42E-07	948.953	2.66E-03
	P/W Recalculation				y=0.0324x	0.338	0.0325	0.2255	0.0713	y=2.72E-10x^15.2	0.677	2.90E-10	1746.7443	4.36E-05
U	Total Load Summary	10.0	17.0	10.4	y=0.0430x	0.326	0.431	0.729	0.447	y=0.852x^-0.0969	0.001	0.681	0.648	0.679
	P/W Recalculation				y=0.0202x	0.364	0.203	0.343	0.210	y=0.0661x^0.576	0.025	0.249	0.338	0.255
V	Total Load Summary	82.1	254	55.0	y=0.000556x	0.777	0.0457	0.1411	0.0306	y=0.0327x^0.187	0.009	0.0746	0.0921	0.0692
	P/W Recalculation				y=0.000232x	0.823	0.0191	0.0589	0.0128	y=0.00309x^0.485	0.077	0.0262	0.0453	0.0216
Zn	Total Load Summary	29.2	38.1	19.4	y=0.00315x	0.330	0.0918	0.1200	0.0611	y=0.309x^-0.152	0.013	0.185	0.1777	0.1969
	P/W Recalculation				y=0.00161x	0.448	0.0469	0.0613	0.0312	y=0.00387x^0.786	0.090	0.0548	0.0677	0.0398

Table 5-1A
Pearson element correlations for Stockpile C original pad underdrain samples at pH>7 (Station 2.4-2)

	N		Ca	Al	As	Cu	Fe	Mo	Ni	Pb	Se	U	V	Zn	^{226}Ra	SO_4
Ca	24	Pearson Corr.	1.00													
		p-value	--													
Al	24	Pearson Corr.	0.11	1.00												
		p-value	0.611	--												
As	28	Pearson Corr.	-0.51	-0.07	1.00											
		p-value	0.011	0.740	--											
Cu	29	Pearson Corr.	0.01	0.41	-0.22	1.00										
		p-value	0.975	0.045	0.255	--										
Fe	22	Pearson Corr.	0.67	0.43	-0.09	0.28	1.00									
		p-value	5.70E-04	0.046	0.698	0.202	--									
Mo	26	Pearson Corr.	-0.21	0.67	0.25	0.47	-0.11	1.00								
		p-value	0.322	3.73E-04	0.235	0.014	0.640	--								
Ni	27	Pearson Corr.	0.89	0.23	-0.19	0.01	0.87	-0.14	1.00							
		p-value	1.27E-08	0.290	0.338	0.953	1.54E-07	0.502	--							
Pb	30	Pearson Corr.	-0.01	0.67	-0.28	0.67	0.15	0.73	-0.09	1.00						
		p-value	0.956	3.55E-04	0.153	7.06E-05	0.508	2.66E-05	0.662	--						
Se	24	Pearson Corr.	0.43	-0.04	-0.15	0.04	0.17	0.07	0.35	-0.24	1.00					
		p-value	0.037	0.836	0.498	0.862	0.458	0.762	0.105	0.257	--					
U	23	Pearson Corr.	0.45	-0.16	-0.36	-0.19	0.52	-0.42	0.42	-0.09	0.06	1.00				
		p-value	0.032	0.454	0.094	0.394	0.014	0.048	0.050	0.692	0.803	--				
V	24	Pearson Corr.	0.02	0.28	-0.25	-0.12	-0.22	0.04	-0.12	0.28	-0.20	-0.17	1.00			
		p-value	0.912	0.182	0.246	0.575	0.329	0.854	0.591	0.190	0.348	0.432	--			
Zn	30	Pearson Corr.	0.59	0.11	0.11	0.01	0.80	-0.19	0.77	-0.11	0.09	0.30	-0.09	1.00		
		p-value	2.23E-03	0.619	0.567	0.974	8.76E-06	0.365	2.57E-06	0.564	0.688	0.172	0.688	--		
^{226}Ra	30	Pearson Corr.	0.01	-0.24	-0.38	0.08	0.00	-0.34	-0.13	-0.11	-0.06	0.25	-0.06	-0.17	1.00	
		p-value	0.948	0.264	0.044	0.674	0.985	0.095	0.502	0.582	0.781	0.249	0.778	0.387	--	
SO_4	25	Pearson Corr.	0.93	-0.03	-0.27	-0.12	0.69	-0.25	0.89	-0.20	0.57	0.42	-0.13	0.60	-0.10	1.00
		p-value	2.31E-11	0.903	0.200	0.583	4.33E-04	0.226	4.74E-09	0.345	3.61E-03	0.044	0.550	1.69E-03	0.651	--

Table 5-1B
Pearson element correlations for Stockpile C original pad underdrain samples at pH<7 (Station 2.4-2)

	N		Ca	Al	As	Cu	Fe	Mo	Ni	Pb	Se	U	V	Zn	^{226}Ra	SO_4
Ca	11	Pearson Corr.	1.00													
		p-value	--													
Al	11	Pearson Corr.	0.45	1.00												
		p-value	0.161	--												
As	11	Pearson Corr.	-0.04	0.57	1.00											
		p-value	0.908	0.065	--											
Cu	10	Pearson Corr.	0.73	0.97	0.61	1.00										
		p-value	0.017	5.08E-06	0.060	--										
Fe	11	Pearson Corr.	-0.18	0.61	0.84	0.78	1.00									
		p-value	0.586	0.046	1.12E-03	7.50E-03	--									
Mo	11	Pearson Corr.	0.88	0.18	-0.16	-0.29	-0.38	1.00								
		p-value	3.14E-04	0.587	0.648	0.425	0.248	--								
Ni	11	Pearson Corr.	0.64	0.95	0.46	0.92	0.43	0.45	1.00							
		p-value	0.032	1.05E-05	0.156	1.28E-04	0.185	0.160	--							
Pb	11	Pearson Corr.	-0.33	-0.34	-0.27	-0.40	-0.12	-0.09	-0.33	1.00						
		p-value	0.326	0.306	0.420	0.246	0.728	0.785	0.316	--						
Se	11	Pearson Corr.	0.88	0.20	-0.15	0.11	-0.34	1.00	0.47	-0.07	1.00					
		p-value	3.10E-04	0.557	0.662	0.758	0.300	2.41E-11	0.143	0.840	--					
U	11	Pearson Corr.	0.31	0.83	0.40	0.93	0.53	-0.12	0.66	-0.42	-0.11	1.00				
		p-value	0.354	1.51E-03	0.229	1.06E-04	0.091	0.732	0.026	0.197	0.746	--				
V	11	Pearson Corr.	-0.31	-0.30	-0.09	-0.35	-0.19	-0.14	-0.36	0.76	-0.16	-0.30	1.00			
		p-value	0.348	0.376	0.797	0.317	0.578	0.689	0.280	6.32E-03	0.639	0.368	--			
Zn	11	Pearson Corr.	0.91	0.32	-0.08	0.90	-0.27	0.99	0.57	-0.13	0.99	0.00	-0.18	1.00		
		p-value	1.10E-04	0.336	0.816	4.36E-04	0.415	1.05E-08	0.065	0.706	8.61E-09	0.996	0.600	--		
^{226}Ra	11	Pearson Corr.	0.21	0.50	0.42	0.49	0.32	0.22	0.42	0.10	0.20	0.34	0.37	0.29	1.00	
		p-value	0.543	0.121	0.199	0.151	0.343	0.525	0.196	0.762	0.559	0.305	0.263	0.385	--	
SO_4	11	Pearson Corr.	0.95	0.69	0.18	0.95	0.07	0.79	0.84	-0.38	0.80	0.49	-0.37	0.86	0.32	1.00
		p-value	5.11E-06	0.018	0.603	3.23E-05	0.848	3.65E-03	1.22E-03	0.250	3.16E-03	0.128	0.257	7.41E-04	0.332	--

Table 5-1C
Pearson element correlations for Stockpile C extension are underdrain samples (Station 2.4-3)

	N		Ca	Al	As	Cu	Fe	Mo	Ni	Pb	Se	U	V	Zn	^{226}Ra	SO_4
Ca	20	Pearson Corr.	1.00													
		p-value	--													
Al	20	Pearson Corr.	0.17	1.00												
		p-value	0.461	--												
As	20	Pearson Corr.	0.54	0.11	1.00											
		p-value	0.013	0.652	--											
Cu	20	Pearson Corr.	-0.16	0.31	-0.18	1.00										
		p-value	0.512	0.187	0.442	--										
Fe	20	Pearson Corr.	0.20	0.91	0.28	0.18	1.00									
		p-value	0.390	3.98E-08	0.237	0.456	--									
Mo	20	Pearson Corr.	0.35	-0.21	0.29	-0.19	-0.23	1.00								
		p-value	0.136	0.364	0.219	0.415	0.322	--								
Ni	20	Pearson Corr.	0.18	0.50	0.29	0.06	0.76	-0.20	1.00							
		p-value	0.439	0.024	0.207	0.806	8.77E-05	0.398	--							
Pb	20	Pearson Corr.	-0.22	-0.05	-0.13	0.74	-0.07	0.15	0.06	1.00						
		p-value	0.361	0.835	0.590	1.67E-04	0.771	0.516	0.807	--						
Se	20	Pearson Corr.	0.10	-0.31	0.16	-0.04	-0.30	0.63	-0.28	0.21	1.00					
		p-value	0.678	0.177	0.492	0.851	0.194	2.99E-03	0.224	0.364	--					
U	20	Pearson Corr.	0.17	0.55	0.31	0.29	0.57	-0.42	0.37	0.11	-0.38	1.00				
		p-value	0.465	0.012	0.181	0.218	9.16E-03	0.067	0.107	0.655	0.095	--				
V	20	Pearson Corr.	-0.12	-0.13	0.25	0.12	-0.04	0.47	0.14	0.25	0.45	-0.05	1.00			
		p-value	0.618	0.589	0.279	0.607	0.879	0.035	0.550	0.279	0.047	0.821	--			
Zn	20	Pearson Corr.	0.19	0.57	0.27	0.12	0.82	-0.20	0.98	0.09	-0.27	0.41	0.10	1.00		
		p-value	0.423	8.95E-03	0.252	0.625	8.17E-06	0.396	6.49E-15	0.698	0.258	0.075	0.660	--		
^{226}Ra	20	Pearson Corr.	-0.11	-0.01	-0.14	0.80	-0.17	0.13	-0.22	0.75	-0.01	0.16	0.30	-0.19	1.00	
		p-value	0.659	0.970	0.560	2.43E-05	0.475	0.590	0.360	1.31E-04	0.950	0.499	0.194	0.428	--	
SO_4	20	Pearson Corr.	0.92	0.34	0.56	-0.32	0.41	0.15	0.35	-0.44	-0.02	0.33	-0.15	0.35	-0.36	1.00
		p-value	8.32E-09	0.147	0.010	0.169	0.075	0.536	0.130	0.051	0.941	0.157	0.530	0.126	0.124	--

Table 5-1D
Pearson element correlations for Stockpile C expansion are underdrain samples (Station 2.4-4)

	N		Ca	Al	As	Cu	Fe	Mo	Ni	Pb	Se	U	V	Zn	^{226}Ra	SO_4
Ca	28	Pearson Corr.	1.00													
		p-value	--													
Al	27	Pearson Corr.	-0.27	1.00												
		p-value	0.172	--												
As	27	Pearson Corr.	-0.24	0.00	1.00											
		p-value	0.226	0.983	--											
Cu	27	Pearson Corr.	-0.14	0.70	0.05	1.00										
		p-value	0.479	4.94E-05	0.809	--										
Fe	27	Pearson Corr.	-0.32	0.43	-0.21	0.45	1.00									
		p-value	0.103	0.026	0.289	0.018	--									
Mo	27	Pearson Corr.	-0.06	0.33	0.27	0.17	-0.04	1.00								
		p-value	0.783	0.091	0.175	0.399	0.844	--								
Ni	28	Pearson Corr.	-0.28	0.43	0.03	-0.02	0.27	0.38	1.00							
		p-value	0.160	0.026	0.874	0.939	0.178	0.053	--							
Pb	28	Pearson Corr.	-0.27	0.61	0.13	0.59	0.41	0.57	0.39	1.00						
		p-value	0.172	8.09E-04	0.512	1.27E-03	0.031	2.05E-03	0.038	--						
Se	27	Pearson Corr.	0.12	-0.10	-0.04	-0.01	-0.16	0.65	0.13	0.37	1.00					
		p-value	0.552	0.616	0.838	0.945	0.433	2.20E-04	0.516	0.056	--					
U	27	Pearson Corr.	-0.08	-0.14	-0.01	-0.16	-0.03	-0.02	0.36	-0.07	0.37	1.00				
		p-value	0.674	0.477	0.955	0.426	0.865	0.906	0.068	0.715	0.060	--				
V	28	Pearson Corr.	-0.06	0.69	-0.10	0.51	0.02	0.58	0.40	0.63	0.41	-0.01	1.00			
		p-value	0.748	6.71E-05	0.629	7.21E-03	0.941	1.55E-03	0.034	3.35E-04	0.032	0.970	--			
Zn	28	Pearson Corr.	-0.24	0.23	-0.19	0.38	0.62	0.20	0.20	0.43	0.24	0.05	0.13	1.00		
		p-value	0.236	0.243	0.335	0.048	5.36E-04	0.321	0.316	0.021	0.227	0.787	0.506	--		
^{226}Ra	27	Pearson Corr.	-0.05	0.59	-0.15	0.55	-0.06	-0.06	0.01	0.14	-0.06	0.08	0.61	-0.09	1.00	
		p-value	0.795	1.56E-03	0.456	3.74E-03	0.781	0.774	0.948	0.499	0.768	0.713	9.25E-04	0.651	--	
SO_4	28	Pearson Corr.	0.26	-0.01	0.02	0.03	-0.20	0.71	0.19	0.43	0.91	0.20	0.50	0.24	-0.05	1.00
		p-value	0.187	0.973	0.907	0.865	0.312	3.81E-05	0.333	0.025	4.63E-11	0.317	7.93E-03	0.223	0.802	--

Table 5-2
Stockpile C underdrain summary statistics for various areas and over time

		Mean	Median	Min	Max
2001	Original	10.7	10.7	3.8	18.2
2001	Extension	10.1	8.6	6.2	23.7
2017	Original	5.4	5.7	4.1	6.3
2017	Extension	6.3	6.2	3.4	9.5
2017	Expansion	8.3	7.8	4.3	15.2

Table 6-1
Summary of source term update predictions for Stockpile C, remaining Phase I rock and Phase II rock

COPC	**Solids Content**				**Percent Leachable (all)**			**Porewater Concentration**			
	2001 EIS	Stockpile C	Phase I (remaining)	Phase II	*2001 EIS*	Stockpile C	Phase II	*2001 EIS*	Current Work	Phase I (remaining)	Phase II
	µg/g	µg/g	µg/g	µg/g	*%*	%	%	*mg/L*	mg/L	mg/L	mg/L
Arsenic	*200*	100	277	203	*20*	4.34	5.50	*21*	9.6	18.1	15.1
Cadmium	--	0.14	0.14 [1]	0.15 [2]	--	n/a	n/a	--	0.0087	0.0087	0.0089
Cobalt	*84*	47	24.6	33.0	*1.0*	1.35	0.056	*0.3*	0.40	0.30	0.35
Copper	*25*	30	21.9	48.8 [2]	*0.2*	0.63	0.063	*0.003*	0.040	0.026	0.058
Molybdenum	*15*	6.5	22.6	7.0	*55*	12.3	16.3	*11*	3.3	11.5	3.6
Nickel	*111*	90	217	104	*1.5*	0.86	0.076	*0.25*	0.2	0.9	0.2
Lead	*23*	23	30	81 [2]	*0.3*	0.76	0.047	*0.004*	0.070	0.091	0.24
Radium-226	--	0.18 (Bq/g)	0.86 (Bq/g)	0.52 [2] (Bq/g)	--	0.26	0.17	--	1.2 (Bq/L)	5.8 (Bq/L)	3.5 (Bq/L)
Selenium	--	1.0	7.0	2.2	--	4.75	5.25	--	0.18	1.2	0.39
Uranium	*9.0*	10	17.0	10.4	--	0.21	0.27	*0.5*	0.43	0.73	0.45
Vanadium	--	29	254	55.0	--	0.39	0.06	--	0.046	0.14	0.031
Zinc	*40*	29	38.1	19.4 [2]	*1.0*	3.97	1.73	*0.006*	0.092	0.12	0.061

Note: Data for the 2001 EIS is provided for comparison.
[1] Assumed similar to Stockpile C
[2] Values from limited 2017 drilling data

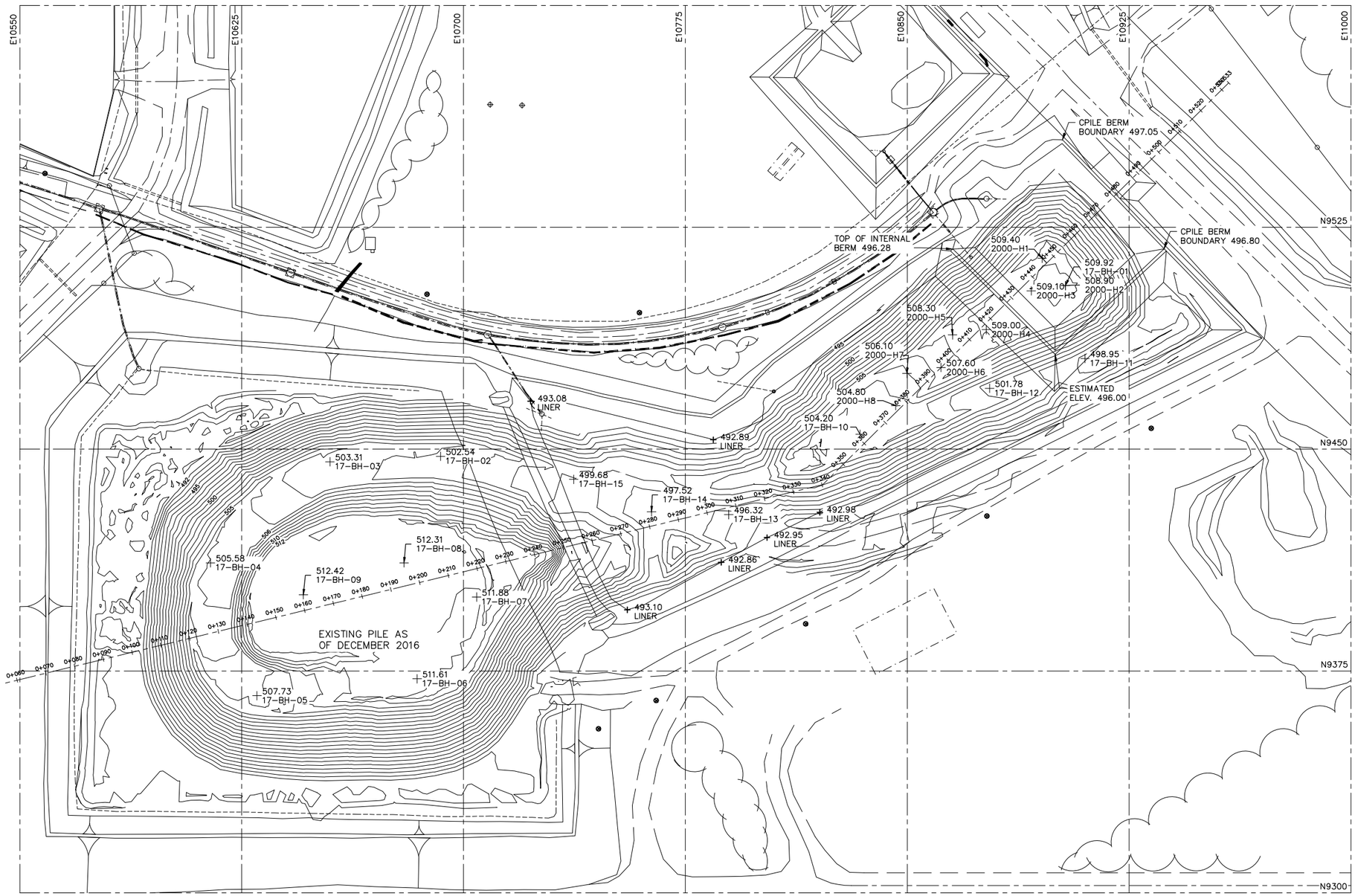
Table 6-2
Comparison of waste rock solids data to the potentially reactive waste rock agreement

			PRWR Agreement	Stockpile C			Phase I Remaining	Phase II [1]
				2001 EIS Data	2017 Drilling Data	All - Weighted		
Volume (2017)		m^3				361,500	77,700	175,000
Arsenic	Average	µg/g	200	180	100	100	**277**	**203**
	Median	µg/g	--	33	31	28	125	90
	Maximum	µg/g	10,000	1,590	2,020	2,020	4,940	**15,840**
Cobalt	Average	µg/g	84	**112**	42	47	25	33
	Median	µg/g	--	22	3.8	28	20	11
	Maximum	µg/g	5,000	655	330	655	50	561
Copper	Average	µg/g	25	**48**	**28**	**30**	22	**49**
	Median	µg/g	--	45	21	22	10	32
	Maximum	µg/g	2,000	115	130	130	140	150
Molybdenum	Average	µg/g	15	12	6.5	6.5	**23**	7.0
	Median	µg/g	--	6.0	3.9	3.9	20	4.4
	Maximum	µg/g	200	59	111	111	**380**	94
Nickel	Average	µg/g	111	**202**	77	90	**217**	104
	Median	µg/g	--	86	60	61	135	46
	Maximum	µg/g	5,000	1,220	638	1,220	3,400	**12,600**
Lead	Average	µg/g	23	**30**	21	23	**30**	**81**
	Median	µg/g	--	17	17	17	20	20
	Maximum	µg/g	2,000	254	130	254	230	990
Radium-226	Average	µg/g	0.10	--	**0.18**	**0.18**	**0.86**	**0.52**
	Median	µg/g	--	--	0.12	0.12	0.18	0.15
	Maximum	µg/g	1.0	--	0.83	0.83	**6.70**	**5.10**
Sulfur	Average	µg/g	14,000	9,850	6,702	6,501	**16,784**	8,759
	Median	µg/g	--	8,850	5,950	5,900	15,800	5,300
	Maximum	µg/g	200,000	23,100	29,000	29,000	55,500	78,400
Uranium	Average	µg/g	8.5	**24**	8.4	**10**	**17**	**10**
	Median	µg/g	--	8.0	6.0	6.0	4.2	8.5
	Maximum	µg/g	1,000	340	51	340	653	34
Zinc	Average	µg/g	40	36	27	29	38	19
	Median	µg/g	--	36	26	27	10	17
	Maximum	µg/g	300	89	73	89	**1,140**	37

Note: Values flagged in red exceed the PRWR by some degree.
[1] Cu, Pb, ^{226}Ra, and Zn are from a limited 2017 database.
Remainder of statistics from historical and current Phase II drill programs.

FIGURES

FIGURES



GENERAL NOTES:

1. THE GRID SYSTEM SHOWN IS CIGAR LAKE MINE GRID BASED ON UNIVERSAL TRANSVERSE MERCATOR (UTM) NORTH AMERICAN DATUM (NAD27):
   MINE GRID 10 000N IS UTM 6 436 473.500N
   MINE GRID 10 000E IS UTM 526 549.100E
2. ALL COORDINATES AND ELEVATIONS ARE SHOWN IN METRES AND DECIMALS THEREOF.
3. CONTOURS ARE SHOWN AT 1.0m INTERVALS.

	Mine Grid	
	Easting	Northing
2000-H1	10,895.60	9,514.50
2000-H2	10,903.50	9,505.30
2000-H3	10,891.90	9,503.50
2000-H4	10,876.70	9,490.40
2000-H5	10,865.30	9,488.60
2000-H6	10,861.40	9,477.60
2000-H7	10,849.90	9,475.60
2000-H8	10,846.10	9,464.70
17-BH-01	10903.50	9505.30
17-BH-02	10692.22	9447.57
17-BH-03	10654.82	9445.73
17-BH-04	10614.45	9411.58
17-BH-05	10630.17	9366.64
17-BH-06	10684.31	9372.37
17-BH-07	10704.41	9399.99
17-BH-08	10679.89	9411.57
17-BH-09	10645.86	9400.78
17-BH-10	10834.05	9455.02
17-BH-11	10910.07	9480.64
17-BH-12	10877.83	9470.55
17-BH-13	10789.64	9427.87
17-BH-14	10763.55	9428.85
17-BH-15	10737.23	9439.78

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10 0 10 30 50
METRES 1:750

REFERENCE

DWG No.	DESCRIPTION

REVISIONS

No.	DATE	DESCRIPTION	BY	CK	DESIGN LEAD	DESIGN AUTH.
B	03/13/18	FOR INFORMATION ONLY – UPDATED BOREHOLE INFO	MML			
A	04/04/17	FOR INFORMATION ONLY	MML			

REVISIONS

No.	DATE	DESCRIPTION	BY	CK	DESIGN LEAD	DESIGN AUTH.

Cameco

MANAGEMENT RELEASE:

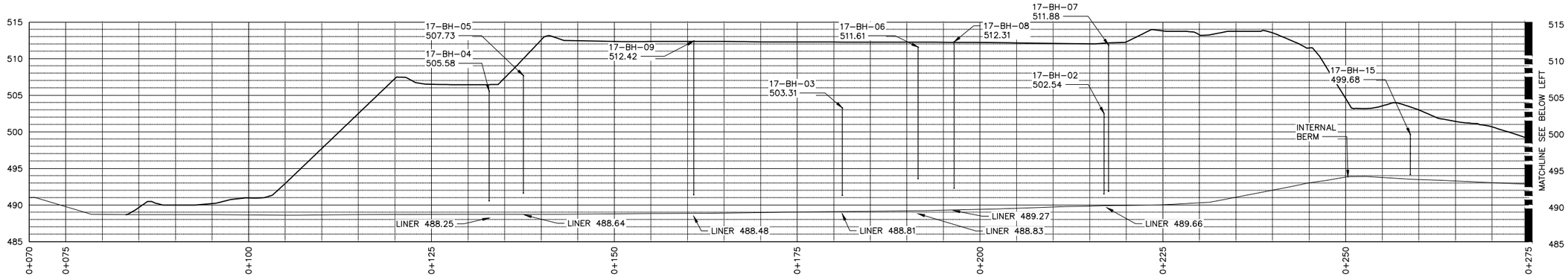
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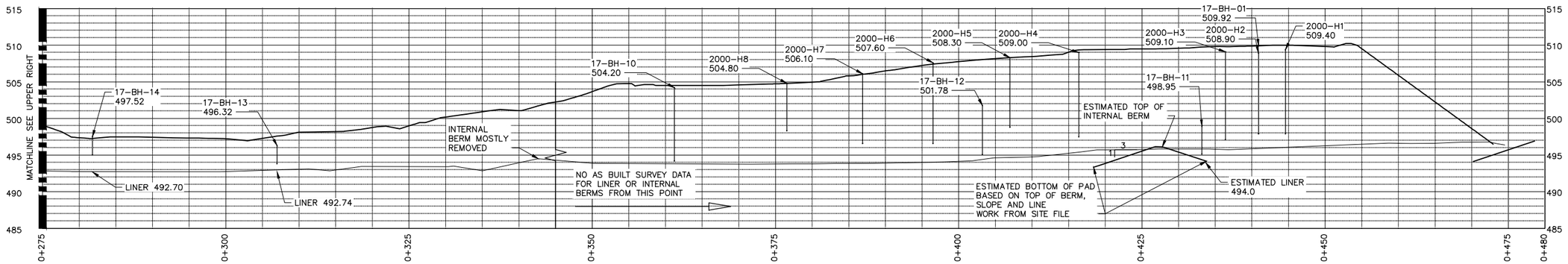
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AREA WASTE ROCK FACILITIES
TITLE WASTE ROCK STOCKPILE C
2017 BOREHOLE PROGRAM
PLAN
SKETCH

DWG. No. FIGURE 2-1 REV B

GENERAL NOTES:

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   MINE GRID 10 000N IS UTM 6 436 473.500N
   MINE GRID 10 000E IS UTM 526 549.100E
2. ALL COORDINATES AND ELEVATIONS ARE SHOWN IN METRES AND DECIMALS THEREOF.





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5 0 5 10 15 20 25
METRES 1:300

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DESIGN AUTH. APPROVAL:		MM/DD/YY

LOC. **CIGAR LAKE PROJECT**

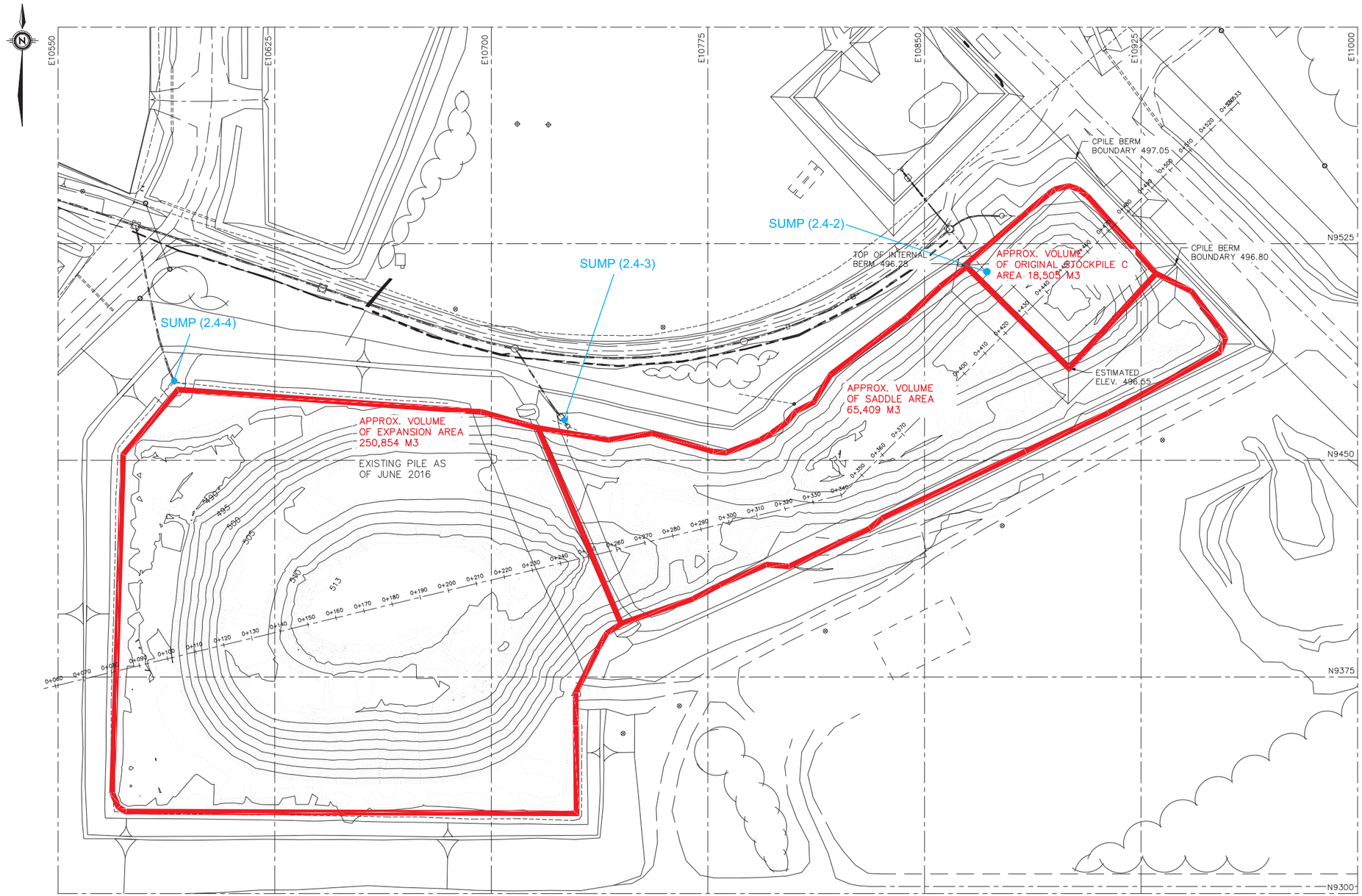
AREA **WASTE ROCK FACILITIES**

TITLE **STOCKPILE C**
2017 BOREHOLE PROGRAM
SECTIONS
SKETCH

DWG. No. **FIGURE 2-2** REV B

GENERAL NOTES:

1. THE GRID SYSTEM SHOWN IS CIGAR LAKE MINE GRID BASED ON UNIVERSAL TRANSVERSE MERCATOR (UTM) NORTH AMERICAN DATUM (NAD27):
   MINE GRID 10 000N IS UTM 6 436 473.500N
   MINE GRID 10 000E IS UTM 526 549.100E
2. ALL COORDINATES AND ELEVATIONS ARE SHOWN IN METRES AND DECIMALS THEREOF.
3. CONTOURS ARE SHOWN AT 0.5m INTERVALS.



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No.	DATE	DESCRIPTION	BY	CK	DESIGN LEAD	DESIGN AUTH.

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CHECKED:		MM/DD/YY
DESIGN LEAD APPROVAL:		MM/DD/YY
DESIGN AUTH. APPROVAL:		MM/DD/YY

LOC. CIGAR LAKE PROJECT

AREA WASTE ROCK FACILITIES

TITLE WASTE ROCK STOCKPILE C EXPANSION
PLAN
SKETCH

DWG. No. FIGURE 2-3

REV A

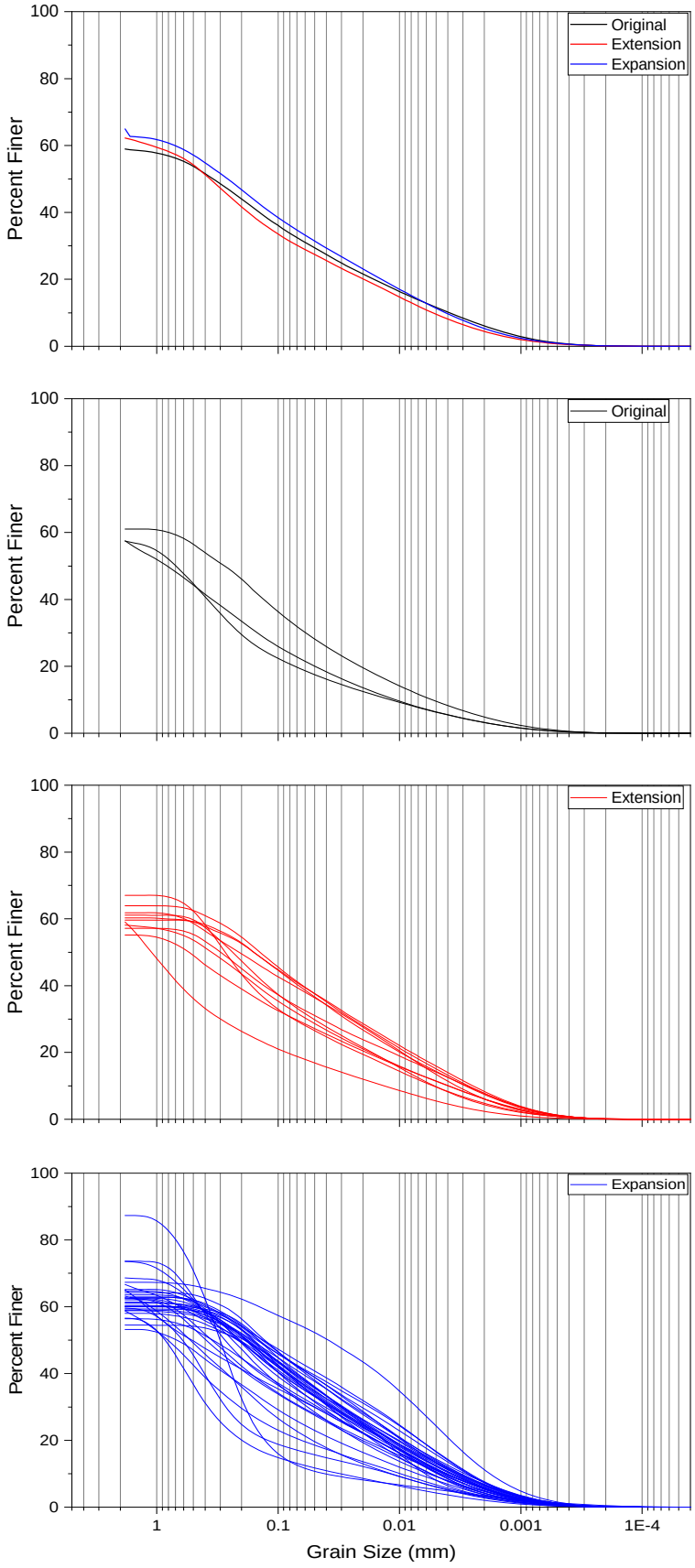


Figure 4-1: Particle size distribution curves for each area in Stockpile C as determined using light scattering methodology

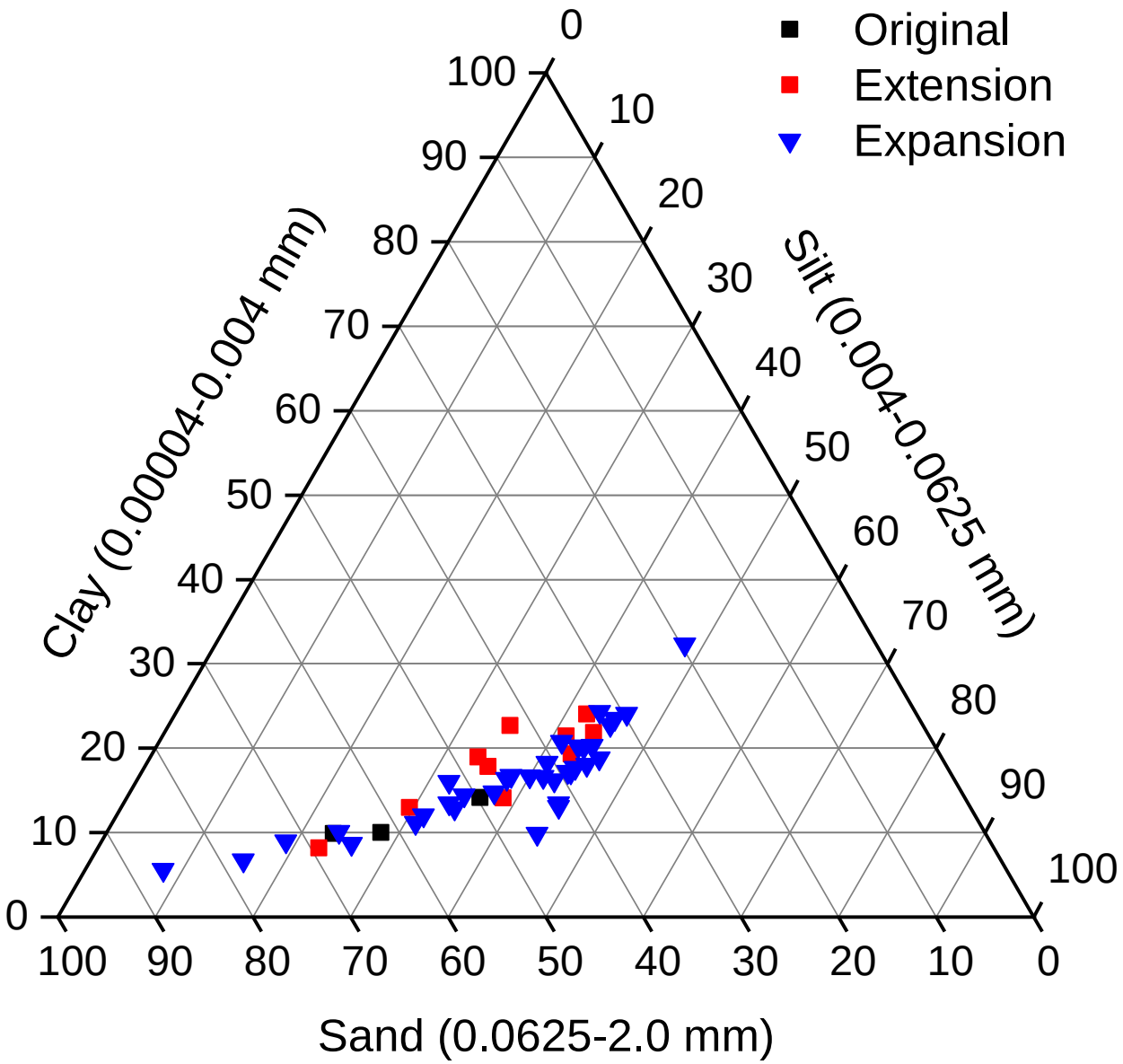


Figure 4-2: Trilinear diagram of percent of sand, silt and clay within Stockpile C

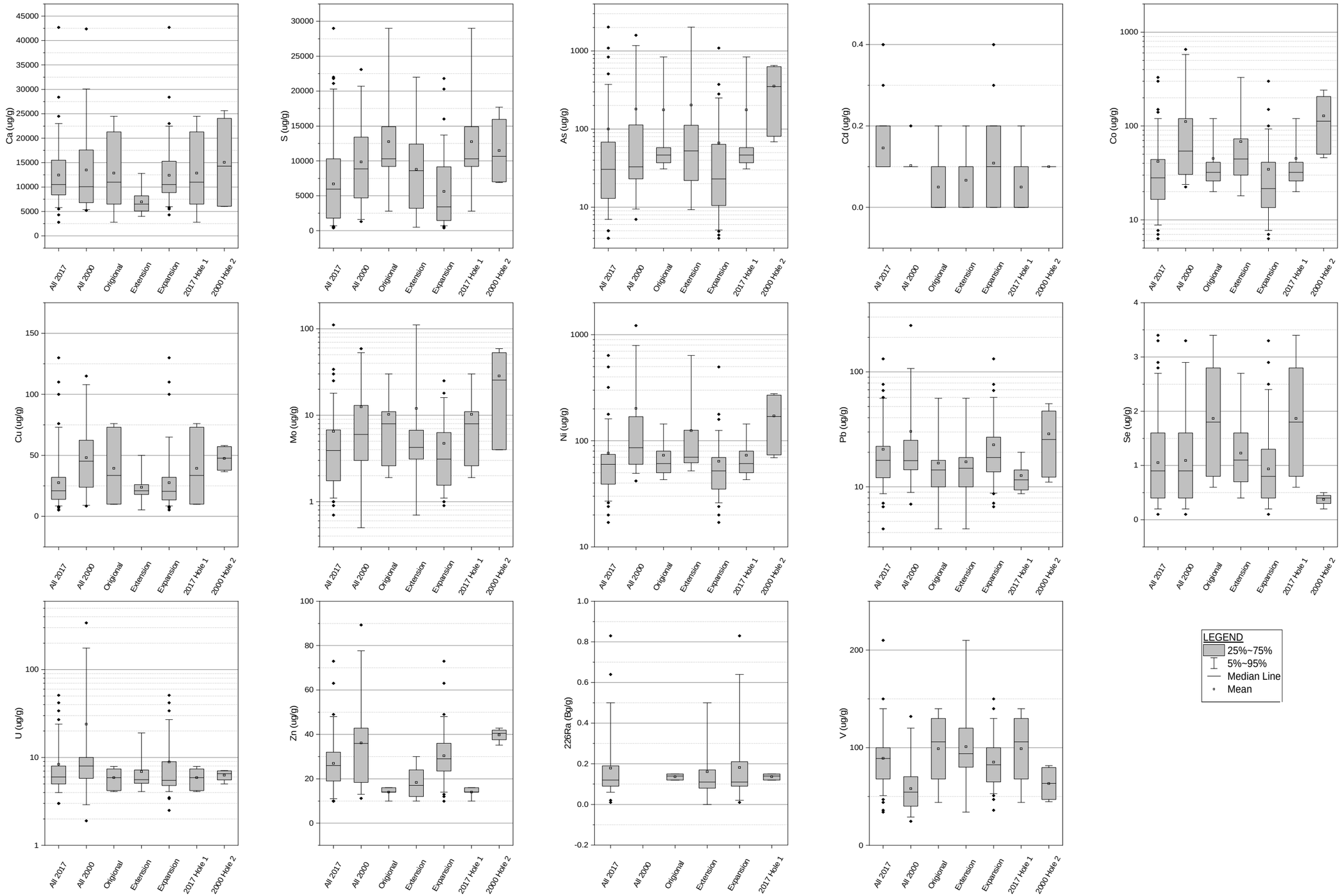


Figure 4-3: Solids geochemistry box and whisker plots for Stockpile C comparing different programs and pile areas

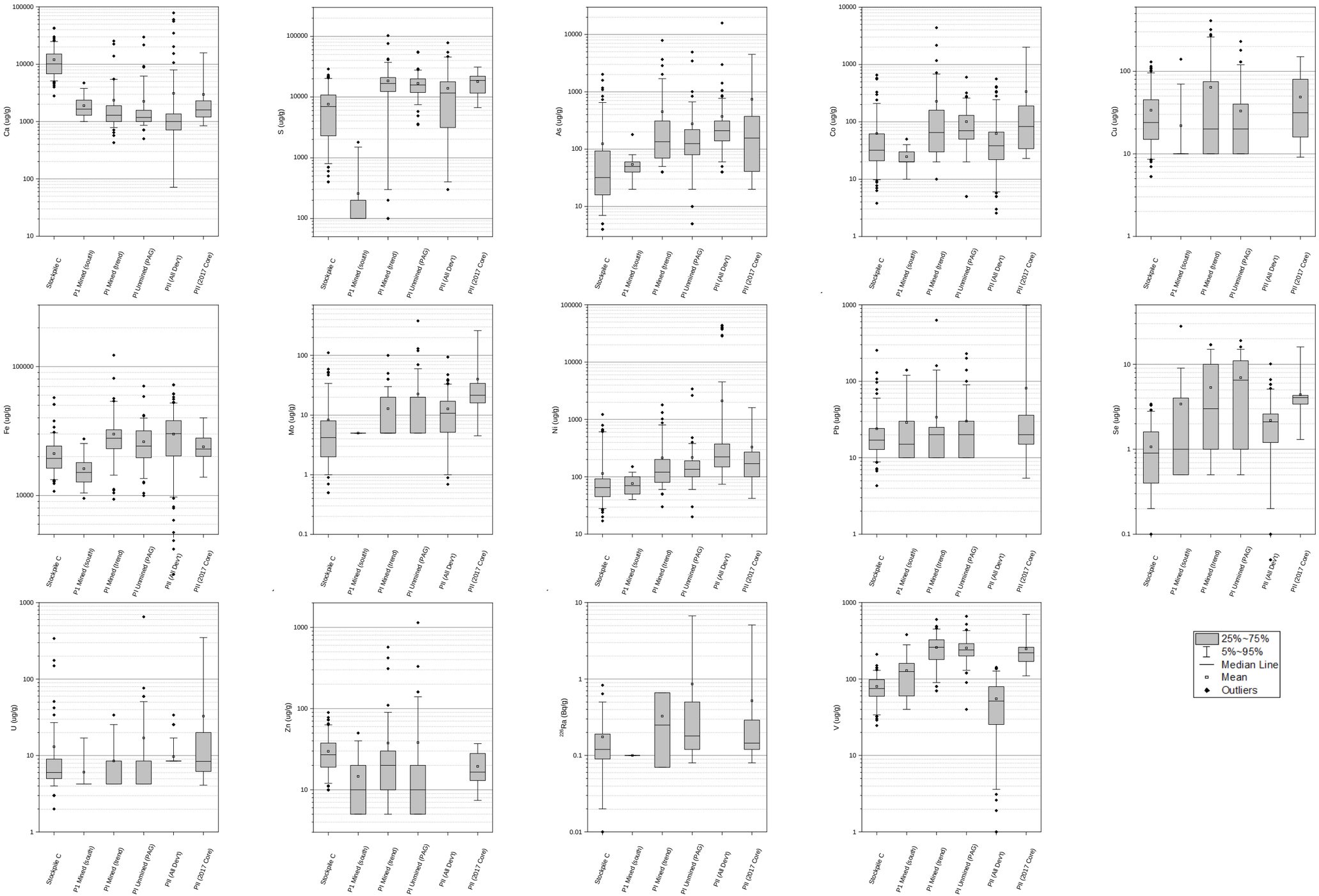


Figure 4-4: Solids geochemistry box and whisker plots for all deposit areas compared to the overall Stockpile C values

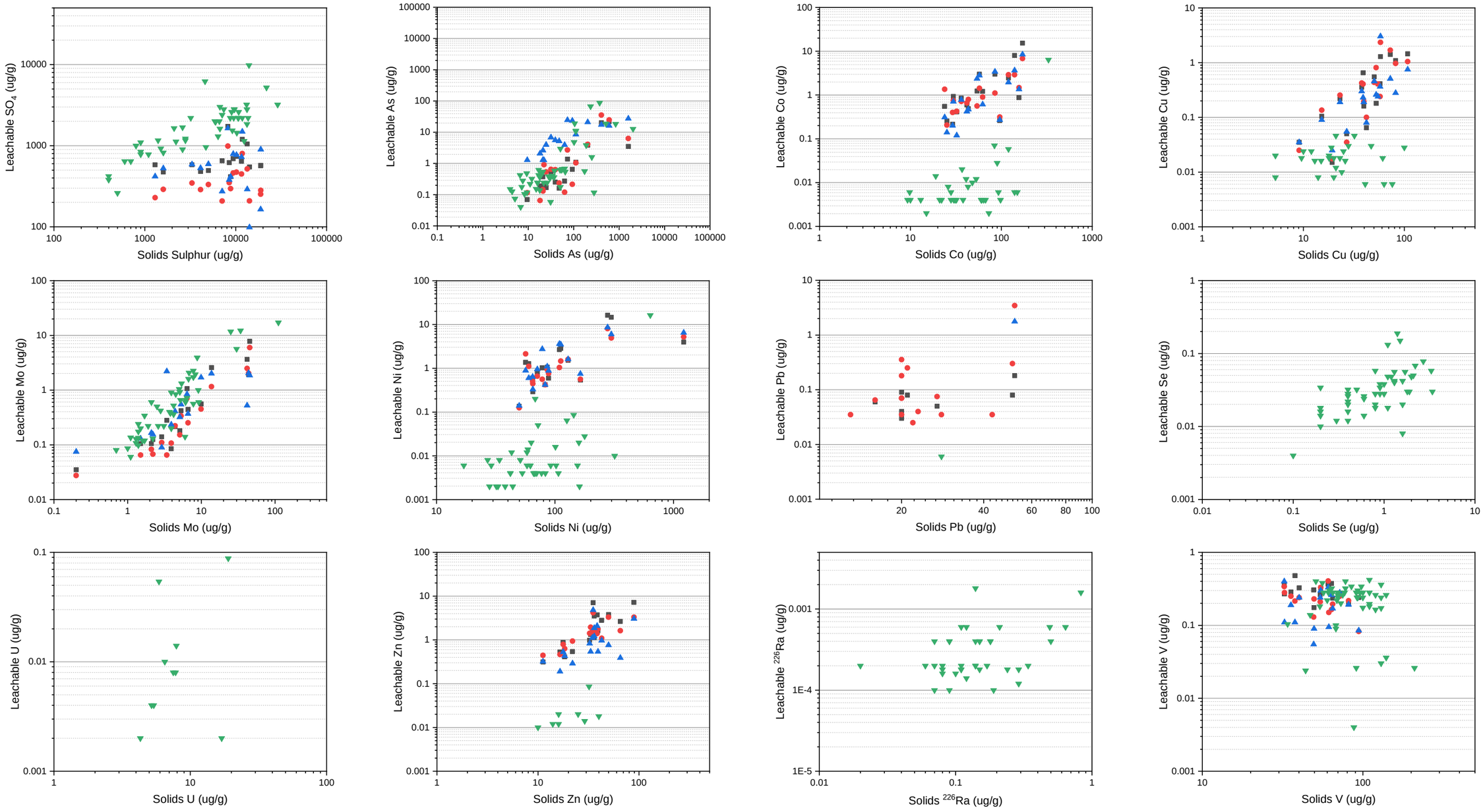


Figure 4-5: Leach testing results for 2017 Stockpile C samples compared to scoping level leach testing from 2001

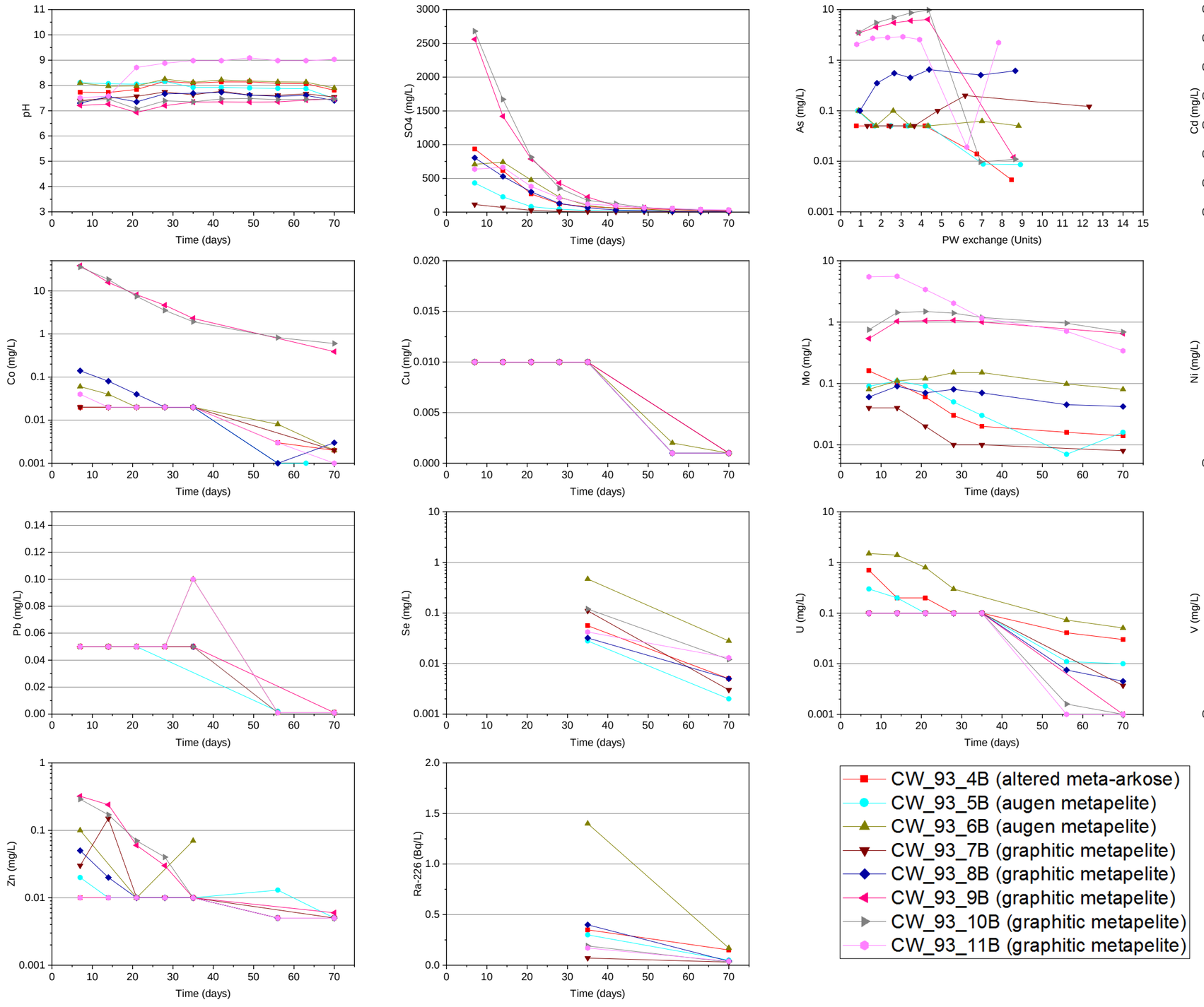


Figure 4-6: Results of saturated column testing completed in 1993 on various core samples

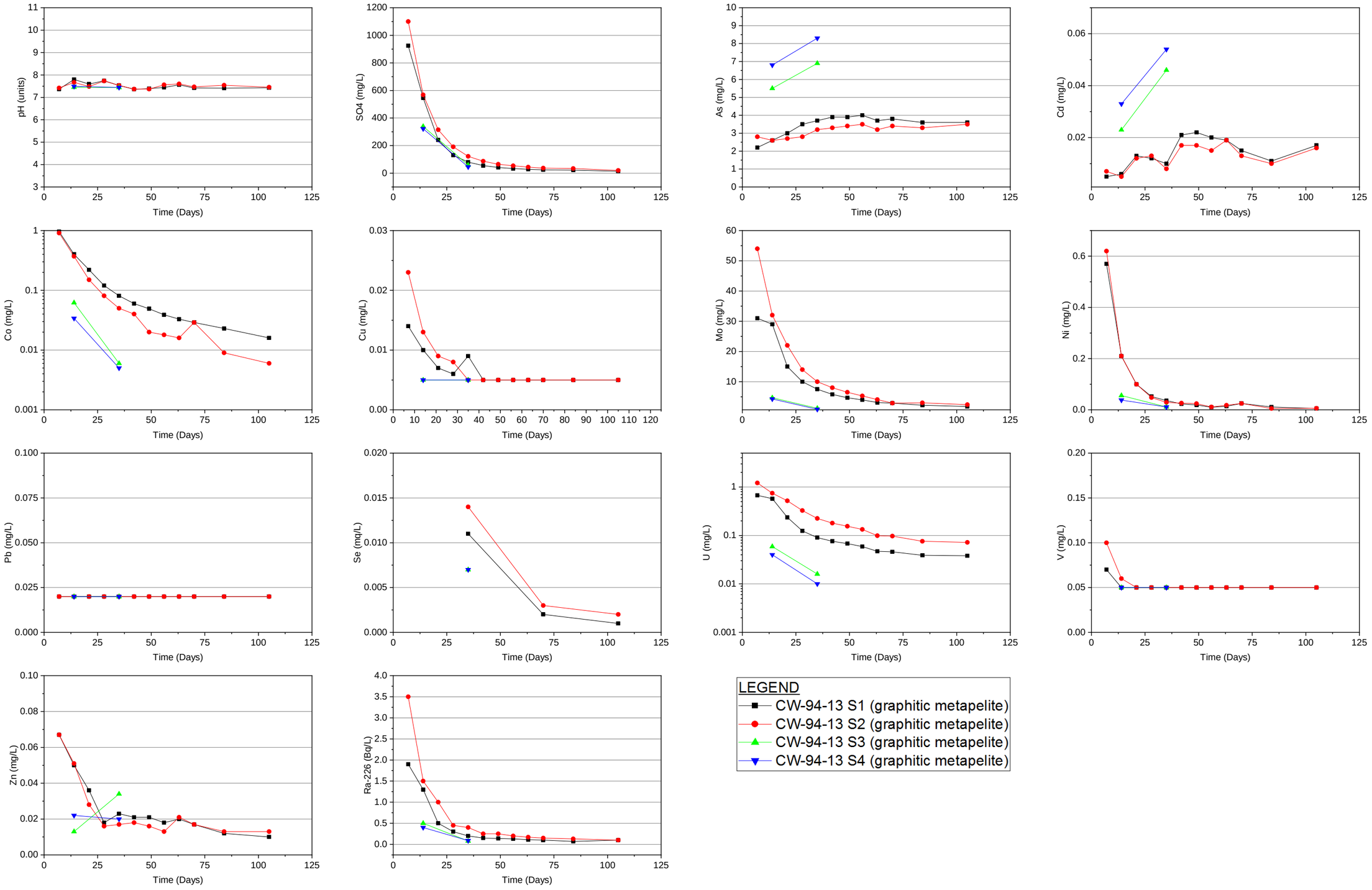


Figure 4-7: Results of saturated column testing completed in 1994 on various core samples

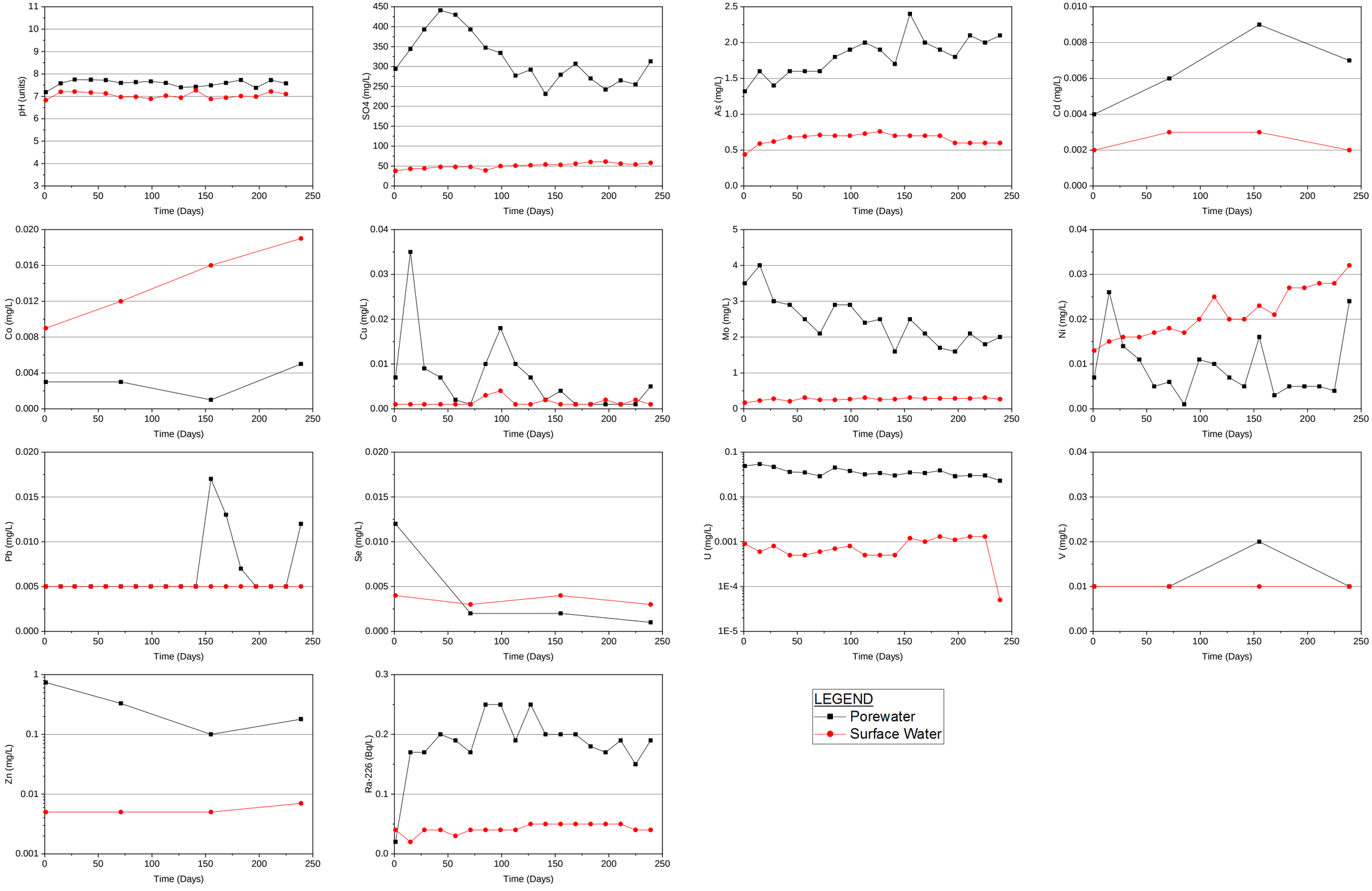


Figure 4-8: Results of the large scale Bizarre Lake bulk leach test work completed in 1994

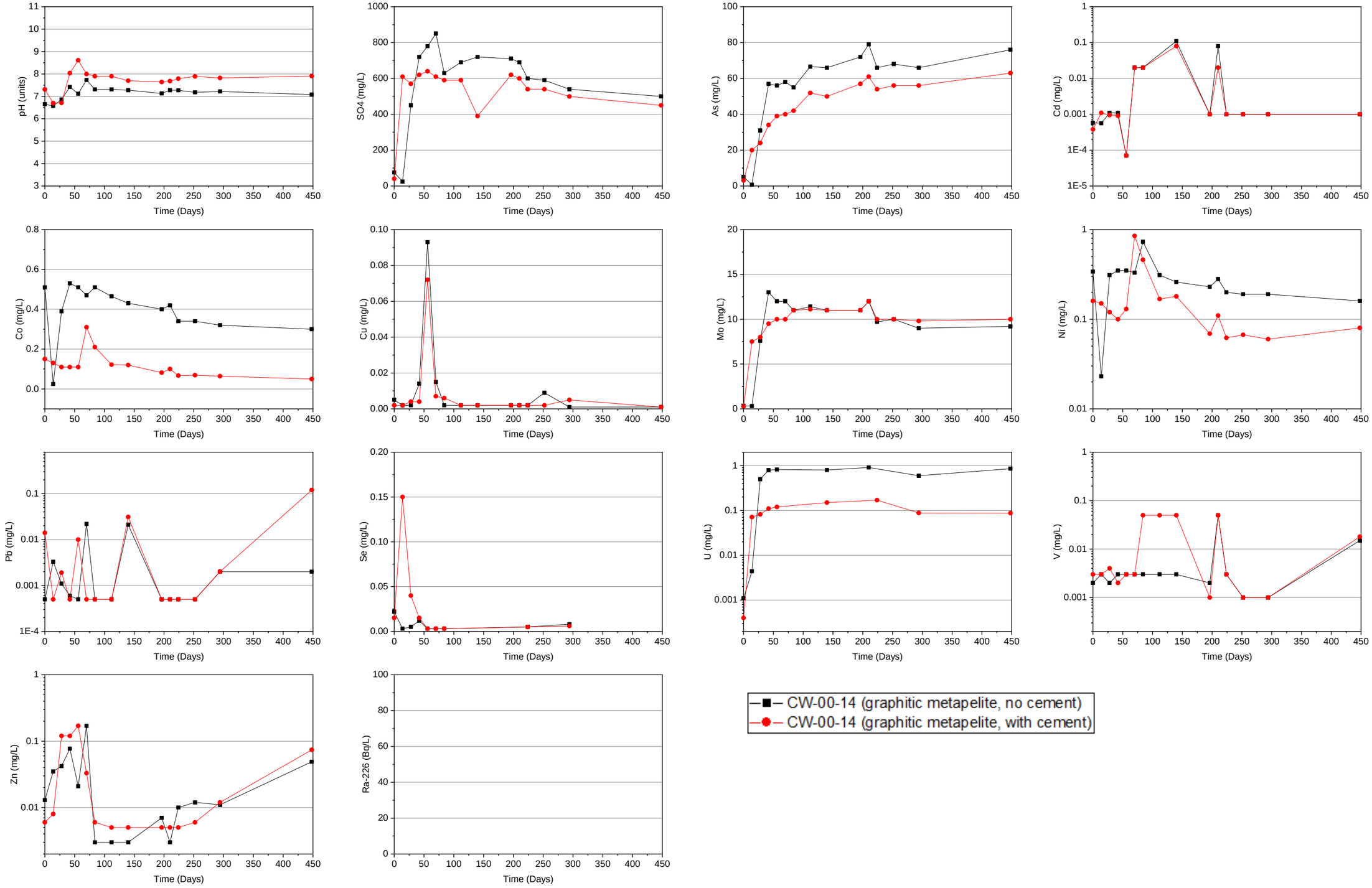


Figure 4-9: Results of saturated column testing completed in 2001 on various core samples

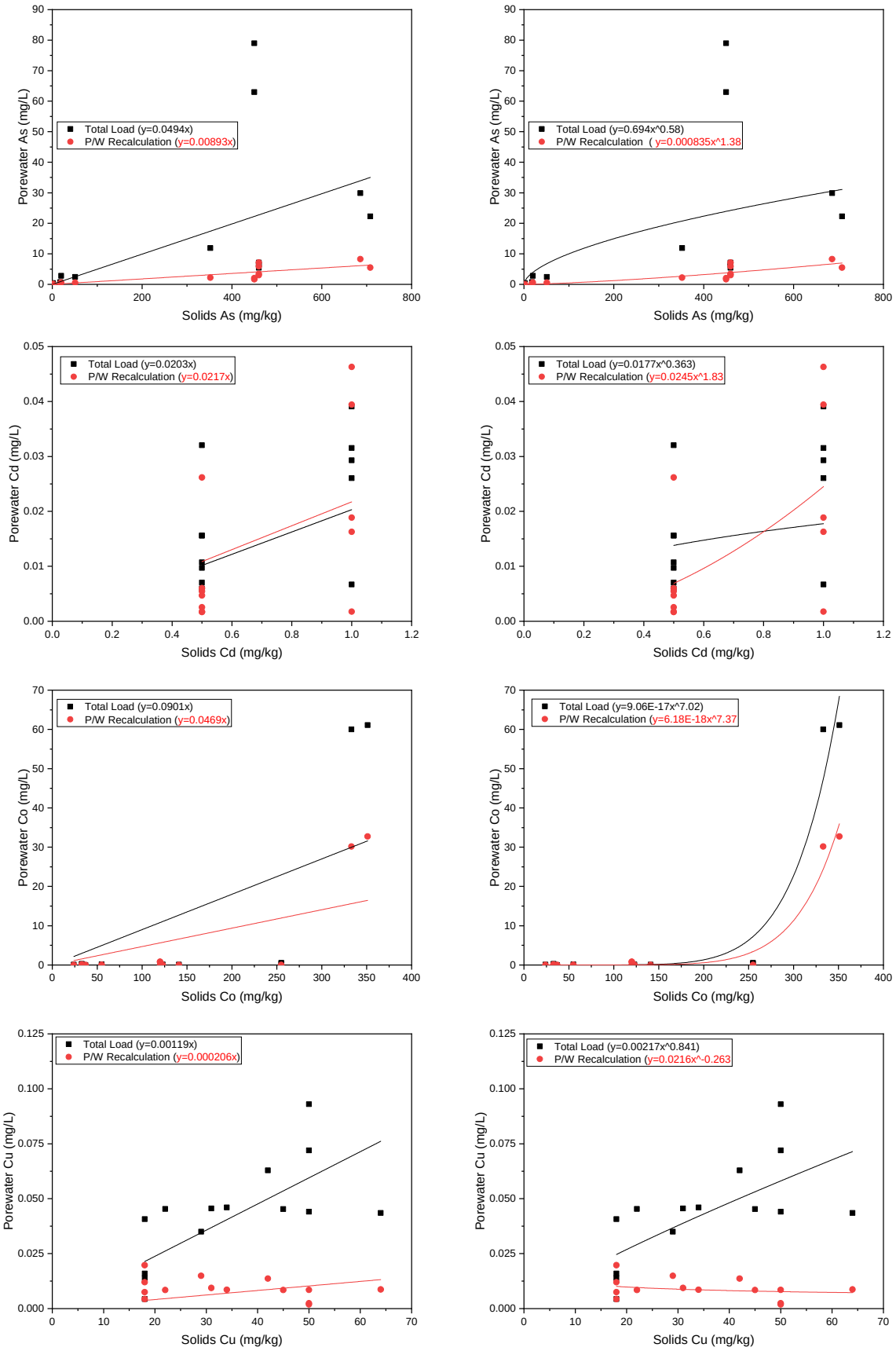


Figure 4-10A: Correlations between various column test results (solids vs porewater concentrations)

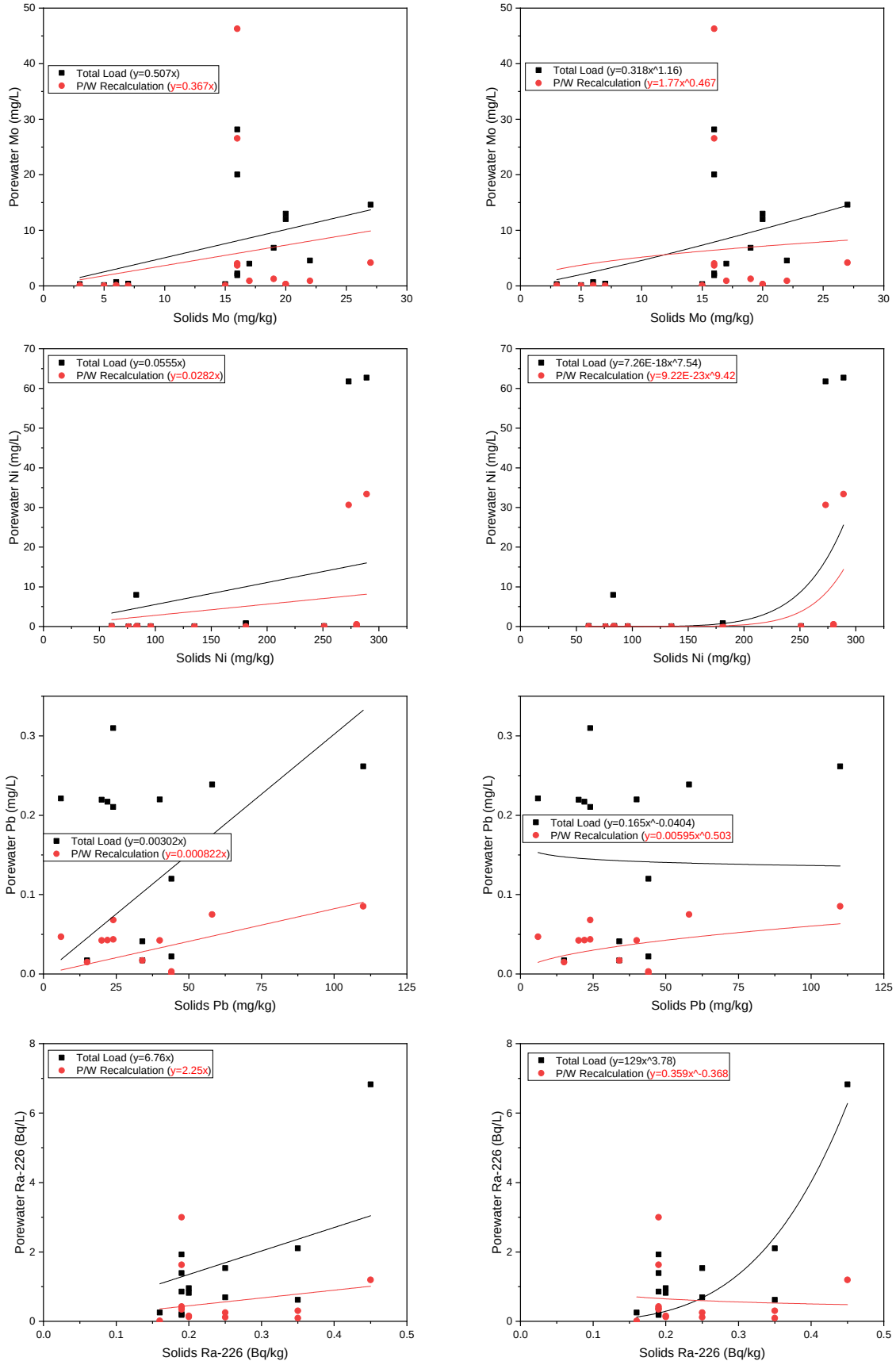


Figure 4-10B: Correlations between various column test results (solids vs porewater concentrations)

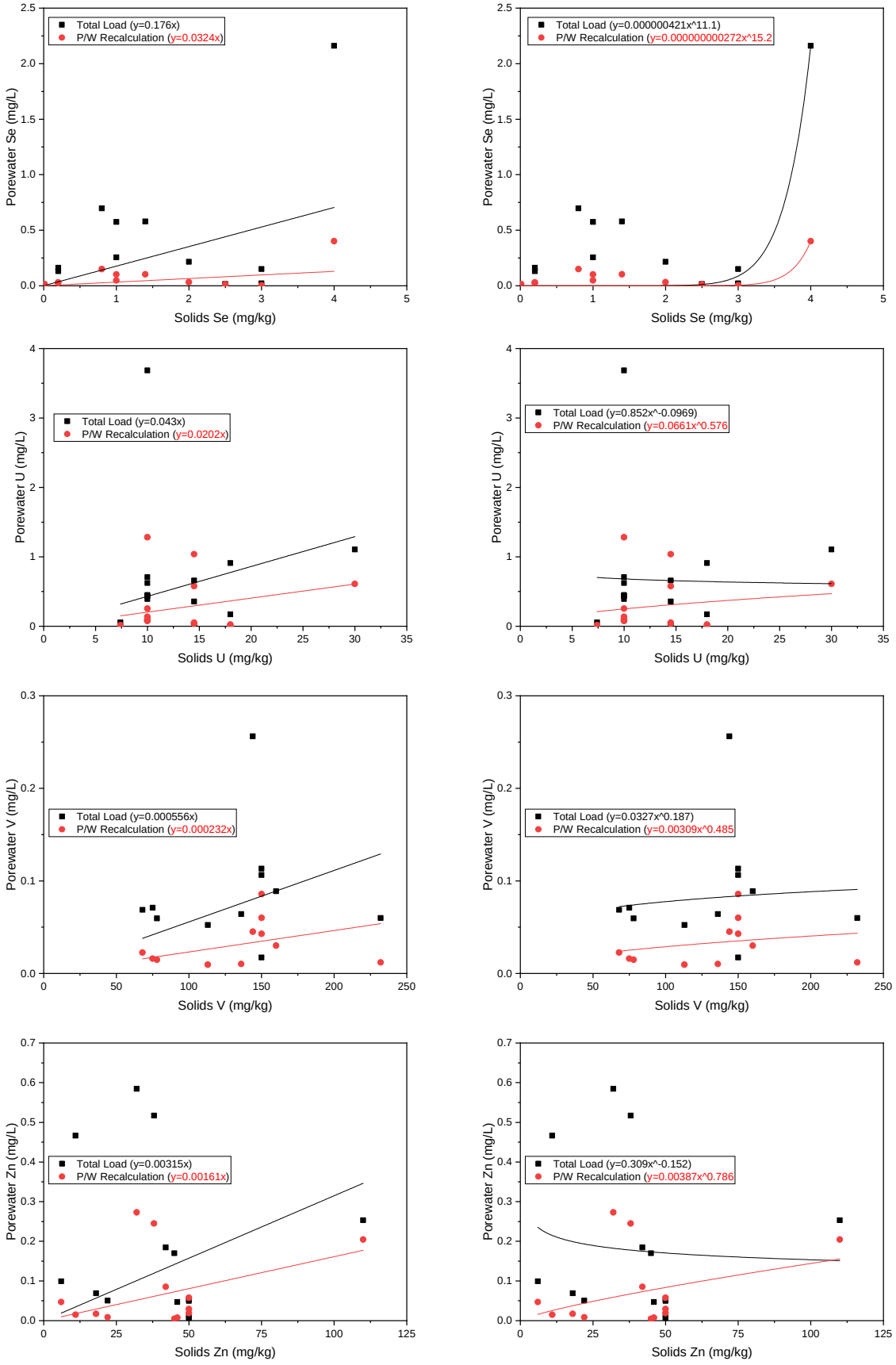


Figure 4-10C: Correlations between various column test results (solids vs porewater concentrations)

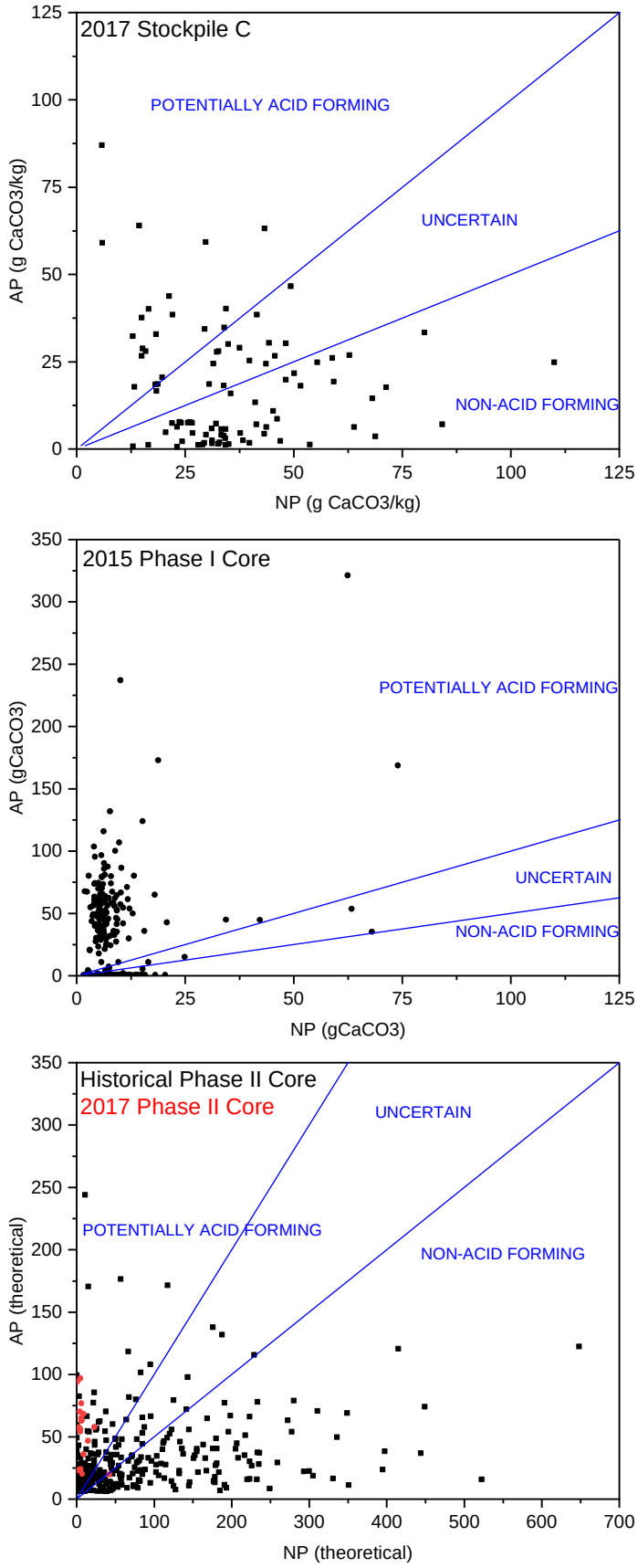
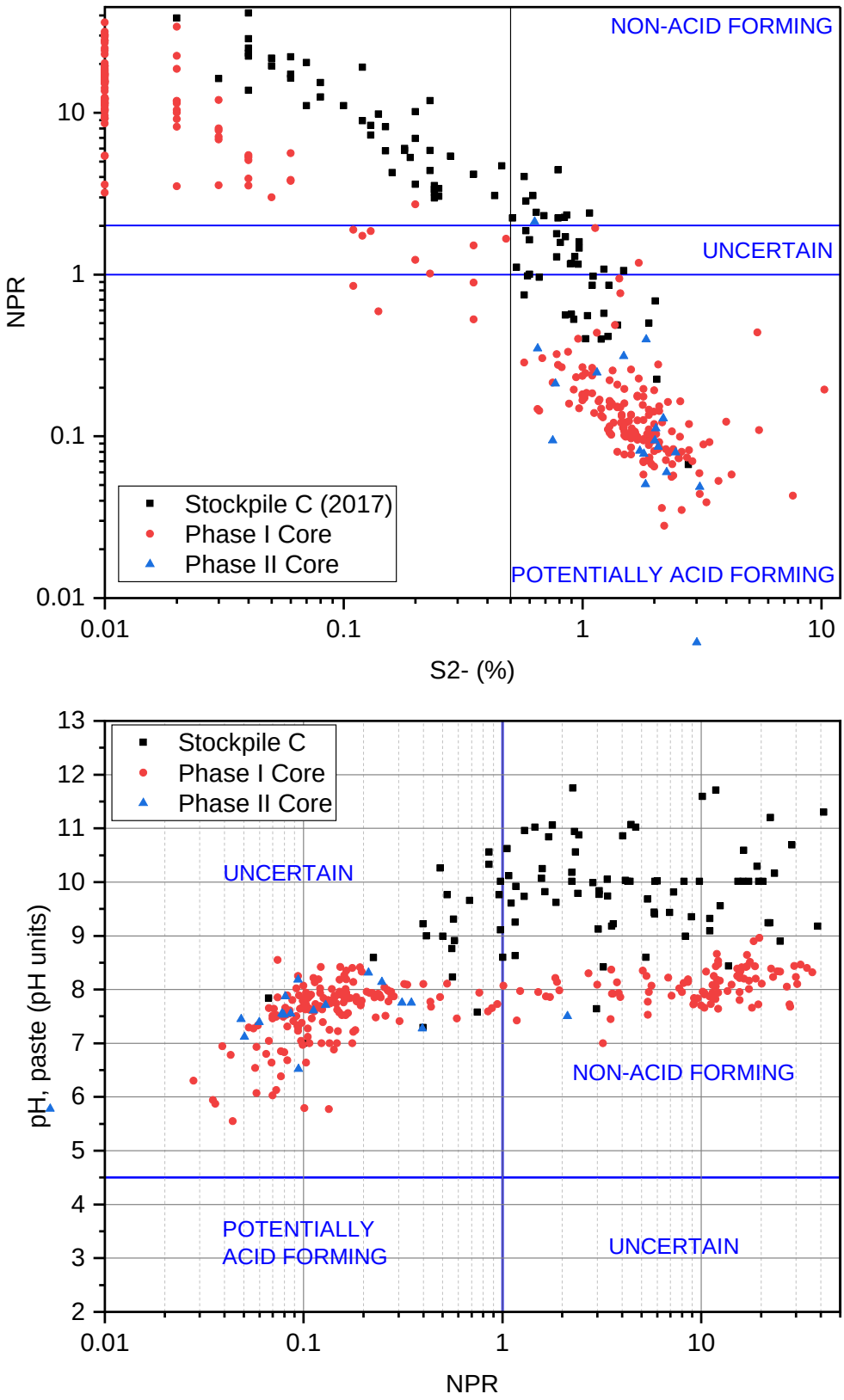


Figure 4-11: Neutralization potential vs acidification potential for Stockpile C, Phase I core samples and Phase II core samples



Note: Lower graph compared the neutralization potential ratio to pH, suggesting no current acidification risk is expected from Stockpile C material.

Figure 4-12: Sulphide content of rock compared to neutralization potential ratio for all Cigar Lake samples in top graph, suggesting that an appropriate cut-off for PAG may be 0.5% S^{2-}

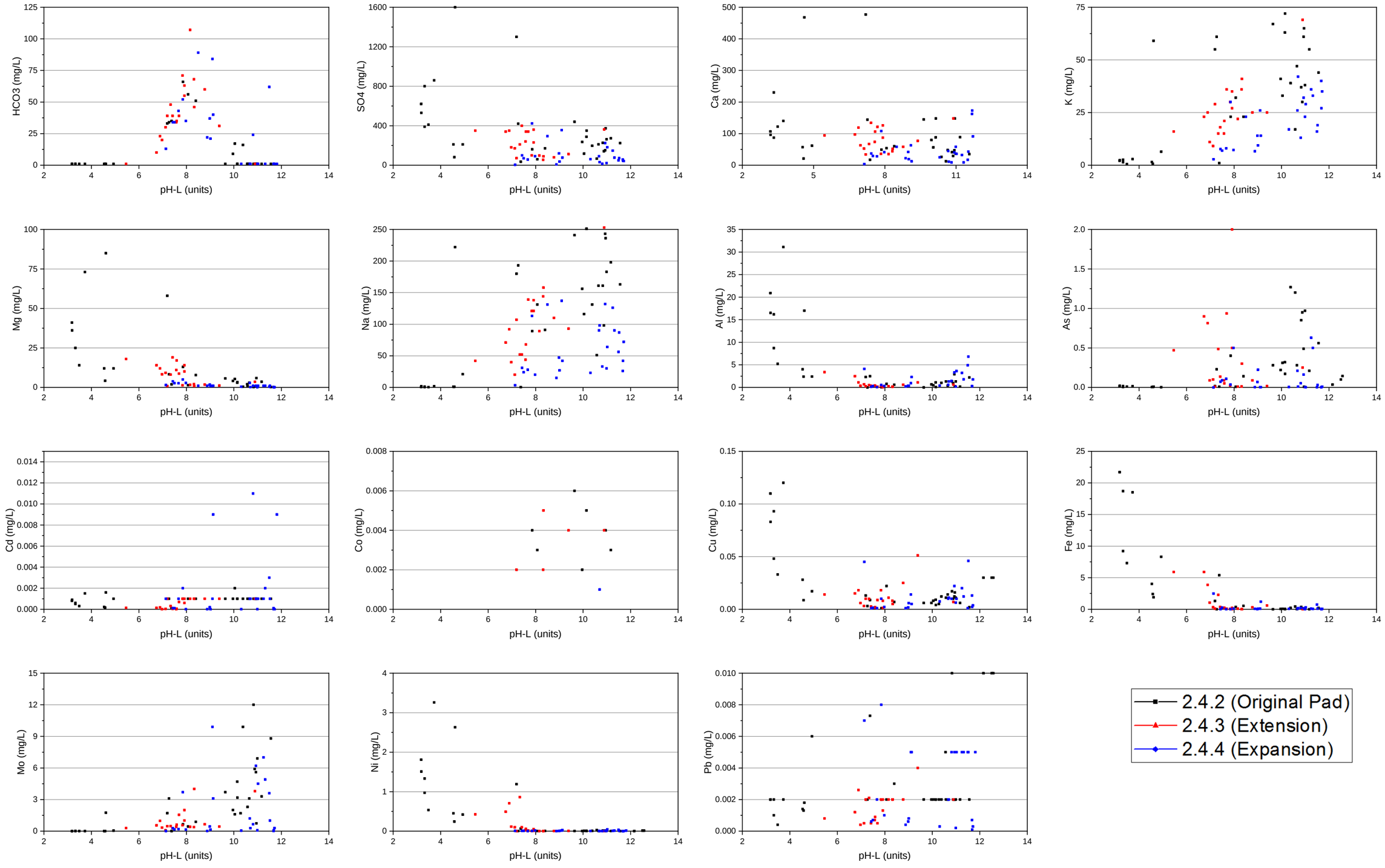


Figure 5-1A: Stockpile C underdrain water quality time series plots for each sump

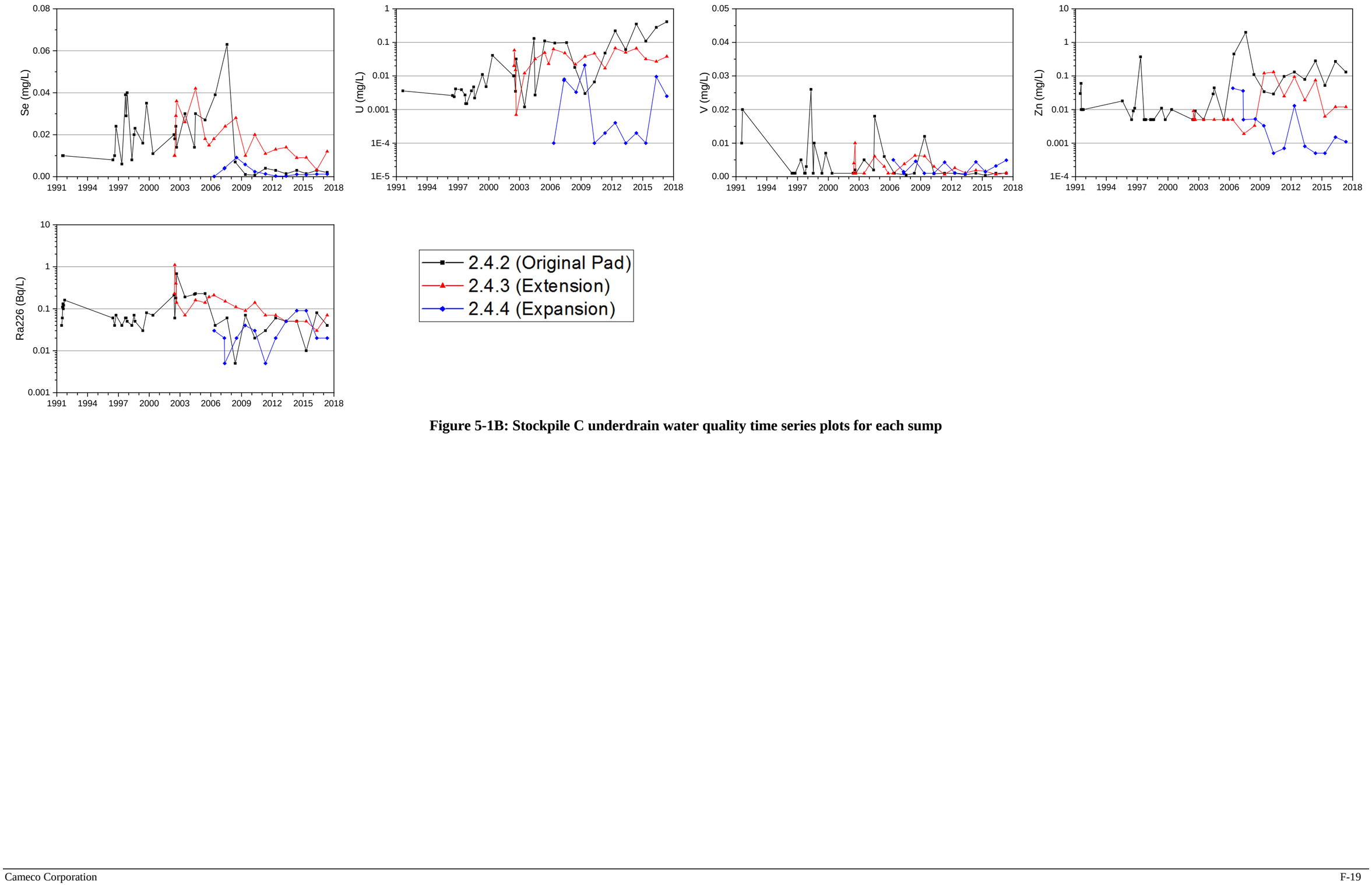


Figure 5-1B: Stockpile C underdrain water quality time series plots for each sump

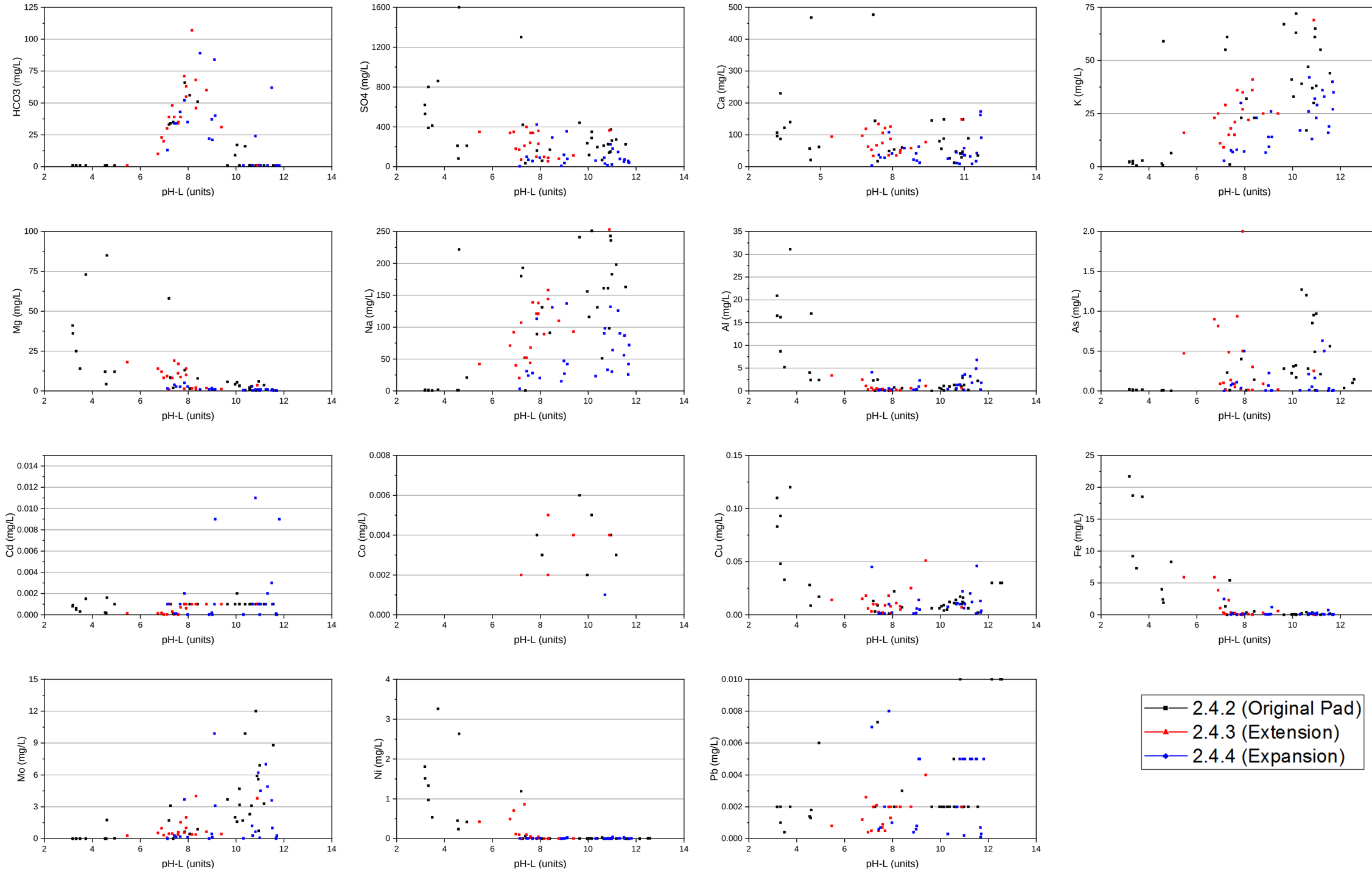


Figure 5-2A: Stockpile C underdrain water quality plotted against sample pH

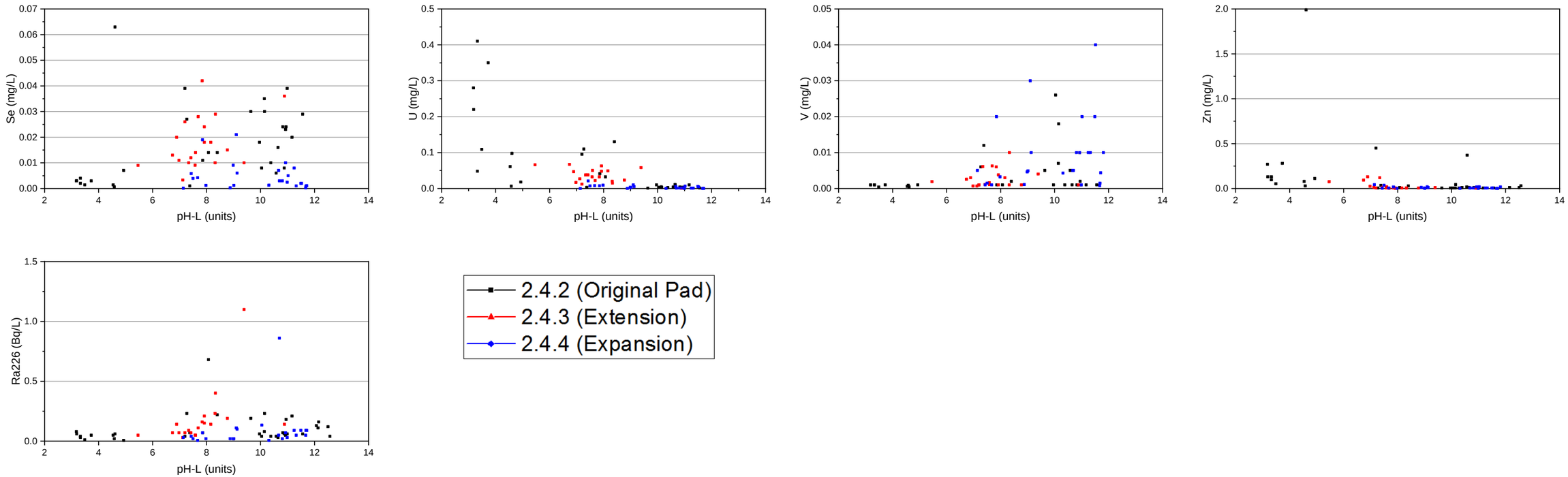


Figure 5-2B: Stockpile C underdrain water quality plotted against sample pH

APPENDIX A

PHASE I DEVELOPMENT
ROCK SOLIDS CHEMISTRY

Appendix A – Phase I Development Rock Solids Chemistry

Hole ID	Sample ID	FROM	TO	Sampling Date	pH	NP	AP	NPR	NAG	S^{2-}	S	SO_4	NAG	Al2O3	As	CaO	Co	Cu	Fe_2O_3	K_2O	MgO	MnO	Mo	Na_2O	Ni	P_2O_5	Pb	Se	TiO_2	U	V	Zn	^{226}Ra
		(m)	(m)			$gCaCO_3$	$gCaCO_3$			µg/g	%	%	$gCaCO_3$	%	ppm	%	ppm	ppm	%	%	%	%	ppm	%	ppm	%	ppm	ppm	%	ppm	ppm	ppm	Bq/g
U064	CAM084512	30	40	27-Jul-14	7.53	2.70	0.5	5.40	2.2	100	0.01	0.012	-2.7	18.8	60	0.09	20	40	2.13	3.26	4.4	0.04	10	0.04	60	0.09	20	3	0.78		230	60	
U064	CAM084513	40	49.5	27-Jul-14	7.00	1.60	0.5	3.20	1.1	100	0.01	0.02	-1.6	15.2	170	0.06	20	10	1.34	1.18	2.67	0.01	10	0.02	80	0.1	10	1	0.56		110	20	
U064	CAM084511	20	30	27-Jul-14	8.16	8.70	0.5	17.40	8.2	100	0.02	0.019	-8.7	18.2	60	0.32	60	30	2.22	2.13	7.82	0.01	10	0.03	90	0.15	30	2	0.63		320	110	
U064	CAM084509	0	10	27-Jul-14	7.00	10.10	57.3	0.18	-47.2	18,000	1.9	0.2	47.2	14.8	70	0.72	30	10	3.85	2.07	4.72	0.01	10	0.04	80	0.45	20	1	0.59		250	30	
U064	CAM084510	10	20	27-Jul-14	7.00	3.00	20.4	0.15	-17.4	6,500	0.68	0.081	17.4	17.9	40	0.16	20	10	2.06	2.75	4.74	0.01	10	0.03	60	0.14	20	1	0.62		260	20	
U084	CAM084514	0	10	27-Jul-14	8.33	12.50	0.5	25.00	12.0	100	0.01	0.005	-12.5	14.1	70	0.53	20	10	1.36	1.37	11.4	0.01	10	0.02	50	0.38	10	1	0.37		40	10	
U084	CAM084515	10	20	27-Jul-14	8.21	7.80	0.5	15.60	7.3	100	0.01	0.005	-7.8	15.4	40	0.27	20	10	1.96	2.03	11.6	0.01	10	0.06	80	0.16	10	1	0.7		120	10	
U084	CAM084516	20	30	27-Jul-14	7.84	4.60	0.5	9.20	4.1	100	0.01	0.005	-4.6	18	40	0.19	30	140	2.17	2.64	7	0.01	10	0.03	100	0.12	30	2	0.78		160	20	
U084	CAM084517	30	40	27-Jul-14	7.46	2.60	4.4	0.59	-1.8	1,400	0.15	0.026	1.8	30.2	70	0.14	40	70	2.84	5.06	8.78	0.01	10	0.06	150	0.09	60	2	1.63		380	40	
U084	CAM084518	40	50	27-Jul-14	7.00	15.20	124.0	0.12	-108.8	40,000	4.12	0.46	109	23.7	450	0.76	300	410	8.08	3.77	7.04	0.02	20	0.07	280	0.1	70	1	0.88		320	70	
U084	CAM084519	50	60	27-Jul-14	5.79	4.90	48.3	0.10	-43.4	15,000	1.72	0.52	43.4	22.6	740	0.26	370	30	3.64	3.31	7.15	0.01	20	0.06	250	0.11	40	1	0.7		350	20	
U084	CAM084520	60	70	27-Jul-14	6.03	4.00	57.4	0.07	-53.4	18,000	1.87	0.098	53.4	25.1	770	0.18	430	30	3.98	3.27	8.31	0.01	10	0.06	310	0.15	20	1	1.05		490	40	
U084	CAM084521	70	80	27-Jul-14	6.13	4.40	60.2	0.07	-55.8	19,000	2.01	0.25	55.8	17.6	200	0.16	120	20	3.93	2.7	5.95	0.01	10	0.06	190	0.07	20	1	0.62		290	20	
U084	CAM084522	80	90	27-Jul-14	6.07	3.20	54.8	0.06	-51.6	18,000	1.82	0.2	51.6	17.2	280	0.12	140	20	3.42	2.59	5.3	0.01	30	0.05	180	0.09	10	1	0.48		290	10	
U084	CAM084523	90	100	27-Jul-14	6.54	4.20	74.2	0.06	-70.0	24,000	2.45	0.23	70	16.9	220	0.14	100	20	5.28	2.76	5.72	0.02	20	0.06	170	0.11	10	1	0.52		370	60	
U084	CAM084524	100	110	27-Jul-14	6.64	3.90	56.3	0.07	-52.4	18,000	1.86	0.18	52.4	15	130	0.16	60	20	3.85	2.32	5.17	0.01	10	0.04	120	0.09	20	3	0.45		210	20	
U084	CAM084525	110	120	27-Jul-14	6.68	6.10	73.4	0.08	-67.3	24,000	2.4	0.15	67.3	17	150	0.12	60	10	4.27	2.88	5.27	0.01	20	0.05	140	0.09	80	3	0.51		280	10	
U084	CAM084526	120	130	27-Jul-14	5.55	4.20	95.5	0.04	-91.3	31,000	3.15	0.28	91.3	21.2	260	0.21	160	20	6.52	3.7	6.27	0.01	10	0.07	180	0.16	20	1	0.5		200	10	
U084	CAM084527	130	140	27-Jul-14	5.94	2.80	80.2	0.04	-77.4	26,000	2.62	0.16	77.4	16.4	250	0.11	110	20	5.5	2.98	4.78	0.01	10	0.06	130	0.11	20	1	0.41		180	20	
U084	CAM084528	140	150	27-Jul-14	6.80	4.10	63.4	0.07	-59.3	20,000	2.09	0.18	59.3	19.4	230	0.15	130	10	4.48	2.86	6.4	0.01	10	0.07	160	0.12	10	3	0.49		170	10	
U084	CAM084529	150	160	27-Jul-14	6.30	1.90	67.7	0.03	-65.8	22,000	2.23	0.19	65.8	17.7	90	0.2	60	10	4.32	2.8	5.62	0.01	10	0.05	110	0.17	10	3	0.44		120	10	
U084	CAM084530	160	170	27-Jul-14	6.64	5.20	50.3	0.10	-45.1	16,000	1.67	0.18	45.1	13.5	170	0.24	70	10	3.72	2.17	4.46	0.01	10	0.04	90	0.19	30	3	0.38		80	30	
U084	CAM084531	170	180	27-Jul-14	7.24	5.90	32.4	0.18	-26.5	10,000	1.1	0.19	26.5	15.6	130	0.39	40	10	3.16	3.07	4.52	0.01	10	0.07	50	0.17	20	1	0.44		70	30	
U084	CAM084532	180	190	27-Jul-14	7.04	4.90	50.6	0.10	-45.7	16,000	1.65	0.096	45.7	16.1	70	0.17	30	10	4.59	2.99	5.1	0.01	10	0.04	90	0.12	10	1	0.59		270	10	
U084	CAM084533	190	200	27-Jul-14	7.21	5.60	31.5	0.18	-25.9	10,000	1.05	0.13	25.9	15.7	90	0.1	30	260	3.8	2.61	5.09	0.02	20	0.05	80	0.08	20	3	0.48		250	20	
U084	CAM084534	200	210	27-Jul-14	6.97	5.10	51.7	0.10	-46.6	17,000	1.7	0.14	46.6	15.6	40	0.16	40	80	4.73	2.86	5.5	0.01	10	0.04	90	0.1	10	1	0.59		220	10	
U084	CAM084535	210	220	27-Jul-14	6.38	3.70	47.9	0.08	-44.2	15,000	1.6	0.2	44.2	15.5	70	0.13	30	120	4.43	2.7	5.35	0.01	10	0.04	60	0.08	10	1	0.53		180	20	
U084	CAM084536	220	230	27-Jul-14	7.56	5.40	32.3	0.17	-26.9	10,000	1.06	0.076	26.9	15.6	50	0.18	20	30	3.82	2.95	5.07	0.01	10	0.04	50	0.11	10	1	0.55		160	10	
U084	CAM084537	230	235.5	27-Jul-14	7.41	6.50	21.4	0.30	-14.9	6,800	0.72	0.11	14.9	16.9	70	0.18	20	20	3.34	3.19	5.37	0.01	10	0.04	30	0.12	10	2	0.6		220	10	
U209	CAM084094	0	10	27-Jul-14	8.19	6.90	42.0	0.16	-35.1	13,000	1.35	0.018	35.1	15.7	70	0.2	30	70	3.42	2.92	4.91	0.01	10	0.04	70	0.12	10	3	0.52		200	10	
U209	CAM084095	10	20	27-Jul-14	8.18	6.20	40.7	0.15	-34.5	13,000	1.31	0.019	34.5	16.1	60	0.2	30	60	3.98	3.32	5.11	0.01	10	0.04	70	0.13	10	1	0.61		200	10	
U209	CAM084096	20	30	27-Jul-14	7.80	5.20	59.0	0.09	-53.8	19,000	1.9	0.035	53.8	16.5	50	0.12	30	150	5.21	3.38	4.49	0.03	10	0.06	80	0.09	20	1	0.48		180	30	
U209	CAM084097	30	40	27-Jul-14	7.90	8.60	35.7	0.24	-27.1	11,000	1.15	0.027	27.2	17	150	0.48	50	230	4.1	3.09	5.33	0.02	10	0.05	100	0.34	10	1	0.44		190	40	
U209	CAM084098	40	50	27-Jul-14	7.96	6.60	43.4	0.15	-36.8	14,000	1.4	0.032	36.9	19	80	0.21	30	90	4.28	2.7	6.9	0.01	20	0.05	110	0.15	40	1	0.63		320	20	
U209	CAM084099	50	60	27-Jul-14	8.02	9.80	107.0	0.09	-97.2	34,000	3.45	0.047	97.5	23.1	120	0.39	60	270	7.72	2.72	8.62	0.01	10	0.06	160	0.3	20	3	0.61		280	20	
U209	CAM084100	60	70	27-Jul-14	7.99	9.30	35.2	0.26	-25.9	11,000	1.14	0.041	25.9	17.6	70	0.4	30	170	3.47	2.46	6.11	0.01	10	0.05	70	0.24	10	2	0.35		160	10	
U209	CAM084501	70	80	27-Jul-14	7.88	6.90	41.8	0.17	-34.9	13,000	1.35	0.033	34.9	16.3	60	0.16	30	70	4.92	2.28	6.45	0.02	10	0.04	60	0.12	10	3	0.47		180	10	
U209	cAM084502	80	90	27-Jul-14	7.64	5.40	56.2	0.10	-50.8	18,000	1.82	0.062	50.8	16.4	60	0.12	30	40	4.03	2.09	6.06	0.01	20	0.04	120	0.08	10	2	0.47		270	10	
U209	CAM084503	90	100	27-Jul-14	7.89	5.20	54.6	0.10	-49.4	17,000	1.76	0.039	49.4	18	90	0.16	50	20	4.08	1.63	7.04	0.01	20	0.04	130	0.11	10	1	0.46		300	10	
U209	CAM084504	100	110	27-Jul-14	7.00	7.90	58.5	0.14	-50.6	19,000	1.89	0.054	50.6	18.3	550	0.15	160	20	4.37	2.34	6.69	0.01	20	0.04	250	0.13	20	1	0.58		350	20	

Hole ID	Sample ID	FROM (m)	TO (m)	Sampling Date	pH	NP $gCaCO_3$	AP $gCaCO_3$	NPR	NAG	S^{2-} µg/g	S %	SO_4 %	NAG $gCaCO_3$	Al2O3 %	As ppm	CaO %	Co ppm	Cu ppm	Fe_2O_3 %	K_2O %	MgO %	MnO %	Mo ppm	Na_2O %	Ni ppm	P_2O_5 %	Pb ppm	Se ppm	TiO_2 %	U ppm	V ppm	Zn ppm	^{226}Ra Bq/g
U209	CAM084505	110	120	27-Jul-14	7.88	7.40	31.4	0.24	-24.0	10,000	1.02	0.05	24	19.2	130	0.16	70	10	3.82	2.59	8.3	0.02	10	0.05	120	0.12	20	4	0.63		340	10	
U209	CAM084506	120	130	27-Jul-14	7.55	4.20	49.2	0.09	-45.0	16,000	1.6	0.076	45	16.1	70	0.16	30	100	3.84	1.73	6.79	0.01	10	0.04	100	0.1	10	1	0.56		290	10	
U209	CAM084507	130	140	27-Jul-14	7.00	5.00	46.8	0.11	-41.8	15,000	1.53	0.1	41.8	16.6	80	0.13	60	130	3.82	2.02	6.38	0.01	10	0.03	110	0.09	20	2	0.66		280	10	
U209	CAM084508	140	150	27-Jul-14	7.65	9.60	10.8	0.89	-1.2	3,500	0.37	0.069	1.2	16.5	100	0.29	70	30	3.08	2.56	6.25	0.01	10	0.04	90	0.06	30	4	0.73		270	80	
U216	CAM052803	20	30	15-Mar-15	7.68	14.00	0.5	28.00	13.5	100	0.01	0.005	-14	12	50	0.27	20	10	5.51	1.21	11.1	0.02	10	0.02	60	0.14	10	1	0.5	10	80	10	
U216	CAM052804	30	40	15-Mar-15	7.72	9.70	0.5	19.40	9.2	100	0.01	0.005	-9.7	11.3	40	0.28	20	10	3.13	0.87	12.1	0.01	10	0.02	40	0.13	10	1	0.44	5	60	10	0.09
U216	CAM052807	60	70	15-Mar-15	8.20	8.20	0.5	16.40	7.7	100	0.01	0.005	-8.2	14	50	0.25	20	10	4.1	2.51	13.9	0.02	10	0.08	50	0.14	10	1	0.65	5	80	20	
U216	CAM052809	80	90	15-Mar-15	7.80	7.80	0.5	15.60	7.3	100	0.01	0.005	-7.8	13.7	20	0.51	10	10	3.51	2.75	7.62	0.01	10	0.05	30	0.36	10	1	0.54	20	60	20	
U216	CAM052810	90	100	15-Mar-15	7.74	4.60	0.5	9.20	4.1	100	0.01	0.005	-4.6	14.5	10	0.26	10	10	3.08	2.44	8.22	0.01	10	0.03	50	0.1	10	1	0.69	5	100	10	
U216	CAM052811	100	110	15-Mar-15	7.83	4.80	0.5	9.60	4.3	100	0.01	0.005	-4.8	15.6	30	0.24	20	10	2.22	2.69	6	0.01	10	0.04	80	0.16	20	1	0.74	20	140	30	
U216	CAM052827	260	270	15-Mar-15	7.77	2.70	0.5	5.40	2.2	100	0.01	0.006	-2.7	18.4	20	0.07	20	10	1.5	2.15	4.88	0.01	10	0.02	120	0.08	10	1	0.7	5	190	30	
U216	CAM052828	270	280	15-Mar-15	7.92	1.80	0.5	3.60	1.3	100	0.01	0.005	-1.8	18.6	20	0.05	10	10	0.98	3.43	3.27	0.01	10	0.02	80	0.06	10	1	0.72	5	150	20	
U216	CAM052801	0	10	15-Mar-15	7.88	6.40	0.9	7.11	5.5	300	0.03	0.005	-5.5	13.2	200	0.24	20	10	2.36	2.29	6.49	0.01	10	0.05	60	0.16	10	1	0.5	40	90	30	
U216	CAM052802	10	20	15-Mar-15	7.92	3.20	0.9	3.56	2.3	300	0.03	0.005	-2.3	13.9	120	0.39	20	30	2.19	2.96	5.64	0.01	10	0.04	50	0.28	20	1	0.54	5	100	30	
U216	CAM052805	40	50	15-Mar-15	7.95	7.10	1.3	5.46	5.8	400	0.04	0.005	-5.8	13.9	10	0.26	10	10	5.11	2.74	10.1	0.01	10	0.04	40	0.15	10	1	0.6	5	70	10	
U216	CAM052806	50	60	15-Mar-15	8.06	7.10	0.6	11.83	6.5	200	0.02	0.005	-6.5	12.4	20	0.22	10	10	5.29	2.45	9.86	0.01	10	0.04	40	0.13	10	1	0.53	5	80	10	
U216	CAM052808	70	80	15-Mar-15	8.09	4.80	1.6	3.00	3.2	500	0.05	0.005	-3.2	12.5	50	0.24	10	10	2.76	1.99	10.7	0.01	10	0.08	40	0.16	10	1	0.53	5	50	10	
U216	CAM052826	250	260	15-Mar-15	7.70	5.00	0.5	10.00	4.5	200	0.02	0.01	-4.5	18.6	110	0.13	60	20	3.79	1.76	6.11	0.02	10	0.02	180	0.05	20	1	0.76	30	240	20	
U216	CAM052830	290	300	15-Mar-15	7.45	2.10	0.6	3.50	1.5	200	0.02	0.005	-1.5	19.3	60	0.08	30	10	2.14	2.42	5.16	0.01	10	0.03	250	0.07	20	1	0.7	50	130	70	
U216	CAM052812	110	120	15-Mar-15	7.59	2.80	3.3	0.85	-0.5	1,100	0.11	0.01	0.5	20.8	90	0.12	40	70	2.34	3.5	5.9	0.01	10	0.05	130	0.07	80	1	0.74	30	400	70	
U216	CAM052813	120	130	15-Mar-15	7.87	24.90	15.0	1.66	9.9	4,800	0.49	0.033	-9.9	23.2	220	1.29	130	40	1.79	2.26	7.8	0.02	10	0.03	190	0.1	20	1	0.8	20	430	20	
U216	CAM052814	130	140	15-Mar-15	7.95	16.50	10.9	1.51	5.6	3,500	0.36	0.036	-5.6	22	150	0.76	80	40	1.49	2.59	6.75	0.01	20	0.04	150	0.1	30	2	0.69	20	360	20	
U216	CAM052815	140	150	15-Mar-15	5.77	4.90	36.7	0.13	-31.8	12,000	1.23	0.17	31.8	19.5	3460	0.26	160	30	2.28	2.38	6.05	0.01	20	0.04	2620	0.17	40	4	0.6	40	380	20	0.5
U216	CAM052816	150	160	15-Mar-15	6.85	3.80	49.3	0.08	-45.5	16,000	1.61	0.1	45.5	14.3	670	0.2	320	110	4.43	3.11	3	0.01	20	0.05	340	0.12	20	1	0.39	5	230	20	
U216	CAM052817	160	170	15-Mar-15	7.27	5.30	50.3	0.11	-45.0	16,000	1.63	0.059	45	17.1	540	0.16	260	20	3.17	2.08	5.41	0.01	20	0.04	270	0.11	10	1	0.48	5	300	10	
U216	CAM052818	170	180	15-Mar-15	7.12	4.20	39.9	0.11	-35.7	13,000	1.3	0.065	35.7	15.1	190	0.17	100	20	2.93	2.55	4.05	0.01	10	0.04	140	0.1	10	1	0.46	5	200	10	
U216	CAM052819	180	190	15-Mar-15	7.39	6.60	52.7	0.13	-46.1	17,000	1.7	0.039	46.1	18	200	0.37	120	20	3.13	3.23	4.32	0.01	20	0.06	180	0.26	30	1	0.48	10	290	10	
U216	CAM052820	190	200	15-Mar-15	7.66	5.00	61.9	0.08	-56.9	20,000	1.99	0.032	56.8	17.5	210	0.22	110	20	3.7	1.96	5.75	0.01	20	0.03	210	0.16	10	1	0.5	5	280	10	
U216	CAM052821	200	210	15-Mar-15	7.25	6.80	50.3	0.14	-43.5	16,000	1.62	0.029	43.5	15.5	360	0.16	180	20	3.08	1.34	5.56	0.01	130	0.03	230	0.11	20	1	0.35	5	140	10	
U216	CAM052822	210	220	15-Mar-15	7.58	3.50	43.7	0.08	-40.2	14,000	1.41	0.033	40.2	15.4	110	0.07	60	20	2.87	1.76	4.9	0.01	30	0.04	150	0.05	10	1	0.43	10	230	10	
U216	CAM052823	220	230	15-Mar-15	7.73	4.70	40.9	0.12	-36.2	13,000	1.32	0.036	36.2	17.8	80	0.17	40	20	3.1	1.34	6.93	0.01	10	0.03	140	0.1	10	1	0.62	5	190	10	0.08
U216	CAM052824	230	240	15-Mar-15	7.48	6.80	29.5	0.23	-22.7	9,400	0.96	0.047	22.7	15.3	80	0.31	40	10	2.9	1.64	5.6	0.01	10	0.02	100	0.18	10	1	0.63	5	230	10	
U216	CAM052825	240	250	15-Mar-15	7.22	4.50	30.3	0.15	-25.8	9,700	0.99	0.062	25.8	16.3	160	0.18	50	20	2.42	2.08	5.11	0.01	10	0.04	150	0.14	10	1	0.6	10	210	10	
U243	CAM084088	0	10	27-Jul-14	8.23	15.00	0.5	30.00	14.5	100	0.01	0.005	-15	12.9	50	0.37	20	10	1.82	0.75	10.8	0.01	10	0.03	40	0.26	10	3	0.6		40	10	
U243	CAM084089	10	20	27-Jul-14	8.34	12.10	0.5	24.20	11.6	100	0.01	0.005	-12.1	17.4	60	0.66	40	10	2.19	2.35	10.7	0.01	10	0.04	80	0.41	20	1	0.54		110	10	
U243	CAM084090	20	30	27-Jul-14	8.18	6.00	0.5	12.00	5.5	100	0.01	0.005	-6	16.4	70	0.16	30	10	3.45	3.48	7.26	0.01	10	0.04	80	0.08	10	1	0.71		280	10	
U243	CAM084091	30	40	27-Jul-14	8.16	6.20	0.5	12.40	5.7	100	0.01	0.005	-6.2	16.7	50	0.16	20	20	3.62	2.91	7.76	0.01	10	0.04	60	0.1	10	3	0.96		160	10	
U243	CAM084092	40	50	27-Jul-14	8.25	6.90	1.3	5.31	5.6	400	0.04	0.005	-5.6	17.6	50	0.17	30	50	3.56	2.78	7.54	0.01	10	0.04	80	0.13	10	1	0.88		190	30	
U243	CAM084093	50	60	27-Jul-14	7.74	6.90	50.7	0.14	-43.8	16,000	1.64	0.057	43.8	19	140	0.19	100	180	3.87	2.6	6.98	0.01	10	0.04	150	0.1	10	2	0.79		390	30	
U247	CAM084565	130	140	03-Dec-14	8.10	7.80	24.3	0.32	-16.5	7,800	0.79	0.037	16.5	17.4	90	0.27	60	30	2.2	2.26	5.93	0.01	20	0.02	120	0.18	100		0.77	770	400	140	6.7
U247	CAM084554	20	30	03-Dec-14	8.33	5.30	0.5	10.60	4.8	100	0.01	0.005	-5.3	13.6	80	0.24	10	10	2.44	3.04	4.98	0.01	10	0.02	50	0.14	50		0.56	5	80	30	

Hole ID	Sample ID	FROM	TO	Sampling Date	pH	NP	AP	NPR	NAG	S^{2-}	S	SO_4	NAG	Al2O3	As	CaO	Co	Cu	Fe_2O_3	K_2O	MgO	MnO	Mo	Na_2O	Ni	P_2O_5	Pb	Se	TiO_2	U	V	Zn	^{226}Ra
		(m)	(m)			$gCaCO_3$	$gCaCO_3$			µg/g	%	%	$gCaCO_3$	%	ppm	%	ppm	ppm	%	%	%	%	ppm	%	ppm	%	ppm	ppm	%	ppm	ppm	ppm	Bq/g
U247	CAM084555	30	40	03-Dec-14	8.25	5.80	0.5	11.60	5.3	100	0.01	0.005	-5.8	14.5	20	0.35	10	10	4.23	3.61	7.02	0.02	10	0.04	40	0.22	20		0.65	5	40	20	
U247	CAM084556	40	50	03-Dec-14	8.30	7.80	0.5	15.60	7.3	100	0.01	0.005	-7.8	12.9	80	0.24	10	10	4.39	1.97	10	0.01	10	0.03	40	0.14	10		0.56	20	80	10	
U247	CAM084557	50	60	03-Dec-14	8.41	8.00	0.5	16.00	7.5	100	0.01	0.005	-8	13.9	30	0.25	10	10	4.08	2.99	10.1	0.01	10	0.03	40	0.14	10		0.62	5	90	10	0.03
U247	CAM084558	60	70	03-Dec-14	8.43	8.50	0.5	17.00	8.0	100	0.01	0.005	-8.5	13.2	120	0.24	10	10	3.33	2.68	11.4	0.01	10	0.03	50	0.15	10		0.62	5	90	10	
U247	CAM084559	70	80	03-Dec-14	8.96	9.80	0.5	19.60	9.3	100	0.01	0.005	-9.8	12.8	100	0.16	10	10	3.01	2.45	12.8	0.02	10	0.04	40	0.1	10		0.66	10	90	20	
U247	CAM084560	80	90	03-Dec-14	8.64	8.50	0.5	17.00	8.0	100	0.01	0.005	-8.5	14.8	40	0.34	10	10	3.04	2.89	12.1	0.02	10	0.03	50	0.25	20		0.91	20	90	40	
U247	CAM084561	90	100	03-Dec-14	8.47	6.10	0.5	12.20	5.6	100	0.01	0.005	-6.2	14.1	80	0.19	10	10	2.95	2.49	7.82	0.02	10	0.03	60	0.11	30		0.92	5	100	40	
U247	CAM084564	120	130	03-Dec-14	8.53	6.10	0.5	12.20	5.6	100	0.01	0.005	-6.1	17.9	90	0.22	10	10	1.2	2.52	5.59	0.01	10	0.02	80	0.16	20		0.84	20	400	30	
U247	CAM084552	0	10	03-Dec-14	8.43	7.10	0.6	11.83	6.5	200	0.02	0.005	-6.5	13.8	50	0.31	10	20	2.52	2.83	6.71	0.01	10	0.04	40	0.19	60		0.67	70	100	40	
U247	CAM084553	10	20	03-Dec-14	8.22	7.50	1.1	6.82	6.4	300	0.04	0.018	-6.4	16.7	150	0.34	10	10	3.04	3.62	6.32	0.01	10	0.03	50	0.22	20		0.78	5	120	30	
U247	CAM084562	100	110	03-Dec-14	8.37	4.60	1.3	3.54	3.3	400	0.04	0.005	-3.3	14.1	80	0.13	20	50	3.52	2.49	5.56	0.03	10	0.03	90	0.04	20		0.58	10	290	40	
U247	CAM084563	110	120	03-Dec-14	8.14	6.60	3.5	1.89	3.1	1,100	0.12	0.026	-3.1	17	80	0.26	30	20	2.09	2.83	6.35	0.01	10	0.02	160	0.17	40		0.88	30	410	90	
U247	CAM084566	140	150	03-Dec-14	8.10	12.00	29.9	0.40	-17.9	9,600	0.98	0.065	17.9	20.7	350	0.67	180	20	2.44	3.57	5.92	0.01	120	0.03	170	0.13	40		0.94	30	520	160	
U247	CAM084567	150	160	03-Dec-14	5.87	2.40	67.3	0.04	-64.9	21,500	2.26	0.32	64.9	26.8	4940	0.16	600	60	4.17	4.84	7.34	0.01	380	0.05	3400	0.08	80		1.16	70	660	40	
U247	CAM084568	160	170	03-Dec-14	7.04	4.10	60.8	0.07	-56.7	19,500	1.99	0.13	56.7	18.4	840	0.15	270	40	4.94	4.23	4.18	0.02	40	0.07	480	0.1	20		0.6	5	320	20	
U247	CAM084569	170	181.1	03-Dec-14	8.02	5.10	42.0	0.12	-36.9	13,500	1.36	0.044	36.9	16.5	350	0.15	90	20	2.71	2.36	5.27	0.01	30	0.05	240	0.08	20		0.48	5	240	10	
U282	CAM084002	10	20	17-May-14	7.87	5.50	0.5	11.00	5.0	100	0.01	0.015	-5.5	18.1	20	0.21	10	10	1.71	3.28	6.23	0.01	10	0.04	60	0.1	20	9	0.85	5	140	10	
U282	CAM084003	20	30	17-May-14	7.96	5.10	0.5	10.20	4.6	100	0.01	0.012	-5.1	20.1	50	0.17	20	10	2.02	3.42	6.77	0.01	10	0.05	70	0.11	10	6	0.97	5	150	10	
U282	CAM084004	30	40	17-May-14	7.93	5.20	0.5	10.40	4.7	100	0.01	0.011	-5.2	17.2	40	0.16	20	10	1.93	2.58	5.91	0.01	10	0.04	80	0.11	20	11	0.79	5	120	10	
U282	CAM084001	0	10	17-May-14	7.72	6.40	0.7	9.14	5.7	200	0.03	0.023	-5.7	17.3	30	0.32	30	10	2.07	3.63	6.38	0.01	10	0.04	60	0.18	100	6	0.77	5	110	60	
U282	CAM084005	40	50	17-May-14	7.91	5.20	0.5	10.40	4.7	200	0.02	0.012	-4.7	20.7	40	0.26	20	10	1.97	3.34	7.73	0.01	10	0.04	90	0.18	10	6	0.98	20	140	10	
U282	CAM084006	50	60	17-May-14	8.08	5.70	0.5	11.40	5.2	200	0.02	0.008	-5.2	24.5	40	0.2	10	20	2.02	5.28	6.21	0.01	10	0.08	70	0.12	10	6	0.72	10	140	20	0.09
U282	CAM084007	60	70	17-May-14	7.42	63.30	53.6	1.18	9.7	17,200	1.78	0.19	-9.7	20.8	460	3.04	260	120	4.42	3.9	7.16	0.06	20	0.07	380	0.07	230	15	0.97	5	260	120	0.18
U282	CAM084008	70	80	17-May-14	7.85	12.20	53.8	0.23	-41.6	17,200	1.74	0.053	41.6	14.6	120	0.54	70	10	5.03	2.63	6.06	0.05	10	0.03	100	0.1	60	13	0.61	5	210	10	
U282	CAM084009	80	90	17-May-14	7.38	6.00	61.1	0.10	-55.1	19,500	1.97	0.049	55.1	15.2	70	0.16	60	10	4.66	2.43	5.8	0.02	10	0.05	120	0.1	10	12	0.4	5	220	10	
U282	CAM084010	90	100	17-May-14	7.61	5.60	65.8	0.09	-60.2	21,000	2.12	0.04	60.2	13.7	190	0.14	80	10	3.73	1.57	5.03	0.01	30	0.04	180	0.1	30	10	0.36	5	230	10	
U282	CAM084011	100	110	17-May-14	7.78	6.00	32.5	0.19	-26.5	10,400	1.05	0.034	26.5	16.9	80	0.12	50	10	3.34	2.68	6.04	0.02	20	0.05	90	0.09	20	7	0.48	5	280	10	
U282	CAM084012	110	120	17-May-14	7.29	5.30	56.2	0.09	-50.9	18,000	1.82	0.061	50.9	17	500	0.14	230	10	3.15	2.83	5.16	0.01	30	0.05	260	0.1	50	12	0.45	5	300	10	
U282	CAM084013	120	128.6	17-May-14	7.65	5.50	51.8	0.11	-46.3	16,600	1.67	0.037	46.3	13.9	270	0.14	130	10	2.94	2.02	4.71	0.01	10	0.04	130	0.1	20	3	0.43	5	170	30	
U306	CAM084014	0	10	15-May-14	8.90	9.20	0.5	18.40	8.7	100	0.01	0.013	-9.2	16	50	0.34	50	10	2.15	2.78	7.22	0.01	10	0.04	100	0.11	10	9	0.74	5	130	10	0.1
U306	CAM084015	10	20	15-May-14	7.82	5.90	0.5	11.80	5.4	100	0.01	0.005	-5.9	16.5	20	0.2	20	10	2.44	2.62	7.18	0.01	10	0.04	70	0.13	10	5	0.78	5	120	10	
U306	CAM084016	20	30	15-May-14	7.94	5.70	0.5	11.40	5.2	100	0.01	0.005	-5.7	17	20	0.19	10	10	1.9	3.35	5.51	0.01	10	0.04	70	0.12	10	8	0.74	5	120	20	
U306	CAM084017	30	40	15-May-14	7.95	7.80	0.5	15.60	7.3	100	0.01	0.005	-7.8	16.9	40	0.14	10	10	1.6	2.78	6.52	0.01	10	0.03	70	0.08	10	5	0.87	5	140	10	
U306	CAM084018	40	50	15-May-14	7.73	62.40	321.2	0.19	-258.8	103,000	10.3	0.063	258.8	16.6	860	3.14	580	280	17.5	1.58	6.76	0.05	30	0.03	590	0.07	70	17	0.72	5	170	30	
U306	CAM084019	50	60	15-May-14	8.04	10.70	42.0	0.26	-31.3	13,400	1.35	0.019	31.3	19.1	140	0.37	80	10	2.91	1.86	7.25	0.01	10	0.05	170	0.11	10	9	0.63	5	260	10	
U306	CAM084020	60	70	15-May-14	7.57	6.80	44.9	0.15	-38.1	14,400	1.45	0.041	38.1	20.1	730	0.18	410	20	3.76	3.16	7.02	0.02	20	0.05	310	0.11	30	10	0.92	5	400	10	
U306	CAM084021	70	80	15-May-14	7.72	6.60	63.8	0.10	-57.2	20,400	2.05	0.03	57.2	15.2	120	0.08	80	20	4.74	1.93	5.89	0.02	10	0.04	150	0.08	20	9	0.52	5	250	10	0.07
U306	CAM084022	80	90	15-May-14	6.88	8.80	62.1	0.14	-53.3	19,900	2.02	0.096	53.3	25.1	1700	0.39	680	20	4.67	4.36	7.72	0.02	50	0.08	800	0.35	40	11	0.64	20	390	20	0.25
U306	CAM084023	90	100	15-May-14	7.33	5.50	59.0	0.09	-53.5	18,900	1.9	0.032	53.5	17.4	570	0.13	290	10	4.99	4.1	4.46	0.03	20	0.08	260	0.11	10	12	0.5	5	330	30	
U306	CAM084024	100	110	15-May-14	7.64	5.00	70.0	0.07	-65.0	22,400	2.25	0.029	65	16.7	160	0.13	90	10	4.14	1.74	6.06	0.01	20	0.04	190	0.1	10	15	0.44	5	320	10	
U306	CAM084025	110	120	15-May-14	7.87	5.50	51.6	0.11	-46.1	16,500	1.66	0.028	46.1	17.5	220	0.13	120	10	3.06	1.92	6.11	0.01	20	0.04	210	0.1	10	11	0.48	5	350	10	

Hole ID	Sample ID	FROM (m)	TO (m)	Sampling Date	pH	NP $gCaCO_3$	AP $gCaCO_3$	NPR	NAG	S^{2-} µg/g	S %	SO_4 %	NAG $gCaCO_3$	Al2O3 %	As ppm	CaO %	Co ppm	Cu ppm	Fe_2O_3 %	K_2O %	MgO %	MnO %	Mo ppm	Na_2O %	Ni ppm	P_2O_5 %	Pb ppm	Se ppm	TiO_2 %	U ppm	V ppm	Zn ppm	^{226}Ra Bq/g
U306	CAM084026	120	130	15-May-14	7.62	7.90	74.1	0.11	-66.2	23,700	2.39	0.052	66.2	24.5	910	0.22	460	10	4.3	3.36	7.8	0.01	20	0.08	430	0.13	20	12	0.73	10	400	20	
U306	CAM084027	130	140	15-May-14	6.93	7.70	131.9	0.06	-124.2	42,200	4.25	0.09	124.2	20.8	300	0.36	150	20	7.68	2.64	6.84	0.01	40	0.05	170	0.28	630	15	0.5	5	270	20	
U306	CAM084028	140	150	15-May-14	7.67	7.90	79.9	0.10	-72.0	25,600	2.58	0.074	72	28.2	380	0.21	210	20	5.14	3.48	9.21	0.01	20	0.08	220	0.18	30	12	0.6	5	270	40	
U306	CAM084029	150	160	15-May-14	7.68	74.00	168.8	0.44	-94.8	54,000	5.44	0.12	94.8	24.8	160	4.16	130	70	10.1	3.1	10.1	0.03	20	0.07	160	1.29	140	19	0.57	90	270	1140	
U306	CAM084030	160	170	15-May-14	7.94	34.40	44.9	0.77	-10.5	14,400	1.45	0.043	10.4	23.5	50	1.24	60	70	2.68	4.78	5.97	0.02	10	0.06	90	0.13	90	10	0.65	60	330	330	1.1
U306	CAM084031	170	180	15-May-14	8.11	5.70	10.8	0.53	-5.1	3,500	0.35	0.011	5.1	21.1	70	0.2	20	10	1.43	3.2	6	0.01	10	0.05	80	0.14	20	6	0.56	5	170	20	0.18
U318	CAM084032	0	10	15-May-14	7.91	6.60	43.6	0.15	-37.0	14,000	1.4	0.015	37	13.4	80	0.19	50	10	3.11	2.13	4.6	0.01	10	0.03	60	0.14	10	5	0.41	5	90	10	
U318	CAM084033	10	20	15-May-14	7.87	4.40	27.6	0.16	-23.2	8,800	0.89	0.019	23.2	13.6	80	0.23	40	10	2.19	2.36	4.22	0.01	10	0.03	70	0.17	10	6	0.46	5	80	10	
U318	CAM084034	20	30	15-May-14	7.69	5.50	45.3	0.12	-39.8	14,500	1.46	0.036	39.8	13.4	60	0.26	50	10	2.55	1.93	4.5	0.01	10	0.03	100	0.19	20	7	0.47	5	70	10	
U318	CAM084035	30	40	15-May-14	7.87	6.00	58.4	0.10	-52.4	18,700	1.88	0.033	52.4	16.3	170	0.21	80	10	3.26	2.19	5.44	0.01	10	0.04	110	0.13	10	7	0.44	5	120	10	
U318	CAM084036	40	50	15-May-14	7.27	4.10	73.7	0.06	-69.6	23,600	2.38	0.069	69.6	19.3	940	0.27	510	20	4.19	3.27	5.45	0.01	10	0.05	310	0.13	20	9	0.52	10	160	30	
U318	CAM084037	50	60	15-May-14	7.68	8.20	67.4	0.12	-59.2	21,600	2.17	0.041	59.2	22.6	720	0.21	400	20	4.21	2.82	7.64	0.01	10	0.05	270	0.16	10	10	0.65	5	240	10	
U318	CAM084038	60	70	15-May-14	7.94	5.40	52.3	0.10	-46.9	16,700	1.68	0.024	46.9	18.7	370	0.2	210	10	2.9	2.94	5.83	0.01	10	0.05	160	0.13	10	8	0.49	5	190	10	
U338	CAM084058	0	10	15-May-14	7.66	5.20	0.5	10.40	4.7	100	0.01	0.008	-5.2	16.8	40	0.2	20	10	1.77	2.76	5.68	0.01	10	0.04	70	0.13	120	28	0.82	5	130	50	
U338	CAM084059	10	20	15-May-14	7.72	13.90	0.5	27.80	13.4	100	0.01	0.012	-13.9	25.1	20	0.26	20	10	1.66	4.14	7.42	0.01	10	0.07	120	0.18	70	4	1.2	5	190	40	
U338	CAM084060	20	30	15-May-14	7.95	6.40	0.8	8.00	5.6	300	0.03	0.009	-5.6	23	40	0.16	30	70	1.5	4.04	6.83	0.01	10	0.05	120	0.11	20	8	0.95	20	170	10	
U338	CAM084061	30	40	15-May-14	7.98	68.00	35.2	1.93	32.8	11,300	1.14	0.037	-32.8	27.6	3670	3.56	2160	100	2.68	3.81	9.06	0.07	10	0.07	870	0.1	30	11	0.89	10	350	310	
U338	CAM084062	40	50	15-May-14	7.73	42.20	44.7	0.94	-2.5	14,300	1.45	0.056	2.5	29.2	1300	1.94	680	90	3.14	2.96	10.9	0.02	10	0.06	420	0.18	30	10	1.18	5	460	50	
U338	CAM084063	50	60	15-May-14	7.52	8.70	55.9	0.16	-47.2	17,900	1.81	0.063	47.2	28.3	770	0.27	410	30	3.97	2.53	11.4	0.01	20	0.06	440	0.15	30	12	1.43	20	600	80	
U338	CAM084064	60	70	15-May-14	6.94	4.00	103.5	0.04	-99.5	33,100	3.34	0.084	99.5	27.3	2020	0.17	470	50	6.18	4.59	8.13	0.01	30	0.06	1320	0.11	20	15	0.96	10	450	40	
U348	CAM084039	0	10	15-May-14	8.35	6.00	36.6	0.16	-30.6	11,700	1.18	0.03	30.6	14.3	20	0.2	30	40	2.81	2.12	4.68	0.01	10	0.04	60	0.09	10	5	0.39	10	150	10	
U348	CAM084040	10	20	15-May-14	7.62	4.40	40.0	0.11	-35.6	12,800	1.29	0.03	35.6	15.7	30	0.13	30	130	3.52	2.27	5.35	0.01	10	0.04	70	0.09	10	6	0.48	5	230	10	
U348	CAM084041	20	30	15-May-14	8.01	6.70	41.0	0.16	-34.3	13,100	1.32	0.02	34.3	15.8	40	0.27	40	20	4.2	2.36	5.82	0.02	10	0.03	80	0.16	30	5	0.66	5	180	10	
U348	CAM084042	30	40	15-May-14	7.84	5.50	32.0	0.17	-26.5	10,200	1.03	0.021	26.5	14.6	20	0.16	20	40	4.97	2.86	4.9	0.03	10	0.04	60	0.14	10	11	0.53	5	210	40	
U348	CAM084043	40	50	15-May-14	7.77	5.00	38.2	0.13	-33.2	12,200	1.23	0.019	33.2	13.4	10	0.13	10	230	2.82	2.19	3.81	0.01	10	0.06	20	0.15	10	8	0.14	5	40	10	
U348	CAM084044	50	60	15-May-14	7.87	5.10	17.9	0.29	-12.8	5,700	0.58	0.018	12.8	12.9	10	0.1	10	70	1.82	1.71	4.23	0.01	10	0.04	30	0.1	10	9	0.27	5	90	10	
U348	CAM084045	60	70	15-May-14	7.79	6.20	45.7	0.14	-39.5	14,600	1.47	0.02	39.5	14.6	60	0.25	20	100	4.64	2.14	5.51	0.02	10	0.04	60	0.18	10	11	0.53	5	210	10	0.2
U348	CAM084046	70	80	15-May-14	7.85	7.90	32.2	0.25	-24.3	10,300	1.04	0.018	24.4	16.6	70	0.38	20	50	3.4	2.38	6.04	0.01	10	0.04	60	0.28	20	15	0.56	5	180	10	0.11
U348	CAM084047	80	90	15-May-14	7.93	5.70	47.0	0.12	-41.3	15,100	1.51	0.014	41.3	14.6	80	0.16	40	40	3.69	2.61	4.97	0.01	10	0.02	80	0.1	80	7	0.6	5	180	10	
U348	CAM084048	90	100	15-May-14	8.01	5.00	36.1	0.14	-31.1	11,200	1.16	0.015	31.1	15.5	150	0.19	70	30	4.07	3.12	5.2	0.02	10	0.03	100	0.14	10	11	0.57	5	200	20	0.14
U348	CAM084049	100	110	15-May-14	7.93	5.00	23.3	0.22	-18.3	7,500	0.75	0.011	18.3	15.6	60	0.19	30	20	4.42	3.1	5.58	0.04	10	0.03	70	0.14	20	13	0.62	5	210	30	
U348	CAM084050	110	120	15-May-14	7.46	4.20	59.8	0.07	-55.6	19,100	1.92	0.024	55.6	15.1	120	0.12	60	10	4.78	3.2	4.31	0.02	10	0.05	120	0.07	10	16	0.43	5	190	20	
U348	CAM084051	120	130	15-May-14	7.63	4.20	41.3	0.10	-37.1	13,200	1.33	0.022	37.1	16.3	120	0.1	80	10	5.7	3.68	4.88	0.03	20	0.05	120	0.08	10	11	0.66	5	320	20	
U348	CAM084052	130	140	15-May-14	7.78	5.20	51.4	0.10	-46.2	16,400	1.65	0.016	46.2	15.5	40	0.12	40	10	4.52	2.71	5.29	0.02	20	0.04	120	0.09	10	11	0.53	5	290	10	
U348	CAM084053	140	150	15-May-14	7.65	5.00	74.5	0.07	-69.5	23,800	2.39	0.022	69.5	16.4	170	0.13	80	10	5.14	2.55	5.55	0.01	30	0.04	200	0.09	10	11	0.54	5	340	10	
U348	CAM084054	150	160	15-May-14	7.79	4.70	47.6	0.10	-42.9	15,200	1.53	0.018	42.9	15.6	90	0.16	50	10	2.84	1.86	5.74	0.01	20	0.03	120	0.12	10	9	0.46	5	260	10	
U348	CAM084055	160	170	15-May-14	7.83	6.20	36.9	0.17	-30.7	11,800	1.19	0.023	30.7	16.8	140	0.21	60	10	2.62	2.04	6.16	0.01	20	0.03	110	0.15	20	7	0.45	10	300	10	
U348	CAM084056	170	180	15-May-14	7.53	7.20	87.6	0.08	-80.4	28,000	2.82	0.052	80.4	15.3	70	0.13	70	20	5.22	1.48	6.38	0.01	20	0.03	190	0.09	10	15	0.5	5	290	10	
U348	CAM084057	180	189.3	15-May-14	7.50	6.00	65.5	0.09	-59.5	21,000	2.11	0.043	59.5	15.7	120	0.13	90	20	4.54	1.97	5.9	0.01	20	0.04	180	0.08	10	15	0.52	5	340	10	
U353	CAM084065	0	10	15-May-14	7.41	8.90	100.3	0.09	-91.4	32,100	3.24	0.092	91.4	26.4	2870	0.24	1170	20	5.88	2.65	9.37	0.01	40	0.07	1020	0.13	50	17	0.63	5	480	20	
U353	CAM084066	11	20	15-May-14	7.33	5.70	96.7	0.06	-91.0	30,900	3.11	0.048	91	18.5	1050	0.17	460	30	6.06	3.63	4.89	0.02	30	0.07	380	0.13	20	14	0.51	5	380	30	

Hole ID	Sample ID	FROM	TO	Sampling Date	pH	NP	AP	NPR	NAG	S^{2-}	S	SO_4	NAG	Al2O3	As	CaO	Co	Cu	Fe_2O_3	K_2O	MgO	MnO	Mo	Na_2O	Ni	P_2O_5	Pb	Se	TiO_2	U	V	Zn	^{226}Ra
		(m)	(m)			$gCaCO_3$	$gCaCO_3$			µg/g	%	%	$gCaCO_3$	%	ppm	%	ppm	ppm	%	%	%	%	ppm	%	ppm	%	ppm	ppm	%	ppm	ppm	ppm	Bq/g
U353	CAM084067	21	30	15-May-14	7.46	6.50	59.3	0.11	-52.8	19,000	1.91	0.037	52.8	17	170	0.14	80	20	5.16	3.98	4.22	0.04	30	0.09	140	0.11	20	12	0.48	5	310	20	
U353	CAM084068	31	40	15-May-14	7.59	5.20	46.2	0.11	-41.0	14,800	1.49	0.034	41	16.3	200	0.13	110	10	4.3	2.85	5.45	0.02	20	0.05	150	0.1	10	14	0.53	5	280	10	
U353	CAM084069	41	50	15-May-14	7.51	12.90	50.0	0.26	-37.1	16,000	1.62	0.057	37.1	23.8	1410	0.47	720	30	3.9	3.12	8.81	0.02	10	0.06	500	0.19	10	8	0.95	5	400	20	
U353	CAM084070	51	60	15-May-14	7.86	3.00	20.8	0.14	-17.8	6,600	0.67	0.018	17.8	20.3	50	0.15	30	70	1.57	4.77	3.84	0.01	10	0.05	60	0.09	60	7	0.35	20	120	30	
U353	CAM084071	61	70	15-May-14	7.77	15.60	35.9	0.44	-20.3	11,500	1.16	0.036	20.3	22	60	0.66	50	20	2.33	4.2	5.64	0.01	10	0.05	100	0.36	140	8	0.73	30	280	60	
U353	CAM084072	71	80	15-May-14	7.86	20.80	42.7	0.49	-21.9	13,700	1.38	0.045	21.9	31.2	70	0.77	90	240	2.99	5.66	8.16	0.01	20	0.08	120	0.18	140	11	0.82	30	340	570	0.66
U353	CAM084073	81	90	15-May-14	7.87	18.00	64.9	0.28	-46.9	20,800	2.1	0.069	46.9	29.7	70	0.71	100	30	4.37	3.94	9.91	0.01	10	0.08	140	0.28	160	11	0.72	20	220	420	
U353	CAM084074	91	100	15-May-14	7.52	11.60	71.2	0.16	-59.6	22,800	2.3	0.063	59.6	26.2	180	0.53	130	20	4.77	3.42	8.7	0.01	10	0.07	180	0.4	20	15	0.6	5	260	90	
U353	CAM084075	101	110	15-May-14	7.29	6.20	115.9	0.05	-109.7	37,100	3.73	0.062	109.7	18.1	260	0.2	160	30	6.94	2.01	6.37	0.01	10	0.04	240	0.13	20	7	0.43	40	240	10	
U353	CAM084076	111	121	15-May-14	6.83	6.50	81.1	0.08	-74.6	26,000	2.6	0.12	74.6	26.7	7900	0.25	4380	20	4.47	3.81	8.4	0.01	100	0.08	1790	0.16	140	12	0.68	10	370	20	
U374	CAM084078	10	20	15-Jul-14	8.05	13.50	0.5	27.00	13.0	100	0.01	0.005	-13.5	13.1	80	0.28	40	10	1.83	0.58	12.1	0.01	10	0.02	50	0.16	10	1	0.46		60	10	
U374	CAM084079	20	30	15-Jul-14	8.10	15.20	0.5	30.40	14.7	100	0.01	0.005	-15.2	12.9	60	0.33	20	10	1.94	0.6	14.1	0.01	10	0.03	40	0.18	10	1	0.25		40	10	
U374	CAM084080	30	40	15-Jul-14	8.32	18.10	0.5	36.20	17.6	100	0.01	0.005	-18.1	13.5	60	0.33	30	10	2.4	0.93	17.5	0.01	10	0.03	60	0.19	20	1	0.48		50	10	
U374	CAM084077	0	10	15-Jul-14	8.30	15.20	5.6	2.71	9.6	2,000	0.18	0.007	-9.6	14.4	180	0.27	20	20	2.33	0.73	19.2	0.02	10	0.03	50	0.15	20	1	0.63		90	10	
U376	CAM084082	10	20	27-Jul-14	8.23	11.50	0.5	23.00	11.0	100	0.01	0.005	-11.5	14.7	60	0.36	20	10	2.04	1.73	10.4	0.01	10	0.39	40	0.2	140	3	0.26		40	10	
U376	CAM084083	20	30	27-Jul-14	8.44	14.70	0.5	29.40	14.2	100	0.01	0.005	-14.7	14.8	60	0.32	20	10	3.93	1.94	15.5	0.01	10	0.03	50	0.2	20	1	0.68		100	20	
U376	CAM084085	40	50	27-Jul-14	8.25	7.60	0.5	15.20	7.1	100	0.01	0.005	-7.6	18	50	0.21	20	10	2.58	2.35	8.89	0.01	10	0.03	100	0.12	20	1	0.84		140	10	
U376	CAM084081	0	10	27-Jul-14	8.40	20.40	0.6	34.00	19.8	200	0.02	0.005	-19.8	8.99	70	0.36	40	10	3.2	0.38	17.4	0.01	10	0.03	30	0.16	50	1	0.36		60	20	
U376	CAM084084	30	40	27-Jul-14	8.35	6.60	1.3	5.08	5.3	400	0.04	0.005	-5.3	17.8	50	0.23	20	10	2.85	3.58	8.75	0.01	10	0.04	50	0.11	10	1	0.83		130	10	
U376	CAM084086	50	60	27-Jul-14	8.12	4.90	0.6	8.17	4.3	200	0.02	0.005	-4.3	20.4	40	0.23	20	10	1.69	4.15	5.81	0.01	10	0.05	100	0.13	30	1	0.97		160	30	
U376	CAM084087	60	70	27-Jul-14	8.13	6.80	1.8	3.78	5.0	600	0.06	0.006	-5	17.5	40	0.18	20	10	2.38	2.34	7.92	0.01	10	0.04	100	0.1	20	1	0.88		150	10	
U377	CAM084538	0	10	27-Jul-14	8.46	15.80	0.5	31.60	15.3	100	0.01	0.01	-15.8	14.3	70	0.35	30	10	2.95	0.78	19.3	0.01	10	0.03	50	0.2	20	1	0.5		70	20	
U377	CAM084542	40	50	27-Jul-14	8.51	8.80	0.5	17.60	8.3	100	0.01	0.005	-8.8	16.6	60	0.35	40	20	8.22	4.78	5.93	0.2	10	0.35	60	0.09	10	1	0.77		130	20	
U377	CAM084544	60	70	27-Jul-14	8.39	7.60	0.5	15.20	7.1	100	0.01	0.005	-7.6	16.8	70	0.19	40	10	7.55	4.38	5.57	0.14	10	0.17	60	0.1	20	2	0.76		140	20	
U377	CAM084545	70	80	27-Jul-14	8.42	8.40	0.5	16.80	7.9	100	0.01	0.005	-8.4	17.2	50	0.21	40	20	5.77	3.86	7.61	0.05	10	0.11	60	0.11	10	1	0.79		120	10	
U377	CAM084547	90	100	27-Jul-14	8.35	7.90	0.5	15.80	7.4	100	0.01	0.005	-7.9	16.6	50	0.16	30	10	5.08	3.24	7.52	0.02	10	0.06	60	0.08	10	1	0.84		140	10	
U377	CAM084548	100	110	27-Jul-14	8.19	4.30	0.5	8.60	3.8	100	0.01	0.005	-4.3	20.6	50	0.17	20	10	3.27	3.58	6.97	0.01	10	0.04	70	0.08	10	1	1.07		170	10	
U377	CAM084549	110	120	27-Jul-14	8.14	4.30	0.5	8.60	3.8	100	0.01	0.005	-4.3	21.9	50	0.14	20	10	2.37	3.61	7.34	0.01	10	0.04	90	0.08	10	1	1.11		170	10	
U377	CAM084539	10	20	27-Jul-14	8.39	13.50	0.6	22.50	12.9	200	0.02	0.006	-12.9	13.5	50	0.35	30	10	3.16	0.88	16.9	0.01	10	0.03	50	0.22	20	1	0.5		110	10	
U377	CAM084543	50	60	27-Jul-14	8.43	11.20	0.6	18.67	10.6	200	0.02	0.005	-10.6	17.9	70	0.28	40	20	6.37	4.1	8.31	0.11	10	0.13	60	0.11	20	1	0.88		140	20	
U377	CAM084546	80	90	27-Jul-14	8.66	10.80	0.9	12.00	9.9	300	0.03	0.005	-9.9	17.4	40	0.32	50	20	8.59	6.29	6.15	0.28	10	0.23	60	0.12	10	1	0.86		140	20	
U377	CAM084540	20	30	27-Jul-14	8.21	7.40	4.0	1.85	3.4	1,300	0.13	0.01	-3.4	17.3	40	0.21	40	30	4.94	2.99	9.83	0.03	10	0.04	50	0.13	20	1	0.76		190	20	
U377	CAM084541	30	40	27-Jul-14	8.07	7.40	7.3	1.01	0.1	2,300	0.24	0.016	0.5	17.4	70	0.16	30	20	5.49	2.92	7.9	0.03	10	0.05	60	0.11	30	1	0.84		190	10	
U385	CAM085401	0	10	28-Jan-15	8.09	7.10	0.5	14.20	6.6	100	0.01	0.005	-7.1	16.6	70	0.24	50	40	2.21	3.66	6.22	0.01	10	0.03	120	0.13	20		0.79	60	170	30	0.21
U385	CAM085403	20	30	28-Jan-15	8.01	8.70	0.5	17.40	8.2	100	0.01	0.005	-8.7	13.4	10	0.24	10	10	4.22	2.43	10.4	0.01	10	0.02	50	0.15	10		0.58	10	60	10	
U385	CAM085405	40	50	28-Jan-15	7.97	6.80	0.5	13.60	6.3	100	0.01	0.005	-6.8	13.7	20	0.26	10	10	4.51	3.25	11	0.01	10	0.04	50	0.15	10		0.62	5	80	10	0.02
U385	CAM085406	50	60	28-Jan-15	8.20	9.40	0.5	18.80	8.9	100	0.01	0.005	-9.4	13.7	40	0.22	10	10	4.1	2.48	13.5	0.02	10	0.07	50	0.13	10		0.63	10	70	20	
U385	CAM085407	60	70	28-Jan-15	8.11	10.10	0.5	20.20	9.6	100	0.01	0.005	-10.1	13.8	10	0.31	10	10	3.74	2.11	11.9	0.02	10	0.04	40	0.2	10		0.52	20	60	10	
U385	CAM085408	70	80	28-Jan-15	7.66	9.00	0.5	18.00	8.5	100	0.01	0.005	-9	13.5	10	0.5	10	10	2.27	2.05	6.07	0.01	10	0.07	20	0.4	10		0.26	30	30	10	
U385	CAM085409	80	90	28-Jan-15	7.64	6.10	0.5	12.20	5.6	100	0.01	0.005	-6.1	13.4	10	0.24	10	10	3.61	3.34	7.52	0.02	10	0.03	50	0.12	10		0.61	10	80	10	
U385	CAM085410	90	100	28-Jan-15	7.73	5.60	0.5	11.20	5.1	100	0.01	0.005	-5.6	17.4	10	0.17	20	10	2.32	3.31	7.06	0.01	10	0.02	80	0.08	40		1.22	10	240	30	

Hole ID	Sample ID	FROM	TO	Sampling Date	pH	NP	AP	NPR	NAG	S^{2-}	S	SO_4	NAG	Al2O3	As	CaO	Co	Cu	Fe_2O_3	K_2O	MgO	MnO	Mo	Na_2O	Ni	P_2O_5	Pb	Se	TiO_2	U	V	Zn	^{226}Ra
		(m)	(m)			$gCaCO_3$	$gCaCO_3$			µg/g	%	%	$gCaCO_3$	%	ppm	%	ppm	ppm	%	%	%	%	ppm	%	ppm	%	ppm	ppm	%	ppm	ppm	ppm	Bq/g
U385	CAM085402	10	20	28-Jan-15	7.93	7.30	1.9	3.84	5.4	600	0.06	0.005	-5.4	15.8	30	0.3	20	10	3.6	4.06	8	0.01	10	0.04	60	0.18	10		0.66	20	70	10	
U385	CAM085404	30	40	28-Jan-15	8.02	7.00	0.9	7.78	6.1	300	0.03	0.005	-6.1	14.8	10	0.26	10	10	5.14	3.43	8.57	0.01	10	0.04	40	0.15	10		0.66	20	80	10	
U385	CAM085411	100	110	28-Jan-15	8.07	10.70	1.9	5.63	8.8	600	0.06	0.005	-8.8	16.7	10	0.38	10	20	1.5	2	6.17	0.01	10	0.02	90	0.13	20		0.72	10	350	20	
U385	CAM085413	120	130	28-Jan-15	7.86	6.60	3.8	1.74	2.8	1,200	0.12	0.005	-2.8	19.3	20	0.19	30	10	1.06	2.51	5.46	0.01	10	0.02	90	0.14	20		0.7	20	340	10	
U385	CAM085412	110	120	28-Jan-15	7.97	7.50	6.1	1.23	1.4	2,000	0.2	0.012	-1.4	18.4	30	0.24	20	10	1.13	2.29	5.43	0.01	40	0.02	80	0.09	40		0.68	20	380	10	
U385	CAM085414	130	140	28-Jan-15	7.62	5.60	37.8	0.15	-32.2	12,000	1.22	0.035	32.2	17.4	140	0.16	140	30	2.24	2.46	5.17	0.01	50	0.03	150	0.09	40		0.72	40	390	10	
U385	CAM085415	140	150	28-Jan-15	7.96	6.80	24.6	0.28	-17.8	7,900	0.79	0.013	17.8	18.8	110	0.19	100	10	1.94	2.58	5.91	0.01	10	0.03	190	0.11	20		0.77	10	440	10	
U385	CAM085416	150	160	28-Jan-15	7.49	5.60	71.0	0.08	-65.4	23,000	2.29	0.05	65.4	16.7	450	0.14	280	20	4.69	3.6	4.3	0.02	20	0.05	310	0.08	70		0.69	20	290	20	
U385	CAM085417	160	170	28-Jan-15	7.84	6.50	62.0	0.11	-55.5	20,000	1.99	0.018	55.5	15.2	80	0.14	60	10	3.4	2.09	4.82	0.01	20	0.04	150	0.08	10		0.47	5	230	10	
U385	CAM085418	170	180	28-Jan-15	7.79	10.70	54.7	0.20	-44.0	18,000	1.76	0.026	44	15.8	320	0.45	140	20	3.14	2.37	4.91	0.01	10	0.04	180	0.34	20		0.48	10	260	40	0.12
U385	CAM085419	180	190	28-Jan-15	7.70	5.60	28.8	0.19	-23.2	9,200	0.93	0.023	23.2	13.8	310	0.13	200	20	2.27	2.49	3.62	0.01	20	0.04	150	0.09	20		0.41	10	170	10	
U385	CAM085420	190	200	28-Jan-15	7.88	9.20	64.5	0.14	-55.3	21,000	2.08	0.045	55.2	19	450	0.34	260	50	3.77	2.75	5.63	0.01	70	0.05	270	0.25	20		0.58	10	430	20	
U385	CAM085421	200	210	28-Jan-15	7.92	8.50	35.8	0.24	-27.3	11,000	1.15	0.018	27.3	18.4	50	0.23	90	20	2.17	2.06	6.28	0.01	20	0.04	140	0.16	10		0.52	5	300	20	
U385	CAM085422	210	220	28-Jan-15	7.74	8.50	58.4	0.15	-49.9	19,000	1.88	0.03	49.9	18.7	260	0.17	140	20	3.32	2.45	6.29	0.01	20	0.04	180	0.13	20		0.67	5	260	10	
U385	CAM085423	220	230	28-Jan-15	7.78	8.70	32.6	0.27	-23.9	10,000	1.05	0.024	23.9	16.8	180	0.17	80	10	2.21	1.36	6.43	0.01	20	0.03	160	0.12	20		0.53	5	250	10	
U385	CAM085424	230	240	28-Jan-15	8.09	9.10	27.3	0.33	-18.2	8,700	0.93	0.17	18.2	18.3	40	0.22	50	20	2	1.77	6.85	0.01	10	0.03	110	0.13	20		0.63	5	280	20	
U385	CAM085425	240	250	28-Jan-15	7.96	9.40	45.1	0.21	-35.7	14,000	1.45	0.018	35.7	16.4	120	0.23	80	10	2.52	1.43	6.21	0.01	10	0.03	110	0.18	20		0.61	5	230	10	
U385	CAM085426	250	260	28-Jan-15	7.90	18.80	172.9	0.11	-154.1	55,000	5.55	0.055	154.1	13.7	110	0.87	90	20	8.38	1.3	4.86	0.01	20	0.03	140	0.27	200		0.44	20	200	10	
U385	CAM085427	260	270	28-Jan-15	7.93	9.20	41.4	0.22	-32.2	13,000	1.33	0.012	32.2	16.7	10	0.18	40	10	3.3	1.79	6.43	0.01	10	0.02	100	0.13	20		0.75	5	200	10	
U385	CAM085428	270	279.4	28-Jan-15	7.97	6.90	25.8	0.27	-18.9	8,200	0.83	0.014	18.9	16.1	10	0.15	50	20	2.35	1.75	5.48	0.01	10	0.02	80	0.07	40		0.65	5	230	20	0.14
U409	CAM084570	0	10	03-Dec-14	8.55	4.40	59.8	0.07	-55.4	19,100	1.92	0.018	55.4	19.8	100	0.13	60	20	3.86	2.57	6.65	0.01	10	0.04	130	0.07	20		0.58	5	260	20	
U409	CAM084571	10	20	03-Dec-14	8.42	5.80	47.7	0.12	-41.9	15,300	1.53	0.014	41.9	16.6	160	0.15	60	10	3.07	1.71	5.9	0.01	10	0.04	110	0.1	10		0.42	5	130	10	
U409	CAM084572	20	30	03-Dec-14	8.07	4.90	49.2	0.10	-44.3	15,800	1.58	0.014	44.3	17.3	130	0.14	50	10	3.65	2.8	5.58	0.01	10	0.04	100	0.09	20		0.68	5	270	30	
U409	CAM084573	30	40	03-Dec-14	8.21	5.60	50.2	0.11	-44.6	16,100	1.61	0.011	44.6	14.7	80	0.15	40	10	3.38	2.77	4.21	0.01	10	0.05	70	0.08	10		0.37	5	120	20	
U409	CAM084574	40	50	03-Dec-14	8.13	5.30	46.5	0.11	-41.2	14,900	1.49	0.008	41.2	16.1	170	0.19	60	10	2.55	3.4	3.99	0.01	10	0.04	90	0.1	10		0.53	5	230	10	
U409	CAM084575	50	60	03-Dec-14	8.25	5.80	61.4	0.09	-55.6	19,700	1.97	0.013	55.6	16.1	200	0.19	70	10	3.24	2.81	4.44	0.01	10	0.05	100	0.11	20		0.42	5	160	10	
U409	CAM084576	60	70	03-Dec-14	7.52	5.80	79.4	0.07	-73.6	25,400	2.55	0.031	73.6	18	1010	0.29	250	20	3.93	2.8	5.14	0.01	60	0.05	400	0.22	20		0.51	5	250	10	
U409	CAM084577	70	80	03-Dec-14	7.80	6.10	45.7	0.13	-39.6	14,600	1.47	0.021	39.6	18.6	460	0.18	210	10	2.61	2.69	5.48	0.01	30	0.05	230	0.13	20		0.46	5	230	10	
U409	CAM084578	80	90	03-Dec-14	7.85	6.30	85.7	0.07	-79.4	27,400	2.75	0.024	79.4	15.7	330	0.16	210	20	4.73	1.95	5.21	0.01	20	0.04	270	0.1	20		0.45	5	310	10	
U409	CAM084579	90	100.8	03-Dec-14	7.89	5.80	70.1	0.08	-64.3	22,400	2.25	0.025	64.3	16.3	180	0.16	100	20	4.96	2.99	4.87	0.02	20	0.04	200	0.1	20		0.53	5	250	10	
U410	CAM084580	0	10	06-Dec-14	7.94	6.10	0.5	12.20	5.6	100	0.01	0.005	-6.1	17.7	50	0.15	10	10	2.24	2.82	6.61	0.01	10	0.04	90	0.07	20		0.76	5	140	10	
U410	CAM084581	10	20	06-Dec-14	7.85	5.70	0.5	11.40	5.2	100	0.01	0.005	-5.7	21.6	90	0.2	10	10	1.52	3.32	6.9	0.01	10	0.04	150	0.11	10		1.01	5	180	10	
U410	CAM084582	20	30	06-Dec-14	7.86	5.10	1.3	3.92	3.8	400	0.04	0.005	-3.8	16.2	70	0.17	10	20	1.59	2.64	5.23	0.01	10	0.04	90	0.1	10		0.77	5	130	30	
U410	CAM084583	30	40	06-Dec-14	7.86	6.30	34.3	0.18	-28.0	11,000	1.1	0.012	28	16.8	120	0.21	60	10	3.25	2.59	5.64	0.02	10	0.04	130	0.14	10		0.78	5	270	20	
U410	CAM084584	40	50	06-Dec-14	7.76	6.60	41.6	0.16	-35.0	13,300	1.34	0.025	35	19.6	190	0.17	90	10	4.2	3	5.53	0.04	10	0.04	120	0.12	10		0.64	5	240	20	
U410	CAM084585	50	60	06-Dec-14	7.31	5.40	65.1	0.08	-59.7	20,800	2.1	0.05	59.7	17.5	220	0.16	110	10	4.95	3.6	4.82	0.02	20	0.06	160	0.11	40		0.6	5	260	50	
U410	CAM084586	60	70	06-Dec-14	7.23	5.60	59.3	0.09	-53.7	19,000	1.93	0.072	53.7	17	170	0.14	80	10	4.21	3.11	4.86	0.01	20	0.05	150	0.09	40		0.53	5	240	160	
U410	CAM084587	70	80	06-Dec-14	7.51	6.30	90.4	0.07	-84.1	28,900	2.92	0.05	84.1	16.8	140	0.15	80	20	4.94	2.16	5.86	0.01	20	0.04	210	0.1	20		0.48	5	280	20	
U410	CAM084588	80	90	06-Dec-14	7.49	5.80	79.1	0.07	-73.3	25,300	2.55	0.056	73.3	17.3	90	0.17	60	10	5.3	3.1	5.02	0.01	20	0.06	170	0.09	50		0.51	5	320	40	
U410	CAM084589	90	100	06-Dec-14	7.63	6.10	49.0	0.12	-42.9	15,700	1.58	0.034	42.9	16.7	190	0.13	60	20	4.44	2.9	5.32	0.02	20	0.06	170	0.08	40		0.48	70	270	20	
U410	CAM084590	100	110	06-Dec-14	7.94	13.20	80.3	0.16	-67.1	25,700	2.59	0.061	67.1	14.3	130	0.65	70	20	5.92	2.38	5.01	0.03	10	0.05	120	0.13	60		0.38	10	120	40	

Hole ID	Sample ID	FROM	TO	Sampling Date	pH	NP	AP	NPR	NAG	S^{2-}	S	SO_4	NAG	Al2O3	As	CaO	Co	Cu	Fe_2O_3	K_2O	MgO	MnO	Mo	Na_2O	Ni	P_2O_5	Pb	Se	TiO_2	U	V	Zn	^{226}Ra
		(m)	(m)			$gCaCO_3$	$gCaCO_3$			µg/g	%	%	$gCaCO_3$	%	ppm	%	ppm	ppm	%	%	%	%	ppm	%	ppm	%	ppm	ppm	%	ppm	ppm	ppm	Bq/g
U410	CAM084591	110	120	06-Dec-14	7.66	7.40	62.4	0.12	-55.0	20,000	2.01	0.04	55	15	120	0.16	30	120	4.54	1.77	6.01	0.01	10	0.04	60	0.1	10		0.39	5	140	10	
U410	CAM084592	120	130	06-Dec-14	7.84	7.10	56.3	0.13	-49.2	18,000	1.81	0.023	49.2	15	80	0.17	20	130	4.24	1.88	6.09	0.01	10	0.04	60	0.12	20		0.45	5	230	10	
U440	CAM085429	0	10	04-Jun-15	8.26	7.30	45.7	0.16	-38.4	15,000	1.47	0.022	38.4	13.9		0.12	40	100	4.1	1.65	5.7	0.02	10	0.04	80	0.08	20		0.47	10	200	10	
U440	CAM085430	10	20	04-Jun-15	8.41	11.80	61.4	0.19	-49.6	20,000	1.97	0.019	49.6	16.4		0.18	40	230	4.53	2.32	6.21	0.02	10	0.03	80	0.12	20		0.57	10	240	10	
U440	CAM085431	20	30	04-Jun-15	8.40	9.30	52.9	0.18	-43.6	17,000	1.7	0.019	43.6	14.8		0.14	30	170	3.95	1.98	5.59	0.02	10	0.04	70	0.09	10		0.5	5	260	10	
U440	CAM085432	30	40	04-Jun-15	6.78	10.10	237.0	0.04	-226.9	76,000	7.61	0.085	227	13.2		0.25	30	320	11.6	1.59	4.87	0.01	10	0.04	60	0.17	20		0.26	5	120	50	
U440	CAM085433	40	50	04-Jun-15	8.33	9.10	46.4	0.20	-37.3	15,000	1.49	0.02	37.3	14.8		0.13	20	120	3.5	1.94	5.51	0.01	10	0.04	50	0.09	10		0.36	10	160	10	
U440	CAM085434	50	60	04-Jun-15	8.14	9.30	52.2	0.18	-42.9	17,000	1.68	0.029	42.9	15.2		0.15	60	50	4.42	1.84	5.93	0.01	10	0.04	130	0.1	20		0.41	30	180	10	
U440	CAM085435	60	70	04-Jun-15	8.19	10.30	86.6	0.12	-76.3	28,000	2.78	0.03	76.3	14.8		0.15	30	180	6	1.71	6.24	0.02	10	0.04	90	0.09	20		0.43	5	170	10	
U440	CAM085436	70	80	04-Jun-15	8.42	10.20	66.7	0.15	-56.5	21,000	2.14	0.02	56.5	14.7		0.16	20	40	4.87	1.76	6.35	0.01	10	0.04	80	0.09	30		0.42	10	210	20	

APPENDIX B

PHASE II DEVELOPMENT
ROCK SOLIDS CHEMISTRY

Appendix B – Phase II Development Rock Solids Chemistry

Hole ID	From	To	Sample ID	Middle of x	Middle of y	Middle of z	Al µg/g	As µg/g	Ca µg/g	Co µg/g	Fe µg/g	K µg/g	Mg µg/g	Mo µg/g	Na µg/g	Ni µg/g	P µg/g	S pct	S µg/g	Se ppm	U µg/g	V ppm
15	540.0	540.2	CIG_15___1BAS020	10051.5	9960.4	941.9	46,521	160	142.9402	15	37,979	36609.483	18573.509			92					0	
15	557.6	557.8	CIG_15___1BAS021	10052.1	9960.3	924.3	50,808	140	6789.6595	14	32,034	22912.057	15317.114			80					8.48002	
17	459.5	459.9	CIG_17___1BAS011	9756.1	9919.9	1004.6	78,753		285.8804		25,599	9048.6023	90937.829		148.3714		916.4841					
17	461.0	461.4	CIG_17___1BAS012	9756.1	9919.9	1003.1	92,619	80	500.2907	11	33,363	1079.1911	159804.54	1	74.1857	28	567.3473	0.03	300		0	
17	467.6	468.0	CIG_17___1BAS013	9756.1	9920.0	996.5	86,797	70	285.8804	12	24,760	14361.543	102516.12	1	2151.3853	24	349.1368	0.07	700		0	
17	471.2	471.6	CIG_17___1BAS014	9756.2	9920.0	992.9	69,861	140	6432.309	28	36,860	1328.2352	167040.97	1	222.5571	56	436.421	0.25	2500			
17	472.0	472.4	CIG_17___1BAS015	9756.2	9920.0	992.1	90,131		3502.0349		9,512	12120.146	37448.536		39170.05		1352.9051					
17	474.1	474.5	CIG_17___1BAS016	9756.2	9920.0	990.0	61,975		214.4103		17,905	249.0441	90455.4		74.1857		261.8526					
17	476.6	477.0	CIG_17___1BAS017	9756.3	9920.0	987.5	50,173		78402.7		17,905	3403.6027	71278.855		29377.537		305.4947					
17	477.0	477.4	CIG_17___1BAS018	9756.3	9920.1	987.1	76,741	130	34805.939	26	12,940	9961.764	63921.816	38	42879.335	52	1178.3367	0.13	1300		8.48002	
17	479.7	480.1	CIG_17___1BAS019	9756.3	9920.1	984.4	73,301		56104.029		14,059	6392.1319	45710.129		40282.835		567.3473					
17	480.1	480.4	CIG_17___1BAS020	9756.3	9920.1	984.1	62,452	40	59963.414	5	16,996	6060.0731	77188.608	2	37463.779	8	785.5578	0.04	400		0	
17	480.4	480.5	CIG_17___1BAS020	9756.3	9920.1	984.1	62,452	40	59963.414	5	16,996	6060.0731	77188.608	2	37463.779	8	785.5578	0.04	400		0	
17	480.7	481.1	CIG_17___1BAS021	9756.3	9920.1	983.4	82,457		20226.038		13,989	7637.3524	48906.22		43769.563		523.7052					
17	483.9	484.3	CIG_17___1BAS022	9756.4	9920.1	980.2	98,441	70	3359.0947	14	39,308	35945.365	56444.17	6	4525.3277	20	1527.4735	0.5	5000		16.96004	
17	485.3	485.7	CIG_17___1BAS023	9756.4	9920.1	978.8	107,967	70	1214.9917	19	23,991	22247.94	77188.608	1	74.1857	16	785.5578	0.13	1300			
17	486.1	486.5	CIG_17___1BAS024	9756.4	9920.1	978.0	95,371		1286.4618		12,240	37937.718	36242.464		593.4856		1396.5472					
17	490.6	491.0	CIG_17___1BAS025	9756.5	9920.2	973.5	89,443	100	1143.5216	16	22,242	35945.365	63921.816	1	1186.9712	40	741.9157	0.05	500			
17	493.5	493.9	CIG_17___1BAS026	9756.5	9920.2	970.6	87,909		7933.1811		41,896	32873.821	27739.656		28413.123		480.0631					
17	500.6	501.0	CIG_17___1BAS027	9756.6	9920.3	963.5	97,382	140	571.7608	32	40,917	36360.439	55298.401	3	74.1857	48	960.1262	1.02	10200		0	
17	511.2	511.5	CIG_17___1BAS028	9756.7	9920.4	953.0	77,271	30	71.4701	1	9,163	82101.538	13447.703	2	6231.5988	6	654.6315	0.2	2000		16.96004	
17	512.1	512.5	CIG_17___1BAS029	9756.8	9920.4	952.0	72,984		71.4701		14,198	60600.731	9045.54		3783.4707		567.3473					
17	521.0	521.4	CIG_17___1BAS030	9756.8	9920.6	943.1	105,321	200	71.4701	20	50,359	44661.909	36905.803	12	1632.0854	116	349.1368	2.13	21300			
17	528.9	529.3	CIG_17___1BAS031	9756.9	9920.7	935.3	94,736	170	1214.9917	20	68,265	32375.733	46674.986	9	2299.7567	92	392.7789	2.03	20300		0	
18	460.0	460.4	CIG_18___1BAS008	9805.7	9876.5	1004.6	47,209	180	1643.8123	72	200,038	16519.925	29789.978	4	296.7428	26	305.4947	3.92	39200			
18	470.0	470.4	CIG_18___1BAS009	9806.0	9876.5	994.6	97,911	110	1143.5216	20	41,336	26813.748	72967.356	4	74.1857	45	610.9894	0.3	3000		0	
18	479.0	479.4	CIG_18___1BAS010	9806.3	9876.4	985.6	73,566	40	2001.1628	6	8,043	81188.377	20804.742	3	1854.6425	4	1003.7683	0.5	5000		59.36014	
18	479.9	480.3	CIG_18___1BAS011	9806.3	9876.4	984.7	74,095		2501.4535		43,575	27643.895	36724.892		1112.7855		916.4841					
18	484.6	485.0	CIG_18___1BAS012	9806.5	9876.4	980.0	85,474		1715.2824		26,089	46405.217	32744.855		1261.1569		654.6315					
18	489.9	490.3	CIG_18___1BAS013	9806.6	9876.4	974.7	88,755		5932.0183		33,363	52133.232	27196.924		10608.555		916.4841					
18	499.5	499.9	CIG_18___1BAS014	9806.9	9876.4	965.1	86,427		12221.387		37,420	35115.218	22975.672		29451.723		872.842					
18	501.0	501.4	CIG_18___1BAS015	9807.0	9876.4	963.6	94,418		6003.4884		42,386	52299.261	24302.351		27597.08		218.2105					
18	508.2	508.6	CIG_18___1BAS016	9807.2	9876.4	956.4	92,936		12936.088		29,446	24489.337	18091.08		37463.779		87.2842					
18	509.3	509.7	CIG_18___1BAS017	9807.2	9876.4	955.3	82,881		10863.455		37,000	27394.851	22312.332		34347.979		829.1999					
18	519.8	520.2	CIG_18___1BAS018	9807.5	9876.4	944.8	56,101	60	102916.94	5	33,293	19010.366	69349.14	3	4673.6991	20	1440.1893	0.06	600			
18	524.2	524.6	CIG_18___1BAS019	9807.6	9876.4	940.4	31,438	50	135078.49	5	19,934	19010.366	99500.94	4	890.2284	18	1483.8314	0.21	2100		0	
18	529.6	530.0	CIG_18___1BAS020	9807.8	9876.4	935.0	60,864	40	95055.233	4	24,900	36775.512	41006.448	2	14837.14	10	1178.3367					
19	463.2	463.6	CIG_19___1BAS033	9722.4	9958.6	1001.3	101,616	230	71.4701	40	43,085	30300.366	45288.004	17	74.1857	118	654.6315	2.27	22700		8.48002	
19	473.2	473.6	CIG_19___1BAS034	9722.4	9958.8	991.3	114,847	150	71.4701	32	52,457	33703.968	47820.755	13	445.1142	60	654.6315	0.8	8000		16.96004	
19	477.5	477.9	CIG_19___1BAS035	9722.4	9958.9	987.0	92,407		71.4701		37,560	18595.293	40946.144		74.1857		261.8526					
19	483.2	483.6	CIG_19___1BAS036	9722.4	9959.0	981.3	94,207	110	71.4701	15	51,478	31130.513	37508.839	9	74.1857	53	654.6315	1.21	12100		8.48002	
19	493.2	493.6	CIG_19___1BAS037	9722.4	9959.2	971.3	110,084	290	71.4701	36	46,442	26896.763	51499.274	12	74.1857	174	480.0631	2.73	27300		0	
19	503.2	503.6	CIG_19___1BAS038	9722.4	9959.4	961.3	92,619	170	71.4701	22	43,854	22247.94	55539.616	12	2596.4995	90	305.4947	1.52	15200		0	
19	513.2	513.6	CIG_19___1BAS039	9722.4	9959.6	951.3	96,324	130	71.4701	22	66,586	34285.071	38051.572	19	3560.9136	57	261.8526	1.57	15700		8.48002	

Hole ID	From	To	Sample ID	Middle of x	Middle of y	Middle of z	Al µg/g	As µg/g	Ca µg/g	Co µg/g	Fe µg/g	K µg/g	Mg µg/g	Mo µg/g	Na µg/g	Ni µg/g	P µg/g	S pct	S µg/g	Se ppm	U µg/g	V ppm
20	465.5	465.9	CIG_20___1BAS044	9700.4	9965.9	999.4	120,140	230	1143.5216	46	31,055	28972.13	43358.288	17	74.1857	110	567.3473				8.48002	
20	473.6	474.0	CIG_20___1BAS045	9700.6	9965.6	991.3	90,079		71.4701		31,614	17433.087	37508.839		222.5571		43.6421					
20	475.5	475.9	CIG_20___1BAS046	9700.7	9965.5	989.4	131,783	290	71.4701	52	23,571	23161.101	58192.974	22	74.1857	148	218.2105	0.46	4600		8.48002	
20	478.2	478.6	CIG_20___1BAS047	9700.8	9965.4	986.7	82,351		3430.5648		35,391	38269.777	27196.924		296.7428		2094.8208	0.49	4900			
20	485.5	485.9	CIG_20___1BAS048	9701.0	9965.1	979.4	94,736	80	71.4701	10	29,376	20919.704	45710.129	4	2670.6852	30	130.9263	1.6	16000		16.96004	
20	495.5	495.9	CIG_20___1BAS049	9701.3	9964.6	969.4	122,786	90	357.3505	12	27,907	19425.44	68143.068	4	74.1857	40	261.8526	1.6	16000		8.48002	
20	505.5	505.9	CIG_20___1BAS050	9701.6	9964.2	959.4	112,201	180	714.701	26	47,911	18512.278	74776.464	6	74.1857	92	392.7789	1.69	16900		8.48002	
20	515.5	515.9	CIG_20___1BAS051	9701.9	9963.8	949.4	93,677	80	3859.3854	10	31,894	43001.615	27920.567	4	8605.5412	36	436.421	1.06	10600		8.48002	
20	525.5	525.9	CIG_20___1BAS052	9702.2	9963.4	939.4	94,736	130	571.7608	16	36,650	49642.791	28342.692	5	741.857	64	349.1368	1.69	16900		16.96004	
21	488.0	488.4	CIG_21___1BAS012	10101.9	9912.1	999.3	72,507	70	1072.0515	6	37,280	17848.16	118195.06	3	74.1857	28	436.421	0.03	300		0	
21	492.0	492.4	CIG_21___1BAS013	10102.2	9911.9	995.3	82,034	50	14222.55	2	29,516	14278.528	129652.74	1	1261.1569	21	392.7789	0.01	100		0	
21	499.6	500.0	CIG_21___1BAS014	10102.8	9911.6	987.8	79,388	60	6003.4884	8	15,737	38186.762	71158.248	2	2448.1281	21	436.421	0.01	100		16.96004	
21	502.0	502.4	CIG_21___1BAS015	10102.9	9911.4	985.4	92,619	180	3502.0349	52	36,720	46903.306	70555.212	7	8531.3555	54	567.3473	0.95	9500		8.48002	
21	512.0	512.4	CIG_21___1BAS016	10103.7	9911.0	975.4	79,388	50	500.2907	3	30,985	50140.879	78394.68	1	2003.0139	20	261.8526	0.08	800		8.48002	
21	522.0	522.4	CIG_21___1BAS017	10104.5	9910.5	965.5	69,332	70	11435.216	5	41,336	34534.115	133873.99	3	4673.6991	34	741.9157	0.01	100		0	
21	532.0	532.4	CIG_21___1BAS018	10105.3	9910.0	955.5	68,273	60	5789.0781	2	19,304	13946.47	93470.58		33754.494	29	392.7789	0.01	100		0	
21	542.0	542.4	CIG_21___1BAS019	10106.0	9909.5	945.5	71,449		7861.711		18,325	4399.7791	95279.688		42953.52	16	523.7052	0.01	100		8.48002	
21	550.6	551.0	CIG_21___1BAS020	10106.7	9909.1	937.0	70,390		8290.5316		21,612	3071.5439	89852.364		45624.206	28	261.8526	0.16	1600		8.48002	
22	468.0	468.4	CIG_22___1BAS008	9654.5	10023.9	995.9	126,491	80	71.4701	10	13,289	20836.69	56022.044	4	74.1857	33	349.1368	0.53	5300		8.48002	
22	478.0	478.4	CIG_22___1BAS009	9654.4	10023.8	985.9	116,964	130	71.4701	21	23,081	44246.835	42514.038	9	74.1857	63	130.9263	1.03	10300		8.48002	
22	488.0	488.4	CIG_22___1BAS010	9654.4	10023.7	975.9	125,432	90	428.8206	9	30,425	34949.189	44021.628	6	74.1857	46	349.1368	0.72	7200		8.48002	
22	498.0	498.4	CIG_22___1BAS011	9654.3	10023.7	965.9	98,970	100	500.2907	10	38,399	58276.319	28463.299	6	7344.3843	48	261.8526	1.03	10300		8.48002	
22	508.0	508.4	CIG_22___1BAS012	9654.3	10023.6	955.9	91,560	80	71.4701	7	29,026	86335.288	14894.989	4	6009.0417	38	392.7789	1.07	10700		8.48002	
22	516.6	517.0	CIG_22___1BAS013	9654.3	10023.5	947.3	84,892		15366.072		25,319	27145.807	17186.526		16543.411		349.1368	0.1	1000			
22	518.0	518.4	CIG_22___1BAS014	9654.3	10023.5	945.9	91,560	100	4788.4967	12	42,945	34368.086	27558.745	5	8531.3555	51	436.421	1.45	14500		8.48002	
22	528.0	528.4	CIG_22___1BAS015	9654.2	10023.4	935.9	98,970	130	71.4701	15	70,643	32790.807	39679.769	7	74.1857	66	218.2105	4.16	41600		8.48002	
24	468.0	468.4	CIG_24___1BAS021	10005.9	9990.3	1001.7	118,023	50	71.4701	4	25,739	14112.499	63318.78	3	1409.5283	19	130.9263	0.25	2500		8.48002	
24	478.0	478.4	CIG_24___1BAS022	10005.9	9990.1	991.7	98,441	230	71.4701	30	41,966	23078.087	37750.054	11	2596.4995	134	261.8526	2.64	26400		8.48002	
24	488.0	488.4	CIG_24___1BAS023	10006.1	9989.8	981.7	97,382	120	71.4701	16	43,085	29636.248	31599.086	13	74.1857	56	349.1368	1.04	10400		8.48002	
24	498.0	498.4	CIG_24___1BAS024	10006.2	9989.6	971.7	82,563	40	571.7608	5	21,473	21583.822	28704.514	4	74.1857	10	567.3473	0.58	5800		33.92008	
24	503.6	504.0	CIG_24___1BAS025	10006.2	9989.5	966.1	137,076	90	71.4701	5	39,308	42088.453	49087.13	6	74.1857	48	261.8526	0.5	5000		33.92008	
24	508.0	508.4	CIG_24___1BAS026	10006.3	9989.4	961.7	105,850	50	71.4701	2	29,376	25900.586	45891.04	2	1557.8997	18	87.2842	0.17	1700		16.96004	
25	460.3	460.7	CIG_25___1BAS010	9842.5	9992.5	1004.1	120,669	310	10649.045	54	72,251	15108.675	64524.852	23	74.1857	166	4495.1363	7.84	78400		0	
25	470.3	470.7	CIG_25___1BAS011	9842.8	9992.7	994.1	121,198	210	71.4701	28	30,006	20255.587	56625.08	8	74.1857	112	305.4947	2.13	21300		8.48002	
25	480.3	480.7	CIG_25___1BAS012	9843.1	9992.8	984.1	100,558	60	71.4701	6	17,346	12701.249	64524.852	2	74.1857	22	436.421	0.6	6000		8.48002	
25	490.3	490.7	CIG_25___1BAS013	9843.4	9993.0	974.1	119,611	210	285.8804	18	26,858	27975.954	51318.364	25	1928.8282	133	218.2105	1.17	11700		8.48002	
25	500.3	500.7	CIG_25___1BAS014	9843.8	9993.1	964.1	129,137	140	71.4701	12	28,467	29138.16	56866.295	31	296.7428	78	261.8526	0.92	9200		8.48002	
25	510.3	510.7	CIG_25___1BAS015	9844.1	9993.3	954.1	122,257	230	142.9402	32	52,947	23244.116	69952.176	11	816.0427	130	349.1368	1.6	16000		8.48002	
25	520.3	520.7	CIG_25___1BAS016	9844.4	9993.4	944.1	107,967	110	71.4701	19	58,263	32375.733	63318.78	4	667.6713	46	392.7789	1.4	14000		8.48002	
26	469.3	469.7	CIG_26___1BAS008	10004.9	10047.9	997.6	112,201	140	25228.945	17	26,089	25651.542	49750.47	6	74.1857	76	6939.0939	2.4	24000		8.48002	
26	479.3	479.7	CIG_26___1BAS009	10005.9	10048.1	987.7	119,611	110	71.4701	20	26,509	27145.807	54635.062	3	148.3714	46	349.1368	0.7	7000		8.48002	
26	489.3	489.7	CIG_26___1BAS010	10006.9	10048.4	977.7	114,318	140	71.4701	21	35,321	28889.116	48785.612	3	148.3714	64	305.4947	2.39	23900		8.48002	
26	499.3	499.7	CIG_26___1BAS011	10007.9	10048.6	967.8	110,613	110	71.4701	14	36,091	25568.528	62715.744	2	74.1857	51	261.8526	1.18	11800		8.48002	
26	509.3	509.7	CIG_26___1BAS012	10008.9	10048.9	957.8	101,087	60	71.4701	6	31,125	22413.969	58675.403	4	1928.8282	22	392.7789	1.42	14200		8.48002	
26	519.3	519.7	CIG_26___1BAS013	10009.9	10049.1	947.9	91,031	130	428.8206	17	57,004	37107.571	39559.162	3	1483.714	66	349.1368	1.8	18000		8.48002	

Hole ID	From	To	Sample ID	Middle of x	Middle of y	Middle of z	Al µg/g	As µg/g	Ca µg/g	Co µg/g	Fe µg/g	K µg/g	Mg µg/g	Mo µg/g	Na µg/g	Ni µg/g	P µg/g	S pct	S µg/g	Se ppm	U µg/g	V ppm
26	529.3	529.7	CIG_26___1BAS014	10010.9	10049.4	937.9	97,382	70	71.4701	6	45,043	27975.954	42333.127	4	74.1857	30	174.5684	1.35	13500		8.48002	
27	461.0	461.4	CIG_27___1BAS009	9869.7	9950.9	1002.9	118,552	290	71.4701	37	51,129	20587.646	66936.996	21	1186.9712	173	305.4947	2.96	29600		8.48002	
27	471.0	471.4	CIG_27___1BAS010	9869.9	9950.9	992.9	120,140	160	71.4701	19	46,163	20172.572	79600.752	15	445.1142	89	261.8526	0.98	9800		8.48002	
27	481.0	481.4	CIG_27___1BAS011	9870.2	9950.8	982.9	116,964	270	71.4701	50	52,248	39016.909	47941.362	33	74.1857	132	349.1368	2.99	29900		8.48002	
27	491.0	491.4	CIG_27___1BAS012	9870.4	9950.8	972.9	120,140	220	71.4701	23	39,798	22829.043	68746.104	17	74.1857	135	218.2105	1.96	19600		8.48002	
27	501.0	501.4	CIG_27___1BAS013	9870.7	9950.8	962.9	113,789	220	71.4701	26	63,299	27809.925	59941.778	18	74.1857	130	218.2105	2.54	25400		8.48002	
27	511.0	511.4	CIG_27___1BAS014	9870.9	9950.8	952.9	115,377	220	571.7608	24	51,828	29221.174	58012.063	14	74.1857	130	305.4947	2.11	21100		8.48002	
27	521.0	521.4	CIG_27___1BAS015	9871.2	9950.7	942.9	112,730	210	71.4701	33	53,087	33039.851	44745.271	10	222.5571	109	261.8526	2.59	25900		8.48002	
28	485.6	486.0	CIG_28___1BAS011	10206.6	9991.5	999.5	113,260	330	71.4701	84	113,308	31877.645	49026.827	22	74.1857	138	392.7789	1.22	12200		8.48002	
28	495.6	496.0	CIG_28___1BAS012	10206.5	9991.5	989.5	108,496	50	71.4701	4	17,905	28141.983	46916.201	2	964.4141	14	261.8526	0.2	2000		8.48002	
28	505.6	506.0	CIG_28___1BAS013	10206.4	9991.6	979.5	122,786	50	428.8206	4	21,543	30466.395	55660.223	7	74.1857	14	523.7052	0.53	5300		8.48002	
28	515.6	516.0	CIG_28___1BAS014	10206.3	9991.6	969.5	112,201	130	71.4701	10	36,301	27394.851	49388.648	18	74.1857	73	218.2105	0.99	9900		8.48002	
28	520.4	520.8	CIG_28___1BAS015	10206.3	9991.6	964.7	89,973	90	71.4701	7	20,633	37605.659	34373.052	5	222.5571	45	349.1368	0.85	8500		169.6004	
29	493.0	493.4	CIG_29___1BAS019	10376.8	10048.8	999.7	113,789		71.4701		30,076	25900.586	60906.636	14	74.1857	80	261.8526	1.31	13100		8.48002	
29	503.0	503.4	CIG_29___1BAS020	10377.7	10049.3	989.7	120,669		285.8804		48,471	24987.425	65127.888	12	148.3714	263	305.4947	3.95	39500		8.48002	
29	513.0	513.4	CIG_29___1BAS021	10378.5	10049.8	979.8	105,321		1500.8721		64,488	19259.41	58192.974	22	74.1857	270	654.6315	4.45	44500		8.48002	
29	523.0	523.4	CIG_29___1BAS022	10379.3	10050.2	969.8	123,845		571.7608		32,524	41175.291	39800.376	4	74.1857	111	261.8526	1.7	17000		8.48002	
29	533.0	533.4	CIG_29___1BAS023	10380.2	10050.7	959.9	102,675		428.8206		25,250	23825.219	52946.561	8	74.1857	26	480.0631	0.47	4700		16.96004	
29	543.0	543.4	CIG_29___1BAS024	10381.0	10051.2	949.9	94,207		71.4701		28,047	20670.66	47579.54	8	74.1857	46	261.8526	0.78	7800		16.96004	
29	548.0	548.4	CIG_29___1BAS025	10381.4	10051.4	944.9								10		70					8.48002	
30	465.0	465.4	CIG_30___1BAS010	9579.9	9931.7	999.2	109,555	90	428.8206	3	20,983	26979.778	59881.475	4	74.1857	49	130.9263	0.04	400		8.48002	
31	469.8	470.2	CIG_31___1BAS015	9461.7	9942.1	996.8	105,850	590	786.1711	114	53,017	20919.704	48122.273	25	74.1857	312	305.4947	4.66	46600		8.48002	
31	479.8	480.2	CIG_31___1BAS016	9461.8	9942.1	986.8	113,260	420	214.4103	105	42,246	24157.278	57228.116	22	74.1857	186	305.4947	2.79	27900		8.48002	
31	489.8	490.2	CIG_31___1BAS017	9461.9	9942.1	976.8	106,379	170	71.4701	20	42,805	33288.895	45770.432	12	519.2999	90	174.5684	4.5	45000		8.48002	
31	499.8	500.2	CIG_31___1BAS018	9462.0	9942.0	966.8	103,733	190	71.4701	20	38,259	21583.822	55419.008	14	74.1857	111	261.8526	1.52	15200		8.48002	
31	509.8	510.2	CIG_31___1BAS019	9462.1	9942.0	956.8	105,850	190	428.8206	40	42,246	22829.043	56383.866	11	74.1857	85	305.4947	1.07	10700		8.48002	
31	519.8	520.2	CIG_31___1BAS020	9462.2	9941.9	946.8	108,496	150	571.7608	16	45,113	32624.777	39559.162	19	74.1857	85	392.7789	1.09	10900		8.48002	
31	529.8	530.2	CIG_31___1BAS021	9462.4	9941.9	936.8	95,794	200	71.4701	77	78,336	31130.513	35036.392	15	74.1857	42	261.8526	3.33	33300		8.48002	
33	478.0	478.4	CIG_33___1BAS006	9313.2	9899.7	998.0	84,151	110	1000.5814	16	21,053	3320.588	88947.81	17	370.9285	47	218.2105	0.005	50		8.48002	
33	488.0	488.4	CIG_33___1BAS007	9313.5	9899.7	988.0	76,371	60	12650.208	8	23,851	21002.719	72183.409	3	14243.654	19	218.2105	0.005	50		8.48002	
33	492.2	492.4	CIG_33___1BAS008	9313.6	9899.7	983.9	51,867	430		160		24904.41		110		110					339.2008	
33	498.0	498.4	CIG_33___1BAS009	9313.8	9899.7	978.0	103,469	30	7218.4801	4	10,771	40843.232	14593.471	1	33977.051	1	87.2842	0.006	60		8.48002	
33	508.0	508.4	CIG_33___1BAS010	9314.2	9899.8	968.0	75,683	190	4574.0864	75	18,325	22413.969	67540.032	3	9421.5839	31	174.5684	0.028	280		0	
33	516.2	516.6	CIG_33___1BAS011	9314.4	9899.9	959.8	73,354		2501.4535		22,102	33122.865	72846.749		74.1857		654.6315	0.06	600			
33	518.4	518.8	CIG_33___1BAS012	9314.5	9899.9	957.6	79,123	70	2144.103	6	19,584	23493.16	70434.605	2	370.9285	28	218.2105	0.012	120		0	
33	528.0	528.4	CIG_33___1BAS013	9314.8	9900.0	948.0	78,541	90	1786.7525	8	28,117	13365.367	77309.215	1	816.0427	44	218.2105	0.008	80		0	
33	537.0	537.2	CIG_33___1BAS014	9315.2	9900.1	939.1	35,460	440		110		25734.557		22		190					1204.1628	
33	537.6	537.8	CIG_33___1BAS015	9315.2	9900.1	938.5	33,872	130		33		46488.232		12		46					636.0015	
33	538.0	538.4	CIG_33___1BAS016	9315.2	9900.1	938.0	89,073	170	1643.8123	30	56,654	39930.071	37870.661	11	2225.571	83	43.6421	1.79	17900		8.48002	
34	472.2	472.6	CIG_34___1BAS005	9311.8	10006.5	999.0	106,379	70	3073.2143	9	5,176	22995.072	23759.618	2	74.1857	23	1091.0525	0.096	960		8.48002	
34	480.7	481.1	CIG_34___1BAS006	9312.1	10006.6	990.5	85,104	210	1214.9917	45	21,752	10791.911	28402.996	6	74.1857	92	392.7789	1.71	17100		8.48002	
34	490.6	491.0	CIG_34___1BAS007	9312.3	10006.9	980.6	73,195	60	15366.072	5	7,974	25568.528	28282.388	1	0	25	174.5684	0.14	1400		25.44006	
34	501.5	501.9	CIG_34___1BAS008	9312.6	10007.1	969.7	101,828	50	2001.1628	4	10,841	19674.484	23880.226	1	0	17	392.7789	0.188	1880		8.48002	
34	510.4	510.8	CIG_34___1BAS009	9312.8	10007.3	960.8	78,223	40	1429.402	2	5,386	57280.143	10372.219	1	1483.714	8	392.7789	0.128	1280		8.48002	
34	518.9	519.3	CIG_34___1BAS010	9313.0	10007.5	952.3	83,251	100	1643.8123	16	29,586	19508.455	39197.34	2	370.9285	39	480.0631	1.01	10100		8.48002	

Hole ID	From	To	Sample ID	Middle of x	Middle of y	Middle of z	Al µg/g	As µg/g	Ca µg/g	Co µg/g	Fe µg/g	K µg/g	Mg µg/g	Mo µg/g	Na µg/g	Ni µg/g	P µg/g	S pct	S µg/g	Se ppm	U µg/g	V ppm
34	530.7	531.1	CIG_34___1BAS011	9313.3	10007.8	940.5	80,234	110	2358.5133	15	36,930	21251.763	38413.393	6	222.5571	49	349.1368	1.43	14300		8.48002	
35	474.0	474.4	CIG_35___1BAS007	9312.5	10057.2	995.6	88,544	70	1072.0515	6	16,926	18512.278	34011.23	1	148.3714	33	261.8526	0.12	1200		0	
35	484.0	484.4	CIG_35___1BAS008	9312.8	10057.4	985.6	77,324	80	1000.5814	11	29,166	15938.822	31538.783	1	74.1857	34	305.4947	0.16	1600		0	
35	485.0	485.4	CIG_35___1BAS009	9312.8	10057.5	984.6	74,095		1357.9319		30,565	14859.631	32744.855		890.2284		523.7052	0.1	1000			
35	494.0	494.4	CIG_35___1BAS010	9313.1	10057.7	975.6	81,505	80	1357.9319	11	18,605	20172.572	32865.462	1	222.5571	33	305.4947	0.14	1400		8.48002	
35	506.0	506.4	CIG_35___1BAS011	9313.5	10058.0	963.6	86,480	80	1072.0515	10	31,055	18014.19	35760.035	1	148.3714	37	392.7789	0.22	2200		8.48002	
35	507.0	507.4	CIG_35___1BAS012	9313.5	10058.0	962.6	82,087		1143.5216		33,153	18429.263	36543.982		964.4141		436.421	0.04	400			
35	514.0	514.4	CIG_35___1BAS013	9313.7	10058.2	955.6	78,170	90	1286.4618	11	28,677	20753.675	30151.8	1	74.1857	42	174.5684	0.09	900		0	
35	524.0	524.4	CIG_35___1BAS014	9313.9	10058.4	945.6	90,237	100	10506.105	15	49,100	27643.895	20985.653	1	10608.555	41	305.4947	0.26	2600		8.48002	
35	525.0	525.4	CIG_35___1BAS015	9313.9	10058.5	944.6	81,505		7004.0698		44,834	35198.233	17910.169		9273.2125		349.1368	0.05	500			
35	529.7	530.1	CIG_35___1BAS016	9314.0	10058.6	939.9	88,914		5217.3173		57,563	38435.806	20985.653		7121.8272		261.8526	0.05	500			
35	530.1	530.5	CIG_35___1BAS017	9314.1	10058.6	939.5	83,622		5360.2575		47,492	47235.364	17367.437		8457.1698		436.421	0.07	700			
35	531.0	531.4	CIG_35___1BAS018	9314.1	10058.6	938.7	86,480		13364.909		57,214	21749.851	21829.903		11795.526		436.421	0.19	1900			
35	532.3	532.7	CIG_35___1BAS019	9314.1	10058.6	937.4	40,011		1858.2226		21,543	14195.514	9708.8796		519.2999		174.5684					
35	534.0	534.4	CIG_35___1BAS020	9314.1	10058.7	935.7	92,407	90	2644.3937	14	50,919	44661.909	24061.136	1	2670.6852	40	436.421	0.052	520		0	
35	535.0	535.4	CIG_35___1BAS021	9314.2	10058.7	934.7	85,421		2858.804		50,849	40926.247	30754.836		3041.6137		567.3473					
35	535.5	535.9	CIG_35___1BAS022	9314.2	10058.7	934.2	97,964		10148.754		43,715	32956.836	20804.742		14243.654		349.1368					
036A	491.0	491.4	CIG_36_A_1BAS007	10351.1	10074.4	998.8	86,109	170	71.4701	27	33,713	16851.984	38292.786	5	296.7428	84	218.2105	1.65	16500		8.48002	
036A	500.0	500.4	CIG_36_A_1BAS008	10351.1	10074.5	989.8	97,594	50	1000.5814	5	12,450	28058.969	30393.014	4	148.3714	17	261.8526	0.21	2100		16.96004	
037A	493.0	493.4	CIG_37_A_1BAS007	10340.3	10018.9	999.2	81,663	170	71.4701	28	39,028	27145.807	21407.778	20	74.1857	86	436.421	1.56	15600		8.48002	
037A	503.0	503.4	CIG_37_A_1BAS008	10340.1	10019.2	989.2	73,778	190	0	34	43,505	21251.763	25025.994	13	148.3714	93	218.2105	3.63	36300		8.48002	
371	474.6	474.8	CAM76705	9227.9	9947.3	1003.0	82,563	280	857.6412	55	28,047	18014.19	31116.658	17.1	296.7428	134	353.50101			1.8	8.48002	57.9
371	487.4	487.6	CAM76706	9228.4	9948.5	990.3	85,739	380	1143.5216	88.5	19,025	17267.058	30272.407	22.1	222.5571	174	541.16204			1.9	8.48002	28.5
371	494.4	494.6	CAM76707	9228.7	9949.2	983.3	79,917	240	857.6412	47.2	15,597	20919.704	24000.833	12.4	296.7428	114	375.32206			1.9	8.48002	23.4
372	472.5	472.7	CAM77004	9175.7	9974.7	1003.0	94,736	520	857.6412	155	37,070	38767.865	18694.116	11.9	445.1142	198	903.39147			3.7	8.48002	73.6
372	481.2	481.4	CAM77005	9175.9	9975.3	994.3	91,031	200	1143.5216	30.2	40,987	34866.174	20503.224	19.4	370.9285	108	554.25467			4	8.48002	111
372	491.6	491.8	CAM77006	9176.2	9976.1	983.9	92,619	200	929.1113	28.1	38,329	22579.998	35820.338	13.7	296.7428	106	497.51994			2.6	8.48002	136
372	497.6	497.8	CAM77007	9176.3	9976.6	977.9	89,973	220	1357.9319	34.2	36,720	30549.41	29789.978	14	370.9285	116	650.26729			2	8.48002	99.2
373	474.3	474.5	CAM76713	9280.0	9978.5	1000.9	146,603	15840	857.6412	412	21,473	40013.085	40343.108	94.1	370.9285	12600	410.23574			2.3	33.92008	31
373	480.1	480.3	CAM76714	9280.2	9979.0	995.1	117,494	2990	1929.6927	282	40,567	35530.292	32925.766	23.1	370.9285	2070	912.11989			2.5	16.96004	67.6
373	494.8	495.0	CAM76715	9280.7	9980.4	980.5	88,385	240	1929.6927	42.8	25,669	17516.102	39317.947	7.51	148.3714	122	816.10727			2	8.48002	64
374-1	501.0	501.2	CAM76719	9347.4	9967.0	1002.9	81,505	240	1072.0515	50	37,769	26315.66	27739.656	9.5	222.5571	107	589.16835			2.5	8.48002	111
374-1	511.7	511.9	CAM76721	9348.0	9970.7	992.9	93,677	170	929.1113	25	30,425	21583.822	34553.963	10.4	296.7428	85.1	432.05679			1.6	8.48002	75.3
374-1	520.3	520.5	CAM76722	9348.4	9973.7	984.8	51,126	40	714.701	2.56	2,448	11456.029	14955.293	0.69	148.3714	8.7	344.77259			0.1	8.48002	1.9
374-1	529.3	529.5	CAM76723	9348.9	9976.8	976.4	80,975	190	1643.8123	41	42,386	11373.014	47881.058	5.12	148.3714	81.6	680.81676			0.7	8.48002	51.4
374-1	538.1	538.3	CAM76724	9349.5	9979.8	968.1	86,797	140	1572.3422	23.5	32,384	20753.675	43056.77	8.08	148.3714	66.8	532.43362			0.8	0	50.6
374-1	548.6	548.8	CAM76725	9350.1	9983.4	958.3	78,329	50	1643.8123	7.58	9,093	29553.233	17427.74	0.48	296.7428	8.5	562.98309			0.05	8.48002	6.1
374-1	557.9	558.1	CAM76726	9350.7	9986.5	949.6	70,920	30	1357.9319	1.16	4,686	63589.26	6150.9672	0.52	1112.7855	5.3	606.62519			0.3	16.96004	0.3
374-1	569.5	569.7	CAM76727	9351.5	9990.5	938.7	97,911	100	1429.402	16.6	34,062	43416.688	56805.991	2.91	1335.3426	41.7	519.34099			0.4	8.48002	20.6
375	496.2	496.4	CAM77013	9532.6	9960.5	994.4	85,209	320	1000.5814	90	35,181	23493.16	30151.8	4.4	296.7428	121	528.06941			1.7	8.48002	42.8
375	506.4	506.6	CAM77014	9533.8	9963.3	984.7	76,212	350	1286.4618	95	37,560	20338.602	28463.299	12.9	222.5571	135	523.7052			2.5	8.48002	100
375	515.2	515.4	CAM77015	9534.8	9965.6	976.3	87,326	200	1572.3422	46.4	17,136	27892.939	25086.298	7.37	222.5571	80.9	593.53256			1.8	16.96004	27.8
375	526.0	526.2	CAM77016	9536.0	9968.5	965.9	86,268	310	1143.5216	75.3	27,278	16436.911	37810.357	4.3	222.5571	131	449.51363			2.5	8.48002	48.3
375	536.2	536.4	CAM77017	9537.2	9971.2	956.2	80,446	250	1357.9319	32.9	21,962	13780.44	35518.82	1.81	222.5571	144	480.0631			0.6	8.48002	31.3
375	547.0	547.2	CAM77018	9538.4	9974.1	945.8	81,505	80	1429.402	12	44,064	20421.616	42815.556	0.38	222.5571	29.2	567.3473			0.2	8.48002	38.1

Hole ID	From	To	Sample ID	Middle of x	Middle of y	Middle of z	Al µg/g	As µg/g	Ca µg/g	Co µg/g	Fe µg/g	K µg/g	Mg µg/g	Mo µg/g	Na µg/g	Ni µg/g	P µg/g	S pct	S µg/g	Se ppm	U µg/g	V ppm
376-2	505.3	505.5	CAM77025	9451.2	9967.3	995.3	91,560	450	714.701	81.9	42,106	13365.367	42996.467	21.1	222.5571	236	288.03786			4.8	8.48002	95.6
376-2	515.6	515.8	CAM77026	9451.9	9970.7	985.6	89,443	320	786.1711	51.5	33,643	16270.881	34433.356	13.9	296.7428	176	401.50732			4	8.48002	46
376-2	525.0	525.2	CAM77027	9452.7	9973.8	976.7	97,382	380	929.1113	112	18,395	21749.851	31900.604	11.3	222.5571	142	375.32206			2.1	8.48002	24.8
376-2	535.0	535.2	CAM77028	9453.5	9977.2	967.4	82,563	150	1000.5814	26.1	21,822	18512.278	29367.853	3.67	222.5571	67	436.421			2.4	8.48002	28.5
376-2	545.4	545.6	CAM77029	9454.3	9980.7	957.6	85,209	100	6074.9585	13.6	37,490	37107.571	18151.384	4.7	11795.526	48.7	384.05048			1.2	8.48002	107
376-2	555.3	555.5	CAM77030	9455.1	9984.1	948.3	81,505	100	5503.1977	16	43,365	42088.453	15196.507	2.1	10534.369	38.2	366.59364			0.9	8.48002	59
377	470.2	470.4	CAM76732	9481.2	9965.4	998.2	93,677	1420	4145.2658	561	21,543	22496.984	29367.853	5.74	222.5571	369	567.3473			2.6	16.96004	17.9
377	492.4	492.6	CAM76733	9481.6	9968.3	976.2	87,856	830	1929.6927	340	16,087	31711.615	22734.457	15	222.5571	188	619.71782			1.2	8.48002	27.7
377	500.8	501.0	CAM76734	9481.8	9969.4	967.9	86,268	910	1858.2226	329	36,720	22247.94	31176.961	9.82	222.5571	277	353.50101			2.7	8.48002	53.3
377	511.1	511.3	CAM76735	9482.0	9970.7	957.7	74,624	120	1143.5216	16.2	36,371	28640.072	25206.905	9.73	1780.4568	55.1	257.48839			1	8.48002	134
377	522.0	522.2	CAM76736	9482.3	9972.1	946.8	74,624	170	714.701	40.6	37,490	21085.734	26533.584	6.6	370.9285	61.8	279.30944			1.6	8.48002	51.2
378	501.0	501.2	CAM76741	9377.4	9966.2	1000.0	85,739	310	714.701	93.8	40,497	29055.145	29428.157	10.2	370.9285	106	453.87784			2.8	8.48002	50.2
378	510.5	510.7	CAM76742	9377.6	9969.5	991.1	91,031	120	786.1711	23.3	16,507	14278.528	38353.09	3.9	222.5571	45.5	541.16204			0.6	8.48002	25.4
378	520.6	520.8	CAM76743	9377.7	9973.0	981.6	91,560	210	2072.6329	60.8	20,563	21251.763	30393.014	2.87	148.3714	69	637.17466			1	8.48002	18
378	530.0	530.2	CAM76744	9377.9	9976.2	972.8	88,385	310	2001.1628	69.1	39,868	29719.263	25930.548	14.7	222.5571	138	562.98309			4.4	8.48002	28.6
378	540.0	540.2	CAM76745	9378.1	9979.7	963.4	83,092	230	857.6412	46.4	32,873	24074.263	27016.013	12.8	222.5571	103	523.7052			3	8.48002	59.8
378	545.6	545.8	CAM76746	9378.2	9981.6	958.1	78,858	130	1429.402	24	19,654	20670.66	24724.476	4.73	148.3714	58.9	549.89046			0.8	8.48002	24.4
379	506.5	506.7	CAM77032	9259.3	9962.7	999.3	89,973	770	1357.9319	244	55,885	30300.366	23458.1	23.1	370.9285	279	628.44624			6.6	8.48002	68.7
379	519.9	520.1	CAM77033	9260.3	9967.0	986.7	92,619	170	571.7608	37.9	43,854	25485.513	33166.98	6.31	445.1142	66.5	257.48839			2.1	8.48002	85.9
379	537.0	537.1	CAM77034	9261.9	9972.4	970.6	89,443	130	1214.9917	24.6	47,561	29636.248	32322.73	12.5	296.7428	51.7	506.24836			1.7	8.48002	85.4
379	546.0	546.1	CAM77035	9262.8	9975.2	962.1	89,973	200	2287.0432	30.8	28,887	28972.13	28402.996	17.7	222.5571	106	925.21252			1.8	8.48002	50.8
379	560.9	561.0	CAM77036	9264.2	9979.9	948.0	92,619	60	1572.3422	5.21	39,868	29055.145	40946.144	10.4	445.1142	19.8	541.16204			0.4	8.48002	104
392	465.0	465.2	CAM76750	9463.8	9960.8	1002.0	77,800	60	1000.5814	6.13	4,476	12369.19	28402.996	1.12	519.2999	23.3	532.43362			0.05	8.48002	1
392	475.0	475.2	CAM76751	9463.8	9960.9	992.0	58,747	90	357.3505	23.2	18,395	23161.101	13085.881	10.7	445.1142	21.4	213.84629			0.7	8.48002	20.5
392	485.0	485.2	CAM76752	9463.8	9961.0	982.0	87,326	540	1214.9917	186	61,620	31130.513	22071.118	37.8	445.1142	171	672.08834			5.8	8.48002	61.3
392	494.8	495.0	CAM76753	9463.8	9961.0	972.2	69,332	170	1072.0515	35.5	29,726	15606.764	29247.246	1.81	222.5571	76.3	519.34099			1.1	16.96004	1
393	466.1	466.3	CAM77043	9413.9	9950.6	1001.5	89,973	400	714.701	79.5	41,966	17516.102	36845.5	10.2	296.7428	198	305.4947			5.1	8.48002	102
393	475.9	476.1	CAM77044	9414.0	9950.7	991.7	82,034	220	1429.402	68.4	31,195	26730.733	18694.116	12.4	964.4141	66.4	580.43993			3	8.48002	39.4
393	485.8	486.0	CAM77045	9414.2	9950.9	981.8	55,571	60	571.7608	10.5	9,722	10127.793	21166.564	1.75	148.3714	19.2	493.15573			1.2	8.48002	3.6
394	472.0	472.2	CAM76762	9223.6	9975.5	999.6	86,797	520	2072.6329	106	3,847	24572.351	21648.992	39.5	148.3714	260	907.75568			0.2	0	3.1
394	482.0	482.2	CAM76763	9223.6	9975.6	989.6	90,502	170	1000.5814	29.4	32,104	25568.528	32262.426	12.2	296.7428	83	480.0631			2.4	8.48002	84.3
394	488.8	489.0	CAM76764	9223.6	9975.7	982.8	90,502	180	1000.5814	38.7	23,921	20172.572	34192.141	9.4	222.5571	73.9	440.78521			1.2	0	61.2
395	471.7	471.9	CAM77049	9198.5	9975.7	1000.4	86,797	1050	786.1711	399	35,671	38518.821	13568.31	34	370.9285	288	436.421			5.2	8.48002	30.7
395	482.2	482.4	CAM77050	9198.7	9975.9	989.9	75,154	390	1500.8721	136	35,531	6500.051	41730.091	2.23	74.1857	117	637.17466			2.4	8.48002	54.7
395	492.0	492.2	CAM77051	9198.8	9976.1	980.1	97,382	100	1072.0515	20.3	36,301	39681.027	23216.886	14.5	370.9285	38.6	501.88415			2	8.48002	116
395	499.9	501.0	CAM077052	9199.0	9976.2	971.7	87,326	190	929.1113	33.6	37,629	32292.718	25387.816	10.1	296.7428	88.4	414.59995			0.8	0	97.8
396	471.8	472.0	CAM77545	9157.9	9975.5	1002.6	90,502	230	1000.5814	47.8	38,469	26315.66	30513.622	13.4	370.9285	106	432.05679			2.1	8.48002	127
396	482.0	482.2	CAM77546	9158.2	9975.7	992.4	103,733	220	1143.5216	31.2	36,650	21749.851	44926.182	4.03	222.5571	120	510.61257			0.7	8.48002	70
396	492.0	492.2	CAM77547	9158.5	9975.8	982.4	76,741	140	1143.5216	24.2	34,762	23244.116	27558.745	6.01	222.5571	62.8	436.421			1.3	8.48002	106
396	502.0	502.2	CAM77548	9158.8	9975.9	972.4	89,973	100	1429.402	10.2	37,629	26564.704	38172.179	9.67	296.7428	46.2	541.16204			0.3	8.48002	94.8
397	475.1	475.3	CAM77056	9174.8	9966.7	997.4	95,794	220	1000.5814	54.7	40,008	37605.659	23458.1	11.8	593.4856	88.8	501.88415			1.8	0	34.1
397	484.9	485.1	CAM77057	9174.8	9966.8	987.6	91,031	420	571.7608	100	72,042	24821.395	37569.143	15.6	370.9285	187	322.95154			3.4	8.48002	139
397	495.0	495.2	CAM77058	9174.8	9966.8	977.5	76,741	220	1572.3422	57.9	30,915	25568.528	25146.601	3.05	222.5571	80.4	680.81676			2.1	8.48002	21.9
398	470.0	470.2	CAM76768	9243.8	9954.5	1003.2	97,382	310	1143.5216	47.7	28,817	19176.396	35036.392	33	296.7428	168	549.89046			2.9	8.48002	55.6
398	480.0	480.2	CAM76769	9243.9	9954.4	993.2	85,209	450	929.1113	120	22,662	16436.911	28885.424	19.2	222.5571	187	405.87153			2.6	8.48002	24.2

Hole ID	From	To	Sample ID	Middle of x	Middle of y	Middle of z	Al µg/g	As µg/g	Ca µg/g	Co µg/g	Fe µg/g	K µg/g	Mg µg/g	Mo µg/g	Na µg/g	Ni µg/g	P µg/g	S pct	S µg/g	Se ppm	U µg/g	V ppm
399	474.0	474.2	CAM77063	9187.0	9944.8	998.1	55,042	330	500.2907	75.8	20,074	10708.896	20985.653	10.8	148.3714	149	178.93261			2.6	0	27.7
399	484.0	484.2	CAM77064	9187.1	9944.6	988.1	89,973	320	1000.5814	75	26,998	28474.042	26593.888	23	370.9285	142	379.68627			2.3	8.48002	69.1
399	494.0	494.2	CAM77065	9187.4	9944.4	978.1	80,975	350	714.701	53.9	58,053	30715.439	23156.582	20.9	445.1142	195	366.59364			4.2	8.48002	67.2
399	503.8	504.0	CAM77066	9187.7	9944.2	968.3	81,505	260	1286.4618	45.1	36,161	19259.41	32805.158	14.2	222.5571	135	532.43362			1.7	0	61.3
400	474.0	474.2	CAM76774	9168.7	9990.3	999.6	81,505	240	929.1113	41.9	51,828	26896.763	26774.798	23.2	296.7428	125	453.87784			2.6	8.48002	125
400	481.0	481.2	CAM76775	9168.8	9990.3	992.6	127,020	690	1858.2226	170	30,775	46405.217	27016.013	29.7	222.5571	316	803.01464			1.7	25.44006	10.5
400	491.0	491.2	CAM76776	9168.8	9990.5	982.6	87,856	90	1786.7525	7.13	33,853	12950.293	46554.379	1.32	148.3714	43.5	667.72413			0.2	8.48002	46.8
401	475.0	475.2	CAM77069	9162.9	9952.5	998.1	68,803	130	857.6412	32.4	11,960	14112.499	29006.032	9.52	222.5571	40.8	283.67365			0.8	8.48002	20
401	485.2	485.4	CAM77070	9163.2	9952.4	987.9	76,212	860	2001.1628	328	43,924	15357.72	36724.892	15	148.3714	235	693.90939			2.3	8.48002	63.7
401	491.8	492.0	CAM77071	9163.5	9952.4	981.3	85,209	280	1214.9917	37.6	42,456	22829.043	34976.088	7.53	148.3714	160	414.59995			2.1	8.48002	55.4
402	464.8	465.0	CAM76779	9552.1	9942.4	999.8	95,794	220	786.1711	45.9	34,342	30632.424	32503.64	21.1	445.1142	95.4	497.51994			2.2	8.48002	91
402	474.8	475.0	CAM76781	9552.2	9942.4	989.8	83,092	340	1000.5814	107	35,671	18263.234	41911.002	15.4	296.7428	116	475.69889			2.4	8.48002	137
403	474.0	474.2	CAM77074	9143.0	9961.6	1000.5	73,566	220	714.701	35.3	25,879	13365.367	29428.157	6.51	296.7428	110	375.32206			3.7	0	37.2
403	484.0	484.2	CAM77075	9143.2	9961.6	990.5	87,326	220	857.6412	32.4	28,607	13199.337	37689.75	20.5	148.3714	120	344.77259			3.7	0	79.9
404	465.0	465.2	CAM76786	9553.3	9966.9	1000.0	84,680	220	857.6412	54.2	15,457	19176.396	25689.334	5.34	148.3714	83.9	314.22312			1.7	16.96004	10.5
404	475.0	475.2	CAM76787	9553.5	9966.9	990.0	81,505	170	929.1113	32.2	21,053	20504.631	25267.208	4.4	148.3714	74.6	510.61257			1.8	8.48002	14.4
405	468.0	468.2	CAM77081	9330.8	9971.2	1002.9	84,680	350	714.701	85.8	35,042	17101.028	32563.944	9.98	296.7428	153	349.1368			3	8.48002	55.5
405	478.0	478.2	CAM77082	9331.0	9971.2	992.9	91,560	290	929.1113	54	32,803	21417.793	34312.748	19	296.7428	145	375.32206			4.4	8.48002	52.6
405	488.0	488.2	CAM77083	9331.2	9971.1	982.9	53,984	50	571.7608	5.73	6,435	10210.808	18814.723	0.89	148.3714	17.9	314.22312			0.05	8.48002	12.8
406	475.0	475.2	CAM77087	9327.2	9940.2	995.8	87,856	250	857.6412	43.7	29,236	19010.366	35880.642	25.8	296.7428	126	405.87153			3.1	8.48002	84.9
406	485.1	485.3	CAM77088	9327.5	9940.2	985.7	87,856	200	1072.0515	34.4	33,363	27062.792	28945.728	11.5	296.7428	100	541.16204			1.4	0	45.9
406	495.0	495.2	CAM77089	9327.7	9940.3	975.8	88,914	280	643.2309	64.4	33,573	29138.16	26473.28	18.4	593.4856	121	231.30313			1.6	16.96004	18.3
406	503.8	504.0	CAM77090	9328.0	9940.4	967.0	92,619	150	857.6412	20.7	39,938	31213.527	29548.764	27.8	445.1142	80.2	340.40838			2.6	8.48002	141
407	470.0	470.2	CAM76791	9417.8	9975.8	998.2	111,143	160	4859.9668	20.1	8,183	16768.969	39438.554	3.09	445.1142	85.1	440.78521			3	25.44006	13.7
407	480.0	480.2	CAM76792	9417.9	9975.9	988.2	64,039	110	500.2907	15.9	12,170	11539.043	20985.653	14.7	222.5571	50.5	261.8526			0.7	8.48002	4.6
407	489.7	489.9	CAM76793	9418.0	9976.1	978.5	89,973	1060	6003.4884	399	20,843	11206.985	39076.733	33.3	148.3714	303	270.58102			2.2	8.48002	26.6
408	468.0	468.2	CAM76797	9446.1	9983.8	1000.2	84,680	170	1214.9917	25.7	14,688	27145.807	21950.51	12	148.3714	82.4	488.79152			1.4	8.48002	12.7
408	478.0	478.2	CAM76798	9446.2	9983.9	990.2	81,505	150	714.701	19.3	25,250	19425.44	27438.138	6.78	222.5571	78.6	471.33468			1.7	8.48002	40.7
408	485.8	486.0	CAM76799	9446.3	9984.0	982.4	84,680	180	1000.5814	25.1	21,543	16602.94	31237.265	3.61	148.3714	96.6	554.25467			2.1	8.48002	15.8
409	478.0	478.2	CAM77093	9153.2	9941.5	996.1	77,800	180	1072.0515	30	39,378	21251.763	31538.783	9.35	296.7428	89.6	480.0631			1.9	8.48002	62.1
409	488.6	488.8	CAM77094	9153.4	9941.4	985.5	79,388	130	1429.402	18	22,802	18180.219	37388.232	8.48	222.5571	60.2	532.43362			1.1	0	57.8
409	494.7	494.9	CAM77095	9153.4	9941.4	979.4	83,092	200	1357.9319	25	33,153	19176.396	40584.323	10.3	148.3714	108	541.16204			1.6	8.48002	60
410	475.5	475.7	CAM78105	9260.0	9960.2	998.1	91,031	340	1286.4618	73.9	40,917	22164.925	34493.659	5.2	296.7428	162	576.07572			2.6	8.48002	73.3
410	484.3	484.5	CAM78106	9260.1	9960.1	989.3	94,207	380	1072.0515	115	36,790	36194.409	23518.404	18	519.2999	131	532.43362			2.5	8.48002	59.2
410	491.6	491.8	CAM78107	9260.2	9959.9	982.0	89,973	170	1000.5814	27	30,425	26979.778	29910.586	18.4	370.9285	83.7	458.24205			1.9	0	78.2
411	474.0	474.2	CAM77099	9220.6	9953.9	997.9	73,037	150	786.1711	35.6	14,478	19259.41	22674.154	16.6	296.7428	55	427.69258			1.1	8.48002	28.3
411	483.9	484.1	CAM78108	9220.6	9953.9	988.0	79,388	250	929.1113	53.5	14,548	20919.704	23156.582	11.4	296.7428	115	405.87153			2.2	8.48002	12.5
421	466.0	466.1	CAM69406	9398.3	9964.7	1002.2	75,154	430	428.8206	161	21,123	14029.484	33227.284	7.95	296.7428	110	353.50101			1.4	8.48002	21.1
421	476.0	476.1	CAM69407	9398.3	9964.8	992.2	52,396	300	357.3505	82.6	48,401	15689.778	20744.438	19.1	222.5571	110	218.2105			2.6	8.48002	142
421	486.0	486.1	CAM69408	9398.2	9964.8	982.2	86,797	230	714.701	44.2	45,253	25485.513	33347.891	6.28	370.9285	107	318.58733			2.6	8.48002	62.7
422	465.0	465.1	CAM69412	9599.2	9973.0	1002.8	150,837	420	929.1113	98.7	35,042	23244.116	54574.758	22	148.3714	191	571.71151			5.8	16.96004	36.8
422	475.0	475.1	CAM69413	9600.2	9973.6	992.8	83,092	130	1214.9917	20.4	16,227	26813.748	23880.226	5.76	148.3714	56.1	392.7789			1.4	8.48002	26.2
422	485.0	485.1	CAM69414	9601.2	9974.1	982.9	102,675	90	857.6412	12.1	16,437	31047.498	28402.996	3.03	370.9285	36.3	423.32837			1.2	8.48002	17.8
422	495.0	495.1	CAM69415	9602.2	9974.7	973.0	88,914	200	857.6412	36.4	29,726	27062.792	27799.96	6.69	222.5571	95.8	296.76628			2.3	8.48002	72.7
422	505.0	505.1	CAM69418	9603.2	9975.2	963.0	89,443	210	929.1113	39.5	41,616	17267.058	41066.752	4.39	296.7428	100	301.13049			3.8	8.48002	51.6

Hole ID	From	To	Sample ID	Middle of x	Middle of y	Middle of z	Al µg/g	As µg/g	Ca µg/g	Co µg/g	Fe µg/g	K µg/g	Mg µg/g	Mo µg/g	Na µg/g	Ni µg/g	P µg/g	S pct	S µg/g	Se ppm	U µg/g	V ppm
422	515.0	515.1	CAM69419	9604.2	9975.7	953.1	85,209	160	643.2309	28.8	49,730	30383.38	25146.601	2.8	519.2999	73.8	283.67365			2.2	8.48002	86.8
422	525.0	525.1	CAM69420	9605.2	9976.2	943.1	80,446	80	10791.985	14.4	38,958	30881.468	15498.025	1.11	14392.026	30.1	497.51994			0.7	0	50.1
CL490	483.1	483.2	CAM084728	9128.6	9984.9	1002.9	83,622	220	1929.6927	44.7	45,113	29636.248	24362.654	18.3	370.9285	102	846.65674	2.53	25300	4	0	118
CL490	496.6	496.7	CAM084729	9129.1	9987.6	989.7	91,031	120	1000.5814	16.5	29,586	19259.41	37388.232	12.2	222.5571	60.2	549.89046	0.72	7200	0.2	8.48002	87.1
CL490	506.5	506.6	CAM084730	9129.4	9989.5	980.0	56,630	120	1143.5216	18.6	31,824	24738.381	12603.452	9.41	222.5571	57	458.24205	1.79	17900	2.5	8.48002	43.9
CL490	519.0	519.1	CAM084731	9129.8	9991.9	967.7	77,800	70	1357.9319	7.76	29,376	16187.867	43961.324	9.52	148.3714	26.6	497.51994	0.22	2200	0.05	8.48002	96.9
CL490	529.2	529.3	CAM084732	9130.1	9993.8	957.7	74,624	100	3216.1545	19.5	35,181	23576.175	40644.626	5.62	222.5571	33.2	1300.5346	0.88	8800	0.2	8.48002	52.9
CL490	539.6	539.7	CAM084733	9130.4	9995.7	947.5	83,622	100	5646.1379	14.1	26,089	25402.498	47820.755	5.98	519.2999	40.8	2491.9639	0.82	8200	0.4	8.48002	56.1
CL494	475.0	475.2	CAM084843	9768.5	9984.0	996.3	96,324	290	1572.3422	102	32,104	20587.646	42694.949	12	148.3714	80.1	554.25467	1.16	11600	0.6	8.48002	58.3
CL494	484.8	485.0	CAM084844	9768.6	9985.5	986.6	90,502	220	1500.8721	50	31,684	22413.969	35699.731	1.98	296.7428	89.8	571.71151	1.54	15400	0.6	8.48002	32.7
CL494	495.0	495.2	CAM084845	9768.7	9987.0	976.5	88,385	200	1214.9917	29.5	29,796	27975.954	25809.941	9.95	222.5571	102	362.22943	1.85	18500	2.5	8.48002	22.1
CL494	504.9	505.1	CAM084846	9768.8	9988.5	966.7	88,914	100	1214.9917	15.6	33,573	28889.116	35156.999	11.7	296.7428	42.7	440.78521	0.73	7300	1.2	8.48002	65.2
CL496A	468.0	468.1	CAM084880	9775.4	9964.5	996.8	73,037	620	428.8206	92.2	61,270	16768.969	26895.406	16.1	296.7428	371	152.74735	5.49	54900	10.1	8.48002	76.5
CL496A	474.0	474.1	CAM084881	9775.5	9964.8	990.8	79,388	200	571.7608	18.2	33,013	18429.263	33468.498	24.7	296.7428	120	261.8526	1.19	11900	1.5	8.48002	91.3
CL496A	486.0	486.1	CAM084882	9775.7	9965.4	978.8	84,151	200	1143.5216	26.1	45,323	24821.395	32443.337	12.1	296.7428	107	637.17466	1.73	17300	2.4	8.48002	93
CL496A	495.4	495.5	CAM084883	9775.8	9965.9	969.4	70,920	110	571.7608	13.3	24,200	18180.219	28282.388	7.22	296.7428	53.4	174.5684	0.75	7500	0.7	0	56.7
CL496A	507.0	507.1	CAM084884	9776.0	9966.6	957.8	115,377	70	1572.3422	6	38,049	19674.484	76585.572	1.01	222.5571	28.7	493.15573	0.06	600	0.2	8.48002	58.1
CL496A	518.9	519.0	CAM084885	9776.2	9967.3	946.0	79,917	130	1072.0515	8.4	20,843	29802.277	26533.584	16.8	1335.3426	77.4	296.76628	0.63	6300	0.7	8.48002	10.6
CL496A	521.2	521.3	CAM084886	9776.2	9967.5	943.7	89,973	90	51529.942	12	46,093	48231.541	30513.622	1.86	1112.7855	39.1	536.79783	0.52	5200	0.3	8.48002	54.9
CL496A	534.1	534.2	CAM084887	9776.4	9968.2	930.8	83,092	230	1643.8123	30.4	63,019	26398.675	36001.249	7.44	370.9285	130	392.7789	2.12	21200	2.4	8.48002	109
CL496A	540.3	540.4	CAM084889	9776.5	9968.6	924.6	73,037	40	1643.8123	2.62	17,905	39099.924	10553.13	3.46	6825.0844	12.3	270.58102	0.19	1900	0.2	8.48002	7.6
CL525	475.0	475.1	CAM241966	9280.7	9958.4	1000.7	86,797	280	714.701	56.5	15,947	14444.558	32865.462	17.5	296.7428	130	410.23574	1.3	13000	1.1	8.48002	24.3
CL525	483.3	483.4	CAM241967	9280.9	9959.2	992.4	91,031	210	2144.103	32	18,465	12452.205	41428.573	2.08	148.3714	108	763.73675	0.38	3800	0.3	8.48002	34.6
CL525	490.6	490.7	CAM241968	9281.1	9959.9	985.2	92,090	270	1072.0515	49.6	40,078	24406.322	34252.445	14	222.5571	133	519.34099	1.79	17900	3.2	8.48002	136
CL526_2	470.0	470.1	CAM231881	9437.5	9974.0	1004.3	85,739	370	857.6412	86.3	25,529	13033.308	34312.748	14.9	148.3714	167	375.32206	2.5	25000	3.2	8.48002	21.3
CL526_2	480.6	480.7	CAM231882	9437.2	9975.9	993.9	70,920	160	714.701	45.4	11,401	21915.881	19176.545	12	222.5571	47.4	314.22312	0.92	9200	0.1	8.48002	2.6
CL526_2	496.7	496.8	CAM231883	9436.8	9978.7	978.1	84,680	140	643.2309	19.5	22,312	24157.278	26232.066	6.09	296.7428	70.1	231.30313	1.3	13000	1.4	8.48002	43.2
CL527	478.0	478.1	CAM084685	9324.0	9955.0	1002.5	98,441	310	1000.5814	69.4	28,817	30134.336	26714.495	27.7	370.9285	139	401.50732	1.59	15900	3	8.48002	104
CL527	488.0	488.1	CAM084686	9324.2	9956.2	992.5	86,797	200	857.6412	32.7	28,957	25402.498	27016.013	16.7	370.9285	97.6	384.05048	1.3	13000	1.6	8.48002	74.4
CL527	499.9	500.0	CAM084687	9324.4	9957.6	980.7	108,496	170	1929.6927	32.6	34,342	14112.499	52645.043	2.58	148.3714	79.3	628.44624	1.01	10100	0.8	8.48002	79.4
CL533	471.8	471.9	CAM245414	9596.4	9960.5	994.1	86,797	170	857.6412	38.7	15,457	17350.072	33830.32	4.93	148.3714	65.6	305.4947	0.96	9600	0.7	8.48002	29.1
CL533	480.9	481.0	CAM245415	9596.3	9961.1	985.0	87,856	200	1357.9319	50.9	20,493	25485.513	28463.299	3.34	148.3714	72.5	484.42731	1.39	13900	0.9	8.48002	26.2
CL533	485.8	485.9	CAM245416	9596.2	9961.5	980.1	89,443	210	1286.4618	49.3	16,157	26647.719	27498.442	6.44	222.5571	85.4	462.60626	1.28	12800	1.4	8.48002	36.6
CL533	493.8	493.9	CAM245417	9596.1	9962.0	972.1	84,680	260	4216.7359	44.1	24,410	17682.131	40101.894	47.6	148.3714	137	296.76628	1.68	16800	2.1	8.48002	88
CL533	504.8	504.9	CAM245418	9595.9	9962.7	961.1	83,622	250	3502.0349	35.6	34,482	16353.896	38895.822	3.29	148.3714	139	750.64412	1.7	17000	2.4	8.48002	67.3
CL538	480.8	481.0	CAM246502	9131.1	9998.4	1001.5	97,911	260	1000.5814	45.5	24,060	19259.41	37991.268	10	148.3714	136	418.96416			2.1	8.48002	43.6
CL538	498.0	498.2	CAM246503	9131.3	10001.1	984.5	67,215	150	1214.9917	27.3	28,047	18595.293	31297.568	3.26	148.3714	64	370.95785			1.3	8.48002	64.7
CL538	513.0	513.2	CAM246504	9131.4	10003.4	969.7	93,148	120	1357.9319	14.4	34,272	13863.455	69349.14	1.23	296.7428	57.5	519.34099			0.8	8.48002	71.4
CL544	496.0	496.2	CAM246603	9910.9	9962.0	992.6	90,502	160	714.701	15.9	24,130	17350.072	39016.429	19.4	222.5571	87.7	222.57471			1.3	0	66.4
CL544	517.0	517.2	CAM246604	9909.6	9966.0	972.0	83,622	140	1500.8721	23.4	45,533	29055.145	27196.924	2.63	222.5571	67.1	558.61888			1	0	72.8
CL545	492.1	492.3	CAM246509	10028.6	9969.5	998.4	90,502	180	1143.5216	24.4	22,522	19840.513	37930.964	15.5	222.5571	96	379.68627			1.7	0	57.2
CL545	508.2	508.4	CAM246510	10028.3	9971.4	982.4	95,265	160	857.6412	17.8	26,858	19010.366	41669.788	14.8	296.7428	91.3	314.22312			1.9	0	88
CL545	526.4	526.6	CAM246511	10028.1	9973.6	964.4	76,212	150	1000.5814	16.2	28,607	23327.131	31237.265	18.8	445.1142	81.2	331.67996			1.9	0	103
CL548	488.0	488.2	CAM246559	10232.9	10010.6	1003.1	134,430	1090	571.7608	98.6	48,471	48978.673	32684.551	35.3	667.6713	747	353.50101			2.1	16.96004	152
CL548	502.4	502.6	CAM246560	10233.3	10013.0	988.9	88,914	190	643.2309	21.6	36,510	33039.851	23639.011	20.8	445.1142	108	322.95154			0.7	8.48002	69.2

Hole ID	From	To	Sample ID	Middle of x	Middle of y	Middle of z	Al µg/g	As µg/g	Ca µg/g	Co µg/g	Fe µg/g	K µg/g	Mg µg/g	Mo µg/g	Na µg/g	Ni µg/g	P µg/g	S pct	S µg/g	Se ppm	U µg/g	V ppm
CL548	515.0	515.2	CAM246561	10233.8	10015.1	976.4	95,265	160	1072.0515	15.7	23,641	20919.704	36664.589	20.5	296.7428	91.5	436.421			1.8	8.48002	58.1
CL550	496.4	496.6	CAM246515	10064.4	10002.9	999.3	94,207	190	714.701	26.3	33,992	26730.733	31056.354	19.9	519.2999	106	266.21681			2	8.48002	90.5
CL552	497.7	497.9	CAM246518	10103.1	9987.6	998.7	78,858	170	1072.0515	21.5	48,890	22413.969	38895.822	11.3	148.3714	87.9	497.51994			2.3	8.48002	79.4
CL553_1	501.6	501.8	CAM246565	10272.8	10040.8	996.9	88,914	100	643.2309	15.7	42,875	30466.395	25146.601	27.2	370.9285	46	305.4947			0.7	8.48002	116
CL553_1	510.5	510.7	CAM246566	10273.9	10042.8	988.3	89,443	220	929.1113	37.5	36,650	19508.455	36604.285	7.43	222.5571	115	418.96416			1.2	0	46.8
CL554	479.2	479.4	CAM246526	9683.2	9963.6	996.7	100,558	350	857.6412	51.6	38,958	29885.292	28885.424	9.77	445.1142	196	349.1368			3.4	0	49.2
CL556	506.8	507.0	CAM246612	10313.8	10034.6	990.3	97,911	280	857.6412	33.7	32,454	20587.646	39679.769	21.7	222.5571	164	288.03786			2.7	8.48002	55
CL556	537.4	537.6	CAM246613	10314.9	10039.0	960.0	92,619	120	1214.9917	16.8	36,510	23410.145	35096.695	17.1	445.1142	53.1	418.96416			0.7	50.88012	5
CL557	491.1	491.3	CAM246569	10177.6	10018.4	1004.6	88,385	210	1072.0515	22.5	31,964	18180.219	36785.196	23.8	296.7428	120	453.87784			1	8.48002	56.6
CL557	505.8	506.0	CAM246572	10176.1	10020.8	990.2	75,683	290	857.6412	44.3	65,887	23991.248	25809.941	15.8	370.9285	163	218.2105			5.8	8.48002	100

APPENDIX C

2017 PARTICLE SIZE DISTRIBUTION RESULTS

Appendix C – 2017 Particle Size Distribution Results

Table 1 – 17-BH-01A to 17-BH-05A

Sample Name	17-BH-01A 0-2	17-BH-01A 4-6	17-BH-01A 8-10	17-BH-02A 0-2	17-BH-02A 4-6	17-BH-02A 8-10	17-BH-03A 0-2	17-BH-03A 4-6	17-BH-03A 8-10	17-BH-04A 0-2	17-BH-04A 4-6	17-BH-04A 8-10	17-BH-04A 12-14	17-BH-05A 0-2	17-BH-05A 4-6	17-BH-05A 8-10	17-BH-05A 12-14
SRC Sample #	**28713a**	**28631**	**28632**	**26512**	**26514**	**26516**	**26518**	**26520**	**26522**	**26524**	**26526**	**26528**	**26530**	**26576**	**26578**	**26580**	**26582**
Particle Size (um)																	
0.04	0.0000	0	0	0	0	0	0	1.82E-09	3.00E-05	9.36E-09	2.02E-04	0	2.06E-06	1.26E-08	4.77E-05	1.89E-05	0
0.04391	0.0001	0	0	0	0	0	0	7.67E-08	6.29E-05	3.27E-07	2.50E-04	0	5.54E-06	3.45E-07	6.34E-05	2.77E-05	0
0.0482	0.0001	0	0	0	0	0	0	1.03E-06	1.41E-04	3.64E-06	3.75E-04	0	1.67E-05	3.05E-06	1.07E-04	5.27E-05	0
0.05292	0.0002	0	0	0	0	0	0	5.73E-06	2.85E-04	1.75E-05	7.05E-04	0	4.23E-05	1.19E-05	2.16E-04	1.12E-04	0
0.05809	0.0004	0	0	0	0	0	0	1.31E-05	5.38E-04	3.84E-05	0.00148	0	8.31E-05	2.48E-05	4.48E-04	2.30E-04	0
0.06377	0.0007	0	1.54E-07	1.60E-07	2.97E-08	0	0	2.28E-05	9.70E-04	6.57E-05	0.00291	0	1.53E-04	4.38E-05	8.71E-04	4.38E-04	8.05E-09
0.07	0.0012	3.03E-07	4.84E-06	5.42E-06	1.63E-06	0	4.75E-07	4.51E-05	0.00164	1.26E-04	0.00485	0	2.84E-04	8.92E-05	0.00153	7.80E-04	9.59E-07
0.07685	0.0019	7.37E-06	5.10E-05	5.83E-05	2.57E-05	2.39E-07	1.41E-05	1.35E-04	0.00253	3.34E-04	0.00678	3.66E-07	5.18E-04	2.28E-04	0.00237	0.00127	1.89E-05
0.08436	0.0027	6.34E-05	2.62E-04	2.96E-04	1.71E-04	8.08E-06	1.24E-04	3.68E-04	0.00366	8.10E-04	0.00869	1.07E-05	8.46E-04	5.49E-04	0.00338	0.00188	1.40E-04
0.09261	0.0036	2.77E-04	8.26E-04	9.20E-04	6.32E-04	8.64E-05	5.31E-04	8.08E-04	0.00513	0.00163	0.01073	9.82E-05	0.00127	0.00113	0.00458	0.00264	5.41E-04
0.1017	0.0048	7.63E-04	0.00184	0.00201	0.00154	4.29E-04	0.00141	0.00145	0.00694	0.00278	0.01302	4.36E-04	0.00182	0.002	0.00611	0.00362	0.00135
0.1116	0.0062	0.00155	0.0033	0.00356	0.00288	0.00127	0.00276	0.00231	0.00899	0.0043	0.01536	0.00119	0.00251	0.00318	0.00791	0.0048	0.00257
0.1225	0.0077	0.00261	0.0052	0.00558	0.00463	0.00263	0.00455	0.00341	0.01125	0.0062	0.01768	0.00237	0.00329	0.00466	0.00989	0.00613	0.00417
0.1345	0.0094	0.00399	0.00764	0.00816	0.00692	0.00449	0.00691	0.00471	0.01405	0.00844	0.02014	0.00394	0.00415	0.00647	0.01204	0.00757	0.00626
0.1476	0.0114	0.00578	0.01065	0.01135	0.00978	0.00694	0.00991	0.0063	0.0174	0.01113	0.02276	0.00602	0.00524	0.00869	0.01465	0.00936	0.00889
0.1621	0.0137	0.00801	0.01434	0.01522	0.0133	0.01021	0.01364	0.00822	0.02137	0.01443	0.02554	0.00877	0.00656	0.01141	0.0177	0.01148	0.01212
0.1779	0.0164	0.01077	0.01883	0.02	0.01762	0.01445	0.01825	0.01061	0.02595	0.01848	0.02854	0.01228	0.00813	0.01474	0.02126	0.01399	0.01609
0.1953	0.0195	0.01422	0.0244	0.02602	0.02308	0.01992	0.02413	0.0135	0.03166	0.02335	0.03199	0.01673	0.00993	0.0188	0.02536	0.01688	0.02108
0.2144	0.0234	0.01857	0.03132	0.03362	0.03002	0.02698	0.03167	0.01711	0.0386	0.0294	0.03601	0.0224	0.01221	0.02387	0.03043	0.02049	0.02737
0.2354	0.0281	0.02393	0.03972	0.04302	0.0386	0.036	0.04112	0.02153	0.04658	0.0368	0.04062	0.02949	0.01501	0.03008	0.03654	0.02489	0.03511
0.2584	0.0334	0.03016	0.04938	0.05402	0.04863	0.04686	0.05227	0.02669	0.05521	0.0454	0.04568	0.0379	0.01824	0.03733	0.0435	0.02995	0.04411
0.2836	0.0392	0.03701	0.05986	0.06616	0.05969	0.05915	0.06465	0.03232	0.06419	0.05476	0.05109	0.04729	0.02178	0.04536	0.05096	0.03543	0.05397
0.3113	0.0452	0.04419	0.07071	0.07891	0.07129	0.07243	0.07776	0.03821	0.07366	0.06449	0.05662	0.05734	0.02552	0.05389	0.05866	0.04115	0.06427
0.3418	0.0516	0.05176	0.08197	0.0924	0.08353	0.08684	0.09171	0.04443	0.08374	0.07471	0.06235	0.0681	0.02952	0.063	0.06668	0.04721	0.07506
0.3752	0.0584	0.0598	0.09382	0.10691	0.09665	0.1027	0.1068	0.0511	0.09467	0.08561	0.06841	0.07974	0.03381	0.0729	0.07516	0.05367	0.08652
0.4119	0.0658	0.06845	0.10643	0.12276	0.11092	0.12029	0.12336	0.05834	0.10652	0.09742	0.07511	0.09242	0.03851	0.08379	0.08431	0.06069	0.09887
0.4521	0.0737	0.07767	0.11973	0.13996	0.12633	0.13971	0.14142	0.06615	0.11932	0.11014	0.08248	0.10614	0.04365	0.09572	0.09417	0.06832	0.11205
0.4963	0.0823	0.08746	0.1337	0.1585	0.14286	0.16103	0.16101	0.07456	0.13314	0.12378	0.09055	0.1209	0.04924	0.10871	0.10475	0.07659	0.12606
0.5449	0.0915	0.09778	0.1483	0.17847	0.16055	0.18441	0.18218	0.08359	0.14796	0.13844	0.0994	0.13673	0.05531	0.12289	0.1161	0.08554	0.14084
0.5981	0.1013	0.1086	0.1635	0.19989	0.1794	0.20993	0.20495	0.09325	0.16387	0.15407	0.10928	0.1536	0.06183	0.13833	0.12822	0.09513	0.15637
0.6566	0.1117	0.11985	0.17919	0.22274	0.19932	0.23759	0.2293	0.10351	0.1809	0.1707	0.12037	0.17147	0.06884	0.1551	0.14119	0.10541	0.17255
0.7208	0.1226	0.13148	0.19535	0.24696	0.22027	0.26745	0.25517	0.11433	0.19919	0.18829	0.1328	0.19032	0.07633	0.17325	0.15501	0.1164	0.18929
0.7913	0.1341	0.14346	0.21193	0.27254	0.24218	0.2996	0.28253	0.12577	0.21871	0.20692	0.14672	0.21014	0.08434	0.19287	0.16981	0.12818	0.20652
0.8686	0.1461	0.15573	0.22895	0.29952	0.26502	0.33413	0.31135	0.13779	0.23958	0.22661	0.16247	0.23095	0.09281	0.21412	0.18558	0.14069	0.22418
0.9536	0.1586	0.1682	0.24634	0.32781	0.28868	0.37096	0.34147	0.15037	0.26185	0.24735	0.18041	0.25268	0.10175	0.23709	0.20245	0.15397	0.2421
1.047	0.1714	0.18076	0.26402	0.35723	0.31292	0.41	0.37264	0.16339	0.28555	0.26908	0.20087	0.27527	0.11111	0.26185	0.22047	0.168	0.26011
1.149	0.1845	0.19334	0.28195	0.38757	0.33753	0.45096	0.40455	0.17683	0.31049	0.29177	0.22395	0.29861	0.12087	0.28835	0.23968	0.18278	0.27807
1.261	0.1977	0.20585	0.30013	0.41858	0.3623	0.49346	0.43682	0.19054	0.33659	0.31526	0.24969	0.32259	0.13088	0.31644	0.25998	0.19815	0.29585
1.385	0.2109	0.21825	0.31852	0.44999	0.38698	0.53695	0.46902	0.20444	0.36369	0.33942	0.27808	0.34707	0.14108	0.34598	0.28135	0.21403	0.31336
1.52	0.2239	0.2304	0.33695	0.48142	0.41123	0.58082	0.50065	0.21834	0.3917	0.36406	0.30909	0.37184	0.15134	0.37671	0.30368	0.23025	0.33039
1.669	0.2368	0.24226	0.35536	0.51258	0.43481	0.62448	0.53127	0.23214	0.42041	0.38903	0.34258	0.39679	0.16159	0.40842	0.32695	0.24676	0.34689

Sample Name	17-BH-01A 0-2	17-BH-01A 4-6	17-BH-01A 8-10	17-BH-02A 0-2	17-BH-02A 4-6	17-BH-02A 8-10	17-BH-03A 0-2	17-BH-03A 4-6	17-BH-03A 8-10	17-BH-04A 0-2	17-BH-04A 4-6	17-BH-04A 8-10	17-BH-04A 12-14	17-BH-05A 0-2	17-BH-05A 4-6	17-BH-05A 8-10	17-BH-05A 12-14
SRC Sample #	**28713a**	**28631**	**28632**	**26512**	**26514**	**26516**	**26518**	**26520**	**26522**	**26524**	**26526**	**26528**	**26530**	**26576**	**26578**	**26580**	**26582**
Particle Size (um)																	
1.832	0.2494	0.25381	0.37373	0.54318	0.4575	0.66736	0.56047	0.24573	0.44973	0.41416	0.37829	0.42179	0.17174	0.44084	0.35104	0.26343	0.36283
2.011	0.2616	0.2651	0.3921	0.57306	0.47923	0.70891	0.58792	0.25907	0.47941	0.43934	0.41591	0.44681	0.18171	0.47372	0.37589	0.28017	0.37831
2.208	0.2735	0.27613	0.41037	0.60192	0.49981	0.7484	0.61323	0.27205	0.50923	0.46441	0.45498	0.47172	0.19142	0.5067	0.40139	0.29683	0.39336
2.423	0.2850	0.28691	0.42843	0.6295	0.51912	0.78517	0.63608	0.28457	0.53898	0.48915	0.49494	0.49641	0.2008	0.53942	0.42739	0.31327	0.40805
2.66	0.2962	0.29753	0.44621	0.65563	0.53713	0.81875	0.65633	0.29662	0.56846	0.51343	0.53509	0.52083	0.20978	0.57153	0.45377	0.32942	0.42255
2.92	0.3070	0.3081	0.4638	0.68033	0.55402	0.84895	0.67406	0.30825	0.59754	0.53715	0.57475	0.54503	0.21836	0.60281	0.48042	0.34522	0.4371
3.206	0.3177	0.3188	0.48123	0.70362	0.57	0.87562	0.68941	0.31956	0.62591	0.56032	0.61324	0.56906	0.22654	0.63309	0.50735	0.36061	0.45199
3.519	0.3280	0.32962	0.49831	0.72532	0.58506	0.8984	0.70234	0.33051	0.6532	0.58277	0.6498	0.59282	0.23427	0.66209	0.53442	0.37541	0.46722
3.863	0.3379	0.3405	0.5147	0.74514	0.59913	0.91689	0.71275	0.34108	0.67898	0.60428	0.68367	0.61609	0.24149	0.68956	0.5615	0.38941	0.48276
4.241	0.3472	0.35136	0.53009	0.7628	0.61209	0.93083	0.72061	0.3512	0.70309	0.62462	0.71409	0.6386	0.24812	0.71519	0.58837	0.40239	0.49844
4.656	0.3558	0.3623	0.54448	0.77841	0.62414	0.9405	0.72628	0.36104	0.72542	0.6438	0.74067	0.66029	0.25419	0.73904	0.61511	0.4143	0.51436
5.111	0.3639	0.37342	0.55796	0.79211	0.63552	0.94634	0.73013	0.37072	0.74598	0.66194	0.76325	0.68116	0.25975	0.76122	0.64185	0.42508	0.53058
5.611	0.3714	0.38479	0.57064	0.80412	0.64642	0.94883	0.73258	0.38037	0.76471	0.67924	0.78195	0.7012	0.26487	0.78191	0.66878	0.43469	0.54714
6.159	0.3783	0.39648	0.58261	0.81465	0.65695	0.94856	0.7341	0.3901	0.78179	0.6958	0.79686	0.72035	0.26959	0.8012	0.696	0.44316	0.56407
6.761	0.3849	0.40879	0.59441	0.82438	0.66763	0.9468	0.73568	0.4002	0.79776	0.71198	0.80836	0.73882	0.27403	0.8194	0.72371	0.45073	0.58172
7.422	0.3919	0.4224	0.60726	0.83458	0.67954	0.94566	0.73899	0.41126	0.81312	0.72855	0.81711	0.75723	0.27849	0.83721	0.75254	0.45791	0.60098
8.148	0.3997	0.43795	0.62245	0.84653	0.69379	0.9472	0.74558	0.42383	0.82789	0.74628	0.82378	0.77613	0.28323	0.85524	0.78318	0.46514	0.62272
8.944	0.4085	0.45576	0.64071	0.86069	0.71085	0.95214	0.7561	0.43819	0.84072	0.7655	0.82866	0.79549	0.28837	0.87352	0.8161	0.47246	0.64731
9.819	0.4178	0.47513	0.66107	0.87572	0.72942	0.95855	0.76921	0.45366	0.84976	0.78522	0.83102	0.8138	0.29347	0.8907	0.85057	0.47903	0.67365
10.78	0.4266	0.49484	0.68181	0.88947	0.74748	0.96297	0.78246	0.46929	0.85306	0.80376	0.82987	0.82883	0.2979	0.90487	0.88539	0.4838	0.69992
11.83	0.4337	0.51325	0.70091	0.89966	0.76287	0.96172	0.79296	0.4838	0.85003	0.81913	0.82433	0.83819	0.30098	0.91396	0.91885	0.48562	0.72381
12.99	0.4385	0.52923	0.71762	0.90546	0.77503	0.95327	0.79921	0.49665	0.84106	0.83036	0.81475	0.84093	0.30247	0.91716	0.94994	0.48407	0.74407
14.26	0.4408	0.54188	0.73165	0.9069	0.7842	0.93808	0.80083	0.50757	0.8274	0.83713	0.80211	0.83739	0.30231	0.91435	0.97766	0.47931	0.76016
15.65	0.4408	0.551	0.74296	0.90471	0.79122	0.91836	0.79873	0.51683	0.81091	0.83978	0.78778	0.82911	0.30065	0.90625	1.00113	0.47242	0.7726
17.18	0.4396	0.55735	0.7515	0.90014	0.79706	0.89738	0.79491	0.52529	0.79408	0.8392	0.7733	0.81838	0.29789	0.89438	1.01984	0.46542	0.78283
18.86	0.4388	0.56292	0.75793	0.89527	0.80301	0.87897	0.7921	0.53435	0.78074	0.837	0.76048	0.80792	0.29483	0.8815	1.03432	0.46102	0.79308
20.71	0.4407	0.57112	0.76525	0.89397	0.81221	0.86804	0.79417	0.54658	0.77465	0.83636	0.75231	0.80127	0.29317	0.87233	1.0475	0.46218	0.80691
22.73	0.4471	0.585	0.77756	0.90006	0.82817	0.86856	0.80418	0.56425	0.7786	0.84061	0.75166	0.80142	0.29472	0.87157	1.06319	0.47042	0.82722
24.95	0.4593	0.60609	0.79896	0.91607	0.85419	0.88245	0.8235	0.58886	0.79221	0.85221	0.76036	0.8101	0.30081	0.88241	1.08483	0.48493	0.85566
27.39	0.4761	0.63269	0.83009	0.94052	0.89029	0.90712	0.85006	0.61959	0.81158	0.87046	0.77717	0.82611	0.31115	0.90372	1.11251	0.50188	0.89049
30.07	0.4954	0.66017	0.86702	0.96774	0.93247	0.93566	0.87881	0.65335	0.83073	0.89117	0.79753	0.84529	0.32363	0.92989	1.1422	0.51576	0.92691
33.01	0.5144	0.68286	0.90238	0.99018	0.97391	0.95932	0.904	0.68603	0.84381	0.90805	0.81517	0.86202	0.3351	0.95287	1.16738	0.52201	0.95889
36.24	0.5311	0.69643	0.92807	1.00152	1.00735	0.97086	0.92155	0.71397	0.84843	0.91512	0.82455	0.87109	0.34256	0.96526	1.18151	0.51922	0.98127
39.78	0.5455	0.70061	0.94024	1.0007	1.02921	0.96871	0.93165	0.73623	0.84652	0.90996	0.82404	0.87048	0.34501	0.96438	1.18196	0.5105	0.99285
43.67	0.5589	0.6992	0.94135	0.99221	1.04083	0.95749	0.938	0.75456	0.8435	0.89478	0.81654	0.86182	0.34386	0.95302	1.17081	0.50176	0.99656
47.94	0.5731	0.69854	0.9398	0.984	1.04795	0.9459	0.94552	0.77268	0.84574	0.87563	0.80818	0.84968	0.34243	0.93813	1.15408	0.49935	0.99848
52.63	0.5885	0.70474	0.94625	0.98361	1.05802	0.94275	0.95733	0.79447	0.85758	0.85994	0.80551	0.83965	0.34451	0.92753	1.13888	0.50763	1.00529
57.77	0.6044	0.72078	0.96847	0.99439	1.0767	0.95285	0.9727	0.82214	0.88028	0.85334	0.81233	0.83605	0.35261	0.9265	1.13024	0.52729	1.02142
63.42	0.6193	0.74572	1.00827	1.01482	1.10652	0.97573	0.98832	0.85604	0.91189	0.85809	0.82887	0.84105	0.36739	0.93672	1.13001	0.55566	1.04805
69.62	0.6330	0.77522	1.06035	1.03963	1.14652	1.00616	1.00084	0.8949	0.94885	0.8724	0.85199	0.85427	0.38763	0.95656	1.13679	0.58804	1.08294
76.43	0.6470	0.80378	1.11457	1.06314	1.19369	1.03686	1.00986	0.93713	0.9879	0.89156	0.87719	0.87345	0.4112	0.98297	1.14767	0.62028	1.12195
83.9	0.6647	0.82762	1.16066	1.08249	1.24482	1.06194	1.01863	0.98171	1.02731	0.90993	0.90091	0.89535	0.43645	1.01343	1.15994	0.65026	1.16083
92.1	0.6892	0.84662	1.19284	1.09861	1.29725	1.0788	1.03192	1.02822	1.06776	0.92306	0.92161	0.9165	0.46292	1.04663	1.17214	0.67767	1.19672
101.1	0.7221	0.86487	1.21286	1.11462	1.34897	1.08903	1.05316	1.0767	1.11192	0.92987	0.94015	0.93443	0.49182	1.08215	1.18453	0.70368	1.22964

Sample Name	17-BH-01A 0-2	17-BH-01A 4-6	17-BH-01A 8-10	17-BH-02A 0-2	17-BH-02A 4-6	17-BH-02A 8-10	17-BH-03A 0-2	17-BH-03A 4-6	17-BH-03A 8-10	17-BH-04A 0-2	17-BH-04A 4-6	17-BH-04A 8-10	17-BH-04A 12-14	17-BH-05A 0-2	17-BH-05A 4-6	17-BH-05A 8-10	17-BH-05A 12-14
SRC Sample #	**28713a**	**28631**	**28632**	**26512**	**26514**	**26516**	**26518**	**26520**	**26522**	**26524**	**26526**	**26528**	**26530**	**26576**	**26578**	**26580**	**26582**
Particle Size (um)																	
111	0.7627	0.88879	1.22892	1.13244	1.39795	1.09727	1.08204	1.12732	1.16332	0.93329	0.95924	0.94883	0.5255	1.11932	1.19872	0.73063	1.26287
121.8	0.8097	0.92374	1.25098	1.14988	1.44173	1.10917	1.11387	1.18047	1.22432	0.93892	0.98315	0.96208	0.56685	1.15635	1.217	0.76244	1.30209
133.7	0.8633	0.97056	1.28473	1.16053	1.47755	1.12857	1.14095	1.23622	1.29355	0.95168	1.01738	0.97807	0.61852	1.19029	1.24084	0.80386	1.3523
146.8	0.9266	1.0236	1.32678	1.15605	1.50188	1.15388	1.15512	1.29265	1.36466	0.97192	1.06734	0.9991	0.68198	1.21716	1.2688	0.85786	1.41328
161.2	1.0035	1.07221	1.36394	1.12976	1.50964	1.17599	1.1497	1.34414	1.42718	0.99383	1.13645	1.02295	0.75711	1.23244	1.29502	0.92299	1.47661
176.9	1.0950	1.10529	1.37769	1.07934	1.49371	1.1785	1.11971	1.38112	1.47042	1.0074	1.22379	1.04197	0.84197	1.23158	1.30959	0.99201	1.52655
194.2	1.1967	1.1166	1.35273	1.00737	1.44635	1.14277	1.06285	1.39345	1.4887	1.00403	1.32345	1.04595	0.93392	1.21136	1.30158	1.05407	1.54679
213.2	1.2994	1.1081	1.2859	0.9206	1.36321	1.05708	0.98218	1.37648	1.48434	0.98281	1.42658	1.02808	1.03134	1.17205	1.26414	1.10046	1.53035
234.1	1.3928	1.08853	1.1899	0.82864	1.24787	0.92415	0.88832	1.33635	1.46652	0.95264	1.52557	0.99011	1.13532	1.11915	1.19859	1.13029	1.48609
256.9	1.4707	1.0699	1.08956	0.74233	1.11364	0.76358	0.79775	1.29009	1.44552	0.92904	1.61811	0.94302	1.25016	1.06276	1.11539	1.15292	1.43691
282.1	1.5319	1.06185	1.01163	0.67121	0.97965	0.60496	0.72663	1.25887	1.42591	0.92665	1.70788	0.9017	1.38175	1.0139	1.02957	1.18294	1.4094
309.6	1.5788	1.06856	0.97402	0.62011	0.86253	0.47359	0.68358	1.25843	1.40223	0.95272	1.80142	0.87723	1.53451	0.97899	0.95417	1.23251	1.42159
339.9	1.6133	1.08725	0.97942	0.58675	0.76889	0.38153	0.66547	1.29158	1.35943	1.00358	1.90253	0.87091	1.70777	0.95543	0.89424	1.30404	1.47467
373.1	1.6347	1.1117	1.01461	0.56162	0.69261	0.3243	0.65774	1.34639	1.27888	1.06635	2.00737	0.8729	1.8935	0.9309	0.84611	1.38915	1.55149
409.6	1.6399	1.1329	1.05339	0.53089	0.61829	0.28608	0.63958	1.40026	1.1482	1.1229	2.10274	0.8657	2.07679	0.88717	0.79824	1.47058	1.62212
449.7	1.6264	1.1435	1.0659	0.48271	0.52955	0.24801	0.59361	1.43016	0.96949	1.15768	2.16858	0.83219	2.23887	0.80822	0.73762	1.52995	1.65615
493.6	1.5950	1.13777	1.03082	0.41368	0.41986	0.19502	0.51641	1.42417	0.7623	1.16267	2.18367	0.76493	2.36253	0.68952	0.65551	1.55424	1.63653
541.9	1.5529	1.11995	0.94695	0.33152	0.29932	0.11942	0.42134	1.38839	0.55748	1.1413	2.13173	0.67066	2.43625	0.54236	0.55504	1.54462	1.56797
594.9	1.5078	1.09643	0.8326	0.25102	0.19207	0.05033	0.33179	1.34107	0.38114	1.10266	2.00539	0.56703	2.4551	0.39064	0.44973	1.50993	1.47231
653	1.4639	1.07513	0.71444	0.18433	0.12021	0.01051	0.26697	1.30278	0.24704	1.05477	1.80798	0.47252	2.42009	0.26036	0.35537	1.46361	1.37556
716.9	1.4133	1.05194	0.60833	0.13487	0.08676	9.25E-04	0.23031	1.28254	0.15236	0.99525	1.55216	0.39535	2.33291	0.16482	0.27738	1.41091	1.29109
786.9	1.3415	1.02553	0.51691	0.09808	0.08102	1.37E-06	0.21123	1.27396	0.08298	0.91813	1.25492	0.33323	2.19225	0.10302	0.22008	1.3552	1.21335
863.9	1.2316	0.98655	0.42656	0.06631	0.08622	0	0.19063	1.25955	0.0357	0.81209	0.94009	0.27545	1.99853	0.06507	0.17103	1.29342	1.12101
948.3	1.0769	0.93176	0.32035	0.03626	0.08326	0	0.15127	1.21807	0.00954	0.67492	0.63416	0.20993	1.75409	0.03685	0.1177	1.22285	0.99124
1041	0.8850	0.85745	0.19101	0.01374	0.05806	0	0.0902	1.13758	0.00134	0.51343	0.36199	0.14416	1.47061	0.01604	0.0593	1.14037	0.81644
1143	0.6894	0.79802	0.07927	0.00265	0.02587	0	0.03517	1.02273	6.49E-05	0.36185	0.15755	0.08989	1.16739	0.00349	0.01792	1.06395	0.61723
1255	0.5179	0.77105	0.01799	2.07E-04	0.0054	0	0.00669	0.87907	0	0.24839	0.04458	0.05433	0.86267	3.27E-04	0.00261	0.99556	0.42668
1377	0.3926	0.79879	0.00189	0	4.42E-04	0	4.83E-04	0.7179	0	0.19082	0.00644	0.02834	0.57423	0	1.39E-04	0.94081	0.2747
1512	0.3168	0.86171	3.43E-05	0	0	0	0	0.54464	0	0.18715	3.06E-04	0.01166	0.31444	0	0	0.88068	0.17211
1660	0.2796	0.93063	0	0	0	0	0	0.41617	0	0.21128	0	0.00248	0.15705	0	0	0.83206	0.11792
1822	0.2864	1.03805	0	0	0	0	0	0.30284	37.1504	0.28651	0	2.52E-04	0.04803	0	0	0.79642	0.09788
2000	42.5683	42.4858	38.9983	41.0308	39.5989	40.0084	41.9853	36.8687	0	36.7809	26.4057	43.573	43.4133	39.8894	37.4218	41.2249	26.4219

Table 2 – 17-BH-06A to 17-BH-08A

Sample Name	17-BH-06A 0-2	17-BH-06A 4-6	17-BH-06A 8-10	17-BH-06A 12-14	17-BH-06A 16-18	17-BH-07A 0-2	17-BH-07A 4-6	17-BH-07A 8-10	17-BH-07A 12-14	17-BH-07A 16-18	17-BH-08A 0-2	17-BH-08A 4-6	17-BH-08A 8-10	17-BH-08A 12-14	17-BH-08A 16-18
SRC Sample #	26497	26499	26501	26503	26505	26532	26534	26536	26538	26540	26542	26544	26546	26548	26550
Particle Size (um)															
0.04	0	0	2.97E-05	0	0	5.16E-04	0	2.13E-04	0	1.70E-04	0	0	1.08E-04	4.96E-09	9.95E-09
0.04391	0	0	4.36E-05	0	0	6.39E-04	0	2.63E-04	0	2.13E-04	0	0	1.35E-04	2.14E-07	3.60E-07
0.0482	0	0	8.30E-05	0	0	9.55E-04	0	3.93E-04	0	3.27E-04	0	0	2.09E-04	2.81E-06	4.07E-06
0.05292	0	0	1.77E-04	0	0	0.00181	0	7.38E-04	0	6.23E-04	0	0	3.97E-04	1.53E-05	1.95E-05
0.05809	0	0	3.62E-04	0	0	0.00382	0	0.00155	0	0.00131	0	0	8.32E-04	3.49E-05	4.27E-05
0.06377	0	0	6.90E-04	0	5.17E-09	0.00742	0	0.00305	0	0.00255	0	0	0.00163	6.22E-05	7.50E-05
0.07	5.24E-07	0	0.00123	0	9.70E-07	0.01204	2.08E-07	0.0051	0	0.00427	0	2.60E-08	0.00277	1.25E-04	1.52E-04
0.07685	1.30E-05	8.85E-08	0.002	6.71E-07	1.84E-05	0.01643	5.49E-06	0.00715	0	0.00605	1.90E-07	2.08E-06	0.004	3.65E-04	4.28E-04
0.08436	1.08E-04	3.32E-06	0.00299	1.82E-05	1.34E-04	0.0206	4.94E-05	0.00917	0	0.00785	7.52E-06	3.33E-05	0.00528	9.62E-04	0.00108
0.09261	4.47E-04	4.01E-05	0.00423	1.64E-04	5.11E-04	0.02495	2.21E-04	0.01133	6.41E-07	0.00982	8.84E-05	2.15E-04	0.00671	0.00206	0.00223
0.1017	0.00118	2.25E-04	0.00584	7.26E-04	0.00127	0.02958	6.23E-04	0.01377	1.71E-05	0.01209	4.66E-04	7.50E-04	0.00842	0.00364	0.00387
0.1116	0.00233	7.50E-04	0.00779	0.002	0.00242	0.03404	0.00128	0.01627	1.49E-04	0.01446	0.00144	0.00174	0.01026	0.00575	0.00607
0.1225	0.00386	0.00173	0.00998	0.00397	0.00393	0.03831	0.00219	0.01874	6.29E-04	0.01686	0.00306	0.00315	0.01216	0.00843	0.00882
0.1345	0.00589	0.00314	0.0124	0.00663	0.00592	0.04265	0.00337	0.02135	0.00167	0.01939	0.0053	0.00501	0.01422	0.01163	0.01209
0.1476	0.00847	0.00503	0.01536	0.01008	0.00845	0.0468	0.00491	0.02411	0.00327	0.02219	0.00822	0.00747	0.01658	0.0155	0.01605
0.1621	0.01172	0.00759	0.01888	0.01464	0.01158	0.05087	0.00686	0.02704	0.00544	0.02523	0.01211	0.01065	0.01922	0.02021	0.02087
0.1779	0.01573	0.01111	0.02303	0.02048	0.01545	0.055	0.00929	0.03018	0.00835	0.02859	0.01713	0.01467	0.02219	0.02602	0.02677
0.1953	0.02081	0.01585	0.02782	0.02789	0.02033	0.05953	0.01236	0.03373	0.0124	0.03239	0.02355	0.01977	0.02562	0.03306	0.03388
0.2144	0.02728	0.02205	0.03372	0.03739	0.02652	0.06428	0.01627	0.03779	0.01789	0.03689	0.03176	0.02636	0.02979	0.0418	0.04263
0.2354	0.03535	0.02971	0.04086	0.04934	0.0342	0.06919	0.02116	0.04237	0.02506	0.04212	0.04209	0.03468	0.03474	0.0525	0.05327
0.2584	0.04485	0.0386	0.04901	0.06348	0.04323	0.07409	0.02694	0.04728	0.03385	0.0479	0.05433	0.0446	0.04034	0.06496	0.06557
0.2836	0.05541	0.04836	0.05776	0.07913	0.05329	0.0789	0.03337	0.05237	0.04395	0.05405	0.06791	0.05575	0.04638	0.07857	0.07896
0.3113	0.06662	0.0591	0.06683	0.09562	0.064	0.08335	0.04021	0.05741	0.05495	0.06034	0.08226	0.06774	0.05266	0.09282	0.09293
0.3418	0.07852	0.07108	0.07632	0.11306	0.07544	0.08744	0.04753	0.06247	0.06691	0.06685	0.09745	0.08067	0.05924	0.10784	0.10761
0.3752	0.0914	0.08456	0.08638	0.13171	0.08785	0.09122	0.05547	0.06763	0.08008	0.0736	0.11373	0.09479	0.06628	0.12399	0.12331
0.4119	0.10553	0.09959	0.0972	0.15184	0.10148	0.09503	0.0642	0.07317	0.09471	0.08085	0.13133	0.1104	0.07404	0.14159	0.14032
0.4521	0.12095	0.1162	0.10884	0.17339	0.11634	0.0987	0.07375	0.07912	0.1108	0.08855	0.15021	0.12754	0.0826	0.16067	0.15867
0.4963	0.13765	0.1345	0.12134	0.19639	0.13243	0.1022	0.08416	0.08547	0.12836	0.09671	0.17036	0.14622	0.09196	0.18129	0.17839
0.5449	0.15572	0.15457	0.13477	0.22077	0.1498	0.1054	0.09547	0.09231	0.14744	0.10521	0.19182	0.16655	0.10222	0.20363	0.19967
0.5981	0.17524	0.17639	0.14907	0.24641	0.16849	0.10863	0.10776	0.09989	0.16804	0.11404	0.21453	0.18852	0.11354	0.22774	0.22254
0.6566	0.19626	0.19992	0.16434	0.27311	0.18848	0.11184	0.12103	0.10837	0.19009	0.12318	0.2384	0.21212	0.12608	0.2537	0.24709
0.7208	0.2188	0.22515	0.1806	0.30078	0.2097	0.1151	0.13534	0.11794	0.21351	0.13252	0.26342	0.23732	0.13995	0.28155	0.27339
0.7913	0.24289	0.25209	0.19803	0.32933	0.23214	0.11835	0.15074	0.12878	0.23822	0.14196	0.28959	0.26409	0.15529	0.31148	0.30165
0.8686	0.26868	0.28063	0.21658	0.3586	0.25579	0.12197	0.16731	0.14127	0.26416	0.15132	0.31694	0.29241	0.17232	0.34366	0.33205
0.9536	0.29627	0.31055	0.23637	0.38825	0.28059	0.12622	0.18507	0.15586	0.29111	0.16048	0.34539	0.32216	0.19134	0.3782	0.36478
1.047	0.32569	0.34151	0.25745	0.41799	0.30637	0.13141	0.20403	0.17297	0.31878	0.16923	0.37487	0.35311	0.2126	0.41514	0.39996
1.149	0.35682	0.37312	0.2799	0.4476	0.3329	0.13778	0.22409	0.19283	0.3468	0.1774	0.40526	0.38496	0.2362	0.45443	0.43763
1.261	0.38951	0.405	0.30358	0.47684	0.35993	0.14577	0.24511	0.21557	0.37479	0.18477	0.43648	0.41734	0.26208	0.49589	0.47769
1.385	0.42361	0.43666	0.3284	0.50541	0.38726	0.15584	0.26687	0.24129	0.40231	0.19125	0.46829	0.44989	0.29024	0.53922	0.5199
1.52	0.4589	0.46768	0.35419	0.53296	0.41455	0.16847	0.28906	0.27	0.42884	0.19669	0.50043	0.48211	0.32065	0.58401	0.56398
1.669	0.49511	0.49765	0.38086	0.5593	0.44155	0.18418	0.31144	0.30162	0.45394	0.20104	0.53269	0.51361	0.35322	0.62988	0.60962
1.832	0.53194	0.52625	0.40828	0.58436	0.46801	0.20352	0.33371	0.33587	0.47721	0.20419	0.56486	0.54397	0.38774	0.67636	0.65648

Sample Name	17-BH-06A 0-2	17-BH-06A 4-6	17-BH-06A 8-10	17-BH-06A 12-14	17-BH-06A 16-18	17-BH-07A 0-2	17-BH-07A 4-6	17-BH-07A 8-10	17-BH-07A 12-14	17-BH-07A 16-18	17-BH-08A 0-2	17-BH-08A 4-6	17-BH-08A 8-10	17-BH-08A 12-14	17-BH-08A 16-18
SRC Sample #	**26497**	**26499**	**26501**	**26503**	**26505**	**26532**	**26534**	**26536**	**26538**	**26540**	**26542**	**26544**	**26546**	**26548**	**26550**
Particle Size (um)															
2.011	0.56917	0.55315	0.43631	0.60817	0.49379	0.22713	0.35559	0.37243	0.49835	0.20617	0.5968	0.57292	0.42401	0.723	0.70413
2.208	0.60647	0.57812	0.46471	0.63066	0.5187	0.25564	0.37669	0.41073	0.51703	0.20705	0.62827	0.60006	0.46172	0.76909	0.75194
2.423	0.64347	0.60102	0.49319	0.65185	0.54253	0.28963	0.39666	0.45005	0.533	0.20693	0.65898	0.62507	0.50051	0.81387	0.79922
2.66	0.67975	0.62196	0.52154	0.67192	0.56517	0.32957	0.41526	0.48953	0.54626	0.20597	0.68877	0.64775	0.53994	0.85655	0.8453
2.92	0.71504	0.64118	0.54959	0.69123	0.58662	0.37577	0.43239	0.52826	0.55704	0.20431	0.71761	0.6681	0.57956	0.89651	0.88959
3.206	0.74915	0.65886	0.57716	0.71009	0.60698	0.42844	0.44801	0.56534	0.56568	0.2022	0.7455	0.68626	0.61899	0.9331	0.93142
3.519	0.7818	0.67519	0.60381	0.72841	0.62616	0.48747	0.46197	0.59979	0.57239	0.1998	0.77221	0.70215	0.65777	0.96545	0.96988
3.863	0.81263	0.69036	0.62908	0.74593	0.64404	0.55247	0.47419	0.63065	0.57735	0.19733	0.79735	0.71573	0.69546	0.99257	1.004
4.241	0.84127	0.70484	0.65245	0.76233	0.66041	0.62262	0.48463	0.65703	0.58083	0.19486	0.82053	0.72697	0.73152	1.01362	1.03285
4.656	0.8677	0.71907	0.67374	0.77764	0.67544	0.69691	0.49356	0.6785	0.58338	0.19256	0.84168	0.73629	0.76576	1.02836	1.05594
5.111	0.89214	0.73352	0.69286	0.7919	0.68929	0.77405	0.50126	0.69498	0.5855	0.19052	0.86089	0.74415	0.79812	1.03689	1.07306
5.611	0.91492	0.74853	0.7098	0.80511	0.70224	0.85262	0.50808	0.70673	0.58764	0.18884	0.87838	0.75106	0.8287	1.03962	1.08421
6.159	0.93628	0.76463	0.72459	0.81736	0.71443	0.93097	0.5143	0.7142	0.59016	0.18758	0.89433	0.75745	0.85759	1.03707	1.08969
6.761	0.95666	0.78276	0.7377	0.82942	0.72628	1.00735	0.52055	0.71811	0.5938	0.18672	0.90945	0.7642	0.88495	1.03046	1.09049
7.422	0.97697	0.8038	0.75011	0.84294	0.73879	1.07987	0.52785	0.7196	0.59988	0.18644	0.92504	0.7728	0.91129	1.02183	1.08826
8.148	0.99827	0.82818	0.76282	0.85959	0.75294	1.14612	0.53708	0.71987	0.60967	0.1868	0.94248	0.78478	0.93713	1.0133	1.08464
8.944	1.02115	0.85477	0.77612	0.87995	0.76925	1.20308	0.54856	0.71991	0.62357	0.18796	0.96221	0.80097	0.96278	1.00593	1.08029
9.819	1.04459	0.88144	0.78883	0.90218	0.78677	1.24653	0.56115	0.71965	0.64007	0.18962	0.98239	0.82034	0.98751	0.99866	1.07395
10.78	1.06649	0.90528	0.79909	0.92319	0.80397	1.2721	0.57305	0.7185	0.65656	0.19159	0.99949	0.84079	1.01016	0.98924	1.06341
11.83	1.08425	0.92418	0.80504	0.93956	0.81898	1.27602	0.58216	0.71552	0.67004	0.19338	1.0092	0.85943	1.02935	0.97546	1.04636
12.99	1.09634	0.93695	0.80612	0.94971	0.83119	1.25676	0.58755	0.71064	0.67879	0.19485	1.00887	0.87425	1.04458	0.95687	1.02221
14.26	1.10189	0.94413	0.80264	0.95346	0.84049	1.21534	0.5894	0.70447	0.68235	0.19589	0.99823	0.88364	1.05568	0.93409	0.99235
15.65	1.10053	0.94805	0.79553	0.95208	0.84724	1.15596	0.58897	0.69832	0.68156	0.19657	0.97975	0.88694	1.06279	0.90827	0.96029
17.18	1.09225	0.95253	0.78621	0.94782	0.85231	1.08635	0.58823	0.69394	0.67829	0.19727	0.95794	0.88498	1.06643	0.88079	0.93121
18.86	1.07808	0.96257	0.77681	0.94403	0.85751	1.01721	0.58928	0.69306	0.67527	0.19842	0.93815	0.88074	1.06804	0.85405	0.91055
20.71	1.06162	0.98181	0.77075	0.94576	0.86687	0.96097	0.59455	0.69787	0.67632	0.20106	0.92593	0.88009	1.07087	0.83262	0.90267
22.73	1.04795	1.01127	0.77132	0.95747	0.88474	0.92783	0.60554	0.7098	0.68469	0.20605	0.9249	0.88905	1.0785	0.82173	0.90824
24.95	1.04214	1.04749	0.78039	0.98163	0.91465	0.92291	0.62274	0.72912	0.70206	0.21435	0.93585	0.91169	1.0935	0.82519	0.92314
27.39	1.04582	1.08338	0.79619	1.01576	0.95595	0.94346	0.6445	0.75355	0.72655	0.22607	0.95521	0.94666	1.11482	0.84189	0.93857
30.07	1.0556	1.11105	0.81332	1.05255	1.00324	0.97951	0.66746	0.77853	0.75293	0.24067	0.97584	0.98706	1.13745	0.86499	0.94456
33.01	1.06424	1.12474	0.82477	1.08251	1.04806	1.01722	0.68792	0.79875	0.77456	0.25723	0.9894	1.02313	1.15429	0.8842	0.9348
36.24	1.0632	1.12399	0.82464	1.09768	1.08192	1.04398	0.70303	0.80999	0.78589	0.27485	0.98928	1.04618	1.15901	0.88979	0.90965
39.78	1.04752	1.11325	0.81169	1.09636	1.1011	1.0542	0.71258	0.81156	0.78581	0.29402	0.97413	1.0536	1.14978	0.8782	0.87666
43.67	1.01813	1.09992	0.78972	1.08375	1.10803	1.05091	0.71869	0.80653	0.77795	0.31668	0.9486	1.04962	1.12997	0.85357	0.84681
47.94	0.98184	1.09122	0.76588	1.0698	1.11048	1.04355	0.72494	0.80059	0.76935	0.34643	0.92202	1.04337	1.10668	0.82596	0.8302
52.63	0.94845	1.09131	0.74738	1.06481	1.11805	1.04265	0.73476	0.79965	0.76743	0.3874	0.90482	1.04456	1.08724	0.80654	0.83187
57.77	0.92629	1.101	0.73817	1.07465	1.13778	1.05413	0.75006	0.8071	0.77678	0.44296	0.90407	1.05909	1.07555	0.80239	0.8494
63.42	0.91949	1.11844	0.73803	1.0992	1.17193	1.0768	0.77114	0.82289	0.79796	0.51511	0.92084	1.08748	1.07076	0.81454	0.87454
69.62	0.9269	1.14104	0.74317	1.13274	1.21732	1.10276	0.79704	0.8436	0.82759	0.60397	0.94929	1.12528	1.06782	0.83817	0.89703
76.43	0.94333	1.16706	0.74866	1.16706	1.26718	1.12131	0.82642	0.86424	0.86029	0.7089	0.97857	1.16572	1.06017	0.86546	0.90925
83.9	0.96219	1.19585	0.75123	1.19549	1.31428	1.12454	0.85822	0.88059	0.89121	0.82961	0.99732	1.20297	1.04303	0.88941	0.90859
92.1	0.97834	1.22733	0.75057	1.21556	1.35355	1.11158	0.89143	0.8909	0.91758	0.96733	0.9988	1.23393	1.01572	0.90636	0.89756
101.1	0.99072	1.26082	0.74931	1.22993	1.38365	1.08963	0.925	0.89687	0.93951	1.12553	0.985	1.25869	0.98241	0.91688	0.88274

Sample Name	17-BH-06A 0-2	17-BH-06A 4-6	17-BH-06A 8-10	17-BH-06A 12-14	17-BH-06A 16-18	17-BH-07A 0-2	17-BH-07A 4-6	17-BH-07A 8-10	17-BH-07A 12-14	17-BH-07A 16-18	17-BH-08A 0-2	17-BH-08A 4-6	17-BH-08A 8-10	17-BH-08A 12-14	17-BH-08A 16-18
SRC Sample #	**26497**	**26499**	**26501**	**26503**	**26505**	**26532**	**26534**	**26536**	**26538**	**26540**	**26542**	**26544**	**26546**	**26548**	**26550**
Particle Size (um)															
111	1.00315	1.29424	0.75113	1.24481	1.40655	1.0705	0.95762	0.90303	0.95966	1.30992	0.96619	1.27935	0.95038	0.92486	0.87252
121.8	1.02261	1.324	0.75892	1.26682	1.42524	1.06477	0.9879	0.91518	0.98269	1.52818	0.95568	1.29862	0.92685	0.93563	0.87437
133.7	1.05474	1.34503	0.77332	1.29904	1.44083	1.0766	1.01445	0.93809	1.01419	1.78845	0.96252	1.31853	0.91522	0.95389	0.89188
146.8	1.09838	1.35123	0.79214	1.33735	1.44952	1.10119	1.03535	0.97314	1.05838	2.09599	0.98563	1.3384	0.91242	0.98072	0.92237
161.2	1.14258	1.33643	0.81099	1.36895	1.44166	1.12655	1.0478	1.01716	1.11522	2.4486	1.01283	1.35307	0.90918	1.01138	0.95618
176.9	1.16884	1.29614	0.82462	1.37501	1.40373	1.13885	1.04852	1.06314	1.17816	2.8322	1.02568	1.35232	0.89364	1.03481	0.97869
194.2	1.15898	1.23005	0.82904	1.33764	1.32363	1.12911	1.03579	1.10305	1.23506	3.22029	1.00849	1.32322	0.85756	1.03679	0.97512
213.2	1.10551	1.14385	0.82387	1.24926	1.19787	1.09784	1.01215	1.13193	1.27323	3.57847	0.9571	1.25631	0.80209	1.00695	0.9363
234.1	1.0172	1.04859	0.8134	1.1186	1.03623	1.055	0.98569	1.15059	1.28656	3.87346	0.88088	1.15236	0.73872	0.94555	0.86269
256.9	0.91664	0.95716	0.80613	0.96937	0.8612	1.01612	0.96847	1.16581	1.28011	4.08237	0.79753	1.02573	0.68497	0.8653	0.76451
282.1	0.82961	0.87898	0.81055	0.83026	0.70018	0.99626	0.97168	1.18683	1.26812	4.19706	0.72478	0.90045	0.65619	0.7857	0.65819
309.6	0.77398	0.8158	0.8311	0.72197	0.57357	1.00523	1.0004	1.22048	1.26638	4.22229	0.67315	0.79971	0.65975	0.72261	0.56093
339.9	0.75357	0.76089	0.86409	0.64926	0.48769	1.04449	1.04993	1.26711	1.28366	4.16924	0.64398	0.73602	0.69252	0.68047	0.48491
373.1	0.75905	0.70193	0.89921	0.60154	0.43364	1.10694	1.10529	1.3197	1.31648	4.04874	0.63074	0.70644	0.7432	0.64999	0.43442
409.6	0.77108	0.62713	0.92207	0.55752	0.39227	1.17739	1.14535	1.36542	1.35025	3.86849	0.62217	0.69404	0.79522	0.61225	0.40634
449.7	0.76887	0.53242	0.9222	0.49562	0.34323	1.23618	1.15036	1.39078	1.36572	3.63421	0.60764	0.67497	0.83385	0.54836	0.39165
493.6	0.73736	0.42457	0.89867	0.40353	0.27361	1.26363	1.11068	1.38635	1.34877	3.35402	0.58183	0.62854	0.85013	0.45133	0.37811
541.9	0.67716	0.31811	0.8679	0.28851	0.18385	1.24751	1.03111	1.35186	1.29682	3.04182	0.54658	0.54804	0.84641	0.33183	0.35395
594.9	0.6012	0.22782	0.85184	0.17542	0.09971	1.18546	0.92888	1.29349	1.21701	2.71571	0.51134	0.44526	0.83018	0.21717	0.31121
653	0.52203	0.15898	0.87231	0.09114	0.0467	1.0843	0.82519	1.21908	1.11963	2.39258	0.48622	0.34127	0.80961	0.1363	0.25077
716.9	0.44055	0.10845	0.93398	0.04354	0.02644	0.95283	0.73487	1.12913	1.00868	2.08168	0.47206	0.25349	0.78399	0.09854	0.17959
786.9	0.35662	0.07049	1.03115	0.02663	0.02426	0.80525	0.66117	1.02029	0.87557	1.78385	0.4576	0.18708	0.75278	0.09562	0.10423
863.9	0.25614	0.03865	1.14159	0.02331	0.02989	0.64669	0.59539	0.88399	0.71193	1.49482	0.41964	0.13464	0.70841	0.1113	0.04441
948.3	0.14701	0.01587	1.23767	0.02199	0.03481	0.48274	0.52213	0.71802	0.51672	1.20767	0.33465	0.08708	0.64898	0.12229	0.01092
1041	0.05653	0.00331	1.29128	0.01354	0.02762	0.3182	0.42949	0.52919	0.2958	0.92282	0.20067	0.04398	0.57361	0.09631	0.00135
1143	0.0112	2.98E-04	1.30817	0.00381	0.0138	0.17206	0.31574	0.35097	0.1189	0.64343	0.07854	0.01474	0.50578	0.04829	4.52E-05
1255	8.57E-04	0	1.28765	3.60E-04	0.00315	0.07837	0.18802	0.21422	0.02464	0.3782	0.01496	0.00255	0.4611	0.01095	0
1377	0	0	1.24468	0	3.04E-04	0.0423	0.08187	0.13917	0.00223	0.16796	0.00107	1.64E-04	0.45476	9.93E-04	0
1512	0	0	1.1679	0	0	0.0519	0.02175	0.12023	1.17E-05	0.0474	0	0	0.4802	0	0
1660	0	0	1.09663	0	0	0.07956	0.00307	0.13119	0	0.00689	0	0	0.51679	0	0
1822	0	37.0871	1.03947	0	0	0.1299	1.82E-04	0.19305	0	3.27E-04	0	0	0.57979	0	0
2000	34.8279	0	35.0016	35.7863	40.6282	31.3375	46.8	37.2726	37.9268	12.7095	37.5897	36.4272	33.3555	38.5825	38.9723

Table 3 – 17-BH-09A to 17-BH-15A

Sample Name	17-BH-09A 0-2	17-BH-09A 4-6	17-BH-09A 8-10	17-BH-09A 12-14	17-BH-09A 16-18	17-BH-09A 20-21	17-BH-10A 0-2	17-BH-10A 4-6	17-BH-10A 8-10	17-BH-11A 0-2	17-BH-12A 0-2	17-BH-12A 4-6	17-BH-13A 0-2	17-BH-14A 0-2	17-BH-15A 0-2	17-BH-15A 4-5
SRC Sample #	**26552**	**26554**	**26556**	**26558**	**26560**	**26562**	**26507**	**26509**	**26511**	**26564**	**26565**	**26567**	**26572**	**26574**	**26569**	**26571**
Particle Size (um)																
0.04	0	1.73E-07	0	0	0	1.09E-05	0	0	0	0	0	0	1.76E-07	0	3.21E-07	6.54E-05
0.04391	0	2.23E-06	0	0	0	1.75E-05	2.16E-08	0	0	0	0	0	2.07E-06	0	3.89E-06	8.61E-05
0.0482	0	1.21E-05	0	0	0	3.61E-05	5.80E-07	0	0	0	0	0	9.66E-06	0	1.91E-05	1.42E-04
0.05292	0	4.05E-05	0	0	0	7.91E-05	4.42E-06	0	0	0	0	0	2.87E-05	0	5.88E-05	2.82E-04
0.05809	0	8.22E-05	0	0	0	1.59E-04	1.10E-05	0	0	0	0	0	5.64E-05	0	1.16E-04	5.85E-04
0.06377	0	1.45E-04	0	0	0	3.01E-04	2.04E-05	0	0	0	0	0	1.01E-04	2.18E-07	2.06E-04	0.00114
0.07	0	2.76E-04	0	1.61E-07	0	5.38E-04	4.75E-05	0	0	0	2.72E-08	0	1.93E-04	6.65E-06	3.95E-04	0.00196
0.07685	3.08E-08	5.94E-04	0	5.70E-06	1.29E-07	8.92E-04	1.87E-04	1.48E-07	7.43E-07	1.06E-06	2.67E-06	0	3.86E-04	6.58E-05	8.11E-04	0.00296
0.08436	3.69E-06	0.00117	1.54E-06	6.63E-05	5.64E-06	0.00135	6.35E-04	6.64E-06	2.13E-05	3.07E-05	4.58E-05	0	6.89E-04	3.14E-04	0.0015	0.00411
0.09261	7.22E-05	0.00203	3.03E-05	3.62E-04	6.43E-05	0.00192	0.0016	8.93E-05	1.89E-04	2.52E-04	3.03E-04	0	0.0011	9.28E-04	0.00246	0.00546
0.1017	4.82E-04	0.00319	2.12E-04	0.00116	3.29E-04	0.00266	0.00311	5.11E-04	8.05E-04	0.00101	0.00106	2.85E-06	0.00165	0.00197	0.00374	0.00715
0.1116	0.00171	0.00471	7.61E-04	0.00258	9.84E-04	0.00355	0.00516	0.00165	0.00215	0.0025	0.00246	6.36E-05	0.00235	0.00344	0.00539	0.00909
0.1225	0.00391	0.00654	0.00181	0.00455	0.00206	0.00456	0.0078	0.00359	0.00419	0.00466	0.00442	4.38E-04	0.00317	0.00534	0.00732	0.0112
0.1345	0.00702	0.00864	0.00335	0.00712	0.00353	0.00567	0.01102	0.00625	0.00692	0.00746	0.007	0.00153	0.00409	0.00776	0.00949	0.0135
0.1476	0.01106	0.01122	0.00542	0.01048	0.00548	0.00706	0.01492	0.00973	0.01048	0.01117	0.01039	0.00344	0.00524	0.01074	0.01219	0.01624
0.1621	0.01649	0.01438	0.00818	0.01475	0.00809	0.00872	0.01962	0.01438	0.01516	0.01595	0.01475	0.00611	0.00665	0.01435	0.01549	0.01942
0.1779	0.0236	0.01824	0.01182	0.02008	0.01148	0.01069	0.02539	0.02044	0.02113	0.022	0.02023	0.00964	0.00833	0.0188	0.01947	0.02309
0.1953	0.03285	0.02282	0.01656	0.02679	0.01584	0.01296	0.03245	0.02824	0.02872	0.02966	0.02715	0.01458	0.0103	0.02436	0.0241	0.02732
0.2144	0.04482	0.02855	0.02268	0.03541	0.02147	0.01581	0.04117	0.03827	0.03848	0.03955	0.03605	0.02134	0.01278	0.03134	0.02986	0.0325
0.2354	0.06012	0.03561	0.03044	0.04619	0.02863	0.01931	0.05174	0.05103	0.05078	0.05202	0.04722	0.03022	0.01581	0.03993	0.03691	0.03869
0.2584	0.07846	0.04385	0.03975	0.05886	0.03727	0.02335	0.06391	0.06626	0.06535	0.06679	0.06044	0.04106	0.01934	0.04995	0.04508	0.04571
0.2836	0.09902	0.0529	0.05025	0.0728	0.04705	0.02778	0.07704	0.0833	0.08146	0.08312	0.07516	0.05345	0.0232	0.06098	0.05399	0.05324
0.3113	0.12091	0.06243	0.06154	0.08744	0.05767	0.03246	0.09056	0.10142	0.09842	0.10032	0.09083	0.06687	0.02727	0.07257	0.06337	0.06101
0.3418	0.14429	0.07258	0.07368	0.10287	0.06921	0.03747	0.10457	0.12077	0.11635	0.11854	0.10756	0.08135	0.03159	0.08479	0.07335	0.06912
0.3752	0.16966	0.08354	0.08688	0.11933	0.0819	0.04288	0.11931	0.14166	0.13554	0.13805	0.12563	0.09709	0.03625	0.09794	0.08406	0.07769
0.4119	0.1975	0.09557	0.10134	0.13716	0.09598	0.04883	0.13501	0.1644	0.15629	0.15918	0.14537	0.11437	0.04137	0.1123	0.09569	0.08694
0.4521	0.22786	0.10873	0.11706	0.15635	0.11148	0.05537	0.1516	0.18895	0.17859	0.18193	0.16677	0.13317	0.04698	0.12789	0.10828	0.09691
0.4963	0.26081	0.12307	0.13405	0.17687	0.12844	0.06252	0.16909	0.21536	0.20243	0.20632	0.18985	0.15346	0.0531	0.14471	0.12186	0.10763
0.5449	0.29653	0.13872	0.15237	0.19874	0.14695	0.07034	0.18748	0.24359	0.22781	0.23227	0.2146	0.17519	0.0598	0.16288	0.13649	0.11914
0.5981	0.3351	0.15568	0.17203	0.22189	0.16704	0.07882	0.20664	0.2735	0.2546	0.25961	0.24095	0.19825	0.06709	0.18247	0.15205	0.13146
0.6566	0.3765	0.17404	0.19301	0.24624	0.18868	0.08805	0.22649	0.30487	0.28266	0.28817	0.26877	0.22249	0.07503	0.20352	0.16855	0.14467
0.7208	0.4208	0.19381	0.21532	0.27174	0.21186	0.09802	0.24692	0.33759	0.31192	0.3178	0.29794	0.24785	0.08365	0.22603	0.18593	0.15882
0.7913	0.46813	0.21515	0.239	0.29834	0.23657	0.10883	0.26795	0.37151	0.34229	0.34835	0.32837	0.2741	0.09303	0.25007	0.20426	0.17404
0.8686	0.51868	0.23806	0.26413	0.32596	0.26283	0.12044	0.28947	0.40641	0.37364	0.37948	0.35985	0.30106	0.10322	0.27581	0.22336	0.19035
0.9536	0.57241	0.26263	0.2907	0.35445	0.29054	0.13294	0.31129	0.44183	0.4057	0.41076	0.39206	0.32838	0.11429	0.30329	0.24314	0.2079
1.047	0.6293	0.28881	0.31871	0.38361	0.31955	0.14632	0.33318	0.47734	0.43817	0.44171	0.42461	0.3557	0.12631	0.33255	0.2634	0.22679
1.149	0.68905	0.31655	0.34804	0.41323	0.3496	0.16058	0.35505	0.51254	0.47079	0.47191	0.45709	0.38259	0.13927	0.36346	0.28407	0.2471
1.261	0.75131	0.34558	0.37854	0.44308	0.38042	0.17556	0.37671	0.54702	0.50325	0.50091	0.48906	0.40868	0.1531	0.39591	0.30487	0.26873
1.385	0.81542	0.37568	0.40996	0.4729	0.41168	0.19118	0.39793	0.58027	0.53518	0.5282	0.52008	0.43346	0.16775	0.42971	0.32564	0.29167
1.52	0.8807	0.40649	0.44199	0.50233	0.44302	0.20729	0.41837	0.61176	0.56612	0.55326	0.5496	0.45642	0.18311	0.46459	0.34612	0.31582
1.669	0.9464	0.43774	0.47438	0.53115	0.47412	0.22381	0.43784	0.64113	0.59574	0.57573	0.57722	0.47719	0.1991	0.50027	0.36621	0.34117
1.832	1.0118	0.46907	0.50684	0.55914	0.50467	0.24057	0.45622	0.66818	0.62379	0.59543	0.60262	0.49549	0.2156	0.53651	0.38577	0.3676

Sample Name	17-BH-09A 0-2	17-BH-09A 4-6	17-BH-09A 8-10	17-BH-09A 12-14	17-BH-09A 16-18	17-BH-09A 20-21	17-BH-10A 0-2	17-BH-10A 4-6	17-BH-10A 8-10	17-BH-11A 0-2	17-BH-12A 0-2	17-BH-12A 4-6	17-BH-13A 0-2	17-BH-14A 0-2	17-BH-15A 0-2	17-BH-15A 4-5
SRC Sample #	**26552**	**26554**	**26556**	**26558**	**26560**	**26562**	**26507**	**26509**	**26511**	**26564**	**26565**	**26567**	**26572**	**26574**	**26569**	**26571**
Particle Size (um)																
2.011	1.07613	0.50018	0.53908	0.58621	0.53443	0.25745	0.47344	0.69275	0.65009	0.61226	0.62564	0.51115	0.23249	0.57307	0.40483	0.39506
2.208	1.13834	0.53064	0.5707	0.61215	0.56315	0.27429	0.48932	0.71466	0.67439	0.62612	0.64607	0.52397	0.24959	0.6096	0.42334	0.42337
2.423	1.19736	0.56004	0.60135	0.6368	0.59054	0.29091	0.50379	0.73387	0.69648	0.63708	0.66383	0.53399	0.26672	0.64569	0.44129	0.45235
2.66	1.25224	0.58803	0.63078	0.66014	0.61645	0.30713	0.51696	0.75058	0.71638	0.6455	0.67906	0.54151	0.2837	0.68101	0.45876	0.48181
2.92	1.30235	0.6144	0.65887	0.68229	0.64084	0.32285	0.52912	0.76516	0.73432	0.6519	0.69214	0.54714	0.30037	0.71535	0.4759	0.51159
3.206	1.34698	0.63905	0.68554	0.70336	0.66377	0.33793	0.54051	0.77796	0.75052	0.65676	0.70354	0.55143	0.31661	0.74852	0.49291	0.54154
3.519	1.38515	0.66174	0.7106	0.72319	0.68515	0.35219	0.55105	0.78895	0.76493	0.66012	0.71349	0.55467	0.3322	0.78013	0.50977	0.57131
3.863	1.41567	0.68231	0.73384	0.74149	0.70485	0.3654	0.56052	0.798	0.77741	0.66187	0.72214	0.55698	0.34696	0.80971	0.52634	0.60052
4.241	1.43763	0.70062	0.75512	0.75792	0.72269	0.37733	0.56874	0.805	0.78784	0.66184	0.72957	0.55851	0.36066	0.83679	0.54236	0.62871
4.656	1.45078	0.71691	0.7746	0.77246	0.73881	0.38789	0.57586	0.81014	0.79648	0.66019	0.73624	0.55961	0.37327	0.86125	0.55781	0.65563
5.111	1.45532	0.73153	0.79243	0.78514	0.7534	0.39706	0.58196	0.81355	0.80363	0.65702	0.74258	0.56047	0.38477	0.88311	0.57268	0.6811
5.611	1.45171	0.74494	0.80883	0.79598	0.76669	0.40489	0.58716	0.81542	0.80956	0.65246	0.74896	0.56125	0.39523	0.90243	0.58701	0.70498
6.159	1.44072	0.75752	0.82407	0.80506	0.77881	0.4114	0.59172	0.81614	0.81469	0.6469	0.75573	0.56217	0.4047	0.91922	0.60073	0.72711
6.761	1.42419	0.76994	0.83884	0.81298	0.79014	0.41679	0.59662	0.81692	0.81998	0.64162	0.76363	0.56419	0.41331	0.93393	0.614	0.74757
7.422	1.40511	0.78334	0.85426	0.82097	0.80149	0.42144	0.60356	0.81987	0.82722	0.63878	0.77414	0.56914	0.42144	0.94747	0.62744	0.76676
8.148	1.3865	0.79883	0.87123	0.83022	0.81364	0.42572	0.61419	0.82695	0.83809	0.64045	0.78867	0.57877	0.42942	0.96069	0.64172	0.785
8.944	1.36951	0.81702	0.88991	0.84095	0.82677	0.42967	0.62903	0.839	0.8532	0.6473	0.80774	0.59348	0.43736	0.97356	0.65702	0.80214
9.819	1.35195	0.837	0.90884	0.8514	0.83954	0.43255	0.64647	0.85471	0.87087	0.65751	0.8297	0.61115	0.4447	0.98436	0.67201	0.81682
10.78	1.32946	0.85712	0.9258	0.85883	0.84998	0.43331	0.6637	0.87153	0.8882	0.66781	0.85165	0.62787	0.45068	0.99059	0.68463	0.82737
11.83	1.29775	0.8752	0.93813	0.86053	0.85604	0.43088	0.67766	0.88609	0.90179	0.67462	0.87026	0.6394	0.45456	0.98999	0.69265	0.8321
12.99	1.25537	0.88996	0.94425	0.85579	0.85705	0.42496	0.6869	0.89543	0.90969	0.67617	0.88376	0.64362	0.45631	0.98214	0.69562	0.83074
14.26	1.20378	0.90057	0.944	0.84563	0.85324	0.41578	0.69132	0.89697	0.91108	0.67232	0.89178	0.64103	0.45624	0.96808	0.69427	0.82383
15.65	1.1465	0.90691	0.93946	0.83239	0.84565	0.40399	0.69204	0.88982	0.90658	0.66442	0.89526	0.63453	0.45497	0.94976	0.68999	0.81282
17.18	1.08782	0.90973	0.93496	0.819	0.836	0.39046	0.69103	0.87638	0.89832	0.65488	0.89616	0.62792	0.45328	0.92965	0.68368	0.79994
18.86	1.03238	0.91111	0.93577	0.80847	0.82683	0.37634	0.69091	0.86292	0.89	0.64697	0.89732	0.62448	0.45215	0.91064	0.67568	0.78804
20.71	0.98546	0.91522	0.94658	0.80448	0.82229	0.36354	0.6954	0.85824	0.88724	0.64515	0.90312	0.62674	0.45329	0.89667	0.66752	0.78122
22.73	0.95142	0.9264	0.96828	0.80983	0.8263	0.35405	0.70755	0.86896	0.89492	0.65318	0.91753	0.6355	0.45823	0.89117	0.66201	0.78296
24.95	0.93225	0.94773	0.99695	0.82579	0.84137	0.3495	0.72889	0.89574	0.91546	0.67291	0.94294	0.65015	0.46798	0.89587	0.66347	0.79522
27.39	0.92533	0.97816	1.02406	0.85018	0.86594	0.35	0.75723	0.93053	0.94608	0.70196	0.97748	0.66832	0.48174	0.9085	0.67512	0.8164
30.07	0.92368	1.01233	1.04032	0.87753	0.89426	0.35388	0.7869	0.95943	0.97937	0.73393	1.01484	0.68649	0.49689	0.92288	0.69701	0.8415
33.01	0.91859	1.04245	1.04042	0.90089	0.91842	0.35838	0.81086	0.96936	1.00628	0.76065	1.04649	0.70133	0.50997	0.93118	0.72537	0.86413
36.24	0.90329	1.06123	1.02554	0.91443	0.93147	0.3607	0.82338	0.95523	1.0199	0.77535	1.06468	0.71053	0.51799	0.92704	0.75293	0.87894
39.78	0.87651	1.06598	1.00322	0.9167	0.93142	0.35976	0.82358	0.92385	1.01947	0.77649	1.06668	0.71404	0.52029	0.90932	0.7724	0.88493
43.67	0.84213	1.05943	0.98325	0.9109	0.92197	0.35656	0.81571	0.89016	1.01018	0.76815	1.05562	0.71331	0.51868	0.88243	0.77943	0.88552
47.94	0.80601	1.04861	0.97363	0.90343	0.91089	0.35389	0.80753	0.86999	1.0005	0.75824	1.03923	0.7102	0.51676	0.85439	0.77526	0.8871
52.63	0.77219	1.04165	0.9772	0.90108	0.90631	0.35506	0.80695	0.87303	0.9982	0.75493	1.02645	0.70597	0.51811	0.8331	0.76667	0.89601
57.77	0.74099	1.04413	0.99072	0.90797	0.91297	0.36231	0.81851	0.89851	1.0069	0.76304	1.02341	0.70098	0.52467	0.82287	0.76308	0.91568
63.42	0.7112	1.05756	1.00763	0.92476	0.93109	0.37641	0.84219	0.9362	1.02596	0.783	1.03189	0.69605	0.53628	0.82357	0.77324	0.94604
69.62	0.68318	1.07924	1.02201	0.94889	0.95687	0.39647	0.87373	0.97134	1.05177	0.81115	1.04894	0.69343	0.55105	0.83148	0.80199	0.98399
76.43	0.66024	1.1042	1.03192	0.97622	0.98529	0.42088	0.90687	0.99289	1.08045	0.8421	1.06889	0.69671	0.56667	0.84184	0.84906	1.02565
83.9	0.64725	1.12774	1.03935	1.00289	1.01312	0.4483	0.93641	0.99906	1.10967	0.87142	1.08599	0.70925	0.58179	0.85149	0.90985	1.06819
92.1	0.64776	1.14751	1.04771	1.02626	1.04053	0.47831	0.96031	0.99679	1.13815	0.89723	1.09654	0.73217	0.59646	0.85971	0.97771	1.11063
101.1	0.66151	1.16481	1.05962	1.04529	1.07104	0.51184	0.98071	0.99699	1.16465	0.92074	1.10046	0.76317	0.6121	0.86799	1.04717	1.15369

Sample Name	17-BH-09A 0-2	17-BH-09A 4-6	17-BH-09A 8-10	17-BH-09A 12-14	17-BH-09A 16-18	17-BH-09A 20-21	17-BH-10A 0-2	17-BH-10A 4-6	17-BH-10A 8-10	17-BH-11A 0-2	17-BH-12A 0-2	17-BH-12A 4-6	17-BH-13A 0-2	17-BH-14A 0-2	17-BH-15A 0-2	17-BH-15A 4-5
SRC Sample #	26552	26554	26556	26558	26560	26562	26507	26509	26511	26564	26565	26567	26572	26574	26569	26571
Particle Size (um)																
111	0.68183	1.18374	1.07546	1.05982	1.109	0.55091	1.00267	1.00843	1.1874	0.94532	1.1011	0.79707	0.6306	0.8786	1.11662	1.19896
121.8	0.69713	1.20845	1.09357	1.06969	1.15659	0.59876	1.03147	1.03331	1.20511	0.97495	1.10354	0.82861	0.65344	0.89336	1.18914	1.24803
133.7	0.69787	1.23921	1.11071	1.07367	1.2114	0.65981	1.06929	1.06588	1.21824	1.01245	1.11135	0.85615	0.68091	0.91267	1.27108	1.30151
146.8	0.68317	1.26921	1.12214	1.06844	1.26591	0.73939	1.11246	1.09341	1.22777	1.05747	1.12276	0.88204	0.71138	0.93454	1.36848	1.35736
161.2	0.65925	1.28478	1.12149	1.04855	1.30982	0.84305	1.15142	1.1004	1.23206	1.10531	1.1292	0.90875	0.74146	0.95412	1.48303	1.40977
176.9	0.63271	1.27028	1.10122	1.00761	1.33406	0.97479	1.17388	1.07392	1.22415	1.14726	1.11777	0.93407	0.76724	0.96434	1.6095	1.44955
194.2	0.60482	1.21607	1.05501	0.94107	1.33485	1.13558	1.17076	1.00907	1.19325	1.17348	1.07745	0.9504	0.78618	0.95864	1.73646	1.4673
213.2	0.57203	1.12531	0.98146	0.84998	1.31531	1.32236	1.14185	0.91298	1.13128	1.17785	1.00632	0.95013	0.79943	0.93544	1.85053	1.45854
234.1	0.53039	1.01409	0.8867	0.74267	1.28365	1.52829	1.09726	0.80409	1.04091	1.16182	0.91433	0.93351	0.81202	0.90148	1.94195	1.42775
256.9	0.48185	0.90456	0.78383	0.63369	1.24918	1.74404	1.05352	0.70656	0.93828	1.13444	0.81964	0.91235	0.83222	0.87094	2.00783	1.38733
282.1	0.43354	0.81478	0.68829	0.53826	1.21802	1.95837	1.0258	0.64072	0.84642	1.10753	0.73951	0.9055	0.86721	0.85952	2.05041	1.35148
309.6	0.39521	0.75141	0.61162	0.46566	1.19075	2.158	1.02074	0.61533	0.78327	1.08839	0.68153	0.92879	0.92037	0.87668	2.07147	1.32745
339.9	0.37037	0.70871	0.55716	0.41581	1.1625	2.32682	1.03277	0.62465	0.75252	1.07445	0.64051	0.98595	0.98862	0.91968	2.06691	1.30895
373.1	0.35766	0.67208	0.5193	0.37942	1.12523	2.4466	1.04554	0.64879	0.74174	1.05236	0.60112	1.06446	1.06551	0.97174	2.02526	1.27638
409.6	0.34859	0.62537	0.48559	0.34189	1.07126	2.50002	1.03738	0.65803	0.72722	1.00307	0.54508	1.13803	1.14257	1.00623	1.93193	1.20321
449.7	0.33345	0.55899	0.44229	0.29028	0.99653	2.47589	0.99084	0.62408	0.68462	0.91148	0.46071	1.17698	1.21453	0.99732	1.77813	1.06815
493.6	0.30499	0.47434	0.38122	0.21971	0.90296	2.37434	0.90104	0.53397	0.60211	0.7762	0.34973	1.16188	1.27937	0.93259	1.56863	0.87006
541.9	0.26904	0.38302	0.30512	0.13714	0.79808	2.20955	0.78059	0.39836	0.48775	0.61302	0.22735	1.0925	1.34565	0.81923	1.32346	0.63281
594.9	0.23455	0.29992	0.22827	0.06414	0.69227	2.00624	0.65314	0.24953	0.36407	0.45019	0.11923	0.98659	1.42027	0.68036	1.07153	0.39584
653	0.18466	0.23266	0.16849	0.02127	0.59545	1.79323	0.54254	0.13369	0.25476	0.31388	0.04965	0.86889	1.50838	0.5431	0.83717	0.2096
716.9	0.12932	0.18075	0.13533	0.00666	0.51221	1.59218	0.45967	0.07334	0.17135	0.21504	0.0192	0.75809	1.59919	0.42382	0.63171	0.09806
786.9	0.08533	0.13661	0.12757	0.00681	0.43711	1.41142	0.40263	0.05995	0.11173	0.14941	0.01037	0.65991	1.68325	0.32509	0.4546	0.04962
863.9	0.07322	0.09119	0.13387	0.01182	0.36072	1.24745	0.35781	0.07585	0.06756	0.10325	0.00649	0.56755	1.74791	0.23993	0.29975	0.03083
948.3	0.05657	0.04685	0.13758	0.01631	0.27267	1.08867	0.31015	0.10342	0.03392	0.06343	0.00326	0.46965	1.78718	0.15957	0.16595	0.02097
1041	0.03091	0.01538	0.10628	0.01376	0.16431	0.92314	0.24913	0.09726	0.01241	0.02979	7.83E-04	0.36044	1.79452	0.08387	0.06907	0.01186
1143	0.00754	0.00256	0.05488	0.00715	0.06969	0.74811	0.18658	0.05628	0.00243	0.00864	8.08E-05	0.24594	1.79551	0.02994	0.01844	0.0044
1255	7.97E-04	1.51E-04	0.01276	0.00165	0.01516	0.5653	0.13624	0.01387	2.11E-04	0.00128	0	0.13993	1.78513	0.00541	0.00262	7.96E-04
1377	0	0	0.00125	1.54E-04	0.00145	0.38014	0.11165	0.00141	0	6.20E-05	0	0.0637	1.764	3.76E-04	1.44E-04	4.82E-05
1512	0	0	0	0	8.52E-06	0.22071	0.11185	0	0	0	0	0.02473	1.689	0	0	0
1660	0	0	0	0	0	0.12181	0.12474	0	0	0	0	0.01236	1.60727	0	0	0
1822	0	0	0	0	0	0.07095	0.16676	0	0	0	0	0.01138	1.51692	0	0	0
2000	32.7007	39.9616	41.211	45.516	35.2918	40.4159	41.874	39.7046	36.0655	42.8016	40.3662	44.8458	40.9298	38.1456	32.9714	38.9089

APPENDIX D

2017 SOLIDS TEST WORK RESULTS

Appendix D – 2017 Solids Test Work Results

Table 1 – pH, SpC, MC, AN, AP, NAG, S^{2-}, S total, SO_4 acid sol, Ag, Al, As, B, Ba, Be, and Ca

Hole	Depth		SRC Group	SRC Sample #	pH, paste	SpC	MC	AN	AP	NAG	S^{2-}	S tot	SO_4 acid sol	Ag	Al	As	B	Ba	Be	Ca
	From	To			pH units	µS/cm	%	g $CaCO_3$/ kg	g $CaCO_3$/ kg	g $CaCO_3$/ kg	µg/g	%	%	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
17-BH-01A	0	2	2017-7858	26677	10.84	1,210	4.1	45.7	26.7	-19.0	8,500	0.92	0.2	0.2	42,200	37	79	84	2.5	15,400
17-BH-01A	2	4	2017-7858	26679	11.75	3,400	5.55	58.9	26.1	-32.8	8,400	0.94	0.31	0.2	50,300	49	80	120	3.2	21,300
17-BH-01A	4	6	2017-7858	26681	11.59	2,200	6.34	63.9	6.3	-57.6	2,000	0.28	0.24	0.1	38,200	31	75	52	2.2	24,500
17-BH-01A	6	8	2017-7858	28628	9.76	1,660	3.63	15.2	28.8	13.6	9,200	1.12	0.6	0.3	59,700	58	120	93	3.4	6,500
17-BH-01A	8	10	2017-7858	28629	7.84	1,840	5.74	5.8	87.0	81.2	27,800	2.9	0.35	0.8	62,100	838	82	160	3.9	2,800
17-BH-01A	10	12	2017-7858	28630	10.26	1,700	4.22	21.3	43.8	22.5	14,000	1.49	0.27	0.2	56,700	44	100	61	3.6	6,600
17-BH-02A	0	2	2017-7858	26605	10.01	1,290	6.76	34.0	34.8	0.8	11,100	1.18	0.2	0.2	56,500	20	96	62	3.4	10,400
17-BH-02A	2	4	2017-7858	26606	9.22	780	7.16	23.1	6.4	-16.7	2,000	0.23	0.076	0.2	55,400	6.9	100	57	2.6	6,000
17-BH-02A	4	6	2017-7858	26607	10.01	970	5.42	46.9	2.3	-44.6	700	0.11	0.11	0.2	44,100	8.3	92	71	2.3	14,400
17-BH-02A	6	8	2017-7858	26608	10.01	1,050	7.66	38.3	2.5	-35.8	800	0.12	0.12	0.2	48,600	13	120	70	2.6	11,800
17-BH-02A	8	10	2017-7858	26609	10.69	1,130	6.11	34.3	1.2	-33.1	400	0.07	0.098	0.1	43,600	9.4	120	60	2.4	10,400
17-BH-02A	10	11	2017-7858	26610	10.01	830	8.17	20.5	4.8	-15.7	1,600	0.18	0.075	0.2	66,100	110	170	60	4.2	6,900
17-BH-03A	0	2	2017-7858	26611	10.88	1,430	7.93	48.2	19.9	-28.3	6,400	0.71	0.22	0.3	52,300	30	140	68	3.4	15,600
17-BH-03A	2	4	2017-7858	26612	11.71	1,880	14.95	84.2	7.1	-77.1	2,300	0.33	0.31	0.2	51,500	11	97	120	3.1	28,400
17-BH-03A	4	6	2017-7858	26613	10.01	900	13.28	33.3	5.7	-27.6	1,800	0.22	0.11	0.2	48,500	17	100	79	2.7	9,500
17-BH-03A	6	8	2017-7858	26614	10.01	840	7.67	32.9	1.9	-31.0	600	0.09	0.085	0.2	47,300	9.2	120	63	2.7	9,700
17-BH-03A	8	10	2017-7858	26615	10.01	890	7.87	13.0	0.8	-12.2	300	0.04	0.039	0.3	21,500	4	56	38	1.3	4,300
17-BH-03A	10	12	2017-7858	26616	10.01	1,890	9.66	31.2	1.6	-29.6	500	0.08	0.089	0.2	35,500	7.4	73	93	2	10,400
17-BH-04A	0	2	2017-7858	26617	10.01	1,780	8.33	35.5	15.9	-19.6	5,100	0.6	0.27	0.2	56,100	65	100	93	3.2	12,300
17-BH-04A	2	4	2017-7858	26618	10.96	1,320	16.09	37.5	29.0	-8.5	9,300	1.04	0.34	0.4	57,400	187	110	110	3.2	17,500
17-BH-04A	4	6	2017-7858	26619	11.06	1,460	14.94	43.6	24.4	-19.2	7,800	0.87	0.27	0.5	39,500	251	76	100	2.5	15,500
17-BH-04A	6	8	2017-7858	26620	11.02	1,610	8.9	68.1	14.5	-53.6	4,600	0.57	0.32	0.3	49,700	36	100	110	2.8	23,000
17-BH-04A	8	10	2017-7858	26621	9.32	1,020	7.4	34.2	3.1	-31.1	1,000	0.14	0.12	0.2	49,400	18	86	52	2.8	11,000
17-BH-04A	10	12	2017-7858	26622	9.24	850	6.68	32.6	1.5	-31.1	500	0.08	0.092	0.1	52,600	11	100	42	2.7	10,100
17-BH-04A	12	14	2017-7858	26623	8.90	1,060	6.13	35.0	1.4	-33.6	400	0.08	0.11	0.2	48,900	11	95	64	2.6	10,800
17-BH-04A	14	15	2017-7858	26624	8.99	910	7.46	33.3	4.0	-29.3	1,300	0.16	0.1	0.1	46,300	16	83	60	2.8	9,700
17-BH-05A	0	2	2017-7858	26669	9.61	1,340	8.35	18.4	16.6	-1.8	5,300	0.59	0.18	0.2	57,600	50	92	160	3.4	6,800
17-BH-05A	2	4	2017-7858	26670	9.76	1,380	7.33	19.7	20.5	0.8	6,600	0.72	0.19	0.2	66,600	68	100	120	3.6	6,400
17-BH-05A	4	6	2017-7858	26671	10.12	1,900	14.84	41.5	38.5	-3.0	12,300	1.33	0.29	0.3	57,200	189	99	86	2.8	13,800
17-BH-05A	6	8	2017-7858	26672	9.99	1,800	10.33	51.6	18.1	-33.5	5,800	0.68	0.3	0.2	53,300	24	93	61	2.7	17,700
17-BH-05A	8	10	2017-7858	26673	9.81	800	6.28	29.8	4.1	-25.7	1,300	0.16	0.086	0.8	52,100	12	120	57	2.8	8,700
17-BH-05A	10	12	2017-7858	26674	9.09	710	8.97	24.3	2.2	-22.1	700	0.09	0.062	0.1	49,800	7	100	64	2.7	6,400
17-BH-05A	12	14	2017-7858	26675	9.74	990	15.2	26.1	7.7	-18.4	2,500	0.28	0.1	0.1	51,600	17	91	59	3.5	7,900
17-BH-05A	14	16	2017-7858	26676	9.56	860	8.04	31.2	2.5	-28.7	800	0.11	0.094	0.1	52,700	10	120	65	2.6	9,700
17-BH-06A	0	2	2017-7858	26590	11.02	1,520	11.95	44.3	30.4	-13.9	9,700	1.08	0.32	0.2	69,200	15	110	89	3	15,100
17-BH-06A	2	4	2017-7858	26591	10.94	1,630	5.54	50.1	21.7	-28.4	6,900	0.8	0.32	0.2	60,500	68	89	160	3	16,500
17-BH-06A	4	6	2017-7858	26592	10.56	1,540	7.24	34.4	40.2	5.8	12,900	1.37	0.25	0.2	64,100	63	87	150	3	11,400
17-BH-06A	6	8	2017-7858	26593	10.62	1,530	7.19	49.3	46.6	-2.7	14,900	1.6	0.33	0.4	64,200	156	97	100	2.8	16,300
17-BH-06A	8	10	2017-7858	26594	10.86	1,510	8.52	71.3	17.7	-53.6	5,700	0.66	0.28	0.3	66,300	54	120	100	3.4	22,500
17-BH-06A	10	12	2017-7858	26595	10.01	1,540	10.06	43.2	4.4	-38.8	1,400	0.19	0.15	0.2	52,000	9.1	78	73	3.2	14,000
17-BH-06A	12	14	2017-7858	26596	9.18	600	4.26	26.6	7.5	-19.1	2,400	0.26	0.059	0.2	56,100	6.6	110	47	3.4	5,800
17-BH-06A	14	16	2017-7858	26597	10.01	910	5.57	32.1	7.3	-24.8	2,300	0.26	0.084	0.2	55,200	15	120	49	3	9,100
17-BH-06A	16	18	2017-7858	26598	9.35	800	4.54	33.9	3.8	-30.1	1,200	0.15	0.084	0.2	48,800	7.6	110	100	2.8	9,300
17-BH-07A	0	2	2017-7858	26625	11.07	1,870	10.35	110.0	24.8	-84.9	7,900	1.03	0.71	0.3	39,400	281	64	140	2.1	42,700
17-BH-07A	2	4	2017-7858	26626	10.18	1,730	6.82	55.4	24.8	-30.6	7,900	0.93	0.41	0.2	55,400	114	83	160	3	20,000
17-BH-07A	4	6	2017-7858	26627	10.25	1,570	5.5	48.2	30.3	-17.9	9,700	1.07	0.3	0.2	55,600	174	78	140	3.2	16,000
17-BH-07A	6	8	2017-7858	26628	9.73	1,580	17.81	31.5	24.5	-7.0	7,800	0.87	0.26	0.2	49,500	50	73	110	2.8	21,000
17-BH-07A	8	10	2017-7858	26629	9.77	1,740	9.9	59.2	19.3	-39.9	6,200	0.74	0.37	0.3	56,100	56	100	91	2.9	6,000
17-BH-07A	10	12	2017-7858	26630	10.29	1,080	11.05	68.8	3.6	-65.2	1,200	0.18	0.19	0.2	58,400	44	91	60	3.1	6,200
17-BH-07A	12	14	2017-7858	26631	9.43	1,200	8.4	43.7	6.3	-37.4	2,000	0.26	0.18	0.3	49,600	28	84	99	2.6	14,100
17-BH-07A	14	16	2017-7858	26632	10.03	1,360	9.96	45.3	10.9	-34.4	3,500	0.43	0.24	0.2	46,100	44	64	210	2.7	14,500
17-BH-07A	16	18	2017-7858	26633	9.11	1,240	5.77	18.1	18.5	<0.5	5,900	0.64	0.14	0.3	35,000	373	61	83	2.1	5,500
17-BH-07A	18	20	2017-7858	26634	8.99	1,770	6.93	29.7	59.3	29.6	19,000	2.03	0.4	0.9	65,800	1090	110	130	4.6	10,400
17-BH-08A	0	2	2017-7858	26635	9.66	2,300	7.71	43.3	63.2	19.9	20,200	2.18	0.47	0.3	56,900	34	84	120	3	14,900
17-BH-08A	2	4	2017-7858	26636	10.56	1,590	4.51	62.8	26.9	-35.9	8,600	0.98	0.36	0.2	56,200	73	81	180	3.2	21,500
17-BH-08A	4	6	2017-7858	26637	9.82	1,370	6.38	30.5	18.6	-11.9	6,000	0.67	0.22	0.2	59,600	16	86	170	3.4	10,200
17-BH-08A	6	8	2017-7858	26638	9.79	1,440	10.21	80.1	33.4	-46.7	10,700	1.15	0.24	0.3	60,700	37	95	51	3	7,800
17-BH-08A	8	10	2017-7858	26639	9.62	1,710	13.22	33.9	18.2	-15.7	5,800	0.67	0.26	0.2	61,400	22	110	44	3.2	10,800
17-BH-08A	10	12	2017-7858	26640	9.41	1,100	9.85	41.4	7.1	-34.3	2,300	0.27	0.13	0.2	60,800	16	110	44	3.2	11,000
17-BH-08A	12	14	2017-7858	26641	9.18	670	5.81	23.1	0.6	-22.5	200	0.04	0.059	0.2	41,800	7.2	120	48	2.6	7,100
17-BH-08A	14	16	2017-7858	26642	9.44	850	3.78	26.7	4.6	-22.1	1,500	0.18	0.097	0.1	41,200	28	61	89	2.2	9,000
17-BH-08A	16	18	2017-7858	26643	9.24	1,080	7.99	39.8	1.8	-38.0	600	0.09	0.1	0.1	47,300	18	120	72	2.6	13,400
17-BH-08A	18	20	2017-7858	26644	9.68	1,460	7.24	46.2	8.6	-37.6	2,800	0.35	0.22	0.2	45,700	26	100	92	2.9	16,400
17-BH-09A	0	2	2017-7858	26645	8.91	1,770	7.76	22.1	38.5	16.4	12,300	1.32	0.26	0.3	65,400	38	110	90	3.1	8,400
17-BH-09A	2	4	2017-7858	26646	9.92	1,960	9.08	32.7	28.0	-4.7	9,000	1.03	0.4	0.2	56,300	96	92	150	3.2	15,700
17-BH-09A	4	6	2017-7858	26647	10.07	1,680	9.43	39.8	25.3	-14.5	8,100	0.9	0.27	0.2	61,300	26	86	230	3.8	13,700
17-BH-09A	6	8	2017-7858	26648	10.33	1,660	17.27	29.5	34.4	4.9	11,000	1.18	0.24	0.2	63,700	67	110	98	3.3	10,600
17-BH-09A	8	10	2017-7858	26649	9.25	1,690	7.78	32.3	27.8	-4.5	8,900	0.97	0.24	0.2	59,400	102	110	110	3.2	10,400
17-BH-09A	10	12	2017-7858	26650	10.02	900	9.67	34.3	5.7	-28.6	1,800	0.22	0.11	0.1	47,200	7.3	59	53	3.1	9,700
17-BH-09A	12	14	2017-7858	26651	10.16	790	4.57	28.0	1.2	-26.8	400	0.06	0.067	<0.1	51,400	4.4	99	40	3	7,800
17-BH-09A	14	16	2017-7858	26652	9.12	920	5.86	23.7	7.8	-15.9	2,500	0.28	0.096	0.2	49,600	16	75	63	2.9	6,600
17-BH-09A	16	18	2017-7858	26653	10.59	1,060	9.48	29.4	1.8	-27.6	600	0.09	0.098	0.1	48,500	5.1	110	59	2.6	10,300
17-BH-09A	18	20	2017-7858	26654	11.20	1,410	4.08	29.0	1.3	-27.7	400	0.07	0.088	<0.1	28,600	4.9	80	55	1.4	9,900

Hole	Depth		SRC Group	SRC Sample #	pH, paste	SpC	MC	AN	AP	NAG	S^{2-}	S tot	SO_4 acid sol	Ag	Al	As	B	Ba	Be	Ca
	From	To			pH units	µS/cm	%	g $CaCO_3$/ kg	g $CaCO_3$/ kg	g $CaCO_3$/ kg	µg/g	%	%	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
17-BH-09A	20	21	2017-7858	26655	11.30	1,450	6.01	53.7	1.3	-52.4	400	0.09	0.15	0.1	36,000	6.8	90	64	2.2	17,200
17-BH-10A	0	2	2017-7858	26600	10.01	1,200	7.26	37.7	4.6	-33.1	1,500	0.21	0.19	0.2	55,300	21	160	41	5	12,800
17-BH-10A	2	4	2017-7858	26601	7.00	2,400	10.04	5.9	59.1	53.2	18,900	2.2	0.93	0.4	86,700	171	140	280	5	4,000
17-BH-10A	4	6	2017-7858	26602	8.23	1,800	4.84	15.0	26.7	11.7	8,500	0.96	0.32	0.2	64,100	16	100	40	3.1	4,900
17-BH-10A	6	8	2017-7858	26603	8.60	1,340	4.2	18.7	18.6	<0.5	6,000	0.66	0.19	0.1	62,200	22	99	58	3.6	5,200
17-BH-10A	8	10	2017-7858	26604	8.63	1,700	7.31	34.9	30.1	-4.8	9,600	1.06	0.29	0.5	58,300	510	98	64	3.8	9,300
17-BH-11A	0	2	2017-7858	26656	8.42	1,660	3.43	24.1	7.5	-16.6	2,400	0.32	0.24	0.2	46,000	112	140	43	3.5	8,100
17-BH-11A	2	3	2017-7858	26657	7.29	1,900	15.84	12.9	32.3	19.4	10,300	1.4	1.1	2.2	73,600	2020	140	68	5.8	6,800
17-BH-12A	0	2	2017-7858	26658	8.44	480	6.47	16.5	1.2	-15.3	400	0.05	0.034	<0.1	52,900	9.3	130	14	3.9	5,200
17-BH-12A	2	4	2017-7858	26659	7.58	1,850	8.41	13.3	17.8	4.5	5,700	0.77	0.6	0.3	59,100	13	120	37	3.9	4,800
17-BH-12A	4	6	2017-7858	26660	7.64	2,300	5.74	22.0	7.4	-14.6	2,400	0.46	0.67	0.2	58,500	51	88	28	3.9	6,900
17-BH-12A	6	6	2017-7858	26661	8.60	1,410	9.78	31.1	5.9	-25.2	1,900	0.25	0.18	0.2	53,400	28	100	44	3.6	8,900
17-BH-13A	0	2	2017-7858	26662	9.22	1,140	5.67	15.0	37.6	22.6	12,000	1.24	0.11	0.4	58,000	236	110	73	3.2	4,600
17-BH-13A	2	2	2017-7858	26663	8.76	1,190	7.26	18.3	32.9	14.6	10,500	1.1	0.14	0.2	56,000	86	83	110	3.9	5,600
17-BH-14A	0	2	2017-7858	26664	9.00	1,290	5.97	16.6	40.1	23.5	12,800	1.33	0.14	0.2	56,400	111	86	170	3.4	5,100
17-BH-14A	2	2	2017-7858	26665	8.59	1,750	10.4	14.4	64.0	49.6	20,500	2.11	0.19	0.2	57,100	54	98	170	3.8	7,000
17-BH-15A	0	2	2017-7858	26666	9.84	840	9.54	41.1	13.4	-27.7	4,300	0.47	0.12	0.2	45,100	51	91	71	2.7	11,500
17-BH-15A	2	4	2017-7858	26667	10.05	740	3.96	25.6	7.6	-18.0	2,400	0.27	0.078	0.1	41,800	38	100	58	2.6	8,200
17-BH-15A	4	5	2017-7858	26668	9.31	1,330	7.01	15.9	28.0	12.1	9,000	0.95	0.16	0.2	49,200	105	100	71	2.9	6,200
CL505	474.0	495.0	2017-7457	26479	7.75	600	--	7.1	20.4	13.3	6500	0.67	0.054	0.3	66100	41	110	14	4	2000
CL509	516.4	521.0	2017-7457	26481	8.31	400	--	5.1	24.1	19	7700	0.78	0.025	0.2	62800	25	43	350	4.4	840
CL541_1	446.2	455.0	2017-7457	26487	7.75	900	--	14.6	46.7	32.1	14900	1.52	0.079	0.7	77000	79	120	270	4.1	5100
CL554	473.3	485.0	2017-7457	26493	7.87	500	--	4.4	54.3	49.9	17400	1.75	0.035	0.3	68300	74	75	330	3.7	1000
CL526_3	473.0	509.0	2017-7457	26483	7.55	800	--	4.4	56.5	52.1	18100	1.83	0.064	0.3	67900	20	170	27	4.5	1500
CL564	466.5	473.2	2017-7457	26495	7.12	700	--	2.9	57.6	54.7	18400	1.86	0.054	0.5	72800	373	68	470	3.5	1200
CL539_1	436.9	440.3	2017-7457	26485	7.27	1600	--	22.9	57.8	34.9	18500	1.9	0.15	2.8	96400	2340	280	110	6.2	8300
CL565_1	462.0	496.6	2017-7457	26496	7.55	800	--	5.6	65.1	59.5	20800	2.11	0.078	0.6	73000	350	120	370	4.3	1800
CL540	433.0	436.2	2017-7457	26486	7.5	1100	--	42	19.8	-22.2	6300	0.67	0.11	2.3	93800	3930	250	100	13	15800
CL543_1	461	482.1	2017-7457	26488	5.78	2500	--	<0.5	94.1	94.1	30100	3.11	0.3	1.3	116000	4500	170	820	6.1	1600
CL545	478.3	518.6	2017-7457	26489	8.18	400	--	5.9	62.8	56.9	20100	2.02	0.028	0.3	68800	25	120	190	4.6	1200
CL549A	447.5	479.0	2017-7457	26491	7.53	900	--	6.1	76.8	70.7	24600	2.48	0.067	0.6	80800	482	110	240	4.1	2100
CL551A_1	443.6	450.1	2017-7457	26492	6.52	1000	--	2.2	23.4	21.2	7500	0.78	0.092	0.7	78800	61	200	34	4.6	1400
CL557_1	451.0	515.0	2017-7457	26494	8.14	500	--	8.9	36	27.1	11500	1.16	0.028	0.4	65500	88	100	240	4.6	3400
CL531_1	440.0	464.4	2017-7457	26484	7.61	900	--	7.1	63.4	56.3	20300	2.06	0.091	1.2	86000	224	130	210	5.2	1600
CL525_1	445.0	500.0	2017-7457	26482	7.71	900	--	8.8	68.3	59.5	21800	2.21	0.077	0.4	73000	358	94	140	3.9	2300
CL546A	461.6	506.0	2017-7457	26490	7.39	700	--	4.2	70.2	66	22500	2.27	0.071	0.3	73200	27	70	480	4.1	930
CL508A	454.5	510.0	2017-7457	26480	7.45	900	--	4.7	96.9	92.2	31000	3.13	0.092	0.5	63500	343	81	160	3.9	1300

Table 2 – Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Sn, Sr, Th, Ti, U, V, Zn, and ^{226}Ra

Hole	Depth		SRC Group	SRC Sample #	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Se	Sn	Sr	Th	Ti	U	V	Zn	^{226}Ra
	From	To			µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	Bq/g
17-BH-01A	0	2	2017-7858	26677	0.2	26	160	25	18,700	11,500	24,800	96	2.6	220	43	400	9.4	0.2	0.8	1.2	52	<0.2	600	7.4	68	14	0.15
17-BH-01A	2	4	2017-7858	26679	0.1	29	150	9.9	17,500	13,300	30,400	95	6	340	64	460	14	<0.2	1.6	1	64	<0.2	500	4.2	92	14	
17-BH-01A	4	6	2017-7858	26681	<0.1	41	140	10	16,600	10,000	31,800	100	1.9	280	58	530	11	<0.2	0.6	1.5	59	<0.2	970	7	44	16	0.12
17-BH-01A	6	8	2017-7858	28628	<0.1	20	150	42	18,000	16,800	28,200	67	9.9	230	50	440	8.7	0.4	2	1	50	0.2	400	4.8	130	14	
17-BH-01A	8	10	2017-7858	28629	<0.1	120	170	76	29,600	13,100	27,200	66	30	140	144	350	20	1.6	3.4	0.7	34	0.6	180	7.9	140	16	0.14
17-BH-01A	10	12	2017-7858	28630	<0.1	35	140	73	20,900	13,300	36,200	71	11	240	80	410	12	<0.2	2.8	1.1	48	<0.2	450	4.1	120	10	
17-BH-02A	0	2	2017-7858	26605	0.1	64	130	63	23,700	14,300	46,000	95	4.2	270	92	450	21	0.3	3.3	2.4	47	0.3	740	5.7	100	19	0.11
17-BH-02A	2	4	2017-7858	26606	<0.1	12	140	14	17,400	17,300	40,100	100	1.9	300	37	530	130	2.7	0.6	1.7	27	0.3	1,100	4.8	78	24	
17-BH-02A	4	6	2017-7858	26607	0.1	10	130	13	15,300	13,800	36,900	130	1.3	240	29	490	16	0.4	0.4	2.6	42	0.2	1,000	4.1	60	38	0.06
17-BH-02A	6	8	2017-7858	26608	0.1	13	160	13	15,600	16,000	39,700	130	1.5	330	33	550	59	1.3	0.4	2.8	39	0.3	990	4.5	68	36	
17-BH-02A	8	10	2017-7858	26609	0.1	9.8	160	9.6	13,100	14,400	29,700	120	1.3	320	27	430	30	0.7	0.2	1.9	46	0.2	720	5.4	54	36	0.09
17-BH-02A	10	11	2017-7858	26610	<0.1	45	150	14	13,400	20,400	41,100	93	2.3	210	82	780	20	0.4	0.5	1.6	66	0.2	700	6.1	86	21	
17-BH-03A	0	2	2017-7858	26611	0.2	32	140	23	17,600	16,800	35,300	120	5.1	330	58	400	16	0.4	1.4	2.1	62	0.4	750	7	110	23	0.11
17-BH-03A	2	4	2017-7858	26612	0.3	15	150	20	15,800	13,600	40,100	130	2.6	680	36	490	27	0.8	0.6	2	73	0.3	990	4.6	74	41	
17-BH-03A	4	6	2017-7858	26613	0.1	15	140	21	16,000	16,400	38,400	120	1.5	250	34	620	69	0.2	0.4	2.4	31	0.3	1,000	4.9	64	40	0.19
17-BH-03A	6	8	2017-7858	26614	0.2	10	170	14	16,900	17,300	37,700	130	1.5	240	29	570	12	0.2	0.3	2.5	38	0.3	1,200	5.2	65	28	
17-BH-03A	8	10	2017-7858	26615	0.1	3.8	250	5.3	17,400	7,900	14,000	69	1.1	160	17	340	6.7	<0.2	0.1	2.6	120	<0.2	580	5.5	51	14	0.29
17-BH-03A	10	12	2017-7858	26616	<0.1	7	210	19	19,000	16,700	27,700	150	1.4	460	24	450	9.9	<0.2	0.2	2.4	48	0.3	1,400	3.4	60	32	
17-BH-04A	0	2	2017-7858	26617	<0.1	43	200	21	16,500	14,400	30,700	140	6.8	270	68	380	18	0.4	0.9	1.4	67	0.2	520	10	93	32	0.29
17-BH-04A	2	4	2017-7858	26618	0.4	100	160	34	15,700	17,000	25,900	130	18	300	101	400	27	0.9	1.9	1.8	70	0.4	410	11	100	44	
17-BH-04A	4	6	2017-7858	26619	0.4	90	180	12	13,900	11,100	19,400	110	25	290	101	340	22	0.8	1.3	1.6	62	0.4	350	6	91	73	0.21
17-BH-04A	6	8	2017-7858	26620	0.2	26	180	34	15,200	15,100	33,400	120	4.1	380	45	550	19	0.5	0.8	2.1	66	0.3	730	5.9	92	29	
17-BH-04A	8	10	2017-7858	26621	0.1	21	110	14	12,800	13,100	43,400	110	2.1	290	42	620	19	0.3	0.4	2.1	40	0.2	1,100	4.5	61	28	0.11
17-BH-04A	10	12	2017-7858	26622	0.1	14	120	8	12,900	13,000	49,600	120	1	230	33	600	19	0.2	0.2	2.4	36	<0.2	970	5.1	53	27	
17-BH-04A	12	14	2017-7858	26623	<0.1	12	140	15	16,900	15,400	41,000	130	1.4	250	33	490	16	<0.2	0.2	2.2	34	0.3	1,300	4.7	65	29	0.08
17-BH-04A	14	15	2017-7858	26624	0.1	16	140	14	14,100	13,400	44,200	110	1.6	270	40	550	17	<0.2	0.3	2.3	36	0.2	1,100	5	62	27	
17-BH-05A	0	2	2017-7858	26669	0.1	29	160	22	23,600	15,800	27,700	380	6.1	220	66	240	9.3	0.2	0.8	1.2	40	0.4	890	5.4	93	24	0.11
17-BH-05A	2	4	2017-7858	26670	0.2	43	140	17	19,400	14,800	34,800	180	4	210	69	400	15	0.4	1	1.1	43	0.2	640	7.6	98	21	
17-BH-05A	4	6	2017-7858	26671	0.2	93	160	22	16,100	13,900	28,500	100	7.8	330	107	510	28	1	1.7	1.7	62	0.4	330	8.8	96	32	0.18
17-BH-05A	6	8	2017-7858	26672	0.1	21	110	17	15,300	12,900	37,500	98	3.2	270	46	530	17	0.4	1.1	2.1	56	<0.2	700	4.8	86	25	
17-BH-05A	8	10	2017-7858	26673	<0.1	13	110	10	14,000	14,800	41,800	99	1.7	200	32	500	14	<0.2	0.4	2.1	35	0.2	700	6.1	70	20	0.08
17-BH-05A	10	12	2017-7858	26674	<0.1	11	140	10	18,000	18,100	35,200	120	0.9	260	33	400	18	<0.2	0.3	2	29	0.4	1,400	5.1	79	26	
17-BH-05A	12	14	2017-7858	26675	0.2	16	130	14	18,200	14,600	38,700	120	2.5	240	44	470	15	0.2	0.6	2.1	33	0.3	1,200	4.6	70	29	0.10
17-BH-05A	14	16	2017-7858	26676	0.1	25	150	16	19,500	17,800	38,400	130	1.2	240	33	530	8.8	<0.2	0.4	2.1	32	0.3	1,400	4.8	67	26	
17-BH-06A	0	2	2017-7858	26590	0.2	21	160	61	19,100	15,500	27,800	92	6.1	270	62	420	29	0.6	1.3	1.4	85	0.3	290	34	110	63	0.64
17-BH-06A	2	4	2017-7858	26591	0.1	41	220	40	24,400	13,900	25,400	210	5.6	310	69	330	22	0.5	0.9	1.3	64	0.4	710	18	90	34	
17-BH-06A	4	6	2017-7858	26592	<0.1	36	170	36	23,200	13,200	29,200	120	7.8	240	83	400	28	0.5	1.8	1.2	52	0.3	430	9.7	130	23	0.15
17-BH-06A	6	8	2017-7858	26593	<0.1	67	160	25	21,800	12,800	28,900	120	16	280	125	360	32	0.9	2.3	1.3	73	0.4	360	9.1	140	28	
17-BH-06A	8	10	2017-7858	26594	0.2	38	160	24	18,100	16,700	39,900	150	4.5	550	68	450	29	0.6	0.8	2.3	79	0.2	580	9.1	96	36	0.14
17-BH-06A	10	12	2017-7858	26595	0.2	17	160	23	15,900	11,400	44,500	120	1.8	400	42	590	18	0.3	0.3	2.1	46	0.3	1,100	4.6	70	29	
17-BH-06A	12	14	2017-7858	26596	0.1	12	140	17	16,700	12,600	50,500	110	1.7	220	38	590	60	<0.2	0.3	2.8	29	0.2	980	17	77	19	0.26
17-BH-06A	14	16	2017-7858	26597	<0.1	17	140	8.7	13,300	14,500	37,100	96	2.2	320	41	770	28	0.4	0.5	2.4	31	0.2	590	4.8	70	32	
17-BH-06A	16	18	2017-7858	26598	0.1	14	180	39	23,000	19,500	31,000	230	2.2	330	38	430	14	0.2	0.4	2.2	28	0.5	1,400	5	78	49	0.10
17-BH-07A	0	2	2017-7858	26625	0.2	84	170	32	17,400	10,200	20,600	200	7.8	560	178	420	28	1.3	1.1	2.3	110	0.3	530	51	91	48	0.83
17-BH-07A	2	4	2017-7858	26626	0.2	50	190	32	21,700	14,400	25,400	220	8.7	370	87	450	18	0.6	1.2	1.4	72	0.3	660	15	100	38	
17-BH-07A	4	6	2017-7858	26627	0.2	48	140	32	23,400	13,500	33,000	290	8.3	300	102	520	16	0.5	1.3	1.5	51	0.4	750	6	100	24	0.09
17-BH-07A	6	8	2017-7858	26628	<0.1	28	150	10	17,500	11,400	28,500	88	6.2	300	66	420	17	0.2	1.6	1	63	0.2	530	4.5	97	13	
17-BH-07A	8	10	2017-7858	26629	<0.1	19	140	41	17,000	13,900	24,800	62	8.8	200	51	350	8.7	0.4	2.1	1	48	0.2	400	4.6	120	12	0.24
17-BH-07A	10	12	2017-7858	26630	<0.1	34	150	65	22,200	11,200	32,900	63	10	210	81	340	14	<0.2	2.9	1	46	<0.2	430	4.8	130	9.9	
17-BH-07A	12	14	2017-7858	26631	<0.1	22	120	20	17,600	13,800	36,000	210	3.9	330	42	520	13	0.8	0.5	2	43	0.3	1,000	7.3	70	35	0.01
17-BH-07A	14	16	2017-7858	26632	0.1	29	150	20	17,400	11,100	35,400	190	5.2	330	53	530	20	0.4	0.7	2.3	50	0.2	920	5.5	70	29	
17-BH-07A	16	18	2017-7858	26633	0.2	150	180	13	13,500	10,500	19,900	130	5	320	159	370	27	0.9	0.9	1.3	41	0.3	560	7.8	73	38	0.15
17-BH-07A	18	20	2017-7858	26634	0.2	300	170	30	27,300	17,200	36,300	200	16	350	497	530	28	2	2.5	1.9	55	0.7	550	15	150	48	
17-BH-08A	0	2	2017-7858	26635	0.2	28	150	100	24,200	12,600	26,100	110	9.1	320	59	400	28	0.4	2	1	56	0.4	310	42	120	42	0.49
17-BH-08A	2	4	2017-7858	26636	<0.1	41	180	27	24,200	14,800	29,100	370	8.8	360	82	470	14	0.5	1.3	1.3	61	0.4	800	24	120	26	
17-BH-08A	4	6	2017-7858	26637	0.2	28	170	30	33,900	17,400	30,500	810	3.8	310	61	390	13	0.2	1	1.1	41	0.4	1,500	6.6	100	26	0.18
17-BH-08A	6	8	2017-7858	26638	0.1	28	160	31	17,300	12,400	34,700	77	8.7	250	71	410	17	0.3	2.2	1	54	<0.2	480	5.1	130	26	
17-BH-08A	8	10	2017-7858	26639	<0.1	21	140	48	17,000	14,800	38,400	100	2.8	230	57	460	12	0.2	0.9	1.9	47	<0.2	360	5.6	92	17	0.12
17-BH-08A	10	12	2017-7858	26640	0.1	20	130	51	15,900	14,800	39,100	90	2.8	260	57	460	11	0.2	0.9	1.8	47	<0.2	360	5.3	93	24	
17-BH-08A	12	14	2017-7858	26641	0.2	8.8	120	8.6	13,700	16,100	37,000	90	1	250	28	480	7.2	<0.2	0.2	1.9	29	0.2	890	4.3	62	21	0.10
17-BH-08A	14	16	2017-7858	26642	0.2	20	120	17	15,500	12,900	31,800	140	1.2	330	40	850	11	<0.2	0.4	2	29	0.3	1,200	6.2	56	38	
17-BH-08A	16	18	2017-7858	26643	0.1	13	140	11	16,100	17,100	32,500	140	1.4	310	33	840	12	0.4	0.4	2.2	39	0.3	880	5.4	69	36	0.08
17-BH-08A	18	20	2017-7858	26644	0.1	23	150	22	17,200	15,700	31,100	130	2.7	380	49	720	21	0.5	0.8	2.4	52	0.4	790	11	79	43	
17-BH-09A	0	2	2017-7858	26645	<0.1	25	150	40	21,400	16,400	30,600	93	6.4	210	67	600	18	0.3	1.6	0.9	57	0.3	250	19	130	20	0.33
17-BH-09A	2	4	2017-7858	26646	<0.1	52	170	65	21,300	14,300	28,400	130	7.1	340	72	540	17	0.5	1.2	1.1	60	0.4	440	27	100	39	
17-BH-09A	4	6	2017-7858	26647	0.1	30	150	31	28,800	18,000	30,600	350	4.2	340	61	460	13	0.3	1.2	1.3	46	0.5	1,200	8.3	110	31	0.19
17-BH-09A	6	8	2017-7858	26648	0.1	41	160	130	19,700	15,900	28,700	100	4.6	320	64	490	25	0.4	2.4	1.4	58	0.3	380	10	110	30	
17-BH-09A	8	10	2017-7858	26649	0.1	60	140	24	15,300	16,200	29,200	100	5.4	270	69	600	21	0.5	1.5	1.3	63	0.3	370	7.9	98	32	0.02
17-BH-09A	10	12	2017-7858	26650	0.1	19	120	110	16,700	10,000	51,900	97	3	230	70	490	20	0.3	0.4	2.7	32	0.2	740	5.3	64	26	
17-BH-09A	12	14	2017-7858	26651	0.1	10	120	7	15,100	14,100	46,800	95	1.4	250	38	650	78	2	0.2	2.6	32	0.2	980	4.7	56	21	0.07
17-BH-09A	14	16	2017-7858	26652	0.1	20	120	14	14,500	14,000	38,800	92	2	210	36	470	59	0.4	0.4	2.1	28	0.3	810	4.5	57	43	
17-BH-09A	16	18	2017-7858	26653	<0.1	7.7	170	9.1	18,100	14,900	33,200	120	1.6	290	26	430	12	0.2	0.2	3	42	0.2	1,100	4.1	57	23	0.10
17-BH-09A	18	20	2017-7858	26654	<0.1	6.3	170	8.5	10,800	9,300	18,900	96	1.4	260	20	300	10	<0.2	0.2	1.2	45	<0.2	600	2.5	36	19	
17-BH-09A	20	21	2017-7858	26655	0.1	9.3	130	12	12,400	12,000	25,900	110	1.1	290	28	390	10	0.2	0.2	1.8	51	0.2	630	3.5	47	29	0.07
17-BH-10A	0	2	2017-7858	26600	0.1	90	110	24	25,800	15,900	40,000	120	1.4	200	161	660	15	<0.2	1.1	4.7	58	<0.2	650	15	78	16	0.34
17-BH-10A	2	4	2017-7858	26601	<0.1	43	160	14	25,600	22,300	37,200	66	4.3	430	87	620	16	0.5	1.6	1.3	90	0.4	280	5.4	99	10	

Hole	Depth		SRC Group	SRC Sample #	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Se	Sn	Sr	Th	Ti	U	V	Zn	^{226}Ra
	From	To			µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	Bq/g
17-BH-10A	4	6	2017-7858	26602	<0.1	27	160	26	17,200	13,000	33,100	59	6	540	62	850	9.1	<0.2	1.6	1.3	41	<0.2	290	4.3	130	12	0.50
17-BH-10A	6	8	2017-7858	26603	<0.1	25	110	35	17,800	12,100	43,900	73	4.2	520	53	680	18	0.5	0.6	1.9	36	0.6	530	4.7	86	12	
17-BH-10A	8	10	2017-7858	26604	0.1	140	180	18	20,000	13,000	37,600	100	34	380	319	410	16	1.9	1.9	1.7	54	0.3	510	6.3	110	16	0.17
17-BH-11A	0	2	2017-7858	26656	<0.1	73	120	20	15,400	15,500	28,200	100	5.2	150	126	950	11	0.3	0.6	1.9	45	0.2	440	6.5	68	12	0.09
17-BH-11A	2	3	2017-7858	26657	0.2	330	150	19	19,200	19,300	40,300	100	111	190	638	500	59	5.1	2.2	2.1	49	1.3	260	19	210	25	0.14
17-BH-12A	0	2	2017-7858	26658	<0.1	53	94	5.3	19,400	15,100	45,200	71	0.7	130	63	1000	4.3	<0.2	0.4	4.5	37	<0.2	550	5.2	34	10	<0.01
17-BH-12A	2	4	2017-7858	26659	0.1	18	120	50	18,600	14,400	39,600	88	5.4	180	52	420	10	<0.2	1.6	1.4	39	<0.2	440	4.2	120	11	
17-BH-12A	4	6	2017-7858	26660	0.1	37	110	47	16,300	10,300	50,700	83	3.9	130	72	670	23	<0.2	1	1.9	38	<0.2	430	5.9	88	24	0.07
17-BH-12A	6	6	2017-7858	26661	0.1	27	130	20	16,100	15,600	48,000	120	3.1	220	66	460	17	<0.2	0.7	2.1	36	<0.2	800	7.2	97	13	
17-BH-13A	0	2	2017-7858	26662	0.1	98	160	18	19,200	17,500	29,200	88	6.7	210	155	370	11	<0.2	2.7	1.1	46	0.3	480	5.4	130	24	0.14
17-BH-13A	2	2	2017-7858	26663	0.1	46	120	21	19,300	13,700	42,200	100	7.6	200	70	780	26	0.6	1.2	2.4	38	0.4	440	7.6	97	25	
17-BH-14A	0	2	2017-7858	26664	0.1	61	150	15	21,400	17,800	28,200	120	9.2	220	77	430	8.9	0.4	1.6	1.1	39	0.4	450	5.2	140	18	0.08
17-BH-14A	2	2	2017-7858	26665	<0.1	32	160	24	23,100	16,400	28,400	390	3.9	230	67	250	10	0.2	0.9	1.2	42	0.4	830	5.8	91	24	
17-BH-15A	0	2	2017-7858	26666	0.1	31	170	28	15,500	14,500	34,500	120	3.1	210	53	510	14	0.3	0.8	1.8	47	0.2	810	4.1	75	27	0.09
17-BH-15A	2	4	2017-7858	26667	<0.1	30	110	21	13,100	16,200	25,100	110	2.3	200	55	580	9.8	0.2	0.5	1	34	0.3	820	5.1	80	21	
17-BH-15A	4	5	2017-7858	26668	0.1	67	170	25	15,200	16,500	23,000	96	3.7	180	70	430	19	<0.2	1.1	0.8	43	0.3	330	7.5	85	30	0.13
CL505	474.0	495.0	2017-7457	26479	<0.1	34	130	14	20400	11900	33700	90	4.5	90	60	750	18	0.6	1.3	1.6	40	0.5	180	19	110	17	0.24
CL509	516.4	521.0	2017-7457	26481	<0.1	23	140	37	28800	22300	26700	140	9	290	42	300	5.4	<0.2	1.3	0.7	20	0.6	240	6.4	140	22	0.13
CL541_1	446.2	455.0	2017-7457	26487	<0.1	52	220	13	13900	18200	27600	53	84	290	117	360	28	0.5	3.7	0.4	66	0.6	170	6.6	370	16	0.14
CL554	473.3	485.0	2017-7457	26493	<0.1	53	160	16	22400	17800	26600	95	38	220	140	320	8.7	<0.2	4.1	0.5	60	0.5	140	4.1	220	18	0.13
CL526_3	473.0	509.0	2017-7457	26483	<0.1	25	130	9.1	20100	20800	23900	43	5.4	260	59	340	36	0.5	1.6	1.1	65	0.4	210	4.2	120	15	0.09
CL564	466.5	473.2	2017-7457	26495	<0.1	190	170	81	27700	29100	19200	160	22	310	181	400	18	0.8	3.9	1.1	98	1	220	48	220	31	0.98
CL539_1	436.9	440.3	2017-7457	26485	0.1	930	180	33	17900	25700	31300	70	260	360	969	350	100	4.6	4.3	0.6	65	2.4	200	52	370	13	0.74
CL565_1	462.0	496.6	2017-7457	26496	<0.1	190	180	30	24400	23000	23500	150	25	300	171	310	28	0.8	5.8	0.8	71	0.9	220	6.2	260	16	0.08
CL540	433.0	436.2	2017-7457	26486	0.3	2000	240	15	17100	18200	38700	200	30	470	1120	840	990	3.3	16	1	81	1.2	250	350	700	31	5.1
CL543_1	461	482.1	2017-7457	26488	<0.1	1800	150	79	27400	39900	27700	30	34	550	1610	370	44	4.6	5.1	0.4	120	1.2	180	10	320	7.4	0.23
CL545	478.3	518.6	2017-7457	26489	<0.1	30	140	82	27900	18900	31400	120	16	220	100	340	11	<0.2	4.1	0.6	32	0.4	240	5.1	240	15	0.15
CL549A	447.5	479.0	2017-7457	26491	0.2	190	180	25	23500	21900	27300	92	26	260	336	410	15	1.1	3.8	0.9	98	0.7	190	7.3	220	8.4	0.12
CL551A_1	443.6	450.1	2017-7457	26492	0.1	70	170	100	14700	21100	27900	94	18	300	167	300	30	0.8	4.1	0.6	86	<0.2	170	21	200	10	0.42
CL557_1	451.0	515.0	2017-7457	26494	<0.1	40	180	80	20200	19200	24100	130	21	260	106	810	15	0.3	3	0.8	52	0.5	160	9.5	170	12	0.12
CL531_1	440.0	464.4	2017-7457	26484	<0.1	130	150	20	21600	18400	35900	62	81	380	191	280	57	1.2	3.4	0.7	67	1	190	20	190	33	0.29
CL525_1	445.0	500.0	2017-7457	26482	0.2	96	170	18	28500	18900	28900	160	17	270	270	530	22	1.1	4	0.8	54	0.8	220	6.7	220	37	0.12
CL546A	461.6	506.0	2017-7457	26490	<0.1	29	190	150	33200	22600	28200	210	17	340	84	290	13	<0.2	4.2	0.5	61	0.8	280	4.1	230	28	0.08
CL508A	454.5	510.0	2017-7457	26480	<0.1	160	140	76	40000	19200	27400	140	12	270	195	390	18	0.8	5.3	1.1	47	0.9	160	9.8	160	19	0.18

APPENDIX E

2017 LEACH TEST WORK RESULTS

Appendix E – 2017 Leach Test Work Results

Table 1 – pH, SpC, HCO_3, CO_3, OH, Alk-Tot, Alk-P, Hard-Tot, Cl, Ca, Mg, K, Na, SO_4, Sum of ions, NO3, F, Ag, Al, As, B, Ba, Be

Hole	Depth		SRC group	SRC Sample #	pH	SpC	HCO_3	CO_3	OH	Alk-Tot	Alk-P	Hard-Tot	Cl	Ca	Mg	K	Na	SO_4	Sum of ions	NO_3	F	Ag	Al	As	B	Ba	Be
	From	To			pH units	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L
17-BH-01A	0	2	2017-10605	35868	11.36	776	67	127	<10	267	106	245	2	98	0.1	12	3.8	77	387	<0.04	0.71	<0.0005	2.17	18	0.06	0.02	<0.0001
17-BH-01A	4	6	2017-10605	35869	11.74	1980	<1	208	26	422	249	459	2	184	<0.1	16	8	58	502	0.05	0.97	<0.0005	1.46	2.9	<0.01	0.037	<0.0001
17-BH-01A	8	10	2017-10605	35870	8.79	379	66	6	<10	64	5	169	2	58	6	6.2	3.2	160	308	0.19	0.23	<0.0005	0.001	917	0.03	0.0014	<0.0001
17-BH-02A	0	2	2017-10605	35871	10.3	292	58	14	<10	72	12	92	2	37	<0.1	9.2	7.6	110	245	7.2	0.23	<0.0005	0.33	24	0.07	0.0081	<0.0001
17-BH-02A	4	6	2017-10605	35872	10.84	375	78	41	<10	132	34	97	4	39	<0.1	12	5.3	39	231	13	0.33	<0.0005	1.28	5.2	0.11	0.012	<0.0001
17-BH-02A	8	10	2017-10605	35873	11.01	522	83	48	<10	148	40	125	11	50	<0.1	12	9.8	32	255	9.5	0.16	<0.0005	1.81	5.9	0.12	0.016	<0.0001
17-BH-03A	0	2	2017-10605	35874	11.08	643	100	56	<10	176	47	174	4	70	<0.1	15	8.3	120	385	12	0.46	<0.0005	1.45	17	0.09	0.013	<0.0001
17-BH-03A	4	6	2017-10605	35875	10.56	281	112	10	<10	108	8	80	2	32	<0.1	11	5	56	234	6.2	0.3	<0.0005	0.86	31	0.11	0.0058	<0.0001
17-BH-03A	8	10	2017-10605	35876	10.11	179	62	10	<10	67	8	55	13	22	<0.1	6.8	4.2	19	146	9.1	0.13	<0.0005	0.56	7.5	0.06	0.0042	<0.0001
17-BH-04A	0	2	2017-10605	35877	10.84	483	83	44	<10	142	37	155	3	62	<0.1	9.6	8.6	98	324	16	0.35	<0.0005	1.63	27	0.06	0.015	<0.0001
17-BH-04A	4	6	2017-10605	35878	10.95	553	43	52	<10	121	43	195	3	78	0.1	11	6.8	110	309	4.9	0.89	<0.0005	3.31	79	0.09	0.02	<0.0001
17-BH-04A	8	10	2017-10605	35879	10.57	327	82	<1	<10	67	<10	110	2	44	0.1	9.7	6.5	58	219	17	0.5	<0.0005	1.5	18	0.16	0.0071	<0.0001
17-BH-04A	12	14	2017-10605	35880	10.24	266	67	<1	<10	55	<10	85	2	34	<0.1	10	7	50	193	23	0.43	<0.0005	0.68	11	0.17	0.0062	<0.0001
17-BH-05A	0	2	2017-10605	35881	10.28	309	49	<1	<10	40	<10	115	3	46	<0.1	9.4	4.6	100	219	7.1	0.47	<0.0005	1.57	31	0.15	0.0048	<0.0001
17-BH-05A	4	6	2017-10605	35882	10.46	419	58	<1	<10	48	<10	160	3	64	<0.1	8.6	8.7	140	295	13	0.37	<0.0005	1.86	191	0.1	0.0064	<0.0001
17-BH-05A	8	10	2017-10605	35883	10.29	218	66	<1	<10	54	<10	67	2	27	<0.1	9.9	5.4	41	156	4.9	0.36	<0.0005	0.85	16	0.14	0.0092	<0.0001
17-BH-05A	12	14	2017-10605	35884	10.12	228	70	<1	<10	57	<10	77	2	31	<0.1	10	5.7	61	186	6.2	0.39	<0.0005	0.93	21	0.16	0.0053	<0.0001
17-BH-06A	0	2	2017-10605	35885	10.98	568	229	<1	<10	188	<10	192	4	77	<0.1	13	8.7	130	464	2.6	0.89	<0.0005	2.82	7.6	0.12	0.012	<0.0001
17-BH-06A	4	6	2017-10605	35886	10.59	373	96	<1	<10	79	<10	140	3	56	<0.1	11	6.1	110	288	6.4	0.62	<0.0005	1.61	34	0.11	0.0058	<0.0001
17-BH-06A	8	10	2017-10605	35887	11.05	630	100	<1	<10	82	<10	214	3	86	<0.1	16	9	100	324	9.5	0.99	<0.0005	1.67	31	0.14	0.012	<0.0001
17-BH-06A	12	14	2017-10605	35888	9.22	145	57	<1	<10	47	<10	38	3	15	0.2	10	5.2	45	142	6.3	0.28	<0.0005	0.2	21	0.14	0.0014	<0.0001
17-BH-06A	16	18	2017-10605	35889	9.49	180	67	<1	<10	55	<10	55	2	22	0.1	13	5	46	162	6.7	0.28	<0.0005	0.6	14	0.18	0.0035	<0.0001
17-BH-07A	0	2	2017-10605	35890	11.07	1260	<1	126	52	364	259	399	10	160	<0.1	24	15	72	461	1.6	0.16	<0.0005	1.83	5.8	0.01	0.061	<0.0001
17-BH-07A	4	6	2017-10605	35891	10.73	549	11	103	<10	181	86	232	4	93	<0.1	12	7.4	110	349	8.4	0.17	<0.0005	2.55	28	0.08	0.013	<0.0001
17-BH-07A	8	10	2017-10605	35892	10.54	513	168	68	<10	252	57	214	3	86	<0.1	12	9	140	493	6.9	0.15	<0.0005	2.44	33	0.08	0.024	<0.0001
17-BH-07A	12	14	2017-10605	35893	10.2	335	266	<1	<10	218	<10	135	3	54	<0.1	15	7.2	84	437	7.9	0.2	<0.0005	1.99	19	0.2	0.0095	<0.0001
17-BH-07A	16	18	2017-10605	35894	9.36	239	82	<1	<10	67	<10	85	3	34	<0.1	7.1	8.8	65	202	2.4	0.14	<0.0005	0.5	4350	0.09	0.0086	<0.0001
17-BH-08A	0	2	2017-10605	35895	10.01	522	132	<1	<10	108	<10	239	9	96	<0.1	11	8.5	260	532	16	0.24	<0.0005	2.28	20	0.12	0.0097	<0.0001
17-BH-08A	4	6	2017-10605	35896	11.02	304	50	29	<10	89	24	155	2	62	<0.1	12	5.8	81	254	12	0.2	<0.0005	2.33	12	0.17	0.0074	<0.0001
17-BH-08A	8	10	2017-10605	35897	10.43	432	89	<1	<10	73	<10	135	3	54	<0.1	12	7.1	150	320	4.9	0.19	<0.0005	1.3	12	0.13	0.0049	<0.0001
17-BH-08A	12	14	2017-10605	35898	10.16	193	80	<1	<10	66	<10	45	1	18	<0.1	11	4.9	21	142	6.5	0.17	<0.0005	0.71	8.8	0.14	0.0027	<0.0001
17-BH-08A	16	18	2017-10605	35899	10.67	419	67	19	<10	87	16	105	6	42	<0.1	12	7.3	42	209	14	0.16	<0.0005	1.76	6.9	0.14	0.013	<0.0001

Hole	Depth		SRC group	SRC Sample #	pH	SpC	HCO_3	CO_3	OH	Alk-Tot	Alk-P	Hard-Tot	Cl	Ca	Mg	K	Na	SO_4	Sum of ions	NO_3	F	Ag	Al	As	B	Ba	Be
	From	To			pH units	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L
17-BH-09A	0	2	2017-10605	35900	9.77	376	68	<1	<10	56	<10	132	5	53	<0.1	9.9	5.1	160	308	7.1	0.24	<0.0005	0.93	29	0.14	0.0045	<0.0001
17-BH-09A	4	6	2017-10605	35901	10.45	716	56	52	<10	132	43	207	3	83	<0.1	11	7.3	130	353	11	0.17	<0.0005	3.4	12	0.15	0.012	<0.0001
17-BH-09A	8	10	2017-10605	35902	9.72	403	77	<1	<10	63	<10	135	4	54	<0.1	11	7	140	308	15	0.22	<0.0005	1.61	238	0.16	0.0053	<0.0001
17-BH-09A	12	14	2017-10605	35903	9.74	241	71	<1	<10	58	<10	62	2	25	<0.1	13	5.5	32	156	8	0.27	<0.0005	0.53	6.3	0.16	0.0031	<0.0001
17-BH-09A	16	18	2017-10605	35904	9.97	339	82	<1	<10	67	<10	92	9	37	<0.1	13	7.4	39	196	9	0.17	<0.0005	1.44	3.7	0.19	0.0089	<0.0001
17-BH-09A	20	21	2017-10605	35905	10.59	753	88	43	<10	144	36	197	11	79	<0.1	14	8.2	55	308	9.8	0.14	<0.0005	2.86	2	0.18	0.036	<0.0001
17-BH-10A	0	2	2017-10605	35906	9.33	238	38	<1	<10	31	<10	83	<1	33	0.2	7.6	2.8	82	165	1.6	0.17	<0.0005	0.39	27	0.13	0.0064	<0.0001
17-BH-10A	4	6	2017-10605	35911	6.69	354	28	<1	<10	23	<10	144	1	46	7.1	8.4	2.3	140	233	0.17	0.23	<0.0005	0.012	12	0.1	0.0048	<0.0001
17-BH-10A	8	10	2017-10605	35912	8.58	314	67	<1	<10	55	<10	108	1	43	0.2	11	5.7	110	242	4.6	0.27	<0.0005	0.35	944	0.14	0.0051	<0.0001
17-BH-11A	0	2	2017-10605	35913	6.74	285	20	<1	<1	16	<1	108	<1	37	3.9	8.1	2.2	110	181	0.12	0.24	<0.0005	0.013	554	0.08	0.0062	<0.0001
17-BH-11A	2	3.8	2017-10605	35914	6.86	1000	39	<1	<1	32	<1	524	1	172	23	4.9	2.5	490	733	0.62	0.15	<0.0005	0.0053	637	0.08	0.017	<0.0001
17-BH-12A	0	2	2017-10605	35915	7.98	90	32	<1	<1	26	<1	18	<1	6.6	0.5	6.2	6.8	13	66	0.82	0.2	<0.0005	2.11	24	0.17	0.0014	0.0001
17-BH-12A	4	6	2017-10605	35917	6.97	698	35	<1	<1	29	<1	329	<1	104	17	7.7	2.4	310	477	0.55	0.24	<0.0005	0.0078	8.8	0.11	0.0098	<0.0001
17-BH-13A	0	2	2017-10605	35918	8.32	190	30	<1	<1	25	<1	56	2	22	0.3	7.7	5.7	57	133	8.4	0.13	<0.0005	0.021	3340	0.15	0.002	<0.0001
17-BH-14A	0	2	2017-10605	35919	8.89	230	56	<1	<10	46	<10	70	2	28	0.1	10	4.6	92	200	7.3	0.16	<0.0005	0.05	532	0.13	0.0022	<0.0001
17-BH-15A	0	2	2017-10605	35920	9.69	247	78	<1	<10	64	<10	82	2	33	<0.1	8.2	3.6	48	181	8.1	0.14	<0.0005	0.48	147	0.12	0.0031	<0.0001
17-BH-15A	4	5.5	2017-10605	35921	8.5	251	38	<1	<10	31	<10	78	2	31	0.3	9.6	3.3	110	200	6.2	0.24	<0.0005	0.22	946	0.11	0.0018	<0.0001
CL-505	474	495	2017-11343	38606	6.45	89	4	<1	<1	3	<1	22	1.5	2.9	3.5	5.7	3.2	31	52	<0.04	0.17	<0.0005	0.025	38	0.09	0.13	<0.0001
CL-509	516.4	521	2017-11343	38607	6.2	42	2	<1	<1	2	<1	5	0.7	0.7	0.9	6.1	2.6	14	27	<0.04	0.22	<0.0005	0.26	40	0.1	0.24	<0.0001
CL-526_3	473	509	2017-11343	38608	7.19	116	27	<1	<1	22	<1	29	0.8	5.7	3.5	8	5.2	36	86	<0.04	0.27	<0.0005	0.041	12	0.14	0.25	<0.0001
CL-539_1	436.9	440.3	2017-11343	38609	7.68	279	56	<1	<1	46	<1	116	0.8	30	10	8	2.5	81	188	<0.04	0.14	<0.0005	0.0088	5600	0.09	0.082	<0.0001
CL-540	443	436.2	2017-11343	38610	7.6	233	51	<1	<1	42	<1	99	0.6	27	7.8	6.4	2.3	67	162	<0.04	0.22	<0.0005	0.0097	7340	0.11	0.13	<0.0001
CL-541_1	446.2	455	2017-11343	38611	7.48	146	35	<1	<1	29	<1	55	0.7	13	5.6	4.6	2	40	101	<0.04	0.13	<0.0005	0.05	249	0.06	0.13	<0.0001
CL-554	473.3	485	2017-11343	38612	7.99	126	45	<1	<1	37	<1	7	2.1	1	1.2	5.3	21	20	96	<0.04	0.27	<0.0005	0.19	367	0.16	0.0013	<0.0001
CL-564	466.5	473.2	2017-11343	38613	7.13	100	15	<1	<1	12	<1	20	1.1	2.8	3.2	7	6	29	64	<0.04	0.12	<0.0005	0.16	1740	0.15	0.0023	<0.0001
CL-565_1	462	496.6	2017-11343	38614	7.94	174	52	<1	<1	43	<1	51	1.4	13	4.5	7.4	9.7	39	127	<0.04	0.18	<0.0005	0.028	1600	0.1	0.0022	<0.0001

Table 2 – Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Th, Ti, U, V, Zn, and ^{226}Ra

Hole	Depth		SRC group	SRC Sample #	Cd	Co	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Th	Ti	U	V	Zn	^{226}Ra
	From	To			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	Bq/L
17-BH-01A	0	2	2017-10605	35868	<0.0001	0.0004	0.012	0.0012	0.018	<0.0005	0.011	0.0006	<0.0001	0.0009	0.0014	<0.0001	0.24	<0.0002	<0.0002	<0.1	0.005	<0.0005	0.02
17-BH-01A	4	6	2017-10605	35869	<0.0001	0.0006	0.016	0.0012	0.0059	<0.0005	0.011	0.0006	<0.0001	0.0002	0.0013	<0.0001	0.63	<0.0002	<0.0002	<0.1	0.0012	0.0006	0.03
17-BH-01A	8	10	2017-10605	35870	<0.0001	0.0029	<0.0005	0.0003	<0.0005	0.0011	0.282	0.0043	<0.0001	0.0027	0.0015	<0.0001	0.14	<0.0002	0.0011	0.7	0.0018	<0.0005	0.01
17-BH-02A	0	2	2017-10605	35871	<0.0001	0.0002	0.0018	0.0003	0.0041	<0.0005	0.018	0.0003	<0.0001	0.0031	0.0029	<0.0001	0.17	<0.0002	<0.0002	<0.1	0.014	<0.0005	0.03
17-BH-02A	4	6	2017-10605	35872	<0.0001	0.0002	0.0046	0.0008	0.0024	<0.0005	0.0064	0.0003	<0.0001	0.0034	0.0008	<0.0001	0.18	<0.0002	<0.0002	<0.1	0.011	<0.0005	0.01
17-BH-02A	8	10	2017-10605	35873	<0.0001	0.0003	0.0054	0.0009	0.0037	<0.0005	0.0054	0.0004	<0.0001	0.0049	0.0009	<0.0001	0.24	<0.0002	<0.0002	<0.1	0.0091	<0.0005	0.02
17-BH-03A	0	2	2017-10605	35874	<0.0001	0.0002	0.0097	0.0009	0.0068	<0.0005	0.046	0.0003	<0.0001	0.003	0.0094	<0.0001	0.32	<0.0002	<0.0002	<0.1	0.021	<0.0005	0.009
17-BH-03A	4	6	2017-10605	35875	<0.0001	0.0001	0.0064	0.0006	0.0016	<0.0005	0.01	0.0004	<0.0001	0.0032	0.0011	<0.0001	0.16	<0.0002	<0.0002	<0.1	0.016	0.0009	<0.005
17-BH-03A	8	10	2017-10605	35876	<0.0001	<0.0001	0.0021	0.0004	0.0015	<0.0005	0.003	0.0003	<0.0001	0.0014	0.0002	<0.0001	0.15	<0.0002	<0.0002	<0.1	0.02	0.0006	0.006
17-BH-04A	0	2	2017-10605	35877	<0.0001	0.0004	0.0042	0.0023	0.023	<0.0005	0.104	0.01	<0.0001	0.0025	0.0017	<0.0001	0.26	<0.0002	0.0005	<0.1	0.012	0.0043	0.009
17-BH-04A	4	6	2017-10605	35878	<0.0001	0.0014	0.0098	0.0012	0.0064	<0.0005	0.587	0.0008	<0.0001	0.0056	0.0021	<0.0001	0.28	<0.0002	0.0021	<0.1	0.014	<0.0005	0.03
17-BH-04A	8	10	2017-10605	35879	<0.0001	0.0002	0.0092	0.0004	<0.0005	<0.0005	0.03	0.0002	<0.0001	0.0032	0.001	<0.0001	0.22	<0.0002	0.0002	<0.1	0.014	<0.0005	0.01
17-BH-04A	12	14	2017-10605	35880	<0.0001	<0.0001	0.0086	<0.0002	<0.0005	<0.0005	0.012	0.0001	<0.0001	0.0025	0.0007	<0.0001	0.18	<0.0002	<0.0002	<0.1	0.014	<0.0005	0.01
17-BH-05A	0	2	2017-10605	35881	<0.0001	<0.0001	0.0051	<0.0002	<0.0005	<0.0005	0.033	0.0002	<0.0001	0.0036	0.0009	<0.0001	0.22	<0.0002	<0.0002	<0.1	0.015	<0.0005	0.009
17-BH-05A	4	6	2017-10605	35882	<0.0001	0.0003	0.0086	<0.0002	0.012	<0.0005	0.113	0.0002	0.0003	0.0089	0.0028	<0.0001	0.24	<0.0002	0.0006	<0.1	0.014	<0.0005	0.02
17-BH-05A	8	10	2017-10605	35883	<0.0001	<0.0001	0.005	<0.0002	<0.0005	<0.0005	0.017	0.0001	<0.0001	0.0025	0.0013	<0.0001	0.16	<0.0002	<0.0002	<0.1	0.012	<0.0005	<0.005
17-BH-05A	12	14	2017-10605	35884	<0.0001	<0.0001	0.0092	<0.0002	<0.0005	<0.0005	0.025	0.0001	<0.0001	0.0025	0.0012	<0.0001	0.15	<0.0002	<0.0002	<0.1	0.013	<0.0005	<0.005
17-BH-06A	0	2	2017-10605	35885	<0.0001	<0.0001	0.01	0.0009	0.018	<0.0005	0.03	0.0003	<0.0001	0.0038	0.0028	<0.0001	0.33	<0.0002	<0.0002	<0.1	0.0091	<0.0005	0.03
17-BH-06A	4	6	2017-10605	35886	<0.0001	<0.0001	0.0035	<0.0002	0.0045	<0.0005	0.028	0.0002	<0.0001	0.004	0.0015	<0.0001	0.23	<0.0002	<0.0002	<0.1	0.018	<0.0005	0.02
17-BH-06A	8	10	2017-10605	35887	<0.0001	0.0002	0.0064	<0.0002	0.012	<0.0005	0.042	0.0002	<0.0001	0.0034	0.0029	<0.0001	0.36	<0.0002	0.0002	<0.1	0.014	<0.0005	0.02
17-BH-06A	12	14	2017-10605	35888	<0.0001	<0.0001	0.0018	<0.0002	0.0069	<0.0005	0.006	0.0001	<0.0001	0.0016	0.0006	<0.0001	0.089	<0.0002	0.0002	0.1	0.014	<0.0005	<0.005
17-BH-06A	16	18	2017-10605	35889	<0.0001	<0.0001	0.0062	<0.0002	<0.0005	<0.0005	0.0065	<0.0001	<0.0001	0.0037	0.0014	<0.0001	0.089	<0.0002	0.0004	<0.1	0.016	<0.0005	<0.005
17-BH-07A	0	2	2017-10605	35890	<0.0001	0.0035	0.019	0.0023	0.057	<0.0005	0.086	0.0014	<0.0001	0.0005	0.0009	<0.0001	0.86	<0.0002	0.0003	<0.1	0.0013	<0.0005	0.08
17-BH-07A	4	6	2017-10605	35891	<0.0001	0.0005	0.011	<0.0002	0.022	<0.0005	0.097	0.0003	<0.0001	0.0034	0.002	<0.0001	0.34	<0.0002	0.0003	<0.1	0.0087	<0.0005	0.005
17-BH-07A	8	10	2017-10605	35892	<0.0001	0.0007	0.0094	0.0003	0.021	<0.0005	0.196	0.0004	<0.0001	0.0042	0.0025	<0.0001	0.33	<0.0002	0.0005	<0.1	0.0082	<0.0005	0.009
17-BH-07A	12	14	2017-10605	35893	<0.0001	0.0002	0.0098	0.0004	0.0037	<0.0005	0.045	0.0002	<0.0001	0.0034	0.0016	<0.0001	0.23	<0.0002	0.0002	<0.1	0.014	<0.0005	<0.005
17-BH-07A	16	18	2017-10605	35894	<0.0001	0.0003	0.0027	<0.0002	<0.0005	<0.0005	0.052	0.001	<0.0001	0.011	0.0019	<0.0001	0.13	<0.0002	<0.0002	0.4	0.01	<0.0005	0.009
17-BH-08A	0	2	2017-10605	35895	<0.0001	0.0003	0.0051	0.0014	0.017	<0.0005	0.05	0.0007	<0.0001	0.0033	0.0024	<0.0001	0.28	<0.0002	0.0002	<0.1	0.013	<0.0005	0.03
17-BH-08A	4	6	2017-10605	35896	<0.0001	0.0002	0.0077	<0.0002	0.0063	<0.0005	0.019	<0.0001	<0.0001	0.0021	0.0014	<0.0001	0.26	<0.0002	<0.0002	<0.1	0.012	<0.0005	0.02
17-BH-08A	8	10	2017-10605	35897	<0.0001	<0.0001	0.0013	<0.0002	0.016	<0.0005	0.021	<0.0001	<0.0001	0.0025	0.0014	<0.0001	0.25	<0.0002	<0.0002	<0.1	0.012	<0.0005	0.007
17-BH-08A	12	14	2017-10605	35898	<0.0001	<0.0001	0.004	<0.0002	<0.0005	<0.0005	0.0043	<0.0001	<0.0001	0.0016	0.0005	<0.0001	0.11	<0.0002	<0.0002	<0.1	0.015	<0.0005	0.008
17-BH-08A	16	18	2017-10605	35899	<0.0001	0.0002	0.017	<0.0002	0.0031	<0.0005	0.0067	<0.0001	<0.0001	0.0034	0.0016	<0.0001	0.22	<0.0002	<0.0002	<0.1	0.011	<0.0005	0.008
17-BH-09A	0	2	2017-10605	35900	<0.0001	<0.0001	0.0025	<0.0002	0.0011	<0.0005	0.036	0.0002	<0.0001	0.0027	0.001	<0.0001	0.2	<0.0002	<0.0002	<0.1	0.012	<0.0005	<0.005

Hole	Depth		SRC group	SRC Sample #	Cd	Co	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Th	Ti	U	V	Zn	^{226}Ra
	From	To			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	Bq/L
17-BH-09A	4	6	2017-10605	35901	<0.0001	0.0002	0.0097	<0.0002	0.016	<0.0005	0.026	<0.0001	<0.0001	0.0026	0.0024	<0.0001	0.32	<0.0002	<0.0002	<0.1	0.0098	<0.0005	0.005
17-BH-09A	8	10	2017-10605	35902	<0.0001	0.0002	0.004	<0.0002	0.0046	<0.0005	0.066	<0.0001	<0.0001	0.0064	0.0075	<0.0001	0.24	<0.0002	<0.0002	<0.1	0.017	<0.0005	0.01
17-BH-09A	12	14	2017-10605	35903	<0.0001	<0.0001	0.005	<0.0002	<0.0005	<0.0005	0.0087	<0.0001	<0.0001	0.027	0.0009	<0.0001	0.16	<0.0002	<0.0002	<0.1	0.019	<0.0005	0.005
17-BH-09A	16	18	2017-10605	35904	<0.0001	<0.0001	0.0051	<0.0002	<0.0005	<0.0005	0.006	<0.0001	<0.0001	0.0025	0.0008	<0.0001	0.2	<0.0002	<0.0002	<0.1	0.014	<0.0005	<0.005
17-BH-09A	20	21	2017-10605	35905	<0.0001	0.0002	0.013	<0.0002	0.0036	<0.0005	0.0068	0.0001	<0.0001	0.0022	0.0017	<0.0001	0.42	<0.0002	<0.0002	<0.1	0.0069	0.0007	0.01
17-BH-10A	0	2	2017-10605	35906	<0.0001	<0.0001	0.0008	0.0005	0.0069	<0.0005	0.0049	0.0001	<0.0001	0.001	0.0066	<0.0001	0.17	<0.0002	<0.0002	<0.1	0.02	<0.0005	0.01
17-BH-10A	4	6	2017-10605	35911	<0.0001	<0.0001	<0.0005	0.0008	<0.0005	<0.0005	0.007	0.0003	<0.0001	0.0003	0.0004	<0.0001	0.2	<0.0002	<0.0002	0.1	0.0015	<0.0005	0.02
17-BH-10A	8	10	2017-10605	35912	<0.0001	0.0003	<0.0005	0.0009	0.002	<0.0005	0.61	0.0005	<0.0001	0.0086	0.0015	<0.0001	0.17	<0.0002	0.002	<0.1	0.014	0.001	0.01
17-BH-11A	0	2	2017-10605	35913	<0.0001	0.0001	0.0007	0.0009	0.0019	<0.0005	0.033	0.0032	<0.0001	0.0043	0.0007	<0.0001	0.2	<0.0002	<0.0002	0.5	0.0045	<0.0005	0.02
17-BH-11A	2	3.8	2017-10605	35914	<0.0001	0.32	<0.0005	0.0014	0.0006	0.085	0.859	0.815	<0.0001	0.0081	0.0034	<0.0001	0.39	0.0002	0.0029	4.4	0.0013	0.001	0.09
17-BH-12A	0	2	2017-10605	35915	<0.0001	0.0006	0.0028	0.001	0.48	0.0012	0.004	0.001	<0.0001	0.0002	0.0006	0.0003	0.039	<0.0002	0.0052	0.2	0.0052	0.0005	<0.005
17-BH-12A	4	6	2017-10605	35917	<0.0001	0.001	<0.0005	0.0015	0.0012	0.0044	0.01	0.0025	<0.0001	0.0007	0.0019	<0.0001	0.52	<0.0002	<0.0002	2.7	0.0002	<0.0005	0.02
17-BH-13A	0	2	2017-10605	35918	<0.0001	0.0002	0.0018	0.001	0.0017	<0.0005	0.08	0.0003	<0.0001	0.0072	0.0039	<0.0001	0.14	<0.0002	0.0003	0.2	0.0086	<0.0005	0.01
17-BH-14A	0	2	2017-10605	35919	<0.0001	0.0002	0.0028	0.0008	0.0006	<0.0005	0.03	0.0002	<0.0001	0.003	0.0021	<0.0001	0.12	<0.0002	0.0004	<0.1	0.013	<0.0005	0.009
17-BH-15A	0	2	2017-10605	35920	<0.0001	0.0002	0.0083	0.0015	0.0005	<0.0005	0.011	0.0002	<0.0001	0.0015	0.001	<0.0001	0.12	<0.0002	<0.0002	<0.1	0.013	<0.0005	<0.005
17-BH-15A	4	5.5	2017-10605	35921	<0.0001	0.0002	0.0067	<0.0002	<0.0005	<0.0005	0.02	0.0002	<0.0001	0.0037	0.0024	<0.0001	0.18	<0.0002	<0.0002	0.4	0.017	<0.0005	<0.005
CL-505	474	495	2017-11343	38606	<0.0001	0.0012	<0.0005	0.0009	0.014	0.0018	0.028	0.0008	<0.0001	0.0013	0.0068	<0.0001	0.062	<0.0002	<0.0002	<0.1	0.0013	0.032	0.008
CL-509	516.4	521	2017-11343	38607	<0.0001	0.0006	<0.0005	0.0018	0.13	0.0006	0.0083	0.0005	0.0002	0.0006	0.0006	<0.0001	0.017	<0.0002	0.0007	<0.1	0.0022	0.014	0.02
CL-526_3	473	509	2017-11343	38608	<0.0001	0.0004	<0.0005	0.0005	0.016	0.0055	0.025	0.0005	<0.0001	0.0013	0.0013	<0.0001	0.099	<0.0002	<0.0002	<0.1	0.0011	0.01	0.01
CL-539_1	436.9	440.3	2017-11343	38609	<0.0001	0.061	<0.0005	<0.0002	0.0006	0.0066	3.01	0.086	<0.0001	0.03	0.01	<0.0001	0.23	0.0007	0.012	5	0.014	0.016	0.04
CL-540	443	436.2	2017-11343	38610	<0.0001	0.021	<0.0005	0.0003	0.0016	0.0082	0.328	0.044	<0.0001	0.022	0.054	<0.0001	0.18	<0.0002	0.0012	124	0.054	0.025	0.21
CL-541_1	446.2	455	2017-11343	38611	<0.0001	0.0006	<0.0005	0.0002	0.0062	0.002	1.4	0.0008	<0.0001	0.0024	0.018	<0.0001	0.092	<0.0002	0.006	0.4	0.0063	0.013	0.02
CL-554	473.3	485	2017-11343	38612	<0.0001	0.0019	0.0008	0.0003	0.074	<0.0005	0.36	0.0021	0.0002	0.0007	0.0029	<0.0001	0.012	<0.0002	0.0018	<0.1	0.008	<0.0005	0.01
CL-564	466.5	473.2	2017-11343	38613	<0.0001	0.0077	0.0015	0.002	0.072	<0.0005	0.105	0.02	0.0002	0.0022	0.0046	<0.0001	0.024	<0.0002	0.0009	1.1	0.0062	0.001	0.02
CL-565_1	462	496.6	2017-11343	38614	<0.0001	0.0024	<0.0005	0.0002	0.0084	0.0007	0.202	0.0045	<0.0001	0.004	0.027	<0.0001	0.093	<0.0002	0.0008	<0.1	0.0093	<0.0005	0.01

APPENDIX F

STOCKPILE C
UNDERDRAIN WATER QUALITY

Appendix F – Stockpile C Underdrain Water Quality

Table 1 - pH-F, pH-L, Cond-F, Cond-L, Temp-H_{20}, Ca, Mg, Na, K, Cl, CO_3, HCO_3, OH, SO_4, Hardness, Ag, Al , As, Ba, B, Be, Cd, and Co

Sample Date	Station	pH-F	pH-L	Cond-F	Cond-L	Temp-H_2O	Ca	Mg	Na	K	Cl	CO_3	HCO_3	OH	SO_4	Hardness	Ag	Al	As	Ba	B	Be	Cd	Co
				µS/cm	µS/cm		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stockpile C Underdrain - Original Pad																								
31/05/1991	2.4;2		13.10	2200		5.2																		
22/06/1991	2.4;2		12.57	1800		6.3													144					
18/07/1991	2.4;2														94				100					
24/07/1991	2.4;2						123	1	234	78	39				68			5	100	0.15				
29/07/1991	2.4;2		12.13	2800		7.8																		
07/08/1991	2.4;2		12.07	2300		7.3																		
20/08/1991	2.4;2						103	1	136	40	35				222			5	50	0.09				
30/08/1991	2.4;2		12.50	1900		3.1													100					
09/10/1991	2.4;2		12.15	800		9													36					
27/07/1995	2.4;2		10.56	691		16.1		2					<1				<0.001							
21/06/1996	2.4;2		10.88	530		11.5	29	0.5	98	30	37		<1		141		<0.001	0.9	950	0.022			<0.001	
18/08/1996	2.4;2		10.38	743		17.2	26	0.4	131	39	55		16		197		<0.001	1	1270	0.024			<0.001	
09/10/1996	2.4;2		10.83	1067		18.1	41	0.2	161	37	66		<1		227		<0.001	1.3	850	0.035			<0.001	
05/05/1997	2.4;2		10.58	228		5.8	12	0.9	51	17	13		<1		66		<0.001	1.3	1200	0.028			<0.001	
08/09/1997	2.4;2		10.99	965		13.6	36	0.3	183	38	55		<1		262		<0.001	1.3	970	0.015			<0.001	
02/10/1997	2.4;2		11.56	820		8	35	0.2	163	44	53		<1		224		<0.001	2.2	560	0.032			<0.001	
09/11/1997	2.4;2					3.5	49	0.45	184	60	66		<1		210		<0.001	2.6	470	0.049			<0.001	
26/04/1998	2.4;2		10.04	929		8.3	56	5.3	116	33	34		17		116		0.002	0.45	310	0.027			0.002	
30/04/1998	2.4;2		10.28	1.14		7.4																		
15/07/1998	2.4;2						86	5.3	213	63	69		<1		150		<0.001	1.2	290	0.064			<0.001	
17/07/1998	2.4;2		11.21	1290		13.6																		
17/08/1998	2.4;2		10.93	996		12.7	47	0.7	243	61	82		<1		150		<0.001	2.9	490	0.031			<0.001	
20/05/1999	2.4;2		10.65	1310		11.1	48	3	161	47	49	49	<1		211	132	<0.001	0.37	280	0.033			<0.001	
28/09/1999	2.4;2		10.14	1630		8.1	88	3	251	63	68		<1		288		<0.001	1.1	320	0.054	0.076	<0.001	<0.001	0.005
15/05/2000	2.4;2		7.86	819		6.4	49	13	89	23	18		66		160		<0.001	0.022	400	0.03	0.23	<0.001	<0.001	0.004
15/07/2000	2.4;2		9.80																					
16/07/2000	2.4;2		10.90																					
04/06/2002	2.4;2		11.17	1310		5.1	89	3.6	198	55	47	23	<1		272	237	<0.001	0.17	210	0.062	0.13	<0.001	<0.001	0.003
01/07/2002	2.4;2		9.96	1210		7.4	80	4.1	156	41	36	34	9		236	216	<0.001	0.65	220	0.043	0.16	<0.001	<0.001	0.002
09/08/2002	2.4;2		10.95	1960		9.6	148	5.9	236	65	52	26	<1	3	373	393	<0.001	0.24	6.7	0.3	0.034	<0.001	<0.001	0.004
02/09/2002	2.4;2		8.07	1.1		13.2	54	1.4	131	32	159	<1	56	<1	60	140	<0.001	0.74	7.6	0.35	0.031	<0.001	<0.001	0.003
26/09/2002	2.4;2																							
30/06/2003	2.4;2		9.64	2020		8.2	145	5.7	241	67	52	19	<1	<1	440	385	<0.001	<0.005	280	0.043	0.14	<0.001	<0.001	0.006
31/05/2004	2.4;2	8.72	8.40	725	901	6.2	60	7.8	91	23	25	<1	51	<1	170	182	<0.001	0.57	140	0.08			<0.001	
08/07/2004	2.4;2		10.15		2230		148	3.3	251	72	52	23	<1	4	350	383	<0.001	0.078	170	0.046			<0.001	
14/06/2005	2.4;2	9.12	7.27	1790	1890	11.1	144	8.3	193	61	42	<1	34	<1	420	393	<0.001	<0.005	230	0.038			<0.001	
08/06/2006	2.4;2	6.01	7.20	84.1	3260	13.1	477	58	180	55	49	<1	33	<1	1300	1430	<0.001	2.3	16	0.045			<0.001	
05/08/2007	2.4;2	4.73	4.61	3380	3710	14.7	468	85	222	59	63	<1	<1	<1	1600	1520	0.0002	17	7.1	0.049			0.0016	
19/05/2008	2.4;2	4.87	4.93	542	571	6.9	62	12	21	6.4	5	<1	<1	<1	210	204	<0.001	2.4	<1	0.009			<0.001	
19/05/2009	2.4;2	7.67	7.38	109.8	113	3	17	1.9	0.4	1	0.2	<1	35	<1	34	50	<0.0001	2.46	7.8	0.088			0.0001	
17/04/2010	2.4;2	4.15	4.58	196.4	212	2	21	4.2	0.9	0.7	0.1	<1	<1	<1	82	70	<0.00001	2.38	5.5	0.016			0.00016	

Sample Date	Station	pH-F	pH-L	Cond-F	Cond-L	Temp-H_2O	Ca	Mg	Na	K	Cl	CO_3	HCO_3	OH	SO_4	Hardness	Ag	Al	As	Ba	B	Be	Cd	Co
				µS/cm	µS/cm		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L
02/05/2011	2.4;2	3.42	3.33	888.3	906	6.6	87	25	1.2	2.6	<1	<1	<1	<1	390	320	<0.0005	8.7	16	0.018			0.0005	
01/05/2012	2.4;2	3.39	3.19	1079	1170	0.2	96	36	1.7	2.4	1	<1	<1	<1	530	387	<0.0005	16.5	21	0.027			0.0009	
06/05/2013	2.4;2	4.10	4.54	489	494	4	57	12	0.8	1.5	1	<1	<1	<1	210	191	<0.00005	4.03	4.5	0.042			0.00021	
18/05/2014	2.4;2	3.31	3.73	1534	1520	4.3	140	73	1.7	2.9	7	<1	<1	<1	860	649	<0.0005	31.1	15	0.02			0.0015	
21/04/2015	2.4;2	3.47	3.49	901	896	8.9	122	14	0.4	0.5	1	<1	<1	<1	410	362	<0.00005	5.2	9.6	0.005			0.0003	
01/05/2016	2.4;2	3.29	3.18	1227	1300	11.7	107	41	0.6	2.1	1		<1		620	435	<0.0005	20.9	14	0.037			0.0008	
08/05/2017	2.4;2	3.25	3.33	1525	1490	13.3	230	25	0.4	1.4	1		<1		800	676	<0.0005	16.2	6	0.006			0.0006	
Stockpile C Underdrain - Saddle/Extension																								
17/06/2002	2.4;3		8.32	1.24		11.1	44	2.1	144	36	80	<1	68		54	118	<0.001	0.13	13	0.22	0.033	<0.001	<0.001	0.002
01/07/2002	2.4;3		9.39	1060		13.1	77	1.2	93	25	148	8	31		112	197	<0.001	1.1	17	0.43	0.078	<0.001	<0.001	0.004
09/08/2002	2.4;3		8.33	1420		18	52	0.9	158	41	159	<1	46	<1	90	133	<0.001	0.18	300	0.052	0.12	<0.001	<0.001	0.005
02/09/2002	2.4;3		10.89	1.9		8.4	148	3.5	253	69	59	29	<1	8	363	383	<0.001	0.61	250	0.052	0.1	<0.001	<0.001	0.004
30/06/2003	2.4;3		7.20	806		15.2	34	0.8	107	29	111	<1	39	<1	72	88	<0.001	0.24	9.4	0.12	0.03	<0.001	<0.001	0.002
08/07/2004	2.4;3		7.84		892		36	1.3	121	30	71	<1	71	<1	100	95	<0.001	0.3	23	0.096			<0.001	
14/06/2005	2.4;3	7.68	8.16	780	724	16.7	35	1.6	89	22	58	<1	107	<1	97	94	<0.001	0.24	10	0.11			<0.001	
31/10/2005	2.4;3	9.02	8.77	909	974	13.7	58	1.8	110	25	62	10	60	<1	80	152	<0.001	0.57	89	0.15			<0.001	
23/04/2006	2.4;3	7.77	7.92	1026	1200	3.6	87	10	121	27	39	<1	55	<1	230	258	<0.001	0.18	500	0.17			<0.001	
30/05/2007	2.4;3	7.73	7.92	1446	1480	17.3	126	14	138	35	30	<1	63	<1	360	372	<0.0001	0.022	2000	0.043			0.0006	
14/06/2008	2.4;3	9.51	7.69	1625	1430	12.7	121	8.7	139	36	32	<1	39	<1	340	338	<0.0001	0.12	937	0.041			0.0007	
20/05/2009	2.4;3	7.10	7.34	712.9	728	4	67	8.1	52	15	11	<1	48	<1	210	200	<0.0001	0.5	486	0.035			0.0003	
17/04/2010	2.4;3	6.02	6.89	1069	1190	2.6	119	12	92	25	22	<1	23	<1	350	346	0.00003	1.09	813	0.025			0.00018	
02/05/2011	2.4;3	6.33	6.98	667.5	626	4.7	63	8.2	40	11	16	<1	20	<1	180	191	<0.00005	0.35	88	0.018			0.00001	
01/05/2012	2.4;3	6.28	6.74	985	985	0.6	97	14	71	23	17	<1	10	<1	340	299	<0.00005	2.48	899	0.021			0.00014	
06/05/2013	2.4;3	7.62	7.59	999	1020	0.6	106	17	68	21	16	<1	35	<1	340	334	<0.00005	0.37	50	0.024			0.00005	
18/05/2014	2.4;3	5.43	5.46	872	852	20	94	18	42	16	14	<1	<1	<1	350	308	<0.00005	3.39	470	0.018			0.00013	
21/04/2015	2.4;3	7.51	7.58	741	730	7.6	74	11	44	15	8	<1	34	<1	240	230	<0.00005	0.41	88	0.015			<0.00001	
01/05/2016	2.4;3	6.57	7.12	479	501	4.4	53	9.2	20	9.1	9		30		170	170	<0.00005	0.67	99	0.01			0.00003	
08/05/2017	2.4;3	6.92	7.42	1151	1110	1.2	134	19	52	18	27		39		400	412	<0.00005	0.35	135	0.021			0.00003	
Stockpile C Underdrain - Expansion																								
02/05/2006	2.4;4	6.14	7.14	56	40	8.5	3.4	1.5	3.2	2.8	1.2	<1	13	<1	4.4	15	<0.001	4.1	0.4	0.053			<0.001	
01/05/2007	2.4;4	7.55	7.50	335	334	6.3	29	2.7	24	6.9	7	<1	34	<1	70	83	<0.0001	0.3	90	0.023			<0.0001	
13/05/2007	2.4;4	7.50	7.67	364	343	8.6	28	2.6	28	8	10	<1	43	<1	58	81	<0.001	0.048	109	0.026			<0.001	
07/07/2008	2.4;4	8.99	8.99	0.43	546	15.7	42	1.8	47	14	24	5	37	<1	120	112	<0.0001	0.33	68	0.055			0.0002	
08/05/2009	2.4;4	7.93	7.43	432.7	424	1.4	37	3.8	31	7.7	8	<1	34	<1	100	108	<0.0001	0.11	72	0.022			0.0001	
17/04/2010	2.4;4	11.96	10.99	1016	746	7.4	58	0.1	30	23	62	32	<1	26	21	145	<0.00001	0.17	3.6	0.51			<0.00001	
02/05/2011	2.4;4	11.01	10.31	523.6	431	9.6	25	0.4	23	17	26	32	<1	4	61	64	<0.00005	0.38	5.3	0.075			<0.00001	
01/05/2012	2.4;4	9.53	8.88	256	243	5.6	22	1	15	6.6	38	5	22	<1	7.7	59	<0.00005	0.22	2.2	0.055			0.00001	
06/05/2013	2.4;4	12.26	11.67	2567	2280	4.9	162	0.3	26	40	21	42	<1	137	58	405	0.00005	0.29	0.8	0.36			0.0001	
18/05/2014	2.4;4	11.62	11.71	1521	1180	11.6	91	<0.1	72	35	171	29	<1	29	42	227	<0.00005	1.77	8.4	0.17			0.00001	
21/04/2015	2.4;4	12.02	11.68	2345	2010	5.6	173	<0.1	42	27	16	41	<1	133	45	431	<0.00005	0.25	2.2	0.36			<0.00001	
01/05/2016	2.4;4	8.98	7.98	384	382	9.2	41	2.8	20	7.2	21		35		91	114	<0.00005	0.31	499	0.015			<0.00001	
08/05/2017	2.4;4	9.63	9.01	321	299	8.1	19	0.8	27	9.4	28		21		37	51	<0.00005	0.35	224	0.022			<0.00001	
Stockpile B/C Underdrain - Likely a composite of 2.4.1 & 2.4.2																								
05/04/1993	*2.4;4*		*10.81*	*139*		*1.3*	*9*	*<1*	*33*	*13*	*10*		*24*		*14*		*<0.001*	*1.4*	*53*	*0.04*			*0.011*	
12/04/1993	*2.4;4*			*182*		*4.7*	*14*	*4*	*37*	*14*	*13*		*39*		*24*		*<0.001*	*1.7*	*261*	*0.045*			*<0.001*	

Sample Date	Station	pH-F	pH-L	Cond-F	Cond-L	Temp-H_2O	Ca	Mg	Na	K	Cl	CO_3	HCO_3	OH	SO_4	Hardness	Ag	Al	As	Ba	B	Be	Cd	Co
				µS/cm	µS/cm		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L
06/07/1993	*2.4;4*		*8.50*	*774*		*16.1*	*58*	*1*	*131*	*23*	*44*		*89*		*294*									
09/07/1993	*2.4;4*		*11.52*	*656*		*9*	*43*	*<1*	*87*	*19*	*59*				*72*		*<0.001*	*6.8*	*31*	*0.34*			*<0.001*	
02/08/1993	*2.4;4*		*11.25*	*940*		*19.5*	*32*	*<1*	*126*	*36*	*50*				*147*		*<0.001*	*3.2*	*630*	*0.17*			*0.001*	
22/08/1993	*2.4;4*		*10.93*	*862*		*19.3*	*40*	*<1*	*132*	*32*	*48*				*223*		*<0.001*	*3.3*	*162*	*0.12*			*<0.001*	
06/09/1993	*2.4;4*		*9.10*	*250*		*11.2*	*63*	*1*	*137*	*26*	*36*		*84*		*355*		*<0.001*	*0.94*	*2.9*	*0.13*			*0.001*	
30/04/1994	*2.4;4*		*11.49*	*380*		*7.6*	*17*	*0.4*	*56*	*16*	*26*		*62*		*49*		*<0.001*	*4.9*	*1.4*	*0.022*			*0.003*	
29/05/1994	*2.4;4*		*11.32*	*565*		*11.7*	*9*	*<1*	*90*	*33*	*34*		*<1*		*77*		*<0.001*	*1.8*	*500*	*0.013*			*0.002*	
19/09/1994	*2.4;4*		*7.85*	*886*		*15.5*	*108*	*5*	*113*	*30*	*28*		*52*		*423*		*<0.002*	*0.53*	*36*	*0.24*			*<0.002*	
05/05/1995	*2.4;4*		*9.13*	*208*		*4.4*	*12*	*1*	*42*	*14*	*24*		*40*		*77*		*<0.001*	*2.3*	*2.8*	*2.3*			*0.009*	
27/07/1995	*2.4;4*		*11.81*	*776*		*11.5*							*<1*				*<0.001*						*0.009*	
09/08/1995	*2.4;4*		*11.02*	*549*		*12.2*	*36*	*<1*	*64*	*29*	*32*		*<1*		*181*		*<0.001*	*3.6*	*1.8*	*0.15*			*<0.001*	
04/09/1995	*2.4;4*		*10.05*	*195*		*13.2*																		
26/04/1998	*2.4;4*		*10.67*	*943*		*14*	*45*	*2.8*	*90*	*26*	*31*		*<1*		*91*		*<0.001*	*0.56*	*210*	*0.12*			*<0.001*	
10/06/2000	*2.4;4*		*10.70*	*804*		*15.5*	*11*	*0.2*	*98*	*42*	*48*	*22*	*<1*		*31*	*28*	*<0.001*	*1.3*	*10*	*0.28*	*0.05*	*<0.001*	*<0.001*	*<0.001*
24/05/2001	*2.4;4*						*34*	*4.1*	*56*	*19*	*24*	*<1*	*50*		*99*	*102*	*<0.001*	*0.78*	*110*	*0.19*	*0.16*	*<0.001*	*<0.001*	*0.023*
13/11/2003	*2.4;4*		*8.83*	*370*		*4.6*																		

Table 2 – Cr, Cu, F, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Sr, Ti, V, W, Zn, U, ^{226}Ra, ^{210}Pb, ^{210}Po, ^{230}Th, NH_3-N, and P-(TP)

Sample Date	Station	Cr	Cu	F	Fe	Hg	Mn	Mo	Ni	Pb	Sb	Se	Sr	Ti	V	W	Zn	U	^{226}Ra	^{210}Pb	^{210}Po	^{230}Th	NH_3-N	P-(TP)
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	Bq/L	Bq/L	Bq/L	Bq/L	mg/L	mg/L
Stockpile C Underdrain - Original Pad																								
31/05/1991	2.4;2																							
22/06/1991	2.4;2		0.03						0.01	0.01							0.03		0.04					
18/07/1991	2.4;2		0.02					14	0.04	0.01							0.06		0.06					
24/07/1991	2.4;2		0.02				0.02	15	0.03	0.01		0.01			0.01		0.01		0.11					
29/07/1991	2.4;2																		0.11					
07/08/1991	2.4;2																		0.13					
20/08/1991	2.4;2		0.01				0.01	8.1		0.01		0.01			0.02		0.01	3.6	0.1	0.02	0.01	0.03		
30/08/1991	2.4;2		0.03						0.01	0.01							0.01		0.12					
09/10/1991	2.4;2		0.03						0.001	0.01							0.01		0.16					
27/07/1995	2.4;2					<0.05				<0.005							0.018			<0.02		<0.01		
21/06/1996	2.4;2		0.01		0.084	<0.05	0.048	5.9	0.006	<0.002		0.008			<0.001		<0.005	2.6	0.06	<0.04	0.02	<0.02	0.43	
18/08/1996	2.4;2		0.012		0.22	<0.05	0.23	9.9	0.009	<0.002		0.01			<0.001		0.009	2.4	0.04	<0.02	0.03	<0.01	0.54	
09/10/1996	2.4;2		0.017		0.35	<0.05	0.09	12	0.011	0.01		0.024			<0.001		0.011	4.1	0.07	0.04	0.02	<0.02	1.4	
05/05/1997	2.4;2		0.011		0.41	<0.05	0.11	2.3	0.027	<0.002		0.006			0.005		0.37	3.9	0.04	0.04	0.04	0.02	0.38	
08/09/1997	2.4;2		0.011		0.12	<0.05	0.038	6.9	0.007	<0.002		0.039			<0.001		<0.005	2.7	0.06	<0.02	0.02	<0.01	0.14	
02/10/1997	2.4;2		0.002		0.19	<0.05	0.025	8.8	<0.001	<0.002		0.029			<0.001		<0.005	1.5	0.06	<0.02	0.01	<0.01	1.3	
09/11/1997	2.4;2		0.023		0.15	<0.05	0.45	9.8	0.011	<0.002		0.04			0.003		<0.005	1.5	0.05	<0.04	<0.01	<0.02	5.2	
26/04/1998	2.4;2		0.008		0.072	<0.05	0.025	1.6	0.009	<0.002		0.008			0.026		<0.005	3.6	0.04	0.03	<0.005	<0.01	4.9	
30/04/1998	2.4;2		0.005					1.7		<0.002							<0.005							
15/07/1998	2.4;2		0.008		0.087		0.037	3.6	0.006	<0.002		0.02			<0.001		<0.005	4.7	0.07	0.04	0.02	<0.02		
17/07/1998	2.4;2																							
17/08/1998	2.4;2		0.012		0.14	<0.05	0.013	5.6	0.012	<0.002		0.023			0.01		<0.005	2.2	0.05	<0.04	<0.01	<0.02		
20/05/1999	2.4;2		0.014		0.018	<0.05	0.022	3.1	0.004	<0.002		0.016			<0.001		0.011	11	0.03	<0.02	0.03	<0.01	6.5	
28/09/1999	2.4;2	0.008	0.009		0.048	0.12	0.046	4.7	0.007	<0.002		0.035		<0.001	0.007		<0.005	4.8	0.08	<0.02	<0.005	0.02	4.7	
15/05/2000	2.4;2	0.001	<0.001		0.048	<0.05	0.003	0.65	0.005	<0.002		0.011	0.74	<0.001	<0.001		0.01	41	0.07	<0.04	0.02	<0.02	0.67	0.02
15/07/2000	2.4;2																							
16/07/2000	2.4;2																							
04/06/2002	2.4;2	0.005	0.006		0.008	<0.05	<0.001	3.3	0.004	<0.002		0.02	1.5	<0.001	<0.001		<0.005	10	0.21	<0.04	0.04	<0.02	0.86	0.03
01/07/2002	2.4;2	0.004	0.006		0.054	<0.05	0.005	2	0.003	<0.002		0.018	1.1	0.004	<0.001		<0.005	10	0.06	<0.04	<0.01	<0.02	0.87	0.05
09/08/2002	2.4;2	0.007	0.016		0.15	<0.05	0.34	0.74	0.003	<0.002		0.024	1	0.004	0.002		<0.005	3.5	0.18	<0.04	0.03	<0.02	1.4	0.07
02/09/2002	2.4;2	0.005	0.022		0.34	<0.05	0.23	0.45	0.002	<0.002		0.014	0.93	0.014	<0.001		0.009	32	0.68	0.17	0.31	0.04	1.2	0.06
26/09/2002	2.4;2						0.12																	
30/06/2003	2.4;2	0.018	0.006		0.008	<0.05	<0.001	3.7	0.004	<0.002		0.03	2.2	<0.001	0.005		<0.005	1.2	0.19	0.06	0.01	<0.01	1.6	0.05
31/05/2004	2.4;2		0.007		0.54	<0.05	0.018	0.88	0.005	0.003		0.014			0.002		0.029	130	0.22	0.04	0.08	<0.02	0.31	
08/07/2004	2.4;2		0.004		0.016	<0.05	0.002	3.17	0.003	<0.002		0.03			0.018		0.044	2.7	0.23	0.08	0.02	<0.02	1.7	
14/06/2005	2.4;2		0.003		0.003	<0.05	<0.001	3.1	0.002	<0.002		0.027			0.006		<0.005	110	0.23	0.12	0.02	<0.01	0.65	
08/06/2006	2.4;2		0.013		1.32	<0.05	0.76	1.71	1.19	<0.002		0.039			0.001		0.45	95	0.04	<0.04	0.04	<0.02	0.08	
05/08/2007	2.4;2		1.37		1.9	<0.05	1.23	1.75	2.63	0.0018		0.063			0.0005		1.99	98	0.06	<0.04	0.02	0.05	<0.01	
19/05/2008	2.4;2		0.017		8.3	<0.05	0.24	0.039	0.42	0.006		0.007			0.001		0.11	18	<0.005	<0.04	<0.01	<0.02	0.23	
19/05/2009	2.4;2		0.0088		5.4	<0.05	0.1	0.0011	0.061	0.0073		0.001			0.012		0.034	3	0.07	0.14	0.05	0.05	0.15	
17/04/2010	2.4;2		0.0086		2.41	<0.02	0.12	0.0001	0.242	0.0013		0.0007			0.0009		0.029	6.6	0.02	0.08	0.06	<0.02	0.03	
02/05/2011	2.4;2		0.048		18.7	<0.02	0.37	0.019	0.97	0.002		0.004			<0.001		0.097	48	0.03	0.05	0.02	0.21	<0.01	
01/05/2012	2.4;2		0.083		21.7	<0.02	0.55	<0.001	1.51	0.002		0.003			<0.001		0.13	220	0.06	<0.04	<0.01	0.62	<5	

Sample Date	Station	Cr	Cu	F	Fe	Hg	Mn	Mo	Ni	Pb	Sb	Se	Sr	Ti	V	W	Zn	U	^{226}Ra	^{210}Pb	^{210}Po	^{230}Th	NH_3-N	P-(TP)
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	Bq/L	Bq/L	Bq/L	Bq/L	mg/L	mg/L
06/05/2013	2.4;2		0.028		4.01	<0.02	0.23	0.0011	0.452	0.0014		0.0014			0.0006		0.079	61	0.05	<0.02	0.02	0.05	<0.01	
18/05/2014	2.4;2		0.12		18.5	<0.02	1.1	0.002	3.26	0.002		0.003			<0.001		0.28	350	0.05	<0.02	<0.005	0.58	<0.01	
21/04/2015	2.4;2		0.033		7.3	<0.02	0.16	0.0008	0.534	0.0004		0.0014			0.0004		0.052	109	0.01	<0.04	0.01	0.12	<0.01	
01/05/2016	2.4;2		0.11		21.7	<0.02	0.69	<0.001	1.81	0.002		0.003			<0.001		0.27	280	0.08	0.09	0.03	0.5	<0.01	
08/05/2017	2.4;2		0.093		9.2	7	0.41	0.003	1.33	<0.001		0.002			<0.001		0.13	410	0.04	<0.04	0.01	0.55	<0.01	
Stockpile C Underdrain - Saddle/Extension																								
17/06/2002	2.4;3	<0.001	0.008		0.023	<0.05	0.28	0.38	<0.001	<0.002		0.01	0.73	<0.001	<0.001		<0.005	20	0.23	<0.04	0.05	<0.02	10	0.12
01/07/2002	2.4;3	0.012	0.051		0.58	<0.05	0.1	0.44	0.006	0.004		0.01	0.98	0.023	0.004		0.009	58	1.1	0.4	0.51	0.06	1.3	0.05
09/08/2002	2.4;3	0.011	0.005		0.01	<0.05	<0.001	4	0.004	<0.002		0.029	2.3	<0.001	0.01		<0.005	15	0.4	<0.04	<0.01	<0.02	3.2	0.05
02/09/2002	2.4;3	0.008	0.007		0.025	<0.05	0.002	3.8	0.004	<0.002		0.036	1.8	<0.001	<0.001		<0.005	0.7	0.14	<0.04	0.02	<0.01	1.9	0.06
30/06/2003	2.4;3	0.006	0.01		0.1	<0.05	0.16	0.47	0.001	<0.002		0.026	0.58	0.004	<0.001		<0.005	12	0.07	<0.02	0.06	<0.01	1	0.04
08/07/2004	2.4;3		0.018		0.045	<0.05	0.024	0.56	0.002	<0.002		0.042			0.006		<0.005	32	0.16	<0.04	0.05	<0.02	0.06	
14/06/2005	2.4;3		0.011		0.11	<0.05	0.12	0.4	0.001	<0.002		0.018			0.003		<0.005	49	0.14	0.08	0.05	<0.01	1	
31/10/2005	2.4;3	0.006	0.025		0.31		0.11	0.65	0.003	<0.002		0.015			<0.001		<0.005	23	0.19					
23/04/2006	2.4;3		0.008		0.23	<0.05	0.16	1.01	0.009	<0.002		0.018			<0.001		<0.005	63	0.21	<0.02	0.07	0.04	4.6	
30/05/2007	2.4;3		0.0012		0.012	<0.05	0.0055	1.99	0.048	0.0013		0.024			0.0038		0.0019	48	0.15	0.03	0.02	0.01	<0.01	
14/06/2008	2.4;3		0.0088		0.084	<0.05	0.026	1.55	0.016	0.0005		0.028			0.0063		0.0033	22	0.11	<0.02	0.02	0.01	0.87	
20/05/2009	2.4;3		0.0098		2.28	0.1	0.23	0.481	0.861	0.0021		0.01			0.0061		0.12	38	0.09	0.06	0.07	0.04	0.78	
17/04/2010	2.4;3		0.018		3.85	<0.02	0.15	0.974	0.706	0.0026		0.02			0.003		0.13	47	0.14	<0.04	0.04	0.1	<0.01	
02/05/2011	2.4;3		0.0059		1.04	<0.02	0.054	0.328	0.113	0.0004		0.011			0.0007		0.025	17	0.07	<0.02	0.02	<0.01	<0.01	
01/05/2012	2.4;3		0.015		5.9	0.03	0.12	0.54	0.492	0.0012		0.013			0.0026		0.093	67	0.07	<0.04	0.03	0.36	<2	
06/05/2013	2.4;3		0.002		0.24	<0.02	0.032	0.608	0.057	0.0009		0.014			0.0011		0.019	50	0.05	0.03	0.03	<0.01	0.03	
18/05/2014	2.4;3		0.014		5.9	<0.02	0.1	0.293	0.422	0.0008		0.009			0.0019		0.074	66	0.05	<0.02	0.02	0.18	<0.01	
21/04/2015	2.4;3		0.0015		0.21	<0.02	0.029	0.407	0.024	0.0007		0.0091			0.0016		0.0062	32	0.05	<0.04	0.03	<0.02	0.08	
01/05/2016	2.4;3		0.0031		0.33	<0.02	0.033	0.086	0.096	0.0005		0.0033			0.0007		0.012	27	0.03	<0.04	0.03	<0.02	<0.01	
08/05/2017	2.4;3		0.0026		0.35	7	0.1	0.278	0.098	0.0005		0.012			0.0011		0.012	38	0.07	<0.04	0.04	<0.02	<0.01	
Stockpile C Underdrain - Expansion																								
02/05/2006	2.4;4		0.045		2.47	<0.05	0.07	0.003	0.007	0.007		<0.0001			0.005		0.043	0.1	0.03	<0.04	0.02	0.02	0.16	
01/05/2007	2.4;4		0.0015		0.26	<0.05	0.021	0.166	0.0087	0.0007		0.0039			0.0015		0.036	7.4	0.02	<0.02	0.009	0.01	0.25	
13/05/2007	2.4;4		0.001		0.025	<0.05	0.001	0.19	<0.001	0.002		0.0042			<0.001		<0.005	8	0.005	<0.02	0.007	<0.01	0.23	
07/07/2008	2.4;4		0.0017		0.028	<0.05	0.0033	0.45	0.0015	0.0006		0.0091			0.0046		0.0052	3.3	0.02	<0.04	0.01	<0.02	0.1	
08/05/2009	2.4;4		0.001		0.043	<0.05	0.016	0.28	0.0049	0.0006		0.0058			0.001		0.0033	21	0.04	<0.04	0.02	<0.02	0.17	
17/04/2010	2.4;4		0.0062		0.0093	<0.02	0.0012	0.081	0.0025	0.0002		0.0024			0.001		<0.0005	<0.1	0.03	<0.04	<0.01	<0.02	0.25	
02/05/2011	2.4;4		0.0075		0.073	<0.02	0.0027	0.04	0.0034	0.0003		0.0013			0.0043		0.0007	0.2	<0.005	<0.02	0.02	<0.01	0.43	
01/05/2012	2.4;4		0.001		0.063	<0.02	0.0025	0.011	0.0004	0.0004		0.0003			0.0011		0.013	0.4	0.02	<0.04	<0.01	<0.02	1.2	
06/05/2013	2.4;4		0.013		0.076	<0.02	0.0015	0.015	0.0007	0.0007		0.0003			0.0008		0.0008	0.1	0.05	<0.02	0.01	<0.01	0.82	
18/05/2014	2.4;4		0.0037		0.058	<0.02	0.0007	0.293	0.0006	0.0003		0.0011			0.0044		<0.0005	0.2	0.09	<0.02	<0.005	<0.01	2.3	
21/04/2015	2.4;4		0.0022		0.006	<0.02	<0.0005	0.088	0.0003	0.0001		0.0009			0.0015		<0.0005	<0.1	0.09	<0.04	<0.01	<0.02	0.34	
01/05/2016	2.4;4		0.0021		0.11	<0.02	0.0039	0.131	0.017	0.001		0.0012			0.0032		0.0015	9.5	0.02	<0.04	0.01	<0.02	0.5	
08/05/2017	2.4;4		0.0058		0.081	7	0.0019	0.132	0.0077	0.0008		0.0012			0.0049		0.0011	2.5	0.02	<0.04	0.02	<0.02	0.97	
Stockpile B/C Underdrain - Likely a composite of 2.4.1 & 2.4.2																								
05/04/1993	*2.4;4*		*0.01*		*0.23*	*<0.05*	*0.022*	*0.65*	*<0.001*	*<0.005*		*0.003*			*0.01*		*0.006*	*1.3*	*0.02*	*<0.04*	*0.03*	*0.09*	*0.2*	
12/04/1993	*2.4;4*		*0.021*		*0.097*	*0.09*	*0.008*	*0.87*	*0.015*	*0.007*		*0.002*			*<0.01*		*0.006*	*0.9*	*0.03*	*<0.04*	*0.02*	*0.02*	*0.3*	
06/07/1993	*2.4;4*																							
09/07/1993	*2.4;4*		*0.046*		*0.1*	*<0.05*	*0.003*	*1*	*0.008*	*<0.005*		*0.002*			*0.04*		*<0.005*	*4.5*	*1.8*	*0.55*	*0.08*	*0.03*		

Sample Date	Station	Cr	Cu	F	Fe	Hg	Mn	Mo	Ni	Pb	Sb	Se	Sr	Ti	V	W	Zn	U	^{226}Ra	^{210}Pb	^{210}Po	^{230}Th	NH_3-N	P-(TP)
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	Bq/L	Bq/L	Bq/L	Bq/L	mg/L	mg/L
02/08/1993	*2.4;4*		*0.02*		*0.1*	*<0.05*	*0.013*	*7*	*0.008*	*<0.005*		*0.008*			*0.01*		*<0.005*	*0.9*	*0.09*	*<0.04*	*<0.01*	*<0.02*		
22/08/1993	*2.4;4*		*0.022*		*0.13*	*<0.05*	*0.064*	*6.2*	*0.007*	*<0.005*		*0.01*			*0.01*		*0.018*	*1.7*	*0.07*	*<0.04*	*0.02*	*0.04*	*3.7*	
06/09/1993	*2.4;4*		*0.014*		*0.1*	*<0.005*	*0.061*	*9.9*	*0.014*	*<0.005*		*0.021*			*0.03*		*0.019*	*10*	*0.11*	*<0.04*	*0.08*	*<0.02*		
30/04/1994	*2.4;4*		*0.001*		*0.72*	*<0.05*	*0.034*	*3.6*	*0.032*	*<0.005*		*0.002*			*0.02*		*<0.005*	*6*	*0.09*	*0.08*	*0.04*	*0.03*	*0.3*	
29/05/1994	*2.4;4*		*0.012*		*0.044*	*<0.05*	*0.018*	*4.9*	*0.01*	*<0.005*		*<0.001*			*0.01*		*<0.005*	*0.9*	*0.05*	*<0.04*	*<0.01*	*<0.02*	*0.19*	
19/09/1994	*2.4;4*		*0.01*		*0.026*	*<0.05*	*0.18*	*3.7*	*0.006*	*<0.008*		*0.019*			*<0.02*		*0.017*	*7.6*	*0.07*	*0.06*	*0.06*	*<0.02*	*1.1*	
05/05/1995	*2.4;4*		*0.005*		*1.2*	*<0.05*	*0.062*	*3.1*	*0.026*	*<0.005*		*0.006*			*0.01*		*0.009*	*5.3*	*0.1*	*0.13*	*0.12*	*0.07*	*0.05*	
27/07/1995	*2.4;4*					*<0.05*	*0.11*		*0.011*	*<0.005*					*0.01*		*0.018*			*0.03*	*0.01*	*<0.01*		
09/08/1995	*2.4;4*		*0.01*		*0.3*	*<0.05*	*0.13*	*4.5*	*0.045*	*<0.005*		*0.005*			*0.02*		*0.019*	*6.6*		*0.07*	*0.04*	*0.04*	*0.4*	
04/09/1995	*2.4;4*																		*0.134*					
26/04/1998	*2.4;4*		*0.01*		*0.052*	*<0.05*	*0.009*	*1.2*	*0.005*	*<0.002*		*0.007*			*0.005*		*<0.005*	*5.4*	*0.05*	*0.08*	*0.008*	*<0.01*	*3.3*	
10/06/2000	*2.4;4*	*0.009*	*0.011*		*0.18*	*<0.05*	*0.002*	*0.28*	*0.001*	*<0.002*		*0.003*	*0.66*	*0.004*	*0.005*		*<0.005*	*1.1*	*0.86*	*0.03*	*0.02*	*0.01*	*2*	*0.08*
24/05/2001	*2.4;4*	*0.005*	*0.009*		*0.31*	*<0.05*	*0.028*	*0.39*	*0.024*	*<0.002*		*0.01*	*0.44*	*0.006*	*0.004*		*0.01*	*45*	*0.35*	*0.09*	*0.06*	*0.04*	*0.5*	*0.04*
13/11/2003	*2.4;4*																							

Appendix AIII: Waste Rock Characterization and Source Term Development McClean, Caribou, and Sue D Underground Projects

WASTE ROCK CHARACTERIZATION AND SOURCE TERM DEVELOPMENT FOR THE McCLEAN, CARIBOU, AND SUE D UNDERGROUND PROJECTS

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WASTE ROCK CHARACTERIZATION AND SOURCE TERM DEVELOPMENT FOR THE McCLEAN, CARIBOU, AND SUE D UNDERGROUND PROJECTS

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EXECUTIVE SUMMARY

AREVA Resources Canada (AREVA) is completing environmental investigations to support mining of the McClean, Caribou, and Sue D uranium deposits that will supply feed to the McClean mill in Northern Saskatchewan.

Several previous assessments and characterization studies of other uranium deposits in the southeast region of the Athabasca basin have shown that some of the mine rock, locally referred to as special waste rock, can be a source of acid and metals release as a result of sulphide mineral oxidation if the rock is stored on land. The definition of "clean waste rock" for uranium deposits in Northern Saskatchewan (e.g. Caribou, Sue E, Midwest) has been primarily based on uranium and arsenic contents with cut-off values of 250 mg/kg (ppm) and 75 mg/kg (ppm), respectively, while "special waste rock" consisted of mine rock with uranium and arsenic contents above these values.

An investigation was initiated to characterize the mine rock materials from the proposed McClean Underground mine to assess the leaching behaviour and compare the results with those from other uranium deposits in Northern Saskatchewan. A total of 68 samples from three deposits (McClean, Caribou, and Sue D) and the access ramp areas of the McClean and Caribou deposits (Background) were included in the characterization studies. Background samples represent waste rock in the vicinity of the ramp accesses. The material was also investigated to ensure that water quality from potential construction material and on-land stockpiles will not represent a risk to water quality. The mine rock characterization study involved the selection and testing of representative materials from existing drill core samples. The testing was conducted in the laboratory and involved chemical analyses of the rock, including metal content analysis, acid base accounting (ABA), sequential leach tests, and humidity cell testing (HCT). Humidity cell tests were initiated to assess the leaching properties of the mine rock materials for scenarios of use in construction and above ground stockpile storage, using composite samples created from mine rock from the three deposits and the Background samples.

Arsenic, cobalt, nickel, sulphur, and uranium contents demonstrated substantial variations between ore deposits, while copper, lead, zinc, and molybdenum contents were relatively similar between ore deposits. In general, nickel and molybdenum contents increase with increasing arsenic content. Weak correlations between uranium and arsenic exist for the McClean deposit samples, but not for other ore bodies. Weak correlations between uranium and total sulphur are evident for the Caribou samples. Total contents of antimony, cobalt, molybdenum, nickel, and selenium were elevated above screening levels, predominantly amongst Background and Caribou samples.

Sulphur occurs mainly as sulphide-sulphur amongst all 68 samples, with total sulphur values varying between 0.05 and 5.4 %S, with a median of 0.027 %S. Sulphide-sulphur values varied from below the detection limit of 0.01 %S to 5.2 %S, with a median value of

0.020 %S. The acid potential (AP) values for all samples, calculated from the sulphide-sulphur values, varied from below detection (0.31 kg $CaCO_3$/t) to 164 kg $CaCO_3$/t, with a median of 0.62 kg $CaCO_3$/t. The measured Sobek neutralization potential (Sobek-NP) values ranged from below detection limits (0.05 kg $CaCO_3$/t) to 78 kg $CaCO_3$/t, with a median of 3.4 kg $CaCO_3$/t. Typically, Carbonate NP (Carb-NP) values were lower than the Sobek-NP values, ranging from 0.27 to 213 kg $CaCO_3$/t with a median value of 0.83 kg $CaCO_3$/t. A majority of the samples have Sobek-NP values that are larger than their corresponding Carb-NP values, suggesting that there is NP from non-carbonate sources that may not be available for acid neutralization. The Carb-NP is considered to represent the effective NP in the samples and is a more conservative indicator for classification of potentially acid generating (PAG) materials.

The NP/AP ratios (or NPR) were assessed to classify mine rock as PAG or non-PAG. All rock types were characterized by carbonate NPR (Carb-NPR) values between 1.0 and 2.0, with a median of 1.6 and an average of 9.2. Similarly, all samples had median Sobek-NPR values above 2.0, with median and average values of 4.9 and 5.4, respectively. Mine rock is classified as non-PAG if its Carb-NPR is greater than 2. Therefore, in order to classify the rock as PAG or non-PAG during mining, the sulphur and inorganic carbon would need to be measured and the appropriate carbon to sulphur ratio would need to be met to have a Carb-NPR value of 2 or greater. The rock can then be segregated based on the carbon:sulphur ratios if appropriate for rock management objectives and if practical.

Sequential leaching tests were completed on the drill core samples to evaluate inventories and availability of various metals in the solids related to underwater storage. A total of 40 samples, representing a range of uranium and arsenic contents, were tested. The results were consistent with those for mine rock from other uranium deposits in the eastern Athabasca Basin. The results suggest that even though significant fractions of leaching can occur, the median water-leachable and total leachable arsenic for both sandstone and basement rock are less than 10 % of the total arsenic content. Little difference was observed between the results from the leachability of sandstone and basement rock samples. The leach test results for the McClean, Caribou, and Sue D samples were well correlated with results from previous mine rock investigations within the Athabasca uranium deposit area. The results suggest that the leaching behaviour of the McClean Lake special waste rock should be similar to that observed for other uranium deposits in the McClean Lake region, such as Sue E and Midwest, after in-pit disposal and flooding. Source terms for pore water arsenic concentrations in the flooded special waste rock material can therefore be represented by source terms previously developed for those deposits.

The HCTs that were in progress at the publication date of this report focused on the on-land storage of mine rock to evaluate the leaching rates and constituent loadings of the potential mine rock material. The preliminary HCT results were evaluated to estimate loading rates for constituents of potential concern (COPC), which can be used in water quality predictions for the Project. Testing was completed on three composite samples with different uranium

and arsenic contents (HIGH, MID, LOW). The loading rates for most COPC were elevated during the initial 10 weeks, but declined to lower, constant, values after week 10. The higher initial rates represent an initial flushing of the crushed mine rock samples and the lower values at later time represent a more constant rate of release associated with ongoing weathering processes. Additionally, most COPC had relatively higher loading rates associated with the HIGH composite sample. The observed relationships of higher rates with increasing arsenic contents are consistent for many COPCs and suggest that lower arsenic contents will results in lower loading rates for several COPCs.

Field adjusted COPC loading rates were calculated from the laboratory rates by accounting for known differences between storage temperature and grain-size distribution between the two settings. The mass loading rates were then determined for the McClean, Caribou, and Sue D mine rock samples using the field adjusted rates and the estimated quantity of mine rock to be stockpiled. Further estimates of stockpile water quality will be determined from these results at a future date.

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1.0 INTRODUCTION

AREVA Resources Canada (AREVA) is completing environmental investigations to support underground mining of the McClean, Caribou, and Sue D deposits that will supply feed to the McClean mill in Northern Saskatchewan. Underground mining at McClean Lake was approved in the 1991 McClean Lake Environmental Assessment. However, development of the project was postponed until favourable uranium market conditions were realized. Recently, the underground mining plan has been expanded to include the mining of the Caribou and Sue D deposits. EcoMetrix Incorporated (EcoMetrix) was retained by AREVA to evaluate the waste rock (herein referred to as mine rock) that will potentially be associated with mine development and operation of these deposits.

The definition of "clean waste rock" mine rock for uranium deposits in Northern Saskatchewan (e.g. Caribou, Sue E, Midwest) has been primarily based on uranium and arsenic contents with cut-off values of 250 mg/kg (ppm) and 75 mg/kg (ppm), respectively, while "special waste rock" consists of mine rock above these values. The estimated quantities of mine rock to be generated are provided in **Table 1.1**. The waste rock will be predominantly basement rock, particularly for the Mine Development waste (waste rock from the ramp accesses). Geochemical evaluation of the potential basement rock material was required and is the focus of this report.

The McClean, Caribou, and Sue D deposits are located in the McClean Lake area (**Figure 1.1**) and represent uranium anomalies associated with the geologic contact and unconformity between the Athabasca sandstone and the basement rocks. The deposit appears to be geochemically consistent with other uranium ore zones in the area, but may have increased mineralization zones surrounding the ore. The mineralized zones have developed as a result of fluid interaction and various degrees of geochemical alteration have occurred. The alteration zones are generally characterized by the presence of sulphide and arsenide minerals that can affect the quality of water associated with disposal of mine rock that is removed during mining. Identification and characterization of the mineralized rock is required to develop appropriate management strategies for environmental protection.

Several previous assessments and characterization studies of other uranium deposits in the southeast region of the Athabasca basin have shown that some of the mine rock can be a source of acid and metals release as a result of sulphide mineral oxidation if the rock is deposited on land. However, studies have also shown that the same rock can be a source of elevated arsenic concentrations when deposited underwater, a mitigation measure intended to minimize sulphide mineral oxidation. The effects and implications of arsenic leaching from mineralized mine rock associated with several deposits, including JEB, Cigar Lake, Midwest, Caribou, Sue A, Sue B, Sue C, and Sue E have been evaluated through several studies (Cogema and CLMC, 2001). Previous studies identified a relationship between the soluble arsenic that can dissolve in pore water and the arsenic content of the

solids when the mine rock is flooded. A relationship between the arsenic content of the rock and the steady-state concentration of arsenic in the pore water was also demonstrated.

Geochemical data on solids contents of mine rock samples were available for the McClean and Sue D deposits based on core analysis and limited ABA testing. However, leach testing had not yet been completed for materials from these deposits. A mine rock characterization study was completed in 2008 (EcoMetrix, 2008) for the Caribou deposit for an open-pit mining scenario. However, those investigations focused on sandstone rock material above the zones of mineralization. Access to the uranium deposits for the proposed underground mining is planned through a common access ramp located at the bottom of the mined-out Sue B pit and a 2 km decline that would connect to each deposit underground. Development of the access ramp would be primarily through basement rock. The development rock excavated from the access ramps classified as meeting clean waste rock criteria will be permanently stockpiled on surface. As the majority of clean waste rock testing for the McClean Lake Operation has been limited to sandstone, further study was required to assess the impact of stockpiling clean basement waste rock on surface. Other mine rock, from the ramp development and from immediately around the ore bodies, classified as special waste rock is planned to be stored in the Sue C/A pit together with special waste rock from other local deposits.

An investigation was initiated to characterize the mine rock materials from the proposed McClean, Caribou, and Sue D deposits and their access ramps to assess the leaching behaviour and to compare the results with those from other uranium deposits in Northern Saskatchewan.

1.1 Background

Mine rock characterization studies for deposits in the McClean Lake region were initiated in the late 1980s (COGEMA, 1999). The initial results showed that some of the mineralized rock contained elevated levels of sulphide sulphur, and could generate acid and leach metals when exposed to air and moisture in on-land stockpiles. Because of the concern for acid generation, it was decided by regulators and operators that all potentially reactive mine rock, classified as special waste rock, should be stored underwater, typically in mined-out pits. At the McClean Lake site, this involved backfilling of mined-out pits with special waste rock where natural inflow of water would fill the pits and eventually cover the potentially reactive rock and prevent oxidation reactions.

The mine rock characterization studies in the late 1980s and early 1990s identified potential leaching of some constituents of potential concern (COPC), such as arsenic, if the special waste rock was deposited underwater. Several test programs were established in the early 1990s to assess the leaching characteristics of special waste rock in submerged repositories (COGEMA, 1999). The work on arsenic leaching was conducted in the laboratory on columns with resident water volumes of approximately 2 L. The columns were sampled every two

weeks by removing the entire water volume and replacing it with fresh water. In later studies (BEAK, 2002), it was discovered that the two week residence time was not sufficient to allow arsenic concentrations in the pore water to attain "equilibrium" levels that would likely develop for the in-pit disposal scenario where residence times for pore water were on the order of several years. Test protocols since the late 1990s have; therefore, included an assessment of arsenic leaching in column tests with residence times of months, in order to better estimate source-term concentrations. In addition, test protocols have been established to evaluate the amount of water-leachable arsenic, in order to provide a source-term function that can be applied to the assessment of in-pit storage of special waste rock and the potential downstream impacts in the overall environmental assessment of special waste rock containment over the long term. This document presents the assessment of the potential mine rock from the McClean, Caribou, and Sue D deposits using the updated protocols presented by Cogema and CLMC (2001) and BEAK (2002) for arsenic leaching tests. The updated protocols have been used for other uranium mine rock investigations ,including Cigar Lake, Midwest, Sue E, and Caribou mine rock (Cogema and CLMC, 2001; Cogema, 2004; AREVA, 2007; EcoMetrix, 2008).

1.2 Objectives and Scope

The overall goal of the mine rock characterization program was to optimize long-term management options so as to minimize environmental effects. The specific objectives of this study were to:

- Provide a geochemical evaluation of the potential mine rock in support of the development of source-term functions, and

- Provide an assessment of criteria that could be used to define mine rock as clean waste rock that can be safely deposited in above-ground waste rock stockpiles, and special waste rock that will be deposited for sub-aqueous storage in the Sue C/A pit.

The mine rock characterization study was conducted in the laboratory and involved chemical analysis of the rock, including metals analysis, acid base accounting (ABA), customized leach tests, and humidity cell testing, which were used to assess arsenic leaching and associated water quality.

The test program protocols, as well as the interpretation of the results, are founded on a large body of cumulative information that has been collected over more than 15 years. For this reason, the mine rock characterization study was focused on the key issues that have been recognized for mine rock from other similar deposits in the McClean Lake area and Athabasca region of Northern Saskatchewan.

2.0 GEOLOGY

The McClean Lake area ore deposits are located within the eastern margin of the Athabasca basin. The regional geology of the area consists of crystalline basement rock overlain by sandstone. The uranium ore bodies in this region are generally spatially associated with unconformities between the sandstone basins and underlying metamorphic basement rock. In general, uranium mineralization consists of uranium oxide (pitchblende and uraninite; UO_2) and uranium silicate (coffinite; $U(SiO_4)_{1-x}(OH)_{4x}$) with variable amounts of nickel, cobalt and arsenic. Associated nickel and arsenic minerals typically include rammelsbergite ($NiAs_2$), gersdorffite (NiAsS), and niccolite (NiAs).

The following geological description (Section 2.1) is adapted from Section 4.2.1 of AREVA (2008).

2.1 Regional Geology

Steeply dipping crystalline basement rock overlain by approximately 200 m of flat to gently dipping sandstone and conglomeratic sandstone of the Athabasca group comprise the bedrock stratigraphic column typical of the area. The basement rock surface is weathered and eroded, forming an unconformable contact with the overlying sandstone. The sandstone of the area is covered by surficial deposits, which were laid down during recent glacial episodes and consist mainly of unconsolidated glacial till.

2.1.1 Basement Rock

The regional assessment boundary straddles a litho-structural boundary between the Wollaston Domain to the east and the Mudjatik Domain to the west. These domains are the result of the Hudsonian Orogeny. During this thermo-tectonic period, Archean rocks were remobilized, in-folding the overlying Aphebian age rocks. Archean aged rocks underlie approximately one half of the area. Geophysical and core data suggest that Archean age rocks form circular to elongate antiformal granitic dome structures. The domes consist of rocks ranging from massive granitoids in the core, to foliated gneissic rocks and migmatites at the margins (Tourigny et al. 2001). Aphebian aged paragneissic rocks of the Wollaston Domain cover these Archean rocks.

The Wollaston Group is comprised of metasedimentary rocks of metarkose, quartzite, pelite, graphitic gneiss, calcsilicate gneiss, and minor marble (Sibald 1983). The lowermost succession of paragneiss cover contains one to several graphitic units.

Following the Hudsonian Orogeny, the area was eroded to a gently undulating surface. The basement units at or below the exposed surface were extensively altered producing a weathered soil profile. This regolith is typically 20 m to 40 m thick but may be more extensively developed in areas of intense fracturing or may be thinner where the basement

floor had strong relief. This unit persists throughout the basin and many of the known uranium deposits occur near this boundary.

2.1.2 Athabasca Group Sandstone

The sandstone in the eastern portion of the Athabasca Basin belongs to the Athabasca Group Manitou Falls Formation (MF) and consists of four members. The MFb member is characterized by thick conglomerates (clasts > 2 cm), which are interbedded with fine to coarse sandstones, pebbly sandstones, and minor mudstones. The pebbles are predominately coarse crystalline quartz (Jefferson et al. 2001). In areas where the MFa member is present, the MFb member overlies the MFa member unconformably (Long, 2001). The MFb strata are interpreted to have been deposited by a broad alluvial plain with semi-ephemeral to perennial braided rivers. The conglomerates are interpreted to represent the main channel deposits; the fine-grained beds as being deposited in channel fills, and pebbly sandstone being interfluvial flood plain deposits.

The MFc member consists of interbedded pebbly sandstones and sandstones with minor mudstones. This unit is lacking in conglomerate beds (< 2%) (Ramaekers 1990). The upper part of this member has been eroded near the Athabasca basin margin and sandstones resembling MFc strata may be conglomerate-poor sections belonging to the MFb member. MFb strata grades transitionally upwards and laterally into MFc and the upper contact is arbitrarily placed at the top of the last series of 2 cm thick conglomerate beds (Yeo et al. 2002).

The MFd member is characterized by a sharp upward increase in intraclast abundance as well as small, but abrupt, decreases in grain size. This member is not present in the regional assessment boundary.

2.1.3 Quaternary

The regional surficial geology is dominated by glacial deposits resulting from several advances and retreats of the Continental glaciers of the Quaternary period. The most extensive deposits in the area are till material that were deposited as a result of lodgement and basal melt-out deposition beneath the last major ice movement from the Keewatin ice centre northwest of Hudson Bay, or during minor re-advancements and retreats of the ice flow (COGEMA 1997).

Drumlins, flutings, and striations indicated the ice movement occurred from the north to northeast, with the dominant ice flow direction in a NE-SW and NNE-SSW direction (Campbell et al. 2002). During the final retreat of the ice sheet, melt water deposited sand and gravel associated with kames and outwash plains. In general, the area has been ice free for at least 8,300 years and since that time only minor changes in the surficial geology have occurred.

Till deposits frequently occur as drumlins, which exceed 10 m to 15 m in height. Drumlins may occur in isolation or in drumlin fields where they can be found in a series of parallel features.

In the regional assessment boundary, other areas of positive relief include fluvio-glacial deposits, such as eskers. The deposits generally trend north to south, or northeast to southwest, and are generally composed of well to poorly sorted coarse sand and intermixed gravels. Surface topography, in such areas, is commonly hummocky and well drained.

Low-lying areas are also common and often occur as muskeg areas, where thin deposits of till and silty, gravelly sand are often overlain by a layer of organic material generally less than 10 cm thick. The muskeg is mainly fibrous wet organic material with a coarse surficial mat.

Post glacial deposits of lacustrine and alluvial deposits are found throughout the area and are predominantly fine-grained sands and silts with a high organic content.

Along the edges of lakes and muskeg areas, the tills thin out and boulder fields may occasionally be found. These fields are level to gently sloping and are generally covered by flat angular blocks of sandstone. These deposits are likely the result of frost heave of the upper jointed portion of the sandstone bedrock in areas of thin glacial cover (COGEMA 1995).

3.0 METHODS

An investigation was initiated to characterize the mine rock materials from the proposed McClean, Caribou, and Sue D deposits and the mine rock material in the vicinity of their access ramps to assess the leaching behaviour and compare the results with those from other uranium deposits in Northern Saskatchewan. The material was also investigated to ensure that water quality from potential construction material and on-land stockpiles will not represent a risk to water quality.

The mine rock characterization study involved the selection and testing of representative materials from existing drill core samples. The testing was conducted in the laboratory and involved chemical analyses of the rock, including metal content analysis, ABA testing, sequential leach testing, and humidity cell testing. The customized leach tests included shake flask testing and modified-special waste rock extraction procedure (SWEP) tests of the mine rock material, to evaluate inventories of soluble constituents. Humidity cell tests were initiated to assess the leaching properties of the mine rock materials for scenarios of use in construction and above ground stockpile storage.

3.1 Sample Selection

Over 11,700 drill core samples from the vicinity of the proposed ramp and within 50 m of the McClean deposits ore bodies were submitted by AREVA for laboratory analysis, as part of the exploration programs for the McClean deposits project. Of these, 471 samples were from boreholes drilled after 2001. The geochemical data of the post-2001 samples were evaluated by EcoMetrix to assist with sample selection and waste characterization.

Based on preliminary characterization during exploration, samples were selected to provide a range of locations, depths, and arsenic and uranium contents, with a focus on samples from the basement rock material. Sandstone samples were also selected to serve as the basis for comparison to historical sample characterization. Samples were collected by AREVA from the core racks at the McClean site. A list of the selected samples is provided in **Table 3.1**. Samples were collected from locations across the ore deposits including; 23 from the vicinity of the McClean deposit, nine from the Caribou deposit, eight from around the Sue D deposit, and 28 samples from the vicinity of the McClean and Caribou access ramp areas (herein referred to as Background mine rock). Of these, 54 samples were shipped to EcoMetrix for evaluation. The remaining 14 samples were submitted to the Saskatchewan Research Council (SRC), a radioactive licensed facility, in Saskatoon, SK, for assessment using EcoMetrix procedures and protocols, due to elevated gamma radiation levels.

Composite samples were prepared from the drill core fragments for kinetic tests (**Table 3.2**). Because the mine rock stockpile will be comprised of rock from all of the deposits, composites did not differentiate between deposits. Comparison of mine rock from each deposit, as discussed in Section 4 below, indicated that the potential clean waste rock from each area

was similar in nature, with the possible exception of the Background material. This mine rock exhibited higher metal concentrations in solids, in comparison to rock from the McClean, Caribou, and Sue D deposits. Composites were intended to be representative of low (LOW), medium (MID), and high (HIGH) arsenic and uranium contents, relative to overall metal concentration ranges, as shown in **Table 3.2**. However, analysis of the composite samples revealed that uranium and arsenic content ranges were not entirely representative of the contents reported for individual samples in each composite. Regardless, the conclusions of the overall program remain valid. The results of the composite sample analyses are discussed further in **Appendix B**.

3.2 Solids Characterization

Rock samples were submitted for laboratory analysis to SGS Lakefield in Lakefield, ON, or SRC for metals content and either ABA or sulphur speciation. Selected samples were submitted for ABA, as indicated in **Table 3.3**. Metals content analyses included multi-element determination by *aqua-regia* digestion followed by ICP-MS quantification. The ABA analyses included determination of neutralization potential (NP) using the Sobek method, acid generation potential (AP), sulphur speciation, total carbon content (C_T) and carbonate content (CO_3). Sulphur speciation included total sulphur (S_T), sulphate-sulphur (S_{SO4}), and sulphide-sulphur (S_{S2-}). Drill core samples were prepared by crushing them to a size range of 1.00 to 1.25 inches and sub-samples were taken for each of the requested analyses.

3.3 Leachability Testing

Short term leaching tests were also completed on each core sample segment, crushed to 1.00 to 1.25 inches, to determine the total inventory of soluble metals in the solids and to provide information on the characterization of potential mine rock, as well as to evaluate the implications for potential disposal and long-term management of mine rock.

Several assessments and characterization studies of uranium deposits in the Athabasca region of Northern Saskatchewan have shown that some mine rock can be a source of acid and metals as a result of sulphide mineral oxidation, if the rock is deposited and stored on land. However, studies have also shown that the same rock can be a source of elevated arsenic concentrations when deposited under water, a mitigation measure intended to eliminate sulphide mineral oxidation and consequent acid generation. The effects and implications of arsenic leaching from mineralized mine rock, associated with several deposits in the Athabasca basin, have been evaluated and reported on in several studies (COGEMA and CLMC, 2001; COGEMA, 2004; AREVA, 2007, EcoMetrix, 2008). These studies identified relationships between the soluble arsenic that can dissolve in pore water when the rock is flooded and the solids arsenic content. Relationships between the mine rock arsenic content and equilibrium concentration of arsenic in the pore water were also demonstrated.

Sequential leaching tests were completed on the drill core samples to evaluate inventories and availability of various metals in the solids related to underwater storage. The leach test protocol generally followed the rationale for leach testing of the Cigar Lake mine rock (COGEMA and CLMC 2001), Sue E special waste rock (COGEMA 2004), Midwest special waste rock (AREVA 2007), and Caribou special waste rock (EcoMetrix 2008), which focused on metal leaching with an emphasis on arsenic release. A total of 40 mine rock samples, representing a range of uranium and arsenic contents, were used in the tests (**Table 3.3**). Identical leach testing methodologies were employed for samples processed at the EcoMetrix (26 samples) and SRC (14 samples) laboratory facilities. This involved a SWEP protocol utilizing a liquid to solids ratio of 3:1 (approximately 450 mL of water to 150 g of solids) to assess metals leachability. For all samples, the leach solutions were agitated intermittently, with sampling and leachate replacement at 48 hour intervals, using the following sequential steps:

- Leach 1 De-ionized Water (t = 48 hr);
- Leach 2 De-ionized Water (t = 96 hr);
- Leach 3 pH 4 Phosphoric Acid (t = 120 hr); and
- Leach 4 pH 4 Phosphoric Acid (t = 144 hr).

The phosphate concentration in the last two leaching solutions was approximately 200 mg/L. After each leaching step, leachate samples were filtered and preserved as required prior to laboratory submission. The pH and conductivity of the leach solutions were measured immediately after sample collection.

For each COPC, the amount recovered in Leach 1 and Leach 2 is considered the water-leachable fraction (mg/kg), while the amount recovered from all four leaches is considered the total leachable fraction (mg/kg).

3.4 Kinetic Testing

Static testing provides an indication of the total and soluble constituent concentrations in the mine rock materials at a particular time, but does not provide an indication of potential changes with time during mining operations or after mine closure. Kinetic testing can be used to provide information on the relative rates of acid generation, neutralization, the approximate timing for the onset of acid generation, and if it is predicted to occur. Additionally, kinetic testing can be used to determine potential drainage chemistry and downstream loadings from the mine rock material, which result from metal leaching in the presence or absence of acidic drainage.

Special waste rock from the proposed underground mining operations will either be used for backfill in the underground or stored in the Sue C/A pit together with special waste rock from other deposits. All special waste rock placed in the Sue C/A pit will be stored underwater; therefore, no HCTs were completed on the special waste rock material. However, because the clean waste rock will be deposited on land, and consists primarily of basement rock that

has not previously been assessed in detail, modified HCTs were conducted on the basement rock.

Humidity cell tests were conducted for a period of 40 weeks on three composite mine rock samples from the McClean, Caribou, and Sue D deposits. Each cell contained approximately 1.0 kg of clean waste rock and was flushed weekly with 1.0 L of distilled water. Samples of leachate were collected approximately two hours after initial inundation, filtered, preserved as required, and then submitted to the laboratory for analysis. Measurements of pH and conductivity were completed on the leachate immediately after collection, but prior to filtering and preservation.

3.5 Clean Waste Rock Loading Rate Calculations

Although HCTs can provide a good indicator of the behavior of the mine rock stockpile, it is well known that loading rates from small scale humidity cell tests with finely crushed materials are not appropriate to directly calculate loading rates in stockpiles for full scale mine rock facilities. In general, the specific surface area of rock particles, temperature, and freezing conditions should be considered to adjust loading rates observed in laboratory humidity cell tests to field conditions. Therefore, the HCT results were adjusted to account for temperature and grain-size distribution (or specific surface area).

A temperature correction factor for the HCT results is required because the testing was completed at room temperature (about 20ºC) while temperatures under field conditions for the stockpile will be approximately equal to the average air temperature at the site. The average temperature at the McClean site was estimated to be 10 ºC for five months of the year and -13 ºC for the remaining seven months, based on Environment Canada data for Collins Bay station between 1992 and 2007. It should be noted that the measured air temperatures are typically 2 to 3 ºC lower than the ground temperatures.

Most weathering reactions, including oxidation of sulphide minerals such as pyrite, are temperature dependent, as described by the Arrhenius equation:

$$\ln\left(\frac{k_1}{k_2}\right) = \frac{E_a\left(T_1 - T_2\right)}{RT_1T_2}$$

where k_1 and k_2 are reaction rates at temperatures T_1 and T_2 in Kelvins, E_a is the activation energy of the reaction (J/mol), and R is the universal gas constant (8.314 J/mol/K). The values of E_a for pyrite oxidation reactions, that are likely responsible for releasing metals, have been shown to be about 80 kJ/mol (Nicholson *et al*., 1988). Therefore, a temperature difference from laboratory temperature (20 ºC) to field temperatures, where field temperatures were assumed to be -13 ºC for seven months and 10 ºC for five months would result in a weighted

difference factor of about 39.6 in the reaction rate. Estimated metal loads from the stockpile (field loads) therefore include a correction factor of 0.14 (or 1/39.6) applied to the calculated laboratory loading rate.

The second correction factor applied to the loadings estimates accounts for the fine grain size of the mine rock samples used in the HCTs. Based on unit-mass, the fine-grained component of the mine rock should effectively contribute all of the leached constituents. This is due to the relatively large surface area associated with the fines compared to coarse-grained material. A qualitative grain-size analysis was estimated for the material in the three HCTs. The estimated surface area of the mine rock was used to establish a representative factor, which would account for the difference in overall grain-size between the materials in the lab tests and those expected for field conditions. Therefore, based on these observations and to maintain a conservative approach to loading estimates, it was assumed that 5 % of the material in the field stockpile will be of similar size to the HCT material (about 1" to 1.25"). As such, a scaling factor of 0.05 was applied to the calculated laboratory loading rates.

The loading calculation was then completed as follows:

$$MLR_{SP} = MLR_{HC} \times M_r \times GS_f \times T_f \times Appropriate\ Unit\ Conversions$$

where:
- MLR_{SP} = the mass loading rate for the stockpile (kg/a)
- MLR_{HC} = the mass loading rate for the humidity cell (mg/kg/wk)
- M_r = the estimated mass of rock in the stockpile (kg)
- T_f = is the temperature factor
- GS_f = grain size factor

Values for the HCTs mass loading rates were based on the average rates of each cell under observed "steady-state" conditions rather than during initial flushing of soluble oxidation products that formed on the rock surface prior to the testing.

4.0 RESULTS

4.1 Static Tests

4.1.1 Mine Rock Classification

In addition to the typical use of uranium concentrations to differentiate between special and clean waste rock, arsenic and nickel contents have also been applied for some deposits. For the McClean, Caribou, and Sue D projects, the classification of mine rock as special waste rock or clean waste rock is based on arsenic contents, uranium contents and the acid generating potential, which is similar to the criteria applied to other deposits in the McClean Lake area. Mine rock samples are classified as special waste rock if the arsenic content is above 75 mg/kg, uranium content is above 250 mg/kg, and the NP/AP ratio is less than 2.0. Otherwise, the mine rock is classified as clean waste rock.

Based on the selected criteria, 40 of the 68 samples evaluated were classified as special waste rock and the remaining 28 as clean waste rock. Samples identified as special waste rock and the classification criteria they exceeded are summarized in **Table 4.1**.

4.1.2 Solids Content

Selected solids metal content results for the 68 mine rock samples are presented by deposit (**Table 4.2**), by rock type (**Table 4.3**), and by classification as special waste rock (**Table 4.4**) or clean waste rock (**Table 4.5**). The complete metal contents are presented in **Appendix C**.

Although no regulatory criteria exist for metal contents in mine rock solids, values were compared to average crustal abundances as recommended by Price (2009). This comparison is meant only as a guide at this stage of the geochemical characterization and it should be noted that, as expected for mining properties, some metal concentrations will be elevated relative to average crustal abundances. Elevated concentrations of metals in the solid phase do not necessarily increase the potential for impacts, but rather identifies parameters for further consideration. Therefore, for screening purposes, results of the mine rock and tailings bulk analysis were compared to 10 times (10X) the average crustal abundances from Faure (1998) to identify constituents that may require additional investigation or scrutiny.

Arsenic contents in the 68 mine rock samples ranged between less than detection limits (0.5 mg/kg) and 8300 mg/kg, with a median value of 15.5 mg/kg. The majority of Background, Caribou, and Sue D mine rock samples exceeded the 10 mg/kg screening threshold value, while the majority of McClean mine rock samples fell below the threshold.

The uranium contents ranged between 0.6 to 460 mg/kg, with a median value of 10 mg/kg, for the 68 mine rock samples. The majority of Caribou samples exceeded the 10X crustal

abundance screening value of 9.1 mg/kg. Conversely, a majority of the Background and nearly all McClean and Sue D samples were below the screening values.

The screening values were also exceeded for additional COPCs, including antimony, cobalt, molybdenum, nickel, and selenium, with the majority occurring amongst Background and Caribou mine rock samples (**Appendix C**). Additionally, arsenic, cobalt, nickel, sulphur, and uranium contents demonstrated substantial variations between ore deposits, while copper, lead, zinc, and molybdenum contents were relatively similar between ore deposits (**Table 4.1**).

4.1.3 Solids Correlations

In general, nickel and molybdenum contents increase with increasing arsenic content (**Figure 4.1**). A weak correlation between uranium and arsenic is seen for the McClean samples, but is not seen in the remaining sample types; although, there were limited samples evaluated with low arsenic content (**Figure 4.2**). Weak correlations between uranium and total sulphur are only evident for the Caribou samples (**Figure 4.3**).

4.1.4 Acid Generation Potential

The ABA analyses results are summarized by deposit (**Table 4.6**), rock type (**Table 4.7**), and as special waste rock (**Table 4.8**) and clean waste rock (**Table 4.9**). The complete ABA results are presented in **Appendix C**.

The evaluation for the potential of acid generation is based on the ratio of NP to AP (Neutralization Potential Ratio; NPR), and is typically compared to guideline values. The commonly used guidelines set out by Price (2009) suggest that NPR values above 2 indicate no potential for acid generation, when the NP is effective, while NPR values less than 1 indicate that materials are potentially acid generating. The NP is considered to be effective if it is based on calcium and magnesium carbonates and is commonly referred to as carbonate NP (Carb-NP). Ratios between 1 and 2 suggest some uncertainty of acid generation with further evaluation required. In addition, although ABA testing can indicate the potential for acid generation within the material it does not provide any information regarding the rates at which acid generation or neutralization will proceed and does not address the interpretation of potential metal leaching (ML). The rates of reaction and metal leaching are addressed with kinetic testing, which is discussed in more detail in **Section 4.3**.

Paste pH and Sulphur Speciation

The paste pH values of all 68 mine rock samples varied between 4.3 and 8.7, with a median value of 7.3 (**Appendix C)**. However, only one sample, collected from the McClean deposit, was characterized by a paste pH value below 6.0**.** The median paste pH values for the Background, McClean, Caribou, and Sue D mine rock samples were 7.9, 7.2, 7.7, and 6.7, respectively (**Table 4.6**).

Sulphur was predominantly observed as sulphide-sulphur amongst all 68 mine rock samples, with total sulphur values varying between 0.05 and 5.4 %S, with a median of 0.027 %S (**Appendix C**). Sulphide-sulphur values varied between below detection limit (0.01 %S) and 5.2 %S, with a median value of 0.020 %S (**Table 4.6**). The dominance of sulphide-sulphur speciation amongst all 68 samples is illustrated in **Figure 4.4**.

Acid Generation Potential (AP)

The AP values for all samples, calculated from the sulphide-sulphur values, varied between below detection (0.31 kg $CaCO_3$/t) and 164 kg $CaCO_3$/t, with a median of 0.62 kg $CaCO_3$/t (**Appendix C**). The AP values for the Background, McClean, Caribou, and Sue D mine rock samples are summarized in **Table 4.6**. In general, Background and McClean mine rock samples demonstrated higher percentages of sulphide than the other ore deposits and were observed to contain potentially acid generating material (PAG).

Carbon Speciation

The Sobek method for measuring NP is very aggressive and is known to over-estimate the available NP in most samples (Price, 1997). A more conservative estimate of the neutralization potential is based on the Carb-NP, as it only considers the neutralizing capacity provided by carbonate minerals that maintain pH values above 5, and not the aluminosilicate and silicate minerals that may neutralize acid but may not maintain pH values above 5. In addition, carbonate minerals typically react at higher rates than do silicate minerals and, therefore; they will be more available for neutralization reactions. The Carb-NP can be calculated from the reported carbonate content, which also provides an indication of the amount of carbonate minerals that may be present, including siderite and other iron carbonate minerals.

The total carbonate values for all four rock types, measured as percent carbon (%C), ranged between 0.032 %C and 0.2.6 %C, with a median value of 0.010 %C (**Table 4.6**). Total carbonate values were highest amongst the Background samples and lowest amongst the Caribou samples (**Table 4.6**).

Neutralization Potential (NP)

The measured Sobek-NP values ranged from below detection limits (0.05 kg $CaCO_3$/t) to 78 kg $CaCO_3$/t, with a median of 3.4 kg $CaCO_3$/t (**Appendix C**). Typically, Carb-NP values were lower than the Sobek-NP values, ranging from 0.27 to 213 kg $CaCO_3$/t with a median value of 0.83 kg $CaCO_3$/t (**Appendix C**). The median Sobek-NP and Carb-NP values for each of the five mine rock types are summarized in **Table 4.6**.

The relationship between Carb-NP and Sobek-NP values is shown in **Figure 4.5** and there is no consistent relationship observed between the two NPR values. A majority of the samples have Sobek-NP values that are larger than their corresponding Carb-NP values, suggesting that there is NP from non-carbonate sources that may not be available for acid neutralization. The Carb-NP is generally considered to be the effective and available NP in

mine materials. However, for a number Background, McClean, and Sue D samples, Carb-NP values greatly exceed Sobek-NP values, suggesting the presence of iron carbonates.

Neutralization Potential Ratios (NPR)

All rock types were characterized by Carb-NPR median values between 1.0 and 2.0, with a median of 1.6 and an average of 9.2 (**Appendix C**; **Table 4.6**). Similarly, all mine rock samples had median Sobek-NPR values above 2.0, with median and average values of 4.9 and 5.4, respectively. The Background, McClean, and Caribou samples were characterized by having nearly equal numbers of samples with Carb-NPR values less than 1, between 1 and 2 and greater than 2, while nearly all available Sobek-NPR values were above 2. The majority of Background samples had Carb-NPR values were either between 1 and 2 or greater than 2, and a majority of Sobek-NPR values were greater than 2. Conversely, all Sue D samples were characterized by Carb-NPR and Sobek-NPR values greater than 1 (Appendix C).

The Sobek-NPR and Carb-NPR values were plotted against sulphide contents to illustrate the division between the potentially acid generating (PAG) and non-potentially acid generating (non-PAG) mine rock samples (**Figure 4.6**). Samples with NPR values less than 1.0 are considered PAG, while samples with values greater than 2.0 are considered to be non-PAG. The plot of Sobek-NPR versus sulphide content indicates that most mine rock samples with sulphide contents less than 0.1 %S have NPR values greater than 2. For the Carb-NPR ratios, there is no practical sulphide-sulphur cutoff value that separates PAG and non-PAG mine rock samples (**Figure 4.6**). These results suggest that the potential for segregation of non-PAG from PAG rock is low if these samples are representative of expected mine rock during mining.

Price (2009) suggests that mine rock will not be potentially acid generating, or will be non-PAG, if the NPR is greater than 2 if the NP is considered to be effective. In Figure 4.6, comparing the Sobek-NPR and Carb-NPR plots shows that a greater percentage of samples would be classified as PAG using the Carb-NPR than the Sobek NPR criteria. The Carb-NP is considered to represent the effective NP in the samples and is a more conservative indicator for PAG classification. In order to classify the rock as PAG or non-PAG during mining, the sulphur and inorganic carbon would need to be measured and the appropriate carbon to sulphur ratio would need to be met to have a Carb-NPR of 2 or greater. The rock can then be segregated based on the carbon:sulphur ratios.

4.2 Sequential Leach Test Results

Special waste rock from the McClean, Caribou, and Sue D developments will be disposed of in the Sue C/A Pit along with special waste rock from other deposits. Therefore, results from the leachability testing for the current investigation were compared against results from historical testing performed on uranium deposit samples from the Athabasca region. Relationships between leachability of arsenic and total arsenic contents in previous

investigations focused on high arsenic special waste rock material. However, classification of special waste rock from McClean, Caribou, and Sue D deposits also includes material with low arsenic contents, elevated uranium contents, and/or acid generating potential. Therefore, the leachability relationships were expanded to include all potential mine rock, including material that could be classified as clean waste rock based on arsenic content alone.

Results of the leach tests conducted on the 40 McClean, Caribou, and Sue D and basement and sandstone rock samples, for selected COPCs, are summarized in **Table 4.10**. The leach results are summarized by COPC in **Appendix D** and the full dataset is presented in **Appendix E**. The amounts of COPCs leached as percentages of the total solids contents are also summarized in **Table 4.10**. Data from previous investigations, including JEB, Midwest, Sue A, B, C and E, Caribou Open Pit, and Cigar Lake, were compiled with the results of the current leach tests. The combined results were plotted as leachable fraction (mg/kg equivalent) versus solids content (mg/kg) for the water-leachable (**Figure 4.7**) and total leachable (**Figure 4.8**) fractions. Assessments of metal leachability for each deposit are shown in **Figures 4.9** through **4.12**. Summaries of the leachability testing for selected COPCs are presented in **Appendix D**. A compilation of all leach test data is provided in **Appendix E**.

For the considered COPCs, the water and total leachable fractions for basement and sandstone rock samples are well correlated with trends observed in historical analysis of the sandstone material (**Figure 4.9** to **Figure 4.13**). This indicates that the McClean, Caribou, and Sue D material leachability should be similar to other uranium deposits in the McClean Lake region.

4.2.1 Arsenic Leachability

The median mass of water-leachable arsenic was 0.08 mg/kg and 0.14 mg/kg for the sandstone and basement samples, respectively. The median mass of total leachable arsenic was 1.4 mg/kg and 0.64 mg/kg for the sandstone and basement samples, respectively.

For the sandstone, the relative percentage of water-leachable arsenic ranged from approximately 0.1 % to 27 % of the total arsenic content, with a median value of 0.6 % (**Table 4.10**). The total leachable arsenic ranged from approximately 2 % to 38 %, with a median value of 9.2 %. On average, the water-leachable fraction represents about 16 % of the total leachable arsenic. For the basement rock samples, the median relative percentage of water and total leachable arsenic were 2 % and 6 % of the total arsenic content, respectively. The water-leachable fraction represented approximately 30 % of the total leachable arsenic in the basement rock.

4.2.2 Uranium Leachability

The relative percentage of water-leachable uranium ranged from 0.03 % to 40 % in the sandstone samples and from 0.006 % to 1.9 % in the basement rock, with median values of 4.6 % and 0.3 %, respectively (**Table 4.10**). The median total leachable percentages were 5.5 % and 0.7 % for the sandstone and basement samples, respectively. For the sandstone samples, the water-leachable fraction represents 48 % of the total leachable uranium. For the basement rock samples, the water-leachable fraction represents 26.7 % of the total leachable uranium

4.2.3 Leachability of Other COPCs

Results of the sequential extraction tests for cobalt, copper, lead, nickel, molybdenum, sulphur, and zinc are also provided in **Table 4.10**. For the sandstone samples, the total leachable amounts were less than 10 % of the total copper, lead, molybdenum, and selenium solids contents. Conversely, cobalt, nickel, and sulphur had total leachable amounts of 17 %, 14 %, and 17 % of the total sandstone solids contents, respectively. In the basement rock samples, the total leachable amounts of cobalt, copper, nickel, sulphur, and zinc were 2 to 8 times lower than calculated for the sandstone samples. However, both total leachable lead and molybdenum amounts were generally the same for both rock types. For the sandstone samples, the water-leachable fractions for all COPCs were between 28 % and 87 %, with an average of 66 %, of the total leachable amount, while. The same water-leachable amounts were between 28 % and 83 % of the total leachable amount, with an average of 52 %, for the basement rock samples.

The leach test results indicate that the leachable masses in the McClean, Caribou, and Sue D mine rock are well correlated with results from previous mine rock investigations from sites within the Athabasca uranium deposit area. Little difference was observed between the results from the leachability of sandstone and basement rock samples.

The results suggest that the leaching behaviour of the McClean, Caribou, and Sue D special waste rock should be similar to that observed for other uranium deposits in the McClean Lake region, such as Sue E and Midwest, after in-pit disposal and flooding. Source terms for arsenic concentrations in the pore water in the flooded special waste rock material can therefore be represented by source terms previously developed (EcoMetrix, 2008):

$$Y \text{ (average pore water concentration)} = 0.01\ X^{1.29}$$

for the average pore water concentration within the submerged waste, and

$$Y \text{ (average pore water concentration)} = X^{(0.735)}$$

for the upper bound case, where X is equal to the arsenic solids content.

4.3 Clean Waste Rock Humidity Cell Tests

The leach test results indicate that the leachable masses in the basement material from the McClean, Caribou, and Sue D deposits are well correlated with those observed in historical sandstone samples from the area. In addition, the results suggest that even though significant fractions of leaching can occur, the median water-leachable and total leachable arsenic for both sandstone and basement rock are less than 10 % of the total arsenic content. Although the inventories of arsenic are not large, it is possible that an initial leaching by rainfall in the field could have a measurable effect on arsenic levels in drainage from rock piles. Therefore, in order to determine if the leached loadings of arsenic are sustainable or represent a single leach event such as initial rinsing of the rock, the mine rock samples were subjected to a modified HCT.

The on-going HCTs focused on the on-land storage of mine rock to evaluate the leaching rates and constituent loadings of the potential mine rock material. The preliminary HCT results were evaluated to estimate COPC loading rates, which can be used in water quality predictions for the Project. Testing was completed on three composite samples with different uranium and arsenic contents. The uranium, arsenic, and total sulphur contents of the composite samples are summarized in **Table 4.11**.

For the HCTs, the laboratory loading rates (mg/kg/week) are equivalent to the COPC concentration, because for each cell 1 kg of rock was rinsed with 1 L of water each week. The complete loading rate calculations are tabulated in **Appendix F**, plots for selected COPC loading rates are presented in **Figure 4.13**, and additional COPC loading rate plots are presented in **Appendix G**. In general, long-term steady-state loading rates were observed for most COPCs by week 10 (**Figure 4.13**).

4.3.1 pH

The leachate pH in all three cells has remained circum-neutral throughout the initial 28 weeks of the tests. The pH in the LOW and HIGH cells was initially depressed below 6.0 but increased to above 6.0 by week 3 (**Figure 4.13**). Steady-state pH conditions were observed for all three cells from week 5 to 20 (pH 6.3 to 7.0); however, pH values have decreased between weeks 20 and 28 to below 6.0. Despite the recent decrease in pH, the values are expected to remain circum-neutral as the composite material for all three HCTs is classified as likely non-acid generating with NP/AP ratios above 4.

4.3.2 Sulphate

Sulphate loading rates were elevated during the initial 10 weeks, but declined to lower, constant, values after week 10 (**Figure 4.13**). The higher initial rates represent an initial flushing of the crushed mine rock samples and the lower values at later time represent a more constant rate of release. The constant values observed after week 10 may be related to naturally occurring oxidation or other weathering reactions. Values have been below 5

mg/kg/wk since week 6 in all cells. Calculated loading rates were relatively higher for the HIGH cell in the initial 10 weeks, which is consistent with the elevated sulphur content of the samples.

4.3.3 Arsenic

The calculated arsenic loading rates for the LOW, MID, and HIGH HCTs are illustrated in Figure 4.15. The relative magnitude of the loading rates is correlated to the solids arsenic content for the composite samples, the highest rate is associated with the highest solids content. In general, there is a one to two orders-of-magnitude difference between the HIGH and the LOW and MID composites. Since week 10, the steady-state loading rates week 10 are approximately 0.0002, 0.001 and 0.012 mg/kg/wk for the LOW, MID and HIGH composites, respectively.

4.3.4 Uranium

Similar to the trends observed for arsenic loading rates, the relative magnitude of uranium release rates are likely related to the solids content of the composite samples (**Figure 4.13**). Loading rates were less than 0.005 mg/kg/wk after week 6 in the HIGH HCT, and exhibited a steady-state release of approximately 0.001 mg/kg/wk since week 10. Calculated loading rates for the HIGH material have generally been one to two orders-of-magnitude greater than rates from the LOW and MID composites samples, for the duration of testing to date.

4.3.5 Other COPCs

Concentrations of cadmium, chloride, lead, vanadium and zinc were typically below detection in the humidity cell leachates. Copper concentrations were also below detection for most of the testing, however the most recent samples were above detection and have shown a possible increasing trend.

Generally, most other COPCs (e.g. cobalt, molybdenum, nickel) demonstrate similar loading rate trends as those observed for arsenic and uranium, with relatively higher rates associated with the HIGH composite sample (**Figure 4.13**). However, these trends were not observed for selenium, which is characterized by the MID composite sample having the highest loading rate of the three samples.

4.3.6 Loading Rate Correlations

The relationship between steady-state loading rates of arsenic, uranium, cobalt, nickel and molybdenum between weeks 8 and 24 and initial solids arsenic content of the composite samples are presented in **Figure 4.14**. The correlations observed between COPC loading rates and solids arsenic content are summarized in **Table 4.12**. The strong correlations between arsenic contents and arsenic, cobalt, molybdenum, nickel, and uranium loading rates are a function of three data points for arsenic contents, two of which had similar values.

Because of the relatively similar arsenic contents in the LOW and MID composites, these correlations are not as strong as those suggested by the correlation coefficients. Nonetheless, the relationships of higher rates with increasing arsenic contents are consistent for many COPCs and suggest that lower arsenic contents will results in lower loading rates for several COPCs.

4.3.7 Field Adjusted Loading Rates

The calculated laboratory COPC loading rates are provided in **Table 4.13**. The rates were calculated using the loading rate relationships (**Table 4.12**) using the 50th (Average) and 90th (Upper Bound) percentiles of arsenic contents from all clean basement rock samples (6.2 and 158 mg/kg, respectively). The average and upper bound laboratory loading rates were identical for COPCs that were not correlated with solids arsenic contents. As described in **Section 3.5**, the laboratory loading rates must be adjusted to account for differences in grain size and temperatures between the humidity cells and on-land stockpiles in the field. A summary of corresponding field adjusted COPC loading rates are also presented in **Table 4.13**.

4.3.8 Mass Loading Rates

Corresponding estimates of mass loading rates, as described in **Section 3.5**, are presented in **Table 4.14** based on an estimated mine rock stockpile mass of 0.51 Mtonnes (**Table 1.1**).

Predictions of COPC concentrations in rock drainage from stockpiles will be determined by using the loading rates to assess water quality when masses of rock and the local water balance is better defined.

5.0 PRELIMINARY CONCLUSIONS

The characterization of the potential mine rock from the McClean, Caribou, and Sue D deposits focused on key issues that have been identified for other similar deposits in the region. This study included chemical analysis of the solids, ABA analyses, short-term leach tests, and humidity cell tests. These characterization steps were taken to assess the appropriateness of rock storage scenarios and to quantify source terms for mine rock materials in order to evaluate the effects on water quality. The study included basement rock material that had not previously been evaluated in detail. These results were compared to historical investigations to determine if the leaching relationships developed for the sandstone material were applicable to the basement rock.

The results of the investigation lead to the following conclusions:

Mine Rock Solids Content

- Overall, concentrations of metals in the sandstone mine rock samples are similar to those observed in previous investigations;
- The arsenic, cobalt, nickel, sulphur, and uranium solids contents varied among investigated historical ore deposits, while copper, lead, zinc, and molybdenum contents were similar amongst all studied ore deposits;
- In general, solids nickel and molybdenum contents increase with increasing arsenic content;
- Weak correlations between uranium and arsenic are seen for the McClean samples, but are not amongst the Background or other ore body samples, and
- Weak correlations between solids uranium and total sulphur contents were evident for the Caribou samples.

Mine Rock Acid Potential

- The Background, McClean, and Caribou mine rock samples are characterized by individual samples that are PAG, non-PAG, and others whose acid generating potential is uncertain ($1 > NPR < 2$);
- Overall, the Background, McClean, and Caribou mine rock types have uncertain acid generating potential, while Sue D samples are non-PAG, and
- If segregation of rock is desirable during mining, it is suggested that inorganic carbon and total sulphur be analysed to determine the Carb-NPR values. Rock with Carb-NPR values greater than or equal to two can be classified as non-PAG.

Arsenic Leachability

- A substantial amount of solids arsenic content can be potentially leached from the mine rock when submerged, as has been observed for mine rock from other Athabasca Basin uranium deposits, and
- Approximately 2 % of the basement rock's arsenic content is potentially water-leachable and 6 % can potentially be leached over an extended period of time. These values were similar to those observed for sandstone mine rock samples, that had 0.6 % of the arsenic as water-leachable and 9.2 % in the total leachable fractions, respectively.

COPC Loading Rates

- The leaching behaviour of the McClean, Caribou, and Sue D mine rock is similar to mine rock from other McClean Lake region uranium deposits; therefore, previously developed source terms for pore water arsenic concentrations in flooded special waste rock material can be applied;
- Loading rates for COPCs for clean waste rock materials have been quantified to provide a basis for estimating water quality concentrations for the McClean, Caribou, and Sue D Project, and
- Stockpile COPC drainage concentrations can be predicted once mine rock masses and the local water balance are better defined.

6.0 REFERENCES

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Appendix A Summary of Drill Core Samples Selected for Investigation

TABLE A.1
List of Sampels Requested for Investigation

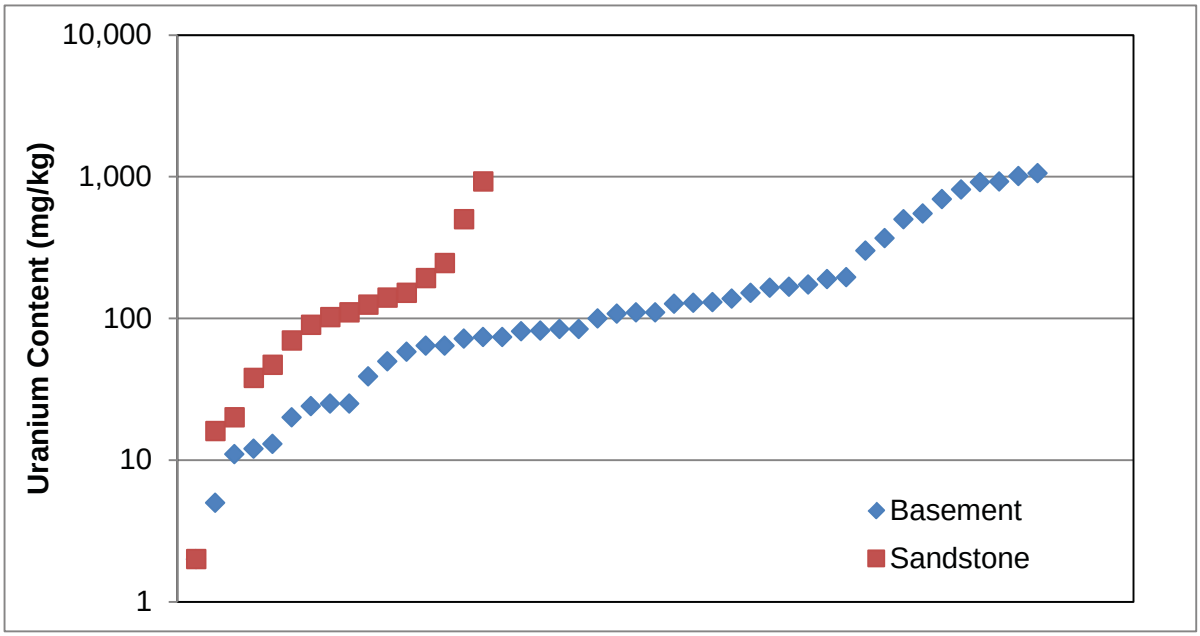
Borehole ID	Sample ID	Sample Type	Depth From (m)	Depth To (m)	AREVA Date Sampled	Arsenic Content (mg/kg) (AREVA)	Uranium Content (mg/kg) (AREVA)	Ore Body	Formation
SUE__S731___	S731SY08	1SYS	81.000000	91	15/01/2003	1	2	Background	Background
SUE__S731___	S731SY13	1SYS	130.000000	133	15/01/2003	3	5	Background	Background
SUE__S730___	S730MN05	1BAS	147.500000	148	15/01/2003	2380	12	Background	Background
SUE__S730___	S730MN10	1BAS	151.600000	152	15/01/2003	3650	13	Background	Background
SUE__S730___	S730MN01	1BAS	141.300000	142	15/01/2003	1790	20	Background	Background
SUE__S730___	S730MN08	1BAS	150.600000	151	15/01/2003	4440	25	Background	Background
SUE__S730___	S730MN07	1BAS	148.500000	149	15/01/2003	47000	110	Background	Background
SUE__S730___	S730MN04	1BAS	142.800000	143	15/01/2003	16800	129	Background	Background
SUE__S730___	S730MN09	1BAS	151.100000	152	15/01/2003	89000	500	Background	Background
SUE__S730___	S730MN06	1BAS	148.000000	149	15/01/2003	59000	550	Background	Background
SUE__S730___	S730MN03	1BAS	142.300000	143	15/01/2003	120000	913	Background	Background
SUE__S730___	S730MN02	1BAS	141.800000	142	15/01/2003	208000	924	Background	Background
SUE__S730___	S730MN09	1BAS	151.1	151.6	15/01/2003	89000	500	Background	
SUE__S730___	S730MN07	1BAS	148.5	149	15/01/2003	47000	110	Background	
SUE__S730___	S730MN02	1BAS	141.8	142.3	15/01/2003	208000	924	Background	
SUE__S730___	S730MN01	1BAS	141.3	141.8	15/01/2003	1790	20	Background	
SUE__S731___	S731SY09	1SYS	91	101	15/01/2003	1.50	1.99999	Background	
SUE__S712___	S712SB03	1BAS	141.300000	142	17/04/2002	79	50	Caribou	Basement
SUE__S701___	S701SB02	1BAS	119.100000	119.600000	05/05/2002	39	72	Caribou	Basement
SUE__S700___	S700SB05	1BAS	128.300000	129	27/03/2002	467	100	Caribou	Basement
SUE__S700___	S700SB08	1BAS	129.800000	130.300000	27/03/2002	1610	138	Caribou	Basement
SUE__S708___	S708SB04	1BAS	133.800000	134	06/05/2002	2730	167	Caribou	Basement
SUE__S744___	S744MN32	1BAS	129.000000	130	01/04/2003	3060	173	Caribou	Basement
SUE__S701___	S701SB03	1BAS	119.600000	120	05/05/2002	554	189	Caribou	Basement
SUE__S782___	S782MN22	1SEL	127.7	128.2	13/04/2003	1740	47	Caribou	Sandstone
SUE__S742___	S742SY10	1SYS	99	109	06/02/2003	128	125	Caribou	Sandstone
MU____08_05_	MU_08_05_1BAS_01	1BAS	155.500000	156	16/08/2009	16	369	MUG Pod 1	Basement
MU____08_05_	MU_08_05_1BAS_19	1BAS	167.500000	168	16/08/2009	508	1060	MUG Pod 1	Basement
MU____08_05_	MU_08_05_1SYB_02	1SYB	178.5	187.5	02/08/2008	71	38	MUG Pod 1	Sandstone
MCG____07_03	MCG07_03_1BAS_25	1BAS	189.600000	190	16/08/2009	282	25	MUG Pod 2	Basement
MCG____07_03	MCG07_03_1BAS_24	1BAS	183.600000	184.100000	16/08/2009	299	74	MUG Pod 2	Basement
MCG____07_03	MCG07_03_1BAS_24	1BAS	183.600000	184.100000	16/08/2009	299	74	MUG Pod 2	Basement
MCG____07_03	MCG07_03_1BAS_16	1BAS	179.600000	180	16/08/2009	113	82	MUG Pod 2	Basement
MCG____07_03	MCG07_03_1BAS_17	1BAS	180.100000	180.600000	16/08/2009	285	110	MUG Pod 2	Basement
MCG____07_03	MCG07_03_1BAS_22	1BAS	182.600000	183	16/08/2009	330	810	MUG Pod 2	Basement
MCS____09___	MCS09_2SYS_02	1SYB	210	220	18/04/2007	1.40	90	MUG Pod 2	Sandstone
MCG____07_03	MCG-07-03_1SYS_12	1SYS	160	170	01/09/2009	4.25	102	MUG Pod 2	Sandstone
MU____08_08_	MU_08_08_1BAS_03	1BAS	160.500000	161	17/08/2009	17	301	MUG Pod 5	Basement
MU____08_08_	MU_08_08_1BAS_12	1BAS	165.000000	166	17/08/2009	531	1010	MUG Pod 5	Basement
MU____08_08_	MU_08_08_1SYB_07	1SYB	150	159.5	17/08/2009	7.00	151	MUG Pod 5	Sandstone
MCS____22___	MCS22_1BAS_03	1BAS	167.000000	168	28/03/2011	8	11	MUG Pod 8E	Basement
MCS____22___	MCS22_1BAS_04	1BAS	167.500000	168	28/03/2011	72	24	MUG Pod 8E	Basement
MCS____22___	MCS22_1BAS_09	1BAS	170.000000	171	28/03/2011	28	58	MUG Pod 8E	Basement
MCS____21___	MCS21_1BAS_11	1BAS	160.500000	161.000000	28/03/2011	3	64	MUG Pod 8E	Basement
MCS____21___	MCS21_1BAS_11	1BAS	160.500000	161.000000	28/03/2011	3	64	MUG Pod 8E	Basement
MCS____21___	MCS21_1BAS_08	1BAS	159.000000	159.500000	28/03/2011	2	108	MUG Pod 8E	Basement
MCS____21___	MCS21_1SEL_29	1SEL	155	155.3	26/03/2011	3.40	192	MUG Pod 8E	Sandstone
MCS____21___	MCS21_1SEL_26	1SEL	153.5	154	26/03/2011	24	246	MUG Pod 8E	Sandstone
MCS____21___	MCS21_1SEL_19	1SEL	150	150.5	26/03/2011	3.80	140	MUG Pod 8E	Sandstone
MCS____05___	MCS05_2SYS_05	1SYB	240	250	16/03/2007	2.30	16	MUG Pod 8W	Sandstone
SUE__S822___	S822_1BAS_04	1BAS	150.500000	151.000000	05/12/2011	10	39	Sue D	Basement
SUE_SGT11-1A	SGT-11-1A_1BAS_125	1BAS	169.000000	169.500000	18/02/2011	2420	81	Sue D	Basement
SUE__S826___	S826_1BAS_01	1BAS	107.500000	108.000000	05/12/2011	12	84	Sue D	Basement
SUE__S826___	S826_1BAS_01	1BAS	107.500000	108	05/12/2011	12	84	Sue D	Basement
SUE__S823___	S823_1BAS_06	1BAS	79.900000	80	05/12/2011	117	127	Sue D	Basement
SUE__S826___	S826_1BAS_04	1BAS	109.000000	109.500000	05/12/2011	3	130	Sue D	Basement
SUE_SGT11-1A	SGT-11-1A_1BAS_57	1BAS	111.000000	111.500000	18/02/2011	20	151	Sue D	Basement
SUE_SGT11-1A	SGT-11-1A_1BAS_63	1BAS	119.500000	120.000000	18/02/2011	2	164	Sue D	Basement
SUE__S827___	S827_1BAS_01	1BAS	141.800000	142	05/12/2011	41	195	Sue D	Basement
SUE__S826___	S826_1BAS_02	1BAS	108.000000	109	05/12/2011	21	693	Sue D	Basement
SUE__S822___	S822_1SYB_09	1SYB	138.7	147.2	05/12/2011	23	69.8	Sue D	Sandstone
MCN____02___	MCN02_1SYB_10	1SYB	275	291	30-Jan-12			Candy Lake	
MCN____04___	MCN04_1SYB_11	1SYB	225	230.5	04-Feb-12			Candy Lake	
MCN____08___	MCN08_1SYB_11	1SYB	232.9	237.2	21-Feb-12			Candy Lake	
MCN____09___	MCN09_1SYB_08	1SYB	234.7	237.6	25-Feb-12			Candy Lake	
MCN____12___	MCN12_1SYB_10	1SYB	218	222				Candy Lake	
MCN____14___	MCN14_1SYB_07	1SYB	225.4	228.3				Candy Lake	
MCN____15___	MCN15_1SYB_08	1SYB	223	234.8				Candy Lake	
MCN____17___	MCN17_1SYB_03	1SYB	180.1	191.3				Candy Lake	
MCN____02___	MCN02_1BAS_03	1BAS	207.7	208.2	30-Jan-12			Candy Lake	
MCN____05___	MCN05_1BAS_07	1BAS	199.3	199.8	05-Feb-12			Candy Lake	
MCN____11___	MCN11_1BAS_04	1BAS	190.7	191.2				Candy Lake	

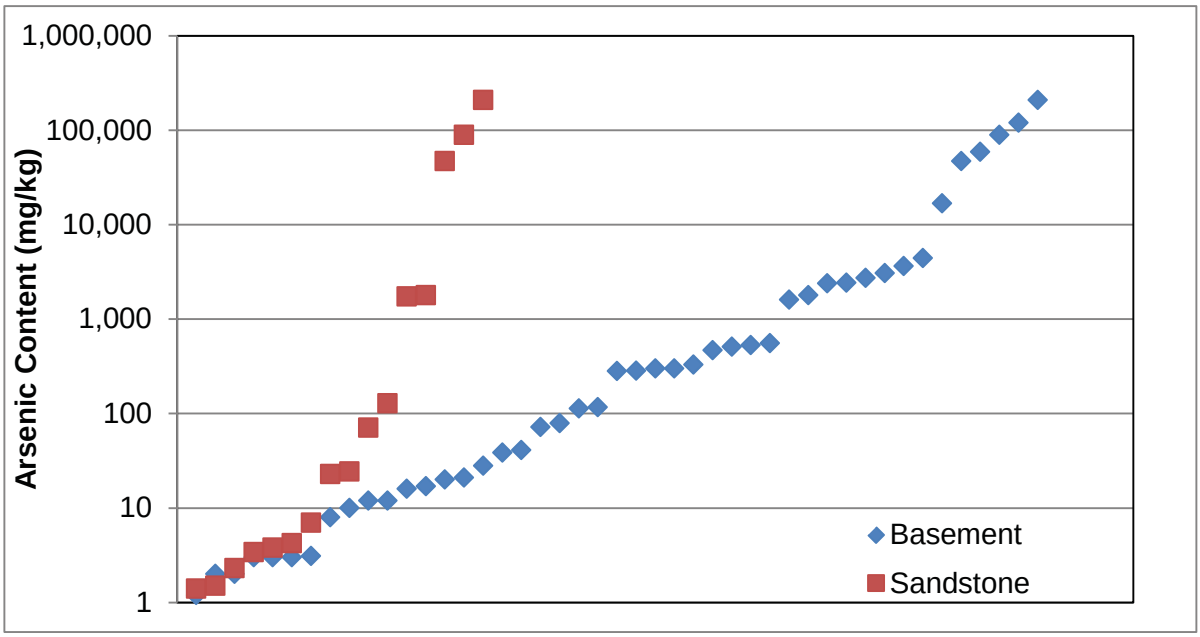
TABLE A.2
Comparison of Samples Requested and Samlpes Obtained

Borehole ID	Sample ID	Depth From (m)	Depth To (m)	Borehole ID	Depth From (m)	Depth To (m)	Sample ID	Ore Body Vicinity	Comment
Basement Rock									
SUE_S730	S730MN01	141.3	141.8	SUE_S730	125.3	125.5	S730_20120418_125.5	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
SUE_S730	S730MN01	141.3	141.8	SUE_S730	131.1	131.3	S730_20120418_131.3	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
SUE_S730	S730MN02	141.8	142.3	SUE_S730	133.0	133.2	S730_20120418_133.2	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
SUE_S730	S730MN02	141.8	142.3	SUE_S730	135.0	135.2	S730_20120418_135.2	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
SUE_S730	S730MN03	142.3	142.8	SUE_S730	138.0	138.2	S730_20120418_138.2	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
SUE_S730	S730MN04	142.8	143.3	SUE_S730	139.7	139.9	S730_20120418_139.9	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
SUE_S730	S730MN05	147.5	148.0	SUE_S730	144.7	144.9	S730_20120418_144.9	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
SUE_S730	S730MN06	148.0	148.5	SUE_S730	146.8	147.0	S730_20120418_147	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
SUE_S730	S730MN07	148.5	149.0	SUE_S730	147.5	147.7	S730_20120418_147.7	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
SUE_S730	S730MN07	148.5	149.0	SUE_S730	150.6	150.8	S730_20120418_150.8	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
SUE_S730	S730MN08	150.6	151.1	SUE_S730	152.6	152.8	S730_20120418_152.8	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
SUE_S730	S730MN09	151.1	151.6	SUE_S730	155.8	156.0	S730_20120418_156	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
SUE_S730	S730MN09	151.1	151.6	SUE_S730	156.1	156.3	S730_20120418_156.3	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
SUE_S730	S730MN10	151.6	152.1	SUE_S730	163.0	163.2	S730_20120418_163.2	Access Ramp	Had to take broader range of sample depths in order to avoid cleaning out entire core box
MCN_02	MCN02_1BAS_03	207.7	208.2	MCN_02	206.5	206.7	MCN02_20120417_206.7	Candy Lake	
MCN_02	MCN02_1SYB_10	275.0	291.0	MCN_02	278.5	278.7	MCN02_20120417_278.7	Candy Lake	
MCN_04	MCN04_1SYB_11	225.0	230.5	MCN_04	226.6	226.8	MCN04_20120417_226.8	Candy Lake	
MCN_05	MCN05_1BAS_07	199.3	199.8	MCN_05	198.5	198.7	MCN05_20120417_198.7	Candy Lake	
MCN_08	MCN08_1SYB_11	232.9	237.2	MCN_08	233.3	233.5	MCN08_20120417_233.5	Candy Lake	
MCN_09	MCN09_1SYB_08	234.7	237.6	MCN_09	206.8	207.0	MCN09_20120417_207	Candy Lake	
MCN_11	MCN11_1BAS_04	190.7	191.2	MCN_11	190.4	190.6	MCN11_20120417_190.6	Candy Lake	
MCN_12	MCN12_1SYB_10	218.0	222.0	MCN_12	217.8	218.0	MCN12_20120417_218	Candy Lake	
MCN_14	MCN14_1SYB_07	225.4	228.3	MCN_14	226.8	227.0	MCN14_20120417_227	Candy Lake	
MCN_15	MCN15_1SYB_08	223.0	234.8	MCN_15	225.8	226.0	MCN15_20120417_226	Candy Lake	
MCN_17	MCN17_1SYB_03	180.1	191.3	MCN_17	189.5	189.7	MCN17_20120417_189.7	Candy Lake	
SUE_S700	S700SB05	128.3	128.8	SUE_S700	128.6	128.8	S700_20120418_128.8	Caribou	
SUE_S700	S700SB08	129.8	130.3	SUE_S700	130.3	130.5	S700_20120418_130.5	Caribou	
SUE_S701	S701SB02	119.1	119.6	SUE_S701	122.1	122.3	S701_20120418_122.3	Caribou	
SUE_S701	S701SB03	119.6	120.3	SUE_S701	123.8	124.0	S701_20120418_124	Caribou	
SUE_S708	S708SB04	133.8	134.3	SUE_S708	134.2	134.4	S708_20120418_134.4	Caribou	
SUE_S712	S712SB03	141.3	141.8	SUE_S712	141.8	142.0	S712_20120418_142	Caribou	
SUE_S744	S744MN32	129.0	129.5	SUE_S744	130.6	130.8	S744_20120418_130.8	Caribou	
MU_08_05	MU_08_05_1BAS_19	167.5	168.0	MU_08_05	168.0	168.2	MU08-05_20120418_168.2	MUG Pod 1	
MU_08_05	MU_08_05_1SYB_02	178.5	187.5	MU_08_05	174.3	174.5	MU08-05_20120418_174.5	MUG Pod 1	
MCG_07_03	MCG07_03_1BAS_16	179.6	180.1	MCG_07_01	178.7	178.8	MCG07-01_20120418_178.8	MUG Pod 2	MCG07-03 was inaccessible due to snow cover. MCG07-01 was sampled instead. MCG07-01 is located very close to MCG07-03, and is inclined in the same direction towards MUG Pod 2.
MCG_07_03	MCG07_03_1BAS_17	180.1	180.6	MCG_07_01	180.0	180.1	MCG07-01_20120418_180.1	MUG Pod 2	MCG07-03 was inaccessible due to snow cover. MCG07-01 was sampled instead. MCG07-01 is located very close to MCG07-03, and is inclined in the same direction towards MUG Pod 2.
MCG_07_03	MCG07_03_1BAS_22	182.6	183.1	MCG_07_01	182.5	182.6	MCG07-01_20120418_182.6	MUG Pod 2	MCG07-03 was inaccessible due to snow cover. MCG07-01 was sampled instead. MCG07-01 is located very close to MCG07-03, and is inclined in the same direction towards MUG Pod 2.

TABLE A.2 (cont.)
Comparison of Samples Requested and Samlpes Obtained

Borehole ID	Sample ID	Depth From (m)	Depth To (m)	Borehole ID	Depth From (m)	Depth To (m)	Sample ID	Ore Body Vicinity	Comment
Basement Rock									
MCG_07_03	MCG07_03_1BAS_24	183.6	184.1	MCG_07_01	184.0	184.1	MCG07-01_20120418_184.1	MUG Pod 2	MCG07-03 was inaccessible due to snow cover. MCG07-01 was sampled instead. MCG07-01 is located very close to MCG07-03, and is inclined in the same direction towards MUG Pod 2.
MCG_07_03	MCG07_03_1BAS_25	189.6	190.1	MCG_07_01	190.0	190.1	MCG07-01_20120418_190.1	MUG Pod 2	MCG07-03 was inaccessible due to snow cover. MCG07-01 was sampled instead. MCG07-01 is located very close to MCG07-03, and is inclined in the same direction towards MUG Pod 2.
MCS_09	MCS09_2SYS_02	210.0	220.0	MCS_09	210.0	210.2	MCS09_20120418_210.2	MUG Pod 2	
MU_08_08	MU_08_08_1SYB_07	150.0	159.5	MU_08_08	172.8	173.0	MU08-08_20120418_173	MUG Pod 5	Requested range was too elevated on SPP2-gamma, sampled deeper
MU_08_08	MU_08_08_1BAS_03	160.5	161.0	MU_08_08	178.0	178.2	MU08-08_20120418_178.2	MUG Pod 5	Requested range was too elevated on SPP2-gamma, sampled deeper
MU_08_08	MU_08_08_1BAS_12	165.0	165.5	MU_08_08	179.3	179.5	MU08-08_20120418_179.5	MUG Pod 5	Requested range was too elevated on SPP2-gamma, sampled deeper
MCS_21	MCS21_1BAS_08	159.0	159.5	MCS_21	158.2	158.4	MCS21_20120418_158.4	MUG Pod 8E	
MCS_21	MCS21_1BAS_11	160.5	161.0	MCS_21	160.5	160.7	MCS21_20120418_160.7	MUG Pod 8E	
MCS_21	MCS21_1BAS_11	160.5	161.0	MCS_21	160.8	161.0	MCS21_20120418_161	MUG Pod 8E	
MCS_22	MCS22_1BAS_03	167.0	167.5	MCS_22	165.5	165.7	MCS22_20120418_165.7	MUG Pod 8E	
MCS_22	MCS22_1BAS_04	167.5	168.0	MCS_22	166.5	166.7	MCS22_20120418_166.7	MUG Pod 8E	
MCS_22	MCS22_1BAS_09	170.0	170.5	MCS_22	170.8	171.0	MCS22_20120418_171	MUG Pod 8E	
SUE_S822	S822_1SYB_09	138.7	147.2	SUE_S822	146.8	147.0	S822_20120418_147	Sue D	
SUE_S822	S822_1BAS_04	150.5	151.0	SUE_S822	149.5	149.7	S822_20120418_149.7	Sue D	
SUE_S826	S826_1BAS_01	107.5	108.0	SUE_S826	107.5	107.7	S826_20120418_107.7	Sue D	
SUE_S826	S826_1BAS_01	107.5	108.0	SUE_S826	103.1	103.3	S826_20120418_103.3	Sue D	
SUE_S826	S826_1BAS_02	108.0	108.5	SUE_S826	105.1	105.3	S826_20120418_105.3	Sue D	
SUE_S826	S826_1BAS_04	109.0	109.5	SUE_S826	111.2	111.4	S826_20120418_111.4	Sue D	
SUE_S827	S827_1BAS_01	141.8	142.3	SUE_S827	141.3	141.5	S827_20120418_141.5	Sue D	
SUE_SGT11-1A	SGT-11-1A_1BAS_57	111.0	111.5	SUE_SGT11-1A	113.8	114.0	SGT11-1A_20120418_114	Sue D	
SUE_S823	S823_1BAS_06	79.9	80.4					Sue D	Could not locate sample
SUE_SGT11-1A	SGT-11-1A_1BAS_63	119.5	120.0					Sue D	Could not collect due to elevated on SPP2-gamma
SUE_SGT11-1A	SGT-11-1A_1BAS_125	169.0	169.5					Sue D	Could not collect due to elevated on SPP2-gamma
Sandstone									
SUE_S731	S731SY08	81.0	91.0	SUE_S731	81.0	81.2	S731_20120418_81.2	Access Ramp	
SUE_S731	S731SY09	91.0	101.0	SUE_S731	99.0	99.2	S731_20120418_99.2	Access Ramp	
SUE_S731	S731SY13	130.0	133.0	SUE_S731	130.4	130.6	S731_20120418_130.6	Access Ramp	
SUE_S742	S742SY10	99.0	109.0	SUE_S742	105.8	106.0	S742_20120418_106	Caribou	
SUE_S782	S782MN22	127.7	128.2	SUE_S782	106.5	106.7	S782_20120418_106.7	Caribou	
MU_08_05	MU_08_05_1BAS_01	155.5	156.0	MU_08_05	156.0	156.2	MU08-05_20120418_156.2	MUG Pod 1	
MCG_07_03	MCG-07-03_1SYS_12	160.0	170.0	MCG_07_01	169.4	169.5	MCG07-01_20120418_169.5	MUG Pod 2	MCG07-03 was inaccessible due to snow cover. MCG07-01 was sampled instead. MCG07-01 is located very close to MCG07-03, and is inclined in the same direction towards MUG Pod 2.
MCS_21	MCS21_1SEL_19	150.0	150.5	MCS_21	150.5	150.7	MCS21_20120418_150.7	MUG Pod 8E	
MCS_22	MCS21_1SEL_26	153.5	154.0	MCS_22	154.0	154.2	MCS21_20120418_154.2	MUG Pod 8E	
MCS_23	MCS21_1SEL_29	155.0	155.3	MCS_23	155.0	155.2	MCS21_20120418_155.2	MUG Pod 8E	
MCS_05	MCS05_2SYS_05	240.0	250.0	MCS_05	140.8	141.0	MCS05_20120418_141	MUG Pod 8W	Core deeper than 141 m could not be located





AREVA Resources Canada		
Range in Arsenic and Uranium Content in Samples Initially Selected for Investigation		
EcoMetrix INCORPORATED	AREVA	Figure A.1

Appendix B Discussion on QA/QC for Metals Analysis on Humidity Cell Composite Sample

QA/QC Discussion for Humidity Cell Composite Samples

Composite samples for the humidity cell testing were comprised of drill core samples from the static testing. Results from the static testing were used to produce composites with ranges in arsenic and uranium content. A summary of the composites with corresponding arsenic and uranium contents are provided in **Table B.1**.

After the composites were prepared, the samples were submitted for laboratory analysis to SGS for metals content and ABA analysis. The results are provided in **Table B.2**. Concentrations of uranium were inconsistent with expected values based on weighted concentrations from each drill core segment. Therefore, sub-samples were also sent to SRC and ALS Chemex in Vancouver, BC for analysis. The sub-samples sent to SRC were also re-analyzed for additional results verification. The results are provided in **Table B.3**.

Results of the QA/QC comparison between laboratories show significant variation (**Figure B.1**). Overall, the average results from SRC show the greatest consistency with expected concentrations for arsenic and uranium based on weighted concentrations from each drill core segment. Therefore, the concentrations used in the assessment for the composite samples were based on the average of the SRC analyses.

TABLE B.2

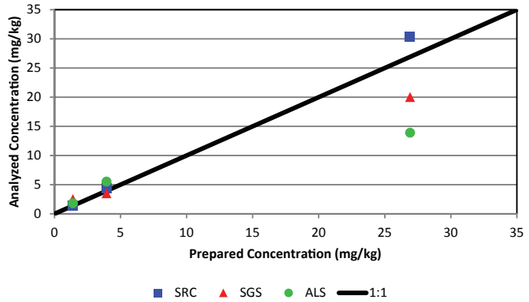
Summary of Metals Content in Humidity Cell Composite Samples - SGS Analysis

Parameter		LOW		MID		HIGH	
		Prepared	SGS	Prepared	SGS	Prepared	SGS
Arsenic	mg/kg	1.40	2.5	3.95	3.5	26.9	20
Cadmium	mg/kg	0.02	<0.02	0.03	<0.02	0.05	<0.02
Cobalt	mg/kg	7.29	2.8	3.80	2.6	3.90	3.2
Copper	mg/kg	3.50	11	3.17	5.7	3.52	5.2
Lead	mg/kg	3.01	2.3	2.46	1.6	5.21	2.3
Molybdenum	mg/kg	1.18	1.2	1.12	1.6	1.67	2.0
Nickel	mg/kg	18.2	13	16.7	14	28.2	26
Selenium	mg/kg	0.90	<0.7	0.70	<0.7	0.46	<0.7
Uranium	mg/kg	1.59	0.50	4.27	4.2	25.0	7.0
Vanadium	mg/kg	11.0	15	10.7	3	44.7	6
Zinc	mg/kg	5.40	5.6	8.68	6.2	3.96	1.5

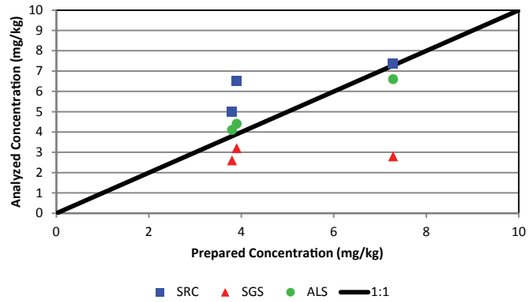
TABLE B.3
Summary of Metals Content in Humidity Cell Composite Samples - All Laboratories

Parameter		LOW						MID						HIGH					
		Prepared	ALS	SGS	SRC			Prepared	ALS	SGS	SRC			Prepared	ALS	SGS	SRC		
					Average	Minimum	Maximum				Average	Minimum	Maximum				Average	Minimum	Maximum
Arsenic	mg/kg	1.40	1.8	2.5	1.45	0.7	2.2	3.95	5.5	3.50	4.4	2.7	6.1	26.92	13.9	20.00	30.3	22.5	38.3
Cadmium	mg/kg	0.02	0.01	0.02	0.1	0.1	0.1	0.03	0.01	0.02	0.1	0.1	0.1	0.05	0.01	0.02	0.1	0.1	0.1
Cobalt	mg/kg	7.29	6.6	2.8	7.35	7.2	7.5	3.80	4.1	2.60	5	5	5	3.90	4.4	3.20	6.52	6.2	7.2
Copper	mg/kg	3.50	5.5	11	11.05	5.6	16.5	3.17	2.6	5.70	10.05	6	14.1	3.52	1.9	5.20	16.18	7.8	24.1
Lead	mg/kg	3.01	31.9	13	43	41	45	2.46	3	1.60	41.5	40	43	5.21	4.3	2.30	58.6	54	69
Molybdenum	mg/kg	1.18	3.7	2.3	4.42	2.87	5.97	1.12	1.13	1.60	2.57	2.38	2.76	1.67	0.79	2.00	6.916	6.13	8.45
Nickel	mg/kg	18.2	0.33	1.2	2.3	2.3	2.3	16.7	24.2	14.00	1.35	0.1	2.6	28.2	25.4	26.00	1.68	0.4	3.3
Selenium	mg/kg	0.90	0.5	0.7	3	1	5	0.70	0.2	0.70	1	1	1	0.46	<0.2	0.70	1	1	1
Uranium	mg/kg	1.59	2.31	0.5	6.19	5.02	7.36	4.27	3.11	4.20	5.01	4.7	5.32	24.96	7.34	7.00	23.56	21.5	24.7
Vanadium	mg/kg	11.0	47	15	89	82	96	10.7	7	3.00	42	40	44	44.7	32	6.00	180.4	166	203
Zinc	mg/kg	5.40	10	5.6	8.5	1	16	8.68	5	6.20	15.5	1	30	3.96	5	1.50	7.2	1	13

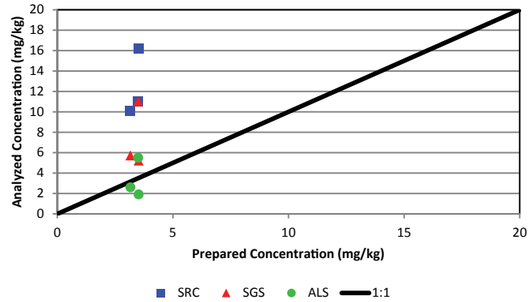
Arsenic Content



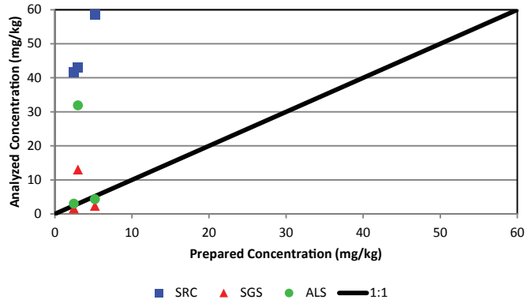
Cobalt Content



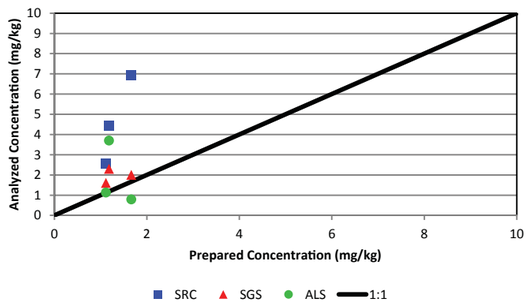
Copper Content



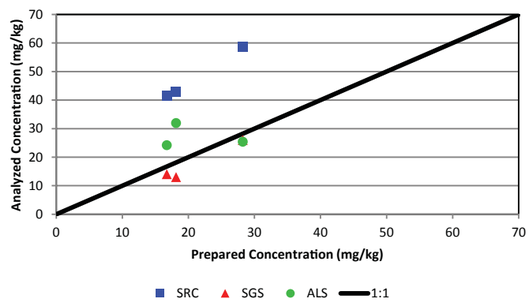
Lead Content



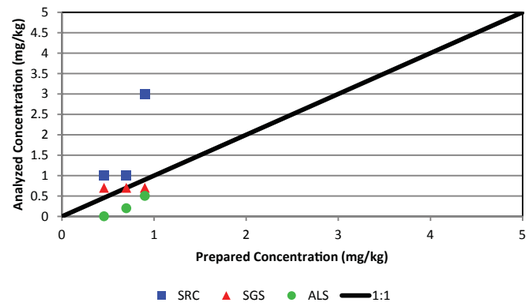
Molybdenum Content



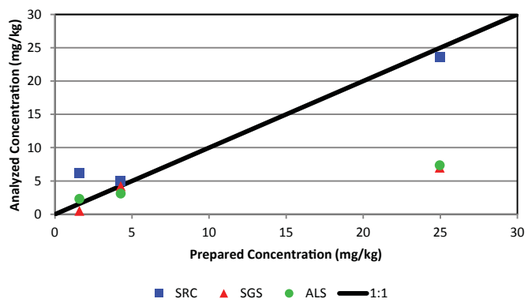
Nickel Content



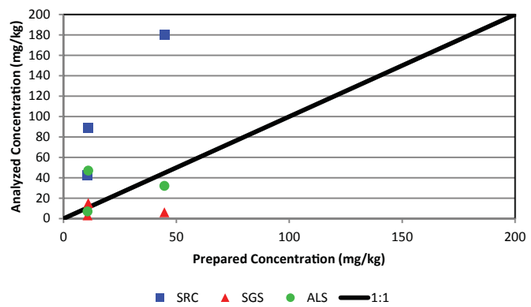
Selenium Content



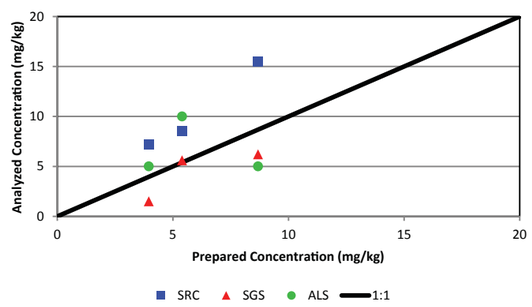
Uranium Content



Vanadium Content



Zinc Content



AREVA Resources Canada

Comparison of Metal Content Analysis Between Analytical Laboratories

EcoMetrix INCORPORATED

AREVA

Figure B.1

Appendix C **Compilation of Solids Chemistry Data**

TABLE C.1
Compilation of Solids Chemistry Data

Sample ID	Ore Body Simplified	Observed Core Type	EcoMetrix/SRC	Moisture	pH, paste	Carbonate	Organic carbon	Total carbon	Total Sulphur	Sulfide Sulphur	Sulphate Sulphur	Neutralization Potential (NP)	Acid Generation Potential (AP)	Net NP	Ratio (NP:AP)
				%	pH units	%	%	%	%	%	%	kg CaCO3/t	kg CaCO3/t	kg CaCO3/t	
Average Crustal Abundance[1]				---	---	---	---	---	---	---	---	---	---	---	---
S730_20120418_152.8	Access Ramp	Basement	EcoMetrix			0.0038	0.007	0.014	0.026	0.030	< 0.01				
S730_20120418_150.8	Access Ramp	Basement	EcoMetrix		7.07	0.264	0.018	0.315	0.132	0.09	0.04	28	2.85	25.0	9.78
S730_20120418_156	Access Ramp	Basement	EcoMetrix			0.0464	0.103	0.23	0.040	0.020	0.020				
S730_20120418_156.3	Access Ramp	Basement	EcoMetrix		8.10	0.014	0.029	0.063	0.040	0.03	< 0.01	4.7	0.94	3.76	5.00
S730_20120418_163.2	Access Ramp	Basement	EcoMetrix			1.432	1.56	1.4	0.10	0.08	0.02				
S730_20120418_139.9	Access Ramp	Basement	EcoMetrix			0.0098	0.009	0.031	0.041	0.020	0.020				
S730_20120418_147.7	Access Ramp	Basement	EcoMetrix		6.20	0.0068	0.011	0.027	0.056	0.03	0.02	2.9	0.94	1.96	3.09
S730_20120418_133.2	Access Ramp	Basement	EcoMetrix		6.56	0.007	0.024	0.032	0.039	0.02	0.02	3.0	0.62	2.38	4.84
S730_20120418_144.9	Access Ramp	Basement	EcoMetrix		7.54	0.0934	0.305	0.510	0.049	0.03	0.02	16	0.94	15.6	17.6
S730_20120418_147	Access Ramp	Basement	EcoMetrix			0.0076	0.008	0.021	0.030	< 0.01	0.030				
S730_20120418_138.2	Access Ramp	Basement	EcoMetrix			0.006	0.012	0.017	0.030	< 0.01	0.030				
S730_20120418_135.2	Access Ramp	Basement	EcoMetrix		6.21	0.0042	0.028	0.022	0.044	0.02	0.02	2.2	0.62	1.58	3.55
S730_20120418_125.5	Access Ramp	Basement	EcoMetrix			0.0044	0.03	0.021	0.029	0.020	< 0.01				
S730_20120418_131.3	Access Ramp	Basement	EcoMetrix			0.0038	0.008	0.013	0.037	0.040	< 0.01				
MCN15_20120417_226	Candy Lake	Basement	EcoMetrix		8.43	0.1788	0.112	0.202	0.536	0.54	< 0.01	16	16.9	-0.52	0.97
MCN04_20120417_226.8	Candy Lake	Basement	EcoMetrix		8.43	1.464	1.40	1.42	2.33	2.30	0.02	15	71.9	-56.7	0.21
MCN05_20120417_198.7	Candy Lake	Basement	EcoMetrix		8.06	0.0068	0.005	0.015	0.024	0.02	< 0.01	5.9	0.61	5.29	9.63
MCN17_20120417_189.7	Candy Lake	Basement	EcoMetrix		7.91	0.146	0.152	0.150	0.010	0.02	< 0.01	5.2	0.62	4.58	8.39
MCN12_20120417_218	Candy Lake	Basement	EcoMetrix		8.62	0.0188	0.020	0.034	0.019	0.02	< 0.01	5.7	0.62	5.08	9.19
MCN14_20120417_227	Candy Lake	Basement	EcoMetrix		8.25	0.0718	0.068	0.072	0.018	0.02	< 0.01	7.9	0.62	7.28	12.7
MCN09_20120417_207	Candy Lake	Basement	EcoMetrix		8.39	0.0812	0.082	0.082	0.498	0.52	< 0.01	7.3	16.4	-9.05	0.45
MCN08_20120417_233.5	Candy Lake	Basement	EcoMetrix		8.61	1.76	1.00	1.83	1.07	1.11	< 0.01	78	34.6	42.9	2.24
MCN02_20120417_278.7	Candy Lake	Basement	EcoMetrix		8.74	0.418	0.410	0.414	0.631	0.45	0.18	8.1	14.1	-5.99	0.57
S700_20120418_130.5	Caribou	Basement	EcoMetrix			0.0044	0.01	0.016	0.034	0.020	0.010				
S701_20120418_124	Caribou	Basement	EcoMetrix		7.69	0.0056	0.014	0.026	0.046	0.03	0.02	5.4	0.94	4.46	5.74
S708_20120418_134.4	Caribou	Basement	EcoMetrix			0.004	0.006	0.008	0.024	0.020	< 0.01				
S700_20120418_128.8	Caribou	Basement	EcoMetrix		7.67	0.016	0.026	0.028	0.029	0.02	0.01	3.8	0.62	3.18	6.13
S701_20120418_122.3	Caribou	Basement	EcoMetrix			0.0054	0.013	0.033	0.023	< 0.01	0.020				
S712_20120418_142	Caribou	Basement	EcoMetrix			0.09	0.116	0.124	0.021	< 0.01	0.020				
S744_20120418_130.8	Caribou	Basement	EcoMetrix			0.0038	< 0.005	0.011	0.027	0.03	< 0.01				
MU08-05_20120418_174.5	MUG	Basement	EcoMetrix		7.21	0.0046	< 0.005	0.009	0.034	< 0.01	0.03	3.2	0.31	2.89	10.3
MU08-05_20120418_168.2	MUG	Basement	EcoMetrix		8.00	0.0244	0.029	0.035	0.026	0.02	< 0.01	5.1	0.62	4.48	8.23
MCG07-01_20120418_190.1	MUG	Basement	EcoMetrix			0.011	0.016	0.017	0.031	0.020	< 0.01				
MCG07-01_20120418_180.1	MUG	Basement	EcoMetrix			0.0066	0.016	0.015	0.040	0.040	< 0.01				
MCG07-01_20120418_178.8	MUG	Basement	EcoMetrix		7.03	0.0052	0.006	0.017	0.020	0.02	< 0.01	3.5	0.62	2.88	5.65
MCG07-01_20120418_182.6	MUG	Basement	EcoMetrix			0.0052	0.015	0.016	0.023	0.020	< 0.01				
MCG07-01_20120418_184.1	MUG	Basement	EcoMetrix		7.87	0.004	0.006	0.011	0.018	< 0.01	0.02	4.9	0.31	4.59	15.8
MCS09_20120418_210.2	MUG	Basement	EcoMetrix			0.079	0.076	0.087	0.032	0.030	< 0.01				
MU08-08_20120418_173	MUG	Basement	EcoMetrix		8.38	0.0254	0.023	0.034	0.032	0.03	< 0.01	9.2	0.94	8.26	9.8
MU08-08_20120418_179.5	MUG	Basement	EcoMetrix			0.0362	0.039	0.038	0.024	0.020	< 0.01				
MU08-08_20120418_178.2	MUG	Basement	EcoMetrix			0.0046	0.006	0.012	0.027	0.030	< 0.01				
MCS21_20120418_161	MUG	Basement	EcoMetrix			0.1332	0.13	0.168	0.006	< 0.01	< 0.01				
MCS22_20120418_171	MUG	Basement	EcoMetrix			0.006	< 0.005	0.008	0.029	< 0.03	< 0.01				
MCS22_20120418_165.7	MUG	Basement	EcoMetrix			0.0044	< 0.005	0.008	0.025	< 0.03	< 0.01				
MCS22_20120418_166.7	MUG	Basement	EcoMetrix		8.06	0.0032	< 0.005	0.007	0.010	< 0.01	0.01	3.2	0.31	2.89	10.3
S822_20120418_149.7	Sue D	Basement	EcoMetrix		7.24	0.0074	0.014	0.012	0.017	< 0.01	0.02	2.8	0.31	2.49	9.03
MCS21_20120418_160.7	MUG	Basement	SRC	0.82	7.34	0.13			0.01	0.01	<0.001	1.7	<0.5	-1.7	3.4
MCS21_20120418_158.4	MUG	Basement	SRC	0.16	7.21	0.03			0.08	0.07	0.025	1.1	2.2	1.1	0.5
S826_20120418_111.4	Sue D	Basement	SRC	0.13	6.48	0.06			0.01	0.01	<0.001	<0.5	<0.5	<0.5	
S826_20120418_107.7	Sue D	Basement	SRC	0.29	6.64	0.01			0.01	0.01	<0.001	<0.5	<0.5	<0.5	
S731_20120418_99.2	Access Ramp	Sandstone	EcoMetrix		6.89	0.007	0.010	0.024	0.016	< 0.01	0.02	3.3	0.31	2.99	10.6

TABLE C.1
Compilation of Solids Chemistry Data

Sample ID	Ore Body Simplified	Observed Core Type	EcoMetrix/SRC	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Average Crustal Abundance[1]				84000	0.2	1.0	250	1.5			0.1		185	29	75	71000	8		1400
S730_20120418_152.8	Access Ramp	Basement	EcoMetrix	4900	1.0	230	2.6	0.73	0.27		< 0.02	430	100	42	2.5	3700	0.72	3800	26
S730_20120418_150.8	Access Ramp	Basement	EcoMetrix	4000	5.6	8300	6.4	0.59	7.9		0.04	12000	100	1800	110	4600	13	2600	160
S730_20120418_156	Access Ramp	Basement	EcoMetrix	5000	2.3	300	5.5	1.1	0.84		0.06	2400	150	100	9.3	10000	1.5	4900	140
S730_20120418_156.3	Access Ramp	Basement	EcoMetrix	5000	1.0	680	4.3	0.92	1.2		0.03	640	180	150	11	5500	1.3	4200	61
S730_20120418_163.2	Access Ramp	Basement	EcoMetrix	7700	< 0.8	1800	12	1.7	25		0.08	1300	36	460	40	7100	16	7300	29
S730_20120418_139.9	Access Ramp	Basement	EcoMetrix	3000	1.1	970	10	0.33	0.15		0.03	1300	130	34	4.4	4200	1.0	1000	30
S730_20120418_147.7	Access Ramp	Basement	EcoMetrix	2400	7.0	4400	3.1	0.14	5.0		< 0.02	370	240	1700	6.4	3900	3.1	1100	38
S730_20120418_133.2	Access Ramp	Basement	EcoMetrix	3200	1.4	99	7.7	0.51	0.13		0.04	330	140	4.9	2.8	2800	2.3	370	46
S730_20120418_144.9	Access Ramp	Basement	EcoMetrix	3500	4.0	5900	8.5	0.38	5.1		0.12	5400	67	240	18	22000	5.7	8100	320
S730_20120418_147	Access Ramp	Basement	EcoMetrix	2900	2.4	1100	7.6	0.34	1.4		< 0.02	810	170	250	4.8	3300	4.1	2100	34
S730_20120418_138.2	Access Ramp	Basement	EcoMetrix	2000	1.1	960	3.6	0.20	0.32		0.02	190	160	67	5.6	2800	1.1	280	23
S730_20120418_135.2	Access Ramp	Basement	EcoMetrix	2900	1.1	140	7.6	0.45	< 0.09		0.04	360	110	39	2.8	2500	6.3	690	67
S730_20120418_125.5	Access Ramp	Basement	EcoMetrix	3500	< 0.8	9.6	5.6	0.24	0.28		0.02	600	4.1	4.7	1.1	410	2.0	360	18
S730_20120418_131.3	Access Ramp	Basement	EcoMetrix	3200	< 0.8	35	2.4	0.25	< 0.09		< 0.02	180	110	2.3	2.0	2000	0.82	260	18
MCN15_20120417_226	Candy Lake	Basement	EcoMetrix	17000	< 0.8	0.7	5.4	0.89	0.14		0.02	3800	77	6.4	6.1	20000	1.6	16000	200
MCN04_20120417_226.8	Candy Lake	Basement	EcoMetrix	26000	< 0.8	210	8.6	4.2	9.3		0.05	4300	140	38	27	38000	3.9	26000	80
MCN05_20120417_198.7	Candy Lake	Basement	EcoMetrix	11000	< 0.8	3.5	4.7	1.2	0.22		0.02	1600	110	8.3	7.4	4700	2.4	6900	56
MCN17_20120417_189.7	Candy Lake	Basement	EcoMetrix	7000	< 0.8	0.9	9.1	0.75	< 0.09		0.02	1200	110	3.5	4.4	4900	1.4	3200	32
MCN12_20120417_218	Candy Lake	Basement	EcoMetrix	9500	< 0.8	1.3	7.7	0.80	0.24		< 0.02	950	50	3.0	47	7800	8.1	6200	37
MCN14_20120417_227	Candy Lake	Basement	EcoMetrix	19000	< 0.8	0.8	12	1.8	0.17		< 0.02	1000	97	7.6	3.1	9300	2.6	17000	36
MCN09_20120417_207	Candy Lake	Basement	EcoMetrix	22000	< 0.8	7.6	25	2.4	1.9		0.25	1800	120	21	22	22000	27	21000	74
MCN08_20120417_233.5	Candy Lake	Basement	EcoMetrix	23000	< 0.8	5.5	2.9	1.7	3.2		0.04	17000	100	18	10	26000	5.2	31000	100
MCN02_20120417_278.7	Candy Lake	Basement	EcoMetrix	24000	< 0.8	5.7	45	1.7	1.2		0.05	1500	140	37	59	34000	7.6	19000	98
S700_20120418_130.5	Caribou	Basement	EcoMetrix	6700	1.7	200	8.2	0.66	0.18		< 0.02	340	130	11	3.3	8100	4.4	2500	30
S701_20120418_124	Caribou	Basement	EcoMetrix	8400	3.9	450	6.3	1.1	0.15		0.02	1900	88	21	3.8	3100	2.2	4400	37
S708_20120418_134.4	Caribou	Basement	EcoMetrix	5100	8.5	170	9.8	0.59	< 0.09		< 0.02	380	100	7.7	3.8	6900	1.3	2400	37
S700_20120418_128.8	Caribou	Basement	EcoMetrix	7400	< 0.8	440	5.1	1.2	0.26		< 0.02	350	140	6.5	5.9	3700	3.4	3800	34
S701_20120418_122.3	Caribou	Basement	EcoMetrix	3900	1.8	66	7.9	0.50	0.23		0.02	570	90	5.0	3.1	4200	1.7	1200	80
S712_20120418_142	Caribou	Basement	EcoMetrix	6900	< 0.8	1.7	4.2	1.1	< 0.09		< 0.02	230	140	4.8	3.1	5600	5.4	4500	87
S744_20120418_130.8	Caribou	Basement	EcoMetrix	3600	0.9	110	8.8	0.27	< 0.09		< 0.02	470	99	2.9	2.0	3800	0.77	600	31
MU08-05_20120418_174.5	MUG	Basement	EcoMetrix	5000	< 0.8	19	6.4	0.71	0.12		< 0.02	330	140	2.2	2.8	3200	3.3	1400	24
MU08-05_20120418_168.2	MUG	Basement	EcoMetrix	5800	< 0.8	12	4.3	0.56	0.27		< 0.02	1100	89	5.9	3.2	2700	1.7	2400	24
MCG07-01_20120418_190.1	MUG	Basement	EcoMetrix	6600	< 0.8	1.9	7.7	0.94	< 0.09		0.04	2200	110	2.1	2.0	9000	1.8	4400	41
MCG07-01_20120418_180.1	MUG	Basement	EcoMetrix	5500	< 0.8	2.6	5.9	0.77	< 0.09		0.02	1500	110	2.1	2.9	3700	2.2	2100	30
MCG07-01_20120418_178.8	MUG	Basement	EcoMetrix	2700	< 0.8	1.0	6.8	0.40	< 0.09		0.02	1600	120	25	7.7	2200	1.6	410	26
MCG07-01_20120418_182.6	MUG	Basement	EcoMetrix	3600	< 0.8	1.2	4.5	0.48	< 0.09		0.02	1600	93	2.3	1.7	2100	5.2	600	22
MCG07-01_20120418_184.1	MUG	Basement	EcoMetrix	4400	< 0.8	2.9	3.8	0.62	< 0.09		0.04	1800	100	0.98	2.2	7500	1.7	1500	31
MCS09_20120418_210.2	MUG	Basement	EcoMetrix	13000	< 0.8	< 0.5	17	0.93	< 0.09		< 0.02	580	120	4.7	1.9	9400	0.76	9100	34
MU08-08_20120418_173	MUG	Basement	EcoMetrix	12000	< 0.8	5.1	3.6	1.2	0.25		0.05	2800	110	7.9	6.0	6600	3.1	8700	40
MU08-08_20120418_179.5	MUG	Basement	EcoMetrix	7300	< 0.8	5.8	1.8	0.45	0.15		< 0.02	1400	110	2.3	3.1	2400	0.95	3900	22
MU08-08_20120418_178.2	MUG	Basement	EcoMetrix	6800	< 0.8	2.3	2.0	0.43	0.95		< 0.02	1100	100	2.0	3.7	2200	5.7	4200	21
MCS21_20120418_161	MUG	Basement	EcoMetrix	1800	< 0.8	2.1	6.8	0.15	< 0.09		< 0.02	450	210	0.87	3.6	5000	0.86	440	33
MCS22_20120418_171	MUG	Basement	EcoMetrix	7200	< 0.8	2.4	3.3	0.62	< 0.09		< 0.02	390	90	2.8	1.8	2800	2.0	4000	22
MCS22_20120418_165.7	MUG	Basement	EcoMetrix	4000	< 0.8	5.0	4.5	0.31	< 0.09		< 0.02	170	130	1.7	2.2	2100	1.5	670	20
MCS22_20120418_166.7	MUG	Basement	EcoMetrix	5000	< 0.8	3.7	4.3	0.42	0.12		< 0.02	280	120	3.3	2.8	2700	1.8	1900	22
S822_20120418_149.7	Sue D	Basement	EcoMetrix	890	< 0.8	15	4.6	0.09	0.15		< 0.02	77	260	2.4	13	6500	1.7	260	43
MCS21_20120418_160.7	MUG	Basement	SRC	8900	<0.2	6.2	16	0.4		32	<0.1		390	0.8	2.2	5600	5.6		45
MCS21_20120418_158.4	MUG	Basement	SRC	67900	<0.2	45	91	2.3		210	0.1		320	2.5	2.3	4700	17		25
S826_20120418_111.4	Sue D	Basement	SRC	44600	<0.2	26	21	0.6		87	0.1		190	0.4	1.3	12400	9.7		24
S826_20120418_107.7	Sue D	Basement	SRC	42800	0.2	73	17	0.6		100	<0.1		160	5.3	1.7	1300	8.3		14
S731_20120418_99.2	Access Ramp	Sandstone	EcoMetrix	1500	< 0.8	16	6.8	0.09	< 0.09		0.03	80	210	2.7	3.8	3100	1.7	66	29

TABLE C.1
Compilation of Solids Chemistry Data

Sample ID	Ore Body Simplified	Observed Core Type	EcoMetrix/SRC	Molybdenum	Nickel	Potassium	Selenium	Silver	Strontium	Sulphur	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Ytrium
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Average Crustal Abundance[1]				1	105		0.05	0.08	260		0.36	2.5	5300	0.9	230	80	
S730_20120418_152.8	Access Ramp	Basement	EcoMetrix	26	170	2100	< 0.7	0.05	9.6	120	0.07	< 0.5	2.5	33	10	2.8	11
S730_20120418_150.8	Access Ramp	Basement	EcoMetrix	14	2100	2900	< 0.7	0.70	24	1700	0.26	< 0.5	16	29	< 1	18	8.3
S730_20120418_156	Access Ramp	Basement	EcoMetrix	87	170	1500	< 0.7	0.36	13	490	0.16	< 0.5	14	28	15	5.4	6.8
S730_20120418_156.3	Access Ramp	Basement	EcoMetrix	26	220	1400	< 0.7	0.29	8.7	350	0.09	< 0.5	13	20	16	4.2	4.5
S730_20120418_163.2	Access Ramp	Basement	EcoMetrix	6.8	180	3100	7.6	0.35	25	1700	0.08	< 0.5	45	13	16	21	7.6
S730_20120418_139.9	Access Ramp	Basement	EcoMetrix	9.5	250	2600	< 0.7	0.15	13	550	0.36	< 0.5	7.1	11	12	6.2	2.9
S730_20120418_147.7	Access Ramp	Basement	EcoMetrix	2.8	900	1800	< 0.7	0.15	11	600	0.10	< 0.5	5.6	11	12	5.6	7.0
S730_20120418_133.2	Access Ramp	Basement	EcoMetrix	0.8	15	2700	< 0.7	0.15	50	430	0.21	< 0.5	7.1	9.4	< 1	14	2.3
S730_20120418_144.9	Access Ramp	Basement	EcoMetrix	6.0	2700	2600	< 0.7	0.38	18	570	0.46	< 0.5	26	7.9	5	29	3.0
S730_20120418_147	Access Ramp	Basement	EcoMetrix	1.4	940	2100	< 0.7	0.11	15	360	0.06	< 0.5	4.3	7.4	11	7.3	2.2
S730_20120418_138.2	Access Ramp	Basement	EcoMetrix	5.7	340	2000	< 0.7	0.11	12	410	0.10	< 0.5	6.2	4.1	2	1.7	1.7
S730_20120418_135.2	Access Ramp	Basement	EcoMetrix	1.7	80	2300	< 0.7	0.09	35	420	0.17	< 0.5	3.4	3.7	12	30	1.4
S730_20120418_125.5	Access Ramp	Basement	EcoMetrix	0.2	10	3200	< 0.7	0.09	34	110	< 0.02	< 0.5	1.4	2.4	12	2.5	1.2
S730_20120418_131.3	Access Ramp	Basement	EcoMetrix	0.4	16	1400	< 0.7	0.06	17	59	< 0.02	< 0.5	1.2	1.5	10	1.8	0.32
MCN15_20120417_226	Candy Lake	Basement	EcoMetrix	0.4	16	3100	< 0.7	0.04	18	5500	0.05	< 0.5	7.9	40	17	26	4.0
MCN04_20120417_226.8	Candy Lake	Basement	EcoMetrix	11	50	2600	< 0.7	0.38	12	23000	0.58	0.9	200	15	48	21	6.4
MCN05_20120417_198.7	Candy Lake	Basement	EcoMetrix	2.2	24	2000	< 0.7	0.05	18	270	0.04	< 0.5	23	12	13	2.0	3.6
MCN17_20120417_189.7	Candy Lake	Basement	EcoMetrix	0.9	17	3000	< 0.7	0.04	47	76	0.03	< 0.5	60	5.0	12	5.4	4.8
MCN12_20120417_218	Candy Lake	Basement	EcoMetrix	0.3	8.5	2600	< 0.7	0.05	14	310	0.06	< 0.5	5.1	4.8	7	11	3.1
MCN14_20120417_227	Candy Lake	Basement	EcoMetrix	0.7	22	2900	< 0.7	0.03	15	170	0.12	0.5	160	3.2	17	10	4.3
MCN09_20120417_207	Candy Lake	Basement	EcoMetrix	4.2	46	4100	< 0.7	0.14	23	5000	0.11	0.7	280	3.0	44	27	5.3
MCN08_20120417_233.5	Candy Lake	Basement	EcoMetrix	6.4	47	2300	< 0.7	0.17	13	10000	0.16	1.1	65	2.5	40	4.7	4.6
MCN02_20120417_278.7	Candy Lake	Basement	EcoMetrix	5.6	43	6800	< 0.7	0.12	31	5600	0.28	1.3	780	2.4	53	36	4.1
S700_20120418_130.5	Caribou	Basement	EcoMetrix	21	370	2300	< 0.7	0.03	14	200	0.06	< 0.5	8.3	89	12	1.9	4.3
S701_20120418_124	Caribou	Basement	EcoMetrix	12	310	1900	< 0.7	0.18	11	320	0.03	< 0.5	24	22	35	5.7	13
S708_20120418_134.4	Caribou	Basement	EcoMetrix	6.2	470	2500	< 0.7	0.06	11	140	< 0.02	< 0.5	11	12	1	3.2	1.2
S700_20120418_128.8	Caribou	Basement	EcoMetrix	16	600	2100	< 0.7	0.06	22	280	0.21	< 0.5	46	10	5	2.3	4.9
S701_20120418_122.3	Caribou	Basement	EcoMetrix	1.0	48	2100	< 0.7	0.13	17	170	0.02	< 0.5	9.9	10	< 1	1.4	3.4
S712_20120418_142	Caribou	Basement	EcoMetrix	0.8	20	790	< 0.7	0.04	7.6	110	0.02	< 0.5	5.5	4.4	11	4.2	1.0
S744_20120418_130.8	Caribou	Basement	EcoMetrix	2.9	160	2700	< 0.7	0.03	35	41	< 0.02	< 0.5	6.0	4.8	11	2.4	2.6
MU08-05_20120418_174.5	MUG	Basement	EcoMetrix	5.0	79	2500	< 0.7	0.05	34	380	0.04	< 0.5	12	13	5	0.7	7.3
MU08-05_20120418_168.2	MUG	Basement	EcoMetrix	2.0	40	2600	< 0.7	0.06	19	170	0.02	< 0.5	19	5.5	9	1.9	6.0
MCG07-01_20120418_190.1	MUG	Basement	EcoMetrix	0.4	9.9	4000	< 0.7	0.06	40	150	0.06	0.8	110	3.7	6	8.3	6.2
MCG07-01_20120418_180.1	MUG	Basement	EcoMetrix	0.5	17	2100	< 0.7	0.03	83	170	0.03	< 0.5	35	1.9	< 1	4.2	6.6
MCG07-01_20120418_178.8	MUG	Basement	EcoMetrix	4.3	30	2300	< 0.7	0.06	20	180	0.02	< 0.5	26	1.6	< 1	2.7	3.9
MCG07-01_20120418_182.6	MUG	Basement	EcoMetrix	0.5	9.9	3200	< 0.7	0.03	31	130	0.03	< 0.5	23	1.1	< 1	3.8	9.1
MCG07-01_20120418_184.1	MUG	Basement	EcoMetrix	0.6	7.9	2200	< 0.7	0.04	36	95	0.02	0.6	33	1.0	1	11	7.5
MCS09_20120418_210.2	MUG	Basement	EcoMetrix	0.5	19	3300	< 0.7	0.04	59	85	0.07	< 0.5	170	0.56	36	11	2.6
MU08-08_20120418_173	MUG	Basement	EcoMetrix	0.8	23	1600	< 0.7	0.04	24	200	0.05	< 0.5	19	6.9	4	35	7.8
MU08-08_20120418_179.5	MUG	Basement	EcoMetrix	0.7	28	1100	< 0.7	0.02	8.7	92	< 0.02	< 0.5	2.8	4.0	17	0.6	2.7
MU08-08_20120418_178.2	MUG	Basement	EcoMetrix	0.6	11	960	1.9	0.02	7.5	110	< 0.02	< 0.5	2.8	1.2	10	0.7	2.6
MCS21_20120418_161	MUG	Basement	EcoMetrix	0.9	6.6	920	< 0.7	0.05	6.8	79	< 0.02	< 0.5	9.5	20	15	0.4	0.60
MCS22_20120418_171	MUG	Basement	EcoMetrix	2.7	11	1200	< 0.7	0.03	21	100	< 0.02	< 0.5	8.0	5.5	11	2.0	1.7
MCS22_20120418_165.7	MUG	Basement	EcoMetrix	0.8	7.4	2100	< 0.7	0.03	23	50	0.03	< 0.5	6.6	2.6	9	2.8	2.2
MCS22_20120418_166.7	MUG	Basement	EcoMetrix	0.9	11	2300	< 0.7	0.03	24	51	0.07	< 0.5	32	2.2	12	7.5	1.6
S822_20120418_149.7	Sue D	Basement	EcoMetrix	1.7	14	260	< 0.7	0.08	4.2	150	< 0.02	< 0.5	5.4	37	14	0.6	1.1
MCS21_20120418_160.7	MUG	Basement	SRC	0.6	10		<0.1	<0.1	47		<0.2	0.2	40	88	11	1.6	
MCS21_20120418_158.4	MUG	Basement	SRC	0.4	22		0.1	<0.1	1900		<0.2	0.5	210	190	75	9.9	
S826_20120418_111.4	Sue D	Basement	SRC	0.7	3.7		<0.1	<0.1	470		<0.2	0.2	69	15	22	2	
S826_20120418_107.7	Sue D	Basement	SRC	4.1	13		<0.1	<0.1	330		<0.2	0.1	38	56	26	3.7	
S731_20120418_99.2	Access Ramp	Sandstone	EcoMetrix	1.4	7.9	460	< 0.7	0.06	50	57	< 0.02	< 0.5	18	0.92	11	2.5	1.2

TABLE C.1
Compilation of Solids Chemistry Data

Sample ID	Ore Body Simplified	Observed Core Type	EcoMetrix/SRC	Moisture	pH, paste	Carbonate	Organic carbon	Total carbon	Total Sulphur	Sulfide Sulphur	Sulphate Sulphur	Neutralization Potential (NP)	Acid Generation Potential (AP)	Net NP	Ratio (NP:AP)
				%	pH units	%	%	%	%	%	%	kg CaCO3/t	kg CaCO3/t	kg CaCO3/t	
Average Crustal Abundance[1]				---	---	---	---	---	---	---	---	---	---	---	---
S731_20120418_130.6	Access Ramp	Sandstone	EcoMetrix			0.0068	0.008	0.016	< 0.005	< 0.01	< 0.01				
S731_20120418_81.2	Access Ramp	Sandstone	EcoMetrix		6.33	0.0052	< 0.005	0.016	0.006	< 0.01	< 0.01	2.7	0.31	2.39	8.71
S742_20120418_106	Caribou	Sandstone	EcoMetrix			0.006	< 0.005	0.02	0.036	< 0.01	0.040				
S782_20120418_106.7	Caribou	Sandstone	EcoMetrix		6.72	0.0056	0.015	0.016	0.010	< 0.01	0.01	3.3	0.31	2.99	10.6
MU08-05_20120418_156.2	MUG	Sandstone	EcoMetrix		5.87	2.56	2.40	2.48	5.36	5.24	0.11	8.9	164	-155	0.05
MCG07-01_20120418_169.5	MUG	Sandstone	EcoMetrix		6.88	0.0074	0.009	0.025	0.019	< 0.01	0.02	2.8	0.31	2.49	9.03
MCS05_20120418_141	MUG	Sandstone	EcoMetrix		8.52	0.009	0.008	0.020	0.155	0.16	< 0.01	9.9	5.04	4.86	1.97
MCS21_20120418_150.7	MUG	Sandstone	SRC	0.16	4.26	0.01			0.13	0.09	0.11	<0.5	2.9	2.9	0.172413793
MCS21_20120418_154.2	MUG	Sandstone	SRC	0.42	7.01	0.01			0.02	0.01	0.023	1	<0.5	-1	>2.
MCS21_20120418_155.2	MUG	Sandstone	SRC	0.37	7.27	0.01			0.01	<0.01	0.006	1	<0.5	-1	>2.
S826_20120418_105.3	Sue D	Sandstone	SRC	0.17	6.59	0.02			0.01	0.01	<0.001	<0.5	<0.5	<0.5	
S826_20120418_103.3	Sue D	Sandstone	SRC	0.33	6.33	0.01			0.01	<0.01	0.009	<0.5	<0.5	<0.5	
SGT11_01A_20120418_114	Sue D	Sandstone	SRC	0.66	7.55	2.12			0.01	0.01	<0.001	3.7	<0.5	-3.7	>7.4
S827_20120418_141.5	Sue D	Sandstone	SRC	0.28	7.43	0.01			0.01	0.01	<0.001	0.5	<0.5	-0.5	1
S822_20120418_147	Sue D	Sandstone	SRC	0.3	6.74	0.01			0.02	0.02	0.015	<0.5	<0.5	<0.5	
MCN11_20120417_190.6	Candy Lake	Basement	SRC	1.54	7.2	0.01			0.27	0.26	0.04	2.5	8	5.5	0.3125
MCN_20120417_206.7	Candy Lake	Basement	SRC	0.33	7.58	0.01			0.01	<0.01	0.003	3.6	<0.5	-3.6	7.2

TABLE C.1
Compilation of Solids Chemistry Data

Sample ID	Ore Body Simplified	Observed Core Type	EcoMetrix/SRC	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Average Crustal Abundance[1]				84000	0.2	1.0	250	1.5			0.1		185	29	75	71000	8		1400
S731_20120418_130.6	Access Ramp	Sandstone	EcoMetrix	1700	< 0.8	5.0	1.9	0.05	< 0.09		< 0.02	86	190	1.1	3.2	3100	0.98	110	29
S731_20120418_81.2	Access Ramp	Sandstone	EcoMetrix	840	< 0.8	26	4.4	0.04	< 0.09		< 0.02	55	190	5.8	3.4	3700	1.3	33	32
S742_20120418_106	Caribou	Sandstone	EcoMetrix	1400	0.8	110	7.1	0.15	1.5		0.18	100	180	15	7.5	3600	7.9	94	28
S782_20120418_106.7	Caribou	Sandstone	EcoMetrix	950	3.0	84	6.9	0.11	< 0.09		0.07	130	210	3.2	7.6	4600	4.7	92	41
MU08-05_20120418_156.2	MUG	Sandstone	EcoMetrix	13000	< 0.8	84	21	1.9	23		0.13	4400	110	36	69	53000	35	9100	120
MCG07-01_20120418_169.5	MUG	Sandstone	EcoMetrix	1200	< 0.8	1.8	3.7	0.08	0.12		0.05	95	190	1.7	5.7	4000	4.3	82	55
MCS05_20120418_141	MUG	Sandstone	EcoMetrix	29000	< 0.8	2.5	5.3	2.7	1.5		0.44	1400	92	6.6	63	15000	35	29000	46
MCS21_20120418_150.7	MUG	Sandstone	SRC	14200	0.6	38	24	1.9		85	0.4		270	19	5.9	4500	59		32
MCS21_20120418_154.2	MUG	Sandstone	SRC	61200	0.4	30	110	3.9		210	0.3		190	5.5	1.5	4200	34		29
MCS21_20120418_155.2	MUG	Sandstone	SRC	68100	<0.2	13	45	4.4		180	0.3		190	8	2.6	5700	30		35
S826_20120418_105.3	Sue D	Sandstone	SRC	56900	<0.2	12	8.7	0.9		220	<0.1		210	2.6	2.6	4500	9.2		26
S826_20120418_103.3	Sue D	Sandstone	SRC	56000	<0.2	18	13	0.7		210	<0.1		220	9.3	1.8	1700	9.3		22
SGT11_01A_20120418_114	Sue D	Sandstone	SRC	86800	<0.2	3.1	72	3.6		260	<0.1		230	4.8	4.3	3600	12		61
S827_20120418_141.5	Sue D	Sandstone	SRC	52500	0.3	18	81	1		160	0.2		230	2	3.7	3100	15		45
S822_20120418_147	Sue D	Sandstone	SRC	7700	0.2	9.8	4.8	0.9		12	0.2		280	10	57	3000	39		28
MCN11_20120417_190.6	Candy Lake	Basement	SRC	63300	<0.2	31	44	7.4		140	<0.1		86	36	67	11000	5.7		94
MCN_20120417_206.7	Candy Lake	Basement	SRC	96200	0.3	6	36	4.3		410	<0.1		220	9.9	4.5	9600	17		49

TABLE C.1
Compilation of Solids Chemistry Data

Sample ID	Ore Body Simplified	Observed Core Type	EcoMetrix/SRC	Molybdenum	Nickel	Potassium	Selenium	Silver	Strontium	Sulphur	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Ytrium
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Average Crustal Abundance[1]				1	105		0.05	0.08	260		0.36	2.5	5300	0.9	230	80	
S731_20120418_130.6	Access Ramp	Sandstone	EcoMetrix	1.6	6.5	1300	< 0.7	0.04	7.1	11	< 0.02	< 0.5	5.3	0.62	14	1.1	0.90
S731_20120418_81.2	Access Ramp	Sandstone	EcoMetrix	1.2	12	130	< 0.7	0.04	24	51	< 0.02	< 0.5	13	0.57	10	1.0	0.97
S742_20120418_106	Caribou	Sandstone	EcoMetrix	12	120	430	< 0.7	0.30	45	310	0.26	< 0.5	24	90	13	17	5.4
S782_20120418_106.7	Caribou	Sandstone	EcoMetrix	15	26	600	< 0.7	0.11	24	59	0.04	< 0.5	11	4.4	11	4.8	2.2
MU08-05_20120418_156.2	MUG	Sandstone	EcoMetrix	48	88	2700	7.9	1.3	13	48000	0.26	< 0.5	27	18	66	9.7	5.9
MCG07-01_20120418_169.5	MUG	Sandstone	EcoMetrix	1.1	7.1	780	< 0.7	0.14	27	190	0.05	< 0.5	15	2.4	13	2.3	1.5
MCS05_20120418_141	MUG	Sandstone	EcoMetrix	3.0	10	1500	< 0.7	0.12	15	1900	0.09	4.5	41	26	5	70	4.0
MCS21_20120418_150.7	MUG	Sandstone	SRC	2.6	40		0.2	0.2	290		0.4	1.7	140	390	72	12	
MCS21_20120418_154.2	MUG	Sandstone	SRC	5.5	50		0.2	<0.1	570		<0.2	0.6	180	460	98	14	
MCS21_20120418_155.2	MUG	Sandstone	SRC	0.5	73		<0.1	<0.1	190		<0.2	1.2	130	148	80	10	
S826_20120418_105.3	Sue D	Sandstone	SRC	0.7	6.7		<0.1	<0.1	68		<0.2	0.4	38	117	71	3.8	
S826_20120418_103.3	Sue D	Sandstone	SRC	0.5	11		<0.1	<0.1	150		<0.2	0.1	47	35	54	3.1	
SGT11_01A_20120418_114	Sue D	Sandstone	SRC	1.9	81		<0.1	<0.1	130		<0.2	1.1	180	12	430	8.8	
S827_20120418_141.5	Sue D	Sandstone	SRC	1.3	9.3		<0.1	<0.1	240		<0.2	0.2	63	47	38	4.7	
S822_20120418_147	Sue D	Sandstone	SRC	0.7	70		0.1	0.2	33		<0.2	1.9	34	103	31	5.2	
MCN11_20120417_190.6	Candy Lake	Basement	SRC	1.8	32		0.3	<0.1	31		0.5	0.6	170	15	57	7.9	
MCN_20120417_206.7	Candy Lake	Basement	SRC	0.8	46		<0.1	<0.1	26		<0.2	1.4	190	19	330	23	

Appendix D Summary of Leachable Masses for Selected Constituents

Arsenic Leach Summary

Hole Number	Sample Number	Waste Category	Ore Deposit	Total Solids Content (mg/kg)	Water Wash 1 Leachable (mg/kg)	Water Wash 2 Leachable (mg/kg)	Phosphoric Acid Wash 1 Leachable (mg/kg)	Phosphoric Acid Wash 2 Leachable (mg/kg)	Total Water Leachable (mg/kg)	Total Leachable (mg/kg)	Water Leachable (% of total inventory)	Water Leachable (% of total leachble)	Total Leachable (% of total inventory)
Sandstone Rock													
S731	S731_20120418_99.2	Clean Waste	Access Ramp	16	3.40	0.92	1.07	0.43	4.32	5.82	27.0	74.3	36.4
MCS21	MCS21_20120418_155.2	Clean Waste	MUG	13	0.02	0.02	0.59	0.41	0.0	1.0	0.33	4.2	8.0
SGT11-01A	SGT11_01A_20120418_114	Clean Waste	Sue D	3.1	0.12	0.09	0.62	0.35	0.20	1.17	6.6	17.4	37.7
S822	S822_20120418_147	Clean Waste	Sue D	9.8	0.01	0.00	0.86	0.44	0.0	1.3	0.2	1.2	13.4
S826	S826_20120418_105.3	Clean Waste	Sue D	12	0.04	0.05	1.00	0.58	0.1	1.7	0.8	5.6	13.9
S826	S826_20120418_103.3	Clean Waste	Sue D	18	0.00	0.00	0.17	0.13	0.0	0.3	0.0	1.4	1.7
S742	S742_20120418_106	Special Waste	Caribou	110	4.50	1.98	6.89	2.68	6.5	16.0	5.9	40.4	14.6
MU08-05	MU08-05_20120418_156.2	Special Waste	MUG	84	0.06	0.05	1.87	0.87	0.1	2.8	0.1	3.8	3.4
MCS21	MCS21_20120418_150.7	Special Waste	MUG	38	0.06	0.01	0.90	0.54	0	2	0	4.8	4.0
MCS21	MCS21_20120418_154.2	Special Waste	MUG	30	0.03	0.03	1.68	1.36	0.1	3.1	0.20	1.9	10.3
MCS05	MCS05_20120418_141	Special Waste	MUG	2.5	0.01	0.01	0.05	0.02	0.022	0.09	0.88	24.1	3.6
S827	S827_20120418_141.5	Special Waste	Sue D	18	0.07	0.10	0.54	0.36	0.17	1.1	0.95	15.9	6.0
Average				**30**	**1**	**0.3**	**1.4**	**0.7**	**1**	**3**	**3.6**	**16.2**	**12.7**
Basement Rock													
MCN08	MCN08_20120417_233.5	Clean Waste	Candy Lake	5.5	0.09	0.05	0.12	0.07	0.1343	0.320	2.442	41.9	5.8
MCN12	MCN12_20120417_218	Clean Waste	Candy Lake	1.3	0.14	0.06	0.14	0.07	0.2049	0.415	15.763	49.4	31.9
MCN	MCN_20120417_206.7	Clean Waste	Candy Lake	6	0.02	0.03	0.45	0.28	0.05	0.78	0.8	6.3	12.9
MCG07-01	MCG07-01_20120418_178.8	Clean Waste	MUG	1	0.00	0.00	0.01	0.00	0.0033	0.013	0.33	25.6	1.3
MCG07-01	MCG07-01_20120418_184.1	Clean Waste	MUG	2.9	0.00	0.00	0.01	0.00	0.00378	0.0131	0.130	28.9	0.5
MCS22	MCS22_20120418_166.7	Clean Waste	MUG	3.7	0.01	0.01	0.03	0.01	0.0213	0.070	0.58	30.4	1.9
MU08-08	MU08-08_20120418_173	Clean Waste	MUG	5.1	0.04	0.02	0.10	0.05	0.064	0.216	1.26	29.6	4.2
MCS09	MCS09_20120418_210.2	Clean Waste	MUG	0.5*	0.07	0.08	0.06	0.00	0.1448	0.2054	28.95	70.5	41.1
MCS22	MCS22_20120418_171	Clean Waste	MUG	2.4	0.04	0.05	0.12	0.05	0.097	0.26	4.06	37.2	10.9
MU08-08	MU08-08_20120418_178.2	Clean Waste	MUG	2.3	0.06	0.07	0.12	0.06	0.1355	0.31	5.89	43.2	13.6
MCS21	MCS21_20120418_160.7	Clean Waste	MUG	6.2	0.12	0.07	0.32	0.16	0.2	0.7	3.1	28.4	10.8
MU08-05	MU08-05_20120418_174.5	Clean Waste	MUG	19	0.04	0.02	0.51	0.14	0.1	0.7	0.3	8.2	3.8
S822	S822_20120418_149.7	Clean Waste	Sue D	15	0.16	0.11	0.22	0.12	0.3	0.6	1.8	43.8	4.1
S826	S826_20120418_111.4	Clean Waste	Sue D	26	0.00	0.00	0.05	0.04	0.009	0.10	0.03	8.8	0.4
S826	S826_20120418_107.7	Clean Waste	Sue D	73	2.27	1.51	9.95	5.37	3.78	19.1	5.17	19.8	26.2
S730	S730_20120418_133.2	Special Waste	Access Ramp	99	0.43	0.16	3.88	1.85	0.59	6.32	0.6	9.3	6.4
S730	S730_20120418_135.2	Special Waste	Access Ramp	140	1.98	1.02	5.09	2.76	3.00	10.85	2.1	27.6	7.8
S730	S730_20120418_147.7	Special Waste	Access Ramp	4400	138.95	37.94	54.47	26.71	176.883	258.06	4.02	68.5	5.9
S730	S730_20120418_156.3	Special Waste	Access Ramp	680	30.51	14.55	28.29	13.44	45.062	86.79	6.63	51.9	12.8
S730	S730_20120418_138.2	Special Waste	Access Ramp	960	212.80	88.94	16.50	37.73	301.74	355.98	31.4	84.8	37.1
S730	S730_20120418_147	Special Waste	Access Ramp	1100	11.39	5.29	6.81	5.84	16.681	29.34	1.52	56.9	2.7
S730	S730_20120418_152.8	Special Waste	Access Ramp	230	5.60	2.92	8.67	3.22	8.514	20.40	3.702	41.7	8.9
S730	S730_20120418_163.2	Special Waste	Access Ramp	1800	69.63	37.21	56.19	28.41	106.837	191.438	5.94	55.8	10.6
MCN09	MCN09_20120417_207	Special Waste	Candy Lake	7.6	0.02	0.01	0.10	0.04	0.0255	0.168	0.335	15.1	2.2
MCN04	MCN04_20120417_226.8	Special Waste	Candy Lake	210	0.06	0.04	0.25	0.14	0.104	0.50	0.05	20.8	0.2
MCN11	MCN11_20120417_190.6	Special Waste	Candy Lake	31	0.04	0.07	0.84	0.53	0.11	1.48	0.4	7.5	4.8
S700	S700_20120418_130.5	Special Waste	Caribou	200	10.30	6.10	13.34	7.37	16.4	37.1	8.2	44.2	18.6
MCS21	MCS21_20120418_158.4	Special Waste	MUG	45	0.01	0.01	0.11	0.08	0.0	0.2	0.0	8.7	0.5
Average				**360**	**17.31**	**7.01**	**7.38**	**4.8**	**24.33**	**36.5**	**4.8**	**34.5**	**10.3**

Notes:
Values reported as "less than" detection limit in leachate assumed to be equal to the detection limit.

Cadmium Leach Summary

Hole Number	Sample Number	Waste Category	Ore Deposit	Total Solids Content (mg/kg)	Water Wash 1 Leachable (mg/kg)	Water Wash 2 Leachable (mg/kg)	Phosphoric Acid Wash 1 Leachable (mg/kg)	Phosphoric Acid Wash 2 Leachable (mg/kg)	Total Water Leachable (mg/kg)	Total Leachable (mg/kg)	Water Leachable (% of total inventory)	Water Leachable (% of total leachble)	Total Leachable (% of total inventory)
Sandstone Rock													
S731	S731_20120418_99.2	Clean Waste	Access Ramp	0.03	8.15E-05	2.75E-05	4.59E-05	3.02E-05	0.00	0.00	0.4	58.9	0.6
MCS21	MCS21_20120418_155.2	Clean Waste	MUG	0.3	4.30E-04	4.30E-04	4.30E-04	4.30E-04	0.0	0.0	0.29	50.0	0.6
SGT11-01A	SGT11_01A_20120418_114	Clean Waste	Sue D	<0.1	2.99E-04	2.99E-04	8.98E-04	2.99E-04	0.00	0.00	0.6	33.3	1.8
S822	S822_20120418_147	Clean Waste	Sue D	0.2	3.00E-04	3.00E-04	1.50E-03	8.99E-04	0.0	0.0	0.3	20.0	1.5
S826	S826_20120418_105.3	Clean Waste	Sue D	<0.1	3.00E-04	3.00E-04	1.20E-03	9.00E-04	0.0	0.0	0.6	22.2	2.7
S826	S826_20120418_103.3	Clean Waste	Sue D	<0.1	3.00E-04	3.00E-04	6.00E-04	6.00E-04	0.0	0.0	0.6	33.3	1.8
S742	S742_20120418_106	Special Waste	Caribou	0.18	5.46E-03	1.42E-03	8.79E-04	5.34E-04	0.0	0.0	3.8	82.9	4.6
MU08-05	MU08-05_20120418_156.2	Special Waste	MUG	0.13	9.95E-04	2.51E-04	1.39E-04	8.18E-05	0.0	0.0	1.0	85.0	1.1
MCS21	MCS21_20120418_150.7	Special Waste	MUG	0.4	7.92E-03	1.38E-03	1.03E-03	6.89E-04	0	0	2	84.4	2.8
MCS21	MCS21_20120418_154.2	Special Waste	MUG	0.04	3.00E-04	3.00E-04	3.00E-04	3.00E-04	0.0	0.0	1.50	50.0	3.0
MCS05	MCS05_20120418_141	Special Waste	MUG	0.44	2.98E-05	2.89E-05	2.05E-04	9.67E-05	0.000	0.00	0.01	16.3	0.1
S827	S827_20120418_141.5	Special Waste	Sue D	0.04	2.99E-04	2.99E-04	5.99E-04	5.99E-04	0.00	0.0	1.50	33.3	4.5
Average				**0**	**0**	**0.0**	**0.0**	**0.0**	**0**	**0**	**1.1**	**47.5**	**2.1**
Basement Rock													
MCN08	MCN08_20120417_233.5	Clean Waste	Candy Lake	0.2	2.96E-05	2.78E-05	2.89E-05	2.82E-05	0.0001	0.000	0.029	50.1	0.1
MCN12	MCN12_20120417_218	Clean Waste	Candy Lake	< 0.02	2.93E-05	2.82E-05	2.83E-05	2.74E-05	0.0001	0.000	0.287	50.8	0.6
MCN	MCN_20120417_206.7	Clean Waste	Candy Lake	<0.1	3.00E-04	8.39E-03	3.00E-04	3.00E-04	0.01	0.01	8.7	93.5	9.3
MCG07-01	MCG07-01_20120418_178.8	Clean Waste	MUG	0.02	2.96E-05	2.81E-05	2.81E-05	2.74E-05	0.0001	0.000	0.29	51.0	0.6
MCG07-01	MCG07-01_20120418_184.1	Clean Waste	MUG	0.04	2.93E-05	2.75E-05	2.81E-05	2.79E-05	0.00006	0.0001	0.142	50.4	0.3
MCS22	MCS22_20120418_166.7	Clean Waste	MUG	< 0.02	2.97E-05	2.88E-05	2.86E-05	2.83E-05	0.0001	0.000	0.29	50.7	0.6
MU08-08	MU08-08_20120418_173	Clean Waste	MUG	0.05	2.94E-05	2.78E-05	2.81E-05	2.84E-05	0.000	0.000	0.11	50.3	0.2
MCS09	MCS09_20120418_210.2	Clean Waste	MUG	< 0.02	2.98E-05	2.67E-05	2.74E-05	2.69E-05	0.0001	0.0001	0.28	51.0	0.6
MCS22	MCS22_20120418_171	Clean Waste	MUG	< 0.02	2.97E-05	2.75E-05	3.58E-05	2.79E-05	0.000	0.00	0.29	47.3	0.6
MU08-08	MU08-08_20120418_178.2	Clean Waste	MUG	< 0.02	3.01E-05	2.82E-05	2.88E-05	2.76E-05	0.0001	0.00	0.29	50.8	0.6
MCS21	MCS21_20120418_160.7	Clean Waste	MUG	<0.1	3.11E-04	3.11E-04	6.21E-04	3.11E-04	0.0	0.0	0.6	40.0	1.6
MU08-05	MU08-05_20120418_174.5	Clean Waste	MUG	< 0.02	1.43E-04	2.86E-05	4.51E-05	2.81E-05	0.0	0.0	0.9	70.1	1.2
S822	S822_20120418_149.7	Clean Waste	Sue D	< 0.02	2.95E-05	2.78E-05	3.30E-05	3.11E-05	0.0	0.0	0.3	47.2	0.6
S826	S826_20120418_111.4	Clean Waste	Sue D	0.1	3.00E-04	3.00E-04	2.40E-03	6.00E-04	0.001	0.00	0.60	16.7	3.6
S826	S826_20120418_107.7	Clean Waste	Sue D	<0.1	3.00E-04	3.00E-04	6.00E-04	6.00E-04	0.00	0.0	0.60	33.3	1.8
S730	S730_20120418_133.2	Special Waste	Access Ramp	0.3	1.13E-04	2.71E-05	5.82E-05	3.90E-05	0.00	0.00	0.0	59.0	0.1
S730	S730_20120418_135.2	Special Waste	Access Ramp	0.04	5.58E-04	1.54E-04	2.30E-04	1.48E-04	0.00	0.00	1.8	65.4	2.7
S730	S730_20120418_147.7	Special Waste	Access Ramp	< 0.02	2.93E-04	5.46E-05	5.50E-05	2.71E-05	0.000	0.00	1.74	80.9	2.1
S730	S730_20120418_156.3	Special Waste	Access Ramp	0.03	4.49E-04	2.23E-04	8.53E-05	8.54E-05	0.001	0.00	2.24	79.7	2.8
S730	S730_20120418_138.2	Special Waste	Access Ramp	0.02	6.06E-04	2.68E-04	5.45E-05	1.35E-04	0.00	0.00	4.4	82.2	5.3
S730	S730_20120418_147	Special Waste	Access Ramp	< 0.02	2.98E-05	2.80E-05	8.55E-05	2.78E-05	0.000	0.00	0.29	33.8	0.9
S730	S730_20120418_152.8	Special Waste	Access Ramp	< 0.02	3.57E-04	8.26E-04	2.52E-04	8.04E-05	0.001	0.00	5.915	78.1	7.6
S730	S730_20120418_163.2	Special Waste	Access Ramp	0.08	2.90E-04	1.35E-04	1.40E-04	1.35E-04	0.000	0.001	0.53	60.7	0.9
MCN09	MCN09_20120417_207	Special Waste	Candy Lake	0.25	5.75E-05	2.81E-05	3.22E-04	2.48E-04	0.0001	0.001	0.034	13.1	0.3
MCN04	MCN04_20120417_226.8	Special Waste	Candy Lake	0.05	2.40E-04	8.39E-05	5.69E-05	5.65E-05	0.000	0.00	0.65	74.1	0.9
MCN11	MCN11_20120417_190.6	Special Waste	Candy Lake	<0.1	3.00E-04	3.00E-04	3.00E-04	3.00E-04	0.00	0.00	0.6	50.0	1.2
S700	S700_20120418_130.5	Special Waste	Caribou	< 0.02	1.48E-04	1.39E-04	1.37E-04	7.65E-05	0.0	0.0	1.4	57.4	2.5
MCS21	MCS21_20120418_158.4	Special Waste	MUG	0.1	3.00E-04	3.00E-04	3.00E-04	3.00E-04	0.0	0.0	0.6	50.0	1.2
Average				**0.07**	**0.00**	**0.00**	**0.00**	**0.0**	**0.00**	**0.0**	**1.2**	**54.9**	**1.8**

Notes:
Values reported as "less than" detection limit in leachate assumed to be equal to the detection limit.

Cobalt Leach Summary

Hole Number	Sample Number	Waste Category	Ore Deposit	Total Solids Content (mg/kg)	Water Wash 1 Leachable (mg/kg)	Water Wash 2 Leachable (mg/kg)	Phosphoric Acid Wash 1 Leachable (mg/kg)	Phosphoric Acid Wash 2 Leachable (mg/kg)	Total Water Leachable (mg/kg)	Total Leachable (mg/kg)	Water Leachable (% of total inventory)	Water Leachable (% of total leachble)	Total Leachable (% of total inventory)
Sandstone Rock													
S731	S731_20120418_99.2	Clean Waste	Access Ramp	3	0.01	0.00	0.01	0.00	0.01	0.02	0.3	44.1	0.6
MCS21	MCS21_20120418_155.2	Clean Waste	MUG	8	0.00	0.00	0.09	0.19	0.0	0.3	0.03	0.8	3.5
SGT11-01A	SGT11_01A_20120418_114	Clean Waste	Sue D	4.8	0.00	0.00	0.01	0.02	0.00	0.03	0.0	1.9	0.6
S822	S822_20120418_147	Clean Waste	Sue D	10	0.14	0.03	0.54	0.38	0.2	1.1	1.7	15.9	10.9
S826	S826_20120418_105.3	Clean Waste	Sue D	2.6	0.00	0.00	0.10	0.34	0.0	0.4	0.0	0.1	16.6
S826	S826_20120418_103.3	Clean Waste	Sue D	9.3	0.26	0.02	0.98	1.48	0.3	2.7	3.0	10.1	29.3
S742	S742_20120418_106	Special Waste	Caribou	15	4.29	1.25	0.60	0.37	5.5	6.5	36.9	85.2	43.4
MU08-05	MU08-05_20120418_156.2	Special Waste	MUG	36	10.30	2.53	1.01	0.67	12.8	14.5	35.6	88.4	40.3
MCS21	MCS21_20120418_150.7	Special Waste	MUG	19	7.65	0.95	0.30	0.11	9	9	45	95.5	47.4
MCS21	MCS21_20120418_154.2	Special Waste	MUG	5.5	0.03	0.00	0.06	0.16	0.0	0.2	0.52	11.8	4.4
MCS05	MCS05_20120418_141	Special Waste	MUG	6.6	0.00	0.00	0.00	0.00	0.001	0.01	0.01	10.4	0.1
S827	S827_20120418_141.5	Special Waste	Sue D	2	0.00	0.00	0.05	0.10	0.00	0.2	0.03	0.4	7.8
Average				**10**	**2**	**0.4**	**0.3**	**0.3**	**2**	**3**	**10.3**	**30.4**	**17.1**
Basement Rock													
MCN08	MCN08_20120417_233.5	Clean Waste	Candy Lake	18.0	0.001	0.001	0.010	0.004	0.0018	0.016	0.010	11.5	0.1
MCN12	MCN12_20120417_218	Clean Waste	Candy Lake	3.0	0.001	0.000	0.005	0.001	0.0012	0.008	0.040	14.9	0.3
MCN	MCN_20120417_206.7	Clean Waste	Candy Lake	10	0.005	0.001	0.066	0.186	0.01	0.26	0.1	2.4	2.6
MCG07-01	MCG07-01_20120418_178.8	Clean Waste	MUG	25.0	0.000	0.000	0.002	0.001	0.0007	0.004	0.00	18.4	0.0
MCG07-01	MCG07-01_20120418_184.1	Clean Waste	MUG	1	0.000	0.000	0.000	0.000	0.00057	0.0012	0.058	46.9	0.1
MCS22	MCS22_20120418_166.7	Clean Waste	MUG	3.3	0.000	0.000	0.002	0.000	0.0006	0.003	0.02	22.9	0.1
MU08-08	MU08-08_20120418_173	Clean Waste	MUG	7.9	0.000	0.000	0.002	0.001	0.001	0.004	0.01	19.5	0.0
MCS09	MCS09_20120418_210.2	Clean Waste	MUG	4.70	0.000	0.000	0.002	0.001	0.0006	0.0029	0.01	19.4	0.1
MCS22	MCS22_20120418_171	Clean Waste	MUG	2.8	0.000	0.000	0.006	0.002	0.001	0.01	0.02	6.5	0.3
MU08-08	MU08-08_20120418_178.2	Clean Waste	MUG	2.0	0.000	0.000	0.006	0.002	0.0006	0.01	0.03	6.7	0.4
MCS21	MCS21_20120418_160.7	Clean Waste	MUG	1	0.000	0.000	0.031	0.025	0.0	0.1	0.1	1.1	7.1
MU08-05	MU08-05_20120418_174.5	Clean Waste	MUG	2	0.019	0.003	0.009	0.003	0.0	0.0	1.0	63.4	1.5
S822	S822_20120418_149.7	Clean Waste	Sue D	2	0.005	0.001	0.003	0.003	0.0	0.0	0.2	46.5	0.5
S826	S826_20120418_111.4	Clean Waste	Sue D	0	0.000	0.000	0.005	0.006	0.001	0.01	0.15	5.1	2.9
S826	S826_20120418_107.7	Clean Waste	Sue D	5	0.003	0.001	0.905	1.619	0.00	2.5	0.07	0.2	47.7
S730	S730_20120418_133.2	Special Waste	Access Ramp	4.9	0.110	0.009	0.055	0.031	0.12	0.21	2.4	57.9	4.2
S730	S730_20120418_135.2	Special Waste	Access Ramp	39.0	4.021	1.182	1.413	0.997	5.20	7.61	13.3	68.3	19.5
S730	S730_20120418_147.7	Special Waste	Access Ramp	1700	4.221	1.122	5.419	2.071	5.343	12.83	0.31	41.6	0.8
S730	S730_20120418_156.3	Special Waste	Access Ramp	150	0.091	0.027	0.358	0.254	0.117	0.73	0.08	16.1	0.5
S730	S730_20120418_138.2	Special Waste	Access Ramp	67.0	1.916	0.480	0.054	0.361	2.40	2.81	3.6	85.2	4.2
S730	S730_20120418_147	Special Waste	Access Ramp	250.0	0.255	0.089	0.063	0.277	0.344	0.68	0.14	50.3	0.3
S730	S730_20120418_152.8	Special Waste	Access Ramp	42	0.012	0.003	0.394	0.035	0.015	0.44	0.035	3.3	1.1
S730	S730_20120418_163.2	Special Waste	Access Ramp	460	0.177	0.040	0.674	0.346	0.217	1.237	0.05	17.5	0.3
MCN09	MCN09_20120417_207	Special Waste	Candy Lake	21.0	0.004	0.001	0.029	0.015	0.0048	0.049	0.023	10.0	0.2
MCN04	MCN04_20120417_226.8	Special Waste	Candy Lake	38	0.006	0.002	0.049	0.023	0.008	0.08	0.02	9.5	0.2
MCN11	MCN11_20120417_190.6	Special Waste	Candy Lake	36	0.011	0.004	0.087	0.441	0.01	0.54	0.0	2.8	1.5
S700	S700_20120418_130.5	Special Waste	Caribou	11	0.831	0.083	0.232	0.103	0.9	1.2	8.3	73.2	11.4
MCS21	MCS21_20120418_158.4	Special Waste	MUG	3	0.001	0.000	0.006	0.014	0.0	0.0	0.0	4.3	0.8
Average				**104**	**0.42**	**0.11**	**0.35**	**0.2**	**0.53**	**1.1**	**1.1**	**25.9**	**3.9**

Notes:
Values reported as "less than" detection limit in leachate assumed to be equal to the detection limit.

Copper Leach Summary

Hole Number	Sample Number	Waste Category	Ore Deposit	Total Solids Content (mg/kg)	Water Wash 1 Leachable (mg/kg)	Water Wash 2 Leachable (mg/kg)	Phosphoric Acid Wash 1 Leachable (mg/kg)	Phosphoric Acid Wash 2 Leachable (mg/kg)	Total Water Leachable (mg/kg)	Total Leachable (mg/kg)	Water Leachable (% of total inventory)	Water Leachable (% of total leachble)	Total Leachable (% of total inventory)
Sandstone Rock													
S731	S731_20120418_99.2	Clean Waste	Access Ramp	4	0.02	0.00	0.01	0.00	0.02	0.03	0.5	60.5	0.9
MCS21	MCS21_20120418_155.2	Clean Waste	MUG	2.6	0.00	0.01	0.01	0.01	0.0	0.0	0.31	33.9	0.9
SGT11-01A	SGT11_01A_20120418_114	Clean Waste	Sue D	4.3	0.00	0.00	0.01	0.00	0.01	0.01	0.1	36.0	0.3
S822	S822_20120418_147	Clean Waste	Sue D	57	0.02	0.01	2.64	3.30	0.0	6.0	0.1	0.6	10.5
S826	S826_20120418_105.3	Clean Waste	Sue D	2.6	0.00	0.01	0.01	0.02	0.0	0.0	0.3	21.2	1.5
S826	S826_20120418_103.3	Clean Waste	Sue D	1.8	0.00	0.00	0.01	0.02	0.0	0.0	0.4	18.3	2.2
S742	S742_20120418_106	Special Waste	Caribou	8	0.26	0.07	0.05	0.03	0.3	0.4	4.4	80.2	5.5
MU08-05	MU08-05_20120418_156.2	Special Waste	MUG	69	6.28	1.45	0.68	0.39	7.7	8.8	11.2	87.9	12.8
MCS21	MCS21_20120418_150.7	Special Waste	MUG	5.9	1.14	0.18	0.15	0.09	1	2	22	84.7	26.3
MCS21	MCS21_20120418_154.2	Special Waste	MUG	1.5	0.00	0.00	0.01	0.00	0.0	0.0	0.50	47.2	1.1
MCS05	MCS05_20120418_141	Special Waste	MUG	63.0	0.00	0.00	0.00	0.00	0.003	0.01	0.00	44.5	0.0
S827	S827_20120418_141.5	Special Waste	Sue D	3.7	0.00	0.00	0.01	0.01	0.01	0.0	0.16	22.5	0.7
Average				**19**	**1**	**0.1**	**0.3**	**0.3**	**1**	**1**	**3.4**	**44.8**	**5.2**
Basement Rock													
MCN08	MCN08_20120417_233.5	Clean Waste	Candy Lake	10.0	0.002	0.001	0.004	0.001	0.0025	0.007	0.025	35.7	0.1
MCN12	MCN12_20120417_218	Clean Waste	Candy Lake	47.0	0.002	0.001	0.004	0.001	0.0032	0.008	0.007	40.8	0.0
MCN	MCN_20120417_206.7	Clean Waste	Candy Lake	5	0.003	0.006	0.009	0.003	0.01	0.02	0.2	41.7	0.5
MCG07-01	MCG07-01_20120418_178.8	Clean Waste	MUG	7.7	0.001	0.001	0.003	0.002	0.0019	0.006	0.02	29.8	0.1
MCG07-01	MCG07-01_20120418_184.1	Clean Waste	MUG	2	0.001	0.001	0.003	0.001	0.00209	0.0068	0.095	30.9	0.3
MCS22	MCS22_20120418_166.7	Clean Waste	MUG	2.8	0.001	0.001	0.003	0.001	0.0017	0.006	0.06	30.0	0.2
MU08-08	MU08-08_20120418_173	Clean Waste	MUG	6.0	0.002	0.002	0.003	0.002	0.004	0.008	0.06	43.8	0.1
MCS09	MCS09_20120418_210.2	Clean Waste	MUG	1.90	0.002	0.001	0.002	0.003	0.0027	0.0075	0.14	35.7	0.4
MCS22	MCS22_20120418_171	Clean Waste	MUG	1.8	0.002	0.001	0.004	0.001	0.003	0.01	0.17	33.3	0.5
MU08-08	MU08-08_20120418_178.2	Clean Waste	MUG	3.7	0.001	0.001	0.002	0.001	0.0027	0.01	0.07	42.9	0.2
MCS21	MCS21_20120418_160.7	Clean Waste	MUG	2	0.002	0.005	0.023	0.050	0.0	0.1	0.3	9.0	3.6
MU08-05	MU08-05_20120418_174.5	Clean Waste	MUG	3	0.005	0.002	0.004	0.001	0.0	0.0	0.3	56.4	0.5
S822	S822_20120418_149.7	Clean Waste	Sue D	13	0.044	0.010	0.017	0.011	0.1	0.1	0.4	65.8	0.6
S826	S826_20120418_111.4	Clean Waste	Sue D	1	0.005	0.004	0.015	0.027	0.009	0.05	0.67	17.1	3.9
S826	S826_20120418_107.7	Clean Waste	Sue D	2	0.002	0.004	0.011	0.013	0.01	0.0	0.35	19.4	1.8
S730	S730_20120418_133.2	Special Waste	Access Ramp	2.8	0.010	0.003	0.007	0.004	0.01	0.02	0.5	54.7	0.9
S730	S730_20120418_135.2	Special Waste	Access Ramp	2.8	0.029	0.010	0.013	0.007	0.04	0.06	1.4	66.1	2.1
S730	S730_20120418_147.7	Special Waste	Access Ramp	6	0.006	0.001	0.003	0.002	0.007	0.01	0.11	61.6	0.2
S730	S730_20120418_156.3	Special Waste	Access Ramp	11	0.003	0.002	0.003	0.002	0.005	0.01	0.04	49.1	0.1
S730	S730_20120418_138.2	Special Waste	Access Ramp	5.6	0.030	0.009	0.002	0.005	0.04	0.05	0.7	86.2	0.8
S730	S730_20120418_147	Special Waste	Access Ramp	4.8	0.002	0.002	0.002	0.001	0.004	0.01	0.09	56.6	0.2
S730	S730_20120418_152.8	Special Waste	Access Ramp	3	0.003	0.002	0.005	0.001	0.005	0.01	0.181	41.4	0.4
S730	S730_20120418_163.2	Special Waste	Access Ramp	40	0.010	0.005	0.007	0.005	0.015	0.027	0.04	56.3	0.1
MCN09	MCN09_20120417_207	Special Waste	Candy Lake	22.0	0.002	0.001	0.002	0.001	0.0028	0.006	0.013	49.3	0.0
MCN04	MCN04_20120417_226.8	Special Waste	Candy Lake	27	0.001	0.001	0.003	0.002	0.002	0.01	0.01	28.1	0.0
MCN11	MCN11_20120417_190.6	Special Waste	Candy Lake	67	0.006	0.006	0.011	0.009	0.01	0.03	0.0	37.4	0.0
S700	S700_20120418_130.5	Special Waste	Caribou	3	0.004	0.003	0.003	0.002	0.0	0.0	0.2	54.3	0.4
MCS21	MCS21_20120418_158.4	Special Waste	MUG	2	0.001	0.006	0.006	0.003	0.0	0.0	0.3	46.3	0.7
Average				**11**	**0.01**	**0.00**	**0.01**	**0.0**	**0.01**	**0.0**	**0.2**	**43.6**	**0.7**

Notes:
Values reported as "less than" detection limit in leachate assumed to be equal to the detection limit.

Nickel Leach Summary

Hole Number	Sample Number	Waste Category	Ore Deposit	Total Solids Content (mg/kg)	Water Wash 1 Leachable (mg/kg)	Water Wash 2 Leachable (mg/kg)	Phosphoric Acid Wash 1 Leachable (mg/kg)	Phosphoric Acid Wash 2 Leachable (mg/kg)	Total Water Leachable (mg/kg)	Total Leachable (mg/kg)	Water Leachable (% of total inventory)	Water Leachable (% of total leachble)	Total Leachable (% of total inventory)
Sandstone Rock													
S731	S731_20120418_99.2	Clean Waste	Access Ramp	8	0.02	0.00	0.01	0.00	0.03	0.04	0.3	66.5	0.5
MCS21	MCS21_20120418_155.2	Clean Waste	MUG	73	0.02	0.01	0.43	0.86	0.0	1.3	0.04	2.3	1.8
SGT11-01A	SGT11_01A_20120418_114	Clean Waste	Sue D	81	0.02	0.01	0.15	0.37	0.03	0.54	0.0	5.1	0.7
S822	S822_20120418_147	Clean Waste	Sue D	70	1.05	0.19	2.16	1.66	1.2	5.1	1.8	24.5	7.2
S826	S826_20120418_105.3	Clean Waste	Sue D	6.7	0.00	0.00	0.09	0.32	0.0	0.4	0.0	0.6	6.2
S826	S826_20120418_103.3	Clean Waste	Sue D	11	0.22	0.02	0.80	1.24	0.2	2.3	2.1	10.2	20.7
S742	S742_20120418_106	Special Waste	Caribou	120	40.77	12.23	5.81	3.55	53.0	62.4	44.2	85.0	52.0
MU08-05	MU08-05_20120418_156.2	Special Waste	MUG	88	10.04	2.52	1.02	0.65	12.6	14.2	14.3	88.2	16.2
MCS21	MCS21_20120418_150.7	Special Waste	MUG	40	19.29	2.33	0.70	0.25	22	23	54	95.8	56.4
MCS21	MCS21_20120418_154.2	Special Waste	MUG	50	0.32	0.03	0.51	1.26	0.4	2.1	0.71	16.8	4.2
MCS05	MCS05_20120418_141	Special Waste	MUG	10.0	0.00	0.00	0.00	0.00	0.003	0.01	0.03	39.1	0.1
S827	S827_20120418_141.5	Special Waste	Sue D	9.3	0.01	0.00	0.11	0.21	0.01	0.3	0.09	2.6	3.5
Average				**47**	**6**	**1.4**	**1.0**	**0.9**	**7**	**9**	**9.8**	**36.4**	**14.1**
Basement Rock													
MCN08	MCN08_20120417_233.5	Clean Waste	Candy Lake	47.0	0.003	0.001	0.008	0.003	0.0042	0.015	0.009	27.8	0.0
MCN12	MCN12_20120417_218	Clean Waste	Candy Lake	8.5	0.002	0.001	0.010	0.003	0.0036	0.016	0.043	22.3	0.2
MCN	MCN_20120417_206.7	Clean Waste	Candy Lake	46	0.011	0.004	0.087	0.195	0.02	0.30	0.0	5.2	0.6
MCG07-01	MCG07-01_20120418_178.8	Clean Waste	MUG	30.0	0.003	0.001	0.029	0.019	0.0042	0.052	0.01	8.1	0.2
MCG07-01	MCG07-01_20120418_184.1	Clean Waste	MUG	8	0.001	0.001	0.003	0.002	0.00284	0.0071	0.036	39.9	0.1
MCS22	MCS22_20120418_166.7	Clean Waste	MUG	11.0	0.001	0.001	0.005	0.002	0.0029	0.009	0.03	31.9	0.1
MU08-08	MU08-08_20120418_173	Clean Waste	MUG	23.0	0.001	0.004	0.010	0.010	0.005	0.025	0.02	21.5	0.1
MCS09	MCS09_20120418_210.2	Clean Waste	MUG	19.00	0.001	0.001	0.003	0.002	0.0028	0.0081	0.01	34.8	0.0
MCS22	MCS22_20120418_171	Clean Waste	MUG	11.0	0.002	0.001	0.006	0.002	0.004	0.01	0.03	31.9	0.1
MU08-08	MU08-08_20120418_178.2	Clean Waste	MUG	11.0	0.002	0.001	0.021	0.007	0.0029	0.03	0.03	9.5	0.3
MCS21	MCS21_20120418_160.7	Clean Waste	MUG	10	0.015	0.005	0.538	0.463	0.0	1.0	0.2	1.9	10.2
MU08-05	MU08-05_20120418_174.5	Clean Waste	MUG	79	1.999	0.321	1.210	0.455	2.3	4.0	2.9	58.2	5.0
S822	S822_20120418_149.7	Clean Waste	Sue D	14	0.047	0.011	0.026	0.026	0.1	0.1	0.4	52.8	0.8
S826	S826_20120418_111.4	Clean Waste	Sue D	4	0.001	0.002	0.026	0.036	0.002	0.06	0.06	3.7	1.8
S826	S826_20120418_107.7	Clean Waste	Sue D	13	0.010	0.006	1.796	3.358	0.02	5.2	0.12	0.3	39.8
S730	S730_20120418_133.2	Special Waste	Access Ramp	15.0	0.210	0.020	0.105	0.059	0.23	0.39	1.5	58.3	2.6
S730	S730_20120418_135.2	Special Waste	Access Ramp	80.0	6.151	1.822	2.217	1.543	7.97	11.73	10.0	68.0	14.7
S730	S730_20120418_147.7	Special Waste	Access Ramp	900	3.723	0.972	4.016	1.634	4.694	10.34	0.52	45.4	1.1
S730	S730_20120418_156.3	Special Waste	Access Ramp	220	0.213	0.057	0.503	0.325	0.270	1.10	0.12	24.6	0.5
S730	S730_20120418_138.2	Special Waste	Access Ramp	340.0	24.432	5.599	0.493	3.558	30.03	34.08	8.8	88.1	10.0
S730	S730_20120418_147	Special Waste	Access Ramp	940.0	1.279	0.412	0.239	1.143	1.691	3.07	0.18	55.0	0.3
S730	S730_20120418_152.8	Special Waste	Access Ramp	170	0.049	0.012	0.330	0.137	0.061	0.53	0.036	11.6	0.3
S730	S730_20120418_163.2	Special Waste	Access Ramp	180	0.093	0.020	0.230	0.118	0.113	0.460	0.06	24.6	0.3
MCN09	MCN09_20120417_207	Special Waste	Candy Lake	46.0	0.003	0.001	0.014	0.009	0.0046	0.028	0.010	16.4	0.1
MCN04	MCN04_20120417_226.8	Special Waste	Candy Lake	50	0.006	0.002	0.036	0.017	0.008	0.06	0.02	12.9	0.1
MCN11	MCN11_20120417_190.6	Special Waste	Candy Lake	32	0.015	0.005	0.066	0.186	0.02	0.27	0.1	7.5	0.9
S700	S700_20120418_130.5	Special Waste	Caribou	370	24.974	2.695	6.562	3.136	27.7	37.4	7.5	74.0	10.1
MCS21	MCS21_20120418_158.4	Special Waste	MUG	22	0.026	0.005	0.084	0.198	0.0	0.3	0.1	10.0	1.4
Average				**132**	**2.26**	**0.43**	**0.67**	**0.6**	**2.69**	**3.9**	**1.2**	**30.2**	**3.6**

Notes:
Values reported as "less than" detection limit in leachate assumed to be equal to the detection limit.

Lead Leach Summary

Hole Number	Sample Number	Waste Category	Ore Deposit	Total Solids Content (mg/kg)	Water Wash 1 Leachable (mg/kg)	Water Wash 2 Leachable (mg/kg)	Phosphoric Acid Wash 1 Leachable (mg/kg)	Phosphoric Acid Wash 2 Leachable (mg/kg)	Total Water Leachable (mg/kg)	Total Leachable (mg/kg)	Water Leachable (% of total inventory)	Water Leachable (% of total leachble)	Total Leachable (% of total inventory)
Sandstone Rock													
S731	S731_20120418_99.2	Clean Waste	Access Ramp	2	0.01	0.00	0.00	0.00	0.01	0.01	0.7	86.1	0.8
MCS21	MCS21_20120418_155.2	Clean Waste	MUG	30	0.00	0.00	0.00	0.00	0.0	0.0	0.00	25.0	0.0
SGT11-01A	SGT11_01A_20120418_114	Clean Waste	Sue D	12	0.00	0.00	0.00	0.00	0.00	0.00	0.0	40.0	0.0
S822	S822_20120418_147	Clean Waste	Sue D	39	0.01	0.00	0.13	0.25	0.0	0.4	0.0	3.9	1.0
S826	S826_20120418_105.3	Clean Waste	Sue D	9.2	0.00	0.00	0.00	0.00	0.0	0.0	0.0	20.0	0.0
S826	S826_20120418_103.3	Clean Waste	Sue D	9.3	0.00	0.00	0.00	0.00	0.0	0.0	0.0	23.1	0.0
S742	S742_20120418_106	Special Waste	Caribou	8	0.01	0.00	0.00	0.00	0.0	0.0	0.1	93.7	0.1
MU08-05	MU08-05_20120418_156.2	Special Waste	MUG	35	0.01	0.00	0.00	0.00	0.0	0.0	0.0	95.7	0.0
MCS21	MCS21_20120418_150.7	Special Waste	MUG	59	0.01	0.00	0.00	0.00	0	0	0	79.2	0.0
MCS21	MCS21_20120418_154.2	Special Waste	MUG	34	0.00	0.00	0.00	0.00	0.0	0.0	0.00	27.3	0.0
MCS05	MCS05_20120418_141	Special Waste	MUG	35.0	0.00	0.00	0.01	0.00	0.002	0.01	0.01	16.3	0.0
S827	S827_20120418_141.5	Special Waste	Sue D	15	0.00	0.00	0.00	0.00	0.00	0.0	0.00	20.0	0.0
Average				**24**	**0**	**0.0**	**0.0**	**0.0**	**0**	**0**	**0.1**	**44.2**	**0.2**
Basement Rock													
MCN08	MCN08_20120417_233.5	Clean Waste	Candy Lake	5.2	0.000	0.000	0.000	0.000	0.0006	0.001	0.011	60.1	0.0
MCN12	MCN12_20120417_218	Clean Waste	Candy Lake	8.1	0.001	0.002	0.000	0.000	0.0027	0.003	0.034	81.2	0.0
MCN	MCN_20120417_206.7	Clean Waste	Candy Lake	17	0.015	0.001	0.000	0.000	0.02	0.02	0.1	96.4	0.1
MCG07-01	MCG07-01_20120418_178.8	Clean Waste	MUG	1.6	0.004	0.001	0.000	0.000	0.0050	0.005	0.31	93.1	0.3
MCG07-01	MCG07-01_20120418_184.1	Clean Waste	MUG	2	0.000	0.000	0.000	0.000	0.00046	0.0009	0.027	48.9	0.1
MCS22	MCS22_20120418_166.7	Clean Waste	MUG	1.8	0.002	0.000	0.000	0.000	0.0017	0.002	0.10	76.7	0.1
MU08-08	MU08-08_20120418_173	Clean Waste	MUG	3.1	0.000	0.000	0.000	0.000	0.000	0.001	0.01	52.9	0.0
MCS09	MCS09_20120418_210.2	Clean Waste	MUG	0.76	0.000	0.000	0.000	0.000	0.0004	0.0007	0.06	61.7	0.1
MCS22	MCS22_20120418_171	Clean Waste	MUG	2.0	0.000	0.000	0.001	0.000	0.000	0.00	0.02	38.6	0.1
MU08-08	MU08-08_20120418_178.2	Clean Waste	MUG	5.7	0.000	0.000	0.006	0.001	0.0008	0.01	0.01	10.1	0.1
MCS21	MCS21_20120418_160.7	Clean Waste	MUG	6	0.001	0.001	0.002	0.008	0.0	0.0	0.0	15.4	0.2
MU08-05	MU08-05_20120418_174.5	Clean Waste	MUG	3	0.007	0.005	0.000	0.000	0.0	0.0	0.3	94.8	0.4
S822	S822_20120418_149.7	Clean Waste	Sue D	2	0.000	0.000	0.001	0.000	0.0	0.0	0.0	44.9	0.1
S826	S826_20120418_111.4	Clean Waste	Sue D	10	0.001	0.000	0.001	0.001	0.001	0.00	0.01	37.5	0.0
S826	S826_20120418_107.7	Clean Waste	Sue D	8	0.000	0.000	0.000	0.001	0.00	0.0	0.01	33.3	0.0
S730	S730_20120418_133.2	Special Waste	Access Ramp	2.3	0.003	0.000	0.000	0.000	0.00	0.00	0.2	92.1	0.2
S730	S730_20120418_135.2	Special Waste	Access Ramp	6.3	0.003	0.005	0.000	0.000	0.01	0.01	0.1	90.6	0.1
S730	S730_20120418_147.7	Special Waste	Access Ramp	3	0.003	0.027	0.000	0.000	0.029	0.03	0.94	98.6	1.0
S730	S730_20120418_156.3	Special Waste	Access Ramp	1	0.000	0.000	0.000	0.000	0.001	0.00	0.04	65.5	0.1
S730	S730_20120418_138.2	Special Waste	Access Ramp	1.1	0.007	0.001	0.000	0.001	0.01	0.01	0.8	90.1	0.9
S730	S730_20120418_147	Special Waste	Access Ramp	4.1	0.000	0.000	0.000	0.000	0.001	0.00	0.01	61.1	0.0
S730	S730_20120418_152.8	Special Waste	Access Ramp	1	0.001	0.003	0.000	0.000	0.004	0.00	0.608	94.1	0.6
S730	S730_20120418_163.2	Special Waste	Access Ramp	16	0.001	0.001	0.001	0.001	0.002	0.004	0.01	60.7	0.0
MCN09	MCN09_20120417_207	Special Waste	Candy Lake	27.0	0.002	0.001	0.002	0.002	0.0027	0.007	0.010	41.0	0.0
MCN04	MCN04_20120417_226.8	Special Waste	Candy Lake	4	0.001	0.000	0.000	0.000	0.001	0.00	0.03	77.6	0.0
MCN11	MCN11_20120417_190.6	Special Waste	Candy Lake	6	0.000	0.000	0.000	0.000	0.00	0.00	0.0	50.0	0.0
S700	S700_20120418_130.5	Special Waste	Caribou	4	0.004	0.004	0.001	0.000	0.0	0.0	0.2	88.5	0.2
MCS21	MCS21_20120418_158.4	Special Waste	MUG	17	0.000	0.001	0.000	0.001	0.0	0.0	0.0	42.9	0.0
Average				**6**	**0.00**	**0.00**	**0.00**	**0.0**	**0.00**	**0.0**	**0.1**	**64.2**	**0.2**

Notes:
Values reported as "less than" detection limit in leachate assumed to be equal to the detection limit.

Molybdenum Leach Summary

Hole Number	Sample Number	Waste Category	Ore Deposit	Total Solids Content (mg/kg)	Water Wash 1 Leachable (mg/kg)	Water Wash 2 Leachable (mg/kg)	Phosphoric Acid Wash 1 Leachable (mg/kg)	Phosphoric Acid Wash 2 Leachable (mg/kg)	Total Water Leachable (mg/kg)	Total Leachable (mg/kg)	Water Leachable (% of total inventory)	Water Leachable (% of total leachble)	Total Leachable (% of total inventory)
Sandstone Rock													
S731	S731_20120418_99.2	Clean Waste	Access Ramp	1	0.02	0.00	0.00	0.00	0.02	0.02	1.3	96.9	1.3
MCS21	MCS21_20120418_155.2	Clean Waste	MUG	0.5	0.01	0.01	0.00	0.00	0.0	0.0	3.35	78.0	4.3
SGT11-01A	SGT11_01A_20120418_114	Clean Waste	Sue D	1.9	0.96	0.21	0.04	0.01	1.17	1.22	61.6	95.9	64.3
S822	S822_20120418_147	Clean Waste	Sue D	0.7	0.00	0.00	0.00	0.00	0.0	0.0	0.2	71.4	0.3
S826	S826_20120418_105.3	Clean Waste	Sue D	0.7	0.01	0.00	0.00	0.00	0.0	0.0	2.1	94.3	2.3
S826	S826_20120418_103.3	Clean Waste	Sue D	0.5	0.00	0.00	0.00	0.00	0.0	0.0	0.2	60.0	0.3
S742	S742_20120418_106	Special Waste	Caribou	12	0.11	0.07	0.28	0.17	0.2	0.6	1.4	27.4	5.2
MU08-05	MU08-05_20120418_156.2	Special Waste	MUG	48	0.01	0.00	0.03	0.03	0.0	0.1	0.0	18.3	0.1
MCS21	MCS21_20120418_150.7	Special Waste	MUG	2.6	0.00	0.00	0.03	0.03	0	0	0	5.4	2.4
MCS21	MCS21_20120418_154.2	Special Waste	MUG	5.5	0.28	0.34	0.17	0.04	0.6	0.8	11.23	74.9	15.0
MCS05	MCS05_20120418_141	Special Waste	MUG	3.0	0.03	0.02	0.01	0.01	0.047	0.06	1.58	74.4	2.1
S827	S827_20120418_141.5	Special Waste	Sue D	1.3	0.04	0.02	0.00	0.00	0.06	0.1	4.54	96.6	4.7
Average				**7**	**0**	**0.1**	**0.0**	**0.0**	**0**	**0**	**7.3**	**66.1**	**8.5**
Basement Rock													
MCN08	MCN08_20120417_233.5	Clean Waste	Candy Lake	6.4	0.019	0.007	0.004	0.003	0.0258	0.033	0.404	79.1	0.5
MCN12	MCN12_20120417_218	Clean Waste	Candy Lake	0.3	0.028	0.011	0.004	0.004	0.0384	0.046	12.798	83.3	15.4
MCN	MCN_20120417_206.7	Clean Waste	Candy Lake	1	0.020	0.006	0.002	0.000	0.03	0.03	3.3	92.7	3.6
MCG07-01	MCG07-01_20120418_178.8	Clean Waste	MUG	4.3	0.001	0.000	0.000	0.000	0.0013	0.002	0.03	79.7	0.0
MCG07-01	MCG07-01_20120418_184.1	Clean Waste	MUG	1	0.001	0.000	0.000	0.000	0.00102	0.0015	0.170	65.8	0.3
MCS22	MCS22_20120418_166.7	Clean Waste	MUG	0.9	0.003	0.001	0.001	0.000	0.0033	0.004	0.36	77.3	0.5
MU08-08	MU08-08_20120418_173	Clean Waste	MUG	0.8	0.004	0.001	0.001	0.001	0.006	0.007	0.70	79.8	0.9
MCS09	MCS09_20120418_210.2	Clean Waste	MUG	0.50	0.001	0.000	0.000	0.000	0.0007	0.0010	0.13	68.6	0.2
MCS22	MCS22_20120418_171	Clean Waste	MUG	2.7	0.073	0.027	0.014	0.008	0.100	0.12	3.71	81.9	4.5
MU08-08	MU08-08_20120418_178.2	Clean Waste	MUG	0.6	0.005	0.002	0.001	0.000	0.0063	0.01	1.05	85.7	1.2
MCS21	MCS21_20120418_160.7	Clean Waste	MUG	1	0.013	0.006	0.000	0.000	0.0	0.0	3.1	96.7	3.2
MU08-05	MU08-05_20120418_174.5	Clean Waste	MUG	5	0.005	0.005	0.087	0.050	0.0	0.1	0.2	6.8	2.9
S822	S822_20120418_149.7	Clean Waste	Sue D	2	0.001	0.000	0.000	0.000	0.0	0.0	0.1	74.8	0.1
S826	S826_20120418_111.4	Clean Waste	Sue D	1	0.000	0.000	0.000	0.000	0.001	0.00	0.09	50.0	0.2
S826	S826_20120418_107.7	Clean Waste	Sue D	4	0.723	0.561	0.204	0.150	1.28	1.6	31.30	78.4	39.9
S730	S730_20120418_133.2	Special Waste	Access Ramp	0.8	0.001	0.002	0.003	0.002	0.00	0.01	0.3	32.2	0.9
S730	S730_20120418_135.2	Special Waste	Access Ramp	1.7	0.004	0.002	0.010	0.010	0.01	0.03	0.4	24.7	1.6
S730	S730_20120418_147.7	Special Waste	Access Ramp	3	0.065	0.021	0.010	0.009	0.086	0.10	3.09	82.6	3.7
S730	S730_20120418_156.3	Special Waste	Access Ramp	26	2.866	1.288	0.532	0.416	4.153	5.10	15.97	81.4	19.6
S730	S730_20120418_138.2	Special Waste	Access Ramp	5.7	0.349	0.258	0.143	0.163	0.61	0.91	10.6	66.5	16.0
S730	S730_20120418_147	Special Waste	Access Ramp	1.4	0.011	0.005	0.513	0.001	0.016	0.53	1.13	3.0	37.8
S730	S730_20120418_152.8	Special Waste	Access Ramp	26	2.173	0.955	1.569	0.343	3.128	5.04	12.031	62.1	19.4
S730	S730_20120418_163.2	Special Waste	Access Ramp	7	0.458	0.201	0.072	0.074	0.660	0.806	9.70	81.9	11.9
MCN09	MCN09_20120417_207	Special Waste	Candy Lake	4.2	0.108	0.032	0.015	0.014	0.1401	0.169	3.335	83.1	4.0
MCN04	MCN04_20120417_226.8	Special Waste	Candy Lake	11	1.513	0.428	0.283	0.208	1.941	2.43	17.65	79.8	22.1
MCN11	MCN11_20120417_190.6	Special Waste	Candy Lake	2	0.168	0.084	0.025	0.004	0.25	0.28	14.0	89.6	15.6
S700	S700_20120418_130.5	Special Waste	Caribou	21	0.796	0.788	0.675	0.490	1.6	2.7	7.5	57.6	13.1
MCS21	MCS21_20120418_158.4	Special Waste	MUG	0	0.004	0.005	0.002	0.001	0.0	0.0	2.5	80.5	3.1
Average				**5**	**0.34**	**0.17**	**0.15**	**0.1**	**0.50**	**0.7**	**5.6**	**68.8**	**8.6**

Notes:
Values reported as "less than" detection limit in leachate assumed to be equal to the detection limit.

Selenium Leach Summary

Hole Number	Sample Number	Waste Category	Ore Deposit	Total Solids Content (mg/kg)	Water Wash 1 Leachable (mg/kg)	Water Wash 2 Leachable (mg/kg)	Phosphoric Acid Wash 1 Leachable (mg/kg)	Phosphoric Acid Wash 2 Leachable (mg/kg)	Total Water Leachable (mg/kg)	Total Leachable (mg/kg)	Water Leachable (% of total inventory)	Water Leachable (% of total leachble)	Total Leachable (% of total inventory)
Sandstone Rock													
S731	S731_20120418_99.2	Clean Waste	Access Ramp	0.7*	0.00	0.00	0.00	0.00	0.00	0.00	0.2	73.0	0.3
MCS21	MCS21_20120418_155.2	Clean Waste	MUG	0.10*	0.00	0.00	0.00	0.00	0.0	0.0	1.72	66.7	2.6
SGT11-01A	SGT11_01A_20120418_114	Clean Waste	Sue D	0.10*	0.00	0.00	0.00	0.00	0.01	0.01	5.4	66.7	8.1
S822	S822_20120418_147	Clean Waste	Sue D	0.10	0.01	0.00	0.00	0.00	0.0	0.0	8.7	55.8	15.6
S826	S826_20120418_105.3	Clean Waste	Sue D	0.10*	0.00	0.00	0.00	0.00	0.0	0.0	2.1	58.3	3.6
S826	S826_20120418_103.3	Clean Waste	Sue D	0.10*	0.02	0.00	0.00	0.00	0.0	0.0	24.6	80.4	30.6
S742	S742_20120418_106	Special Waste	Caribou	0.7*	0.00	0.00	0.00	0.00	0.0	0.0	0.7	72.0	1.0
MU08-05	MU08-05_20120418_156.2	Special Waste	MUG	7.9	0.75	0.18	0.10	0.06	0.9	1.1	11.8	85.2	13.8
MCS21	MCS21_20120418_150.7	Special Waste	MUG	0.20	0.01	0.00	0.00	0.00	0	0	7	60.3	10.9
MCS21	MCS21_20120418_154.2	Special Waste	MUG	0.20	0.00	0.00	0.00	0.00	0.0	0.0	2.40	66.7	3.6
MCS05	MCS05_20120418_141	Special Waste	MUG	0.7*	0.02	0.01	0.01	0.00	0.026	0.03	3.78	76.1	5.0
S827	S827_20120418_141.5	Special Waste	Sue D	0.10*	0.00	0.00	0.00	0.00	0.00	0.0	0.60	50.0	1.2
Average				**1**	**0**	**0.0**	**0.0**	**0.0**	**0**	**0**	**5.7**	**67.6**	**8.0**
Basement Rock													
MCN08	MCN08_20120417_233.5	Clean Waste	Candy Lake	0.7*	0.004	0.002	0.001	0.001	0.0056	0.008	0.794	73.2	1.1
MCN12	MCN12_20120417_218	Clean Waste	Candy Lake	0.7*	0.011	0.005	0.004	0.003	0.0159	0.023	2.278	69.2	3.3
MCN	MCN_20120417_206.7	Clean Waste	Candy Lake	0.10*	0.007	0.002	0.001	0.001	0.01	0.01	9.0	78.9	11.4
MCG07-01	MCG07-01_20120418_178.8	Clean Waste	MUG	0.7*	0.000	0.000	0.000	0.000	0.0006	0.001	0.08	51.0	0.2
MCG07-01	MCG07-01_20120418_184.1	Clean Waste	MUG	0.7*	0.000	0.000	0.000	0.000	0.00057	0.0011	0.081	50.4	0.2
MCS22	MCS22_20120418_166.7	Clean Waste	MUG	0.7*	0.000	0.000	0.000	0.000	0.0006	0.001	0.08	50.7	0.2
MU08-08	MU08-08_20120418_173	Clean Waste	MUG	0.7*	0.001	0.000	0.000	0.000	0.001	0.002	0.21	72.4	0.3
MCS09	MCS09_20120418_210.2	Clean Waste	MUG	0.7*	0.001	0.000	0.000	0.000	0.0008	0.0014	0.12	60.5	0.2
MCS22	MCS22_20120418_171	Clean Waste	MUG	0.7*	0.001	0.000	0.000	0.000	0.001	0.00	0.20	71.2	0.3
MU08-08	MU08-08_20120418_178.2	Clean Waste	MUG	1.9	0.076	0.019	0.013	0.009	0.0955	0.12	5.03	81.8	6.1
MCS21	MCS21_20120418_160.7	Clean Waste	MUG	0.10*	0.001	0.000	0.000	0.001	0.0	0.0	0.9	50.0	1.9
MU08-05	MU08-05_20120418_174.5	Clean Waste	MUG	0.7*	0.009	0.003	0.003	0.002	0.0	0.0	1.7	70.1	2.4
S822	S822_20120418_149.7	Clean Waste	Sue D	0.7*	0.001	0.000	0.000	0.000	0.0	0.0	0.2	64.9	0.2
S826	S826_20120418_111.4	Clean Waste	Sue D	0.10*	0.000	0.000	0.000	0.001	0.001	0.00	0.60	33.3	1.8
S826	S826_20120418_107.7	Clean Waste	Sue D	0.10*	0.001	0.001	0.001	0.001	0.00	0.0	1.80	60.0	3.0
S730	S730_20120418_133.2	Special Waste	Access Ramp	0.7*	0.001	0.000	0.000	0.000	0.00	0.00	0.1	65.3	0.2
S730	S730_20120418_135.2	Special Waste	Access Ramp	0.7*	0.001	0.000	0.000	0.000	0.00	0.00	0.1	64.8	0.2
S730	S730_20120418_147.7	Special Waste	Access Ramp	0.7*	0.003	0.001	0.001	0.000	0.003	0.00	0.50	80.9	0.6
S730	S730_20120418_156.3	Special Waste	Access Ramp	0.7*	0.017	0.004	0.003	0.002	0.021	0.02	2.97	83.3	3.6
S730	S730_20120418_138.2	Special Waste	Access Ramp	0.7*	0.006	0.003	0.001	0.001	0.01	0.01	1.2	82.2	1.5
S730	S730_20120418_147	Special Waste	Access Ramp	0.7*	0.000	0.000	0.000	0.000	0.001	0.00	0.08	50.7	0.2
S730	S730_20120418_152.8	Special Waste	Access Ramp	0.7*	0.000	0.000	0.003	0.000	0.001	0.00	0.099	19.1	0.5
S730	S730_20120418_163.2	Special Waste	Access Ramp	7.6	0.281	0.088	0.068	0.047	0.369	0.484	4.86	76.3	6.4
MCN09	MCN09_20120417_207	Special Waste	Candy Lake	0.7*	0.010	0.003	0.003	0.002	0.0134	0.018	1.918	72.7	2.6
MCN04	MCN04_20120417_226.8	Special Waste	Candy Lake	0.7*	0.047	0.015	0.013	0.008	0.063	0.08	8.96	74.6	12.0
MCN11	MCN11_20120417_190.6	Special Waste	Candy Lake	0.3	0.039	0.006	0.002	0.001	0.04	0.05	14.9	94.9	15.7
S700	S700_20120418_130.5	Special Waste	Caribou	0.7*	0.007	0.001	0.000	0.000	0.0	0.0	1.2	91.5	1.3
MCS21	MCS21_20120418_158.4	Special Waste	MUG	0.10	0.001	0.000	0.000	0.000	0.0	0.0	1.2	66.7	1.8
Average				**1**	**0.02**	**0.01**	**0.00**	**0.0**	**0.02**	**0.0**	**2.2**	**66.4**	**2.8**

Notes:
Values reported as "less than" detection limit in leachate assumed to be equal to the detection limit.

Uranium Leach Summary

Hole Number	Sample Number	Waste Category	Ore Deposit	Total Solids Content (mg/kg)	Water Wash 1 Leachable (mg/kg)	Water Wash 2 Leachable (mg/kg)	Phosphoric Acid Wash 1 Leachable (mg/kg)	Phosphoric Acid Wash 2 Leachable (mg/kg)	Total Water Leachable (mg/kg)	Total Leachable (mg/kg)	Water Leachable (% of total inventory)	Water Leachable (% of total leachble)	Total Leachable (% of total inventory)
Sandstone Rock													
S731	S731_20120418_99.2	Clean Waste	Access Ramp	1	0.01	0.00	0.00	0.00	0.02	0.02	1.7	92.8	1.8
MCS21	MCS21_20120418_155.2	Clean Waste	MUG	148	0.07	0.06	0.12	0.58	0.1	0.8	0.09	16.0	0.6
SGT11-01A	SGT11_01A_20120418_114	Clean Waste	Sue D	12	0.01	0.01	0.01	0.01	0.02	0.04	0.2	49.7	0.4
S822	S822_20120418_147	Clean Waste	Sue D	103	0.25	0.15	1.05	3.06	0.4	4.5	0.4	8.8	4.4
S826	S826_20120418_105.3	Clean Waste	Sue D	117	0.27	0.08	0.34	0.68	0.3	1.4	0.3	25.3	1.2
S826	S826_20120418_103.3	Clean Waste	Sue D	35	0.21	0.04	0.11	0.48	0.3	0.8	0.7	29.9	2.4
S742	S742_20120418_106	Special Waste	Caribou	90	3.42	1.13	0.37	0.17	4.5	5.1	5.0	89.3	5.7
MU08-05	MU08-05_20120418_156.2	Special Waste	MUG	18	1.08	0.19	0.03	0.01	1.3	1.3	7.1	96.9	7.3
MCS21	MCS21_20120418_150.7	Special Waste	MUG	390	138.84	16.19	1.71	1.47	155	158	40	98.0	40.6
MCS21	MCS21_20120418_154.2	Special Waste	MUG	460	0.24	0.11	0.10	0.40	0.3	0.8	0.08	41.1	0.2
MCS05	MCS05_20120418_141	Special Waste	MUG	26.0	0.00	0.00	0.02	0.01	0.007	0.03	0.03	20.5	0.1
S827	S827_20120418_141.5	Special Waste	Sue D	47	0.02	0.02	0.04	0.34	0.04	0.4	0.08	9.4	0.9
Average				**121**	**12**	**1.5**	**0.3**	**0.6**	**14**	**14**	**4.6**	**48.1**	**5.5**
Basement Rock													
MCN08	MCN08_20120417_233.5	Clean Waste	Candy Lake	2.5	0.000	0.000	0.002	0.001	0.0002	0.003	0.009	7.5	0.1
MCN12	MCN12_20120417_218	Clean Waste	Candy Lake	4.8	0.000	0.000	0.004	0.002	0.0004	0.006	0.009	6.8	0.1
MCN	MCN_20120417_206.7	Clean Waste	Candy Lake	19	0.007	0.015	0.009	0.016	0.02	0.05	0.1	46.8	0.2
MCG07-01	MCG07-01_20120418_178.8	Clean Waste	MUG	1.6	0.000	0.000	0.002	0.001	0.0004	0.004	0.02	10.1	0.2
MCG07-01	MCG07-01_20120418_184.1	Clean Waste	MUG	1	0.000	0.000	0.000	0.000	0.00006	0.0007	0.006	8.4	0.1
MCS22	MCS22_20120418_166.7	Clean Waste	MUG	2.2	0.000	0.000	0.002	0.001	0.0002	0.003	0.01	8.4	0.1
MU08-08	MU08-08_20120418_173	Clean Waste	MUG	6.9	0.001	0.001	0.003	0.002	0.001	0.007	0.02	19.4	0.1
MCS09	MCS09_20120418_210.2	Clean Waste	MUG	0.56	0.000	0.000	0.000	0.000	0.0002	0.0009	0.04	24.7	0.2
MCS22	MCS22_20120418_171	Clean Waste	MUG	5.5	0.001	0.000	0.008	0.003	0.001	0.01	0.02	9.1	0.2
MU08-08	MU08-08_20120418_178.2	Clean Waste	MUG	1.2	0.001	0.000	0.008	0.003	0.0009	0.01	0.07	7.8	0.9
MCS21	MCS21_20120418_160.7	Clean Waste	MUG	88	0.093	0.090	0.662	2.886	0.2	3.7	0.2	4.9	4.2
MU08-05	MU08-05_20120418_174.5	Clean Waste	MUG	13	0.136	0.023	0.091	0.039	0.2	0.3	1.2	55.1	2.2
S822	S822_20120418_149.7	Clean Waste	Sue D	37	0.130	0.022	0.159	0.088	0.2	0.4	0.4	38.0	1.1
S826	S826_20120418_111.4	Clean Waste	Sue D	15	0.002	0.007	0.033	0.018	0.009	0.06	0.06	15.1	0.4
S826	S826_20120418_107.7	Clean Waste	Sue D	56	0.017	0.014	0.051	0.243	0.03	0.3	0.06	9.7	0.6
S730	S730_20120418_133.2	Special Waste	Access Ramp	9.4	0.019	0.004	0.014	0.007	0.02	0.04	0.2	51.9	0.5
S730	S730_20120418_135.2	Special Waste	Access Ramp	3.7	0.027	0.008	0.009	0.004	0.04	0.05	1.0	73.5	1.3
S730	S730_20120418_147.7	Special Waste	Access Ramp	11	0.005	0.002	0.022	0.007	0.007	0.04	0.06	19.6	0.3
S730	S730_20120418_156.3	Special Waste	Access Ramp	20	0.003	0.002	0.006	0.005	0.005	0.02	0.02	29.9	0.1
S730	S730_20120418_138.2	Special Waste	Access Ramp	4.1	0.046	0.011	0.009	0.011	0.06	0.08	1.4	74.1	1.9
S730	S730_20120418_147	Special Waste	Access Ramp	7.4	0.001	0.000	0.005	0.004	0.001	0.01	0.02	12.9	0.1
S730	S730_20120418_152.8	Special Waste	Access Ramp	33	0.001	0.001	0.012	0.003	0.002	0.02	0.007	14.5	0.1
S730	S730_20120418_163.2	Special Waste	Access Ramp	13	0.001	0.001	0.001	0.001	0.002	0.004	0.01	46.1	0.0
MCN09	MCN09_20120417_207	Special Waste	Candy Lake	3.0	0.000	0.000	0.002	0.001	0.0003	0.004	0.008	7.2	0.1
MCN04	MCN04_20120417_226.8	Special Waste	Candy Lake	15	0.002	0.001	0.011	0.008	0.003	0.02	0.02	12.4	0.1
MCN11	MCN11_20120417_190.6	Special Waste	Candy Lake	15	0.014	0.014	0.007	0.010	0.03	0.05	0.2	61.9	0.3
S700	S700_20120418_130.5	Special Waste	Caribou	89	1.417	0.281	1.195	0.564	1.7	3.5	1.9	49.1	3.9
MCS21	MCS21_20120418_158.4	Special Waste	MUG	190	0.102	0.081	0.105	0.564	0.2	0.9	0.1	21.5	0.4
Average				**24**	**0.07**	**0.02**	**0.09**	**0.2**	**0.09**	**0.3**	**0.3**	**26.7**	**0.7**

Notes:
Values reported as "less than" detection limit in leachate assumed to be equal to the detection limit.

Vanadium Leach Summary

Hole Number	Sample Number	Waste Category	Ore Deposit	Total Solids Content (mg/kg)	Water Wash 1 Leachable (mg/kg)	Water Wash 2 Leachable (mg/kg)	Phosphoric Acid Wash 1 Leachable (mg/kg)	Phosphoric Acid Wash 2 Leachable (mg/kg)	Total Water Leachable (mg/kg)	Total Leachable (mg/kg)	Water Leachable (% of total inventory)	Water Leachable (% of total leachble)	Total Leachable (% of total inventory)
Sandstone Rock													
S731	S731_20120418_99.2	Clean Waste	Access Ramp	11	0.01	0.00	0.00	0.00	0.01	0.02	0.1	69.9	0.2
MCS21	MCS21_20120418_155.2	Clean Waste	MUG	80	0.01	0.01	0.01	0.03	0.0	0.0	0.02	36.3	0.1
SGT11-01A	SGT11_01A_20120418_114	Clean Waste	Sue D	430	0.17	0.14	0.06	0.03	0.31	0.40	0.1	78.3	0.1
S822	S822_20120418_147	Clean Waste	Sue D	31	0.00	0.00	0.07	0.16	0.0	0.2	0.0	1.7	0.8
S826	S826_20120418_105.3	Clean Waste	Sue D	71	0.00	0.01	0.00	0.03	0.0	0.0	0.0	21.9	0.1
S826	S826_20120418_103.3	Clean Waste	Sue D	54	0.00	0.00	0.01	0.04	0.0	0.0	0.0	5.5	0.1
S742	S742_20120418_106	Special Waste	Caribou	13	0.01	0.00	0.01	0.00	0.0	0.0	0.1	52.3	0.2
MU08-05	MU08-05_20120418_156.2	Special Waste	MUG	66	0.00	0.00	0.00	0.00	0.0	0.0	0.0	46.1	0.0
MCS21	MCS21_20120418_150.7	Special Waste	MUG	72	0.02	0.00	1.07	0.63	0	2	0	1.1	2.4
MCS21	MCS21_20120418_154.2	Special Waste	MUG	< 1	0.00	0.00	0.01	0.01	0.0	0.0	0.66	20.2	3.3
MCS05	MCS05_20120418_141	Special Waste	MUG	5	0.00	0.00	0.00	0.00	0.006	0.01	0.12	50.9	0.2
S827	S827_20120418_141.5	Special Waste	Sue D	40	0.01	0.02	0.00	0.01	0.03	0.0	0.08	76.4	0.1
Average				**73**	**0**	**0.0**	**0.1**	**0.1**	**0**	**0**	**0.1**	**38.4**	**0.6**
Basement Rock													
MCN08	MCN08_20120417_233.5	Clean Waste	Candy Lake	38	0.003	0.003	0.003	0.003	0.0057	0.011	0.015	50.1	0.0
MCN12	MCN12_20120417_218	Clean Waste	Candy Lake	7	0.003	0.003	0.003	0.003	0.0057	0.011	0.082	50.8	0.2
MCN	MCN_20120417_206.7	Clean Waste	Candy Lake	330	0.030	0.042	0.039	0.021	0.07	0.13	0.0	54.5	0.0
MCG07-01	MCG07-01_20120418_178.8	Clean Waste	MUG	< 1	0.003	0.003	0.003	0.003	0.0058	0.011	0.58	51.0	1.1
MCG07-01	MCG07-01_20120418_184.1	Clean Waste	MUG	1	0.003	0.003	0.003	0.003	0.00568	0.0113	0.568	50.4	1.1
MCS22	MCS22_20120418_166.7	Clean Waste	MUG	12	0.003	0.003	0.003	0.003	0.0059	0.012	0.05	50.7	0.1
MU08-08	MU08-08_20120418_173	Clean Waste	MUG	4	0.003	0.003	0.003	0.003	0.006	0.012	0.15	50.3	0.3
MCS09	MCS09_20120418_210.2	Clean Waste	MUG	36	0.003	0.003	0.004	0.003	0.0056	0.0122	0.02	46.4	0.0
MCS22	MCS22_20120418_171	Clean Waste	MUG	11	0.003	0.003	0.003	0.003	0.006	0.01	0.05	50.8	0.1
MU08-08	MU08-08_20120418_178.2	Clean Waste	MUG	5	0.003	0.003	0.003	0.003	0.0058	0.01	0.12	50.8	0.2
MCS21	MCS21_20120418_160.7	Clean Waste	MUG	11	0.004	0.005	0.014	0.037	0.0	0.1	0.1	15.9	0.6
MU08-05	MU08-05_20120418_174.5	Clean Waste	MUG	10	0.003	0.003	0.003	0.003	0.0	0.0	0.1	50.9	0.1
S822	S822_20120418_149.7	Clean Waste	Sue D	14	0.003	0.003	0.007	0.003	0.0	0.0	0.0	36.5	0.1
S826	S826_20120418_111.4	Clean Waste	Sue D	22	0.000	0.000	0.000	0.007	0.001	0.01	0.00	8.0	0.0
S826	S826_20120418_107.7	Clean Waste	Sue D	26	0.012	0.014	0.004	0.036	0.03	0.1	0.10	39.5	0.3
S730	S730_20120418_133.2	Special Waste	Access Ramp	98	0.003	0.003	0.003	0.003	0.01	0.01	0.0	50.5	0.0
S730	S730_20120418_135.2	Special Waste	Access Ramp	12	0.003	0.003	0.003	0.003	0.01	0.01	0.0	50.9	0.1
S730	S730_20120418_147.7	Special Waste	Access Ramp	12	0.029	0.005	0.006	0.003	0.035	0.04	0.29	80.9	0.4
S730	S730_20120418_156.3	Special Waste	Access Ramp	16	0.005	0.003	0.003	0.003	0.008	0.01	0.05	59.7	0.1
S730	S730_20120418_138.2	Special Waste	Access Ramp	2	0.061	0.027	0.005	0.013	0.09	0.11	4.4	82.2	5.3
S730	S730_20120418_147	Special Waste	Access Ramp	11	0.003	0.003	0.003	0.003	0.006	0.01	0.05	50.7	0.1
S730	S730_20120418_152.8	Special Waste	Access Ramp	10	0.003	0.003	0.004	0.003	0.006	0.01	0.057	46.5	0.1
S730	S730_20120418_163.2	Special Waste	Access Ramp	16	0.029	0.013	0.014	0.014	0.042	0.070	0.27	60.7	0.4
MCN09	MCN09_20120417_207	Special Waste	Candy Lake	44	0.003	0.003	0.003	0.003	0.0058	0.011	0.013	51.4	0.0
MCN04	MCN04_20120417_226.8	Special Waste	Candy Lake	48	0.003	0.003	0.003	0.003	0.006	0.01	0.01	50.6	0.0
MCN11	MCN11_20120417_190.6	Special Waste	Candy Lake	57	0.003	0.003	0.005	0.003	0.01	0.01	0.0	40.9	0.0
S700	S700_20120418_130.5	Special Waste	Caribou	12	0.003	0.003	0.004	0.003	0.0	0.0	0.0	47.4	0.1
MCS21	MCS21_20120418_158.4	Special Waste	MUG	75	0.002	0.004	0.005	0.015	0.0	0.0	0.0	23.3	0.0
Average				**34**	**0.01**	**0.01**	**0.01**	**0.0**	**0.01**	**0.0**	**0.3**	**48.3**	**0.4**

Notes:
Values reported as "less than" detection limit in leachate assumed to be equal to the detection limit.

Zinc Leach Summary

Hole Number	Sample Number	Waste Category	Ore Deposit	Total Solids Content (mg/kg)	Water Wash 1 Leachable (mg/kg)	Water Wash 2 Leachable (mg/kg)	Phosphoric Acid Wash 1 Leachable (mg/kg)	Phosphoric Acid Wash 2 Leachable (mg/kg)	Total Water Leachable (mg/kg)	Total Leachable (mg/kg)	Water Leachable (% of total inventory)	Water Leachable (% of total leachble)	Total Leachable (% of total inventory)
Sandstone Rock													
S731	S731_20120418_99.2	Clean Waste	Access Ramp	3	0.09	0.01	0.28	0.16	0.11	0.55	4.2	19.3	22.0
MCS21	MCS21_20120418_155.2	Clean Waste	MUG	10	0.01	0.00	0.01	0.04	0.0	0.1	0.13	18.5	0.7
SGT11-01A	SGT11_01A_20120418_114	Clean Waste	Sue D	8.8	0.01	0.00	0.01	0.02	0.01	0.05	0.2	29.0	0.6
S822	S822_20120418_147	Clean Waste	Sue D	5.2	0.02	0.01	0.12	0.09	0.0	0.2	0.4	9.3	4.5
S826	S826_20120418_105.3	Clean Waste	Sue D	3.8	0.00	0.01	0.05	0.17	0.0	0.2	0.4	6.0	6.1
S826	S826_20120418_103.3	Clean Waste	Sue D	3.1	0.01	0.01	0.05	0.10	0.0	0.2	0.5	9.2	5.5
S742	S742_20120418_106	Special Waste	Caribou	17	5.07	1.60	0.74	0.45	6.7	7.9	39.2	84.8	46.2
MU08-05	MU08-05_20120418_156.2	Special Waste	MUG	10	0.21	0.05	0.03	0.02	0.3	0.3	2.7	83.6	3.3
MCS21	MCS21_20120418_150.7	Special Waste	MUG	12	6.58	0.90	0.28	0.12	7	8	62	94.8	65.7
MCS21	MCS21_20120418_154.2	Special Waste	MUG	14	0.02	0.01	0.03	0.04	0.0	0.1	0.17	27.2	0.6
MCS05	MCS05_20120418_141	Special Waste	MUG	70.0	0.01	0.00	0.02	0.01	0.011	0.04	0.02	24.3	0.1
S827	S827_20120418_141.5	Special Waste	Sue D	4.7	0.01	0.00	0.04	0.11	0.01	0.2	0.25	7.4	3.4
Average				**13**	**1**	**0.2**	**0.1**	**0.1**	**1**	**1**	**9.2**	**34.5**	**13.2**
Basement Rock													
MCN08	MCN08_20120417_233.5	Clean Waste	Candy Lake	4.7	0.003	0.003	0.032	0.022	0.0057	0.060	0.122	9.6	1.3
MCN12	MCN12_20120417_218	Clean Waste	Candy Lake	11.0	0.042	0.003	0.006	0.007	0.0456	0.058	0.414	78.8	0.5
MCN	MCN_20120417_206.7	Clean Waste	Candy Lake	23	0.018	0.004	0.006	0.013	0.02	0.04	0.1	54.3	0.2
MCG07-01	MCG07-01_20120418_178.8	Clean Waste	MUG	2.7	0.006	0.003	0.004	0.041	0.0084	0.053	0.31	15.8	2.0
MCG07-01	MCG07-01_20120418_184.1	Clean Waste	MUG	11	0.006	0.007	0.013	0.013	0.01217	0.0376	0.111	32.3	0.3
MCS22	MCS22_20120418_166.7	Clean Waste	MUG	7.5	0.003	0.003	0.029	0.006	0.0061	0.041	0.08	14.9	0.6
MU08-08	MU08-08_20120418_173	Clean Waste	MUG	35.0	0.003	0.004	0.006	0.008	0.007	0.022	0.02	33.0	0.1
MCS09	MCS09_20120418_210.2	Clean Waste	MUG	11.00	0.012	0.003	0.004	0.006	0.0146	0.0243	0.13	59.9	0.2
MCS22	MCS22_20120418_171	Clean Waste	MUG	2.0	0.042	0.004	0.146	0.018	0.045	0.21	2.26	21.7	10.4
MU08-08	MU08-08_20120418_178.2	Clean Waste	MUG	0.7	0.003	0.004	0.005	0.008	0.0067	0.02	0.95	35.1	2.7
MCS21	MCS21_20120418_160.7	Clean Waste	MUG	2	0.006	0.004	0.050	0.043	0.0	0.1	0.6	9.4	6.4
MU08-05	MU08-05_20120418_174.5	Clean Waste	MUG	1	0.016	0.005	0.078	0.008	0.0	0.1	3.0	19.6	15.3
S822	S822_20120418_149.7	Clean Waste	Sue D	1	0.008	0.006	0.010	0.012	0.0	0.0	2.2	37.5	5.9
S826	S826_20120418_111.4	Clean Waste	Sue D	2	0.006	0.002	0.066	0.114	0.009	0.19	0.43	4.6	9.4
S826	S826_20120418_107.7	Clean Waste	Sue D	4	0.004	0.004	0.039	0.090	0.01	0.1	0.22	5.9	3.7
S730	S730_20120418_133.2	Special Waste	Access Ramp	14.0	0.111	0.058	0.052	0.029	0.17	0.25	1.2	67.7	1.8
S730	S730_20120418_135.2	Special Waste	Access Ramp	30.0	0.408	0.126	0.146	0.128	0.53	0.81	1.8	66.1	2.7
S730	S730_20120418_147.7	Special Waste	Access Ramp	6	0.029	0.009	0.008	0.004	0.038	0.05	0.68	75.7	0.9
S730	S730_20120418_156.3	Special Waste	Access Ramp	4	0.004	0.003	0.003	0.004	0.006	0.01	0.15	48.3	0.3
S730	S730_20120418_138.2	Special Waste	Access Ramp	1.7	0.061	0.027	0.008	0.013	0.09	0.11	5.1	80.4	6.4
S730	S730_20120418_147	Special Waste	Access Ramp	7.3	0.058	0.010	0.005	0.011	0.068	0.08	0.93	80.8	1.2
S730	S730_20120418_152.8	Special Waste	Access Ramp	3	0.051	0.012	0.007	0.015	0.063	0.09	2.250	74.1	3.0
S730	S730_20120418_163.2	Special Waste	Access Ramp	21	0.041	0.013	0.019	0.023	0.054	0.096	0.26	56.1	0.5
MCN09	MCN09_20120417_207	Special Waste	Candy Lake	27.0	0.008	0.003	0.014	0.011	0.0113	0.036	0.042	31.4	0.1
MCN04	MCN04_20120417_226.8	Special Waste	Candy Lake	21	0.003	0.003	0.007	0.030	0.006	0.04	0.03	14.5	0.2
MCN11	MCN11_20120417_190.6	Special Waste	Candy Lake	8	0.011	0.004	0.011	0.010	0.01	0.04	0.2	42.0	0.5
S700	S700_20120418_130.5	Special Waste	Caribou	2	0.015	0.006	0.019	0.008	0.0	0.0	1.1	42.8	2.5
MCS21	MCS21_20120418_158.4	Special Waste	MUG	10	0.004	0.007	0.009	0.021	0.0	0.0	0.1	28.1	0.4
Average				**10**	**0.03**	**0.01**	**0.03**	**0.0**	**0.05**	**0.1**	**0.9**	**40.7**	**2.8**

Notes:
Values reported as "less than" detection limit in leachate assumed to be equal to the detection limit.

Appendix E Compilation of Leach Testing Chemistry Data

TABLE E.1
Compilation of Solids Chemistry Data

Rinse	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2
Sample ID	MCG07-01_20120418_178.8	MCG07-01_20120418_178.8	MCG07-01_20120418_178.8	MCG07-01_20120418_178.8	MCG07-01_20120418_184.1	MCG07-01_20120418_184.1	MCG07-01_20120418_184.1	MCG07-01_20120418_184.1	MCN04_20120417_226.8	MCN04_20120417_226.8	MCN04_20120417_226.8	MCN04_20120417_226.8	MCN08_20120417_233.5	MCN08_20120417_233.5	MCN08_20120417_233.5	MCN08_20120417_233.5
Weight of Bottle	31.77	31.77	31.77	31.77	33.02	33.02	33.02	33.02	31.95	31.95	31.95	31.95	38.78	38.78	38.78	38.78
Mass of Sample (g)	151.39	160.54	161.59	166.34	155.35	165.76	165.01	163.75	150.59	161.04	158.81	161.39	151.07	161.95	158.92	161.03
Mass of Water Added (g)	447.34	449.72	442.18	439.86	453.67	455.02	449.82	440.19	450.2	449.36	439.3	440.76	446.75	449.75	446.61	442.53
Mass of H3PO4 Added (g)			10.32	14.52			12.63	15.19			11.36	13.83			11.55	11.24
Total Weight	630.45	641.97	645.79	652.4	642	653.83	660.43	652.11	632.74	642.34	641.36	647.92	636.63	650.48	655.82	653.53
pH	5.31	5.54	4.42	4.73	6.05	6.4	4.57	4.81	8.01	7.79	6.01	6.17	7.98	8.62	6.32	6.32
EC (uS/cm)	35.7	15.77	186.6	188.1	23.64	11.73	201.7	217.6	95.9	40	235.5	233.6	74.5	36.1	240.4	257.2
Dissolved Metals (mg/L)																
Aluminum (Al)-Dissolved	0.0406	0.0179	0.123	0.0727	0.0461	0.0161	0.0822	0.175	0.0537	0.0357	0.0404	0.478	0.325	0.184	0.309	0.367
Antimony (Sb)-Dissolved	<0.0001	<0.0001	0.00016	0.00022	<0.0001	<0.0001	0.00013	0.00025	0.00082	0.00057	0.00082	0.00068	0.00026	0.00014	0.00032	0.00040
Arsenic (As)-Dissolved	0.00069	0.00044	0.00226	0.00116	0.00083	0.00049	0.00232	0.00100	0.0215	0.0140	0.0886	0.0505	0.0299	0.0164	0.0405	0.0244
Barium (Ba)-Dissolved	0.000208	0.000126	0.00238	0.00210	0.000167	0.000117	0.00312	0.00194	0.00200	0.000793	0.00252	0.00203	0.000695	0.000417	0.00265	0.00207
Beryllium (Be)-Dissolved	<0.0001	<0.0001	0.00034	0.00022	<0.0001	<0.0001	0.00041	0.00022	<0.0001	<0.0001	0.00013	0.00011	<0.0001	<0.0001	0.00010	0.00011
Bismuth (Bi)-Dissolved	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron (B)-Dissolved	0.020	0.012	0.012	<0.01	0.035	0.018	0.019	0.012	0.034	0.018	0.028	0.017	0.073	0.038	0.054	0.032
Cadmium (Cd)-Dissolved	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00008	<0.00003	<0.00002	<0.00002	<0.00001	<0.00001	<0.00001	<0.00001
Calcium (Ca)-Dissolved	0.155	0.071	1.54	1.04	0.086	0.082	2.21	1.36	4.91	2.38	8.10	6.04	1.34	0.880	8.60	5.98
Chromium (Cr)-Dissolved	0.00012	<0.0001	0.00035	0.00015	<0.0001	<0.0001	0.00024	0.00020	<0.0001	0.00011	0.00015	0.00016	0.00021	0.00015	0.00028	0.00023
Cobalt (Co)-Dissolved	0.00013	<0.0001	0.00065	0.00041	<0.0001	<0.0001	0.00013	<0.0001	0.00196	0.00059	0.0172	0.00804	0.00043	0.00020	0.00335	0.00156
Copper (Cu)-Dissolved	0.00036	0.00030	0.00099	0.00063	0.00032	0.00042	0.00115	0.00052	0.00040	0.00034	0.00123	0.00071	0.00053	0.00034	0.00122	0.00036
Iron (Fe)-Dissolved	<0.01	<0.01	0.019	0.011	<0.01	<0.01	0.021	0.021	<0.01	<0.01	<0.01	0.013	0.032	0.020	0.017	0.041
Lead (Pb)-Dissolved	0.00138	0.000329	0.000084	<0.00005	0.000058	0.000105	0.000121	0.000050	0.000203	0.000164	<0.00005	0.000059	0.000141	<0.00005	0.000079	<0.00005
Lithium (Li)-Dissolved	0.00489	0.00178	0.00400	0.00187	0.00221	0.00096	0.00518	0.00307	0.00483	0.00235	0.00389	0.00234	0.00522	0.00268	0.00363	0.00241
Magnesium (Mg)-Dissolved	0.0552	0.0136	0.743	0.497	0.0237	0.0091	1.18	0.774	2.31	0.981	3.35	2.35	0.814	0.554	4.98	3.63
Manganese (Mn)-Dissolved	0.00309	0.000474	0.0393	0.0256	0.000913	0.000178	0.0458	0.0289	0.0118	0.00459	0.0597	0.0404	0.000914	0.000685	0.0182	0.0111
Molybdenum (Mo)-Dissolved	0.000340	0.000111	0.000071	<0.00005	0.000277	0.000076	0.000129	0.000060	0.505	0.153	0.0994	0.0737	0.00650	0.00236	0.00138	0.00101
Nickel (Ni)-Dissolved	0.00094	<0.0005	0.0103	0.00690	<0.0005	<0.0005	0.00093	0.00060	0.00196	0.00069	0.0127	0.00594	0.00096	<0.0005	0.00260	0.00123
Phosphorus (P)-Dissolved	<0.3	<0.3	56.3	64.3	<0.3	<0.3	66.9	77.4	<0.3	<0.3	65.7	70.5	<0.3	<0.3	63.2	77.3
Potassium (K)-Dissolved	2.27	1.05	4.68	3.03	0.920	0.700	5.00	3.29	4.91	2.98	3.39	2.44	3.79	2.01	4.23	3.14
Selenium (Se)-Dissolved	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0158	0.00549	0.00456	0.00297	0.00133	0.00058	0.00041	0.00030
Silicon (Si)-Dissolved	0.472	0.235	0.514	0.329	0.439	0.224	0.550	0.428	0.542	0.311	0.992	0.598	1.10	0.584	0.783	0.716
Silver (Ag)-Dissolved	0.000043	0.000122	<0.00001	<0.00001	<0.00001	0.000024	<0.00001	<0.00001	0.000096	0.000173	<0.00001	<0.00001	0.000112	0.000015	<0.00001	<0.00001
Sodium (Na)-Dissolved	2.70	1.25	33.7	41.2	2.24	1.11	38.8	48.9	3.08	1.34	35.0	44.4	6.97	3.22	32.3	48.4
Strontium (Sr)-Dissolved	0.00159	0.00032	0.0270	0.0179	0.00050	<0.0002	0.0397	0.0253	0.0656	0.0289	0.0929	0.0630	0.0252	0.0171	0.141	0.0972
Sulfur (S)-Dissolved	2.42	0.83	0.71	0.54	<0.5	<0.5	<0.5	<0.5	8.53	3.15	1.96	1.38	3.26	1.30	1.07	0.73
Thallium (Tl)-Dissolved	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.000036	0.000013	0.000048	0.000034	<0.00001	<0.00001	<0.00001	<0.00001
Tin (Sn)-Dissolved	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium (Ti)-Dissolved	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (U)-Dissolved	0.000096	0.000030	0.000734	0.000449	0.000010	<0.00001	0.000161	0.000059	0.000660	0.000245	0.00384	0.00281	0.000040	0.000036	0.000524	0.000417
Vanadium (V)-Dissolved	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc (Zn)-Dissolved	0.0019	<0.001	0.0016	0.0148	0.0019	0.0024	0.0045	0.0046	<0.001	0.0012	0.0025	0.0107	<0.001	<0.001	0.0111	0.0077
Sulpahte	7.26	2.49	2.13	1.62	1.5	1.5	1.5	1.5	25.59	9.45	5.88	4.14	9.78	3.9	3.21	2.19

TABLE E.1
Compilation of Solids Chemistry Data

Rinse	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2
Sample ID	MCN09_201 20417_207	MCN09_201 20417_207	MCN09_201 20417_207	MCN09_201 20417_207	MCN12_201 20417_218	MCN12_201 20417_218	MCN12_201 20417_218	MCN12_201 20417_218	MCS05_201 20418_141	MCS05_201 20418_141	MCS05_201 20418_141	MCS05_201 20418_141	MCS22_201 20418_166.7	MCS22_201 20418_166.7	MCS22_201 20418_166.7	MCS22_201 20418_166.7
Weight of Bottle	30.89	30.89	30.89	30.89	32.04	32.04	32.04	32.04	31.95	31.95	31.95	31.95	30.78	30.78	30.78	30.78
Mass of Sample (g)	151.76	162.09	160.44	168.68	153.81	159.71	161.05	163.62	152.18	160.87	160.53	159.53	150.57	158.06	159.17	159.02
Mass of Water Added (g)	458.05	454.82	440.97	440.55	449.39	449.16	442.62	435.77	452.1	464.32	438.82	441.37	446.8	453.44	442.17	436.08
Mass of H3PO4 Added (g)			11.28	12.99			12.69	11.06			11.8	11.35			12.26	12.26
Total Weight	640.69	647.81	643.55	653.1	635.27	640.92	648.58	642.49	636.19	657.13	643.09	644.12	628.1	642.28	644.35	638.1
pH	6.74	6.88	5.12	5.59	6.86	5.2	5.06	5.37	6.65	6.72	5.68	5.71	6.4	4.91	4.86	5.5
EC (uS/cm)	65.3	24.34	206.9	269.8	20.76	16.82	234.6	239	52.9	18.28	218.7	204.3	12.42	7.46	245.4	219
Dissolved Metals (mg/L)																
Aluminum (Al)-Dissolved	0.0524	0.0420	0.0535	0.0891	0.352	0.0299	0.188	0.0499	0.123	0.0340	0.0430	0.0919	0.0634	0.0334	0.505	0.0330
Antimony (Sb)-Dissolved	0.00021	0.00012	0.00026	0.00040	0.00021	0.00011	0.00034	0.00040	0.00013	<0.0001	0.00040	0.00034	0.00019	<0.0001	0.00033	0.00034
Arsenic (As)-Dissolved	0.00545	0.00320	0.0352	0.0161	0.0485	0.0223	0.0492	0.0259	0.00406	0.00343	0.0169	0.00761	0.00475	0.00250	0.0120	0.00509
Barium (Ba)-Dissolved	0.00128	0.000321	0.00497	0.00420	0.000457	0.000132	0.00332	0.00193	0.000669	0.000217	0.00197	0.00101	0.000292	0.000109	0.00510	0.00239
Beryllium (Be)-Dissolved	<0.0001	<0.0001	0.00012	0.00012	<0.0001	<0.0001	0.00018	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth (Bi)-Dissolved	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron (B)-Dissolved	0.162	0.076	0.129	0.061	0.024	0.014	0.032	0.016	0.091	0.042	0.055	0.033	0.043	0.021	0.034	0.017
Cadmium (Cd)-Dissolved	0.000019	<0.00001	0.000114	0.000092	<0.00001	<0.00001	0.000010	<0.00001	<0.00001	<0.00001	0.000073	0.000034	<0.00001	<0.00001	<0.00001	<0.00001
Calcium (Ca)-Dissolved	1.21	0.256	5.02	4.22	0.567	0.039	3.69	2.12	0.758	0.217	4.39	2.51	0.067	0.064	2.88	1.34
Chromium (Cr)-Dissolved	0.00011	<0.0001	0.00020	0.00013	0.00011	<0.0001	0.00027	0.00013	<0.0001	<0.0001	0.00016	<0.0001	<0.0001	0.00010	0.00023	0.00014
Cobalt (Co)-Dissolved	0.00129	0.00033	0.0103	0.00542	0.00031	<0.0001	0.00190	0.00052	0.00014	<0.0001	0.00145	0.00071	<0.0001	<0.0001	0.00058	0.00011
Copper (Cu)-Dissolved	0.00066	0.00030	0.00069	0.00036	0.00072	0.00038	0.00125	0.00039	0.00066	0.00039	0.00099	0.00038	0.00031	0.00028	0.00105	0.00036
Iron (Fe)-Dissolved	<0.01	<0.01	0.015	0.027	<0.01	<0.01	0.033	<0.01	0.026	<0.01	0.040	0.013	0.012	<0.01	0.057	0.016
Lead (Pb)-Dissolved	0.000660	0.000246	0.000814	0.000584	0.000410	0.000542	0.000158	0.000068	0.000559	0.000221	0.00393	0.000271	0.000534	<0.00005	0.000134	<0.00005
Lithium (Li)-Dissolved	0.00646	0.00281	0.00610	0.00365	0.00139	0.00072	0.00344	0.00163	0.00219	0.00103	0.00503	0.00319	0.00070	<0.0005	0.00136	0.00080
Magnesium (Mg)-Dissolved	0.725	0.162	3.03	2.65	0.0771	0.0166	2.16	1.23	0.489	0.0929	2.90	1.62	0.0212	0.0090	1.37	0.751
Manganese (Mn)-Dissolved	0.00815	0.00191	0.0581	0.0450	0.00132	0.000195	0.00989	0.00434	0.000893	0.000293	0.00967	0.00451	0.000412	0.000142	0.0278	0.0126
Molybdenum (Mo)-Dissolved	0.0357	0.0114	0.00523	0.00509	0.00947	0.00378	0.00145	0.00131	0.0100	0.00604	0.00375	0.00202	0.000870	0.000239	0.000203	0.000134
Nickel (Ni)-Dissolved	0.00104	<0.0005	0.00510	0.00324	0.00076	<0.0005	0.00342	0.00110	0.00052	<0.0005	0.00113	0.00052	<0.0005	<0.0005	0.00158	0.00061
Phosphorus (P)-Dissolved	<0.3	<0.3	60.7	92.5	<0.3	<0.3	76.3	85.4	<0.3	<0.3	74.4	66.2	<0.3	<0.3	81.2	78.6
Potassium (K)-Dissolved	4.22	2.01	7.27	6.12	0.951	0.551	4.64	3.05	3.48	1.36	5.82	3.75	10.4	0.194	4.93	2.86
Selenium (Se)-Dissolved	0.00333	0.00119	0.00109	0.00073	0.00375	0.00176	0.00153	0.00101	0.00679	0.00215	0.00184	0.00110	<0.0001	<0.0001	<0.0001	<0.0001
Silicon (Si)-Dissolved	0.565	0.401	1.28	0.710	0.434	0.233	0.916	0.368	0.540	0.281	1.24	0.732	0.337	0.188	0.620	0.272
Silver (Ag)-Dissolved	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.000030	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.000563	<0.00001	<0.00001	<0.00001
Sodium (Na)-Dissolved	4.11	1.69	28.2	52.4	2.17	0.995	42.3	52.4	4.52	1.88	40.5	40.5	1.23	0.775	48.3	50.8
Strontium (Sr)-Dissolved	0.0226	0.00458	0.0943	0.0795	0.00181	0.00030	0.0631	0.0381	0.0167	0.00284	0.0958	0.0528	0.00043	<0.0002	0.0456	0.0254
Sulfur (S)-Dissolved	6.79	2.54	1.65	1.09	0.73	<0.5	<0.5	<0.5	3.11	1.05	0.81	0.68	<0.5	<0.5	0.53	<0.5
Thallium (Tl)-Dissolved	0.000015	<0.00001	0.000033	0.000029	<0.00001	<0.00001	<0.00001	<0.00001	0.000017	<0.00001	0.000038	0.000031	<0.00001	<0.00001	<0.00001	<0.00001
Tin (Sn)-Dissolved	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium (Ti)-Dissolved	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (U)-Dissolved	0.000053	0.000033	0.000689	0.000489	0.000086	0.000057	0.00139	0.000627	0.00151	0.000806	0.00619	0.00319	0.000060	0.000018	0.000631	0.000250
Vanadium (V)-Dissolved	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc (Zn)-Dissolved	0.0028	<0.001	0.0049	0.0040	0.0145	0.0011	0.0020	0.0024	0.0021	0.0015	0.0066	0.0051	0.0011	<0.001	0.0102	0.0021
Sulpahte	20.37	7.62	4.95	3.27	2.19	1.5	1.5	1.5	9.33	3.15	2.43	2.04	1.5	1.5	1.59	1.5

TABLE E.1
Compilation of Solids Chemistry Data

Rinse	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2
Sample ID	MU08-05_20120418_156.2	MU08-05_20120418_156.2	MU08-05_20120418_156.2	MU08-05_20120418_156.2	MU08-05_20120418_174.5	MU08-05_20120418_174.5	MU08-05_20120418_174.5	MU08-05_20120418_174.5	MU08-08_20120418_173	MU08-08_20120418_173	MU08-08_20120418_173	MU08-08_20120418_173	S730_20120418_133.2	S730_20120418_133.2	S730_20120418_133.2	S730_20120418_133.2
Weight of Bottle	32.43	32.43	32.43	32.43	38.91	38.91	38.91	38.91	32.34	32.34	32.34	32.34	38.37	38.37	38.37	38.37
Mass of Sample (g)	151.65	161.51	162.89	161.22	151.83	158.21	159.62	160.69	154.07	162.62	164.35	160.4	151.12	167.76	163.86	163.97
Mass of Water Added (g)	450.52	454.34	442.67	440.82	449.76	451.91	437.65	439.66	451.95	451.27	448.58	443.3	448.07	452.7	440.27	440.61
Mass of H3PO4 Added (g)			17.51	12.86			11.38	10.26			12.5	11.61			12.8	14.95
Total Weight	634.6	648.26	655.46	647.34	640.53	649.03	647.63	649.46	638.32	646.21	657.29	647.59	637.49	658.79	655.26	657.79
pH	3.59	4.3	3.84	3.81	6.19	4.97	4.31	4.56	4.37	5.92	5.21	5.27	4.16	5.02	3.99	4.11
EC (uS/cm)	765	266.4	417	254.6	148.6	39.7	241.1	158.7	112.1	12.46	222.8	177.4	280.3	62.6	257.5	209
Dissolved Metals (mg/L)																
Aluminum (Al)-Dissolved	4.74	0.665	0.466	0.256	0.0091	0.0166	1.47	0.0313	0.0223	0.0885	0.0531	0.0541	0.118	0.840	0.0737	0.0835
Antimony (Sb)-Dissolved	0.00016	0.00012	0.00033	0.00030	0.00054	0.00028	0.00064	0.00039	<0.0001	<0.0001	0.00025	0.00025	0.00135	0.00141	0.00190	0.00150
Arsenic (As)-Dissolved	0.0207	0.0167	0.660	0.308	0.0142	0.00562	0.181	0.0514	0.0150	0.00717	0.0356	0.0184	0.144	0.0597	1.40	0.664
Barium (Ba)-Dissolved	0.00775	0.00209	0.000870	0.000582	0.00584	0.00163	0.00531	0.00177	0.000184	0.000151	0.00276	0.00162	0.0128	0.00193	0.00764	0.00449
Beryllium (Be)-Dissolved	0.0103	0.00256	0.00127	0.00076	0.00022	<0.0001	0.00028	<0.0001	<0.0001	<0.0001	0.00011	<0.0001	0.00126	0.00014	0.00111	0.00062
Bismuth (Bi)-Dissolved	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron (B)-Dissolved	0.040	0.023	0.020	0.018	0.019	0.011	0.016	<0.01	0.040	0.021	0.031	0.020	0.013	0.013	<0.01	<0.01
Cadmium (Cd)-Dissolved	0.000334	0.000089	0.000049	0.000029	0.000048	<0.00001	0.000016	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.000038	<0.00001	0.000021	0.000014
Calcium (Ca)-Dissolved	32.2	9.87	5.53	4.06	2.85	0.513	3.08	0.708	0.489	0.100	2.91	1.68	6.36	1.42	3.15	1.67
Chromium (Cr)-Dissolved	0.00314	0.00049	0.00041	0.00025	0.00011	0.00012	0.00029	<0.0001	0.00012	0.00015	0.00024	0.00011	0.00270	0.00110	0.00272	0.00149
Cobalt (Co)-Dissolved	3.46	0.896	0.358	0.237	0.00625	0.00101	0.00323	0.00116	<0.0001	0.00014	0.00068	0.00032	0.0369	0.00339	0.0198	0.0113
Copper (Cu)-Dissolved	2.11	0.513	0.240	0.138	0.00169	0.00081	0.00155	0.00046	0.00067	0.00059	0.00097	0.00067	0.00349	0.00105	0.00266	0.00129
Iron (Fe)-Dissolved	11.7	3.03	0.493	0.250	0.221	0.031	0.111	0.040	<0.01	0.038	0.014	0.011	0.552	0.063	0.304	0.164
Lead (Pb)-Dissolved	0.00296	0.000545	0.000114	<0.00005	0.00219	0.00174	0.000175	<0.00005	0.000056	0.000055	<0.00005	<0.00005	0.00117	0.000131	0.000069	<0.00005
Lithium (Li)-Dissolved	0.106	0.0226	0.00862	0.00628	0.0143	0.00399	0.00330	0.00172	0.00081	<0.0005	0.00441	0.00259	0.0186	0.00420	0.00356	0.00171
Magnesium (Mg)-Dissolved	43.1	11.1	4.63	3.15	2.01	0.343	1.39	0.494	0.0330	0.0308	1.76	1.05	2.75	0.306	1.46	0.830
Manganese (Mn)-Dissolved	3.20	0.803	0.314	0.202	0.0412	0.00697	0.0274	0.00980	0.000283	0.000469	0.0238	0.0137	0.135	0.0134	0.0729	0.0413
Molybdenum (Mo)-Dissolved	0.00291	0.00158	0.0117	0.00906	0.00177	0.00164	0.0309	0.0179	0.00149	0.000444	0.000314	0.000188	0.000172	0.000663	0.00100	0.000745
Nickel (Ni)-Dissolved	3.37	0.892	0.361	0.232	0.673	0.112	0.429	0.162	<0.0005	0.00140	0.00352	0.00339	0.0705	0.00741	0.0379	0.0213
Phosphorus (P)-Dissolved	<0.3	<0.3	83.0	53.0	<0.3	<0.3	68.6	45.3	<0.3	<0.3	69.5	63.4	<0.3	<0.3	63.2	64.5
Potassium (K)-Dissolved	6.34	2.88	1.72	1.30	7.56	3.28	3.79	1.92	1.23	0.371	5.51	3.60	9.24	2.77	4.60	2.89
Selenium (Se)-Dissolved	0.251	0.0647	0.0348	0.0224	0.00306	0.00091	0.00107	0.00070	0.00040	0.00011	<0.0001	<0.0001	0.00026	<0.0001	<0.0001	<0.0001
Silicon (Si)-Dissolved	1.85	1.01	0.962	1.05	0.489	0.262	0.464	0.226	0.412	0.385	1.01	0.583	0.935	0.580	0.584	0.473
Silver (Ag)-Dissolved	0.000057	0.000277	0.000014	<0.00001	0.000058	0.000049	<0.00001	<0.00001	0.000012	0.000154	<0.00001	<0.00001	0.000076	0.000018	<0.00001	<0.00001
Sodium (Na)-Dissolved	5.20	1.44	57.4	38.4	3.67	1.26	44.1	31.3	2.05	1.12	40.0	39.1	26.2	6.26	37.7	40.9
Strontium (Sr)-Dissolved	0.396	0.130	0.0600	0.0443	0.0613	0.0105	0.0443	0.0164	0.00101	0.00034	0.0527	0.0317	0.0959	0.0102	0.0500	0.0281
Sulfur (S)-Dissolved	122	33.4	16.6	12.3	11.8	3.12	3.28	1.96	0.84	<0.5	<0.5	<0.5	29.6	6.11	3.10	1.91
Thallium (Tl)-Dissolved	0.000346	0.000158	0.000104	0.000079	0.000166	0.000058	0.000097	0.000053	<0.00001	<0.00001	0.000013	<0.00001	0.000426	0.000123	0.000256	0.000154
Tin (Sn)-Dissolved	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium (Ti)-Dissolved	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (U)-Dissolved	0.364	0.0687	0.0100	0.00436	0.0459	0.00798	0.0321	0.0140	0.000253	0.000212	0.00114	0.000824	0.00651	0.00134	0.00505	0.00261
Vanadium (V)-Dissolved	0.0010	<0.001	0.0014	<0.001	<0.001	<0.001	<0.001	<0.001	0.0011	<0.001	0.0011	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc (Zn)-Dissolved	0.0711	0.0192	0.0112	0.0072	0.0053	0.0018	0.0275	0.0030	<0.001	0.0015	0.0022	0.0029	0.0372	0.0215	0.0187	0.0103
Sulpahte	366	100.2	49.8	36.9	35.4	9.36	9.84	5.88	2.52	1.5	1.5	1.5	88.8	18.33	9.3	5.73

TABLE E.1
Compilation of Solids Chemistry Data

Rinse	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2
Sample ID	S730_20120418_135.2	S730_20120418_135.2	S730_20120418_135.2	S730_20120418_135.2	S730_20120418_147.7	S730_20120418_147.7	S730_20120418_147.7	S730_20120418_147.7	S730_20120418_156.3	S730_20120418_156.3	S730_20120418_156.3	S730_20120418_156.3	S731_20120418_99.2	S731_20120418_99.2	S731_20120418_99.2	S731_20120418_99.2
Weight of Bottle	37.95	37.95	37.95	37.95	32.51	32.51	32.51	32.51	38.47	38.47	38.47	38.47	31.78	31.78	31.78	31.78
Mass of Sample (g)	151.52	160.51	162.26	162.48	152.48	165.23	166.74	168.02	150.32	161.2	159.19	161.78	153.84	165.31	168.2	165.43
Mass of Water Added (g)	453.53	447.37	442.3	438.01	445.87	449.85	444.7	444.02	448.56	448.2	438.27	445.54	446.58	453.52	438.64	439.71
Mass of H3PO4 Added (g)			10.79	13.35			12.89	10.97			13.31	13.92			14.18	13
Total Weight	643.01	645.88	653.21	651.71	630.92	647.66	656.8	655.45	637.24	647.93	649.19	659.72	632.18	650.63	652.76	649.9
pH	4.08	4.69	3.97	4.08	5.88	6.14	4.9	5.19	6.57	6.63	5.23	4.93	6.84	6.87	4.2	4.33
EC (uS/cm)	333	125.2	276.8	234.6	322	94.7	265.4	174.6	212.1	60.3	238.8	189.9	66.8	11.38	244.5	167.8
Dissolved Metals (mg/L)																
Aluminum (Al)-Dissolved	0.103	0.0568	0.0614	0.325	0.089	0.0445	0.141	0.0502	0.0840	0.0740	0.0365	0.0494	2.13	0.0504	0.0342	0.640
Antimony (Sb)-Dissolved	0.00078	0.00067	0.00084	0.00084	0.0371	0.0219	0.0156	0.0135	0.00975	0.00847	0.00807	0.00613	0.00022	<0.0001	0.00030	0.00025
Arsenic (As)-Dissolved	0.660	0.365	1.82	0.991	47.4	13.9	19.8	9.84	10.2	5.22	9.95	4.72	1.17	0.334	0.395	0.156
Barium (Ba)-Dissolved	0.00934	0.00333	0.00422	0.00342	0.00280	0.00160	0.00216	0.000914	0.000495	0.000277	0.000617	0.000393	0.0127	0.000674	0.00426	0.00221
Beryllium (Be)-Dissolved	0.00267	0.00083	0.00146	0.00095	<0.001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	0.00014	<0.0001	0.00016	<0.0001	<0.0001	<0.0001
Bismuth (Bi)-Dissolved	<0.0005	<0.0005	<0.0005	<0.0005	<0.005	<0.001	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron (B)-Dissolved	0.012	<0.01	<0.01	<0.01	<0.1	<0.02	<0.02	<0.01	0.024	0.011	<0.01	<0.01	0.036	<0.01	<0.01	<0.01
Cadmium (Cd)-Dissolved	0.000186	0.000055	0.000082	0.000053	<0.0001	<0.00002	<0.00002	<0.00001	<0.00015	<0.00008	<0.00003	<0.00003	0.000028	<0.00001	0.000017	0.000011
Calcium (Ca)-Dissolved	11.4	3.72	4.72	3.72	9.71	2.61	5.43	2.48	6.39	1.44	5.07	2.90	0.485	0.123	1.20	1.05
Chromium (Cr)-Dissolved	0.00060	0.00031	0.00050	0.00028	<0.001	0.00024	0.00058	0.00026	0.00023	0.00018	0.00054	0.00032	0.00307	0.00051	0.00092	0.00048
Cobalt (Co)-Dissolved	1.34	0.423	0.505	0.358	1.44	0.411	1.97	0.763	0.0303	0.00955	0.126	0.0893	0.00227	0.00020	0.00246	0.00089
Copper (Cu)-Dissolved	0.00966	0.00364	0.00480	0.00238	<0.002	0.00051	0.00107	0.00058	0.00099	0.00059	0.00095	0.00073	0.00536	0.00149	0.00347	0.00128
Iron (Fe)-Dissolved	0.941	0.302	0.358	0.209	<0.1	<0.02	0.031	0.011	0.016	0.012	0.027	0.026	0.266	0.024	0.057	0.022
Lead (Pb)-Dissolved	0.00115	0.00170	0.000162	0.000142	0.00089	0.00972	<0.0001	<0.00005	0.000083	0.000105	<0.00005	<0.00005	0.00371	0.000519	0.000516	0.000212
Lithium (Li)-Dissolved	0.0321	0.00950	0.00478	0.00307	0.0559	0.0214	0.0157	0.00999	0.0148	0.00518	0.00479	0.00283	0.00101	<0.0005	<0.0005	<0.0005
Magnesium (Mg)-Dissolved	6.59	2.09	2.50	1.78	14.5	3.85	6.18	3.06	3.79	0.947	3.29	1.85	0.187	0.0151	0.422	0.227
Manganese (Mn)-Dissolved	1.06	0.334	0.382	0.268	0.00799	0.00274	0.0164	0.00525	0.00843	0.00257	0.0247	0.0150	0.00276	0.000322	0.00925	0.00426
Molybdenum (Mo)-Dissolved	0.00147	0.000782	0.00370	0.00352	0.0223	0.00772	0.00346	0.00321	0.958	0.462	0.187	0.146	0.00561	0.000592	0.000124	0.000089
Nickel (Ni)-Dissolved	2.05	0.652	0.792	0.554	1.27	0.356	1.46	0.602	0.0712	0.0206	0.177	0.114	0.00801	0.00090	0.00340	0.00139
Phosphorus (P)-Dissolved	<0.3	<0.3	55.3	60.2	<3.0	<0.6	71.3	50.9	<0.3	<0.3	73.0	61.6	<0.3	<0.3	80.5	60.4
Potassium (K)-Dissolved	9.33	4.77	3.83	3.01	6.39	61.2	1.48	0.980	4.94	2.06	2.22	1.34	1.74	0.561	0.982	0.579
Selenium (Se)-Dissolved	0.00025	<0.0001	<0.0001	<0.0001	<0.001	<0.0002	<0.0002	<0.0001	0.00552	0.00154	0.00089	0.00058	0.00041	<0.0001	<0.0001	<0.0001
Silicon (Si)-Dissolved	0.814	0.412	0.426	0.435	0.93	0.60	0.41	0.391	1.25	0.782	0.843	0.686	3.09	0.168	0.200	0.177
Silver (Ag)-Dissolved	0.000012	0.000027	<0.00001	<0.00001	0.00116	0.00302	<0.00002	<0.00001	0.000030	0.000044	<0.00001	<0.00001	0.000325	0.000034	<0.00001	<0.00001
Sodium (Na)-Dissolved	17.2	4.80	33.4	40.3	16.4	4.61	39.5	33.3	15.5	4.30	42.6	38.7	10.9	2.21	50.3	40.0
Strontium (Sr)-Dissolved	0.159	0.0519	0.0685	0.0507	0.0735	0.0203	0.0398	0.0189	0.0541	0.0125	0.0462	0.0270	0.144	0.00347	0.0107	0.00563
Sulfur (S)-Dissolved	36.3	12.3	8.21	7.03	29.6	7.32	3.81	3.34	13.8	3.44	1.58	1.25	2.49	<0.5	<0.5	<0.5
Thallium (Tl)-Dissolved	0.000575	0.000284	0.000278	0.000209	0.00035	0.000129	0.000162	0.000108	0.000086	0.000033	0.000062	0.000037	<0.00001	<0.00001	<0.00001	<0.00001
Tin (Sn)-Dissolved	<0.0001	<0.0001	<0.0001	<0.0001	<0.001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00017	<0.0001	<0.0001	<0.0001
Titanium (Ti)-Dissolved	<0.01	<0.01	<0.01	<0.01	<0.1	<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.063	<0.01	<0.01	<0.01
Uranium (U)-Dissolved	0.00913	0.00280	0.00320	0.00134	0.00175	0.000653	0.00793	0.00242	0.000881	0.000692	0.00215	0.00162	0.00480	0.000532	0.000287	0.000152
Vanadium (V)-Dissolved	<0.001	<0.001	<0.001	<0.001	<0.01	<0.002	<0.002	<0.001	0.0017	0.0012	<0.001	<0.001	0.0034	<0.001	<0.001	<0.001
Zinc (Zn)-Dissolved	0.136	0.0450	0.0520	0.0461	<0.01	0.0033	0.0030	0.0015	0.0012	<0.001	<0.001	0.0014	0.0324	0.0043	0.105	0.0582
Sulpahte	108.9	36.9	24.63	21.09	88.8	21.96	11.43	10.02	41.4	10.32	4.74	3.75	7.47	1.5	1.5	1.5

TABLE E.1
Compilation of Solids Chemistry Data

Rinse	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2
Sample ID	S822_20120418_149.7	S822_20120418_149.7	S822_20120418_149.7	S822_20120418_149.7	MCS09_20120418_210.2	MCS09_20120418_210.2	MCS09_20120418_210.2	MCS09_20120418_210.2	MCS22_20120418_171	MCS22_20120418_171	MCS22_20120418_171	MCS22_20120418_171	MU08-08_20120418_178.2	MU08-08_20120418_178.2	MU08-08_20120418_178.2	MU08-08_20120418_178.2
Weight of Bottle	30.91	30.91	30.91	30.91	30.93	30.93	30.93	30.93	30.9	30.9	30.9	30.9	31.38	31.38	31.38	31.38
Mass of Sample (g)	151.82	160.01	164.46	161.47	151.95	169.36	164.72	167.64	152.26	166.45	163.95	164.4	150.67	162.1	159.54	164.6
Mass of Water Added (g)	446.63	443.68	440.24	439.62	451.57	450.39	439.3	436.67	451.57	456.44	436.17	447.43	451.98	455.82	446.33	441.28
Mass of H3PO4 Added (g)			10.6	15.13			10.94	12.97			13.78	10.97			12.44	11.97
Total Weight	629.36	634.51	646.08	647.1	634.45	650.67	645.86	648.06	634.45	653.76	644.74	653.72	634.13	649.27	649.66	649.21
pH	5.37	5.63	5.23	4.63	6.98	6.05	4.95	4.98	6.69	6.3	4.79	4.6	6.57	5.98	4.57	4.99
EC (uS/cm)	26.25	10.29	193.1	185.6	22.51	9.95	183.6	191.6	14.35	7.48	230.1	172.4	31.7	10.83	202.8	158.8
Dissolved Metals (mg/L)																
Aluminum (Al)-Dissolved	0.0083	0.0018	0.0198	0.0248	0.0385	0.0024	0.0392	0.0290	0.459	0.0168	1.64	0.148	0.0450	0.0078	0.0563	0.0268
Antimony (Sb)-Dissolved	0.00013	<0.0001	0.00028	0.00032	<0.0001	<0.0001	0.00020	0.00023	0.00017	0.00012	0.00028	0.00027	<0.0001	<0.0001	0.00018	0.00021
Arsenic (As)-Dissolved	0.0555	0.0381	0.0805	0.0441	0.0221	0.0296	0.0218	0.00034	0.0151	0.0191	0.0419	0.0177	0.0207	0.0260	0.0423	0.0204
Barium (Ba)-Dissolved	0.00168	0.000508	0.00266	0.00238	0.000190	0.000102	0.00313	0.00156	0.000481	0.000116	0.00622	0.00217	0.000196	0.000153	0.00334	0.00121
Beryllium (Be)-Dissolved	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00026	0.00013	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth (Bi)-Dissolved	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron (B)-Dissolved	<0.01	<0.01	<0.01	<0.01	0.046	0.025	0.022	0.015	0.053	0.027	0.046	0.022	0.060	0.030	0.044	0.023
Cadmium (Cd)-Dissolved	<0.00001	<0.00001	0.000012	0.000011	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.000013	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Calcium (Ca)-Dissolved	1.04	0.328	0.869	0.640	0.162	0.090	1.82	1.03	0.496	0.077	4.75	1.50	0.159	0.090	3.40	1.32
Chromium (Cr)-Dissolved	0.00017	0.00013	0.00018	0.00018	0.00022	0.00014	0.00035	0.00021	0.00013	0.00015	0.00081	0.00018	<0.0001	0.00013	0.00016	<0.0001
Cobalt (Co)-Dissolved	0.00157	0.00028	0.00120	0.00104	<0.0001	<0.0001	0.00058	0.00028	<0.0001	<0.0001	0.00233	0.00065	<0.0001	<0.0001	0.00223	0.00059
Copper (Cu)-Dissolved	0.0148	0.00367	0.00602	0.00406	0.00057	0.00036	0.00075	0.00102	0.00065	0.00038	0.00163	0.00053	0.00041	0.00053	0.00085	0.00043
Iron (Fe)-Dissolved	0.018	<0.01	0.047	0.079	<0.01	<0.01	0.033	0.019	<0.01	<0.01	0.123	0.033	<0.01	<0.01	0.058	0.014
Lead (Pb)-Dissolved	0.000105	0.000151	0.000275	<0.00005	0.000094	0.000059	<0.00005	<0.00005	0.000090	0.000063	0.000204	<0.00005	0.000122	0.000141	0.00196	0.000416
Lithium (Li)-Dissolved	0.00181	0.00063	0.00078	0.00057	<0.0005	<0.0005	0.00132	0.00092	0.00054	<0.0005	0.00390	0.00193	<0.0005	<0.0005	0.00293	0.00132
Magnesium (Mg)-Dissolved	0.358	0.0962	0.300	0.238	0.0318	0.0084	1.26	0.688	0.0880	0.0152	2.17	0.828	0.0671	0.0129	2.37	0.921
Manganese (Mn)-Dissolved	0.0473	0.0136	0.0762	0.0640	0.000760	0.000234	0.0413	0.0225	0.00193	0.000233	0.0565	0.0186	0.000684	0.000196	0.0581	0.0209
Molybdenum (Mo)-Dissolved	0.000489	0.000117	0.000142	0.000073	0.000180	<0.00005	0.000063	<0.00005	0.0247	0.00971	0.00503	0.00299	0.00158	0.000545	0.000202	0.000168
Nickel (Ni)-Dissolved	0.0161	0.00389	0.00962	0.00906	<0.0005	<0.0005	0.00120	0.00074	0.00081	<0.0005	0.00232	0.00061	<0.0005	<0.0005	0.00713	0.00262
Phosphorus (P)-Dissolved	<0.3	<0.3	62.4	69.7	<0.3	<0.3	76.7	68.8	1.35	<0.3	71.3	55.7	<0.3	<0.3	68.5	54.5
Potassium (K)-Dissolved	0.631	0.456	0.238	0.202	2.47	0.632	4.94	2.96	0.913	0.454	5.51	2.71	1.12	0.504	4.60	2.41
Selenium (Se)-Dissolved	0.00029	<0.0001	0.00012	<0.0001	0.00019	<0.0001	<0.0001	<0.0001	0.00036	0.00011	<0.0001	<0.0001	0.0253	0.00688	0.00443	0.00309
Silicon (Si)-Dissolved	0.190	0.115	0.219	0.180	0.375	0.237	0.673	0.415	0.385	0.222	1.17	0.433	0.360	0.201	1.06	0.446
Silver (Ag)-Dissolved	<0.00001	0.000017	<0.00001	<0.00001	0.000138	0.000016	<0.00001	<0.00001	<0.00001	0.000016	<0.00001	<0.00001	<0.00001	0.000013	<0.00001	<0.00001
Sodium (Na)-Dissolved	1.26	0.593	41.8	46.1	2.60	1.24	44.7	42.9	2.71	1.10	38.4	33.7	3.84	1.40	35.3	33.1
Strontium (Sr)-Dissolved	0.0120	0.00307	0.0109	0.00852	0.00075	0.00023	0.0389	0.0213	0.00200	0.00026	0.0623	0.0253	0.00154	0.00035	0.0648	0.0256
Sulfur (S)-Dissolved	1.54	0.58	<0.5	<0.5	0.87	<0.5	<0.5	<0.5	0.79	<0.5	1.02	<0.5	1.19	<0.5	<0.5	<0.5
Thallium (Tl)-Dissolved	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Tin (Sn)-Dissolved	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium (Ti)-Dissolved	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (U)-Dissolved	0.0441	0.00782	0.0580	0.0313	0.000059	0.000015	0.000163	0.000079	0.000289	0.000114	0.00299	0.00124	0.000224	0.000069	0.00263	0.000979
Vanadium (V)-Dissolved	<0.001	<0.001	0.0025	0.0011	<0.001	<0.001	0.0013	0.0011	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc (Zn)-Dissolved	0.0026	0.0020	0.0036	0.0043	0.0040	<0.001	0.0013	0.0023	0.0140	0.0013	0.0529	0.0064	0.0010	0.0013	0.0016	0.0028
Sulpahte	4.62	1.74	1.5	1.5	2.61	1.5	1.5	1.5	2.37	1.5	3.06	1.5	3.57	1.5	1.5	1.5

TABLE E.1
Compilation of Solids Chemistry Data

Rinse	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2
Sample ID	S700_20120418_130.5	S700_20120418_130.5	S700_20120418_130.5	S700_20120418_130.5	S730_20120418_138.2	S730_20120418_138.2	S730_20120418_138.2	S730_20120418_138.2	S730_20120418_147	S730_20120418_147	S730_20120418_147	S730_20120418_147	S730_20120418_152.8	S730_20120418_152.8	S730_20120418_152.8	S730_20120418_152.8
Weight of Bottle	31.4	31.4	31.4	31.4	32.1	32.1	32.1	32.1	30.75	30.75	30.75	30.75	31.89	31.89	31.89	31.89
Mass of Sample (g)	152.57	165.81	165.41	179.91	150.48	167	165.58	167.18	151.13	162.13	161.11	162.77	150.62	164.01	164.7	169.56
Mass of Water Added (g)	450.35	460.51	436.19	445.2	455.03	446.29	437.44	438.11	449.5	452.79	446.53	440.66	447.22	450.35	445.78	440.89
Mass of H3PO4 Added (g)			15	12.46			12.41	11.42			11.58	11.1			13.74	12.72
Total Weight	634.33	657.67	647.94	668.91	637.61	645.35	647.46	648.73	631.4	645.58	649.95	645.27	629.7	646.22	656.05	655.07
pH	4.67	5.19	4.49	4.37	4.04	4.75	5.53	4.1	5.79	5.77	5.6	4.98	6.68	6.8	5.38	5.13
EC (uS/cm)	338	58.9	213.5	178.3	436	135.1	244.2	200.7	91.6	33.3	216.6	190.2	81.8	28.84	258.3	188.2
Dissolved Metals (mg/L)																
Aluminum (Al)-Dissolved	0.187	0.180	0.370	0.102	0.276	0.124	0.0184	0.0553	0.616	0.0927	0.0337	0.0396	0.417	0.193	0.0379	0.0232
Antimony (Sb)-Dissolved	0.00392	0.00425	0.00419	0.00349	0.0082	0.0093	0.00232	0.00548	0.00649	0.00479	0.00482	0.00369	0.00961	0.00550	0.0179	0.00358
Arsenic (As)-Dissolved	3.48	2.19	4.88	2.89	70.2	33.2	6.06	14.0	3.82	1.89	2.39	2.10	1.88	1.06	3.10	1.20
Barium (Ba)-Dissolved	0.0164	0.00250	0.00959	0.00509	0.0110	0.00277	0.00168	0.00166	0.00233	0.000749	0.00322	0.00152	0.00118	0.000413	0.00219	0.00177
Beryllium (Be)-Dissolved	0.00026	<0.0001	0.00023	0.00013	<0.002	<0.001	<0.0002	<0.0005	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00010	<0.0001
Bismuth (Bi)-Dissolved	<0.0005	<0.0005	<0.0005	<0.0005	<0.01	<0.005	<0.001	<0.0025	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron (B)-Dissolved	0.013	<0.01	<0.01	<0.01	<0.2	<0.1	<0.02	<0.05	0.013	<0.01	0.014	<0.01	0.031	0.015	0.013	<0.01
Cadmium (Cd)-Dissolved	<0.00005	<0.00005	<0.00005	<0.00003	<0.0002	<0.0001	<0.00002	<0.00005	<0.00001	<0.00001	<0.00003	<0.00001	<0.00012	<0.0003	<0.00009	<0.00003
Calcium (Ca)-Dissolved	15.3	1.47	3.75	1.78	16.4	3.99	6.38	2.40	3.72	1.05	4.77	2.12	1.68	0.635	5.07	2.68
Chromium (Cr)-Dissolved	0.00088	0.00047	0.00073	0.00038	<0.002	<0.001	0.00024	<0.0005	0.00016	0.00017	0.00025	0.00014	0.00016	0.00013	0.00072	0.00014
Cobalt (Co)-Dissolved	0.281	0.0298	0.0849	0.0402	0.632	0.179	0.0199	0.134	0.0855	0.0318	0.0221	0.0997	0.00392	0.00109	0.141	0.0132
Copper (Cu)-Dissolved	0.00135	0.00090	0.00115	0.00091	0.0099	0.0033	0.00061	0.0017	0.00082	0.00072	0.00082	0.00039	0.00100	0.00056	0.00191	0.00039
Iron (Fe)-Dissolved	0.058	0.048	0.043	0.030	<0.2	<0.1	<0.02	<0.05	<0.01	<0.01	0.035	<0.01	0.011	<0.01	0.039	0.016
Lead (Pb)-Dissolved	0.00143	0.00155	0.000243	0.000173	0.0024	<0.0005	<0.0001	<0.00025	0.000099	0.000091	0.000074	<0.00005	0.000305	0.00126	<0.00005	<0.00005
Lithium (Li)-Dissolved	0.0567	0.0131	0.00917	0.00523	0.014	0.0056	0.0019	<0.0025	0.0120	0.00431	0.00278	0.00214	0.00282	0.00135	0.00302	0.00184
Magnesium (Mg)-Dissolved	7.03	0.821	2.10	1.03	7.10	1.91	1.82	1.17	2.24	0.679	2.51	1.29	0.674	0.220	2.84	1.40
Manganese (Mn)-Dissolved	0.284	0.0312	0.0854	0.0423	0.0219	0.00746	0.0252	0.00522	0.00479	0.00150	0.0380	0.00449	0.00745	0.00210	0.0830	0.0203
Molybdenum (Mo)-Dissolved	0.269	0.283	0.247	0.192	0.115	0.0963	0.0525	0.0604	0.00375	0.00168	0.180	0.000233	0.730	0.347	0.561	0.128
Nickel (Ni)-Dissolved	8.44	0.968	2.40	1.23	8.06	2.09	0.181	1.32	0.429	0.147	0.0837	0.411	0.0165	0.00433	0.118	0.0512
Phosphorus (P)-Dissolved	<0.3	<0.3	80.2	58.6	<6.0	<3.0	49.8	50.1	0.34	<0.3	73.1	61.2	<0.3	<0.3	75.3	61.8
Potassium (K)-Dissolved	8.26	3.14	4.02	2.43	9.8	4.05	1.96	2.01	3.71	1.51	3.59	1.21	3.82	2.03	3.14	2.23
Selenium (Se)-Dissolved	0.00252	0.00031	0.00018	0.00011	<0.002	<0.001	<0.0002	<0.0005	<0.0001	<0.0001	<0.0001	<0.0001	0.00014	<0.0001	0.00095	<0.0001
Silicon (Si)-Dissolved	0.950	0.767	0.560	0.495	<1.0	0.63	0.47	0.32	0.684	0.465	0.961	0.333	0.581	0.385	1.11	0.566
Silver (Ag)-Dissolved	0.000042	0.000030	<0.00001	<0.00001	<0.0002	<0.0001	<0.00002	<0.00005	<0.00001	0.000013	<0.00001	<0.00001	0.000051	0.000066	<0.00001	<0.00001
Sodium (Na)-Dissolved	17.1	3.74	45.7	35.7	37.1	11.1	29.1	35.2	2.67	1.14	42.5	39.1	8.59	3.35	44.3	38.2
Strontium (Sr)-Dissolved	0.199	0.0224	0.0575	0.0300	0.152	0.0478	0.0426	0.0307	0.0401	0.0126	0.0686	0.0266	0.0182	0.00558	0.0616	0.0386
Sulfur (S)-Dissolved	42.8	6.03	2.23	1.25	38.7	8.75	2.75	2.58	7.19	2.48	0.94	1.33	3.94	1.56	1.31	0.70
Thallium (Tl)-Dissolved	0.000178	0.000063	0.000103	0.000062	0.00028	0.00014	0.000022	0.000083	0.000082	0.000038	0.000040	0.000047	0.000028	0.000012	0.000039	0.000027
Tin (Sn)-Dissolved	<0.0001	<0.0001	<0.0001	<0.0001	<0.002	<0.001	<0.0002	<0.0005	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium (Ti)-Dissolved	<0.01	<0.01	<0.01	<0.01	<0.2	<0.1	<0.02	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (U)-Dissolved	0.479	0.101	0.437	0.221	0.0152	0.00426	0.00326	0.00416	0.000279	0.000171	0.00188	0.00126	0.000488	0.000345	0.00413	0.000976
Vanadium (V)-Dissolved	<0.001	<0.001	0.0014	<0.001	<0.02	<0.01	<0.002	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0014	<0.001
Zinc (Zn)-Dissolved	0.0050	0.0021	0.0071	0.0032	<0.02	<0.01	0.0029	<0.005	0.0194	0.0037	0.0017	0.0041	0.0171	0.0044	0.0026	0.0055
Sulpahte	128.4	18.09	6.69	3.75	116.1	26.25	8.25	7.74	21.57	7.44	2.82	3.99	11.82	4.68	3.93	2.1

TABLE E.1
Compilation of Solids Chemistry Data

Rinse	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2
Sample ID	S730_20120418_163.2	S730_20120418_163.2	S730_20120418_163.2	S730_20120418_163.2	S742_20120418_106	S742_20120418_106	S742_20120418_106	S742_20120418_106	S826_20120418_111.4	S826_20120418_111.4	S826_20120418_111.4	S826_20120418_111.4	S826_20120418_105.3	S826_20120418_105.3	S826_20120418_105.3	S826_20120418_105.3
Weight of Bottle	31.06	31.06	31.06	31.06	31.16	31.16	31.16	31.16								
Mass of Sample (g)	154.3	167.23	163.59	167.24	150.38	162.53	164.66	164.91	150.06	150.06	150.06	150.06	150.02	150.02	150.02	150.02
Mass of Water Added (g)	446.55	449.79	442.27	439.43	449.68	449.66	440.97	441.86	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Mass of H3PO4 Added (g)			13.96	12.05			11.59	11.14								
Total Weight	632.04	648.01	650.79	649.65	631.19	643.17	648.19	648.96								
pH	6.48	6.69	5.18	5.3	3.17	4.58	4.16	4.07	5.34	5.12	3.24	2.89	5.73	4.94	3.45	3.06
EC (uS/cm)	21.7	62.2	263	183.5	224.9	77.7	242.1	175.1	40	10	100	476	40	10	100	250
Dissolved Metals (mg/L)																
Aluminum (Al)-Dissolved	0.250	0.235	0.0420	0.104	0.285	0.998	0.273	0.147	0.011	0.066	0.43	4.93	0.049	0.19	0.18	1.23
Antimony (Sb)-Dissolved	0.0017	0.00162	0.00133	0.00127	0.00133	0.00128	0.00303	0.00199	<0.0002	<0.0002	<0.0002	<0.0002	0.0007	0.0007	0.0004	<0.0002
Arsenic (As)-Dissolved	24.0	13.8	20.1	10.5	1.50	0.715	2.50	0.974	0.0015	0.0014	0.018	0.012	0.015	0.016	0.333	0.192
Barium (Ba)-Dissolved	0.00461	0.00109	0.00643	0.00380	0.0159	0.00657	0.00294	0.00178	0.032	<0.0005	0.0081	0.02	0.015	0.0008	0.0061	0.027
Beryllium (Be)-Dissolved	<0.001	<0.0005	<0.0005	<0.0005	0.00081	0.00024	0.00011	<0.0001	<0.0001	<0.0001	0.0002	0.0012	<0.0001	<0.0001	0.0002	0.0015
Bismuth (Bi)-Dissolved	<0.005	<0.0025	<0.0025	<0.0025	<0.001	<0.0005	<0.0005	<0.0005								
Boron (B)-Dissolved	<0.1	<0.05	<0.05	<0.05	<0.02	<0.01	<0.01	<0.01	0.1	0.04	0.03	0.04	0.16	0.06	0.05	0.06
Cadmium (Cd)-Dissolved	<0.0001	<0.00005	<0.00005	<0.00005	0.00182	0.000511	0.000319	0.000194	<0.0001	<0.0001	0.0008	0.0002	<0.0001	<0.0001	0.0004	0.0003
Calcium (Ca)-Dissolved	3.91	0.76	5.27	3.16	5.31	2.34	1.01	0.665								
Chromium (Cr)-Dissolved	0.0022	0.00177	0.00143	0.00112	0.00078	0.00033	0.00030	0.00019	<0.0005	<0.0005	<0.0005	0.0025	<0.0005	<0.0005	<0.0005	0.0009
Cobalt (Co)-Dissolved	0.0610	0.0147	0.241	0.128	1.43	0.452	0.216	0.134	<0.0001	<0.0001	0.0016	0.0021	<0.0001	<0.0001	0.032	0.112
Copper (Cu)-Dissolved	0.0036	0.0018	0.0026	0.0017	0.0876	0.0248	0.0196	0.0101	0.0016	0.0013	0.0051	0.009	0.0005	0.0023	0.0036	0.0068
Iron (Fe)-Dissolved	<0.1	<0.05	<0.05	<0.05	0.678	0.256	0.056	0.032	0.0011	0.0069	0.3	0.6	0.0053	0.0087	0.03	0.14
Lead (Pb)-Dissolved	<0.0005	<0.00025	<0.00025	<0.00025	0.00224	0.000356	0.000116	0.000071	0.0002	<0.0001	0.0002	0.0003	<0.0001	<0.0001	0.0003	0.0005
Lithium (Li)-Dissolved	0.0454	0.0153	0.0179	0.0097	0.0025	0.00051	<0.0005	<0.0005								
Magnesium (Mg)-Dissolved	2.76	0.580	4.31	2.51	1.98	0.712	0.331	0.202								
Manganese (Mn)-Dissolved	0.00768	0.00181	0.0216	0.0117	0.0705	0.0220	0.0106	0.00634	0.0009	<0.0005	0.14	0.17	<0.0005	<0.0005	0.13	0.42
Molybdenum (Mo)-Dissolved	0.158	0.0747	0.0259	0.0273	0.0352	0.0236	0.102	0.0621	<0.0001	0.0001	<0.0001	<0.0001	0.004	0.001	0.0002	0.0001
Nickel (Ni)-Dissolved	0.0321	0.0074	0.0821	0.0435	13.6	4.41	2.11	1.29	0.0002	0.0006	0.0088	0.012	0.0001	0.0008	0.031	0.107
Phosphorus (P)-Dissolved	<3.0	<1.5	68.1	67.9	<0.6	0.44	59.9	48.1								
Potassium (K)-Dissolved	8.60	3.79	7.81	5.18	1.56	0.581	0.250	0.159								
Selenium (Se)-Dissolved	0.0970	0.0326	0.0244	0.0173	0.00129	0.00047	0.00048	0.00025	<0.0001	<0.0001	<0.0001	0.0003	0.0005	0.0002	0.0002	0.0003
Silicon (Si)-Dissolved	2.41	1.78	1.86	1.41	0.18	0.207	0.110	0.087								
Silver (Ag)-Dissolved	<0.0001	<0.00005	<0.00005	<0.00005	0.000043	0.000011	<0.00001	0.000019	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Sodium (Na)-Dissolved	21.5	7.68	37.6	42.4	3.09	1.66	42.1	33.5								
Strontium (Sr)-Dissolved	0.0563	0.0110	0.0895	0.0513	0.0511	0.0160	0.00784	0.00510	0.0017	0.0019	0.15	0.21	0.0008	0.0016	0.065	0.22
Sulfur (S)-Dissolved	16.3	3.22	1.09	0.58	22.2	7.56	3.82	2.32								
Thallium (Tl)-Dissolved	<0.0001	<0.00005	<0.00005	<0.00005	0.00665	0.00214	0.00167	0.000927	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tin (Sn)-Dissolved	<0.001	<0.0005	<0.0005	<0.0005	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001
Titanium (Ti)-Dissolved	<0.1	<0.05	<0.05	<0.05	<0.02	<0.01	<0.01	<0.01	<0.0002	0.0003	0.0069	0.0002	0.0002	0.0004	0.0075	0.0002
Uranium (U)-Dissolved	0.00037	0.000273	0.000449	0.000318	1.14	0.406	0.135	0.0634	0.0008	0.0022	0.011	0.0059	0.089	0.027	0.114	0.228
Vanadium (V)-Dissolved	<0.01	<0.005	<0.005	<0.005	0.0029	<0.001	0.0025	0.0013	<0.0001	0.0001	<0.0001	0.0022	0.0012	0.0018	0.0009	0.0098
Zinc (Zn)-Dissolved	0.014	<0.005	0.0068	0.0086	1.69	0.578	0.268	0.165	0.0021	0.0008	0.022	0.038	0.0009	0.0038	0.016	0.057
Sulpahte	48.9	9.66	3.27	1.74	66.6	22.68	11.46	6.96	0.3	0.5	0.5	0.3	2.5	0.8	0.3	0.5

TABLE E.1
Compilation of Solids Chemistry Data

Rinse	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2
Sample ID	S826_20120418_103.3	S826_20120418_103.3	S826_20120418_103.3	S826_20120418_103.3	S826_20120418_107.7	S826_20120418_107.7	S826_20120418_107.7	S826_20120418_107.7	SGT11_01A_20120418_114	SGT11_01A_20120418_114	SGT11_01A_20120418_114	SGT11_01A_20120418_114	MCN11_20120417_190.6	MCN11_20120417_190.6	MCN11_20120417_190.6	MCN11_20120417_190.6
Weight of Bottle																
Mass of Sample (g)	150.09	150.09	150.09	150.09	150.09	150.09	150.09	150.09	150.28	150.28	150.28	150.28	150.1	150.1	150.1	150.1
Mass of Water Added (g)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Mass of H3PO4 Added (g)																
Total Weight																
pH	5.62	4.51	3.17	2.9	5.73	5.21	3.43	3.03	7.36	6.66	4.35	3.63	7.17	6.8	5.14	4.19
EC (uS/cm)	50	20	120	320	30	10	100	250	50	20	120	180	230	60	120	150
Dissolved Metals (mg/L)																
Aluminum (Al)-Dissolved	0.027	0.015	0.58	3	0.012	0.13	0.36	3.76	0.47	0.29	0.14	0.31	0.23	0.28	0.22	0.13
Antimony (Sb)-Dissolved	<0.0002	0.0002	0.0002	<0.0002	0.0092	0.0076	0.0016	0.0005	0.0008	0.0004	0.0003	<0.0002	0.0008	0.0008	0.0008	0.0003
Arsenic (As)-Dissolved	0.0008	0.0006	0.058	0.044	0.756	0.504	3.32	1.79	0.039	0.029	0.206	0.116	0.013	0.024	0.28	0.178
Barium (Ba)-Dissolved	0.006	0.0007	0.01	0.024	0.0079	0.0005	0.0062	0.02	0.0021	0.0009	0.0081	0.018	0.0091	0.0027	0.0049	0.0071
Beryllium (Be)-Dissolved	0.0001	<0.0001	0.0004	0.0021	<0.0001	<0.0001	0.0002	0.0013	<0.0001	<0.0001	<0.0001	0.0003	<0.0001	<0.0001	<0.0001	0.0001
Bismuth (Bi)-Dissolved																
Boron (B)-Dissolved	0.12	0.05	0.05	0.05	0.12	0.04	0.04	0.04	0.33	0.14	0.2	0.15	0.36	0.14	0.16	0.12
Cadmium (Cd)-Dissolved	<0.0001	<0.0001	0.0002	0.0002	<0.0001	<0.0001	0.0002	0.0002	<0.0001	0.0001	0.0003	0.0001	<0.0001	<0.0001	0.0001	<0.0001
Calcium (Ca)-Dissolved																
Chromium (Cr)-Dissolved	<0.0005	<0.0005	0.0006	0.0017	<0.0005	<0.0005	0.0006	0.0025	0.0007	<0.0005	0.0005	0.0007	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt (Co)-Dissolved	0.086	0.006	0.326	0.492	0.001	0.0003	0.302	0.54	0.0001	<0.0001	0.0031	0.0071	0.0037	0.0013	0.029	0.147
Copper (Cu)-Dissolved	0.001	0.0014	0.0042	0.0065	0.0006	0.0014	0.0038	0.0045	0.0007	0.0011	0.0018	0.0014	0.002	0.002	0.0037	0.003
Iron (Fe)-Dissolved	0.042	0.0014	0.023	0.096	0.0019	0.0028	0.028	0.14	0.022	0.014	0.02	0.086	0.02	0.03	0.019	0.018
Lead (Pb)-Dissolved	0.0002	<0.0001	0.0002	0.0008	<0.0001	<0.0001	0.0001	0.0003	0.0001	<0.0001	0.0001	0.0002	0.0001	<0.0001	0.0001	0.0001
Lithium (Li)-Dissolved																
Magnesium (Mg)-Dissolved																
Manganese (Mn)-Dissolved	0.061	0.0042	0.22	0.31	0.0005	<0.0005	0.15	0.24	0.006	0.0021	0.34	0.66	0.044	0.011	0.12	0.25
Molybdenum (Mo)-Dissolved	0.0001	0.0002	0.0001	0.0001	0.241	0.187	0.068	0.05	0.321	0.07	0.014	0.0028	0.056	0.028	0.0084	0.0013
Nickel (Ni)-Dissolved	0.072	0.0055	0.266	0.415	0.0034	0.0019	0.599	1.12	0.0067	0.0024	0.049	0.122	0.0051	0.0017	0.022	0.062
Phosphorus (P)-Dissolved																
Potassium (K)-Dissolved																
Selenium (Se)-Dissolved	0.0068	0.0014	0.0013	0.0007	0.0004	0.0002	0.0002	0.0002	0.0015	0.0003	0.0004	0.0005	0.013	0.0019	0.0006	0.0002
Silicon (Si)-Dissolved																
Silver (Ag)-Dissolved	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Sodium (Na)-Dissolved																
Strontium (Sr)-Dissolved	0.033	0.0037	0.12	0.19	0.0006	0.0014	0.11	0.21	0.006	0.0025	0.13	0.25	0.16	0.029	0.12	0.19
Sulfur (S)-Dissolved																
Thallium (Tl)-Dissolved	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tin (Sn)-Dissolved	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium (Ti)-Dissolved	<0.0002	0.0005	0.0087	0.0003	<0.0002	0.0006	0.0062	0.0002	0.002	0.0009	0.0093	0.0003	0.0004	0.0003	0.0082	<0.0002
Uranium (U)-Dissolved	0.07	0.014	0.037	0.16	0.0057	0.0048	0.017	0.081	0.004	0.0034	0.0028	0.0047	0.0048	0.0048	0.0024	0.0035
Vanadium (V)-Dissolved	0.0004	0.0005	0.0026	0.013	0.0039	0.0048	0.0013	0.012	0.056	0.048	0.019	0.0099	0.0009	0.0009	0.0017	0.0009
Zinc (Zn)-Dissolved	0.0035	0.0018	0.017	0.035	0.0012	0.0015	0.013	0.03	0.0038	0.0011	0.0045	0.0075	0.0037	0.0013	0.0036	0.0033
Sulpahte	30	6.7	2.6	0.8	1.6	0.9	0.4	0.2	2.4	0.7	0.5	0.2	67	16	7.2	2.4

TABLE E.1
Compilation of Solids Chemistry Data

Rinse	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2
Sample ID	S827_20120418_141.5	S827_20120418_141.5	S827_20120418_141.5	S827_20120418_141.5	MCN_20120417_206.7	MCN_20120417_206.7	MCN_20120417_206.7	MCN_20120417_206.7	S822_20120418_147	S822_20120418_147	S822_20120418_147	S822_20120418_147	MCS21_20120418_160.7	MCS21_20120418_160.7	MCS21_20120418_160.7	MCS21_20120418_160.7
Weight of Bottle																
Mass of Sample (g)	150.265	150.265	150.265	150.265	150.24	150.24	150.24	150.24	150.195	150.195	150.195	150.195	144.83	144.83	144.83	144.83
Mass of Water Added (g)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Mass of H3PO4 Added (g)																
Total Weight																
pH	7.24	6.76	3.76	3.14	7.34	6.95	4.8	3.98	5.89	5.38	3.18	2.84	7.16	6.76	3.3	2.85
EC (uS/cm)	70	20	130	270	100	20	120	170	150	30	210	430	90	20	200	420
Dissolved Metals (mg/L)																
Aluminum (Al)-Dissolved	0.35	0.42	0.21	1.4	0.32	0.4	0.18	0.16	0.078	0.027	1.01	2.87	0.19	0.28	1.05	3
Antimony (Sb)-Dissolved	0.0005	0.0003	0.0002	<0.0002	0.0021	0.0024	0.0019	0.0005	0.0008	0.0009	0.0008	0.0005	0.0013	0.0009	0.0004	0.0002
Arsenic (As)-Dissolved	0.022	0.035	0.18	0.121	0.0062	0.01	0.151	0.092	0.0036	0.0016	0.287	0.146	0.038	0.023	0.104	0.05
Barium (Ba)-Dissolved	0.0022	0.0012	0.023	0.11	0.0036	0.001	0.0088	0.016	0.017	0.0041	0.059	0.054	0.0097	0.0026	0.17	0.21
Beryllium (Be)-Dissolved	<0.0001	<0.0001	0.0001	0.001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	0.0018	0.0029	<0.0001	<0.0001	0.001	0.002
Bismuth (Bi)-Dissolved																
Boron (B)-Dissolved	0.09	0.04	0.06	0.04	0.31	0.12	0.16	0.12	0.05	0.01	0.02	0.01	0.06	0.02	0.04	0.02
Cadmium (Cd)-Dissolved	<0.0001	0.0001	0.0002	0.0002	<0.0001	0.0028	0.0001	<0.0001	0.0001	0.0001	0.0005	0.0003	<0.0001	<0.0001	0.0002	0.0001
Calcium (Ca)-Dissolved																
Chromium (Cr)-Dissolved	0.0005	<0.0005	<0.0005	0.0012	0.0005	0.0007	<0.0005	<0.0005	<0.0005	<0.0005	0.0064	0.013	0.0053	0.0085	0.014	0.033
Cobalt (Co)-Dissolved	0.0001	<0.0001	0.018	0.034	0.0017	0.0004	0.022	0.062	0.048	0.0098	0.179	0.127	0.0001	<0.0001	0.01	0.0081
Copper (Cu)-Dissolved	0.0008	0.0012	0.003	0.0039	0.001	0.002	0.0031	0.0011	0.0083	0.0041	0.88	1.1	0.0008	0.0015	0.0073	0.016
Iron (Fe)-Dissolved	0.018	0.02	0.0086	0.035	0.05	0.27	0.055	0.75	0.0088	0.0069	0.24	0.63	0.076	0.14	1.17	1.87
Lead (Pb)-Dissolved	0.0001	0.0001	0.0002	0.0006	0.0051	0.0003	0.0001	0.0001	0.004	0.0011	0.042	0.084	0.0003	0.0003	0.0008	0.0025
Lithium (Li)-Dissolved																
Magnesium (Mg)-Dissolved																
Manganese (Mn)-Dissolved	0.0031	0.001	0.46	0.86	0.018	0.002	0.19	0.35	0.27	0.055	0.4	0.22	0.013	0.0036	0.33	0.2
Molybdenum (Mo)-Dissolved	0.014	0.0057	0.0004	0.0003	0.0068	0.0021	0.0006	0.0001	0.0003	0.0002	0.0001	0.0001	0.0041	0.0018	0.0001	0.0001
Nickel (Ni)-Dissolved	0.002	0.0008	0.036	0.07	0.0038	0.0014	0.029	0.065	0.35	0.065	0.722	0.555	0.0047	0.0017	0.173	0.149
Phosphorus (P)-Dissolved																
Potassium (K)-Dissolved																
Selenium (Se)-Dissolved	0.0001	<0.0001	<0.0001	0.0001	0.0024	0.0006	0.0005	0.0003	0.0024	0.0005	0.0011	0.0012	0.0002	0.0001	0.0001	0.0002
Silicon (Si)-Dissolved																
Silver (Ag)-Dissolved	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Sodium (Na)-Dissolved																
Strontium (Sr)-Dissolved	0.0061	0.0019	0.093	0.16	0.034	0.0035	0.14	0.23	0.15	0.029	0.15	0.079	0.031	0.0064	0.18	0.11
Sulfur (S)-Dissolved																
Thallium (Tl)-Dissolved	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tin (Sn)-Dissolved	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.0001
Titanium (Ti)-Dissolved	0.0006	0.0007	0.0097	<0.0002	0.001	0.0015	0.0093	<0.0002	<0.0002	<0.0002	0.0097	<0.0002	0.0033	0.0043	0.012	0.0002
Uranium (U)-Dissolved	0.0068	0.0064	0.015	0.112	0.0025	0.0049	0.003	0.0054	0.084	0.049	0.352	1.02	0.03	0.029	0.213	0.929
Vanadium (V)-Dissolved	0.0047	0.006	0.0013	0.002	0.01	0.014	0.013	0.007	0.0007	0.0006	0.023	0.054	0.0014	0.0017	0.0044	0.012
Zinc (Zn)-Dissolved	0.0028	0.0012	0.012	0.038	0.006	0.0015	0.0019	0.0044	0.0053	0.002	0.04	0.031	0.0019	0.0012	0.016	0.014
Sulpahte	1.4	0.6	0.4	0.2	21	4.6	0.7	0.3	35	8.1	3.1	1.2	4.2	1.1	<0.2	0.5

TABLE E.1
Compilation of Solids Chemistry Data

Rinse	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2	Water Rinse 1	Water Rinse 2	Phosphate Rinse 1	Phosphate Rinse 2
Sample ID	MCS21_201 20418_150.7	MCS21_201 20418_150.7	MCS21_201 20418_150.7	MCS21_201 20418_150.7	MCS21_201 20418_154.2	MCS21_201 20418_154.2	MCS21_201 20418_154.2	MCS21_201 20418_154.2	MCS21_201 20418_155.2	MCS21_201 20418_155.2	MCS21_201 20418_155.2	MCS21_201 20418_155.2	MCS21_201 20418_158.4	MCS21_201 20418_158.4	MCS21_201 20418_158.4	MCS21_201 20418_158.4
Weight of Bottle																
Mass of Sample (g)	130.62	130.62	130.62	130.62	150.09	150.09	150.09	150.09	104.77	104.77	104.77	104.77	150.06	150.06	150.06	150.06
Mass of Water Added (g)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Mass of H3PO4 Added (g)																
Total Weight																
pH	3.35	3.34	2.76	2.67	5.97	5.75	4.22	3.55	6.54	6.25	3.99	3.37	6.06	5.85	4.11	3.41
EC (uS/cm)	510	120	540	640	160	30	90	180	50	20	120	220	150	40	100	210
Dissolved Metals (mg/L)																
Aluminum (Al)-Dissolved	5.4	0.41	1	1.17	0.055	0.24	0.15	0.37	0.22	0.3	0.17	0.52	0.077	0.33	0.13	0.58
Antimony (Sb)-Dissolved	0.0003	<0.0002	0.0008	0.0007	0.0013	0.0014	0.0014	0.0004	0.001	0.001	0.0005	0.0002	0.0004	0.0004	0.0004	0.0002
Arsenic (As)-Dissolved	0.017	0.004	0.262	0.156	0.011	0.0088	0.559	0.455	0.0055	0.0046	0.137	0.096	0.0035	0.0026	0.036	0.028
Barium (Ba)-Dissolved	0.047	0.041	0.0086	0.0061	0.018	0.0025	0.014	0.044	0.0036	0.001	0.02	0.073	0.011	0.002	0.013	0.046
Beryllium (Be)-Dissolved	0.012	0.0017	0.0015	0.001	<0.0001	<0.0001	0.0001	0.0009	<0.0001	<0.0001	0.0002	0.0016	<0.0001	<0.0001	0.0001	0.0012
Bismuth (Bi)-Dissolved																
Boron (B)-Dissolved	0.05	0.02	0.02	0.02	0.21	0.07	0.07	0.06	0.13	0.05	0.05	0.04	0.15	0.05	0.06	0.05
Cadmium (Cd)-Dissolved	0.0023	0.0004	0.0003	0.0002	<0.0001	<0.0001	0.0001	0.0001	<0.0001	<0.0001	0.0001	0.0001	<0.0001	<0.0001	0.0001	<0.0001
Calcium (Ca)-Dissolved																
Chromium (Cr)-Dissolved	0.087	0.0039	0.021	0.017	<0.0005	0.0005	0.0006	0.0007	<0.0005	<0.0005	0.0005	0.0007	<0.0005	0.0012	0.0006	0.0015
Cobalt (Co)-Dissolved	2.22	0.277	0.087	0.032	0.0084	0.0012	0.02	0.052	0.0004	0.0001	0.021	0.044	0.0002	<0.0001	0.0019	0.0047
Copper (Cu)-Dissolved	0.33	0.052	0.043	0.026	0.0009	0.0016	0.0018	0.001	0.0006	0.0013	0.0024	0.0013	0.0005	0.002	0.0019	0.001
Iron (Fe)-Dissolved	34	5.7	0.78	0.57	0.035	0.029	0.019	0.04	0.025	0.029	0.021	0.1	0.01	0.03	0.014	0.079
Lead (Pb)-Dissolved	0.0033	0.0009	0.0004	0.0007	<0.0001	0.0002	0.0002	0.0006	0.0001	0.0002	0.0002	0.0007	<0.0001	0.0002	0.0001	0.0003
Lithium (Li)-Dissolved																
Magnesium (Mg)-Dissolved																
Manganese (Mn)-Dissolved	0.91	0.14	0.058	0.023	0.15	0.015	0.18	0.4	0.022	0.0021	0.25	0.42	0.084	0.0099	0.15	0.3
Molybdenum (Mo)-Dissolved	0.0009	0.0001	0.0089	0.0085	0.094	0.112	0.057	0.012	0.0021	0.0018	0.0008	0.0003	0.0015	0.0018	0.0006	0.0002
Nickel (Ni)-Dissolved	5.6	0.676	0.202	0.073	0.108	0.011	0.169	0.419	0.0054	0.0016	0.1	0.2	0.0088	0.0017	0.028	0.066
Phosphorus (P)-Dissolved																
Potassium (K)-Dissolved																
Selenium (Se)-Dissolved	0.0035	0.0003	0.0014	0.0011	0.0013	0.0003	0.0005	0.0003	0.0003	0.0001	<0.0001	0.0001	0.0003	0.0001	0.0001	0.0001
Silicon (Si)-Dissolved																
Silver (Ag)-Dissolved	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Sodium (Na)-Dissolved																
Strontium (Sr)-Dissolved	0.24	0.054	0.023	0.011	0.098	0.01	0.099	0.22	0.018	0.0038	0.13	0.23	0.12	0.015	0.16	0.33
Sulfur (S)-Dissolved																
Thallium (Tl)-Dissolved	0.0012	0.0004	0.0008	0.0007	<0.0002	<0.0002	0.0002	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tin (Sn)-Dissolved	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium (Ti)-Dissolved	0.0015	0.0005	0.0089	0.0008	0.0002	0.0008	0.0064	<0.0002	0.0005	0.003	0.0093	0.0004	0.0015	0.0019	0.0074	<0.0002
Uranium (U)-Dissolved	40.3	4.7	0.495	0.428	0.08	0.036	0.034	0.132	0.016	0.015	0.028	0.135	0.034	0.027	0.035	0.188
Vanadium (V)-Dissolved	0.0051	0.0004	0.311	0.182	0.0008	0.0014	0.0049	0.0038	0.0018	0.0023	0.0013	0.0059	0.0008	0.0013	0.0018	0.0051
Zinc (Zn)-Dissolved	1.91	0.26	0.082	0.036	0.0055	0.0026	0.0087	0.013	0.0022	0.0008	0.0032	0.01	0.0015	0.0024	0.0031	0.0069
Sulpahte	140	29	21	6.5	46	9.2	3.6	1.2	12	2.9	1.4	0.4	46	11	3.9	1.8

Appendix F Compilation of Humidity Cell Testing Chemistry Data

TABLE F.1
Compilation of Humidity Cell Leachate Chemistry Data

Sample ID		LOW DAY 0	LOW DAY 7	LOW DAY 14	LOW DAY 21	LOW DAY 28	LOW DAY 35	LOW DAY 42	LOW DAY 49	LOW DAY 56	LOW DAY 63	LOW DAY 70
Date Sampled		13-FEB-13	20-FEB-13	27-FEB-13	06-MAR-13	13-MAR-13	20-MAR-13	27-MAR-13	03-APR-13	10-APR-13	17-APR-13	24-APR-13
Week Counter		0	1	2	3	4	5	6	7	8	9	10
Original Mass	g	1,276.44	1,315.08	N/A	1,294.65	1,296.49	1,293.38	1,291.51	1,302.13	1,301.11	1,301.11	1,306.31
Mass + Water	g	2,270.07	2,313.03	2,292.20	2,285.72	2,287.10	2,284.90	2,285.56	2,292.78	2,291.87	2,291.87	2,297.22
Mass After	g	1,317.03	1,320.79	1,318.52	1,319.32	1,314.89	1,315.72	1,317.92	1,314.90	1,317.97	1,317.97	1,312.33
Total Volume Removed	mL	955.17	994.46	975.86	968.56	974.38	971.35	969.80	980.07	976.08	976.08	987.09
pH		5.91	5.72	5.82	5.88	6.4	6.49	6.36	6.42	6.66	6.66	6.91
Conductivity	(µS/cm)	50.5	56.6	38.1	35.2	26.2	26.06	17.26	14.04	6.76	10.76	14.36
Acidity (as CaCO3)	mg/L		2.2	4.2	1.4	1.9	3.3	1.9	2.1	2.8	1.8	1.8
Aluminum (Al)	mg/L	0.0517	0.0063	0.0237	0.0161	0.0042	0.0413	0.0440	0.0353	0.0181	0.0016	0.0043
Ammonia, Total (as N)	mg/L	0.0856			0.0557	0.0386	0.0620	0.186	0.0222	0.0418	0.0248	0.0240
Antimony (Sb)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Arsenic (As)	mg/L	0.00066	0.00067	0.00040	0.00043	0.00049	0.00073	0.00120	0.00161	0.00060	0.00041	0.00045
Barium (Ba)	mg/L	0.00171	0.000916	0.000467	0.000457	0.000204	0.000178	0.000093	0.000071	<0.00005	<0.00005	0.000074
Beryllium (Be)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth (Bi)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron (B)	mg/L	0.051	0.046	0.036	0.035	0.036	0.045	0.053	0.036	0.021	0.022	0.027
Bromide (Br)	mg/L		<0.05	<0.05								
Cadmium (Cd)	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Calcium (Ca)	mg/L	0.906	0.879	0.618	0.565	0.280	0.115	0.061	0.079	0.059	0.027	0.034
Chloride (Cl)	mg/L	1.59	4.19	1.99	1.99	1.22	1.38	<0.5	0.51	<0.5	<0.5	0.57
Chromium (Cr)	mg/L	0.00018	<0.0001	<0.0001	<0.0001	<0.0001	0.00014	0.00012	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt (Co)	mg/L	0.00044	0.00071	0.00023	0.00017	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper (Cu)	mg/L	0.00098	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Fluoride (F)	mg/L		<0.02	<0.02								
Iron (Fe)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (Pb)	mg/L	0.000138	0.000077	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Lithium (Li)	mg/L	0.00337	0.00497	0.00334	0.00266	0.00141	0.00188	0.00133	0.00083	0.00070	<0.0005	<0.0005
Magnesium (Mg)	mg/L	0.327	0.503	0.320	0.275	0.167	0.0757	0.0429	0.0339	0.0240	0.0189	0.0155
Manganese (Mn)	mg/L	0.0108	0.0176	0.00932	0.00896	0.00399	0.00209	0.00111	0.000760	0.000711	0.000559	0.000407
Molybdenum (Mo)	mg/L	0.000186	0.000111	0.000083	0.000079	0.000068	0.000095	0.000134	0.000086	0.000113	<0.00005	0.000188
Nickel (Ni)	mg/L	0.00533	0.00550	0.00235	0.00216	0.00096	0.00055	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Nitrate (as N)	mg/L		0.0812	0.0616								
Nitrite (as N)	mg/L		0.0057	0.0349								
Phosphorus (P)	mg/L	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium (K)	mg/L	2.41	2.80	2.15	1.91	1.39	1.35	1.15	1.18	0.524	0.486	0.515
Selenium (Se)	mg/L	0.00320	0.00600	0.00353	0.00311	0.00281	0.00287	0.00231	0.00144	0.00078	0.00087	0.00082
Silicon (Si)	mg/L	0.269	0.247	0.217	0.215	0.209	0.375	0.488	0.376	0.194	0.177	0.202
Silver (Ag)	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.000378	<0.00001	<0.00001	<0.00001
Sodium (Na)	mg/L	3.56	4.95	3.32	2.83	2.17	2.20	1.87	1.25	0.765	0.717	0.719
Strontium (Sr)	mg/L	0.0127	0.0156	0.00975	0.00961	0.00397	0.00173	0.00087	0.00065	0.00053	0.00036	0.00039
Sulfate (SO4)	mg/L	11.1	13.2	10.1	8.69	5.93	5.30	3.96	2.48	1.51	1.49	1.40
Sulfur (S)	mg/L	3.69	4.46	3.27	2.97	2.01	1.79	1.35	0.90	0.57	0.58	0.56
Thallium (Tl)	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Tin (Sn)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium (Ti)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tungsten (W)	mg/L											
Uranium (U)	mg/L	0.000149	0.000187	0.000111	0.000099	0.000077	0.000079	0.000069	0.000051	0.000039	0.000033	0.000029
Vanadium (V)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc (Zn)	mg/L	0.0017	0.0019	0.0016	0.0012	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zirconium (Zr)	mg/L											

TABLE F.1
Compilation of Humidity Cell Leachate Chemistry Data

Sample ID		LOW DAY 84	LOW DAY 98	LOW DAY 112	LOW DAY 126	LOW DAY 140	LOW DAY 168	MID DAY 0	MID DAY 7	MID DAY 14	MID DAY 21	MID DAY 28
Date Sampled		08-MAY-13	22-MAY-13	05-JUN-13	19-JUN-13	03-JUL-13	31-JUL-13	13-FEB-13	20-FEB-13	27-FEB-13	06-MAR-13	13-MAR-13
Week Counter		12	14	16	18	20	24	0	1	2	3	4
Original Mass	g	1,273.31	1,274.40	1,306.99	1,321.19	1,266.53	1,265.29	1,276.13	1,306.85	N/A	1,279.75	1,279.21
Mass + Water	g	2,268.41	2,266.71	2,297.92	2,315.66	2,260.37	2,260.76	2,267.07	2,302.36	2,282.72	2,274.48	2,272.88
Mass After	g	1,306.20	1,308.34	1,308.81	1,304.61	1,302.75	1,302.60	1,307.55	1,306.75	1,305.83	1,303.74	1,305.92
Total Volume Removed	mL	964.36	960.51	991.32	1,013.31	959.76	960.30	961.66	997.84	979.07	972.91	969.12
pH		6.74	6.72	7.28	6.56	6.53	5.43	6.41	6.27	6.23	6.36	6.67
Conductivity	(µS/cm)	7.98	7.94	7.29	8.75	5.67	7.67	23.91	31.4	20.75	14.45	11.39
Acidity (as CaCO3)	mg/L	5.75	1.9	5.5	<1.0	1.1		3.3	1.7	4.0	1.7	1.7
Aluminum (Al)	mg/L	0.002185	0.0072	0.0136	0.0038	0.0086	0.0028	0.0063	0.477	0.0296	0.0213	0.0042
Ammonia, Total (as N)	mg/L	0.076	0.0266	0.0385	0.0335	0.0355		0.101			0.0403	0.0682
Antimony (Sb)	mg/L	0.000059	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Arsenic (As)	mg/L	0.0004665	0.00058	0.00041	0.00030	0.00040	0.00036	0.00394	0.00281	0.00187	0.00208	0.00229
Barium (Ba)	mg/L	0.00228	0.000198	<0.00005	<0.00005	<0.00005	0.000057	0.000263	0.000778	0.000297	0.000224	0.000090
Beryllium (Be)	mg/L	0.000012	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth (Bi)	mg/L	<0.00016	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron (B)	mg/L	0.0188	0.025	0.019	0.015	0.017	0.017	0.057	0.049	0.032	0.031	0.032
Bromide (Br)	mg/L								<0.05	<0.05		
Cadmium (Cd)	mg/L	<0.000008	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Calcium (Ca)	mg/L	0.029	0.027	0.027	0.026	0.030	0.044	0.196	0.383	0.308	0.451	0.088
Chloride (Cl)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5		4.89	1.05	<0.5	<0.5	<0.5
Chromium (Cr)	mg/L	<0.0001	0.00012	<0.0001	<0.0001	<0.0001	<0.0001	0.00010	0.00017	<0.0001	0.00037	<0.0001
Cobalt (Co)	mg/L	<0.00001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00017	<0.0001	<0.0001	<0.0001
Copper (Cu)	mg/L	<0.00016	0.00042	0.00049	<0.0002	0.00035	0.00041	0.00089	0.00027	<0.0002	<0.0002	<0.0002
Fluoride (F)	mg/L								0.026	<0.02		
Iron (Fe)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.054	<0.01	0.053	<0.01
Lead (Pb)	mg/L	<0.00003	0.000080	<0.00005	<0.00005	<0.00005	<0.00005	0.000081	0.000168	<0.00005	<0.00006	<0.00005
Lithium (Li)	mg/L	0.00066	<0.0005	0.00060	<0.0005	<0.0005	0.00098	0.00099	0.00140	0.00058	<0.00051	<0.0005
Magnesium (Mg)	mg/L	0.01205	0.0104	0.0148	0.0117	0.0144	0.0204	0.128	0.410	0.158	0.132	0.0565
Manganese (Mn)	mg/L	0.0004015	0.000306	0.000327	0.000270	0.000361	0.000553	0.00315	0.00725	0.00301	0.0343	0.000865
Molybdenum (Mo)	mg/L	0.000044	<0.00005	0.000254	<0.00005	<0.00005	<0.00005	0.00275	0.00383	0.00221	0.002055	0.00197
Nickel (Ni)	mg/L	<0.00014	<0.0005	0.00244	<0.0005	<0.0005	<0.0005	0.00079	0.00113	<0.0005	<0.0005	<0.0005
Nitrate (as N)	mg/L								0.0505	0.0857		
Nitrite (as N)	mg/L								0.0086	0.0371		
Phosphorus (P)	mg/L	0.0304	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium (K)	mg/L	0.4445	0.826	0.496	0.321	0.435	0.482	1.49	1.87	1.13	0.845	0.611
Selenium (Se)	mg/L	0.000685	0.00075	0.00062	0.00041	0.00047	0.00053	0.00036	0.00080	0.00044	0.000285	0.00024
Silicon (Si)	mg/L	0.168	0.224	0.241	0.204	0.181	0.204	0.205	0.821	0.173	0.178	0.147
Silver (Ag)	mg/L	<0.000006	0.000119	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.000083	<0.00001
Sodium (Na)	mg/L	0.446	0.577	0.577	0.440	0.457	0.484	2.41	3.26	1.89	1.385	1.07
Strontium (Sr)	mg/L	0.000342	<0.0002	0.00026	0.00023	0.00028	0.00047	0.00296	0.00731	0.00505	0.00237	0.00112
Sulfate (SO4)	mg/L	1.09	0.88	1.01	0.79	0.72	1.5	28.7	7.53	5.36	3.11	1.98
Sulfur (S)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.56	2.81	1.81	1.105	0.70
Thallium (Tl)	mg/L	<0.000004	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Tin (Sn)	mg/L	<0.00007	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium (Ti)	mg/L	<0.0007	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tungsten (W)	mg/L	<0.01										
Uranium (U)	mg/L	0.00003675	0.000045	0.000646	0.000028	0.000030	0.000032	0.000597	0.000678	0.000242	0.000215	0.000178
Vanadium (V)	mg/L	0.000077	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc (Zn)	mg/L	<0.0007	0.0016	0.0013	0.0011	<0.001	<0.001	0.0014	0.0013	<0.001	0.0013	<0.001
Zirconium (Zr)	mg/L	<0.004										

TABLE F.1
Compilation of Humidity Cell Leachate Chemistry Data

Sample ID		MID DAY 35	MID DAY 42	MID DAY 49	MID DAY 56	MID DAY 63	MID DAY 70	MID DAY 84	MID DAY 98	MID DAY 112	MID DAY 126	MID DAY 140
Date Sampled		20-MAR-13	27-MAR-13	03-APR-13	10-APR-13	17-APR-13	24-APR-13	08-MAY-13	22-MAY-13	05-JUN-13	19-JUN-13	03-JUL-13
Week Counter		5	6	7	8	9	10	12	14	16	18	20
Original Mass	g	1,287.43	1,292.77	1,277.81	1,299.21	1,299.21	1,290.72	1,267.73	1,276.22	1,285.99	1,319.67	1,274.66
Mass + Water	g	2,279.54	2,287.62	2,270.47	2,291.61	2,291.61	2,280.86	2,259.08	2,267.18	2,279.22	2,313.93	2,266.89
Mass After	g	1,304.91	1,304.35	1,305.27	1,304.16	1,304.16	1,303.34	1,300.49	1,301.85	1,298.99	1,301.73	1,298.96
Total Volume Removed	mL	976.81	985.47	967.36	989.66	989.66	979.70	960.73	967.49	982.42	1,014.46	970.09
pH		6.75	6.9	6.69	6.56	6.56	6.8	6.94	6.85	6.77	6.67	6.7
Conductivity	(µS/cm)	11.53	10.62	8.35	6.51	6.51	5.64	4.41	5.35	5.35	4.9	4.6
Acidity (as CaCO3)	mg/L	2.4	1.8	2.0	1.7	1.5	<1.0	5.5	1.8	3.1	<1.0	1.3
Aluminum (Al)	mg/L	0.0253	0.0200	0.0354	0.0232	0.0022	0.0042	0.001315	0.0075	0.0063	0.0038	0.0052
Ammonia, Total (as N)	mg/L	0.0382	0.201	0.0232	0.0326	0.0193	0.0238	0.07	0.0281	0.0796	0.0234	0.0252
Antimony (Sb)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.000051	<0.0001	<0.0001	<0.0001	<0.0001
Arsenic (As)	mg/L	0.00389	0.00459	0.00386	0.00186	0.00198	0.00191	0.002445	0.00258	0.00190	0.00151	0.00180
Barium (Ba)	mg/L	0.000088	0.000088	0.000055	0.000081	0.00005	<0.00005	<0.00005	0.000088	0.000051	<0.00005	0.000064
Beryllium (Be)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth (Bi)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00016	<0.0005	<0.0005	<0.0005	<0.0005
Boron (B)	mg/L	0.037	0.050	0.035	0.020	0.02	0.0195	0.0202	0.023	0.018	0.016	0.019
Bromide (Br)	mg/L											
Cadmium (Cd)	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000008	<0.00001	<0.00001	<0.00001	<0.00001
Calcium (Ca)	mg/L	0.037	0.043	0.035	0.049	<0.02	0.078	0.038	0.022	0.035	0.026	0.026
Chloride (Cl)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium (Cr)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00018
Cobalt (Co)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00001	<0.0001	<0.0001	<0.0001	<0.0001
Copper (Cu)	mg/L	0.00022	<0.0002	<0.0002	<0.0002	<0.0002	<0.00023	<0.00016	<0.0002	<0.0002	<0.0002	0.00020
Fluoride (F)	mg/L											
Iron (Fe)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (Pb)	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00006	0.000052	0.000116	<0.00005	<0.00005	<0.00005
Lithium (Li)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Magnesium (Mg)	mg/L	0.0282	0.0246	0.0249	0.0252	0.0121	0.0108	0.0061	0.0083	0.0166	0.0126	0.0128
Manganese (Mn)	mg/L	0.000523	0.000458	0.000466	0.000622	0.000344	0.000282	0.0001775	0.000239	0.000406	0.000295	0.000260
Molybdenum (Mo)	mg/L	0.00249	0.00319	0.00188	0.00121	0.00101	0.000995	0.0008295	0.000880	0.000792	0.000764	0.000443
Nickel (Ni)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00014	<0.0005	<0.0005	<0.0005	<0.0005
Nitrate (as N)	mg/L											
Nitrite (as N)	mg/L											
Phosphorus (P)	mg/L	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.017	<0.3	<0.3	<0.3	<0.3
Potassium (K)	mg/L	0.679	0.660	0.518	0.328	0.322	0.464	0.4205	0.351	0.333	0.309	0.287
Selenium (Se)	mg/L	0.00022	0.00013	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silicon (Si)	mg/L	0.279	0.352	0.297	0.164	0.139	0.144	0.1515	0.186	0.153	0.154	0.127
Silver (Ag)	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.000123	0.000033	0.000016	<0.00001	0.000014	0.000028
Sodium (Na)	mg/L	1.25	1.28	0.904	0.612	0.562	0.526	0.3375	0.460	0.423	0.417	0.354
Strontium (Sr)	mg/L	0.00047	0.00050	0.00040	0.00053	<0.0002	0.00048	0.000138	0.00022	0.00024	0.00026	0.00022
Sulfate (SO4)	mg/L	1.55	0.94	0.54	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulfur (S)	mg/L	0.60	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium (Tl)	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000004	<0.00001	<0.00001	<0.00001	<0.00001
Tin (Sn)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00007	<0.0001	<0.0001	<0.0001	<0.0001
Titanium (Ti)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0007	<0.01	<0.01	<0.01	<0.01
Tungsten (W)	mg/L							<0.01				
Uranium (U)	mg/L	0.000195	0.000244	0.000204	0.000140	0.0001	0.0001215	0.000141	0.000107	0.000165	0.000104	0.000103
Vanadium (V)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.000209	<0.001	<0.001	<0.001	<0.001
Zinc (Zn)	mg/L	<0.001	0.0010	<0.001	<0.001	<0.001	<0.001	<0.0007	0.0020	0.0012	<0.001	0.0012
Zirconium (Zr)	mg/L							<0.004				

TABLE F.1
Compilation of Humidity Cell Leachate Chemistry Data

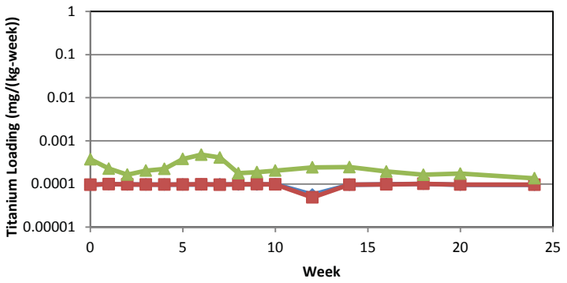
Sample ID		MID DAY 168	HIGH DAY 0	HIGH DAY 7	HIGH DAY 14	HIGH DAY 21	HIGH DAY 28	HIGH DAY 35	HIGH DAY 42	HIGH DAY 49	HIGH DAY 56	HIGH DAY 63
Date Sampled		31-JUL-13	13-FEB-13	20-FEB-13	27-FEB-13	06-MAR-13	13-MAR-13	20-MAR-13	27-MAR-13	03-APR-13	10-APR-13	17-APR-13
Week Counter		24	0	1	2	3	4	5	6	7	8	9
Original Mass	g	1,270.29	1,277.80	1,328.26	N/A	1,314.98	1,310.06	1,311.01	1,314.01	1,319.47	1,321.60	1,321.60
Mass + Water	g	2,265.34	2,270.11	2,321.09	2,305.87	2,308.43	2,305.11	2,303.69	2,307.06	2,309.99	2,315.21	2,315.21
Mass After	g	1,298.61	1,332.68	1,335.53	1,337.23	1,335.26	1,332.48	1,329.18	1,329.15	1,332.02	1,326.57	1,326.57
Total Volume Removed	mL	968.89	939.53	987.76	970.80	975.35	974.80	976.69	980.10	980.16	990.85	990.85
pH		6.26	5.81	5.76	5.81	6.11	6.09	6.2	6.52	6.27	6.38	6.38
Conductivity	(µS/cm)	5.35	100.5	98.1	53.9	51.1	34.1	31.1	25.67	17.75	11.76	11.76
Acidity (as CaCO3)	mg/L		5.1	2.6	4.4	2.2	2.0	3.3	2.0	2.5	1.8	2.4
Aluminum (Al)	mg/L	0.0013	0.313	0.0183	0.0419	0.0527	0.0434	0.0495	0.0680	0.06605	0.0480	0.0043
Ammonia, Total (as N)	mg/L		0.158			0.0676	0.0496	0.0279	0.0472	0.0417	0.0246	0.0334
Antimony (Sb)	mg/L	<0.0001	0.00040	0.00023	0.00017	0.00021	0.00023	0.00039	0.00049	0.00042	0.00018	0.00019
Arsenic (As)	mg/L	0.00170	0.103	0.113	0.0684	0.0470	0.0452	0.0581	0.0613	0.0466	0.0261	0.0269
Barium (Ba)	mg/L	<0.00005	0.00383	0.00334	0.00200	0.00155	0.000951	0.000821	0.000556	0.0003085	0.000270	0.000202
Beryllium (Be)	mg/L	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth (Bi)	mg/L	<0.0005	<0.0005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron (B)	mg/L	0.017	0.050	0.041	0.030	0.031	0.030	0.036	0.037	0.029	0.015	0.019
Bromide (Br)	mg/L			0.05	<0.05							
Cadmium (Cd)	mg/L	<0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Calcium (Ca)	mg/L	0.042	2.99	2.65	1.91	1.30	0.755	0.531	0.342	0.214	0.204	0.162
Chloride (Cl)	mg/L		0.91	6.05	2.33	1.85	0.63	0.61	0.59	<0.5	<0.5	<0.5
Chromium (Cr)	mg/L	<0.0001	0.00031	0.00012	0.00011	0.00012	0.00012	<0.0001	0.00017	<0.0001	<0.0001	<0.0001
Cobalt (Co)	mg/L	<0.0001	0.00459	0.00442	0.00284	0.00199	0.00120	0.00092	0.00058	0.000395	0.00032	0.00028
Copper (Cu)	mg/L	0.00078	0.00209	0.00093	0.00045	0.00045	<0.0002	0.00020	0.00033	<0.0002	<0.0002	0.0002
Fluoride (F)	mg/L			0.026	0.023							
Iron (Fe)	mg/L	<0.01	0.020	0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (Pb)	mg/L	<0.00005	0.000167	0.000056	<0.00005	<0.00005	<0.00005	0.000051	<0.00005	<0.00005	<0.00005	<0.00005
Lithium (Li)	mg/L	0.00063	0.00735	0.00837	0.00517	0.00456	0.00280	0.00347	0.00288	0.00219	0.00140	0.00083
Magnesium (Mg)	mg/L	0.0163	1.13	1.46	0.898	0.632	0.374	0.290	0.190	0.128	0.106	0.0885
Manganese (Mn)	mg/L	0.000630	0.0439	0.0528	0.0339	0.0258	0.0156	0.0123	0.00785	0.005575	0.00482	0.00451
Molybdenum (Mo)	mg/L	0.000357	0.00650	0.0055	0.00406	0.00431	0.00424	0.00653	0.00732	0.00586	0.00268	0.003
Nickel (Ni)	mg/L	<0.0005	0.0935	0.133	0.0771	0.0471	0.0299	0.0219	0.0125	0.008345	0.00657	0.00622
Nitrate (as N)	mg/L			0.127	0.0735							
Nitrite (as N)	mg/L			0.0179	0.0534							
Phosphorus (P)	mg/L	<0.3	<0.3	0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium (K)	mg/L	0.315	4.60	4.2	3.17	2.78	1.96	2.20	1.78	1.36	0.917	0.944
Selenium (Se)	mg/L	<0.0001	0.00126	0.00305	0.00188	0.00157	0.00101	0.00093	0.00058	0.000285	0.00014	0.00017
Silicon (Si)	mg/L	0.156	0.818	0.38	0.319	0.377	0.338	0.505	0.616	0.5385	0.278	0.251
Silver (Ag)	mg/L	<0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	0.000034	<0.00001	<0.00001	<0.00001	<0.00001
Sodium (Na)	mg/L	0.438	8.13	8.21	4.42	3.71	2.35	2.34	1.83	1.255	0.788	0.622
Strontium (Sr)	mg/L	0.00026	0.0436	0.0444	0.0329	0.0212	0.0126	0.00927	0.00572	0.00357	0.00320	0.00259
Sulfate (SO4)	mg/L	<0.5	4.22	25.8	19.1	14.9	9.90	8.78	6.41	4.13	3.46	2.47
Sulfur (S)	mg/L	<0.5	9.66	8.78	6.14	4.94	3.34	2.96	2.21	1.47	1.03	0.89
Thallium (Tl)	mg/L	<0.00001	0.000017	0.000019	0.000012	0.000010	<0.00001	0.000015	<0.00001	<0.00001	<0.00001	<0.00001
Tin (Sn)	mg/L	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium (Ti)	mg/L	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tungsten (W)	mg/L											
Uranium (U)	mg/L	0.000091	0.0265	0.0263	0.0128	0.00690	0.00560	0.00565	0.00464	0.003855	0.00251	0.00284
Vanadium (V)	mg/L	<0.001	0.0015	0.001	<0.001	<0.001	<0.001	<0.001	0.0010	<0.001	<0.001	<0.001
Zinc (Zn)	mg/L	0.0010	0.0029	0.0025	0.0012	0.0020	0.0013	0.0012	0.0011	<0.001	<0.001	<0.001
Zirconium (Zr)	mg/L											

TABLE F.1
Compilation of Humidity Cell Leachate Chemistry Data

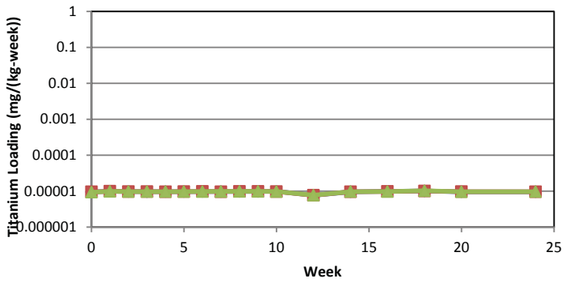
Sample ID		HIGH DAY 70	HIGH DAY 84	HIGH DAY 98	HIGH DAY 112	HIGH DAY 126	HIGH DAY 140	HIGH DAY 168
Date Sampled		24-APR-13	08-MAY-13	22-MAY-13	05-JUN-13	19-JUN-13	03-JUL-13	31-JUL-13
Week Counter		10	12	14	16	18	20	24
Original Mass	g	1,308.92	1,293.74	1,315.26	1,303.33	1,342.97	1,286.86	1,270.23
Mass + Water	g	2,300.80	2,287.48	2,308.01	2,296.10	2,336.89	2,280.63	2,274.24
Mass After	g	1,326.90	1,322.39	1,326.74	1,318.97	1,314.28	1,313.90	1,306.33
Total Volume Removed	mL	976.08	967.25	970.79	979.31	1,024.90	968.89	970.07
pH		6.39	6.34	6.385	6.51	6.45	6.39	6.22
Conductivity	(µS/cm)	11.63	11.02	11.695	8.89	7.93	7.57	11.87
Acidity (as CaCO3)	mg/L	<1.0	4.9	1.9	2.5	<1.0	1.8	
Aluminum (Al)	mg/L	0.0034	0.0041	0.0182	0.0126	0.0056	0.0050	0.0033
Ammonia, Total (as N)	mg/L	0.0356	0.061	0.0337	0.0306	0.0304	0.0337	
Antimony (Sb)	mg/L	0.00021	0.000251	0.000255	0.00020	0.00016	0.00018	0.00014
Arsenic (As)	mg/L	0.0272	0.0279	0.0273	0.0224	0.0169	0.0187	0.0138
Barium (Ba)	mg/L	0.000202	0.0002505	0.000236	0.000166	0.000170	0.000159	0.000263
Beryllium (Be)	mg/L	<0.0001	0.00001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth (Bi)	mg/L	<0.0005	<0.00016	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron (B)	mg/L	0.016	0.0172	0.0185	0.016	0.012	0.013	0.014
Bromide (Br)	mg/L							
Cadmium (Cd)	mg/L	<0.00001	<0.000008	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Calcium (Ca)	mg/L	0.165	0.198	0.137	0.133	0.143	0.132	0.240
Chloride (Cl)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Chromium (Cr)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt (Co)	mg/L	0.00029	0.0002975	0.00022	0.00021	0.00020	0.00022	0.00026
Copper (Cu)	mg/L	<0.0002	0.000285	<0.00024	0.00037	<0.0002	<0.0002	0.00059
Fluoride (F)	mg/L							
Iron (Fe)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (Pb)	mg/L	<0.00005	0.0001125	0.0001245	0.000069	<0.00005	0.000114	<0.00005
Lithium (Li)	mg/L	0.00117	0.00162	0.00131	0.00117	0.00093	0.00097	0.00164
Magnesium (Mg)	mg/L	0.0914	0.09845	0.0775	0.0717	0.0701	0.0726	0.105
Manganese (Mn)	mg/L	0.00457	0.004975	0.0038	0.00369	0.00370	0.00405	0.00565
Molybdenum (Mo)	mg/L	0.00313	0.00303	0.0031	0.00247	0.00236	0.00187	0.00166
Nickel (Ni)	mg/L	0.00597	0.006395	0.00472	0.00420	0.00397	0.00413	0.00613
Nitrate (as N)	mg/L							
Nitrite (as N)	mg/L							
Phosphorus (P)	mg/L	<0.3	0.0249	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium (K)	mg/L	1.05	1.055	0.9785	0.912	0.697	0.794	0.797
Selenium (Se)	mg/L	0.00015	0.00012	0.000115	<0.0001	<0.0001	<0.0001	<0.0001
Silicon (Si)	mg/L	0.254	0.266	0.314	0.261	0.271	0.236	0.233
Silver (Ag)	mg/L	<0.00001	0.00001225	0.000157	<0.00001	<0.00001	0.000014	<0.00001
Sodium (Na)	mg/L	0.612	0.522	0.4425	0.354	0.298	0.251	0.237
Strontium (Sr)	mg/L	0.00269	0.00298	0.002125	0.00190	0.00232	0.00200	0.00312
Sulfate (SO4)	mg/L	2.55	2.48	1.93	1.65	1.51	1.55	2.04
Sulfur (S)	mg/L	0.94	1.02	0.79	0.62	0.59	0.58	0.68
Thallium (Tl)	mg/L	<0.00001	0.0000049	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Tin (Sn)	mg/L	<0.0001	<0.00007	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium (Ti)	mg/L	<0.01	<0.0007	<0.01	<0.01	<0.01	<0.01	<0.01
Tungsten (W)	mg/L		<0.01					
Uranium (U)	mg/L	0.00259	0.00256	0.0024	0.00214	0.00212	0.00203	0.00249
Vanadium (V)	mg/L	<0.001	0.000671	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc (Zn)	mg/L	<0.001	0.0011	0.00115	0.0011	<0.001	<0.001	0.0020
Zirconium (Zr)	mg/L		<0.004					

Appendix G Summary of Humidity Cell Testing on Clean Waste Rock for Selected Constituents

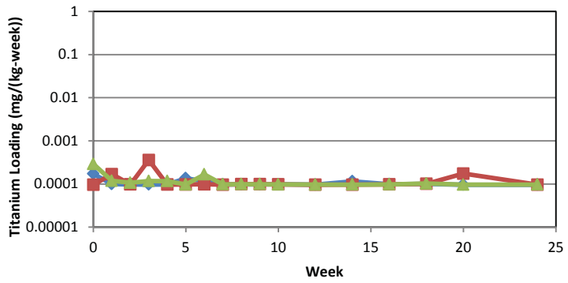
Antimony



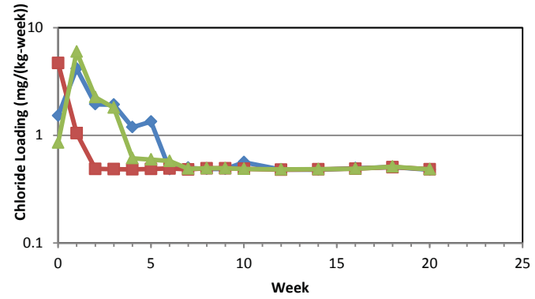
Cadmium



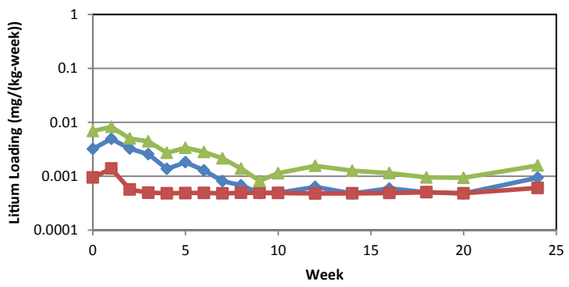
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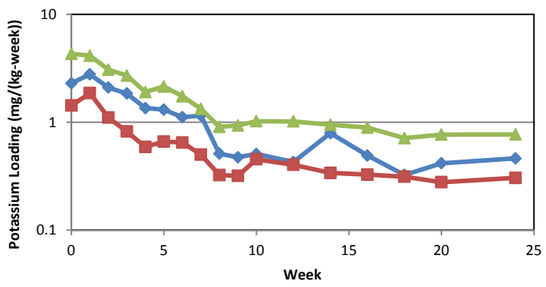
Chloride



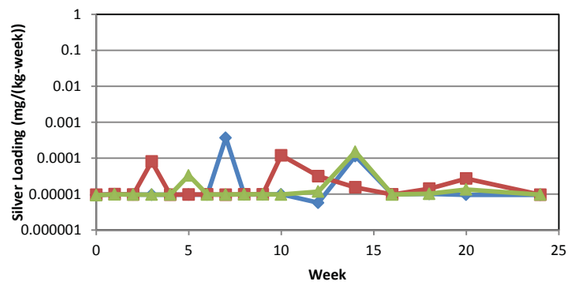
Lithium



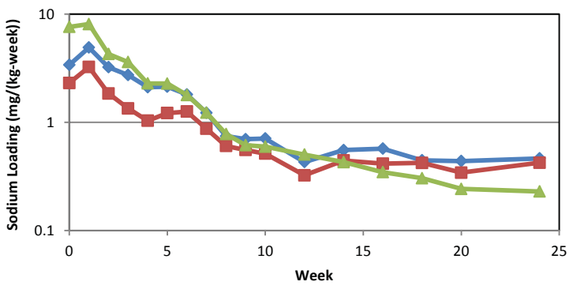
Potassium



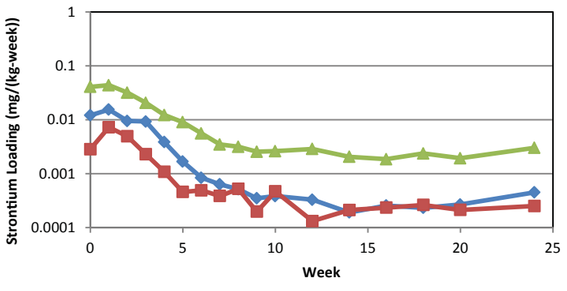
Silver



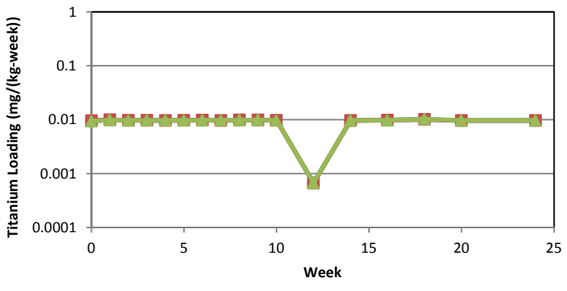
Sodium



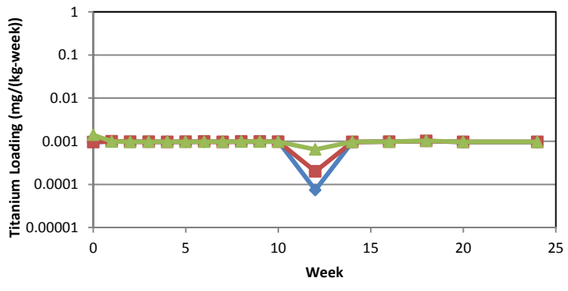
Strontium



Titanium



Vanadium



“LOW” Composite Sample

“MID” Composite Sample

“HIGH” Composite Sample

AREVA Resources Canada

Summary of Humidity Cell Testing on Clean Waste Rock
Additional Constituents

EcoMetrix INCORPORATED

AREVA

Figure G.1

Orano Canada Inc.

McClean Lake Operation

Waste Rock Management Technical Information Document

Part B: Modelling and Sensitivity Studies

Version 3 Revision 1

January 2023

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Appendix B-II: Pore Water Concentrations

Appendix B-III: Source Terms

Appendix B-IV: Partition Coefficients

Appendix B-V: Clean Waste Stockpile Calculations

Appendix B-VI : Sue Pit Volume Calculations

1 Introduction

1.1 Purpose and Scope

Part B of the Waste Rock Management Technical Information Document (TID) updates long term impact predictions for waste rock management at the McClean Lake Operation using the most recent models; laboratory analytical results and field measurements; and evaluates and presents additional waste rock management scenarios.

Since the initial publication of the Waste Rock TID in 2004 (COGEMA 2004b), several waste rock characterization studies have been carried out and the regional groundwater flow model has been updated (AREVA 2011c). The Waste Rock TID was updated in 2013 (AREVA 2013) to include a number of waste rock characterization and placement programs that took place between 2004 and 2013. Since the submission of the 2013 Waste Rock TID, additional programs and projects have taken place that relate to the waste rock and associated storage facilities at the McClean Lake Operation, which have necessitated an update to the TID. Modelling and data updates since 2013 are discussed in Section 1.2.

The 2021 Waste Rock TID evaluates several scenarios for waste rock placement. These include:

- re-analysis of the most recently assessed and approved waste rock placement plan updated with current knowledge (Scenario 1);
- consideration of updates to mine plans that impact waste rock placement (Scenario 3);
- evaluation for potential final placement of operational wastes, which are temporally stored on the JEB and Sue ore pads as well as in the CX pond, in the contaminated landfill in Sue C/A pit (Scenario 3A);
- evaluation for placement of operational waste and future SABRE waste rock in the Sue C/A pit without a till cap/cover (Scenario 3B);
- evaluation of treating pit lake water to meet SEQG guidelines for arsenic (Scenario 3C);
- evaluation of replacing the pit lake above Sue C/A waste rock with clean waste rock to understand the boundaries for waste rock placement (Scenario 4); and
- incorporation of the impact of the placement of waste rock from the Midwest Project into the Midwest pit, as assessed and approved in the 2011 Midwest Project EIS (Scenario 5).

1.2 Modelling and Data Updates

1.2.1 Regional Groundwater Model

The 2011 regional groundwater flow model described in the Regional Groundwater TID (AREVA 2011c) will be used for all groundwater flow calculations. The regional model was developed using the FEFLOW software (Diersch 2010). The 2011 calibrated hydraulic conductivities were updated from those calibrated for the 2004 regional model (COGEMA 2004a) based on additional data gathered at the Sue site since 2004. In particular, an additional calibration target was incorporated which used site data gathered at Sue B, Sue E, and Sue C/A open pits. The inclusion of new data allowed for a more detailed description of the hydraulic conductivities in the vicinity of the Sue pits.

1.2.2 Recent Waste Rock Studies and Field Measurements

Table 4-1 of Waste Rock TID Part A provides an overview of waste rock testing to date. Testing done since the 2004 Waste Rock TID is summarized here:

- radiometric and X-ray fluorescence (XRF) scanning of blast hole samples carried out during Sue A, B, and E mining (2008)
    - composite samples sent to SRC for calibration
    - elements analysed include arsenic, nickel, lead, and uranium
- installation of piezometers in the JEB, Sue C, and Sue E clean waste rock stockpiles for the purpose of monitoring pore water quality (2007-2008)
    - these piezometers replaced toe seepage sampling
- Caribou special waste samples collected through various drilling campaigns (in support of the Caribou open pit mine) (2009)
    - underwater column testing to simulate in-pit disposal
    - sequential leach testing to determine the total inventory of soluble metals
    - Acid Base Accounting (ABA) analysis, solids content analysis, and modified humidity cell testing for clean waste rock assessment
- four multi-level piezometers installed in the Sue E special waste in the Sue C pit (2009)
    - to verify Sue E special waste pore water source terms
    - one of the piezometers intersected Sue A special waste, providing data for Sue A special waste pore water quality at depths from 20 to 80 m below ground surface

- McClean Underground, Caribou, and Sue D waste rock characterization program (in support of the McClean Underground project) (2013)
    - quantities, solids analysis and sequential leaching tests
    - humidity cell testing completed in July 2013
    - underwater column testing not done since waste rock behaves similarly to other samples from the Sue area
- geochemical characterization of Potentially Reactive Waste Rock (PRWR) at the Cigar Lake mine (2018)
    - to provide an update on the geochemical nature of the material on Stockpile C at the Cigar Lake mine
    - to expand the source terms of COPCs to include production related waste rock remaining in the Cigar Lake mine Phase I ore deposit and characterize the material expected for Cigar Lake mine Phase II ore to allow for future waste rock management purposes.

The data collected in these studies has been incorporated into the updated groundwater flow and contaminant transport analyses.

2 Description of Decommissioned State

2.1 Waste Rock Placement

The evaluation of an optimal waste rock placement strategy involves the consideration of a number of aspects, including:

- operational considerations, such as pit slope and ramp stability;
- production schedule and uncertainties;
- minimizing water to be pumped and treated; and
- providing waste rock placement configurations with acceptable post-decommissioning impacts to the environment.

This analysis is concerned with the last of these aspects, the analysis of the environmental impact of the proposed waste rock placement options.

2.1.1 Early Assessments for the Sue Area

As part of the license application for the Sue mining area (COGEMA 1999), approval was requested to use the Sue C pit for the disposal of special waste. Sensitivity analyses showed that the Sue C pit would be suitable for the disposal of waste rock from the McClean Lake Operation, as well as the Midwest Project and Cigar Lake mine (COGEMA 1999, Volume 2, Appendix I, Section 6).

A review of the various options for the disposal of Cigar Lake waste rock was carried out in 1999 (CLMC 1999). The study concluded that Sue C pit had adequate capacity and was an appropriate location to dispose of Cigar Lake waste rock.

As part of the Disposal of Cigar Lake Waste Rock EIS (COGEMA and CLMC 2001), a detailed review was undertaken of the geochemistry of the various waste rock types planned for disposal in Sue C pit. This study resulted in an update of the source terms for the various waste rock types to be disposed in Sue C pit and a re-evaluation of the modelling process (COGEMA and CLMC 2001, Appendix II, Section 3.2). The analysis showed that the Saskatchewan Surface Water Quality Objective (SSWQO) would be met in the long term in both the receiving surface waters and in the flooded Sue C pit.

As a response to regulatory review comments to the Disposal of Cigar Lake Waste Rock EIS, a technical review was performed to examine waste rock placement alternatives (COGEMA and CAMECO 2002). The placement configurations evaluated included a layered configuration, a configuration considered most efficient from an operational perspective, and a “preferred” configuration. Under the “preferred”

configuration, both Sue A and Sue B waste rock were to be placed from about 460 mASL into a partially dewatered pit. A sandstone “window” in the northwest corner of the pit would not be filled with Sue A or Sue B waste rock. Long term performance would be enhanced if this “window” were blocked with low conductivity Cigar Lake waste rock instead.

The modelling results indicated that the groundwater flow through the waste rock and out the Sue C pit for the various alternatives did not vary significantly Also, the predicted impact to McClean Lake and Collins Creek was not significantly sensitive to how waste rock was placed in the pit (COGEMA and CAMECO 2002, Table E4.1). However, the “preferred” placement did show the smallest impact on Collins Creek. The “preferred” placement was also the most advantageous placement configuration from an operational perspective (i.e. operationally realistic, achievable, and flexible) and was recommended as the best choice for the path forward.

2.1.2 2004 Waste Rock TID

In the 2004 Waste Rock TID (COGEMA 2004b), the layered placement scenario was used for simplicity. The layered placement scenario was considered to represent a configuration with performance that would be equaled or bettered at the time of actual placement.

2.1.3 Sue E EIS

With the mining of the Sue E pit, the earlier placement plans were no longer applicable. In the Sue E EIS (COGEMA 2004c) three waste rock placement options for Sue C and Sue E pits were examined and analyzed in terms of their potential impact to the receiving surface water bodies.

Option 1a:

- required intensive waste segregation
- only Sue C/A pit to be used for waste rock disposal
- a limited quantity of Sue E material in the Sue C/A pit
- a surface stockpile of $8x10^6$ bank cubic metres (bcm) of Sue mine rock
- maximum Sue C/A waste rock elevation to be 410 mASL
- Sue E pit flooded

Option 1b:

- less intensive segregation
- more Sue E material in the Sue C/A pit – all Sue E material below 418 mASL
- maximum Sue C/A waste rock elevation 426 mASL

- Sue E pit required for disposal of Sue B, McClean Underground, and Midwest waste rock
- maximum Sue E waste rock elevation 394 mASL
- lower volume of surface stockpiled rock

Option 2:

- all Sue E mine rock disposed in the Sue C/A pit
- Sue C/A pit fully backfilled to 453 mASL
- Sue E pit required for disposal of Sue B, McClean Underground, and Midwest waste rock
- maximum Sue E waste rock elevation 390 mASL

The three options were analyzed using the Sue sub-model extracted from the 2004 regional groundwater flow model and a one-dimensional contaminant transport model. Option 1b was shown to be slightly favorable in terms of environmental impact. Option 1b also had the advantage of requiring less intensive waste rock segregation.

2.1.4 Midwest Project EIS

Subsequent to the 2004 Sue E EIS, management of Midwest waste rock at the Midwest site was proposed instead of management in the Sue C/A pit (AREVA 2011b). The proposed long-term waste rock disposal option in the Midwest area involves the placement of all waste rock in the mined-out Midwest pit. A two-metre compacted till cap will be placed on top of the waste rock upon decommissioning. Following decommissioning, the Midwest pit would be allowed to flood until water levels in the pit reach a steady state condition.

An alternate scenario to this decommissioning plan was considered for the Midwest pit, should the pit lake water quality evolve unacceptably, and the water treatment plant is unable to treat the Midwest pit lake water. Under this scenario, the problematic waste rock would be placed at the bottom of the Midwest pit and a fraction of the clean waste rock would be used to entirely backfill the pit. The main advantage of this alternative decommissioning plan would be to eliminate the potential for a long-term water quality issue of the Midwest pit lake. In addition, this option would reduce the volume of material to be managed in clean waste rock piles.

Based on waste rock characterization and block modeling results, the volume of problematic waste rock was estimated to range between 930,000 m^3 (bcm) and 1,400,000 m^3 (bcm). Based on a swelling factor of 1.35, the volume of waste rock to be disposed in the Midwest pit would range between 1,255,500 loose cubic metres (lcm) and 1,890,000 lcm, which would fill the Midwest pit to a maximum elevation of 328 mASL. It is expected that, by application of field screening for metals content, the actual volume would fall toward the lower end of the range presented above. However, as a conservative approach, the volume of special waste rock requiring in pit disposal has been taken as 2,500,000 m^3 (bcm) for the purpose of the

current Midwest assessment. This increased volume was used both to simulate the post-decommissioning flow regime and to simulate the source term for the placed waste rock. A volume of 2,500,000 m^3 (bcm) translates to a loose volume of approximately 3,400,000 m^3 (lcm), which would fill the Midwest pit to an elevation of approximately 335 mASL.

For the purposes of the modelling done for the 2013 Waste Rock TID and the 2021 Waste Rock TID, the Midwest pit will be considered to be filled to a level of 335 mASL with 3,400,000 m^3 (lcm) of waste rock.

2.1.5 Caribou EIS

Under the Caribou Environmental Impact Assessment, Caribou waste rock would be placed in the Sue C/A pit instead of Midwest waste rock. The proposed volumes of rock from the Caribou and Cigar Lake mines were estimated and the final elevations of rock in the pit were evaluated. It was determined that the final elevation in Sue C/A pit would be 428 mASL or 425.5 mASL, depending on whether waste materials at elevations between 335 and 350 mASL of the Caribou pit could be segregated during mining.

The contaminant transport analysis was revised according to the source term resulting from the new waste rock placement. The transport analysis used the groundwater flow rates calculated for the Sue E EIS. The approved maximum elevation of waste rock in Sue C/A pit for the Sue E EIS was 426 mASL and it was expected that that level could be achieved by appropriate segregation.

2.1.6 2013 Waste Rock TID

Waste rock management plans have evolved since the Caribou EIS (AREVA 2009a). Section 3.2 of Part A of the 2013 Waste Rock TID described the current as-built conditions of each pit, and the current waste rock placement plans. The Sue E pit has been partially backfilled with Sue B waste rock up to a level of 400 mASL and the wastes capped with a 2 m lift of clean till. Sue E is currently being allowed to flood naturally with groundwater. No further physical decommissioning works are expected to be required. The Sue B pit contains no waste rock. Two metres of clean till have been placed at the bottom of the pit and the pit has been allowed to flood naturally.

Four different end states for the Sue C/A pit were considered in the 2013 document. These are described in terms of four scenarios as follows:

- an “Update to Approved Case” scenario considered the Sue C/A pit waste rock placement approved in the Caribou EIS but with new data for pore water concentration, waste rock quantities, and solids content incorporated. Groundwater flow rates were based on the 2011 regional groundwater flow model;
- an “Interim Return to Natural Water Level Case” considered the impact of an interim condition on the end state, the interim condition being the suspension of Sue C/A hydraulic containment until Cigar Lake waste rock is placed;

- a “Future Projects Case” which considered the impact of not only new pore water data, waste rock quantities, solids content data, and groundwater flow model but also a revision of the waste rock placement strategy for the Sue C/A and Sue E pits;
- a “Fully Backfilled Sue C/A Pit Case” which considered additional waste rock placement in Sue C/A pit.

2.1.7 2021 Waste Rock TID

The number of scenarios simulated was reduced in the 2021 Waste Rock TID. Scenario 2 was considered to be no longer relevant and was therefore eliminated. The numbering of the scenarios remains the same in order to facilitate comparison to the 2013 Waste Rock TID.

In the 2021 Waste Rock TID the “Update to Approved Case” (Scenario 1) and “Future Projects Case” (Scenario 3) were further refined:

- in both Scenario 1 and Scenario 3, the volume and arsenic content of Cigar Lake waste rock were reduced;
- in Scenario 1, the characterization of the McClean Lake Underground waste rock in Sue E pit was refined based on the 2013 McClean Underground waste rock study;
- In Scenario 3 the characterization of the Caribou, McClean Underground and Sue D waste rock solid content was based only on samples that were also analysed for leachable fraction;
- in both Scenario 1 and Scenario 3 the contaminated landfill, built on a west-side bench of the Sue C/A pit in 2017, at an elevation of approximately 437 mASL, was included;
- sub-cases of Scenario 3, labelled Scenario 3A, Scenario 3B, and Scenario 3C, were developed to consider potential future plans for disposal of operational waste and waste rock from future SABRE mining of the Midwest ore in Sue C/A pit.

2.1.8 Waste Rock Elevation

Each scenario will result in a different final elevation of placed waste rock in the Sue C/A pit. The waste rock elevations have been calculated using a cumulative volume versus elevation relationship based on the final as-built drawing for the empty Sue C/A pit, shown on Figure 2-1.

The cumulative volume versus waste rock elevation relationships are documented in Appendix B-VI. Volumes and masses in Table 2-1 and Table 2-2 gives the calculation of the waste rock elevation in the Sue E pit. For the “Update to Approved Case” the waste rock elevation is calculated to be 400 mASL and for the “Future Projects Case” to be 399 mASL, reflecting the placement of waste rock from McClean Underground into the Sue C/A pit instead of Sue E. For modelling purposes, the elevation of the top of the waste rock

was reduced by 1 m for the second case. The actual “as-built” elevation varies slightly above and slightly below 400 mASL, as illustrated in Figure 1-2 in Appendix B-VI.

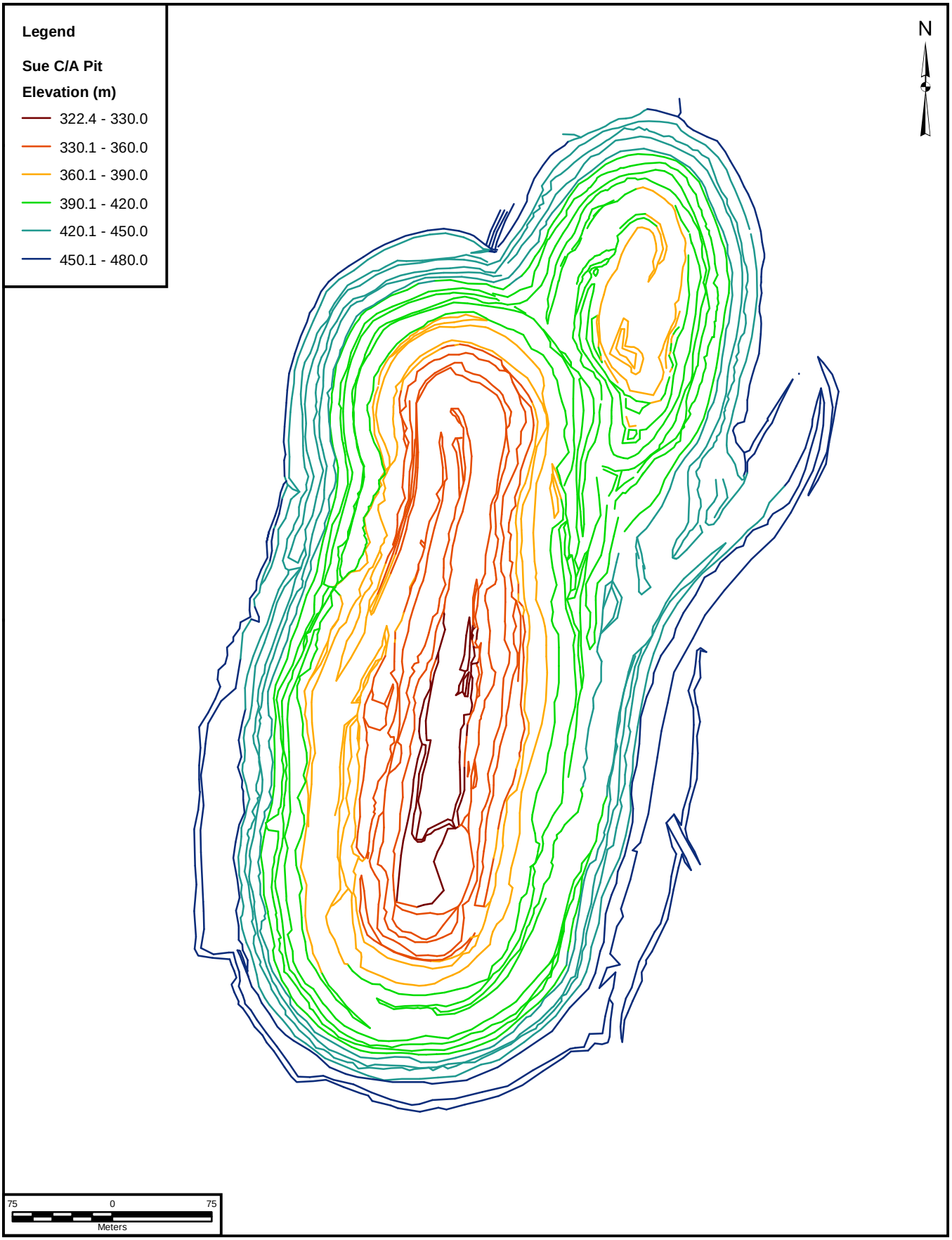
Table 2-2 were taken from the bank cubic metre (bcm) values in Table 3-1 of Part A of the 2021 Waste Rock TID and converted to loose cubic metres (lcm). The mass of the contaminated landfill is taken from Table 4-9 of Part A of the 2021 Waste Rock TID. A swell factor of 1.3464 lcm/bcm was used to convert the waste rock volumes in Table 2-1 and Table 2-2 gives the calculation of the waste rock elevation in the Sue E pit. For the “Update to Approved Case” the waste rock elevation is calculated to be 400 mASL and for the “Future Projects Case” to be 399 mASL, reflecting the placement of waste rock from McClean Underground into the Sue C/A pit instead of Sue E. For modelling purposes, the elevation of the top of the waste rock was reduced by 1 m for the second case. The actual “as-built” elevation varies slightly above and slightly below 400 mASL, as illustrated in Figure 1-2 in Appendix B-VI.

Table 2-2, except for the Sue B waste rock. For the Sue B waste rock, it is possible to calculate an actual swell factor based on the measured quantity of waste rock mined using Table 3-1 of the 2021 Waste Rock TID Part A and the data in Appendix B-VI. The swell factor for Sue B waste rock is calculated to be 1.44 lcm/bcm. The results in Table 2-1 and Table 2-2 gives the calculation of the waste rock elevation in the Sue E pit. For the “Update to Approved Case” the waste rock elevation is calculated to be 400 mASL and for the “Future Projects Case” to be 399 mASL, reflecting the placement of waste rock from McClean Underground into the Sue C/A pit instead of Sue E. For modelling purposes, the elevation of the top of the waste rock was reduced by 1 m for the second case. The actual “as-built” elevation varies slightly above and slightly below 400 mASL, as illustrated in Figure 1-2 in Appendix B-VI.

Table 2-2 update lcm values for waste rock quantities documented in the Caribou EIS (AREVA 2009a).

Table 2-1 shows the calculations for waste rock elevation in Sue C/A pit for the “Update to Approved Case”, the “Future Projects Case”, and the “Fully Backfilled Sue C/A Pit Case”. For the fully backfilled scenario the maximum level of waste rock in the pit is 453 mASL, i.e. the waste rock elevation derived for the fully backfilled case in the Sue E EIS, described in Section 2.1.3 above. The volume of additional waste rock required to fill to the 453 mASL level was calculated from the volume versus elevation relationship. Filling the pit to 453 mASL would allow an additional 4,900,000 lcm of waste rock to be placed.

The maximum waste rock level in Sue C/A pit for the “Update to Approved Case” and for the “Future Projects Case” is calculated to be 424 mASL and 425 mASL, respectively. The difference is due to the addition of McClean Underground and Sue D waste rock in the “Future Projects Case”. For modelling purposes, it is assumed that the Cigar Lake waste rock is placed as defined for Option 1b in the Sue E EIS (COGEMA 2004c, Appendix IX, Figure 4.2). In this placement Cigar Lake waste rock is the last waste rock placed in the Sue C/A pit and forms a layer about 12 m thick over most of the surface. However, there is an area in the southwest part of the pit where Sue E waste rock forms the top layer.



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman
Drawn: T.Lohman
Date: 5/31/2021
Scale: 1:4,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 2-1
ELEVATIONS IN SUE C/A EMPTY PIT

WASTE ROCK MANAGEMENT
TECHNICAL INFORMATION DOCUMENT

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Part B\Figure 2-1 Elevations in empty Sue CA pit.mxd

Table 2-1: Elevation of the Placed Waste Rock in Sue C/A Pit

Source	In Place Mass (Tonnes)	In Place Volume (bcm)	Loose Waste Volume (m^3)	Cumulative Placed Waste Volume (m^3)	Elevation from As-Built (mASL)
"Update to Approved Case"					
JEB	67,544	27,796	37,424	37,424	331
Sue C	663,448	273,024	367,599	405,023	351
Sue A	3,520,684	1,448,841	1,950,720	2,355,743	387
Sue E	5,923,907	2,437,882	3,282,283	5,638,026	416
Caribou	501,105	206,216	277,649	5,915,675	418
Contaminated Landfill	406	167	225	5,915,900	418
Cigar	1,492,506	614,200	826,959	6,742,859	**424**
"Future Projects Case"					
JEB	67,544	27,796	37,424	37,424	331
Sue C	663,448	273,024	367,599	405,023	351
Sue A	3,520,684	1,448,841	1,950,720	2,355,743	387
Sue E	5,923,907	2,437,882	3,282,283	5,638,026	416
McClean Underground, Sue D, Caribou	804,180	330,938	445,575	6,083,601	420
Contaminated Landfill	406	167	225	6,083,826	420
Cigar	1,492,506	614,200	826,959	6,910,785	425
Operational Process Waste	6,089		11,381	6,922,166	425
Midwest SABRE	32,309	13,296	17,902	6,940,068	**425**
"Fully Backfilled Sue C/A Pit Case"					
JEB	67,544	27,796	37,424	37,424	331
Sue C	663,448	273,024	367,599	405,023	351
Sue A	3,520,684	1,448,841	1,950,720	2,355,743	387
Sue E	5,923,907	2,437,882	3,282,283	5,638,026	416
McClean Underground, Sue D, Caribou	804,180	330,938	445,575	6,083,601	420
Contaminated Landfill	406	167	225	6,083,826	420
Cigar	1,492,506	614,200	826,959	6,910,785	425
Midwest SABRE	32,309	13,296	17,902	6,928,687	425
Backfill	8,811,096	3,625,966	4,882,000	11,810,687	**453**

Table 2-2 gives the calculation of the waste rock elevation in the Sue E pit. For the "Update to Approved Case" the waste rock elevation is calculated to be 400 mASL and for the "Future Projects Case" to be 399 mASL, reflecting the placement of waste rock from McClean Underground into the Sue C/A pit instead of Sue E. For modelling purposes, the elevation of the top of the waste rock was reduced by 1 m for the second case. The actual "as-built" elevation varies slightly above and slightly below 400 mASL, as illustrated in Figure 1-2 in Appendix B-VI.

Table 2-2: Elevation of Placed Waste Rock in Sue E Pit

Source	In Place Mass (Tonnes)	In Place Volume (bcm)	Loose Waste Volume (m^3)	Cumulative Placed Waste Volume (m^3)	Elevation from As-Built (mASL)
"Update to Approved Case"					
Sue B	3,502,481	1,441,350	2,076,358	2,076,358	399
McClean Underground	190,000	78,189	105,274	2,181,632	400
"Future Projects Case" and "Fully Backfilled Sue C/A Pit Case"					
Sue B	3,502,481	1,441,350	2,076,358	2,076,358	399

2.2 Till Cap Placement

A typical feature of waste rock management plans is a low conductivity till cap over the waste rock. It is currently proposed that a 2 m till cap be constructed over the waste rock. The till cap will be constructed with a hydraulic conductivity at least two orders of magnitude lower than the underlying waste rock and will mitigate upward advective groundwater flow. The till cap will also reduce upward diffusion of COPCs.

In the Disposal of Cigar Lake Waste Rock Addendum (COGEMA and Cameco 2002, Appendix D) the pros and cons of placing an intermediate clean waste/till cap over waste rock layers between placement of Cigar Lake mine Phase I and Phase II material were considered. The analysis showed only a marginal improvement in pit lake quality, due to the fact that Cigar Lake waste rock is of low conductivity and it would be difficult to achieve a lower conductivity in the till cap. In addition, adding additional capping material would raise the final elevation of waste rock in the pit leading to an increase in groundwater flow from the waste rock laterally out into the adjacent sandstone. The effect would be to increase peak concentrations in Collins Creek (COGEMA and Cameco 2002, p. 3-48).

2.3 Waste Rock Stockpiles

Clean waste rock stockpiles are located at the JEB, Sue, and Midwest sites.

2.3.1 Sue Site Stockpiles

The clean waste rock from the Sue C pit consists predominantly of unaltered sandstone with low concentrations of constituents of potential concern (COPCs), although some basement rock is present in the Sue C stockpile. This stockpile is currently about 67 ha in area and reaches an elevation of 495 mASL. The Sue C clean waste stockpile is at the north end of the Sue site. The current inventory of the Sue C stockpile is 10,006,102 bcm or 24,314,828 tonnes using a conversion factor of 2.43 tonnes/bcm. Approximately 56,345 bcm of the Sue C clean waste rock stockpile was used prior to 2017 and an estimated 9,000 bcm is anticipated to be used between 2018 and 2026 for a variety of construction projects including road repairs.

The clean waste rock from the Sue E pit consists entirely of sandstone material, as a cut-off elevation in the lower sandstone was used during segregation. The stockpile covers an area of approximately 35.6 ha and reaches an elevation of 477 mASL. The stockpile is located southwest of the Sue C/A pit. The approximate volume of the Sue E clean waste rock stockpile is 4,587,836 bcm or 11,148,441 tonnes using a conversion factor of 2.43 tonnes/bcm. An estimated 5,500 m^3 and 2,600 m^3 of the Sue E clean waste rock stockpile were used respectively in 2018 and 2019 for the SABRE pad extensions.

2.3.2 JEB Site Stockpiles

JEB clean waste rock is permanently stockpiled in the JEB clean waste rock stockpile area located east of the JEB pit. The clean waste rock consists predominantly of unaltered sandstone with low concentrations of COPCs. The stockpile is about 31 ha in area and reaches an elevation of 490 mASL. The stockpile contains about 4,445,884 bcm of material as of March 2020. A portion of the waste rock will be used in the construction of the JEB TMF expansion liner and embankment and the JEB TMF cover during decommissioning. The volume of the JEB clean waste rock pile at the start of decommissioning is expected to be 3,580,000 bcm.

2.3.3 Midwest Project Stockpiles

Under the currently assessed option to develop the Midwest project by open pit mining, two clean waste rock stockpiles will be constructed to accommodate the majority of material excavated from the pit. Approximately 35,000,000 m^3 (bcm) of clean waste rock will be generated. Stockpile A, covering an area of about 100 ha, will be located to the north of the Midwest pit. Stockpile B, covering an area of about 75 ha will be located to the south of the pit. Both stockpiles will be surrounded by perimeter ditches designed to collect runoff water from the stockpiles. Berms will be constructed along the outer edge of each ditch. These berms are designed to prevent surface runoff from flowing into surrounding undeveloped areas.

On-going research and development of Surface Access Borehole Resource Extraction (SABRE) is demonstrating the practicality of more advanced mining techniques to significantly reduce the mining waste generated. Implementation of the SARBE technique and the corresponding reductions in mining waste volumes for the Midwest Project are assessed later in this document as part of Scenario 3B.

3 Description of the Modelling Scenarios

3.1 Scenario 1: Update to Approved Case for Sue Pits

The “Approved Case” refers to the waste rock placement plan presented in the most recently assessed and approved EIS for the Sue area, the Caribou Project EIS (AREVA 2009a). It reflects the waste rock management plan for the future mining of the Midwest and Caribou ore bodies using open pit methods and involves placement of Caribou special waste into the Sue C/A pit. Although the Midwest EIS (AREVA 2011b) is a more recently issued and approved document, it does not discuss the waste rock placement plan at the Sue site but rather focuses on waste rock management at the Midwest site.

The “Update to Approved Case” repeats the analysis done for the most recently approved case but with groundwater flow rates based on the 2011 groundwater flow model and also incorporates recent field measurements. The purpose of the analysis is to ensure that predicted effects on surface water receptors fall within the boundary of the approved case. The assumptions made in the analysis of the ”Approved Case” for Sue mining area (AREVA 2009a, Appendix VIIIB, Section 4) and the updates to this analysis are listed below.

The specifications for the “Update to Approved Case” used in the 2013 Waste Rock TID are listed below. Some additional revisions were made to the “Update to Approved Case” in the 2021 Waste Rock TID and are listed in the following section.

3.1.1 2013 TID

- The water levels in the three pits in the Sue mining area, Sue B, Sue C/A, and Sue E have reached steady state at the natural groundwater elevation.
- The maximum waste rock elevation in Sue C/A and Sue E pits is 427 mASL and 400 mASL, respectively.
- The contaminant transport sources include placed special waste rock from JEB, Sue C/A, Sue B, Sue E, McClean Underground, and Cigar Lake; Sue C/A and Sue E pit waters; and the Sue C stockpile.
- The Sue E stockpile was not included as a contaminant source in the analysis for the “Approved Case” (2004 TID); leaching from the waste rock on the Sue E stockpile was considered to be not significant (AREVA 2009a, Appendix VIIIB, Section 4.3.2) in comparison to the mass flux from the waste rock in Sue E pit. Both the Sue C and Sue E stockpiles were included as contaminant sources in the 2013 “Update to Approved Case”.
- The quantities of Sue C, Sue A, Sue E, and Sue B waste rock have been updated to reflect as-mined quantities. The “Approved Case” presented in the Caribou Project EIS (AREVA 2009a) used predicted quantities for Sue A, Sue B, and Sue E waste rock. Final mined quantities for these projects were not available at the time the Caribou Project EIS was prepared. The Sue C quantities

have also changed slightly since the publication of the Caribou Project EIS due to resurveying at the mine site and they were also updated.

- Predicted solids content and initial pore water concentrations have been replaced by data acquired from waste rock testing field measurements made since the Caribou Project EIS was published, including:
    - arsenic, nickel, lead, and uranium solids content in Sue A and Sue B waste rock; pore water concentrations in Sue A and Sue E waste rock, for all COPCs; and
    - Sue C stockpile pore water concentrations, for all COPCs
- Measured pit lake water quality was used for transport calculations from Sue C/A and Sue E pit lakes.

3.1.2 2021 Waste Rock TID

- The pit areas were modified to conform to the Sue Site Water Management Strategy Update (Orano 2020).
- The recharge to the pit areas was updated to be consistent with the Sue C and Sue B water balance models (Orano 2016).
- The solids content, leachable fraction, and pore water values for Cigar Lake waste rock were revised based on the 2017 Potentially Acid Generating Waste Geochemical Update (CAMECO 2018).
- The values for McClean Underground special waste placed in Sue E pit were revised based on the 2013 McClean Underground waste rock testing program (EcoMetrix 2013).
- The water quality sampling in Sue C/A, Sue E and Sue B pit lakes has continued. Since 2018, sampling includes monthly top samples and quarterly bottom samples.
- The Sue E stockpile and the Sue C stockpile were included as constant flux sources in the “Update to Approved Case” transport analysis.

3.2 Scenario 3: Future Projects Case for Sue Pits

The “Future Projects Case” evaluates changes to the mine plan for the McClean Lake Operation including underground mining of the McClean, Sue D and Caribou ore bodies with placement of problematic waste rock into the Sue C/A pit. The assumptions made in this case for Sue pits reflect changes to the mining plan including changes in mining methods, waste rock quantities, waste rock placement, and monitoring data acquired since the publication of the Caribou Project EIS (AREVA 2009a). The following changes are incorporated in the analysis of the “Future Projects Case”. The specifications for the “Future Projects Case” defined in the 2013 Waste Rock TID are listed below. Some additional revisions were made to the “Future Projects Case” in the 2021 Waste Rock TID and these are listed in the following section.

In the 2021 TID, several sub-cases, labeled Scenario 3A, Scenario 3B, and Scenario 3C, were developed to consider potential future plans for disposal in Sue C/A pit.

3.2.1 2013 Waste Rock TID

- No additional waste rock is to be placed in the Sue E pit.
- McClean Underground waste rock is disposed of in the Sue C/A pit rather than Sue E pit and the quantity has been revised to reflect current mining estimates.
- The quantity of Caribou waste rock has changed to reflect the change in mining method from open pit to underground mining.
- A quantity for Sue D waste rock has been added to reflect the addition of this ore body to the McClean Underground program.
- The quantities of Sue C, Sue A, Sue E, and Sue B waste rock have been updated to reflect as-mined quantities, as discussed in the "Update to Approved Case".
- The Sue C, Sue E, and JEB stockpiles were included as contaminant transport sources in the "Future Projects Case" in the 2013 Waste Rock TID. Clean waste rock stockpiles were not included in the first edition of the Waste Rock TID (COGEMA 2004b); the focus was on special waste.
- The new data for solids content, waste rock pore water concentration, and pit lake water quality have been incorporated, as discussed for the "Update to Approved Case".
- The correlation for water leachable arsenic versus solids content has been revised to include new data.
- The groundwater flow rates were predicted using sub-models extracted from the 2011 regional groundwater flow model.
- The water quality sampling in Sue C/A, Sue E and Sue B has continued since 2018. Sampling typically includes monthly top samples and quarterly bottom samples.

3.2.2 2021 Waste Rock TID

The modifications discussed in Section 3.1.2 above were included in the 2021 Waste Rock TID. In addition

- the source term for the McClean Underground, Caribou and Sue D material in Sue C/A pit was revised to include only solid content data that corresponded to leachable fraction measurements.
- The solids content, leachable fraction, and pore water values for Cigar Lake waste rock were revised based on the 2017 Potentially Acid Generating Waste Geochemical Update (CAMECO 2018).

3.2.3 Scenario 3A: Operational Process Waste in Sue C/A Pit

The Sue C Contaminated Landfill is currently considered as the disposal site for the future placement of operational process wastes that are temporarily stored in the CX pond as well as on the JEB and Sure ore pads respectively. The wastes in the CX pond are mostly CX solution and waste sludge from JWTP before the TMF was completed whereas the waste on JEB and Sue ore pads are waste sludge from

pre-sedimentation and sedimentation ponds of the Sue WTP. The effect of these wastes is included as a sub-case defined as Scenario 3A.

The addition of approximately 11,000 m^3 of the future operational process waste does not affect the calculation for the elevation of the submerged waste rock surface in Sue C/A pit, as shown in Table 2-1.

3.2.4 Scenario 3B: Operational Process Waste, SABRE Special Waste Rock, in Sue C/A Pit with No Till Cap

Scenario 3B includes the same wastes in Sue C/A pit as in Scenario 3A and also includes 13,300 m^3 of future waste rock from SABRE method mining of the Midwest ore, as opposed to the presently approved Midwest open pit method which will result in the generation of 6,000,000 m^3 of waste rock. The scenario is modelled without a till cap over the submerged waste rock.

The additional waste rock does not affect the calculation of the elevation of the submerged waste rock surface, as shown in Table 2-1.

3.2.5 Scenario 3C: Pit Lakes Water Treated

Scenario 3C is the same as Scenario 3B except that the Sue C/A, Sue E, and Sue B pit lake water has been treated to meet the Saskatchewan Environmental Quality Guidelines (SEQG) for Surface Water arsenic concentration of 5 ug/L. At present, arsenic concentration in all pit lakes is above SEQG for surface water.

3.3 Scenario 4: Fully Backfilled Sue C/A Pit

As an alternative to the current decommissioning plan, the Sue C/A pit could be entirely backfilled. Under this scenario, clean waste rock would be used to entirely backfill the pit. One advantage of this alternative decommissioning plan would be to eliminate the potential for a long-term water quality issue in the pit lake.

The “Fully Backfilled Sue C/A Pit Case” analysis is identical to the “Future Projects Case” analysis, except that additional waste rock is placed in the Sue C/A pit to bring the surface elevation of the waste rock above the water table. A fully backfilled scenario was also analysed in the Sue E EIS. The waste rock elevation derived for the fully backfilled case in the Sue E EIS was 453 mASL (COGEMA 2004c, Appendix IX, Table 4.1(b)). The same waste rock elevation is used in the current analysis. The additional waste rock has been given the mean properties (initial pore water concentration and leachable fraction) of the clean waste rock in the JEB, Sue C, and Sue E clean waste rock piles.

3.4 Scenario 5: Midwest Project

The “Approved Case” analysis in the Caribou Project EIS did not include the cumulative effect of the Midwest project. For completeness, in this TID update, Midwest is included as part of the McClean Lake Operation and a simulation is included of the cumulative impact of Midwest waste rock.

The Midwest scenario is included with the same assumptions made in the analysis of the currently approved case for Midwest waste rock, described in the 2011 Midwest Project EIS (AREVA 2011b, Append4ix IX, Section 4). The assumptions are as follows:

- waste rock will be placed in the mined-out Midwest pit and clean waste rock will be deposited in two proposed surface stockpiles, to the north and to the south of the pit;
- the maximum waste rock elevation in the Midwest pit will be 335 mASL, with a 2 m thick till cap; and
- the contaminant transport sources include only the placed special waste rock in the Midwest pit.

4 Flow Models

4.1 Regional Model

The groundwater flow analysis was based on the 2011 regional groundwater flow model presented in the "Hydrogeology and Groundwater Modelling of the Collins Creek Basin Technical Information Document" (AREVA 2011c). The regional model was developed using the FEFLOW software developed by the WASY Institute of Germany (Diersch 2010). Figure 4-1 shows the areal extent of the regional model.

The regional model has numerical limitations that justify the extraction of sub-models for site-specific flow calculations. For example, the regional model was constructed with seven vertical layers representing the hydrostatigraphy of the entire region. However, additional vertical refinement is required to reproduce the elevations of the waste rock placed in the pits. The 2004 Groundwater TID (COGEMA 2004a) had an additional limitation due to the use of the MODFLOW software, which introduced a large number of additional cells when localized grid refinement was employed. The FEFLOW software does not have this restriction since the finite element formulation allows local grid refinement in a natural way.

The sub-models were extracted from the 2011 regional groundwater flow model using the following criteria:

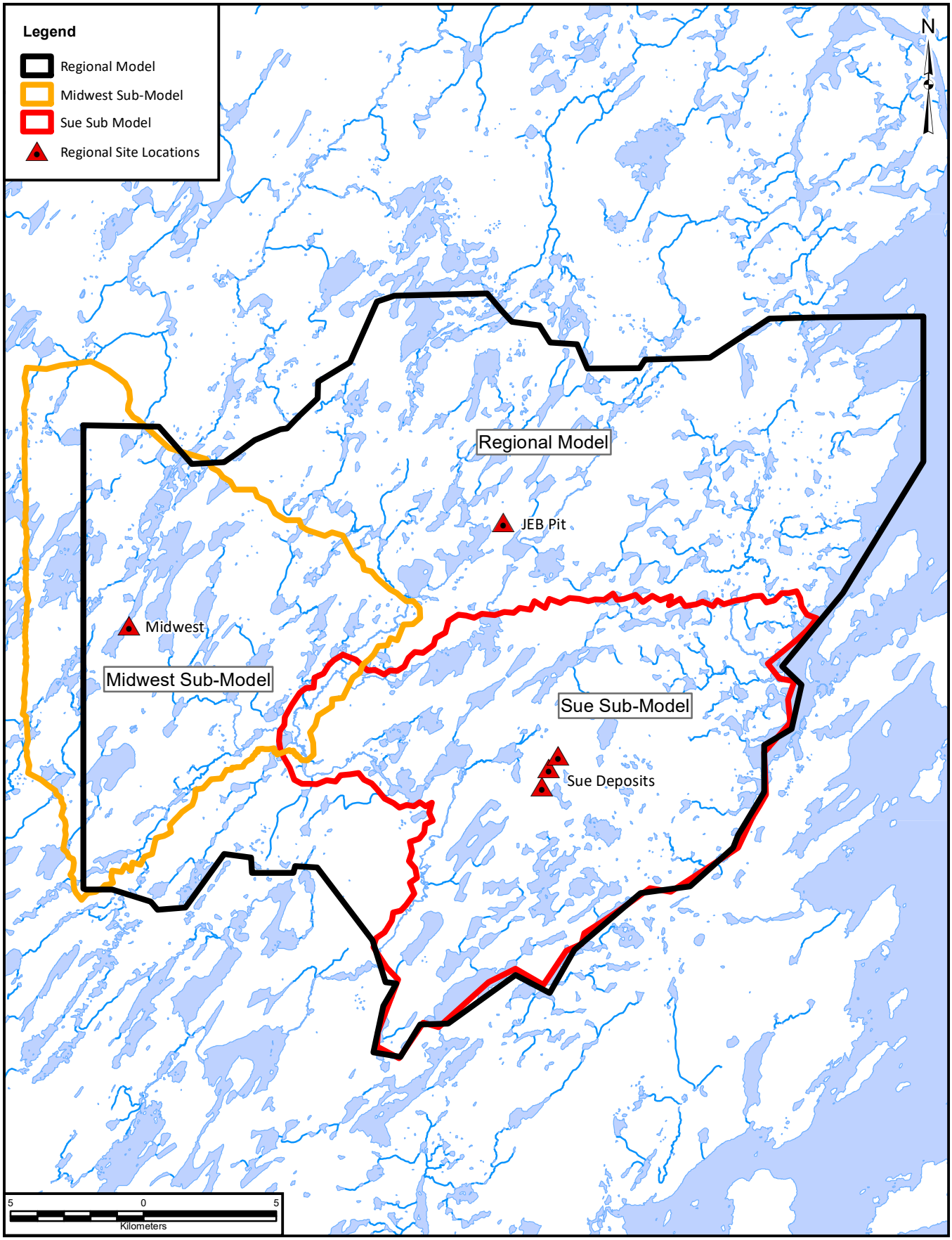
- the sub-model should reproduce the results provided by the regional model in the extracted areas;
- the boundary conditions of the sub-model are consistent with those of the regional model; and
- the areal extent of the sub-model should be sufficiently large that the boundaries are not influenced by modelling scenarios.

4.1.1 Boundary Conditions

Boundary conditions specified in the groundwater flow model simulate the general groundwater flow regime and include specified head boundary conditions, head-dependent boundaries (river/lake boundaries), and no-flow boundaries.

Specified Head Boundary Conditions

A specified head boundary condition of 398 mASL was assigned to all layers at the eastern boundary of the model to simulate Wollaston Lake/Collins Bay. Assigning a specified head to all layers is reasonable since Wollaston Lake is the main surface water body in the area and acts as a regional groundwater discharge zone for both shallow and deep flow systems. Specified head boundaries were also assigned to Collins Creek and McClean Lake, which are the two major surface water features in the Sue area.



Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/31/2021 Scale: 1:200,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 4-1

GEOGRAPHICAL LIMITS OF THE 2011 REGIONAL GROUNDWATER FLOW MODEL, THE SUE SUB-MODEL AND THE MIDWEST SUB-MODEL

WASTE ROCK MANAGEMENT
TECHNICAL INFORMATION DOCUMENT

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Part B\Figure 4-1 Geographical Limit of the 2011 Regional_Sue_Midwest.mxd

River/Lake Boundary Conditions

River boundaries were assigned to all lakes and creeks within the model domain. Reference water elevations were specified according to measured data, where available. If measured data was not available, surface elevations were used. The reference elevations used for lakes in the Sue and Midwest sub-models are shown in Table 4-1**.** Conductance values, which describe the connectivity between the lake or creek and the underlying aquifer, are a function of the sediment thickness and hydraulic conductivity. For major lakes, the conductivity is set to a large value so that the boundary condition becomes essentially a specified head boundary.

Table 4-1: Average Lake Levels Used in the Sue and Midwest Sub-models

Sue Sub-Model Lakes[1]		Midwest Sub-Model Lakes[2]	
Lake Name	**Average Water Level (mASL)**	**Lake Name**	**Average Water Level (mASL)**
Sue Lake	457.3	North McMahon	476.6
Vulture Lake	438.1	South McMahon	478.1
McClean Lake	434.0	Mink Arm	478.5
Candy Lake	438.5	Pig Lake	478.0
Moffat Lake	441.9	Shallow Lake	477.5
Tut Lake	457.2	Deborah Lake	487.7
Esto Lake	458.3	Henday Lake	490.1
Kewen Lake	425.1	Too Small Lake	476.6
Torwalt Lake	441.5	Lake C1	473.9
Sils Lake	452.6	Lake W1	487.4
Bena Lake	438.8	John Pond	480.9
Telephone Lake	435.3		
Sharp Lake	438.2		

[1] Table 2.3-9 (AREVA 2011c) (mean of 2004 to 2011 elevations)
[2] Table 3.1 (AREVA 2011b, Appendix V)

No-Flow Boundary Conditions

No-flow boundaries for horizontal inflow/outflow to the model were used to represent inferred groundwater flow divides at the lateral extents of the model. These boundaries are located at a sufficiently large distance from the mine sites to have negligible effect on model prediction. Rivers or lakes at the edges of the model represent natural zero flux boundaries to horizontal flow.

A no-flow boundary for vertical flow was also assigned at the bottom of the model at 150 mASL. Groundwater flow below 150 mASL elevation is expected to have negligible effect on model predictions due to the low permeability of the basement rock.

4.1.2 Groundwater Recharge

The groundwater recharge is the net infiltration to the surface of the model, i.e. the net inflow from precipitation, runoff, and evapotranspiration. The groundwater recharge is implemented in the numerical model using the “In/outflow on top” property in the FEFLOW software. This property operates independently of the boundary condition settings discussed in the previous section, i.e. a particular node or region of the model can have both “In/outflow on top” specified and also a river/lake boundary condition specified. The recharge over the lakes and rivers is set to zero so that inflow/outflow from the lakes and rivers is governed by the head-dependent lake/river boundary condition.

The regional groundwater recharge is initially calibrated to the overall watershed water balance. A higher groundwater recharge rate is typically used for drumlins and uplands areas since the water table is considered to be lower in these areas resulting in greater driving hydraulic gradients. The recharge for pit lakes is also typically set to a percentage of the average annual precipitation, although a higher percentage than used for the regional recharge. The higher value is due to the fact that the pit lake accumulates runoff as well as precipitation and has no surface water outlet.

In the calibration process for the 2011 regional groundwater flow model (AREVA 2011c) recharge in the drumlin areas was lowered from 88 mm/year used in the 2004 regional model to 55 mm/year. Previously upland/drumlin areas were inferred to receive a higher rate of groundwater recharge. However, since the vertical hydraulic conductivity of the drumlin areas was interpreted to be approximately three times lower than the surrounding area and since the reduced vertical hydraulic conductivity would likely reduce recharge from precipitation, the net recharge rate in the drumlin areas was reduced and set equal to the regional recharge rate of 55 mm/year.

Table 4-2 shows historically calibrated values for recharge. Recharge values calculated for the Midwest sub-model are lower than those for the Sue sub-model. Since no separate precipitation data is available for the Midwest area, it is not known whether there is real difference in precipitation between the two. The Midwest mining area is also part of a different watershed (Smith Creek Watershed) than the Sue area (Upper Collins Creek Watershed). The difference could also be attributed to the different topography and soil conditions of the Midwest area.

For the purposes of this document, the recharge values calibrated for the Midwest Project EIS were used in the Midwest sub-model calculations. For the Sue sub-model, regional, drumlin/upland and stockpile recharge was set to 55 mm/year. Recharge to the pit lakes was re-evaluated based on the 2016 Sue C/A water balance model (Orano 2016) and the 2020 Sue site water management update (Orano 2020).

4.1.2.1 Pit Water Balance Modelling

In 2016 a detailed water balance for the Sue C and Sue B pits was completed (Orano 2016). The purpose of the model was to develop an understanding of how groundwater inflow, precipitation, evaporation, and waste rock placement affect the water level in the Sue C pit. The aim was to develop an effective model that

could assist in developing strategies and contingency options for waste rock placement that maintain the pit level below the maximum level that allow for waste and landfill deposition, while minimizing the volume of water to be treated in the Sue water treatment plant.

The model was calibrated to monitored Sue C water levels, precipitation, water treatment, and pumping from Sue B for the period 2013 to 2016. The forecasting period considered in this analysis is 2017 to 2027, although the model allows forecasting up to 2050.

The calibrated model allowed a prediction of the net inflow to Sue C/A and Sue B pits. These values were used as recharge to the numerical model. The calibrated recharge is given in Table 4-2 below.

A minor revision to the Sue C/A and Sue B pit area was made as a result of the Sue Site Water Management Strategy update submitted to Saskatchewan Ministry of Environment (SMOE) and the Canadian Nuclear Safety Commission (CNSC) in 2020 (Orano 2020).

Table 4-2: Summary of the history of calibrated recharge rates (mm/year) for the Sue and Midwest areas

Recharge (mm/year)	Lakes and Creeks	Regional	Drumlins Uplands	Stockpiles	Pit Lakes	Reference
Disposal of Cigar Lake Waste Rock EIS	0	110	--	--	240	• Appendix II, Section 3.2.1 • pit lake value based on study by Saskatchewan Environment and Resource Management (SERM) (COGEMA 2001, Section 3, Table 1
2004 Regional Groundwater TID	0	55	85	120	n/a	• Section 6.5.1.1 and Figure 6.5-1 • Sue C stockpile is from numerical model and on Figure 6.5.1.1.
2004 Waste Rock Management TID	--	55	85	--	--	• Section 5.1.3.2 • based on 2004 Regional Groundwater TID
Sue E EIS	0	55	85	120	240	• Table 3.1, Appendix IV • pit lake value taken from Section 5, Appendix IV and from the numerical model input • Sue C stockpile is from in numerical model
Midwest EIS	0	25	55	55	150	• Table 3.1, Appendix IX • pit lake value taken from numerical model • stockpile value assumed to be same as drumlins/uplands (not documented in EIS)
2013 Waste Rock TID	0	• 55 in Sue area • 25 in Midwest area	55	55	• 55 in Sue area • 150 in Midwest area	• Section 5.5.8.2, 2011 Regional Groundwater Model (AREVA 2011c) • stockpile value assumed to be same as drumlins/uplands • pit lake value for Sue area assumed to be the same as the regional value
2021 Waste Rock TID	0	• 55 in Sue area • 25 in Midwest area	55	55	• Sue B 450 • Sue C/A 170 • Sue E 240 • 150 in Midwest	• Section 5.5.8.2, 2011 Regional Groundwater Model (AREVA 2011c) • stockpile value assumed to be same as drumlins/uplands • pit lake area based on the 2020 Sue Water Management Strategy (Orano 2020), • pit lake recharge based on water balance models (AREVA 2016)

4.1.3 Hydraulic Conductivity Distribution

The range of calibrated hydraulic conductivities for the regional model is taken from the Hydrogeology and Groundwater Modelling of the Collins Creek Basin TID (AREVA 2011c, Table 5.5-5). These values are reproduced in Table 4-3, for the area encompassing the Sue and Midwest sub-models. For the decommissioned analysis, conductivities of the pits have been modified to represent the waste rock placed in the pits and the overlying pit lakes.

Hydraulic conductivities used in the sub-model simulations for the waste rock, till cap and pit lakes are also shown in Table 4-3. A value of 10^{-4} m/s was assumed for all waste rock except the Cigar Lake waste rock. The Cigar Lake waste rock consists predominantly of strongly fractured clay altered basement graphitic metapelite rock, and the hydraulic conductivity is lower than waste rock from the McClean Lake Operation. For modelling purposes, the hydraulic conductivity of Cigar Lake waste rock is conservatively taken to be $2x10^{-6}$ m/s (COGEMA 2004b, Section 5.2.1). The hydraulic conductivity of the till cap was determined from in situ measurements of tills in the Sue area. The conductivity of the pit lakes is theoretically infinite but is represented in the numerical model by a number several orders of magnitude larger than the other conductivities. This number has been chosen because it does not impede model convergence but still represents the physics correctly.

Table 4-3: Hydraulic Conductivities Used in Numerical Model

Unit	Horizontal Conductivity (m/s)	Vertical Conductivity (m/s)
Aquifer Layers		
Overburden	$4x10^{-8}$ to $3x10^{-6}$	$8x10^{-9}$ to $1x10^{-6}$
Upper Sandstone	$5x10^{-9}$ to $2x10^{-5}$	$5x10^{-9}$ to $2x10^{-5}$
Lower Sandstone	$5x10^{-9}$ to $1x10^{-5}$	$5x10^{-9}$ to $1x10^{-5}$
Basement Regolith	$4x10^{-7}$	$1x10^{-7}$
Basement	$5x10^{-8}$	$5x10^{-9}$
Decommissioned Pits		
JEB, Sue A/B/C/E Waste Rock and Special Waste	$1x10^{-4}$	$1x10^{-4}$
McClean Underground and Midwest Special Waste, Contaminated Landfill	$1x10^{-4}$	$1x10^{-4}$
Cigar Lake Waste Rock	2×10^{-6}	2×10^{-6}
Till Cap	1×10^{-7}	1×10^{-7}
Pit Lake	$5x10^{-1}$	$5x10^{-1}$

4.2 Sue Sub-Model

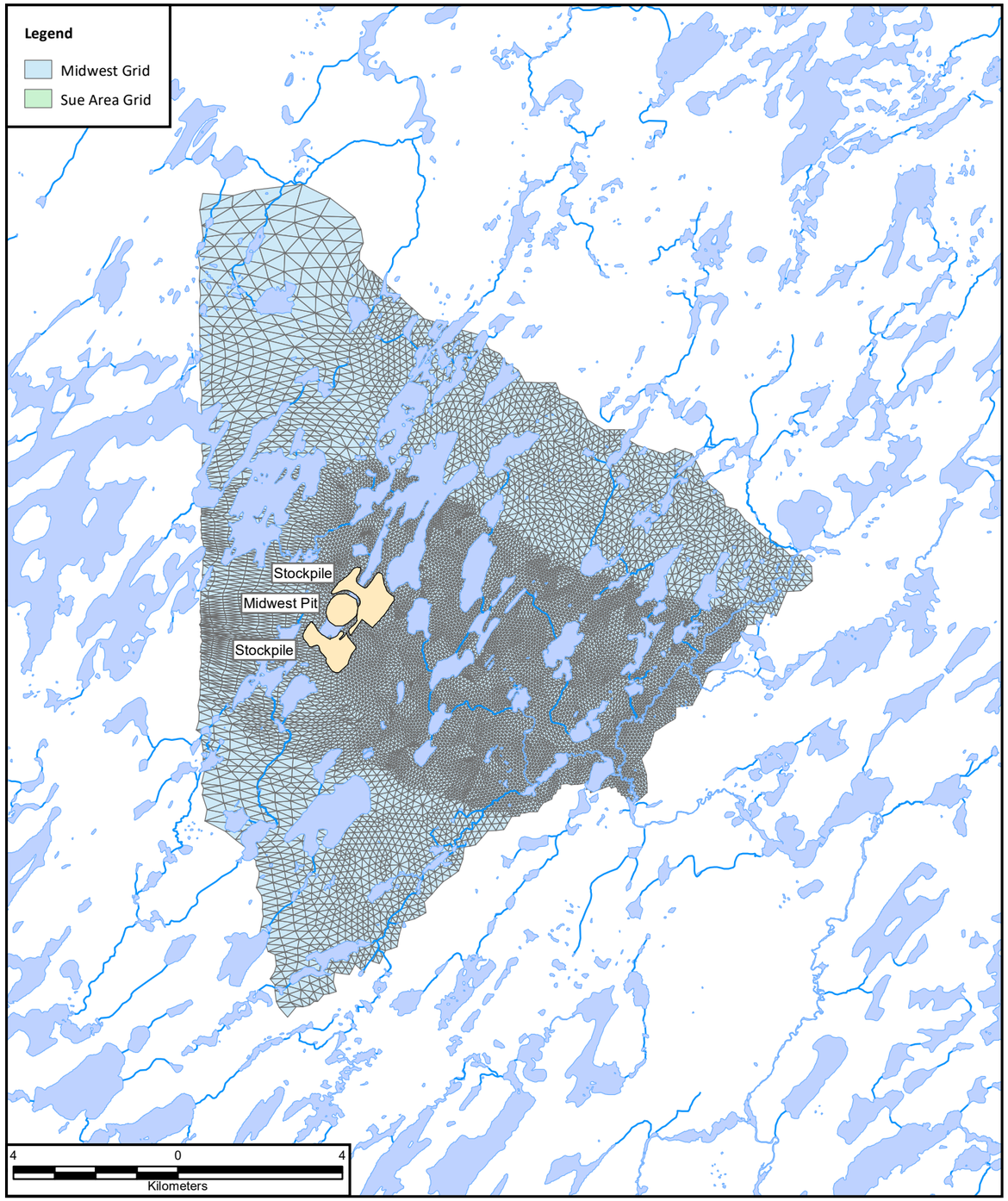
Figure 4-1 shows the geographical boundaries of the Sue sub-model. The boundaries of the Sue sub-model are coincident with the Sue sub-model extracted from the 2004 regional model. The east and south limits of the sub-model are similar to the regional model. They were treated as a river/lake boundary for Collins Creek and Kewen Lake and as a constant head boundary for Wollaston Lake/Collins Bay. The west limit of the sub-model corresponds to Collins Creek and a constant head boundary was used in a manner similar to the regional model. The north limit of the Sue/McClean sub-model corresponds to the south limit of the JEB sub-model. A river boundary, which represents a natural no-flow boundary, was used to simulate Torwalt Lake and the western part of Collins Creek. An imposed no-flow boundary was used for the rest of the model. The dimensions of the model grid were chosen to be sufficiently large to eliminate the influence of boundary conditions on model predictions.

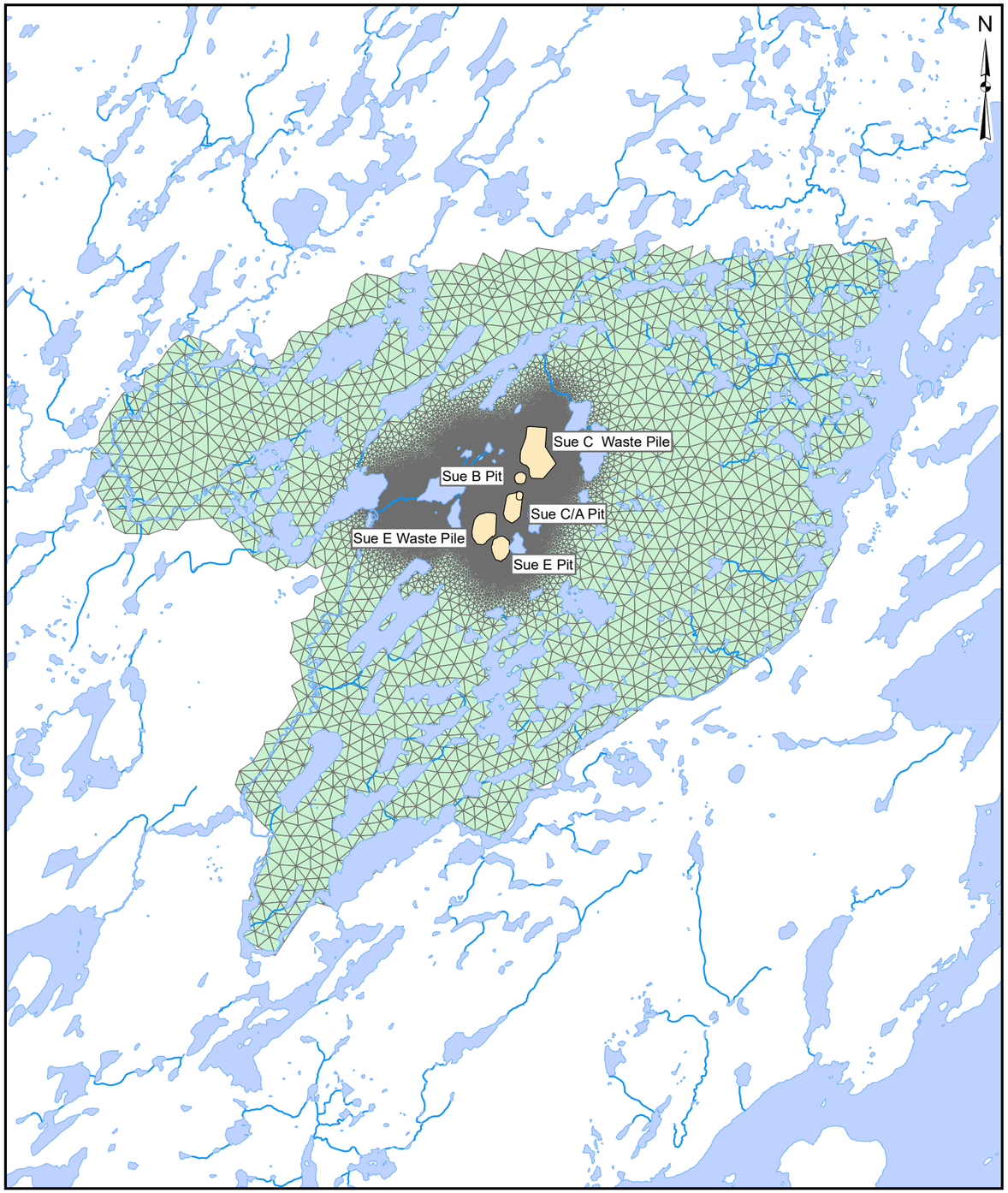
4.2.1 Model Discretization

The grid of the sub-model extracted from the regional model was refined in the horizontal and vertical directions. Areal refinement was added around the three Sue pits and the two stockpiles. This vertical layering was increased for the sub-model to account for the contours of the open pits and the placement of waste rock in the pits. The vertical discretization varied depending on the scenario being modelled; the number of vertical layers varies from 14 to 18.

The top layer represents the overburden. The bottom two layers represent the basement rock. The two layers above the basement layers represent the basement regolith. The remaining layers represent the upper and lower sandstone.

The location and extent of the finite element grid for the Sue sub-model is shown on Figure 4-2. The model grid consists of 64,276 elements per layer.





Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 5/31/2021 Scale: 1:125,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 4-2
FINITE MESH FOR THE MIDWEST AND SUE SUB-MODELS

WASTE ROCK MANAGEMENT
TECHNICAL INFORMATION DOCUMENT

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Part B\Figure 4-2 Finite Element Mesh for the Midwest and Sue Sub-model.mxd

4.2.2 Hydraulic Conductivity Distribution

The range of hydraulic conductivity calibrated for the 2011 regional model is documented in Table 4-3. The calibrated conductivities in the Sue area were updated from those calibrated for the 2004 regional model based on additional data gathered at the Sue site since 2004. In particular, an additional calibration scenario was incorporated which used site data gathered in December 2008 at Sue B, Sue E, and Sue C/A open pits. The data used in the calibration process consisted of hydraulic heads measured in piezometers installed in the overburden, sandstone, regolith and/or basement, and measured groundwater inflows to the open pits and dewatering wells.

Water level monitoring indicated that wells located close to the Sue C/A pit to the north, south, and east did not respond to dewatering as significantly as wells located to the west of the pit. However, these same wells showed a significant response to dewatering at the Sue B and E pits, despite these pits being located at a greater distance than the Sue C/A pit. To reproduce this observation, the enhanced permeability feature trending north-south along the eastern edge of the Sue C/A pit was modified during calibration. This feature, which was originally implemented in the 2004 regional model, was modified such that the hydraulic conductivity parallel to this feature was relatively high ($8x10^{-6}$ m/s) and hydraulic conductivity perpendicular to the trend of the feature was relatively low ($5x10^{-9}$ m/s). The extent of this feature was modified based on hydraulic head response in nearby wells such that it extended between the Sue C/A and Sue B pits and between the Sue C/A and Sue E pits.

The monitoring data evidence noted above is reinforced by anecdotal evidence which reported slumping of the east wall of the Sue C pit during mining and also a noticeable change in conductivity encountered partway through the excavation of Sue A pit.

Other significant changes to hydraulic conductivities made as a part of the 2011 regional model include:

- decreasing the hydraulic conductivity of two enhanced permeability features in the area of Candy Lake to $6x10^{-6}$ m/s (from $3x10^{-5}$ m/s)
    - pumping tests conducted in the area since the 2004 report indicate the bulk hydraulic conductivity of the sandstone is likely lower than $2x10^{-5}$ m/s
- removing a lower conductivity feature ($8x10^{-7}$ m/s) incorporated in the 2004 regional model in the lower sandstone to the west of McClean Lake
    - three monitoring wells are located in this area, but the predicted hydraulic heads at these locations were found to be insensitive to the presence or absence of the feature
    - the rationale for the inclusion of this feature was not apparent in the previous study

The main impact of the changes to the hydraulic conductivities noted above is expected to be on the groundwater flow regime between Sue E pit and the surface water. The Sue sub-model hydraulic conductivity distributions in the vicinity of the Sue pits are shown on Figure 4-3.

4.3 Midwest Sub-Model

4.3.1 Model Discretization

The location and extent of the Midwest sub-model is shown on Figure 4-1 and the finite element grid on Figure 4-2. The model grid consists of 32,990 elements per layer. The model covers an area that extends from Henday Lake to Collins Creek. The western sub-model boundary was found to be too close to the Midwest pit to match the hydraulic head contours predicted by the Midwest EIS. Therefore, the grid was expanded to the western edge of Henday Lake East Basin and a match was obtained.

The grid of the sub-model extracted from the regional model was refined in the horizontal and vertical directions. Areal refinement was added around the Midwest pit and the two stockpiles. The vertical layering was increased for the sub-model to account for the contours of the open pits, the placement of waste rock in the pits, and the variability of the sandstone sequence. The sub-model was vertically sub-divided into 15 layers. The top layer represents the overburden. Layers 2 through 11 represent the sandstone and layers 12 and 13 represent the basal conglomerate. Layer 14 represents the upper weathered part of the basement rock and layer 15 represents the basement rock.

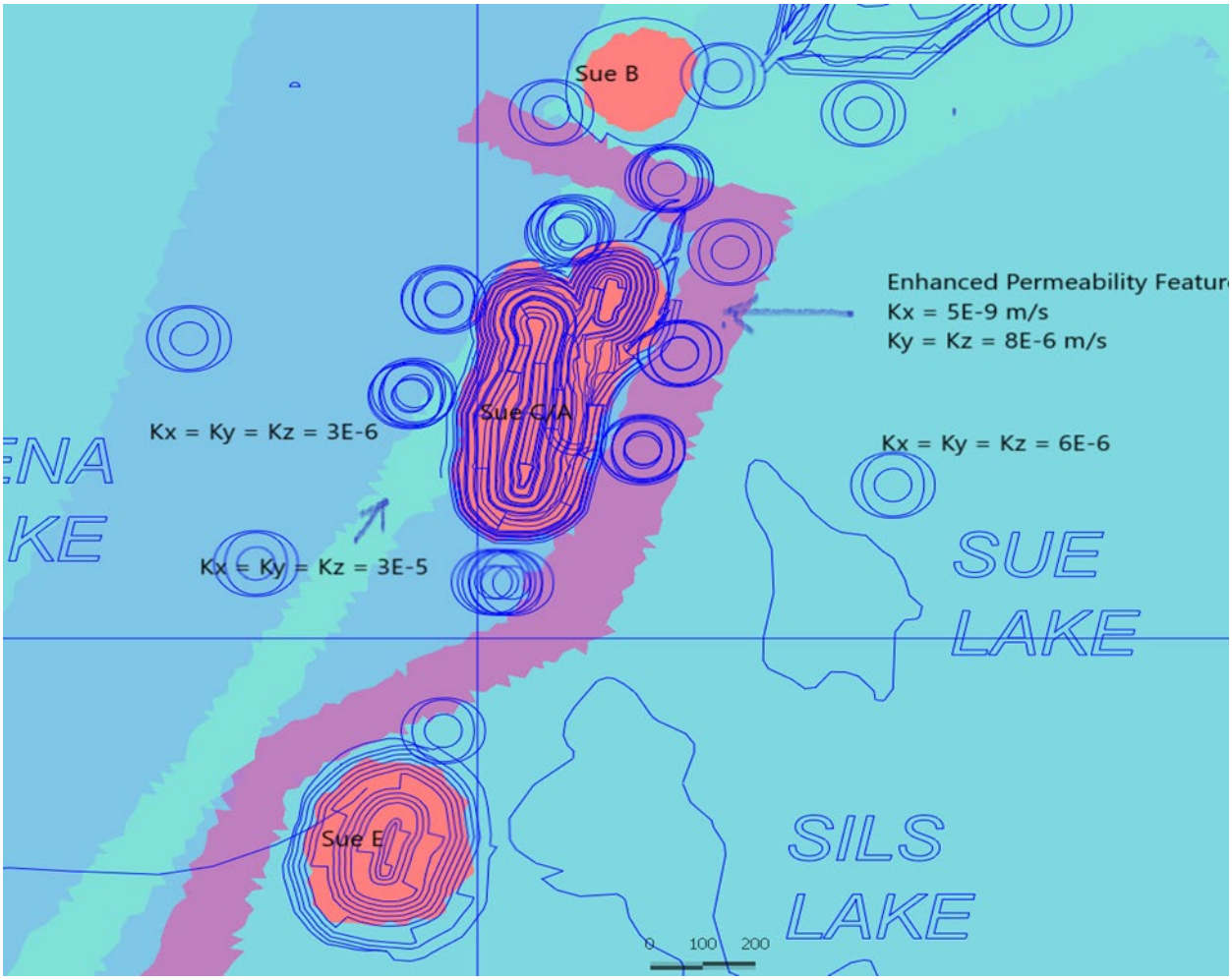


Figure 4-3: Low Conductivity Feature Running East of Sue C/A Pit and West of Sue E Pit.

4.3.2 Hydraulic Conductivity Distribution

The numerical model developed for the Midwest Project EIS included three different calibrated hydraulic conductivity distributions, illustrated in Figure 3.5 of Appendix IV (AREVA 2011b) and listed in Table 3.1 of Appendix IX (AREVA 2011b). The distributions are not significantly different; however, they do change which surface water receptors are affected.

In the Midwest Project EIS, under Case 1 and Case 2 hydraulic conductivity distributions, South McMahon Lake and Shallow Lake were predicted to be affected by groundwater flow through the waste rock placed in the Midwest pit (AREVA 2011b, Table 4.7, Appendix IX). Collins Creek was a receptor in all three cases (AREVA 2011b, Table 4.8, Appendix IX). Plots of predicted arsenic loadings and predicted incremental surface water concentrations (AREVA 2011b, Figures 4.7 and 4.8, Appendix IX) indicate that Case 3 has the largest impact on Collins Creek. Therefore, for the purposes of this report, the Case 3 hydraulic conductivity distributions were used.

Several inconsistencies were noted between the conductivity values in Table 3.1 of the Midwest Project EIS (AREVA 2011b, Appendix IX) and the values actually implemented in the numerical model associated with the Midwest Project EIS. The numerical model presented in this report was run with the conductivities as described in Table 4-4 and also with the conductivities implemented in the numerical model. No significant differences were observed with respect to the impact on surface water receptors.

Table 3.1 of the Midwest sub-model (AREVA 2011b, Appendix IX, Table 3.1) is reproduced here as Table 4-4.

Table 4-4: Calibrated Hydraulic Conductivities for the Midwest Area

Material	Model Hydraulic Conductivity (m/s)[1]
Overburden	$K_x,K_y = 4x10^{-7}$ to $1x10^{-5}$; $K_z=4x10^{-7}$ to $5x10^{-6}$
Upper Sandstone	$K_x,K_y = 4x10^{-7}$ to $8x10^{-7}$; $K_z=4x10^{-8}$ to $8x10^{-8}$
Lower Sandstone	$K_x,K_y = 4x10^{-7}$ to $2x10^{-6}$; $K_z=4x10^{-7}$ to $2x10^{-6}$
Basal Conglomerate	$K_x,K_y = 1x10^{-5}$; $K_z=1x10^{-5}$
Weathered Basement	$K_x,K_y = 2x10^{-7}$; $K_z=2x10^{-8}$
Basement	$K_x,K_y = 5x10^{-8}$; $K_z=5x10^{-9}$

[1] Case 3 from the Midwest EIS (AREVA 2011b, Table 3.1, Appendix IX)
K_x and K_y correspond to K_h in Table 3.1
K_z corresponds to K_v in Table 3.1

5 Contaminant Transport

5.1 Source Terms

5.1.1 Placed Waste Rock Source Terms

The single source term approach involves using a mass weighted average pore water concentration and the flow rate through the waste rock to determine a total mass flux out of the waste rock. The derivation of the mass weighted average pore water concentration is documented in Appendix B-III.

In the July 2002 Cigar Lake Waste Rock EIS Addendum (COGEMA and Cameco 2002) a sensitivity analysis of the single source versus multi-source approach was done. The multi-source approach considers each waste rock type/zone with sufficiently different geochemical properties as a separate source term with a specific groundwater flow through that waste rock and with a distinct pore water concentration. Contaminant transport to the receiving surface waters is modelled separately for each waste rock type, resulting in waste-rock specific contaminant mass flux arrival time. The concentration of COPCs in the receiving surface waters is then estimated by summing the resulting mass fluxes as a function of time. In the 2002 sensitivity analysis, it was concluded that the results are not significantly affected by the use of a single weighted average source term compared to multiple source terms corresponding to each main waste rock type.

The single source approach was used for the Sue E EIS assessment and the multi-source approach was used as part of the sensitivity analysis. Appendix IX of the Sue E EIS compares the mass flux for the single source term and the multi-source term approach. Three options and three receptors are compared. Option 1b is the basis for the “Approved Case”. Table 5.3 (in Appendix IX of the Sue E EIS) summarizes the calculated peak loadings to surface water for the two source term approaches. The conservatism of the single source term approach was confirmed for Option 1a. For Option 1b, mass flux to Candy/Bena Lake was 15% higher for the single source approach. The difference was attributed to the fact that the flux from the uppermost layer of waste rock dominates. The uppermost layer is Cigar Lake waste rock, and it has a larger pore water concentration than the average pore water concentration used in the single source calculation. The sensitivity analysis result in the Sue E EIS suggests that the single source approach might underestimate mass flux for nearby receptors, under some conditions.

The single source approach was used for the 2013 and 2021 waste rock TIDs. The 2013 and 2021 Waste Rock TIDs were based on an updated groundwater flow model and in this model the flux from the Sue C/A waste rock does not intercept Candy/Bena Lakes. The closest lake that intercepts mass flux from Sue C/A waste rock is Telephone Lake.

A sensitivity simulation was carried out, using the 2021 groundwater and transport models. The waste rock was divided into two separate sources; the Cigar Lake waste rock and the rest of the waste rock. There was very little difference in the flux to Telephone Lake using single source and multi-source approach, as shown in Figure 5-1 below.

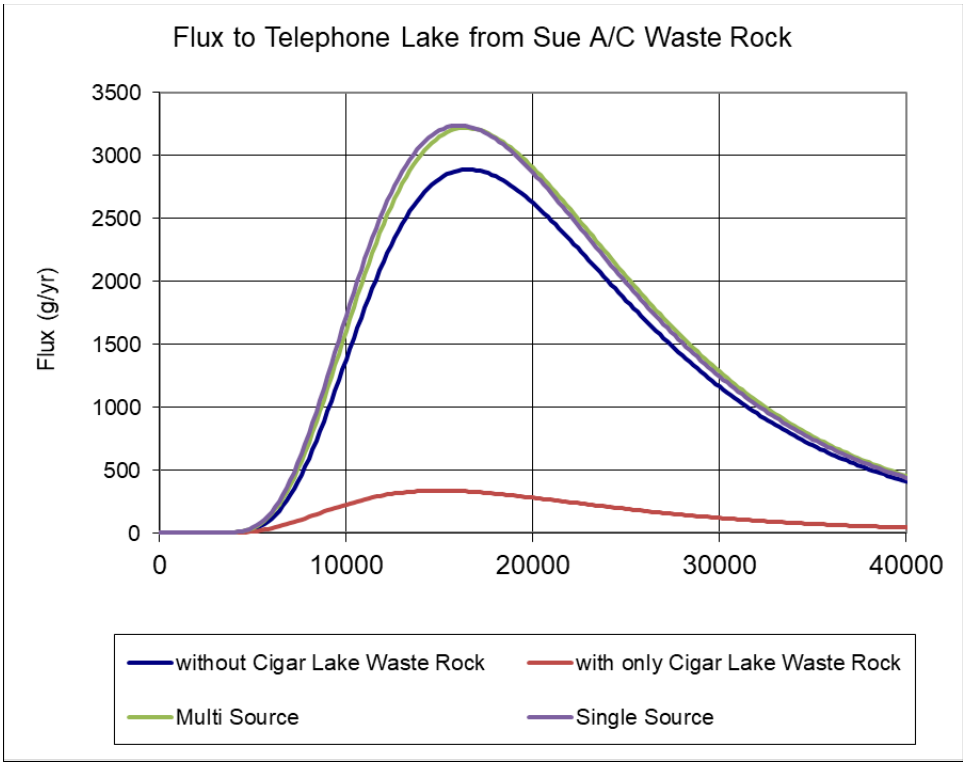


Figure 5-1: Comparison of Single Source and Multi Source Approach

5.1.1.1 Scenario 1: Update to Approved Case for Sue Pits

Scenario 1 quantities, solids content, leachable fractions, and initial pore water concentrations are based on a combination of the currently assessed values from the Caribou Project EIS (AREVA 2009a) and the waste rock studies and field measurements made since the Caribou Project EIS was published. The changes due to the replacement of predicted values by measured values include:

- the quantities of Sue A, B, C, and E waste rock;
- a small increase to JEB solids content, due to a re-categorization of waste rock samples;
- updated Sue A, Sue B, and Sue E solids content for arsenic, nickel, lead, and uranium;
- updated Sue A and Sue E waste rock pore water concentrations, for all COPCs.

The updated quantities are given in Table 3-1 of Part A of the 2021 Waste Rock TID. The updated solids content based on these measurements are given in Tables 4-2, 4-3, 4-5, and 4.6 of Part A of the 2021 Waste Rock TID. The updated pore water concentrations for Sue A and Sue E waste rock are given in Tables 4-4 and 4-7 of Part A of the 2021 Waste Rock TID. More recent waste rock analysis has resulted in:

- updated quantities, solid content, leachable fraction, and pore water concentration for Cigar Lake waste rock; and
- quantities and solid content for contaminated landfill process waste placed in Sue C/A pit.

The updated solid content, leachable fraction, and pore water concentration for Cigar Lake waste rock are given in Table 4-10 of Part A of the 2021 Waste Rock TID. The contaminated landfill process waste is discussed in Section 4.2.6 of Part A; quantities and solid content are given in Table 4-9.

Arsenic is a special case in that the leachable fraction and initial pore water concentration are both based on correlations. The arsenic leachable fractions and initial pore water concentrations were calculated using the correlations developed for the Caribou Project EIS (AREVA 2009a, Appendix VIIIB, Section 4.3.1) but updated using new measurements for solids content, where applicable. An exception to this is the arsenic pore water concentration in Sue A and Sue E special waste rock, where measured field data is used.

The tables documenting the source term parameters resulting from the combined data are in Appendix B-III. Table 1-2 documents the arsenic source term parameters used for the “Update to Approved Case”. Table 1-7 documents the mass-weighted initial pore water concentrations developed for all COPCs other than arsenic for the “Update to Approved Case”. Table 1-12 gives the leachable inventory for all COPCs other than arsenic for the “Update to Approved Case”.

5.1.1.2 Scenario 3: Future Projects Case for Sue Pits

The “Future Projects Case” (Scenario 3) includes the changes to quantities, solids content, and waste rock pore water concentration documented in Section 5.1.1.1. Additional changes are the result of changes in mining plan since the Caribou Project EIS was published. These include:

- the decommissioned Sue E pit containing only Sue B special waste rock;
- the placement of Caribou, McClean, and Sue D special waste rock in the Sue C/A pit;
- Caribou, McClean, and Sue D special waste rock characterization (EcoMetrix 2013),
- the revision of the correlation for leachable arsenic fraction to include new data; documented in Appendix B-I.

Pore water chemistry was not measured for the McClean Underground, Caribou, and Sue D special waste rock, and therefore the pore water correlation was not updated. The correlation developed for the Caribou

Project EIS was used for the “Future Projects Case”. An exception to this is the arsenic pore water concentration in Sue A and Sue E special waste rock, where measured field data was used.

In Appendix B-III, Table 1-3 documents the arsenic source term parameters for the “Future Projects Case”. Table 1-5 compares the updated parameters calculated for the “Future Projects Case” in the 2013 and 2021 TIDs to those developed for the Caribou Project EIS.

Also, Tables 1-7 and 1-11 document the initial pore water concentrations, for all COPCs other than arsenic and the leachable inventory for all COPCs other than arsenic, for the “Future Projects Case”. Note that additional COPCs are being tracked in the 2013 and 2021 Waste Rock TIDs. They are listed in Table 1-1 of Appendix B-III.

5.1.1.3 Scenario 3A: Operational Waste in Sue C/A Pit

The source term for Scenario 3A includes all the sources documented in “Future Projects Case” (Scenario 3). In addition, a source term for operational waste (sludges) is included.

The properties used in the development of the sludge component of the source term for Scenario 3A are shown in Table 5-1. Assumptions were made in the development of the JEB and Sue component of the sludge source term:

CX Sludge Pond data were taken from the spreadsheet “Temp Sludge Pond - Estimation of Contaminants v2.1” and from the document “CX Sludge Management” (AREVA 2017). The data was averaged over nine sample locations at top, middle, and bottom levels. The average properties were as follows:

- the average bulk density was found to be 535 kg/m3;
- the average arsenic pore water concentration was found to be 1.17 mg/L

JEB and Sue sludge data were taken from the spreadsheet “JEB & Sue sludge assays”. The data was XRF measurements of solid content. Volume data were available but no data for density or pore water concentration were available. Therefore, the density was assumed to be the same as the CX sludge pond density. The pore water concentration in the JEB and Sue sludge was taken to be the CX sludge pond pore water concentration prorated by the solid content of the respective components (see AREVA 2015, Appendix B.3). The weighted average source term that includes all contaminant sources is shown in Appendix B-III (Table1-4).

Table 5-1: Properties of Operational Process Waste for Scenario 3A

Source	Volume (m^3)	Bulk Density (tonne /m^3)	Mass of Sludge (tonne)	Arsenic Content (µg/g)	Arsenic Leachable Mass (tonne)	Arsenic Pore Water Concentration (mg/L)
CX Pond Sludge	2081	0.535	1113	1289	1.4	1.2
JEB Ore Pad Sludge	8900	0.535	4762	3463	16.5	3.1 [1]
Sue Ore Pad Sludge	400	0.535	214	15810	3.4	14 [1]
Operational Process Waste Source Term	**11381** [3]		**6089** [3]	**3500** [2]	**21** [3]	**3.2** [2]

[1] From ratio of solid content
[2] Weighted average
[3] Sum

5.1.1.4 Scenario 3B: Operational Waste and Midwest SABRE Waste Rock in Sue C/A Pit with No Till Cap

The properties used in the development of the arsenic source term for Scenario 3B are shown in Appendix B-III (Table 1-5).

Table 5-2. The Midwest SABRE Waste Rock data were taken from the spreadsheet "Volume of Waste from Midwest SABRE Method". The weighted average source term that includes all contaminant sources is shown in Appendix B-III (Table 1-5).

Table 5-2: Properties of Waste Materials for Scenario 3B.

Source	Volume (m^3)	Bulk Density (tonne/m^3)	Mass (tonne)	Arsenic Content (µg/g)	Arsenic Leachable Mass (tonne)	Arsenic Pore Water Concentration (mg/L)
Operational Process Waste [1]	11,381	0.535	6,089	3500	21	3.2
Midwest SABRE Waste Rock	13,296	2.43	32,309	86	4 [2]	86 [3]

[1] From Table 5-1
[2] From Formula: $S_L = 0.0168\ S^{1.2763}$ (AREVA 2011, Appendix VIII)
[3] From Formula: $C_0 = 0.123\ S^{0.935}$ (AREVA 2011)

5.1.1.5 Scenario 4: Fully Backfilled Sue C/A Pit

The composition of the backfill waste rock in the "Fully Backfilled Sue C/A Pit Case" was given the average properties of the clean waste rock in the JEB, Sue C, and Sue E waste rock stockpiles. The arsenic source term parameters for the "Fully Backfilled Sue C/A Pit Case" are shown in Table 5-3. The complete arsenic source term is shown in Appendix B-III (Table 1-6).

Table 5-3: Properties of Backfill Waste Rock for Scenario 4

	Volume	Mass	Solid Content (Part A 2021, Table 4.8)	Pore Water Concentration
	(m^3 bcm)	(kg)	(ug/g)	(mg/L)
JEB Clean Waste	3,580,000	9,093,200	9	
Sue C Clean Waste	9,997,102	25,392,639	9.5	
Sue E Clean Waste	4,587,836	11,653,103	2.6	
Weighted Average			7.7	0.13 [1]

[1] From Formula: $C_0 = 0.123\ S^{0.935}$ (AREVA 2011)

5.1.1.6 Scenario 5: Midwest

The Midwest sub-model solids content, initial pore concentrations, and leachable inventories are based on the values used in the 2011 Midwest Project EIS (AREVA 2011b). They are reproduced in Tables 1-10 and 1-14 of Appendix B-III and in Table 5-4 below.

Table 5-4: Source Term Parameters for Midwest Waste Rock

COC	Average Solid Concentration (mg/kg or MBq/kg)	Leachable Inventory (tonnes or MBq)	Initial Pore Water Concentration (mg/L or Bq/L)
As	1100	768	86
Cd	--	--	0.001
Co	403	36	73
Cu	692	62	0.4
Mo	23	58	7.3
Ni	621	56	115
Pb	347	31	0.1
Se	0.2	0.02	0.3
U	260	23	0.3
V	--	--	0.0068
Zn	735	66	2.7
^{226}Ra	1.5	1.4×10^5	1.2
^{210}Pb	--	--	0.03
^{210}Po	--	--	--
^{230}Th	0.9	8.1×10^4	0.04
Cl	--	--	--
SO_4	--	--	20
NH_3 / NH_4	--	--	--

5.1.1.7 Comparison of Source Terms

Sensitivity analyses (Section 7.2) indicate that leachable inventory is the model parameter that has the largest impact on the modelled arsenic concentration in Collins Creek. Pore water concentration has a relatively minor impact. Table 5-5 and Table 5-6 compare the most recently assessed and approved case from the Caribou Project EIS, i.e. the “Approved Case”, the “Update to Approved Case”, and the “Future Projects Case” source term parameters for leachable inventory. Both the 2013 and 2021 Waste Rock TIDs are included. The COPCs included are those tracked in the Caribou Project EIS.

Update to Approved Case

Comparing the most recently assessed and approved case from the Caribou Project EIS to the 2013 and 2021 Waste Rock TIDs “Update to Approved Case” for the Sue C/A pit, the main difference is seen in the leachable inventory of arsenic. The measured arsenic solids content for the Sue A waste rock is almost double the value from Sue A waste rock predicted in the Caribou Project EIS. Also, the Sue A pit was redesigned after the submission of the Caribou Project EIS, resulting in an increase in waste rock quantity. The nickel solids content in the Sue A waste rock is also higher, but this increase is offset by a decrease in nickel solids content in the Sue E waste rock, which has a larger inventory.

Comparing the 2013 and 2021 Waste Rock TIDs “Update to Approved Case” for the Sue C/A pit, the main difference is in the leachable inventory of arsenic. The difference lies in the Cigar Lake waste rock. Both the volume and arsenic solid content of the Cigar Lake waste rock are smaller in the 2021 assessment.

In the Sue E pit, the inventory of arsenic, nickel, lead, and uranium is lower in the 2013 Waste Rock TID compared to the approved case due to the lower solids content for these COPCs in the revised Sue B waste rock characterization.

Comparing the 2013 and 2021 Waste Rock TIDs “Update to Approved Case” for the Sue E pit, the main difference is in the leachable inventory of arsenic. The waste rock characterization for the McClean Underground waste rock in the Sue E pit was revised. The Caribou Project EIS and the 2013 Waste Rock TID used the data from a single sample taken close to the ore body. The 2021 Waste Rock TID used data from five special waste samples taken during the 2013 waste rock study (EcoMetrix 2013).

Future Projects Case

Comparing the 2013 Waste Rock TID “Update to Approved Case” to the 2013 Waste Rock TID “Future Projects Case” for the Sue C/A pit, the main difference is again seen in the leachable inventory of arsenic. The increased leachable inventory of arsenic in the “Future Projects Case” compared to the “Update to Approved Case” is a result of the higher arsenic content of the underground mine waste rock. There is also decrease in nickel leachable inventory compared to the “Update to Approved Case” which is a result of the removal of the open pit mined Caribou waste rock and its replacement by the underground mine waste rock. The open pit mined Caribou waste rock has higher nickel solids content.

As in the “Update to Approved Case”, both the volume and solid content of the Cigar Lake waste rock are smaller in the 2021 assessment. Also, in the 2021 assessment the solid content and leachable inventory of the McClean Underground, Caribou and Sue D waste rock were revised to include only samples for which leachable inventory data was available.

In the Sue E pit the inventory of arsenic, nickel, lead, and uranium is lower in both the 2013 and 2021 Waste Rock TID, due to the smaller solids content of these elements in the Sue B waste rock, even though the as-mined quantity of Sue B waste rock was larger. The removal of the McClean Underground waste rock for the “Future Projects Case” also reduced the arsenic inventory.

Table 5-5: Comparison of Approved Case (Caribou EIS), the Update to Approved Case, and the Future Projects Case Source Term Parameters for the Sue C/A Pit

	Leachable Inventory (tonnes or MBq)				
COPC	**Approved Case (Caribou EIS)**	**Update to Approved Case (2013 Waste Rock TID)**	**Future Projects Case (2013 Waste Rock TID)**	**Update to Approved Case (2021 Waste Rock TID)**	**Future Projects Case (2021 Waste Rock TID)**
As	**55**	**78**	**84**	**70**	**74**
Co	6.8	7.1	5.6	4.7	8.7
Cu	8.3	9.0	8.7	8.5	9.9
Mo	35	39	39	35	35
Ni	57	55	44	52	49
Pb	9.8	13	13	13	15
Se	12	13	13	13	13
U	14	15	14	15	20
Zn	10	11	11	7.7	9.0
^{226}Ra	1.9E+05	2.1E+05	2.0E+05	2.0E+05	2.1E+05
^{210}Pb	1.8E+05	2.0E+05	1.9e+05	2.0E+05	2.0E+05
^{230}Th	1.5E+05	1.6E+05	1.6E+05	1.6E+05	1.7E+05

Table 5-6: Comparison of Approved Case (Caribou EIS), the Update to Approved Case, and the Future Projects Case Source Term Parameters for the Sue E Pit

	Leachable Inventory (tonnes or MBq)				
COPC	**Approved Case (Caribou EIS)**	**Update to Approved Case (2013 Waste Rock TID)**	**Future Projects Case (2013 Waste Rock TID)**	**Update to Approved Case (2021 Waste Rock TID)**	**Future Projects Case (2021 Waste Rock TID)**
As	**86**	**40**	**7.1**	**7.1**	**7.1**
Co	0.5	0.61	0.58	1.0	0.58
Cu	1.9	2.2	2.2	2.6	2.2
Mo	33	38	29	29	29
Ni	4.5	2.9	2.6	3.7	2.6
Pb	7.6	3.4	3.1	3.1	3.1
Se	4.5	5.5	5.5	5.5	5.5
U	2	2.1	0.74	4.6	0.74
Zn	2.4	2.9	2.6	3.2	2.6
^{226}Ra	3.1E+04	3.4E+04	1.7E+04	3.4E+04	1.7E+04
^{210}Pb	3.1E+04	3.4E+04	1.7E+04	3.4E+04	1.7E+04
^{230}Th	3.1E+04	3.4E+04	1.7E+04	3.4E+04	1.7E+04

5.1.2 Pit Lake Source Terms

5.1.2.1 Measured Pit Lake Contaminant Concentrations

Pit lake water quality has been monitored since 2002. The data is discussed in Part A, Section 3.2.4. The water quality values are reproduced in Table 5-7 for the COPCs being tracked in this section (taken from Table 3-5 of Part A). The values shown are the stabilized average values.

Table 5-7: Summary of COPC Concentrations in Pit Lakes

COPC	Concentration (mg/L or Bq/L)		
	Sue C/A Pit Lake	Sue E Pit Lake	Sue B Pit Lake
As	2.56	0.43	0.03
Cd	0.00005	0.00001	0.00002
Co	0.062	0.0018	0.0006
Cu	0.00095	0.00045	0.00081
Mo	0.50	0.013	0.003
Ni	3.47	0.44	0.24
Pb	0.0003	0.0001	0.0003
Se	0.0012	0.0001	0.0005
U	0.0075	0.00026	0.0068
V	0.0029	0.0008	0.0002
Zn	0.024	0.0030	0.0054
^{226}Ra	0.196	0.015	0.065
^{210}Pb	0.033	0.023	0.030
^{210}Po	0.022	0.006	0.021
^{230}Th	0.02	0.01	0.02
Cl	3.2	1.8	2.9
SO_4	35.0	6.3	9.9
NH_3 / NH_4	--	--	--

5.1.2.2 Transport from Submerged Waste Rock through the Till Cap

Contaminant release from the placed waste rock to the overlying pit lake may be due to advection, a function of the flow rate through the till cap and/or molecular diffusion, which is a function of the chemical gradient on either side of the till cap. In previous studies (AREVA 2009a, COGEMA 2004b, COGEMA 2004c), diffusion from the waste rock pore water through the till cap was assumed to be a minor effect and was not included in the contaminant transport calculations.

Justification for Ignoring Diffusion Through the Till Cap

The validity of the assumption that diffusion through the till cap can be ignored is examined by calculating the Péclet number. The Péclet number quantifies the relative importance of advection and diffusion. It is given by

$$P_e = \frac{qZ}{\theta D_e}$$

where $q = Q/A$ is Darcy velocity, θ is the till cap effective porosity, Z is a characteristic distance, and D_e is the effective diffusion coefficient. The "Future Projects Case" values were used in the calculation, as follows:

Q = 1.1 m^3/day for Sue C/A pit; Q = 0.07 m^3/day for Sue E pit (from Table 5-7);

A = 1.87x10^5 m^2 for Sue C/A pit; A=6.90x10^4 m^2 for Sue E pit (from the numerical model);

θ = 0.11;

D_e= 1x10^{-10} m^2/s = 8.6x10^{-6} m^2/day (from AREVA 2011b, Appendix IX, Section 4.5.1);

Z = 2 m (the thickness of the till cap).

In the Midwest EIS (AREVA 2011b, Appendix IX, Section 4.5.1), values ranging from 5 x10^{-11} m^2/s to 4.4 x10^{-10} m^2/s were considered for the effective diffusion coefficient for the diffusive movement of arsenic through the till cap. A mean value of 1 x10^{-10} m^2/s was assumed. This value is considered to be relatively conservative. For instance, an effective diffusion coefficient of 3.0x10^{-11} m^2/s was estimated for arsenic from radial diffusion tests conducted on sandstone core from the JEB site (COGEMA 1997).

The resulting value for Péclet number is 12 for Sue C/A and 2.1 for Sue E, using a diffusion coefficient of 8.6x10^{-6} m^2/day. Using the smaller diffusion coefficient, the Péclet number is 41 and 7.1 for Sue C/A and Sue E, respectively. Advection is considered to dominate diffusion for a Peclet number bigger than 10 (Garges and Baehr 1998). Péclet numbers between 1 and 10 characterize a regime where both dispersion and advection are important. By this criterion, diffusion through the Sue E till cap may be marginally significant.

The preceding calculation provides justification for the assumption that diffusion effects can be ignored in cases where the Péclet number is sufficiently large. Although neglecting diffusion simplifies the modelling, it does not imply that conservatism is not maintained. The calculation of transport through the till cap includes only the upward advective flow. Typically, there is also a downward advective flow through the till cap and this is usually larger than the upward component (see Table 5-8). Also, for the "Update to Approved Case" and the "Future Projects Case" the initial pit lake water quality used for the transport calculations was the currently measured values for COPCs in the pit lake water. This is a conservative choice since the currently

measured COPCs in the pit lakes are larger than would be expected for the decommissioned state, as discussed in Section 5.1.2.3 below.

Sue E and Caribou EIS

Mass flux of COPCs to the pit lakes from submerged waste rock was calculated from the upward flow through the 2 m thick till caps that overly the waste rock. The mass of COPCs in the pit lake from submerged waste rock was given by the product of the initial pore water concentration in the waste rock and the ratio of the steady state flow rate upward through the till cap to the steady-state flow rate through the pit lake. The calculation did not take credit for the downward flow through the till cap into the waste rock.

The pore water concentration of the uppermost waste rock layer was used in the calculation of Sue C/A pit lake water quality. The analogous calculation for Sue E pit used an average waste rock pore water concentration (COGEMA 2004c, Appendix IX, Table 4.8).

Midwest EIS

The Midwest Project EIS prepared a detailed calculation of the effect of the submerged waste rock on pit lake water quality. A calculation of the Péclet number, as described above, gives a value of 5.5, using the parameters cited in the Midwest Project EIS (AREVA 2100b, Section 4.5.1). Therefore, an analysis of the effect of diffusion was carried out. Also, the large arsenic source term in the waste rock warranted a more detailed analysis.

The calculation is based on an analytical solution for the case of a mass of waste that is separated from a “mixing layer” by a barrier system of finite thickness. The solution was developed assuming that water infiltrates into the waste and mobilizes soluble COPCs released from the waste, while the resulting solute flux migrates through the barrier layer and into the mixing layer. Dispersion in the barrier was included, as the sum of mechanical dispersion and molecular diffusion. Migration from the source through the barrier was assumed to be governed by the one-dimensional advection and diffusion-dispersion equation, with the possibility of linear retardation and first order decay. The solution for the concentration in the mixing layer was expressed in closed form (from Guyonnet et al, 1998). This solution is discussed in more detail in Section 2.3 of Appendix IX of the Midwest Project EIS (AREVA 2011b).

Figure 4.6 of Appendix IX of the Midwest Project EIS presents predicted long-term concentrations in the Midwest pit lake as function of both the upward flow from the waste rock through the till cap and the value of the diffusion coefficient. The numerical model calculated that the upward flow from the waste rock through the till cap and into the Midwest pit was negligible; therefore, a maximum value of 1 m^3/day was used in the calculation. Assuming the pit lake acts as a full mixing layer, the predicted pit water quality for arsenic would range from approximately a few μg/L to 0.6 mg/L. However, based on Orano’s corporate experience at the Cluff Lake Project the assumption of full mixing is likely not valid for pit lakes. A more likely scenario is that a chemocline will form, resulting in meromictic state which would isolate contaminated water in the lower part of the water column in the pit.

5.1.2.3 Pit Lake Source Terms Used in the 2021 Analysis

In the “Update to Approved Case” (Scenario 1), the “Future Projects Case” (Scenario 3), and the “Fully Backfilled C/A Pit Case” (Scenario 4) the Sue C/A and Sue E pit lakes were integrated in the contaminant transport analysis.

There are two components to the pit lake source terms; one from the initial contaminant mass of COPCs in the pit lake, determined by the measured concentrations in the pit lake (Table 5-7) and one from the flow of COPCs up from the submerged waste rock and through the till cap.

The initial contaminant mass in the pit lakes was calculated by multiplying the volume of the pit lake and the current pit lake contaminant concentration (Table 5-7). The contaminant concentration in the pit lake decays according to the mass of contaminant and the flow through the pit lake.

The flux from the waste rock source was calculated from the flow rate up through the till cap from Table 5-8, the waste rock contaminant pore water concentration, and the waste rock contaminant decay rate. The flux from the waste rock source is much smaller than the flux from the pit lake source. The comparison is shown on Figure 5-2 below.

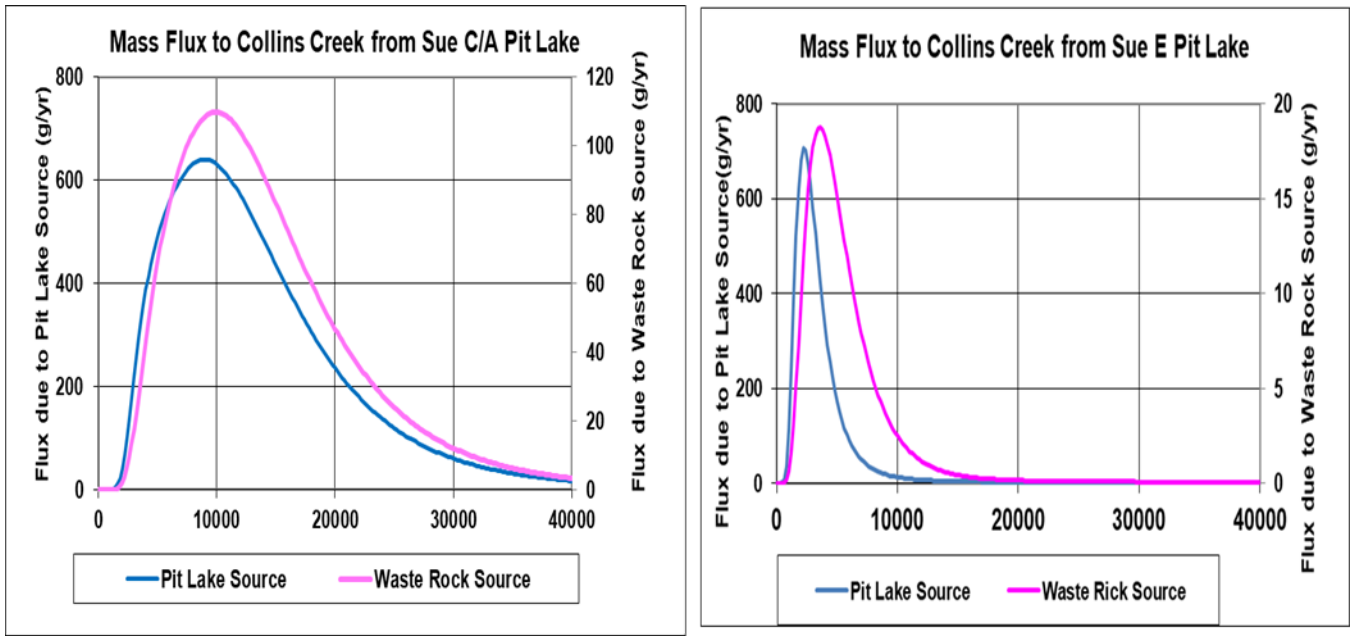


Figure 5-2: Comparison of Mass Flux from Pit Lake Source and Mass Flux from Waste Rock Source.

5.1.3 Waste Rock Stockpile Source Terms

The solids contents of the JEB, Sue C, and Sue E clean waste rock piles were assessed in Part A of this study in Appendices A-I.1, A-I.2, and A-I.5, respectively, and detailed calculations can be found in these appendices. For JEB, solids content data was available for arsenic, uranium, and lead. For Sue C and Sue E, solids content data was available for arsenic, nickel, uranium, and lead. Laboratory analysis was limited to these key COPCs and other COPCs (cobalt, copper, molybdenum, selenium, zinc, radium-226, lead-210, and thorium-230) were not analysed.

In earlier documents, pore water concentrations were developed for the Sue C stockpile using seepage results collected from the pile (COGEMA 2004b). For the 2013 study, pore water concentration predictions for each stockpile were updated using the average of the most recent samples collected from the piezometers in the JEB, Sue C, and Sue E stockpiles. For the 2021 Waste Rock TID, pore water concentration predictions were based on the most recent six samples from each sample location. Pore water source terms were assigned to each stockpile, as shown in Table 4-14 of Part A of the Waste Rock TID. A base case and an upper bound case were assessed. Details of the pore water assignment are given in Appendix AI.6. Pore water concentrations are not available for the Midwest clean waste rock stockpile.

The current analysis implements the stockpile source terms as constant flux boundary conditions, with a value given by the peak flux. This approach is consistent with that used in earlier analyses (COGEMA 2004b, Section 5; COGEMA 2004c, Appendix IX, Section 4; AREVA 2009a, Appendix VIIIB, Section 4).

Peak incremental mass flux, peak incremental concentration, and the resulting impact on surface water bodies are calculated in Appendix B-VII.

A more precise description of the stockpile source terms requires data for the leachable fraction of COPCs in an above ground environment. Humidity cell tests have been carried out to assess the release rates of JEB, Sue C, and Sue E clean waste rock (Minatco 1991); (COGEMA 2004c, Appendix VIII). These analyses provide an indication of the maximum loading resulting from the clean waste rock when stored in on-land stockpiles but do not establish a leachable fraction for the contaminants in the clean waste rock.

Figure 5-3 shows the arsenic flux to Collins Creek from the Sue E stockpile as a function of a hypothetical leachable fraction of 10% and 1%. The constant flux term with a non-decaying source is included for comparison. It illustrates that both the peak flux and the duration of contaminant release decline as the leachable fraction decreases. Therefore, the use of a constant flux boundary condition based on the peak fluxes provides an upper bound to the stockpile flux and provides a very conservative estimate of the impact of the stockpile contaminants. Ultimately more mass would be released than was contained in the stockpile.

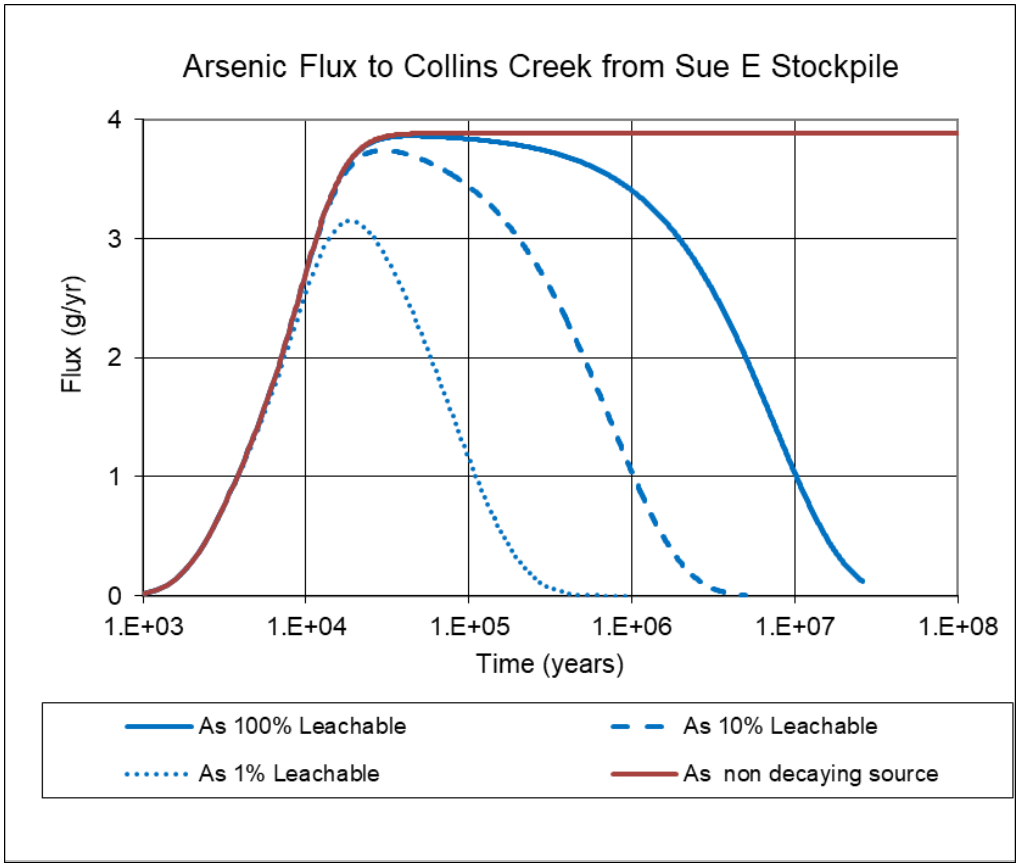


Figure 5-3: Arsenic Flux from Sue E Stockpile as a Function of Leachable Fraction

5.2 Groundwater Flow Rates

Groundwater flow simulations were performed under steady state conditions, as would exist following decommissioning. Groundwater flow rates were calculated for flow through the placed waste rock, the pit lakes and the clean waste stockpiles. In addition, the flow rates were calculated for flow through the till caps overlying the waste rock. The flow rates were calculated using the flux integration domain feature of the FEFLOW software. The calculated steady-state flow rates used in the contaminant transport analysis are tabulated in Table 5-8.

Table 5-8: Post-Decommissioning Groundwater Flow Rates

Simulation Case	Update to Approved Case	Future Projects Case	Fully Backfilled Sue C/A Pit Case	Midwest
Scenario	1	3	4	5
	Flow (m3/day)			
Sue C/A Pit				
lateral flow through pit lake	118	117	n/a	
lateral flow through waste rock	45.2	45.8	160	
flow down through till cap from pit lake	22.5	22.9	n/a	
flow up through till cap from waste rock	1.11	1.09	n/a	
Sue E Pit				
lateral flow through pit lake	154	154	171	
lateral flow through waste rock	4.99	4.92	5.4	
flow down through till cap from pit lake	0.88	0.89	1.0	
flow up through till cap from waste rock	0.07	0.07	0.07	
Sue B Pit				
flow through pit lake	146	146	154	
Midwest Pit				
lateral flow through pit lake				130
lateral flow through waste rock				56.7
flow down through till cap from pit lake				53.4
flow up through till cap from waste rock				0.0
Stockpiles				
flow through Sue C Stockpile	95.2	95.2	95.2	
flow through Sue E Stockpile	53.2	53.2	53.2	
flow through JEB Stockpile	53.6	53.6	53.6	
flow through Midwest Stockpile				

Table 5-8 indicates that both upward and downward flow through the till cap is possible. The upward flow occurs at the north end of the till cap. Downward flow occurs through the middle and south end of the till cap. Figure 5-4 illustrates the steady state solution for hydraulic head in layer 5 (bottom of till cap) and layer 6 (top of waste rock). The hydraulic head in the top of the waste rock at the north end of model is larger than the hydraulic head in the till cap. Therefore, upward flow will occur. Conversely, at the south end of the model, hydraulic head is lower at the top of the waste rock and downward flow will occur.

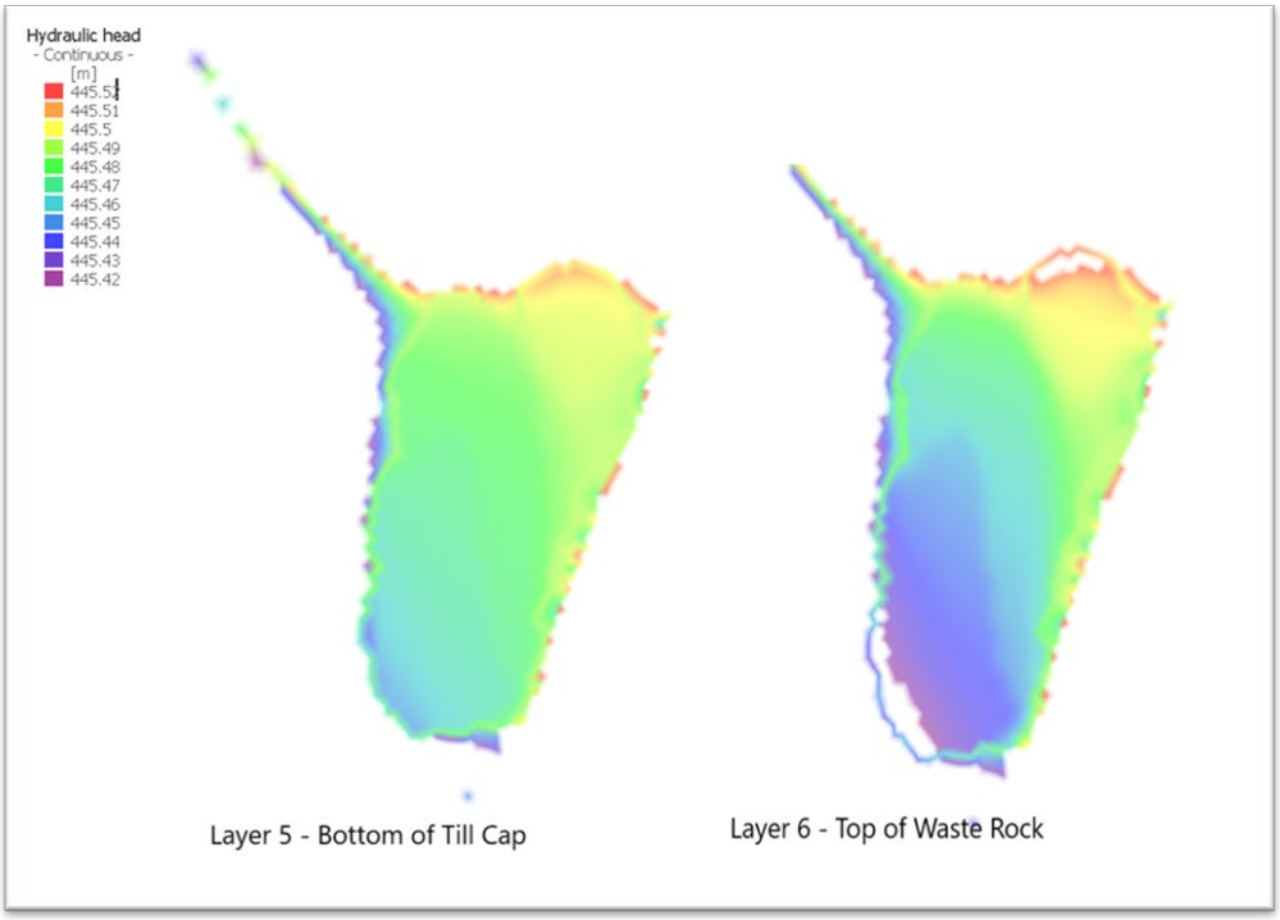


Figure 5-4: Hydraulic Head at the Bottom of the Till Cap and the Top of the Waste Rock.

5.3 Surface Water Flow Rates

Surface water flow rates are typically determined by monitoring the flow rate in the outflowing stream. Stream flow monitoring has been conducted since 1979, initially on Collins Creek, and then expanded to cover key streams and lakes in the watershed. The flow rate through some of the surface water receiving bodies were updated in the 2011 Groundwater Modelling TID (AREVA 2011c), to include the most recent data. The updated flow rates are given in Table 2.3-3 of the Groundwater Modelling TID and reproduced here in . Data sources are included in 8.

Table 5-9: Flow Rates through Surface Water Receptors

Stream	Daily Mean Flow (m^3/s) (1997 – 2011 Data)	Data Source
Collins Creek	1.58	Table 2.3-3 (AREVA 2011c)
Candy Lake	0.051	Table 2.3-3 (AREVA 2011c)
Bena Lake	0.0143	Table 2.3-7 (AREVA 2011c)
Telephone Lake	0.0492	Table 2.3-7 (AREVA 2011c)
Sharp Lake	0.0492	The value for Telephone Lake was used as an analogue. There is no discharge data available for Sharp Lake. This is assumed to be a conservative choice since Sharp Lake is a significantly deeper lake with a maximum depth of 19m versus 3.6m for Telephone Lake.
Moffat Lake	0.086	Table 2.3-7 (AREVA 2011c)
Vulture Lake	0.055	Table 2.3-3 (AREVA 2011c)
Fox Lake	0.184	Table 2.3-3 (AREVA 2011c)
Johannes Lake	0.188	Table 2.3-3 (AREVA 2011c)
Pat Lake	0.213	Table 2.3-7 (AREVA 2011c)

5.4 Pathline Analysis

Pathline analysis was carried out using the steady-state hydrostatic head regime calculated by the groundwater flow model. Particle pathline analysis is a technique which tracks the flow of contaminants within a system by tracking the paths followed by particles which originate at the contaminant source. The mass of COCs arriving at the surface water bodies over time is calculated, taking into account the groundwater flow velocity, dispersion, and attenuation along the flow pathway due to sorption behaviour and, when relevant, decay of the contaminant.

Pathlines were calculated for particles originating in the pit lakes, in the placed waste rock, and in the clean waste stockpiles. It is important to define a fairly large number of particles, usually several hundred, so that the combined pathline data defines a normal distribution. The pathline data is exported as a text file by the FEFLOW software and serves as an input to the contaminant transport analysis.

The particle pathline method is described in Section 2.3 of Appendix VIIIB of the Caribou EIS (AREVA 2009a).

5.5 Contaminant Transport Equations

Contaminant transport along each pathline is simulated using the analytical solution of the one-dimensional advection-dispersion equation. The solution was developed for a semi-infinite one-dimensional configuration to simulate transport of solutes involved in sequential first-order decay reactions (van Genuchten 1985). Various boundary conditions can be imposed, including concentration-type or flux type conditions and declining or pulse-type input functions. The solution can be generalized to include radioactive decay.

5.6 Input Parameters

Input parameters for solute transport calculations are summarized in Table 5-10 . The basis for parameter selection is discussed below.

Table 5-10: Contaminant Transport Solution Input Parameters

Parameter	Value
Travel Distance	Computed from the particle pathline data file • see Table 5-11
Effective Porosity	11% (COGEMA 1997)
Pore Water Velocity	Computed from the particle pathline data file • see Table 5-11
Longitudinal Dispersivity	10% of the flow path distance
Distribution Coefficient (K_d)	• 1 L/kg for As, Co, Cu, Mo, Ni, Pb, Se, Zn, U, Th • 3.8 L/kg for Ra-226
Radioactive Decay Constant	• Pb-210: 3.10×10^{-2} ($year^{-1}$) ($T_{1/2}$=22.3 years) • Po-210: 5.00×10^{-3} ($year^{-1}$) ($T_{1/2}$=138 years) • Ra-226: 4.28×10^{-4} ($year^{-1}$) ($T_{1/2}$=1620 years) • Th-230: 8.66×10^{-6} ($year^{-1}$) ($T_{1/2}=8 \times 10^4$ years)

5.6.1 Travel Distance

The travel distance (x) is calculated internally by the particle paths analysis algorithm. Each particle path has its own flow path length. Values averaged over all pathlines are output by the algorithm, for each surface water receptor. Table 5-11 gives the minimum, maximum, and mean path lengths for all contaminant pathways. The shortest mean pathway is the one followed by contaminants from Sue E pit lake to Sharp Lake. The longest is between Sue E waste rock and Collins Creek.

5.6.2 Pore Water Velocity

The pore water velocity is also calculated internally by the particle path analysis algorithm, using an effective porosity of 11%. The value of 11% is based on laboratory testing that was conducted on sandstone samples from the JEB site (COGEMA 1997, Table 12.2-5-1). Each particle path is associated with a distinct average groundwater velocity. A value averaged over all pathlines is output by the algorithm, for each of

the surface water receptors. Table 5-11 gives the minimum, maximum, and mean velocities for all contaminant pathways. The contaminant flow to Sharp Lake from Sue E pit lake is the fastest at 9 m/year, followed by the flow to Telephone Lake from the Sue C/A pit lake, with a mean velocity of 4 m/year. The contaminant flow from Sue E waste rock and Sue E pit lake is considerably slower, due to the barrier to flow presented by the low conductivity feature to the west of the Sue E pit. This contrasts with the fast pathway from Sue E pit lake to Sharp Lake which flows parallel to the same conductivity feature; the pathway has enhanced conductivity in the direction parallel to the feature.

Table 5-11: Distance and Velocity Distributions for Contaminant Pathways

		Receptor			
Source	**Units**	**Collins Creek (directly)**	**Telephone Lake**	**Bena Lake**	**Sharpe Lake**
Sue C/A Waste Rock					
Xmin	m	3449	2596	n/a	n/a
Xmax	m	10010	3585	n/a	n/a
Xmean	m	6058	2942	n/a	n/a
Vmin	m/year	<0.5	1	n/a	n/a
Vmax	m/year	2	4	n/a	n/a
Vmean	m/year	<1	3	n/a	n/a
Sue C/A Pit Lake					
Xmin	m	3438	2372	1303	n/a
Xmax	m	10050	3622	1613	n/a
Xmean	m	5281	2929	1446	n/a
Vmin	m/year	<0.5	2	4	n/a
Vmax	m/year	3	5	6	n/a
Vmean	m/year	<1	4	5	n/a
Sue E Waste Rock					
Xmin	m	8678	2156	n/a	n/a
Xmax	m	8889	2898	n/a	n/a
Xmean	m	8804	2439	n/a	n/a
Vmin	m/year	<0.5	<0.5	n/a	n/a
Vmax	m/year	<0.5	<0.5	n/a	n/a
Vmean	m/year	<0.5	<0.5	n/a	n/a
Sue E Pit Lake					
Xmin	m	n/a	1979	n/a	601
Xmax	m	n/a	2686	n/a	2629
Xmean	m	n/a	2344	n/a	1715
Vmin	m/year	n/a	<0.5	n/a	<0.5
Vmax	m/year	n/a	2	n/a	14
Vmean	m/year	n/a	1	n/a	11

5.6.3 Longitudinal Dispersivity

Dispersivity is generally recognized to increase with flow path distance. The value of 10% of the flow path, used in the current calculation, is based on literature review (Gelhar et al 1992). The literature results are based on tracer tests and observation of contaminant events.

5.6.4 Distribution Coefficient

Appendix B-IV contains a detailed analysis of the available data for distribution coefficients, the values used in earlier documents, and a literature survey has been conducted. Testing has been focused on obtaining distribution coefficients for arsenic, molybdenum, nickel, and radium-226 in sandstone. Considering that no new data for distribution coefficients has been collected since the 2004 Waste Rock TID, the current calculations will use the same values. The currently assessed values are based on the following considerations:

- distribution coefficients for sandstone and sand at the Cigar Lake, Key Lake, and Midwest sites range from 1 L/kg to 128 L/kg for arsenic;
- distribution coefficients for radium-226 were found to range from 3.8 L/kg to 128 L/kg for sandstone units within the Athabasca basin; and
- results specific to sandstone samples collected from the JEB site indicated a distribution coefficient of 50 L/kg for sorption of radium-226 onto altered sandstone.

Therefore, for the Sue and Midwest sites, distribution coefficients for trace metals were set to 1 L/kg (As, Co, Cu, Mo, Ni, Pb, Se, U, Zn). The distribution coefficient for radium-226 was set to 3.8 L/kg. Using the lowest value over the range of known values is considered to be conservative since it will result in the shortest breakthrough time.

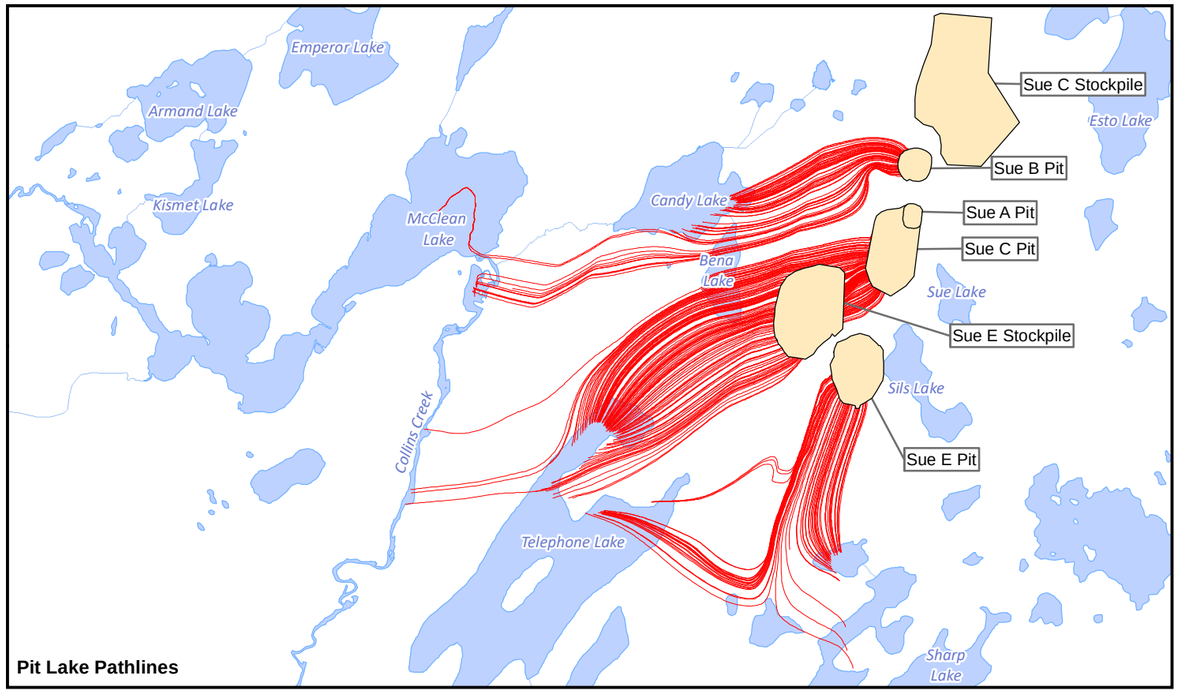
6 Surface Water Quality Predictions

The loadings of COPCs to surface water receptors, and the resulting surface water concentrations, are presented in this section. The assessment includes all the surface water bodies that may be affected by shallow and deep groundwater flow. Figure 6-1 illustrates all the contaminant pathways from placed waste rock, pit lakes, and surface stockpiles. The contaminant pathways follow the same pattern for all scenarios modelled, although the magnitude of the flows to individual surface water bodies varies between scenarios.

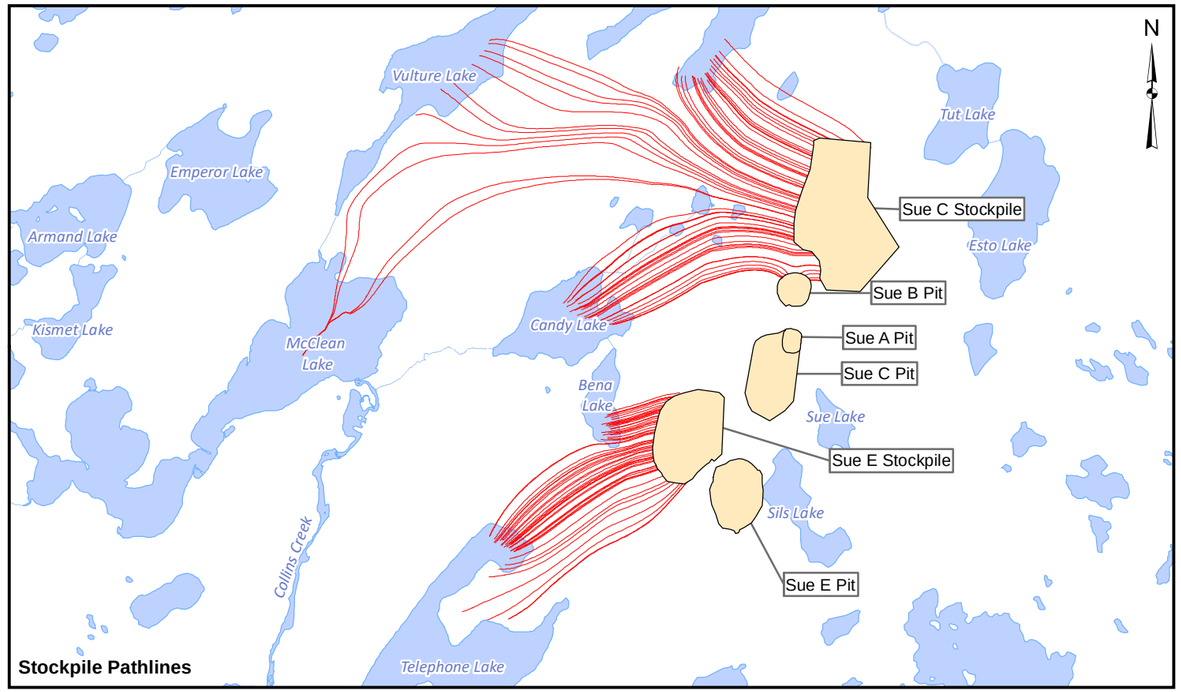
The water quality guidelines that apply to the receiving surface water bodies are shown in Table 6-1. The Canadian Council of Ministers of the Environment (CCME) objectives for some COPCs are currently represented as equations, as a function of hardness. The Saskatchewan Environmental Quality Guidelines (SEQG) for surface water values are defined over ranges of hardness.

The baseline values often have only one significant figure because they represent detection limits. The calculations of peak incremental flux and peak incremental concentration in the following tables are displayed with two significant figures. In cases where the incremental value changes the baseline value in the second significant figure, two significant figures are displayed.

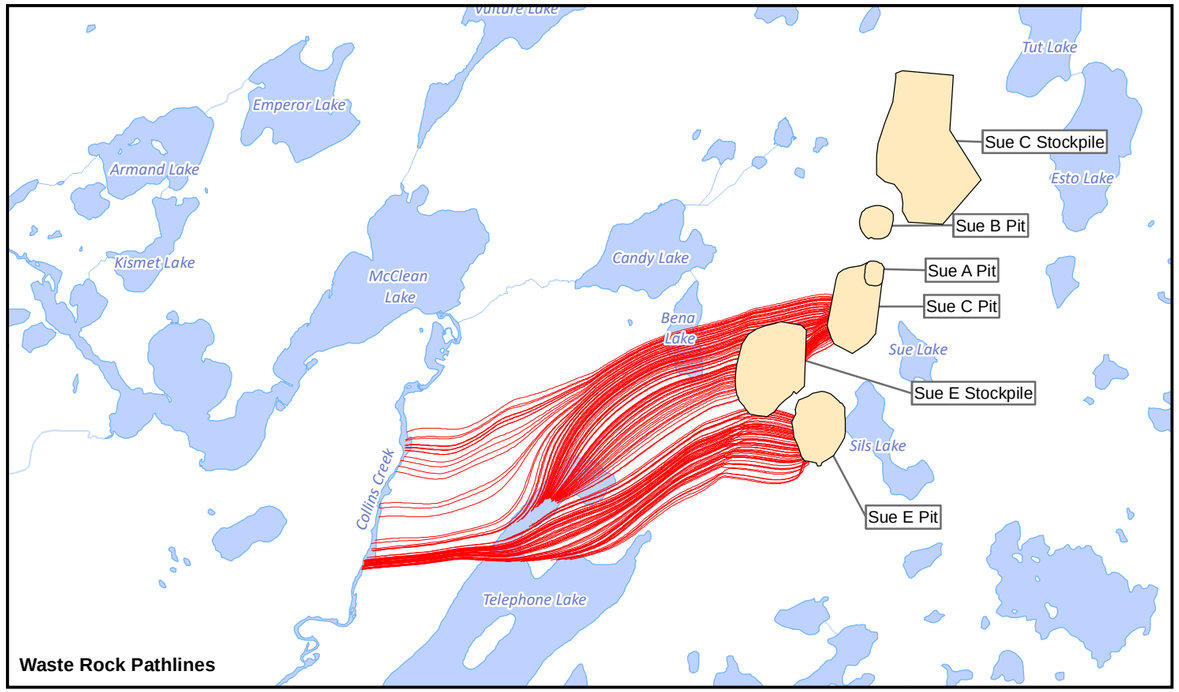
It should be noted that the surface water concentrations presented in this section represent a “dilution” concentration. No credit is taken for mechanisms that might possibly reduce the mass flux from the contaminant sources. For example, lake sediments can significantly reduce metal loadings. In the 2019 Cluff Hydrology and Groundwater Modelling TID (Orano 2019b) a review of site-specific testing, modelling, and literature demonstrated that the potential for arsenic attenuation in the lake sediments was very high, resulting in the selection of a base case value of 90% attenuation (Orano 2019b, Section 6.2.2.4).



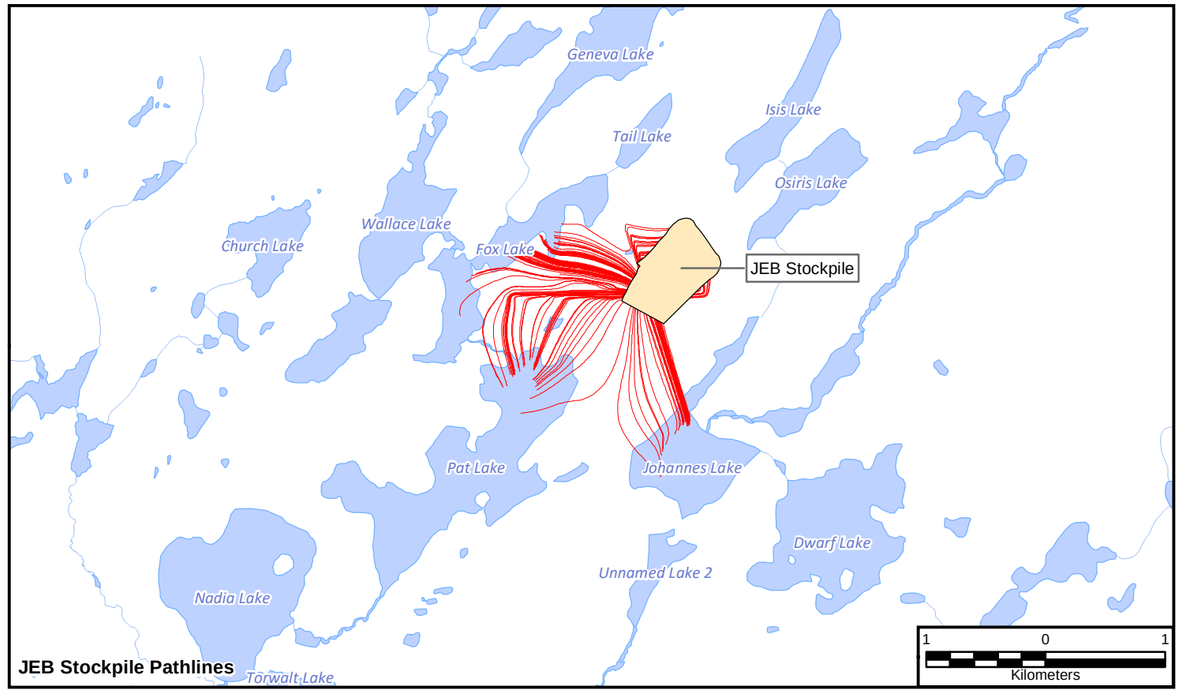
Pit Lake Pathlines



Stockpile Pathlines



Waste Rock Pathlines



JEB Stockpile Pathlines

Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 6/17/2021 Scale: 1:50,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 6-1
CONTAMINANT FLOW PATHWAYS

WASTE ROCK MANAGEMENT
TECHNICAL INFORMATION DOCUMENT

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Part B\Figure 6-1 Contaminant Flow Pathlines.mxd

Table 6-1: Applicable Water Quality Guidelines

Constituent of Concern	Saskatchewan Environmental Quality Guidelines (SEQG) for surface water (µg/L or Bq/L)	Canadian Council of Ministers of the Environment (CCME) (µg/L or Bq/L)
As	5	5
Cd	0.017-0.10(1)	$10^{\{0.86[\log(\text{hardness})]-3.2\}}$
Co	--	--
Cu	2-4(2)	$e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$
Mo	--	73
Ni	25-150(3)	$e^{\{0.76[\ln(\text{hardness})]+1.06\}}$
Pb	1-7(4)	$e^{\{1.273[\ln(\text{hardness})]-4.705\}}$
Se	1	1
U	15	15
V	--	--
Zn	30	30
^{226}Ra	--	--
^{210}Pb	--	--
^{210}Po	--	--
^{230}Th	--	--
Cl	--	120,000
SO_4	--	--
NH_3 / NH_4	1230(5)	1540(5)

(1) Cadmium Objective: 0.017 µg/L where hardness is 0-48.5 mg/L; 0.032 µg/L where hardness is 48.5 -97 mg/L; 0.058 µg/L where hardness is 97-194 mg/L; 0.10 µg/L where hardness is >194 mg/L.

(2) Copper Objective: 2 µg/L where hardness is 0-120 mg/L; 3 µg/L where hardness is 120-180 mg/L; 4 µg/L where hardness >180 mg/L.

(3) Nickel Objective: 25 µg/L where hardness is 0-60 mg/L; 65 µg/L where hardness is 60-120 mg/L; 110 µg/L where hardness 120-180 mg/L; 150 µg/L where hardness is >180 mg/L.

(4) Lead Objective: 1 µg/L where hardness is 0-60 mg/L; 2 µg/L where hardness is 60-120 mg/L; 4 µg/L where hardness 120-180 mg/L; 7 µg/L where hardness is >180 mg/L.

(5) At pH 7.5 and 20°C

6.1 Placed Waste Rock and Pit Lakes

6.1.1 Sue C/A and Sue E

Contaminants from the Sue C/A waste rock and the Sue E waste rock flow to Telephone Lake and Collins Creek. The breakthrough time for contaminants from Sue E waste rock is significantly longer than for Sue C/A waste rock. This effect is discussed in Section 6.3.2 below.

Contaminants from the Sue C/A pit lake also flow mainly to Telephone Lake and Collins Creek, with a smaller component of flow to Bena Lake.

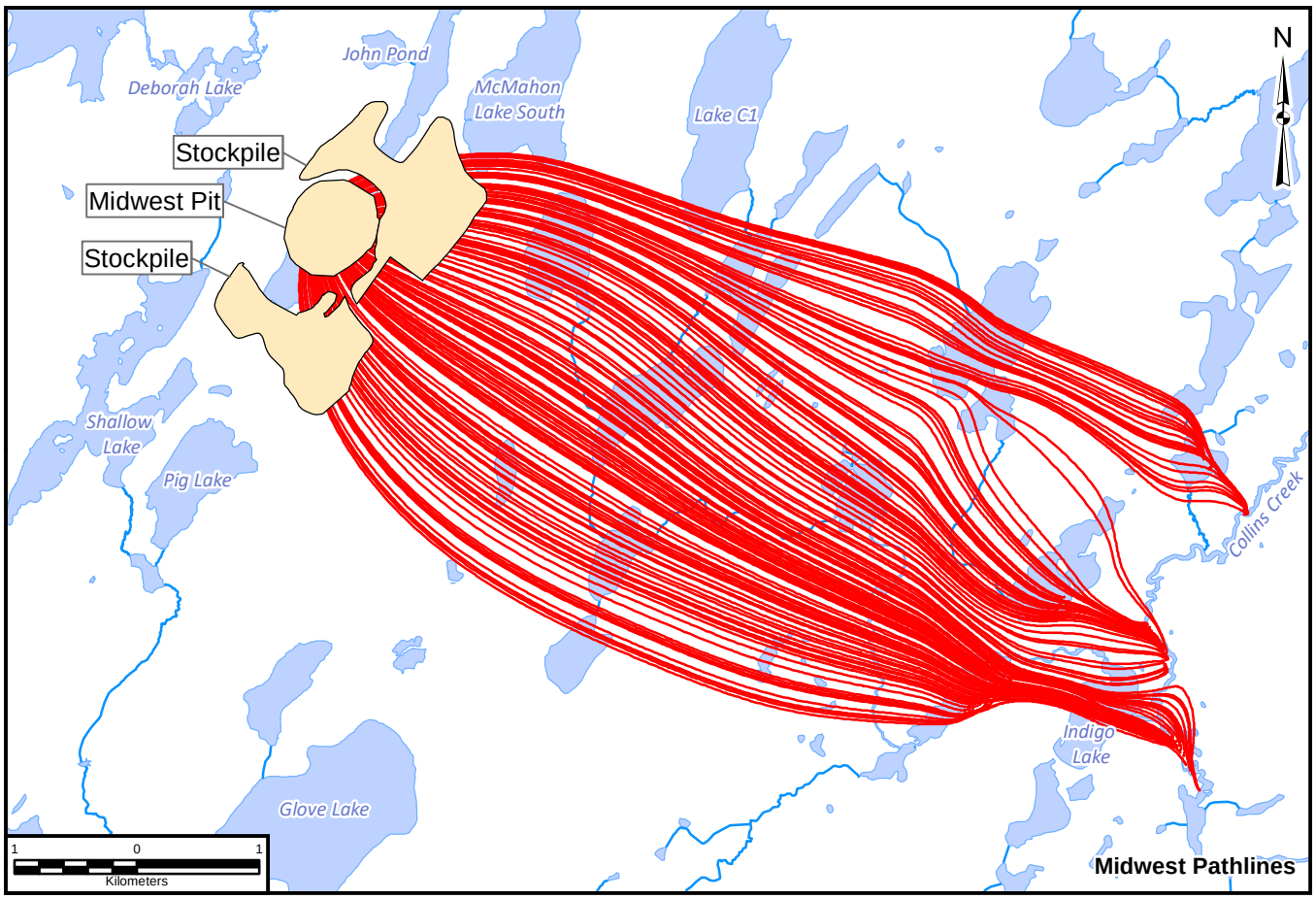
Contaminants in the Sue E pit lake follow a different path than those from the deeper waste rock, travelling both to Telephone Lake and Sharpe Lake. This flow pattern differs from that seen in earlier documents and is a result of the low conductivity feature running along the west side of the Sue E pit.

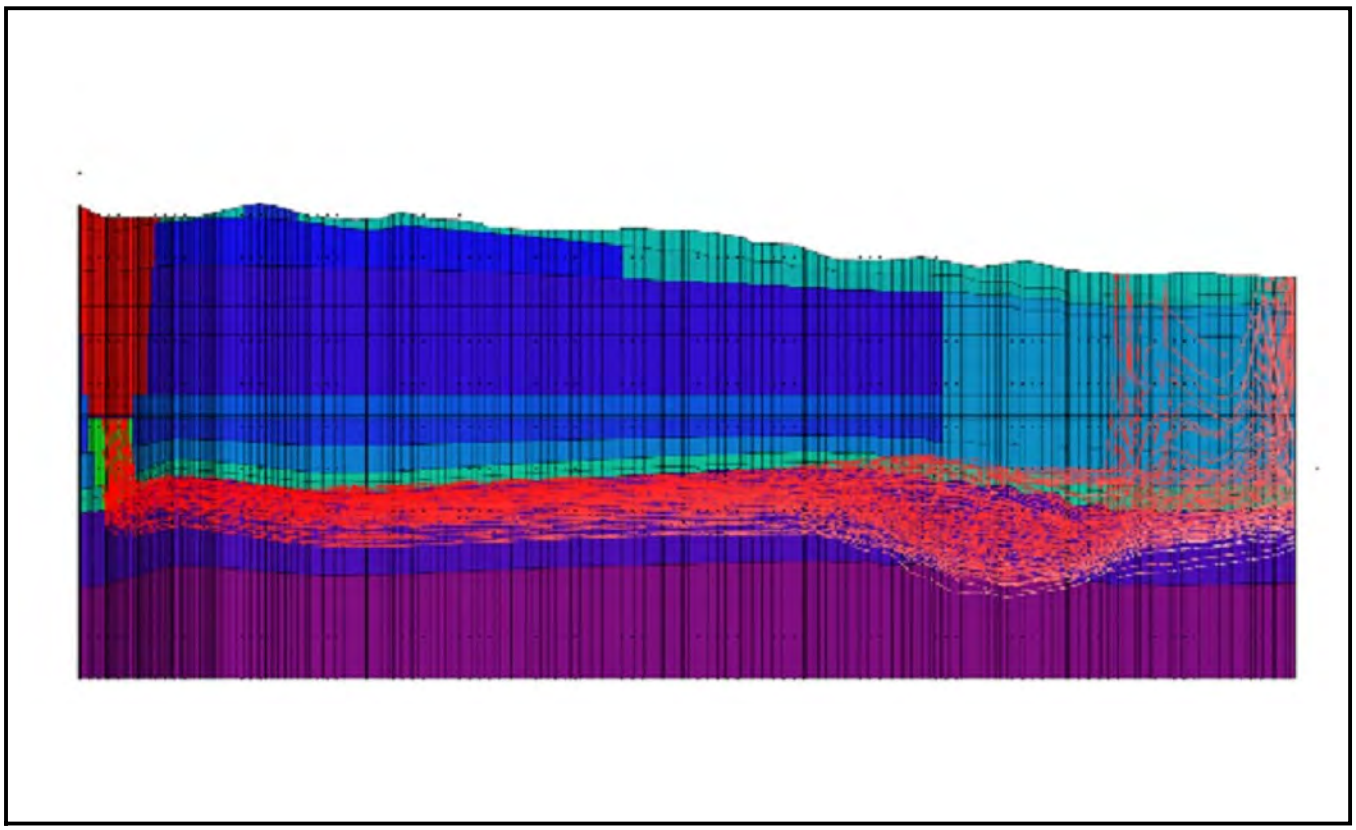
6.1.2 Sue B

In the decommissioned state Sue B pit will not contain waste rock. Therefore, there should be no contaminant plume travelling from Sue B due to submerged waste rock. Flow through the southern end Sue C clean waste rock stockpile intersects the Sue B pit lake, providing a contaminant source. Contaminant transport pathways from the Sue C clean waste rock stockpile which pass through Sue B pit lake are discussed in Section 6.1.4.

6.1.3 Midwest

Pathway analysis shows that for Midwest Case 3 contaminants originating from the placed waste rock in the Midwest pit discharge to Collins Creek over a distance of about 2 to 2.5 km, as illustrated in Figure 6-2. The figure also shows a cross-section of the area between the Midwest pit and Collins Creek. The contaminants travel through the basal conglomerate, which acts as a drain between the waste rock in the pit and Collins Creek. A small fraction of the contaminant flow does reach the surface in the unnamed lakes which drain into Collins Creek.





Projection: NAD 1983 UTM Zone 13N
Compiled: T.Lohman Drawn: T.Lohman
Date: 6/1/2021 Scale: 1:60,000
Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, ORANO Canada Inc.

McCLEAN LAKE OPERATION

FIGURE 6-2
FLOW PATH FOR CONTAMINANTS FROM THE MIDWEST PLACED WASTE ROCK (MIDWEST CASE 3)

WASTE ROCK MANAGEMENT
TECHNICAL INFORMATION DOCUMENT

orano

File: Q:\SHEQ\GIS\McCLEAN_LAKE\2021\WR TID\Maps\Part B\Figure 6-2 Flow Path for Contaminants from the Midwest Placed Waste Rock.mxd

6.1.4 Clean Waste Rock Stockpiles

The peak flux results for the clean waste rock stockpiles discussed in the following sections represent the peak flux from a stockpile contaminant source that is non-decaying and 100 percent leachable. In reality, the stockpile contaminant sources will decay over time and the inventory of COPCs leachable from the stockpile will represent some fraction of the total inventory.

6.1.4.1 JEB Stockpile

Contaminants from the JEB stockpile discharge to Pat Lake, Fox Lake, and Johannes Lake. The flow paths from the JEB stockpile are strongly impacted by a feature running north-south to the west of the stockpile, as shown on Figure 6-3. This feature has a low conductivity in the east-west direction and a high conductivity in the north-south direction.

The mass flux from the JEB area is not included in the cumulative effects analysis; however, the peak incremental mass flux to and peak incremental concentrations in Pat, Fox, and Johannes Lake, resulting from the JEB stockpile COPCs are given in Table1-1 of Appendix B-V. The measured contaminant levels in the JEB stockpile are low for all COPCs. The baseline concentrations and resulting total peak concentrations in receptors are also given in Table 1-2 of Appendix B-V. For all COPCs, the peak incremental concentrations are much smaller than the baseline concentrations, so there is a negligible impact on the surface water receptors.

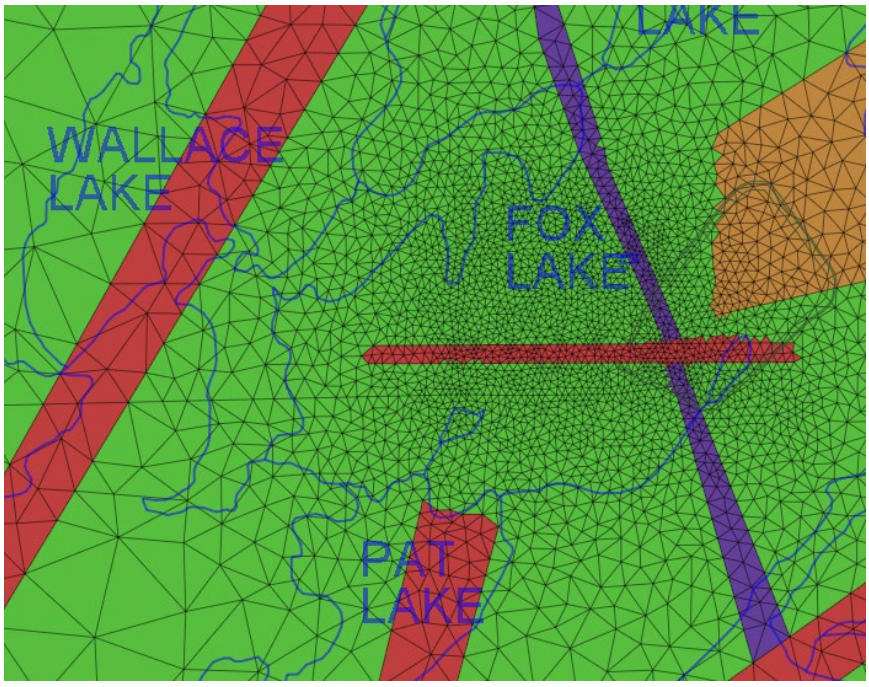


Figure 6-3: Conductivity Map Showing the High Conductivity Feature Adjacent to JEB Clean Waste Stockpile

6.1.4.2 Sue C Stockpile

Contaminants from the southern part of the Sue C clean waste stockpile discharge mainly to the Sue B pit lake and Candy Lake. Contaminants from the northern end of the stockpile discharge to Moffat Lake and Vulture Lake. A smaller portion of the contaminants are associated with longer travel paths and discharge to McClean Lake.

The most significant COPC sources in the Sue C stockpile are nickel and radium-226. The peak incremental flux of nickel from Sue C stockpile is 15 kg/year, most of which flows to Moffat Lake; Moffat Lake is not part of the Collins Creek watershed. There is a peak flux of 3.1kg/year to Candy Lake, 0.86 kg/year to the Sue B pit, 0.095 kg/year to Vulture Lake and 0.097 kg/year to McClean Lake, giving a combined flux of 4.2 kg/year to the Collins Creek watershed.

The peak incremental mass flux, peak incremental concentration, baseline concentrations, and resulting peak concentrations in the lakes affected by the Sue C stockpile are given in Table 1-3 and 1-4 of Appendix B-V. The incremental concentrations for nickel and radium-226 are large enough to impact the baseline water quality in Candy Lake and Moffat Lake. The peak mass fluxes are included in the cumulative effects discussed in Section 6.2.5.

6.1.4.3 Sue E Stockpile

Contaminants from the Sue E stockpile discharge to Bena Lake and Telephone Lake. The peak incremental mass flux to Telephone Lake and Bena Lake from the Sue E stockpile is given in Table 1-5 of Appendix B-V. The most significant sources in the Sue E stockpile are copper, nickel and radium-226. These mass fluxes are included in the cumulative effects discussed in Section 6.2.5.

6.2 Scenarios

Arsenic is considered most significant among the COPCs identified as potentially harmful to the environment. The quantity of arsenic present in the waste rock is significant. The estimated weighted solids content of arsenic in the Sue C/A pit for the "Future Projects Case" (Scenario 3) is 135 g/kg; for nickel it is 99 g/kg and for lead it is 72 g/kg (see Tables 4-11 and 4-12 of Part A). More importantly, arsenic is more leachable than the other COPCs and the leachable fraction is a function of the solid content of the waste rock. The leachable mass of arsenic estimated for the Sue C/A pit is 74 tonnes (Table 4-12 Part A), compared to 49 tonnes and 15 tonnes for nickel and lead, respectively (Table 1-11 of Appendix B-III).

Figure 6-4 shows modelled results for time-dependent incremental COPC concentrations profiles in Collins Creek for "Future Projects Case" (Scenario 3). The comparison of the relative concentration for each COPC (i.e. concentration of COPC/guideline value for COPC) illustrate why arsenic (even though significantly lower than the SEQG surface water value of 5 µg/L at peak concentration) is identified as more important than the other COPCs from a potential risk to the environment perspective. A relative concentration of a COPC >1 would signify a modelled concentration above the guideline for that COPC.

A full analysis was done for the arsenic source associated with waste rock managed at McClean Lake. Time-dependant incremental arsenic mass flux and arsenic concentration profiles were determined for each scenario. For the other COPCs peak values are reported.

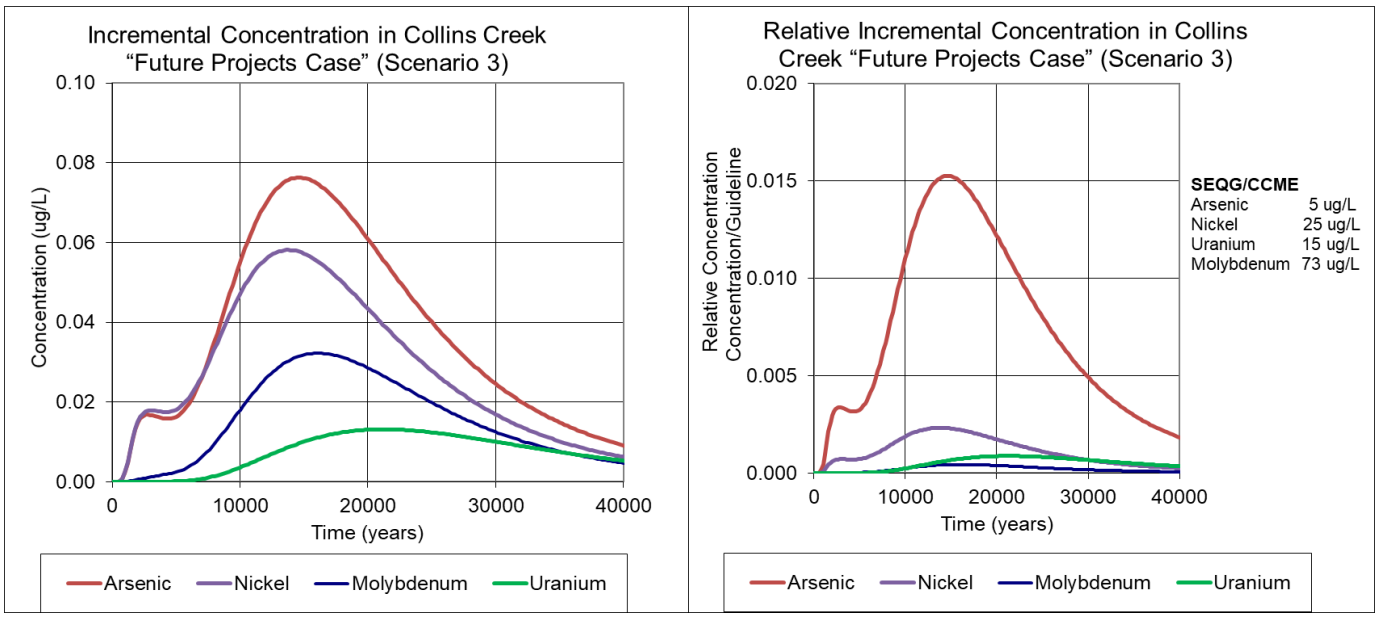


Figure 6-4: Contaminants of Potential Concern (COPC) Concentrations and Relative Concentrations for each COPC (i.e. Concentration of COPC/Guideline Value for COPC) in Collins Creek for the "Future Projects Case" (Scenario 3)

6.2.1 Update to Approved Case for Sue Pits (Scenario 1)

The “Update to Approved Case” analysis includes contributions from long-term modelling of the placed waste rock and the pit lakes. The waste rock stockpiles contributions were included as constant flux boundary conditions, as discussed in Section 6.1.4.

The “Update to Approved Case” includes changes to quantities, solids content, and initial pore water concentrations compared to the “Approved Case”. These changes are discussed in Section 3.1. The measured arsenic solids content for Sue B waste rock was smaller than the predicted value by about a factor of three. The impact of this change was to decrease the leachable inventory of Sue B waste rock in Sue E pit, and therefore the mean value for the leachable arsenic inventory in the Sue E pit.

In contrast the measured arsenic solids content and the as-mined quantity for the Sue A waste rock were both larger in the “Update to Approved Case”; the solids content was larger by about a factor of two and the as-mined quantity of waste rock was also larger by a factor of two. These two factors produced a mean arsenic inventory for the Sue C/A pit that was twice as large for the “Update to Approved Case” compared to the “Approved Case”. The effect of the updated Sue A and Sue E initial pore water concentrations was to decrease the mean pore water values for all COPCs except for nickel. Nickel had a slightly larger mean pore water concentration.

In the 2021 TID the “Update to Approved Case” was further refined. The volume and characterization of the Cigar Lake waste rock was changed. The volume of Cigar Lake waste rock was reduced by almost 40%. The arsenic content of the waste rock was about 13% smaller. The characterization of the McClean Underground waste rock in Sue E pit was redefined based on the 2013 McClean Underground waste rock study. As a result, the arsenic content in the McClean Underground waste rock in the Sue E pit was reduced from 2100 mg/kg to 40 mg/kg. The 2013 characterization of McClean Underground waste rock in the Sue E pit was based on single sample taken close to the ore body, resulting in unrealistically high contaminant concentrations.

Another difference in the “Update to Approved Case” simulation versus the “Approved Case” simulation resulted from the new regional groundwater flow model. The refined hydraulic conductivity description of the Sue area results in significantly different flow paths, particularly between the Sue E pit and the surface water receptors to the west. Also flow rates through the pits are reduced due to a low conductivity feature running to the east of Sue C/A pit and continuing on the west side of Sue E pit.

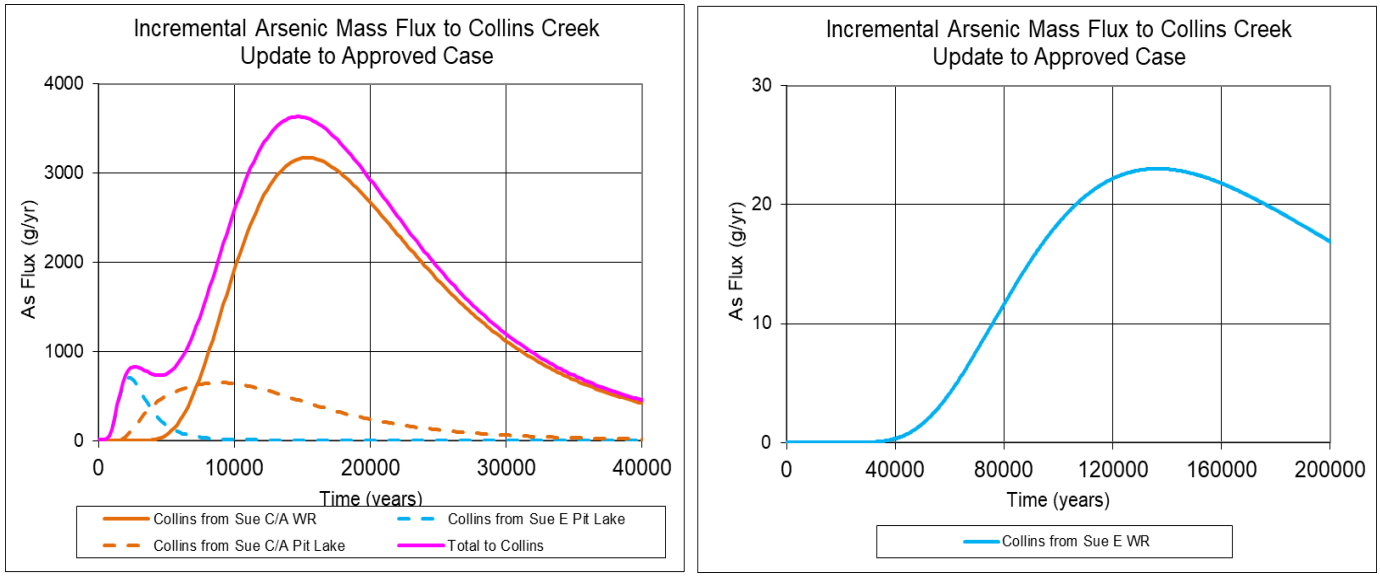


Figure 6-5: Arsenic Mass Flux to Collins Creek for the "Update to Approved Case" (Scenario 1)

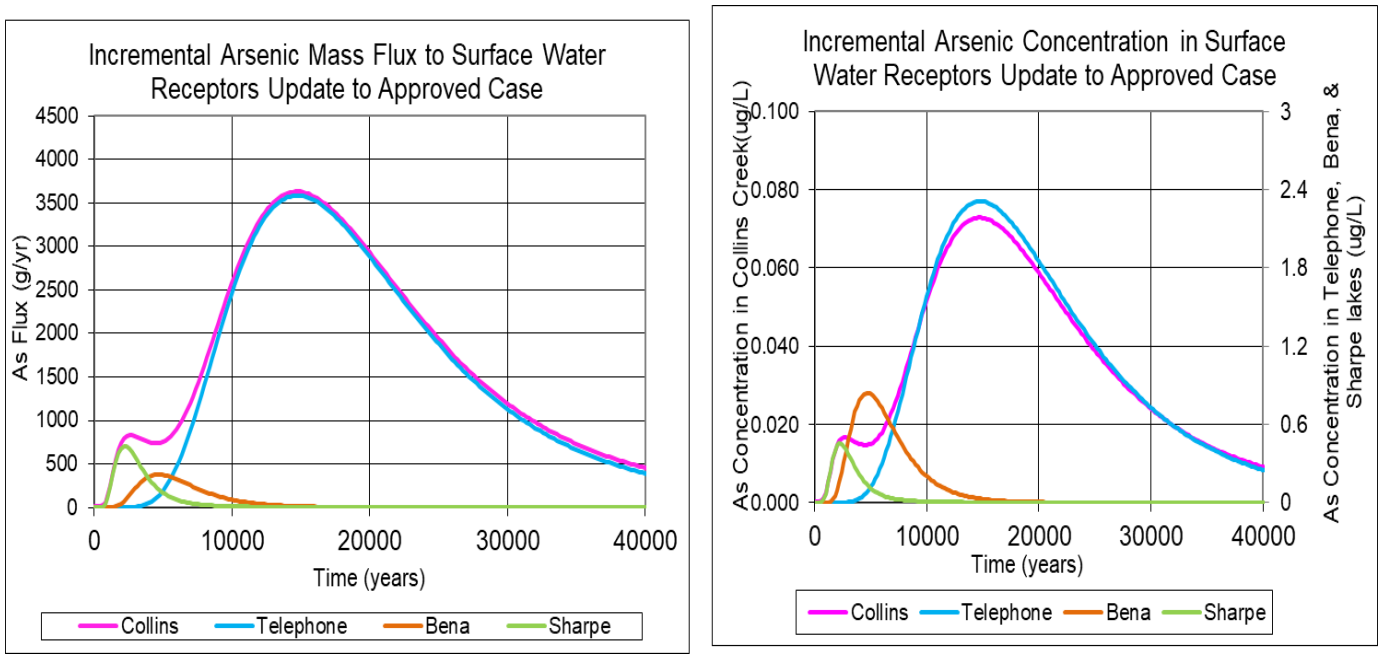


Figure 6-6: Arsenic Mass Flux and Concentration in Surface Water Receptors for the "Update to Approved Case" (Scenario 1)

The incremental arsenic mass flux and concentration are shown on Figure 6-5 and Figure 6-6. The most significant feature of the mass flux to Collins Creek is that breakthrough time for contaminants from Sue C/A waste rock and Sue E waste rock are quite different. The contaminant flux from the placed waste rock in Sue C/A pit peaks at about 15,000 years; the contaminant flux from the placed waste rock in the Sue E pit peaks much later, after more than 120,000 years. The conductivity feature running north-south just west of the Sue E pit is the reason that the contaminants from Sue E pit are delayed. This feature has low conductivity in the east-west direction and higher conductivity in the north-south direction. The mean velocities shown in Table 5-8 demonstrate the difference between contaminants originating from Sue E and those originating from Sue C/A and flowing towards Telephone Lake. The contaminants from Sue E waste rock and Sue E pit lake flowing to Telephone Lake have mean velocities that are smaller by a factor of four for the pit lakes and ten for the waste rock. Contaminants flowing towards Sharpe Lake, on pathlines parallel to the low conductivity feature have a mean velocity that is ten times as large as those flowing towards Telephone Lake in the low conductivity direction.

The impact of the 2021 changes can be seen in Figure 6-5 and 6-6. The peak mass flux to Collins Creek is about 14% lower than predicted by the 2013 TID. The peak mass flux to Sharpe Lake is lower due the lower leachable arsenic inventory in Sue E pit; 7 tonnes versus 40 tonnes in the 2013 TID analysis.

6.2.2 Future Projects Case for Sue Pits (Scenario 3)

The “Future Projects Case” analysis includes contributions from long-term modelling of the placed waste rock and the pit lakes. The waste rock stockpiles contributions were included as constant flux boundary conditions, as discussed in Section 6.1.4.

The “Future Projects Case” includes the same changes to quantities, solids content and initial pore water concentrations discussed in Section 6.2.1 for the “Update to Approved Case”. In addition, waste rock quantities were updated to reflect changes in mining methods and waste rock placement. Table 5-5 and Table 5-6 compare the source term parameters for the 2013 and 2021 “Future Projects Case” to those used in the Caribou EIS, the approved assessment case (AREVA 2009a).

For the Sue C/A pit the following differences with respect to the “Update to Approved Case” were noted:

- the mass of placed waste rock increased by about 300,000 tonnes (volume of 125,000 bcm)
    - due to the replacement of the open pit Caribou mining plan by an underground mining plan that included waste rock from the Sue D, Caribou, and McClean deposits
- the 2021 TID used the arsenic solid content data from samples that also had leachable fraction data
    - resulted in a leachable mass of arsenic from Caribou/ McClean Underground /Sue D that was twice that of the “Update to Approved Case”
    - the overall leachable arsenic in the Sue C/A pit was 5% higher

For the Sue E pit the following differences were noted:

- the mass of placed waste rock decreased by about 190,000 tonnes (volume of 80,000 bcm) due to the removal of the McClean Underground waste rock

Figure 6-7 and Figure 6-8 show the incremental arsenic mass flux and concentration results for the Future Projects (Scenario 3) Base Case. The incremental arsenic mass flux to Collins Creek from Sue C/A pit is about 5% larger at its peak (about 15,000 years) than for the “Update to Approved Case”, due to the larger arsenic inventory in Sue C/A pit, as noted above. The arsenic inventory in Sue E pit is similar and there is no discernible difference in the peaks produced.

The peak incremental mass flux to Collins Creek is about 3.8 kg/year, with the main contribution coming from the special waste rock placed in the Sue C/A pit. The incremental concentration in Collins Creek is 0.077 μg/L, occurring at about 15,000 years. The largest impact is on Telephone Lake, where the peak incremental concentration is 2.4 μg/L. The arsenic concentration in Bena Lake has an early peak at about 5,000 years due to contributions from the Sue C/A pit lake contaminants.

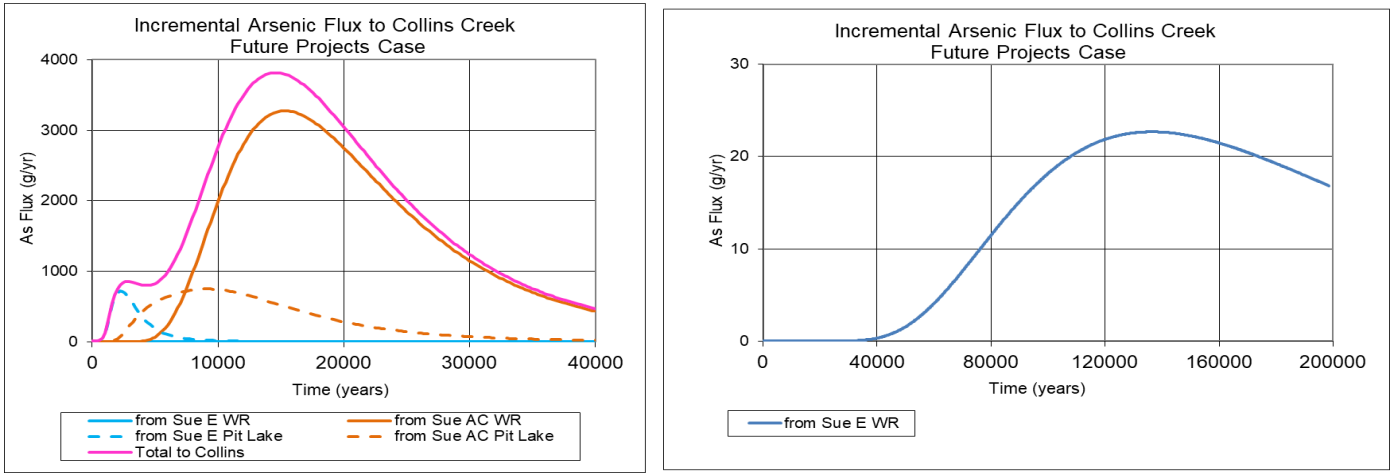


Figure 6-7: Arsenic Mass Flux to Collins Creek – Future Projects Base Case

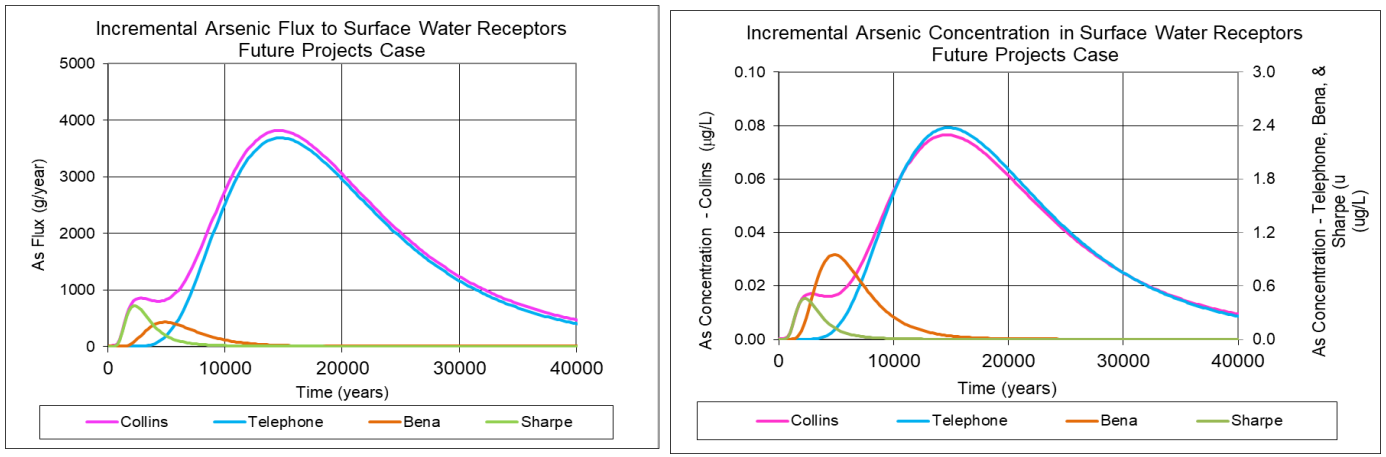


Figure 6-8: Arsenic Mass Flux and Concentration in Surface Water Receptors – Future Projects Base Case

6.2.3 Operational Process Waste in Sue C/A Pit (Scenario 3A)

The possible future placement of operational process wastes that are temporarily stored in the CX pond as well as on the JEB and Sure ore pads has been considered. The effect of storing these wastes in the Sue C/A pit is included as a sub-case to the Future Projects case defined as Scenario 3A. Measured quantities, solid content and inventory of all operational waste placed in the Sue C/A Contaminated Landfill are shown in Table 5-1.

The mass flux and concentrations resulting from the Sue C/A pit with operational waste in the pit are shown on Figure 6-. Adding operational waste to the Sue C/A pit increases the peak incremental mass flux to and dilution concentration in Collins Creek and Telephone Lake by 25 percent. The concentration in Collins Creek and Telephone Lake does not exceed the Saskatchewan Environmental Quality Guideline (SEQG) for surface water arsenic concentration of 5 ug/L.

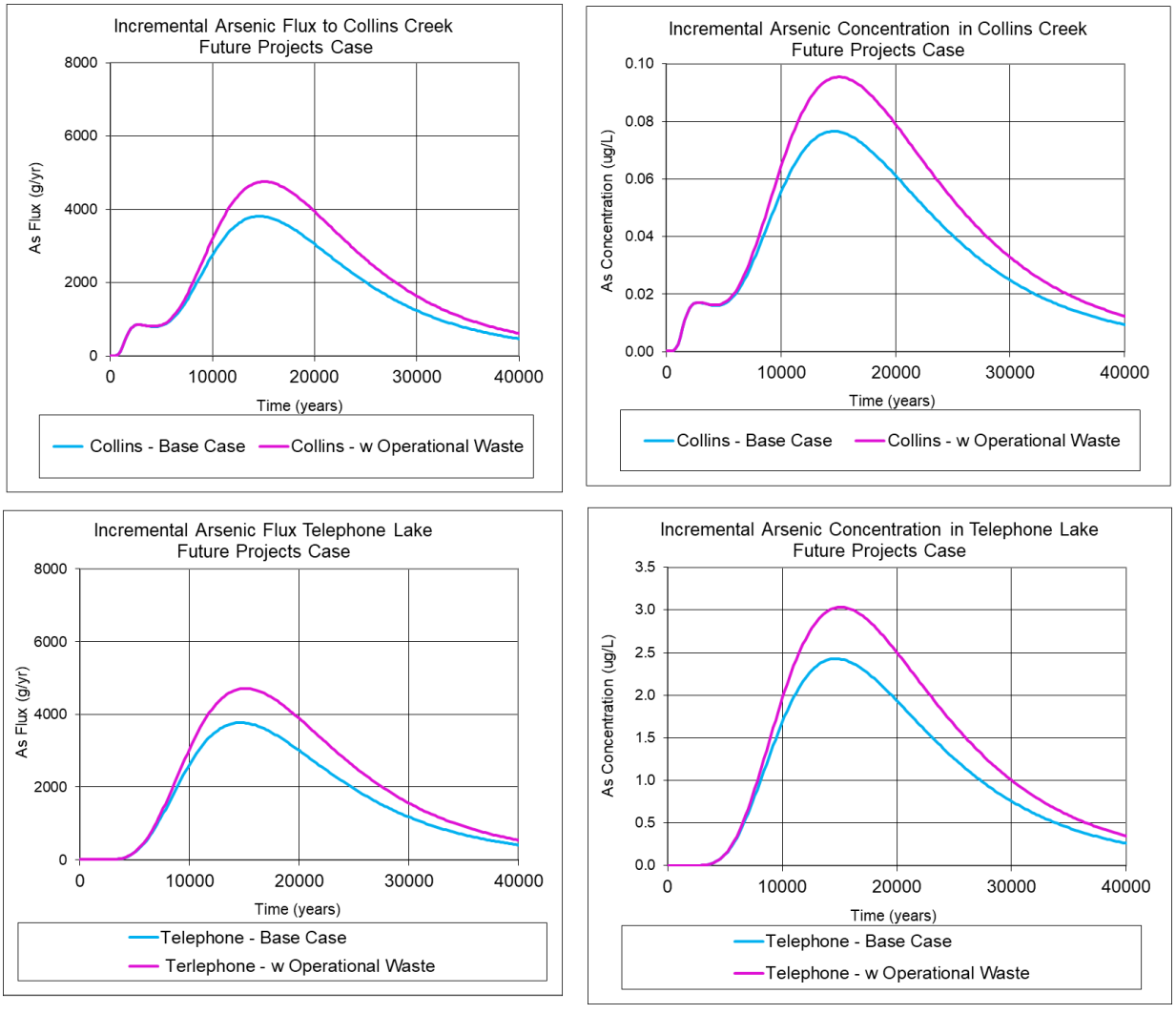


Figure 6-9: Impact of Placing Operational Process Waste in Sue C/A Pit

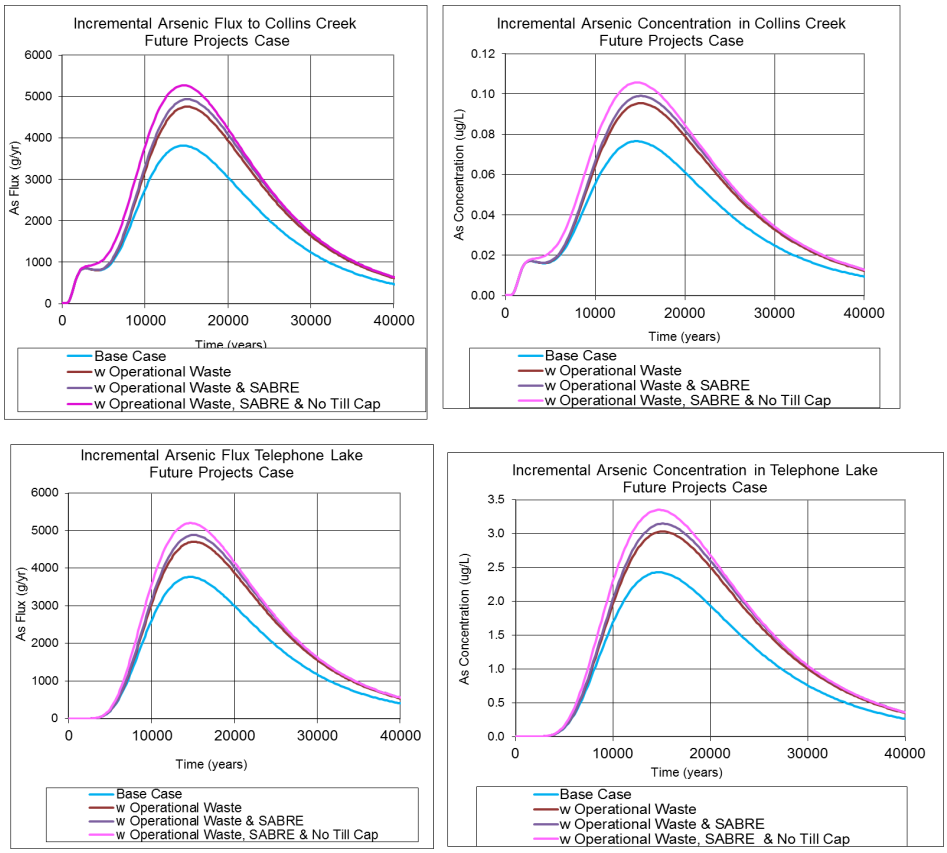
6.2.4 Operational Waste and Midwest SABRE Waste Rock in Sue C/A Pit Without Till Cap (Scenario 3B)

The properties used in the development of the source term for Scenario 3B are shown in Table 5-2. The mass flux and concentrations resulting from the Sue C/A pit with operational waste and Midwest SABRE waste rock deposited in the pit are shown on

Figure 6-. The figure illustrates the incremental effect of first adding operational waste, then SABRE waste rock, and finally the effect of no cover/till cap on the surface of the waste rock. The addition of operational waste has the largest impact.

Adding the SABRE waste rock to the Sue C/A pit increases the peak incremental mass flux to and dilution concentration in Collins Creek and Telephone Lake by 4 percent. Removing the requirement for a till cap further increases the peak incremental mass flux to and dilution concentration in Collins Creek by 7 percent and to Telephone Lake by 6 percent.

The concentration in Collins Creek and Telephone Lake does not exceed the SEQG for surface water arsenic concentration of 5 ug/L.



Base Case (Scenario 3 Base case); w Operational Waste (Scenario 3A); w Operational Waste, SABRE & No Till Cap (Scenario 3B);

Figure 6-10: Impact of Placing Operational Process Waste and Midwest SABRE Special Waste Rock in Sue C/A pit Without Till Cap

6.2.5 Pit Lake Water Treated (Scenario 3C)

The mass flux and concentrations resulting from the Sue C/A pit with operational process waste and Midwest SABRE waste rock deposited in the pit, but with both the Sue C/A and Sue E pit lake arsenic concentration remediated to the SEQG level, are shown on Figure 6-11

Remediating the Sue C/A and Sue E pit lake water decreases the mass flux and concentration in in Collins Creek and Telephone Lake by 8.5 and 8.2 percent, respectively. In addition, the early peak in mass flux to and concentration in Collins Creek, due to transport from the Sue C/A and Sue E pit lakes, is absent.

The impact of remediating Sue B pit lake water is also shown on Figure 6-11. The concentration in Collins Creek due to Sub B pit lake is small. Remediating the pit lake water reduces it by approximately 80 percent.

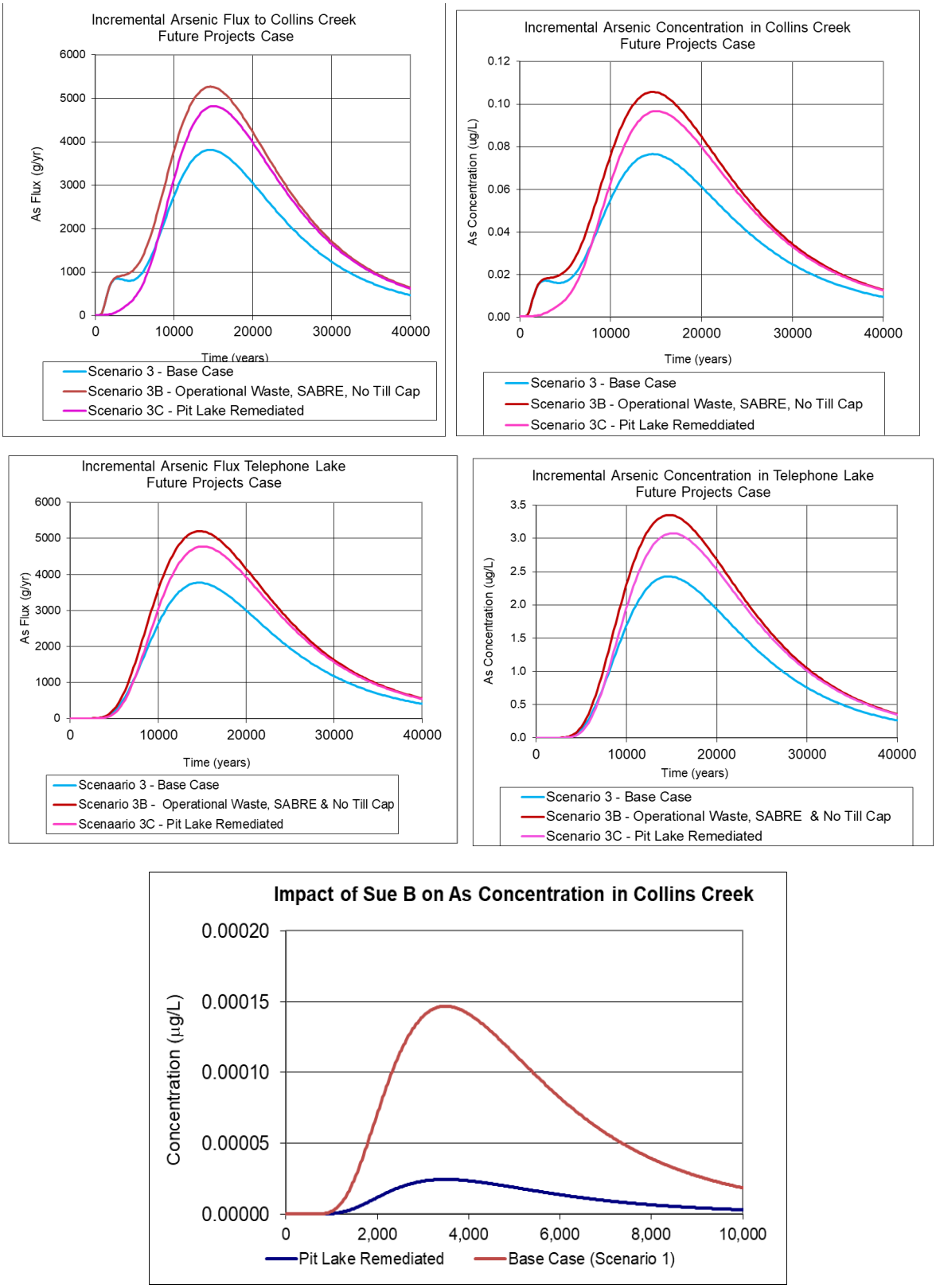


Figure 6-11: Impact of Treating Pit Lake Water

6.2.6 Fully Backfilled Sue C/A Pit (Scenario 4)

The “Fully Backfilled Sue C/A Case” analysis is identical to that for “Future Projects Case” analysis except that an additional $8.8x10^6$ tonnes of waste rock is to be placed in the Sue C/A pit to bring the surface elevation of the waste rock up to 453 mASL. The value of 453 mASL was used for the fully backfilled case in the Sue E EIS (COGEMA 2004c, Appendix IX, Table 4.1(b)). The additional waste rock has been given the weighted average properties of the combined JEB, Sue C, Sue E clean waste rock, as shown in Table 5-3. compares the incremental arsenic flux to and concentration in Telephone Lake and Collins Creek for the “Update to Approved Case”, the “Future Projects Case”, and the “Fully Backfilled Sue C/A Pit Case”. The “Fully Backfilled Sue C/A Pit Case” shows an earlier peak and a 25 percent increase in incremental flux and concentration. This is because the groundwater flow through the waste rock in Sue C/A pit is larger (Table 5-8) in Scenario 4B (“Fully Backfilled Sue C/A Pit Case”), resulting in a higher and earlier peak. The concentration in Collins Creek and Telephone Lake does not exceed the SEQG for surface water arsenic concentration of 5 ug/L.

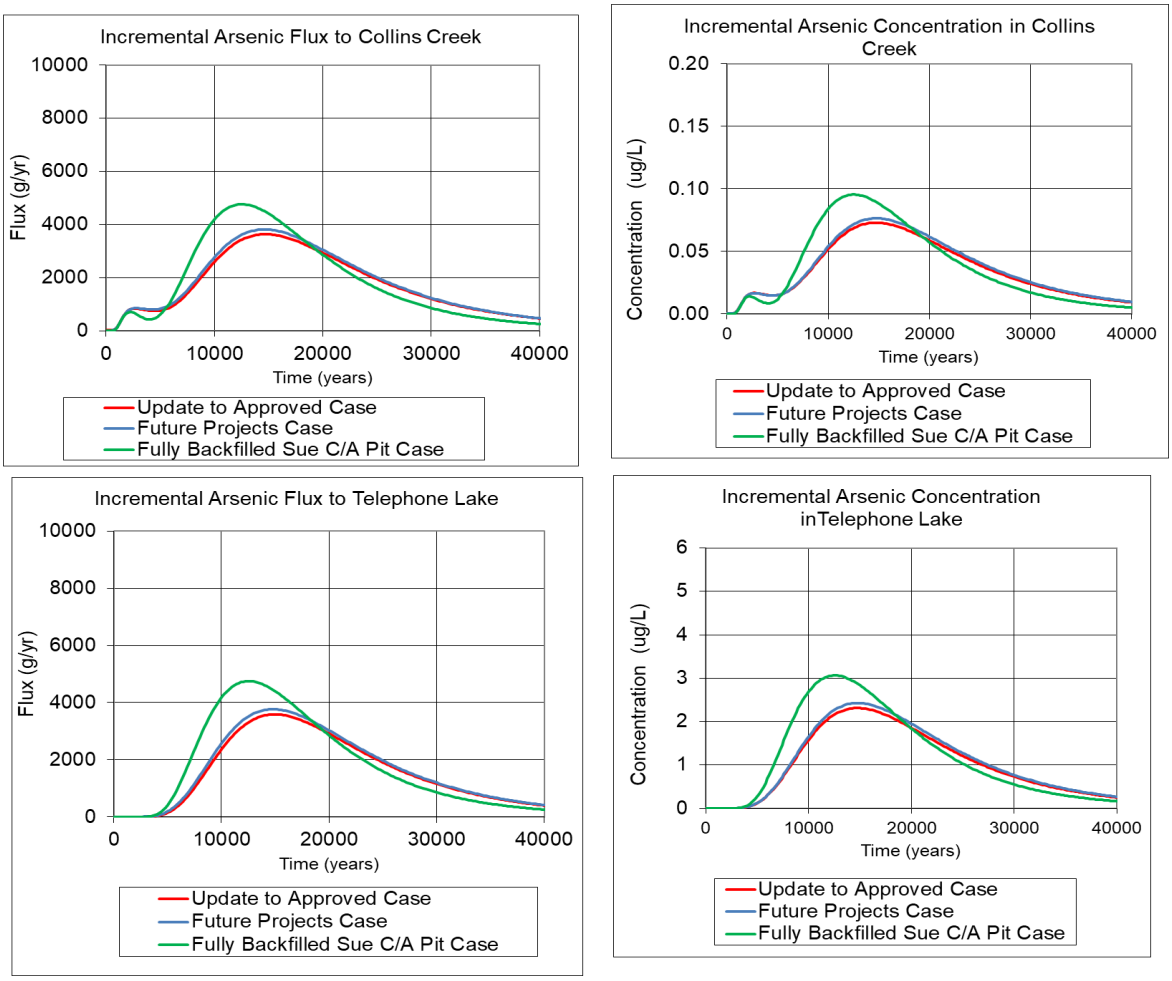


Figure 6-12: Comparison of Fully Backfilled Case to Update to Approved and Future Projects Cases

6.2.7 Midwest (Scenario 5)

The Midwest analysis involves the contaminant transport from the waste rock placed in the Midwest pit to surface water receptors. In the Midwest EIS (AREVA 2011b) three cases were analysed. Only Case 3 is included in this document. In Case 3 all contaminants from the placed waste rock are transported to Collins Creek.

A fraction of the contaminant flow does reach the surface in two unnamed lakes which flow into Collins Creek. The mass flux split between these lakes and Collins Creek is shown on Figure 6-13. The mass flux to the lakes is included in the total mass flux to Collins Creek.

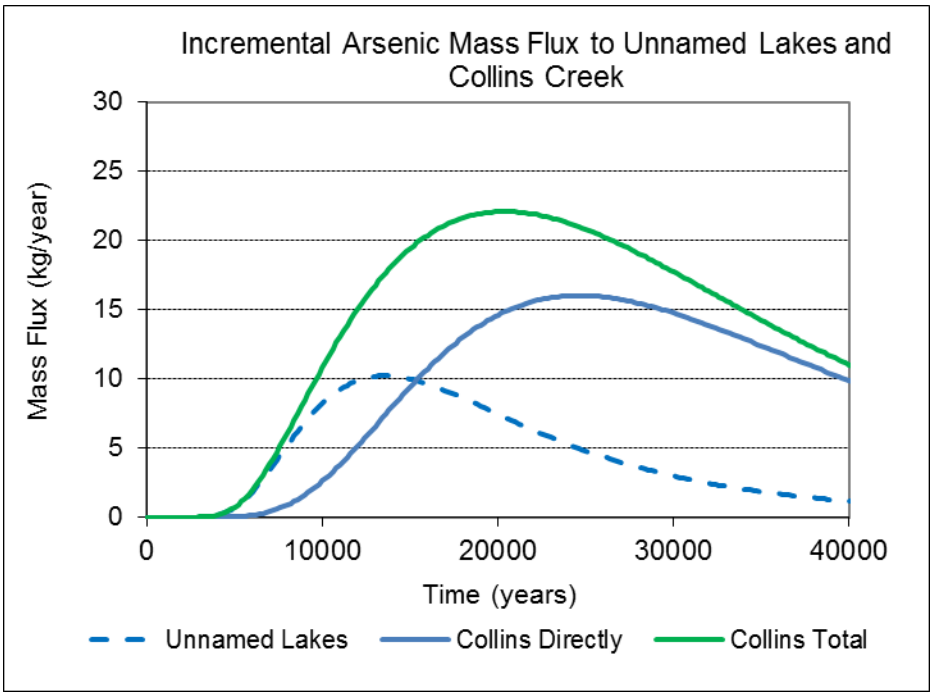


Figure 6-13: Mass Flux from Midwest Waste Rock Split Between Unnamed Lakes and Collins Creek.

The incremental arsenic mass flux and incremental concentration in Collins Creek are shown on Figure 6-14 and Figure 6-15. Both the incremental arsenic mass flux and the incremental arsenic concentration are significantly larger than the comparable effects from the decommissioned Sue area pits

Comparing and Table 4-12 of Part A clearly shows that the Midwest waste rock is much more problematic than any waste rock placed in the Sue area pits. The arsenic inventory is ten times larger and the initial pore water concentration twenty times larger than for the “Future Projects Case”. Large increases are also seen for cobalt, copper, lead, uranium, and zinc.

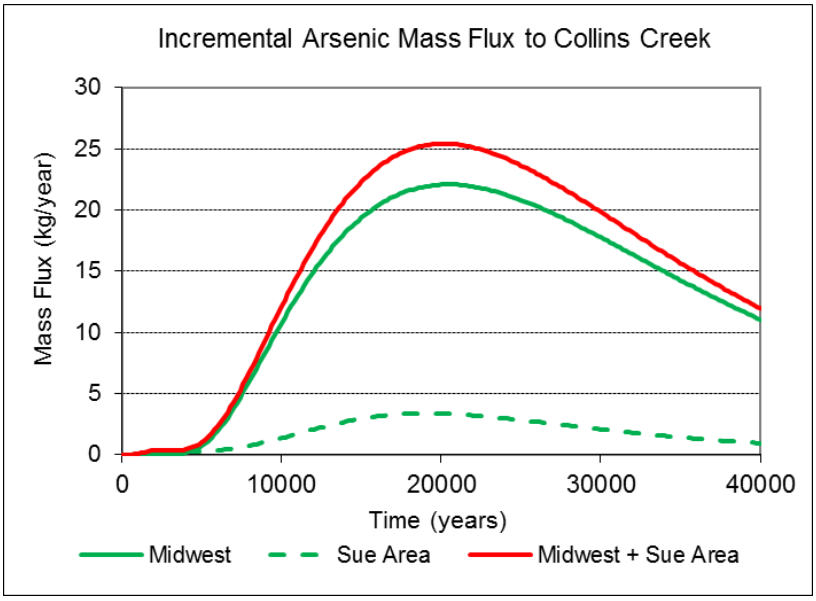


Figure 6-14: Cumulative Incremental Arsenic Mass Flux to Collins Creek

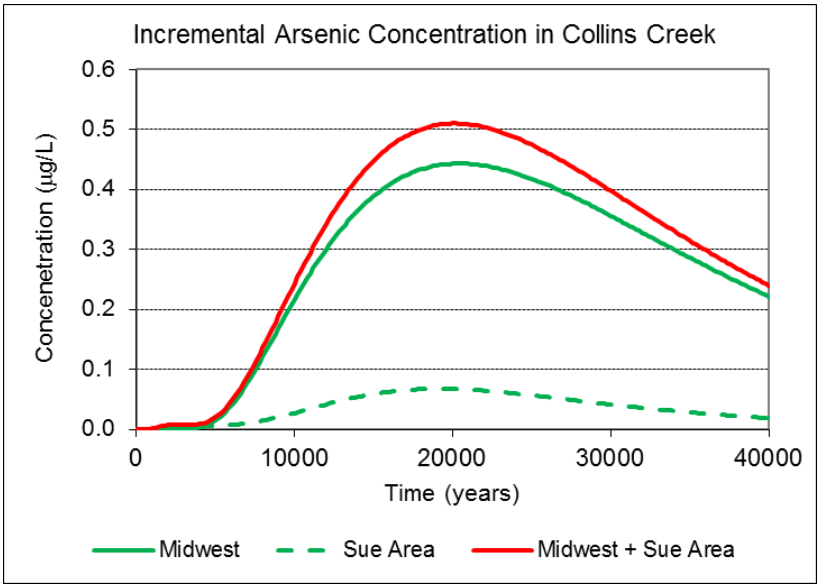


Figure 6-15: Cumulative Incremental Arsenic Concentration in Collins Creek

6.2.8 Cumulative Effects

The peak incremental flux and the peak incremental concentration in surface water receptors for all COPCs are given in Table 6-2. These results are for the “Future Projects Case” which is considered to be the new base case.

Table 6-3 gives the baseline concentrations and resulting peak concentrations for Bena, Sharpe, and Telephones Lakes as well as Collins Creek, which is the ultimate receptor. The mass flux to Collins Creek includes the flux from all upstream surface receptors as well as the mass flux that flows directly to Collins Creek. The direct flow to Collins Creek is small compared to the mass flux flowing to the lakes.

Baseline concentrations for Sharpe Lake are based on the average of measurements taken at station WQ21E since 2003.

The cumulative effects analysis indicates that SEQG for surface water have been met for all COPCs.

Table 6-2: Peak Incremental Flux and Peak Incremental Concentration in Surface Water Receptors

COPC	Incremental Mass Flux (g/year or Bq/year)				Incremental Concentration (ug/L or Bq/L)			
	Bena Lake	Sharpe Lake	Telephone Lake	Collins Creek	Bena Lake	Sharpe Lake	Telephone Lake	Collins Creek
As	429	718	3687	3815	0.95	0.46	2.4	0.077
Cd	2.3	0.02	5.1	14	0.0052	0.00001	0.0033	0.00029
Co	80	3	381	597	0.18	0.0021	0.25	0.012
Cu	44	1	119	245	0.10	0.00053	0.08	0.005
Mo	81	24	938	949	0.18	0.02	0.60	0.019
Ni	794	797	4557	6287	1.8	0.51	2.9	0.13
Pb	1.0	1	17	26	0.0021	0.0005	0.010	0.0005
Se	0.9	0.2	61	142	0.0021	0.0001	0.04	0.003
U	2	0	118	129	0.01	0.0003	0.08	0.003
V	1.3	1	12	14	0.0029	0.0009	0.01	0.0003
Zn	94	5	254	560	0.21	0.0035	0.16	0.011
^{226}Ra	4.0E+06	2.7E+05	6.9E+06	1.4E+07	8.8E+03	1.8E+04	4.5e+03	2.8E+04
^{210}Pb	3.7E+05	4.2E+04	6.1E+05	1.4E+06	8.2E+04	3.0E+05	3.9E+04	3.0E+05
^{210}Po								
^{230}Th	1.2E+05	1.8E+04	2.0E+05	4.2E+05	2.6E+04	1.0E+05	1.3E+04	1.0E+05
Cl	1.6E+04		3.1 E+04	8.0E+04	36		20	1.6
SO_4	8.9E+03		9.3E+04	6.1E+05	20		60	12
NH_3 / NH_4								

Table 6-3: Baseline Concentrations and Peak Incremental Concentration in Receptors

COPC	Baseline[1] (µg/L or Bq/L)				Resulting Peak Concentrations (µg/L or Bq/L)				Water Quality Objective
	Bena	Sharp	Telephone	Collins	Bena	Sharp	Telephone	Collins	
As	0.4	0.22	0.25	0.5	1.4	0.68	2.7	0.58	5
Cd				<1	0.0052	0.50	0.0033	<1	0.017-0.10[2]
Co				<1	0.18	0.50	0.25	<1	
Cu	1	0. 6	1	2	1.1	0.60	1.1	2.0	2-4[3]
Mo	1	0. 5	1	6	1.2	0.52	1.6	6.0	73
Ni	1	0. 5	1	3	2.8	1.0	3.9	3.1	25-150[4]
Pb	2	1.0	2	7	2.0	1.0	2.0	7.0	1-7[5]
Se	<1	<1	<1	<1	0.60	0.10	0.64	<1	1
U	0.3	0.1	0.1	0.6	0.31	0.10	0.18	0.6	15
V		0. 5		10	0.0029	0.50	0.008	10	
Zn	1	3.3	20	5	1.2	3.3	20	5	30
^{226}Ra	0.005	0.005	0.005	0.006	0.014	0.0052	0.0095	0.0063	0.11
^{210}Pb	0.02	0.03	0.02	0.02	0.021	0.030	0.020	0.020	
^{210}Po		-		0.009					
^{230}Th	0.01	0.01	0.01	0.01	0.010	0.010	0.010	0.010	
Cl				150	36		20	152	
SO_4				500	20		60	512	
NH_3 / NH_4				23				23	

(1) Baseline values for Collins Creek were taken from Tables 4.3-3, 4.3-4, 4.3-5, 4.3-6 (Station WQ13E) of Existing Environment TID (COGEMA 2003) Hardness in Collins Creek was reported as 6 mg/L. Baseline values for Bena Lake and Telephone Lake were taken from Table 4.13, Appendix VIIIB of the Caribou Project EIS. Baseline concentrations for Sharp Lake are based on the average of measurements taken at station WQ21E since 2003.

(2) Cadmium Objective: 0.017 µg/L where hardness is 0-48.5 mg/L; 0.032 µg/L where hardness is 48.5 - 97 mg/L; 0.058 µg/L where hardness is 97-194 mg/L; 0.10 µg/L where hardness is >194 mg/L..

(3) Copper Objective: 2 µg/L where hardness is 0-120 mg/L; 3 µg/L where hardness is 120-180 mg/L; 4 µg/L where hardness >180 mg/L.

(4) Nickel Objective: 25 µg/L where hardness is 0-60 mg/L; 65 µg/L where hardness is 60-120 mg/L; 110 µg/L where hardness 120-180 mg/L; 150 µg/L where hardness is >180 mg/L.

(5) Lead Objective: 1 µg/L where hardness is 0-60 mg/L; 2 µg/L where hardness is 60-120 mg/L; 4 µg/L where hardness 120-180 mg/L; 7 µg/L where hardness is >180 mg/L.

7 Bounding and Sensitivity Cases

Analyses were performed to assess source term and transport pathway uncertainties. The parameters chosen for the analyses were those considered to have a significant impact on calculated loadings, or those whose values are considered to be uncertain. The analysis was based on the “Future Projects Case", which is considered to be the new base case for the Sue area. The following parameter changes were considered:

- the leachable mass of arsenic;
- initial arsenic pore water concentration in the waste rock;
- the flow through the Sue C/A and Sue E waste rock and pit lakes;
- the distribution coefficient for arsenic in sandstone.

7.1 Bounding Case Parameters

For the bounding cases, two simulation cases were run for each parameter, one representing an upper value case and one representing a lower value case.

7.1.1 Leachable Mass

For the upper value bounding case, the leachable arsenic inventory was estimated using the correlation for total leachable arsenic content instead of the water leachable arsenic content. The development of both of these correlations is discussed in Appendix B-I. The empirically derived relationship between the total leachable arsenic content and the arsenic solids content is based on a best-fit curve as described by the following equation (power law):

$$S_T = 0.0498\, S^{1.1572}$$

where

S_T = total leachable arsenic (mg/kg)

S = arsenic solids content (mg/kg).

This value represents the upper value case. The lower value for the leachable mass was taken to be 80% of the leachable mass for the base case.

7.1.2 Waste Rock Pore Water Concentration

For the upper value simulation, the empirically derived relationship between the upper bound for initial arsenic pore water concentration and the arsenic solids content is based on a best-fit curve as described by the following equation (power law):

$$C_o = S^{0.735}$$

where

C_o = initial arsenic concentration in pore water (mg/L)

S = arsenic solids content (mg/kg).

This function represents an extreme case that incorporates all of the data, even the high arsenic content data points. The function is plotted as Figure 2-2 of Appendix B-II.

For the lower value case, the arsenic pore water concentration for Sue C/A was taken to be 3.7 mg/L, the value from the Caribou EIS (AREVA 2009a, Appendix VIIIB, Table 4.5).

The initial arsenic concentration in the Sue C/A and Sue E pit lakes was the base case value.

7.1.3 Flow through the Waste Rock and Pit Lakes

For the upper value simulation, the flow through the waste rock and pit lakes was increased by 50%, from the Base Case value for both pits. For the lower value simulation, the flow through the waste rock and pit lakes was decreased by 50% from the Base Case value.

7.1.4 Distribution Coefficient

The potential variation in distribution coefficient was analysed by varying the distribution coefficient for arsenic in sandstone. The upper value was taken from Table 1-1 of Appendix B-IV for “reddish sandstone” at the Cigar Lake site. The lower value was taken to be half of the base case distribution coefficient.

7.1.5 Flow in Collins Creek

The concentration in Collins Creek is a dilution concentration and is simply the mass flux divided by the flow rate through Collins Creek. As such it is proportional to the mass flux and adds no new information to the analysis. The mass flux to Collins Creek predicted by the transport model is the sum of all mass flux pathways in the Collins Creek watershed – including mass flux to intermediate lakes. Therefore, mass flux is an upper bound since mass can be removed at any stage in the transport – for instance by lake

sediments. The mass flux that flows directly to Collins Creek from contaminant sources is a small part of the total transported mass flux.

In the 2013 TID, the sensitivity to flow in Collins Creek was analysed by using the maximum mean annual flow rate and the minimum mean annual flow rate taken from measurements between 1997 and 2011 (AREVA 2011c, Table 2.3-2). The base case flow rate was the average of the mean annual flow rates from these same measurements. Applying the maximum and minimum mean annual flow rates through rates through Collins Creek, 2.4 and 1.13 m3/s, respectively, gives a minimum and maximum arsenic concentration of 0.50 and 1.07 ug/L, respectively, in Collins Creek. The value of 1.07 ug/L is below the SEQG for surface water value of 5 ug/L.

Since the concentration in Collins Creek is not a model parameter it will not be included in the bounding case analysis.

7.1.6 Bounding Simulation Results

Table 7-1 lists the base case parameters and the corresponding parameters used for the bounding case simulations. The “Central Values” refer to the Base Case values.

Table 7-1: Parameters Choices for the Bounding Cases

Case	Parameter	Units	Central Values	Lower Values	Upper Values
Case 1	Arsenic Leachable Mass Sue C/A	tonnes	74	59	181
	Arsenic Leachable Mass Sue E		7.1	5.7	21
Case 2	Arsenic Initial Pore Water Concentration Sue C/A waste rock	mg/L	4.3	3.7	37
	Arsenic Initial Pore Water Concentration Sue E waste rock		2.0	2.0	21
Case 3	Flow through Sue C/A waste rock	m3/day	46	23	69
	Flow through Sue C/A pit lake		117	59	176
	Flow through Sue E waste rock		4.9	2.5	7.4
	Flow through Sue E pit lake		2.0	1.0	3.0
Case 4	Distribution Coefficient (K_d)	L/kg	1.0	0.5	2.5

The results of the bounding simulations are presented in terms of the peak incremental mass flux to Collins Creek. The results are displayed on Figure 7-1 as “tornado” graphs. The values plotted on the “tornado” graph are the difference between the Upper Values and the Central Values on the right and the difference between the Lower Values and the Central Values on the left.

The Sue C/A waste rock leachable mass, the distribution coefficient, initial pore water concentration, and flow through the waste rock are the only parameters that showed a discernible difference between the upper and lower bounding cases.

The parameter with the largest effect is leachable mass of Sue C/A waste rock, followed by distribution coefficient.

The effect of increasing the leachable mass is to increase the size of the peak in incremental mass flux. The effect of the smaller distribution coefficient is to increase the peak values but also to cause an earlier breakthrough time.

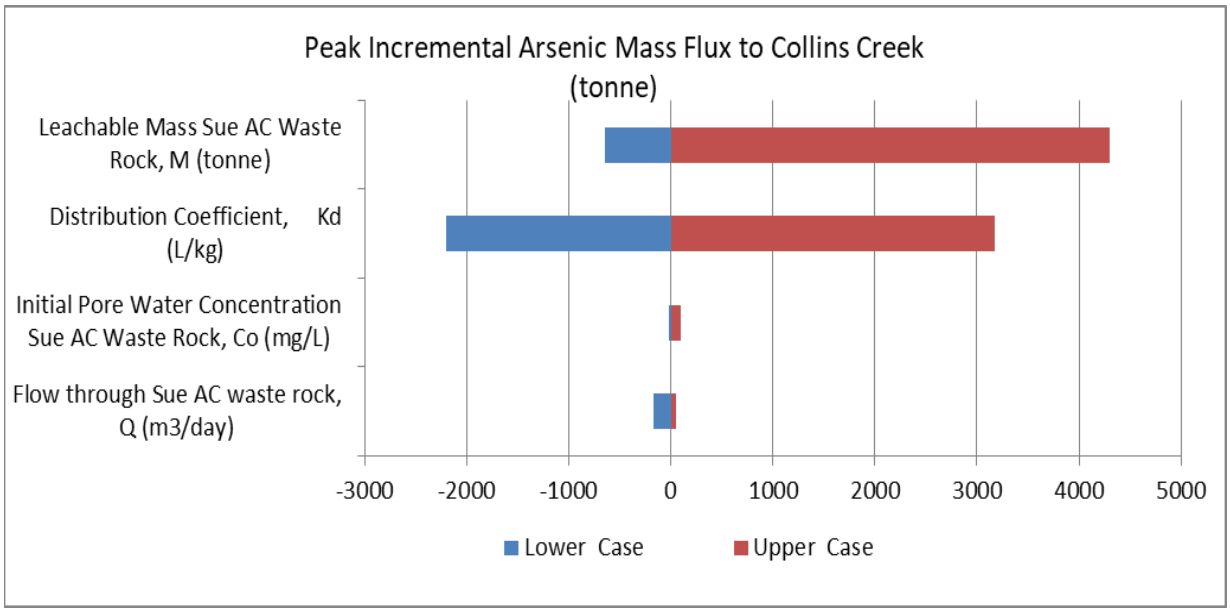


Figure 7-1: Effect of Bounding Simulations on Peak Incremental Mass Flux to Collins Creek

7.1.7 Upper Bound Case

An upper bound simulation was defined based on bounding case parameters with the largest impact, i.e. the leachable arsenic mass in Sue C/A and the distribution coefficient. The upper bound simulation had a leachable arsenic mass in Sue C/A of 181 tonnes and a K_d of 0.5 L/kg.

The resulting incremental arsenic mass flux to Collins Creek, Telephone Lake, and Bena Lake is shown on Figure 7-2, Figure 7-3, and Figure 7-4. The base case profile is plotted for comparison.

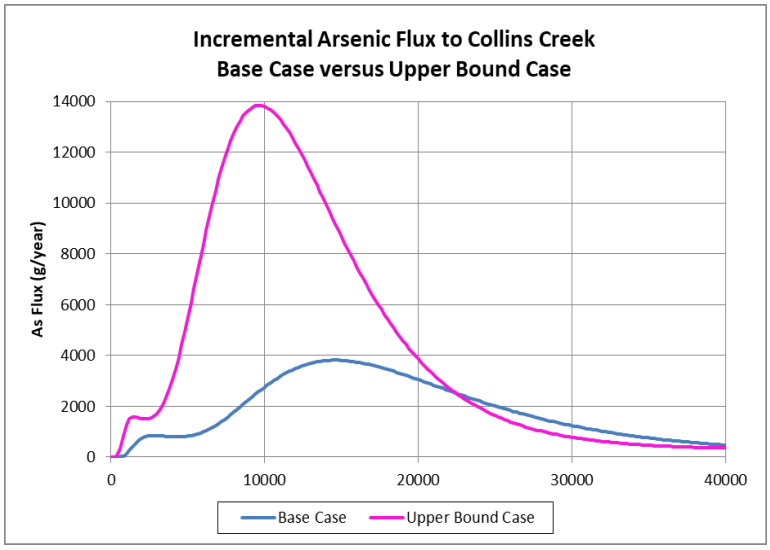


Figure 7-2: Comparison of Incremental Arsenic Mass Flux to Collins Creek for the Base Case versus the Upper Bound Case

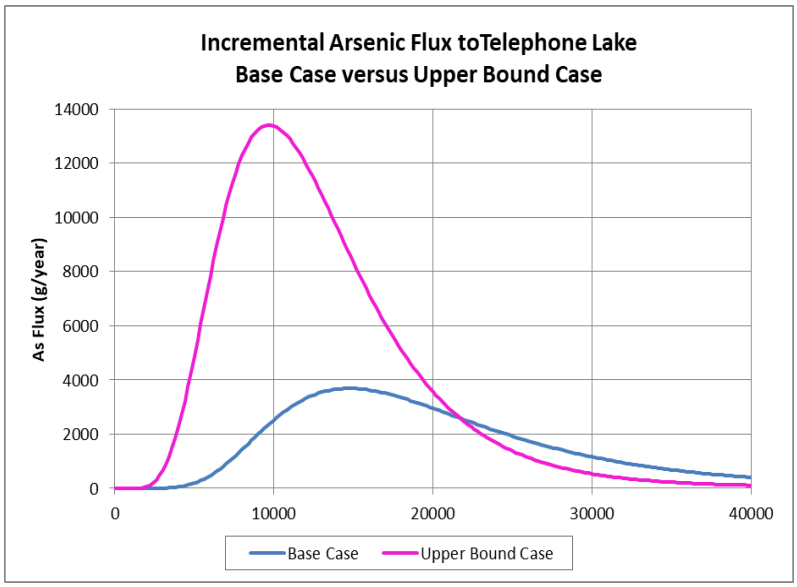


Figure 7-3: Comparison of Incremental Arsenic Mass Flux to Telephone Lake for the Base Case versus the Upper Bound Case

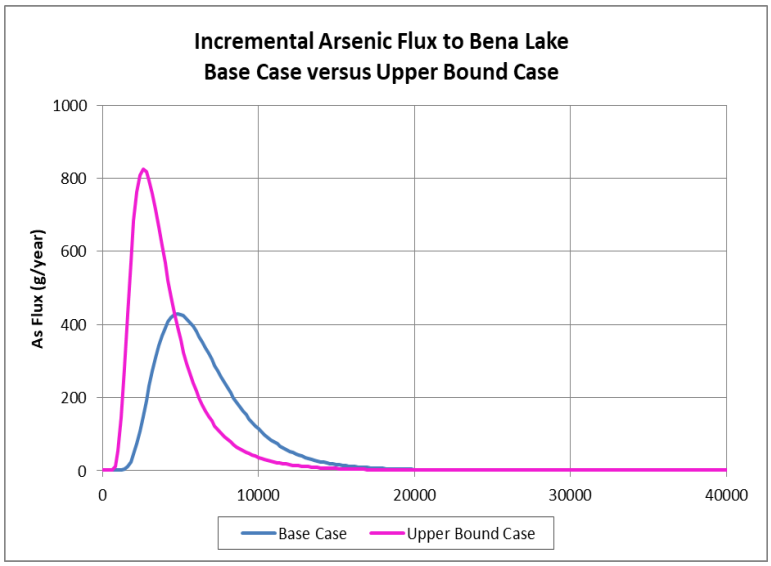


Figure 7-4 Comparison of Incremental Arsenic Mass Flux to Bena Lake for the Base Case versus the Upper Bound Case

7.2 Sensitivity Cases

The purpose of the sensitivity analysis is to identify the parameters with the strongest influence on model results. An approach, known as the one-step-at-a time method (Hamby 1994), was used for the sensitivity analysis on key transport model inputs. The method varies one parameter at a time, by a given percentage, while holding the other parameters fixed. The sensitivity cases differ from the bounding cases in that all parameters are varied in the same way, by the same amount,

The parameters chosen to test were based on the results of the bounding case analysis. Table 7-2 lists the parameters evaluated for sensitivity. The base case parameter values were decreased and increased by 25% to create the lower and upper bounds, respectively. The results do not reflect potential future site performance or uncertainty; the results demonstrate which input parameters have the greatest impact on the transport model results.

Table 7-2: Parameter Choices for the Sensitivity Cases

Case	Parameter	Units	Central Values	Lower Values	Upper Values
Case 1	Arsenic Leachable Mass Sue C/A	tonnes	74	56	93
Case 2	Arsenic Initial Pore Water Concentration Sue C/A waste rock	mg/L	4.3	3.2	5.4
Case 3	Flow through Sue C/A waste rock	m3/day	46	34	57
Case 4	Distribution Coefficient (K_d)	L/kg	1.0	0.75	1.25

7.2.1 Sensitivity Case Results

The results of the sensitivity analysis are defined in terms of the peak incremental flux to Collins Creek. The results are displayed on Figure 7-5: Effect of Sensitivity Simulations on Peak Incremental Mass Flux to Collins Creekas a “tornado” graph

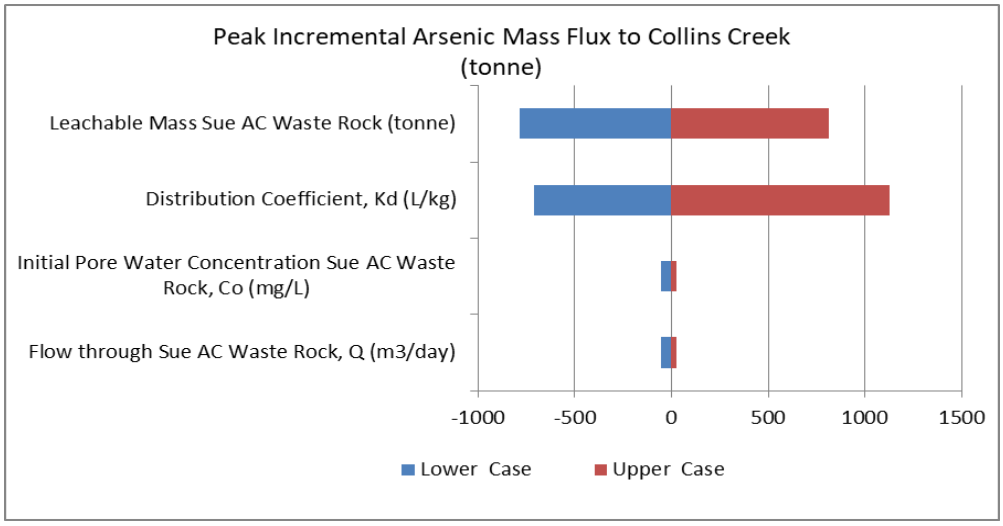


Figure 7-5: Effect of Sensitivity Simulations on Peak Incremental Mass Flux to Collins Creek

The mass flux to Collins Creek is most sensitive to changes in the distribution coefficient of arsenic in sandstone. The second most sensitive parameter is the leachable mass of arsenic in the waste rock.

8 Monitoring and Follow-Up

The existing monitoring program at the McClean Lake Operation is well established and comprehensive. Monitoring at the JEB and Sue sites, for the currently licensed activities, is incorporated into the McClean Lake Environmental Monitoring Program (EMP). Follow-up programs have also been designed to obtain specific information or validate assumptions related to waste rock management. These monitoring and follow-up programs will result in the collection and analysis of waste rock data many years in advance of the eventual decommissioning of the facility.

The objectives of the follow-up and operational monitoring programs are:

- to determine the effectiveness of measures taken to mitigate the potential adverse environmental effects of the operation;
- to verify the accuracy of the environmental assessment; and,
- to identify 'deviations' from predicted long-term behaviour that may trigger contingency measures.

8.1 Monitoring Program

The existing McClean Lake Operation Environmental Monitoring Program (Orano 2019a) provides the JEB and Sue site monitoring requirements, subject to revisions and licensing conditions, throughout the life of the operation. The components of the existing monitoring program at the JEB and Sue site pertaining to waste rock management are as follows.

- groundwater flow and chemistry around the Sue C/A, Sue B, and Sue E pits is monitored through a series of groundwater monitoring wells;
- groundwater flow and chemistry around the JEB, Sue C, and Sue E stockpiles is monitored through a series of groundwater monitoring wells;
- pore water quality in placed Sue A/E special waste in the Sue C pit is monitored through a series of multi-level piezometers, when possible given the water level in the Sue C pit (see Section 3.2.1.1 of Part A of this document for more information);
- pore water quality in the JEB, Sue C, and Sue E stockpiles is measured through the installation of dedicated piezometers in each stockpile; the piezometers are sampled annually in order to assess the performance of the stockpiles on an ongoing basis (see Section 2.1.3 of Part A of this document for more information);
- surface water quality and lake levels in lakes potentially affected by the operation (Sue, Sils, Candy, and Bena Lakes at Sue, and Fox and Pat Lakes at JEB) are monitored; and
- pit lake water quality is routinely monitored (see Section 3.2.4 Part A).

More information on the JEB and Sue EMP monitoring wells can be found in Section 2 of the Environmental Performance TID (AREVA 2016). Further information on surface water quality monitoring can be found in Section 4 of the Environmental Performance TID (AREVA 2016). A summary of Sue A/E special waste pore water quality can be found in Appendix A-I.7 of Part A of this study. A summary of clean waste rock pore water quality can be found in Appendix A-I.6 of Part A of this study.

8.2 Follow-Up Program

Orano has committed to continual improvement with respect to environmental performance. Accordingly, follow-up programs have been designed to monitor and confirm key parameters, validate and calibrate models and predictive tools, and assess new techniques where appropriate. The specific details of follow-up programs during operation are dealt with as part of the licensing process, as the programs require continual evaluation and adjustment as data is collected and assessed. Some aspects of the operational monitoring program provide data required for the follow-up programs.

In general, follow-up programs pertaining to waste rock management focus on the source terms and hydrogeological and contaminant transport parameters/assumptions required to assess long-term effects of waste rock disposal in the Sue C and Sue E pits.

Potential effects to nearby surface water bodies resulting from waste rock disposal in the Sue C/A and Sue E pits will not be observed directly within the time frame of the post-decommissioning monitoring phase carried out by Orano. Therefore, validation of contaminant transport predictions for waste rock disposal in the Sue C/A and Sue E pits focuses on monitoring the behaviour of in-pit waste rock pore water chemistry, and the collection and interpretation of hydrogeology data. Monitoring will be conducted to confirm that waste rock pore water concentrations, in combination with hydrogeology data, result in performance within the predicted envelope of values with respect to contaminant transport to the overlying pit water and the receiving surface water bodies.

8.2.1 Sue E Follow-Up Program

A follow-up program was completed for the Sue E project and included the following components:

- validation of the hydrogeological modelling, using Sue E dewatering and reflooding rates;
- validation of clean and special waste rock geochemistry, using systematic samples from mining operations; and
- validation of special waste pore water source terms, using data collected from four piezometers installed in the Sue A/E special waste in the Sue C pit.

Orano was successful in completing all components of the Sue E follow-up program, and results were generally consistent with Sue E EIS predictions for all components. More information on the Sue E follow-up program can be found in the Sue E Follow-Up Program Report (AREVA 2012b).

8.2.2 Waste Rock Follow-Up Program

Clean waste rock pore water quality is monitored using piezometers installed in each of the JEB, Sue C, and Sue E clean waste rock stockpiles. These piezometers were installed as part of the waste rock follow-up program in 2007 (AREVA 2009b) and are sampled annually. A review of the results to date is completed in Appendix A-I.6 of Part A of this study. The analysis of this data suggests that clean waste rock was effectively segregated from special waste rock, and the potential for acid generation from the placed waste rock appears to be low.

The Sue C stockpile results indicate levels of cobalt, copper, lead-210, nickel, and zinc that are slightly elevated above the other two stockpiles. These results, particularly the results for cobalt and nickel, are likely due to a lower pH in the Sue C stockpile. These results may be due to the placement of some segregated basement waste rock on the Sue C stockpile, while the JEB and Sue E stockpiles consist of entirely sandstone waste rock. Overall, the metals concentrations in the Sue C stockpile are low and appear to be stabilizing over time.

The chemistry of all stockpiles will continue to be monitored and evaluated on an ongoing basis.

8.2.3 Further Follow-Up Initiatives

Calibration and validation of hydrogeological models is ongoing and described in further detail in the Hydrogeology and Groundwater Modelling of the Collins Creek Basin TID (AREVA 2011c).

9 Contingency Measures

Contingencies and mitigation measures have been considered in the event that the assumptions and the predicted long-term effects are found to be incorrect based on operational monitoring and follow-up program results. The proposed contingency measures are presented below.

9.1 Pit Lake Water Quality

Unacceptable post-decommissioning pit lake water quality can be mitigated by implementing an alternative cover design that can further reduce the flux of groundwater flow through the waste rock and into the overlying pit waters. As well, pit lakes could be treated to encourage the formation of a chemocline in the deep bottom waters to create an additional diffusion barrier to prevent contaminant migration into the upper oxygenated waters.

9.2 Waste Rock Pore Water Concentrations

If pore water concentrations in the waste rock are significantly and unacceptably higher than predicted, which may result in unacceptable level of effects to the receiving environment, then a 'pump and treat' measure can be implemented. This involves locating a collection sump down-gradient of the groundwater inflow so that the pit would act as a large dewatering well. The groundwater flowing through the placed waste rock would displace contaminated pore water toward the collection sump. The sump water would be pumped to the water treatment plant for treatment. This flushing process can be further improved, if necessary, by installing a network of injection wells within the waste rock, which could facilitate the possibility of adding chemicals to allow *in situ* treatment of waste rock pore water with the objective of removing a significant mass of the COPCs. The treatment sludge could be disposed in the JEB tailings management facility after processing through the tailings neutralization circuit.

9.3 Groundwater Flow Through Waste Rock

Modifying the in-situ waste rock properties may be suitable if long-term monitoring results indicate significantly higher than predicted groundwater flow through the placed waste rock (which may result in an unacceptable level of effects to the receiving environment). For instance, a modifying agent (*e.g.*, silica gel) could be injected in the waste rock pore spaces to reduce groundwater flow through the waste rock.

9.4 Stockpile Performance

As noted in Section 8.1 and 8.2.2 of this study, stockpile performance is monitored routinely through piezometer measurements. The data to date suggests that the stockpiles are performing well to date and

this is not expected to change. However, should stockpile pore water quality evolve unacceptably, improvements could be considered to the design of the stockpile cover used in decommissioning.

10 Conclusions

Subsequent to the 2013 version of this Waste Rock Management Technical Information Document, additional monitoring data has been collected on pore water samples from piezometers placed in the JEB, Sue C, and Sue E clean waste rock stockpiles. Similarly, additional pit water quality monitoring data has been collected from Sue C/A, Sue E and Sue B pit to help assess the extent to which special waste respectively placed in the pits affect the evolution of the pit water quality and the potential effect on the environment. Additional studies have been conducted to understand the characteristics of waste rock for future projects such as Cigar Lake, McClean, Caribou and Sue D Underground especially concerning the concentrations of contaminants of potential concern in the waste rock and the development of the respective source terms. Also, the contaminated landfill has been relocated from the JEB TMF to the Sue C/A; whereas non-process wastes are not expected to produce any COPC source terms, process wastes have the potential to add COPC source terms to the Sue C/A pit. The potential effect of the placement of the process wastes in the Sue C contaminated landfill on the environment has been determined through contaminant transport modelling presented in this document.

10.1 Part A – Summary of Current Waste Rock Management Practice

In Part A, Orano undertook an initiative to compile and summarize relevant waste rock studies to provide a comprehensive, current understanding of waste rock management and operational performance at the McClean Lake Operation. The conclusions from Part A of the study are summarized below. Overall, waste rock quantities and concentrations of contaminants of potential concern for all projects to date are generally consistent with EIS predictions.

- The review of solids content data showed that the McClean Lake Operation segregation methodology to date has been effective and conservative.
- The JEB, Sue C, and Sue E stockpiles are performing well. Based on recent and historical stockpile pore water samples from the clean waste rock piezometers, the clean waste rock was effectively segregated from special waste rock. The potential for acid generation from the placed waste rock stockpiles appears to be low.
- Measured special waste pore water data was available for Sue A and Sue E special waste rock. The measured data was generally consistent with EIS predictions for all COPCs with the exception of nickel in Sue A special waste and arsenic in Sue E special waste. Pore water source terms for Sue A and Sue E special waste were adjusted to reflect the higher values.
- Updated pit water quality data for Sue C/A, Sue E and Sue B pits show that the concentration of COPC has generally stabilized or on decreasing trend. However, there is insufficient information at this time to predict the post-decommissioning temporal concentrations for key COPCs in the Sue pit lakes for the approved waste management scenario and the six other waste management scenarios.

- A full geochemical source term reassessment was completed on Cigar Lake Stockpile C waste rock as well as the unmined Cigar Lake Phase I and Phase II special waste rock, utilizing data from previous waste rock assessments and data from the 2017 Stockpile C drilling campaign test work program. The results from the assessment indicate that the source terms are generally consistent, or lower than, the 2001 EIS.
- Results from an investigation to characterize and assess the leaching behaviour of waste rock from the proposed McClean, Caribou, and Sue D projects show that the leaching behaviour of the McClean, Caribou, and Sue D projects waste rock is similar to mine rock from other McClean Lake region uranium deposits; therefore, previously developed source terms for pore water concentrations in flooded special waste rock material can be applied.
- Advancement in the understanding of the characteristics of the placed and future waste rock, together with the update to the regional groundwater model, warranted an update to the contaminant transport modelling. In the modelling described in Part B, predicted waste rock quantities, solids content, and pore water source term values were replaced with known, measured values when available from completed projects.

10.2 Part B – Modelling, Bounding and Sensitivity Studies

In Part B, Orano has updated the predictions of long-term environmental performance based on the updated understanding of waste rock management in Part A. Part B of the 2013 waste rock TID evaluated scenarios for waste rock management beyond the approved case described by the Caribou EIS. Part B of the 2021 TID further updates three of the 2013 scenarios; Scenario 2 was not carried forward and the Midwest Scenario was not updated. For both the 2013 and 2021 waste rock TIDs, modelling of waste rock management scenarios was done based on the 2011 regional groundwater flow model and a one-dimensional solution of the advection-dispersion equation. The waste rock management scenario described in the Caribou EIS was re-evaluated using an updated groundwater flow model and updated waste rock and pore water quantities and characteristics. No significant changes in predictions of environmental performance were identified. Additional scenarios were modelled to assess the impact of different waste rock management strategies and the cumulative impact of the waste rock placed in the decommissioned Midwest pit. The cumulative effect of placed special waste rock, contaminated pit water, and clean waste rock stockpiles was analysed in terms of each of the four scenarios. The conclusions from Part B of the study are summarized below.

- Modelling of the waste rock management scenario described by the Caribou EIS using the updated flow model and waste rock characteristics results in no significant change to environmental performance predictions presented in the Caribou EIS.
- Considering special waste rock placement for all foreseeable future projects, water quality objectives are anticipated to be met in receiving water bodies over the long term. The predicted peak incremental arsenic flux to Collins Creek will be about 3.8 kg per year occurring at about 15,000

years and will result in an incremental concentration increase in Collins Creek of 0.08 μg/L. The baseline value in Collins Creek is 0.5 ug/L so the resulting concentration will be 0.58 ug/L, below the Saskatchewan Environmental Quality (SEQG) for surface water arsenic value of 5 ug/L.

- The main contribution to the incremental arsenic flux in Collins Creek will be from the placed waste rock in Sue C/A pit. There will be a small early peak from Sue E pit lake water and a smaller, much later peak flux from waste rock in the Sue E pit.
- The impact of potential future placement of operational process waste and Midwest SABRE special waste in the Sue C/A pit, with or without a till cap, will not result in an exceedance of water quality objectives.
- Remediating pit lake water reduces the arsenic concentration in Collins Creek by less than 10 percent.
- Completely backfilling the Sue C/A pit to 453 mASL with waste rock with the properties of the JEB, Sue C, Sue E clean waste rock piles is not anticipated to result in exceeding water quality objectives in any surface water body.
- Long term concentrations in Telephone Lake are sensitive to the elevation of waste rock placed in Sue C/A pit. Fully backfilling the Sue C/A pit to 453 mASL with clean waste rock does not result in exceedance of any water quality guidelines in Telephone Lake. Further study is warranted prior to using other forms of backfill material.
- The cumulative effect on Collins Creek of placed waste rock at the Midwest site and the Sue site is not anticipated to result in exceedance of water quality objectives.
- Bounding and sensitivity analyses were performed to assess source term and transport pathway uncertainties. The sensitivity case parameters considered were leachable mass, waste rock pore water concentration, flow through the waste rock and pit lakes, and distribution coefficients. Predicted peak concentrations in Collins Creek for a base (most probable) case and upper bound case are well below water quality guidelines and are not measurably different from baseline concentrations, and therefore not likely to result in unacceptable effects in the long term.
- The analysis did not take credit for removal of contaminant by lake sediments.

10.3 Overall Conclusions

The operational data to date shows that problematic waste rock has been effectively segregated from clean waste rock at the McClean Lake Operation.

Disposal of problematic waste in the Sue C/A pit is not anticipated to result in concentrations that exceed SEQG in receiving surface water bodies under any of the following scenarios considered:

- Scenario 1: “Update to the Approved Case for Sue Pits”, which considers the currently approved waste rock management scenario;
- Scenario 3: “Future Projects Case for Sue Pits” which considers an updated waste rock placement plan and forms the current base case for the Sue area;
- Scenario 4: “Fully Backfilled Sue C/A Pit Case” which considers a fully backfilled Sue C/A pit to 453 mASL, where the additional waste rock is assumed to have the mean properties of JEB, Sue C, and Sue E clean waste rock stockpiles.

The cumulative effect of waste rock placement in the Sue and Midwest mining areas has been evaluated. The incremental effects to Collins Creek are significantly larger than the comparable effects from the decommissioned Sue area pits. However, the combined effect is not anticipated to result in concentrations that exceed SEQG for surface water in Collins Creek.

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Appendix B-I: Leachable Fractions

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1 Waste Rock Testing

Geochemical evaluation of sandstone and basement rock is carried out through static, modified Special Waste Extraction Procedure (SWEP) tests. These tests are used to determine the total inventory of soluble metals in the waste rock solids. A detailed description of the SWEP procedure is given in Section 3.2 of Appendix VIII of the 2009 Caribou EIS (AREVA 2009).

1.1 McClean Lake

Twelve samples of McClean waste rock from Sue A, Sue B, Sue C, and JEB pits were subjected to sequential leach tests. The results are shown in Table E3.3.6 of Appendix E, Addendum 2002 (COGEMA and CAMECO 2002) and in Table 8.2 of Appendix I (COGEMA and CLMC 2001).

With the exception of As, Mo and Zn, the water leachable fractions ranged from 0.2% to 0.8% of the solids inventory for McClean Lake samples (Table 8.2, Appendix I, COGEMA and CLMC 2001). A conservative value of 1.5% was assumed as the water leachable fraction for Cu, Co, Ni, Pb, Se, U, Ra-226, Pb-210 and Th-230. The values for Mo and Zn were set to 11% and 5%, respectively. These values are reproduced in Table 3.1 below.

1.2 Cigar Lake

1.2.1 2000/2001 WR Testing

An investigation of the Cigar Lake waste rock was initiated in support of the Cigar Lake EIS. The investigation had two main components: column studies with water residence times of one to two years that simulated underwater disposal of waste rock; and sequential leaching tests that were designed to quantify the leachable fractions of arsenic and other key elements.

A water balance on the column tests (COGEMA 2001, Table 3.3, Appendix I) indicated that the water leachable fractions for all COC tested (Ni, U, Cu, Co, Mo, Se, Pb, Zn) were less than 1%, except for As and Mo. The Mo water leachable fraction was 30% and the As was 4.5%.

Sequential leach tests were conducted on representative blends of drill core samples. With the exception of As and Mo, the water leachable fractions ranged from 0.2% to 1.5% for Cigar Lake waste rock (Table 8.2, Appendix I, COGEMA and CLMC 2001). For simplicity, 1.5% was assumed as the leachable fraction for Cu, Co, Ni, Pb, Se, U, Ra-226, Pb-210 and Th-230. The values for Mo and Zn were set to 18% and 5%, respectively. The leachable Mo fraction of 18% was derived from the 11% for McClean Lake samples and 55% for Cigar Lake samples. The respective percentages were applied to each of the Mo inventory for McClean Lake and Cigar Lake, producing an average of 18%.

1.2.2 2017 Geochemical Update

Since 2001 a number of changes have occurred at Cigar Lake including; disposal of slimes on Stockpile C and higher than anticipated production of waste rock. In 2017 an analysis was done of the geochemical nature of the material on Stockpile C at the Cameco Cigar Lake Operation (Cameco 2018). This work was intended to expand the list of sources of COPCs to include production related waste rock remaining in the Cigar Lake Phase I ore deposit and characterize the material expected for Cigar Lake Phase II ore to allow for future waste rock management purposes.

Leach testing was initiated after solids geochemistry was completed and reviewed. Leach test samples were chosen based on solids chemistry and locale. A total of 42 samples were chosen for leach testing. The 2001 test work was also reassessed. The results of the reassessed 2001 data and the 2017 data are shown in Table 6-1 of the 2017 analysis (Cameco 2018) and reproduced in Table 1-1 below.

The leachable fraction term used in the transport analysis is calculated as a mass-weighted average of the Stockpile C, Phase I, and Phase II leachable fractions. Phase I leachable fraction is assumed to be the same as Phase II. These values are shown in Table 3-1 below.

Table 1-1: Water Leachable Fraction for Cigar Lake Waste Rock

COPC	2001 EIS	Stockpile C	Phase II
	%	%	%
As	20	4.34	5.5
Cd	--	n/a	n/a
Co	1.0	1.35	0.056
Cu	0.2	0.63	0.063
Mo	55	12.3	16.3
Ni	1.5	0.86	0.076
Pb	0.3	0.76	0.047
Ra-226	-	0.26	0.17
Se	-	4.75	5.25
U	-	0.21	0.27
V	-	0.39	0.06
Zn	1.0	3.97	1.73

1.3 Midwest

A review of past studies and waste rock characterization results was initiated in 2000 in support of the Cigar Lake Waste Rock EIS (COGEMA and CLMC 2001). This review included the Midwest waste rock and suggested that previous estimates were potentially non-conservative. New protocols for sequential leach tests were developed to determine leachable fractions and subsequent inventory of soluble metal. Both a water

leachable fraction and a total leachable fraction were assessed. These are described in Section 4.3 of the Midwest EIS.

The results of the leach tests for As, Co, Cu, Mo, Ni, Se, and U are presented in Tables 4.4 to 4.12 of Appendix VIII of the Midwest EIS. Data presented indicate that, except for arsenic and molybdenum, all are associated with relatively small water leachable fractions of less than one percent of the total solids inventory. Average arsenic and molybdenum water leachable fractions are 18.9% and 41.8% respectively. However, the molybdenum solids content is small and therefore the associated soluble molybdenum inventory will be low. Arsenic remains the primary constituent of concern in terms of soluble inventory for Midwest special waste rock.

For purposes of modelling, the water leachable fractions of all COC except arsenic and molybdenum were conservatively set to 1.5%. The molybdenum water leachable fraction was set to 41.8%.

The data water leachable fraction for arsenic was used to derive a correlation between solids content of arsenic in the rock and the fraction of that content that is leachable. The development of the correlation is discussed in Section 2.

1.4 Sue E

In 2003/2004, a special waste characterization program was carried out. Sue E special waste samples collected in 1992, 2001 and 2004 were subjected to mineralogical analysis and sequential leach tests.

The data for fraction of water leachable arsenic was added to the database for the arsenic correlation discussed below in Section 2.

For the other constituents, an average was taken over all three data sets. The calculations for Mo, Ni, Se, U, Zn, and SO4 are shown in Table 1-2. Mo, Ni, Se, and U data are taken from Tables 3.4-2 to 3.4-5, Appendix VIII, Sue E EIS (COGEMA 2004b). The Zn and SO4 data are taken from the raw data in spreadsheet “Sue E Data file No 2”.

The values calculated in Table 1-2 were not used in the Sue E EIS transport calculations. Rather, all water leachable fractions were set to 1.5% except for molybdenum which was set to 18% and zinc which was set to 5.0%.

The values calculated in Table 1-2 for average molybdenum, nickel, selenium, and uranium water leachable fractions were used in the transport calculations done for the Caribou EIS. Zinc was given a value of 5%.The remaining COPCs were assigned the nominal value of 1.5% which is larger than their calculated values.

The 2013 and 2021 WR TIDS used the same leachable fractions as were used in the Caribou EIS.

Table 1-2: Water Leachable Fractions for Sue E Waste Rock

Hole Number	Water leachable (% of original sample)					
	Mo	Ni	Se	U	Zn	SO4
1992 Low Arsenic Content Special Waste						
S426	6.4	2.6		10.3	5.4	
S431	10.1	5.0		1.4	9.2	66.0
S419	15.6	1.2		3.5	7.0	27.2
S435	64.4	9.1		32.3	15.1	24.8
S436	34.0	1.9		0.7	45.6	53.4
S430	48.7	0.7		0.9	10.5	
2001 High Arsenic Content Special Waste						
S617	0.7	15.2	9.6	0.75	11.2	70.3
S613	13.9	0.1	1.9	0.02	0.09	37.9
S612	28.3	3.1	10.1	0.34	4.2	46.9
S627	65.9	82.6	61.4	6.25	48.0	92.3
S678	32.8	6.1		0.69	79.9	13.1
S603	51.2	5.6		0.04	18.3	39.9
2004 Arsenic Content Special Waste						
SG04-03-182.0	70.8	1.86		0.50		
SG04-03-183.1	80	1.98		0.96		
SG04-03-185.2	65	0.52		0.23		
Average over all samples	**39**	**9.2**	**21**	**3.9**	**21**	**47**

Source: Mo, Ni, Se, and U data re from Tables 3.4-4, 3.4-3, 3.4-5, 3.4-2 Appendix VIII, Sue E EIS (COGEMA 2004b). Zn and SO_4 data are not documented in the EIS (Data from spreadsheet "Sue E Data file No ".)

1.5 Caribou

Targeted leaching studies were completed on the samples of special waste to determine the inventory of soluble metals in the solids. A total of 12 sub-samples of special waste material representing ranges in arsenic contents between 2 and 30,000 mg/kg were used in the tests (AREVA 2009, Appendix VIIIA, Table 3.1). The standard Special Waste Extraction Procedure (SWEP) which uses water to solids ratio of 20:1 (1 L of water to 50g of solids) was used for all leach tests. The sequential extraction tests established leachable fractions for arsenic, cobalt, copper, nickel, molybdenum, uranium, and zinc (AREVA 2009, Appendix VIIIA, Tables 3.3 to 3.9).

Note that The Caribou EIS WR leaching results have been revised due to an error in the calculation. The Caribou EIS contains the original uncorrected results. The corrected results are shown in the 2021 WR TID section of Table 3-1 below.

1.6 McClean Underground (MUG)

A 2013 investigation (EcoMetrix 2013) was carried out to characterize the potential mine rock from the McClean, Caribou, and Sue D deposits. The study included chemical analysis of the solids, ABA analyses, short-term leach tests, and humidity cell tests. Drill core samples were selected from 68 locations across the ore deposits including 17 samples from the proposed Access Ramp area, 11 from the vicinity of the Candy Lake ore deposit, 9 from the vicinity of the Caribou ore deposit, 23 from the vicinity of the McClean

underground (MUG) ore deposit, and eight from the vicinity of the Sue D ore deposit. Based on preliminary characterization, samples were selected to provide a range of locations, depths, arsenic and uranium contents, and with a focus on samples from the basement rock material. Thirty samples were characterized as either clean waste or special waste. Special waste was defined as having an arsenic concentration greater than 75 mg/kg or NP/AP (Neutralization Potential/Acid Potential) ratio less than two or uranium content greater than 250 mg/kg.

Sequential leaching tests were completed on 40 of the drill core samples to evaluate inventories of various metals in the solids. The leach test protocol generally followed the rationale for leach testing of the Cigar Lake waste rock, Sue E special waste, Midwest special waste, and Caribou special waste which focused on metal leaching with an emphasis on arsenic release. Details of the leach test are given in Appendix D of the EcoMetrix study (EcoMetrix 2013).

Two average values were calculated for each COPC, one for special waste rock and one for clean waste rock. These two averages were then combined according to an estimate for the volume ratio of special waste rock to clean waste rock. This is the same split between special waste and clean waste that was used in evaluating the total metal content in Table 4-10 of Part A of this TID. The leachable fractions are used in the calculation of the source term for Scenario 3.

The 23 special waste samples from the vicinity of the MUG ore deposit were used to calculate the leachable fraction for MUG special waste rock deposited in Sue E pit. Previous analyses had used a MUG leachable fraction based on a single sample (Minatco 1991a, Supporting Document IV, Table 2.2).

The leachable fractions for MUG-only special waste are shown in Table 3-1 below. These values are used in the calculation of the Scenario 1 source term.

1.7 Contaminated Landfill

The analysis of the material in the contaminated landfill did not include an estimate of leachable fraction. The source term for the transport analysis was developed assuming that all material was 100 percent leachable.

1.8 Claude (Cluff Lake Project)

Although Claude waste rock is not deposited in any of the McClean waste rock pits, the data gathered from leaching studies on Claude waste rock have been included in developing the correlation for leachable arsenic as a function of arsenic solids content.

Six trenches were excavated in the Claude waste rock pile in 1999. Leaching studies were conducted in 2004 on composite waste rock samples from Claude Trenches 1, 2, 3, 5, 6/11 and a composite of Trenches 1, 3 and 6/11 to determine the total inventory of soluble metals in the solids. A sample of DJX overburden was also subjected to leaching. The standard Special Waste Extraction Procedure (SWEP) water to solids ratio of 20:1 was used to assess leachability from all rock samples. The results are shown in Table 4.3.1 of the Claude Waste Rock Testing report (COGEMA 2005).

2 Arsenic Correlation

A relationship between arsenic content in the solids and the amount of leachable arsenic was identified at the time of the waste rock studies for the Cigar Lake Project (Beak 2002). Since that time there has been a growing database to support the relationship. Earlier studies used a linear relationship. More recent studies, beginning with those conducted on Sue E waste rock (COGEMA 2004b), have applied a power function to account for any non-linearity in the correlation between the leachable fraction and solids arsenic content.

The current database that supports this relationship includes waste rock data from Sue A/B/C/E, JEB, Cigar Lake, Midwest, Caribou, and McClean Underground. The McClean Underground data encompasses several locations, as described above.

Table 2-1 documents the data used for the water leachable and total leachable fractions. Source references are also noted. Figure 2-1 and Figure 2-2 show plots of the water leachable and total leachable data, with a power law trend line imposed.

The power law functions representing the leachable fractions are given by

$$S_{\mathrm{W}} = 0.0108\, S^{1.2654}$$

$$S_T = 0.0498\, S^{1.1572}$$

where

S_W = water leachable equivalent arsenic content (mg/kg)

S_T = total leachable equivalent arsenic content (mg/kg)

S = arsenic solids content (mg/kg).

For the Midwest EIS only Midwest waste rock data was used for the leachable versus solids content correlation for arsenic since the Midwest pit will contain only Midwest waste rock. The correlations are shown in Figure 2-3 and Figure 2-4. The corresponding power laws are

$$S_{\mathrm{W}} = 0.0168\, S^{1.2763}$$

$$S_T = 0.0467\, S^{1.2335}$$

Table 2-1: Data for Leachable Arsenic Correlation

	Sample ID	Solids As Content (mg/kg)	Water Leachable (mg/kg)	Total Leachable (mg/kg)
McClean	SA19	2,680	300	458
	SA22	233	14.2	38.2
Table 5.5	SAC	58.2	21.7	24.9
Appendix I	SB15	1,010	31.8	46.0
Cigar Lake EIS	SB24	221	6.80	12.74
	SBC	22.3	1.94	3.24
	SC19	5.2	0.34	0.74
	SC23	69.3	8.80	17.5
	SC28	388	104	151
	JB13	3.8	0.22	0.52
	JB20	235	11.4	20.2
	JB29	18.9	2.74	4.44
Cigar Lake				
Figure 5.1, Appendix I, Cigar Lake WR EIS	CW-00-14	650	80	108
Table 6.2, Appendix I, Cigar Lake WR EIS	H1-U	73	10.8	48.8
	H1-L	22.3	3.6	2.5
	H2-U	93.2	0.86	46.6
	H2-L	606	74.6	8
	H3-U	112	4.2	17
	H3-L	406	97.6	34.6
	H4-U	47.8	0.94	10.3
	H4-L	1590	25.2	54.8
	H5-U	63.3	0.48	7.8
	H5-L	24.7	2.1	21.2
	H6-U	21.1	0.5	5.2
	H6-L	204	16.4	42
	H7-U	18.2	0.28	4.2
	H7-L	31.7	2.6	13.6
	H8	39.4	2.5	15.2
Table 7.1, Appendix I, Cigar Lake WR EIS	New Drill Core	270	9	50
	New Drill Core	2400	12	22
Sue E	S426	63	1.04	6.87
	S431	9	0.10	0.198
Table 3.4-1	S419	45	0.10	0.423
Appendix VIII	S435	216	18.40	30.9
Sue E EIS	S436	136	7.85	20.6
	S430	62	30.93	39.0
	S617	333	3.20	53.6
	S613	3260	145	170
	S612	107	3.23	20.1
	S627	3687	3102	3645
	S678	3742	1895	1982

	Sample ID	Solids As Content (mg/kg)	Water Leachable (mg/kg)	Total Leachable (mg/kg)
	S603	9776	6034	6676
	SG04-03-182.0	1950	666	1488
	SG04-03-183.1	1820	710	1122
	SG04-03-185.2	1300	358	676
Caribou Special Waste	703(2)	6.33	1.35	2.66
Table 3.3	705(10)	7.42	0.65	1.76
Appendix VIII	701(20)	15.02	0.38	2.01
Caribou EIS	743(50)	45.16	2.72	6.48
	701(100)	60.76	2.04	10.5
	738(250)	213.24	4.01	8.62
	767(500)	520.9	45.0	125
	767(750)	682.1	27.1	45.5
	738(1000)	168.6	10.5	19.3
	784(5000)	7,848	1,580	2,114
	784(10000)	30,784	7,003	8,542
	728(30000)	10,597	2,273	3,088
Caribou Clean Waste	Clean A	74.3	0.71	0.71
Table 4.2	Clean B	12.2	0.99	0.99
Appendix VIII	Clean C	8.3	0.40	0.40
Caribou EIS	Clean D	7.3	1.37	1.37
	Clean 80 - 90	10.6	0.18	0.18
	Clean 90 - 105	32.7	1.33	2.94
Midwest Special Waste	MW1-a	1170	268	340
Table 4.4	MW1-b	2840	334	504
Appendix VIII	MW1-c	2810	460	680
Midwest EIS	MW2-a	4940	330	630
	MW2-b	1260	306	370
	MW2-c	1490	236	364
	MW56-a	626	112	174
	MW56-b	440	104	166
	MW56-c	441	136	202
Midwest Clean Waste	MWG04-01 SA#02	1.98	0.04	0.08
Table 5.3	MWG04-01 SA#04	2.88	0.04	0.08
Appendix VIII	MWG04-02 SA#01	12.41	0.21	0.61
Midwest EIS	MWG04-02 SA#04	8.47	3.24	4.17
	MWG04-03 SA#01	2.16	0.10	0.16
	MWG04-03 SA#03	4.64	0.04	0.34
	MWG04-01 400-410	5.30	0.99	1.16
	MWG04-01 410-420	10.20	1.80	2.19

	Sample ID	Solids As Content (mg/kg)	Water Leachable (mg/kg)	Total Leachable (mg/kg)
	MWG04-01 440-450	20.20	6.12	6.41
	MWG04-02 420-430	8.00	0.12	0.19
	MWG04-03 440-450	3.40	0.05	0.08
	Sub-sample C	7.90	0.02	0.08
	MW677 140-150	70.40	0.35	11.75
	MW685 170-180	68.75	0.33	5.59
	MW685 180-190	69.20	0.73	7.81
MUG Special Waste				
	S742	110	6.5	16
	MU08-05	84	0.1	2.9
	MCS21	38	0.07	1.5
	MCS21	30	0.06	3.1
	MCS05	2.5	0.02	0.09
	S827	18	0.2	1.1
	S730	99	0.6	6.1
	S730	140	3.0	11
	S730	4400	177	258
	S730	680	45	85
	S730	960	302	357
	S730	1100	17	30
	S730	230	9	20
	S730	1800	107	193
	MCN09	7.6	0.03	0.2
	MCN04	210	0.1	0.5
	MCN11	31	0.11	1.5
	S700	200	16	37
	MCS21	45	0.02	0.2
MUG Clean Waste				
	S731	16	4.3	5.8
	MCS21	13	0.04	1.0
	SGT11-01A	3.1	0.2	1.2
	S822	9.8	0.02	1.3
	S826	12	0.09	1.7
	S826	18	0.004	0.3
	MCN08	5.5	0.1	0.3
	MCN12	1.3	0.2	0.4
	MCN	6	0.05	0.8
	MCG07-01	1	0.003	0.01
	MCG07-01	2.9	0.004	0.01
	MCS22	3.7	0.02	0.07
	MU08-08	5.1	0.06	0.2
	MCS09	0.5	0.1	0.2
	MCS22	2.4	0.1	0.3
	MU08-08	2.3	0.1	0.3
	MCS21	6.2	0.2	0.7
	MU08-05	19	0.06	0.7
	S822	15	0.3	0.6

	Sample ID	Solids As Content (mg/kg)	Water Leachable (mg/kg)	Total Leachable (mg/kg)
	S826	26	0.009	0.1
	S826	73	3.8	19
Claude Waste Rock				
	CWR - T1(20)	34.92	0.59	1.76
	CWR - T1(3)	46.53	0.33	0.52
	CWR - T3(20)	15.67	0.08	0.34
	CWR - T3(3)	7.42	0.03	0.03
	CWR - T2	6.73	0.08	0.12
	CWR - T5	11.08	0.08	0.12
	CWR - T6/11	10.27	0.08	0.12
	CWR - DJX	0.87	0.08	0.12
	CWR - TANK	20.67	0.08	0.14

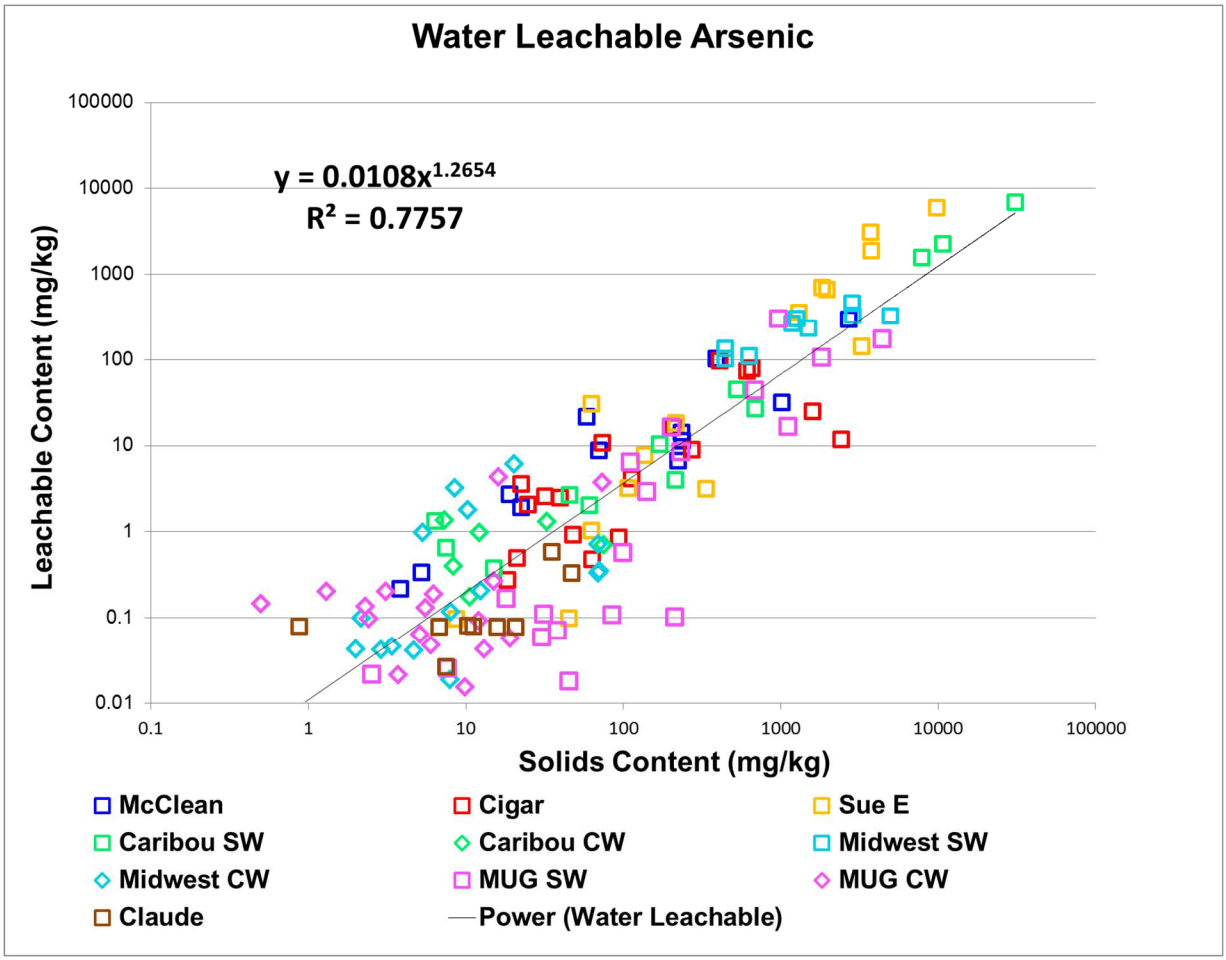


Figure 2-1: Correlation for Arsenic Water Leachable Content

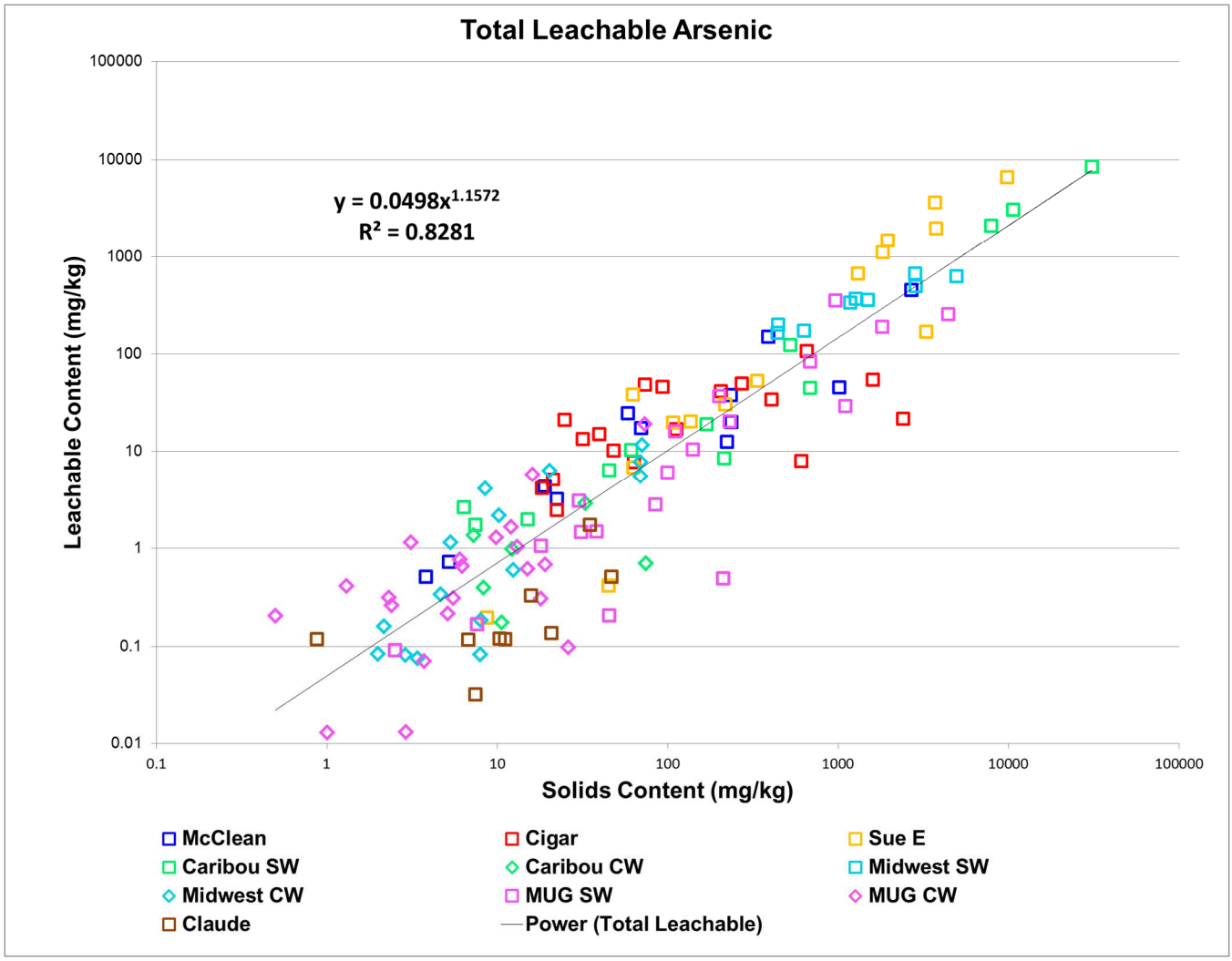


Figure 2-2: Correlation for Arsenic Total Leachable Content

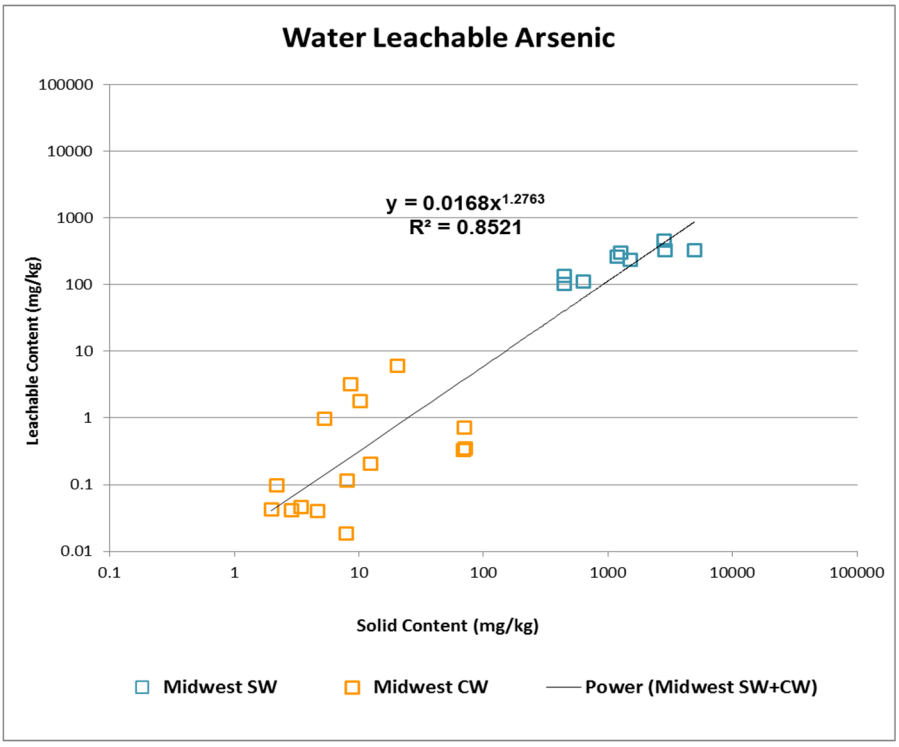


Figure 2-3: Midwest Correlation for Arsenic Water Leachable Content

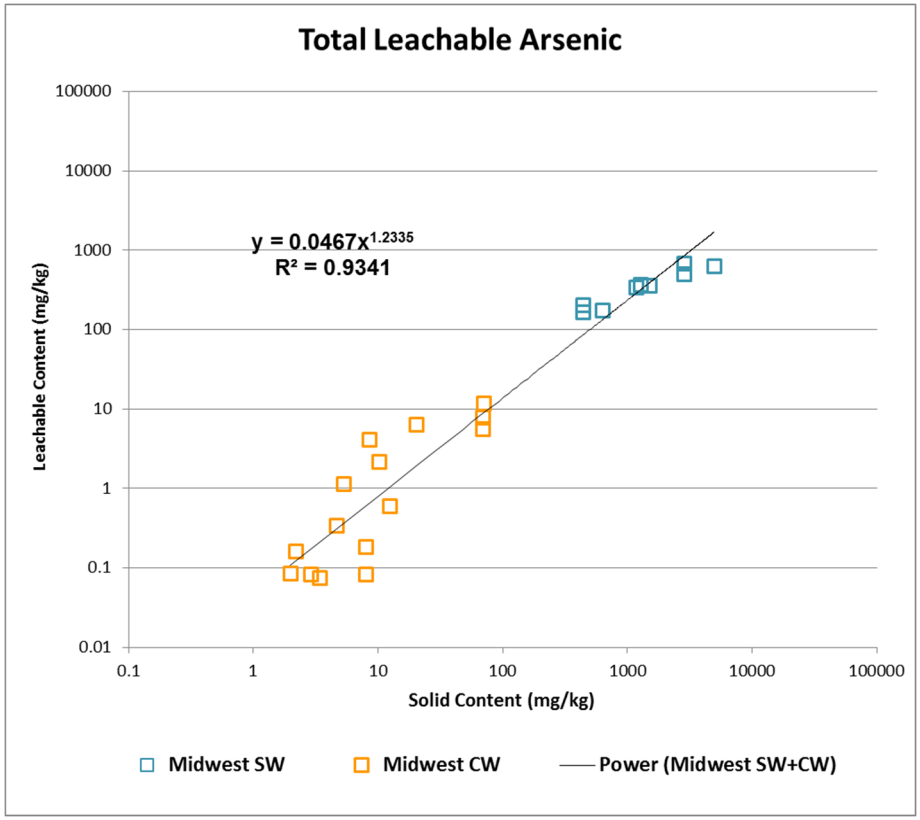


Figure 2-4: Midwest Correlation for Arsenic Total Leachable Content

3 Summary of Data

The water leachable fractions for all COPCs, other than arsenic, derived for the current document are shown in Table 3-1.

A summary of values used for all assessments starting with the 2001 Cigar Lake EIS is also given in Table 3-1.

Table 3-1: Water Leachable Fractions (% ofTotal Inventory)

	Cd	Co	Cu	Mo	Ni	Pb	Se	U	V	Zn	^{226}Ra	^{210}Pb	^{210}Po	^{230}Th	Cl	SO_4	NH_3 NH_4
Disposal of Cigar Lake Cigar Lake WR EIS (COGEMA and CLMC 2001, Appendix I, Table 8.2)																	
JEB & Sue A/B/C	--	0.2	0.8	11	0.4	0.6	--	--	--	5.0	--	--	--	--	-	--	--
Cigar	--	1.0	0.2	55	1.5	0.3	--	--	--	0.4	--	--	--	--	-	--	--
Midwest	--	1.7	0.1	--	2.2	0.1	--	--	--	0.1	--	--	--	--	-	--	--
MUG	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-	--	--
2004 WR TID (COGEMA 2004a)																	
JEB & Sue A/B/C	--	1.5	1.5	11	1.5	1.5	1.5	1.5	--	5	1.5	1.5	--	1.5	-	--	--
Cigar/MUG	--	0.5	0.66	0.51	6.07	0.006	0.005	0.26	--	0.9	0.03	1.2	--	0.04	-	--	--
Sue E EIS (COGEMA 2004b)																	
JEB & Sue A/B/C	--	1.5	1.5	18	1.5	1.5	1.5	1.5	--	5	1.5	1.5	--	1.5	-	--	--
Cigar	--	1.5	1.5	18	1.5	1.5	1.5	1.5	--	5	1.5	1.5	--	1.5	-	--	--
Midwest	--	1.5	1.5	18	1.5	1.5	1.5	1.5	--	5	1.5	1.5	--	1.5	-	--	--
MUG	--	1.5	1.5	18	1.5	1.5	1.5	1.5	--	5	1.5	1.5	--	1.5	-	--	--
Sue E	--	1.5	1.5	18	1.5	1.5	1.5	1.5	--	5	1.5	1.5	--	1.5	-	--	--
Caribou EIS (AREVA 2009)																	
JEB & Sue A/B/C	--	1.5	1.5	18	1.5	1.5	1.5	1.5	--	5	1.5	1.5	--	1.5	-	--	--
Cigar	--	1.5	1.5	18	1.5	1.5	1.5	1.5	--	5	1.5	1.5	--	1.5	-	--	--
MUG		1.5	1.5	18	1.5	1.5	1.5	1.5	--	5	1.5	1.5	--	1.5	-	--	--
Sue E	--	1.5	1.5	39	9.2	1.5	20	3.9	--	5	1.5	1.5	--	1.5	-	--	--
Caribou	--	11	7	6	13	1.5	1.5	3	--	3.8	3	3	--	3	-	--	--
Midwest EIS (AREVA 2011)																	
Midwest	--	1.5	1.5	42	1.5			1.5		1.5			--		-	--	--
2013 WR TID																	
JEB & Sue A/B/C	1.5	1.5	1.5	18	1.5	1.5	1.5	1.5	1.5	5	1.5	1.5	--	1.5	-	--	--
Cigar	1.5	1.5	1.5	18	1.5	1.5	1.5	1.5	--	5	1.5	1.5	--	1.5	-	-	--
Sue E	--	1.5	1.5	39	9.2	1.5	20	3.9	1.5	5	1.5	1.5	--	1.5	-	--	--
MUG	1.5	3.5	3.4	5.7	3.8	0.12	3.2	1.5	1.5	2.8	1.5	1.5	--	1.5	-	--	--

2021 WR TID																	
	Cd	**Co**	**Cu**	**Mo**	**Ni**	**Pb**	**Se**	**U**	**V**	**Zn**	**^{226}Ra**	**^{210}Pb**	**^{210}Po**	**^{230}Th**	**Cl**	**SO_4**	**NH_3 NH_4**
JEB & Sue A/B/C	1.5	1.5	1.5	18	1.5	1.5	1.5	1.5	1.5	5	1.5	1.5	--	1.5	-	--	--
Cigar	1.5	0.82	0.40	14	0.54	0.47	5.0	0.23	0.25	3.0	0.22	1.5		1.5			
Sue E	--	1.5	1.5	39	9.2	1.5	20	3.9	1.5	5	1.5	1.5	--	1.5	-	--	--
Caribou (Scenario 1)	-5.2	11	7.7	6.1	13	0.030	0.0	3.2	0.10	4.1	3	3	--	3	-	100-	--
MUG/Caribou /Sue D (Scenario 3)	1.1	14	21	25	16	25	28	16	18	20	3.0	3.0		3.0		9.8	
MUG only (Scenario 1)	4.0e-4	16	6.9	3.1	14	0.014	5.1	9.4	0.16	13	1.5	1.5	--	1.5		0.80	
Contaminated Landfill	100	100	100	100	100	100	100	100	100	100						100	

4 Definitions

- NP/AP (Neutralization Potential/Acid Potential)

  Neutralization Potential Ratio: The ratio of neutralization potential to acid production potential for mine waste rock (USGS 2003)

- Solids Content

  The amount of a COPC present in the waste rock (mg/kg or %).

- Total Inventory

  The mass of a COPC in the waste rock. Given by the product of the mass of waste rock and the solids content.

- Total Leachable Fraction

  The percent of the inventory that can be leached by the water wash phase followed by the acid wash phase of a leach test (%).

- Water Leachable Fraction

  The percent of the inventory that can be leached by the water wash phase of a leach test (%).

5 References

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Appendix B-II: Pore Water Concentrations

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1 Pore Water Concentrations

This appendix summarizes studies used to confirm release rates for arsenic, uranium and other metals from special waste for subaqueous disposal and to examine the evolution of arsenic concentrations in pore water.

1.1 Cigar Lake

1.1.1 Long Residence Time Tests

In 2000/2001 column tests were conducted of Cigar, Midwest, and McClean Lake waste rock samples in support of the Cigar Lake Project. Pore water residence time was approximately 1.5 years. A subset of the samples contained shotcrete to assess the effect of cement in the waste rock. The results are shown in Table 3.2 of Appendix I of the Disposal of Cigar Lake Waste Rock EIS (COGEMA and CLMC 2001) and reproduced in Table 1- 1 of this appendix.

The results showed that the concentration for most constituents of concern remained below 1 mg/L. Arsenic exhibited values in the range of 60 mg/L for the Cigar Lake waste rock, from 12 to 180 mg/L for the Midwest waste rock, and from 13 to 22 mg/L for the McClean Lake waste rock. Molybdenum concentrations ranged from 10 to 15 mg/L for the Cigar and Midwest waste rock. Concentrations for nickel and cobalt were relatively high in the Midwest waste rock with pore water concentrations that ranged from 40 to 190 mg/L. Zinc was also elevated in the Midwest waste rock, with one sample testing at 13 mg/L.

Table 1-1: Mean Steady State Pore Water Concentrations in Tests Conducted on Cigar Lake, Midwest and McClean Waste Rock.

	Cigar Lake		Midwest Project				McClean Lake	
Constituent	CW-00-14C1[1]	CW-00-14C2[2]	MWC1	MWC2	MWC3	MWC4	ML-C1[3]	ML-C2[4]
pH	7.2	7.7	5.7	6.5	4.4	4.9	6.8	7.5
As (mg/L)	64	55	180	125	44	12	13	22
SO4 (mg/L)	675	575	1200	2300	2100	1600	115	280
Ni (mg/L)	0.3	0.2	90	190	190	110	0.5	0.4
U	0.80	0.14	0.04	0.7	NA	NA	0.035	0.080
Cu	<0.002	0.003	0.03	<0.05	0.05	0.01	0.005	0.003
Co (mg/L)	0.40	0.13	80	40	160	80	0.5	0.5
Mo (mg/L)	11	10	13	15	0.02	0.01	0.08	2.0
Pb (mg/L)	0.004	0.003	<0.2	<0.2	0.03	0.01	0.006	0.002
Zn (mg/L)	0.006	0.005	0.3	0.2	13	7	0.9	0.008

[1] – Without cement
[2] – With cement
[3] - Without Cigar Lake waste rock
[4] - With Cigar Lake waste rock (and cement)
NA – Not analysed.

1.1.2 Short Residence Time Tests

The results of four previous test programs with short residence times were recalculated to extrapolate to the steady state condition. The results for arsenic pore water concentrations in Cigar Lake, Midwest, and McClean Lake waste rock are shown in Tables 3.5, 3.6, and 3.7 of Appendix I of the Disposal of Cigar Lake Waste Rock EIS (COGEMA and CLMC 2001).

1.1.3 Geochemical Characterization of PRWR at Cigar Lake

In 2017 the geochemical nature of the material on Stockpile C at the Cameco Cigar Lake Operation (Cameco 2018) was analyzed. This analysis was intended to expand the source terms of COPCs to include production related waste rock remaining in the Cigar Lake Phase I ore deposit and to characterize the material expected for Cigar Lake Phase II ore to allow for future waste rock management purposes.

No column tests were completed as part of the 2017 Cameco study; however, column testing was completed a number of times on Cigar Lake waste rock in the past. This historical information was used to predict pore water concentrations for both surface and subaqueous disposal methods. All historical column tests were evaluated, and relevant data was used to determine source term concentrations for COPCs. The column testing data used were from:

- 1993 test program on a variety of potential waste rock types (Golder 1995),

- 1994 test program on fresh graphitic metapelite (Golder 1995),
- bulk leach test conducted on a blend of materials from site (SENES 1995)
- 2000/2001 test program on relatively fresh graphitic metapelite (Beak 2001a).

The results of the analysis are discussed in Section 4.6 of the Cameco document (Cameco 2018). and shown in Table 6.1 The pore water source term used in the transport analysis is calculated as a mass-weighted average of the three components: Stockpile C pore water, remaining Phase I pore water, and Phase II pore water. The resulting pore water source terms are shown in Table 3.1 below.

A copy of the *2017 Cigar Lake Potentially Acid Generating Waste Geochemical Update* is included as Appendix A II of this document.

1.2 Midwest

No further testing was done on Midwest waste rock after the 2000/2001 column tests. The results of the shorter residence time tests are reproduced in Table 4.13 of Appendix VIII of the Midwest EIS (AREVA 2011). The results have not been extrapolated to the steady state condition. For the Midwest EIS transport calculations, initial pore water concentrations for all COC except arsenic are taken as the average over the four column results in Table 4.13. The arsenic initial pore water concentration is taken from a correlation developed between total solids content and water leachable content. This correlation is discussed in more detail in Section 2 of this appendix.

1.2.1 Sue E

Samples of Sue E waste rock were subjected to underwater column tests conducted according to the testing protocol developed for Cigar Lake Waste Rock (COGEMA and CLMC 2001). This protocol was also used for testing Midwest, MacLean Lake, Sue A/B and JEB Project material. Two composite samples, each with a mass of about 25 kg, were placed in columns and submerged in water for a period of 24 weeks. Pore water was sampled periodically and analyzed. The two composite samples represented low arsenic (72 mg/kg) and high arsenic (1,630 mg/kg) rock.

The pore water in both columns was characterized by elevated concentrations of sulphate, arsenic, nickel, and molybdenum. The low arsenic column also had elevated levels of uranium. The results are shown in Table 3.4.-6, Appendix VIII of the Sue E Project EIS (COGEMA 2004b).

Differences between the Sue E and the Cigar and McClean Lake special waste leaching behaviour were noted. The Sue E samples exhibited acidic pH values in pore water when initially submerged that persisted for the duration of the tests. Also, the low arsenic sample exhibited an anomalously high uranium concentration compared to other waste rock. Nickel and molybdenum were high but similar to previous test results. Table 1-1 summarizes the results of all available waste rock test data, except for arsenic, which will be discussed in Section 2.

1.3 Caribou

Samples of special waste material were subjected to underwater (column) testing conducted in a manner similar to that performed on Cigar Lake, Midwest and Sue E waste rock (COGEMA and CLMC 2001; AREVA 2009; COGEMA 2004b). The updated test protocols presented by BEAK (2002) and COGEMA and CLMC (2001) for arsenic leaching tests were used. The testing procedure is described in the Caribou EIS (AREVA 2009, Section 3.1).

1.4 McClean Underground (MUG)

Column testing was not done for the drill core samples of MUG waste rock.

The leaching behaviour of the McClean, Caribou, and Sue D mine rock is similar to mine rock from other McClean Lake region uranium deposits. Therefore, it was assumed that previously developed source terms for pore water concentrations in flooded special waste rock material could be applied.

The pore water concentrations developed for the Caribou EIS were used in the MUG/Caribou/Sue D source term development. The development of these pore water concentrations is described in Appendix VIIIB of the Caribou EIS (AREVA 2009).

1.5 Contaminated Landfill

No data is available for pore water concentration in the contaminated landfill material. A correlation developed for Claude Lake (AREVA 2015, Appendix B.3) waste rock was used to estimate initial pore water concentration.

The leachable mass concentration (in mg/kg of rock) was converted to equivalent concentration in the resident pore water (C_o) that has a volume that is on average equal to 85 L per cubic meter of rock (5% moisture content by weight is equivalent to a volumetric moisture content of 8.5% when solids have a dry bulk density of 1,700 kg/m^3), as follows.

$$C_o = \frac{S_L \times \rho}{\theta \times 1000} \qquad \text{(B-II.1)}$$

where

S_L is the leachable mass concentration in (mg/kg),

ρ is the dry bulk density = 1700 kg/m^3, and

θ is the volumetric moisture content = 0.085.

The only variable quantity is the leachable mass concentration. Therefore, the pore water concentration of any COPC is proportional to the ratio of leachable mass concentration of that COPC to the arsenic leachable mass concentration. The initial pore water concentration for arsenic, calculated according to the

formula developed in Section 2 below, was used to calculate initial pore water concentration for the contaminated landfill material. The leachable mass concentration is the same as the solid concentration, since the leachable fraction has been conservatively assumed to be 1.0 for all the material in the contaminated landfill. The resulting pore water concentrations using this method are shown in Table 3- 1.

1.6 Claude (Cluff Lake Project)

Although Claude waste rock is not deposited in any of the McClean waste rock pits, the data gathered from columns studies on Claude waste rock have been included in developing the correlation for arsenic initial pore water concentration as a function of arsenic solids content. The geological source of Claude waste rock is similar to that of Cigar Lake waste rock, although the Claude waste rock is much lower in arsenic. It is considered appropriate to include this data in the development of the correlation in Section 2.

Table 1-2: Summary of Available Pore Water Data for all COC but Arsenic (in mg/L)

Data Source	Description	Cd	Co	Cu	Mo	Ni	Pb	Se	U	V	Zn	^{226}Ra	^{210}Pb	^{210}Po	^{230}Th	Cl	SO_4	NH4
Cigar Lake WR EIS, Appendix I, Table 3.2	average over MCW1, MCW2, MCW3, MCW4 samples (long residence time tests)	--	90	0.028	7.01	145	0.02	--	0.37	--	5.13						1800	
Midwest EIS, Appendix VIII, Table 4.13	average over MCW1, MCW2, MCW3, MCW4 samples (short residence time tests)	--	73	0.026	7.27	115	--	--	0.242	--	2.72						1598	
Sue E EIS, Appendix VIII, Table 3.4-6	low arsenic composite sample	--	0.092	0.08	8.1	1.4	--	--	17	--	0.32						250	
	high arsenic composite sample	--	0.92	--	7	32	--	--	0.049	--	0.098						510	
Caribou EIS, Appendix VIIIA, Sub-Appendix 4	average over SW (20), SW(20/50), SW(100/500), SW(500/2000) samples	0.008	2.34	0.45	0.28	42.4	0.075	0.38	0.64	0.075	0.90	1.2	0.03		0.04		297	
Sue E WR Pore Water Monitoring Table 4.9 Part A	average of 19 pore water samples	0.00038	0.12	0.0019	0.80	1.7	3.2e-4	0.013	0.055	0.0012	0.090	0.81	0.056	0.015	0.020	9.0	127	4.6
Sue A WR Pore Water Monitoring Table 4-9 Part A	average of 14 pore water samples	0.00012	0.21	0.0013	0.40	3.4	6e-4	1.7e-3	0.0094	0.0039	0.075	0.49	0.039	0.012	0.019	5.1	46	8.7
Cigar Lake Pore Water *2017 Cigar Lake Potentially Acid Generating Waste Geochemical Update* *Section 4.6, Table 6.1*	All historical column tests were re-evaluated, and relevant data was used to determine source term relationships for COPCs.	0.0088	0.37	0.043	4.4	0.29	0.12	0.37	0.47	0.054	0.087	2.4	0.03					

2 Arsenic Correlation

2.1 Sue Mining Area

A relationship between arsenic content in the solids and the initial pore water concentration of arsenic was identified at the time of the waste rock studies for the Cigar Lake Project (Beak 2002). Since that time there has been a growing database to support the relationship. Earlier studies used a linear relationship. More recent studies, beginning with those conducted on Sue E waste rock (COGEMA 2004b), have applied a power function to account for any non-linearity in the correlation between the leachable fraction and solids arsenic content.

The current database that supports this relationship includes waste rock data from Sue A/B/C/E, JEB, Cigar Lake, Midwest, Caribou, and McClean Underground. The McClean Underground data encompasses several locations, as described above.

Table 2-1 documents the data used for the correlation for initial arsenic pore water concentration. Source references are also supplied. Figure 2-1 shows a plot of the data, with a power law trend line imposed. It is evident that two of the recalculated values (Sue C and Sue A/B composite) are outliers and they are not representative of measured arsenic concentrations. They are not included in the correlation.

The power law function representing the initial pore water concentration for arsenic is given by

$$C_o = 0.0096S^{1.291}$$

where

C_o = initial arsenic concentration in pore water (mg/L)

S = arsenic solids content (mg/kg).

To estimate the upper bound for the initial arsenic pore water concentration, the equilibrium arsenic concentrations from all column studies (Cigar Lake, McClean Lake, Midwest, Sue E and Caribou) were plotted against arsenic content in the solids. It was found that the following relationship defines a reasonable upper bound of initial arsenic concentration in pore water as function of solid arsenic content:

$$C_o = S^{0.735}$$

A plot of this correlation versus the data is shown on Figure 2-2.

Table 2-1: Data Used for Most Recent Arsenic Pore Water Correlation

Source	Sample ID	Solids As Content (mg/kg)	Initial Pore Water Concentration (mg/L)
Cigar Lake WR EIS (Appendix I, COGEMA and CLMC 2001)			
Table 3.2 (long residence time tests)	CW-00-14C1	444	64
	CW-00-14C2 (w cement)	444	55
	MWC1	1258	180
	MWC2	3213	125
	MWC3	530	44
	MWC4	406	12
	ML-C1	539	13
	ML-C2 (w Cigar Lake WR and cement)	535	22
Table 3.5 (short residence time tests with extrapolated concentrations)	CW-93-7B	24	1.1
	CW-93-8B	20	5.2
	CW-93-9B	708	60
	CW-93-10B	686	75
	CW-94-13S1	460	38
	CW-94-13S2	460	35
	CW-94-13S3	460	45
	CW-94-13S4	460	55
	Bizarre Lake	51	7
Table 3.6 (short residence time tests with extrapolated concentrations)	Drill Level	1600	64
	Bench Overcut	4000	321
	Haulage and Drainage	1700	212
Table 3.4 (short residence time tests with extrapolated concentrations)	Sue A/B SW [1]	1700	475 [1]
	Sue C SW [1]	420	170 [1]
	JEB SW	420	60
Sue E EIS, Appendix VIII			
Table 3.4-6 (final – 374 day values)	Low As sample	72	3.2
	High As sample	1630	190
Caribou EIS, Appendix VIIIA			
Sub-Appendix 4 (Cmax values used)	SW(20)	22.9	1.33
	SW(20/50)	128.5	4
	SW(100/500)	431	16.6
	SW(500/2000)	1900	70.3
Claude WR Testing			
Tables 4.1.1 and 4.5.1	CWR-T1	59.7	0.49
	CWR-T3	5.7	0.034
	CWR-T6/11	24.4	0.075
	CWR-T1 CW	59.7	0.45
	CWR-T1 LRT	59.7	0.41

[1]These recalculated values have not been used in the correlation. They are shown as outliers on Figure 2.1.

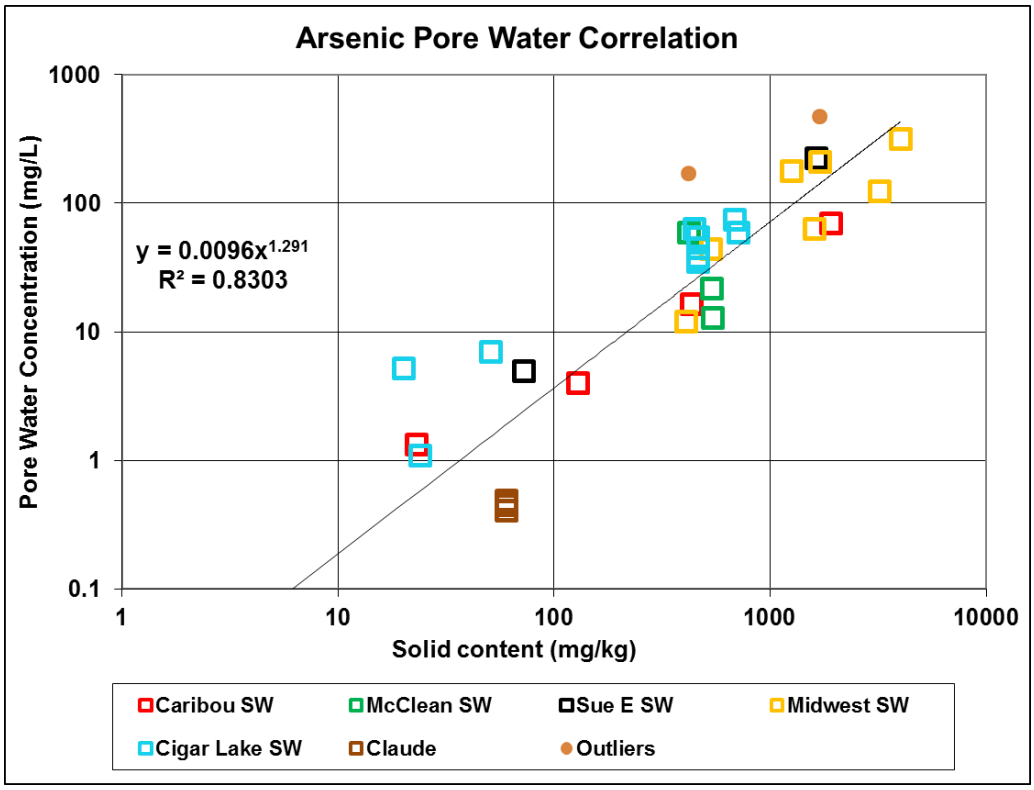


Figure 2-1: Pore Water Correlation for Arsenic Based on Historical Data

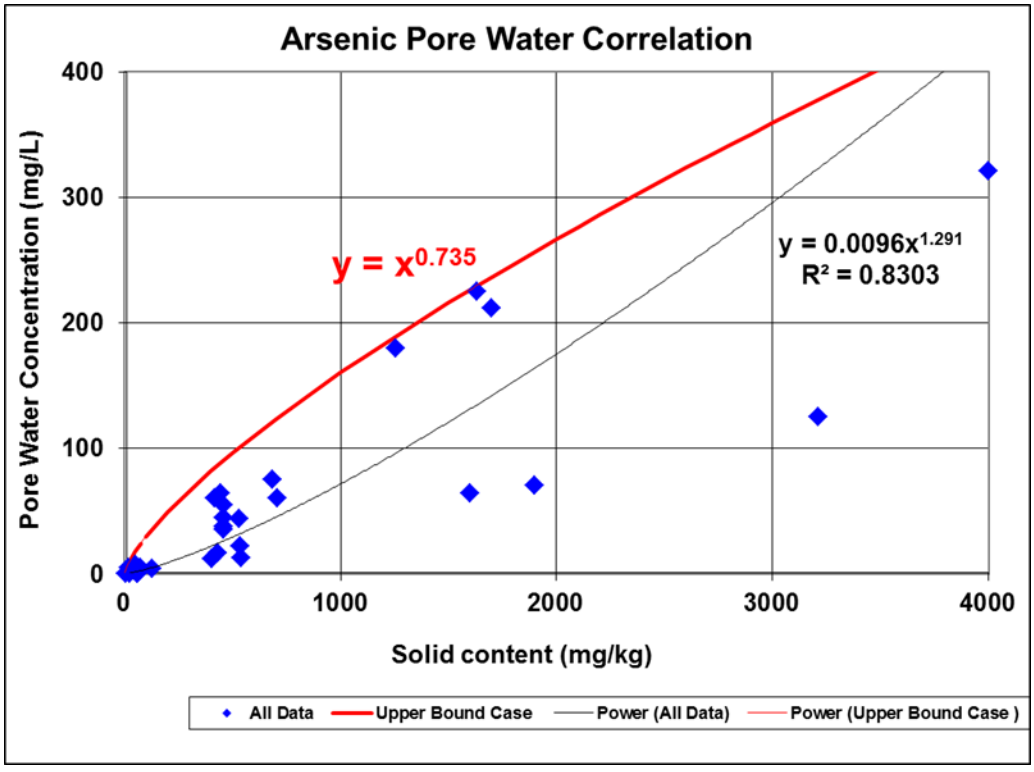


Figure 2-2: Upper Bound to Pore Water Correlation for Arsenic

2.2 Midwest Mining Area

For the Midwest EIS only Midwest waste rock data was used for the arsenic pore water concentration versus solids content correlation since the Midwest pit will contain only Midwest waste rock. The correlation is shown on Figure 4.8 of Appendix VIII of the Midwest EIS (AREVA 2011). The corresponding data is given in Table 2-2. The derived power law is

$$C_o = 0.123\, S^{0.935}$$

A plot of this correlation versus the data is shown on Figure 2-3. For the upper bound case, the same relationship was used, with an increased solids content value.

Table 2-2: Data Used for Midwest Arsenic Pore Water Correlation

Source	Sample ID	Solids As Content (mg/kg)	Initial Pore Water Concentration (mg/L)
Cigar Lake WR EIS (Appendix I, COGEMA and CLMC 2001) Table 3.6 (short residence time tests)	Drill Level	1600	64
	Bench Overcut	4000	321
	Haulage and Drainage	1700	212
	MWC1	1258	200
	MWC2	3213	150
	MWC3	530	45
	MWC4	406	15

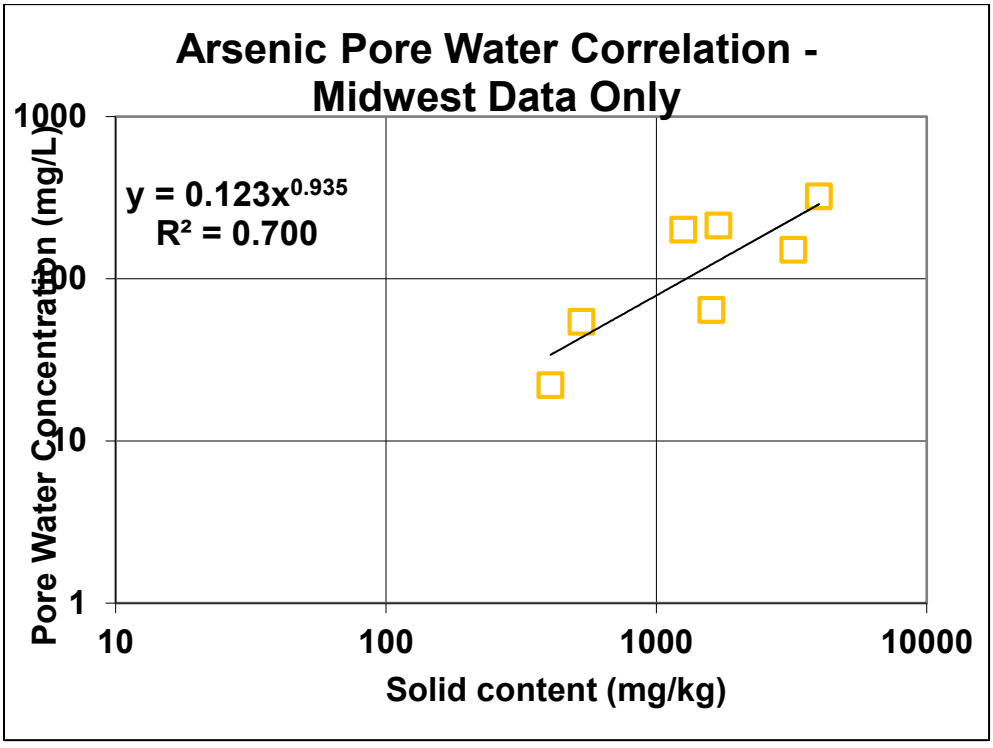


Figure 2-3: Correlation Used for Arsenic Pore Water Concentration in Midwest Pit

3 Summary of Data

A summary of pore water concentration source terms used for previous assessments is given in Table 3-1.

Table 3-1: Summary of Pore Water Concentration Data (mg/L) for Other COPC

Source	Cd	Co	Cu	Mo	Ni	Pb	Se	U	V	Zn	^{226}Ra	^{210}Pb	^{210}Po	^{230}Th	Cl	SO_4	NH_3 NH_4
2004 WR TID (COGEMA 2004a)																	
JEB & Sue A/B/C	--	0.5	0.66	0.51	6.07	0.006	0.005	0.26	-	0.9	1.2	0.03	--	0.04	25.3	168	--
Cigar/MUG	--	0.5	0.66	2.8	6.07	0.006	0.005	0.5		0.9	1.2	0.03	--	0.04	25.3	850	--
Sue E EIS (COGEMA 2004b)																	
JEB & Sue A/C	--	0.5	0.4	2.3	0.8	0.3	0.05	0.8	--	0.3	1.2	--	--	0.04	-	--	--
Sue B	--	3.5	0.5	1.4	5.2	0.02	0.07	0.4		0.1	1.2	--	--	0.04			
Cigar	--	0.5	0.4	2.3	0.8	0.3	0.05	0.8	--	0.3	1.2	--	--	0.04	-	--	--
Midwest	--	3.5	0.5	1.4	5.2	0.02	0.07	0.4	--	0.1	1.2	--	--	0.04	-	--	--
MUG	--	3.5	0.5	1.4	5.2	0.02	0.07	0.4	--	0.1	1.2	--	--	0.04	-	--	--
Sue E	--	0.5	0.4	2.3	0.8	0.3	0.05	0.8	--	0.3	1.2	--	--	0.04	-	--	--
Caribou EIS (AREVA 2009)																	
JEB & Sue A/C	--	0.5	0.5	1.2	0.2	0.005	0.05	0.35	--	0.035	1.2	0.03	--	0.04	-	--	--
Sue B	--	0.5	0.5	1.2	0.2	0.005	0.05	0.35		0.035	1.2	0.03	--	0.04			
Cigar	--	0.4	0.1	10.0	0.4	0.02	0.05	0.9	--	0.1	1.2	0.03	--	0.04	-	--	--
MUG	--	0.5	0.5	1.2	0.2	0.005	0.05	0.35	--	0.035	1.2	0.03	--	0.04	-	--	--
Sue E	--	0.5	0.47	0.68	1.3	0.47	0.1	1.1	--	0.48	1.2	0.03	--	0.04	-	--	--
Caribou	0.008	2.3	0.5	0.3	42	0.075	0.38	0.64	0.08	0.9	1.2	0.03	--	0.04	-	297	--
Midwest EIS (AREVA 2011)																	
Midwest	--	73	0.4	7.3	115	0.1	0.3	0.3		2.7	1.2	0.03	--	0.04	-	--	--
2013 WR TID																	
JEB	5.6e-3	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.0007	0.035	1.2	0.03	--	0.04	0.9	4.0	--
Sue C	1.9e-3	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.0020	0.035	1.2	0.03	--	0.04	0.9	4.0	--
Sue A	1.2e-4	0.21	0.0013	0.40	3.4	6.0e-4	1.7e-3	9.4e-3	0.0039	0.075	0.49	0.039	0.012	0.019	5.1	46	8.7
Sue E	3.8e-4	0.12	0.0019	0.80	1.7	3.2e-4	0.013	0.055	0.0012	0.09	0.81	0.056	0.015	0.020	9.0	127	4.6
MUG	--	0.5	0.5	1.2	0.2	0.005	0.05	0.35	--	0.035	1.2	0.03	--	0.04	-		--
Cigar	1.0e-3	0.4	0.1	10	0.4	0.02	0.05	0.9	0.001	0.1	1.2	0.03	--	0.04	-	2.9	--
Sue B	0.0017	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.014	0.035	1.2	0.03	--	0.04	1.0	2.0	--

	Cd	Co	Cu	Mo	Ni	Pb	Se	U	V	Zn	^{226}Ra	^{210}Pb	^{210}Po	^{230}Th	Cl	SO_4	NH_3/ NH_4
2021 WR TID																	
JEB	0.0056	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.0007	0.035	1.2	0.03		0.04	0.9	4.0	
Sue C	0.0019	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.0020	0.035	1.2	0.03		0.04	0.9	4.0	
Sue A	0.00012	0.21	0.0013	0.40	3.4	0.0006	0.0017	0.0094	0.0039	0.075	0.49	0.039	0.012	0.019	5.1	46	8.7
Sue E	0.00038	0.12	0.0019	0.80	1.7	0.00032	0.013	0.055	0.0012	0.090	0.81	0.056	0.015	0.020	9.0	127	4.6
Caribou	0.008	2.3	0.45	0.28	42	0.075	0.38	0.64	0.0.076	0.91	1.2	0.03		0.04		297	
Cigar	0.0088	0.37	0.043	4.4	0.29	0.12	0.37	0.47	0.054	0.087	2.4	0.03		0.04			
Sue B	0.0017	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.014	0.035	1.2	0.03		0.04	1.0	2.0	
MUG	8.6E-07	2.2	1.9	0.36	5.7	0.0048	0.091	20	0.070	3.0	1.2	0.03		0.04		585	
Caribou/ MUG/Sue D	0.008	2.3	0.45	0.28	42	0.075	0.38	0.64	0.076	0.91	1.2	0.03		0.04		297	
Contam. Landfill		0.24	16	6.3	23	`	0.54	91	7.1	0.68						6.9	

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Appendix B-III: Source Terms

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1 Source Terms

This appendix documents the source term parameters for arsenic and the other Constituents of concern (COC). There are separate tables for initial pore water concentrations and initial inventories. In general, there are separate tables for each scenario. The arsenic data is listed separately from the data for the other COC. The list of COC is given in Table 1-1 . It has been expanded from the list used in earlier assessments in order to make the list consistent with the list used in other reports.

Table 1-2 through Table 1-6 list the arsenic source term parameters for all the scenarios, except for Scenario 2, “Interim Return to Natural Water Level”. Scenario 2 has not been included in the current update. The scenario numbering scheme has remained the same to allow comparison with the 2013 WR TID. Table 1-7 compares the arsenic source term for the “Approved Case” to the “Future Projects Case”. Table 1-8 through Table 1-11 list the initial pore water concentrations for all COPC. Table 1-12 through Table 1-15 list the leachable inventories for all COPC.

Table 1-1: List of Contaminants Tracked

Trace Metals			**Radionuclides and Major Ions**		
Contaminant	**Chemical Name**	**Units**	**Contaminant**	**Chemical Name**	**Units**
Arsenic	As		Lead-210	^{210}Pb	
Cadmium	Cd		Polonium-210	^{210}Po	
Cobalt	Co		Radium-226	^{226}Ra	
Copper	Cu		Thorium-230	^{230}Th	
Lead	Pb		Ammonium	NH_3/NH_4	
Molybdenum	Mo		Chloride	Cl	
Nickel	Ni		Sulfate	SO_4	
Selenium	Se				
Uranium	U				
Vanadium	V				
Zinc	Zn				

Table 1-2: Arsenic Source Term Parameters for the "Update to Approved Case" (Scenario 1)

Source	Mass	Arsenic Content	Arsenic Inventory	Leachable Mass of Arsenic (a)	Initial Arsenic Pore Water Concentration (b)
	(tonne)	(mg/kg)	(tonne)	(tonne)	(mg/L)
Sue C/A Pit					
JEB	67,544	339	23	1.2	18
Sue C	663,448	148	98	4.0	6.1
Sue A	3,520,684	278	979	47	4.4
Sue E	5,923,907	32	190	5.2	1.3
Caribou	501,105	160	80	3.3	6.7
Contaminated Landfill	**406**	**736**	0.30	0.30	**11**
Cigar	**1,492,506**	**152**	227	9.3	**12**
Sum / Weighted Average	**12,169,600**	**131**	**1597**	**70**	**4.1**
Sue E Pit					
Sue B	3,502,481	62	218	7.1	2.0
McClean Underground [c)]	190,000	40	7.6	0.022	1.1
Sum / Weighted Average	**3,692,481**	**61**	**226**	**7.1**	**2.0**
Midwest Pit					
Midwest	6,000,000	1100	**6600**	768	86
Sum / Weighted Average	**6,000,000**	**1100**	**6600**	**768**	**86**

Note: Bolded values represent updated with quantities, solids content, and pore water measurements obtained since the 2013 Waste Rock TID was published

(a) JEB, Sue C, Sue A, Sue E, Caribou, Cigar, Sue B: Calculated using relationship $S_L = 0.0108S^{1.2654}$ (AREVA 2013b, Appendix B-1)

Midwest: Calculated using relationship $S_L = 0.0168S^{1.2763}$ (AREVA 2011, Appendix VIII)

(b) JEB, Sue C, Caribou, Contaminated Landfill, Sue B, McClean Underground: Calculated using relationship $Co = 0.0096S^{1.2911}$ (AREVA 2009a)

Midwest: Calculated using relationship $Co = 0.123S^{0.935}$ (AREVA 211)

Sue A and Sue E: Based on average of field measurements (AREVA 2013b, Appendix I-G)

Cigar Lake: Based on average of field measurements (Appendix A-II of this document)

(c) McClean Underground data replaced with data from 2013 McClean Underground waste rock testing. Previous calculation was based on a single sample close to the ore body.

Table 1-3: Arsenic Source Term Parameters for the "Future Projects Case" (Scenario 3)

Source	Mass	Arsenic Content	Arsenic Inventory	Leachable Mass of Arsenic	Initial Arsenic Pore Water Concentration
	(tonne)	(mg/kg)	(tonne)	(tonne)	(mg/L)
Sue C/A Pit					
JEB	67,544	339	23	1.2	18
Sue C	663,448	148	98	4.0	6.1
Sue A	3,520,684	278	979	47	4.4
Sue E	5,923,907	32	190	5.2	1.3
McClean Underground, Caribou, Sue D	**804,180**	204	164	**7.3**	9.2
Contaminated Landfill	**406**	**736**	0.30	**0.30**	**11**
Cigar	**1,492,506**	**152**	227	**9.3**	**12**
Sum / Weighted Average	**12,472,675**	**135**	**1681**	**74**	**4.3**
Sue E Pit					
Sue B	**3,502,481**	**62**	**218**	**7.1**	**2.0**
Midwest Pit					
Midwest	6,000,000	1100	**6600**	768	86

Note: Bolded values represent updated with quantities, solids content, and pore water measurements obtained since the 2013 Waste Rock TID was published. Conditions (a), (b), and (c) noted for Table 1-2 apply.

Table 1-4: Arsenic Source Term Parameters for the "Future Projects Case" (Scenario 3A)

Source	Mass	Arsenic Content	Arsenic Inventory	Leachable Mass of Arsenic	Initial Arsenic Pore Water Concentration
	(tonne)	(mg/kg)	(tonne)	(tonne)	(mg/L)
Sue C/A Pit					
JEB	67,544	339	23	1.2	18
Sue C	663,448	148	98	4.0	6.1
Sue A	3,520,684	278	979	47	4.4
Sue E	5,923,907	32	190	5.2	1.3
McClean Underground, Caribou, Sue D	**804,180**	204	164	**7.3**	9.2
Contaminated Landfill	**406**	**736**	0.30	**0.30**	**11**
Operational Process Waste	6089	3500	21	21	3.2
Cigar	**1,492,506**	**152**	227	**9.3**	**12**
Sum / Weighted Average	**12,478,762**	**136**	**1702**	**96**	**4.3**

Table 1-4: Arsenic Source Term Parameters for the "Future Projects Case" (Scenario 3B)

Source	Mass	Arsenic Content	Arsenic Inventory	Leachable Mass of Arsenic	Initial Arsenic Pore Water Concentration
	(tonne)	(mg/kg)	(tonne)	(tonne)	(mg/L)
Sue C/A Pit					
JEB	67,544	339	23	1.2	18
Sue C	663,448	148	98	4.0	6.1
Sue A	3,520,684	278	979	47	4.4
Sue E	5,923,907	32	190	5.2	1.3
McClean Underground, Caribou, Sue D	**804,180**	204	164	**7.3**	9.2
Contaminated Landfill	**406**	**736**	0.30	**0.30**	**11**
Operational Process Waste	6089	3500	21	21	3.2
Cigar	**1,492,506**	**152**	227	**9.3**	**12**
Midwest SABRE Waste[1]	**32,309**	**1100**	36	**4.1**	**86**
Sum / Weighted Average	**12,511,071**	**139**	**1738**	**100**	**4.5**

Table 1-5: Arsenic Source Term Parameters for the "Fully Backfilled Sue C/A Pit Case" (Scenario 4)

Source	Mass	Arsenic Content	Arsenic Inventory	Leachable Mass of Arsenic	Initial Arsenic Pore Water Concentration
	(tonne)	(mg/kg)	(tonne)	(tonne)	(mg/L)
Sue C/A Pit					
JEB	67,544	339	23	1.2	18
Sue C	663,448	148	98	4.0	6.1
Sue A	3,520,684	278	979	47	4.4
Sue E	5,923,907	32	190	5.2	1.3
McClean Underground, Caribou, Sue D	**804,180**	204	164	**7.3**	9.2
Contaminated Landfill	**406**	**736**	0.30	**0.30**	**11**
Cigar	**1,492,506**	**152**	227	**9.3**	**12**
Midwest SABRE	**32,309**	**1100**	36	**4.1**	**86**
Sue C/A Extra backfill	8,843,583	7.7	68	1.3 [1]	0.13 [2]
Sum / Weighted Average	**21,316,080**	**84**	**1785**	**80**	**2.7**

[1] $S_L = 0.0108S^{1.2654}$ (AREVA 2013b, Appendix B-1)

[2] Co = 0.123S0.935 (AREVA 211)

Table 1-6: Comparison of Caribou EIS, 2013 WR TID, and 2021 WR TID "Future Projects Case"

Waste Rock Source	Mass			Arsenic Content			Arsenic Inventory		
	(tonne)			(mg/kg)			(tonne)		
			Sue C/A Pit						
	Caribou EIS	**2013 TID**	**2021 TID**	**Caribou EIS**	**2013 TID**	**2021 TID**	**Caribou EIS**	**2013 TID**	**2021 TID**
JEB	67,544	67,544	67,544	326	339	339	22	23	23
Sue C	595,605	663,448	663,448	148	148	148	88	98	98
Sue A	32,868	3,520,684	3,520,684	1200	278	278	39	978	979
Sue A	1,896,554			130			247		
Sue E	6,369,254	5,923,907	5,923,907	32	32	32	204	190	190
McClean Underground, Caribou, Sue D	501,105	804,180	804,180	160	233	204	80	187	164
Contaminated Landfill			406			736			0.30
Cigar Lake	2,195,000	2,382,600	1,492,506	175	175	152	384	417	227
Sum / Weighted Average	**11,657,930**	**13,362,363**	**12,472,675**	**91**	**142**	**135**	**1,064**	**1,894**	**1681**
			Sue E Pit						
Sue B	24,543	3,502,481	3,502,481	1700	62	62	42	218	**218**
Sue B	2,858,390			160			457		
McClean Underground	190,000			2100			399		
Sum / Weighted Average	**3,072,933**	**3,502,481**	**3,502,481**	**292**	**62**	**62**	**898**	**218**	**218**

Table 1-7 (continued)

Waste Rock Source	Leachable Mass of Arsenic			Initial Arsenic Pore Water Concentration		
	(tonne)			(mg/L)		
Sue C/A Pit						
	Caribou EIS	**2013 TID**	**2021 TID**	**Caribou EIS**	**2013 TID**	**2021 TID**
JEB	1.6	1.2	1.2	17	18	18
Sue C	4.6	4.0	4.0	6.1	6.1	6.1
Sue A	4.5	47	47	91	4.4	4.4
Sue A	12			5.1		
Sue E	6.1	5.2	5.2	0.84	1.3	1.3
McClean Underground, Caribou, Sue D	4.3	8.6	7.3	6.7	11	9.2
Contaminated Landfill			0.30			11
Cigar Lake	22	18	9.3	7.6	7.6	12
Sum / Weighted Average	**55**	**84**	**74**	**3.7**	**4.1**	**4.3**
Sue E Pit						
Sue B	5.4	7.1	7.1	142	2.0	2.0
Sue B	25			6.7		
McClean Underground	56.0			187		
Sum / Weighted Average	**86**	**7.1**	**7.1**	**19**	**2.0**	**2.0**

Table 1-7: Initial Pore Water Concentrations for "Update to Approved Case" (Scenario 1)

Source	Mass	Cd	Co	Cu	Mo	Ni	Pb	Se	U	V	Zn
	(tonne)	*Sue C/A Pit (mg/L)*									
JEB	67,544	0.0056	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.0007	0.035
Sue C	663,448	0.0019	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.002	0.035
Sue A	3,520,684	0.00012	0.21	0.0013	0.40	3.4	6e-4	1.7e-3	0.0094	0.0039	0.075
Sue E	5,923,907	0.00038	0.12	0.0019	0.80	1.7	3.2e-4	0.013	0.055	0.0012	0.090
Caribou	501,105	--0.008	2.3	0.45	0.28	42	0.075	0.38	0.64	0.076--	0.91
Contaminated Landfill	406		0.06	3.7	1.4	5.3	7.7	0.12	20	1.6	0.15
Cigar	1,492,506	0088	0.37	0.043	4.4	0.29	0.12	0.37	0.47	0.054	0.087
Weighted Average		**0.0018**	**0.29**	**0.055**	**1.1**	**3.6**	**0.019**	**0.071**	**0.14**	**0.012**	**0.12**
	(tonne)	**Sue E Pit (mg/L)**									
Sue B	3,502,481	0.0017	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.014	0.035
McClean Underground	190,000	8.58e-7	2.2	1.9	0.36	5.7	0.0048	0.91	20	0.070	3.0
Weighted Average		**0.0016**	**0.59**	**0.57**	**1.2**	**0.48**	**0.0050**	**0.052**	**1.4**	**0.017**	**0.19**

Source	Mass	^{226}Ra	^{210}Pb	^{210}Po	^{230}Th	Cl	SO_4	NH_3 / NH_4
	(tonne)	Sue C/A Pit (Bq/L)				Sue C/A Pit (mg/L)		
JEB	67,544	1.2	0.03		0.04	0.9	4	
Sue C	663,448	1.2	0.03		0.04	0.9	4	
Sue A	3,520,684	0.49	0.039	0.012	0.019	5.1	46	
Sue E	5,923,907	0.81	0.056	0.015	0.020	9.0	127	
Caribou	501,105	1.2	0.03		0.04		297	
Contaminated Landfill	406						6.9	
Cigar	1,492,506	2.4	0.03	--	0.04	-		
Weighted Average		**0.96**	**0.045**	**0.014**	**0.024**	**7.1**	**100**	
	(tonne)	**Sue E Pit (Bq/L)**				**Sue E Pit (mg/L)**		
Sue B	3,502,481	1.2	0.03	--	0.04	1	2	
McClean Underground	190,000	1.2	0.03	--	0.04	--	585-	
Weighted Average		**1.2**	**0.03**	**--**	**0.04**	**0.95**	**32**	

Table 1-8: Initial Pore Water Concentrations (mg/L) for "Future Projects Case" (Scenario 3)

Source	Mass	Cd	Co	Cu	Mo	Ni	Pb	Se	U	V	Zn
	(tonne)	Sue C/A Pit (mg/L)									
JEB	67,544	0.0056	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.0007	0.035
Sue C	663,448	0.0019	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.002	0.035
Sue A	3,520,684	0.00012	0.21	0.0013	0.40	3.4	6e-4	1.7e-3	0.0094	0.0039	0.075
Sue E	5,923,907	0.00038	0.12	0.0019	0.80	1.7	3.2e-4	0.013	0.055	0.0012	0.090
McClean Underground/Caribou/ Sue D	804,180	--0.008	2.3	0.45	0.28	42	0.075	0.38	0.64	0.076--	0.91
Contaminated Landfill	406		0.06	3.7	1.4	5.3	7.7	0.12	20	1.6	0.15
Cigar	1,492,506	0088	0.37	0.043	4.4	0.29	0.12	0.37	0.47	0.054	0.087
Weighted Average	**12,472,675**	**0.0019**	**0.34**	**0.06**	**1.1**	**4.6**	**0.020**	**0.078**	**0.15**	**0.013**	**0.14**
	(tonne)	Sue E Pit (mg/L)									
Sue B	3,502,481	0.0017	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.014	0.035

Source	Mass	^{226}Ra	^{210}Pb	^{210}Po	^{230}Th	Cl	SO_4	NH_3 / NH_4
	(tonne)	Sue C/A Pit (Bq/L)				Sue C/A Pit (mg/L)		
JEB	67,544	1.2	0.03		0.04	0.9	4	
Sue C	663,448	1.2	0.03		0.04	0.9	4	
Sue A	3,520,684	0.49	0.039	0.012	0.019	5.1	46	
Sue E	5,923,907	0.81	0.056	0.015	0.020	9.0	127	
McClean Underground/Caribou/Sue D	804,180	1.2	0.03		0.04		297	
Contaminated Landfill	406						6.9	
Cigar	1,492,506	2.4	0.03		0.04			
Weighted Average		**0.96**	**0.045**	**0.014**	**0.025**	**7.1**	**106**	
	(tonne)	Sue E Pit (Bq/L)				Sue E Pit (mg/L)		
Sue B	3,502,481	1.2	0.03		0.04	1.0	2.0	

Table 1-9: Initial Pore Water Concentrations (mg/L) for "Fully Backfilled Sue C/A Pit" (Scenario 4)

Source	Mass	Cd	Co	Cu	Mo	Ni	Pb	Se	U	V	Zn
	(tonne)	Sue C/A Pit (mg/L)									
JEB	67,544	0.0056	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.0007	0.035
Sue C	663,448	0.0019	0.5	0.5	1.2	0.2	0.005	0.05	0.35	0.002	0.035
Sue A	3,520,684	0.00012	0.21	0.0013	0.40	3.4	6e-4	1.7e-3	0.0094	0.0039	0.075
Sue E	5,923,907	0.00038	0.12	0.0019	0.80	1.7	3.2e-4	0.013	0.055	0.0012	0.090
McClean Underground/Caribou/ Sue D	804,180	--0.008	2.3	0.45	0.28	42	0.075	0.38	0.64	0.076--	0.91
Contaminated Landfill	406		0.055	3.7	1.4	5.3	7.7	0.12	21	1.6	0.15
Cigar	1,492,506	0088	0.37	0.043	4.4	0.29	0.12	0.37	0.47	0.054	0.087
Sue C/A Extra	8,843,583	0.0019	0.34	0.065	1.1	4.6	0.020	0.078	0.15	0.013	0.14
Weighted Average	**21,316,258**	**0.0019**	**0.34**	**0.065**	**1.1**	**4.6**	**0.020**	**0.078**	**0.15**	**0.013**	**0.14**

Source	Mass	^{226}Ra	^{210}Pb	^{210}Po	^{230}Th	Cl	SO_4	NH_3 / NH_4
	(tonne)	Sue C/A Pit (Bq/L)				Sue C/A Pit (mg/L)		
JEB	67,544	1.2	0.03		0.04	0.9	4	
Sue C	663,448	1.2	0.03		0.04	0.9	4	
Sue A	3,520,684	0.49	0.039	0.012	0.019	5.1	46	
Sue E	5,923,907	0.81	0.056	0.015	0.020	9.0	127	
McClean Underground/Caribou/ Sue D	804,180	1.2	0.03		0.04		297	
Contaminated Landfill	406						6.9	
Cigar	1,492,506	2.4	0.03		0.04			
Sue C/A Extra Backfill	8,843,583	0.96	0.045	0.014	0.025	7.1	106	
Weighted Average		**1.0**	**0.048**	**0.012**	**0.027**	**7.1**	**106**	

Table 1-10: Initial Pore Water Concentrations for Midwest (Scenario 5)

Trace Metals			Radionuclides and Major Ions		
Chemical Name	**Units**	**Initial Pore Water Concentration**	**Chemical Name**	**Units**	**Initial Pore Water Concentration**
As	mg/L	86			
Cd	mg/L	0.001	^{226}Ra	Bq/L	1.2
Co	mg/L	73	^{210}Pb	Bq/L	0.03
Cu	mg/L	0.4	^{210}Po	Bq/L	
Mo	mg/L	7.3	^{230}Th	Bq/L	0.04
Ni	mg/L	115	NH_3/NH_4	mg/L	
Pb	mg/L	0.1	Cl	mg/L	
Se	mg/L	0.3	SO4	mg/L	20
U	mg/L	0.3			
V	mg/L	0.0068			
Zn	mg/L	2.7			

Table 1-11: Leachable Inventory for "Update to Approved Case" (Scenario 1)

Source	Mass	Cd	Co	Cu	Mo	Ni	Pb	Se	U	V	Zn
	(tonne)	Sue C/A Pit (tonne)									
JEB	67,544	0.0092	0.015	0.031	0.24	0.29	0.032	0.0013	0.35	0.29	0.048
Sue C	663,448	0.10	0.050	0.090	3.7	1.4	0.26	0.010	3.2	2.1	0.23
Sue A	3,520,684	0.17	0.39	2.2	10	8.9	11	4.1	1.2	4.5	1.8
Sue E	5,923,907		0.83	5.2	18	26	1.3	8.8	8.4		4.0
Caribou	501,105		2.9	0.69	0.25	14	0.0026	0.0	1.2		0.36
Contaminated Landfill	406		0.0015	0.10	0.039	0.15	0.21	0.0033	0.56	0.044	0.0042
Cigar	1,492,506	0.0032	0.49	0.20	1.8	0.88	0.28	0.16	0.039	0.25	1.2
Sum	**12,169,600**	**0.28**	**4.7**	**8.5**	**35**	**52**	**13**	**13**	**15**	**7.1**	**7.7**
		Sue E Pit (tonne)									
Sue B	3,502,481	0.079	0.58	2.2	29	2.6	3.1	5.5	0.74	3.8	2.6
McClean Underground	190,000	1.7E-07	0.43	0.37	0.070	1.1	0.0009	0.018	3.9	0.014	0.57
Sum	**3,629,481**	**7.9E-02**	**1.0**	**2.6**	**29**	**3.7**	**3.1**	**5.5**	**4.6**	**3.8**	**3.2**

Source	Mass	^{226}Ra	^{210}Pb	^{210}Po	^{230}Th	Cl	SO_4	NH_3 / NH_4
	(tonne)	Sue C/A Pit (MBq)				Sue C/A Pit (tonne)		
JEB	67,544	8.6E+03	9.1E+03		6.1E+03			
Sue C	663,448	1.0E+05	9.0E+04		7.0E+04			
Sue A	3,520,684	1.9+04	2.0E+04		1.5E+04			
Sue E	5,923,907	6.1E+04	6.1E+04		5.5E+04			
Caribou	501,105	1.4E+04	1.4E+04		1.2E+04		--110	
Contaminated Landfill	406						0.043	
Cigar	1,492,506	1.2E+03	2.2E+03		2.24E+03		--	
Sum	**12,169,600**	**2.0E+05**	**2.0E+05**		**1.6E+05**		**110**	
	(tonne)	***Sue E Pit (MBq)***				***Sue E Pit (tonne)***		
Sue B	3,502,481	1.7E+04	1.7E+04		1.7E+04			
McClean Underground	190,000	1.7E+04	1.7E+04		1.7E+04		114	
Sum	**3,629,481**	**3.4E+04**	**3.4E+04**		**3.4E+04**		**114**	

Table 1-12: Leachable Inventory for "Future Projects Case" (Scenario 3)

Source	Mass	Cd	Co	Cu	Mo	Ni	Pb	Se	U	V	Zn
	(tonne)	**Sue C/A Pit (tonne)**									
JEB	67,544	0.0092	0.015	0.031	0.24	0.29	0.032	0.0013	0.35	0.29	0.048
Sue C	663,448	0.10	0.050	0.090	3.7	1.4	0.26	0.010	3.2	2.1	0.23
Sue A	3,520,684	0.17	0.39	2.2	10	8.9	11	4.1	1.2	4.5	1.8
Sue E	5,923,907		0.83	5.2	18	26	1.3	8.8	8.4		4.0
McClean Underground/ Caribou/Sue D	804,180	0.001	6.9	2.0	0.9	12	2.1	0.2	6.3	7.1	1.6
Contaminated Landfill	406		0.0015	0.10	0.039	0.15	0.21	0.0033	0.56	0.044	0.0042
Cigar	1,492,506	0.0032	0.49	0.20	1.8	0.88	0.28	0.16	0.039	0.25	1.2
Sum	**12,472,675**	**0.28**	**8.7**	**9.9**	**35**	**49**	**15**	**13**	**20**	**14**	**9.0**
	(tonne)	**Sue E Pit (tonne)**									
Sue B	3,502,481	0.079	0.58	2.2	29	2.6	3.1	5.5	0.74	3.8	2.6

Source	Mass	^{226}Ra	^{210}Pb	^{210}Po	^{230}Th	Cl	SO_4	NH_3 NH_4
	(tonne)	**Sue C/A Pi (MBq)**				**Sue C/A Pit (tonne)**		
JEB	67,544	8.6E+03	9.1E+03		6.1E+03			
Sue C	663,448	1.0E+05	9.0E+04		7.0E+04			
Sue A	3,520,684	1.9E+04	2.0E+04		1.6E+04			
Sue E	5,933,907	6.1E+04	6.1E+04		5.5E+04			
McClean Underground/Caribou/Sue D	804,180	2.2E+04	2.2E+04		1.9E+04		660	
Contaminated Landfill	406						0.043	
Cigar	1,492,506	1.9E+03	2.2E+03		2.2E+03			
Sum	**12,472,675**	**2.1 E+05**	**2.0E+05**		**1.7E+05**		**660--**	
	(tonne)	**Sue E Pit (MBq)**				**Sue E Pit (tonne)**		
Sue B	3,502,481	1.7E+04	1.7E+04		1.7E+04			

Table 1-13: Leachable Inventory for "Fully Backfilled Sue C/A Pit Case" (Scenario 4)

Source	Mass	Cd	Co	Cu	Mo	Ni	Pb	Se	U	V	Zn
	(tonne)	*Sue C/A Pit (tonne)*									
JEB	67,544	0.0092	0.015	0.031	0.24	0.29	0.032	0.0013	0.35	0.29	0.048
Sue C	663,448	0.10	0.050	0.090	3.7	1.4	0.26	0.010	3.2	2.1	0.23
Sue A	3,520,684	0.17	0.39	2.2	10	8.9	11	4.1	1.2	4.5	1.8
Sue E	5,933,907		0.83	5.2	18	26	1.3	8.8	8.4		4.0
McClean Underground/Caribou/Sue D	804,180	0.001	6.9	2.0	0.94	12	2.1	0.18	6.3	7.1	1.6
Contaminated Landfill			0.0015	0.10	0.039	0.15	0.21	0.0033	0.56	0.04	0.0042
Cigar	1,492,506	0.0032	0.49	0.20	1.8	0.88	0.28	0.16	0.039	0.25	1.2
Sue C/A Extra	8,843,583	0.38	3.2	11	29	53	19	29	15	19	7.1
Sum	**21,316,258**	**0.66**	**12**	**21**	**64**	**103**	**34**	**42**	**34**	**34**	**16**

Source	Mass	^{226}Ra	^{210}Pb	^{210}Po	^{230}Th	Cl	SO_4	NH_3 / NH_4
	(tonne)	*Sue C/A Pit (MBq)*				*Sue C/A Pit (tonne)*		
JEB	67,544	8.6E+03	9.1E+03		6.1E+03			
Sue C	663,448	1.0E+04	9.0E+04		7.0E+04			
Sue A	3,520,684	1.9E+04	2.0E+04		1.5E+04			
Sue E	5,933,907	6.1E+04	6.1E+04		5.5E+04			
McClean Underground/Caribou/ Sue D	804,180	2.2E+04	2.2E+04		1.9E+04		660	
Contaminated Landfill	406						0.043	
Cigar	1,492,506	1.2E+03	2.2E+03		2.2E+03			
Sue C/A Extra	8,843,583	1.4E+05	1.5E+05		1.2E+05		906	
Sum	**21,316,258**	3.5E+05	3.5E+05		2.9E+05		**1,566**	

Table 1-14: Leachable Inventory for trace Metals, Radionuclides, and Major Ions – Midwest

Trace Metals			Radionuclides and Major Ions		
Chemical Name	**Units**	**Leachable Inventory**	**Chemical Name**	**Units**	**Leachable Inventory**
Cd	tonne		^{226}Ra	MBq	1.4E+05
Co	tonne	36	^{210}Pb	MBq	
Cu	tonne	62	^{210}Po	MBq	
Mo	tonne	58	^{230}Th	MBq	8.1E+04
Ni	tonne	56	NH_3/NH_4	tonne	
Pb	tonne	31	Cl	tonne	
Se	tonne	0.02	SO4	tonne	
U	tonne	23			
V	tonne				
Zn	tonne	66			

Appendix B-IV: Partition Coefficients

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1 Partition Coefficients

As typically used in contaminant transport calculations, the K_d is defined as the ratio of the contaminant concentration associated with the solid to the contaminant concentration in the surrounding aqueous solution when the system is at equilibrium. The K_d parameter is important to understanding the fate and transport of dissolved contaminants in groundwater. In this context, the term sorption is a generic term including all mechanisms by which a contaminant can be associated with the solid phase. These include being adsorbed on to the surface of a solid, absorbed into the structure of a solid, precipitated as a 3-dimensional molecular structure on the surface of the solid, or partitioned into the organic matter. It is known that use of generic or default K_d values can result in significant error when used to predict the impact of contaminant migration. Therefore, it is important, wherever possible, to use partition coefficients measured at site-specific conditions.

Values for K_d vary between contaminants and also vary as a function of aqueous and solid phase chemistry. The K_d model is based on a linear isotherm which implies that the sorption is independent of contaminant concentration. In general, it is valid only for low contaminant concentrations, i.e. at a distance from the contaminant source. Other sorption isotherms that account for non-linear behaviour are the Freundlich isotherm or the Langmuir isotherms. The Freundlich isotherm is a power law isotherm characterized by a coefficient, K_f and a concentration exponent, ε. The Langmuir isotherm has the advantage of correctly accounting for finite sorption capacity at high concentrations of solute.

A number of issues exist concerning the measurement of K_d values and the selection of K_d values from the literature. These issues include:

- using simple versus complex geologic materials as absorbents,
- porous media heterogeneities on a field scale,
- the “gravel” issue,
- the “colloid issue”, and
- the particle concentration effect.

The use of simplified systems containing single mineral phases and aqueous phases with 1 or 2 dissolved species provides an understanding of the sorption processes in more complex, natural systems. However, the K_d values generated from these simple systems are generally of little value for importing directly into transport models. Values for transport models should be generated from materials from or similar to the study site. The “gravel issue” is the problem of converting laboratory-derived K_d values based on experiments using the less than 2-mm fraction into values that can be used in systems containing particles greater than 2 mm in size. No standard methods exist to address this issue. The “colloid issue” refers to the fact that components of the solid phase may exist as colloids and be transported with the groundwater. Some investigators have observed that K_d values determined in the laboratory often decrease as the ratio of solid to solution used in the measurements increases. However, from a theoretical perspective, a K_d value should not depend on the solid-to-solution ratio.

1.1 Laboratory Measurements

The most common method used to measure K_d values is the laboratory batch method. However other methods such as the in-situ batch method, the laboratory column method, and the field pilot method are used. Each method has advantages and disadvantages, and each method has its own set of assumptions for calculating K_d values from experimental data. Consequently, it is expected that K_d values measured by different methods will produce different values.

This section provides a short description of the laboratory measurements done for soil and rock materials which are characteristic of those found in the vicinity of the McClean and Midwest sites. Table 1-1 summarizes the data gathered for each of these site-specific studies.

1.1.1 Key Lake Site

Laboratory batch tests were carried out for Key Lake soil and rock in 1981 (Knight and Piesold 1981). Sand, till, and Athabasca sandstone were analyzed. Testing was done with leachate at a range of pH values; 3.9-4.7 for sand, 5.0-6.4 for till, and 5.5-6.5 for Athabasca sandstone.

The National Uranium Tailings Program (NUTP), funded by the Federal Government, was a 5-year program with a mandate to investigate the long-term significance of various methods of management of uranium mine tailings in Canada. One part of the program was to carry out a series of laboratory and field investigations that would collect data on fundamental environmental processes. The Key Lake site was included as one site to be investigated. Distribution coefficients for arsenic, molybdenum, nickel, uranium, zinc, thorium-230, and radium-226 were measured as part of the program. Details of the testing procedures are not available.

Laboratory batch tests were also done on Key Lake filter sand for radium-226 and arsenic (Golder 1993). The sorption isotherm was found to be linear and essentially irreversible for radium-226, and non-linear and reversible for arsenic. Testing was done with tailings leachate at a pH of 11.8.

1.1.2 Rabbit Lake Site

Laboratory batch tests were carried out on Rabbit Lake filter sand (Golder 1994). In this case, the sorption isotherm was found to be linear/irreversible for radium-226 and nickel, and linear/reversible for arsenic. Testing was completed with tailings leachate at a pH of 7 to 8.

Additional laboratory testing was done on other site-specific soils/rock for Rabbit Lake (Golder 1999). Arsenic and radium-226 were considered the main solutes of concern. Batch sorption/desorption tests were completed for filter sand, overburden (till), sandstone and faulted rock materials from the Rabbit Lake pit area. The sorption characteristics for radium-226 were fitted to a linear isotherm (K_d), but arsenic sorption was more characteristic of a Freundlich isotherm (K_f and ε). However, a linear isotherm was recommended for modelling of arsenic transport since it would be conservative. Desorption tests carried out on the filter sand showed little desorption for arsenic and no desorption for radium-226. Tests were carried out at a pH of ~7 for the overburden and sandstone materials, at a pH of ~8 for the faulted rock, and at a pH of ~9 for the filter sand.

1.1.3 Midwest Site

Distribution coefficients were measured for arsenic, molybdenum, nickel, and radium-226 for soil samples collected in the vicinity of the Midwest Lake Project. The experimental procedure used is described in Supporting Document V, Appendix D of the MJV EIS (MJV 1991). Four soil types were tested. A stock equilibrium solution was prepared from each soil type. The pH level in the stock solutions varied from 7, for the till and sand, to 8, for the till with bentonite and for the Athabasca sandstone. Contaminant levels used in the experimental procedure were selected to simulate freshly discharged tailings solution.

Two duplicate runs were carried out. Two K_d estimates were determined for each analyte. For radium-226, the measured K_d's are lowest for till, slightly higher for sand, significantly higher for Athabasca sandstone, and highest for the till-bentonite mixture. Nickel follows the same trend, except that the highest K_d is for Athabasca sandstone. Arsenic and molybdenum follow an opposite trend. For these analytes the highest K_d's are for till; while adding bentonite to the till does not increase the K_d.

1.1.4 Cigar Lake Site

Distribution coefficients were measured for arsenic and radium-226. The experimental procedure used is described in Appendix G of Supporting Document 4A of the 1995 Midwest EIS (COGEMA 1995). Core samples of Athabasca sandstone taken at depths of 24 m and 44.5 m were tested. Tailings leachate was used for the testing at a pH of 7. The sandstone tested was collected in the vicinity of the Cigar Lake Tailings Management Facility.

Five successive samples were analyzed over a range of solution concentrations. An upper and lower estimate was determined for the K_d of arsenic and radium-226. Desorption batch tests were also performed, and the process was found to be irreversible.

1.1.5 McClean Lake JEB Site

Sorption testing was performed on drift and sandstone samples to estimate the sorption capacity of arsenic and radium-226. The testing was done with three different initial aqueous solution concentrations: 2.0, 10, and 20 mg/L for arsenic and 0.1, 1.0, and 5.0 Bq/L for radium-226. The pH of the test solution was adjusted to 7. The experimental procedure used is described in Appendix G of the JEB TMF document (COGEMA 1997). Samples were tested in triplicate. Both drift samples and sandstone samples were subjected to a static test (no agitation). The drift samples were also subjected to a test involving either vibration or agitation.

1.1.6 McClean Lake Sue Site

No site-specific tests have been done for soil or rock from the Sue site.

1.2 Literature Surveys

1.2.1 AECL Survey

Thibault et al (1990) documented distribution coefficients from literature sources for the four major soil types found in the Canadian Shield. This study was done as part of the project for geological containment of spent nuclear fuel. Data was acquired from literature sources, where available. If no data existed in the literature for a given element, then soil-to-plant concentration ratio was used as a means to predict a default K_d. Values for molybdenum, nickel, radium, and uranium are given in Table 1-1.

1.2.2 US Environmental Protection Agency (EPA) Survey

In 1999 the US Environmental Protection Agency (US EPA 1999) prepared a two-volume report designed to provide EPA and other environmental remediation professionals with a discussion of the major issues related to the selection and measurement of the partition coefficient for a select group of contaminants. The selected contaminants investigated in Volume II of this study included: chromium, cadmium, cesium, lead, plutonium, radon, strontium, thorium, tritium (^3H), and uranium. In 2004 an additional volume was published (US EPA 2004) which included a discussion of americium, arsenic, curium, iodine, neptunium, radium, and technetium.

The main focus of the study was to develop look-up tables for use in contaminant transport models. In K_d look-up tables, separate K_d values are assigned to a matrix of discrete categories defined by chemically important ancillary parameters, such as pH and soil texture. The study produced a wide range of K_d values for the contaminants studied over many different soil and geochemical parameter scenarios. For transport modelling, the K_d s used should represent the local conditions. Therefore, the K_d s reported in Table 1- 1 are those that apply to local conditions.

2 Distribution Coefficients used in Transport Calculations

The distribution coefficients used for contaminant transport calculations in sandstone which have been used in the various regulatory documents are shown in Table 2.1. All regulatory documents published since 2004 have used the same approach for estimating K_d values.

The distribution coefficient (K_d) values for sandstone and sand at the Cigar Lake, Key Lake and Midwest sites range from 1 L/kg to 128 L/kg for arsenic. Given the absence of McClean Sue site-specific data, arsenic K_d was conservatively assumed to be 1 L/kg for this site.

Table 1-1: Distribution Coefficient Measurements

Soil/Rock Type	K_d (L/kg)						Comments
	As	Mo	Ni	U	Th-230	Ra-226	
Key Lake Site							
sand	92 *(46 -184)*		0			6 *(4 - 9)*	Knight and Piesold 1981. Published in Cameco 1995, Appendix 4, Sub-Appendix A, Table 11. Geometric mean values. Observed range of values in brackets.
till	66 *(33 -132)*		0			32 *(16 - 24)*	
Athabasca sandstone	64 *(32 -128)*		2 *(0 -10)*			11 *(5 - 20)*	
sand	92	49	0	0	5	6	NUTP 1986. Published in MJV EIS 1991, Table 5.5.11.5.
glacial till + 3% bentonite	37	2	2	54	9	130	
till	66	7	0	30	1	32	
Athabasca sandstone	64	28	2	18	5	11	
filter sand	8.0 - 20					25	Golder 1993. Published in Cameco 2006, Appendix E2, Table 3.2.7.
Rabbit Lake Site							
filter sand	2.0 - 13		3 - 7			30 - 40	Golder 1994. Published in Cameco 2006, Appendix E2, Table 3.2.7.
overburden (till)	1.1-4.3 *(2.9)*					780 - 1100 *(867)*	Golder 1999 Values in brackets are averages. Published in Cameco 2006, Appendix E2, Table 3.2.9.
sandstone	0.3 - 2.1 *(1.5)*					36 - 62 *(43)*	
faulted rock	0.6 - 1.3 *(1.1)*					55 - 200 *(100)*	
filter sand	0.9 - 1.2 *(1.1)*					28 - 38 *(34)*	

Soil/Rock Type	K_d (L/kg)						Comments
	As	Mo	Ni	U	Th-230	Ra-226	
Midwest Site							
till	57, 52 *(1.2, 1.3)*	24, 29 *(1.7, 1.4)*	0.7, 0.7 *(18, 18)*			26, 24 *(9700,10400)*	MJV EIS 1991, Supporting Document V, Volume 2, Appendix D. Values in brackets represent the equilibrium aqueous solution concentration (mg/L or pCi/L).
sand	47, 46 *(1.4, 1.4)*	6, 4 *(4.7, 5.5)*	1.3, 1.4 *(16,15)*			27, 34 *(9290, 7630*	
till + 3% bentonite	16, 13 *(3.9, 5.5)*	<0.3, <0.3 *(12, 11)*	31, 67 *(1.6,1.0)*			300,320 *(990, 920)*	
Athabasca sandstone	2.5, 2.1 *(11, 11)*	<0.3, 0.3 *(11, 12)*	88, 75 *(0.75,0.76)*			97, 105 *(2940,2740)*	
Cigar Lake Site							
tan sandstone (24 m depth)	1.0 - 2.4 *(0 - 2.5)*					3.8 - 5.5 *(0 - 8)*	COGEMA 1995, Supporting Document 4A, Appendix G, Table G-7. Range of validity in brackets (mg/L or pCi/L).
reddish sandstone (44.5 m depth)	1.0 - 2.1 *(0 - 2.5)*					3.7 - 6.1 *(0 - 8)*	
McClean Lake – JEB Pit Site							
drift	1.1 - 1.5 *(0 - 18)*					100 *(0 - 0.6)*	COGEMA 1997, Appendix G, Table 5.3. Laboratory tests of site-specific materials. Range of validity shown in brackets (mg/L or Bq/L).
silicified sandstone	1.1 *(0 - 18)*					25 *(0.1 - 1.9)*	
altered sandstone	1.0 *(0 - 18)*					50 *(0.1 - 1.9)*	
AECL Literature Survey							
sand		10 *(1 - 52)*	400 *(60-3,600)*	35 *(0.03-2,200)*		500 *(57-21,000)*	Thibault 1990. K_d's compiled for typical Canadian Shield soils. Geometric mean values shown. Observed range of values in brackets.
silt		125	300	15 *(0.2-4,500)*		36 *(1,262-530,000)*	
clay		90 *(13-400)*	650 *(305-2,467)*	1,600 *(46-395,100)*		9,100 *(696-56,000)*	
organic		25 *(18-50)*	1,100 *(360-4,700)*	410 *(33 – 7,350)*		2,400	

Table 2.1: Distribution Coefficients used in Regulatory Documents

			Sandstone K_d's (L/kg)												
	As	**Cl**	**Co**	**Cu**	**Mo**	**Ni**	**Pb**	**Se**	**SO4**	**U**	**Zn**	**Pb-210**	**Po-210**	**Ra-226**	**Th-230**
MJV EIS (August 1991)[1]	2	-	-	-	0	2	-	-	0	-	-	-	-	11	5
JEB TMF (December 1997)[2]	1	-	-	-	-	-	-	-	0	-	-	-	-	50	-
Application for Approval to Operate Sue Open Pits and Associated Facilities (June 1999)[3]	1	-	-	2	0.3	2	-	-	0	2	2	-	-	2	-
Disposal of Cigar Lake WR EIS (August 2001)[4]	1	-	-	2	0.3	2	-	-	0	2	2	-	-	10	-
WR TID (March 2004)[5]	1	0	1	1	1	1	1	1	0	1	1	-	-	3.8	1
Sue E EIS (November 2004)[6]	1	0	1	1	1	1	1	1	0	1	1	-	-	3.8	1
Caribou EIS (February 2009)[7]	1	-	1	1	1	1	1	1	-	1	1	-	-	3.8	1
Midwest Project EIS (September 2011)[8]															
- **JEB Site**	1	-	1	1	1	2	1	1	-	1	1	1	1	50	1
- **Midwest Site**	1	-	1	1	1	1	1	1	-	1	1	-	-	3.8	1

[1] Source: MJV 1991, Supporting Document V, Appendix D, Table K4.2
[2] Source: COGEMA 1997, Table 12.2.5-1
[3] Source: COGEMA 1999, Appendix I, Table 5.1.3
[4] Source: COGEMA and CLMC (2001), Appendix II, Table 3.8
[5] Source: COGEMA 2004a, Table 5.1-3.
[6] Source: COGEMA 2004b, Appendix IX, Table 4.10
[7] Source: AREVA 2009, Appendix VIIIB, Table 4.10
[8] Source: AREVA 2011, Appendix XI, Table 2.5

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Appendix B-V: Clean Waste Stockpile Calculations

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1 Clean Waste Stockpile Calculations

Clean waste stockpile pore water concentrations were updated based on the most recent piezometer data. The stockpile pore water concentrations are documented in Appendix AI.6 and reproduced in Table 4-14 of Part A. Peak incremental mass flux, peak incremental concentration, and the resulting impact on surface water bodies are calculated in this appendix using Base Case and Upper Bound Case source terms.

1.1 Base Case Source term modelling Estimates

The Base Case source term pore water concentrations are given in Table 4-14 of Part A and in Appendix AI.6. The Base Case source term pore water concentrations represent the average stockpile piezometer concentration in each of the respective clean waste rock stockpiles.

1.1.1 JEB Clean Waste Stockpile

The resulting peak incremental mass flux and peak incremental concentration to receptors are shown in Table 1 for the Base Case source term modelling. The baseline concentrations and total incremental concentrations reporting to receptors are shown inTable 2.

Table 1: Peak Incremental Mass Flux and Peak Incremental Concentration due to the JEB Clean Waste Stockpile

COC	Incremental Mass Flux (g/year or Bq/year)			Incremental Concentration (μg/L or Bq/L)		
	Pat Lake	Fox Lake	Johannes Lake	Pat Lake	Fox Lake	Johannes Lake
As	0.23	1.3	0.44	3.4E-05	2.2E-04	7.4E-05
Cd	0.030	0.17	0.57	4.4E-06	2.9E-05	9.6E-06
Co	1.2	6.4	2.2	1.7E-04	1.1E-03	3.7E-04
Cu	2.3	13	4.4	3.4E-04	2.2E-03	7.4E-04
Mo	0.23	1.3	0.4	3.4E-05	2.2E-04	7.4E-05
Ni	3.4	19	6.6	5.1E-04	3.3E-03	1.1E-03
Pb	0.39	2.2	0.74	5.8E-05	3.8E-04	1.3E-04
Se	0.23	1.3	0.44	3.4E-05	2.2E-04	7.4E-05
U	1.5	8.4	2.8	2.2E-04	1.4E-03	4.8E-04
V	1.1	6.1	2.1	1.6E-04	1.0E-03	3.5E-04
Zn	4.6	26	8.8	6.8E-04	4.4E-03	1.5E-03
^{226}Ra	3.7E+04	2.1E+05	7.0E+04	5.5E-06	3.6E-05	1.2E-05
^{210}Pb	5.5E+04	3.1E+05	1.1E+05	8.2E-06	5.3E-05	1.8E-05
^{210}Po	1.2E+04	6.6E+04	2.2E+04	1.7E-06	1.1E-05	3.8E-06
^{230}Th	3.0E+04	1.7E+05	5.7E+04	4.4E-06	2.9E-05	9.6E-06
Cl	4,811	27,077	9,196	0.72	4.7	1.6
SO_4	19,474	109,599	37,222	2.9	19	6.3
NH_3 / NH_4	124	696	236	0.018	0.12	0.040

Table 2: Baseline Concentrations and Peak Incremental Concentration in Receptors for JEB Clean Waste Rock Pile

COC	Baseline (1) (µg/L or Bq/L)			Resulting Peak Concentrations (µg/L or Bq/L)		
	Pat Lake	Fox Lake	Johannes Lake	Pat Lake	Fox Lake	Johannes Lake
As	0.74	0.52	0.59	0.74	0.52	0.59
Cd	1	1	1	1	1	1
Co	1	1	1	1	1	1
Cu	2	2	2	2	2	2
Mo	5	11	5	5	11	5
Ni	3	3	2	3	3	2
Pb	6	5	6	6	5	6
Se	1	1	1	1	1	1
U	0.6	0.6	0.5	0.6	0.6	0.5
V	10	10	10	10	10	10
Zn	6	6	5	6	6	5
^{226}Ra	0.006	0.005	0.006	0.006	0.005	0.006
^{210}Pb	0.02	0.02	0.02	0.02	0.02	0.02
^{210}Po	0.006	0.008	0.008	0.006	0.008	0.008
^{230}Th	0.013	0.012	0.017	0.013	0.012	0.017
Cl	120	133	120	121	138	122
SO_4	710	630	570	713	652	576
NH_3 / NH_4	14	21	10	14	21	10

(1) Baseline values taken from Tables 4.3-3, 4.3-4, 4.3-5, 4.3-6 of Existing Environment TID (COGEMA 2003)

Peak incremental concentration in Fox Lake, Pat Lake, and Johannes Lake are shown on Figure 1-1. The Baseline concentrations are shown for comparison. The peak incremental concentrations are smaller than the baseline values by several orders of magnitude.

1.1.2 Sue C Clean Waste Stockpile

The pore water concentrations for the Sue C clean waste stockpile are documented in Table 4-14 of Part A. The peak incremental mass flux and peak incremental concentration reporting to receptors are shown in Table 3. The baseline concentrations and resulting total incremental concentrations reporting to receptors are shown in Table 4.

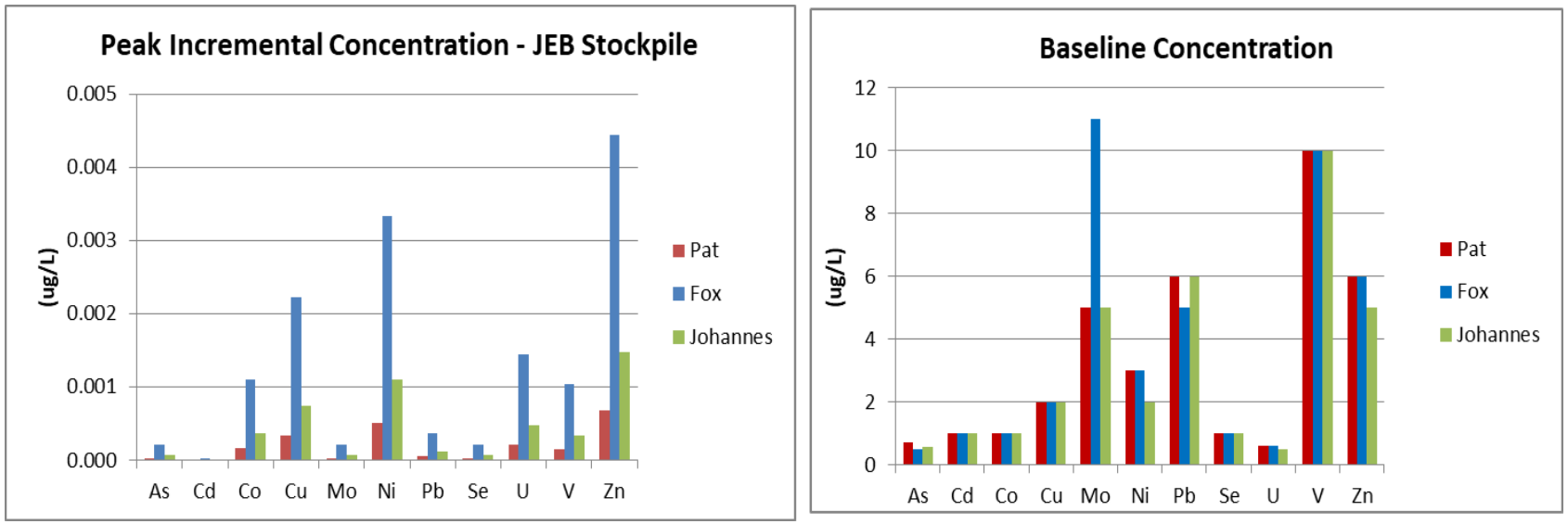


Figure 1: Impact of JEB Clean Waste Stockpile on Surface Water Receptors.

Table 3: Peak Incremental Mass Flux and Peak Incremental Concentration due to the Sue C Clean Waste Stockpile

COC	Peak Incremental Mass Flux (g/year or Bq/year)					Peak Incremental Concentration (µg/L or Bq/L)				
	McClean Lake	Candy Lake	Moffat Lake	Vulture Lake	Sue B Pit	McClean Lake	Candy Lake	Moffat Lake	Vulture Lake	Sue B Pit
As	0.24	7.6	26	0.24	2.2	4.9E-06	0.0047	0.0097	1.4E-04	0.050
Cd	0.16	5.1	18	0.16	1.4	3.3E-06	0.0032	0.0065	9.2E-05	0.034
Co	3.4	107	369	3.3	30	6.8E-05	0.066	0.14	0.0019	0.7
Cu	1.9	61	211	1.9	17	3.9E-05	0.038	0.078	1.1E-03	0.40
Mo	0.024	0.76	2.6	0.024	0.22	4.9E-07	4.7E-04	9.7E-04	1.4E-05	0.0050
Ni	34	1,068	3,692	33	302	6.8E-04	0.66	1.4	0.019	7.1
Pb	0.19	6	20	0.18	1.7	3.7E-06	0.004	0.007	1.1E-04	0.04
Se	1.9	59	206	1.9	17	3.8E-05	0.037	0.076	0.0011	0.39
U	0.22	7	24	0.22	2.0	4.5E-06	0.0044	0.0089	1.3E-04	0.046
V	0.024	0.76	2.6	0.024	0.22	4.9E-07	4.7E-04	9.7E-04	1.4E-05	0.0050
Zn	5.1	160	554	5.0	45	1.0E-04	0.100	0.20	0.0029	1.06
^{226}Ra	7.0E+04	2.2E+06	7.6E+06	6.9E+04	6.2E+05	1.4E-06	1.4E-03	2.8E-03	4.0E-05	1.5E-02
^{210}Pb	1.1E+04	3.4E+05	1.2E+06	1.1E+04	9.7E+04	2.2E-07	2.1E-04	4.4E-04	6.2E-06	2.3E-03
^{210}Po	1.7E+03	5.3E+04	1.8E+05	1.7E+03	1.5E+04	3.4E-08	3.3E-05	6.8E-05	9.6E-07	3.5E-04
^{230}Th	2.4E+03	7.6E+04	2.6E+05	2.4E+03	2.2E+04	4.9E-08	4.7E-05	9.7E-05	1.4E-06	5.0E-04
Cl	774	24,403	84,390	762	6,893	0.016	15	31	0.44	161
SO_4	12,052	379,775	1,313,326	11,852	107,269	0.24	236	484	6.8	2,512
NH_3 / NH_4	653	20,590	71,204	643	5,816	0.0131	13	26.3	0.370	136

Table 4: Baseline Concentrations and Peak Incremental Concentration in Receptors for Sue C Clean Waste Rock Pile

COC	Baseline [1] (µg/L or Bq/L)				Resulting Peak Concentrations (µg/L or Bq/L)			
	McClean Lake	Candy Lake	Moffat Lake	Vulture Lake	McClean Lake	Candy Lake	Moffat Lake	Vulture Lake
As	0.66	0.5	0.5	0.67	0.66	0.5	0.5	0.67
Cd	1	1	--	1	1	1	--	1
Co	1	1	1	1	1	1	1	1
Cu	1	1	1	2	1	1	1	2
Mo	5	1	5	5	5	1	5	5
Ni	2	1	1	2	2	2	2	2
Pb	5	2	5	5	5	2	5	5
Se	1	1	1	1	1	1	**1.1**	1
U	0.7	0.7	0.5	0.6	0.7	0.7	0.5	0.6
V	10	1	--	10	10	1	--	10
Zn	6	5	2	6	6	5	2	6
^{226}Ra	0.005	0.005	0.005	0.005	0.005	**0.006**	**0.008**	0.005
^{210}Pb	0.02	0.03	0.02	0.02	0.020	0.030	0.020	0.020
^{210}Po	0.007	0.008	--	0.007	0.007	0.008	--	0.0070
^{230}Th	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cl	175	200	--	222	175	**225**	**--**	**223**
SO_4	550	200	--	544	550	**665**	--	**557**
NH_3 / NH_4	20	73	--	11	20	**105**	--	**12**

[1] Baseline values for McClean Lake and Vulture Lake taken from Tables 4.3-3, 4.3-4, 4.3-5, 4.3-6 of Existing Environment TID (COGEMA 2003)
Baseline values for Candy Lake taken from Tables 4.3-9, 4.3-10, 4.3-11, 4.3-12 of Existing Environment TID (COGEMA 2003)
Bolded values indicate that resulting peak incremental concentrations are greater than baseline.

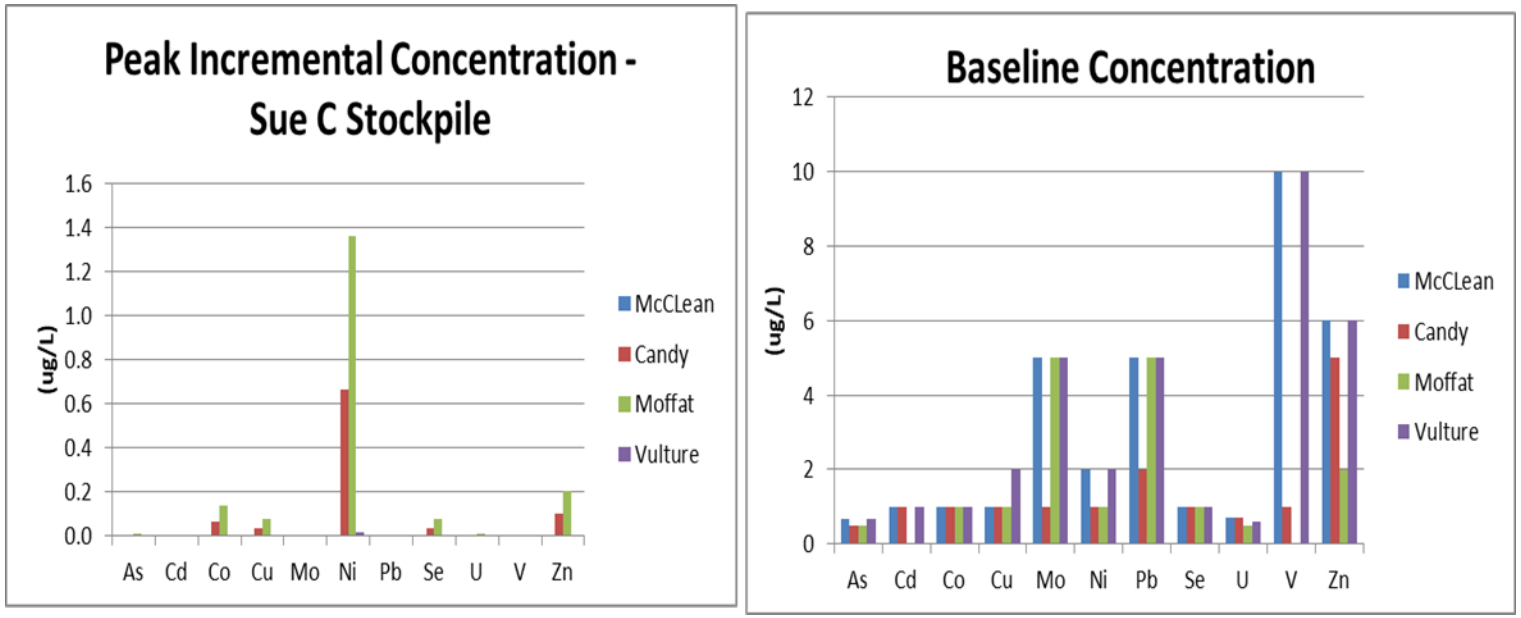


Figure 2: Impact of Sue C Clean Waste Stockpile.

Peak incremental concentration in McClean Lake, Candy Lake, Moffat Lake, and Vulture Lake are shown on Figure 2. The Baseline concentrations are shown for comparison. Except for nickel, the peak incremental concentrations are smaller than the baseline values by several orders of magnitude. There will be no impact on surface water concentration.

The nickel concentrations in Candy Lake and Moffat Lake are higher than the baseline concentration, although well below SSWQO which is 25 to 150 ug/L, depending on hardness. Moffat Lake is not part of the Collins Creek watershed.

1.1.3 Sue E Clean Waste Stockpile

The pore water concentrations for the Sue E clean waste stockpile are documented in Table 4-14 of Part A. The peak incremental mass flux and peak incremental concentration to receptors are shown in.Table 5. The baseline concentrations and resulting total incremental concentrations in the receptors are shown in Table 6.

Table 5: Peak Incremental Mass Flux due to the Sue E Clean Waste Stockpile

COC	Peak Incremental Mass Flux (g/year or Bq/year)		Peak Incremental Concentration (µg/L or Bq/L)	
	Telephone Lake	Bena Lake	Telephone Lake	Bena Lake
As	2.4	1.5	0.0015	0.0033
Cd	3.6	2.3	0.0023	0.0050
Co	110	70	0.071	0.16
Cu	69	44	0.04	0.10
Mo	4.7	3.0	0.0031	0.0067
Ni	392	249	0.25	0.55
Pb	1.4	0.9	0.0009	0.0020
Se	1.2	0.8	0.00076	0.0017
U	2.0	1.3	0.0013	0.0028
V	1.3	0.8	0.00084	0.0018
Zn	142	90.6	0.092	0.20
^{226}Ra	6.2E+06	3.9E+06	4.0E-03	8.7E-06
^{210}Pb	5.7E+05	3.6E+05	3.7E-04	8.0E-07
^{210}Po	7.1E+04	4.5E+04	4.6E-05	1.0E-07
^{230}Th	1.8E+05	1.1E+05	1.1E-04	2.5E-07
Cl	24,917	15,859	16	35
SO4	5,339	3,398	3.4	7.5
NH_3 / NH_4	--	--	--	--

Table 6: Baseline Concentrations and Peak Incremental Concentration in Receptors for Sue E Clean Waste Rock Pile

COC	Baseline [1] (µg/L or Bq/L)		Resulting Peak Concentrations (µg/L or Bq/L)	
	Telephone Lake	Bena Lake	Telephone Lake	Bena Lake
As	0.25	0.4	0.25	0.40
Cd	--	--	0.0023	0.0050
Co	--	--	0.071	0.16
Cu	1	1	1.0	1.1
Mo	1	1	1.0	1.0
Ni	1	1	1.3	1.6
Pb	2	2	2.0	2.0
Se	0.6	0.6	0.60	0.60
U	0.1	0.3	0.10	0.30
V	--	--	0.00084	0.0018
Zn	20	1	20	1.2
^{226}Ra	0.005	0.005	0.009	0.014
^{210}Pb	0.02	0.02	0.02	0.02
^{210}Po	--	--	--	--
^{230}Th	0.01	0.01	0.01	0.01
Cl	--	--	16	35
SO_4	--	--	3.4	7.5
NH_3 / NH_4	--	--	--	--

[1] Baseline values for McClean Lake and Vulture Lake taken from Tables 4.3-3, 4.3-4, 4.3-5, 4.3-6 of Existing Environment TID (COGEMA 2003). Baseline values for Candy Lake taken from Tables 4.3-9, 4.3-10, 4.3-11, 4.3-12 of Existing Environment TID (COGEMA 2003).

Peak incremental concentration in Telephone Lake and Bena Lake are shown on Figure 3. The Baseline concentrations are shown for comparison. Except for nickel, the peak incremental concentrations are smaller than the baseline values by several orders of magnitude. Although the peak nickel concentration in Bena Lake is relatively higher than the other COPCs it is still well below the baseline value as well as the SSWQO value of 25 to 150 ug/. Therefore, there will be no impact on surface water concentration.

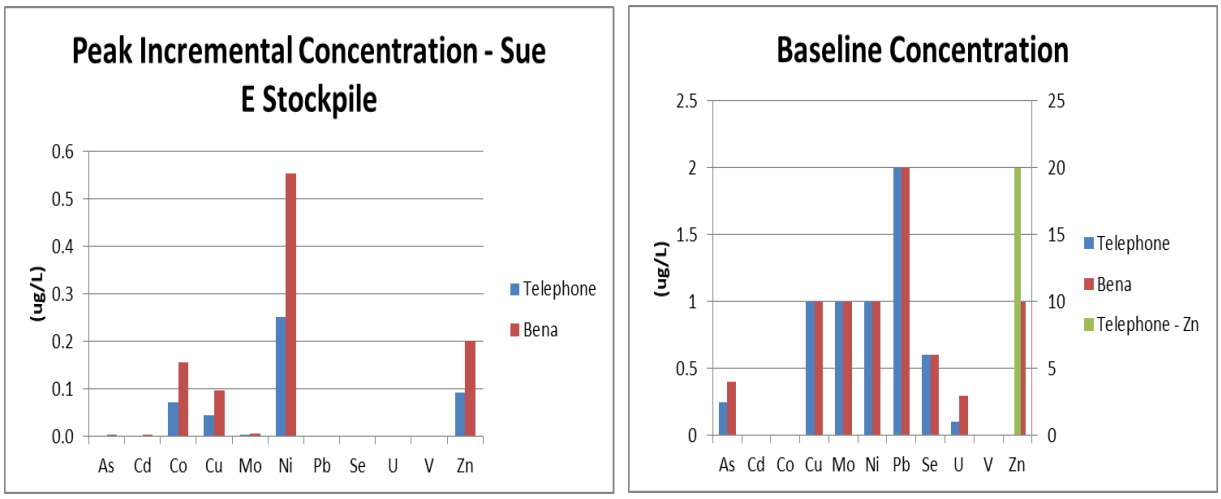


Figure 3: Impact of Sue E Clean Waste Stockpile

1.2 Upper Bounding Case Source term modelling Estimates

The Upper Bounding Case pore water concentrations are given in Table 4-14 of Part A and in Appendix AI.6. The Upper Bounding Case pore water concentrations represent the data from the stockpile piezometer with the largest concentration readings in each of the respective clean waste rock piles. The peak incremental mass flux reporting to and resulting concentration in receptors are shown in Table 7, Table 8, and Table 9 for JEB, Sue C and Sue E stockpiles, respectively.

Table 7: Upper Bounding Case Peak Incremental Mass Flux and Peak Incremental Concentration due to the JEB Clean Waste Stockpile

COPC	Incremental Mass Flux (g/year or Bq/year)			Incremental Concentration (□g/L or Bq/L)		
	Pat Lake	Fox Lake	Johannes Lake	Pat Lake	Fox Lake	Johannes Lake
As	0.2	1.3	0.4	3.4E-05	2.2E-04	7.4E-05
Cd	0.046	0.3	0.09	6.8E-06	4.4E-05	1.5E-05
Co	2.3	13	4.4	3.4E-04	2.2E-03	7.4E-04
Cu	5.5	31	11	8.2E-04	5.3E-03	1.8E-03
Mo	0.2	1.3	0.4	3.4E-05	2.2E-04	7.4E-05
Ni	4.4	24	8.3	6.5E-04	4.2E-03	1.4E-03
Pb	0.69	3.9	1.31	1.0E-04	6.7E-04	2.2E-04
Se	0.23	1.3	0.44	3.4E-05	2.2E-04	7.4E-05
U	2.3	13	4.4	3.4E-04	2.2E-03	7.4E-04
V	1.4	8.0	2.7	2.1E-04	1.4E-03	4.6E-04
Zn	6.4	36	12	9.5E-04	6.2E-03	2.1E-03
^{226}Ra	5.3E+04	3.0E+05	1.0E+05	7.8E-06	5.1E-05	1.7E-05
^{210}Pb	6.9E+04	3.9E+05	1.3E+05	1.0E-05	6.7E-05	2.2E-05
^{210}Po	1.2E+04	6.7E+04	2.3E+04	1.8E-06	1.2E-05	3.8E-06
^{230}Th	4.6E+04	2.6E+05	8.8E+04	6.8E-06	4.4E-05	1.5E-05
Cl	6,415	36,103	12,261	1.0	6	2
SO_4	29,325	165,043	56,051	4	28	9
NH_3 / NH_4	167	--	--	1.0	6	2

Table 8: Upper Bounding Case Peak Incremental Mass Flux and Peak Incremental Concentration due to the Sue C Clean Waste Stockpile

COPC	Peak Incremental Mass Flux (g/year or Bq/year)					Peak Incremental Concentration (µg/L or Bq/L)				
	McClean Lake	Candy Lake	Moffat Lake	Vulture Lake	Sue B Pit	McClean Lake	Candy Lake	Moffat Lake	Vulture Lake	Sue B Pit
As	0.34	10.7	37	0.33	3.0	6.8E-06	0.0066	0.014	1.9E-04	0.071
Cd	0.24	7.6	26	0.24	2.2	4.9E-06	0.005	0.010	1.4E-04	0.050
Co	4.6	145	501	4.5	41	9.2E-05	0.090	0.18	0.0026	0.96
Cu	2.1	65	224.2	2.0	18	4.1E-05	0.040	0.083	0.0012	0.43
Mo	0.024	0.76	2.6	0.024	0.2	4.9E-07	4.7E-04	0.0010	1.4E-05	0.005
Ni	58	1,830	6,329	57	517	1.2E-03	1.14	2.3	0.033	12.1
Pb	0.3	9.2	32	0.3	2.6	5.8E-06	0.006	0.012	0.0002	0.06
Se	3.9	122	422	3.8	34	7.8E-05	0.076	0.156	0.0022	0.81
U	0.34	10.7	37	0.33	3.0	6.8E-06	0.0066	0.0136	1.9E-04	0.071
V	0.02	0.76	2.6	0.024	0.22	4.9E-07	4.7E-04	0.0010	1.4E-05	0.005
Zn	6.3	198	686	6.2	56	1.3E-04	0.123	0.25	0.004	1.31
^{226}Ra	9.0E+04	2.8E+06	9.8E+06	8.8E+04	8.0E+05	1.8E-06	1.8E-03	3.6E-03	5.1E-05	1.9E-02
^{210}Pb	1.5E+04	4.7E+05	1.6E+06	1.5E+04	1.3E+05	3.0E-07	2.9E-04	6.0E-04	8.5E-06	3.1E-03
^{210}Po	2.4E+03	7.6E+04	2.6E+05	2.4E+03	2.2E+04	4.9E-08	4.7E-05	9.7E-05	1.4E-06	5.0E-04
^{230}Th	2.4E+03	7.6E+04	2.6E+05	2.4E+03	2.2E+04	4.9E-08	4.7E-05	9.7E-05	1.4E-06	5.0E-04
Cl	1,258	39,655	137,134	1,238	11,201	0.025	24.7	51	0.71	262
SO_4	23,716	747,348	2,584,456	23,324	211,092	0.48	465	953	13.4	4943
NH_3 / NH_4	1,621	51,094	176,692	1,595	14,432	3.3E-02	31.8	65.1	0.919	338

Table 9: Upper Bounding Case Peak Incremental Mass Flux and Peak Incremental Concentration due to the Sue E Clean Waste Stockpile

COPC	Peak Incremental Mass Flux (g/year or Bq/year)		Peak Incremental Concentration (µg/L or Bq/L)	
	Telephone Lake	Bena Lake	Telephone Lake	Bena Lake
As	2.4	1.5	0.00008	0.0033
Cd	4.7	3.0	0.00016	0.01
Co	131	83	0.0043	0.18
Cu	131	83	0.0043	0.18
Mo	8.3	5.3	0.000	0.01
Ni	581	370	0.0191	0.82
Pb	1.5	1.0	0.00005	0.0022
Se	1.2	0.8	0.00004	0.0017
U	2.1	1.4	0.00007	0.0030
V	1.3	0.8	0.000	0.00
Zn	154	98	0.01	0.22
^{226}Ra	8.5E+06	5.4E+06	2.8E+02	1.2E-02
^{210}Pb	5.7E+05	3.6E+05	1.9E-05	8.0E-04
^{210}Po	7.9E+04	5.1E+04	2.6E-06	1.1E-04
^{230}Th	2.4E+05	1.5E+05	7.8E-06	3.3E-04
Cl	28,476	18,125	0.94	40.2
SO_4	5,933	3,776	0.19	8
NH_3 / NH_4	--	--	--	--

The impact of using the Upper Bounding Case pore water concentrations is illustrated on Figure 4. The baseline values for Collins Creek are shown on Figure 5. They are taken from Tables 4.3-3, 4.3-4, 4.3-5, and 4.3-6 of the 2003 Existing Environment TID (COGEMA 2003). The SSWQO and CCME values are given in Table 6-1 of Part B.

For the JEB stockpile, the largest flux is from the Upper Bounding Case concentrations of copper, nickel and zinc. However, the peak incremental concentrations are still well below baseline values.

The largest flux for peak incremental concentration in Collins Creek for the flux from Sue C stockpile is due to cobalt, nickel, selenium, and zinc. The upper bound peak incremental concentration for nickel is 0.05 ug/L and the baseline value is 3 ug/L. The sum of the two is still well below the minimum SSWQO value of 25 ug/L (Table 6-1, Part B).

The largest peak incremental concentration in Collins Creek due to flux from the Sue E stockpile is due to nickel. The upper bound peak incremental concentration is 0.019 ug/L but when added to the baseline concentration of 3 ug/L the result is still well below SSWQO.

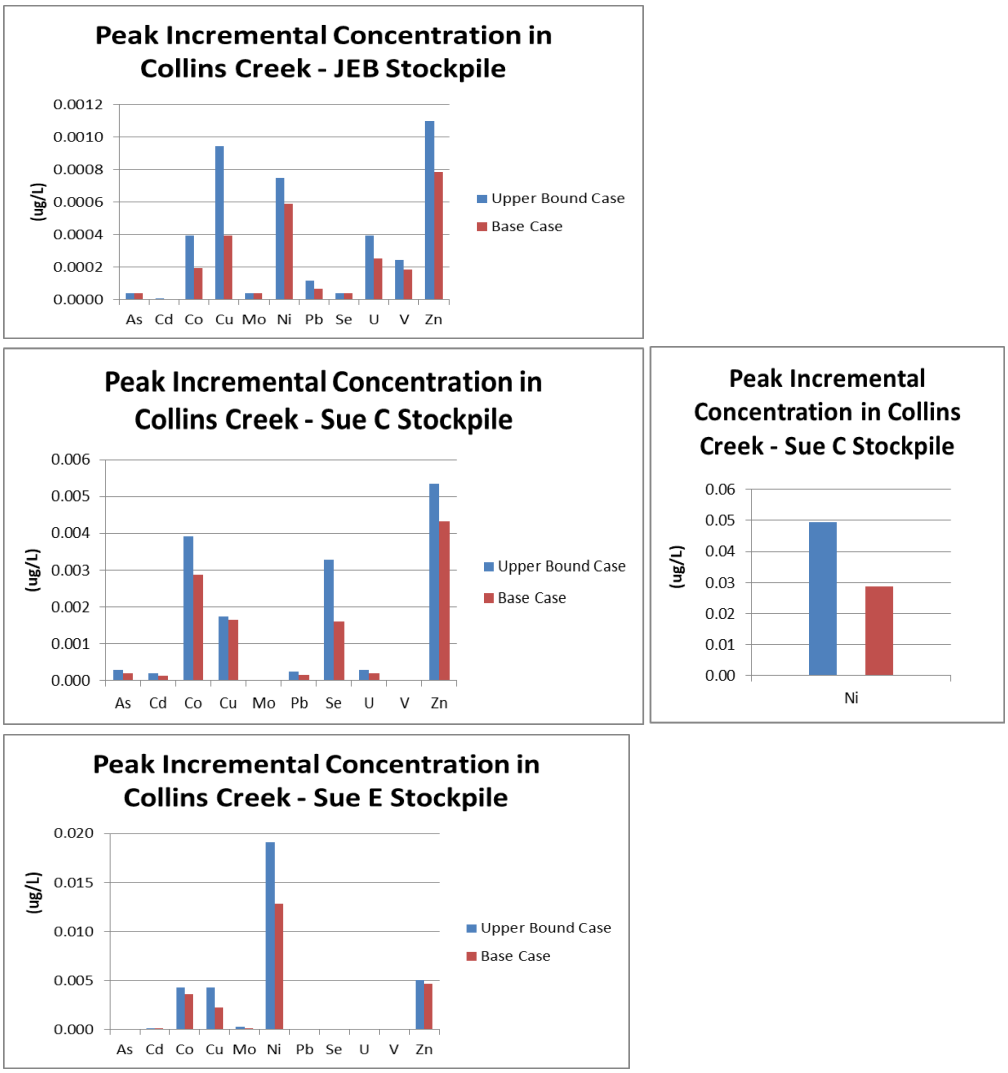


Figure 4: Concentration in Collins Creek for Upper Bound Stockpile Pore Water Terms.

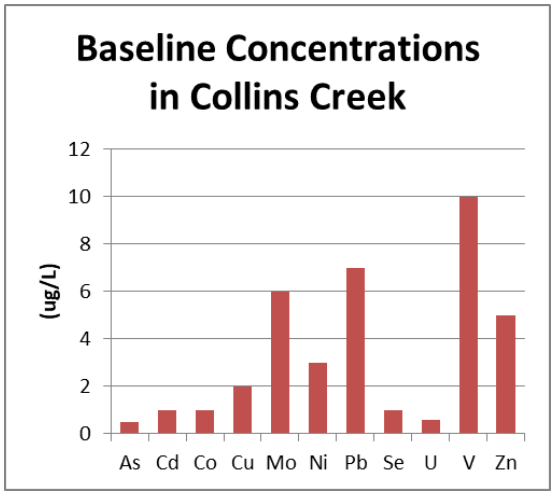


Figure 5: Baseline Concentrations in Collins Creek.

The comparison of upper bound and bases cases for the radionuclides, major ions, and ammonia are shown on Figures 6, 7, and 8. The baseline values are also shown.

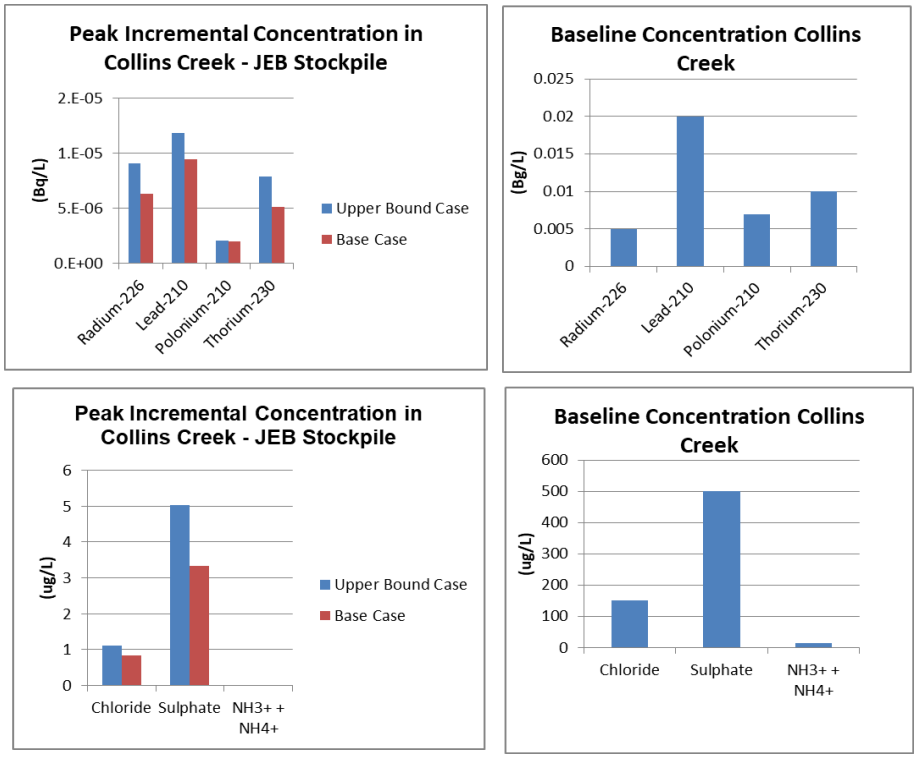


Figure 6: Upper Bound versus Base Case - JEB stockpile.

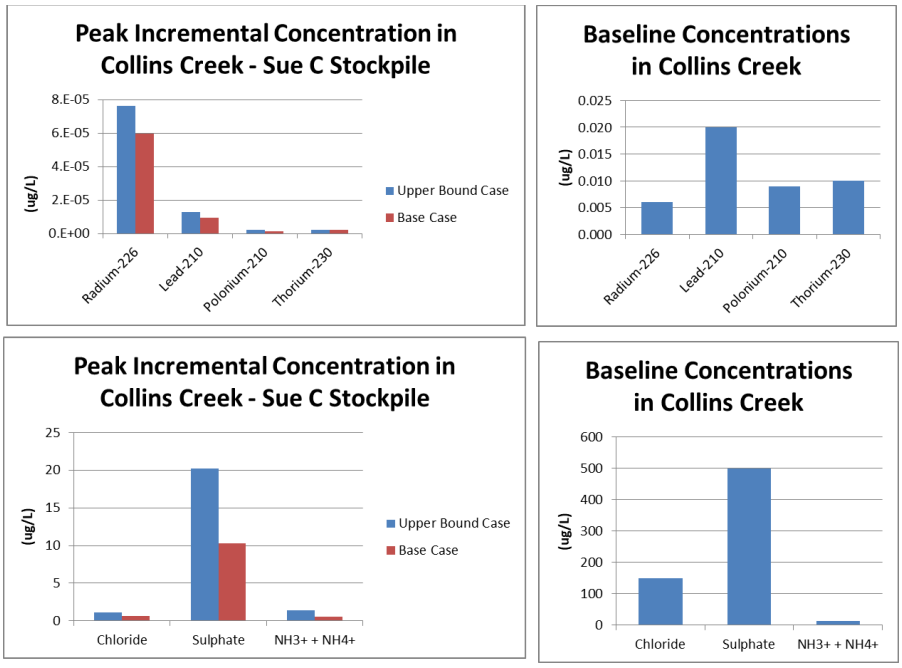


Figure 7: Upper Bound versus Base Case – Sue C stockpile.

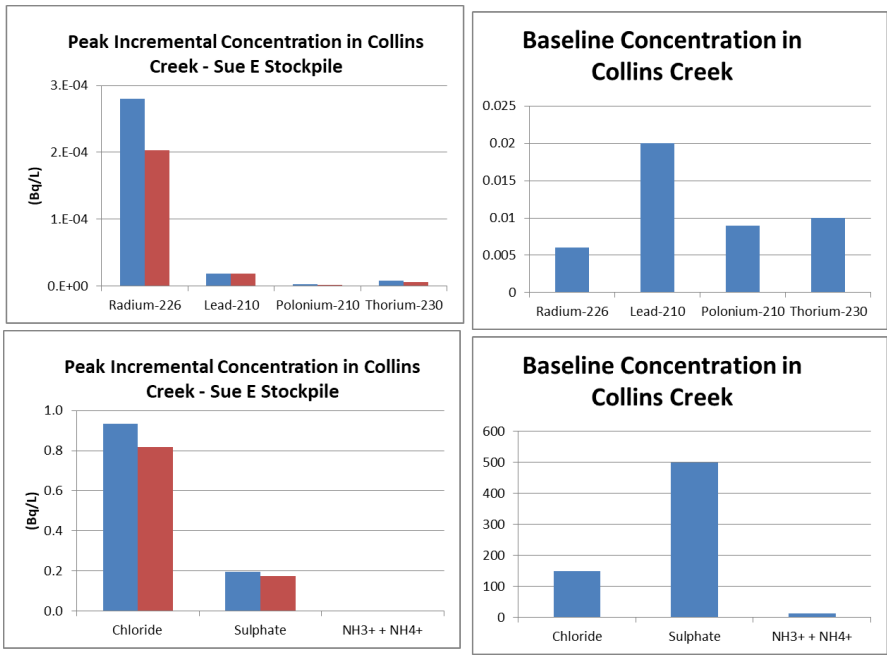


Figure 8: Upper Bound versus Base Case – Sue E stockpile.

1.3 Summary

The impact of the JEB, Sue C, and Sue E clean waste rock stockpiles on surface water bodies has been assessed. Both Base Case and Upper Bounding Case source terms were analyzed. The analysis was based on the stockpile pore water concentrations evaluated in Appendix AI.6. The metric used was the peak incremental concentration in surface water receptors as compared to baseline concentrations.

- For most cases, using the Base Case and Upper Bounding Case source terms, the respective peak incremental concentration was found to be much lower than the baseline value.
- Of the COPCs assessed, the largest concentration increase reporting to the receiving water body was for nickel. The concentration of nickel in receptors was largest for mass flux from all stockpiles. However, the sum of peak incremental concentration and baseline concentration was much lower than the respective SSWQO and CCME guidelines.
- The peak incremental concentration for all COPCs is based on the assumption that the contaminants in the stockpiles will be 100% leachable. The assumption of 100% leachability is very conservative and, as such, it is the upper bound to the peak concentration. An illustration of the effect of leachable fraction is shown on Figure 5-1 of Part B.
- Leachable fraction of COPCs in above-ground stored waste rock is determined by humidity cell testing. The humidity cell tests are discussed in more detail in Appendix B-1.
- The Base Case and Upper Bounding Case for radionuclides, major ions, and ammonia were also analyzed. The incremental concentration was found to be lower than baseline for all cases.

2 References

COGEMA 2003. Existing Environment Technical Information Document. Version 01/Revision 00. September 2004.

Appendix B-VI: Sue Pit Volume Calculations

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1 Pit Volume Calculations

Updated pit volumes were calculated in December, 2011. The following sections summarize these calculations.

1.1 Sue C/A Pit Volume

The total excavated Sue C/A pit volume was calculated from 321 mASL to 449 mASL in 0.1 m increments at the end of Sue A mining. It was based on drawings "233-018 sue_c_asbuilt_oct_2010/449_elevation.dtm" and "233-012 suec-a_finalasbuilt_nofill.dtm". The part of the Sue C/A pit volume not filled with special waste was also calculated as of December 2011, from 370 mASL to 449 mASL in 0.1 increments, based on drawings "449 elevation.dtm" and "sue_c_oct2010.dtm". These two volume calculations are summarized in Table 1-1. Calculated volumes are presented to the nearest unit value. Some apparent rounding errors may occasionally occur in the calculated volumes. For this calculation it was assumed that no special waste will be deposited above 447 mASL. The majority of the special waste is currently deposited below 438 mASL.

The calculations in Table 1-1 show that the total pit volume is 11,126,619 m^3 and the volume of special waste currently placed in the pit is 5,306,335 lcm. Figure 1- 1 shows a plot of elevation versus cumulative volume for the total pit and the special waste in the pit, as of December 2011.

Table 1-1: Summary of Sue C/A Pit Volumes

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
321	321.1	0	0	0	0	0	0
321.1	321.2	0	0	0	0	0	0
321.2	321.3	0	0	0	0	0	0
321.3	321.4	0	0	0	0	0	0
321.4	321.5	0	0	0	0	0	0
321.5	321.6	0	0	0	0	0	0
321.6	321.7	0	0	0	0	0	0
321.7	321.8	0	0	0	0	0	0
321.8	321.9	0	0	0	0	0	0
321.9	322	0	0	0	0	0	0
322	322.1	0	0	0	0	0	0
322.1	322.2	0	0	0	0	0	0
322.2	322.3	0	0	0	0	0	0
322.3	322.4	0	0	0	0	0	0
322.4	322.5	0	0	0	0	0	0
322.5	322.6	1	2	1	2	0	0
322.6	322.7	5	6	5	6	0	0
322.7	322.8	10	16	10	16	0	0
322.8	322.9	20	36	20	36	0	0
322.9	323	61	97	61	97	0	0
323	323.1	133	230	133	230	0	0
323.1	323.2	196	426	196	426	0	0
323.2	323.3	218	644	218	644	0	0
323.3	323.4	231	875	231	875	0	0

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
323.4	323.5	240	1,115	240	1,115	0	0
323.5	323.6	249	1,363	249	1,363	0	0
323.6	323.7	257	1,620	257	1,620	0	0
323.7	323.8	265	1,886	265	1,886	0	0
323.8	323.9	273	2,159	273	2,159	0	0
323.9	324	281	2,440	281	2,440	0	0
324	324.1	287	2,727	287	2,727	0	0
324.1	324.2	293	3,020	293	3,020	0	0
324.2	324.3	301	3,321	301	3,321	0	0
324.3	324.4	309	3,630	309	3,630	0	0
324.4	324.5	315	3,945	315	3,945	0	0
324.5	324.6	321	4,266	321	4,266	0	0
324.6	324.7	328	4,594	328	4,594	0	0
324.7	324.8	338	4,932	338	4,932	0	0
324.8	324.9	349	5,281	349	5,281	0	0
324.9	325	364	5,645	364	5,645	0	0
325	325.1	383	6,028	383	6,028	0	0
325.1	325.2	404	6,432	404	6,432	0	0
325.2	325.3	421	6,854	421	6,854	0	0
325.3	325.4	439	7,293	439	7,293	0	0
325.4	325.5	453	7,746	453	7,746	0	0
325.5	325.6	466	8,211	466	8,211	0	0
325.6	325.7	476	8,687	476	8,687	0	0
325.7	325.8	485	9,171	485	9,171	0	0
325.8	325.9	493	9,665	493	9,665	0	0
325.9	326	502	10,167	502	10,167	0	0
326	326.1	511	10,678	511	10,678	0	0
326.1	326.2	520	11,198	520	11,198	0	0
326.2	326.3	528	11,727	528	11,727	0	0
326.3	326.4	537	12,263	537	12,263	0	0
326.4	326.5	545	12,808	545	12,808	0	0
326.5	326.6	553	13,361	553	13,361	0	0
326.6	326.7	561	13,922	561	13,922	0	0
326.7	326.8	568	14,490	568	14,490	0	0
326.8	326.9	575	15,065	575	15,065	0	0
326.9	327	583	15,648	583	15,648	0	0
327	327.1	590	16,238	590	16,238	0	0
327.1	327.2	598	16,836	598	16,836	0	0
327.2	327.3	605	17,441	605	17,441	0	0
327.3	327.4	612	18,054	612	18,054	0	0
327.4	327.5	620	18,673	620	18,673	0	0
327.5	327.6	627	19,300	627	19,300	0	0
327.6	327.7	633	19,933	633	19,933	0	0
327.7	327.8	640	20,573	640	20,573	0	0
327.8	327.9	646	21,219	646	21,219	0	0
327.9	328	653	21,872	653	21,872	0	0
328	328.1	660	22,532	660	22,532	0	0
328.1	328.2	666	23,198	666	23,198	0	0
328.2	328.3	672	23,870	672	23,870	0	0
328.3	328.4	678	24,548	678	24,548	0	0
328.4	328.5	684	25,232	684	25,232	0	0
328.5	328.6	690	25,922	690	25,922	0	0
328.6	328.7	695	26,618	695	26,618	0	0
328.7	328.8	701	27,319	701	27,319	0	0
328.8	328.9	707	28,025	707	28,025	0	0
328.9	329	712	28,737	712	28,737	0	0
329	329.1	718	29,456	718	29,456	0	0
329.1	329.2	724	30,180	724	30,180	0	0
329.2	329.3	730	30,910	730	30,910	0	0

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
329.3	329.4	736	31,646	736	31,646	0	0
329.4	329.5	742	32,388	742	32,388	0	0
329.5	329.6	748	33,136	748	33,136	0	0
329.6	329.7	754	33,890	754	33,890	0	0
329.7	329.8	761	34,651	761	34,651	0	0
329.8	329.9	767	35,417	767	35,417	0	0
329.9	330	773	36,191	773	36,191	0	0
330	330.1	779	36,970	779	36,970	0	0
330.1	330.2	786	37,756	786	37,756	0	0
330.2	330.3	792	38,547	792	38,547	0	0
330.3	330.4	798	39,345	798	39,345	0	0
330.4	330.5	804	40,149	804	40,149	0	0
330.5	330.6	810	40,959	810	40,959	0	0
330.6	330.7	816	41,776	816	41,776	0	0
330.7	330.8	822	42,598	822	42,598	0	0
330.8	330.9	829	43,427	829	43,427	0	0
330.9	331	835	44,262	835	44,262	0	0
331	331.1	841	45,103	841	45,103	0	0
331.1	331.2	848	45,950	848	45,950	0	0
331.2	331.3	855	46,805	855	46,805	0	0
331.3	331.4	864	47,669	864	47,669	0	0
331.4	331.5	876	48,545	876	48,545	0	0
331.5	331.6	884	49,429	884	49,429	0	0
331.6	331.7	892	50,321	892	50,321	0	0
331.7	331.8	899	51,220	899	51,220	0	0
331.8	331.9	906	52,126	906	52,126	0	0
331.9	332	912	53,038	912	53,038	0	0
332	332.1	919	53,957	919	53,957	0	0
332.1	332.2	925	54,882	925	54,882	0	0
332.2	332.3	931	55,813	931	55,813	0	0
332.3	332.4	937	56,750	937	56,750	0	0
332.4	332.5	943	57,692	943	57,692	0	0
332.5	332.6	949	58,641	949	58,641	0	0
332.6	332.7	955	59,596	955	59,596	0	0
332.7	332.8	961	60,557	961	60,557	0	0
332.8	332.9	967	61,524	967	61,524	0	0
332.9	333	974	62,498	974	62,498	0	0
333	333.1	981	63,478	981	63,478	0	0
333.1	333.2	988	64,466	988	64,466	0	0
333.2	333.3	995	65,461	995	65,461	0	0
333.3	333.4	1,001	66,462	1,001	66,462	0	0
333.4	333.5	1,008	67,470	1,008	67,470	0	0
333.5	333.6	1,014	68,484	1,014	68,484	0	0
333.6	333.7	1,021	69,505	1,021	69,505	0	0
333.7	333.8	1,027	70,532	1,027	70,532	0	0
333.8	333.9	1,033	71,565	1,033	71,565	0	0
333.9	334	1,040	72,605	1,040	72,605	0	0
334	334.1	1,046	73,651	1,046	73,651	0	0
334.1	334.2	1,053	74,704	1,053	74,704	0	0
334.2	334.3	1,060	75,765	1,060	75,765	0	0
334.3	334.4	1,067	76,832	1,067	76,832	0	0
334.4	334.5	1,074	77,906	1,074	77,906	0	0
334.5	334.6	1,081	78,987	1,081	78,987	0	0
334.6	334.7	1,088	80,076	1,088	80,076	0	0
334.7	334.8	1,096	81,171	1,096	81,171	0	0
334.8	334.9	1,103	82,274	1,103	82,274	0	0
334.9	335	1,118	83,392	1,118	83,392	0	0
335	335.1	1,143	84,535	1,143	84,535	0	0
335.1	335.2	1,162	85,696	1,162	85,696	0	0

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
335.2	335.3	1,177	86,874	1,177	86,874	0	0
335.3	335.4	1,190	88,064	1,190	88,064	0	0
335.4	335.5	1,201	89,264	1,201	89,264	0	0
335.5	335.6	1,211	90,475	1,211	90,475	0	0
335.6	335.7	1,221	91,695	1,221	91,695	0	0
335.7	335.8	1,230	92,926	1,230	92,926	0	0
335.8	335.9	1,240	94,166	1,240	94,166	0	0
335.9	336	1,249	95,415	1,249	95,415	0	0
336	336.1	1,258	96,673	1,258	96,673	0	0
336.1	336.2	1,267	97,940	1,267	97,940	0	0
336.2	336.3	1,276	99,216	1,276	99,216	0	0
336.3	336.4	1,284	100,500	1,284	100,500	0	0
336.4	336.5	1,292	101,792	1,292	101,792	0	0
336.5	336.6	1,299	103,091	1,299	103,091	0	0
336.6	336.7	1,306	104,396	1,306	104,396	0	0
336.7	336.8	1,312	105,709	1,312	105,709	0	0
336.8	336.9	1,319	107,028	1,319	107,028	0	0
336.9	337	1,326	108,354	1,326	108,354	0	0
337	337.1	1,333	109,687	1,333	109,687	0	0
337.1	337.2	1,339	111,026	1,339	111,026	0	0
337.2	337.3	1,346	112,372	1,346	112,372	0	0
337.3	337.4	1,353	113,725	1,353	113,725	0	0
337.4	337.5	1,359	115,084	1,359	115,084	0	0
337.5	337.6	1,366	116,450	1,366	116,450	0	0
337.6	337.7	1,372	117,822	1,372	117,822	0	0
337.7	337.8	1,379	119,201	1,379	119,201	0	0
337.8	337.9	1,386	120,587	1,386	120,587	0	0
337.9	338	1,397	121,984	1,397	121,984	0	0
338	338.1	1,411	123,395	1,411	123,395	0	0
338.1	338.2	1,426	124,822	1,426	124,822	0	0
338.2	338.3	1,441	126,263	1,441	126,263	0	0
338.3	338.4	1,456	127,719	1,456	127,719	0	0
338.4	338.5	1,470	129,190	1,470	129,190	0	0
338.5	338.6	1,484	130,674	1,484	130,674	0	0
338.6	338.7	1,498	132,171	1,498	132,171	0	0
338.7	338.8	1,511	133,682	1,511	133,682	0	0
338.8	338.9	1,523	135,205	1,523	135,205	0	0
338.9	339	1,535	136,741	1,535	136,741	0	0
339	339.1	1,547	138,287	1,547	138,287	0	0
339.1	339.2	1,557	139,844	1,557	139,844	0	0
339.2	339.3	1,567	141,412	1,567	141,412	0	0
339.3	339.4	1,576	142,988	1,576	142,988	0	0
339.4	339.5	1,585	144,573	1,585	144,573	0	0
339.5	339.6	1,594	146,168	1,594	146,168	0	0
339.6	339.7	1,603	147,770	1,603	147,770	0	0
339.7	339.8	1,610	149,380	1,610	149,380	0	0
339.8	339.9	1,617	150,997	1,617	150,997	0	0
339.9	340	1,624	152,622	1,624	152,622	0	0
340	340.1	1,631	154,253	1,631	154,253	0	0
340.1	340.2	1,639	155,892	1,639	155,892	0	0
340.2	340.3	1,646	157,538	1,646	157,538	0	0
340.3	340.4	1,653	159,191	1,653	159,191	0	0
340.4	340.5	1,660	160,851	1,660	160,851	0	0
340.5	340.6	1,668	162,519	1,668	162,519	0	0
340.6	340.7	1,675	164,194	1,675	164,194	0	0
340.7	340.8	1,682	165,877	1,682	165,877	0	0
340.8	340.9	1,690	167,566	1,690	167,566	0	0
340.9	341	1,697	169,264	1,697	169,264	0	0
341	341.1	1,705	170,968	1,705	170,968	0	0

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
341.1	341.2	1,712	172,680	1,712	172,680	0	0
341.2	341.3	1,720	174,400	1,720	174,400	0	0
341.3	341.4	1,727	176,127	1,727	176,127	0	0
341.4	341.5	1,734	177,861	1,734	177,861	0	0
341.5	341.6	1,742	179,603	1,742	179,603	0	0
341.6	341.7	1,750	181,353	1,750	181,353	0	0
341.7	341.8	1,757	183,110	1,757	183,110	0	0
341.8	341.9	1,765	184,874	1,765	184,874	0	0
341.9	342	1,772	186,647	1,772	186,647	0	0
342	342.1	1,780	188,426	1,780	188,426	0	0
342.1	342.2	1,787	190,214	1,787	190,214	0	0
342.2	342.3	1,795	192,009	1,795	192,009	0	0
342.3	342.4	1,803	193,811	1,803	193,811	0	0
342.4	342.5	1,810	195,622	1,810	195,622	0	0
342.5	342.6	1,818	197,440	1,818	197,440	0	0
342.6	342.7	1,827	199,267	1,827	199,267	0	0
342.7	342.8	1,836	201,102	1,836	201,102	0	0
342.8	342.9	1,844	202,947	1,844	202,947	0	0
342.9	343	1,853	204,800	1,853	204,800	0	0
343	343.1	1,862	206,661	1,862	206,661	0	0
343.1	343.2	1,870	208,532	1,870	208,532	0	0
343.2	343.3	1,879	210,411	1,879	210,411	0	0
343.3	343.4	1,888	212,299	1,888	212,299	0	0
343.4	343.5	1,897	214,196	1,897	214,196	0	0
343.5	343.6	1,906	216,102	1,906	216,102	0	0
343.6	343.7	1,915	218,017	1,915	218,017	0	0
343.7	343.8	1,924	219,940	1,924	219,940	0	0
343.8	343.9	1,933	221,873	1,933	221,873	0	0
343.9	344	1,942	223,816	1,942	223,816	0	0
344	344.1	1,952	225,767	1,952	225,767	0	0
344.1	344.2	1,962	227,729	1,962	227,729	0	0
344.2	344.3	1,972	229,701	1,972	229,701	0	0
344.3	344.4	1,983	231,685	1,983	231,685	0	0
344.4	344.5	1,995	233,679	1,995	233,679	0	0
344.5	344.6	2,006	235,686	2,006	235,686	0	0
344.6	344.7	2,019	237,705	2,019	237,705	0	0
344.7	344.8	2,035	239,740	2,035	239,740	0	0
344.8	344.9	2,056	241,796	2,056	241,796	0	0
344.9	345	2,081	243,877	2,081	243,877	0	0
345	345.1	2,112	245,989	2,112	245,989	0	0
345.1	345.2	2,146	248,134	2,146	248,134	0	0
345.2	345.3	2,179	250,314	2,179	250,314	0	0
345.3	345.4	2,215	252,528	2,215	252,528	0	0
345.4	345.5	2,249	254,777	2,249	254,777	0	0
345.5	345.6	2,281	257,058	2,281	257,058	0	0
345.6	345.7	2,313	259,372	2,313	259,372	0	0
345.7	345.8	2,346	261,717	2,346	261,717	0	0
345.8	345.9	2,384	264,101	2,384	264,101	0	0
345.9	346	2,438	266,539	2,438	266,539	0	0
346	346.1	2,506	269,045	2,506	269,045	0	0
346.1	346.2	2,565	271,611	2,565	271,611	0	0
346.2	346.3	2,614	274,224	2,614	274,224	0	0
346.3	346.4	2,656	276,880	2,656	276,880	0	0
346.4	346.5	2,702	279,582	2,702	279,582	0	0
346.5	346.6	2,738	282,320	2,738	282,320	0	0
346.6	346.7	2,771	285,092	2,771	285,092	0	0
346.7	346.8	2,811	287,903	2,811	287,903	0	0
346.8	346.9	2,852	290,755	2,852	290,755	0	0
346.9	347	2,891	293,646	2,891	293,646	0	0

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
347	347.1	2,934	296,580	2,934	296,580	0	0
347.1	347.2	2,963	299,543	2,963	299,543	0	0
347.2	347.3	2,988	302,531	2,988	302,531	0	0
347.3	347.4	3,010	305,541	3,010	305,541	0	0
347.4	347.5	3,029	308,570	3,029	308,570	0	0
347.5	347.6	3,045	311,615	3,045	311,615	0	0
347.6	347.7	3,058	314,673	3,058	314,673	0	0
347.7	347.8	3,067	317,740	3,067	317,740	0	0
347.8	347.9	3,077	320,817	3,077	320,817	0	0
347.9	348	3,086	323,902	3,086	323,902	0	0
348	348.1	3,095	326,997	3,095	326,997	0	0
348.1	348.2	3,104	330,101	3,104	330,101	0	0
348.2	348.3	3,114	333,215	3,114	333,215	0	0
348.3	348.4	3,123	336,338	3,123	336,338	0	0
348.4	348.5	3,132	339,470	3,132	339,470	0	0
348.5	348.6	3,142	342,612	3,142	342,612	0	0
348.6	348.7	3,151	345,763	3,151	345,763	0	0
348.7	348.8	3,159	348,922	3,159	348,922	0	0
348.8	348.9	3,166	352,088	3,166	352,088	0	0
348.9	349	3,174	355,261	3,174	355,261	0	0
349	349.1	3,181	358,443	3,181	358,443	0	0
349.1	349.2	3,189	361,632	3,189	361,632	0	0
349.2	349.3	3,196	364,828	3,196	364,828	0	0
349.3	349.4	3,204	368,032	3,204	368,032	0	0
349.4	349.5	3,212	371,244	3,212	371,244	0	0
349.5	349.6	3,219	374,463	3,219	374,463	0	0
349.6	349.7	3,227	377,691	3,227	377,691	0	0
349.7	349.8	3,235	380,926	3,235	380,926	0	0
349.8	349.9	3,244	384,169	3,244	384,169	0	0
349.9	350	3,252	387,421	3,252	387,421	0	0
350	350.1	3,260	390,681	3,260	390,681	0	0
350.1	350.2	3,269	393,951	3,269	393,951	0	0
350.2	350.3	3,279	397,230	3,279	397,230	0	0
350.3	350.4	3,289	400,519	3,289	400,519	0	0
350.4	350.5	3,299	403,818	3,299	403,818	0	0
350.5	350.6	3,309	407,127	3,309	407,127	0	0
350.6	350.7	3,320	410,447	3,320	410,447	0	0
350.7	350.8	3,330	413,777	3,330	413,777	0	0
350.8	350.9	3,340	417,117	3,340	417,117	0	0
350.9	351	3,348	420,465	3,348	420,465	0	0
351	351.1	3,356	423,821	3,356	423,821	0	0
351.1	351.2	3,364	427,186	3,364	427,186	0	0
351.2	351.3	3,372	430,558	3,372	430,558	0	0
351.3	351.4	3,380	433,939	3,380	433,939	0	0
351.4	351.5	3,388	437,327	3,388	437,327	0	0
351.5	351.6	3,396	440,723	3,396	440,723	0	0
351.6	351.7	3,404	444,127	3,404	444,127	0	0
351.7	351.8	3,411	447,539	3,411	447,539	0	0
351.8	351.9	3,419	450,958	3,419	450,958	0	0
351.9	352	3,426	454,384	3,426	454,384	0	0
352	352.1	3,433	457,817	3,433	457,817	0	0
352.1	352.2	3,441	461,258	3,441	461,258	0	0
352.2	352.3	3,448	464,707	3,448	464,707	0	0
352.3	352.4	3,456	468,163	3,456	468,163	0	0
352.4	352.5	3,464	471,627	3,464	471,627	0	0
352.5	352.6	3,473	475,100	3,473	475,100	0	0
352.6	352.7	3,482	478,582	3,482	478,582	0	0
352.7	352.8	3,490	482,072	3,490	482,072	0	0
352.8	352.9	3,498	485,570	3,498	485,570	0	0

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
352.9	353	3,506	489,076	3,506	489,076	0	0
353	353.1	3,514	492,590	3,514	492,590	0	0
353.1	353.2	3,522	496,112	3,522	496,112	0	0
353.2	353.3	3,529	499,642	3,529	499,642	0	0
353.3	353.4	3,537	503,178	3,537	503,178	0	0
353.4	353.5	3,544	506,722	3,544	506,722	0	0
353.5	353.6	3,551	510,274	3,551	510,274	0	0
353.6	353.7	3,558	513,832	3,558	513,832	0	0
353.7	353.8	3,565	517,397	3,565	517,397	0	0
353.8	353.9	3,572	520,969	3,572	520,969	0	0
353.9	354	3,580	524,549	3,580	524,549	0	0
354	354.1	3,587	528,136	3,587	528,136	0	0
354.1	354.2	3,595	531,730	3,595	531,730	0	0
354.2	354.3	3,602	535,333	3,602	535,333	0	0
354.3	354.4	3,610	538,942	3,610	538,942	0	0
354.4	354.5	3,618	542,560	3,618	542,560	0	0
354.5	354.6	3,625	546,185	3,625	546,185	0	0
354.6	354.7	3,634	549,819	3,634	549,819	0	0
354.7	354.8	3,643	553,463	3,643	553,463	0	0
354.8	354.9	3,653	557,116	3,653	557,116	0	0
354.9	355	3,663	560,779	3,663	560,779	0	0
355	355.1	3,673	564,452	3,673	564,452	0	0
355.1	355.2	3,684	568,135	3,684	568,135	0	0
355.2	355.3	3,694	571,830	3,694	571,830	0	0
355.3	355.4	3,705	575,535	3,705	575,535	0	0
355.4	355.5	3,716	579,251	3,716	579,251	0	0
355.5	355.6	3,726	582,977	3,726	582,977	0	0
355.6	355.7	3,737	586,714	3,737	586,714	0	0
355.7	355.8	3,748	590,461	3,748	590,461	0	0
355.8	355.9	3,759	594,220	3,759	594,220	0	0
355.9	356	3,771	597,991	3,771	597,991	0	0
356	356.1	3,782	601,773	3,782	601,773	0	0
356.1	356.2	3,795	605,568	3,795	605,568	0	0
356.2	356.3	3,808	609,376	3,808	609,376	0	0
356.3	356.4	3,821	613,197	3,821	613,197	0	0
356.4	356.5	3,836	617,033	3,836	617,033	0	0
356.5	356.6	3,851	620,884	3,851	620,884	0	0
356.6	356.7	3,866	624,750	3,866	624,750	0	0
356.7	356.8	3,882	628,632	3,882	628,632	0	0
356.8	356.9	3,899	632,532	3,899	632,532	0	0
356.9	357	3,917	636,448	3,917	636,448	0	0
357	357.1	3,936	640,384	3,936	640,384	0	0
357.1	357.2	3,956	644,340	3,956	644,340	0	0
357.2	357.3	3,976	648,316	3,976	648,316	0	0
357.3	357.4	3,997	652,313	3,997	652,313	0	0
357.4	357.5	4,018	656,332	4,018	656,332	0	0
357.5	357.6	4,040	660,371	4,040	660,371	0	0
357.6	357.7	4,061	664,432	4,061	664,432	0	0
357.7	357.8	4,083	668,515	4,083	668,515	0	0
357.8	357.9	4,104	672,619	4,104	672,619	0	0
357.9	358	4,126	676,746	4,126	676,746	0	0
358	358.1	4,148	680,894	4,148	680,894	0	0
358.1	358.2	4,170	685,064	4,170	685,064	0	0
358.2	358.3	4,191	689,255	4,191	689,255	0	0
358.3	358.4	4,212	693,467	4,212	693,467	0	0
358.4	358.5	4,231	697,698	4,231	697,698	0	0
358.5	358.6	4,251	701,948	4,251	701,948	0	0
358.6	358.7	4,269	706,218	4,269	706,218	0	0
358.7	358.8	4,288	710,505	4,288	710,505	0	0

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
358.8	358.9	4,305	714,811	4,305	714,811	0	0
358.9	359	4,322	719,132	4,322	719,132	0	0
359	359.1	4,338	723,470	4,338	723,470	0	0
359.1	359.2	4,353	727,823	4,353	727,823	0	0
359.2	359.3	4,367	732,190	4,367	732,190	0	0
359.3	359.4	4,382	736,572	4,382	736,572	0	0
359.4	359.5	4,397	740,969	4,397	740,969	0	0
359.5	359.6	4,412	745,380	4,412	745,380	0	0
359.6	359.7	4,426	749,806	4,426	749,806	0	0
359.7	359.8	4,437	754,243	4,437	754,243	0	0
359.8	359.9	4,447	758,690	4,447	758,690	0	0
359.9	360	4,458	763,148	4,458	763,148	0	0
360	360.1	4,469	767,617	4,469	767,617	0	0
360.1	360.2	4,479	772,096	4,479	772,096	0	0
360.2	360.3	4,490	776,586	4,490	776,586	0	0
360.3	360.4	4,500	781,086	4,500	781,086	0	0
360.4	360.5	4,511	785,597	4,511	785,597	0	0
360.5	360.6	4,521	790,118	4,521	790,118	0	0
360.6	360.7	4,532	794,650	4,532	794,650	0	0
360.7	360.8	4,542	799,192	4,542	799,192	0	0
360.8	360.9	4,552	803,743	4,552	803,743	0	0
360.9	361	4,561	808,305	4,561	808,305	0	0
361	361.1	4,571	812,876	4,571	812,876	0	0
361.1	361.2	4,579	817,455	4,579	817,455	0	0
361.2	361.3	4,586	822,041	4,586	822,041	0	0
361.3	361.4	4,594	826,635	4,594	826,635	0	0
361.4	361.5	4,601	831,236	4,601	831,236	0	0
361.5	361.6	4,608	835,843	4,608	835,843	0	0
361.6	361.7	4,615	840,458	4,615	840,458	0	0
361.7	361.8	4,622	845,080	4,622	845,080	0	0
361.8	361.9	4,628	849,708	4,628	849,708	0	0
361.9	362	4,635	854,343	4,635	854,343	0	0
362	362.1	4,641	858,985	4,641	858,985	0	0
362.1	362.2	4,648	863,632	4,648	863,632	0	0
362.2	362.3	4,654	868,287	4,654	868,287	0	0
362.3	362.4	4,660	872,947	4,660	872,947	0	0
362.4	362.5	4,666	877,613	4,666	877,613	0	0
362.5	362.6	4,673	882,286	4,673	882,286	0	0
362.6	362.7	4,679	886,965	4,679	886,965	0	0
362.7	362.8	4,685	891,649	4,685	891,649	0	0
362.8	362.9	4,691	896,340	4,691	896,340	0	0
362.9	363	4,697	901,037	4,697	901,037	0	0
363	363.1	4,704	905,741	4,704	905,741	0	0
363.1	363.2	4,711	910,452	4,711	910,452	0	0
363.2	363.3	4,718	915,170	4,718	915,170	0	0
363.3	363.4	4,725	919,895	4,725	919,895	0	0
363.4	363.5	4,731	924,626	4,731	924,626	0	0
363.5	363.6	4,737	929,364	4,737	929,364	0	0
363.6	363.7	4,743	934,107	4,743	934,107	0	0
363.7	363.8	4,749	938,856	4,749	938,856	0	0
363.8	363.9	4,755	943,611	4,755	943,611	0	0
363.9	364	4,761	948,371	4,761	948,371	0	0
364	364.1	4,767	953,138	4,767	953,138	0	0
364.1	364.2	4,773	957,911	4,773	957,911	0	0
364.2	364.3	4,779	962,690	4,779	962,690	0	0
364.3	364.4	4,789	967,479	4,789	967,479	0	0
364.4	364.5	4,797	972,276	4,797	972,276	0	0
364.5	364.6	4,803	977,079	4,803	977,079	0	0
364.6	364.7	4,809	981,888	4,809	981,888	0	0

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
364.7	364.8	4,815	986,703	4,815	986,703	0	0
364.8	364.9	4,822	991,525	4,822	991,525	0	0
364.9	365	4,828	996,353	4,828	996,353	0	0
365	365.1	4,835	1,001,188	4,835	1,001,188	0	0
365.1	365.2	4,842	1,006,030	4,842	1,006,030	0	0
365.2	365.3	4,848	1,010,878	4,848	1,010,878	0	0
365.3	365.4	4,855	1,015,734	4,855	1,015,734	0	0
365.4	365.5	4,862	1,020,596	4,862	1,020,596	0	0
365.5	365.6	4,869	1,025,465	4,869	1,025,465	0	0
365.6	365.7	4,876	1,030,341	4,876	1,030,341	0	0
365.7	365.8	4,883	1,035,224	4,883	1,035,224	0	0
365.8	365.9	4,890	1,040,113	4,890	1,040,113	0	0
365.9	366	4,896	1,045,010	4,896	1,045,010	0	0
366	366.1	4,903	1,049,913	4,903	1,049,913	0	0
366.1	366.2	4,910	1,054,822	4,910	1,054,822	0	0
366.2	366.3	4,916	1,059,738	4,916	1,059,738	0	0
366.3	366.4	4,923	1,064,661	4,923	1,064,661	0	0
366.4	366.5	4,930	1,069,591	4,930	1,069,591	0	0
366.5	366.6	4,936	1,074,527	4,936	1,074,527	0	0
366.6	366.7	4,943	1,079,470	4,943	1,079,470	0	0
366.7	366.8	4,950	1,084,421	4,950	1,084,421	0	0
366.8	366.9	4,957	1,089,378	4,957	1,089,378	0	0
366.9	367	4,964	1,094,342	4,964	1,094,342	0	0
367	367.1	4,971	1,099,313	4,971	1,099,313	0	0
367.1	367.2	4,978	1,104,290	4,978	1,104,290	0	0
367.2	367.3	4,984	1,109,275	4,984	1,109,275	0	0
367.3	367.4	4,991	1,114,266	4,991	1,114,266	0	0
367.4	367.5	4,998	1,119,264	4,998	1,119,264	0	0
367.5	367.6	5,005	1,124,268	5,005	1,124,268	0	0
367.6	367.7	5,011	1,129,280	5,011	1,129,280	0	0
367.7	367.8	5,018	1,134,298	5,018	1,134,298	0	0
367.8	367.9	5,025	1,139,323	5,025	1,139,323	0	0
367.9	368	5,032	1,144,355	5,032	1,144,355	0	0
368	368.1	5,039	1,149,394	5,039	1,149,394	0	0
368.1	368.2	5,046	1,154,439	5,046	1,154,439	0	0
368.2	368.3	5,053	1,159,492	5,053	1,159,492	0	0
368.3	368.4	5,060	1,164,551	5,060	1,164,551	0	0
368.4	368.5	5,067	1,169,618	5,067	1,169,618	0	0
368.5	368.6	5,074	1,174,691	5,074	1,174,691	0	0
368.6	368.7	5,081	1,179,772	5,081	1,179,772	0	0
368.7	368.8	5,088	1,184,860	5,088	1,184,860	0	0
368.8	368.9	5,098	1,189,958	5,098	1,189,958	0	0
368.9	369	5,109	1,195,067	5,109	1,195,067	0	0
369	369.1	5,121	1,200,188	5,121	1,200,188	0	0
369.1	369.2	5,136	1,205,325	5,136	1,205,325	0	0
369.2	369.3	5,152	1,210,476	5,152	1,210,476	0	0
369.3	369.4	5,166	1,215,643	5,166	1,215,643	0	0
369.4	369.5	5,185	1,220,828	5,185	1,220,828	0	0
369.5	369.6	5,210	1,226,038	5,210	1,226,038	0	0
369.6	369.7	5,252	1,231,290	5,252	1,231,290	0	0
369.7	369.8	5,304	1,236,595	5,304	1,236,595	0	0
369.8	369.9	5,353	1,241,948	5,353	1,241,948	0	0
369.9	370	5,401	1,247,349	5,401	1,247,349	0	0
370	370.1	5,449	1,252,798	5,449	1,252,798	0	0
370.1	370.2	5,514	1,258,312	5,514	1,258,312	0	0
370.2	370.3	5,586	1,263,898	5,586	1,263,898	0	0
370.3	370.4	5,633	1,269,531	5,633	1,269,531	0	0
370.4	370.5	5,680	1,275,211	5,680	1,275,211	0	0
370.5	370.6	5,726	1,280,937	5,726	1,280,937	0	0

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
370.6	370.7	5,765	1,286,702	5,765	1,286,702	0	0
370.7	370.8	5,802	1,292,504	5,802	1,292,504	0	0
370.8	370.9	5,834	1,298,338	5,834	1,298,338	0	0
370.9	371	5,864	1,304,202	5,864	1,304,202	0	0
371	371.1	5,896	1,310,098	5,896	1,310,098	0	0
371.1	371.2	5,933	1,316,031	5,933	1,316,031	0	0
371.2	371.3	5,980	1,322,011	5,980	1,322,011	0	0
371.3	371.4	6,027	1,328,038	6,027	1,328,038	0	0
371.4	371.5	6,072	1,334,109	6,072	1,334,109	0	0
371.5	371.6	6,112	1,340,221	6,112	1,340,221	0	0
371.6	371.7	6,143	1,346,365	6,143	1,346,365	0	0
371.7	371.8	6,168	1,352,533	6,168	1,352,533	0	0
371.8	371.9	6,192	1,358,725	6,192	1,358,725	0	0
371.9	372	6,214	1,364,939	6,214	1,364,939	0	0
372	372.1	6,235	1,371,174	6,235	1,371,174	0	0
372.1	372.2	6,254	1,377,428	6,254	1,377,427	0	1
372.2	372.3	6,272	1,383,700	6,271	1,383,699	1	1
372.3	372.4	6,287	1,389,987	6,286	1,389,985	1	2
372.4	372.5	6,301	1,396,288	6,300	1,396,284	1	4
372.5	372.6	6,314	1,402,602	6,312	1,402,597	2	5
372.6	372.7	6,326	1,408,928	6,324	1,408,920	2	8
372.7	372.8	6,338	1,415,266	6,335	1,415,255	3	11
372.8	372.9	6,350	1,421,616	6,346	1,421,601	4	15
372.9	373	6,361	1,427,977	6,355	1,427,956	6	21
373	373.1	6,372	1,434,349	6,364	1,434,320	8	29
373.1	373.2	6,383	1,440,732	6,373	1,440,693	10	39
373.2	373.3	6,393	1,447,125	6,381	1,447,074	12	51
373.3	373.4	6,403	1,453,528	6,389	1,453,463	14	65
373.4	373.5	6,413	1,459,941	6,396	1,459,859	17	82
373.5	373.6	6,422	1,466,362	6,402	1,466,261	20	101
373.6	373.7	6,431	1,472,793	6,409	1,472,670	22	123
373.7	373.8	6,440	1,479,233	6,415	1,479,085	25	148
373.8	373.9	6,449	1,485,682	6,421	1,485,506	28	176
373.9	374	6,457	1,492,139	6,426	1,491,932	31	207
374	374.1	6,466	1,498,605	6,432	1,498,364	34	241
374.1	374.2	6,474	1,505,079	6,437	1,504,801	37	278
374.2	374.3	6,483	1,511,562	6,443	1,511,245	40	317
374.3	374.4	6,491	1,518,053	6,448	1,517,693	43	360
374.4	374.5	6,499	1,524,552	6,453	1,524,146	46	406
374.5	374.6	6,508	1,531,059	6,459	1,530,603	49	456
374.6	374.7	6,516	1,537,575	6,464	1,537,067	52	508
374.7	374.8	6,524	1,544,100	6,468	1,543,536	56	564
374.8	374.9	6,533	1,550,633	6,474	1,550,010	59	623
374.9	375	6,542	1,557,175	6,480	1,556,490	62	685
375	375.1	6,550	1,563,725	6,484	1,562,974	66	751
375.1	375.2	6,558	1,570,283	6,489	1,569,463	69	820
375.2	375.3	6,566	1,576,849	6,493	1,575,956	73	893
375.3	375.4	6,574	1,583,423	6,498	1,582,453	76	970
375.4	375.5	6,582	1,590,006	6,502	1,588,956	80	1,050
375.5	375.6	6,590	1,596,596	6,506	1,595,462	84	1,134
375.6	375.7	6,598	1,603,194	6,510	1,601,973	88	1,221
375.7	375.8	6,606	1,609,801	6,515	1,608,488	91	1,313
375.8	375.9	6,614	1,616,415	6,519	1,615,007	95	1,408
375.9	376	6,622	1,623,037	6,523	1,621,530	99	1,507
376	376.1	6,630	1,629,668	6,527	1,628,058	103	1,610
376.1	376.2	6,639	1,636,306	6,532	1,634,589	107	1,717
376.2	376.3	6,647	1,642,953	6,536	1,641,125	111	1,828
376.3	376.4	6,655	1,649,608	6,540	1,647,665	115	1,943
376.4	376.5	6,663	1,656,271	6,544	1,654,209	119	2,062

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
376.5	376.6	6,671	1,662,941	6,548	1,660,756	123	2,185
376.6	376.7	6,679	1,669,620	6,551	1,667,307	128	2,313
376.7	376.8	6,687	1,676,307	6,555	1,673,862	132	2,445
376.8	376.9	6,695	1,683,002	6,472	1,680,334	223	2,668
376.9	377	6,703	1,689,706	6,460	1,686,795	243	2,911
377	377.1	6,711	1,696,417	6,462	1,693,257	249	3,160
377.1	377.2	6,719	1,703,136	6,463	1,699,720	256	3,416
377.2	377.3	6,727	1,709,863	6,464	1,706,184	263	3,679
377.3	377.4	6,735	1,716,598	6,465	1,712,650	270	3,948
377.4	377.5	6,743	1,723,341	6,466	1,719,116	277	4,225
377.5	377.6	6,751	1,730,091	6,466	1,725,581	285	4,510
377.6	377.7	6,760	1,736,852	6,466	1,732,049	294	4,803
377.7	377.8	6,779	1,743,631	6,467	1,738,515	312	5,116
377.8	377.9	6,790	1,750,422	6,467	1,744,983	323	5,439
377.9	378	6,799	1,757,221	6,467	1,751,450	332	5,771
378	378.1	6,808	1,764,029	6,466	1,757,916	342	6,113
378.1	378.2	6,817	1,770,845	6,466	1,764,382	351	6,463
378.2	378.3	6,825	1,777,670	6,465	1,770,847	360	6,823
378.3	378.4	6,834	1,784,504	6,465	1,777,312	369	7,192
378.4	378.5	6,843	1,791,347	6,465	1,783,776	378	7,571
378.5	378.6	6,851	1,798,198	6,464	1,790,240	387	7,958
378.6	378.7	6,860	1,805,058	6,464	1,796,704	396	8,354
378.7	378.8	6,868	1,811,926	6,463	1,803,166	405	8,760
378.8	378.9	6,877	1,818,803	6,463	1,809,629	414	9,174
378.9	379	6,886	1,825,688	6,463	1,816,091	423	9,597
379	379.1	6,894	1,832,583	6,463	1,822,555	431	10,028
379.1	379.2	6,903	1,839,486	6,463	1,829,018	440	10,468
379.2	379.3	6,912	1,846,399	6,463	1,835,482	449	10,917
379.3	379.4	6,921	1,853,320	6,464	1,841,946	457	11,374
379.4	379.5	6,930	1,860,250	6,465	1,848,411	465	11,839
379.5	379.6	6,939	1,867,189	6,465	1,854,876	474	12,313
379.6	379.7	6,948	1,874,137	6,466	1,861,342	482	12,795
379.7	379.8	6,957	1,881,094	6,467	1,867,808	490	13,286
379.8	379.9	6,966	1,888,060	6,468	1,874,276	498	13,784
379.9	380	6,975	1,895,034	6,469	1,880,744	506	14,290
380	380.1	6,984	1,902,018	6,470	1,887,213	514	14,805
380.1	380.2	6,993	1,909,011	6,470	1,893,683	523	15,328
380.2	380.3	7,003	1,916,014	6,471	1,900,155	532	15,859
380.3	380.4	7,012	1,923,026	6,471	1,906,626	541	16,400
380.4	380.5	7,023	1,930,049	6,472	1,913,099	551	16,950
380.5	380.6	7,034	1,937,082	6,468	1,919,566	566	17,516
380.6	380.7	7,045	1,944,127	6,457	1,926,023	588	18,104
380.7	380.8	7,057	1,951,185	6,442	1,932,466	615	18,719
380.8	380.9	7,070	1,958,255	6,417	1,938,883	653	19,372
380.9	381	7,082	1,965,337	6,388	1,945,271	694	20,066
381	381.1	7,098	1,972,435	6,359	1,951,630	739	20,805
381.1	381.2	7,145	1,979,580	6,351	1,957,981	794	21,599
381.2	381.3	7,200	1,986,781	6,360	1,964,341	840	22,440
381.3	381.4	7,285	1,994,065	6,400	1,970,741	885	23,324
381.4	381.5	7,392	2,001,457	6,461	1,977,201	931	24,256
381.5	381.6	7,459	2,008,916	6,478	1,983,679	981	25,237
381.6	381.7	7,489	2,016,405	6,471	1,990,149	1,018	26,256
381.7	381.8	7,512	2,023,917	6,474	1,996,623	1,038	27,294
381.8	381.9	7,528	2,031,446	6,477	2,003,101	1,051	28,345
381.9	382	7,542	2,038,988	6,480	2,009,581	1,062	29,407
382	382.1	7,556	2,046,544	6,485	2,016,066	1,071	30,478
382.1	382.2	7,569	2,054,113	6,489	2,022,555	1,080	31,558
382.2	382.3	7,583	2,061,696	6,495	2,029,051	1,088	32,645
382.3	382.4	7,597	2,069,292	6,501	2,035,551	1,096	33,741

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
382.4	382.5	7,612	2,076,904	6,508	2,042,059	1,104	34,845
382.5	382.6	7,627	2,084,531	6,516	2,048,575	1,111	35,956
382.6	382.7	7,643	2,092,175	6,524	2,055,100	1,119	37,075
382.7	382.8	7,660	2,099,834	6,533	2,061,632	1,127	38,202
382.8	382.9	7,676	2,107,510	6,542	2,068,174	1,134	39,336
382.9	383	7,692	2,115,202	6,550	2,074,723	1,142	40,479
383	383.1	7,708	2,122,911	6,558	2,081,283	1,150	41,628
383.1	383.2	7,725	2,130,636	6,568	2,087,851	1,157	42,785
383.2	383.3	7,741	2,138,377	6,576	2,094,427	1,165	43,950
383.3	383.4	7,758	2,146,135	6,585	2,101,012	1,173	45,123
383.4	383.5	7,774	2,153,909	6,593	2,107,604	1,181	46,305
383.5	383.6	7,790	2,161,699	6,600	2,114,204	1,190	47,495
383.6	383.7	7,806	2,169,505	6,607	2,120,811	1,199	48,694
383.7	383.8	7,821	2,177,326	6,612	2,127,423	1,209	49,903
383.8	383.9	7,836	2,185,162	6,618	2,134,041	1,218	51,121
383.9	384	7,849	2,193,011	6,622	2,140,663	1,227	52,348
384	384.1	7,861	2,200,872	6,625	2,147,287	1,236	53,585
384.1	384.2	7,873	2,208,745	6,628	2,153,916	1,245	54,829
384.2	384.3	7,883	2,216,628	6,630	2,160,546	1,253	56,082
384.3	384.4	7,894	2,224,522	6,633	2,167,179	1,261	57,343
384.4	384.5	7,904	2,232,426	6,635	2,173,814	1,269	58,612
384.5	384.6	7,915	2,240,342	6,638	2,180,453	1,277	59,889
384.6	384.7	7,926	2,248,267	6,641	2,187,093	1,285	61,174
384.7	384.8	7,937	2,256,204	6,644	2,193,737	1,293	62,467
384.8	384.9	7,947	2,264,151	6,646	2,200,383	1,301	63,768
384.9	385	7,958	2,272,109	6,649	2,207,031	1,309	65,078
385	385.1	7,968	2,280,078	6,651	2,213,683	1,317	66,395
385.1	385.2	7,979	2,288,056	6,653	2,220,335	1,326	67,721
385.2	385.3	7,988	2,296,045	6,653	2,226,989	1,335	69,056
385.3	385.4	7,998	2,304,043	6,654	2,233,643	1,344	70,400
385.4	385.5	8,008	2,312,050	6,654	2,240,297	1,354	71,753
385.5	385.6	8,018	2,320,068	6,654	2,246,951	1,364	73,117
385.6	385.7	8,028	2,328,096	6,654	2,253,605	1,374	74,491
385.7	385.8	8,040	2,336,136	6,655	2,260,260	1,385	75,876
385.8	385.9	8,051	2,344,187	6,657	2,266,916	1,394	77,271
385.9	386	8,063	2,352,250	6,659	2,273,576	1,404	78,674
386	386.1	8,074	2,360,324	6,661	2,280,237	1,413	80,087
386.1	386.2	8,085	2,368,409	6,663	2,286,901	1,422	81,508
386.2	386.3	8,095	2,376,504	6,664	2,293,565	1,431	82,939
386.3	386.4	8,106	2,384,610	6,667	2,300,232	1,439	84,378
386.4	386.5	8,116	2,392,725	6,668	2,306,898	1,448	85,827
386.5	386.6	8,126	2,400,852	6,669	2,313,568	1,457	87,284
386.6	386.7	8,136	2,408,987	6,670	2,320,237	1,466	88,750
386.7	386.8	8,146	2,417,133	6,671	2,326,907	1,475	90,226
386.8	386.9	8,157	2,425,290	6,672	2,333,579	1,485	91,711
386.9	387	8,170	2,433,460	6,675	2,340,255	1,495	93,205
387	387.1	8,183	2,441,643	6,679	2,346,933	1,504	94,710
387.1	387.2	8,196	2,449,840	6,682	2,353,616	1,514	96,224
387.2	387.3	8,209	2,458,049	6,685	2,360,301	1,524	97,748
387.3	387.4	8,220	2,466,269	6,686	2,366,987	1,534	99,282
387.4	387.5	8,231	2,474,500	6,686	2,373,673	1,545	100,827
387.5	387.6	8,242	2,482,742	6,686	2,380,358	1,556	102,384
387.6	387.7	8,252	2,490,994	6,684	2,387,042	1,568	103,952
387.7	387.8	8,263	2,499,257	6,683	2,393,725	1,580	105,532
387.8	387.9	8,274	2,507,531	6,682	2,400,407	1,592	107,124
387.9	388	8,285	2,515,816	6,682	2,407,089	1,603	108,727
388	388.1	8,296	2,524,111	6,681	2,413,769	1,615	110,342
388.1	388.2	8,307	2,532,418	6,680	2,420,450	1,627	111,968
388.2	388.3	8,319	2,540,738	6,681	2,427,132	1,638	113,606

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
388.3	388.4	8,331	2,549,068	6,682	2,433,813	1,649	115,255
388.4	388.5	8,342	2,557,411	6,682	2,440,495	1,660	116,916
388.5	388.6	8,354	2,565,764	6,682	2,447,176	1,672	118,588
388.6	388.7	8,366	2,574,130	6,682	2,453,858	1,684	120,272
388.7	388.8	8,378	2,582,508	6,681	2,460,539	1,697	121,969
388.8	388.9	8,390	2,590,898	6,680	2,467,219	1,710	123,679
388.9	389	8,401	2,599,299	6,677	2,473,896	1,724	125,403
389	389.1	8,413	2,607,712	6,674	2,480,570	1,739	127,142
389.1	389.2	8,426	2,616,138	6,672	2,487,242	1,754	128,896
389.2	389.3	8,439	2,624,577	6,669	2,493,911	1,770	130,666
389.3	389.4	8,451	2,633,028	6,665	2,500,576	1,786	132,452
389.4	389.5	8,464	2,641,492	6,663	2,507,239	1,801	134,253
389.5	389.6	8,478	2,649,970	6,663	2,513,901	1,815	136,069
389.6	389.7	8,491	2,658,461	6,662	2,520,563	1,829	137,898
389.7	389.8	8,504	2,666,965	6,661	2,527,224	1,843	139,741
389.8	389.9	8,518	2,675,483	6,661	2,533,885	1,857	141,598
389.9	390	8,531	2,684,014	6,660	2,540,544	1,871	143,470
390	390.1	8,546	2,692,560	6,661	2,547,205	1,885	145,355
390.1	390.2	8,563	2,701,123	6,664	2,553,869	1,899	147,254
390.2	390.3	8,580	2,709,703	6,663	2,560,532	1,917	149,171
390.3	390.4	8,595	2,718,297	6,660	2,567,191	1,935	151,106
390.4	390.5	8,608	2,726,906	6,659	2,573,851	1,949	153,055
390.5	390.6	8,622	2,735,528	6,659	2,580,509	1,963	155,019
390.6	390.7	8,635	2,744,162	6,658	2,587,166	1,977	156,996
390.7	390.8	8,648	2,752,810	6,657	2,593,823	1,991	158,987
390.8	390.9	8,661	2,761,471	6,656	2,600,480	2,005	160,991
390.9	391	8,673	2,770,144	6,655	2,607,134	2,018	163,010
391	391.1	8,686	2,778,831	6,654	2,613,789	2,032	165,042
391.1	391.2	8,699	2,787,529	6,654	2,620,442	2,045	167,087
391.2	391.3	8,711	2,796,241	6,652	2,627,095	2,059	169,146
391.3	391.4	8,724	2,804,965	6,652	2,633,747	2,072	171,218
391.4	391.5	8,738	2,813,703	6,653	2,640,400	2,085	173,303
391.5	391.6	8,752	2,822,455	6,654	2,647,054	2,098	175,401
391.6	391.7	8,767	2,831,222	6,655	2,653,709	2,112	177,513
391.7	391.8	8,781	2,840,003	6,656	2,660,365	2,125	179,638
391.8	391.9	8,794	2,848,797	6,656	2,667,022	2,138	181,775
391.9	392	8,807	2,857,604	6,656	2,673,678	2,151	183,926
392	392.1	8,821	2,866,425	6,657	2,680,334	2,164	186,091
392.1	392.2	8,835	2,875,259	6,658	2,686,991	2,177	188,268
392.2	392.3	8,849	2,884,109	6,658	2,693,650	2,191	190,459
392.3	392.4	8,864	2,892,973	6,660	2,700,310	2,204	192,663
392.4	392.5	8,881	2,901,854	6,662	2,706,972	2,219	194,882
392.5	392.6	8,899	2,910,753	6,665	2,713,637	2,234	197,116
392.6	392.7	8,923	2,919,676	6,671	2,720,308	2,252	199,368
392.7	392.8	8,946	2,928,622	6,677	2,726,986	2,269	201,636
392.8	392.9	8,969	2,937,591	6,684	2,733,670	2,285	203,921
392.9	393	8,995	2,946,586	6,695	2,740,365	2,300	206,221
393	393.1	9,035	2,955,621	6,719	2,747,083	2,316	208,538
393.1	393.2	9,093	2,964,714	6,761	2,753,844	2,332	210,870
393.2	393.3	9,161	2,973,876	6,812	2,760,657	2,349	213,219
393.3	393.4	9,224	2,983,100	6,859	2,767,516	2,365	215,584
393.4	393.5	9,281	2,992,381	6,899	2,774,414	2,382	217,967
393.5	393.6	9,339	3,001,721	6,940	2,781,355	2,399	220,366
393.6	393.7	9,391	3,011,112	6,974	2,788,329	2,417	222,783
393.7	393.8	9,436	3,020,548	7,002	2,795,331	2,434	225,217
393.8	393.9	9,493	3,030,041	7,041	2,802,372	2,452	227,669
393.9	394	9,563	3,039,604	7,091	2,809,463	2,472	230,141
394	394.1	9,640	3,049,244	7,149	2,816,612	2,491	232,632
394.1	394.2	9,733	3,058,977	7,222	2,823,833	2,511	235,144

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
394.2	394.3	9,812	3,068,788	7,280	2,831,113	2,532	237,675
394.3	394.4	9,883	3,078,671	7,331	2,838,443	2,552	240,228
394.4	394.5	9,953	3,088,625	7,379	2,845,824	2,574	242,801
394.5	394.6	10,020	3,098,645	7,425	2,853,248	2,595	245,397
394.6	394.7	10,082	3,108,727	7,465	2,860,713	2,617	248,014
394.7	394.8	10,139	3,118,866	7,499	2,868,213	2,640	250,653
394.8	394.9	10,199	3,129,065	7,525	2,875,738	2,674	253,327
394.9	395	10,257	3,139,323	7,547	2,883,286	2,710	256,037
395	395.1	10,309	3,149,632	7,568	2,890,854	2,741	258,778
395.1	395.2	10,359	3,159,991	7,589	2,898,443	2,770	261,548
395.2	395.3	10,416	3,170,408	7,608	2,906,053	2,808	264,355
395.3	395.4	10,457	3,180,865	7,615	2,913,668	2,842	267,197
395.4	395.5	10,487	3,191,352	7,617	2,921,285	2,870	270,067
395.5	395.6	10,518	3,201,870	7,618	2,928,903	2,900	272,967
395.6	395.7	10,552	3,212,422	7,616	2,936,519	2,936	275,903
395.7	395.8	10,590	3,223,012	7,616	2,944,134	2,974	278,878
395.8	395.9	10,623	3,233,635	7,618	2,951,752	3,005	281,883
395.9	396	10,645	3,244,280	7,618	2,959,370	3,027	284,910
396	396.1	10,661	3,254,941	7,616	2,966,987	3,045	287,954
396.1	396.2	10,674	3,265,615	7,614	2,974,600	3,060	291,015
396.2	396.3	10,686	3,276,300	7,611	2,982,210	3,075	294,090
396.3	396.4	10,697	3,286,997	7,608	2,989,818	3,089	297,179
396.4	396.5	10,707	3,297,705	7,603	2,997,422	3,104	300,283
396.5	396.6	10,718	3,308,422	7,600	3,005,021	3,118	303,401
396.6	396.7	10,728	3,319,150	7,596	3,012,616	3,132	306,534
396.7	396.8	10,738	3,329,888	7,591	3,020,208	3,147	309,680
396.8	396.9	10,748	3,340,636	7,588	3,027,795	3,160	312,841
396.9	397	10,758	3,351,394	7,584	3,035,379	3,174	316,015
397	397.1	10,769	3,362,163	7,581	3,042,960	3,188	319,203
397.1	397.2	10,779	3,372,942	7,576	3,050,536	3,203	322,406
397.2	397.3	10,789	3,383,732	7,572	3,058,109	3,217	325,623
397.3	397.4	10,800	3,394,532	7,568	3,065,677	3,232	328,855
397.4	397.5	10,810	3,405,342	7,563	3,073,239	3,247	332,103
397.5	397.6	10,821	3,416,162	7,558	3,080,797	3,263	335,365
397.6	397.7	10,831	3,426,994	7,553	3,088,351	3,278	338,643
397.7	397.8	10,842	3,437,836	7,548	3,095,898	3,294	341,938
397.8	397.9	10,853	3,448,689	7,543	3,103,441	3,310	345,248
397.9	398	10,864	3,459,553	7,537	3,110,979	3,327	348,574
398	398.1	10,875	3,470,427	7,532	3,118,509	3,343	351,918
398.1	398.2	10,885	3,481,312	7,524	3,126,033	3,361	355,279
398.2	398.3	10,899	3,492,211	7,517	3,133,550	3,382	358,661
398.3	398.4	10,915	3,503,126	7,511	3,141,061	3,404	362,065
398.4	398.5	10,926	3,514,052	7,501	3,148,562	3,425	365,490
398.5	398.6	10,937	3,524,989	7,491	3,156,053	3,446	368,936
398.6	398.7	10,947	3,535,936	7,480	3,163,533	3,467	372,403
398.7	398.8	10,958	3,546,894	7,471	3,171,005	3,487	375,889
398.8	398.9	10,970	3,557,864	7,463	3,178,468	3,507	379,396
398.9	399	10,981	3,568,845	7,454	3,185,922	3,527	382,923
399	399.1	10,992	3,579,837	7,445	3,193,368	3,547	386,469
399.1	399.2	11,003	3,590,839	7,436	3,200,803	3,567	390,036
399.2	399.3	11,014	3,601,853	7,427	3,208,229	3,587	393,624
399.3	399.4	11,025	3,612,878	7,418	3,215,647	3,607	397,231
399.4	399.5	11,036	3,623,913	7,409	3,223,055	3,627	400,858
399.5	399.6	11,048	3,634,961	7,402	3,230,457	3,646	404,504
399.6	399.7	11,069	3,646,031	7,403	3,237,861	3,666	408,170
399.7	399.8	11,089	3,657,120	7,400	3,245,260	3,689	411,860
399.8	399.9	11,103	3,668,223	7,388	3,252,648	3,715	415,575
399.9	400	11,117	3,679,340	7,377	3,260,025	3,740	419,315
400	400.1	11,131	3,690,471	7,370	3,267,394	3,761	423,077

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
400.1	400.2	11,145	3,701,616	7,364	3,274,758	3,781	426,858
400.2	400.3	11,158	3,712,774	7,357	3,282,115	3,801	430,659
400.3	400.4	11,171	3,723,945	7,350	3,289,465	3,821	434,480
400.4	400.5	11,184	3,735,128	7,343	3,296,808	3,841	438,320
400.5	400.6	11,196	3,746,325	7,335	3,304,144	3,861	442,181
400.6	400.7	11,209	3,757,533	7,328	3,311,471	3,881	446,062
400.7	400.8	11,221	3,768,754	7,320	3,318,791	3,901	449,963
400.8	400.9	11,233	3,779,987	7,311	3,326,102	3,922	453,885
400.9	401	11,245	3,791,233	7,302	3,333,406	3,943	457,827
401	401.1	11,257	3,802,490	7,293	3,340,699	3,964	461,791
401.1	401.2	11,269	3,813,759	7,285	3,347,984	3,984	465,775
401.2	401.3	11,281	3,825,040	7,276	3,355,259	4,005	469,781
401.3	401.4	11,293	3,836,333	7,267	3,362,526	4,026	473,807
401.4	401.5	11,305	3,847,639	7,258	3,369,785	4,047	477,854
401.5	401.6	11,317	3,858,956	7,249	3,377,034	4,068	481,922
401.6	401.7	11,329	3,870,285	7,240	3,384,273	4,089	486,012
401.7	401.8	11,341	3,881,626	7,230	3,391,503	4,111	490,123
401.8	401.9	11,354	3,892,980	7,221	3,398,725	4,133	494,255
401.9	402	11,366	3,904,347	7,211	3,405,936	4,155	498,411
402	402.1	11,379	3,915,726	7,201	3,413,137	4,178	502,589
402.1	402.2	11,392	3,927,117	7,191	3,420,327	4,201	506,790
402.2	402.3	11,404	3,938,522	7,180	3,427,508	4,224	511,014
402.3	402.4	11,417	3,949,939	7,171	3,434,679	4,246	515,260
402.4	402.5	11,430	3,961,368	7,163	3,441,841	4,267	519,527
402.5	402.6	11,443	3,972,811	7,155	3,448,996	4,288	523,815
402.6	402.7	11,456	3,984,267	7,148	3,456,143	4,308	528,124
402.7	402.8	11,468	3,995,735	7,139	3,463,282	4,329	532,453
402.8	402.9	11,481	4,007,216	7,132	3,470,414	4,349	536,802
402.9	403	11,494	4,018,711	7,125	3,477,540	4,369	541,171
403	403.1	11,507	4,030,218	7,117	3,484,657	4,390	545,561
403.1	403.2	11,521	4,041,739	7,110	3,491,767	4,411	549,972
403.2	403.3	11,534	4,053,273	7,102	3,498,869	4,432	554,404
403.3	403.4	11,548	4,064,821	7,095	3,505,964	4,453	558,857
403.4	403.5	11,560	4,076,381	7,087	3,513,051	4,473	563,330
403.5	403.6	11,573	4,087,954	7,079	3,520,130	4,494	567,824
403.6	403.7	11,585	4,099,539	7,071	3,527,201	4,514	572,338
403.7	403.8	11,597	4,111,136	7,063	3,534,264	4,534	576,872
403.8	403.9	11,609	4,122,745	7,055	3,541,320	4,554	581,425
403.9	404	11,622	4,134,367	7,048	3,548,368	4,574	585,999
404	404.1	11,635	4,146,002	7,041	3,555,409	4,594	590,593
404.1	404.2	11,647	4,157,649	7,033	3,562,442	4,614	595,207
404.2	404.3	11,660	4,169,309	7,026	3,569,468	4,634	599,841
404.3	404.4	11,672	4,180,981	7,017	3,576,486	4,655	604,495
404.4	404.5	11,684	4,192,665	7,008	3,583,494	4,676	609,171
404.5	404.6	11,696	4,204,361	7,000	3,590,494	4,696	613,867
404.6	404.7	11,709	4,216,070	6,992	3,597,486	4,717	618,584
404.7	404.8	11,721	4,227,792	6,984	3,604,471	4,737	623,321
404.8	404.9	11,735	4,239,526	6,977	3,611,447	4,758	628,079
404.9	405	11,750	4,251,276	6,971	3,618,418	4,779	632,858
405	405.1	11,767	4,263,044	6,967	3,625,386	4,800	637,658
405.1	405.2	11,786	4,274,830	6,965	3,632,351	4,821	642,479
405.2	405.3	11,805	4,286,635	6,961	3,639,312	4,844	647,323
405.3	405.4	11,830	4,298,465	6,963	3,646,275	4,867	652,190
405.4	405.5	11,858	4,310,323	6,968	3,653,243	4,890	657,080
405.5	405.6	11,888	4,322,210	6,974	3,660,216	4,914	661,994
405.6	405.7	11,926	4,334,136	6,984	3,667,200	4,942	666,936
405.7	405.8	11,976	4,346,113	7,000	3,674,201	4,976	671,912
405.8	405.9	12,015	4,358,127	7,003	3,681,203	5,012	676,924
405.9	406	12,062	4,370,189	7,005	3,688,208	5,057	681,981

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
406	406.1	12,104	4,382,293	6,994	3,695,201	5,110	687,092
406.1	406.2	12,145	4,394,438	6,989	3,702,191	5,156	692,247
406.2	406.3	12,185	4,406,622	6,987	3,709,177	5,198	697,445
406.3	406.4	12,224	4,418,847	6,981	3,716,159	5,243	702,688
406.4	406.5	12,264	4,431,111	6,975	3,723,135	5,289	707,976
406.5	406.6	12,296	4,443,407	6,968	3,730,103	5,328	713,304
406.6	406.7	12,323	4,455,730	6,957	3,737,060	5,366	718,670
406.7	406.8	12,346	4,468,076	6,942	3,744,001	5,404	724,075
406.8	406.9	12,371	4,480,447	6,926	3,750,928	5,445	729,519
406.9	407	12,405	4,492,852	6,918	3,757,846	5,487	735,006
407	407.1	12,434	4,505,287	6,903	3,764,750	5,531	740,537
407.1	407.2	12,458	4,517,744	6,884	3,771,633	5,574	746,111
407.2	407.3	12,486	4,530,231	6,863	3,778,497	5,623	751,734
407.3	407.4	12,528	4,542,759	6,851	3,785,349	5,677	757,410
407.4	407.5	12,570	4,555,329	6,837	3,792,186	5,733	763,143
407.5	407.6	12,604	4,567,932	6,821	3,799,007	5,783	768,925
407.6	407.7	12,631	4,580,563	6,811	3,805,817	5,820	774,746
407.7	407.8	12,654	4,593,217	6,802	3,812,619	5,852	780,598
407.8	407.9	12,672	4,605,889	6,792	3,819,412	5,880	786,477
407.9	408	12,685	4,618,574	6,781	3,826,193	5,904	792,381
408	408.1	12,698	4,631,272	6,770	3,832,962	5,928	798,310
408.1	408.2	12,710	4,643,982	6,757	3,839,720	5,953	804,262
408.2	408.3	12,722	4,656,704	6,745	3,846,465	5,977	810,239
408.3	408.4	12,733	4,669,437	6,732	3,853,197	6,001	816,240
408.4	408.5	12,745	4,682,182	6,719	3,859,916	6,026	822,266
408.5	408.6	12,756	4,694,937	6,703	3,866,618	6,053	828,319
408.6	408.7	12,767	4,707,705	6,687	3,873,306	6,080	834,399
408.7	408.8	12,778	4,720,483	6,672	3,879,979	6,106	840,504
408.8	408.9	12,790	4,733,273	6,659	3,886,638	6,131	846,635
408.9	409	12,801	4,746,074	6,646	3,893,283	6,155	852,791
409	409.1	12,814	4,758,888	6,634	3,899,917	6,180	858,971
409.1	409.2	12,826	4,771,714	6,621	3,906,538	6,205	865,176
409.2	409.3	12,839	4,784,554	6,609	3,913,148	6,230	871,406
409.3	409.4	12,853	4,797,406	6,598	3,919,745	6,255	877,661
409.4	409.5	12,866	4,810,272	6,585	3,926,330	6,281	883,942
409.5	409.6	12,880	4,823,152	6,574	3,932,904	6,306	890,248
409.6	409.7	12,893	4,836,045	6,562	3,939,466	6,331	896,579
409.7	409.8	12,906	4,848,950	6,549	3,946,014	6,357	902,936
409.8	409.9	12,918	4,861,868	6,536	3,952,550	6,382	909,318
409.9	410	12,929	4,874,797	6,522	3,959,072	6,407	915,725
410	410.1	12,939	4,887,736	6,507	3,965,580	6,432	922,156
410.1	410.2	12,949	4,900,685	6,493	3,972,073	6,456	928,612
410.2	410.3	12,959	4,913,644	6,479	3,978,552	6,480	935,092
410.3	410.4	12,968	4,926,612	6,464	3,985,016	6,504	941,596
410.4	410.5	12,977	4,939,589	6,449	3,991,465	6,528	948,124
410.5	410.6	12,986	4,952,576	6,434	3,997,900	6,552	954,676
410.6	410.7	12,995	4,965,571	6,419	4,004,319	6,576	961,252
410.7	410.8	13,004	4,978,574	6,405	4,010,723	6,599	967,851
410.8	410.9	13,012	4,991,587	6,389	4,017,113	6,623	974,474
410.9	411	13,021	5,004,608	6,375	4,023,489	6,646	981,119
411	411.1	13,030	5,017,637	6,361	4,029,848	6,669	987,789
411.1	411.2	13,038	5,030,675	6,346	4,036,194	6,692	994,481
411.2	411.3	13,047	5,043,723	6,331	4,042,526	6,716	1,001,197
411.3	411.4	13,057	5,056,780	6,318	4,048,844	6,739	1,007,936
411.4	411.5	13,068	5,069,848	6,305	4,055,148	6,763	1,014,700
411.5	411.6	13,078	5,082,926	6,291	4,061,439	6,787	1,021,487
411.6	411.7	13,089	5,096,015	6,278	4,067,717	6,811	1,028,298
411.7	411.8	13,099	5,109,114	6,265	4,073,982	6,834	1,035,132
411.8	411.9	13,109	5,122,223	6,251	4,080,233	6,858	1,041,990

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
411.9	412	13,117	5,135,340	6,235	4,086,469	6,882	1,048,871
412	412.1	13,125	5,148,465	6,219	4,092,687	6,906	1,055,778
412.1	412.2	13,133	5,161,598	6,202	4,098,889	6,931	1,062,709
412.2	412.3	13,140	5,174,738	6,183	4,105,072	6,957	1,069,666
412.3	412.4	13,148	5,187,886	6,164	4,111,236	6,984	1,076,650
412.4	412.5	13,155	5,201,041	6,144	4,117,379	7,011	1,083,662
412.5	412.6	13,163	5,214,204	6,124	4,123,503	7,039	1,090,701
412.6	412.7	13,171	5,227,376	6,103	4,129,607	7,068	1,097,769
412.7	412.8	13,179	5,240,555	6,081	4,135,688	7,098	1,104,867
412.8	412.9	13,188	5,253,743	6,059	4,141,746	7,129	1,111,997
412.9	413	13,195	5,266,938	6,034	4,147,780	7,161	1,119,158
413	413.1	13,203	5,280,141	6,009	4,153,788	7,194	1,126,353
413.1	413.2	13,211	5,293,352	5,982	4,159,770	7,229	1,133,582
413.2	413.3	13,218	5,306,570	5,953	4,165,723	7,265	1,140,847
413.3	413.4	13,226	5,319,796	5,923	4,171,647	7,303	1,148,149
413.4	413.5	13,233	5,333,030	5,892	4,177,539	7,341	1,155,491
413.5	413.6	13,241	5,346,271	5,862	4,183,401	7,379	1,162,870
413.6	413.7	13,249	5,359,519	5,833	4,189,233	7,416	1,170,286
413.7	413.8	13,256	5,372,776	5,804	4,195,039	7,452	1,177,737
413.8	413.9	13,264	5,386,040	5,777	4,200,815	7,487	1,185,225
413.9	414	13,272	5,399,311	5,747	4,206,562	7,525	1,192,749
414	414.1	13,279	5,412,591	5,715	4,212,278	7,564	1,200,313
414.1	414.2	13,287	5,425,878	5,685	4,217,963	7,602	1,207,915
414.2	414.3	13,296	5,439,174	5,656	4,223,619	7,640	1,215,555
414.3	414.4	13,306	5,452,480	5,633	4,229,252	7,673	1,223,228
414.4	414.5	13,317	5,465,796	5,610	4,234,861	7,707	1,230,935
414.5	414.6	13,326	5,479,123	5,587	4,240,449	7,739	1,238,674
414.6	414.7	13,335	5,492,458	5,564	4,246,013	7,771	1,246,445
414.7	414.8	13,344	5,505,802	5,542	4,251,555	7,802	1,254,247
414.8	414.9	13,352	5,519,154	5,519	4,257,074	7,833	1,262,080
414.9	415	13,360	5,532,515	5,492	4,262,567	7,868	1,269,948
415	415.1	13,368	5,545,883	5,457	4,268,024	7,911	1,277,859
415.1	415.2	13,376	5,559,259	5,417	4,273,442	7,959	1,285,817
415.2	415.3	13,384	5,572,643	5,376	4,278,818	8,008	1,293,825
415.3	415.4	13,391	5,586,034	5,339	4,284,157	8,052	1,301,877
415.4	415.5	13,399	5,599,433	5,303	4,289,460	8,096	1,309,973
415.5	415.6	13,407	5,612,840	5,257	4,294,717	8,150	1,318,123
415.6	415.7	13,415	5,626,255	5,193	4,299,910	8,222	1,326,345
415.7	415.8	13,423	5,639,677	5,123	4,305,032	8,300	1,334,645
415.8	415.9	13,431	5,653,108	5,070	4,310,102	8,361	1,343,006
415.9	416	13,439	5,666,547	5,024	4,315,127	8,415	1,351,420
416	416.1	13,447	5,679,995	4,978	4,320,106	8,469	1,359,889
416.1	416.2	13,456	5,693,450	4,936	4,325,041	8,520	1,368,409
416.2	416.3	13,464	5,706,915	4,895	4,329,937	8,569	1,376,978
416.3	416.4	13,473	5,720,388	4,856	4,334,793	8,617	1,385,595
416.4	416.5	13,482	5,733,870	4,818	4,339,611	8,664	1,394,259
416.5	416.6	13,492	5,747,362	4,784	4,344,395	8,708	1,402,967
416.6	416.7	13,501	5,760,863	4,752	4,349,147	8,749	1,411,716
416.7	416.8	13,510	5,774,373	4,722	4,353,869	8,788	1,420,504
416.8	416.9	13,520	5,787,893	4,693	4,358,562	8,827	1,429,331
416.9	417	13,529	5,801,423	4,666	4,363,229	8,863	1,438,194
417	417.1	13,539	5,814,962	4,641	4,367,870	8,898	1,447,092
417.1	417.2	13,549	5,828,510	4,616	4,372,485	8,933	1,456,025
417.2	417.3	13,559	5,842,069	4,592	4,377,077	8,967	1,464,992
417.3	417.4	13,570	5,855,639	4,570	4,381,648	9,000	1,473,991
417.4	417.5	13,583	5,869,222	4,549	4,386,197	9,034	1,483,025
417.5	417.6	13,600	5,882,822	4,532	4,390,729	9,068	1,492,093
417.6	417.7	13,618	5,896,440	4,520	4,395,248	9,098	1,501,192
417.7	417.8	13,641	5,910,082	4,514	4,399,763	9,127	1,510,319

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
417.8	417.9	13,680	5,923,761	4,525	4,404,288	9,155	1,519,473
417.9	418	13,746	5,937,507	4,562	4,408,850	9,184	1,528,657
418	418.1	13,832	5,951,339	4,617	4,413,466	9,215	1,537,873
418.1	418.2	13,902	5,965,241	4,652	4,418,118	9,250	1,547,123
418.2	418.3	13,962	5,979,203	4,670	4,422,788	9,292	1,556,415
418.3	418.4	14,030	5,993,233	4,694	4,427,482	9,336	1,565,751
418.4	418.5	14,104	6,007,337	4,721	4,432,203	9,383	1,575,134
418.5	418.6	14,172	6,021,509	4,742	4,436,945	9,430	1,584,564
418.6	418.7	14,240	6,035,749	4,757	4,441,701	9,483	1,594,048
418.7	418.8	14,327	6,050,076	4,765	4,446,467	9,562	1,603,609
418.8	418.9	14,401	6,064,478	4,771	4,451,239	9,630	1,613,239
418.9	419	14,463	6,078,940	4,774	4,456,012	9,689	1,622,928
419	419.1	14,524	6,093,464	4,777	4,460,789	9,747	1,632,675
419.1	419.2	14,574	6,108,038	4,778	4,465,568	9,796	1,642,470
419.2	419.3	14,615	6,122,652	4,776	4,470,342	9,839	1,652,310
419.3	419.4	14,645	6,137,297	4,771	4,475,113	9,874	1,662,184
419.4	419.5	14,676	6,151,973	4,763	4,479,876	9,913	1,672,097
419.5	419.6	14,710	6,166,683	4,754	4,484,630	9,956	1,682,053
419.6	419.7	14,741	6,181,424	4,747	4,489,377	9,994	1,692,047
419.7	419.8	14,758	6,196,182	4,736	4,494,112	10,022	1,702,070
419.8	419.9	14,771	6,210,953	4,725	4,498,837	10,046	1,712,116
419.9	420	14,784	6,225,737	4,715	4,503,553	10,069	1,722,184
420	420.1	14,794	6,240,531	4,705	4,508,258	10,089	1,732,273
420.1	420.2	14,801	6,255,332	4,695	4,512,953	10,106	1,742,379
420.2	420.3	14,807	6,270,139	4,684	4,517,637	10,123	1,752,502
420.3	420.4	14,814	6,284,953	4,674	4,522,311	10,140	1,762,642
420.4	420.5	14,821	6,299,774	4,664	4,526,975	10,157	1,772,799
420.5	420.6	14,828	6,314,602	4,655	4,531,630	10,173	1,782,972
420.6	420.7	14,836	6,329,438	4,646	4,536,276	10,190	1,793,162
420.7	420.8	14,844	6,344,282	4,637	4,540,913	10,207	1,803,369
420.8	420.9	14,852	6,359,134	4,629	4,545,542	10,223	1,813,592
420.9	421	14,859	6,373,992	4,620	4,550,161	10,239	1,823,831
421	421.1	14,866	6,388,858	4,610	4,554,771	10,256	1,834,087
421.1	421.2	14,874	6,403,733	4,602	4,559,374	10,272	1,844,359
421.2	421.3	14,884	6,418,616	4,597	4,563,970	10,287	1,854,646
421.3	421.4	14,893	6,433,509	4,590	4,568,560	10,303	1,864,949
421.4	421.5	14,900	6,448,409	4,582	4,573,142	10,318	1,875,267
421.5	421.6	14,907	6,463,316	4,574	4,577,716	10,333	1,885,600
421.6	421.7	14,913	6,478,229	4,564	4,582,280	10,349	1,895,949
421.7	421.8	14,920	6,493,149	4,556	4,586,836	10,364	1,906,313
421.8	421.9	14,926	6,508,075	4,547	4,591,383	10,379	1,916,692
421.9	422	14,933	6,523,008	4,539	4,595,922	10,394	1,927,086
422	422.1	14,940	6,537,948	4,530	4,600,452	10,410	1,937,496
422.1	422.2	14,947	6,552,895	4,522	4,604,974	10,425	1,947,921
422.2	422.3	14,954	6,567,849	4,513	4,609,487	10,441	1,958,362
422.3	422.4	14,961	6,582,810	4,504	4,613,991	10,457	1,968,819
422.4	422.5	14,968	6,597,778	4,496	4,618,487	10,472	1,979,291
422.5	422.6	14,975	6,612,753	4,487	4,622,974	10,488	1,989,779
422.6	422.7	14,982	6,627,735	4,479	4,627,453	10,503	2,000,282
422.7	422.8	14,989	6,642,724	4,470	4,631,923	10,519	2,010,801
422.8	422.9	14,996	6,657,720	4,462	4,636,385	10,534	2,021,335
422.9	423	15,003	6,672,723	4,453	4,640,838	10,550	2,031,885
423	423.1	15,010	6,687,733	4,445	4,645,284	10,565	2,042,449
423.1	423.2	15,017	6,702,751	4,437	4,649,721	10,580	2,053,030
423.2	423.3	15,024	6,717,775	4,429	4,654,150	10,595	2,063,625
423.3	423.4	15,032	6,732,807	4,422	4,658,572	10,610	2,074,235
423.4	423.5	15,039	6,747,846	4,413	4,662,985	10,626	2,084,861
423.5	423.6	15,046	6,762,892	4,405	4,667,390	10,641	2,095,502
423.6	423.7	15,053	6,777,945	4,397	4,671,788	10,656	2,106,157

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
423.7	423.8	15,061	6,793,006	4,390	4,676,178	10,671	2,116,828
423.8	423.9	15,068	6,808,074	4,382	4,680,560	10,686	2,127,514
423.9	424	15,075	6,823,149	4,374	4,684,934	10,701	2,138,215
424	424.1	15,080	6,838,229	4,364	4,689,298	10,716	2,148,931
424.1	424.2	15,086	6,853,315	4,355	4,693,652	10,731	2,159,663
424.2	424.3	15,092	6,868,407	4,345	4,697,998	10,747	2,170,409
424.3	424.4	15,097	6,883,504	4,335	4,702,333	10,762	2,181,171
424.4	424.5	15,103	6,898,606	4,326	4,706,658	10,777	2,191,948
424.5	424.6	15,108	6,913,715	4,316	4,710,975	10,792	2,202,740
424.6	424.7	15,114	6,928,829	4,307	4,715,281	10,807	2,213,548
424.7	424.8	15,120	6,943,949	4,298	4,719,579	10,822	2,224,370
424.8	424.9	15,126	6,959,074	4,288	4,723,867	10,838	2,235,207
424.9	425	15,132	6,974,206	4,279	4,728,146	10,853	2,246,060
425	425.1	15,139	6,989,346	4,270	4,732,417	10,869	2,256,929
425.1	425.2	15,148	7,004,493	4,264	4,736,680	10,884	2,267,813
425.2	425.3	15,156	7,019,649	4,257	4,740,937	10,899	2,278,712
425.3	425.4	15,165	7,034,814	4,252	4,745,189	10,913	2,289,625
425.4	425.5	15,173	7,049,987	4,245	4,749,433	10,928	2,300,554
425.5	425.6	15,181	7,065,169	4,238	4,753,672	10,943	2,311,497
425.6	425.7	15,190	7,080,358	4,232	4,757,903	10,958	2,322,455
425.7	425.8	15,198	7,095,557	4,225	4,762,129	10,973	2,333,428
425.8	425.9	15,206	7,110,763	4,218	4,766,347	10,988	2,344,416
425.9	426	15,215	7,125,978	4,212	4,770,560	11,003	2,355,418
426	426.1	15,223	7,141,201	4,205	4,774,765	11,018	2,366,436
426.1	426.2	15,231	7,156,432	4,198	4,778,963	11,033	2,377,469
426.2	426.3	15,239	7,171,670	4,191	4,783,154	11,048	2,388,516
426.3	426.4	15,246	7,186,917	4,184	4,787,339	11,062	2,399,578
426.4	426.5	15,254	7,202,171	4,177	4,791,516	11,077	2,410,655
426.5	426.6	15,261	7,217,432	4,169	4,795,685	11,092	2,421,747
426.6	426.7	15,268	7,232,700	4,161	4,799,846	11,107	2,432,854
426.7	426.8	15,276	7,247,976	4,155	4,804,001	11,121	2,443,975
426.8	426.9	15,283	7,263,259	4,147	4,808,148	11,136	2,455,111
426.9	427	15,290	7,278,548	4,139	4,812,286	11,151	2,466,262
427	427.1	15,298	7,293,846	4,132	4,816,417	11,166	2,477,429
427.1	427.2	15,309	7,309,155	4,126	4,820,543	11,183	2,488,612
427.2	427.3	15,318	7,324,473	4,119	4,824,663	11,199	2,499,810
427.3	427.4	15,327	7,339,800	4,114	4,828,776	11,213	2,511,024
427.4	427.5	15,336	7,355,136	4,108	4,832,885	11,228	2,522,251
427.5	427.6	15,344	7,370,480	4,102	4,836,987	11,242	2,533,493
427.6	427.7	15,352	7,385,833	4,096	4,841,084	11,256	2,544,749
427.7	427.8	15,360	7,401,193	4,089	4,845,173	11,271	2,556,020
427.8	427.9	15,368	7,416,561	4,083	4,849,255	11,285	2,567,306
427.9	428	15,376	7,431,937	4,076	4,853,331	11,300	2,578,606
428	428.1	15,383	7,447,320	4,069	4,857,400	11,314	2,589,920
428.1	428.2	15,391	7,462,711	4,062	4,861,462	11,329	2,601,249
428.2	428.3	15,398	7,478,109	4,055	4,865,518	11,343	2,612,591
428.3	428.4	15,405	7,493,514	4,048	4,869,566	11,357	2,623,948
428.4	428.5	15,413	7,508,928	4,042	4,873,609	11,371	2,635,319
428.5	428.6	15,422	7,524,350	4,036	4,877,644	11,386	2,646,706
428.6	428.7	15,432	7,539,781	4,030	4,881,673	11,402	2,658,108
428.7	428.8	15,442	7,555,223	4,023	4,885,697	11,419	2,669,526
428.8	428.9	15,453	7,570,677	4,017	4,889,714	11,436	2,680,963
428.9	429	15,467	7,586,143	4,012	4,893,725	11,455	2,692,418
429	429.1	15,481	7,601,624	4,006	4,897,731	11,475	2,703,893
429.1	429.2	15,495	7,617,119	4,001	4,901,732	11,494	2,715,387
429.2	429.3	15,511	7,632,630	3,996	4,905,728	11,515	2,726,902
429.3	429.4	15,529	7,648,159	3,993	4,909,721	11,536	2,738,438
429.4	429.5	15,550	7,663,710	3,993	4,913,715	11,557	2,749,995
429.5	429.6	15,582	7,679,291	4,002	4,917,717	11,580	2,761,574

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
429.6	429.7	15,621	7,694,912	4,017	4,921,733	11,604	2,773,179
429.7	429.8	15,663	7,710,575	4,029	4,925,763	11,634	2,784,812
429.8	429.9	15,728	7,726,303	4,054	4,929,816	11,674	2,796,487
429.9	430	15,795	7,742,098	4,079	4,933,896	11,716	2,808,202
430	430.1	15,869	7,757,967	4,108	4,938,003	11,761	2,819,964
430.1	430.2	15,936	7,773,903	4,129	4,942,132	11,807	2,831,771
430.2	430.3	15,986	7,789,889	4,141	4,946,274	11,845	2,843,615
430.3	430.4	16,037	7,805,926	4,155	4,950,428	11,882	2,855,498
430.4	430.5	16,085	7,822,010	4,166	4,954,593	11,919	2,867,417
430.5	430.6	16,135	7,838,145	4,177	4,958,770	11,958	2,879,375
430.6	430.7	16,181	7,854,326	4,183	4,962,953	11,998	2,891,373
430.7	430.8	16,234	7,870,560	4,195	4,967,148	12,039	2,903,412
430.8	430.9	16,281	7,886,841	4,203	4,971,352	12,078	2,915,489
430.9	431	16,323	7,903,164	4,204	4,975,556	12,119	2,927,608
431	431.1	16,363	7,919,526	4,205	4,979,760	12,158	2,939,766
431.1	431.2	16,398	7,935,924	4,203	4,983,963	12,195	2,951,961
431.2	431.3	16,432	7,952,356	4,202	4,988,166	12,230	2,964,190
431.3	431.4	16,461	7,968,817	4,202	4,992,368	12,259	2,976,449
431.4	431.5	16,492	7,985,310	4,205	4,996,574	12,287	2,988,736
431.5	431.6	16,528	8,001,838	4,212	5,000,786	12,316	3,001,052
431.6	431.7	16,564	8,018,403	4,219	5,005,006	12,345	3,013,397
431.7	431.8	16,597	8,035,000	4,223	5,009,229	12,374	3,025,771
431.8	431.9	16,626	8,051,625	4,224	5,013,453	12,402	3,038,172
431.9	432	16,651	8,068,276	4,223	5,017,676	12,428	3,050,600
432	432.1	16,673	8,084,949	4,221	5,021,897	12,452	3,063,052
432.1	432.2	16,694	8,101,644	4,220	5,026,118	12,474	3,075,526
432.2	432.3	16,714	8,118,358	4,218	5,030,336	12,496	3,088,022
432.3	432.4	16,736	8,135,095	4,220	5,034,557	12,516	3,100,538
432.4	432.5	16,753	8,151,848	4,218	5,038,775	12,535	3,113,073
432.5	432.6	16,768	8,168,616	4,215	5,042,990	12,553	3,125,626
432.6	432.7	16,781	8,185,396	4,210	5,047,199	12,571	3,138,197
432.7	432.8	16,793	8,202,189	4,204	5,051,403	12,589	3,150,786
432.8	432.9	16,805	8,218,995	4,198	5,055,603	12,607	3,163,392
432.9	433	16,818	8,235,813	4,194	5,059,796	12,624	3,176,017
433	433.1	16,832	8,252,644	4,190	5,063,986	12,642	3,188,658
433.1	433.2	16,846	8,269,490	4,187	5,068,172	12,659	3,201,318
433.2	433.3	16,860	8,286,350	4,183	5,072,355	12,677	3,213,995
433.3	433.4	16,875	8,303,225	4,180	5,076,535	12,695	3,226,690
433.4	433.5	16,891	8,320,116	4,178	5,080,712	12,713	3,239,404
433.5	433.6	16,907	8,337,023	4,175	5,084,888	12,732	3,252,135
433.6	433.7	16,923	8,353,946	4,173	5,089,061	12,750	3,264,885
433.7	433.8	16,938	8,370,884	4,169	5,093,230	12,769	3,277,654
433.8	433.9	16,953	8,387,837	4,166	5,097,396	12,787	3,290,441
433.9	434	16,968	8,404,804	4,162	5,101,557	12,806	3,303,247
434	434.1	16,982	8,421,787	4,158	5,105,716	12,824	3,316,071
434.1	434.2	16,997	8,438,784	4,153	5,109,869	12,844	3,328,915
434.2	434.3	17,015	8,455,798	4,152	5,114,020	12,863	3,341,778
434.3	434.4	17,028	8,472,826	4,148	5,118,167	12,880	3,354,659
434.4	434.5	17,038	8,489,865	4,140	5,122,309	12,898	3,367,556
434.5	434.6	17,048	8,506,913	4,133	5,126,442	12,915	3,380,471
434.6	434.7	17,058	8,523,971	4,126	5,130,568	12,932	3,393,403
434.7	434.8	17,068	8,541,038	4,119	5,134,686	12,949	3,406,352
434.8	434.9	17,077	8,558,116	4,110	5,138,798	12,967	3,419,318
434.9	435	17,087	8,575,202	4,102	5,142,899	12,985	3,432,303
435	435.1	17,096	8,592,298	4,092	5,146,991	13,004	3,445,307
435.1	435.2	17,105	8,609,403	4,083	5,151,074	13,022	3,458,329
435.2	435.3	17,114	8,626,518	4,073	5,155,148	13,041	3,471,370
435.3	435.4	17,124	8,643,641	4,064	5,159,212	13,060	3,484,429
435.4	435.5	17,134	8,660,775	4,053	5,163,265	13,081	3,497,510

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
435.5	435.6	17,145	8,677,921	4,044	5,167,310	13,101	3,510,611
435.6	435.7	17,157	8,695,077	4,035	5,171,344	13,122	3,523,733
435.7	435.8	17,168	8,712,245	4,027	5,175,370	13,141	3,536,875
435.8	435.9	17,178	8,729,423	4,018	5,179,388	13,160	3,550,035
435.9	436	17,188	8,746,611	4,009	5,183,397	13,179	3,563,214
436	436.1	17,198	8,763,808	4,000	5,187,396	13,198	3,576,412
436.1	436.2	17,208	8,781,016	3,992	5,191,388	13,216	3,589,628
436.2	436.3	17,217	8,798,233	3,983	5,195,372	13,234	3,602,861
436.3	436.4	17,226	8,815,459	3,976	5,199,348	13,250	3,616,111
436.4	436.5	17,234	8,832,693	3,968	5,203,316	13,266	3,629,377
436.5	436.6	17,243	8,849,936	3,961	5,207,277	13,282	3,642,659
436.6	436.7	17,252	8,867,188	3,955	5,211,232	13,297	3,655,956
436.7	436.8	17,260	8,884,448	3,947	5,215,179	13,313	3,669,269
436.8	436.9	17,269	8,901,717	3,941	5,219,119	13,328	3,682,598
436.9	437	17,277	8,918,994	3,932	5,223,052	13,345	3,695,942
437	437.1	17,285	8,936,279	3,885	5,226,937	13,400	3,709,342
437.1	437.2	17,293	8,953,573	3,750	5,230,687	13,543	3,722,886
437.2	437.3	17,301	8,970,874	3,594	5,234,281	13,707	3,736,593
437.3	437.4	17,310	8,988,183	3,405	5,237,685	13,905	3,750,498
437.4	437.5	17,318	9,005,501	3,157	5,240,842	14,161	3,764,659
437.5	437.6	17,326	9,022,827	2,864	5,243,706	14,462	3,779,121
437.6	437.7	17,333	9,040,160	2,597	5,246,304	14,736	3,793,856
437.7	437.8	17,341	9,057,501	2,354	5,248,658	14,987	3,808,843
437.8	437.9	17,348	9,074,850	2,117	5,250,776	15,231	3,824,074
437.9	438	17,356	9,092,205	1,857	5,252,633	15,499	3,839,572
438	438.1	17,363	9,109,568	1,666	5,254,298	15,697	3,855,270
438.1	438.2	17,370	9,126,939	1,481	5,255,780	15,889	3,871,159
438.2	438.3	17,378	9,144,317	1,308	5,257,087	16,070	3,887,230
438.3	438.4	17,385	9,161,702	1,184	5,258,271	16,201	3,903,431
438.4	438.5	17,392	9,179,094	1,092	5,259,363	16,300	3,919,731
438.5	438.6	17,399	9,196,493	1,033	5,260,396	16,366	3,936,097
438.6	438.7	17,406	9,213,899	985	5,261,381	16,421	3,952,518
438.7	438.8	17,413	9,231,312	949	5,262,330	16,464	3,968,982
438.8	438.9	17,420	9,248,732	923	5,263,253	16,497	3,985,479
438.9	439	17,427	9,266,159	904	5,264,157	16,523	4,002,002
439	439.1	17,433	9,283,592	884	5,265,041	16,549	4,018,551
439.1	439.2	17,440	9,301,032	864	5,265,905	16,576	4,035,127
439.2	439.3	17,447	9,318,479	853	5,266,757	16,594	4,051,722
439.3	439.4	17,454	9,335,932	843	5,267,600	16,611	4,068,332
439.4	439.5	17,460	9,353,393	834	5,268,434	16,626	4,084,959
439.5	439.6	17,467	9,370,860	825	5,269,260	16,642	4,101,600
439.6	439.7	17,474	9,388,334	818	5,270,078	16,656	4,118,256
439.7	439.8	17,482	9,405,816	811	5,270,889	16,671	4,134,927
439.8	439.9	17,489	9,423,305	803	5,271,692	16,686	4,151,613
439.9	440	17,496	9,440,800	796	5,272,487	16,700	4,168,313
440	440.1	17,503	9,458,303	788	5,273,275	16,715	4,185,028
440.1	440.2	17,510	9,475,813	780	5,274,055	16,730	4,201,758
440.2	440.3	17,517	9,493,330	771	5,274,826	16,746	4,218,504
440.3	440.4	17,524	9,510,855	761	5,275,587	16,763	4,235,268
440.4	440.5	17,531	9,528,386	749	5,276,336	16,782	4,252,050
440.5	440.6	17,539	9,545,925	736	5,277,072	16,803	4,268,853
440.6	440.7	17,546	9,563,471	720	5,277,792	16,826	4,285,679
440.7	440.8	17,553	9,581,024	700	5,278,492	16,853	4,302,532
440.8	440.9	17,562	9,598,586	675	5,279,167	16,887	4,319,419
440.9	441	17,575	9,616,161	653	5,279,820	16,922	4,336,341
441	441.1	17,593	9,633,754	638	5,280,458	16,955	4,353,296
441.1	441.2	17,616	9,651,370	630	5,281,088	16,986	4,370,282
441.2	441.3	17,649	9,669,019	628	5,281,715	17,021	4,387,304
441.3	441.4	17,678	9,686,697	621	5,282,336	17,057	4,404,361

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
441.4	441.5	17,708	9,704,404	614	5,282,949	17,094	4,421,455
441.5	441.6	17,739	9,722,143	610	5,283,559	17,129	4,438,584
441.6	441.7	17,777	9,739,920	611	5,284,170	17,166	4,455,750
441.7	441.8	17,827	9,757,747	619	5,284,789	17,208	4,472,958
441.8	441.9	17,872	9,775,619	622	5,285,412	17,250	4,490,207
441.9	442	17,904	9,793,523	622	5,286,033	17,282	4,507,490
442	442.1	17,938	9,811,460	618	5,286,650	17,320	4,524,810
442.1	442.2	17,977	9,829,437	609	5,287,259	17,368	4,542,178
442.2	442.3	18,023	9,847,460	599	5,287,858	17,424	4,559,602
442.3	442.4	18,077	9,865,537	595	5,288,454	17,482	4,577,083
442.4	442.5	18,142	9,883,679	599	5,289,052	17,543	4,594,627
442.5	442.6	18,206	9,901,885	605	5,289,658	17,601	4,612,227
442.6	442.7	18,271	9,920,156	622	5,290,279	17,649	4,629,877
442.7	442.8	18,336	9,938,492	640	5,290,919	17,696	4,647,573
442.8	442.9	18,403	9,956,895	659	5,291,578	17,744	4,665,317
442.9	443	18,473	9,975,368	676	5,292,255	17,797	4,683,113
443	443.1	18,539	9,993,908	687	5,292,943	17,852	4,700,965
443.1	443.2	18,598	10,012,506	689	5,293,632	17,909	4,718,874
443.2	443.3	18,657	10,031,163	684	5,294,316	17,973	4,736,847
443.3	443.4	18,718	10,049,881	673	5,294,989	18,045	4,754,892
443.4	443.5	18,764	10,068,645	661	5,295,650	18,103	4,772,995
443.5	443.6	18,795	10,087,440	643	5,296,293	18,152	4,791,147
443.6	443.7	18,821	10,106,261	627	5,296,920	18,194	4,809,341
443.7	443.8	18,844	10,125,105	613	5,297,533	18,231	4,827,572
443.8	443.9	18,865	10,143,970	604	5,298,138	18,261	4,845,832
443.9	444	18,884	10,162,855	597	5,298,736	18,287	4,864,119
444	444.1	18,901	10,181,756	588	5,299,324	18,313	4,882,432
444.1	444.2	18,917	10,200,672	578	5,299,901	18,339	4,900,771
444.2	444.3	18,932	10,219,604	568	5,300,469	18,364	4,919,135
444.3	444.4	18,946	10,238,550	554	5,301,022	18,392	4,937,528
444.4	444.5	18,960	10,257,510	518	5,301,540	18,442	4,955,970
444.5	444.6	18,974	10,276,484	475	5,302,015	18,499	4,974,469
444.6	444.7	18,989	10,295,473	432	5,302,447	18,557	4,993,026
444.7	444.8	19,008	10,314,481	402	5,302,849	18,606	5,011,632
444.8	444.9	19,027	10,333,508	378	5,303,227	18,649	5,030,281
444.9	445	19,043	10,352,551	360	5,303,587	18,683	5,048,964
445	445.1	19,057	10,371,608	346	5,303,934	18,711	5,067,674
445.1	445.2	19,070	10,390,678	334	5,304,268	18,736	5,086,410
445.2	445.3	19,084	10,409,761	324	5,304,591	18,760	5,105,170
445.3	445.4	19,097	10,428,858	312	5,304,902	18,785	5,123,956
445.4	445.5	19,109	10,447,967	300	5,305,202	18,809	5,142,765
445.5	445.6	19,120	10,467,087	288	5,305,490	18,832	5,161,597
445.6	445.7	19,131	10,486,218	276	5,305,767	18,855	5,180,451
445.7	445.8	19,142	10,505,360	265	5,306,032	18,877	5,199,328
445.8	445.9	19,153	10,524,513	253	5,306,285	18,900	5,218,228
445.9	446	19,164	10,543,677	241	5,306,525	18,923	5,237,152
446	446.1	19,175	10,562,852	228	5,306,754	18,947	5,256,098
446.1	446.2	19,187	10,582,039	218	5,306,972	18,969	5,275,067
446.2	446.3	19,198	10,601,237	208	5,307,180	18,990	5,294,057
446.3	446.4	19,209	10,620,446	195	5,307,375	19,014	5,313,071
446.4	446.5	19,220	10,639,666	178	5,307,553	19,042	5,332,113
446.5	446.6	19,231	10,658,898	158	5,307,712	19,073	5,351,186
446.6	446.7	19,242	10,678,140	132	5,307,844	19,110	5,370,296
446.7	446.8	19,254	10,697,394	103	5,307,947	19,151	5,389,447
446.8	446.9	19,265	10,716,659	84	5,308,031	19,181	5,408,628
446.9	447	19,277	10,735,937	67	5,308,099	19,210	5,427,838
447	447.1	19,289	10,755,226	40	5,308,138	19,249	5,447,088
447.1	447.2	19,300	10,774,526	0	5,308,144	19,300	5,466,382
447.2	447.3	19,312	10,793,838	0	5,308,108	19,312	5,485,730

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
447.3	447.4	19,322	10,813,160	0	5,308,020	19,322	5,505,140
447.4	447.5	19,333	10,832,494	0	5,307,885	19,333	5,524,609
447.5	447.6	19,346	10,851,840	0	5,307,710	19,346	5,544,130
447.6	447.7	19,363	10,871,202	0	5,307,511	19,363	5,563,691
447.7	447.8	19,398	10,890,600	0	5,307,314	19,398	5,583,286
447.8	447.9	19,438	10,910,038	0	5,307,128	19,438	5,602,910
447.9	448	19,490	10,929,529	0	5,306,967	19,490	5,622,562
448	448.1	19,547	10,949,075	0	5,306,838	19,547	5,642,237
448.1	448.2	19,584	10,968,659	0	5,306,726	19,584	5,661,933
448.2	448.3	19,618	10,988,277	0	5,306,626	19,618	5,681,651
448.3	448.4	19,657	11,007,934	0	5,306,544	19,657	5,701,390
448.4	448.5	19,708	11,027,642	0	5,306,490	19,708	5,721,152
448.5	448.6	19,757	11,047,399	0	5,306,464	19,757	5,740,935
448.6	448.7	19,782	11,067,182	0	5,306,442	19,782	5,760,740
448.7	448.8	19,800	11,086,981	0	5,306,413	19,800	5,780,568
448.8	448.9	19,813	11,106,794	0	5,306,377	19,813	5,800,417
448.9	449	19,825	11,126,619	0	5,306,335	19,825	5,820,284

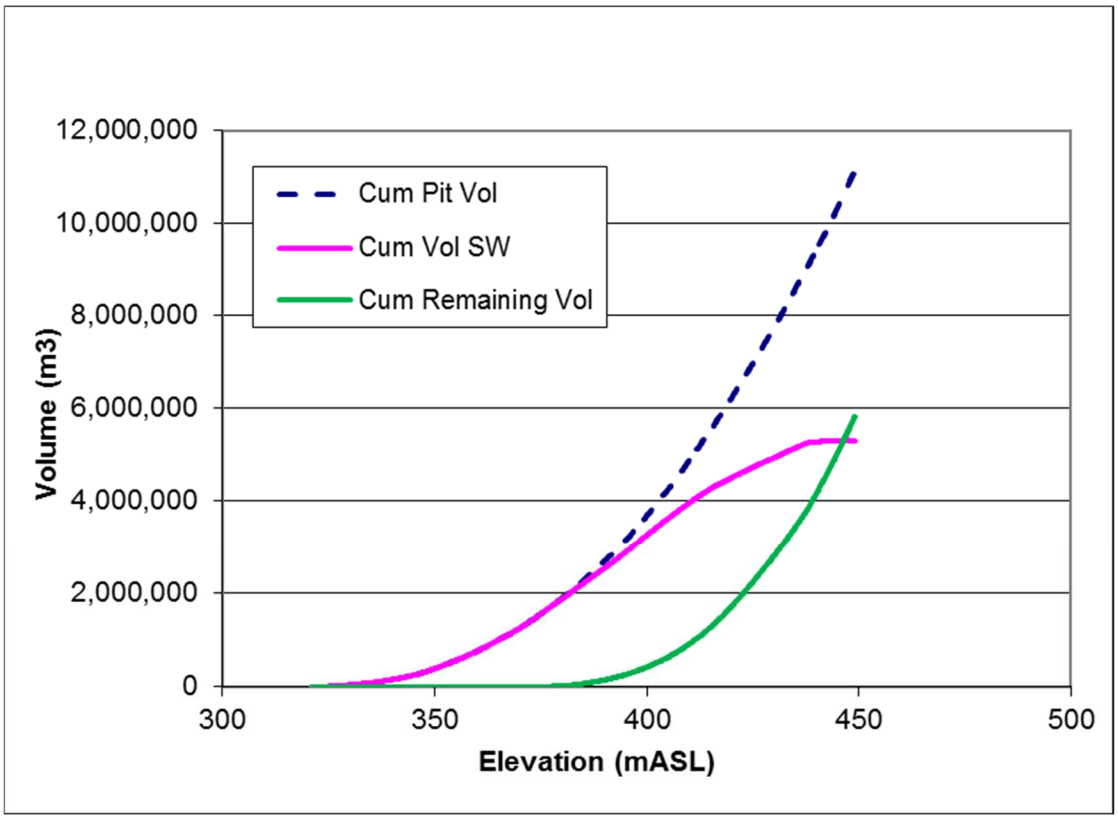


Figure 1- 1: Sue C/A Pit Volumes

1.2 Sue E Pit Volume

The total excavated Sue E pit volume was calculated from 327.5 mASL to the surface in 0.1 m increments as of March 15, 2018. It was based on drawings "*235c088c_suee_topo_expanded.dtm*" and "*mar15_2008_sueeasb.dtm*". The empty part of the Sue E pit volume (volume not filled with special waste) was calculated from 371 mASL to Surface in 0.1 increments as of December, 2011, based on drawings "*235c088c_suee_topo_expanded.dtm*" and "*till cap final(235c151).dtm*". These two volume calculations are summarized in Table 1-2. Calculated volumes are presented to the nearest unit value. Some apparent rounding errors may occasionally occur in the calculated volumes.

The calculations in Table 1-2 show that the total pit volume is 7,948,957 m^3 and the volume of special waste currently placed in the pit is 2,076,358 lcm. Figure 1- 2 shows a plot of elevation versus cumulative volume for the total pit and the special waste in the pit, as of December 2011.

The swell factor for Sue B waste rock can be calculated from the ratio of the volume (in loose cubic meter, lcm) of special waste placed in Sue E pit and the mined quantity of Sue B waste rock (in bank cubic meter, bcm) in Table 3-1 of Part A. The calculation shows that

$$SwellFactor = 2{,}076{,}358 / 1{,}441{,}350 = 1.44 \text{ lcm/bcm}$$

Table 1-2: Summary of Sue E Pit Volumes

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
327.5	327.6	0	0	0	0		
327.6	327.7	0	0	0	0		
327.7	327.8	0	0	0	0		
327.8	327.9	0	0	0	0		
327.9	328	0	0	0	0		
328	328.1	13	13	13	13	0	
328.1	328.2	13	26	13	26	0	
328.2	328.3	14	40	14	40	0	
328.3	328.4	15	55	15	55	0	
328.4	328.5	15	70	15	70	0	
328.5	328.6	16	86	16	86	0	
328.6	328.7	17	103	17	103	0	
328.7	328.8	17	120	17	120	0	
328.8	328.9	18	137	18	137	0	
328.9	329	18	156	18	156	0	
329	329.1	19	175	19	175	0	
329.1	329.2	20	194	20	194	0	
329.2	329.3	20	215	20	215	0	
329.3	329.4	21	235	21	235	0	
329.4	329.5	21	257	21	257	0	
329.5	329.6	22	279	22	279	0	
329.6	329.7	23	302	23	302	0	
329.7	329.8	23	325	23	325	0	
329.8	329.9	24	349	24	349	0	
329.9	330	25	374	25	374	0	
330	330.1	25	399	25	399	0	
330.1	330.2	26	425	26	425	0	
330.2	330.3	26	451	26	451	0	
330.3	330.4	27	478	27	478	0	

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
330.4	330.5	28	506	28	506	0	
330.5	330.6	28	534	28	534	0	
330.6	330.7	29	563	29	563	0	
330.7	330.8	30	593	30	593	0	
330.8	330.9	30	623	30	623	0	
330.9	331	31	654	31	654	0	
331	331.1	32	686	32	686	0	
331.1	331.2	32	718	32	718	0	
331.2	331.3	33	751	33	751	0	
331.3	331.4	37	788	37	788	0	
331.4	331.5	38	826	38	826	0	
331.5	331.6	39	865	39	865	0	
331.6	331.7	39	904	39	904	0	
331.7	331.8	40	944	40	944	0	
331.8	331.9	41	985	41	985	0	
331.9	332	42	1,027	42	1,027	0	
332	332.1	43	1,070	43	1,070	0	
332.1	332.2	43	1,113	43	1,113	0	
332.2	332.3	44	1,157	44	1,157	0	
332.3	332.4	45	1,202	45	1,202	0	
332.4	332.5	46	1,248	46	1,248	0	
332.5	332.6	47	1,296	47	1,296	0	
332.6	332.7	49	1,345	49	1,345	0	
332.7	332.8	52	1,397	52	1,397	0	
332.8	332.9	55	1,452	55	1,452	0	
332.9	333	57	1,509	57	1,509	0	
333	333.1	60	1,569	60	1,569	0	
333.1	333.2	62	1,630	62	1,630	0	
333.2	333.3	64	1,694	64	1,694	0	
333.3	333.4	65	1,759	65	1,759	0	
333.4	333.5	67	1,827	67	1,827	0	
333.5	333.6	69	1,896	69	1,896	0	
333.6	333.7	71	1,966	71	1,966	0	
333.7	333.8	72	2,038	72	2,038	0	
333.8	333.9	74	2,112	74	2,112	0	
333.9	334	75	2,188	75	2,188	0	
334	334.1	77	2,265	77	2,265	0	
334.1	334.2	80	2,344	80	2,344	0	
334.2	334.3	82	2,427	82	2,427	0	
334.3	334.4	85	2,512	85	2,512	0	
334.4	334.5	89	2,601	89	2,601	0	
334.5	334.6	93	2,694	93	2,694	0	
334.6	334.7	97	2,791	97	2,791	0	
334.7	334.8	100	2,890	100	2,890	0	
334.8	334.9	102	2,993	102	2,993	0	
334.9	335	105	3,098	105	3,098	0	
335	335.1	108	3,206	108	3,206	0	
335.1	335.2	111	3,316	111	3,316	0	
335.2	335.3	113	3,429	113	3,429	0	
335.3	335.4	117	3,546	117	3,546	0	
335.4	335.5	122	3,668	122	3,668	0	
335.5	335.6	129	3,798	129	3,798	0	
335.6	335.7	137	3,935	137	3,935	0	
335.7	335.8	146	4,081	146	4,081	0	
335.8	335.9	157	4,239	157	4,239	0	
335.9	336	174	4,412	174	4,412	0	
336	336.1	193	4,605	193	4,605	0	
336.1	336.2	213	4,818	213	4,818	0	
336.2	336.3	230	5,048	230	5,048	0	

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
336.3	336.4	243	5,291	243	5,291	0	
336.4	336.5	253	5,544	253	5,544	0	
336.5	336.6	262	5,806	262	5,806	0	
336.6	336.7	272	6,078	272	6,078	0	
336.7	336.8	280	6,358	280	6,358	0	
336.8	336.9	289	6,647	289	6,647	0	
336.9	337	298	6,945	298	6,945	0	
337	337.1	308	7,253	308	7,253	0	
337.1	337.2	318	7,571	318	7,571	0	
337.2	337.3	328	7,900	328	7,900	0	
337.3	337.4	338	8,238	338	8,238	0	
337.4	337.5	350	8,588	350	8,588	0	
337.5	337.6	360	8,948	360	8,948	0	
337.6	337.7	369	9,317	369	9,317	0	
337.7	337.8	376	9,693	376	9,693	0	
337.8	337.9	384	10,077	384	10,077	0	
337.9	338	395	10,472	395	10,472	0	
338	338.1	405	10,877	405	10,877	0	
338.1	338.2	411	11,288	411	11,288	0	
338.2	338.3	417	11,705	417	11,705	0	
338.3	338.4	421	12,126	421	12,126	0	
338.4	338.5	426	12,552	426	12,552	0	
338.5	338.6	431	12,983	431	12,983	0	
338.6	338.7	436	13,418	436	13,418	0	
338.7	338.8	441	13,859	441	13,859	0	
338.8	338.9	446	14,305	446	14,305	0	
338.9	339	451	14,756	451	14,756	0	
339	339.1	457	15,213	457	15,213	0	
339.1	339.2	464	15,676	464	15,676	0	
339.2	339.3	470	16,147	470	16,147	0	
339.3	339.4	477	16,623	477	16,623	0	
339.4	339.5	483	17,106	483	17,106	0	
339.5	339.6	489	17,595	489	17,595	0	
339.6	339.7	495	18,091	495	18,091	0	
339.7	339.8	501	18,592	501	18,592	0	
339.8	339.9	507	19,099	507	19,099	0	
339.9	340	513	19,611	513	19,611	0	
340	340.1	519	20,130	519	20,130	0	
340.1	340.2	524	20,655	524	20,655	0	
340.2	340.3	531	21,185	531	21,185	0	
340.3	340.4	538	21,723	538	21,723	0	
340.4	340.5	548	22,272	548	22,272	0	
340.5	340.6	559	22,830	559	22,830	0	
340.6	340.7	568	23,398	568	23,398	0	
340.7	340.8	577	23,975	577	23,975	0	
340.8	340.9	587	24,563	587	24,563	0	
340.9	341	595	25,157	595	25,157	0	
341	341.1	601	25,758	601	25,758	0	
341.1	341.2	607	26,365	607	26,365	0	
341.2	341.3	612	26,976	612	26,976	0	
341.3	341.4	617	27,593	617	27,593	0	
341.4	341.5	622	28,215	622	28,215	0	
341.5	341.6	627	28,841	627	28,841	0	
341.6	341.7	631	29,473	631	29,473	0	
341.7	341.8	636	30,109	636	30,109	0	
341.8	341.9	641	30,750	641	30,750	0	
341.9	342	646	31,396	646	31,396	0	
342	342.1	651	32,047	651	32,047	0	
342.1	342.2	655	32,702	655	32,702	0	

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
342.2	342.3	660	33,362	660	33,362	0	
342.3	342.4	665	34,028	665	34,028	0	
342.4	342.5	670	34,697	670	34,697	0	
342.5	342.6	682	35,380	682	35,380	0	
342.6	342.7	687	36,067	687	36,067	0	
342.7	342.8	692	36,759	692	36,759	0	
342.8	342.9	697	37,457	697	37,457	0	
342.9	343	702	38,159	702	38,159	0	
343	343.1	707	38,866	707	38,866	0	
343.1	343.2	712	39,579	712	39,579	0	
343.2	343.3	717	40,296	717	40,296	0	
343.3	343.4	723	41,018	723	41,018	0	
343.4	343.5	728	41,746	728	41,746	0	
343.5	343.6	734	42,480	734	42,480	0	
343.6	343.7	739	43,219	739	43,219	0	
343.7	343.8	744	43,963	744	43,963	0	
343.8	343.9	749	44,712	749	44,712	0	
343.9	344	755	45,467	755	45,467	0	
344	344.1	760	46,227	760	46,227	0	
344.1	344.2	765	46,992	765	46,992	0	
344.2	344.3	770	47,763	770	47,763	0	
344.3	344.4	775	48,538	775	48,538	0	
344.4	344.5	780	49,317	780	49,317	0	
344.5	344.6	785	50,102	785	50,102	0	
344.6	344.7	790	50,891	790	50,891	0	
344.7	344.8	795	51,686	795	51,686	0	
344.8	344.9	800	52,486	800	52,486	0	
344.9	345	805	53,291	805	53,291	0	
345	345.1	810	54,100	810	54,100	0	
345.1	345.2	814	54,914	814	54,914	0	
345.2	345.3	819	55,733	819	55,733	0	
345.3	345.4	823	56,556	823	56,556	0	
345.4	345.5	828	57,384	828	57,384	0	
345.5	345.6	833	58,216	833	58,216	0	
345.6	345.7	837	59,054	837	59,054	0	
345.7	345.8	842	59,896	842	59,896	0	
345.8	345.9	847	60,743	847	60,743	0	
345.9	346	852	61,594	852	61,594	0	
346	346.1	856	62,450	856	62,450	0	
346.1	346.2	861	63,311	861	63,311	0	
346.2	346.3	866	64,177	866	64,177	0	
346.3	346.4	871	65,049	871	65,049	0	
346.4	346.5	876	65,925	876	65,925	0	
346.5	346.6	882	66,807	882	66,807	0	
346.6	346.7	890	67,697	890	67,697	0	
346.7	346.8	897	68,594	897	68,594	0	
346.8	346.9	906	69,500	906	69,500	0	
346.9	347	915	70,415	915	70,415	0	
347	347.1	926	71,341	926	71,341	0	
347.1	347.2	943	72,285	943	72,285	0	
347.2	347.3	977	73,261	977	73,261	0	
347.3	347.4	1,012	74,274	1,012	74,274	0	
347.4	347.5	1,045	75,319	1,045	75,319	0	
347.5	347.6	1,085	76,404	1,085	76,404	0	
347.6	347.7	1,111	77,514	1,111	77,514	0	
347.7	347.8	1,144	78,658	1,144	78,658	0	
347.8	347.9	1,176	79,834	1,176	79,834	0	
347.9	348	1,216	81,050	1,216	81,050	0	
348	348.1	1,228	82,278	1,228	82,278	0	

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
348.1	348.2	1,240	83,518	1,240	83,518	0	
348.2	348.3	1,252	84,770	1,252	84,770	0	
348.3	348.4	1,263	86,033	1,263	86,033	0	
348.4	348.5	1,273	87,305	1,273	87,305	0	
348.5	348.6	1,282	88,588	1,282	88,588	0	
348.6	348.7	1,293	89,880	1,293	89,880	0	
348.7	348.8	1,303	91,183	1,303	91,183	0	
348.8	348.9	1,314	92,497	1,314	92,497	0	
348.9	349	1,329	93,826	1,329	93,826	0	
349	349.1	1,339	95,165	1,339	95,165	0	
349.1	349.2	1,345	96,509	1,345	96,509	0	
349.2	349.3	1,350	97,860	1,350	97,860	0	
349.3	349.4	1,356	99,216	1,356	99,216	0	
349.4	349.5	1,362	100,578	1,362	100,578	0	
349.5	349.6	1,368	101,947	1,368	101,947	0	
349.6	349.7	1,374	103,321	1,374	103,321	0	
349.7	349.8	1,380	104,701	1,380	104,701	0	
349.8	349.9	1,386	106,087	1,386	106,087	0	
349.9	350	1,392	107,479	1,392	107,479	0	
350	350.1	1,398	108,876	1,398	108,876	0	
350.1	350.2	1,404	110,281	1,404	110,281	0	
350.2	350.3	1,411	111,692	1,411	111,692	0	
350.3	350.4	1,418	113,109	1,418	113,109	0	
350.4	350.5	1,425	114,534	1,425	114,534	0	
350.5	350.6	1,431	115,965	1,431	115,965	0	
350.6	350.7	1,438	117,404	1,438	117,404	0	
350.7	350.8	1,445	118,849	1,445	118,849	0	
350.8	350.9	1,452	120,301	1,452	120,301	0	
350.9	351	1,459	121,760	1,459	121,760	0	
351	351.1	1,466	123,226	1,466	123,226	0	
351.1	351.2	1,473	124,699	1,473	124,699	0	
351.2	351.3	1,481	126,180	1,481	126,180	0	
351.3	351.4	1,488	127,668	1,488	127,668	0	
351.4	351.5	1,495	129,162	1,495	129,162	0	
351.5	351.6	1,502	130,664	1,502	130,664	0	
351.6	351.7	1,509	132,172	1,509	132,172	0	
351.7	351.8	1,516	133,688	1,516	133,688	0	
351.8	351.9	1,523	135,211	1,523	135,211	0	
351.9	352	1,530	136,741	1,530	136,741	0	
352	352.1	1,537	138,279	1,537	138,279	0	
352.1	352.2	1,545	139,823	1,545	139,823	0	
352.2	352.3	1,551	141,375	1,551	141,375	0	
352.3	352.4	1,558	142,932	1,558	142,932	0	
352.4	352.5	1,564	144,496	1,564	144,496	0	
352.5	352.6	1,570	146,066	1,570	146,066	0	
352.6	352.7	1,577	147,643	1,577	147,643	0	
352.7	352.8	1,585	149,228	1,585	149,228	0	
352.8	352.9	1,598	150,826	1,598	150,826	0	
352.9	353	1,619	152,445	1,619	152,445	0	
353	353.1	1,642	154,087	1,642	154,087	0	
353.1	353.2	1,664	155,751	1,664	155,751	0	
353.2	353.3	1,688	157,438	1,688	157,438	0	
353.3	353.4	1,708	159,146	1,708	159,146	0	
353.4	353.5	1,724	160,870	1,724	160,870	0	
353.5	353.6	1,740	162,610	1,740	162,610	0	
353.6	353.7	1,754	164,364	1,754	164,364	0	
353.7	353.8	1,768	166,132	1,768	166,132	0	
353.8	353.9	1,781	167,913	1,781	167,913	0	
353.9	354	1,791	169,704	1,791	169,704	0	

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
354	354.1	1,799	171,503	1,799	171,503	0	
354.1	354.2	1,807	173,310	1,807	173,310	0	
354.2	354.3	1,815	175,125	1,815	175,125	0	
354.3	354.4	1,822	176,948	1,822	176,948	0	
354.4	354.5	1,830	178,777	1,830	178,777	0	
354.5	354.6	1,839	180,616	1,839	180,616	0	
354.6	354.7	1,845	182,461	1,845	182,461	0	
354.7	354.8	1,850	184,311	1,850	184,311	0	
354.8	354.9	1,855	186,167	1,855	186,167	0	
354.9	355	1,861	188,028	1,861	188,028	0	
355	355.1	1,866	189,894	1,866	189,894	0	
355.1	355.2	1,872	191,765	1,872	191,765	0	
355.2	355.3	1,878	193,643	1,878	193,643	0	
355.3	355.4	1,885	195,528	1,885	195,528	0	
355.4	355.5	1,891	197,419	1,891	197,419	0	
355.5	355.6	1,897	199,316	1,897	199,316	0	
355.6	355.7	1,903	201,219	1,903	201,219	0	
355.7	355.8	1,909	203,128	1,909	203,128	0	
355.8	355.9	1,915	205,043	1,915	205,043	0	
355.9	356	1,920	206,964	1,920	206,964	0	
356	356.1	1,925	208,889	1,925	208,889	0	
356.1	356.2	1,930	210,820	1,930	210,820	0	
356.2	356.3	1,936	212,755	1,936	212,755	0	
356.3	356.4	1,941	214,696	1,941	214,696	0	
356.4	356.5	1,946	216,641	1,946	216,641	0	
356.5	356.6	1,951	218,592	1,951	218,592	0	
356.6	356.7	1,956	220,548	1,956	220,548	0	
356.7	356.8	1,961	222,509	1,961	222,509	0	
356.8	356.9	1,967	224,476	1,967	224,476	0	
356.9	357	1,972	226,448	1,972	226,448	0	
357	357.1	1,978	228,425	1,978	228,425	0	
357.1	357.2	1,984	230,409	1,984	230,409	0	
357.2	357.3	1,990	232,399	1,990	232,399	0	
357.3	357.4	1,996	234,396	1,996	234,396	0	
357.4	357.5	2,004	236,399	2,004	236,399	0	
357.5	357.6	2,011	238,411	2,011	238,411	0	
357.6	357.7	2,022	240,432	2,022	240,432	0	
357.7	357.8	2,036	242,468	2,036	242,468	0	
357.8	357.9	2,048	244,516	2,048	244,516	0	
357.9	358	2,058	246,574	2,058	246,574	0	
358	358.1	2,069	248,642	2,069	248,642	0	
358.1	358.2	2,080	250,722	2,080	250,722	0	
358.2	358.3	2,091	252,813	2,091	252,813	0	
358.3	358.4	2,105	254,918	2,105	254,918	0	
358.4	358.5	2,125	257,043	2,125	257,043	0	
358.5	358.6	2,144	259,186	2,144	259,186	0	
358.6	358.7	2,157	261,344	2,157	261,344	0	
358.7	358.8	2,172	263,516	2,172	263,516	0	
358.8	358.9	2,186	265,701	2,186	265,701	0	
358.9	359	2,198	267,899	2,198	267,899	0	
359	359.1	2,210	270,109	2,210	270,109	0	
359.1	359.2	2,227	272,336	2,227	272,336	0	
359.2	359.3	2,247	274,582	2,247	274,582	0	
359.3	359.4	2,260	276,843	2,260	276,843	0	
359.4	359.5	2,274	279,116	2,274	279,116	0	
359.5	359.6	2,287	281,403	2,287	281,403	0	
359.6	359.7	2,299	283,703	2,299	283,703	0	
359.7	359.8	2,311	286,013	2,311	286,013	0	
359.8	359.9	2,326	288,340	2,326	288,340	0	

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
359.9	360	2,353	290,692	2,353	290,692	0	
360	360.1	2,381	293,073	2,381	293,073	0	
360.1	360.2	2,405	295,477	2,405	295,477	0	
360.2	360.3	2,423	297,900	2,423	297,900	0	
360.3	360.4	2,438	300,338	2,438	300,338	0	
360.4	360.5	2,447	302,785	2,447	302,785	0	
360.5	360.6	2,453	305,238	2,453	305,238	0	
360.6	360.7	2,460	307,698	2,460	307,698	0	
360.7	360.8	2,467	310,165	2,467	310,165	0	
360.8	360.9	2,474	312,639	2,474	312,639	0	
360.9	361	2,480	315,119	2,480	315,119	0	
361	361.1	2,487	317,607	2,487	317,607	0	
361.1	361.2	2,494	320,101	2,494	320,101	0	
361.2	361.3	2,501	322,601	2,501	322,601	0	
361.3	361.4	2,507	325,109	2,507	325,109	0	
361.4	361.5	2,515	327,624	2,515	327,624	0	
361.5	361.6	2,524	330,148	2,524	330,148	0	
361.6	361.7	2,531	332,679	2,531	332,679	0	
361.7	361.8	2,538	335,216	2,538	335,216	0	
361.8	361.9	2,545	337,761	2,545	337,761	0	
361.9	362	2,552	340,312	2,552	340,312	0	
362	362.1	2,559	342,871	2,559	342,871	0	
362.1	362.2	2,566	345,437	2,566	345,437	0	
362.2	362.3	2,573	348,010	2,573	348,010	0	
362.3	362.4	2,580	350,590	2,580	350,590	0	
362.4	362.5	2,588	353,178	2,588	353,178	0	
362.5	362.6	2,596	355,774	2,596	355,774	0	
362.6	362.7	2,604	358,378	2,604	358,378	0	
362.7	362.8	2,612	360,991	2,612	360,991	0	
362.8	362.9	2,620	363,611	2,620	363,611	0	
362.9	363	2,629	366,241	2,629	366,241	0	
363	363.1	2,641	368,881	2,641	368,881	0	
363.1	363.2	2,651	371,532	2,651	371,532	0	
363.2	363.3	2,659	374,192	2,659	374,192	0	
363.3	363.4	2,670	376,861	2,670	376,861	0	
363.4	363.5	2,678	379,539	2,678	379,539	0	
363.5	363.6	2,685	382,225	2,685	382,225	0	
363.6	363.7	2,693	384,918	2,693	384,918	0	
363.7	363.8	2,700	387,618	2,700	387,618	0	
363.8	363.9	2,707	390,325	2,707	390,325	0	
363.9	364	2,714	393,039	2,714	393,039	0	
364	364.1	2,721	395,759	2,721	395,759	0	
364.1	364.2	2,727	398,487	2,727	398,487	0	
364.2	364.3	2,734	401,220	2,734	401,220	0	
364.3	364.4	2,740	403,960	2,740	403,960	0	
364.4	364.5	2,746	406,706	2,746	406,706	0	
364.5	364.6	2,752	409,459	2,752	409,459	0	
364.6	364.7	2,758	412,217	2,758	412,217	0	
364.7	364.8	2,764	414,981	2,764	414,981	0	
364.8	364.9	2,770	417,751	2,770	417,751	0	
364.9	365	2,777	420,528	2,777	420,528	0	
365	365.1	2,784	423,312	2,784	423,312	0	
365.1	365.2	2,790	426,102	2,790	426,102	0	
365.2	365.3	2,796	428,897	2,796	428,897	0	
365.3	365.4	2,801	431,699	2,801	431,699	0	
365.4	365.5	2,807	434,506	2,807	434,506	0	
365.5	365.6	2,813	437,319	2,813	437,319	0	
365.6	365.7	2,819	440,137	2,819	440,137	0	
365.7	365.8	2,824	442,962	2,824	442,962	0	

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
365.8	365.9	2,830	445,792	2,830	445,792	0	
365.9	366	2,836	448,628	2,836	448,628	0	
366	366.1	2,842	451,471	2,842	451,471	0	
366.1	366.2	2,848	454,319	2,848	454,319	0	
366.2	366.3	2,854	457,173	2,854	457,173	0	
366.3	366.4	2,860	460,033	2,860	460,033	0	
366.4	366.5	2,866	462,900	2,866	462,900	0	
366.5	366.6	2,873	465,772	2,873	465,772	0	
366.6	366.7	2,879	468,651	2,879	468,651	0	
366.7	366.8	2,886	471,537	2,886	471,537	0	
366.8	366.9	2,893	474,429	2,893	474,429	0	
366.9	367	2,900	477,329	2,900	477,329	0	
367	367.1	2,908	480,237	2,908	480,237	0	
367.1	367.2	2,915	483,153	2,915	483,153	0	
367.2	367.3	2,923	486,076	2,923	486,076	0	
367.3	367.4	2,932	489,008	2,932	489,008	0	
367.4	367.5	2,940	491,948	2,940	491,948	0	
367.5	367.6	2,948	494,897	2,948	494,897	0	
367.6	367.7	2,956	497,852	2,956	497,852	0	
367.7	367.8	2,964	500,816	2,964	500,816	0	
367.8	367.9	2,972	503,788	2,972	503,788	0	
367.9	368	2,979	506,767	2,979	506,767	0	
368	368.1	2,985	509,752	2,985	509,752	0	
368.1	368.2	2,992	512,744	2,992	512,744	0	
368.2	368.3	2,999	515,742	2,999	515,742	0	
368.3	368.4	3,006	518,748	3,006	518,748	0	
368.4	368.5	3,014	521,762	3,014	521,762	0	
368.5	368.6	3,021	524,783	3,021	524,783	0	
368.6	368.7	3,029	527,813	3,029	527,813	0	
368.7	368.8	3,036	530,849	3,036	530,849	0	
368.8	368.9	3,043	533,891	3,043	533,891	0	
368.9	369	3,050	536,941	3,050	536,941	0	
369	369.1	3,058	539,999	3,058	539,999	0	
369.1	369.2	3,066	543,065	3,066	543,065	0	
369.2	369.3	3,077	546,143	3,077	546,143	0	
369.3	369.4	3,095	549,238	3,095	549,238	0	
369.4	369.5	3,120	552,357	3,120	552,357	0	
369.5	369.6	3,152	555,509	3,152	555,509	0	
369.6	369.7	3,186	558,695	3,186	558,695	0	
369.7	369.8	3,230	561,924	3,230	561,924	0	
369.8	369.9	3,288	565,213	3,288	565,213	0	
369.9	370	3,351	568,564	3,351	568,564	0	
370	370.1	3,406	571,970	3,406	571,970	0	
370.1	370.2	3,449	575,420	3,449	575,420	0	
370.2	370.3	3,489	578,909	3,489	578,909	0	
370.3	370.4	3,525	582,434	3,525	582,434	0	
370.4	370.5	3,542	585,975	3,542	585,975	0	
370.5	370.6	3,555	589,530	3,555	589,530	0	
370.6	370.7	3,569	593,100	3,569	593,100	0	
370.7	370.8	3,590	596,690	3,590	596,690	0	
370.8	370.9	3,622	600,311	3,622	600,311	0	
370.9	371	3,653	603,965	3,653	603,965	0	
371	371.1	3,683	607,648	3,683	607,648	0	0
371.1	371.2	3,709	611,358	3,709	611,358	0	0
371.2	371.3	3,734	615,091	3,734	615,091	0	0
371.3	371.4	3,772	618,864	3,772	618,864	0	0
371.4	371.5	3,811	622,675	3,811	622,675	0	0
371.5	371.6	3,839	626,513	3,839	626,513	0	0
371.6	371.7	3,860	630,373	3,860	630,373	0	0

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
371.7	371.8	3,875	634,248	3,875	634,248	0	0
371.8	371.9	3,887	638,135	3,887	638,135	0	0
371.9	372	3,902	642,037	3,902	642,037	0	0
372	372.1	3,916	645,954	3,916	645,954	0	0
372.1	372.2	3,931	649,885	3,931	649,884	0	1
372.2	372.3	3,945	653,830	3,945	653,829	0	1
372.3	372.4	3,955	657,786	3,954	657,784	1	2
372.4	372.5	3,963	661,748	3,962	661,745	1	3
372.5	372.6	3,970	665,719	3,969	665,715	1	4
372.6	372.7	3,978	669,696	3,977	669,691	1	5
372.7	372.8	3,985	673,682	3,983	673,675	2	7
372.8	372.9	3,993	677,675	3,991	677,666	2	9
372.9	373	4,001	681,675	3,999	681,664	2	11
373	373.1	4,009	685,684	4,006	685,670	3	14
373.1	373.2	4,017	689,701	4,014	689,684	3	17
373.2	373.3	4,025	693,727	4,021	693,706	4	21
373.3	373.4	4,033	697,760	4,029	697,735	4	25
373.4	373.5	4,041	701,801	4,037	701,772	4	29
373.5	373.6	4,048	705,849	4,043	705,815	5	34
373.6	373.7	4,056	709,905	4,051	709,865	5	40
373.7	373.8	4,065	713,970	4,059	713,924	6	46
373.8	373.9	4,075	718,045	4,069	717,993	6	52
373.9	374	4,086	722,131	4,079	722,072	7	59
374	374.1	4,097	726,228	4,089	726,161	8	67
374.1	374.2	4,107	730,335	4,099	730,260	8	75
374.2	374.3	4,117	734,452	4,108	734,369	9	83
374.3	374.4	4,134	738,585	4,125	738,492	9	93
374.4	374.5	4,145	742,730	4,135	742,627	10	103
374.5	374.6	4,155	746,885	4,144	746,772	11	113
374.6	374.7	4,164	751,049	4,153	750,924	11	125
374.7	374.8	4,174	755,223	4,162	755,086	12	137
374.8	374.9	4,184	759,407	4,171	759,257	13	150
374.9	375	4,193	763,601	4,179	763,437	14	164
375	375.1	4,202	767,803	4,188	767,625	14	178
375.1	375.2	4,210	772,013	4,195	771,820	15	193
375.2	375.3	4,218	776,232	4,202	776,022	16	210
375.3	375.4	4,226	780,457	4,209	780,230	17	227
375.4	375.5	4,233	784,690	4,215	784,445	18	245
375.5	375.6	4,240	788,930	4,221	788,666	19	264
375.6	375.7	4,247	793,177	4,227	792,893	20	284
375.7	375.8	4,254	797,431	4,233	797,126	21	305
375.8	375.9	4,261	801,692	4,239	801,365	22	327
375.9	376	4,268	805,961	4,245	805,611	23	350
376	376.1	4,276	810,236	4,252	809,862	24	374
376.1	376.2	4,283	814,519	4,258	814,120	25	399
376.2	376.3	4,290	818,809	4,264	818,384	26	425
376.3	376.4	4,297	823,106	4,269	822,653	28	453
376.4	376.5	4,304	827,409	4,275	826,926	29	483
376.5	376.6	4,311	831,720	4,280	831,206	31	514
376.6	376.7	4,317	836,037	4,284	835,491	33	546
376.7	376.8	4,323	840,360	4,288	839,779	35	581
376.8	376.9	4,330	844,690	4,293	844,072	37	618
376.9	377	4,336	849,026	4,297	848,369	39	657
377	377.1	4,342	853,367	4,300	852,668	42	699
377.1	377.2	4,348	857,715	4,303	856,971	45	744
377.2	377.3	4,354	862,069	4,306	861,277	48	792
377.3	377.4	4,360	866,430	4,308	865,586	52	844
377.4	377.5	4,366	870,796	4,310	869,896	56	900
377.5	377.6	4,372	875,168	4,312	874,208	60	960

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
377.6	377.7	4,379	879,547	4,315	878,523	64	1,024
377.7	377.8	4,387	883,934	4,316	882,839	71	1,095
377.8	377.9	4,395	888,329	4,317	887,156	78	1,173
377.9	378	4,402	892,731	4,318	891,473	84	1,258
378	378.1	4,410	897,141	4,319	895,792	91	1,349
378.1	378.2	4,417	901,558	4,319	900,111	98	1,447
378.2	378.3	4,424	905,982	4,319	904,431	105	1,551
378.3	378.4	4,432	910,414	4,320	908,751	112	1,663
378.4	378.5	4,439	914,852	4,321	913,071	118	1,781
378.5	378.6	4,446	919,299	4,321	917,392	125	1,907
378.6	378.7	4,454	923,753	4,319	921,711	135	2,042
378.7	378.8	4,462	928,215	4,315	926,025	147	2,190
378.8	378.9	4,471	932,686	4,314	930,339	157	2,347
378.9	379	4,480	937,165	4,314	934,652	166	2,513
379	379.1	4,489	941,654	4,317	938,969	172	2,685
379.1	379.2	4,497	946,151	4,319	943,288	178	2,863
379.2	379.3	4,505	950,656	4,322	947,611	183	3,045
379.3	379.4	4,512	955,168	4,325	951,935	187	3,233
379.4	379.5	4,519	959,687	4,327	956,263	192	3,424
379.5	379.6	4,526	964,213	4,330	960,592	196	3,621
379.6	379.7	4,533	968,747	4,332	964,926	201	3,821
379.7	379.8	4,540	973,287	4,335	969,261	205	4,026
379.8	379.9	4,547	977,834	4,338	973,599	209	4,235
379.9	380	4,554	982,389	4,341	977,940	213	4,449
380	380.1	4,561	986,950	4,343	982,284	218	4,666
380.1	380.2	4,568	991,518	4,346	986,630	222	4,888
380.2	380.3	4,574	996,092	4,348	990,978	226	5,114
380.3	380.4	4,580	1,000,672	4,347	995,325	233	5,347
380.4	380.5	4,586	1,005,257	4,344	999,668	242	5,589
380.5	380.6	4,593	1,009,850	4,342	1,004,009	251	5,841
380.6	380.7	4,601	1,014,452	4,342	1,008,353	259	6,099
380.7	380.8	4,608	1,019,060	4,342	1,012,695	266	6,365
380.8	380.9	4,616	1,023,676	4,343	1,017,038	273	6,638
380.9	381	4,623	1,028,299	4,343	1,021,381	280	6,918
381	381.1	4,631	1,032,929	4,345	1,025,725	286	7,204
381.1	381.2	4,638	1,037,568	4,345	1,030,071	293	7,497
381.2	381.3	4,648	1,042,215	4,347	1,034,416	301	7,799
381.3	381.4	4,663	1,046,879	4,354	1,038,771	309	8,108
381.4	381.5	4,687	1,051,565	4,369	1,043,139	318	8,426
381.5	381.6	4,714	1,056,280	4,389	1,047,529	325	8,751
381.6	381.7	4,738	1,061,018	4,406	1,051,935	332	9,083
381.7	381.8	4,760	1,065,778	4,421	1,056,355	339	9,423
381.8	381.9	4,780	1,070,558	4,433	1,060,789	347	9,769
381.9	382	4,803	1,075,361	4,449	1,065,238	354	10,123
382	382.1	4,831	1,080,192	4,470	1,069,708	361	10,484
382.1	382.2	4,857	1,085,049	4,489	1,074,197	368	10,852
382.2	382.3	4,887	1,089,935	4,512	1,078,708	375	11,227
382.3	382.4	4,914	1,094,850	4,533	1,083,242	381	11,608
382.4	382.5	4,946	1,099,796	4,558	1,087,800	388	11,996
382.5	382.6	4,988	1,104,784	4,594	1,092,395	394	12,389
382.6	382.7	5,021	1,109,805	4,622	1,097,016	399	12,789
382.7	382.8	5,048	1,114,853	4,643	1,101,659	405	13,194
382.8	382.9	5,070	1,119,923	4,660	1,106,319	410	13,604
382.9	383	5,089	1,125,012	4,674	1,110,994	415	14,018
383	383.1	5,107	1,130,119	4,688	1,115,682	419	14,437
383.1	383.2	5,120	1,135,239	4,698	1,120,380	422	14,859
383.2	383.3	5,131	1,140,370	4,705	1,125,085	426	15,285
383.3	383.4	5,140	1,145,510	4,711	1,129,796	429	15,714
383.4	383.5	5,149	1,150,660	4,717	1,134,514	432	16,146

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
383.5	383.6	5,159	1,155,819	4,724	1,139,237	435	16,582
383.6	383.7	5,168	1,160,987	4,729	1,143,967	439	17,020
383.7	383.8	5,177	1,166,164	4,735	1,148,702	442	17,462
383.8	383.9	5,186	1,171,350	4,741	1,153,443	445	17,907
383.9	384	5,195	1,176,545	4,747	1,158,189	448	18,356
384	384.1	5,203	1,181,748	4,751	1,162,941	452	18,807
384.1	384.2	5,211	1,186,959	4,756	1,167,697	455	19,262
384.2	384.3	5,218	1,192,178	4,760	1,172,458	458	19,720
384.3	384.4	5,227	1,197,404	4,766	1,177,223	461	20,181
384.4	384.5	5,235	1,202,639	4,771	1,181,994	464	20,645
384.5	384.6	5,243	1,207,883	4,776	1,186,771	467	21,112
384.6	384.7	5,252	1,213,135	4,782	1,191,552	470	21,583
384.7	384.8	5,260	1,218,395	4,786	1,196,339	474	22,056
384.8	384.9	5,269	1,223,664	4,792	1,201,131	477	22,533
384.9	385	5,278	1,228,942	4,798	1,205,929	480	23,013
385	385.1	5,288	1,234,230	4,805	1,210,733	483	23,497
385.1	385.2	5,296	1,239,526	4,809	1,215,543	487	23,983
385.2	385.3	5,302	1,244,828	4,812	1,220,355	490	24,473
385.3	385.4	5,309	1,250,137	4,816	1,225,171	493	24,966
385.4	385.5	5,315	1,255,453	4,819	1,229,990	496	25,463
385.5	385.6	5,322	1,260,774	4,822	1,234,812	500	25,962
385.6	385.7	5,328	1,266,102	4,825	1,239,637	503	26,465
385.7	385.8	5,334	1,271,436	4,828	1,244,465	506	26,971
385.8	385.9	5,340	1,276,776	4,831	1,249,296	509	27,480
385.9	386	5,346	1,282,123	4,834	1,254,130	512	27,993
386	386.1	5,353	1,287,475	4,837	1,258,967	516	28,508
386.1	386.2	5,359	1,292,834	4,840	1,263,807	519	29,027
386.2	386.3	5,365	1,298,199	4,843	1,268,649	522	29,550
386.3	386.4	5,371	1,303,570	4,845	1,273,495	526	30,075
386.4	386.5	5,377	1,308,948	4,848	1,278,343	529	30,605
386.5	386.6	5,384	1,314,332	4,851	1,283,195	533	31,137
386.6	386.7	5,390	1,319,722	4,854	1,288,049	536	31,673
386.7	386.8	5,397	1,325,118	4,858	1,292,905	539	32,213
386.8	386.9	5,403	1,330,521	4,860	1,297,766	543	32,755
386.9	387	5,409	1,335,930	4,863	1,302,628	546	33,302
387	387.1	5,416	1,341,346	4,866	1,307,495	550	33,851
387.1	387.2	5,422	1,346,768	4,869	1,312,364	553	34,404
387.2	387.3	5,429	1,352,197	4,873	1,317,237	556	34,960
387.3	387.4	5,436	1,357,633	4,876	1,322,113	560	35,520
387.4	387.5	5,443	1,363,076	4,880	1,326,993	563	36,083
387.5	387.6	5,449	1,368,525	4,883	1,331,876	566	36,649
387.6	387.7	5,456	1,373,982	4,886	1,336,763	570	37,219
387.7	387.8	5,463	1,379,445	4,890	1,341,653	573	37,792
387.8	387.9	5,470	1,384,915	4,893	1,346,546	577	38,369
387.9	388	5,477	1,390,392	4,897	1,351,442	580	38,950
388	388.1	5,485	1,395,877	4,901	1,356,344	584	39,533
388.1	388.2	5,492	1,401,369	4,905	1,361,248	587	40,121
388.2	388.3	5,499	1,406,868	4,908	1,366,156	591	40,712
388.3	388.4	5,506	1,412,374	4,912	1,371,068	594	41,306
388.4	388.5	5,514	1,417,888	4,916	1,375,984	598	41,904
388.5	388.6	5,521	1,423,409	4,920	1,380,904	601	42,505
388.6	388.7	5,529	1,428,938	4,924	1,385,828	605	43,110
388.7	388.8	5,537	1,434,475	4,929	1,390,757	608	43,718
388.8	388.9	5,544	1,440,019	4,933	1,395,690	611	44,329
388.9	389	5,552	1,445,571	4,937	1,400,627	615	44,944
389	389.1	5,559	1,451,130	4,941	1,405,568	618	45,562
389.1	389.2	5,567	1,456,697	4,946	1,410,514	621	46,183
389.2	389.3	5,575	1,462,272	4,950	1,415,464	625	46,808
389.3	389.4	5,583	1,467,855	4,955	1,420,419	628	47,436

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
389.4	389.5	5,591	1,473,446	4,959	1,425,378	632	48,068
389.5	389.6	5,599	1,479,045	4,964	1,430,342	635	48,703
389.6	389.7	5,606	1,484,652	4,968	1,435,311	638	49,341
389.7	389.8	5,614	1,490,265	4,972	1,440,282	642	49,983
389.8	389.9	5,621	1,495,886	4,976	1,445,258	645	50,628
389.9	390	5,628	1,501,515	4,979	1,450,238	649	51,277
390	390.1	5,635	1,507,150	4,983	1,455,221	652	51,929
390.1	390.2	5,643	1,512,793	4,988	1,460,209	655	52,584
390.2	390.3	5,650	1,518,443	4,991	1,465,200	659	53,243
390.3	390.4	5,658	1,524,100	4,996	1,470,195	662	53,905
390.4	390.5	5,665	1,529,766	4,999	1,475,195	666	54,571
390.5	390.6	5,673	1,535,439	5,004	1,480,199	669	55,240
390.6	390.7	5,681	1,541,119	5,008	1,485,206	673	55,913
390.7	390.8	5,689	1,546,808	5,013	1,490,219	676	56,589
390.8	390.9	5,697	1,552,504	5,017	1,495,235	680	57,269
390.9	391	5,705	1,558,209	5,022	1,500,257	683	57,952
391	391.1	5,713	1,563,923	5,026	1,505,285	687	58,638
391.1	391.2	5,723	1,569,645	5,033	1,510,316	690	59,329
391.2	391.3	5,732	1,575,377	5,037	1,515,354	695	60,023
391.3	391.4	5,741	1,581,118	5,042	1,520,396	699	60,722
391.4	391.5	5,749	1,586,867	5,045	1,525,440	704	61,427
391.5	391.6	5,758	1,592,625	5,049	1,530,489	709	62,136
391.6	391.7	5,767	1,598,392	5,053	1,535,542	714	62,850
391.7	391.8	5,775	1,604,167	5,056	1,540,597	719	63,570
391.8	391.9	5,784	1,609,952	5,059	1,545,657	725	64,295
391.9	392	5,793	1,615,744	5,062	1,550,718	731	65,026
392	392.1	5,801	1,621,545	5,063	1,555,781	738	65,764
392.1	392.2	5,810	1,627,355	5,066	1,560,847	744	66,508
392.2	392.3	5,818	1,633,173	5,067	1,565,914	751	67,259
392.3	392.4	5,826	1,638,999	5,068	1,570,982	758	68,017
392.4	392.5	5,834	1,644,833	5,069	1,576,051	765	68,782
392.5	392.6	5,842	1,650,676	5,070	1,581,122	772	69,554
392.6	392.7	5,851	1,656,527	5,073	1,586,195	778	70,332
392.7	392.8	5,860	1,662,386	5,075	1,591,269	785	71,117
392.8	392.9	5,869	1,668,255	5,078	1,596,346	791	71,909
392.9	393	5,878	1,674,132	5,080	1,601,425	798	72,707
393	393.1	5,888	1,680,020	5,082	1,606,508	806	73,512
393.1	393.2	5,899	1,685,919	5,085	1,611,592	814	74,327
393.2	393.3	5,911	1,691,830	5,088	1,616,680	823	75,150
393.3	393.4	5,926	1,697,756	5,094	1,621,774	832	75,982
393.4	393.5	5,952	1,703,708	5,111	1,626,885	841	76,823
393.5	393.6	5,982	1,709,691	5,132	1,632,018	850	77,673
393.6	393.7	6,017	1,715,707	5,157	1,637,174	860	78,533
393.7	393.8	6,068	1,721,775	5,196	1,642,371	872	79,404
393.8	393.9	6,116	1,727,891	5,230	1,647,601	886	80,290
393.9	394	6,154	1,734,045	5,252	1,652,853	902	81,192
394	394.1	6,190	1,740,235	5,272	1,658,125	918	82,110
394.1	394.2	6,224	1,746,459	5,289	1,663,413	935	83,046
394.2	394.3	6,255	1,752,714	5,300	1,668,713	955	84,001
394.3	394.4	6,289	1,759,003	5,309	1,674,022	980	84,981
394.4	394.5	6,319	1,765,322	5,317	1,679,338	1,002	85,984
394.5	394.6	6,343	1,771,666	5,324	1,684,663	1,019	87,003
394.6	394.7	6,372	1,778,038	5,341	1,690,004	1,031	88,034
394.7	394.8	6,410	1,784,448	5,367	1,695,372	1,043	89,076
394.8	394.9	6,448	1,790,896	5,393	1,700,764	1,055	90,132
394.9	395	6,491	1,797,387	5,423	1,706,187	1,068	91,200
395	395.1	6,524	1,803,910	5,442	1,711,628	1,082	92,282
395.1	395.2	6,547	1,810,457	5,444	1,717,072	1,103	93,385
395.2	395.3	6,562	1,817,019	5,431	1,722,503	1,131	94,516

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
395.3	395.4	6,577	1,823,596	5,417	1,727,919	1,160	95,677
395.4	395.5	6,590	1,830,186	5,401	1,733,320	1,189	96,866
395.5	395.6	6,602	1,836,788	5,389	1,738,709	1,213	98,079
395.6	395.7	6,613	1,843,401	5,377	1,744,086	1,236	99,315
395.7	395.8	6,622	1,850,022	5,363	1,749,448	1,259	100,574
395.8	395.9	6,630	1,856,652	5,350	1,754,797	1,280	101,855
395.9	396	6,638	1,863,291	5,336	1,760,135	1,302	103,156
396	396.1	6,647	1,869,937	5,327	1,765,460	1,320	104,477
396.1	396.2	6,655	1,876,592	5,317	1,770,777	1,338	105,815
396.2	396.3	6,663	1,883,255	5,308	1,776,085	1,355	107,170
396.3	396.4	6,670	1,889,925	5,298	1,781,383	1,372	108,542
396.4	396.5	6,676	1,896,601	5,288	1,786,671	1,388	109,930
396.5	396.6	6,682	1,903,283	5,277	1,791,948	1,405	111,335
396.6	396.7	6,687	1,909,970	5,266	1,797,214	1,421	112,756
396.7	396.8	6,693	1,916,663	5,256	1,802,470	1,437	114,193
396.8	396.9	6,699	1,923,362	5,247	1,807,717	1,452	115,645
396.9	397	6,707	1,930,069	5,240	1,812,956	1,467	117,113
397	397.1	6,714	1,936,782	5,232	1,818,187	1,482	118,595
397.1	397.2	6,720	1,943,503	5,223	1,823,411	1,497	120,092
397.2	397.3	6,727	1,950,229	5,215	1,828,625	1,512	121,604
397.3	397.4	6,733	1,956,962	5,206	1,833,831	1,527	123,131
397.4	397.5	6,739	1,963,701	5,198	1,839,029	1,541	124,672
397.5	397.6	6,746	1,970,447	5,191	1,844,220	1,555	126,227
397.6	397.7	6,752	1,977,199	5,184	1,849,404	1,568	127,795
397.7	397.8	6,759	1,983,958	5,176	1,854,580	1,583	129,378
397.8	397.9	6,767	1,990,725	5,169	1,859,750	1,598	130,975
397.9	398	6,773	1,997,498	5,160	1,864,910	1,613	132,588
398	398.1	6,780	2,004,279	5,152	1,870,063	1,628	134,216
398.1	398.2	6,787	2,011,066	5,143	1,875,206	1,644	135,860
398.2	398.3	6,794	2,017,860	5,136	1,880,342	1,658	137,518
398.3	398.4	6,801	2,024,662	5,127	1,885,470	1,674	139,192
398.4	398.5	6,808	2,031,469	5,119	1,890,588	1,689	140,881
398.5	398.6	6,815	2,038,284	5,111	1,895,699	1,704	142,585
398.6	398.7	6,822	2,045,106	5,103	1,900,801	1,719	144,305
398.7	398.8	6,829	2,051,935	5,094	1,905,896	1,735	146,039
398.8	398.9	6,836	2,058,771	5,086	1,910,981	1,750	147,790
398.9	399	6,843	2,065,614	5,077	1,916,059	1,766	149,555
399	399.1	6,849	2,072,463	5,068	1,921,126	1,781	151,337
399.1	399.2	6,855	2,079,318	5,058	1,926,184	1,797	153,134
399.2	399.3	6,861	2,086,180	5,047	1,931,232	1,814	154,948
399.3	399.4	6,867	2,093,046	5,037	1,936,268	1,830	156,778
399.4	399.5	6,872	2,099,919	5,025	1,941,295	1,847	158,624
399.5	399.6	6,878	2,106,796	5,014	1,946,308	1,864	160,488
399.6	399.7	6,883	2,113,680	5,002	1,951,311	1,881	162,369
399.7	399.8	6,889	2,120,569	4,990	1,956,301	1,899	164,268
399.8	399.9	6,896	2,127,465	4,979	1,961,280	1,917	166,185
399.9	400	6,902	2,134,367	4,967	1,966,248	1,935	168,119
400	400.1	6,907	2,141,274	4,954	1,971,202	1,953	170,072
400.1	400.2	6,913	2,148,187	4,943	1,976,145	1,970	172,042
400.2	400.3	6,919	2,155,106	4,930	1,981,075	1,989	174,031
400.3	400.4	6,925	2,162,031	4,918	1,985,993	2,007	176,038
400.4	400.5	6,931	2,168,963	4,906	1,990,900	2,025	178,063
400.5	400.6	6,938	2,175,901	4,894	1,995,795	2,044	180,106
400.6	400.7	6,944	2,182,845	4,882	2,000,676	2,062	182,169
400.7	400.8	6,950	2,189,795	4,868	2,005,544	2,082	184,251
400.8	400.9	6,956	2,196,751	4,853	2,010,397	2,103	186,354
400.9	401	6,962	2,203,712	4,837	2,015,233	2,125	188,479
401	401.1	6,967	2,210,679	4,818	2,020,051	2,149	190,628
401.1	401.2	6,972	2,217,652	4,795	2,024,847	2,177	192,805

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
401.2	401.3	6,978	2,224,629	4,752	2,029,598	2,226	195,031
401.3	401.4	6,983	2,231,612	4,692	2,034,290	2,291	197,322
401.4	401.5	6,988	2,238,601	4,622	2,038,913	2,366	199,688
401.5	401.6	6,994	2,245,595	4,502	2,043,416	2,492	202,179
401.6	401.7	6,999	2,252,594	4,355	2,047,771	2,644	204,823
401.7	401.8	7,004	2,259,598	4,200	2,051,971	2,804	207,627
401.8	401.9	7,010	2,266,608	3,986	2,055,957	3,024	210,651
401.9	402	7,015	2,273,623	3,740	2,059,697	3,275	213,926
402	402.1	7,021	2,280,644	3,451	2,063,148	3,570	217,496
402.1	402.2	7,026	2,287,670	3,070	2,066,218	3,956	221,452
402.2	402.3	7,031	2,294,701	2,496	2,068,714	4,535	225,987
402.3	402.4	7,037	2,301,738	1,830	2,070,544	5,207	231,194
402.4	402.5	7,043	2,308,781	1,255	2,071,799	5,788	236,982
402.5	402.6	7,049	2,315,829	820	2,072,618	6,229	243,211
402.6	402.7	7,055	2,322,884	599	2,073,217	6,456	249,667
402.7	402.8	7,061	2,329,945	491	2,073,708	6,570	256,237
402.8	402.9	7,067	2,337,012	402	2,074,110	6,665	262,902
402.9	403	7,073	2,344,085	336	2,074,445	6,737	269,640
403	403.1	7,079	2,351,163	291	2,074,736	6,788	276,427
403.1	403.2	7,085	2,358,248	249	2,074,985	6,836	283,263
403.2	403.3	7,091	2,365,339	215	2,075,200	6,876	290,139
403.3	403.4	7,097	2,372,436	197	2,075,397	6,900	297,039
403.4	403.5	7,103	2,379,539	176	2,075,573	6,927	303,966
403.5	403.6	7,110	2,386,649	150	2,075,722	6,960	310,927
403.6	403.7	7,116	2,393,764	125	2,075,847	6,991	317,917
403.7	403.8	7,122	2,400,886	98	2,075,945	7,024	324,941
403.8	403.9	7,128	2,408,014	75	2,076,020	7,053	331,994
403.9	404	7,134	2,415,148	58	2,076,079	7,076	339,069
404	404.1	7,140	2,422,288	41	2,076,120	7,099	346,168
404.1	404.2	7,146	2,429,435	31	2,076,152	7,115	353,283
404.2	404.3	7,153	2,436,587	28	2,076,180	7,125	360,407
404.3	404.4	7,159	2,443,746	25	2,076,205	7,134	367,541
404.4	404.5	7,166	2,450,912	23	2,076,228	7,143	374,684
404.5	404.6	7,173	2,458,085	21	2,076,249	7,152	381,836
404.6	404.7	7,180	2,465,265	19	2,076,268	7,161	388,997
404.7	404.8	7,187	2,472,452	17	2,076,285	7,170	396,167
404.8	404.9	7,194	2,479,646	15	2,076,299	7,179	403,347
404.9	405	7,201	2,486,846	13	2,076,311	7,188	410,535
405	405.1	7,208	2,494,055	11	2,076,323	7,197	417,732
405.1	405.2	7,216	2,501,270	10	2,076,332	7,206	424,938
405.2	405.3	7,224	2,508,494	8	2,076,340	7,216	432,154
405.3	405.4	7,233	2,515,727	6	2,076,346	7,227	439,381
405.4	405.5	7,244	2,522,972	4	2,076,351	7,240	446,621
405.5	405.6	7,256	2,530,228	3	2,076,355	7,253	453,873
405.6	405.7	7,269	2,537,497	2	2,076,357	7,267	461,140
405.7	405.8	7,284	2,544,781	2	2,076,358	7,282	468,423
405.8	405.9	7,314	2,552,095	1	2,076,359	7,313	475,736
405.9	406	7,356	2,559,451	0	2,076,358	7,356	483,093
406	406.1	7,408	2,566,859	0	2,076,358	7,408	490,501
406.1	406.2	7,469	2,574,328	0	2,076,358	7,469	497,970
406.2	406.3	7,547	2,581,875	0	2,076,358	7,547	505,517
406.3	406.4	7,633	2,589,508	0	2,076,358	7,633	513,150
406.4	406.5	7,707	2,597,215	0	2,076,358	7,707	520,857
406.5	406.6	7,760	2,604,975	0	2,076,358	7,760	528,617
406.6	406.7	7,805	2,612,781	0	2,076,358	7,805	536,423
406.7	406.8	7,838	2,620,619	0	2,076,358	7,838	544,261
406.8	406.9	7,864	2,628,483	0	2,076,358	7,864	552,125
406.9	407	7,887	2,636,369	0	2,076,358	7,887	560,011
407	407.1	7,901	2,644,270	0	2,076,358	7,901	567,912

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
407.1	407.2	7,912	2,652,183	0	2,076,358	7,912	575,825
407.2	407.3	7,921	2,660,104	0	2,076,358	7,921	583,746
407.3	407.4	7,929	2,668,033	0	2,076,358	7,929	591,675
407.4	407.5	7,937	2,675,970	0	2,076,358	7,937	599,612
407.5	407.6	7,944	2,683,915	0	2,076,358	7,944	607,557
407.6	407.7	7,951	2,691,866	0	2,076,358	7,951	615,508
407.7	407.8	7,958	2,699,825	0	2,076,358	7,958	623,467
407.8	407.9	7,966	2,707,790	0	2,076,358	7,966	631,432
407.9	408	7,974	2,715,764	0	2,076,358	7,974	639,406
408	408.1	7,983	2,723,747	0	2,076,358	7,983	647,389
408.1	408.2	7,994	2,731,742	0	2,076,358	7,994	655,384
408.2	408.3	8,007	2,739,749	0	2,076,358	8,007	663,391
408.3	408.4	8,018	2,747,766	0	2,076,358	8,018	671,408
408.4	408.5	8,027	2,755,794	0	2,076,358	8,027	679,436
408.5	408.6	8,037	2,763,830	0	2,076,358	8,037	687,472
408.6	408.7	8,045	2,771,876	0	2,076,358	8,045	695,518
408.7	408.8	8,054	2,779,929	0	2,076,358	8,054	703,571
408.8	408.9	8,061	2,787,990	0	2,076,358	8,061	711,632
408.9	409	8,069	2,796,060	0	2,076,358	8,069	719,702
409	409.1	8,077	2,804,137	0	2,076,358	8,077	727,779
409.1	409.2	8,085	2,812,221	0	2,076,358	8,085	735,863
409.2	409.3	8,092	2,820,314	0	2,076,358	8,092	743,956
409.3	409.4	8,099	2,828,413	0	2,076,358	8,099	752,055
409.4	409.5	8,106	2,836,519	0	2,076,358	8,106	760,161
409.5	409.6	8,113	2,844,632	0	2,076,358	8,113	768,274
409.6	409.7	8,120	2,852,751	0	2,076,358	8,120	776,393
409.7	409.8	8,127	2,860,878	0	2,076,358	8,127	784,520
409.8	409.9	8,133	2,869,011	0	2,076,358	8,133	792,653
409.9	410	8,140	2,877,152	0	2,076,358	8,140	800,794
410	410.1	8,147	2,885,299	0	2,076,358	8,147	808,941
410.1	410.2	8,153	2,893,452	0	2,076,358	8,153	817,094
410.2	410.3	8,159	2,901,611	0	2,076,358	8,159	825,253
410.3	410.4	8,166	2,909,777	0	2,076,358	8,166	833,419
410.4	410.5	8,172	2,917,949	0	2,076,358	8,172	841,591
410.5	410.6	8,178	2,926,127	0	2,076,358	8,178	849,769
410.6	410.7	8,185	2,934,312	0	2,076,358	8,185	857,954
410.7	410.8	8,192	2,942,504	0	2,076,358	8,192	866,146
410.8	410.9	8,200	2,950,704	0	2,076,358	8,200	874,346
410.9	411	8,209	2,958,913	0	2,076,358	8,209	882,555
411	411.1	8,220	2,967,133	0	2,076,358	8,220	890,775
411.1	411.2	8,229	2,975,362	0	2,076,358	8,229	899,004
411.2	411.3	8,238	2,983,600	0	2,076,358	8,238	907,242
411.3	411.4	8,245	2,991,845	0	2,076,358	8,245	915,487
411.4	411.5	8,251	3,000,096	0	2,076,358	8,251	923,738
411.5	411.6	8,258	3,008,354	0	2,076,358	8,258	931,996
411.6	411.7	8,264	3,016,618	0	2,076,358	8,264	940,260
411.7	411.8	8,270	3,024,888	0	2,076,358	8,270	948,530
411.8	411.9	8,277	3,033,165	0	2,076,358	8,277	956,807
411.9	412	8,284	3,041,449	0	2,076,358	8,284	965,091
412	412.1	8,290	3,049,739	0	2,076,358	8,290	973,381
412.1	412.2	8,297	3,058,036	0	2,076,358	8,297	981,678
412.2	412.3	8,304	3,066,340	0	2,076,358	8,304	989,982
412.3	412.4	8,310	3,074,650	0	2,076,358	8,310	998,292
412.4	412.5	8,317	3,082,967	0	2,076,358	8,317	1,006,609
412.5	412.6	8,324	3,091,291	0	2,076,358	8,324	1,014,933
412.6	412.7	8,330	3,099,621	0	2,076,358	8,330	1,023,263
412.7	412.8	8,336	3,107,957	0	2,076,358	8,336	1,031,599
412.8	412.9	8,343	3,116,300	0	2,076,358	8,343	1,039,942
412.9	413	8,349	3,124,648	0	2,076,358	8,349	1,048,290

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
413	413.1	8,355	3,133,003	0	2,076,358	8,355	1,056,645
413.1	413.2	8,361	3,141,364	0	2,076,358	8,361	1,065,006
413.2	413.3	8,367	3,149,730	0	2,076,358	8,367	1,073,372
413.3	413.4	8,372	3,158,103	0	2,076,358	8,372	1,081,745
413.4	413.5	8,378	3,166,481	0	2,076,358	8,378	1,090,123
413.5	413.6	8,384	3,174,865	0	2,076,358	8,384	1,098,507
413.6	413.7	8,390	3,183,255	0	2,076,358	8,390	1,106,897
413.7	413.8	8,396	3,191,650	0	2,076,358	8,396	1,115,292
413.8	413.9	8,401	3,200,052	0	2,076,358	8,401	1,123,694
413.9	414	8,407	3,208,459	0	2,076,358	8,407	1,132,101
414	414.1	8,413	3,216,872	0	2,076,358	8,413	1,140,514
414.1	414.2	8,418	3,225,290	0	2,076,358	8,418	1,148,932
414.2	414.3	8,424	3,233,714	0	2,076,358	8,424	1,157,356
414.3	414.4	8,430	3,242,144	0	2,076,358	8,430	1,165,786
414.4	414.5	8,435	3,250,579	0	2,076,358	8,435	1,174,221
414.5	414.6	8,441	3,259,020	0	2,076,358	8,441	1,182,662
414.6	414.7	8,447	3,267,467	0	2,076,358	8,447	1,191,109
414.7	414.8	8,454	3,275,921	0	2,076,358	8,454	1,199,563
414.8	414.9	8,461	3,284,382	0	2,076,358	8,461	1,208,024
414.9	415	8,468	3,292,850	0	2,076,358	8,468	1,216,492
415	415.1	8,475	3,301,324	0	2,076,358	8,475	1,224,966
415.1	415.2	8,482	3,309,806	0	2,076,358	8,482	1,233,448
415.2	415.3	8,490	3,318,296	0	2,076,358	8,490	1,241,938
415.3	415.4	8,498	3,326,794	0	2,076,358	8,498	1,250,436
415.4	415.5	8,506	3,335,301	0	2,076,358	8,506	1,258,943
415.5	415.6	8,515	3,343,816	0	2,076,358	8,515	1,267,458
415.6	415.7	8,523	3,352,338	0	2,076,358	8,523	1,275,980
415.7	415.8	8,531	3,360,869	0	2,076,358	8,531	1,284,511
415.8	415.9	8,539	3,369,408	0	2,076,358	8,539	1,293,050
415.9	416	8,547	3,377,955	0	2,076,358	8,547	1,301,597
416	416.1	8,556	3,386,511	0	2,076,358	8,556	1,310,153
416.1	416.2	8,564	3,395,075	0	2,076,358	8,564	1,318,717
416.2	416.3	8,572	3,403,646	0	2,076,358	8,572	1,327,288
416.3	416.4	8,580	3,412,227	0	2,076,358	8,580	1,335,869
416.4	416.5	8,588	3,420,815	0	2,076,358	8,588	1,344,457
416.5	416.6	8,596	3,429,410	0	2,076,358	8,596	1,353,052
416.6	416.7	8,604	3,438,014	0	2,076,358	8,604	1,361,656
416.7	416.8	8,613	3,446,627	0	2,076,358	8,613	1,370,269
416.8	416.9	8,622	3,455,249	0	2,076,358	8,622	1,378,891
416.9	417	8,632	3,463,881	0	2,076,358	8,632	1,387,523
417	417.1	8,642	3,472,523	0	2,076,358	8,642	1,396,165
417.1	417.2	8,654	3,481,177	0	2,076,358	8,654	1,404,819
417.2	417.3	8,669	3,489,845	0	2,076,358	8,669	1,413,487
417.3	417.4	8,694	3,498,539	0	2,076,358	8,694	1,422,181
417.4	417.5	8,730	3,507,269	0	2,076,358	8,730	1,430,911
417.5	417.6	8,758	3,516,027	0	2,076,358	8,758	1,439,669
417.6	417.7	8,780	3,524,807	0	2,076,358	8,780	1,448,449
417.7	417.8	8,807	3,533,614	0	2,076,358	8,807	1,457,256
417.8	417.9	8,835	3,542,449	0	2,076,358	8,835	1,466,091
417.9	418	8,870	3,551,319	0	2,076,358	8,870	1,474,961
418	418.1	8,928	3,560,247	0	2,076,358	8,928	1,483,889
418.1	418.2	8,984	3,569,231	0	2,076,358	8,984	1,492,873
418.2	418.3	9,030	3,578,261	0	2,076,358	9,030	1,501,903
418.3	418.4	9,077	3,587,338	0	2,076,358	9,077	1,510,980
418.4	418.5	9,126	3,596,464	0	2,076,358	9,126	1,520,106
418.5	418.6	9,184	3,605,648	0	2,076,358	9,184	1,529,290
418.6	418.7	9,239	3,614,886	0	2,076,358	9,239	1,538,528
418.7	418.8	9,280	3,624,166	0	2,076,358	9,280	1,547,808
418.8	418.9	9,311	3,633,477	0	2,076,358	9,311	1,557,119

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
418.9	419	9,337	3,642,814	0	2,076,358	9,337	1,566,456
419	419.1	9,362	3,652,176	0	2,076,358	9,362	1,575,818
419.1	419.2	9,379	3,661,554	0	2,076,358	9,379	1,585,196
419.2	419.3	9,391	3,670,946	0	2,076,358	9,391	1,594,588
419.3	419.4	9,404	3,680,350	0	2,076,358	9,404	1,603,992
419.4	419.5	9,418	3,689,768	0	2,076,358	9,418	1,613,410
419.5	419.6	9,432	3,699,199	0	2,076,358	9,432	1,622,841
419.6	419.7	9,445	3,708,644	0	2,076,358	9,445	1,632,286
419.7	419.8	9,456	3,718,100	0	2,076,358	9,456	1,641,742
419.8	419.9	9,466	3,727,566	0	2,076,358	9,466	1,651,208
419.9	420	9,475	3,737,041	0	2,076,358	9,475	1,660,683
420	420.1	9,485	3,746,526	0	2,076,358	9,485	1,670,168
420.1	420.2	9,493	3,756,019	0	2,076,358	9,493	1,679,661
420.2	420.3	9,501	3,765,521	0	2,076,358	9,501	1,689,163
420.3	420.4	9,509	3,775,030	0	2,076,358	9,509	1,698,672
420.4	420.5	9,517	3,784,547	0	2,076,358	9,517	1,708,189
420.5	420.6	9,525	3,794,071	0	2,076,358	9,525	1,717,713
420.6	420.7	9,533	3,803,604	0	2,076,358	9,533	1,727,246
420.7	420.8	9,540	3,813,144	0	2,076,358	9,540	1,736,786
420.8	420.9	9,548	3,822,692	0	2,076,358	9,548	1,746,334
420.9	421	9,555	3,832,248	0	2,076,358	9,555	1,755,890
421	421.1	9,563	3,841,810	0	2,076,358	9,563	1,765,452
421.1	421.2	9,570	3,851,380	0	2,076,358	9,570	1,775,022
421.2	421.3	9,577	3,860,957	0	2,076,358	9,577	1,784,599
421.3	421.4	9,583	3,870,540	0	2,076,358	9,583	1,794,182
421.4	421.5	9,590	3,880,130	0	2,076,358	9,590	1,803,772
421.5	421.6	9,597	3,889,727	0	2,076,358	9,597	1,813,369
421.6	421.7	9,604	3,899,330	0	2,076,358	9,604	1,822,972
421.7	421.8	9,611	3,908,941	0	2,076,358	9,611	1,832,583
421.8	421.9	9,618	3,918,558	0	2,076,358	9,618	1,842,200
421.9	422	9,625	3,928,183	0	2,076,358	9,625	1,851,825
422	422.1	9,632	3,937,815	0	2,076,358	9,632	1,861,457
422.1	422.2	9,639	3,947,454	0	2,076,358	9,639	1,871,096
422.2	422.3	9,646	3,957,099	0	2,076,358	9,646	1,880,741
422.3	422.4	9,653	3,966,752	0	2,076,358	9,653	1,890,394
422.4	422.5	9,660	3,976,412	0	2,076,358	9,660	1,900,054
422.5	422.6	9,667	3,986,079	0	2,076,358	9,667	1,909,721
422.6	422.7	9,674	3,995,753	0	2,076,358	9,674	1,919,395
422.7	422.8	9,682	4,005,436	0	2,076,358	9,682	1,929,078
422.8	422.9	9,691	4,015,126	0	2,076,358	9,691	1,938,768
422.9	423	9,699	4,024,825	0	2,076,358	9,699	1,948,467
423	423.1	9,708	4,034,533	0	2,076,358	9,708	1,958,175
423.1	423.2	9,716	4,044,249	0	2,076,358	9,716	1,967,891
423.2	423.3	9,724	4,053,973	0	2,076,358	9,724	1,977,615
423.3	423.4	9,732	4,063,705	0	2,076,358	9,732	1,987,347
423.4	423.5	9,739	4,073,445	0	2,076,358	9,739	1,997,087
423.5	423.6	9,747	4,083,192	0	2,076,358	9,747	2,006,834
423.6	423.7	9,754	4,092,946	0	2,076,358	9,754	2,016,588
423.7	423.8	9,761	4,102,707	0	2,076,358	9,761	2,026,349
423.8	423.9	9,767	4,112,474	0	2,076,358	9,767	2,036,116
423.9	424	9,773	4,122,247	0	2,076,358	9,773	2,045,889
424	424.1	9,779	4,132,027	0	2,076,358	9,779	2,055,669
424.1	424.2	9,785	4,141,812	0	2,076,358	9,785	2,065,454
424.2	424.3	9,791	4,151,603	0	2,076,358	9,791	2,075,245
424.3	424.4	9,797	4,161,400	0	2,076,358	9,797	2,085,042
424.4	424.5	9,803	4,171,202	0	2,076,358	9,803	2,094,844
424.5	424.6	9,809	4,181,011	0	2,076,358	9,809	2,104,653
424.6	424.7	9,815	4,190,825	0	2,076,358	9,815	2,114,467
424.7	424.8	9,821	4,200,646	0	2,076,358	9,821	2,124,288

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
424.8	424.9	9,826	4,210,472	0	2,076,358	9,826	2,134,114
424.9	425	9,833	4,220,305	0	2,076,358	9,833	2,143,947
425	425.1	9,839	4,230,144	0	2,076,358	9,839	2,153,786
425.1	425.2	9,846	4,239,989	0	2,076,358	9,846	2,163,631
425.2	425.3	9,852	4,249,842	0	2,076,358	9,852	2,173,484
425.3	425.4	9,859	4,259,701	0	2,076,358	9,859	2,183,343
425.4	425.5	9,866	4,269,567	0	2,076,358	9,866	2,193,209
425.5	425.6	9,872	4,279,440	0	2,076,358	9,872	2,203,082
425.6	425.7	9,879	4,289,318	0	2,076,358	9,879	2,212,960
425.7	425.8	9,885	4,299,203	0	2,076,358	9,885	2,222,845
425.8	425.9	9,891	4,309,094	0	2,076,358	9,891	2,232,736
425.9	426	9,898	4,318,992	0	2,076,358	9,898	2,242,634
426	426.1	9,905	4,328,897	0	2,076,358	9,905	2,252,539
426.1	426.2	9,912	4,338,808	0	2,076,358	9,912	2,262,450
426.2	426.3	9,918	4,348,727	0	2,076,358	9,918	2,272,369
426.3	426.4	9,925	4,358,652	0	2,076,358	9,925	2,282,294
426.4	426.5	9,932	4,368,584	0	2,076,358	9,932	2,292,226
426.5	426.6	9,938	4,378,522	0	2,076,358	9,938	2,302,164
426.6	426.7	9,945	4,388,467	0	2,076,358	9,945	2,312,109
426.7	426.8	9,951	4,398,417	0	2,076,358	9,951	2,322,059
426.8	426.9	9,957	4,408,374	0	2,076,358	9,957	2,332,016
426.9	427	9,963	4,418,337	0	2,076,358	9,963	2,341,979
427	427.1	9,969	4,428,306	0	2,076,358	9,969	2,351,948
427.1	427.2	9,974	4,438,281	0	2,076,358	9,974	2,361,923
427.2	427.3	9,980	4,448,261	0	2,076,358	9,980	2,371,903
427.3	427.4	9,986	4,458,246	0	2,076,358	9,986	2,381,888
427.4	427.5	9,991	4,468,238	0	2,076,358	9,991	2,391,880
427.5	427.6	9,997	4,478,235	0	2,076,358	9,997	2,401,877
427.6	427.7	10,003	4,488,238	0	2,076,358	10,003	2,411,880
427.7	427.8	10,010	4,498,248	0	2,076,358	10,010	2,421,890
427.8	427.9	10,016	4,508,264	0	2,076,358	10,016	2,431,906
427.9	428	10,022	4,518,286	0	2,076,358	10,022	2,441,928
428	428.1	10,028	4,528,314	0	2,076,358	10,028	2,451,956
428.1	428.2	10,034	4,538,348	0	2,076,358	10,034	2,461,990
428.2	428.3	10,040	4,548,389	0	2,076,358	10,040	2,472,031
428.3	428.4	10,046	4,558,434	0	2,076,358	10,046	2,482,076
428.4	428.5	10,052	4,568,486	0	2,076,358	10,052	2,492,128
428.5	428.6	10,058	4,578,543	0	2,076,358	10,058	2,502,185
428.6	428.7	10,064	4,588,607	0	2,076,358	10,064	2,512,249
428.7	428.8	10,070	4,598,677	0	2,076,358	10,070	2,522,319
428.8	428.9	10,076	4,608,753	0	2,076,358	10,076	2,532,395
428.9	429	10,083	4,618,836	0	2,076,358	10,083	2,542,478
429	429.1	10,090	4,628,926	0	2,076,358	10,090	2,552,568
429.1	429.2	10,097	4,639,022	0	2,076,358	10,097	2,562,664
429.2	429.3	10,104	4,649,126	0	2,076,358	10,104	2,572,768
429.3	429.4	10,117	4,659,243	0	2,076,358	10,117	2,582,885
429.4	429.5	10,135	4,669,378	0	2,076,358	10,135	2,593,020
429.5	429.6	10,181	4,679,559	0	2,076,358	10,181	2,603,201
429.6	429.7	10,246	4,689,805	0	2,076,358	10,246	2,613,447
429.7	429.8	10,310	4,700,116	0	2,076,358	10,310	2,623,758
429.8	429.9	10,381	4,710,497	0	2,076,358	10,381	2,634,139
429.9	430	10,447	4,720,944	0	2,076,358	10,447	2,644,586
430	430.1	10,498	4,731,442	0	2,076,358	10,498	2,655,084
430.1	430.2	10,540	4,741,982	0	2,076,358	10,540	2,665,624
430.2	430.3	10,577	4,752,560	0	2,076,358	10,577	2,676,202
430.3	430.4	10,618	4,763,177	0	2,076,358	10,618	2,686,819
430.4	430.5	10,666	4,773,843	0	2,076,358	10,666	2,697,485
430.5	430.6	10,703	4,784,546	0	2,076,358	10,703	2,708,188
430.6	430.7	10,737	4,795,283	0	2,076,358	10,737	2,718,925

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
430.7	430.8	10,770	4,806,054	0	2,076,358	10,770	2,729,696
430.8	430.9	10,800	4,816,854	0	2,076,358	10,800	2,740,496
430.9	431	10,829	4,827,683	0	2,076,358	10,829	2,751,325
431	431.1	10,856	4,838,539	0	2,076,358	10,856	2,762,181
431.1	431.2	10,879	4,849,418	0	2,076,358	10,879	2,773,060
431.2	431.3	10,910	4,860,327	0	2,076,358	10,910	2,783,969
431.3	431.4	10,931	4,871,259	0	2,076,358	10,931	2,794,901
431.4	431.5	10,948	4,882,207	0	2,076,358	10,948	2,805,849
431.5	431.6	10,963	4,893,170	0	2,076,358	10,963	2,816,812
431.6	431.7	10,975	4,904,145	0	2,076,358	10,975	2,827,787
431.7	431.8	10,986	4,915,131	0	2,076,358	10,986	2,838,773
431.8	431.9	10,995	4,926,126	0	2,076,358	10,995	2,849,768
431.9	432	11,004	4,937,129	0	2,076,358	11,004	2,860,771
432	432.1	11,012	4,948,142	0	2,076,358	11,012	2,871,784
432.1	432.2	11,023	4,959,165	0	2,076,358	11,023	2,882,807
432.2	432.3	11,038	4,970,203	0	2,076,358	11,038	2,893,845
432.3	432.4	11,052	4,981,255	0	2,076,358	11,052	2,904,897
432.4	432.5	11,063	4,992,319	0	2,076,358	11,063	2,915,961
432.5	432.6	11,073	5,003,391	0	2,076,358	11,073	2,927,033
432.6	432.7	11,082	5,014,474	0	2,076,358	11,082	2,938,116
432.7	432.8	11,091	5,025,565	0	2,076,358	11,091	2,949,207
432.8	432.9	11,099	5,036,664	0	2,076,358	11,099	2,960,306
432.9	433	11,108	5,047,772	0	2,076,358	11,108	2,971,414
433	433.1	11,116	5,058,888	0	2,076,358	11,116	2,982,530
433.1	433.2	11,124	5,070,012	0	2,076,358	11,124	2,993,654
433.2	433.3	11,132	5,081,145	0	2,076,358	11,132	3,004,787
433.3	433.4	11,140	5,092,285	0	2,076,358	11,140	3,015,927
433.4	433.5	11,148	5,103,433	0	2,076,358	11,148	3,027,075
433.5	433.6	11,156	5,114,588	0	2,076,358	11,156	3,038,230
433.6	433.7	11,164	5,125,752	0	2,076,358	11,164	3,049,394
433.7	433.8	11,172	5,136,923	0	2,076,358	11,172	3,060,565
433.8	433.9	11,180	5,148,103	0	2,076,358	11,180	3,071,745
433.9	434	11,188	5,159,291	0	2,076,358	11,188	3,082,933
434	434.1	11,197	5,170,488	0	2,076,358	11,197	3,094,130
434.1	434.2	11,205	5,181,693	0	2,076,358	11,205	3,105,335
434.2	434.3	11,213	5,192,906	0	2,076,358	11,213	3,116,548
434.3	434.4	11,221	5,204,127	0	2,076,358	11,221	3,127,769
434.4	434.5	11,230	5,215,357	0	2,076,358	11,230	3,138,999
434.5	434.6	11,238	5,226,594	0	2,076,358	11,238	3,150,236
434.6	434.7	11,246	5,237,840	0	2,076,358	11,246	3,161,482
434.7	434.8	11,254	5,249,094	0	2,076,358	11,254	3,172,736
434.8	434.9	11,262	5,260,357	0	2,076,358	11,262	3,183,999
434.9	435	11,270	5,271,627	0	2,076,358	11,270	3,195,269
435	435.1	11,279	5,282,906	0	2,076,358	11,279	3,206,548
435.1	435.2	11,287	5,294,192	0	2,076,358	11,287	3,217,834
435.2	435.3	11,294	5,305,487	0	2,076,358	11,294	3,229,129
435.3	435.4	11,302	5,316,789	0	2,076,358	11,302	3,240,431
435.4	435.5	11,310	5,328,099	0	2,076,358	11,310	3,251,741
435.5	435.6	11,317	5,339,415	0	2,076,358	11,317	3,263,057
435.6	435.7	11,324	5,350,740	0	2,076,358	11,324	3,274,382
435.7	435.8	11,332	5,362,072	0	2,076,358	11,332	3,285,714
435.8	435.9	11,340	5,373,412	0	2,076,358	11,340	3,297,054
435.9	436	11,349	5,384,761	0	2,076,358	11,349	3,308,403
436	436.1	11,358	5,396,119	0	2,076,358	11,358	3,319,761
436.1	436.2	11,367	5,407,486	0	2,076,358	11,367	3,331,128
436.2	436.3	11,376	5,418,862	0	2,076,358	11,376	3,342,504
436.3	436.4	11,385	5,430,246	0	2,076,358	11,385	3,353,888
436.4	436.5	11,393	5,441,639	0	2,076,358	11,393	3,365,281
436.5	436.6	11,401	5,453,041	0	2,076,358	11,401	3,376,683

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
436.6	436.7	11,409	5,464,450	0	2,076,358	11,409	3,388,092
436.7	436.8	11,418	5,475,868	0	2,076,358	11,418	3,399,510
436.8	436.9	11,426	5,487,293	0	2,076,358	11,426	3,410,935
436.9	437	11,434	5,498,727	0	2,076,358	11,434	3,422,369
437	437.1	11,442	5,510,169	0	2,076,358	11,442	3,433,811
437.1	437.2	11,449	5,521,618	0	2,076,358	11,449	3,445,260
437.2	437.3	11,457	5,533,075	0	2,076,358	11,457	3,456,717
437.3	437.4	11,465	5,544,540	0	2,076,358	11,465	3,468,182
437.4	437.5	11,473	5,556,014	0	2,076,358	11,473	3,479,656
437.5	437.6	11,482	5,567,495	0	2,076,358	11,482	3,491,137
437.6	437.7	11,489	5,578,985	0	2,076,358	11,489	3,502,627
437.7	437.8	11,497	5,590,481	0	2,076,358	11,497	3,514,123
437.8	437.9	11,504	5,601,985	0	2,076,358	11,504	3,525,627
437.9	438	11,511	5,613,496	0	2,076,358	11,511	3,537,138
438	438.1	11,518	5,625,014	0	2,076,358	11,518	3,548,656
438.1	438.2	11,525	5,636,539	0	2,076,358	11,525	3,560,181
438.2	438.3	11,532	5,648,071	0	2,076,358	11,532	3,571,713
438.3	438.4	11,542	5,659,613	0	2,076,358	11,542	3,583,255
438.4	438.5	11,554	5,671,167	0	2,076,358	11,554	3,594,809
438.5	438.6	11,566	5,682,733	0	2,076,358	11,566	3,606,375
438.6	438.7	11,577	5,694,310	0	2,076,358	11,577	3,617,952
438.7	438.8	11,588	5,705,898	0	2,076,358	11,588	3,629,540
438.8	438.9	11,599	5,717,497	0	2,076,358	11,599	3,641,139
438.9	439	11,608	5,729,105	0	2,076,358	11,608	3,652,747
439	439.1	11,618	5,740,723	0	2,076,358	11,618	3,664,365
439.1	439.2	11,627	5,752,349	0	2,076,358	11,627	3,675,991
439.2	439.3	11,635	5,763,984	0	2,076,358	11,635	3,687,626
439.3	439.4	11,643	5,775,627	0	2,076,358	11,643	3,699,269
439.4	439.5	11,651	5,787,279	0	2,076,358	11,651	3,710,921
439.5	439.6	11,660	5,798,939	0	2,076,358	11,660	3,722,581
439.6	439.7	11,669	5,810,608	0	2,076,358	11,669	3,734,250
439.7	439.8	11,679	5,822,287	0	2,076,358	11,679	3,745,929
439.8	439.9	11,688	5,833,975	0	2,076,358	11,688	3,757,617
439.9	440	11,697	5,845,672	0	2,076,358	11,697	3,769,314
440	440.1	11,708	5,857,381	0	2,076,358	11,708	3,781,023
440.1	440.2	11,720	5,869,100	0	2,076,358	11,720	3,792,742
440.2	440.3	11,730	5,880,830	0	2,076,358	11,730	3,804,472
440.3	440.4	11,742	5,892,573	0	2,076,358	11,742	3,816,215
440.4	440.5	11,756	5,904,329	0	2,076,358	11,756	3,827,971
440.5	440.6	11,769	5,916,097	0	2,076,358	11,769	3,839,739
440.6	440.7	11,782	5,927,879	0	2,076,358	11,782	3,851,521
440.7	440.8	11,797	5,939,676	0	2,076,358	11,797	3,863,318
440.8	440.9	11,812	5,951,488	0	2,076,358	11,812	3,875,130
440.9	441	11,826	5,963,315	0	2,076,358	11,826	3,886,957
441	441.1	11,840	5,975,155	0	2,076,358	11,840	3,898,797
441.1	441.2	11,858	5,987,013	0	2,076,358	11,858	3,910,655
441.2	441.3	11,879	5,998,892	0	2,076,358	11,879	3,922,534
441.3	441.4	11,899	6,010,791	0	2,076,358	11,899	3,934,433
441.4	441.5	11,918	6,022,709	0	2,076,358	11,918	3,946,351
441.5	441.6	11,940	6,034,649	0	2,076,358	11,940	3,958,291
441.6	441.7	11,967	6,046,616	0	2,076,358	11,967	3,970,258
441.7	441.8	12,002	6,058,618	0	2,076,358	12,002	3,982,260
441.8	441.9	12,034	6,070,652	0	2,076,358	12,034	3,994,294
441.9	442	12,069	6,082,722	0	2,076,358	12,069	4,006,364
442	442.1	12,104	6,094,826	0	2,076,358	12,104	4,018,468
442.1	442.2	12,141	6,106,967	0	2,076,358	12,141	4,030,609
442.2	442.3	12,186	6,119,152	0	2,076,358	12,186	4,042,794
442.3	442.4	12,247	6,131,399	0	2,076,358	12,247	4,055,041
442.4	442.5	12,306	6,143,705	0	2,076,358	12,306	4,067,347

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
442.5	442.6	12,358	6,156,063	0	2,076,358	12,358	4,079,705
442.6	442.7	12,400	6,168,463	0	2,076,358	12,400	4,092,105
442.7	442.8	12,435	6,180,898	0	2,076,358	12,435	4,104,540
442.8	442.9	12,467	6,193,366	0	2,076,358	12,467	4,117,008
442.9	443	12,501	6,205,867	0	2,076,358	12,501	4,129,509
443	443.1	12,539	6,218,406	0	2,076,358	12,539	4,142,048
443.1	443.2	12,568	6,230,974	0	2,076,358	12,568	4,154,616
443.2	443.3	12,591	6,243,565	0	2,076,358	12,591	4,167,207
443.3	443.4	12,612	6,256,177	0	2,076,358	12,612	4,179,819
443.4	443.5	12,631	6,268,808	0	2,076,358	12,631	4,192,450
443.5	443.6	12,648	6,281,455	0	2,076,358	12,648	4,205,097
443.6	443.7	12,663	6,294,119	0	2,076,358	12,663	4,217,761
443.7	443.8	12,678	6,306,796	0	2,076,358	12,678	4,230,438
443.8	443.9	12,692	6,319,488	0	2,076,358	12,692	4,243,130
443.9	444	12,704	6,332,192	0	2,076,358	12,704	4,255,834
444	444.1	12,716	6,344,908	0	2,076,358	12,716	4,268,550
444.1	444.2	12,728	6,357,636	0	2,076,358	12,728	4,281,278
444.2	444.3	12,740	6,370,376	0	2,076,358	12,740	4,294,018
444.3	444.4	12,751	6,383,127	0	2,076,358	12,751	4,306,769
444.4	444.5	12,762	6,395,889	0	2,076,358	12,762	4,319,531
444.5	444.6	12,773	6,408,662	0	2,076,358	12,773	4,332,304
444.6	444.7	12,784	6,421,447	0	2,076,358	12,784	4,345,089
444.7	444.8	12,795	6,434,242	0	2,076,358	12,795	4,357,884
444.8	444.9	12,806	6,447,047	0	2,076,358	12,806	4,370,689
444.9	445	12,816	6,459,864	0	2,076,358	12,816	4,383,506
445	445.1	12,827	6,472,691	0	2,076,358	12,827	4,396,333
445.1	445.2	12,837	6,485,528	0	2,076,358	12,837	4,409,170
445.2	445.3	12,848	6,498,376	0	2,076,358	12,848	4,422,018
445.3	445.4	12,859	6,511,235	0	2,076,358	12,859	4,434,877
445.4	445.5	12,869	6,524,104	0	2,076,358	12,869	4,447,746
445.5	445.6	12,880	6,536,984	0	2,076,358	12,880	4,460,626
445.6	445.7	12,891	6,549,874	0	2,076,358	12,891	4,473,516
445.7	445.8	12,901	6,562,776	0	2,076,358	12,901	4,486,418
445.8	445.9	12,912	6,575,688	0	2,076,358	12,912	4,499,330
445.9	446	12,923	6,588,611	0	2,076,358	12,923	4,512,253
446	446.1	12,934	6,601,544	0	2,076,358	12,934	4,525,186
446.1	446.2	12,944	6,614,489	0	2,076,358	12,944	4,538,131
446.2	446.3	12,956	6,627,444	0	2,076,358	12,956	4,551,086
446.3	446.4	12,968	6,640,412	0	2,076,358	12,968	4,564,054
446.4	446.5	12,980	6,653,392	0	2,076,358	12,980	4,577,034
446.5	446.6	12,992	6,666,384	0	2,076,358	12,992	4,590,026
446.6	446.7	13,004	6,679,388	0	2,076,358	13,004	4,603,030
446.7	446.8	13,015	6,692,403	0	2,076,358	13,015	4,616,045
446.8	446.9	13,026	6,705,429	0	2,076,358	13,026	4,629,071
446.9	447	13,037	6,718,466	0	2,076,358	13,037	4,642,108
447	447.1	13,047	6,731,513	0	2,076,358	13,047	4,655,155
447.1	447.2	13,057	6,744,570	0	2,076,358	13,057	4,668,212
447.2	447.3	13,067	6,757,637	0	2,076,358	13,067	4,681,279
447.3	447.4	13,077	6,770,714	0	2,076,358	13,077	4,694,356
447.4	447.5	13,088	6,783,802	0	2,076,358	13,088	4,707,444
447.5	447.6	13,100	6,796,902	0	2,076,358	13,100	4,720,544
447.6	447.7	13,112	6,810,014	0	2,076,358	13,112	4,733,656
447.7	447.8	13,123	6,823,137	0	2,076,358	13,123	4,746,779
447.8	447.9	13,135	6,836,272	0	2,076,358	13,135	4,759,914
447.9	448	13,147	6,849,420	0	2,076,358	13,147	4,773,062
448	448.1	13,160	6,862,579	0	2,076,358	13,160	4,786,221
448.1	448.2	13,173	6,875,752	0	2,076,358	13,173	4,799,394
448.2	448.3	13,186	6,888,938	0	2,076,358	13,186	4,812,580
448.3	448.4	13,199	6,902,137	0	2,076,358	13,199	4,825,779

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
448.4	448.5	13,212	6,915,349	0	2,076,358	13,212	4,838,991
448.5	448.6	13,224	6,928,573	0	2,076,358	13,224	4,852,215
448.6	448.7	13,237	6,941,811	0	2,076,358	13,237	4,865,453
448.7	448.8	13,252	6,955,063	0	2,076,358	13,252	4,878,705
448.8	448.9	13,269	6,968,332	0	2,076,358	13,269	4,891,974
448.9	449	13,287	6,981,618	0	2,076,358	13,287	4,905,260
449	449.1	13,301	6,994,920	0	2,076,358	13,301	4,918,562
449.1	449.2	13,315	7,008,235	0	2,076,358	13,315	4,931,877
449.2	449.3	13,329	7,021,564	0	2,076,358	13,329	4,945,206
449.3	449.4	13,343	7,034,906	0	2,076,358	13,343	4,958,548
449.4	449.5	13,358	7,048,264	0	2,076,358	13,358	4,971,906
449.5	449.6	13,375	7,061,639	0	2,076,358	13,375	4,985,281
449.6	449.7	13,393	7,075,032	0	2,076,358	13,393	4,998,674
449.7	449.8	13,409	7,088,441	0	2,076,358	13,409	5,012,083
449.8	449.9	13,426	7,101,867	0	2,076,358	13,426	5,025,509
449.9	450	13,442	7,115,309	0	2,076,358	13,442	5,038,951
450	450.1	13,459	7,128,769	0	2,076,358	13,459	5,052,411
450.1	450.2	13,477	7,142,246	0	2,076,358	13,477	5,065,888
450.2	450.3	13,496	7,155,742	0	2,076,358	13,496	5,079,384
450.3	450.4	13,517	7,169,259	0	2,076,358	13,517	5,092,901
450.4	450.5	13,534	7,182,793	0	2,076,358	13,534	5,106,435
450.5	450.6	13,550	7,196,343	0	2,076,358	13,550	5,119,985
450.6	450.7	13,569	7,209,912	0	2,076,358	13,569	5,133,554
450.7	450.8	13,590	7,223,501	0	2,076,358	13,590	5,147,143
450.8	450.9	13,609	7,237,110	0	2,076,358	13,609	5,160,752
450.9	451	13,629	7,250,738	0	2,076,358	13,629	5,174,380
451	451.1	13,649	7,264,387	0	2,076,358	13,649	5,188,029
451.1	451.2	13,669	7,278,056	0	2,076,358	13,669	5,201,698
451.2	451.3	13,689	7,291,745	0	2,076,358	13,689	5,215,387
451.3	451.4	13,710	7,305,455	0	2,076,358	13,710	5,229,097
451.4	451.5	13,733	7,319,188	0	2,076,358	13,733	5,242,830
451.5	451.6	13,755	7,332,943	0	2,076,358	13,755	5,256,585
451.6	451.7	13,780	7,346,723	0	2,076,358	13,780	5,270,365
451.7	451.8	13,804	7,360,527	0	2,076,358	13,804	5,284,169
451.8	451.9	13,828	7,374,354	0	2,076,358	13,828	5,297,996
451.9	452	13,859	7,388,214	0	2,076,358	13,859	5,311,856
452	452.1	13,900	7,402,114	0	2,076,358	13,900	5,325,756
452.1	452.2	13,943	7,416,057	0	2,076,358	13,943	5,339,699
452.2	452.3	13,986	7,430,043	0	2,076,358	13,986	5,353,685
452.3	452.4	14,027	7,444,070	0	2,076,358	14,027	5,367,712
452.4	452.5	14,068	7,458,139	0	2,076,358	14,068	5,381,781
452.5	452.6	14,105	7,472,244	0	2,076,358	14,105	5,395,886
452.6	452.7	14,140	7,486,384	0	2,076,358	14,140	5,410,026
452.7	452.8	14,185	7,500,569	0	2,076,358	14,185	5,424,211
452.8	452.9	14,245	7,514,814	0	2,076,358	14,245	5,438,456
452.9	453	14,313	7,529,127	0	2,076,358	14,313	5,452,769
453	453.1	14,375	7,543,502	0	2,076,358	14,375	5,467,144
453.1	453.2	14,431	7,557,932	0	2,076,358	14,431	5,481,574
453.2	453.3	14,478	7,572,410	0	2,076,358	14,478	5,496,052
453.3	453.4	14,434	7,586,844	0	2,076,358	14,434	5,510,486
453.4	453.5	14,245	7,601,089	0	2,076,358	14,245	5,524,731
453.5	453.6	13,662	7,614,751	0	2,076,358	13,662	5,538,393
453.6	453.7	11,923	7,626,674	0	2,076,358	11,923	5,550,316
453.7	453.8	10,126	7,636,800	0	2,076,358	10,126	5,560,442
453.8	453.9	9,183	7,645,983	0	2,076,358	9,183	5,569,625
453.9	454	8,713	7,654,696	0	2,076,358	8,713	5,578,338
454	454.1	8,388	7,663,083	0	2,076,358	8,388	5,586,725
454.1	454.2	8,079	7,671,162	0	2,076,358	8,079	5,594,804
454.2	454.3	7,767	7,678,929	0	2,076,358	7,767	5,602,571

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
454.3	454.4	7,502	7,686,432	0	2,076,358	7,502	5,610,074
454.4	454.5	7,291	7,693,722	0	2,076,358	7,291	5,617,364
454.5	454.6	7,114	7,700,836	0	2,076,358	7,114	5,624,478
454.6	454.7	6,965	7,707,801	0	2,076,358	6,965	5,631,443
454.7	454.8	6,840	7,714,641	0	2,076,358	6,840	5,638,283
454.8	454.9	6,723	7,721,365	0	2,076,358	6,723	5,645,007
454.9	455	6,612	7,727,976	0	2,076,358	6,612	5,651,618
455	455.1	6,504	7,734,480	0	2,076,358	6,504	5,658,122
455.1	455.2	6,393	7,740,874	0	2,076,358	6,393	5,664,516
455.2	455.3	6,280	7,747,154	0	2,076,358	6,280	5,670,796
455.3	455.4	6,123	7,753,277	0	2,076,358	6,123	5,676,919
455.4	455.5	5,928	7,759,205	0	2,076,358	5,928	5,682,847
455.5	455.6	5,749	7,764,954	0	2,076,358	5,749	5,688,596
455.6	455.7	5,545	7,770,499	0	2,076,358	5,545	5,694,141
455.7	455.8	5,292	7,775,791	0	2,076,358	5,292	5,699,433
455.8	455.9	5,133	7,780,923	0	2,076,358	5,133	5,704,565
455.9	456	4,991	7,785,914	0	2,076,358	4,991	5,709,556
456	456.1	4,870	7,790,784	0	2,076,358	4,870	5,714,426
456.1	456.2	4,764	7,795,548	0	2,076,358	4,764	5,719,190
456.2	456.3	4,662	7,800,210	0	2,076,358	4,662	5,723,852
456.3	456.4	4,537	7,804,746	0	2,076,358	4,537	5,728,388
456.4	456.5	4,395	7,809,141	0	2,076,358	4,395	5,732,783
456.5	456.6	4,240	7,813,381	0	2,076,358	4,240	5,737,023
456.6	456.7	4,086	7,817,467	0	2,076,358	4,086	5,741,109
456.7	456.8	3,936	7,821,403	0	2,076,358	3,936	5,745,045
456.8	456.9	3,803	7,825,206	0	2,076,358	3,803	5,748,848
456.9	457	3,692	7,828,898	0	2,076,358	3,692	5,752,540
457	457.1	3,587	7,832,485	0	2,076,358	3,587	5,756,127
457.1	457.2	3,488	7,835,973	0	2,076,358	3,488	5,759,615
457.2	457.3	3,394	7,839,367	0	2,076,358	3,394	5,763,009
457.3	457.4	3,299	7,842,665	0	2,076,358	3,299	5,766,307
457.4	457.5	3,207	7,845,872	0	2,076,358	3,207	5,769,514
457.5	457.6	3,118	7,848,990	0	2,076,358	3,118	5,772,632
457.6	457.7	3,035	7,852,025	0	2,076,358	3,035	5,775,667
457.7	457.8	2,954	7,854,980	0	2,076,358	2,954	5,778,622
457.8	457.9	2,874	7,857,853	0	2,076,358	2,874	5,781,495
457.9	458	2,793	7,860,646	0	2,076,358	2,793	5,784,288
458	458.1	2,711	7,863,358	0	2,076,358	2,711	5,787,000
458.1	458.2	2,629	7,865,987	0	2,076,358	2,629	5,789,629
458.2	458.3	2,546	7,868,532	0	2,076,358	2,546	5,792,174
458.3	458.4	2,461	7,870,993	0	2,076,358	2,461	5,794,635
458.4	458.5	2,379	7,873,372	0	2,076,358	2,379	5,797,014
458.5	458.6	2,301	7,875,673	0	2,076,358	2,301	5,799,315
458.6	458.7	2,224	7,877,897	0	2,076,358	2,224	5,801,539
458.7	458.8	2,148	7,880,045	0	2,076,358	2,148	5,803,687
458.8	458.9	2,073	7,882,118	0	2,076,358	2,073	5,805,760
458.9	459	1,995	7,884,113	0	2,076,358	1,995	5,807,755
459	459.1	1,920	7,886,033	0	2,076,358	1,920	5,809,675
459.1	459.2	1,847	7,887,880	0	2,076,358	1,847	5,811,522
459.2	459.3	1,782	7,889,662	0	2,076,358	1,782	5,813,304
459.3	459.4	1,719	7,891,381	0	2,076,358	1,719	5,815,023
459.4	459.5	1,656	7,893,037	0	2,076,358	1,656	5,816,679
459.5	459.6	1,596	7,894,634	0	2,076,358	1,596	5,818,276
459.6	459.7	1,544	7,896,178	0	2,076,358	1,544	5,819,820
459.7	459.8	1,499	7,897,677	0	2,076,358	1,499	5,821,319
459.8	459.9	1,462	7,899,139	0	2,076,358	1,462	5,822,781
459.9	460	1,435	7,900,574	0	2,076,358	1,435	5,824,216
460	460.1	1,410	7,901,984	0	2,076,358	1,410	5,825,626
460.1	460.2	1,387	7,903,370	0	2,076,358	1,387	5,827,012

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
460.2	460.3	1,366	7,904,736	0	2,076,358	1,366	5,828,378
460.3	460.4	1,348	7,906,084	0	2,076,358	1,348	5,829,726
460.4	460.5	1,332	7,907,416	0	2,076,358	1,332	5,831,058
460.5	460.6	1,323	7,908,739	0	2,076,358	1,323	5,832,381
460.6	460.7	1,320	7,910,058	0	2,076,358	1,320	5,833,700
460.7	460.8	1,317	7,911,376	0	2,076,358	1,317	5,835,018
460.8	460.9	1,318	7,912,694	0	2,076,358	1,318	5,836,336
460.9	461	1,322	7,914,015	0	2,076,358	1,322	5,837,657
461	461.1	1,323	7,915,338	0	2,076,358	1,323	5,838,980
461.1	461.2	1,319	7,916,657	0	2,076,358	1,319	5,840,299
461.2	461.3	1,315	7,917,972	0	2,076,358	1,315	5,841,614
461.3	461.4	1,319	7,919,291	0	2,076,358	1,319	5,842,933
461.4	461.5	1,323	7,920,614	0	2,076,358	1,323	5,844,256
461.5	461.6	1,332	7,921,945	0	2,076,358	1,332	5,845,587
461.6	461.7	1,319	7,923,264	0	2,076,358	1,319	5,846,906
461.7	461.8	1,291	7,924,555	0	2,076,358	1,291	5,848,197
461.8	461.9	1,259	7,925,814	0	2,076,358	1,259	5,849,456
461.9	462	1,222	7,927,036	0	2,076,358	1,222	5,850,678
462	462.1	1,182	7,928,217	0	2,076,358	1,182	5,851,859
462.1	462.2	1,143	7,929,360	0	2,076,358	1,143	5,853,002
462.2	462.3	1,108	7,930,468	0	2,076,358	1,108	5,854,110
462.3	462.4	1,079	7,931,547	0	2,076,358	1,079	5,855,189
462.4	462.5	1,052	7,932,598	0	2,076,358	1,052	5,856,240
462.5	462.6	1,026	7,933,624	0	2,076,358	1,026	5,857,266
462.6	462.7	997	7,934,621	0	2,076,358	997	5,858,263
462.7	462.8	968	7,935,589	0	2,076,358	968	5,859,231
462.8	462.9	939	7,936,528	0	2,076,358	939	5,860,170
462.9	463	914	7,937,441	0	2,076,358	914	5,861,083
463	463.1	888	7,938,329	0	2,076,358	888	5,861,971
463.1	463.2	861	7,939,190	0	2,076,358	861	5,862,832
463.2	463.3	831	7,940,022	0	2,076,358	831	5,863,664
463.3	463.4	798	7,940,820	0	2,076,358	798	5,864,462
463.4	463.5	757	7,941,576	0	2,076,358	757	5,865,218
463.5	463.6	717	7,942,294	0	2,076,358	717	5,865,936
463.6	463.7	681	7,942,974	0	2,076,358	681	5,866,616
463.7	463.8	644	7,943,618	0	2,076,358	644	5,867,260
463.8	463.9	607	7,944,225	0	2,076,358	607	5,867,867
463.9	464	570	7,944,795	0	2,076,358	570	5,868,437
464	464.1	510	7,945,305	0	2,076,358	510	5,868,947
464.1	464.2	470	7,945,775	0	2,076,358	470	5,869,417
464.2	464.3	432	7,946,207	0	2,076,358	432	5,869,849
464.3	464.4	397	7,946,605	0	2,076,358	397	5,870,247
464.4	464.5	365	7,946,970	0	2,076,358	365	5,870,612
464.5	464.6	320	7,947,289	0	2,076,358	320	5,870,931
464.6	464.7	288	7,947,577	0	2,076,358	288	5,871,219
464.7	464.8	258	7,947,835	0	2,076,358	258	5,871,477
464.8	464.9	230	7,948,065	0	2,076,358	230	5,871,707
464.9	465	201	7,948,266	0	2,076,358	201	5,871,908
465	465.1	160	7,948,427	0	2,076,358	160	5,872,069
465.1	465.2	141	7,948,567	0	2,076,358	141	5,872,209
465.2	465.3	122	7,948,689	0	2,076,358	122	5,872,331
465.3	465.4	102	7,948,792	0	2,076,358	102	5,872,434
465.4	465.5	83	7,948,875	0	2,076,358	83	5,872,517
465.5	465.6	49	7,948,924	0	2,076,358	49	5,872,566
465.6	465.7	24	7,948,948	0	2,076,358	24	5,872,590
465.7	465.8	9	7,948,956	0	2,076,358	9	5,872,598
465.8	465.9	1	7,948,957	0	2,076,358	1	5,872,599
465.9	466	0	7,948,957	0	2,076,358	0	5,872,599
466	466.1	0	7,948,957	0	2,076,358	0	5,872,599

From	To	Pit Volume (m^3)	Cum Pit Volume (m^3)	Volume Special Waste (m^3)	Cum Volume Special Waste (m^3)	Remaining Volume (m^3)	Cum Remaining Volume (m^3)
466.1	466.2	0	7,948,957	0	2,076,358	0	5,872,599
466.2	466.3	0	7,948,957	0	2,076,358	0	5,872,599
466.3	466.4	0	7,948,957	0	2,076,358	0	5,872,599
466.4	466.5	0	7,948,957	0	2,076,358	0	5,872,599
466.5	466.6	0	7,948,957	0	2,076,358	0	5,872,599
466.6	466.7	0	7,948,957	0	2,076,358	0	5,872,599
466.7	466.8	0	7,948,957	0	2,076,358	0	5,872,599
466.8	466.9	0	7,948,957	0	2,076,358	0	5,872,599
466.9	467	0	7,948,957	0	2,076,358	0	5,872,599
467	467.1	0	7,948,957	0	2,076,358	0	5,872,599
467.1	467.2	0	7,948,957	0	2,076,358	0	5,872,599
467.2	467.3	0	7,948,957	0	2,076,358	0	5,872,599
467.3	467.4	0	7,948,957	0	2,076,358	0	5,872,599
467.4	467.5	0	7,948,957	0	2,076,358	0	5,872,599
467.5	467.6	0	7,948,957	0	2,076,358	0	5,872,599
467.6	467.7	0	7,948,957	0	2,076,358	0	5,872,599
467.7	467.8	0	7,948,957	0	2,076,358	0	5,872,599
467.8	467.9	0	7,948,957	0	2,076,358	0	5,872,599
467.9	468	0	7,948,957	0	2,076,358	0	5,872,599
468	468.1	0	7,948,957	0	2,076,358	0	5,872,599
468.1	468.2	0	7,948,957	0	2,076,358	0	5,872,599
468.2	468.3	0	7,948,957	0	2,076,358	0	5,872,599
468.3	468.4	0	7,948,957	0	2,076,358	0	5,872,599
468.4	468.5	0	7,948,957	0	2,076,358	0	5,872,599
468.5	468.6	0	7,948,957	0	2,076,358	0	5,872,599
468.6	468.7	0	7,948,957	0	2,076,358	0	5,872,599
468.7	468.8	0	7,948,957	0	2,076,358	0	5,872,599
468.8	468.9	0	7,948,957	0	2,076,358	0	5,872,599
468.9	469	0	7,948,957	0	2,076,358	0	5,872,599
469	469.1	0	7,948,957	0	2,076,358	0	5,872,599
469.1	469.2	0	7,948,957	0	2,076,358	0	5,872,599
469.2	469.3	0	7,948,957	0	2,076,358	0	5,872,599
469.3	469.4	0	7,948,957	0	2,076,358	0	5,872,599
469.4	469.5	0	7,948,957	0	2,076,358	0	5,872,599

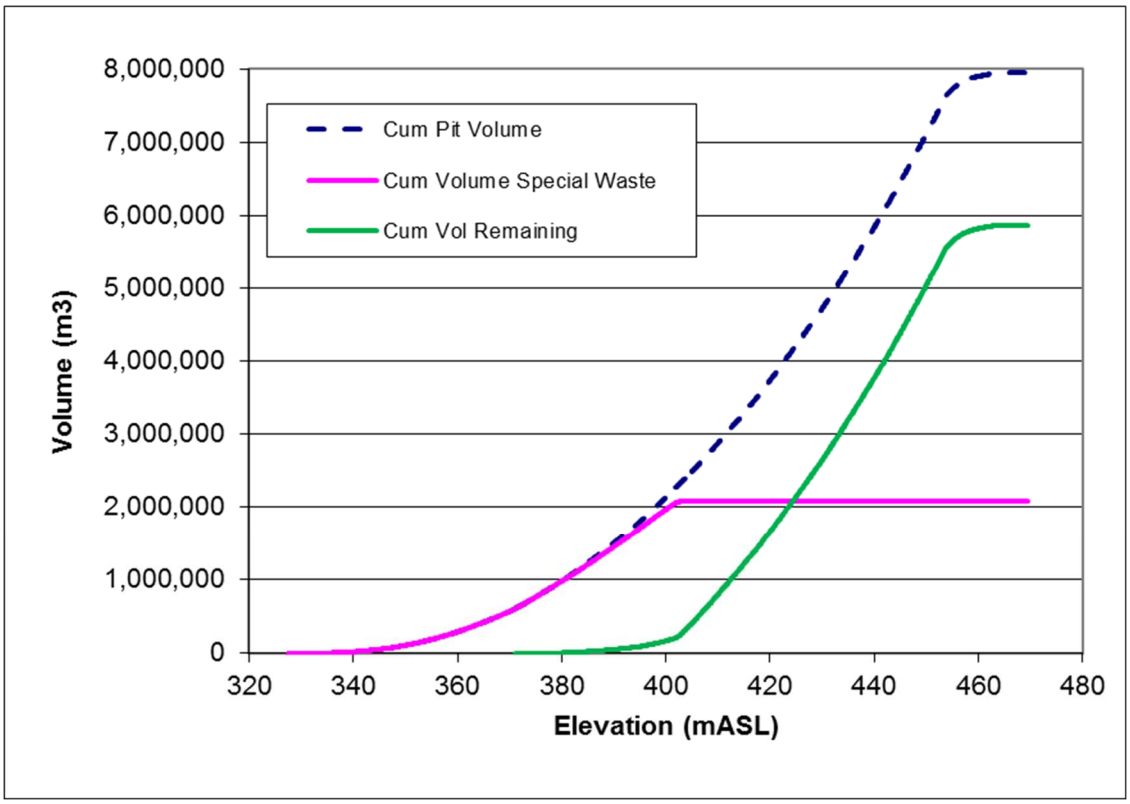


Figure 1- 2: Cumulative Volumes in Sue E Pit

1.3 Sue B Pit Volume

The total excavated Sue B pit volume was calculated from 373 mASL to surface in 0.1 m increments as of November 2008. It was based on drawings "*232-008 sue_b_topo.dtm*" and "*suebasb_nov28_08_final.dtm*". The Sue B pit volume including the overburden cap at the bottom of the pit was also calculated as of December 2011, from 370 mASL to surface in 0.1 increments, based on drawings "*232-008 sue_b_topo.dtm*" and "suebasb*_final_with_overburden_cap"*. These two volume calculations are summarized in Table 1- 3. Calculated volumes are presented to the nearest unit value. Some apparent rounding errors may occasionally occur in the calculated volumes.

The calculations in Table 1- 3 show that the total pit volume is 1,702,794 m^3 without the overburden cap at the bottom of the pit and 1,692,592 m^3 with the overburden cap.

Table 1-3: Summary of Sue B Pit Volumes

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
373	373.1	0	0	0	0
373.1	373.2	0	0	0	0
373.2	373.3	0	0	0	0
373.3	373.4	0	0	0	0
373.4	373.5	0	0	0	0
373.5	373.6	2	2	0	0

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
373.6	373.7	5	7	0	0
373.7	373.8	5	12	0	0
373.8	373.9	6	18	0	0
373.9	374	6	24	0	0
374	374.1	7	31	0	0
374.1	374.2	7	38	0	0
374.2	374.3	8	46	0	0
374.3	374.4	8	54	0	0
374.4	374.5	9	63	0	0
374.5	374.6	10	73	0	0
374.6	374.7	11	84	0	0
374.7	374.8	11	95	0	0
374.8	374.9	13	108	0	0
374.9	375	22	130	0	0
375	375.1	26	156	0	0
375.1	375.2	30	186	0	0
375.2	375.3	33	218	0	0
375.3	375.4	35	253	0	0
375.4	375.5	36	289	0	0
375.5	375.6	38	327	0	0
375.6	375.7	40	367	0	0
375.7	375.8	41	408	0	0
375.8	375.9	43	451	0	0
375.9	376	44	495	0	0
376	376.1	46	541	0	0
376.1	376.2	48	589	0	0
376.2	376.3	49	638	0	0
376.3	376.4	51	689	0	0
376.4	376.5	52	741	0	0
376.5	376.6	54	794	0	0
376.6	376.7	55	849	0	0
376.7	376.8	56	905	0	0
376.8	376.9	57	963	0	0
376.9	377	59	1,022	0	0
377	377.1	60	1,082	0	0
377.1	377.2	62	1,143	0	0
377.2	377.3	63	1,206	0	0
377.3	377.4	65	1,271	0	0
377.4	377.5	67	1,337	0	0
377.5	377.6	69	1,406	0	0
377.6	377.7	71	1,477	0	0
377.7	377.8	73	1,551	0	0
377.8	377.9	76	1,627	0	0
377.9	378	79	1,705	0	0
378	378.1	82	1,787	0	0
378.1	378.2	85	1,872	0	0
378.2	378.3	88	1,960	0	0
378.3	378.4	90	2,051	0	0
378.4	378.5	92	2,143	0	0
378.5	378.6	94	2,237	0	0
378.6	378.7	96	2,333	0	0
378.7	378.8	98	2,431	0	0
378.8	378.9	100	2,531	0	0
378.9	379	101	2,632	0	0
379	379.1	105	2,737	0	0
379.1	379.2	110	2,847	0	0
379.2	379.3	112	2,959	0	0
379.3	379.4	114	3,073	0	0

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
379.4	379.5	116	3,188	0	0
379.5	379.6	118	3,306	0	0
379.6	379.7	119	3,425	0	0
379.7	379.8	121	3,547	0	0
379.8	379.9	123	3,670	0	0
379.9	380	125	3,795	0	0
380	380.1	127	3,921	0	0
380.1	380.2	128	4,050	0	0
380.2	380.3	130	4,180	0	0
380.3	380.4	132	4,312	0	0
380.4	380.5	134	4,446	0	0
380.5	380.6	136	4,581	0	0
380.6	380.7	138	4,719	0	0
380.7	380.8	140	4,859	0	0
380.8	380.9	143	5,001	0	0
380.9	381	145	5,147	0	0
381	381.1	148	5,295	0	0
381.1	381.2	151	5,446	0	0
381.2	381.3	155	5,601	0	0
381.3	381.4	161	5,763	0	0
381.4	381.5	167	5,929	2	3
381.5	381.6	171	6,101	6	9
381.6	381.7	176	6,277	12	20
381.7	381.8	181	6,457	18	38
381.8	381.9	185	6,643	25	63
381.9	382	191	6,833	32	95
382	382.1	196	7,029	39	134
382.1	382.2	201	7,231	47	181
382.2	382.3	207	7,438	54	236
382.3	382.4	213	7,650	62	298
382.4	382.5	218	7,868	70	368
382.5	382.6	223	8,091	78	446
382.6	382.7	228	8,318	86	532
382.7	382.8	233	8,551	93	625
382.8	382.9	238	8,789	102	727
382.9	383	243	9,033	109	836
383	383.1	251	9,284	117	954
383.1	383.2	264	9,548	126	1,080
383.2	383.3	274	9,822	138	1,218
383.3	383.4	282	10,104	151	1,369
383.4	383.5	288	10,392	157	1,526
383.5	383.6	292	10,684	163	1,690
383.6	383.7	297	10,981	170	1,860
383.7	383.8	301	11,282	177	2,037
383.8	383.9	305	11,587	183	2,220
383.9	384	308	11,895	190	2,409
384	384.1	312	12,207	197	2,606
384.1	384.2	315	12,522	206	2,813
384.2	384.3	318	12,841	224	3,037
384.3	384.4	322	13,162	241	3,278
384.4	384.5	328	13,491	261	3,539
384.5	384.6	339	13,830	286	3,825
384.6	384.7	351	14,181	302	4,127
384.7	384.8	360	14,541	316	4,443
384.8	384.9	368	14,909	332	4,775
384.9	385	376	15,285	349	5,124
385	385.1	383	15,668	363	5,487
385.1	385.2	391	16,060	379	5,867

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
385.2	385.3	398	16,457	393	6,260
385.3	385.4	403	16,861	401	6,661
385.4	385.5	408	17,269	407	7,068
385.5	385.6	414	17,683	413	7,481
385.6	385.7	425	18,108	425	7,906
385.7	385.8	437	18,545	437	8,343
385.8	385.9	444	18,990	444	8,788
385.9	386	453	19,443	453	9,241
386	386.1	462	19,904	462	9,702
386.1	386.2	471	20,375	471	10,173
386.2	386.3	481	20,856	481	10,654
386.3	386.4	492	21,348	492	11,146
386.4	386.5	499	21,847	499	11,645
386.5	386.6	506	22,353	506	12,151
386.6	386.7	513	22,866	513	12,664
386.7	386.8	521	23,387	521	13,185
386.8	386.9	529	23,916	529	13,714
386.9	387	535	24,451	535	14,249
387	387.1	541	24,992	541	14,790
387.1	387.2	548	25,540	548	15,338
387.2	387.3	557	26,097	557	15,895
387.3	387.4	564	26,661	564	16,459
387.4	387.5	571	27,232	571	17,030
387.5	387.6	577	27,809	577	17,607
387.6	387.7	582	28,391	582	18,189
387.7	387.8	587	28,979	587	18,777
387.8	387.9	594	29,573	594	19,371
387.9	388	601	30,174	601	19,972
388	388.1	608	30,782	608	20,580
388.1	388.2	613	31,395	613	21,193
388.2	388.3	617	32,012	617	21,810
388.3	388.4	621	32,632	621	22,431
388.4	388.5	625	33,257	625	23,055
388.5	388.6	628	33,885	628	23,683
388.6	388.7	631	34,517	631	24,315
388.7	388.8	634	35,151	634	24,949
388.8	388.9	637	35,788	637	25,586
388.9	389	640	36,429	640	26,227
389	389.1	643	37,071	643	26,869
389.1	389.2	646	37,717	646	27,515
389.2	389.3	648	38,365	648	28,163
389.3	389.4	651	39,016	651	28,814
389.4	389.5	654	39,670	654	29,468
389.5	389.6	656	40,326	656	30,124
389.6	389.7	659	40,985	659	30,783
389.7	389.8	662	41,647	662	31,445
389.8	389.9	665	42,312	665	32,110
389.9	390	668	42,981	668	32,779
390	390.1	672	43,652	672	33,450
390.1	390.2	675	44,327	675	34,125
390.2	390.3	678	45,004	678	34,802
390.3	390.4	680	45,685	680	35,483
390.4	390.5	683	46,368	683	36,166
390.5	390.6	686	47,054	686	36,852
390.6	390.7	689	47,742	689	37,540
390.7	390.8	691	48,433	691	38,231
390.8	390.9	694	49,127	694	38,925
390.9	391	697	49,824	697	39,622

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
391	391.1	699	50,523	699	40,321
391.1	391.2	703	51,226	703	41,024
391.2	391.3	706	51,932	706	41,730
391.3	391.4	709	52,640	709	42,438
391.4	391.5	712	53,352	712	43,150
391.5	391.6	716	54,068	716	43,866
391.6	391.7	720	54,788	720	44,586
391.7	391.8	723	55,511	723	45,309
391.8	391.9	726	56,237	726	46,035
391.9	392	729	56,966	729	46,764
392	392.1	732	57,698	732	47,496
392.1	392.2	737	58,435	737	48,233
392.2	392.3	742	59,176	742	48,974
392.3	392.4	747	59,923	747	49,721
392.4	392.5	751	60,674	751	50,472
392.5	392.6	756	61,430	756	51,228
392.6	392.7	760	62,191	760	51,989
392.7	392.8	766	62,957	766	52,755
392.8	392.9	772	63,729	772	53,527
392.9	393	776	64,505	776	54,303
393	393.1	779	65,284	779	55,082
393.1	393.2	783	66,066	783	55,864
393.2	393.3	786	66,852	786	56,650
393.3	393.4	790	67,642	790	57,440
393.4	393.5	793	68,435	793	58,233
393.5	393.6	797	69,233	797	59,031
393.6	393.7	803	70,035	803	59,833
393.7	393.8	808	70,843	808	60,641
393.8	393.9	813	71,656	813	61,454
393.9	394	817	72,473	817	62,271
394	394.1	821	73,294	821	63,092
394.1	394.2	826	74,120	826	63,918
394.2	394.3	830	74,950	830	64,748
394.3	394.4	834	75,784	834	65,582
394.4	394.5	839	76,623	839	66,421
394.5	394.6	845	77,468	845	67,266
394.6	394.7	849	78,317	849	68,115
394.7	394.8	853	79,170	853	68,968
394.8	394.9	856	80,026	856	69,824
394.9	395	860	80,886	860	70,684
395	395.1	864	81,751	864	71,549
395.1	395.2	869	82,619	869	72,417
395.2	395.3	873	83,492	873	73,290
395.3	395.4	877	84,368	877	74,166
395.4	395.5	880	85,249	880	75,047
395.5	395.6	884	86,133	884	75,931
395.6	395.7	888	87,021	888	76,819
395.7	395.8	892	87,913	892	77,711
395.8	395.9	896	88,809	896	78,607
395.9	396	900	89,709	900	79,507
396	396.1	905	90,614	905	80,412
396.1	396.2	912	91,526	912	81,324
396.2	396.3	921	92,447	921	82,245
396.3	396.4	936	93,383	936	83,181
396.4	396.5	963	94,345	963	84,143
396.5	396.6	999	95,345	999	85,143
396.6	396.7	1,034	96,378	1,034	86,176
396.7	396.8	1,055	97,433	1,055	87,232

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
396.8	396.9	1,066	98,499	1,066	88,297
396.9	397	1,075	99,575	1,075	89,373
397	397.1	1,085	100,659	1,085	90,457
397.1	397.2	1,093	101,752	1,093	91,550
397.2	397.3	1,099	102,851	1,099	92,649
397.3	397.4	1,106	103,957	1,106	93,755
397.4	397.5	1,115	105,072	1,115	94,870
397.5	397.6	1,128	106,200	1,128	95,998
397.6	397.7	1,137	107,337	1,137	97,135
397.7	397.8	1,143	108,480	1,143	98,278
397.8	397.9	1,148	109,628	1,148	99,426
397.9	398	1,153	110,781	1,153	100,579
398	398.1	1,157	111,938	1,157	101,736
398.1	398.2	1,161	113,100	1,161	102,898
398.2	398.3	1,165	114,265	1,165	104,063
398.3	398.4	1,169	115,434	1,169	105,232
398.4	398.5	1,173	116,607	1,173	106,405
398.5	398.6	1,178	117,785	1,178	107,583
398.6	398.7	1,183	118,969	1,183	108,767
398.7	398.8	1,188	120,157	1,188	109,955
398.8	398.9	1,192	121,349	1,192	111,147
398.9	399	1,195	122,544	1,195	112,342
399	399.1	1,199	123,742	1,199	113,540
399.1	399.2	1,202	124,944	1,202	114,742
399.2	399.3	1,205	126,149	1,205	115,947
399.3	399.4	1,208	127,357	1,208	117,155
399.4	399.5	1,211	128,569	1,211	118,367
399.5	399.6	1,214	129,783	1,214	119,581
399.6	399.7	1,217	131,000	1,217	120,798
399.7	399.8	1,220	132,220	1,220	122,018
399.8	399.9	1,223	133,444	1,223	123,242
399.9	400	1,226	134,670	1,226	124,468
400	400.1	1,230	135,900	1,230	125,698
400.1	400.2	1,233	137,132	1,233	126,930
400.2	400.3	1,237	138,369	1,237	128,167
400.3	400.4	1,242	139,611	1,242	129,409
400.4	400.5	1,245	140,856	1,245	130,654
400.5	400.6	1,249	142,105	1,249	131,903
400.6	400.7	1,253	143,358	1,253	133,156
400.7	400.8	1,257	144,615	1,257	134,413
400.8	400.9	1,261	145,876	1,261	135,674
400.9	401	1,264	147,140	1,264	136,938
401	401.1	1,268	148,408	1,268	138,206
401.1	401.2	1,272	149,680	1,272	139,478
401.2	401.3	1,275	150,955	1,275	140,753
401.3	401.4	1,279	152,234	1,279	142,032
401.4	401.5	1,282	153,516	1,282	143,314
401.5	401.6	1,287	154,803	1,287	144,601
401.6	401.7	1,292	156,095	1,292	145,893
401.7	401.8	1,297	157,391	1,297	147,189
401.8	401.9	1,301	158,693	1,301	148,491
401.9	402	1,306	159,999	1,306	149,797
402	402.1	1,310	161,309	1,310	151,107
402.1	402.2	1,314	162,622	1,314	152,421
402.2	402.3	1,317	163,940	1,317	153,738
402.3	402.4	1,321	165,261	1,321	155,059
402.4	402.5	1,325	166,586	1,325	156,384
402.5	402.6	1,328	167,914	1,328	157,712

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
402.6	402.7	1,332	169,246	1,332	159,044
402.7	402.8	1,335	170,581	1,335	160,379
402.8	402.9	1,339	171,920	1,339	161,718
402.9	403	1,342	173,262	1,342	163,060
403	403.1	1,346	174,608	1,346	164,406
403.1	403.2	1,349	175,957	1,349	165,755
403.2	403.3	1,353	177,310	1,353	167,108
403.3	403.4	1,356	178,666	1,356	168,464
403.4	403.5	1,360	180,026	1,360	169,824
403.5	403.6	1,363	181,389	1,363	171,187
403.6	403.7	1,366	182,755	1,366	172,553
403.7	403.8	1,369	184,124	1,369	173,922
403.8	403.9	1,371	185,496	1,371	175,294
403.9	404	1,374	186,869	1,374	176,667
404	404.1	1,376	188,245	1,376	178,043
404.1	404.2	1,379	189,624	1,379	179,422
404.2	404.3	1,381	191,006	1,381	180,804
404.3	404.4	1,384	192,390	1,384	182,188
404.4	404.5	1,388	193,778	1,388	183,576
404.5	404.6	1,391	195,168	1,391	184,966
404.6	404.7	1,394	196,563	1,394	186,361
404.7	404.8	1,398	197,960	1,398	187,758
404.8	404.9	1,401	199,362	1,401	189,160
404.9	405	1,405	200,767	1,405	190,565
405	405.1	1,409	202,176	1,409	191,974
405.1	405.2	1,413	203,589	1,413	193,387
405.2	405.3	1,418	205,007	1,418	194,805
405.3	405.4	1,424	206,431	1,424	196,229
405.4	405.5	1,429	207,859	1,429	197,657
405.5	405.6	1,433	209,293	1,433	199,091
405.6	405.7	1,437	210,730	1,437	200,528
405.7	405.8	1,441	212,172	1,441	201,970
405.8	405.9	1,445	213,617	1,445	203,415
405.9	406	1,449	215,066	1,449	204,864
406	406.1	1,453	216,519	1,453	206,317
406.1	406.2	1,457	217,975	1,457	207,773
406.2	406.3	1,460	219,436	1,460	209,234
406.3	406.4	1,464	220,899	1,464	210,697
406.4	406.5	1,467	222,367	1,467	212,165
406.5	406.6	1,471	223,838	1,471	213,636
406.6	406.7	1,475	225,313	1,475	215,111
406.7	406.8	1,478	226,791	1,478	216,589
406.8	406.9	1,482	228,274	1,482	218,072
406.9	407	1,487	229,760	1,487	219,558
407	407.1	1,490	231,250	1,490	221,048
407.1	407.2	1,494	232,745	1,494	222,543
407.2	407.3	1,498	234,243	1,498	224,041
407.3	407.4	1,502	235,745	1,502	225,543
407.4	407.5	1,506	237,251	1,506	227,049
407.5	407.6	1,510	238,761	1,510	228,559
407.6	407.7	1,514	240,275	1,514	230,073
407.7	407.8	1,519	241,794	1,519	231,592
407.8	407.9	1,524	243,318	1,524	233,116
407.9	408	1,529	244,847	1,529	234,645
408	408.1	1,534	246,381	1,534	236,179
408.1	408.2	1,539	247,920	1,539	237,718
408.2	408.3	1,544	249,464	1,544	239,262
408.3	408.4	1,550	251,014	1,550	240,812

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
408.4	408.5	1,555	252,569	1,555	242,367
408.5	408.6	1,561	254,130	1,561	243,928
408.6	408.7	1,567	255,696	1,567	245,494
408.7	408.8	1,574	257,270	1,574	247,068
408.8	408.9	1,582	258,851	1,582	248,650
408.9	409	1,594	260,445	1,594	250,243
409	409.1	1,617	262,062	1,617	251,860
409.1	409.2	1,648	263,710	1,648	253,508
409.2	409.3	1,695	265,405	1,695	255,203
409.3	409.4	1,742	267,147	1,742	256,945
409.4	409.5	1,787	268,934	1,787	258,732
409.5	409.6	1,825	270,759	1,825	260,557
409.6	409.7	1,846	272,605	1,846	262,403
409.7	409.8	1,857	274,462	1,857	264,260
409.8	409.9	1,868	276,330	1,868	266,128
409.9	410	1,879	278,208	1,879	268,006
410	410.1	1,887	280,096	1,887	269,894
410.1	410.2	1,895	281,991	1,895	271,789
410.2	410.3	1,903	283,893	1,903	273,691
410.3	410.4	1,909	285,802	1,909	275,600
410.4	410.5	1,915	287,717	1,915	277,515
410.5	410.6	1,921	289,639	1,921	279,437
410.6	410.7	1,927	291,566	1,927	281,364
410.7	410.8	1,933	293,498	1,933	283,296
410.8	410.9	1,938	295,436	1,938	285,234
410.9	411	1,942	297,379	1,942	287,177
411	411.1	1,947	299,325	1,947	289,124
411.1	411.2	1,951	301,277	1,951	291,075
411.2	411.3	1,956	303,232	1,956	293,030
411.3	411.4	1,960	305,192	1,960	294,990
411.4	411.5	1,964	307,157	1,964	296,955
411.5	411.6	1,969	309,125	1,969	298,923
411.6	411.7	1,973	311,099	1,973	300,897
411.7	411.8	1,978	313,076	1,978	302,874
411.8	411.9	1,983	315,059	1,983	304,857
411.9	412	1,990	317,049	1,990	306,847
412	412.1	1,998	319,047	1,998	308,845
412.1	412.2	2,003	321,051	2,003	310,849
412.2	412.3	2,008	323,058	2,008	312,856
412.3	412.4	2,012	325,070	2,012	314,868
412.4	412.5	2,016	327,086	2,016	316,884
412.5	412.6	2,020	329,106	2,020	318,904
412.6	412.7	2,024	331,130	2,024	320,928
412.7	412.8	2,028	333,158	2,028	322,956
412.8	412.9	2,032	335,190	2,032	324,988
412.9	413	2,036	337,226	2,036	327,024
413	413.1	2,041	339,267	2,041	329,065
413.1	413.2	2,048	341,315	2,048	331,113
413.2	413.3	2,056	343,371	2,056	333,169
413.3	413.4	2,063	345,434	2,063	335,232
413.4	413.5	2,070	347,504	2,070	337,302
413.5	413.6	2,076	349,580	2,076	339,378
413.6	413.7	2,081	351,662	2,081	341,460
413.7	413.8	2,086	353,748	2,086	343,546
413.8	413.9	2,091	355,838	2,091	345,636
413.9	414	2,095	357,934	2,095	347,732
414	414.1	2,100	360,033	2,100	349,831
414.1	414.2	2,105	362,139	2,105	351,937

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
414.2	414.3	2,111	364,249	2,111	354,047
414.3	414.4	2,116	366,366	2,116	356,164
414.4	414.5	2,123	368,488	2,123	358,286
414.5	414.6	2,128	370,617	2,128	360,415
414.6	414.7	2,134	372,751	2,134	362,549
414.7	414.8	2,140	374,891	2,140	364,689
414.8	414.9	2,145	377,036	2,145	366,834
414.9	415	2,151	379,187	2,151	368,985
415	415.1	2,156	381,342	2,156	371,140
415.1	415.2	2,161	383,503	2,161	373,301
415.2	415.3	2,166	385,669	2,166	375,467
415.3	415.4	2,171	387,840	2,171	377,638
415.4	415.5	2,176	390,015	2,176	379,813
415.5	415.6	2,180	392,195	2,180	381,993
415.6	415.7	2,184	394,379	2,184	384,177
415.7	415.8	2,188	396,567	2,188	386,365
415.8	415.9	2,192	398,759	2,192	388,557
415.9	416	2,195	400,954	2,195	390,752
416	416.1	2,200	403,154	2,200	392,952
416.1	416.2	2,204	405,358	2,204	395,156
416.2	416.3	2,209	407,566	2,209	397,364
416.3	416.4	2,213	409,779	2,213	399,577
416.4	416.5	2,217	411,997	2,217	401,795
416.5	416.6	2,221	414,218	2,221	404,016
416.6	416.7	2,226	416,444	2,226	406,242
416.7	416.8	2,230	418,674	2,230	408,472
416.8	416.9	2,234	420,908	2,234	410,706
416.9	417	2,239	423,147	2,239	412,945
417	417.1	2,243	425,390	2,243	415,188
417.1	417.2	2,248	427,638	2,248	417,436
417.2	417.3	2,253	429,891	2,253	419,689
417.3	417.4	2,257	432,148	2,257	421,946
417.4	417.5	2,262	434,410	2,262	424,208
417.5	417.6	2,266	436,676	2,266	426,474
417.6	417.7	2,271	438,947	2,271	428,745
417.7	417.8	2,275	441,222	2,275	431,020
417.8	417.9	2,280	443,503	2,280	433,301
417.9	418	2,286	445,788	2,286	435,586
418	418.1	2,290	448,079	2,290	437,877
418.1	418.2	2,295	450,374	2,295	440,172
418.2	418.3	2,300	452,674	2,300	442,472
418.3	418.4	2,305	454,979	2,305	444,777
418.4	418.5	2,310	457,289	2,310	447,087
418.5	418.6	2,315	459,604	2,315	449,402
418.6	418.7	2,320	461,924	2,320	451,722
418.7	418.8	2,324	464,248	2,324	454,046
418.8	418.9	2,328	466,577	2,328	456,375
418.9	419	2,332	468,909	2,332	458,707
419	419.1	2,336	471,246	2,336	461,044
419.1	419.2	2,340	473,586	2,340	463,384
419.2	419.3	2,344	475,930	2,344	465,728
419.3	419.4	2,348	478,278	2,348	468,076
419.4	419.5	2,352	480,630	2,352	470,428
419.5	419.6	2,356	482,986	2,356	472,784
419.6	419.7	2,360	485,347	2,360	475,145
419.7	419.8	2,365	487,711	2,365	477,509
419.8	419.9	2,369	490,080	2,369	479,878
419.9	420	2,373	492,453	2,373	482,251

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
420	420.1	2,378	494,830	2,378	484,628
420.1	420.2	2,383	497,213	2,383	487,011
420.2	420.3	2,390	499,603	2,390	489,401
420.3	420.4	2,399	502,002	2,399	491,800
420.4	420.5	2,412	504,414	2,412	494,212
420.5	420.6	2,424	506,838	2,424	496,636
420.6	420.7	2,437	509,275	2,437	499,073
420.7	420.8	2,450	511,725	2,450	501,523
420.8	420.9	2,466	514,191	2,466	503,989
420.9	421	2,488	516,679	2,488	506,477
421	421.1	2,513	519,192	2,513	508,990
421.1	421.2	2,543	521,735	2,543	511,533
421.2	421.3	2,570	524,305	2,570	514,103
421.3	421.4	2,594	526,899	2,594	516,697
421.4	421.5	2,611	529,511	2,611	519,309
421.5	421.6	2,630	532,140	2,630	521,938
421.6	421.7	2,647	534,788	2,647	524,586
421.7	421.8	2,661	537,448	2,661	527,247
421.8	421.9	2,670	540,119	2,670	529,917
421.9	422	2,677	542,796	2,677	532,594
422	422.1	2,684	545,480	2,684	535,278
422.1	422.2	2,690	548,169	2,690	537,967
422.2	422.3	2,695	550,865	2,695	540,663
422.3	422.4	2,701	553,565	2,701	543,363
422.4	422.5	2,706	556,271	2,706	546,069
422.5	422.6	2,710	558,981	2,710	548,779
422.6	422.7	2,715	561,696	2,715	551,494
422.7	422.8	2,720	564,416	2,720	554,214
422.8	422.9	2,725	567,141	2,725	556,939
422.9	423	2,730	569,871	2,730	559,669
423	423.1	2,735	572,606	2,735	562,404
423.1	423.2	2,740	575,346	2,740	565,144
423.2	423.3	2,745	578,091	2,745	567,889
423.3	423.4	2,750	580,841	2,750	570,639
423.4	423.5	2,755	583,596	2,755	573,394
423.5	423.6	2,759	586,355	2,759	576,153
423.6	423.7	2,764	589,119	2,764	578,917
423.7	423.8	2,769	591,888	2,769	581,686
423.8	423.9	2,773	594,661	2,773	584,460
423.9	424	2,778	597,440	2,778	587,238
424	424.1	2,783	600,223	2,783	590,021
424.1	424.2	2,788	603,011	2,788	592,809
424.2	424.3	2,793	605,803	2,793	595,601
424.3	424.4	2,798	608,601	2,798	598,399
424.4	424.5	2,803	611,404	2,803	601,202
424.5	424.6	2,808	614,213	2,808	604,011
424.6	424.7	2,814	617,026	2,814	606,825
424.7	424.8	2,820	619,846	2,820	609,644
424.8	424.9	2,825	622,671	2,825	612,469
424.9	425	2,831	625,502	2,831	615,300
425	425.1	2,836	628,339	2,836	618,137
425.1	425.2	2,841	631,180	2,841	620,978
425.2	425.3	2,846	634,027	2,846	623,825
425.3	425.4	2,851	636,878	2,851	626,676
425.4	425.5	2,856	639,734	2,856	629,532
425.5	425.6	2,861	642,596	2,861	632,394
425.6	425.7	2,866	645,462	2,866	635,260
425.7	425.8	2,871	648,333	2,871	638,131

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
425.8	425.9	2,876	651,210	2,876	641,008
425.9	426	2,881	654,091	2,881	643,889
426	426.1	2,886	656,977	2,886	646,775
426.1	426.2	2,891	659,868	2,891	649,666
426.2	426.3	2,896	662,764	2,896	652,562
426.3	426.4	2,901	665,665	2,901	655,463
426.4	426.5	2,905	668,570	2,905	658,368
426.5	426.6	2,910	671,480	2,910	661,278
426.6	426.7	2,915	674,395	2,915	664,193
426.7	426.8	2,919	677,314	2,919	667,112
426.8	426.9	2,923	680,237	2,923	670,035
426.9	427	2,928	683,165	2,928	672,963
427	427.1	2,933	686,097	2,933	675,895
427.1	427.2	2,937	689,035	2,937	678,833
427.2	427.3	2,942	691,977	2,942	681,775
427.3	427.4	2,947	694,924	2,947	684,722
427.4	427.5	2,952	697,876	2,952	687,674
427.5	427.6	2,957	700,833	2,957	690,631
427.6	427.7	2,962	703,795	2,962	693,593
427.7	427.8	2,968	706,763	2,968	696,561
427.8	427.9	2,973	709,736	2,973	699,534
427.9	428	2,978	712,713	2,978	702,511
428	428.1	2,982	715,695	2,982	705,493
428.1	428.2	2,987	718,682	2,987	708,480
428.2	428.3	2,991	721,673	2,991	711,471
428.3	428.4	2,996	724,669	2,996	714,467
428.4	428.5	3,000	727,669	3,000	717,467
428.5	428.6	3,005	730,674	3,005	720,472
428.6	428.7	3,010	733,684	3,010	723,482
428.7	428.8	3,017	736,701	3,017	726,499
428.8	428.9	3,023	739,724	3,023	729,522
428.9	429	3,029	742,753	3,029	732,551
429	429.1	3,035	745,788	3,035	735,586
429.1	429.2	3,040	748,829	3,040	738,627
429.2	429.3	3,046	751,875	3,046	741,673
429.3	429.4	3,051	754,926	3,051	744,724
429.4	429.5	3,057	757,983	3,057	747,781
429.5	429.6	3,062	761,045	3,062	750,843
429.6	429.7	3,067	764,112	3,067	753,910
429.7	429.8	3,072	767,184	3,072	756,982
429.8	429.9	3,078	770,263	3,078	760,061
429.9	430	3,087	773,349	3,087	763,147
430	430.1	3,094	776,444	3,094	766,242
430.1	430.2	3,101	779,545	3,101	769,343
430.2	430.3	3,111	782,656	3,111	772,454
430.3	430.4	3,125	785,781	3,125	775,579
430.4	430.5	3,134	788,914	3,134	778,712
430.5	430.6	3,140	792,054	3,140	781,852
430.6	430.7	3,146	795,200	3,146	784,998
430.7	430.8	3,151	798,351	3,151	788,149
430.8	430.9	3,155	801,506	3,155	791,304
430.9	431	3,160	804,666	3,160	794,464
431	431.1	3,164	807,830	3,164	797,628
431.1	431.2	3,168	810,998	3,168	800,796
431.2	431.3	3,173	814,171	3,173	803,969
431.3	431.4	3,177	817,348	3,177	807,146
431.4	431.5	3,182	820,531	3,182	810,329
431.5	431.6	3,188	823,719	3,188	813,517

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
431.6	431.7	3,195	826,914	3,195	816,712
431.7	431.8	3,202	830,116	3,202	819,914
431.8	431.9	3,207	833,323	3,207	823,121
431.9	432	3,211	836,534	3,211	826,332
432	432.1	3,215	839,749	3,215	829,547
432.1	432.2	3,219	842,968	3,219	832,766
432.2	432.3	3,223	846,192	3,223	835,990
432.3	432.4	3,228	849,419	3,228	839,217
432.4	432.5	3,232	852,651	3,232	842,449
432.5	432.6	3,236	855,887	3,236	845,685
432.6	432.7	3,240	859,127	3,240	848,925
432.7	432.8	3,244	862,371	3,244	852,170
432.8	432.9	3,249	865,620	3,249	855,418
432.9	433	3,256	868,876	3,256	858,674
433	433.1	3,264	872,140	3,264	861,938
433.1	433.2	3,270	875,410	3,270	865,208
433.2	433.3	3,275	878,685	3,275	868,483
433.3	433.4	3,281	881,966	3,281	871,764
433.4	433.5	3,287	885,254	3,287	875,052
433.5	433.6	3,297	888,551	3,297	878,349
433.6	433.7	3,311	891,862	3,311	881,660
433.7	433.8	3,325	895,187	3,325	884,985
433.8	433.9	3,343	898,529	3,343	888,327
433.9	434	3,365	901,894	3,365	891,692
434	434.1	3,386	905,280	3,386	895,078
434.1	434.2	3,404	908,683	3,404	898,481
434.2	434.3	3,421	912,104	3,421	901,902
434.3	434.4	3,435	915,539	3,435	905,337
434.4	434.5	3,451	918,990	3,451	908,788
434.5	434.6	3,470	922,461	3,470	912,259
434.6	434.7	3,490	925,951	3,490	915,749
434.7	434.8	3,504	929,455	3,504	919,253
434.8	434.9	3,517	932,972	3,517	922,770
434.9	435	3,529	936,501	3,529	926,299
435	435.1	3,540	940,041	3,540	929,839
435.1	435.2	3,549	943,590	3,549	933,388
435.2	435.3	3,558	947,148	3,558	936,946
435.3	435.4	3,565	950,713	3,565	940,511
435.4	435.5	3,571	954,284	3,571	944,082
435.5	435.6	3,579	957,863	3,579	947,661
435.6	435.7	3,589	961,452	3,589	951,250
435.7	435.8	3,597	965,049	3,597	954,847
435.8	435.9	3,603	968,652	3,603	958,450
435.9	436	3,609	972,261	3,609	962,059
436	436.1	3,615	975,877	3,615	965,675
436.1	436.2	3,621	979,497	3,621	969,295
436.2	436.3	3,626	983,124	3,626	972,922
436.3	436.4	3,631	986,755	3,631	976,553
436.4	436.5	3,637	990,392	3,637	980,190
436.5	436.6	3,644	994,036	3,644	983,834
436.6	436.7	3,650	997,687	3,650	987,485
436.7	436.8	3,655	1,001,342	3,655	991,140
436.8	436.9	3,660	1,005,002	3,660	994,800
436.9	437	3,665	1,008,666	3,665	998,464
437	437.1	3,669	1,012,335	3,669	1,002,133
437.1	437.2	3,674	1,016,009	3,674	1,005,807
437.2	437.3	3,678	1,019,687	3,678	1,009,485
437.3	437.4	3,682	1,023,369	3,682	1,013,167

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
437.4	437.5	3,687	1,027,056	3,687	1,016,854
437.5	437.6	3,691	1,030,747	3,691	1,020,545
437.6	437.7	3,696	1,034,443	3,696	1,024,241
437.7	437.8	3,700	1,038,143	3,700	1,027,941
437.8	437.9	3,705	1,041,848	3,705	1,031,646
437.9	438	3,709	1,045,557	3,709	1,035,355
438	438.1	3,714	1,049,270	3,714	1,039,068
438.1	438.2	3,718	1,052,988	3,718	1,042,786
438.2	438.3	3,722	1,056,711	3,722	1,046,509
438.3	438.4	3,727	1,060,438	3,727	1,050,236
438.4	438.5	3,731	1,064,169	3,731	1,053,967
438.5	438.6	3,736	1,067,905	3,736	1,057,703
438.6	438.7	3,741	1,071,646	3,741	1,061,444
438.7	438.8	3,746	1,075,392	3,746	1,065,190
438.8	438.9	3,751	1,079,142	3,751	1,068,941
438.9	439	3,756	1,082,898	3,756	1,072,696
439	439.1	3,761	1,086,659	3,761	1,076,457
439.1	439.2	3,766	1,090,425	3,766	1,080,223
439.2	439.3	3,771	1,094,196	3,771	1,083,994
439.3	439.4	3,776	1,097,972	3,776	1,087,770
439.4	439.5	3,781	1,101,753	3,781	1,091,551
439.5	439.6	3,786	1,105,539	3,786	1,095,337
439.6	439.7	3,791	1,109,330	3,791	1,099,128
439.7	439.8	3,795	1,113,125	3,795	1,102,923
439.8	439.9	3,799	1,116,924	3,799	1,106,722
439.9	440	3,804	1,120,728	3,804	1,110,526
440	440.1	3,808	1,124,536	3,808	1,114,334
440.1	440.2	3,813	1,128,349	3,813	1,118,147
440.2	440.3	3,817	1,132,166	3,817	1,121,964
440.3	440.4	3,822	1,135,988	3,822	1,125,786
440.4	440.5	3,827	1,139,814	3,827	1,129,612
440.5	440.6	3,831	1,143,646	3,831	1,133,444
440.6	440.7	3,837	1,147,482	3,837	1,137,280
440.7	440.8	3,842	1,151,324	3,842	1,141,122
440.8	440.9	3,847	1,155,172	3,847	1,144,970
440.9	441	3,853	1,159,025	3,853	1,148,823
441	441.1	3,859	1,162,884	3,859	1,152,682
441.1	441.2	3,864	1,166,747	3,864	1,156,545
441.2	441.3	3,868	1,170,616	3,868	1,160,414
441.3	441.4	3,873	1,174,489	3,873	1,164,287
441.4	441.5	3,878	1,178,367	3,878	1,168,165
441.5	441.6	3,883	1,182,249	3,883	1,172,047
441.6	441.7	3,887	1,186,137	3,887	1,175,935
441.7	441.8	3,892	1,190,029	3,892	1,179,827
441.8	441.9	3,897	1,193,926	3,897	1,183,724
441.9	442	3,902	1,197,828	3,902	1,187,626
442	442.1	3,907	1,201,735	3,907	1,191,533
442.1	442.2	3,911	1,205,646	3,911	1,195,444
442.2	442.3	3,916	1,209,562	3,916	1,199,360
442.3	442.4	3,921	1,213,482	3,921	1,203,281
442.4	442.5	3,925	1,217,408	3,925	1,207,206
442.5	442.6	3,930	1,221,337	3,930	1,211,135
442.6	442.7	3,934	1,225,272	3,934	1,215,070
442.7	442.8	3,939	1,229,211	3,939	1,219,009
442.8	442.9	3,943	1,233,154	3,943	1,222,952
442.9	443	3,948	1,237,102	3,948	1,226,900
443	443.1	3,952	1,241,054	3,952	1,230,852
443.1	443.2	3,956	1,245,010	3,956	1,234,808

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
443.2	443.3	3,960	1,248,970	3,960	1,238,768
443.3	443.4	3,964	1,252,935	3,964	1,242,733
443.4	443.5	3,969	1,256,903	3,969	1,246,701
443.5	443.6	3,973	1,260,876	3,973	1,250,674
443.6	443.7	3,977	1,264,853	3,977	1,254,651
443.7	443.8	3,981	1,268,835	3,981	1,258,633
443.8	443.9	3,986	1,272,821	3,986	1,262,619
443.9	444	3,992	1,276,813	3,992	1,266,611
444	444.1	3,997	1,280,810	3,997	1,270,608
444.1	444.2	4,001	1,284,811	4,001	1,274,609
444.2	444.3	4,005	1,288,817	4,005	1,278,615
444.3	444.4	4,009	1,292,826	4,009	1,282,624
444.4	444.5	4,013	1,296,839	4,013	1,286,637
444.5	444.6	4,017	1,300,857	4,017	1,290,655
444.6	444.7	4,021	1,304,878	4,021	1,294,676
444.7	444.8	4,025	1,308,904	4,025	1,298,702
444.8	444.9	4,030	1,312,933	4,030	1,302,731
444.9	445	4,034	1,316,967	4,034	1,306,765
445	445.1	4,038	1,321,006	4,038	1,310,804
445.1	445.2	4,043	1,325,048	4,043	1,314,846
445.2	445.3	4,047	1,329,096	4,047	1,318,894
445.3	445.4	4,054	1,333,149	4,054	1,322,948
445.4	445.5	4,060	1,337,209	4,060	1,327,007
445.5	445.6	4,064	1,341,274	4,064	1,331,072
445.6	445.7	4,069	1,345,343	4,069	1,335,141
445.7	445.8	4,074	1,349,416	4,074	1,339,214
445.8	445.9	4,078	1,353,495	4,078	1,343,293
445.9	446	4,083	1,357,578	4,083	1,347,376
446	446.1	4,088	1,361,665	4,088	1,351,463
446.1	446.2	4,092	1,365,757	4,092	1,355,556
446.2	446.3	4,098	1,369,855	4,098	1,359,653
446.3	446.4	4,103	1,373,958	4,103	1,363,756
446.4	446.5	4,108	1,378,067	4,108	1,367,865
446.5	446.6	4,113	1,382,180	4,113	1,371,978
446.6	446.7	4,118	1,386,298	4,118	1,376,096
446.7	446.8	4,124	1,390,421	4,124	1,380,219
446.8	446.9	4,130	1,394,551	4,130	1,384,349
446.9	447	4,141	1,398,693	4,141	1,388,491
447	447.1	4,159	1,402,852	4,159	1,392,650
447.1	447.2	4,182	1,407,034	4,182	1,396,832
447.2	447.3	4,202	1,411,236	4,202	1,401,034
447.3	447.4	4,217	1,415,453	4,217	1,405,251
447.4	447.5	4,232	1,419,685	4,232	1,409,483
447.5	447.6	4,247	1,423,931	4,247	1,413,729
447.6	447.7	4,265	1,428,196	4,265	1,417,994
447.7	447.8	4,284	1,432,480	4,284	1,422,278
447.8	447.9	4,303	1,436,782	4,303	1,426,580
447.9	448	4,320	1,441,102	4,320	1,430,901
448	448.1	4,336	1,445,439	4,336	1,435,237
448.1	448.2	4,351	1,449,790	4,351	1,439,588
448.2	448.3	4,368	1,454,158	4,368	1,443,956
448.3	448.4	4,389	1,458,547	4,389	1,448,345
448.4	448.5	4,411	1,462,958	4,411	1,452,756
448.5	448.6	4,437	1,467,395	4,437	1,457,193
448.6	448.7	4,461	1,471,857	4,461	1,461,655
448.7	448.8	4,483	1,476,340	4,483	1,466,138
448.8	448.9	4,504	1,480,844	4,504	1,470,642
448.9	449	4,522	1,485,366	4,522	1,475,164

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
449	449.1	4,540	1,489,906	4,540	1,479,704
449.1	449.2	4,557	1,494,463	4,557	1,484,261
449.2	449.3	4,578	1,499,040	4,578	1,488,838
449.3	449.4	4,601	1,503,641	4,601	1,493,439
449.4	449.5	4,632	1,508,273	4,632	1,498,071
449.5	449.6	4,672	1,512,946	4,672	1,502,744
449.6	449.7	4,702	1,517,648	4,702	1,507,446
449.7	449.8	4,729	1,522,377	4,729	1,512,175
449.8	449.9	4,756	1,527,133	4,756	1,516,931
449.9	450	4,784	1,531,917	4,784	1,521,715
450	450.1	4,813	1,536,731	4,813	1,526,529
450.1	450.2	4,853	1,541,583	4,853	1,531,382
450.2	450.3	4,880	1,546,464	4,880	1,536,262
450.3	450.4	4,903	1,551,367	4,903	1,541,165
450.4	450.5	4,923	1,556,290	4,923	1,546,088
450.5	450.6	4,940	1,561,230	4,940	1,551,028
450.6	450.7	4,956	1,566,186	4,956	1,555,984
450.7	450.8	4,972	1,571,158	4,972	1,560,956
450.8	450.9	4,988	1,576,146	4,988	1,565,944
450.9	451	5,004	1,581,150	5,004	1,570,948
451	451.1	5,021	1,586,170	5,021	1,575,968
451.1	451.2	5,040	1,591,210	5,040	1,581,008
451.2	451.3	5,061	1,596,271	5,061	1,586,069
451.3	451.4	5,084	1,601,355	5,084	1,591,153
451.4	451.5	5,108	1,606,463	5,108	1,596,261
451.5	451.6	5,130	1,611,593	5,130	1,601,391
451.6	451.7	5,140	1,616,733	5,140	1,606,531
451.7	451.8	5,133	1,621,865	5,133	1,611,663
451.8	451.9	5,130	1,626,995	5,130	1,616,793
451.9	452	5,123	1,632,119	5,123	1,621,917
452	452.1	5,094	1,637,212	5,094	1,627,011
452.1	452.2	4,902	1,642,115	4,902	1,631,913
452.2	452.3	4,714	1,646,829	4,714	1,636,627
452.3	452.4	4,437	1,651,265	4,437	1,641,063
452.4	452.5	4,089	1,655,355	4,089	1,645,153
452.5	452.6	3,823	1,659,178	3,823	1,648,976
452.6	452.7	3,587	1,662,765	3,587	1,652,563
452.7	452.8	3,288	1,666,053	3,288	1,655,851
452.8	452.9	3,062	1,669,115	3,062	1,658,913
452.9	453	2,865	1,671,980	2,865	1,661,778
453	453.1	2,682	1,674,663	2,682	1,664,461
453.1	453.2	2,520	1,677,183	2,520	1,666,981
453.2	453.3	2,376	1,679,558	2,376	1,669,356
453.3	453.4	2,234	1,681,792	2,234	1,671,590
453.4	453.5	2,085	1,683,877	2,085	1,673,675
453.5	453.6	1,930	1,685,808	1,930	1,675,606
453.6	453.7	1,773	1,687,581	1,773	1,677,379
453.7	453.8	1,610	1,689,191	1,610	1,678,989
453.8	453.9	1,457	1,690,648	1,457	1,680,446
453.9	454	1,284	1,691,932	1,284	1,681,730
454	454.1	1,124	1,693,056	1,124	1,682,854
454.1	454.2	1,004	1,694,060	1,004	1,683,858
454.2	454.3	919	1,694,980	919	1,684,778
454.3	454.4	840	1,695,820	840	1,685,618
454.4	454.5	752	1,696,572	752	1,686,370
454.5	454.6	638	1,697,210	638	1,687,008
454.6	454.7	529	1,697,738	529	1,687,536
454.7	454.8	447	1,698,185	447	1,687,983

From	To	Pit Volume without Overburden Cap (m^3)	Cum Pit Volume without Overburden Cap (m^3)	Pit Volume with Overburden Cap (m^3)	Cum Pit Volume with Overburden Cap (m^3)
454.8	454.9	384	1,698,569	384	1,688,367
454.9	455	337	1,698,907	337	1,688,705
455	455.1	309	1,699,216	309	1,689,014
455.1	455.2	291	1,699,507	291	1,689,305
455.2	455.3	278	1,699,785	278	1,689,583
455.3	455.4	269	1,700,054	269	1,689,852
455.4	455.5	262	1,700,316	262	1,690,114
455.5	455.6	254	1,700,570	254	1,690,368
455.6	455.7	248	1,700,818	248	1,690,616
455.7	455.8	242	1,701,060	242	1,690,858
455.8	455.9	236	1,701,296	236	1,691,094
455.9	456	230	1,701,525	230	1,691,323
456	456.1	220	1,701,746	220	1,691,544
456.1	456.2	205	1,701,951	205	1,691,749
456.2	456.3	183	1,702,134	183	1,691,932
456.3	456.4	149	1,702,283	149	1,692,081
456.4	456.5	118	1,702,401	118	1,692,199
456.5	456.6	87	1,702,487	87	1,692,286
456.6	456.7	69	1,702,557	69	1,692,355
456.7	456.8	55	1,702,612	55	1,692,410
456.8	456.9	40	1,702,652	40	1,692,450
456.9	457	30	1,702,682	30	1,692,480
457	457.1	24	1,702,707	24	1,692,505
457.1	457.2	20	1,702,726	20	1,692,525
457.2	457.3	16	1,702,743	16	1,692,541
457.3	457.4	13	1,702,755	13	1,692,554
457.4	457.5	10	1,702,765	10	1,692,563
457.5	457.6	7	1,702,773	7	1,692,571
457.6	457.7	6	1,702,778	6	1,692,576
457.7	457.8	4	1,702,782	4	1,692,580
457.8	457.9	3	1,702,785	3	1,692,583
457.9	458	2	1,702,788	2	1,692,586
458	458.1	2	1,702,790	2	1,692,588
458.1	458.2	1	1,702,791	1	1,692,589
458.2	458.3	1	1,702,792	1	1,692,590
458.3	458.4	1	1,702,793	1	1,692,591
458.4	458.5	0	1,702,793	0	1,692,591
458.5	458.6	0	1,702,793	0	1,692,591
458.6	458.7	0	1,702,793	0	1,692,592
458.7	458.8	0	1,702,794	0	1,692,592
458.8	458.9	0	1,702,794	0	1,692,592
458.9	459	0	1,702,794	0	1,692,592