Updated Phase II Environmental Site Assessment

Gold Brook Lake and Seal Harbour Mine Site

Build Nova Scotia.

60680068

November 2023

Delivering a better world

AECOM Canada Ltd.
1701 Hollis Street
SH400 (PO Box 576 CRO)
Halifax, NS B3J 3M8
Canada

T: 902.428.2021
F: 902.334.4140
www.aecom.com

November 8, 2023

Cory MacPhee, P.Eng.
Project Manager
Build Nova Scotia
45 Wabana Court
Sydney, NS

Project #
60680068

Subject: Updated Phase II Environmental Site Assessment – Gold Brook Lake and Seal Harbour Mine Site

Dear Mr. MacPhee:

AECOM Canada Ltd. (AECOM) is pleased to present this Updated Phase II Environmental Site Assessment (ESA) Report associated with the Gold Brook Lake and Seal Harbour Mine Sites, located in Goldboro, Nova Scotia to Build Nova Scotia (BNS).

If you have any questions about the information presented within this report, please do not hesitate to contact me directly.

Sincerely,

AECOM Canada Ltd.

Rory McNeil
P.Eng. Project Manager
rory.mcneil@aecom.com

Encl.

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("AECOM") for the benefit of the Client ("Client") in accordance with the agreement between AECOM and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- represents AECOM's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.

AECOM shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. AECOM accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

AECOM agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but AECOM makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

Without in any way limiting the generality of the foregoing, any estimates or opinions regarding probable construction costs or construction schedule provided by AECOM represent AECOM's professional judgement in light of its experience and the knowledge and information available to it at the time of preparation. Since AECOM has no control over market or economic conditions, prices for construction labour, equipment or materials or bidding procedures, AECOM, its directors, officers and employees are not able to, nor do they, make any representations, warranties or guarantees whatsoever, whether express or implied, with respect to such estimates or opinions, or their variance from actual construction costs or schedules, and accept no responsibility for any loss or damage arising therefrom or in any way related thereto. Persons relying on such estimates or opinions do so at their own risk.

Except (1) as agreed to in writing by AECOM and Client; (2) as required by-law; or (3) to the extent used by governmental reviewing agencies for the purpose of obtaining permits or approvals, the Report and the Information may be used and relied upon only by Client.

AECOM accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of AECOM to use and rely upon the Report and the Information. Any injury, loss or damages arising from improper use of the Report shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

AECOM: 2015-04-13

Quality Information

Prepared by

Janice Shea, P.Eng.

Prepared by

Mary Ellen Starodub

Digitally signed by Mary Ellen Starodub
DN: cn=Mary Ellen Starodub, c=CA, o=AECOM Canada Ltd., ou=Environment, email=maryellen.starodub@aecom.com
Date: 2023.11.09 09:19:37 -05'00'

Mary Ellen Starodub, M.Sc., QPRA.

Checked by

Michael Sanborn, Senior Risk Assessor

Checked by

Rob McCullough, Senior Technical Lead

Verified by

Derek Heath, P.Geo.

Approved by

Rory McNeil, P.Eng.

Revision History

Rev #	Revision Date	Revised By:	Revision Description
01	2023/04/25	DH	Incorporated BNS' comments from Draft Report
02	2023/11/07	DH	Final Report

Distribution List

# Hard Copies	PDF Required	Association / Company Name
	✓	Build Nova Scotia
	✓	AECOM Canada Ltd.

Prepared for:

Build Nova Scotia
45 Wabana Court
Sydney, NS

Prepared by:

AECOM Canada Ltd.
1701 Hollis Street
SH400 (PO Box 576 CRO)
Halifax, NS B3J 3M8
Canada

T: 902.428.2021
F: 902.334.4140
www.aecom.com

Executive Summary

AECOM Canada Ltd. (AECOM) was retained by Build Nova Scotia (BNS), formally known as Nova Scotia Lands Inc. (NSLI), to complete a Phase II Environmental Site Assessment (ESA) for the Gold Brook Lake and Seal Harbour Mine Sites located in Goldboro, Nova Scotia (associated Parcel Identifier Number (PID): 35094366). As requested by BNS, the area of focus for the Phase II ESA is limited to the historic mining Crown land area within the PID 35094366 (hereafter referred to as the "Site").

The specific objectives of the current report are to:

- Provide an update to the AECOM (2022) Phase II ESA, incorporating newly acquired site specific groundwater, surface water, sediment, and interstitial porewater quality data collected in January, 2023.
- Develop the preliminary problem formulation and identify high-priority data needs in support of a future quantitative HHERA.
- Provide a high-level description of proposed soil and surface water background sampling to be completed at a later date.
- Provide a high-level description of proposed aquatic food-web tissue sampling to be completed at a later date.

The findings and conclusions presented in this report apply only to environmental conditions assessed at the Site. The table below summarizes the findings related to soil, tailings, waste rock, groundwater, surface water, sediment, and porewater investigations completed as part of the scope of work for this Phase II ESA. The maximum parameter concentration for each sampling media is presented in the table below.

Media	Phase II ESA Findings – Maximum Concentration Exceedances to NSE Tier I EQS
Soil	- Aluminum: 20,000 mg/kg - Antimony: 40 mg/kg - Arsenic: 50,000 mg/kg - Beryllium: 1.5 mg/kg - Cadmium: 1.9 mg/kg - Iron: 70,000 mg/kg - Lead: 320 mg/kg - Manganese: 2,000 mg/kg - Mercury: 73 mg/kg - Selenium: 2.5 mg/kg - Thallium: 2.9 mg/kg - Vanadium: 41 mg/kg - Zinc: 850 mg/kg
Tailings	- Antimony: 19 mg/kg - Arsenic: 29,000 mg/kg - Iron: 35,000 mg/kg - Lead: 200 mg/kg - Mercury: 73 mg/kg - Selenium: 1.4 mg/kg
Waste Rock	Detectable concentrations of aluminum, arsenic, barium, chromium, iron, lead and manganese, nickel, vanadium and zinc are present in waste rock samples collected from the Site.
Groundwater	- Aluminum: 270 ug/L - Arsenic: 150 ug/L - Iron: 8,800 ug/L - Manganese: 350 ug/L
Surface Water	- Aluminum: 2,100 µg/L - Arsenic: 7,800 µg/L - Boron: 3,600 µg/L - Cobalt: 3.3 µg/L

Media	Phase II ESA Findings – Maximum Concentration Exceedances to NSE Tier I EQS
	- Copper: 2.8 µg/L - Iron: 18,000 µg/L - Lead: 9.4 µg/L - Manganese: 750 µg/L - Mercury: 0.09 µg/L - Zinc: 16 µg/L - pH: 4.24
Sediment	- Antimony: 34 mg/kg - Arsenic: 160,000 mg/kg - Iron: 230,000 mg/kg - Lead: 270 mg/kg - Manganese: 5,200 mg/kg - Mercury: 68 mg/kg - Nickel: 91 mg/kg - Silver: 4 mg/kg - Zinc: 370 mg/kg
Porewater	- Aluminum: 170,000 µg/L - Antimony: 24 µg/L - Arsenic: 65,000 µg/L - Barium: 1,700 µg/L - Beryllium: 14 µg/L - Boron: 3,100 µg/L - Cadmium: 5.7 µg/L - Chromium: 230 µg/L - Cobalt: 270 µg/L - Copper: 360 µg/L - Iron: 1,100,000 µg/L - Lead: 1,700 µg/L - Manganese: 14,000 µg/L - Mercury: 14 µg/L - Nickel: 730 µg/L - Silver: 1.9 µg/L - Thallium: 3.1 µg/L - Uranium: 11 µg/L - Vanadium: 220 µg/L - Zinc: 10,000 µg/L - pH: 5.1

Note: The data included in this table is based exclusively to AECOM findings. Any additional data previously collected by others is not included in this table.

The vertical and horizontal extent of soil and groundwater contamination has not yet been determined. Additional work will need to be completed to determine this information.

A conceptual site model developed for the Gold Brook Lake and Seal Harbour Mine Site identifies the disposition of tailings and waste rock as well as fugitive particulate deposition associated with the historic mining activities are the original sources of the potential contaminants of concern (PCOC). The Phase II ESA identified thirteen (13) metals measured in soil exceeding the Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS).

Arsenic and mercury are well known toxic contaminants of concern associated with emissions and wastes released to the environment from historic mineral processing and gold extraction, including waste rock and tailings. At the outset of this project arsenic and mercury have been identified as COCs of primary concern and the focus of this investigation. Other potential COCs (PCOCs) identified through the soil screening evaluation are discussed in the following section.

- Arsenic - in excess of the NSE Tier1 EQS of 10 mg/kg for 96% of the samples analysed (44/46); and
- Mercury - in excess of the NSE Tier1 EQS of 6.6 mg/kg for 24% of the samples analysed (11/46)

Additionally, eleven (11) potential COCs (PCOCs) for further consideration for SSRA are identified based on the screening evaluation against the NSE Tier 1 EQS for metals of the available analytical data for soil tailings samples collected from areas impacted by historic mining activities at the Gold Brook Lake and Seal Harbour Mine Site specifically,

- Aluminum, antimony, beryllium, cadmium, iron, lead, manganese, selenium, thallium, vanadium and zinc.

Potential exposure pathways to the above noted COCs and PCOCs for human health and ecological receptors are as follows:

1. Soil Contact / Ingestion: Tailings and waste rock are located on-site and there are currently no barriers (i.e., fencing, asphalt, etc.) to protect human or ecological receptors from coming into contact with the impacted areas. Therefore, the soil contact / ingestion pathway is considered to be operable. For off-site human receptors the nearest residential property for Gold Brook Lake Site is about 400 m and for Seal Harbour Site the nearest residential property is about 30 m to 40 m surrounded by the study area. Therefore, for the nearest sensitive off-site residential receptor direct contact with impacted soil off-site associated with historic activities is considered possible unless data are available to show otherwise.
2. Leaching to Potable Water: Based on the results of the Phase I ESA (AECOM, 2022), it was determined that water wells are present within 250 m of the Site. Therefore, the leaching to potable water pathway is considered to be operable.
3. Inhalation of Indoor Air/Dust: The Inhalation of indoor air/vapour migration to indoor air pathway is considered to be not operable since the COCs in weathered tailings are not volatile. Potential for exposure to airborne particulates and dust indoors associated with bare tailings is considered operable, unless proven otherwise.
4. Inhalation of Outdoor Air: The tailings solids are relatively fine grained and are subject to dusting that can be carried with ground-level winds and dispersed along the direction of the prevailing winds. Therefore, the inhalation of outdoor air pathway is considered to be operable.
5. Leaching and Migrating to Off-Site Surface Water: Tailings deposits and associated surface water runoff have been observed on-Site to be leading into Gold Brook Lake, as well as West Brook which leads into Seal Harbour. Impacts are above the groundwater table, and leaching (from precipitation) to groundwater, and then migrating to surface water. Therefore, the leaching and migrating to off-site surface water pathway is considered to be operable.

The table below provides a summary of the recommended additional field programs recommended for the Site.

Summary of Recommended Additional Field Programs

Environmental Concern	Recommended Additional Field Programs
Waste Rock and Tailings	■ Review and tabulation of historical data ■ Additional geochemical sampling program ■ Additional delineation program ■ Future GPR study of waste rock piles
Impacted Soils	■ Additional soil delineation ■ Additional background soil sampling
Terrestrial Environment	■ Plant survey and plant tissue sampling
Impacted Surface Water and Porewater	■ Aquatic tissue sampling ■ Continued surface water and porewater sampling along with additional background sampling
Impacted Sediment	■ Additional sediment delineation ■ Additional background sediment sampling
Impacted Groundwater	■ Review and tabulation of historical data ■ Installation of additional wells ■ Continued groundwater sampling
Surface Debris	■ A detailed survey of the material including identifying hazardous waste should be completed

It is also recommended that historical reports presented within the report that contain geochemical and/or biological analytical data should be further reviewed and pertinent analytical data should be tabulated for potential use in the future for delineation and/or risk assessment purposes.

Table of Contents

Tables

Figures

Appendices

1. Introduction

AECOM Canada Ltd. (AECOM) was retained by Build Nova Scotia (BNS), formally known as Nova Scotia Lands Inc. (NSLI), to complete a Phase II Environmental Site Assessment (ESA) for the Gold Brook Lake and Seal Harbour Mine Sites located in Goldboro, Nova Scotia (associated Parcel Identifier Number (PID): 35094366). The general location of the property is shown on **Figure 1A (Gold Brook Lake)** and **1B (Seal Harbour)**, **Appendix A**. As requested by BNS, the area of focus for the Phase II ESA is limited to the historic mining Crown land area within the PID 35094366 (hereafter referred to as the "Site"). The approximate property boundary associated with Property Online for PID 35094366, as well as the Phase II ESA area of focus is presented on **Figure 2A (Gold book Lake)** and **2B (Seal Harbour)**, **Appendix A**. Site features, including waste rock, tailings, and former mining infrastructure, are presented on **Figure 3A (Gold Brook Lake)** and **3B (Seal Harbour)**, **Appendix A**.

Subsequent to completion of the Phase II ESA (AECOM 2022), a memo was submitted to BNS in January 2023 with an overview of the proposed additional work. BNS requested that additional investigations be carried out at the Site to:

1. Assess variability and seasonal differences in groundwater, surface water, porewater, and sediment quality;
2. Assess sediment and surface water interactions through paired sediment and surface water chemistry data;
3. Establish a robust estimate of local background soil and surface water quality;
4. Measure concentrations of tailings related contaminants in biological tissues in the aquatic environment; and,
5. Develop a preliminary problem formulation identifying linkages between human and ecological receptors and tailings related contaminants to form the basis of a future quantitative detailed human health and ecological risk assessment (HHERA) and identify data gaps and information needs to support the HHERA.

1.1 Objectives

The specific objectives of the current report are to:

1. Provide an update to the AECOM (2022) Phase II ESA, incorporating newly acquired site specific groundwater, surface water, sediment, and interstitial porewater quality data collected in January, 2023.
2. Develop the preliminary problem formulation and identify high-priority data needs in support of a future quantitative HHERA.
3. Provide a high-level description of proposed soil and surface water background sampling to be completed at a later date.
4. Provide a high-level description of proposed aquatic food-web tissue sampling to be completed at a later date.

2. Regulatory Framework

2.1 Nova Scotia Environment Contaminated Sites Regulations

AECOM, on behalf of BNS submitted Nova Scotia Environment and Climate Change (NSECC) Notification of Free Product or Contamination (FRM-100) under the provincial Contaminated Sites Regulations (CSR) on October 13th, 2022. The submission was acknowledged by NSECC in an obligations letter dated October 26, 2022, and is included herein as **Appendix E**, which makes the Site subject to the Nova Scotia Contaminated Sites Regulations.

2.1.1 Applicable Environmental Quality Standards

The subject property evaluation was completed in accordance with the Nova Scotia Environment (NSE) Contaminated Sites Regulations (July 2013). NSE Tier I Environmental Quality Standards (EQS) criteria provide the applicable guidelines for the Site. Site characteristics that are used to determine the NSE Tier I EQS (NSE-EQS) are as follows: **residential land use, potable water supply, coarse-grained soils.**

Soil and Tailings Guidelines:

- Nova Scotia Environment (NSE) Tier I Environmental Quality Standards (EQS) for Soil – residential, potable water, coarse grained soils (Table 1A)

Groundwater Guidelines:

- Nova Scotia Environment (NSE) Tier I Environmental Quality Standards (EQS) for Groundwater – residential, potable water, coarse grained soils (Table 4A)
- Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Groundwater Discharging to Surface Water (>10 m from Surface Water Body - Freshwater) (Table 3)

Surface Water Guidelines:

- Nova Scotia Environment (NSE) Tier I Environmental Quality Standards (EQS) for Surface Water (Marine); Table 3
- Nova Scotia Environment (NSE) Tier I Environmental Quality Standards (EQS) for Surface Water (Freshwater); Table 3

In the absence of porewater criteria, surface water NSE-EQS were applied to porewater samples to assess potential exposures to benthic organisms in the sediments (bivalves, crustaceans, worms etc.) and bottom-feeding pelagic aquatic organisms.

Sediment Guidelines:

- Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Sediment (marine); Table 2
- Nova Scotia Environment (NSE) Tier I Environmental Quality Standards (EQS) for Sediment (Freshwater); Table 2

2.2 Nova Scotia Environment Contaminated Sites Regulations – Risk Assessment

It is anticipated that a detailed quantitative HHERA will be an important component of any future site risk management strategy. Future quantitative risk assessment will be conducted in accordance with NSECC Contaminated Sites Regulations.

The NSECC Contaminated Sites Regulation (i.e., the Regulation) allows for site specific risk assessment (SSRA), as described in the Nova Scotia Environment (NSE) Remediation Levels Protocol (PRO-500) for the development of site-specific target levels (SSTLs). Additionally, the NSE Remedial Action Plan Protocol (PRO-600) provides direction on the development of risk management planning for conditional closure scenarios where exposure management and long-term site management could be implemented at a site. Long-term exposure management measures may be applied at contaminated sites, such as those with abandoned mine tailings, that cannot be remediated up to acceptable NSE Tier 1 Environmental Quality Standards (EQS) and/or NSE Tier 2 Pathway Specific Standards (PSS) levels; thereby, requiring the development, implementation and reporting of a risk management plan.

In accordance with the NSE Remediation Levels Protocol (PRO-500), for substances other than petroleum hydrocarbons (PHCs), established methodologies and computer models are permitted to be used in SSRA. This includes, but is not limited to, methods developed and published by the CCME for the risk management of contaminated sites in Canada.

A NSE Tier 2 SSRA means a site-specific environmental and human health risk assessment that is based on conditions at a particular site. The NSE Tier 2 SSRA evaluates site risks of adverse effects from exposure to select contaminants of concern (COCs) for human and ecological receptors using standardized methodologies and develops appropriate remediation levels for select COCs that may be used as remediation criteria. Through a NSE Tier 2 SSRA, SSTLs can be developed providing alternative risk-based site-specific remediation levels for a site. The SSTLs should be protective of environmental risks found at a site, based on site-specific information and require detailed site information, as well as a Conceptual Site Model (CSM) to justify their development and application in lieu of the corresponding NSE Tier 2 PSS.

Site data documented physical properties for surface soil (≤ 1.5 metres below ground surface [mbgs]) and subsurface soils (>1.5 mbgs), as well as physical properties of the groundwater; these site-specific measurements were used instead of defaults in mathematical models to quantify risks of adverse effects to environmental receptors and propose site specific target remedial levels. Depending on which default parameters in the risk assessment (RA) exposure model (see NSE Remediation Levels Protocol PRO-500, Appendix 1, Table 2) are modified using site data to produce the SSTLs (if met), the resulting site closure is either unconditional or conditional. Changes to other default parameters in the RA exposure model (e.g., human exposure parameters and building parameters) often signifies the need for ongoing exposure management, as a requirement of site closure for which conditional closure is only allowable under Environmental Site Assessment for Limited Remediation Protocol (PRO-200).

As outlined in the NSE Remediation Levels Protocol (PRO-500), the preferred sources for the required chemical, physical and toxicological data, in the following hierarchy, are:

- Health Canada
- CCME
- Canadian provincial jurisdictions
- US EPA

In accordance with the Regulation and applicable protocols and guidance, prior to conducting an SSRA for substances other than petroleum hydrocarbons (PHCs), the following evaluation steps are required to be completed:

- Evaluation of the substances against protocol NSE Tier 1 EQS, if available, for the substance.
- If NSE Tier 1 EQS do not exist, then an evaluation of site data against screening levels from other jurisdictions (i.e., Health Canada, CCME, other Canadian provincial jurisdictions and the US EPA) should be presented and the findings discussed.
- Provide a detailed written and tabulated hazard, exposure, and receptor assessment to the Nova Scotia Minister of the Environment for review and consideration of whether a more comprehensive quantitative SSRA is required.

The above steps are analogous to steps involved in the Problem Formulation Stage of an Environmental Risk Assessment, one of three core components to the integrated risk management process (CCME, 2016) as shown in

Figure 2-1 and **Figure 2-2** below. It is important to be mindful that the Environmental Risk Assessment and the Problem Formulation Stage is an iterative process, which involves data collection and analysis, model development, gaps analyses and further sampling and environmental investigation to verify key assumptions underpinning the SSRA. Additional environmental studies / surveys to gather new evidence to fill critical knowledge gaps for refining RA model assumptions and reducing uncertainties may be necessary for the development, implementation, and assessment of appropriate remediation options and/or risk management planning.

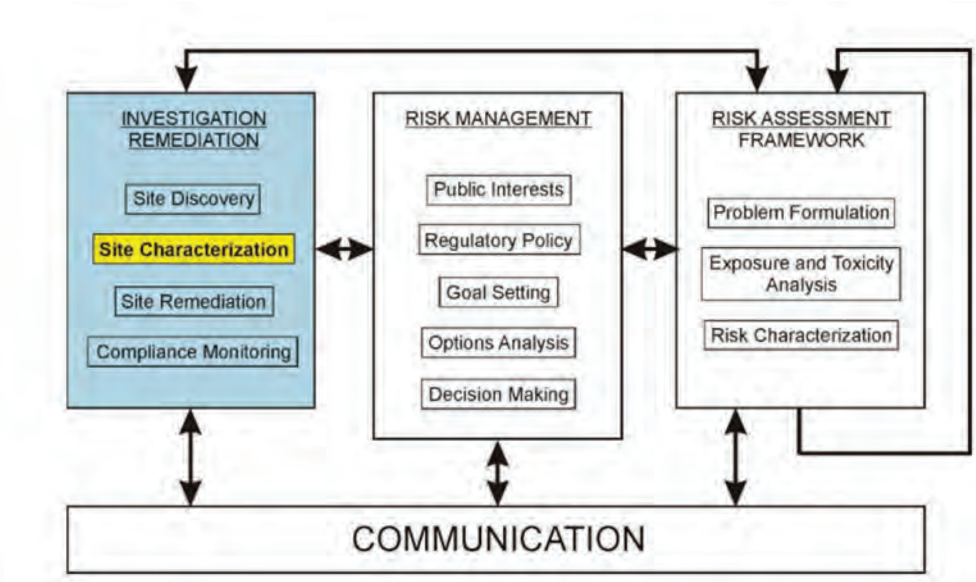


Figure 2-1: Integrated Risk Management Process (CCME, 2016)

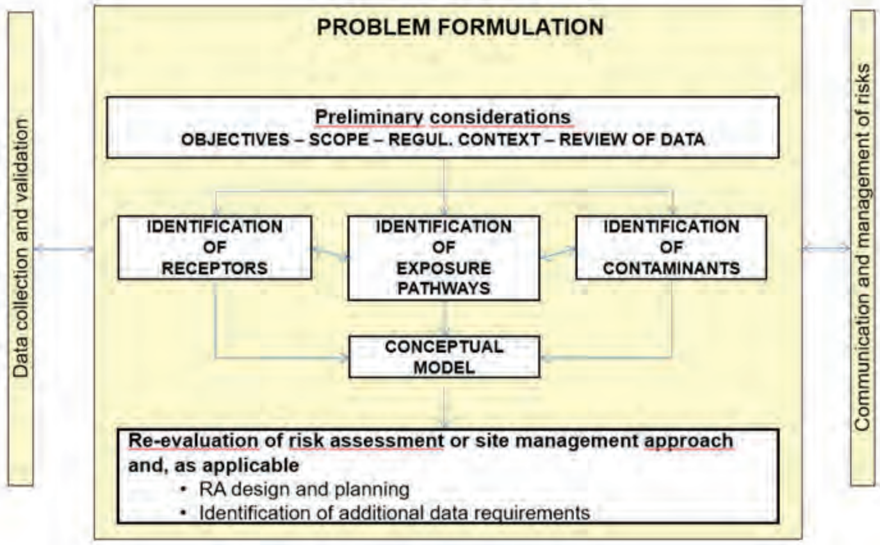


Figure 2-2: Problem Formulation Key Step in Environmental and Human Health Risk Assessment (Source FCSAP Presentation ECCC/HC, February 2017)

2.3 Applicable Federal Acts and Regulations

In addition to the relevant Nova Scotia Acts and Regulations (July 2013, amended 2020), under the Environment Act of Nova Scotia, other relevant Federal Acts include the Fisheries Act, the Canadian Environmental Protection Act, the Species at Risk Act, the Migratory Birds Convention Act, and the Canadian Environmental Assessment Act.

3. Site Information

3.1 Subject Property Description

The two historic gold mine sites, Gold Brook Lake and Seal Harbour, are located in the southern portion of a 38172.8-hectare (94327.0-acre) property (PID#: 35094366) owned by Nova Scotia Department of Natural Resources and Renewables (NSDNRR). This property is located in Guysborough County, Nova Scotia

Gold Brook Lake:

The Gold Brook Lake portion of the Site is part of the Upper Seal Harbour Gold district and is approximately 3 km northeast of Goldboro on the eastern shore of Nova Scotia. The historical mine workings and tailings can be accessed via Goldbrook Road off Highway 316. The historic mine site is mostly forested land and wetlands, to the south of Gold Brook Lake.

Remnants of historic infrastructure, waste rock piles, and tailings, associated with historic mining activity are located generally south of Gold Brook Lake, and north of Gold Brook. To the south of the main building owned by Signal Gold Inc., formally known as Anaconda Mining Inc. directly across Goldbrook Road, is a waste rock area. Adjacent to the northwest portion of this is a waste rock area is a ponded area showing evidence of tailings present. Approximately 120 m southeast of the southern most tip of Gold Brook Lake is another area with waste rock, including a rock core dump area. Adjacent to the southern portion of this rock core dump area is a swamp area showing evidence of tailings present. The concrete foundations, which could potentially be the historic stamp mill, are present beside the shore of the lake, on the west side of the southern tip of the lake. Along the shoreline of Gold Brook Lake was tailings, waste rock, black sand, and metal debris observed along the shoreline). Although, historically, there was once a second stamp mill on the east side of the southern tip of the lake, there was no evidence found of any remaining materials associated with its infrastructure.

Seal Harbour:

The Seal Harbour portion of the Site is part of the Lower Seal Harbour Gold District and is approximately 4.5 km southeast of Goldboro, Nova Scotia. The area is mostly forested land and wetlands, to the southeast of Seal Harbour Lake.

- At the time of the site visit, tailings associated with historic mining activity were located on-Site in a ponded area located northeast of Seal Harbour. Well oxidized sandy tailings were noted leading into Seal Harbour from the discharge at West Brook and under the bridge located at Highway 316 in Seal Harbour.
- Seal Harbour Lake is located approximately 1.7 km northwest of the Site. AECOM personnel walked the area surrounding Seal Harbour Lake and West Brook. This area is where the historical mine workings and tailings deposits are located and can be accessed via Sable Road off Highway 316.

The historic Seal Harbour mine site has concrete foundations of historic infrastructure, waste rock piles, and tailings, located in an area approximately 500-600 m southwest of the eastern most reaches of the Seal Harbour Lake. At the end of Sable Rd, when following the road northwest to southeast, there is a junction where the road forks at a gravel clearing. In the north area of this clearing is a hollowed-out, cube-shaped concrete structure. Various wood, glass, and metal debris was found on the floor of this concrete structure. Approximately 50 m south of this structure is concrete foundation belonging to an old stamp mill. Beside this foundation is an historic mine shaft, now saturated with water. Approximately 50 m west of this mine shaft are concrete foundations from an old cyanide plant. Approximately 50 m southeast of the cyanide plant concrete foundations are waste rock piles, spanning a 130 m stretch of land from northwest to southeast, at the southeast end of which, is evidence of tailings in a wetland area. Historically, near the western shore of Seal Harbour Lake, a stamp mill was present. However, during the field visit, no evidence of this stamp mill was observed.

3.1.1 Historical Land Use

The Gold Brook Lake and Seal Harbour mines operated in the late 1800s to the early 1900s and have been reportedly inactive since the 1950s.

Gold Brook Lake:

The former Gold Brook Lake portion of the Site was reportedly mined intermittently between 1893 and 1958. Ore was transported via trestle on-Site and milled using a variety of stamp mills with mercury amalgamation. The 60-stamp Richardson Mill was considered to be one of the largest mills in Nova Scotia, located on the west side of Gold Brook Lake. Remnants of the stamps and structures for the mercury amalgamation process remain today. This historical mining operation generated the second-largest volume of tailings of all the gold districts in Nova Scotia. During operation large quantities of mine tailings were slurried directly into the upper reaches of Gold Brook. These tailings may be seen on the floodplain for at least 4 km downstream of the Richardson Mill site. Across from the Richardson Mill on the east side of Gold Brook Lake, the East Goldboro mine operated during the same period, leaving behind the foundation of a smaller stamp mill and associated tailings clearly visible south of Goldbrook Road where Gold Brook Lake meets Gold Brook.

Seal Harbour:

The Seal Harbour Lake portion of the Site was reportedly mined between 1905 and 1915 by two mining companies, employing small stamp mills and mercury amalgamation. Sulphide concentrates produced at this site were sent to the Richardson Mill (Upper Seal Harbour) cyanide plant for treatment. Similar mining operations briefly resumed between 1926 and 1928 (Parsons et al. 2012). In 1934, larger-scale mining operations resumed with a newly constructed 200-ton-per-day cyanide plant used to treat the ore until 1942. During operation, tailings from the stamp mills and cyanide plant were discharged into a small tributary to West Brook, which eventually flows to Seal Harbour. These tailings have been and continue to be eroded by local streams; visible tailings exist along the floodplain 2km from the mine site to the ocean at Seal Harbour.

3.1.2 Site Buildings and Structures

Gold Brook Lake:

The Gold Brook Lake portion of the Site is currently vacant and no buildings are located on the property. At the time of the site visit, remnants of historic infrastructure, waste rock piles, and tailings, associated with historic mining activity were located on-Site. The concrete foundations of what could potentially be the historic stamp mill were present beside the shore of the lake, on the west side of the southern tip of the lake. Although, historically, there was once a second stamp mill on the east side of the southern tip of the lake, no evidence was found of any remaining materials associated with its infrastructure.

Signal Gold Inc., formally known as Anaconda Mining Inc., is currently located west and adjacent to the Site who are actively completing exploration activities on the land.

Seal Harbour:

The Seal Harbour portion of the Site is currently vacant and no buildings are located on the property. At the time of the site visit, tailings associated with historic mining activity were located on-Site.

3.2 Physical Setting

3.2.1 Regional Topography

The terrain between the southern tip of Gold Brook Lake and Gold Brook (the approximate location of the activities associated with the Gold Brook Lake mine site) is gradually sloping downward in the north (Gold Brook Lake) to south direction (Gold Brook). The elevation ranges between approximately 35 to 65 meters above sea level (masl). In the west-to-east direction the terrain is relatively flat.

The elevation in the approximate area where the Lower Seal Harbour mining activities took place ranges between approximately 12 and 40 masl. Generally, the terrain tends to slope downwards from northwest to southeast.

Topography for the Site and surrounding area is presented in **Figure 1A** and **1B**, **Appendix A**.

3.2.2 Regional Geology

Bedrock in the area is of Cambro-Ordovician age, belonging to the Meguma group, which comprises the southern half of Nova Scotia's land mass (Patterson 1993). The Meguma group is subdivided into two primary formations: the Goldenville and Halifax formation (Patterson 1993). The basal part is the Goldenville formation, which is overlain by the Halifax formation (Prime and White 2007), except in some areas where it is exposed at the surface.

In the Upper and Lower Seal Harbour area, the Goldenville Formation is exposed at the surface (Malcolm 1929). The Goldenville formation is folded into a series of anticlines and synclines, formed by a north-to-south lateral pressure (Welles 1906). The Goldenville formation is primarily composed of metasandstone, with some interbedded metasiltstone and slate, and in some cases, layering of sheets of rock is clearly visible (Prime and White 2007). The colour of the rock varies from medium grey to green-grey (Prime and White 2007). Low levels of sulphides (typically <1%) are common, usually in the form of isolated pyrite crystals (Prime and White 2007).

In the Upper Seal Harbour area where Gold Brook Lake is situated, the Goldenville Group is at an anticline (Malcolm 1929). In this area, bedrock is composed of metagreywacke, metasiltstone, and slate metamorphosed to biotite-cordierite grade (Percival et al. 2014). The metagreywacke is composed of abundant quartz (65-80%), with some feldspar (10-20%), biotite (5-10%), and minor amounts of other minerals (e.g., sericite, chlorite, carbonates, tourmaline, apatite, sulphides, etc.) (Percival et al. 2014). The soil and till with grain size of < 2mm in the B horizon is predominantly quartz (68-80%), with some Plagioclase Feldspar (15-22%), Muscovite (2-5%), and Chlorite (2-5%) (Percival et al. 2014).

In the Lower Seal Harbour area, gold deposits typically occurred in grey sulphide-rich slate and smoky grey quartz veins (Percival et al. 2014). The soil and till with grain size of < 2mm in the B horizon is predominantly quartz (67-77%), with some Plagioclase Feldspar (15-23%), Muscovite (3-8%), and Chlorite (3-7%) (Percival et al. 2014).

At the Goldboro Mine Site, the glacial till deposits are on average approximately 6.5 meters thick and range from 0.5 m to over 18 m (GHD, 2022).

3.2.3 Regional Hydrogeology

The following regional hydrogeology text and Gold Brook Lake text is sourced from groundwater investigations completed and described within the Goldboro Gold Project - Environmental Assessment Registration Document (GHD, 2022)

Regional groundwater flow in the fractured crystalline bedrock is controlled by secondary permeability and fracturing. The rock matrix permeability is believed to be generally low. Fracture density is high in the weathered shallow bedrock and decreases with depth. Therefore, most bedrock flow is expected to occur in shallower depth intervals and will decrease with depth. Regionally groundwater flow is expected to be towards the Atlantic Ocean; however, groundwater flow at depth is likely minimal due to the low permeability of the deeper bedrock.

Gold Brook Lake:

The water table within the vicinity of the Gold Brook Lake Site is typically close to ground surface (i.e., similar to two metres below ground surface). The bedrock forms a fractured rock aquifer system, which is overlain by a thin overburden aquifer. The groundwater flow system is strongly influenced by topography such that recharge occurs in areas of high elevation and discharge is to low lying streams, rivers, and bogs. General groundwater elevations mimic topographic relief and locally groundwater discharges to low-lying surface water features. Gold Brook Lake is likely the most significant surface water body receiving groundwater discharge.

Two major hydrostratigraphic units are defined in the vicinity of the Gold Brook Lake Site, consisting of the overburden and weathered bedrock hydrostratigraphic units. The overburden is further divided into two main units. These include the upper unit, which is more transmissive to groundwater, and the lower silt-dominated unit, which is less transmissive to groundwater. The identified faults are not considered separate hydrostratigraphic units. The upper till layer is estimated to have a hydraulic conductivity of 3×10^{-6} m/s. The lower till unit is estimated to have a hydraulic conductivity of 6×10^{-7} m/s.

Bedrock hydraulic conductivity in the vicinity of the Gold Brook Lake Site been observed to decrease with depth consistent with the observation of weathered fractured bedrock at shallow depths grading into less fractured and more competent bedrock at depth. In general, the highest hydraulic conductivity values, on the order of 1×10^{-6} m/s to 1×10^{-3} m/s occur within the upper 30 m of bedrock while hydraulic conductivity values on the order of 1×10^{-8} m/s to 1×10^{-6} m/s occur at depths greater than 30 m below the top of bedrock. Overall, hydraulic conductivity testing demonstrates that the hydraulic conductivity of the bedrock decreases with depth.

Seal Harbour:

Based on available provincial bedrock and surficial geology mapping for the Site, groundwater flow is expected to behave similarly within the vicinity of the Seal Harbour Site with respect to the Gold Brook Lake Site. It is anticipated that the groundwater flow system is strongly influenced by topography such that general groundwater elevations mimic topographic relief and locally groundwater discharges to low-lying surface water features. Groundwater monitoring wells are recommended to be installed at the Seal Harbour Site to further assess site specific groundwater quality, groundwater flow direction and hydraulic conductivity conditions.

3.2.4 Regional Hydrology

Site-specific hydrology information includes the following water bodies, wetlands, etc. that are either present On-Site or in the vicinity of the Site. Hydrologic features are presented on **Figure 1A** and **1B**, **Appendix A**.

Gold Brook Lake:

- Gold Brook Lake is located adjacent (north) to the Site.
- Gold Brook is located on-Site, which flows off-site to the southeast and eventually into Seal Harbour Lake.
- Wetland areas are present on-Site and along Gold Brook.
- Seal Harbour Marshes and Rocky Lakes are located approximately 1.3 km east of the Site.

Seal Harbour:

- Seal Harbour Lake is also located approximately 1.7 km northwest of the Site.
- West Brook flows south from Seal Harbour Lake and eventually discharges into Seal Harbour. There are a number of ponds and wetland areas located along West Brook.
- East Brook flows southeast from Seal Harbour Lake (and further upstream, Gold Brook Lake) and eventually discharges into Seal Harbour.
- The community of Seal Harbour is located south of the Site. Immediately to the west of Seal Harbour, approximately 2.0 km from the Site, is the municipality of Drumhead, NS, which is a fishing community.

A search of water wells within a 250 m radius of the Site was conducted as part of the ERIS database search. The search results found that there are 5 water wells present within 250 m radius of the Site.

3.3 Adjacent Land Use

Gold Brook Lake:

North: Gold Brook Lake is located adjacent and north of the Gold Brook Lake portion of the Site. The property beyond Gold Brook Lake largely consists of forested land and wetlands and is currently used as a popular hunting and fishing area.

West: Signal Gold Inc. is currently located west and adjacent to the Site and are actively completing exploration activities on the land. *Further discussion on Signal Gold Inc. is provided below**. Further west largely consists of forested land and wetlands and is currently used as a popular hunting and fishing area. The town of Goldboro, NS, situated on Isaac's Harbour is located approximately 2.15 km west of the Site.

South: The property largely consists of forested land and wetlands and is currently used as a popular hunting and fishing area. Gold Brook flows to the southeast and eventually into Seal Harbour Lake. Further south is the former gas plant (referred to as the "Sable Gas Plant" or "Goldboro Gas Plant"), which is approximately 3.2 km south of the Site. Immediately northwest of this industrial plant are two smaller lots (they are approximately 5000 and 4000 m^2, respectively) that are paved with buildings, and are potentially affiliated with the former gas plant. The town of Goldboro, NS, situated on Isaac's Harbour is located approximately 2.5 km northwest of this gas plant.

East: The property largely consists of forested land and wetlands and is currently used as a popular hunting and fishing area. Rocky Lakes are located approximately further east approximately 1.3 km from the Site.

**Additionally, two buildings are adjacent to the Site and being used for current operations by Signal Gold Inc. south of Gold Brook Lake. One of the buildings is located approximately 100 m west of the southern most tip of the Gold Brook Lake. Various equipment/debris from current activities is present in this area including, but not limited to, fuel tanks on metal sleds, wooden pallets, gas tank cannisters, and various piping and hoses. This building includes a fenced area, and within the fenced area is access to the historic underground mine workings. Approximately 60 m south of this building there is evidence of tailings in a swampy area. The second, smaller building (approximately 12 m x 11 m) is approximately 200 m further west (along Goldbrook Rd) of the other building. It is joined to two shipping containers on either side, which are housed by the same roof.*

Seal Harbour:

North: The property largely consists of forested land and wetlands and is currently used as a popular hunting and fishing area. Northwest of the Site is the former gas plant (referred to as the "Sable Gas Plant" or "Goldboro Gas Plant"), which is located approximately 2.3 km northwest of the Site. Seal Harbour Lake is also located approximately 1.7 km northwest of the Site. AECOM personnel walked the area surrounding Seal Harbour Lake and West Brook – *detailed observations made during the Site visit are presented in* ***Section 3.1***. The town of Goldboro, NS, situated on Isaac's Harbour, is located approximately 5 km northwest of the Site.

West: The areas immediately to the west of the Site largely consists of forested land and wetlands and is currently used as a popular hunting and fishing area.

East: Property adjacent to the north\northeast\east of the Site largely consists of forested land and wetlands and is currently used as a popular hunting and fishing area.

South: The community of Seal Harbour is located south of the Site. Immediately to the west of Seal Harbour, approximately 2.0 km from the Site, is the municipality of Drumhead, NS, which is a fishing community. Recreational/commercial boating/fishing may take place in the waters along the coastline of Seal Harbour and Drumhead. Additionally, Highway 316 runs south of the Site and through the southern reaches of the Site.

3.4 Previous Environmental Site Investigations

Previous environmental reports were provided to AECOM by BNS and a summary of each report is presented within the AECOM Phase I ESA (AECOM, 2022). A summary of the findings from the Phase I ESA is provided below.

3.4.1 Phase I ESA (AECOM, 2022)

Based on the results of the Phase I ESA, AECOM identified the following key information:

1. The two historic gold mine sites, Gold Brook Lake and Seal Harbour, are located in the southern portion of a 38172.8-hectare (94327.0-acre) property (PID#: 35094366) owned by Nova Scotia Department of Natural Resources and Renewables (NSDNRR). This property is located in Guysborough County, Nova Scotia. The Gold Brook Lake site is part of the Upper Seal Harbour Gold district and is approximately 3 km northeast of Goldboro on the eastern shore of Nova Scotia. The historical mine workings and tailings can be accessed via Goldbrook Road off Highway 316. The historic mine site is mostly forested land and wetlands, to the south of Gold Brook Lake. The Seal Harbour site is part of the Lower Seal Harbour Gold District and is approximately 4.5 km southeast of Goldboro, Nova Scotia. The historical mine workings and tailings deposits can be accessed via Sable Road off Highway 316. The historic mine site is mostly forested land and wetlands, to the southeast of Seal Harbour Lake.
2. The Gold Brook Lake portion of the Site is currently vacant and no buildings are located on the property. At the time of the site visit, remnants of historic infrastructure, waste rock piles, and tailings, associated with historic mining activity were located on-Site. The concrete foundations of what could potentially be the historic stamp mill are still present beside the shore of the lake, on the west side of the southern tip of the lake. Although, historically, there was once a second stamp mill on the east side of the southern tip of the lake, no evidence was found of any remaining materials associated with its infrastructure.
3. The Seal Harbour portion of the Site is currently vacant and no buildings are located on the property. The area is mostly forested land and wetlands, to the southeast of Seal Harbour Lake.
4. Tailings associated with historic mining activity were located on-Site.
    - At the time of the site visit, tailings associated with historic mining activity were located on-Site in a ponded area located northeast of Seal Harbour. Well oxidized sandy tailings were noted leading into Seal Harbour from the discharge at West Brook. Additional tailings were found at the bridge located at Highway 316 in Seal Harbour.
    - Tailings were noted during the time of the site visit. Oxidized tailings were located along the southern shoreline and into Gold Brook Lake, as well as in the cleared area southeast of Gold Brook Lake. In Seal Harbour, tailings were located on-Site in a ponded area located northeast of Seal Harbour. Well oxidized sandy tailings were noted leading into Seal Harbour from the discharge at West Brook and under the bridge located at Highway 316 in Seal Harbour.
    - A more detailed review of the Nova Scotia Well Records Database was conducted after the Phase I ESA report was completed. This review identified that the nearest domestic water wells to the two study areas are as follows: one well located within 800m of the Gold Brook Lake Site (19 Dick Giffins Hill, Goldboro); and one well located directly within the Seal Harbour Site.
5. Waste rock was located along the southern shoreline and into Gold Brook Lake, as well as along Goldbrook Road where Signal Mining Inc. is currently set up. No waste rock was noted in Seal Harbour.
6. At the time of the site visit, various debris and waste (consisting of former concrete foundations, wood, metal, drill cores, tires etc.) were littered along the southern shoreline and perimeter of Gold Brook Lake, as well as in the cleared area southeast of Gold Brook Lake.
7. Historical soil samples collected at the Site (by others) show elevated concentrations of arsenic and mercury present in the tailings on-Site.

An additional noteworthy item identified in that based on previous environmental reports and results from the ERIS database report, it is noted that former mine shafts are located on-Site in various areas, mainly in the area directly south of Gold Brook Lake, and areas east and southeast of Gold Brook Lake. Former mine shafts were also present in an area southwest of Seal Harbour Lake. During the site visit, it was noted by Anaconda Mining (now Signal Gold) personnel that there was a collapse of a former mine shaft in 2018 in the area of the former stamp mill at Gold Brook Lake. These pose a significant physical hazard.

Based on the results of the Phase I ESA, AECOM recommended the following:

Solid Waste Management:

1. All debris and other solid wastes should be consolidated prior to disposal.
2. All debris and other solid wastes should be removed from the Site and disposed in compliance with Provincial and Municipal legislation. Characterization of the waste should take place prior to, or concurrently, with removal.

Potential Environmental Contamination:

1. A Phase ll ESA program should be conducted to investigate potential environmental contamination of soil, surface water and groundwater on the Site as a result of historical gold mining operations and the waste generated during that time. The Phase ll ESA should focus on known areas of concern such as known tailings areas, waste storage areas, former stamp mill areas, pond/former shaft areas and any known waste discharge locations. It is expected that the primary COCs will be heavy metals (arsenic and mercury).

Additional items to be considered include the following:

Physical Hazards:

1. ln addition to debris and solid waste, structures such as concrete foundations pose physical hazards to members of the public who may visit the Site. A survey of humanmade structures should be conducted to identify those that require remedial actions to address physical hazards.
2. A survey of former mine shafts should be conducted to identify those that require remedial actions to address physical hazards such as excessive drops and/or falls.

4. Phase II ESA

4.1 Initial Phase II ESA Field Program – July 2022

In July 2022, AECOM completed the initial field program which consisted of test pitting done via shovel and hand augering along with soil, tailings, groundwater, surface water, porewater and sediment sampling, chemical analysis of selected samples, and evaluation of the analytical data.

The Phase II ESA was conducted in accordance with the Nova Scotia Environment (NSE) Contaminated Sites Guidelines (2013) Phase II Environmental Site Assessment Protocol (PRO-400). The field methodology, observations and analytical results from this initial investigation are presented in the Phase II ESA report titled "*Phase II Environmental Site Assessment – Gold Brook Lake and Seal Harbour Mine Site – October 2022*". A summary of the findings are presented in **Table 1** below.

Table 1: Phase II ESA Summary of Findings – July 2022

Phase II ESA Activities		Phase II ESA Findings
Soil and Tailings - Impact Assessment and Delineation		
1.	Collected fifty-two (52) soil samples	▪ Arsenic and mercury, two parameters associated with the gold mining process (arsenic concentrated through refinement of host rock and mercury used as a gold extraction agent), impacts were identified in soil samples. As such, they are suspected to be due to previous mining activities that took place at Site. ▪ The following impacts were noted in soil (maximum concentrations in brackets): - Aluminum (20,000 mg/kg) - Antimony (40 mg/kg) - Arsenic (50,000 mg/kg) - Beryllium (1.5 mg/kg) - Cadmium (1.9 mg/kg) - Iron (70,000 mg/kg) - Lead (320 mg/kg) - Manganese (2000 mg/kg) - Mercury (73 mg/kg) - Selenium (2.5 mg/kg) - Thallium (2.9 mg/kg) - Vanadium (41 mg/kg) - Zinc (850 mg/kg)
2.	Collected two (2) tailings samples and eight (8) tailings delineation samples	Tailings: ▪ Arsenic (Max. Concentration: 29,000 mg/kg) and Iron (Max. Concentration: 35,000 mg/kg) impacts were identified in all tailings samples. ▪ Antimony (Max. Concentration: 19 mg/kg), Lead (Max Concentration: 200 mg/kg) and Mercury (Max Concentration: 73 mg/kg) impacts were identified in one (1) of the tailings samples (S22-T1B). Tailings Delineation: ▪ Arsenic (Max. Concentration: 6,000 mg/kg) impacts identified in all tailings delineation samples. ▪ The following impacts were also noted in tailings delineation samples (maximum concentrations in brackets): - Antimony (9.4 mg/kg), - Iron (30,000 mg/kg), - Lead (130 mg/kg), - Mercury (11 mg/kg), - Selenium (1.4 mg/kg)

	Phase II ESA Activities	Phase II ESA Findings
Soil – Background Assessment		
3.	Collected five (5) background soil samples: BG 1 to BG 5.	▪ Selenium (Max. Concentration: 1.8 mg/kg) impacts were identified at one (1) background location: BG 4.
Waste Rock – Assessment and Delineation		
4.	Collected five (5) waste rock samples: WR-1 to WR-5.	▪ Detectable concentrations of aluminum, arsenic, barium, chromium, iron, lead and manganese, nickel, vanadium and zinc are present in waste rock samples collected from the Site.
Groundwater		
5.	Sampling of the four (4) pre-existing wells on-Site: MW17-2, MW22A, MW23A, MW27A.	▪ Arsenic impacts were identified at one (1) of the four (4) wells (MW22A) ▪ The following impacts were identified at select wells (maximum concentrations in brackets): - Aluminum (270 µg/L) - Arsenic (150 µg/L) - Iron (8,800 µg/L) - Manganese (350 µg/L)
Surface Water and Sediment – Assessment		
6.	Collected four (4) SW and sediment samples: SW3/SED3, SW4/SED4, SW7/SED7, SW19/SED19. Four (4) locations between the former Stamp Mills near Gold Brook Lake and the former Stamp Mill located near Seal Harbour Lake.	**Surface Water:** ▪ Arsenic, aluminum, and iron impacts were identified at all four (4) surface water (SW) locations (maximum concentrations in brackets): - Aluminum (300 µg/L) - Arsenic (480 µg/L) - Iron (1,700 µg/L) **Sediment:** ▪ Arsenic impacts were identified at all four (4) sediment (SED) locations (maximum concentration: 57,000 mg/kg). ▪ The following additional impacts were identified at select SED locations (maximum concentrations in brackets): - Antimony (34 mg/kg) - Iron (100,000 mg/kg) - Lead (110 mg/kg) - Mercury (68 mg/kg) - Nickel (91 mg/kg) - Silver (4 mg/kg)
7.	Collected one (1) SW and sediment sample: SW20/SED20. Outlet of Seal Harbour Lake to the east.	**Surface Water:** ▪ Arsenic (330 µg/L), aluminum (330 µg/L) and iron (1,600 µg/L) impacts were identified at this SW location. **Sediment:** ▪ Arsenic (500 mg/kg) impacts were identified at this SED location.
8.	Collected two (2) SW and sediment samples: SW10/SED10, SW18/SED18. First Pond and Second Pond.	**Surface Water:** First Pond (SW10) ▪ Arsenic (280 µg/L), aluminum (360 µg/L) and iron (1,500 µg/L) impacts were identified at this SW location. Second Pond (SW18) ▪ Arsenic (280 µg/L), aluminum (330 µg/L) and iron (1,500 µg/L) impacts were identified at this SW location. **Sediment:** First Pond (SED10) ▪ Arsenic (210 mg/kg) impacts were identified at this SED location. Second Pond (SED18) ▪ Arsenic (520 mg/kg) impacts were identified at this SED location.
9.	Collected one (1) SW and sediment sample: SW9/SED9.	**Surface Water:**

	Phase II ESA Activities	Phase II ESA Findings
	Outlet to the Atlantic Ocean.	▪ Arsenic (270 µg/L) and mercury (0.02 µg/L) impacts were identified at this SW location. **Sediment:** ▪ Arsenic (440 mg/kg) impacts were identified at this SED location.
10.	Collected three (3) SW and sediment samples: SW5/SED5, SW6/SED6, SW8/SED8. Areas of ponded water south of the waste rock pile southwest of Gold Brook Lake.	**Surface Water:** ▪ Arsenic, aluminum, and iron impacts were identified at all three (3) SW locations. ▪ The following impacts were identified at select SW locations (maximum concentrations in brackets): - Aluminum (140 µg/L) - Arsenic (1,100 ug/L) - Iron (3,700 µg/L) - Cobalt (2.4 µg/L) - Zinc (9.1 µg/L) **Sediment:** ▪ Arsenic impacts were identified at all three (3) SED locations. ▪ The following impacts were identified at select SED locations (maximum concentrations in brackets): - Arsenic (16,000 mg/kg) - Iron (110,000 mg/kg) - Silver (2.7 mg/kg)
11.	Two (2) SW and sediment samples: SW1/SED1, SW2/SED2. Near the tailings plumes southeast of Gold Brook Lake.	**Surface Water:** ▪ Arsenic, aluminum, iron, lead, mercury and zinc impacts were identified at both SW locations. ▪ The following impacts were identified at select SW locations (maximum concentrations in brackets): - Aluminum (2,100 µg/L) - Arsenic (7,800 µg/L) - Iron (18,000 µg/L) - Lead (9.4 µg/L) - Mercury (0.09 µg/L) - Zinc (14 µg/L) - Cobalt (1.7 µg/L) - Copper (2.2 µg/L) **Sediment:** ▪ Arsenic (40,000 mg/kg), iron (87,000 mg/kg) and mercury (6.7 mg/kg) impacts were identified at both SED locations, in addition to silver (1.4 mg/kg) at one location (maximum concentrations in brackets).
12.	Three (3) SW and sediment samples: SW12/SED12, SW13/SED13, SW14/SED14. Long Cove - across the cove at the tailings edge.	**Surface Water:** ▪ Arsenic impacts were identified at all three (3) SW locations. ▪ The following impacts were identified at select SW locations (maximum concentrations in brackets): - Arsenic (240 µg/L) - Boron (2,200 µg/L) - Mercury (0.018 µg/L) **Sediment:** ▪ Arsenic impacts were identified at all three (3) SED locations (Max. concentration: 280 mg/kg).
Surface Water and Sediment – Background Assessment		
13.	Two (2) SW samples: BG-1, SW11. One (1) sediment sample: SED11.	**Surface Water:** ▪ Aluminum (300 µg/L) and Iron (390 µg/L) impacts were identified at BG-1 location (freshwater body). ▪ Boron (3,600 µg/L) impacts were identified at SW11 location (marine water body).

Phase II ESA Activities		Phase II ESA Findings
		Sediment: ▪ No impacts were identified at this background sediment location.
Porewater – Assessment		
14.	Five (5) porewater samples: (PW-1 to PW-5).	▪ The following impacts were identified from the porewater samples collected in freshwater bodies (PW-1, PW-2, PW-3) (maximum concentrations in brackets): - Aluminum (170,000 µg/L) - Antimony (24 µg/L) - Arsenic (65,000 µg/L) - Barium (1,700 µg/L) - Beryllium (14 µg/L) - Cadmium (5.7 µg/L) - Chromium (230 µg/L) - Cobalt (270 µg/L) - Copper (360 µg/L) - Iron (1,100,000 µg/L) - Lead (1,700 µg/L) - Manganese (14,000 µg/L) - Mercury (14 µg/L) - Nickel (730 µg/L) - Silver (1.9 µg/L) - Thallium (3.1 µg/L) - Vanadium (220 µg/L) - Zinc (10,000 µg/L) ▪ The following impacts were identified from the porewater samples collected in marine water bodies (PW-4, PW-5) (maximum concentrations in brackets): - Arsenic (6,400 µg/L) - Boron (3,100 µg/L) - Cadmium (1.1 µg/L) - Chromium (59 µg/L) - Cobalt (64 µg/L) - Copper (61 µg/L) - Lead (200 µg/L) - Mercury (0.63 µg/L) - Nickel (63 µg/L) - Thallium (1.8 µg/L) - Uranium (11 µg/L) - Vanadium (46 µg/L) - Zinc (230 µg/L)

Notes:

The data included in this table is based exclusively to AECOM findings. Any additional data previously collected by others is not included in this table.

Due to laboratory turnaround times, methyl mercury results for select soil samples collected during the initial Phase II were not included in the Phase II ESA report titled "Phase II Environmental Site Assessment – Gold Brook Lake and Seal Harbour Mine Site – October 2022". These analytical results are included in the tables presented in **Appendix B** and the lab COAs presented in **Appendix C**.

4.2 Additional Phase II ESA Field Program – January 2023

AECOM received a request to continue work on the Gold Brook Lake and Seal Harbor Mine ESA project. As per the recommendations provided to BNS in the Phase II ESA report, an additional scope of work was proposed to further evaluate the former Gold Brook Lake and Seal Harbour Mine Site using a staged risk assessment approach.

A memo was submitted to BNS in January 2023 with an overview of the additional work to be completed to support the Human Health and Environment Risk Assessment (HHERA). The scope of work completed consisted of an additional round of surface water and groundwater sampling to establish variability and seasonal differences in groundwater, porewater, and surface water quality, as well as paired sediment sampling at additional locations at Site.

The memo also included the recommendation to complete additional soil background sampling, as well as tissue sampling for both benthic invertebrates and fish tissue. The additional soil background sampling will be completed at a later date due to winter soil conditions. The tissue sampling was recommended to be completed in the summer months as this would lead to more representative samples.

4.2.1 Methodology

AECOM returned to Site in January 2023 to complete an additional Phase II ESA for the Site. The scope of work included an additional round of surface water and groundwater sampling to establish variability and seasonal differences in groundwater, porewater, and surface water quality, as well as paired porewater sampling at additional locations at Site, chemical analysis of selected samples, and evaluation of the analytical data.

AECOM submitted a memo to BNS in January 2023. An overview of the Phase II ESA sampling program that was completed at the Site is as follows:

Groundwater:

- Completed an additional round of groundwater sampling to establish variability and seasonal differences in groundwater. Resampled all existing groundwater monitoring wells and samples were submitted for laboratory analysis of dissolved metals (incl. mercury), and select samples were also submitted for general chemistry.

Paired Surface Water and Sediment Sampling:

- Completed an additional round of surface water sampling to establish variability and seasonal differences in surface water. Resampled all existing surface water locations, with the exception of the background sample location (SW-11). Three (3) additional new surface water stations were sampled (SW-15, SW-16, SW-17). Samples were submitted for laboratory analysis of dissolved metals (incl. mercury). Select locations were also sampled for general chemistry analysis.
- Completed an additional around of sediment sampling. Resampled select existing sediment locations that were paired with surface water locations at select locations and samples were submitted for laboratory analysis for dissolved metals (incl. mercury).
- Select sediment samples were submitted for SEM/AVS analysis to assess bio-accessibility of metals to benthic invertebrates *(RESULTS PENDING)*.

Porewater:

- Completed an additional round of porewater sampling to establish variability and seasonal differences in porewater. Resampled all existing porewater sample locations, except for PW5. Samples were submitted for laboratory analysis of dissolved metals (incl. mercury). Select locations were also sampled for general chemistry analysis.

4.2.2 Sampling Program Rationale

Table 2 below provides a summary of the sample locations and the rationale, as applicable.

Table 2: Sample Locations and Rationale

Phase II ESA Activities		Sampling Rationale	Analyses	Media	Potential Receptor Type
Groundwater					
1.	Completion of an additional round of sampling	To establish variability and seasonal differences in groundwater.	Dissolved Metals incl. mercury, General Chemistry (select locations)	Groundwater	Human Health and Environment
Surface Water and Sediment					
2.	Completion of an additional round of surface water and sediment samples	To establish variability and seasonal differences in surface water and sediment.	Surface Water: Metals incl. mercury, General Chemistry (select locations) Sediment: Metals incl. mercury, SEM/AVS analysis (select samples) to assess bio-accessibility *(RESULTS PENDING)*	Surface Water and Sediment	Human Health and Environment
3.	Completion of sampling at new surface water and sediment locations: SW15/SED15, SW16/SED16, SW17/SED17	Collected additional samples in Long Cove – across the cove at the tailings edge – collected behind SW12/SED12-SW14/SED14	Surface Water: Metals incl. mercury, General Chemistry (select locations) Sediment: Metals incl. mercury	Surface Water and Sediment	Human Health and Environment
Porewater					
4.	Completion of an additional round of porewater sampling	To establish variability and seasonal differences in porewater. Existing locations resampled: PW1 to PW4	Metals incl. mercury, General Chemistry (select locations)	Porewater	Human Health and Environment

4.2.3 Sampling Procedures

4.2.3.1 Groundwater Sampling Procedures

Groundwater sampling took place on January 16, 2023. Prior to groundwater sampling at monitoring well locations, static groundwater level measurements were collected. An oil-water interface probe was used to measure the depth to groundwater and assess for the presence of non-aqueous phase liquid (NAPL) inside the well.

Groundwater monitoring wells were developed by removing groundwater from the monitoring well until the water returned sediment free. Before monitoring wells were sampled, the well was purged by removing a minimum of three (3) well volumes of water from the well. The removal of groundwater was completed by hand purging with WaterraTM dedicated tubing.

Samples were collected upon purging three (3) well volumes of groundwater to remove standing water and to draw a representative sample from the formation. If monitoring wells went dry during purging, they were allowed to recharge sufficiently before immediately collecting a groundwater sample. Groundwater removed from the wells during development and purging activities was discharged on land.

All groundwater samples were collected in pre-cleaned laboratory supplied containers and kept at or below a temperature of 10 degrees Celsius once sampled until submission to the laboratory. Metals samples were collected in laboratory preserved vials and filtered in the field using a 0.45-micron filter media.

A total of five (5) groundwater samples (including one (1) field duplicate) were collected from the pre-existing wells on-Site (MW17-2, MW22A, MW23A, MW27A) and submitted for dissolved metals analysis, including mercury. Additionally, MW23A and the field duplicate were also submitted for general chemistry analysis.

Groundwater sampling locations are shown on **Figure 7**, **Appendix A**.

4.2.3.2 Surface Water Sampling Procedures

Surface water sampling took place between January 16-18, 2023. Surface water samples were collected following AECOM's SOPs from a depth of approximately 5 cm below the water surface. During the surface water sample collection process, the personnel located themselves downstream of the sampling point and as close to the middle of the channel as possible (where safe to do so), thereby minimising disturbance to the stream base and mobilisation of any silts / sediments. Samples were collected in pre-cleaned laboratory supplied containers and kept at or below a temperature of 10 degrees Celsius once sampled until submission to the laboratory.

A total of twenty-one (21) surface water samples (including two (2) field duplicates) were collected during this field program and submitted for metals (incl. mercury) analysis, and select samples were also submitted for general chemistry analysis.

Surface water sampling locations are shown on **Figure 8**, **Appendix A**.

4.2.3.3 Porewater Sampling Procedures

Porewater sampling took place on January 18, 2023. Porewater samples were collected following AECOM's SOPs. A porewater sampler was placed into the sediment of the surface water body and then suction (via syringes) was applied to purge three (3) tube volumes before the samples were collected. Samples were field filtered and collected in laboratory supplied containers and kept below a temperature of 10 degrees Celsius until submission to the laboratory.

A total of five (5) porewater samples (PW1 to PW4) (including one (1) field duplicate) were collected during this field program and submitted for metals (incl. mercury) analysis, and select samples were also submitted for general chemistry analysis.

Porewater sampling locations are shown on **Figure 9**, **Appendix A**.

4.2.3.4 Sediment Sampling Procedures

Sediment sampling took place immediately after porewater sampling on January 16, 2023. Sediment samples were collected following AECOM's SOPs. An Ekman dredge sampler was used to collect the sediment samples by lowering it into the water until the grab hit the bottom of the waterbody. Samples were collected in laboratory supplied containers.

A total of twenty (20) sediment samples were collected during this field program and submitted for metals (incl. mercury) analysis and select samples were also submitted for SEM/AVS analysis to assess bio-accessibility *(RESULTS PENDING)*. The sediment samples were collected in the same location as the surface water samples with the same corresponding number (except for SW9 – no SED sample was collected at this location).

Sediment sampling locations are shown on **Figure 10**, **Appendix A**.

4.2.4 Sample Collection and Analysis

All samples collected as part of this program were submitted to Bureau Veritas Laboratories (BV Labs) located in Bedford, Nova Scotia, for chemical analyses. BV Labs is accredited to ISO/IEC 17025 standards by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC). Laboratory methods and analytical results for each chemical analysis are provided with the laboratory Certificate of Analysis (COAs).

The field program and laboratory analyses are summarized in **Table 3** below.

Table 3: Field and Laboratory Program

Media	Analysis	Samples Submitted	Sample IDs	QAQC Samples	
				Field Duplicates	Analysis
Groundwater					
Groundwater	Metals incl. mercury, General Chemistry (MW23A, DUP1)	4	MW17-2, MW22A, MW23A, MW27A	DUP 1	Metals incl. mercury, General Chemistry
Surface Water and Sediment – Assessment					
Surface Water	Metals incl. mercury, General Chemistry (SW1, SW9)	19	SW1 to SW10 SW12 to SW20	SWDUP1 SWDUP2	Metals incl. mercury
Sediment	Metals incl. mercury, SEM/AVS analysis (select samples) to assess bio-accessibility *(RESULTS PENDINIG)*	18	SED-1 to SED-8, SED-10, SED-12 to SED-20	SEDDUP1 SEDDUP2	Metals incl. mercury
Porewater					
Pore Water	Metals incl. mercury, General Chemistry (PW4)	5	PW1 to PW4	PWDUP1	Metals incl. mercury

4.2.5 Quality Assurance and Quality Control

AECOM's site investigation and quality control program for Phase II ESA activities followed standard QA/QC procedures in accordance with AECOM standard operating procedures (SOPs) to minimize any cross-contamination between samples. Clean nitrile gloves were used throughout the investigation program to eliminate cross-contamination between sampling points.

All field personnel were instructed in proper sampling handling, documentation, and chain-of-custody (COC) procedures before beginning field activities. The field sampler was personally responsible for the care and custody of samples until transferred to the laboratory. A COC record was provided to the analytical laboratory at the time of sample submission. When transferring the possession of samples, the individuals relinquishing and receiving the samples completed the appropriate laboratory forms with the required signature, date and noted the time on the record.

AECOM field personnel followed strict sample collecting handling practices, including changing disposable gloves for each sample collected and decontamination of field sampling equipment between samples, to ensure the integrity of sample collection. All samples were collected in pre-cleaned laboratory supplied containers with the appropriate preservatives provided within the sample containers and all samples were submitted for individual analysis within the laboratory prescribed hold times. Samples were packaged in coolers with sufficient packing material to ensure safe shipment of glass containers and ice was placed in coolers to maintain sample temperatures. All samples were kept below a temperature of 10°C once sampled until submission to the laboratory.

AECOM collected field QA/QC samples to assess for sampling induced variability. **Table 4** below shows the blind field duplicate samples that were submitted for laboratory analyses.

Table 4: Field Duplicate Sample Submission

Field Duplicate Sample ID	Corresponding Sample ID	Laboratory Analyses
Groundwater		
DUP1	MW-23A	Metals incl. mercury, General Chemistry
Surface Water		
SW-DUP1	SW-1	Metals incl. mercury + Gen. Chemistry (parent samples only)
SW-DUP2	SW-9	
Porewater		
PW-DUP1	PW-1	Metals incl. mercury
Sediment		
SEDDUP1	SED-1	Metals incl. mercury
SEDDUP2	SED-8	Metals incl. mercury

BV Labs also undertakes internal duplicate analyses for QA/QC purposes using laboratory duplicates, process blanks, process recovery and matrix spike analyses.

4.3 Field Investigation Observations

4.3.1 Groundwater

Free product was not encountered in any of the monitoring wells visited. No odours were noted on-site while completing groundwater sampling. Light brown tinge and grey tinge, and silt/sand were noted while purging the wells.

In general, the groundwater flow direction is to the south toward the Atlantic Ocean as shown on **Figure 7**, **Appendix A**. The hydraulic conductivity values derived from the packer tests, completed by previous consultants, ranged from 5.70E-07 centimetres per second (cm/s) to 2.82E-04 cm/s (GHD, 2022).

4.3.2 Surface Water

Surface water samples were noted to have a slightly yellow tinge, an almost orange tinge (SW2 and SW3), or clear with orange floating particulate (SW8). No odour or hydrocarbon sheen were noted in the surface water samples.

4.3.3 Porewater

Pore water samples were noted to have a brownish or yellow tinge with traces of silt / sand at select locations. No odour or hydrocarbon sheen were noted in the surface water samples.

4.3.4 Sediment

Sediment samples were noted to be dark brown or grey in color with some rock, silt and organics. No staining or odour were noted in the sediment samples.

4.4 Laboratory Analytical Results

Sampling locations are shown on figures presented in **Appendix A**, analytical results are presented in **Appendix B**, and Laboratory Certificates of Analysis (COAs) are presented in **Appendix C**. Results are described in the sections to follow.

4.4.1 Groundwater Summary

Table 5 below shows the exceedances that were found during the groundwater sampling program.

Table 5: Groundwater Sample Exceedances

Sample ID	Sample Date	Parameter / Concentration (µg/L)	NSE-EQS [1] Guideline Concentration (µg/l)	NSE-EQS [2] (Freshwater) Guideline Concentration (µg/l)
MW17-2	2023-01-16	■ Aluminum: 170	N/A	■ Aluminum: 50
MW22A	2023-01-16	■ Arsenic: 110 ■ Iron: 7,200 ■ Manganese: 250	■ Arsenic: 10 ■ Manganese: 120	■ Arsenic: 50 ■ Iron: 3,000
MW23A	2023-01-16	■ Aluminum: 60 ■ Iron: 4,300 ■ Manganese: 170	■ Manganese: 120	▪ Aluminum: 50 ▪ Iron: 3,000
MW23A (FD)	2023-01-16	■ Aluminum: 60 ■ Iron: 4,100 ■ Manganese: 170	■ Manganese: 120	▪ Aluminum: 50 ▪ Iron: 3,000 ▪
MW27A	2023-01-16	No Exceedances	N/A	N/A

Notes:
[1]: Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Groundwater – residential, potable water, coarse grained soils (Table 4A)
[2]: Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Groundwater Discharging to Surface Water (>10 m from Surface Water Body - Freshwater) (Table 3)

4.4.2 Surface Water Summary

Table 6 below shows the exceedances that were found during the surface water sampling program.

Table 6: Surface Water Sample Exceedances

Sample ID	Sample Date	Parameter / Concentration (µg/L)	NSE-EQS [1] (Marine) Guideline Concentration (ug/l)	NSE-EQS [2] (Freshwater) Guideline Concentration (ug/l)
SW 1	2023-01-18	■ Aluminum: 72 ■ Arsenic: 2,600 ■ Cobalt: 1.8 ■ Iron: 2,300 ■ pH: 5.93	N/A	■ Aluminum: 5 ■ Arsenic: 5 ■ Cobalt: 1.0 ■ Iron: 300 ■ pH: 6.5 – 9.0
SW 1 (FD)	2023-01-18	■ Aluminum: 75 ■ Arsenic: 2,600 ■ Cobalt: 1.6 ■ Iron: 2,300 ■ pH: 6.09	N/A	■ Aluminum: 5 ■ Arsenic: 5 ■ Cobalt: 1.0 ■ Iron: 300 ■ pH: 6.5 – 9.0
SW 2	2023-01-18	■ Aluminum: 630 ■ Arsenic: 1,200 ■ Iron: 3,200 ■ Lead: 2.1	N/A	■ Aluminum: 5 ■ Arsenic: 5 ■ Iron: 300 ■ Lead: 1
SW 3	2023-01-18	■ Aluminum: 1,100 ■ Arsenic: 1,800	N/A	■ Aluminum: 5 ■ Arsenic: 5

Sample ID	Sample Date	Parameter / Concentration (µg/L)	NSE-EQS [1] (Marine) Guideline Concentration (ug/l)	NSE-EQS [2] (Freshwater) Guideline Concentration (ug/l)
		▪ Iron: 5,100 ▪ Lead: 3.9		▪ Iron: 300 ▪ Lead: 1
SW 4	2023-01-16	▪ Aluminum: 350 ▪ Arsenic: 30 ▪ Iron: 480	N/A	▪ Aluminum: 5 ▪ Arsenic: 5 ▪ Iron: 300
SW 5	2023-01-16	▪ Aluminum: 130 ▪ Arsenic: 75	N/A	▪ Aluminum: 5 ▪ Arsenic: 5
SW 6	2023-01-16	▪ Aluminum: 120 ▪ Arsenic: 61 ▪ Iron: 310 ▪ Zinc: 7.3	N/A	▪ Aluminum: 5 ▪ Arsenic: 5 ▪ Iron: 300 ▪ Zinc: 7
SW 7	2023-01-16	▪ Aluminum: 330 ▪ Arsenic: 39 ▪ Iron: 520	N/A	▪ Aluminum: 5 ▪ Arsenic: 5 ▪ Iron: 300
SW 8	2023-01-18	▪ Aluminum: 120 ▪ Arsenic: 180 ▪ Iron: 580 ▪ Zinc: 10	N/A	▪ Aluminum: 5 ▪ Arsenic: 5 ▪ Iron: 300 ▪ Zinc: 7
SW 8 (FD)	2023-01-18	▪ Aluminum: 490 ▪ Arsenic: 670 ▪ Cadmium: 0.094 ▪ Cobalt: 3.3 ▪ Copper: 2.8 ▪ Iron: 31,000 ▪ Lead 1.1 ▪ Manganese: 490 ▪ Zinc: 16	N/A	▪ Aluminum: 5 ▪ Arsenic: 5 ▪ Cadmium: 0.09 ▪ Cobalt: 1 ▪ Copper: 2 ▪ Iron: 300 ▪ Lead 1 ▪ Manganese: 430 ▪ Zinc: 7
SW 9	2023-01-18	▪ Arsenic: 51 ▪ pH: 5.49	▪ Arsenic: 12.5 ▪ pH: 7.0-8.7	N/A
SW 10	2023-01-18	▪ Aluminum: 300 ▪ Arsenic: 51 ▪ Iron: 540	N/A	▪ Aluminum: 5 ▪ Arsenic: 5 ▪ Iron: 300
SW 12	2023-01-18	▪ Arsenic: 53	▪ Arsenic: 12.5	N/A
SW 13	2023-01-18	▪ Arsenic: 46	▪ Arsenic: 12.5	N/A
SW 14	2023-01-18	▪ Arsenic: 47	▪ Arsenic: 12.5	N/A
SW 15	2023-01-18	▪ Arsenic: 56	▪ Arsenic: 12.5	N/A
SW 16	2023-01-18	▪ Arsenic: 41 ▪ Boron: 1,500	▪ Arsenic: 12.5 ▪ Boron: 1,200	N/A
SW 17	2023-01-18	▪ Arsenic: 20 ▪ Boron: 2,200	▪ Arsenic: 12.5 ▪ Boron: 1200	N/A
SW 18	2023-01-18	▪ Aluminum: 300 ▪ Arsenic: 51 ▪ Iron: 520	N/A	▪ Aluminum: 5 ▪ Arsenic: 5 ▪ Iron: 300
SW 19	2023-01-18	▪ Aluminum: 320 ▪ Arsenic: 66 ▪ Iron: 610	N/A	▪ Aluminum: 5 ▪ Arsenic: 5 ▪ Iron: 300
SW 20	2023-01-16	▪ Aluminum: 280 ▪ Arsenic: 51 ▪ Iron: 530	N/A	▪ Aluminum: 5 ▪ Arsenic: 5 ▪ Iron: 300

Notes:
[1]: Nova Scotia Environment (NSE) Tier I Environmental Quality Standards (EQS) for Surface Water and Groundwater Discharging to Surface Water (Marine) (Table 3) (for the following samples: SW-9, SW-11, SW-12, SW-13, SW-14)
[2]: Nova Scotia Environment (NSE) Tier I Environmental Quality Standards (EQS) for Surface Water and Groundwater Discharging to Surface Water (Freshwater) (Table 3)

4.4.3 Porewater Summary

Table 7 below shows the exceedances that were found during the porewater sampling program.

Table 7: Porewater Sample Exceedances

Sample ID	Sample Date	Parameter / Concentration (ug/L)	NSE-EQS [1] (Marine) Guideline Concentration (ug/l)	NSE-EQS [2] (Freshwater) Guideline Concentration (ug/l)
PW1	2023-01-18	▪ Aluminum: 60 ▪ Arsenic: 29,000 ▪ Cobalt: 1.5 ▪ Iron: 32,000 ▪ Mercury: 0.035	N/A	▪ Aluminum: 5 ▪ Arsenic: 5 ▪ Cobalt: 1 ▪ Iron: 300 ▪ Mercury: 0.026
PW1 (FD)	2023-01-18	▪ Aluminum: 60 ▪ Arsenic: 29,000 ▪ Cobalt: 1.5 ▪ Iron: 32,000 ▪ Mercury: 0.033	N/A	▪ Aluminum: 5 ▪ Arsenic: 5 ▪ Cobalt: 1 ▪ Iron: 300 ▪ Mercury: 0.026
PW2	2023-01-18	▪ Aluminum: 390 ▪ Arsenic: 1,800 ▪ Cobalt: 1.5 ▪ Iron: 15,000	N/A	▪ Aluminum: 5 ▪ Arsenic: 5 ▪ Cobalt: 1 ▪ Iron: 300
PW3	2023-01-18	▪ Aluminum: 32 ▪ Arsenic: 590 ▪ Cadmium: 0.17 ▪ Cobalt: 15 ▪ Iron: 1,600 ▪ Manganese: 2,600 ▪ Zinc: 13	N/A	▪ Aluminum: 5 ▪ Arsenic: 5 ▪ Cadmium: 0.09 ▪ Cobalt: 1 ▪ Iron: 300 ▪ Manganese: 430 ▪ Zinc: 7
PW4	2023-01-18	▪ Arsenic: 150 ▪ Cobalt: 5.9 ▪ Copper: 2.8 ▪ Lead: 3.4 ▪ pH: 6.70	▪ Arsenic: 12.5 ▪ Cobalt: 4 ▪ Copper: 2 ▪ Lead: 2 ▪ pH: 7.0 – 8.7	N/A

Notes:
[1]: Nova Scotia Environment (NSE) Tier I Environmental Quality Standards (EQS) for Surface Water and Groundwater Discharging to Surface Water (Marine) (Table 3) (for the following samples: PW-4)
[2]: Nova Scotia Environment (NSE) Tier I Environmental Quality Standards (EQS) for Surface Water and Groundwater Discharging to Surface Water (Freshwater) (Table 3) (for the following samples: PW-1, PW-2, PW-3)

4.4.4 Sediment Summary

Table 8 below shows the exceedances that were found during the surface water sampling program.

Table 8: Sediment Sample Exceedances

Sample ID	Sample Date	Parameter / Concentration (mg/kg)	NSE-EQS [1] (Marine) Guideline Concentration (mg/kg)	NSE-EQS [2] (Freshwater) Guideline Concentration (mg/kg)
SED-1	2023-01-08	▪ Arsenic: 160,000 ▪ Iron: 230,000 ▪ Mercury: 0.83	N/A	▪ Arsenic: 17 ▪ Iron: 43,766 ▪ Mercury: 0.486
SEDDUP1	2023-01-08	▪ Arsenic: 140,000 ▪ Iron: 210,000 ▪ Mercury: 0.8	N/A	▪ Arsenic: 17 ▪ Iron: 43,766 ▪ Mercury: 0.486
SED-2	2023-01-08	▪ Arsenic: 6,700 ▪ Mercury: 4.3	N/A	▪ Arsenic: 17 ▪ Mercury: 0.486

Sample ID	Sample Date	Parameter / Concentration (mg/kg)	NSE-EQS [1] (Marine) Guideline Concentration (mg/kg)	NSE-EQS [2] (Freshwater) Guideline Concentration (mg/kg)
		▪ Silver: 1.0		▪ Silver: 0.5
SED-3	2023-01-08	▪ Arsenic: 3,800 ▪ Mercury: 7.9 ▪ Silver: 3.1	N/A	▪ Arsenic: 17 ▪ Mercury: 0.486 ▪ Silver: 0.5
SED-4	2023-01-18	▪ Antimony: 28 ▪ Arsenic: 43,000 ▪ Iron: 54,000 ▪ Lead: 270 ▪ Mercury: 12 ▪ Silver: 0.75	N/A	▪ Antimony: 25 ▪ Arsenic: 17 ▪ Iron: 43,766 ▪ Lead: 91.3 ▪ Mercury: 0.486 ▪ Silver: 0.5
SED-5	2023-01-18	▪ Arsenic: 550	N/A	▪ Arsenic: 17
SED-6	2023-01-18	▪ Arsenic: 74	N/A	▪ Arsenic: 17
SED-7	2023-01-18	▪ Arsenic: 4700 ▪ Mercury: 4	N/A	▪ Arsenic: 17 ▪ Mercury: 0.486
SED-8	2023-01-18	▪ Arsenic: 31,000 ▪ Iron: 180,000 ▪ Manganese: 1,700 ▪ Silver: 0.99	N/A	▪ Arsenic: 17 ▪ Iron: 43,766 ▪ Manganese: 1,100 ▪ Silver: 0.5
SEDDUP2	2023-01-18	▪ Arsenic: 10,000 ▪ Iron: 96,000 ▪ Lead: 100 ▪ Manganese: 1,900 ▪ Silver: 1.2 ▪ Zinc: 370	N/A	▪ Arsenic: 17 ▪ Iron: 43,766 ▪ Lead: 91.3 ▪ Manganese: 1,100 ▪ Silver: 0.5 ▪ Zinc: 315
SED-10	2023-01-18	▪ Arsenic: 2,300 ▪ Manganese: 5,200 ▪ Mercury: 0.52	N/A	▪ Arsenic: 17 ▪ Manganese: 1,100 ▪ Mercury: 0.486
SED-12	2023-01-18	▪ Arsenic: 380	▪ Arsenic: 41.6	N/A
SED-13	2023-01-18	▪ Arsenic: 230	▪ Arsenic: 41.6	N/A
SED-14	2023-01-18	▪ Arsenic: 410	▪ Arsenic: 41.6	N/A
SED-15	2023-01-18	▪ Arsenic: 480	▪ Arsenic: 41.6	N/A
SED-16	2023-01-18	▪ Arsenic: 310	▪ Arsenic: 41.6	N/A
SED-17	2023-01-18	▪ Arsenic: 240	▪ Arsenic: 41.6	N/A
SED-18	2023-01-18	▪ Arsenic: 520	N/A	▪ Arsenic: 17
SED-19	2023-01-18	▪ Arsenic: 1,200 ▪ Mercury: 2.9	N/A	▪ Arsenic: 17 ▪ Mercury: 0.486
SED 20	2023-01-18	▪ Arsenic: 1,300	N/A	▪ Arsenic: 17

Notes:
[1]: Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Sediment (marine); Table 2
[2]: Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Sediment (freshwater); Table 2

4.5 Summary and Findings

The findings and conclusions presented in this report apply only to the recognized environmental conditions assessed at the Site. **Table 9** below summarizes the findings related to groundwater, surface water, sediment, and porewater investigations completed as part of the scope of work for this Phase II ESA. The maximum concentration between the two sampling events (July 2022 and January 2023) is presented in the table below. The Phase II findings for soil, tailings and waste rock have been presented in **Section 4.1**.

Table 9: Phase II ESA Summary of Findings

Phase II ESA Activities		Phase II ESA Findings
Groundwater		
1.	Sampling of the four (4) pre-existing wells on-Site: MW17-2, MW22A, MW23A, MW27A	▪ Arsenic impacts were identified at one (1) of the four (4) wells (MW22A) ▪ The following impacts were identified at select wells (maximum concentrations in brackets): - Aluminum (270 µg/L) – July 2022 - Arsenic (150 µg/L) – July 2022 - Iron (8,800 µg/L) – July 2022 - Manganese (350 µg/L) – July 2022
Surface Water and Sediment		
2.	Collected three (3) SW and three (3) SED samples from previously sampled locations in 2022: SW3/SED3, SW4/SED4, SW7/SED7 Three (3) locations between the former Stamp Mills near Gold Brook Lake and the former Stamp Mill located near Seal Harbour Lake	**Surface Water:** ▪ Arsenic, aluminum and iron impacts were identified at all three (3) SW locations. ▪ The following impacts were identified at select SW locations (maximum concentrations in brackets): - Aluminum (1,100 µg/L) – Jan. 2023 - Arsenic (1,800 µg/L) – Jan. 2023 - Iron (5,100 µg/L) – Jan. 2023 - Lead (3.9 µg/L) – Jan. 2023 **Sediment:** ▪ Arsenic and mercury impacts were identified at all three (3) SED locations. ▪ The following impacts were identified at select sediment locations (maximum concentrations in brackets): - Antimony (34 mg/kg) – July 2022 - Arsenic (57,000 mg/kg) – July 2022 - Iron (100,000 mg/kg) – July 2022 - Lead (270 mg/kg) – Jan. 2023 - Mercury (68 mg/kg) – July 2022 - Nickel (91 mg/kg) – July 2022 - Silver (4 mg/kg) – July 2022
3.	Collected one (1) SW and sediment sample from previously sampled location in 2022: SW20/SED20 Outlet of Seal Harbour Lake to the east.	**Surface Water:** ▪ The following impacts were identified at this SW location (maximum concentrations in brackets): - Arsenic (330 µg/L) – July 2022 - Aluminum (330 µg/L) – July 2022 - Iron (1,600 µg/L) – July 2022 **Sediment:** ▪ The following impacts were identified at this SED location: - Arsenic (1,300 mg/kg) – Jan. 2023
4.	Collected two (2) SW samples and two (2) SED samples from previously sampled locations in 2022: SW10/SED10, SW18/SED18 First Pond and Second Pond	**Surface Water:** First Pond (SW10): ▪ The following impacts were identified at this SW location (maximum concentrations in brackets): - Arsenic (280 µg/L) – July 2022 - Aluminum (360 µg/L) – July 2022 - Iron (1,500 µg/L) – July 2022 Second Pond (SW18): ▪ The following impacts were identified at this SW location (maximum concentrations in brackets): - Arsenic (280 µg/L) – July 2022 - Aluminum (330 µg/L) – July 2022 - Iron (1,500 µg/L) – July 2022 **Sediment:** First Pond (SED10):

	Phase II ESA Activities	Phase II ESA Findings
		▪ The following impacts were identified at this SED location (maximum concentrations in brackets): - Arsenic (2,300 mg/kg) – Jan. 2023 - Manganese (5,200 mg/kg) – Jan. 2023 - Mercury (0.52 mg/kg) – Jan. 2023 Second Pond (SED18): ▪ The following impacts were identified at this SED location: - Arsenic (Max. Concentration: 520 mg/kg) – July 2022
5.	Collected one (1) SW sample for previously sampled location in 2022: SW9 Outlet to the Atlantic Ocean.	**Surface Water:** ▪ The following impacts were identified at this SW location (maximum concentrations in brackets): - Arsenic (270 µg/L) – July 2022 - Mercury (0.02 µg/L) – July 2022 - pH (5.49) – Jan. 2023 **Sediment – only collected in July 2022:** ▪ The following impacts were identified at this SED location: - Arsenic (Max. Concentration: 440 mg/kg) – July 2022
6.	Collected three (3) SW and three (3) sediment samples from previously sampled locations in 2022: SW5/SED5, SW6/SED6, SW8/SED8 Areas of ponded water south of the waste rock pile southwest of Gold Brook Lake.	**Surface Water:** ▪ Arsenic, aluminum and iron impacts were identified at all three (3) SW locations. ▪ The following impacts were identified at select SW locations (maximum concentrations in brackets): - Aluminum (490 µg/L) – Jan. 2023 - Arsenic (1,100 µg/L) – July 2022 - Cadmium (0.094 µg/L) – Jan. 2023 - Cobalt (3.3 µg/L) – Jan. 2023 - Copper (2.8 µg/L) – Jan. 2023 - Iron (3,700 µg/L) – July 2022 - Lead (1.1 µg/L) – Jan. 2023 - Manganese (490 µg/L) – Jan. 2023 - Zinc (16 µg/L) – Jan. 2023 **Sediment:** ▪ Arsenic impacts (Max. Concentration: 31,000 mg/kg – Jan. 2023) were identified at all SED locations. Other impacts are summarized as follows (maximum concentrations in brackets): - Iron (180,000 mg/kg) – Jan. 2023 - Lead (110 mg/kg) – Jan. 2023 - Manganese (1,900 mg/kg) – Jan. 2023 - Silver (2.7 mg/kg) – July 2022 - Zinc (370 mg/kg) – Jan. 2023 -
7.	Collected two (2) SW samples and two (2) SED samples from previously sampled locations in 2022: SW1/SED1, SW2/SED2 Near the tailings plumes southeast of Gold Brook Lake.	**Surface Water:** ▪ The following impacts were identified at select SW locations (maximum concentrations in brackets): - Aluminum (2,100 µg/L) – July 2022 - Arsenic (7,800 µg/L) – July 2022 - Cobalt (1.8 µg/L) – Jan. 2023 - Copper (2.2 µg/L) – July 2022 - Iron (18,000 µg/L) – July 2022 - Lead (9.4 µg/L) – July 2022 - Mercury (0.09 µg/L) – July 2022 - Zinc (14 µg/L) – July 2022 - pH (5.93) – Jan. 2023

<table>
<tr><th colspan="2">Phase II ESA Activities</th><th>Phase II ESA Findings</th></tr>
<tr><td></td><td></td><td><u>Sediment:</u>
■ The following impacts were identified at select SED locations (maximum concentrations in brackets):
- Arsenic (160,000 mg/kg) – Jan. 2023
- Iron (230,000 mg/kg) – Jan. 2023
- Mercury (6.7 mg/kg) – July 2022
- Silver (1.4 mg/kg) – July 2022</td></tr>
<tr><td>8.</td><td>Collected three (3) SW samples and three (3) SED samples from previously sampled locations in 2022: SW12/SED12, SW13/SED13, SW14/SED14

Long Cove – across the cove at the tailings edge</td><td><u>Surface Water:</u>
■ Arsenic impacts were identified at all three (3) SW locations.
■ The following impacts were identified at select SW locations (maximum concentrations in brackets):
- Arsenic (240 µg/L) – July 2022
- Boron (2,200 µg/L) – July 2022
- Mercury (0.018 µg/L) – July 2022

<u>Sediment:</u>
■ Arsenic impacts were identified at all three (3) SED locations.
- Arsenic (maximum concentration: 410 mg/kg) – Jan. 2023</td></tr>
<tr><td>9.</td><td>Collected three (3) SW samples and three (3) SED samples from new locations: SW15/SED15, SW16/SED16, SW17/SED17

Long Cove – across the cove at the tailings edge – collected behind SW12-SW14</td><td><u>Surface Water – only collected in Jan. 2023:</u>
■ Arsenic impacts were identified at all three (3) SW locations.
■ The following impacts were identified at select SW locations (maximum concentrations in brackets):
- Arsenic (56 µg/L)
- Boron (2,200 µg/L)

<u>Sediment – only collected in Jan. 2023:</u>
■ Arsenic (Max. Concentration: 480 mg/kg) impacts were identified at all three (3) SED locations.</td></tr>
<tr><td colspan="3">Porewater</td></tr>
<tr><td>10.</td><td>Five (5) porewater samples:
(PW-1 to PW-5)</td><td>■ The following impacts were identified from select porewater samples collected in freshwater bodies (PW-1, PW-2, PW-3) (maximum concentrations in brackets):
- Aluminum (170,000 µg/L) – July 2022
- Antimony (24 µg/L) – July 2022
- Arsenic (65,000 µg/L) – July 2022
- Barium (1,700 µg/L) – July 2022
- Beryllium (14 µg/L) – July 2022
- Cadmium (5.7 µg/L) – July 2022
- Chromium (230 ug/L) – July 2022
- Cobalt (270 µg/L) – July 2022
- Copper (360 µg/L) – July 2022
- Iron (1,100,000 µg/L) – July 2022
- Lead (1,700 µg/L) – July 2022
- Manganese (14,000 µg/L) – July 2022
- Mercury (14 µg/L) – July 2022
- Nickel (730 µg/L) – July 2022
- Silver (1.9 ug/L) – July 2022
- Thallium (3.1 ug/L) – July 2022
- Vanadium (220 ug/L) – July 2022
- Zinc (10,000 µg/L) – July 2022

■ The following impacts were identified from the porewater sample collected from the marine water body (PW-4) (maximum concentrations given in brackets):
- Arsenic (6,400 µg/L) – July 2022
- Boron (3,100 ug/L) – July 2022
- Cadmium (1.1 ug/L) – July 2022</td></tr>
</table>

Phase II ESA Activities		Phase II ESA Findings
		- Chromium (59 ug/L) – July 2022 - Cobalt (64 ug/L) – July 2022 - Copper (61 ug/L) – July 2022 - Lead (200 ug/L) – July 2022 - Mercury (0.63 ug/L) – July 2022 - Nickel (63 ug/L) – July 2022 - Thallium (1.8 ug/L) – July 2022 - Uranium (11 ug/L) – July 2022 - Vanadium (46 ug/L) – July 2022 - Zinc (230 ug/L) – July 2022

Notes: The data included in this table is based exclusively to AECOM findings. Any additional data previously collected by others is not included in this table.

The vertical and horizontal extent of soil and groundwater contamination has not yet been determined. Additional work will need to be completed to determine this information, as described in **Section 7.0**.

5. Summary of Other Relevant Information

Subsequent to the completion of the AECOM (2022) Phase II ESA, AECOM staff have engaged with researchers in various government agencies and academic institutions who have been involved in research activities surrounding metals in the environment associated with historical gold mining activities in Nova Scotia. These interactions have identified a significant volume of information related to contamination associated with historical mining, including information specific to the Gold Brook Lake and Seal Harbour Mine Site. The following provides a brief summary of select reports recently gathered from various government/academic sources.

It should be noted that source area impacts identified at what is named the “Lower Seal Harbour” site are located north and outside the Seal Harbour study area of this Updated Phase II ESA report. The source impacted area does however migrate/drain into the Gold Brook watercourse and then into the Seal Harbour Study Area. Historically speaking, the Gold Brook Lake site is referred to with various names over the years including the following: Upper Seal Harbour, Gold Brook, and a sub-area of Isaac’s Harbour.

Throughout the history of the site, there have been various companies who have been interested and involved with the site. It is worth noting that two companies changed their names during the investigation of the site and as a result reports from the same party have two names: Signal Mining (formerly Anaconda) and Pieridae Energy (formerly Keltic Petrochemical).

Summaries of relevant information associated with the Gold Brook and Seal Harbour sites are provided below.

NS Department of Environment – Arsenic Task Force – Interim Report, 1976

The task force was created because a historical patent was admitted for chronic arsenic (As) intoxication and their initial investigations found water from their drinking well “far exceeded” the drinking water standards of the time. People from suspected afflicted communities were interviewed for symptoms and had hair/nails/skin tested along will having their domestic water wells tested for arsenic concentration.

It was identified that 8 of the 21 areas investigated, over 5 counties within NS, reported arsenic exceedances in groundwater. Most exceedances were associated with Halifax County, but this is likely due to the large number of wells sampled in the Waverley area.

Key recommendations made by the task force include the following: Waverley groundwater no longer be consumed; any surface water body exceeding 0.05 mg/L be marked; a ban on moving mining wastes without approval; chemical testing of all future mine waste; the department investigate existing source rock for arsenic presence.

A follow up investigation in the mine site areas determined that arsenic concentration is lower in shallow dug wells verses drilled wells, there is significantly higher arsenic concentration downgradient of “tailings flats” or rock dumps, and there is not enough information to determine if there is seasonal variance.

Glover et al. – Mineral Resource Evaluation (NS, NB, ON) Vol. II, 1983

Ecological and Resources Consultants Limited (ERCL) developed a report to evaluate 895 mineral claims held by Seabright Resources Inc (SRI) under their 94 exploration licenses at 24 sites throughout southeastern NS, which includes claims/licenses/sites for properties containing tailings. The review determined that the collective sites had a proven 996,026 tonnes of tailings and likely more (661,626 probable and 533,957 possible).

Within this report, Seal Harbour is designated as Site 8 and the “Isaac’s Harbour” (Site 7) contains the Gold Brook Site (sub-area within Site 7 referred to as area 6). The report notes that the Seal Harbour facility crushed 41,696 tons of materials from 1894 to 1942 and Gold Brook removed 478,896 tons from 1862 to 1940. It also includes material deposit estimates and evaluates their state of development.

Figures 1-9 and 1-10 within the document show the sample locations and area designations for the two sites. The Jacques Whitford & Associates Ltd (JWAL) reports presented directly below include these samples and hand drawn depictions of Site 8 Area 2 and Site 8 Area 1 Extension.

Jacques Whitford & Associates Ltd. – Nova Scotia Gold Tailings Sampling Program, 1983

The document contains a review of 15 former gold mine sites within Nova Scotia and was generated for Seabright Resources Inc., which was a gold exploration company. SRI refers to Seal Harbour as Site 8 and Gold Brook as Site 7 (Isaac's Harbour). 54 samples were collected within Site 7 over nine areas. Based on the ERCL Mineral Resource Evaluation Figure 1-9, The Gold Brook site was named "area 6" of this evaluation.

Site 8 was sampled 26 times across three sub areas based on the data, Areas 1-Extension and Area 2 have hand drawn figures. Additionally, Figure 1-10 from the 1983 ECRL report has a more high-level perspective. Twenty (8-1-1 to 8-1-20) samples were taken in a waterbody labelled as "Seal Harbour Lake", but more recent records consider the larger lake above it as "Seal Harbour Lake" and Area 1 is unlabelled. Two samples were collected at the outlet of Seal Harbour Lake to the Ocean (8-1-21 and 8-1-22), five were collected by the "old cyanide mill" (8-2-1 to 8-2-5). Area 1 and 2 are within the same waterbody connected through a small channel. Sable Road appears to be an access road and ends at Area 2. The results are discussed in the 1984 report prepared for Seabright Resources Inc. in the JWAL 1985 Report below.

Jacques Whitford & Associates Ltd. – Gold Tailings 1984, Report Volume I, 1985

This report was developed for Seabright Resources Inc., which was a gold exploration company. The objective of the report was to "develop sufficient reserves of tailings material to support the establishment of gold and possible base metal processing materials".

This report combines the Seal Harbour and Gold Brook sites into one, Site 2 – Seal Harbour. The report does not provide a figure showing the delineation of the sub-areas, and only provides a limited description on how to interpret the sub-areas.

It notes that both the Upper and Lower Seal Harbour facilities discharged their tailings into the lakes nearby, which then flowed/discharged into Seal Harbour. The tailings samples taken at the Upper Seal Harbour site were taken for purposes of determining a reserve value; however, the Lower Seal Harbour Site samples were collected more in respect to site reconnaissance.

The report concludes that the total proven number of tailings at each sub-area and provides a "probable estimate" of the non-measured tailings. It was estimated over the 8 sub-areas reviewed within the Upper Seal Harbour areas, that there were approximately 204,341 tonnes of tailings with 0.89 g of gold per tonne (200 kg of gold). The report estimated that there was still probable 108,297 tonnes of tailings throughout the site with 1.15 g/tonne (125 kg of gold) for a total estimate of 312,638 tonnes of tailings.

Orex Exploration – Environmental Assessment Report for a Proposed Gold Mine Project At Goldboro, 1990

This document was submitted by Exploration Orex Inc. (Orex) to NSE to aid in facilitating the provincial approval process for a new mining operation within the Goldbrook study area. The proposed mine operation was expected to be an underground operation extracting 1000 tonnes per day and have an on-site mill and refinery (which included cyanide as part of the processing). The initial expected mine life was 3 years, but longer term operations were expected based on known deposits in the area.

The report contains a layout of the old mine in detail (Figure 1-3 of the report), a new proposed layout (Figure 1-5), a mill process flow diagram (Figure 1-7) and layout (Figure 1-8).

The report noted that no surface water chemistry analytical data was available for the streams on site prior to their work commencement in 1988. They established 5 stations and surface water samples were collected daily for arsenic, suspended solids, and pH along with weekly surface water samples for oil and grease, metals, ammonia, organic carbon. STN1 was the inlet for Gold Brook Lake, STN2 was Rock Lake Brook (north end of GB Lake), and STN3 was in the river system south of site. The program determined that the past and/or present mining activities have affected the surface water quality of Gold Brook.

Groundwater was collected during the Moston – Richardson shaft dewatering process. The report notes that 8 of the 38 parameters analyzed were above the allowable limit for the protection of Freshwater Aquatic Life based on the Canadian Water Quality Guidelines (1987). The parameters exceeding these guidelines were: ammonia, arsenic, iron, manganese, phosphate, colour, turbidity, and suspended solids. The only measured parameter that varied significantly during the dewatering process was pH.

Orex also performed a fish study of the nearby area as well. They identified three significantly sized lakes in the study area (Gold brook, and Rocky Lakes (two lakes)). Gold Brook Lake was surveyed in 1985 by the province and found the lake had a fish community of yellow perch and eels. Only 1 brook trout was caught. Orex conducted a survey in 1989 and only caught Yellow Perch (14 fish) and reportedly confirmed that few, if any, residents of the area fish in the vicinity due to the lack of trout. The Rocky Lakes were not sampled, locals reported that the lakes do support brook trout. A brook trout was also caught via electrofishing in the stream between Gold Brook Lake and Rocky Lakes.

Three small brook trout were also caught in Gold Brook south of the site, in addition to surface water and sediment samples collected where they were caught. The water sample had high levels of TSS, Na, SO4, and arsenic. From Gold Brook. The total arsenic concentrations within the fish tissue averaged 7.2 ug/g, which is nearly 100 times larger than the average arsenic concentration found in fish within the great lakes. Another brook trout was caught in the brook that flows southeast to Hay Lake, indicating that the fish are present within that brook as well.

The report also contains evaluations on: Marine Life in The Seal Harbour, Aquaculture in the area (fishing rates of shellfish, finfish, and molluscs), Wetlands and Waterfowl, Mammals and Birds, and provide details on Rare and Endangered Species in the area (at the time of the report).

Woodman et al. (NS DNR)- Compilation of Seabright Resources Inc. (SRI) Till and Soil geochemical Data (94-021), 1994

The purpose of the documentation was to generate a geoscience database of regional soil and till geochemical data completed as part of gold exploration during 1986 to 1988 by SRI. The report includes 1986 Orientation Surveys, 1986 Regional Surveys in the eastern Meguma terrane, and the 1987 and 1988 regional surveys in eastern and southwest Meguma terrane. The total number of till samples collected in the compilation was 4,455 soil samples across 19 zones. There were 304 samples collected in the Seal Harbour zone (11 F 04).

The total review generally concluded that certain areas with high gold concentrations (>10 ppb) also have high gold in conjunction with Heavy Mineral Concentrations. High and anomalous arsenic values are commonly associated with anomalous gold values. High and anomalous antimony values associated with anomalous gold values are less common than arsenic but are considered locally significant. The data collected in this compilation is used in later reports presented below.

Goodwin et al (NS DNR) – Multi-element Distribution in Humus, Soil, Till, Rock and Tailings Associated with Historic Gold Districts of the Meguma Zone Report, Nova Scotia, 2003

The main objective of the program was to examine the distribution of metals in the environment associated with past producing gold districts throughout the province, which included the Goldbrook and the Seal Harbour (GBSH) sites. They determined these for humus, soil and till by characterizing regional and local background concentrations and speciation of the elements. The authors also anticipated that off-site transport of the elements from mine waste such as tailings, and the transformation and fate of these elements in receiving environments can be quantified.

The report examines the geology of Nova Scotia and observes that the historic goldmines being examined are within a geological terrane. The area being evaluated is called the Meguma Terrane and its gold deposits are characterised by an enrichment of gold and arsenic with lesser enrichment of copper, lead, zinc, tungsten, bismuth, tellurium, and iron (plus other elements and minerals). The GBSH sites are within a sub-formation called the "Goldenville Formation". The report observes that "The Meguma Terrane has been extensively mapped and sampled by Nova Scotia Department of Natural Resources (NSDNR) and the Geological Survey of Canada,"

This report does not discuss any analytical data as these results were pending when the report was published. A follow-up report was issued in 2004 (presented below).

Parsons et al. – Distribution and Speciation of Elements Associated with Historical Mine Tailings at Selected Lode Gold Deposits of the Meguma Terrane, Southern Nova Scotia, 2003

This is the summary of the findings for the first year of a three-year program to examine the distribution and speciation of elements associated with Historical Mine Tailings Deposits of the Meguma Terrane. A description of the program can be found in "Multi-element Distribution in Humus, Soil, Till, Rock and Tailings Associated with Historic Gold Districts of the Meguma Zone Report, Nova Scotia, 2003". This memo discusses some of the results and the expected next steps.

Hyperspectral and polarized radar measurements of the tailings and vegetation at Upper and Lower Seal Harbour were carried out by Geomatics Canada, and samples of water, sediments, and tailings were collected from Lake Catcha and Lower Seal Harbour by the University of Ottawa for microbial measurements and methylmercury analyses.

At most sites, the mine tailings display a well-developed vertical stratigraphy, with reddish-brown oxidized tailings overlying grey, unoxidized tailings. X-ray diffraction results show that secondary minerals such as scorodite ($Fe+3AsO_4•2H_2O$) are abundant at many sites; these phases may serve as a temporary sink for elements released from the mine wastes. Preliminary water chemistry data indicate that the dissolved (<0.45 μm) concentrations of arsenic are very high at some locations (up to 6200 μg/L), as compared to background values of generally less than 25 μg/L (the Health Canada drinking water guideline at the time). Additional chemical and mineralogical results were pending.

Goodwin (NS DNR) – Multi-element Distribution in Humus, Soil and Till Associated with the Upper and Lower Seal Harbour Gold Districts (NTS 11F/04), Nova Scotia, 2004

This document reports on the second year of a 3-year program. This is a follow up report from the 2003 "Multi-element Distribution in Humus, Soil, Till, Rock and Tailings Associated with Historic Gold Districts of the Meguma Zone" report. After sampling each of the ten districts during the 2003 field season, the Upper and Lower Seal Harbour gold districts (Goldbrook and Seal Harbour) were chosen for detailed follow-up work during the 2004 field season. Twenty-two regional samples were collected from the Upper and Lower Seal Harbour gold districts from an area covering approximately 120 km^2 (Figure.1 of the report).

Samples were not collected within our current study area, but 5 samples were within 3 kilometres (km) to the north of the Goldbrook site and 11 samples were taken along an unnamed road west of Ocean Lake. It should be noted that the report considers 16 of 22 samples close enough to the Goldbrook site (Boston Richardson Mill) to be considered in the discussion: "Conversely, almost all of the 16 soil samples collected within and near the footprint of the Boston Richardson Mill complex showed visible anthropogenic effects."

The report does not discuss any analytical data as the results were pending when the report was published. It should be noted that upon further discussions with the province (Nova Scotia Geological Survey), metals in soil analytical summary tables (with sample location coordinates) were provided for both 2003 and 2004 sampling events.

AMEC – Petrochemicals and Liquefied Natural Gas Facility – Environmental Assessment, Goldboro, NS, (2006)

Keltic Petrochemical Inc. (Keltic) proposed the construction and operation of a Petrochemical and Liquefied Natural Gas (LNG) Facility in Goldboro, Nova Scotia (the Project).

Surface water monitoring was conducted by Dillon Consulting Ltd. as part of the Environmental Assessment reporting during September till November in 2007. In total five (5) surface water samples were collected, and all samples were analyzed for general inorganic chemistry, metals, and petroleum hydrocarbons as per the monitoring program agreement. All analysis were compared to the Canadian Water Quality Guidelines (CWQG) for the Protection of Freshwater Aquatic Life (FWAL) and the Atlantic Partnership in Risk-Based Corrective Action Implementation (Atlantic PIRI) Guidelines for petroleum hydrocarbons.

The analytical results conclude that all samples were below the applicable guidelines for petroleum hydrocarbons and general comments included that pH were outside of (below) the guideline range of 6.5 to 9.0 and aluminium was above the applied guideline of 0.005 to 0.1 mg/L (pH dependant) in all samples.

Koch et. al - Arsenic bioaccessibility and speciation in clams and seaweed from a contaminated marine environment, 2007

The paper studied the human bioaccessible concentrations and speciation of arsenic from soft shell clams in Seal Harbour. The total arsenic for the clams from the contaminated area ranged from 218 to 228 ppm wet weight, with a bioaccessible fraction of 34–46%, and the major bioaccessible species of arsenic were inorganic. The seaweed from the contaminated area contained 27–43 ppm wet weight total arsenic, with the bioaccessible fraction ranging from 63–81%, and inorganic arsenic was also predominant.

The paper adds to the conclusion “the higher concentration and proportions of inorganic arsenic in clams and seaweed compared the control samples appear to reflect the elevated inorganic arsenic present in the sediment and the water surrounding the organisms, which are the likeliest arsenic exposure routes. This may be attributable to: (a) differences in the way the exposed organisms metabolize arsenic; (b) saturation of any metabolic pathways; (c) direct bioconcentration/uptake of arsenic by the organism; or (d) a combination of these reasons.

Smith et al. – An investigation of arsenic compounds in fur and feathers using X-ray absorption spectroscopy speciation and imaging, 2008

Historically, the accumulation of arsenic in fur and feathers has been used as an indicator of environmental quality and animal health. However, difficulties remain in distinguishing between arsenic present from external sources versus ingestion. The program attempted to use X-ray absorption spectroscopy (XAS) to determine the arsenic speciation within the samples. However, distinguishing whether internal arsenic arose from exogenous (from the environment) or endogenous (from the body) sources proved difficult with this technique.

Winch et al. – Factors Affecting Methylmercury Levels in Surficial Tailings from Historical Nova Scotia Gold Mines, 2008

The paper investigated the levels of mercury and methylmercury in former mine sites including Upper and Lower Seal Harbour. The program lasted two years and collected samples from tailings and surface water.

It concluded that the total mercury and methylmercury varied in concentration within the tailings (0.2 – 73.5 µmol/kg [0.04-15 mg/kg] and <dl – 56.4 µmol/kg [12.2 mg/kg], respectively) and elevated mercury was linked with >5 µmol/kg [>1 mg/kg], organic matter; hydrology; abundance and activity of sulfate reducing bacteria, and demethylation processes.

Methylmercury levels in tailings from a wet, bog-like site appeared to undergo seasonal fluctuations, with higher concentrations measured in September and October, and lower concentrations in May. The paper added “Evaluations of amalgamation tailings should examine [methylmercury] and [total mercury] transport out of low-lying, saturated tailings dumps after snowmelt and major rainfall events, and should take into account the possibility of seasonal variation in methylmercury levels in northern regions."

Parsons et al - Environmental geochemistry of tailings, sediments and surface waters collected from 14 historical gold mining districts in Nova Scotia, GSC Open File 7150 – Lower Seal Harbour Gold District, 2012

Historical milling operations in the Lower Seal Harbour Gold District left behind a large volume of mine tailings, which have been, and continue to be, eroded by local streams, and transported to the ocean. Tailings were sampled at 36 sites throughout the district on several different occasions in 2003 and 2004 (see 2003/2004 Goodwin reports listed above). Five samples of marine sediments were also collected from the intertidal zone of Seal Harbour to evaluate the dispersion of tailings along the shoreline.

Tailings from the pre-1936 stamp milling operations are primarily located in a small wetland area near the former mill site and are covered by horsetails and other wetland vegetation. These tailings are brown and well oxidized near the surface, contain scorodite-bearing hardpan in some areas, and are underlain by grey, relatively unoxidized tailings below about 20 cm depth. The concentration of arsenic (As) and mercury (Hg) in these stamp mill tailings are considerably higher than concentrations in later tailings from the cyanide plant. This likely reflects the more efficient removal of arsenopyrite in the cyanide plant milling circuit and the cyanide-enhanced leaching over time of Hg and other elements from the more recent tailings.

Tailings from the cyanide plant are sandy and relatively unvegetated within 0.5 km of the former mill foundation and are partially covered in wetland vegetation along the floodplain of West Brook. Most of the cyanidation tailings are deeply weathered, with light brown oxidized tailings grading into olive-green to grey tailings at depth. As compared to the stamp mill tailings, the concentrations of As and Hg are generally lower in the cyanidation tailings. The As and Hg contents of nearshore marine sediments in Seal Harbour show that tailings have been widely dispersed throughout this harbour.

The highest concentrations of As and Hg are found close to the cyanide plant foundation, where sulphide concentrates were dumped adjacent to the mill. Layers of sulphide minerals are shallowly buried in this area and the As concentration in one sample at 30 cm depth was the highest of all samples collected throughout the gold mines in Nova Scotia. Weathering and oxidation of these concentrate layers generates acidic drainage which enters the small tributary running through the tailings near site.

Moriarty et al. – Arsenic Speciation of Terrestrial Invertebrates, 2009

This paper provides arsenic concentrations speciation profiles for eight orders of terrestrial invertebrates collected at the Upper Seal Harbour, Lower Seal Harbour, and Montague historical gold mine sites and one background site at East Brook (East of Upper Seal Harbour (USH) and Lower Seal Harbour (LSH)). Plant and soil samples were collected along the tailings pond edges.

The paper concluded that there was no notable difference between the invertebrates collected at each three mine sites (USH: 6.8 ppm, LSH: 7.2 ppm, Montague: 11ppm); however, all three sites were notably higher than the background site (0.25 ppm). The paper provides a more detailed breakdown of arsenic species within the invertebrates.

Walker et al. – Arsenic Mineralogy of Near-Surface Tailings and Soils: Influences on Arsenic Mobility and Bioaccessibility in the Nova Scotia Gold Mining Districts, 2009

This report was written to determine a full profile of the tailings at 4 former gold mine sites in NS that tend to be frequented by the public (Montague, Oldham, Caribou, and Goldenville). Fourteen samples of near-surface tailings and one of soil from each site were collected and sieved to <150 mm and characterized using conventional mineralogical technique.

The paper concluded that (i) the mineralogy of arsenic (As) in weathered tailings is highly variable; (ii) major differences in As mineralogy in the tailings are mainly controlled by factors that influence the weathering history (e.g., presence or absence of mill concentrates, degree of water saturation, and abundance of relict carbonate minerals); and (iii) the variable solubility of the primary and secondary As-bearing minerals influences both the environmental mobility and the bioaccessibility of As in the samples.

Saunders et al. – Use of biomarkers to show sub-cellular effects in meadow voles (Microtus Pennsylvanicus) living on an abandoned gold mine site, 2009

This study examined meadow voles within Upper Seal Harbour (USH), Lower Seal Harbour (LSH), and East Brook. Using East Brook as a reference site, the study collected soil, vole, and plant samples across all three sites.

The arsenic (As) concentrations in vole tissue were significantly elevated at the former mine's sites for all sample species. Voles' As concentrations ranged up to 4.3 mg/kg at USH (LSH: 0.04-1.4 mg/kg; USH 0.04-4.3 mg/kg; and REF: 0.05-0.78 mg/kg). While arsenic body burden may not always be indicative of a problem for an animal, there was a statistically significant relationships between a reduction of Glutathione in vole livers and increased liver arsenic concentrations. A statistically significant relationship was also observed between increased micro-nucleated monochromatic red blood cells in voles from arsenic-contaminated sites compared to a background location. The results investigations suggest that there are possible sub-cellular effects on voles as a consequence of dietary arsenic exposure.

Leblanc et al - Mercury and Arsenic Concentrations in Fish Tissues and the Influence of Historic Gold Mines in Nova Scotia, 2010

This report developed a study to determine the mercury and arsenic concentrations in freshwater and anadromous fish within lakes associated with historical gold mining in the province. A total of 300 fish across 19 waterbodies representing 11 species of fish were collected over the two years of the program (2006 and 2007). Fifteen of the lakes were considered to be impacted waterbodies and 4 were reference lakes. Seal Harbour Lake was one of the lakes examined, which the Goldbrook Site flows into.

The study found a trend of increasing surface water concentrations for mercury (not statistically significant) and arsenic (statistically significant) in the presence of historic gold mining. This finding did not correlate significantly with fish tissue concentrations, likely based on how these compounds are absorbed into the fish (bioaccumulation, biomagnification, pathway, etc.). The report concluded that fish within Seal Harbour Lake (yellow perch and white sucker) tended to have increased mercury when compared to other sites but these concentrations were still considered to be within the anticipated range.

Meunier et al. - Effects of Soil Composition and Mineralogy on the Bioaccessibility of Arsenic from Tailings and Soil in Gold Mine Districts of Nova Scotia, 2010

The paper concluded that arsenic bioaccessibility ranges from 0.1% to 49%. A weak correlation was observed between total and bioaccessible arsenic concentrations. Arsenic bioaccessibility was not correlated with other elements. Additionally, the presence of a more soluble arsenic phase, even at low concentrations, resulted in increased arsenic bioaccessibility from the mixed arsenic phases associated with tailings and mine-impacted soils.

The paper did not include samples from Seal Harbour nor Gold Brook, but all 29 samples were collected from former gold mines in mainland Nova Scotia.

Moriarty et al. – Arsenic Speciation, Distribution, and Bioaccessibility in Shrews and Their Food, 2011

The study examined the presence of arsenic in shews within the Upper Seal Harbour area. The study included a background brook Northwest of Washington Cove in Seal Harbour to compare vegetation and animals (45.162222,

-61.5675). The difference in arsenic concentration between the two sites is 2900 mg/kg and 6.0 mg/kg (nearly 500 times greater).

The study found that the shrews collected had approximately twice the arsenic body burden and 100 times greater daily intake of arsenic compared with shrews from the background site. Their primary food source, i.e., small invertebrates, appear to also be adsorbing the arsenic to their exoskeletons. Despite the significantly different intake and the comparatively small difference in body burden, the paper concluded that the shews likely have a way to process it and efficiently excrete it. The paper makes the point to note that this may be a bio-process that not all animals have and compare the results to a 2009 study of voles' arsenic body burden in the same area, which found them to have an average concentration of 1000 ug/kg compared to the shrew's 200 ug/kg.

Corriveau et al. - Direct characterization of airborne particles associated with arsenic-rich mine tailings: Particle size, mineralogy and texture, 2011

The paper was intended to examine concentration of arsenic (As) in airborne dust particles from As-rich abandoned gold mine tailings from Lower Seal Harbour, Goldenville, and Montague to help the future development of a Human Health Risk threshold from airborne particles. The As airborne particles were characterized in terms of particle size, As concentration, As oxidation state, mineral species, and texture. All three sites are used for recreational activities and off-road vehicles were racing on the tailings at two mines during sample collection. Total concentrations of As in the <8 um fraction varied from 65 to 1040 ng/m^3 of air. The same samples were found to contain multiple As-bearing mineral species, including Fe–As weathering products.

The As species present in the dust were similar to those observed in the near-surface tailings. The action of vehicles on the tailings surface may disaggregate material cemented with iron-arsenate and contribute additional fine-grained As-rich particles to air-borne dust.

Dillon Consulting Ltd. - Review of Environment Canada's Background Soil Database (2004-2009) Report, 2011

Environment Canada (EC) identified the need to create a background soil database, specifically for Atlantic Canada, to be used for assessment of federal contaminated sites in the Atlantic region. The primary purpose of the background soils database is to provide professionals with background soil concentrations, to be used in risk assessment projects pertaining to federal sites in the Atlantic region. The creation of an Atlantic region background soils database will allow for the comparison of data from a specific site to the background concentration for that region. Chemical concentrations that exceed the relevant Canadian Environmental Quality Guidelines (CCME) guidelines would not be considered contaminants of concern if these concentrations fall within the background concentration range for that parameter in that region.

Dillon Consulting Limited (Dillon) was commissioned by Public Works (PWGSC) on behalf of EC to conduct a critical evaluation of the work completed in the first five years to determine a path forward. Specifically, Dillon was tasked with the following: to validate whether the soil zone approach and sampling protocols that have been used in the five years of the sampling program are appropriate, based on common practices in other jurisdictions; to analyze raw soil data, generating summary statistics and background range values for each soil zone; to determine if there are statistical differences between such soil zones and if there are sufficient numbers of samples to undertake this comparison; to identify data gaps which will allow EC to plan for future sampling in the region; to review the established soil zone approach developed in 2005; to verify and validate such partitioning of the region; and to identify and review other data sets within the region that could potentially be incorporated with the EC data.

The Soil Quality Guidelines (SQG) were created based on a mean background value from a range of data from sites across Canada, and do not consider regional differences. The creation of an Atlantic region background soils database provides a means to compare soil data from a specific site to the background soil concentrations for that region. A review of the analytical results from the soils database collected to date indicates that the concentrations of several chemicals in soil exceed the Soil Quality Guidelines (SQG) for the Protection of Environmental and Human Health, at numerous background locations across the Atlantic region.

Saunders et. al - Inclusion of Soil Arsenic Bioaccessibility in Ecological Risk Assessment and Comparison with Biological Effects, 2011

The purpose of this study was to conduct an ecological risk assessment (ERA) for meadow voles (*Microtus Pennslvanicus*) to compare effects between the affected and control sites. Three arsenic contaminated sites were selected (Upper Seal Harbour (USH), Lower Seal Harbour (LSH), and Montague (MNT)) as well as two background sites.

Using site-specific bioaccessibility (hazard quotients [HQ]: USH=38; LSH=60; and MNT=120) and stomach arsenic contents (HQ: USH=2.1, LSH=7.9, and MNT=6.7) in the ERA resulted in lower numeric risk than compared to risk calculated with 100% bioavailability (HQ: USH=180, LSH=75; MNT=680). The report concluded that using site-specific bioaccessibility in ERAs may provide a more realistic level of conservatism, thereby enhancing the accuracy of predicting risk to wildlife receptors.

Whaley-Martin et al. – Arsenic Speciation in Blue Mussels (Mytilus edulis) Along a Highly Contaminated Arsenic Gradient, 2012

The paper studied the mussels located within the Seal Harbour (SH) marine discharge due to its high arsenic (As) sediment concentration (as high as 770 mg/kg according to this paper). Four Sample sites were selected within Seal Harbour, and one was collected from Coddles Harbour as a reference sample. The four SH samples were placed 300 meters apart to create a gradient from the most concentrated area.

The findings show a clear arsenic gradient ranging from SH Site 1 to Site 4. Site 1 had the maximum arsenic concentrations for sediment (530-670 mg/kg) and porewater (0.5-0.9 mg/L) and Site 2 had the highest concentration of arsenic in surface water (0.2-0.2 mg/L). Sites 3 and 4 were reported to have lower concentrations than 1 and 2. The control site measured an average arsenic concentration of 3 mg/kg in sediment, 0.2 mg/L in porewater, and 0.003 mg/L in surface water.

The amount of arsenic measured in mussels was in a different order. The order was Site 2 (109 mg/kg dry), Site 3 (75 mg/kg dry), Site 4 (65 mg/kg dry), and Site 1 (60 mg/kg dry), while the control site was 34 mg/kg dry. The mean values for the sites varied by 3 mg/kg dry at site 2 and 3, 2 mg/kg at sites 4 and 1, and 1 mg/kg dry at the control site. The report concluded that exposure to arsenic-contaminated surface water through either dermal contact or filter-feeding is a significant exposure pathway, although more significant exposure probably occurs through sediment and porewater of the local environment, because of the higher concentrations in these media.

Button et al. - Arsenic resistance and cycling in earthworms residing at a former gold mine in Canada, 2012

One of the purposes of this study was to determine why two species of earthworms (*Lumbricus castaneous* and *Dendrodrilus rubidus*) can tolerate high levels of arsenic (As) in soil and organic matter. The worms, their host soils and leaf litter were collected from Lower Seal Harbour gold mine due to its widespread As contamination and tested for total and speciated As. Resistance to As toxicity was investigated by measuring DNA damage in exposed earthworm populations. Arsenic in soil at the site ranged from 880 to 2700 mg/kg.

The paper generally found that the earthworms were able to adapt and live within high arsenic concentration soils. It was determined the concentration of the arsenic within the soil had no affect on the DNA damage of earthworms. It also concluded that a specific organo-arsenic compound (Arsenobetaine (AB)) originates from the worms in the area.

Whaley-Martin et al. – Determination of arsenic species in edible periwinkles (Littorina littorea) by HPLC–ICPMS and XAS along a contamination gradient, 2013

The paper studied the periwinkles located within the Seal Harbour marine discharge due to its high Arsenic (As) sediment concentration. Four sample sites were selected within Seal Harbour (SH), and one was collected from

Coddles Harbour as a reference sample. The four SH samples were placed 300 meters apart to create a gradient from the most concentrated area. This paper used the same sampling method as Whaley-Martin et al. (2012) (mussels); however, periwinkles differ from filter feeders as they scrape or “lick” food from rocks and other substrate such as seaweed and therefore could have different mechanism of absorbing arsenic.

The paper identified that the highest total arsenic concentrations were found closest to the mouth of the river (Max: 916 mg/kg dry at SH station 1) and decreased until it was the lowest at the station the furthest away from the mouth (Max: 420 mg/kg at SH station 4). The control site had a maximum concentration of 58 mg/kg dry. The periwinkles seemed to have a much higher proportion of inorganic arsenic than other marine organisms tested and have reach concentrations not seen before in any marine organism (600 mg/kg dry of inorganic-As). This could pose a potential threat to higher trophic consumers.

Koch et. al – Bioaccessibility and speciation of arsenic in country foods from contaminated sites in Canada, 2013

This paper investigates the bioaccessibility of arsenic in country foods, one of the sites evaluated was Seal Harbour in 2004 and 2005 and Yellowknife. The paper notes that “country foods” usually refers to dietary items that are obtained by hunting and gathering, in Canada, as these foods often account for a large proportion of foods consumed by First Nations people.

Berries, mushrooms, hare meat, and other plants were tested as part of the study. Bioaccessibility was higher in mushrooms and hare meat compared to berries. The measured concentrations (in mg/kg wet weight) were as follows:

- Berries: 0.06-21;
- Labrador Tea: 1.9;
- Mushrooms 1.2 – 46 (one species’ concentrations averaged 46) and;
- Hare meat: 0.007-0.6.

The paper added in the conclusion that “great variability” was seen in these sample types.

T. G. Milligan and B. A. Law – Contaminants at the Sediment−Water Interface: Implications for Environmental Impact Assessment and Effects Monitoring, 2013

This paper notes that flocs are conglomerates of material that can contain contaminants and pathogens limited to the superficial sediment layer. Due to their high organic content, they are considered to be a preferred food source of filter feeding organisms. Flocs are difficult to sample with standard sampling equipment due to their small size and ease of dispersion. This paper attempts to demonstrate the mobility and contaminant load of the material at the sediment−water interface that can be lost during sampling with conventional grabs and corers.

Sample collection included 1 cm deep samples from 4 stations in Seal Harbour and another station location in New Brunswick. At Seal Harbour, Station 1 was located near the mouth of West Brook, Station 4 was placed in a sheltered area behind one of the islands in the harbour and the 2 remaining stations were placed between them. The surface sediment mercury and arsenic concentrations were similar to previous studies (As: 134 to 389 mg/kg; Hg: 110 to 120 ug/kg).

Moriarty et al. – Arsenic species and uptake in amphibians (Rana clamitans and Bufo americanus), 2013

Total arsenic concentrations and the chemical form, or species, of arsenic were determined in amphibians (*Rana clamitans and Bufo americanus*) and collected in Upper Seal Harbour. Frogs were chosen as they are “good indicators of overall environmental quality at freshwater sites because adults and larvae live in both aquatic and terrestrial environments. Frogs are particularly sensitive to dissolved contaminants because of their permeable skin, and have been found to accumulate arsenic in the mg/kg range both in tadpoles and in adults at contaminated sites, as well as in laboratory-reared tadpoles.”

The lab found that the frog legs had significantly elevated total arsenic concentrations at a contaminated site (1600-4400 μg/kg) when compared with a nearby background site (110-350 μg/kg). A calculation of the estimated daily intake rates of arsenic indicates that both diet (invertebrate intake) and water absorption are significant sources of arsenic for these adult organisms.

AMEC – Environmental Assessment Report, Goldboro LNG Project, Pieridae Energy (Canada) Ltd, 2013

This document is an Environmental Assessment (EA) report associated with the LNG Facility Project (site located adjacent to subject property) completed for Pieridae Energy (Canada) Ltd. The proposed project was required to prepare a Class II EA under the Nova Scotia Environmental Assessment Regulations for all facets of the proposed project.

The EA report contains the following items of interest within the appendices section of the report:

- Water Supply Assessment that was conducted by Dillon Consulting Limited (2013).
- Habitat, Wetland and Rare Lichen Survey completed by AMEC (2012)
- Odenate Species Survey (AMEC, 2013)
- Wildlife Survey (2004/2005 and 2013)
- Fish Habitat and Invertebrate Results (Dillon 2008)
- Surface Water Monitoring Results report issued by Dillon Consulting Limited (2008) that included the collection of surface water from 5 locations during high flow and low flow periods in 2007 and samples were analyzed for petroleum hydrocarbons (PHC), metals and general chemistry.
- Species at Risk Data – Atlantic Canada Conservation Data Centre Report (2012)
- Mi'Kmaq Ecological Knowledge Study (MEKS) (2013)

J. Dalziel & R. Tordon – Gaseous Mercury Flux Measurements from Two Mine Tailing Sites in the Seal Harbour Area of Nova Scotia, 2014

This paper determined that the surface soil at mine sites, which used mercury in its process release the mercury in a gaseous state. The two sites examined (Gold Brook and Seal Harbour) reportedly had different release rates given the different mining history of the area and each site's use of mercury (Hg) in its process. The measured levels at each site were 0.05 mg/kg at Site 1 (SH) and 23 mg/kg at Site 2 (GB). They also found clear correlations of Hg flux-rate with soil temperature, air temperature, and solar radiation at both sites and an Arrhenius-type relation of Hg flux with soil temperature was also evident.

The paper provides *in situ* measurements and results from lab testing. The results from the lab tests, based on the site conditions, determined that Site 1 had mean flux rate of 17.4 ng/(m^2 h) (ranging of 1.9 to 95) and Site 2 had an average of 652 ng/(m^2 h) (ranging from 305 to 1292). The paper concluded that "these abandoned mines sites from Goldboro, Nova Scotia, have been and continue to be a local source of atmospheric Hg, even decades after the mine operations have ceased."

Percival et al. (NR Can)- Mineralogy and spectral reflectance of soils and tailings from historical gold mines, Nova Scotia, 2014

This paper examines the mineralogy of soils, tills and tailings in the Upper and Lower Seal Harbour gold districts of Nova Scotia. It incorporates the data from the year one (2003) and year two (2004) programs of the 3 year "Multi-element Distribution in Humus, Soil, Till, Rock and Tailings Associated with Historic Gold Districts of the Meguma Zone" project. For this report "Upper Seal Harbour" is the Gold Brook Site and "Lower Seal Harbour" is the Seal Harbour site.

The Upper Seal Harbor site operated intermittently 1904 to 1941. Most of the Gold was reported as being processed using Hg amalgamation at the on-site mill. From 1901 to 1912, sulphide concentrates were treated in a bromo-cyanide plant and large tonnages of arsenical concentrates were shipped to Europe for smelting. Since

1988, work in the area was reported to occur for the purposes of exploration, shaft rehabilitation, diamond drilling and underground exploration.

The Lower Seal Harbour site reported to operate from 1904 to 1941. During this time period, tailings were “slurried into a small tributary to West Brook and are now visible on the floodplain from the mine site to the ocean at Seal Harbour”. From 1905 to 1915 and 1926 to 1928, a mercury (Hg) amalgamation process was used to extract the gold on site and the sulphide concentrates were sent to the Upper Seal Harbour (Gold Brook) site mill. Under a new company from 1934 to 1941, a 200-ton-per-day cyanide plant was constructed to treat the ore using a combination of cyanide methods and barrel amalgamation.

Walker et al. – Metal(loid)s in Sediment, Lobster and Mussel Tissues near Historical Gold Mine Sites, 2015

This paper endeavors to establish a baseline of metalloid concentrations in sediment, lobsters, and mussels prior to any new industrial developments in Isaac’s Harbour. Associated samples were taken in both Seal Harbour and Isaac’s Harbour.

The paper confirmed previous studies findings by establishing that most sediment metal(loid) concentrations still exceeded Canadian Marine Sediment Quality Guidelines, and provided evidence of Canadian Food Inspection Agency fish tissue standards exceedances related to arsenic in lobster and lead in mussel tissues.

G. W. Kennedy and J. Drage – A Review of Activities Related to the Occurrence of Arsenic in Nova Scotia Well Water, 2016

This document is a review of arsenic in Nova Scotia’s groundwater using analytical data dating back from 1970. The report stated that the main anthropogenic source of arsenic in Nova Scotia has been identified as originating from tailings and waste rock in past-producing gold districts in the Goldenville and Halifax groups of the Meguma terrane.

As a result, the document findings include that dug wells located in past-producing gold districts are associated with higher exceedance rates of the Health Canada Maximum Acceptable Concentration (MAC) for arsenic in drinking water compared to dug wells in areas outside of gold districts. Arsenic MAC exceedance rates were reported to be generally around 10% for drilled wells across the province, although much higher exceedance rates (>50%) have been reported in selected communities. Limited arsenic speciation measurements suggest that the dominant species of arsenic (>80%) present in Nova Scotia well water is inorganic As(V). It was also noted that geogenic sources of arsenic are widespread, consisting primarily of arsenopyrite and arsenian pyrite.

Doe, et al – Biological Effects of Gold Mine Tailings on the intertidal Marine Environment in Nova Scotia, Canada, 2017

In 2004 and 2005, sediments, water and mollusc tissues were collected from 29 sampling stations at nine former gold mining areas along the Atlantic coastline and were analysed for arsenic and mercury. Seal Harbour was included in this evaluation and New Harbour was used as a reference site. This document provides results in terms of wet mass, dry mass, and bioaccumulation factor (BAF), which is the ratio of the concentration of the compound in the tissue and the total concentration identified in water.

The 2004 study only included Seal Harbour and identified that sediment arsenic concentrations ranged from 457 to 767 mg/kg across 6 sub-areas and the soft-shell claims contained an average arsenic concentration of 160 mg/kg wet (1200 mg/kg dry) and a sediment BAF of 2.6 compared to the control’s concentration of 1.68 mg/kg wet (12.7 mg/kg dry). A total of 15 clams were used in the test, 10 clams were collected from the Seal Harbour site and 5 clams were for control purposes.

In the 2005 study, 9 sub-areas were selected within the Seal Harbour site. Five clams and 10 mussels were collected from each area. Most of the clams from the 9 sub-areas ranged from 10.1 to 32.2 mg/kg wet while the concentration associated with the control area was 1.62 mg/kg wet. One area within the mudflats measured 259 mg/kg. Despite this outlier concentration, the sediment BAFs ranged between 1.7 and 9.2. The mudflats sample had a sediment BAF of 2.8. The 2005 sample noted that all the Seal Harbour sites, except for sub-area 2, were over the CCME 1999 Guideline for the Protection of Marine Aquatic Life (12.5 µg/L for arsenic, and 0.016 µg/L for mercury). The mussels ranged from 4.55 to 7.85 mg/kg wet across all sub-areas while the control was 1.76 mg/kg wet.

The reason for the difference between the mussel and clam arsenic and mercury uptake was reported to be not clear, but maybe related to different uptake routes for the two species of molluscs.

Anaconda Mining Inc. - Environmental Assessment Registration Document For A Proposed Surface And Underground Gold Mine Project At Goldboro, Nova Scotia, 2018

Anaconda Mining Inc. (Anaconda) is proposing to develop the Project as a 575 tonne per day (tpd) mining and milling facility. The Project is comprised of the West Goldbrook, Boston-Richardson, and East Goldbrook mineralized gold systems. The appendices of this registration document contained the following items of interest:

a) **GEMTEC - Ecological Baseline Studies, Anaconda Mining Inc.'s Goldboro Mine Property, 2017**

In 2017, GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) was retained by Anaconda Mining Inc. (Anaconda) to complete a baseline ecological study at their Goldboro mine property located in Goldboro Nova Scotia. This report contains multiple studies regarding different ecological components to acquire preliminary information for the applicable Valued Environmental Components (VECs) listed in section 6 of "Guide to Preparing an EA Registration Document for Mining Developments in Nova Scotia" (NSE 2006). The ecological baseline studies encompassed:

- Wetland delineation and functional assessments (Wetland Assessment);
- An aquatic habitat assessment;
- A vegetation and rare flora survey;
- A wildlife and rare fauna survey (including a mainland moose survey); and
- A water quality sampling program.

The water quality sampling program was conducted at pre-determined points within the Study Area. The scope of work included the collection of twelve (12) surface water samples from flowing watercourses. The collection of one (1) groundwater source (historic mine shaft) with the addition of a field duplicate sample as per Quality Assurance / Quality Control (QA/QC) protocol requires. The resulting analyses showed that the concentrations of aluminium, arsenic, cadmium, iron, lead, mercury, and zinc in one or more samples in the Study Area exceeded the applied Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic life (CCME FWAL) and / or the Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards for Surface Water (EQS).

b) **GEMTEC - Preliminary Metal Leaching & Acid Rock Drainage Characterization, Goldboro Deposit, Goldboro, Nova Scotia, 2018**

GEMTEC Consulting Engineers and Scientist Limited (GEMTEC) was retained by Anaconda to review results of sampling and laboratory testing programs to characterize the potential for metal leaching and acid rock drainage (ML/ARD) for the project. This report provides the preliminary results of the ML/ARD sampling and testing completed to date for the deposit, as well as recommendations for mine project planning and further ML/ARD testing.

c) **WSP - Goldboro Mining Site, Hydrogeology Investigation, Goldboro, Nova Scotia, 2018**

The primary focus of this program was to characterise hydrogeological conditions surrounding and/or influencing the mining developments for the purpose of providing information for use in the preliminary design for the Goldboro mine, to pre-feasibility levels. Within the framework of this program, the following objectives included: establishing baseline conditions on site with respect to groundwater levels and groundwater quality (metals and general chemistry); developing a hydrogeological conceptual model; identifying and evaluating water management issues that could impact the project, such as mine dewatering and water supply, as well as other environmental aspects that could impact Goldbrook Lake.

Wood - Realignment of Marine Drive Highway 316, Environmental Assessment Registration, Goldboro LNG Project, Pieridae Energy (Canada) 2021

Wood Environment & Infrastructure Solutions Environmental Assessment (Wood), on behalf of Pieridae Energy (Canada) Limited (Pieridae), prepared an Environmental Assessment Registration report for the realignment of approximately 3.5 km of existing Marine Drive (Highway 316) in Goldboro, Nova Scotia (the realignment; the project). The proposed realignment will convey traffic along an approximately 5.6 km new road segment around the site for the planned Goldboro LNG Facility (site located adjacent to subject property). The Pierdae EA report contains the following items of interest within the appendices section of the report:

- Sediment Sample Analyses Results and Guidelines
- Surface Water Sample Analyses Results and Guidelines
- Bird Surveys
- Biophysical Report 2020: Goldboro LNG Road Re-Alignment
- Aquatic Habitat Data Sheets
- Species at Risk and Species of Conservation Interest

GHD - Environmental Assessment Registration Document (EARD), Goldboro, Guysborough County, Nova Scotia, 2022

Signal Gold Inc. (Signal Gold), formerly Anaconda Mining Inc., proposes to develop the Goldboro Gold Project (the Project) located near Goldboro, Guysborough County, Nova Scotia. The Project consists of a conventional open pit mining operation and a 4,000 tonnes per day processing facility based on a combined gravity and leaching circuit using carbon-in-pulp technology. The Project also includes an engineered, fully lined Tailings Management Facility (TMF), three Waste Rock Storage areas (WRSAs), till and organic material stockpiles, and associated infrastructure. The appendices of this registration document contained the following items of interest:

a) **<u>GHD - Limited Phase I and Phase II Environmental Site Assessment, 2021</u>**

Previously provided in AECOM Phase I Environmental Site Assessment Report, Gold Brook Lake and Seal Harbour Mine Sites (October 2022).

b) **<u>Lorax Environmental Service Ltd. - Geochemical Characterization & Source Terms, 2022</u>**

As per the executive summary of this report, the planned project infrastructure includes a tailings management facility (TMF), two open pits, four waste rock storage areas, one of which is currently designed to only contain till), segregated till and organics stockpiles, a processing plant, a polishing pond, and a water treatment plant (WTP). Lorax initiated a comprehensive metal leaching and acid rock drainage (ML/ARD) program in 2020 to support the Project’s Feasibility Study and Environmental Assessment Registration Document (EARD) required for provincial permitting. This program includes static and kinetic testing of waste rock, ore, tailings, and overburden. The geochemical data generated form the basis for the generation of contact water chemistry predictions (i.e., geochemical source terms) in support of the site water quality model prepared by others.

c) **<u>GHD – 2021 Baseline Groundwater Program, Goldboro Project, 2022</u>**

In 2022, GHD Limited (GHD) presented a technical report regarding Groundwater Monitoring for Anaconda Mining Inc. The report includes baseline groundwater monitoring for the Goldboro Gold Project located south from Goldbrook lake and North of Seal Harbour discharge point. Groundwater levels, hydraulic conductivity testing and groundwater sampling activities were performed during three sampling intervals in 2021 to assess groundwater conditions in the region.

d) **<u>GHD – 2021 Surface Water and Sediment Monitoring Program, 2022</u>**

GHD Limited (GHD) conducted a baseline surface water and sediment monitoring program for the Goldboro Gold Project (the Project) in 2021 for the Environmental Assessment Registration document. The surface water monitoring program included flow monitoring along with the collection of ten (10) samples located upstream and downstream of Gold Brook Lake with sampling events covering all four seasons. In addition, a total of twelve (12) sediment samples and one (1) field duplicate were collected from locations from Stream Gold Brook, Gold Brook Lake, and Seal Harbour Lake in late August to early September 2021.

e) **McCallum Environmental Ltd. - Fish and Fish Habitat 2020-2021 Baseline Report, 2022**

The 2020 field program involved four main tasks within the Project Area (PA), including:

- a continuation of seasonal high flow trapping and barrier assessment of WC9 from Fall 2019,
- three rounds of fish sampling (i.e., electrofishing and trapping) within selected watercourses and waterbodies,
- detailed fish habitat characterization and quantification of watercourses predicted to be directly and indirectly affected by Project development, and,
- a continuation of baseline field delineation of watercourses and wetlands within the unmapped portions of the expanded PA.

The 2021 field program involved five tasks within the PA:

- Three rounds of fish sampling (electrofishing and trapping) within watercourses and waterbodies predicted to be directly affected, indirectly affected, and within reference sites unlikely to be impacted by Project development (Summer 2021);
- Detailed fish habitat characterization and quantification of watercourses and waterbodies predicted to be directly and indirectly affected by Project development (Summer 2021);
- Continuation of baseline field delineation of watercourses and wetlands within an expanded project area (throughout 2021);
- eDNA sampling (Fall 2021); and,
- Benthic sampling (Fall 2021).

f) **McCallum Environmental Ltd. - Avifauna Baseline Report, 2022**

The objectives of the avifauna species surveys were to:

- Identify species and habitat usage with a focus on Species at Risk (SAR) and Species of Conservation Interest (SOCI) within and surrounding the PA; and,
- Determine trends in species composition and bird group usage throughout different seasons.

g) **McCallum Environmental Ltd. - Flora and Fauna Baseline Report, 2022**

The objectives of these surveys were to complete flora and fauna inventory and document any rare flora and fauna species or species potential within the PA. Biophysical surveys took place between 2017 - 2021. The field studies were focused on highlighting the ecological linkages within the PA, as well as adjacent habitats. The field components included:

1. Vascular and non-vascular plant surveys (June – July, 2017, August 2019, June 2021, September 2021)
2. Lichen surveys (November 2018, August 2019, November 2020)
3. Species at Risk (SAR) surveys;
    a) Mainland moose (Winter tracking - February 2021, March 2021; pellet group inventory – April 2017, April 2021)
    b) Snapping turtle (June 2021)
    c) Bat hibernaculum (June 2017, 2019, June 2021)
    d) Incidental SAR (all seasons)

h) **McCallum Environmental Ltd. - Vegetation Communities Assessments Baseline Reports, 2022**

The objectives of the vegetation community assessments were to note any uncommon communities, identify habitats that may support Species at Risk (SAR) or Species of Conservation Interest (SOCI) and quantify habitats within the PA. The results of these assessments will then be carried forward to the EARD to predict habitat loss by the Project and discussed in an effects assessment.

i) **GHD – Human Health and Ecological Risk Assessment, 2022**

The Human Health Risk Assessment (HHRA) portion of the study assessed the potential for predicted changes to the environment due to the Project having the potential to result in metals accumulation in or on vegetation or other selected country foods that may be consumed by humans. In addition, the HHRA also provided an assessment of other exposure pathways for humans, including inhalation of Project related emissions in air, incidental ingestion and dermal contact with soil, sediment, and surface water. The HHRA evaluated risks through these exposure pathways to residents, Indigenous people, recreational visitors and workers from exposure to contaminants of potential human concern (COPHCs) in various media associated with the Project.

The Ecological Risk Assessment (ERA) portion of the study assessed whether emissions from the PA, released via Project related activities, have the potential to result in adverse effects to sessile ecological receptors such as vegetation and invertebrates or upper trophic level organisms that may use the habitats in the vicinity of the Project as a food source. The ERA also evaluated potential incremental increases in risk to aquatic ecological receptors compared to current conditions.

j) **Membertou Geomatic Solutions - Gold Brook Project Mi'Kmaq Ecological Knowledge Study (MEKS), 2017 and 2022**

This MEKS mandate was to identify past and present Mi'kmaq traditional uses within the PA, and what Mi'kmaq ecological knowledge presently exists for the area. To ensure accountability and ethical responsibility, the MEKS development has adhered to the "Mi'kmaq Ecological Knowledge Protocol, 2nd Edition". This protocol is a document that has been established by the Assembly of Nova Scotia Mi'kmaq Chiefs, which speaks to the process, procedures and results that are expected of a MEKS.

The Mi'kmaq Ecological Knowledge Study consisted of two major components:

- Mi'kmaq Traditional Land and Resource Use Activities, both past and present,
- A Mi'kmaq Significance Species Analysis, considering the resources that are important to Mi'kmaq use.

6. Preliminary Problem Formulation

All substances/stressors (from both anthropogenic and natural sources) have the potential to cause environmental effects. The magnitude of risk depends on the receptor (person or wildlife) being exposed, the route and magnitude of exposure, and the potential adverse effects of the stressor (its degree of "hazard").

Where all components are present, the possibility or risk of an adverse effect to the receptor exists. This basic principle forms the basis of risk assessment. If one or more of these three components is absent, then there is no opportunity for a risk of an adverse effect to the receptor. For example, a receptor could be exposed to a chemical, but if that chemical is present at levels below those associated with adverse effects, then no risk of harmful exposure (i.e., adverse effects) would be expected. Alternatively, a hazardous material may be present; however, if there is no way for a receptor to be exposed (I.e., material is in a sealed container), then the receptor is not at risk of exposure to the hazardous material.

The first step in the environmental risk assessment framework is the problem formulation. Problem formulation includes a review and compilation of existing data and a summary of past activities documenting areas of impacts by contaminants in environmental media (soil, water, air, sediment, etc.). Additional components of the problem formulation are as follows: identification of the potential contaminants of concern (PCOCs) and the environmental hazards that they may pose to human health or the environment (i.e., threshold toxic response); the potential receptors having contact with the identified contaminants and hazards; and the relevant exposure pathways by which the receptors interact with various environmental media (e.g., air, dust, water, soil, sediment, and food).

The problem formulation integrates this information into a conceptual exposure pathway model for exposure scenarios selected for assessment. This could include current conditions, as well as conceptual remedial options to test hypothetical scenarios. It also involves an assessment of critical knowledge gaps and their implications in assessing the potential for risks. As new information becomes available the problem formulation may be revised to incorporate new knowledge.

The evaluation steps required prior to conducting a SSRA for substances other than PHCs, under the Regulation and applicable guidance for Remediation, are analogous to the Problem Formulation Stage of an Environmental Risk Assessment, as shown **Figure 2-1** and **Figure 2-2** presented in **Section 2.2**.

The Environmental Risk Assessment and the Problem Formulation Stage is integral to the environmental investigation phase of the project and is an iterative process as described in detail in **Section 2.2**. The problem formulation stage may lead to a further preliminary quantitative SSRA involving the development of suitable site-specific target levels (SSTLs) also referred to as site-specific remedial objectives (SSROs) for further informing site management related decisions for the development of a conditional closure risk management plan.

At the time of writing this report, the Problem Formulation is in the preliminary phase with the overarching goal of improving the understanding of the study area in its current condition and providing interpretation of the possible environmental liabilities in terms of exposure risks to humans and the environment. Due to the size complexity and history of the study area, the completion of the Problem Formulation Stage of the SSRA for the Gold Brook Lake and Seal Harbour Mine Site is anticipated to be an iterative process consisting of the following:

- Documenting site data and suitable reference or background data for the PCOCs relevant to the study area, based on the available Phase I & II ESAs for the Site and surrounding area.
- Documenting rationale for the selected COCs carried forward for further evaluation and risk assessment

- Identifying all possible operable exposure pathways, including mechanisms of release transport and uptake by which human receptors and ecological receptors may come into contact with COCs in impacted soil groundwater surface water and sediments associated with historical gold mining tailings and waste rock from the Gold Brook Lake and Seal Harbour Mine Site.
- Developing of a Conceptual Site Model (CSM) that integrates the available information outlined in the previous bullets.
- Defining a relevant study area based on the available information and data analyses.
- Identifying knowledge gaps and key information needs; proposed supplemental environmental investigation sampling and analysis and additional environmental studies; developed and executed sampling plans and field programs to address these.
- Documenting progress reports and deliverables as per the terms of the agreement for the project.

The work presented in this preliminary Problem Formulation report and attached memos, with detailed descriptions for additional environmental field programs/ studies for the Gold Brook Lake and Seal Harbour Mine Site, form a foundation for further development of the Problem Formulation stage for the Site.

6.1 Conceptual Site Model

The conceptual site model (CSM) for the Site is critical to understanding the sources from which the COCs originate, the pathways through which these COCs can travel, and the receptors that are potentially exposed to these COCs.

The objective of the CSM is to characterize the surface and subsurface conditions that exist at the Site and determine the COCs and exposure pathways that are drivers of risk of adverse effects to human and ecological receptors associated with excess exposures due to the release, fate and transport of contaminants from sources and surrounding impacted areas. This information can be used to identify risk management strategies to mitigate the sources and minimize the possibility for harmful exposures in human and ecological receptors to contaminant sources and releases of COC.

For this environmental risk assessment, the following initial list of VECs was identified, based on the preliminary scoping analysis:

- Soil quality
- Groundwater Quality
- Drinking Water Quality
- Surface Water Quality and Sediment Quality
- Air Quality - dust and particulates from exposed tailings
- Freshwater Aquatic Organisms – including Species at Risk for the Region and province of Nova Scotia. [e.g., potentially all taxonomic groups, including primary producers, secondary and tertiary feeding levels - algae, aquatic macrophytes, zooplankton, sport fish, pelagic and bottom feeding fish, reptiles/amphibians, and benthic invertebrates]
- Terrestrial Organisms – including humans, plants (mosses, lichens, fungi) and soil organisms, birds, mammals, reptiles/amphibians.

6.1.1 Contaminant Sources

At the Gold Brook Lake and Seal Harbour Mine Site, the tailings and waste rock associated with the historic mining activities are the original sources of the PCOCs. The COCs that are the focus of this investigation include arsenic and mercury as they are associated with wastes released to the environment from the mineral processing and gold extraction, including waste rock and tailings. However, additional COCs identified in environmental samples collected from areas impacted by historic mining activities at the Gold Brook Lake and Seal Harbour Mine Site and surrounding area would also be retained for further human health and ecological risk assessment.

Arsenic is a naturally occurring chemical constituent within the residual rock material that was milled and then released as a non-economic by-product of the gold extraction process. The original arsenic in the tailings solids was likely in the form of arsenopyrite (FeAsS). Arsenic can be released from this primary mineral form during oxidation processes, resulting in the formation of oxidation products that include dissolved iron, arsenic and sulphate as well as the solid phase ferric oxyhydroxide, simplified as $Fe(OH)_3$.

Metallic or elemental mercury was used as an amalgam in the gold extraction process. Although the mercury is typically collected to recover the gold, some release of mercury typically occurs during the process. Elemental mercury (Hg^0) which is a liquid at room temperature would have been used in the amalgamation process and then burned off to evaporate the mercury, rendering the gold. Liquid elemental mercury (Hg^0) has a very low solubility in water and limited mobility in the subsurface; however, in the environment mercury undergoes natural transformation and bio-geochemical cycling through microbial and chemical oxidation and reduction processes into inorganic ionic mercury (e.g., mercurous Hg^+ and mercuric Hg^{2+}), and organic mercury (e.g., methylmercury, MeHg). The solubilities of the various forms of mercury play a role in their environmental fate and transport and influences their differential toxicities. In order of solubility in water mercuric Hg has the greatest, followed by organic Hg, mercurous Hg, and least soluble is elemental Hg. Dissolved mercury typically has a very limited mobility in water because of its tendency to sorb onto many types of solids, particularly organic carbon and to form insoluble sulfides which can be biotransformed to more volatile and soluble forms that are bioaccumulated in aquatic and terrestrial food webs. This has important implications in the potential pathways for mercury in the environment.

6.1.2 Contaminants of Concern

At the Gold Brook Lake and Seal Harbour Mine Site, the disposition of tailings and waste rock, as well as fugitive particulate deposition, associated with the historic mining activities are the original sources of the PCOCs. The Phase II ESA identified thirteen (13) metals measured in soil exceeding the NSE Tier 1 EQS.

Arsenic and mercury are well known COCs associated with emissions and wastes released to the environment from historic mineral processing and gold extraction, including waste rock and tailings. At the outset of this project arsenic and mercury have been identified as COCs of primary concern and the focus of this investigation. Other potential COCs (PCOCs) identified through the soil screening evaluation are discussed in the following section. The following summarizes frequency of exceedances in soil screening with arsenic and mercury:

- Arsenic - in excess of the NSE Tier1 EQS of 10 mg/kg for 96% of the samples analysed (44/46); and
- Mercury - in excess of the NSE Tier1 EQS of 6.6 mg/kg for 24% of the samples analysed (11/46)

6.1.3 Additional Potential Contaminants of Concern (PCOCs)

Additionally, the following eleven (11) potential COCs (PCOCs) are identified for further consideration in the SSRA based on the screening soil analytical data against the NSE Tier 1 EQS:

- aluminum, antimony, beryllium, cadmium, iron, lead, manganese, selenium, thallium, vanadium and zinc.

As well, two (2) metals, lithium and rubidium were detected in samples of soil tailings analysed for which no NSE Tier 1 EQS exists. Detailed documentation is provided in the analytical tables presented in **Appendix B**.

In accordance with the CCME guidance for HHRA these are evaluated against screening criteria derived by other jurisdictions providing they meet the NSE human health targets corresponding to a hazard quotient (HQ) of ≤ 0.2 for non-carcinogenic adverse effects and an Incremental Lifetime Cancer risk of $1x10^{-5}$.

Soil tailings data for lithium (soil range: <2 – 44 mg/kg; tailings range: <2 – 28 mg/kg) evaluated for potential risk to human health using the US EPA (2022) Regional Soil Screening value of 16 mg/kg for a HQ =0.10 (adjusted to 32 mg/kg for a HQ= 0.2) indicated an unacceptable risk associated with direct contact with impacted soil for children. No soil criterion was identified for lithium for the protection of ecological receptors at the time of writing this preliminary assessment.

No soil criterion was identified for rubidium (soil range: <2 - 72 mg/kg; tailings range: <2 - 47 mg/kg) in the hierarchy of health and environmental protection agencies reviewed in this preliminary assessment.

6.1.4 Human Receptors and Exposure Pathways

For the preliminary problem formulation, a residential/parkland land use has been considered applicable for the off-site exposure scenario as well as the on-site foreseeable future development. This includes the potential for outdoor yard and maintenance work and construction. Based on a residential and parkland land use the following human receptors are proposed for inclusion in the conceptual site and exposure model (CSEM):

- Resident (all ages – infant, toddler, child, teen, adult, and pregnant adult; lifetime receptor)
- Recreational Site-user (toddler, child, teen, adult, pregnant adult; lifetime receptor)
- Outdoor worker

Potential exposure pathways considered during the development of the CSEM (presented as Figure 10) include:

- Soil (including tailings) direct contact with soil through exposed skin and incidental ingestion of soil.
- Leaching from soil, (tailings and waste rock) to potable groundwater
  - Potential exposure via direct contact with impacted groundwater by ingestion (i.e., drinking water, water used in cooking and food preparation) and skin contact (i.e., bathing/ washing and other uses)
  - Potential exposure via groundwater use for watering of livestock and poultry for food
    - Unless otherwise indicated, direct use of groundwater for watering livestock/poultry is assumed to not be present, but could be added pending new information. Livestock watering/game via surface water connectivity to groundwater is represented in the Figure 10.
- Inhalation of dusts and respirable particulate material (PM10; PM 2.5) in indoor / outdoor air
- Leaching from soil, tailings (waste rock) to groundwater and groundwater discharging to surface water (freshwater) and exposure to aquatic life
  - Potential for exposure through consumption of locally caught fish and game
  - Potential for exposure through direct contact with surface water and sediment (i.e., skin contact and incidental ingestion)
- Plant root uptake and foliar uptake
  - Potential for exposure through consumption of locally harvested edible plants, berries, fungi
  - Potential for exposure through consumption of locally grown produced watered with groundwater
  - Potential exposure through consumption of local-caught game that has been exposed via ingestion of vegetation (food-web transfer)
- Migration of impacted surface water and sediment (freshwater) to the marine environment
  - Potential for exposure through locally caught shellfish (clams)
  - Potential for exposure through locally caught fish
  - Potential for exposure through direct contact with surface water and sediment (i.e., skin contact and incidental ingestion)
- Soil – linkages to Terrestrial Ecological Exposure Conceptual Model.
  - Potential for exposure through game, including transfer from soil to game and through foodweb relationships

6.1.5 Ecological Receptors and Exposure Pathways

Based on potential terrestrial and aquatic habitat existing on and near the Site, potential receptors and operability of the release transport mechanism and exposure pathways were reviewed in developing the CSEM for terrestrial and aquatic ecological receptors (Appendix A Figure 11 and Figure 12 respectively) as follows:

- Soil (including tailings): Plants and soil invertebrates direct contact (dermal and ingestion) with impacted soil
- Ingestion and inhalation of soil/dusts: birds, mammals, reptiles
- Leaching from soil (tailings and waste rock) to groundwater and groundwater discharging to freshwater environment:
  - Potential for impacts on surface water quality and sediment quality of ephemeral and permanent surface water bodies used by plants, invertebrates and wildlife - birds, mammals, amphibians, and reptiles (i.e., direct contact, including ingestion)
- Surface runoff to wetlands and surface water bodies:
  - Potential impact on surface water quality and sediment quality and exposure to plants, invertebrates and wildlife - birds, mammals, amphibians, reptiles (i.e., direct contact, including ingestion)
- Migration of impacted surface water and sediment (freshwater) to the marine environment:
  - Potential impact on surface water quality and/or sediment quality and potential exposure to algae, aquatic vegetation, zooplankton, fish, benthic invertebrates, and wildlife – birds, mammals, reptiles (i.e. direct contact, including ingestion).
- Food web relationships with potential exposures to primary and secondary consumers:
  - Potential exposure to bioaccumulative COCs of birds, mammals, amphibians, and reptiles through ingestion of plants and prey, such as piscivorous birds and mammals and terrestrial food web relationships

7. Additional Proposed Field Programs

7.1 Remediation Components Requiring Additional Data

Environmental investigations completed to-date have identified the following site components which require remedial measures. Some of these components require additional data to further define the remedial options and develop a remedial action plan.

7.1.1 Waste Rock and Tailings

The Phase II Environmental Site Assessment has identified that potentially 37,050 m3 of waste rock is likely to contain elevated arsenic and other metal concentrations that may present an unacceptable risk to human and ecological receptors via leaching and dust released from waste rock piles. Remedial measures may be required to mitigate these risks. Further assessment of the potential risk to human health and ecological health is warranted. A review of historical tailings data should be completed and tabulated prior to completing additional delineation sampling.

As identified in the Phase I ESA previous environmental reports estimated 795,321 tonnes of tailings on the Gold Brook Lake and Seal Harbour Sites. The Phase II Environmental Site Assessment has identified that tailings contain elevated arsenic and mercury concentrations that may present a human health risk and adverse ecological effects. Remedial measures are required to mitigate this risk. Due to the limited data collected, AECOM cannot confirm the quantity of tailings and has therefore used the previous volume estimates for the purpose of the ROA and cost estimating. Further assessment of the potential risk to human health and ecological health is warranted. It should also be noted that an unknown portion of the tailings identified above are not part of the subject Site associated with this study; however, they have been contemplated in this ROA and subsequent cost estimate. Further investigation into the tailings off the subject Site would be required to refine the ROA and cost estimate. The tailings areas were divided into “dry” on land tailings deposits, and “wet” tailings deposits in freshwater and marine environments.

7.1.1.1 Additional Waste Rock and Tailings Geochemical Sampling Program

Preliminary Metals Leaching and Acid Rock Drainage data indicate that there is ML/ARD risk associated with the waste rock and tailings. This data is described in the Geochemistry Memo completed for this Site; a copy of this report is provided in **Appendix D**. Based on the preliminary data, additional waste rock sampling for ML/ARD at this Site should be completed.

The objectives of the additional waste rock sampling program for the Site include:

- Collection of additional surface and subsurface waste rock and tailings samples; and
- Greater understanding of ARD/ML risk and effect on remediation options selection.

Sampling Methodology:

Using an excavator or other method, collect 2 kg of waste rock and tailings samples from different locations of piles at 0.5- and 1-meter depth. Based on the estimated volumes, an additional ten (10) waste rock samples, and fifteen (15) tailings samples should be collected. Each sample should be documented by a sample ID, location, GPS coordinates, photo and a detailed description (complete form located in **Appendix D**) and place in tightly sealed sampling bags. Sampling bags should be stored in lightly lidded pails for shipping to laboratory. Chain-of-custody should be completed and included with shipmen for laboratory analysis as described below.

Laboratory Analysis:

The samples collected should be submitted to a certified laboratory for the following analysis:

Table 10: Number of Sample per Geochemical Test

Acid Base Accounting	Ultra trace Metal analysis	Shake Flask Extraction (MEND)	X-Ray Diffraction	QEMSCAN *
All	All	All	3 waste rock 5 tailings	3 waste rock 5 tailings

Notes:
Do Whole Rock Analysis if required for QEMSCAN

Further detail on the static and mineralogical tests is described below:

1. Acid base accounting including:
   - Paste pH
   - Total sulphur by Leco
   - Sulphate sulfur determined by hydrochloric acid leach
   - Sulphide sulphur determined by nitric acid leach
   - Non-extractable sulphur by difference
   - NP determined by Modified Sobek NP
   - Fizz rating
   - Total carbon determined by Leco
   - Total inorganic carbon by Leco
2. Ultra trace metal analysis using an *aqua regia* digestion followed by ICP-MS
3. MEND shake flask extraction and leachate analysis by ICP-MS including the following parameteres: pH, ORP, conductivity, acidity, total acidity, alkalinity, sulphate, chloride, fluoride, nitrate, nitrite, ammonia and dissolved metals including mercury
4. X-ray diffraction with Rietveld refinement (XRD)
5. Quantitative Evaluation of Minerals by Scanning Electron Microscopy (QEMSCAN)

7.1.1.2 Additional Waste Rock and Tailings Delineation Program

To further refine the remedial quantities for both waste rock and tailings at the Site, additional delineation is required, including understanding the vertical and horizontal extents of the waste rock and tailings areas.

AECOM estimated the depths of waste rock by using the surface grades surrounding the waste rock pile and assuming the original grade under the entire waste rock pile was similar. As the original grade is not known, there remains a level of uncertainty in the quantity of waste rock at the Site. To better estimate the depth of the waste rock pile and refine the remedial quantity, AECOM is recommending a Ground Penetrating Radar (GPR) and Resistivity geophysical investigation be completed on the waste rock pile.

The estimated volume of tailings on the Site was based on previous reporting. AECOM was unable to achieve full delineation of the tailing's areas in the horizontal and vertical directions. All samples collected from the Site were above the NSE Tier 1 EQS for one or more parameters. To further the delineation of tailings requiring remediation, AECOM is recommending that an in-depth background soil sampling program be completed which is described below. From this background soil data collection program, AECOM will be able to identify the areas of tailings which are above background concentrations and therefore may require remediation. In addition, AECOM is recommending that a Human Health and Ecological Risk Assessment be completed to determine the acceptable levels of COCs that may remain on Site. The combination of background data and Site-Specific Target Levels for COCs will aid in developing a delineation program for the tailings plumes.

7.1.2 Impacted Soil

The Phase II Environmental Site Assessment has identified soil impacts in many areas of the Site. As soil delineation has not been achieved, AECOM is unable to accurately assess the volume of contaminated soil requiring remedial action. Given the large area of which impacted soil exists, it is unlikely that remedial action will be feasible to address the entirety of the contaminated soil area. Therefore, AECOM is anticipating that a combination of Human Health and Ecological Risk Assessment and risk management will be required to manage the impacted soil area. Some areas with significantly elevated concentrations of COCs may still require remediation; however, given the limited amount of data, remedial options analysis or cost estimation has not been completed for the contaminated soil on the Site. Soil containing elevated arsenic and mercury concentrations, along with other metals, may present a human health risk at the Site. Remedial measures may be required to mitigate this risk. Further assessment of the potential risk to human health and ecological health is warranted for the Site.

7.1.2.1 Soil Delineation

The estimated volume of impacted soil on the Site was based on a combination of analytical data and visual observation in the field, however AECOM was unable to achieve full delineation of the impact soil areas in the horizontal and vertical directions. All samples collected from the Site were above the NSECC EQS for one or more parameters. To further the delineation of impacted soil requiring remediation, AECOM is recommending that an in-depth background soil sampling program be completed which is described below. From this background soil data collection program, AECOM will be able to identify the areas of tailings which are above background concentrations and therefore may require remediation. In addition, AECOM is recommending that a Human Health and Ecological Risk Assessment be completed to determine the acceptable levels of COCs that may remain on Site. The combination of background data and Site-Specific Target Levels for COCs will aid in developing a delineation program for the tailings plumes.

7.1.2.2 Background Soil Sampling

To further the understanding of the Site and complete a HHERA, AECOM is recommending that an in-depth soil background sampling program be completed in the vicinity of the Gold Brook Lake and Seal Harbour Sites. The following soil background sampling program is based on Parsons and Little Study (2015) titled “Establishing geochemical baselines in forest soils for environmental risk assessment in the Montague and Goldenville gold districts, Nova Scotia, Canada.” As both the Montague and Goldenville sites have similar bedrock characteristics to the Gold Brook Lake and Seal Harbour Sites, the following sampling plan is proposed to use the findings identified in the Parsons and Little Study (2015) as baseline values along with completing additional background sampling (based on the Parsons and Little Study (2015) methodology) to verify the assumption and uncertainties. The Parsons and Little Study (2015) was also recently used by others to establish soil background concentrations in soil for various metals parameters at the Montague Gold Mine site; and therefore, it is assumed that NSECC has recently approved methods used within these reports.

The main objectives of the Parson and Little (2015) study were to: (1) establish baseline concentrations of As, Hg, and other elements in soils overlying mineralized bedrock within these mine districts; (2) assess the vertical distribution of metal(loid)s in the soil, and the relative contributions of natural versus anthropogenic sources; and (3) evaluate the role of organic carbon, soil grain size, and digestion protocol in controlling metal(loid) concentrations. Results from this 2015 study can be used to support ecosystem and human health risk assessments, and to help guide management actions at historical gold mine districts in Nova Scotia.

<u>Sampling design and field methods based on the Parson and Little (2015) study:</u>

Collect sample of the top 0–5 cm of soil (the Public Health (PH) layer) from 40 to 50 locations in the vicinity of Gold Brook Lake and Seal Harbour Sites (sample location protocols will be based on further discussions with Michael Parsons and BNS). Restrict most sampling to provincially owned (Crown) land and sites both up-ice and down-ice of the main anticlinal fold hinge to study the effects of glacial dispersion. Soil sample sites are to be positioned in relatively well-drained areas that were free from any obvious sources of contamination (e.g., garbage, metal scraps, waste rock, etc.). Photographs, coordinates, and detailed descriptions of each sample location will be collected during the field program. Background soil samples of the Public Health layer will be collected using field protocols similar to the North American Soil Geochemical Landscapes Project (Friske et al. 2013).

At each sample location, plant litter and partially fermented material will be removed from the soil surface, and then a shovel will be used to expose a cross-section of the soil to a depth of at least 10 cm to check for the presence of distinct soil horizons. For the purposes of sampling, the upper boundary of the first layer that supports root growth (the top of the H-horizon, if present) defines the top of the sampling interval (i.e., 0 cm). All equipment in contact with the sample will be either polyethylene or steel, and sampling implements will be thoroughly cleaned between each location. Approximately 1 kg of soil will be collected at each site and pebbles, roots, and any living plant matter will be removed before the sample is placed in a pre-labelled zip-lock bag.

Samples of individual soil horizons (H, Ae, B, and C) will also be collected from 10 sites to evaluate the vertical distribution of elements in the soil profile. These sites will be evenly distributed both up-ice and down-ice of the main anticlinal fold hinge in each district and situated in areas that displayed well-developed soil horizons. Sampling at these locations will begin by clearing plant litter and partially fermented material from the soil surface, then digging a pit at least 60 cm wide and 60 cm deep to provide access to the top of the C-horizon. One-kilogram samples of each horizon will be collected in sequence from the bottom of the pit to the top to minimize cross-contamination during sampling, cleaned of roots and pebbles, then placed in pre-labelled zip-lock bags. Observations on the thickness of each horizon, the colour and texture of the soil, and other site characteristics will be recorded during the field program.

Chemical analyses and laboratory processing will be conducted at a CALA certified laboratory. Applied laboratory methods will be similar to applied in the Parsons and Little Study (2015).

7.1.3 Terrestrial Environment – Plant Survey and Plant Tissue Sampling

To gain an understanding of the terrestrial environment at the Site, two key knowledge gaps that should be investigated as part of the HHERA are:

1. What vegetation, including edible plants, berries, fungi, and suitable browse/forage and or habitat occur at the Site.
2. Whether the COCs (and PCOCs) in soil and tailings on-site, specifically As and Hg, and other bioaccumulative metals, are environmentally available and being taken uptake into plant tissues and the implications for the HHERA.

As part of the Problem Formulation, it is recommended that a Site reconnaissance visit, by a Terrestrial Plant Biologist/ Ecologist accompanied by the Risk Assessor, and a field vegetation sampling program be conducted in the summer of 2023. Propose using a transect survey approach and a gradient design, versus a reference design. This program is to be developed as part of the next steps for the Site.

Additional value could be added by documenting site-specific data on vegetation species, terrestrial habitat, and plant tissue metals concentrations on the Gold Brook Lake and Seal Harbour Mine sites. This information would be beneficial for verifying key assumptions underpinning the presence of operable exposure pathways connecting human receptors and ecological receptors to select COCs (and PCOCs) in soil and tailings at the site through the potential ingestion of plants growing on-site.

For instance, i) documentation of the presence/absence on-site and adjacent of edible plants and berries for human consumption and of browse/forage for herbivorous ecological receptors anticipated to frequent the Gold Brook Lake and Seal Harbour mining study area; and ii) indication of the magnitude of measured concentrations of COCs (and PCOCs) in plant tissues corresponding to soil impacts.

7.1.4 Impacted Surface Water and Porewater

The Phase II Environmental Site Assessment has identified surface water and sediment impacted by metals in the water course that links Gold Brook Lake to the marine environment. Surface water and sediment concentrations of arsenic and mercury in one or more samples were greater than the applicable criteria indicating possible ecological adverse effects to aquatic organisms. Additionally, this suggests the possible risk to people and wildlife through consumption of aquatic biota from surface waters in sediment impacted areas. Further environmental study and risk assessment is warranted for impacted surface water and sediment areas. Remedial measures may be required to mitigate this risk.

7.1.4.1 Aquatic Tissue Sampling

The Phase II ESA identified tailings containing elevated arsenic (As) and mercury (Hg) concentrations that may present a human health risk and adverse ecological effects. Remedial measures are required to mitigate this risk. The Phase II ESA also identified surface water bodies ranging from Gold Brook Lake to the Atlantic Ocean, and sediment within these surface water bodies are impacted by elevated concentrations of As and Hg. This indicates the potential for ecological adverse effects in aquatic organisms and possibly a risk to people and wildlife through consumption of aquatic biota from surface waters in sediment impacted areas. Further environmental study and risk assessment is warranted for surface water and sediment impacted areas.

The Phase II ESA recommended conducting a site-specific Human Health and Ecological Risk Assessment (HHERA). As such a detailed workplan for a 2023 Aquatic Tissues Field Program at the Site to support a site-specific aquatic HHERA has been developed and is included as a standalone memo in **Appendix D**.

7.1.4.2 Continued Surface Water Sampling

Surface water samples should be collected for metals and mercury on a quarterly basis to establish seasonal baseline analytical data. Surface water samples should be collected following SOPs from a depth of approximately 5 cm below the water surface. During the surface water sample collection process, the field personnel should locate themselves downstream of the sampling point and as close to the middle of the channel as possible (where safe to do so), thereby minimising disturbance to the stream base and mobilisation of any silts / sediments. Samples should be collected in laboratory supplied containers and kept below a temperature of 10 degrees Celsius once sampled until submission to the laboratory.

A total of nineteen (19) surface water sample locations have been sampled previously by AECOM and should be sampled quarterly to establish seasonal baselines. Surface water samples collected should be submitted for metals analysis.

Surface water sampling locations are shown on **Figure 7**, **Appendix A**.

7.1.5 Impacted Sediments

To further the delineation of impacted sediment requiring remediation, AECOM is recommending that an in-depth background sediment sampling program be completed. From this background sediment data collection program, AECOM will be able to identify the areas of sediment which are above background concentrations and therefore may require remediation. In addition, AECOM is recommending that a Human Health and Ecological Risk Assessment be completed to determine the acceptable levels of COCs that may remain on Site. The combination of background data and Site-Specific Target Levels for COCs will aid in developing a delineation program for the impacted sediment.

7.1.6 Impacted Groundwater

The Phase II Environmental Site Assessment (AECOM, 2022) has identified impacted groundwater by metals, specifically Al, As, Fe, and Mn based on limited sampling and analyses. Further environmental study and remedial measures may be required to mitigate any adverse effects on potable ground water quality and in aquatic organisms. Further assessment of the potential risk to human health and ecological health is warranted. Human health and ecological risks may also be mitigated by taking remedial actions at the source of the impacts (waste rock, tailings, soils, etc.). It is recommended that additional groundwater wells should be installed in the Seal Harbour area and Gold Brook Lake area to achieve delineation of groundwater impacts. All historical data related to groundwater should be tabulated and analyzed prior to the installation of additional groundwater wells. Also, all historical groundwater data should be reviewed to potentially determine background concentrations of COCs for the Site.

Groundwater monitoring and sampling should be done on a quarterly basis to establish seasonal baseline analytical data. Groundwater samples should be collected using the methodology summarised in **Section 4.2.1**. Additional groundwater wells may be warranted based on the results of further Environmental Site Assessment and Human Health and Ecological Risk Assessment.

Groundwater sampling locations are shown on **Figure 5**, **Appendix A**.

7.1.7 Debris

Remnants of historical mining activities remain at Site, including machine parts, wood and metal were identified as part of the Phase II Environmental Site Assessment. At the time of this Remedial Options Analysis, the quantity of debris is not known; however, it is expected to be a relatively minor cost item in relation to the remediation of the tailings and waste rock on Site. For cost estimating purposes, AECOM has assumed 200 cubic meters of debris, which will require remedial action. It should be noted that this may not be an accurate estimate and is based on the relative size of the property when compared with similar abandoned mine sites in the province.

The following sections describe each of the above components in more detail, presenting remedial options, and identifying the recommended option for consideration in remedial action planning.

8. Recommendations and Conclusions

Table 11 below provides a summary of the recommended additional field programs for the Site. The additional field programs are described in detail in **Section 6.0**.

Table 11: Summary of Recommended Additional Field Programs

Environmental Concern	Recommended Additional Field Programs
Waste Rock and Tailings	▪ Review and tabulation of historical data ▪ Additional geochemical sampling program ▪ Additional delineation program ▪ Future GPR study of waste rock piles
Impacted Soils	▪ Additional soil delineation ▪ Additional background soil sampling
Terrestrial Environment	▪ Plant survey and plant tissue sampling
Impacted Surface Water and Porewater	▪ Aquatic tissue sampling ▪ Continued surface water and porewater sampling along with additional background sampling
Impacted Sediment	▪ Additional sediment delineation ▪ Additional background sediment sampling
Impacted Groundwater	▪ Review and tabulation of historical data ▪ Installation of additional wells ▪ Continued groundwater sampling
Surface Debris	▪ A detailed survey of the material including identifying hazardous waste should be completed

It is also recommended that historical reports presented in **Section 5.0** that contain geochemical and/or biological analytical data should be further reviewed, and pertinent analytical data should be tabulated for potential use in the future for delineation and/or risk assessment purposes.

9. References

AECOM Canada Ltd. (AECOM). 2022. Phase I Environmental Site Assessment – Gold Brook Lake and Seal Harbour Mine Site (DRAFT). May 2022.

AECOM Canada Ltd. (AECOM). 2022. Nova Scotia Lands Inc. – Gold Brook Lake and Seal Harbour Mine Site – Preliminary Phase II ESA Field Program Memo. June 2022.

AMEC. 2006. Petrochemicals and Liquefied Natural Gas Facility – Environmental Assessment, Goldboro, Nova Scotia (Final Report). Prepared for: Keltic Petro Chemicals Inc. Dated: July 2006.

AMEC. 2013. Environmental Assessment Report (Call 2 Undertaking), Goldboro LNG Project, Pieridae Energy (Canada) Ltd, September 2013

Andaconda Mining Inc. 2018. Environmental Assessment Registration Document For A Proposed Surface And Underground Gold Mine Project at Goldboro, Guysborough County, Nova Scotia. August 2018.

Baycroft, C. 1938. Seal Harbour Mining Operations Report.

Button, M., Koch, I., Reimer, K. J., 2012. Arsenic resistance and cycling in earthworms residing at a former gold mine in Canada. Environmental Pollution, vol 169, p. 74–80.

Canadian Council of Minister of the Environment (CCME). 2016. Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment: Volume 1 Guidance Manual. ISBN 978-1-77202-026-7 PDF

Campbell, A.D. 1933. Upper Seal Harbour Development Memo (and various associated materials). Dates of various materials ranging from Mar 1930 to April 1934.

Corriveau, M.C., Jamieson, H.E., Parsons, M.B., Campbell, J.L., Lanzirotti, A. 2011. Direct characterization of airborne particles associated with arsenic-rich mine tailings: particle size, mineralogy, and texture. Applied Geochemistry, 26: 1639-1648.

Dalziel, J. & Tordon, R., 2014. Gaseous mercury flux measurements from two mine tailing sites in the Seal Harbour area of Nova Scotia. Geochemistry: Exploration, Environment, Analysis, vol:14, p. 17–24

Deputy Inspector of Mines. 1946. Letter Regarding Gold-Prospecting at Seal Harbour Lake Mine. Dated October 1946.

Doe, K., Mroz, R., Tay, K.-L., Burley, J.,Teh, S., Chen, S. 2017. Biological Effects of Gold Mine Tailings on the intertidal Marine Environment in Nova Scotia, Canada. Marine Pollution Bulletin, v:114, p. 64–76

Drage, J. 2015. Review of the Environmental Impacts of Historic Gold Mine Tailings in Nova Scotia. Prepared in Association with Nova Scotia Natural Resources, Geoscience and Mines Branch (Halifax, NS). Dated October 2015.

Dillon Consulting Ltd. 2011. Review of Environment Canada’s Background Soil Database (2004-2009) Report., Dated March 2011.

Exploration Orex Inc. and Rouyn-Noranda Quebec. 1990. Environmental Assessment Report for A Proposed Gold Mine Project at Goldboro Guysborough County, Nova Scotia. Dated May 1990.

Friske, P W B; Rencz, A N; Ford, K L; Kettles, I M; Garrett, R G; Grunsky, E C; McNeil, R J; Klassen, R A. 2013. Overview of the Canadian component of the North American soil geochemical landscapes project with recommendations for acquiring soil geochemical data for environmental and human health risk assessments. Geochemistry: Exploration, Environment, Analysis vol. 13, no. 4, 2013 p. 267-283, https://doi.org/10.1144/geochem2012-140

GHD Ltd. 2022. Goldboro Gold Project Environmental Assessment Registration Document, Goldboro, Guysborough County, Nova Scotia, Signal Gold Inc, June 01, 2022

Goodwin, W.M. 1935. Seal Harbour Gold Mines (Interim Report). Dated November 22, 1935.

Goodwin, T. A., Smith, P. K., and Parsons, M. B. 2004. Multi-element Distribution in Humus, Soil, Till, Rock and Tailings Associated with Historic Gold Districts of the Meguma Zone, Nova Scotia, Canada. Mineral Resources Branch, Report of Activities 2003; Nova Scotia Department of Natural Resources, Report 2004-1, p. 7-14.

Goodwin, T. A. 2005. Multi-element Distribution in Humus, Soil and Till Associated with the Upper and Lower Seal Harbour Gold Districts (NTS 11F/04). Mineral Resources Branch, Report of Activities 2004; Nova Scotia Department of Natural Resources, Report ME 2005-1, p. 27-33.

Glover, J. D., and Hale, W. E., Mineral Resource Evaluation (Nova Scotia, New Brunswick, Ontario) Vol. II of VII; Tailings, Nova Scotia. Ecological and Resources Consultants Ltd. For Seabright Resources Inc. Dated: May 16, 1983.

Jacques, Whitford & Associates Ltd. 1984. Seabright Resources Inc. Gold Tailings, 1984 Volume I. Dated March 30,1985.

Koch, I., McPherson, K., Smith, P., Easton, L., Doe, K. G. and Reimer, K. J. 2007: Arsenic bioaccessibility and speciation in clams and seaweed from a contaminated marine environment; Marine Pollution Bulletin, v. 54, p. 586–594.

Koch, I., Dee, J., house, K., Sui, J., Zhang, J., McKnight-Whitford, A., Reimer, K. J. 2013. Bioaccessibility and speciation of arsenic in country foods from contaminated sites in Canada. Science of the Total Environment, v:449, p.1–8

Kennedy, G. W., and Drage, J. 2016. A Review of Activities Related to the Occurrence of Arsenic in Nova Scotia Well Water. Nova Scotia Department of Natural Resources, Open File Report ME 2016-006. Dated July 2016.

LeBlanc, J.E., and Halfyard E.A. 2010. Mercury and arsenic concentrations in fish tissues and the influence of historic gold mines in Nova Scotia. Nova Scotia Department of Fisheries and Aquaculture. Pictou, Nova Scotia.

Malcolm, W. 1929. Gold Fields of Nova Scotia. Memoir 385. A 1976 reprint by the Geological Survey of Canada (originally Memoir 156).

McKenzie, J.G. 1906. Notes on the Mining Property of the Seal Harbour Mining Co. (a 32-page collection of hand-written notes). Dated April 1906.

McKenzie, N. 1934. Letter from Deputy Minister of Mines re: East Gold Brook Mine Address to the Advisory Board for Gold Mining Development (and various associated materials). Dated April 27, 1934 (various materials dating from 1933 to 1934).

Messervey, J.P. et al. 1935 to 1943. Lower Seal Harbour Gold District. A compilation of letters mostly authored by Hesservey ranging in dates from 1935 to 1943.

Meunier, L., Walker, S. R., Wragg, J., Parsons, M. B., Koch, I., Jamieson, H. E., and Reimer, K. J. 2010. Effects of Soil Composition and Mineralogy on the Bioaccessibility of Arsenic from Tailings and Soil in Gold Mine Districts of Nova Scotia. Environmental Science & Technology, v:44, p.2667–2674

Milligan, T. G., and Law, B. A. 2013. Contaminants at the Sediment−Water Interface: Implications for Environmental Impact Assessment and Effects Monitoring. Environmental Science & Technology, v:47, p. 5828−5834

Moriarty, M. M., Koch, I., Gordon, R. A., and Reimer, K. J.. 2009. Arsenic Speciation of Terrestrial Invertebrates. Environmental Science & Technology, v:43, p.4818-4823

Moriarty, M. M., Koch, I., and Reimer, K. J. 2011. Arsenic Speciation, Distribution, and Bioaccessibility in Shrews and Their Food. Archives of Environmental Contamination and Toxicology, v: 62, p. 529–538.

Moriarty, M. M., Koch, I., and Reimer, K. J. 2013. Arsenic species and uptake in amphibians (Rana clamitans and Bufo americanus). Environmental Science: Processes & Impacts, v:15, p.1520-1528.

Murphy, G.F. 1924. Arsenical Gold Concentrates Memo. Dated December 17, 1924.

Nova Scotia Department of Environment. 1976. Arsenic Task Force - Interim Report. Dated May 17, 1976.

Nova Scotia Department of Health. Potential Occurrence of Radon Gas in Nova Scotia, unknown date.

Nova Scotia Environment (NSE). 2013. Phase 2 Environmental Site Assessment Protocol PRO-400, Revised July 6, 2013.

Nova Scotia Environment (NSE). 2019. Phase 2 Environmental Site Assessment Checklist (CHK400). Revised September 11, 2019.

Parsons, M.B., LeBlanc, K.W.G., Hall, G.E.M., Sangster, A.L., Vaive, J.E., and Pelchat, P. 2012. Environmental geochemistry of tailings, sediments and surface waters collected from 14 historical gold mining districts in Nova Scotia; Geological Survey of Canada, Open File 7150. doi:10.4095/291923

Parsons, M. B., Smith, P. K., Goodwin, T. A., Hali, G. E. M. Sangster, A. L., Percival, J. B. 2003. Distribution and Speciation of Elements Associated with Historical Mine Tailings at Selected Lode Gold Deposits of the Meguma Terrane, Southern Nova Scotia. Mineral Resources Branch, Nova Scotia Department of Natural Resources. Report ME 2003-2, p.11.

Patterson, J.M. 1993. Metalliferous Environments in Nova Scotia: Base Metals. Funded by the Canada-Nova Scotia Cooperation Agreement on Mineral Development. Halifax, NS.

Percival, J.B., White, H.P., Goodwin, T.A., Parsons, M.B., Smith, P.K. 2014. Mineralogy and spectral reflectance of soils and tailings from historical gold mines, Nova Scotia. Geochemistry: Exploration, Environment, Analysis, 14: 3-16. http://dx.doi.org/10.1144/geochem2011-071. © 2014 AAG/The Geological Society of London

Prime, G. A. and White, C. E. 2007: in Mineral Resources Branch, Report of Activities 2006; Nova Scotia Department of Natural Resources, Report ME 2007-1, p. 123-136.

Saunders, J. R., Knopper, L. D., Yagminas, A., Koch, I., and Reimer, K. J. 2009. Use of biomarkers to show sub-cellular effects in meadow voles (Microtus pennsylvanicus) living on an abandoned gold mine site. Science of the Total Environment, v:407, p.5548-5554

Saunders, J. R., Knopper, L. D., Koch, I., and Reimer, K. J. 2011. Inclusion of soil arsenic bioaccessibility in ecological risk assessment and comparison with biological effects. Science of the Total Environment, v:412-413, p.132–137

Smith, P. G., Koch, I., and Reimer, K. J. 2008. An investigation of arsenic compounds in fur and feathers using X-ray absorption spectroscopy speciation and imaging. Science of the Total Environment, v:390, p.198–204

Unnamed Author. 1893. Memo re: Operations. Addressed to President of Richardson Mining Co. (George A. Pyke). Dated October 1893 (in Truro, Halifax).

Unnamed Author. 1907. Boston-Richardson Mine Report Memo. Dated December 26, 1907.

Unnamed Author. 1934. Lease Agreement Memo. Dated January 8, 1934.

Unnamed Author. n.d. Lower Seal Harbour Shaft Options Memo.

Walker, T. R., Grant, J. 2015. Metal(loid)s in sediment, lobster and mussel tissues near historical gold mine sites. Marine Pollution Bulletin, v:101, p.404–408

Walker, S. R., Parsons, M. B., Jamieson, H. E., Lanzirotti, A. 2009. Arsenic Mineralogy of Near-Surface Tailings and Soils: Influences on Arsenic Mobility and Bioaccessibility in the Nova Scotia Gold Mining Districts. The Canadian Mineralogist, v:47, p.533-556

Welles, A.M. 1906. Boston-Richardson Mine Report memo. Dated Jun 12, 1906 (in Denver, NS).

Whaley-Martin, K. J., Koch, I., Moriarty, M. M., and Reimer, K. 2012. Arsenic Speciation in Blue Mussels (Mytilus edulis) Along a Highly Contaminated Arsenic Gradient. Environmental Science & Technology, v:46, p.3110-3118.

Whaley-Martin, K. J., Koch, I., and Reimer, K. 2012. Arsenic species extraction of biological marine samples (Periwinkles, Littorina littorea) from a highly contaminated site. Talanta, v:88, p.187–192

Whaley-Martin, K. J., Koch, I., and Reimer, K. 2013. Determination of arsenic species in edible periwinkles (Littorina littorea) by HPLC–ICPMS and XAS along a contamination gradient. Science of the Total Environment, v:456–457, p.148–153

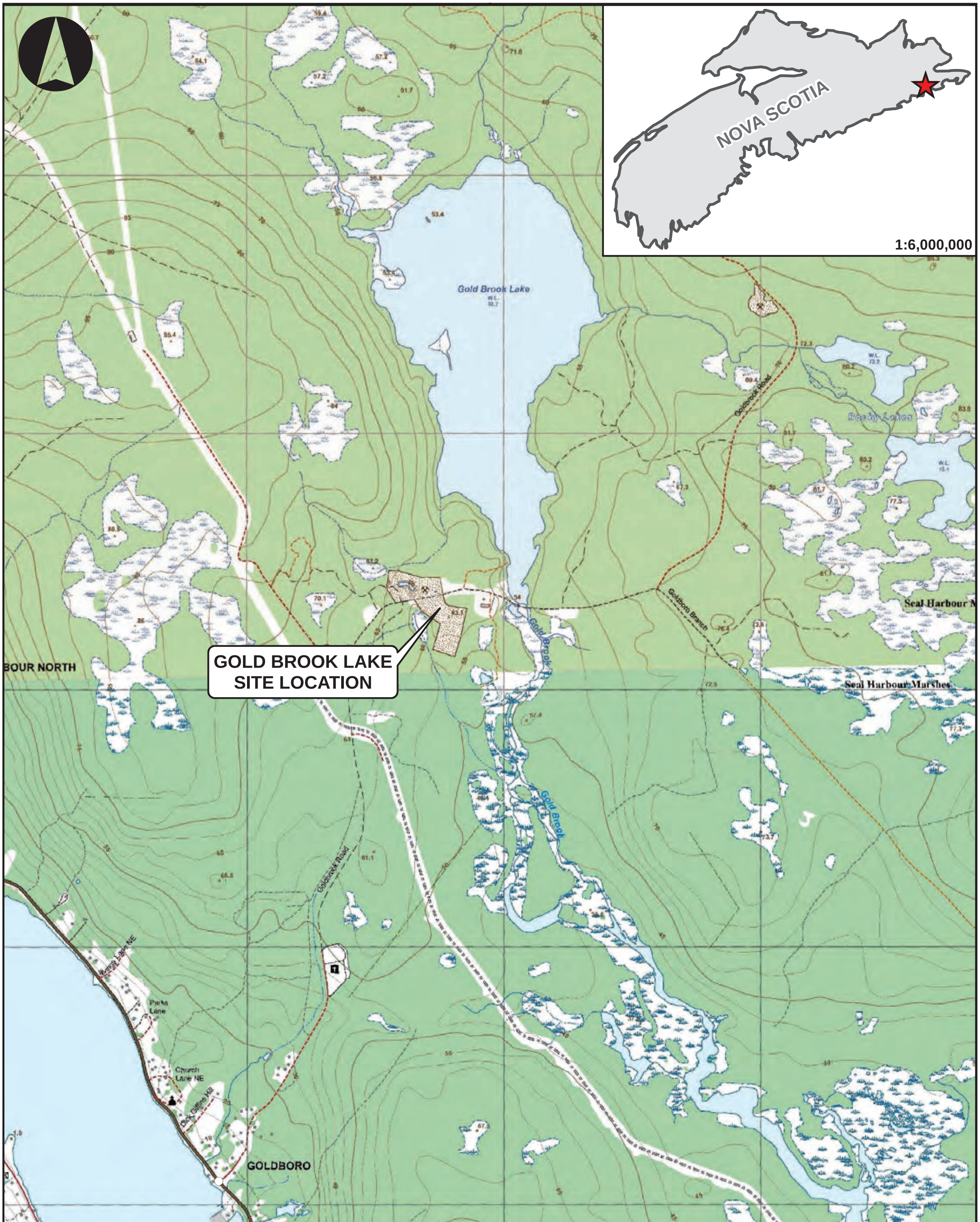
Winch, S., Fortin, D., and Lean, D. R. S. 2008. Factors Affecting Methylmercury Levels in Surficial Tailings from Historical Nova Scotia Gold Mines. Geomicrobiology Journal, v:25, p.112–129

Wood Environment & Infrastructure Solutions, 2021. Goldboro LNG Environmental Assessment – Realignment of Maine Drive (Highway 316). Dated: March 2021.

Woodman, K. K., Duncan, D. R., Graves, R. M., Hudgins, A. B. and Rogers, P. J. 1994. Compliation of Seabright Resources Inc. Till and Soil Geochemical Data, Nova Scotia. Mines and Energy Branches, Nova Scotia Department of Natural Resources. Open File Report 94-021. Dated 1994.

WSP Canada Inc. 2019. Goldboro Site: Historic Tailings Assessment. Prepared for Anaconda Mining Inc. Dated October 2019.

Appendix A. Figures



REFERENCE
LAYER CREDITS: GENOVA

0 200 400 600
m

AECOM

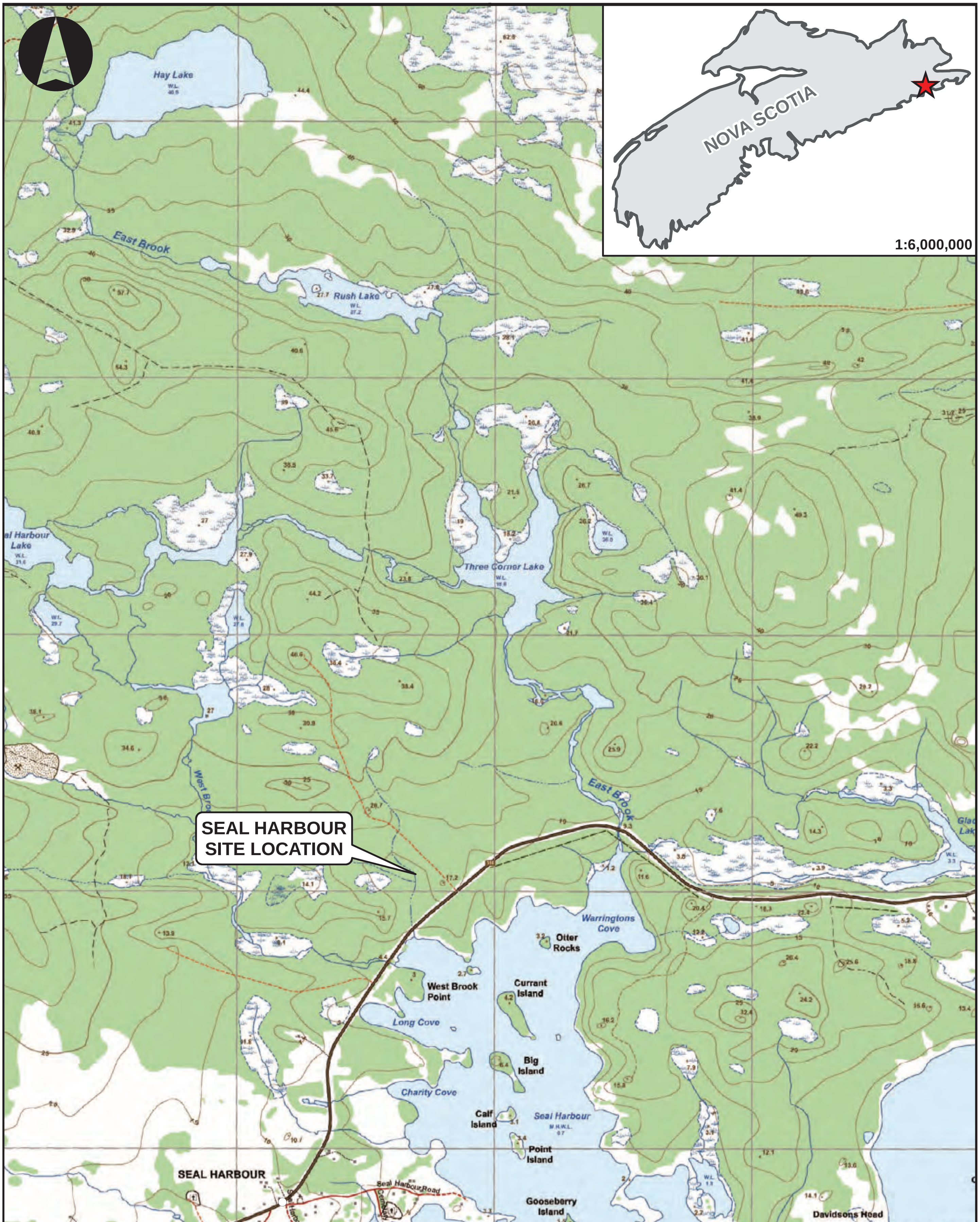
GENERAL SITE LOCATION MAP

CLIENT NAME:
NOVA SCOTIA LANDS INC.

PROJECT LOCATION:
GOLD BROOK LAKE AND
SEAL HARBOUR MINE SITES

DRAWN BY: PC	SCALE: 1:20,000	FIGURE No. **1A**
CHECKED BY: JS	DATE: 2022-09-13	PROJECT NO: 60680068

Last saved by: PAIGE.CROSSMAN (2022-09-13)
L:\Calgary-CACGY3\DCS\GIS\Nova Scotia\60680068\02_MXDs\H001A_60680068_SiteLocation_Gold.mxd



REFERENCE
LAYER CREDITS: GENOVA

0 200 400 600 m

This drawing has been prepared for the use of AECOM's client and may not be used, reproduced or relied upon by third parties, except as agreed by AECOM and its client, as required by law or for use by governmental reviewing agencies. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that modifies this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from stated dimensions.

AECOM

GENERAL SITE LOCATION MAP

CLIENT NAME: NOVA SCOTIA LANDS INC.	PROJECT LOCATION: GOLD BROOK LAKE AND SEAL HARBOUR MINE SITES	DRAWN BY: PC	SCALE: 1:20,000	FIGURE No. **1B**
		CHECKED BY: JS	DATE: 2022-09-13	PROJECT NO: 60680068

Last saved by: PAIGE.CROSSMAN (2022-09-13)
L:\Calgary-CACGY3\DCS\GIS\Nova Scotia\60680068\02_MXDs\H001B_60680068_SiteLocation_Seal.mxd

REFERENCE
NS Property Record Database, Esri World Imagery

0 2,000 4,000 6,000 m

This drawing has been prepared for the use of AECOM's client and may not be used, reproduced or relied upon by third parties, except as agreed by AECOM and its client, as required by law or for use by governmental reviewing agencies. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that modifies this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from stated dimensions.

AECOM

SITE PLAN – PROPERTY BOUNDARY
GOLD BROOK LAKE

CLIENT NAME: NOVA SCOTIA LANDS INC.	PROJECT LOCATION: GOLD BROOK LAKE AND SEAL HARBOUR MINE SITES	DRAWN BY: PC CHECKED BY: JS	SCALE: 1:220,000 DATE: 2022-09-13	FIGURE No. **2A** PROJECT NO: 60680068

Last saved by: PAIGE.CROSSMAN (2022-09-13)
L:\Calgary-CACGY3\DCS\GIS\Nova Scotia\60680068\02_MXDs\H002A_60680068_SitePlan_PropertyBoundary_Gold.mxd

Legend

APPROXIMATE PROPERTY BOUNDARY AS SHOWN ON NOVA SCOTIA PROPERTY ONLINE

PHASE II ESA - STUDY AREA

REFERENCE
NS Property Record Database, Esri World Imagery

0 2,000 4,000 6,000 m

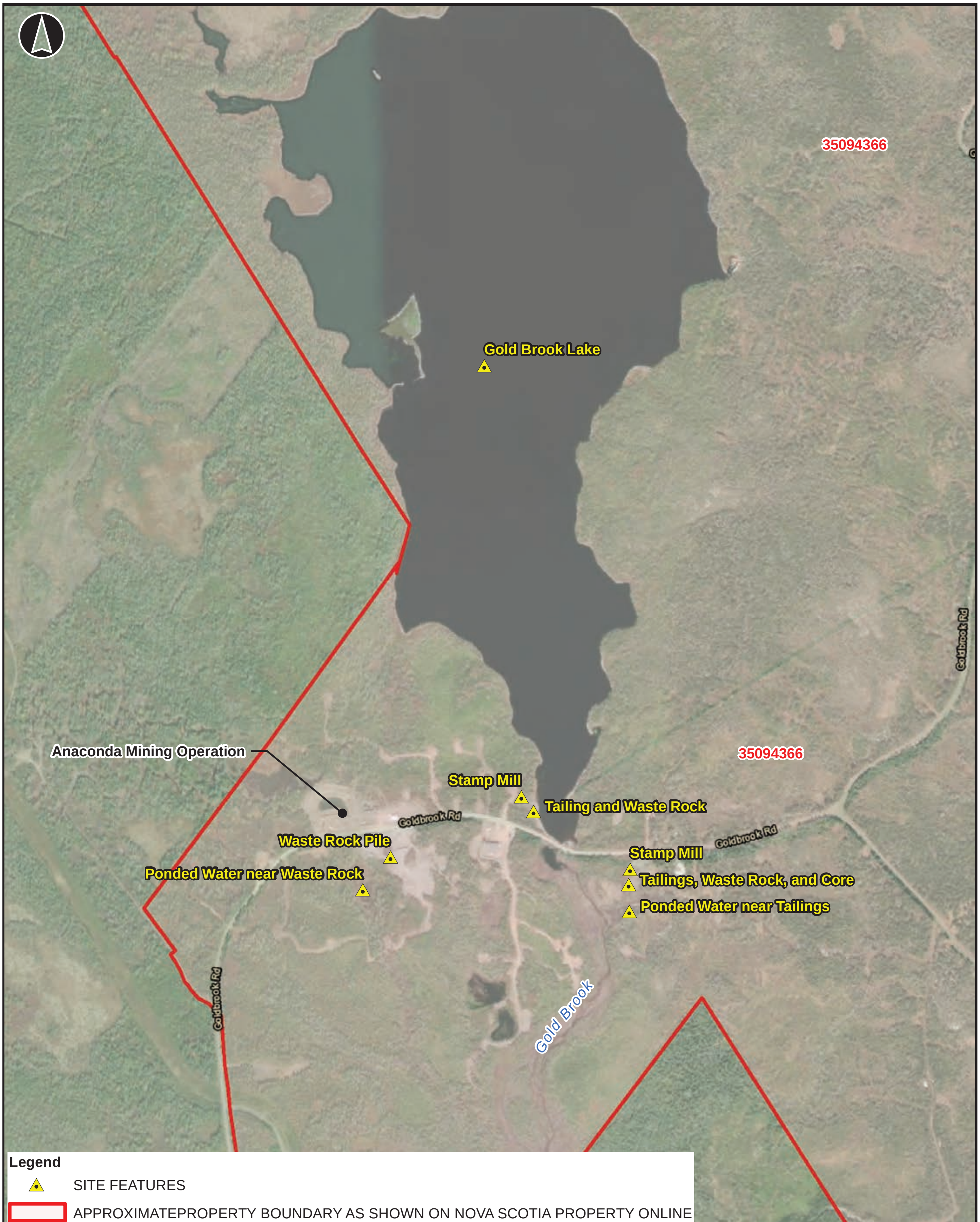
AECOM

CLIENT NAME:
NOVA SCOTIA LANDS INC.

PROJECT LOCATION:
GOLD BROOK LAKE AND
SEAL HARBOUR MINE SITES

SITE PLAN – PROPERTY BOUNDARY
SEAL HARBOUR

DRAWN BY: PC	SCALE: 1:220,000	FIGURE No. **2B**
CHECKED BY: JS	DATE: 2022-09-13	PROJECT NO: 60680068



REFERENCE
NS Property Record Database, Esri World Imagery

0 100 200 300 m

AECOM

GOLD BROOK LAKE SITE PLAN - DETAILS

CLIENT NAME: NOVA SCOTIA LANDS INC.	PROJECT LOCATION: GOLD BROOK LAKE AND SEAL HARBOUR MINE SITES	DRAWN BY: PC	SCALE:1:10,000
		CHECKED BY: JS	DATE: 2022-09-13
		FIGURE No. 3A	PROJECT NO: 60680068

REFERENCE
NS Property Record Database, Esri World Imagery

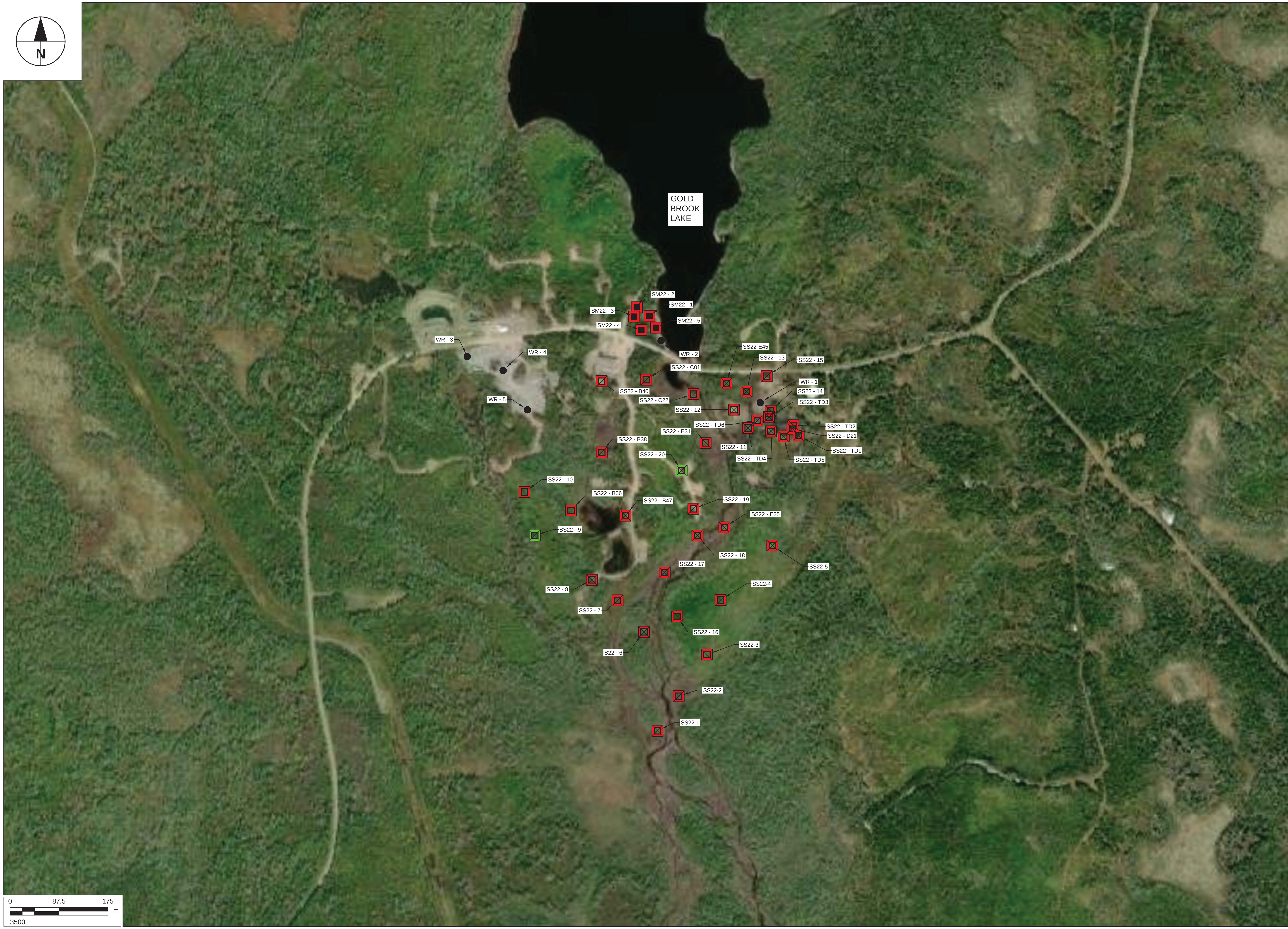
0 200 400 600 m

AECOM

SEAL HARBOUR SITE PLAN - DETAILS

CLIENT NAME: NOVA SCOTIA LANDS INC.	PROJECT LOCATION: GOLD BROOK LAKE AND SEAL HARBOUR MINE SITES	
DRAWN BY: PC	SCALE: 1:20,000	FIGURE No. **3B**
CHECKED BY: JS	DATE: 2022-09-13	PROJECT NO: 60680068

Last saved by: PAIGE.CROSSMAN (2022-09-13)
L:\Calgary-CACGY3\DCS\GIS\Nova Scotia\60680068\02_MXDs\H003B_60680068_APEC_SealHarbour.mxd



LEGEND

- SOIL SAMPLES
- STAMP MILL SOIL SAMPLES
- WASTE ROCK SAMPLES
- SAMPLE EXCEEDS GUIDELINES FOR ONE OR MORE OF THE FOLLOWING PARAMETERS: METALS
- SAMPLE DOES NOT EXCEED GUIDELINES

DRAWING NOTES

1. COORDINATE SYSTEM: NAD83 (CSRS.2010) NOVA SCOTIA ZONE 4.
2. IMAGERY SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/ AIRBUS DS, USDA, USGS, AEROGRID.

Issue Status: DRAFT

Last saved by: DOBRER(2022-10-07) Last Plotted: 2022-10-07
Filename: C:\01.AECOM\00.PROJECTS\3.SEAL HARBOUR UPDATED_SOIL_SAMPLES\09-29-2022\10-07-2022\FIGURE 4 - GOLDBROOK LAKE + SEAL HARBOUR - SOIL SAMPLE AND WASTE ROCK LOCATION PLAN.DWG

PHASE II ENVIRONMENTAL SITE ASSESSMENT

SOIL SAMPLE AND WASTE ROCK LOCATION PLAN

Nova Scotia Lands Inc., Gold Brook Lake and Seal Harbour Mine Site
Project No.: 60680068 Date: 2022-10-07

AECOM

Figure: 4

LEGEND

- MONITORING WELL
- GROUNDWATER FLOW DIRECTION
- SAMPLE EXCEEDS GUIDELINES FOR ONE OR MORE OF THE FOLLOWING PARAMETERS: METALS
- SAMPLE DOES NOT EXCEED GUIDELINES

DRAWING NOTES

1. COORDINATE SYSTEM: NAD83 (CSRS.2010) NOVA SCOTIA ZONE 4.
2. IMAGERY SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/ AIRBUS DS, USDA, USGS, AEROGRID.
3. GROUNDWATER FLOW DIRECTION BASED ON PREVIOUS ENVIRONMENTAL REPORTS.

Issue Status: DRAFT

Last saved by: DOBRER(2023-03-15) Last Plotted: 2023-03-15
Filename: C:\01.AECOM\00.PROIECTE\23. 02-23-2023 - GOLDBROOK LAKE-FIG 5, FIG 7\FIGURE 5 - GOLDBROOK LAKE + SEAL HARBOUR - GROUNDWATER SAMPLE LOCATIONS.DWG

PHASE II ENVIRONMENTAL SITE ASSESSMENT

GROUNDWATER SAMPLE LOCATIONS

AECOM

Nova Scotia Lands Inc., Gold Brook Lake and Seal Harbour Mine Site
Project No.: 60680068 Date: 2023-03-15

Figure: 5

LEGEND

- BACKGROUND SOIL SAMPLES
- SAMPLE EXCEEDS GUIDELINES FOR ONE OR MORE OF THE FOLLOWING PARAMETERS: METALS - SELENIUM
- SAMPLE DOES NOT EXCEED GUIDELINES

DRAWING NOTES

1. COORDINATE SYSTEM: NAD83 (CSRS.2010) NOVA SCOTIA ZONE 4.
2. IMAGERY SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/ AIRBUS DS, USDA, USGS, AEROGRID.

Issue Status: DRAFT

Last saved by: SARBUR(2022-09-14) Last Plotted: 2022-09-14
Filename: C:\USERS\SARBUR1. AECOM\GOLDBROOK LAKE + SEAL HARBOUR\FIGURE 6 - GOLDBROOK LAKE + SEAL HARBOUR - BACKGROUND SOIL SAMPLE LOCATION PLAN.DWG

PHASE II ENVIRONMENTAL SITE ASSESSMENT

BACKGROUND SOIL SAMPLE LOCATION PLAN

Nova Scotia Lands Inc., Gold Brook Lake and Seal Harbour Mine Site
Project No.: 60680068 Date: 2022-09-14

AECOM

Figure: 6