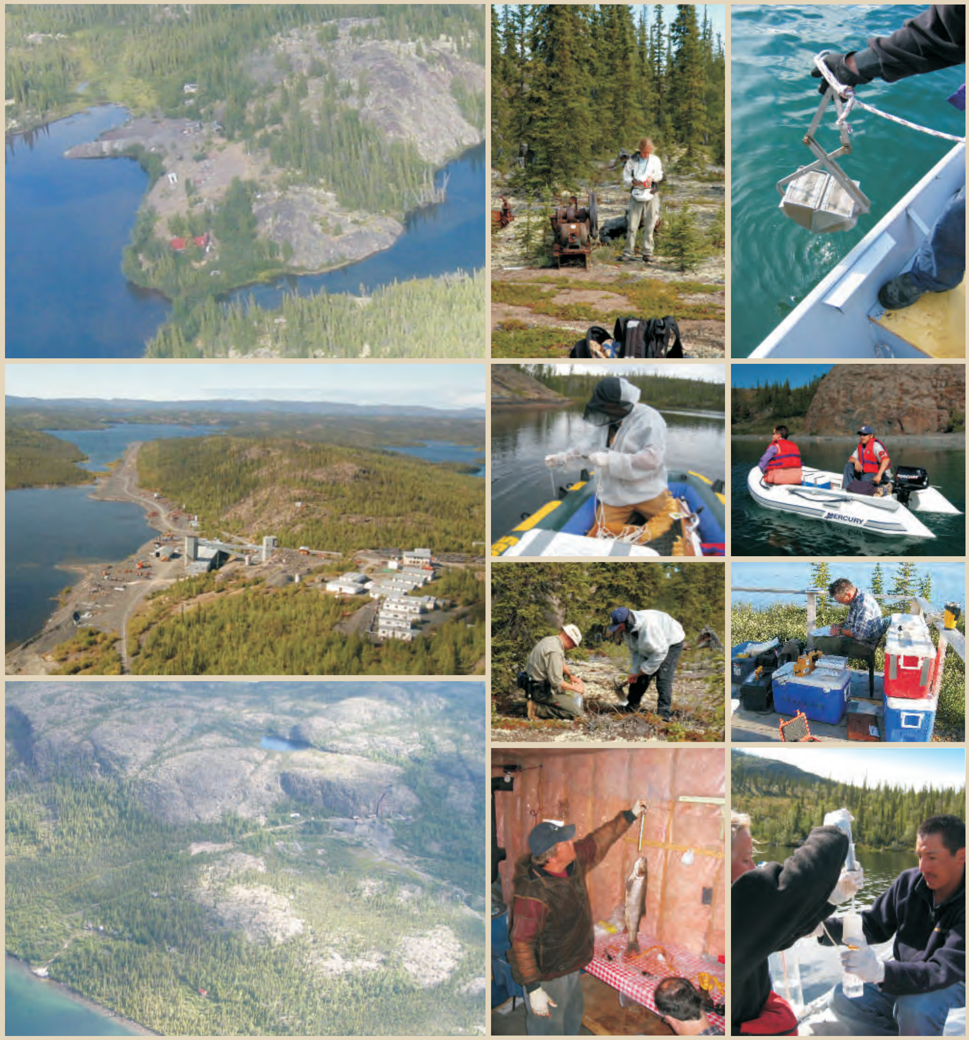
Indigenous and Northern Affairs Canada
Affaires autochtones et du Nord Canada

Annex A-8

Report: Great Bear Lake Sites – Proposed Long-Term, Status of the Environment and Construction Monitoring Plans

GREAT BEAR LAKE SITES
Proposed Long-Term, Status of the Environment and Construction Monitoring Plans



Prepared For:

Indian and Northern Affairs Canada

Prepared By:

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DEVELOPMENT OF GREAT BEAR LAKE LONG-TERM MONITORING, CONSTRUCTION MONITORING AND STATE OF THE ENVIRONMENT PROGRAMS

Prepared for:

Indian and Northern Affairs Canada
Contaminants and Remediation Directorate

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

1.1 BACKGROUND AND SCOPE OF WORK

Indian and Northern Affairs Canada (INAC) intends to remediate several contaminated sites at the east end of Great Bear Lake in the Northwest Territories. Collectively referred to as the Great Bear Lake (GBL) sites, the properties include the former Contact Lake Mine, El Bonanza Mine and the Silver Bear sites (Terra, Northrim, Norex, Graham Vein, and Smallwood).

SENES Consultants Limited (SENES) was retained by INAC to develop aquatic environment monitoring programs for the GBL sites.[1] The scope of work assigned to SENES included the identification of monitoring needs and conceptual development for the following elements:

1) *Construction Monitoring Program* - INAC has developed Remedial Action Plans (RAPs) to address environmental, human health and aesthetic concerns at the GBL sites. Based on current planning, "construction" at the sites is scheduled to begin in 2009 and is likely to extend until at least 2013. Some of the activities associated with remedial works have the potential to impact the aquatic environment. A *Construction Monitoring Program*, focusing on water quality, will be implemented to assist INAC in identifying and responding to potential impacts caused by construction activities.

2) *Long-Term Monitoring Program - In* compliance with regulatory requirements, best practices and a commitment to environmental protection, INAC will monitor the aquatic environments on and in the vicinity of the GBL sites during and after the implementation of remediation. This will be achieved through a *Long-Term Monitoring Program* focusing on water quality. The program will be conducted in a phased approach, with periodic reviews to evaluate monitoring results and modify the program as required.

3) *Status of the Environment Review* - In addition to protecting water quality, the remediation of the GBL sites is intended to reduce or eliminate impacts to other components of the environment, including local species. The overall monitoring strategy for the GBL sites will therefore include periodic *Status of the Environment Reviews* to evaluate conditions in the broader aquatic environment, assess trends, identify environmental components where follow up monitoring is warranted as well as identify areas where environmental monitoring can be discontinued.

The current document presents SENES' recommendations for the implementation of the three monitoring components described above. It should be noted that extensive assessment and

[1] As administered through Call-Up 19 of INAC Standing Offer 00-05-6002-5.

monitoring of environmental conditions has occurred at all of the GBL sites for a period of several years. The locations of previous sampling stations, sampling frequency, types of analysis, number of samples collected and the results of these past programs were all considered in the development of the proposed monitoring programs.

The history, current status and environmental concerns at the GBL sites are presented in detail in a variety of site assessment and monitoring documents. Similarly, information on the remedial strategies for each of the sites can be found in documentation such as RAPS and contract specifications. This information is not repeated in the current document; instead, references to relevant background documents are provided. The reader is encouraged to refer to the Reference List should additional site-specific and background information be required.

It should be noted that, in addition to the Silver Bear, Contact Lake and El Bonanza sites, INAC is also developing a RAP for the Sawmill Bay site. Sawmill Bay is located in the general vicinity of the other sites and may be integrated into the overall GBL remediation strategy. However, descriptions of the long-term monitoring program for Sawmill Bay are not provided in the current document and will be presented at a later date. In the interim, pre-remediation monitoring of water quality is ongoing.

1.2 LOCATION OF MINE SITES

The Contact Lake, El Bonanza and Silver Bear mine sites are all located in the vicinity of the northeast shore of Great Bear Lake (McTavish Arm) in the Northwest Territories within the boundaries of the Sahtu Dene and Métis Comprehensive Land Claim Agreement.

More specifically, the Contact Lake Mine site is located on the north shore of Contact Lake, approximately 425 km northwest of Yellowknife (see Figure 1.2-1). The El Bonanza Mine site is located 12 km to the west on the Dowdell Peninsula of Great Bear Lake. The Silver Bear Mines, which include the Terra, Northrim, Norex, Graham Vein and Smallwood mines, are situated approximately 45 km south of Contact Lake and El Bonanza (390 km northwest of Yellowknife). All of the Silver Bear sites are located within 2 km of Rainy Lake, which is part of the Camsell River that drains into Great Bear Lake. The Terra Mine site is situated on a peninsula situated between the south shore of Rainy Lake and the north shore of Moose Bay (refer to Figure 1.2-2). Relative to the Terra Mine site, the Northrim Mine site is approximately 6.5 km upstream and to the east along the north shore of the Camsell River. The Norex Mine site is to the south of the Camsell River, approximately 1 km southeast of Northrim. Graham Vein and the Smallwood Mine are approximately 1.5 km to the east of the Norex Mine site.

FIGURE 1.2-1
VICINITY SITE LOCATION MAP

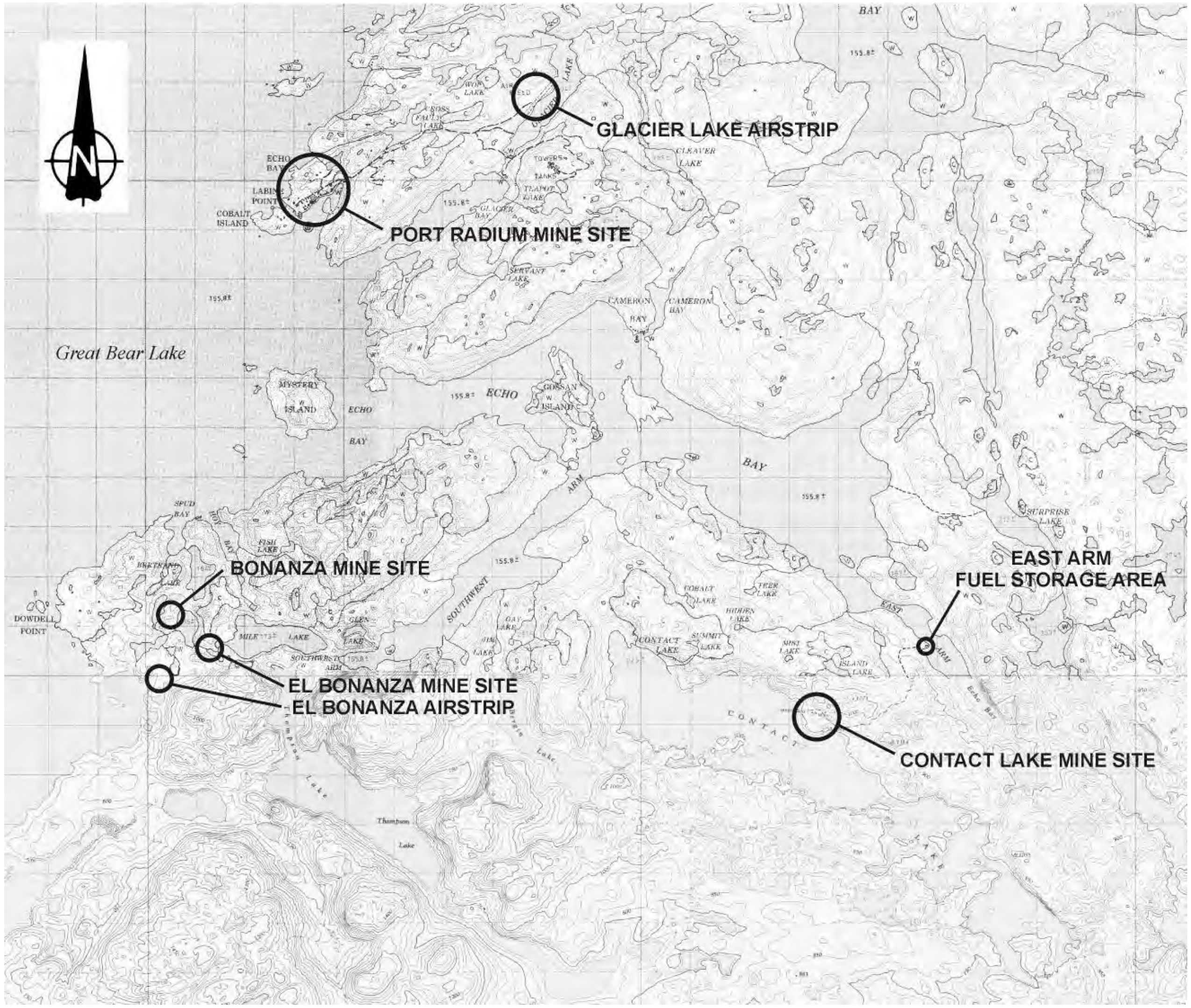
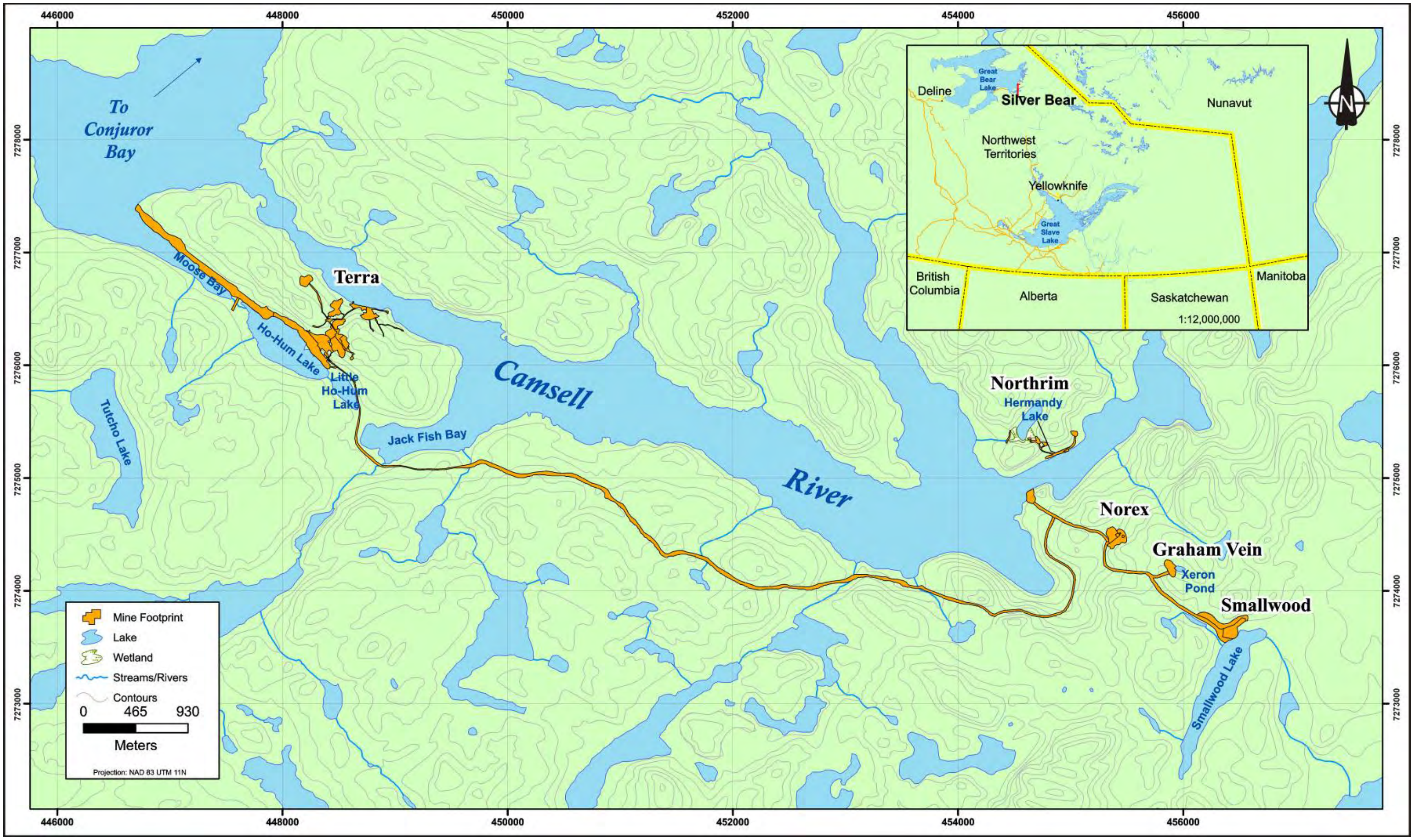


FIGURE 1.2-2
SILVER BEAR MINE LOCATION AND SITE MAP



2.0 REVIEW OF PAST MONITORING PROGRAMS

2.1 PAST MONITORING ACTIVITIES

As indicated previously, extensive site characterization and monitoring work has been performed at all of the GBL sites. The following sections provide an overview of this work on a site-by-site basis.

2.1.1 Contact Lake Mine

Multiple programs to characterize the aquatic environment at the Contact Lake Mine have been conducted over the last sixteen years. The chronology of assessments is as follows:

1) An environmental assessment was completed at the site by EBA Consultants Limited in September 1992 (EBA 1993).
2) From 2002 to 2004, INAC's Water Resources Division (WRD) partnered with the Contaminants and Remediation Directorate (CARD) on four occasions (September 2002; June and August 2003; September 2004) to sample surface water, sediment, groundwater and soil quality in order to augment the record of site conditions.
3) The results from the aforementioned programs were compiled into a report by Gartner Lee Limited in 2005 (Gartner Lee 2005).
4) Additional water and sediment samples were collected again by INAC WRD in August 2005 (INAC 2006a).
5) A detailed site assessment program was completed in July 2006 by SENES (SENES 2007a). The program included a comprehensive evaluation of water quality on the site and in receiving waters.
6) An expanded water quality evaluation was conducted by SENES in June 2007 (SENES 2008a).
7) Follow-up environmental monitoring was also conducted by SENES in June 2008, which included water sampling, as well as background soil and vegetation sampling in the vicinity of the site (SENES 2008b).

2.1.2 El Bonanza Mine

Water sampling programs in support of site assessments have been conducted at the El Bonanza Mine site by:

1) Golder Associates Limited in July 2004 (Golder 2005).
2) A detailed site assessment program was completed by SENES in July 2006 (SENES 2007b).
3) A supplemental program was completed in June 2007 (SENES 2007c).
4) Subsequent environmental monitoring was conducted by SENES in June 2008, which included water sampling, as well as background soil and vegetation sampling in the vicinity of the site (SENES 2008b).

2.1.3 Silver Bear Mines

Water quality in the environment near the Silver Bear Mines has been extensively monitored on a regular basis since 2002. The chronology of monitoring is as follows:

1) A monitoring program was initiated by INAC in 2002 with financial assistance from the department's Financial Management Committee (FMC).
2) With support from the FMC, sampling was also conducted in September 2002 and June 2003 (INAC 2005).
3) Additional sampling was carried out in June, August and September of 2004 with funding from the Federal Contaminated Sites Accelerated Action Plan Fund (FCSAAP) (INAC 2005).
4) INAC Waters carried out additional sampling in June, July and August in each of 2005, 2006, 2007 and 2008[2] with funding from the FCSAP Fund (MAC 2006b; INAC 2007; INAC 2008).

2.2 DESCRIPTION OF PAST MONITORING PROGRAMS

An electronic spreadsheet summarizing previous water quality monitoring activities at the Great Bear Lakes sites was submitted in conjunction with this report. Any tables referenced in Section 2.0 can be found in that spreadsheet.

2.2.1 Contact Lake Mine

<u>EBA Consultants Limited (1992)</u>

The EBA water sampling program that was completed in September 1992 was summarized by Gartner Lee (2005). The EBA study included 15 water sampling locations, which are partly

[2] The 2008 sampling program did not include a July sampling campaign due to lack of personnel.

summarized in Table 2.2-1.[3] A distinction between surface water and groundwater samples was not made in the report and based on the locations of the sampling stations, Gartner Lee (2005) interpreted them as being surface water related. As the details of the EBA sampling program are unclear, and the fact that the sampling stations are not consistent with those established in later programs by WRD and SENES, this program was not considered further in the development of the long-term and construction water quality monitoring programs.

INA C Water Resources Division (2002-2005)

Water samples were collected by INAC's WRD on five different sampling dates: September 2002, June 2003, August 2004, September 2004 and August 2005. The stations that were sampled during each campaign are indicated in Table 2.2-2. From 2002 to 2004, a limited number of surface water samples were collected along the Contact Lake shoreline at station CL-4 just east of the dock or CL-5 where the stream enters Contact Lake, and from on-land waters in the Tailings Pond (CL-3) and a stream emanating from the waste rock pile (CL-2). All of the aforementioned stations were sampled again in 2005, but the Tailings Pond (CL-3) was sampled at two depths, near the surface and the bottom of the water column. In addition, the open waters of Contact Lake were sampled at CL-6 at three depths (surface, middle, and bottom), while a surface water sample was also collected from a nearby reference lake (Tutcho Lake).

With respect to Quality Assurance/Quality Control (QNQC) procedures that were followed from 2002 to 2004, Gartner Lee (2005) indicated that replicate surface water samples were collected from station CL-3 in September 2002 and June 2003 and that a field blank was also submitted with each of these samples. Water samples that were collected in replicate are indicated in bold type in Table 2.2-3. INAC (2005) did not refer to the collection of replicate samples or field blanks during the August 2005 campaign.

Table 2.2-3 summarizes the different types of water samples (e.g. field measurements, general chemistry, total metals, dissolved metals, radionuclides, and petroleum hydrocarbons) that were collected at each station during each sampling campaign, while Table 2.2-4 lists the analytes that were measured in each sample type. Over the 2002 to 2005 monitoring period, field measurements were only taken in 2005 at stations that were sampled at more than one depth (CL-3 and CL-6) and the reference lake (Tutcho Lake), while waters were not sampled for petroleum hydrocarbons. Determinations of nutrients, major ions and physical properties were included under general chemistry. An extensive list of radionuclide isotopes (21 in total) were determined in each radionuclide sample.

[3] Refer to accompanying electronic spreadsheet for Tables 2.2-1 to 2.2-9

SENES Consultants Limited (2006-2008)

The 2005 water quality monitoring program was expanded by SENES (2007a) to include additional sampling stations for the July 2006 site assessment program in order to better define and characterize the existing environmental conditions at the Contact Lake Mine site. The program was further expanded during the supplemental site assessment program in June 2007 (SENES 2008a). The stations that were sampled, the samples that were collected and the analytes that were measured during the SENES sampling campaigns are summarized in Tables 2.2-2, 2.2-3 and 2.2-4, respectively.

In 2006, surface water samples were collected from eleven stations in Contact Lake, the East Arm of Great Bear Lake and on-land surface waters characterized by pond water and runoff water, including Upper Lake, Tailings Pond and runoff from the waste rock pile. Water samples were also collected at depth at two stations in Contact Lake (CL-6 and CL-8), and stations CL-1 and CL-3 in Upper Lake and Tailings Pond, respectively. Relative to 2005, two background stations within Contact Lake, a shoreline station (CL-9) and an open water station (CL-8), were also added to the sampling program.

As was mentioned previously, the sampling program was further augmented during the supplemental site investigation in 2007. At this time, five additional open water stations were sampled in Contact Lake (CL-11, CL-12, CL- 1 3, CL-14, CL-26) and two in the East Arm of Great Bear Lake (CL-16-EA, CL-20-EA), while additional on-land water samples were collected just upstream from the inflow to Tailings Pond (CL-15) and from the bog (CL-17). Also, surface waters from four reference lakes in the local study area were sampled at each end (east and west) to characterize background conditions. As was the case in 2006, several stations in Contact Lake and the East *Arm* of Great Bear Lake were also sampled at depth (CL-6, CL-8, CL-11, CL-13, and CL-7-EA). The 2008 water sampling program (SENES 2008b) basically repeated what was done in 2007.

During all of the SENES water sampling programs an attempt was made to collect field measurements at each station that was sampled, although in some cases the instrumentation was not available to do so as concurrent field sampling was often occurring. Relative to the WRD programs, fewer general chemistry parameters and radionuclides were sampled from 2006 to 2008. The radionuclide analysis focussed on only two isotopes, radium-226 and lead-210. The isotopes were selected as representative surrogates for a complete radionuclide scan. Also, in 2007 the analysis of petroleum hydrocarbons (BTEX, F1 to F4 fractions) was introduced to the program at INAC's request. As part of the QAIQC plan, field and travel blanks were included in each sampling campaign while at least 10% of all samples of each sample type were collected in duplicate.

2.2.2 El Bonanza Mine

Golder Associates Limited (2004)

An “Enhanced" Phase I Environmental Site Assessment (ESA) was conducted by Golder in 2004 (Golder 2005). Apart from preliminary physical characterization of the site, a limited sampling program was carried out for the following environmental media: surface soil, lake sediments, surface water and mine rock. The water sampling program included only three surface water samples that were collected from the near shore areas of Mile Lake and Silver Lake and from the shaft. In addition, one sample was replicated and one background sample was also collected.

SENES Consultants Limited (2006-2008)

Water quality monitoring in the vicinity of the El Bonanza and Bonanza Mines was conducted by SENES in July 2006 during the site assessment program (SENES 2007c) and in June 2007 during the supplemental site assessment (SENES 2007b). Open water, shoreline and on-land water samples encompassing both mine-impacted and background areas were collected. The stations that were sampled and the samples that were collected during the SENES sampling campaigns are summarized in Tables 2.2-5 and 2.2-6, respectively.

In 2006, surface water samples were collected from two stations in Mile Lake, which is located immediately upstream of the mine site and considered background; four stations in Silver Lake, which is located adjacent to the mine; two on-land stations near the Silver Lake outlet; two stations in Great Bear Lake in the vicinity of the abandoned airstrip; and, one station in Whale Lake (a vicinity lake). One station in Mile Lake (ELB-3-ML), one station in Silver Lake (ELB-5-SL) and both stations in Great Bear Lake (ELB-1-GBL and ELB-2-GBL) were also sampled at depth. In 2007, the sampling program was expanded to include more stations and sample collections to better characterize site conditions. Two additional stations were sampled for surface waters in Mile Lake (ELB-10-ML and ELB-11-ML), one station in Great Bear Lake (ELB-9-GBL), while three additional vicinity lakes were also sampled (ELB-RL-2-A, ELB-RL-3-A, and ELB-4-A) as local reference bodies. The 2008 water sampling program (SENES 2008b) basically repeated what was done in 2007, although station ELB-9-GBL in Great Bear Lake was not sampled, while all four stations in Silver Lake were sampled at the surface as well as at depth.

The stream discharging from Silver Lake represented the only on-land water source sampled at El Bonanza as no evidence of surface water runoff and surface flows were observed in the area above the site during the 2006 and 2007 site assessments (SENES 2007b; 2007c). Lake water flows were observed through the culvert connecting Mile Lake and Silver Lake and the culvert discharging Silver Lake to the stream flowing toward Great Bear Lake.

The analytes that were measured during the SENES sampling campaigns at El Bonanza are shown in Table 2.2-6 (Samples Collected During Past Monitoring Programs at El Bonanza Mine (2002-2008)). Field measurements, samples for total measurements and in most cases samples for general chemistry and dissolved metals were taken at all stations during all three sampling campaigns. Radionuclide samples were collected in 2006 and 2007 but were dropped from the program in 2008 as previous results were consistently below method detection limits. A few water samples for BTEX and F1 to F4 fraction petroleum hydrocarbons were collected in 2007 and 2008 from at least one station in each of Mile Lake, Silver Lake and Great Bear Lake. As part of the QNQC plan, field and travel blanks were included in each sampling campaign while at least 10% of all samples of each sample type were collected in duplicate.

2.2.3 Silver Bear Mines

INAC Water Resources Division (2002-2008)

Sampling sites in the Silver Bear water quality monitoring programs have included tailings containment lakes/ponds, seepages from waste rock piles and downstream receiving water bodies where contamination from the mines might occur. Stations where water samples have been collected each year from 2002 to 2008 at each mine site are shown in Table 2.2-7. As can be seen, the monitoring program has been expanded over time, and in some years extra sampling has also been conducted to investigate particular issues (not included on Table 2.2-7). From 2004 to 2007, the Silver Bear Mine sites were sampled on three occasions over the summer period, typically in June, July and August. In 2008, the July sampling campaign was not conducted due to lack of available personnel. Based on the relative consistency of data collected from previous campaigns and years, the reduced sampling frequency in 2008 is not considered to represent a significant gap in the data set.

Reference Sites

Since 2005, water samples have been collected from four reference sites, three of which are located in the Camsell River at the outlet of Clut Lake (R-1), the outlet of Balachey Lake (R-2), and upstream of the Northrim Mine (R-4)[4], and one in Tutcho Lake, which is located upslope of the Terra Mine.

Terra Mine Site

Surface water sampling at the Terra Mine site has typically included: Ho-Hum Lake (T-3, T-5, T-7, T-8, T-9, T-16); Little Ho-Hum Lake (T-2); a number of stations in the Camsell River

[4] Prior to 2005 samples were collected from only three reference sites. Station R-4 was added in 2005.

including Jackfish Bay (T-1), Rainy Lake (T-4), and Moose Bay (T-6, T-1 0, T-12); and, several on-land stations to monitor water quality in the stream draining to Jackfish Bay (T-17), landfill leachate (T-18, T-25), the four adits (T-19, T-20, T-21, T22), and the vent shaft (W-4). The Ho-

Hum Lake sampling stations have included both shoreline and open water stations. The open water station T-8 has always been sampled at the surface and bottom of the water column, and since 2005 at the middle of the water column as well. In addition, detailed depth profiles (at 1-m intervals) of pH, temperature, conductivity and dissolved oxygen have also been taken at this station during each sampling event. A sampling transect was also established in Ho-Hum Lake that extended offshore from the fuel drums to about mid-way into the lake, which included three stations. The transect was only sampled in 2006. In 2007, three additional stations (HH-1, HH-2, HH-3) were sampled at the east end of Moose Bay near the weir to determine total metal concentrations of the water passing through the waste rock of the airstrip. It should be noted that several of the on-land stations such as T-17, T-18, and T-22 are often dry.

Wells have also been established to monitor pore water in the Ho-Hum Lake tailings beach (Well #1, Well #2) and groundwater between the landfill and Jackfish Bay (Well #3). A number of additional pore water and groundwater monitoring wells were established by Lorax Environmental Services in 2005 in the waste rock beside Ho-Hum Lake (TMW-01, TMW-02, TMW-03), near the Camsell River dock (TMW-05, TMW-06, TMW-07), and the airstrip along Moose Bay (TMW-04). In June 2007, an attempt was made to sample all monitoring wells, including wells NRMW-1 and NRMW-2 at the Northrim Mine, for total metals and radionuclides. As is often the case, however, several of the wells were dry, including TMW-01 to 03, TMW-07, Well #2, W-4 and NRMW-1.

In 2006, the Terra Mine water quality monitoring program also incorporated a few special sampling programs. A number of surface water samples were collected in July (HHO-1 to HHO-9) and August (HHO-1, HHO-4, HHO-7, HHO-9) by SRK Consulting Inc. (SRK) on either side of the weir between Moose Bay and Ho-Hum Lake to investigate arsenic and copper concentrations in the outflow area of Moose Bay. Additional surface water samples were also collected in August from shoreline and open water stations in Moose Bay (MB-1 to MB-7) at the request of SRK in order to further define the gradient of outflow from Ho-Hum Lake and to compare shoreline and mid-water metal concentrations. Finally, at the request of INAC-CARD, water samples were collected from shore at four stations (C1 to C4) near the old Terra dock and downstream of the water supply intake and analyzed for total extractable hydrocarbon levels.

Norex Mine Site

Surface water samples at the Norex Mine site have typically been collected from the adit drainage (NX-1, NX-IB) and waste rock seepage (NX-2, NX-3). Extra samples for total metal determinations were collected in July (NX-W, NX-4, NX-4A) and August (NX-4, NX-4A) of 2006 from the drainage running from the Norex seeps to the Camsell River. Reference samples were also collected in July (NX-11, NX- 11A**)** from an adjacent creek that drains east of the Norex site.

Graham Vein Mine Site

Surface water samples at the Graham Vein Mine site have typically been collected from Xeron Pond (NX-8) and/or the small pool of water adjacent to the Xeron Pond (NX-4, MX-1) and standing water from the Graham Vein (NX-5). Xeron Pond has typically been sampled at the top and bottom of the water column, while depth profiles (at 1-m intervals) of pH, temperature, conductivity and dissolved oxygen have also been taken. As the Graham Vein Mine site has no real water quality issues, this site was largely removed from the Silver Bear water quality monitoring program in 2007 and was not sampled at all in 2008.

Smallwood Mine Site

Smallwood Lake represents the only surface water at the Smallwood Mine Site. Both shoreline (SM-1) and open water (SM-6, SM-7) stations have typically been sampled in Smallwood Lake. The open water station SM-7 has always been sampled at three depths at the top, middle and bottom of the water column and depth profiles of pH, temperature, conductivity and dissolved oxygen have also been taken at 1-m intervals.

Northrim Mine Site

Surface water samples at the Northrim Mine site have typically been collected from Hermandy Lake (NO-7, NO-1 1), the leachate ponds (NO-2), the Hermandy Lake outlet stream (NO-4), drainage form the mine adit (NO-1, NO-9), and the Camsell River (NO-6). Water from the mine adit (NO-9) is only collected when water occurs outside the adit and is flowing away from the adit toward the Camsell River. The north end of Hermandy Lake where the submerged tailings occur (NO-11) has always been sampled at least at two depths at the surface and bottom of the water column. Depth profiles of pH, temperature, conductivity and dissolved oxygen have also been collected at this station at 1-m intervals. In addition to surface waters, samples are also collected from the two groundwater wells at Northrim (NRMW-1 and NRMW-2).

Water Sample Analysis

Water samples for general chemistry (including physical parameters, nutrients and major ions) and total metals determinations have typically been collected at all stations (see Table 2.2-8). From 2002 to 2004, water samples for dissolved metals determinations were also commonly collected. The collection of dissolved metals samples was initiated again in 2007 at select stations only to measure the proportions of dissolved and particulate metals in the samples. This was continued in 2008.

At the Terra Mine, water samples have been collected at a few stations during each sampling event for cyanide species (typically total, WAD (weak acid dissociable) and/or SAD (strong acid dissociable)) and in some cases thiocyanate. Station T-8 in Ho-Hum Lake is usually sampled for cyanide species at all three depths. In addition, other stations in Ho-Hum Lake (T-5, T-7A, T-9, T-16A), Little Ho-Hum Lake (T-2), on-land station T-25, and some of the wells (Well#l, TMW-04, TMW-05) have also been sampled on occasion for cyanide species.

Water samples have also been collected at select stations for petroleum hydrocarbons. Between 2002 and 2004 these samples were typically analyzed for total extractable and purgeable hydrocarbons as well as BTEX (benzene, toluene, ethylbenzene and xylene) compounds. Since 2005, however, petroleum hydrocarbon analysis has been limited to total extractable hydrocarbons. Petroleum hydrocarbons samples have been collected at one time or another from all the mine sites with the exception of Graham Vein. An intensive petroleum hydrocarbon program was conducted in August of 2008, which included sample collections for total extractable hydrocarbon analysis from almost every station that was sampled at each mine site.

As the Silver Bear Mines were not mined for uranium, surface water samples have generally not been collected for radionuclide analysis from any of the sites. However, due to some elevated gamma levels that were measured around the Terra camp, a limited number of samples for radionuclide analysis were collected in August 2007, with at least one sample collected from each mine site. Most samples were analyzed for lead-210 and radium-226 only, but a few samples that were collected from Ho-Hum Lake (T-8) were analyzed for a full suite of radionuclides. Additional samples for radionuclide analysis (lead-210, radium-226) were collected from select stations in June 2008.

Analytes that were measured in each sample type during past sampling events at the Silver Bear Mines are summarized in Table 2.2-9.

Quality Assurance/Quality Control

Field QA/QC consisted of travel blanks, field blanks and replicate (usually triplicate) samples. Regardless of the total number of samples collected, zero to three triplicate samples, one field blank and usually one travel blank have typically been collected during each sampling event (e.g. August 2007).

2.3 FINDINGS OF PAST MONITORING PROGRAMS

2.3.1 Contact Lake Mine

EBA Consultants (1992) and INAC Water Resources (2002-2005)

In reviewing the water quality data collected by EBA in 1992 and INAC-WRD from 2002 to 2005, Gartner Lee (2005) concluded that surface runoff at the Contact Lake mine site had been impacted from mining operations. Surface water sampled on the site showed elevated concentrations of some metals including aluminum, arsenic, cadmium, copper, iron, mercury, selenium, and silver, which exceeded their respective Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of aquatic life. In addition, high concentrations of other metals such as barium, manganese, strontium, and uranium and measurable levels of radionuclides (i.e. lead-2 10, potassium-40, polonium-2 10, radium-226, radium-228 and thorium-230) were also detected in the surface water on site. Review of the general chemistry data for surface water on site did not indicate the presence of acid mine drainage. The residual surface tailings at the site, which contained very high levels of many metals, were thought to be a significant source of metals to the surface water. The water quality of Contact Lake was appreciably better than that measured on site, with concentrations of metals being lower and with fewer exceedances of CCME guidelines observed. Concentrations of cadmium, copper and silver exceeded CCME guidelines, indicating possible impact from mining operations; however, the water quality of Contact Lake was similar to that measured in Upper Lake (upstream of the mine), suggesting that regional water quality may reflect naturally occurring metal enrichment. It is significant to note that elevated concentrations of metals in Contact Lake have not been observed during the three years of monitoring conducted by SENES (see below). To the contrary, with the exception of analytical errors for chromium and lead, no CCME exceedances for metals in Contact Lake were found by SENES (see Contact Lake ESA, 2007).

SENES Consultants Limited (2006-2007)[5]

Data collected in 2006 and 2007 during the SENES site assessment programs (2007a; 2008a) showed mean concentrations of metal constituents to be similar at Great Bear Lake and Contact Lake locations with all metal and radionuclide concentrations measuring below applicable guideline values. Metal concentrations measured in four regional lakes in 2007 were generally consistent between the lakes, below guideline values and consistent with results obtained for

[5] A water quality monitoring program at the Contact Lake Mine was also conducted in 2008. The following description was prepared prior to the finalization of the 2008 assessment report. However, the results of the 2008 program found results consistent with those from previous monitoring initiatives. In this regard, the following descriptions and conclusions for the 2006 and 2007 programs also apply to 2008.

Contact Lake. Overall, the results suggest that receiving waters have not been adversely impacted by the Contact Lake Mine.

With the exception of copper, constituent concentrations measured in Upper Lake were well below guideline values. Although some mineral exploration (e.g., diamond drilling) has occurred in the vicinity of Upper Lake, the water body is up-gradient of the mining operation and, as such, is not exposed to the main sources of contamination at the site (e.g., tailings and wasterock). The near proximity of Upper Lake relative to the mine suggests that elevated copper concentrations may be attributable to naturally occurring mineralization.

Concentrations of most constituents measured in the Tailings Pond were elevated including arsenic, barium, copper, manganese, nickel, strontium, and uranium. Constituent concentrations measured in the waste rock seepage were also elevated and in most cases were a factor of 2 times greater than those observed in the tailings pond.

During the 2006 and 2007 site assessment programs, a number of surface water samples were collected from between the mine site and the Tailings Pond and between the Tailings Pond and Contact Lake. The concentrations of arsenic, copper, and uranium at the toe of the waste rock pile were found to be higher than those in Upper Lake, and concentrations increased in down gradient samples between the waste rock pile and the Tailings Pond. Concentrations of arsenic, copper, silver and uranium that exceeded water quality guidelines in the tailings pond decreased in the samples between the pond and Contact Lake and were below detection limits at the inflow to Contact Lake. These results indicated that the waste rock and surface tailings at the mine site are impacting localized on-site runoff water quality particularly with respect to arsenic, copper, and uranium levels. However, the elevated concentrations in run-off have not been found to be having a substantive effect on Contact Lake.

It should be noted that INAC's monitoring activities at the site included the installation of shallow groundwater monitoring wells. The wells were advanced by hand into surficial soils (predominantly moss/muskeg) along the flow path between the tailings pond and Contact Lake. The maximum depth of the wells was less than one meter and, at the time of SENES' sampling programs, all of the wells had been damaged (either by frost jacking and/or wildlife). In cases where the wells were still in place, there was evidence of communication between surface flow and the borehole. On the basis of the above, any samples collected from the wells were considered to be representative of surface water, not groundwater. Further, taking into consideration local topography and ground conditions (i.e., bedrock and permafrost), SENES concluded that the likelihood of contaminated groundwater having a substantive effect on the water quality of Contact Lake is low.

2.3.2 El Bonanza Mine

Golder Associates Limited (2004)

The results of the limited surface water sampling program that was conducted in 2004 by Golder (Golder 2005) showed that the majority of samples collected met the applicable CCME criteria and were consistent with background concentrations at the site. The exceptions included the concentration of copper in Silver Lake and aluminum and zinc in the shaft water (shaft #2).

SENES Consultants Limited (2006-2007)[6]

Mean constituent concentrations measured in 2006 and 2007 in Mile Lake, Silver Lake, Great Bear Lake at the airstrip, as well as the stream downstream of Silver Lake (SENES 2007b; 2007b) were generally low and below applicable water quality guidelines. The results were also comparable between water bodies. Measurements in many cases were below respective detection limits, especially for cadmium, cobalt and selenium that were below detection limits in all samples analyzed. The only constituent that exceeded a water quality guideline was copper in Mile Lake in 2006. Constituent concentrations measured in 2007 in the four vicinity lakes were also below water quality guidelines. Concentrations of PHCs that were measured in surface waters in 2007 were below applicable guidelines in all samples.

2.3.3 Silver Bear Mines

INAC Water Resources Division (2002-2004)

Water samples that were collected from the Silver Bear Mines between 2002 and 2004 (INAC 2005) indicated that there is localized contamination at each mine. Arsenic and copper were the main elements of environmental concern at Terra as levels were consistently high in mine surface water and routinely exceeded the guidelines for the protection of freshwater aquatic life. The surface waters at Norex were elevated with sulphate, arsenic, copper, iron, lead and zinc and at the Graham Vein with arsenic, copper, lead and zinc. At Northrim, concentrations of arsenic, copper, lead, iron and zinc in mine surface water exceeded the guidelines regularly and at Smallwood, metal concentrations (copper, lead and zinc)' in surface water only marginally exceeded the guidelines. Overall, water quality in the Camsell River was found to be good with low constituent concentrations that were also within the historical range of water quality collected from the upstream water quality site, Camsell River at the outlet of Clut Lake.

[6] A water quality monitoring program at the El Bonanza Mine was also conducted in 2008. The following description was prepared prior to the finalization of the 2008 assessment report. However, the results of the 2008 program found results consistent with those from previous monitoring initiatives. In this regard, the following descriptions and conclusions for the 2006 and 2007 programs also apply to 2008.

INAC Water Resources Division (2005-2007)[7]

The potential of acid rock drainage (ARD) from the waste rock and tailings at the Silver Bear Mines was previously identified as an issue of concern. In 2005, INAC (2006b) reported that the high alkalinity and circum-neutral pH at each mine site indicated that the natural buffering capacity of the receiving waters is adequate to neutralize any ARD that may occur. The 2005 water quality monitoring program (INAC 2006b) also showed that high levels of arsenic, copper and other metals in the inflow to Moose Bay from the Ho-Hum Tailings Containment Area but that metal concentrations reach background levels before reaching the end of the airstrip and prior to entering the main flow of the Camsell River. The high arsenic concentrations in the Ho-Hum TCA were attributed to both waste rock and tailings. The presence of a berm and wetland between the Ho-Hum Lake TCA and Moose Bay reportedly reduced arsenic and copper concentrations in the outflow to Moose Bay.

As in previous years, the mine adit water at Norex was contaminated with arsenic, copper, iron, lead, and zinc, while water seeping at the base of the waste rock pile had elevated levels of these metals as well as aluminum and cadmium. Although contamination in water from the seep was identified, the elevated metal levels are not entering the Camsell River due to the presence of the wetland between the adit and the river.

As in previous years, standing water at the Graham Vein had elevated levels of arsenic, copper, lead and zinc, while the water quality of Xeron Pond was good with no indication of tailings present. In Smallwood Lake, only copper concentrations marginally exceeded water quality guidelines. At Northrim, concentrations of aluminum, arsenic, cadmium, copper, iron, lead and zinc in mine surface water exceeded water quality guidelines regularly. Water with elevated concentrations of some of these metals was found to drain into the Camsell River from the mine adit and from the Hermandy Lake outlet stream. However, due to the relatively small volumetric and mass loadings, the influx of contaminants appeared to be having a minimal effect on water quality within the Camsell River.

Similar water quality trends were noted at the mine sites in 2006 and 2007 (INAC 2007; 2008). In addition, metals, including aluminum, arsenic, copper and iron, were found to be leaching from the southern-most landfill at Terra. While there is a channel that runs from the ponded water to Jackfish Bay, elevated metal concentrations were not found in samples collected from the bay.

[7] INAC also performed water quality monitoring at the Silver Bear sites in the summer of 2008. The results from the 2008 program have yet to be reported but should be considered prior to finalizing future monitoring plans for the sites.

3.0 PROPOSED LONG-TERM MONITORING PROGRAM

3.1 OBJECTIVE AND BACKGROUND

The following section presents a proposed *Long-Term Monitoring Program* for the Great Bear Lake (GBL) sites. The overall objective of the program is to confirm environmental conditions surrounding the GBL sites after the implementation of site remediation. Thus, the program is confirmatory in nature, not an attempt to generate additional data for site characterization. The primary mechanism for achieving this objective will be to monitor water quality, both on-site and within the receiving environment.

The Long-Term Monitoring Program was developed to be consistent with potential regulatory requirements, best practices and INAC's commitment to environmental protection. The proposed program builds on previous water quality monitoring initiatives at the GBL sites, as described in Section 2.0.

3.2 MONITORING FREQUENCY AND TIMING

To allow for adaptive management, the Long-Term Monitoring Program will be implemented in a phased approach, with the first phase running for five years after site remediation. The results of the program will be reviewed during, and after the first phase to determine subsequent monitoring requirements.

Pre-remediation monitoring at the Silver Bear sites typically involved three annual sampling campaigns while monitoring at Contact Lake and El Bonanza occurred once per year. Based on the results of past monitoring data, as discussed in Chapter 2 and anticipated conditions following remediation, a single annual monitoring campaign is considered sufficient to confirm environmental conditions at all of the GBL sites. The annual frequency is consistent with the recently established long-term monitoring program for Port Radium.

While a single annual monitoring campaign is considered sufficient to assess overall trends in environmental quality, regulators and stakeholders may desire additional sampling campaigns at the former Terra Mine Site. Specifically, we anticipate that additional monitoring of the Ho-Hum TCA and Moose Bay will be viewed as a priority. SENES has therefore assumed that a second campaign focusing on the TCA and Moose Bay would be conducted annually for the first five years. Additional annual sampling at the other sites and locations is not anticipated unless unexpected results are received from the annual sampling program.

Based on the rationale presented above, it has been assumed that two annual water quality monitoring campaigns will be implemented for the GBL sites. One campaign would involve sampling at all of the sites and a second campaign would focus exclusively on Terra.

The timing of annual campaigns should be fixed to reduce the influence of seasonal variation on the monitoring data set. Monitoring conducted to date at the Silver Bear sites has shown that concentrations of potential contaminants are typically at their greatest early in the open water season. The initially elevated concentrations have been attributed to freshet and other seasonal release/uptake mechanisms. Depending on the performance of remedial measures, a similar relationship is expected to continue in the post-remediation phase. It is therefore recommended that the larger of the two annual long-term monitoring campaigns be conducted as early as possible during the ice free season.

3.3 ANALYTICAL PARAMETERS AND CRITERIA

The analytical parameters proposed for the Long-Term Monitoring Program were selected based on: a) historic land-use; b) contaminants of concern identified prior to remediation; and, c) anticipated post-remediation site conditions. To the extent possible, analytes were selected to be consistent with previous monitoring activities at the sites. However, due to minor differences between previous monitoring programs, adjustments were required in some circumstances to ensure that a consistent approach was used for all sites.

3.3.1 General Chemistry

At the time of sampling, basic limnological characteristics of water temperature, pH, dissolved oxygen, turbidity, and conductivity are to be measured *(in-situ,* wherever feasible). General chemistry parameters for laboratory analysis are to include:

Physical Parameters

- Alkalinity
- Conductivity
- pH
- Turbidity
- Total Dissolved Solids
- Total Suspended Solids

Major Ions

- Calcium
- Chloride
- Total Hardness
- Magnesium
- Potassium
- Sodium
- Sulphate
- Sulphide

Nutrients

- Ammonia (as N)
- Ortho-Phosphate
- Dissolved Phosphorous
- Total Phosphorous
- Nitrate
- Nitrite
- Tot/Diss. Org. Carbon
- Reactive Silica

INAC'S Taiga Environmental Laboratory in Yellowknife has performed these analyses for previous monitoring activities at the GBL sites.

3.3.2 Metals

As former mining properties, metals are the dominant component of the water quality monitoring program for the GBL sites. Specifically, emphasis will placed on metals for which relevant Canadian environmental criteria have been established. For the GBL sites, aquatic species are considered to be the most sensitive receptors. The Canadian Water Quality Guidelines (CWQGs) for the protection of Freshwater Aquatic Life (FAL) are therefore recommended as the most appropriate criteria. Table 3.3-1 identifies the metals that are to be analyzed and their respective criteria.[8]

FAL guidelines are used by provincial, territorial and federal agencies to assess background freshwater quality and are not site-specific. They are meant to be applied to freshwater and to protect all forms of aquatic life, including the most sensitive life stage of the most sensitive species. An exceedance does not necessarily indicate that a particular parameter is having a negative effect on aquatic organisms. FAL guidelines are designed to be applied to ambient receiving water conditions and therefore do not provide a practical guideline for evaluating surface seeps or adit drainages. Nevertheless, the guidelines are used as a reference in the analysis of water quality data to aid in the interpretation of the results.

TABLE 3.3-1
WATER QUALITY METAL ANALYTES

Analyte	CWQG-FAL (µg/L)	Analyte	CWQG-FAL (µg/L)	Analyte	CWQG-FAL (µg/L)
Aluminum	100	Iron	300	Silver	0.1
Arsenic	5	Lead	1-7[c]	Uranium	20[e]
Cadmium	0.017	Molybdenum	73	Zinc	30
Chromium	8.9[a]	Nickel	25-100[d]	Mercury	0.030[f]
Copper	2-4[b]	Selenium	1		

a -The criterion is for CrIII. There is also a criterion for CrVI. Generally samples are only analyzed for total chromium.
b - The guideline for copper varies with hardness (as $CaCO_3$): 2 µg/L at hardness = 0-120 mg/L; 3 µg/L at hardness = 120-180 mg/L; 4 µg/L at hardness > 180 mg/L.
c - The guideline for lead varies with hardness (as $CaCO_3$): 1 µg/L at hardness = 0-60 mg/L; 2 µg/L at hardness = 60-120 mg/L; 4 µg/L at hardness = 120-1 80 mg/L; 7 µg/L at hardness > 180 mg/L.
d - The guideline for nickel varies with hardness (as $CaCO_3$): 25 µg/L at hardness = 0-60 mg/L; 65 µg/L at hardness = 60-120 mg/L; 110 µg/L at hardness = 120-180 mg/L; 150 µg/L at hardness > 180 mg/L.
e - Uranium guideline for Canadian Drinking Water Quality (Health Canada, 2006).
f - The guideline for mercury is 0.026 µg/L for inorganic Hg and 0.04 µg/L for methyl Hg.

[8] Criteria should be reviewed on an annual basis to confirm that levels have not changed.

It should also be noted that the monitoring programs include provisions for sampling from reference/background stations. Based on monitoring conducted to date, some metals are naturally elevated at these sites (e-g., copper). In addition to using the CWQG-FAL criteria, any elevated results from the GBL sites should therefore be evaluated in the context of concentrations observed at the reference stations.

In addition to the metals identified in Table 3.3-1, standard analytical scans for metals often include other metals that have not been assigned a relevant water quality criteria (CWQG-FAL or otherwise). Typically these include: antimony, barium, beryllium, cesium, cobalt, lithium, manganese, rubidium, strontium, thallium, tin, titanium and vanadium. To address the potential that water quality criteria may be developed in the future for some or all of these elements, these additional metals have been included in the scope of the Long-Term Monitoring Program.

The CWQG FAL were derived based on exposures to total metal concentrations. The recommended analyses for the GBL sites therefore focus on the total metal fraction. In addition to total metals, previous monitoring at the GBL sites also included analyses for dissolved metals from most stations. Evaluation of historic monitoring results has shown generally consistent relationships between total and dissolved metal fractions. However, avoiding sample contamination during the filtration process has proven to be challenging, thus putting some of the dissolved metal results into question. On this basis, SENES does not consider ongoing collection of samples for dissolved metals analyses from all stations to be justified. However, in areas where elevated suspended sediment loadings are anticipated (e.g., site runoff, tailings containment areas, groundwater wells), dissolved metals should be analyzed. In addition, approximately ten percent of samples from other stations should be analyzed for dissolved metals. This is recommended as a means of determining general relationships between dissolved and total metal fractions.

The current standard for metals analysis (total and dissolved) is inductively coupled plasma-mass spectrometry (ICP-MS). INAC's Taiga Laboratory in Yellowknife is capable of performing this method.

3.3.3 Petroleum Hydrocarbons

Site assessment work at the GBL sites has confirmed the presence of petroleum hydrocarbon (PHC) contamination at some locations in the vicinity of receiving waters. Remedial measures will involve excavation and treatment/disposal of soils with PHC concentrations above prescribed criteria. Areas with concentrations below criteria will typically be left in place and monitored to confirm that migration to receiving waters is not occurring. Monitoring will be conducted in receiving waters adjacent to locations with historic and/or residual PHC concentrations. Groundwater monitoring for PHCs will also be conducted as appropriate.

Samples collected for the purpose of PHC monitoring will be analyzed for BTEX compounds (i.e. benzene, toluene, ethylbenzene and total xylene) and F1 to F4 hydrocarbon fractions. Water quality guidelines for PHCs in water have not been developed. Results will be compared to pre-remediation monitoring conducted at the sites to determine if any changes have taken place.

INAC's Taiga Environmental Laboratory currently lacks the capacity to analyze for PHCs in water. An alternate analytical laboratory will therefore be required. Purge and Trap/Gas Chromatography are the assumed analytical techniques.

3.3.4 Radionuclides

In addition to uranium, which will be analyzed as part of the metals scan, previous monitoring activities at the GBL sites have measured radium-226 and lead-210 as surrogates for a full radionuclide scan. Although none of the receiving waters were found to have detectable concentrations of these parameters, elevated results were observed in mine waste drainage and groundwater monitoring wells at some locations. The Long-Term Monitoring Program will therefore include the analysis of a limited number of samples for both radium-226 and lead-210.

To date, environmental criteria for individual radionuclides in water have not been developed for protection of aquatic species. In order to provide some perspective, the measured concentrations of radionuclides in water are to be compared to Canadian guidelines for drinking water quality published by Health Canada on behalf of the Federal-Provincial-Territorial Committee on Drinking Water (CDW) (Health Canada 2006). The maximum acceptable concentrations (MACs) for radium-226 is 0.6 Bq/L and for lead-2 10 is 0.1 Bq/L.

Previous radionuclide analyses at the GBL sites have been performed by Becquerel Laboratories Inc. in Mississauga, Ontario. Samples were analyzed using Alpha Spectrometry for radium-226 and Beta Counting for lead-210.

3.4 MONITORING STATIONS

3.4.1 Station Characterization

The Long-Term Monitoring Program will focus on confirming conditions in receiving waters surrounding the remediated sites. Samples will be collected from a total of four station types, two of which are receiving waters (Open Water and Shoreline) and two of which represent potential contaminant sources (Surface Drainage and Groundwater). Descriptions of the various station types and rationale for their inclusion are provided below.

Receiving Waters - Open Water

Open Water sampling has been included in the program to assist in characterizing general impacts (if any) to the receiving environment. The logistical requirements of Open Water sampling are significantly greater than for other sampling types. These requirements may include boats, motors, fuel and potentially additional personnel, all of which represent challenges given the limited infrastructure and support that will be in place following remediation. There is also increased potential of logistical difficulties affecting the ability of the monitoring team to implement the program. Based on these factors, the quantity of Open Water sampling has been reduced or eliminated for some of the GBL sites. However, where justified, Open Water sampling will form an integral component of the Long-Term Monitoring Program. Depending on site-specific requirements, Open Water monitoring may include surface "grab" samples or water column sampling at specified depths. Stations located in potentially impacted and "background" water bodies have been included in the program design.

Receiving Waters – Shoreline

Shoreline samples from receiving waters are considered representative of potential drinking water sources for humans and terrestrial species. Surface grab sampling will be conducted at Shoreline stations. The focus of Shoreline sampling will be on potentially impacted areas, however, sampling from background stations has also been included where appropriate.

Site Drainage and Standing Water

In their current state, there is surface drainage and/or standing water present at some of the GBL sites. These locations represent potential sources of contamination for receiving waters and exposure pathways for terrestrial species. The remediation strategies planned for the GBL sites are intended to address most or all of these sources. However, there remains a potential that some standing water and site drainage will be present following remediation. Allowances for grab sampling and analysis of site drainage have therefore been included in the Long-Term Monitoring Program.

Groundwater

Groundwater monitoring wells have been installed at some of the GBL sites to assist in characterizing potential contamination concerns. Some of these monitoring wells will be decommissioned during remediation but others will remain. Additional wells will be installed to monitor the long-term performance of remediation works (e.g., landfills). Wells may also be installed in the vicinity of PHC treatment areas to confirm that contamination is not entering the environment during the “construction” phase.

Previous monitoring at the Silver Bear sites has compared groundwater results to the *Soil, Groundwater and Sediment Standards* produced by the Ontario Ministry of the Environment. While these standards were developed using data from Ontario groundwater and are not necessarily ideal for use at northern mine sites, they do provide a basis for assessing the environmental risk posed by groundwater. Hence, it is proposed to use these criteria for the GBL monitoring program.

> Note:
>
> SENES has assumed that groundwater monitoring will be required at any locations where "risk managed" contaminants have the potential to migrate into receiving waters. These could include landfills and areas with residual PHC contamination.
>
> There is currently uncertainty regarding some elements of the remediation plans for the sites. As a consequence, detailed requirements for the groundwater monitoring program are not presented in this document. SENES recommends that decisions on the scope and details of the groundwater monitoring program be deferred until remediation plans are finalized.

3.4.2 Contact Lake Mine

Previous investigations at the Contact Lake Mine have concluded that the receiving waters adjacent to the site (i.e., Contact Lake and Great Bear Lake) have not been impacted. Logically, this situation is not expected to change during the post-remediation phase. The scale and focus of the program is designed on this basis and includes the following components.

For the purposes of program design, receiving waters are considered to include: Contact Lake and Great Bear Lake. The tailings pond has been classified as a component of on-site drainage.

Receiving Waters - Open Water

Based on historic results, grab samples from surface are considered sufficient to characterize the receiving waters at the Contact Lake Mine (i.e., depth profiling is not required). A float plane will be required to access the site and, based on the scope of the program, can also be used to conduct Open Water sampling (if a boat is not available). Sampling stations are to include:

- Contact Lake: One station in the vicinity of the mine and one station at the extreme west end of the lake.
- Great Bear Lake: One station in the off-shore waters opposite the former fuel storage area.

- Regional Background Lake: One station from Thompson Lake (CL-RL-1B). The same lake will be used as a reference for the El Bonanza program.

Receiving Waters – Shoreline

Surface grab samples will be collected from locations in the vicinity of previously impacted areas. These include the discharge point to Contact Lake of drainage from the main mine site and shoreline locations adjacent to the former camp and fuel storage areas.

- Contact Lake: One station at the discharge point of drainage from the main mine site, one station near the Contact Lake dock and one station to the east of the mine.
- Great Bear Lake: One station in the area of the former dock.

Site Drainage

With the exception of water stored in the tailings pond, minimal site drainage is anticipated following remediation. Drainage that does exist will be subject to final grades and seasonal conditions. Within this context, an allowance for potential sampling of surface waters has been included in the program.

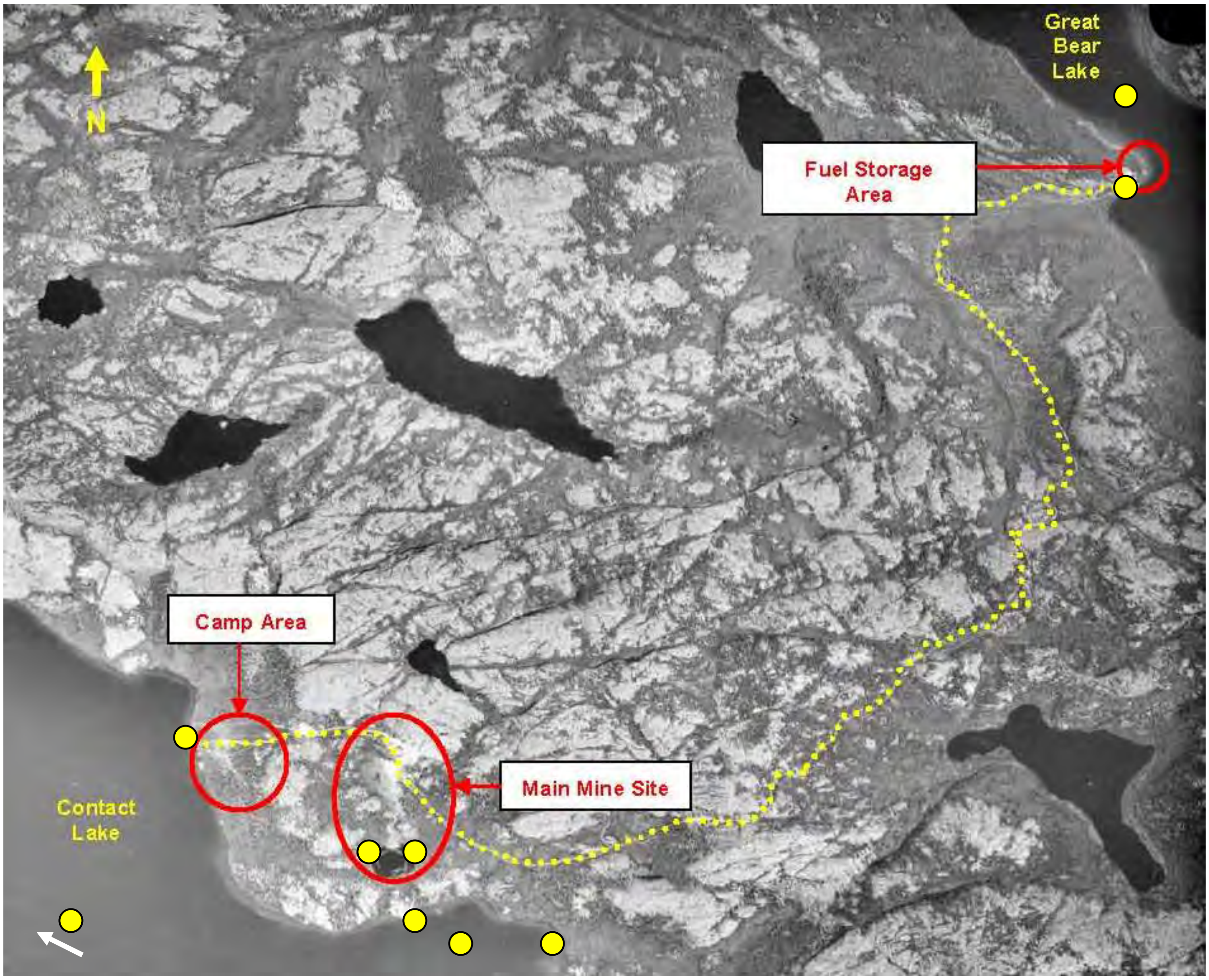
- Tailings Pond: Grab sampling from two shoreline stations (locations to be- determined in the field based on final contouring around the pond).
- Main Mine Site: Allowance for five stations, subject to post-remediation site conditions (locations to be determined).
- Camp Area: No requirements.
- Tank Area: No requirements.

Groundwater

At present, there are no functioning groundwater wells at the Contact Lake Mine. Further, there appears to be no justification to install wells at the main mine site or camp area. However, it has been suggested that monitoring wells may be installed at the former fuel storage area on Great Bear Lake. The monitoring program has been designed to account for this possibility.

- Main Mine Site: No anticipated requirements.
- Camp Area: No anticipated requirements.
- Tank Area: Allowance for three stations (location to be determined).

FIGURE 3.4-1
CONTACT LAKE PROPOSED WATER QUALITY SAMPLING STATIONS



3.4.3 El Bonanza Mine

Previous investigations have concluded that the El Bonanza Mine has had negligible impacts on the water quality of Mile Lake. Metal concentrations observed in Silver Lake (adjacent to the mine) may be partially attributable to the presence of waste rock in and near the lake. However, all metal concentrations are below applicable criteria and, as such, any impacts that might be occurring are not considered to be significant. Similarly, there is no evidence to suggest that downstream receiving waters have been adversely impacted by the mine. This situation is not expected to change during the post-remediation phase. The scale and focus of the program is designed on this basis.

For the purposes of program design, receiving waters are considered to include: Mile Lake, Silver Lake, the stream discharging from Silver Lake and Great Bear Lake. Based on results from previous monitoring activities and an absence of residual contaminant sources (e.g., tailings or waste rock in water) sampling in Whale Lake adjacent to the Bonanza Mine is not justified.[9]

As noted in the sampling program for the Contact Lake Mine, Thompson Lake will be sampled and used as a regional background or reference site. Given its proximity, Thompson Lake will also be used as a reference site for long-term monitoring at El Bonanza.

Receiving Waters - Open Water

Based on historic results, grab samples from surface are considered sufficient to characterize the receiving waters at the El Bonanza Mine (i.e., depth profiling is not necessary). A float plane will be required to access the site and can also be used to conduct Open Water sampling (if a boat is not available).

- Mile Lake: One station, well removed from the site, at a location where sediments can also be collected.
- Silver Lake: Sampling will be limited to the shoreline only (see below).
- Great Bear Lake: One station in shallow water in front of the "airstrip" beach.

Receiving Waters – Shoreline

Surface grab samples will be collected from areas adjacent to impacted areas including Mile Lake, Silver Lake and the stream discharging from Silver Lake. No shoreline sampling is proposed for Great Bear Lake.

[9] A floatplane cannot land on Whale Lake and the site would need to be accessed on foot if included in the program. This would roughly double the duration of the El Bonanza sampling program.

- Mile Lake: One station to the immediate east of the main mine site (location to be determined).
- Silver Lake: One station at the discharge point from Mile Lake (currently a culvert) and one station at the toe of the waste rock pile.
- Stream from Silver Lake - One station immediately downstream of Silver Lake.

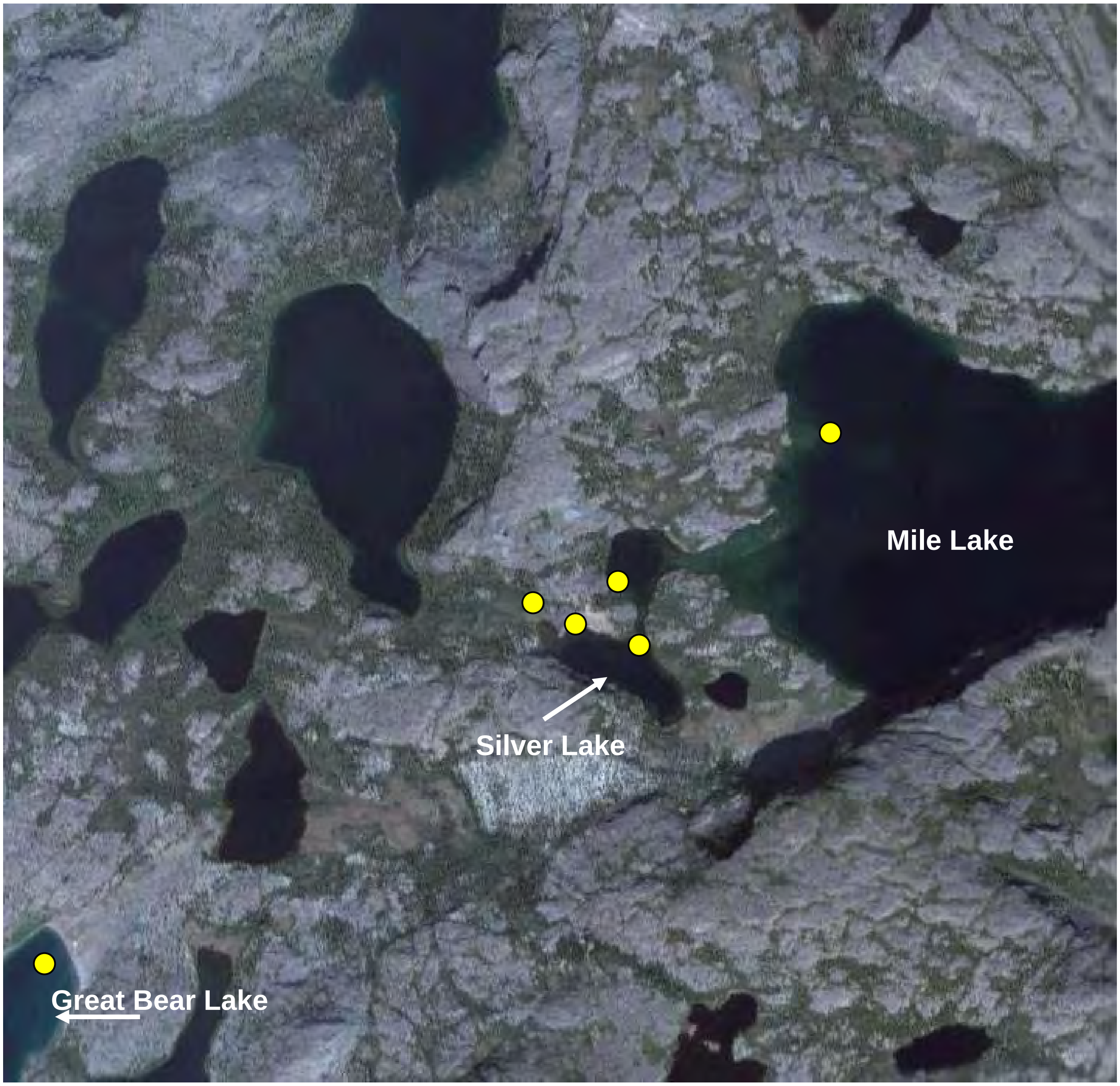
Site Drainage

Prior to remediation, standing water was identified only in unsecured mine shafts, and exploration pits, all of which will be addressed during remediation. Similarly, due to local topography and the presence of glacial till under much of the site, there has been negligible evidence of surface drainage from El Bonanza. On this basis, there are no anticipated requirements for monitoring of site drainage.

Groundwater

There are currently no groundwater wells at the El Bonanza Mine and no requirements to monitor groundwater during the post-remediation phase are anticipated.

FIGURE 3.4-2
EL BONANZA PROPOSED WATER QUALITY SAMPLING STATIONS



3.4.4 Terra Mine

From a water quality perspective, the dominant concern at the Terra Mine is metal loading to Moose Bay from the Ho Hum TCA. The Long-Term Monitoring Program has therefore been designed to focus on this aspect. In addition, the program addresses more localized issues such as site drainage and near-shore soils impacted by petroleum hydrocarbons.

For the purposes of program design, receiving waters are considered to include: Moose Bay, Jackfish Bay, Rainy Lake (i.e., the Camsell River), Little Ho Hum Lake and reference stations. The tailings pond and any associated wetlands have been classified as a component of on-site drainage.

Receiving Waters - Open Water

Depending on the location and water body, the Open Water program at Terra should include water column sampling (i.e., depth profiling) and surface grab sampling. Proposed sampling stations are as follows:

- Moose Bay: Water column sampling (at surface and approximately 2 m from the lake bottom) at five stations along a transect from the discharge of the Ho Hum TCA towards the main stem of the Camsell River (refer to Figures 3.4-3 and 3.4-4).
- Rainy Lake: One Open Water surface grab sample in the vicinity of the current dock.
- Little Ho Hum Lake: One surface grab sample.[10]
- Reference Stations: Two surface grab samples up-gradient of the sites (one from Tutcho Lake and one from the Camsell River).

Receiving Waters – Shoreline

Surface grab samples are to be collected from locations in the vicinity of previously impacted areas including:

- Moose Bay: Two stations along the airstrip.
- Jackfish Bay: One station.
- Rainy Lake: One station in the vicinity of the dock.

[10] If Open Water sampling in Little Ho Hum and Tutcho Lakes is logistically prohibitive, shoreline sampling is considered an acceptable alternative.

Site Drainage

With the exception of water stored in the Ho Hum TCA, minimal site drainage is anticipated following remediation. Drainage that does exist will be subject to final grades and seasonal conditions. Within this context, an allowance for potential sampling of surface waters has been included in the program.

- Ho Hum TCA: Water column sampling at two stations. Shoreline sampling at two stations.
- Ho Hum Wetland: Surface grab sampling at two stations.
- Site Drainage: Allowance for five stations, subject to post-remediation site conditions (locations to be determined).

Groundwater

Refer to the note at the end of Section 3.4.1. Design of the groundwater monitoring program for the Silver Bear sites can be completed following finalization of detailed remedial planning (landfill locations, residual PHC areas, etc.).

FIGURE 3.4.3
TERRA PROPOSED WATER QUALITY SAMPLING STATIONS (1)

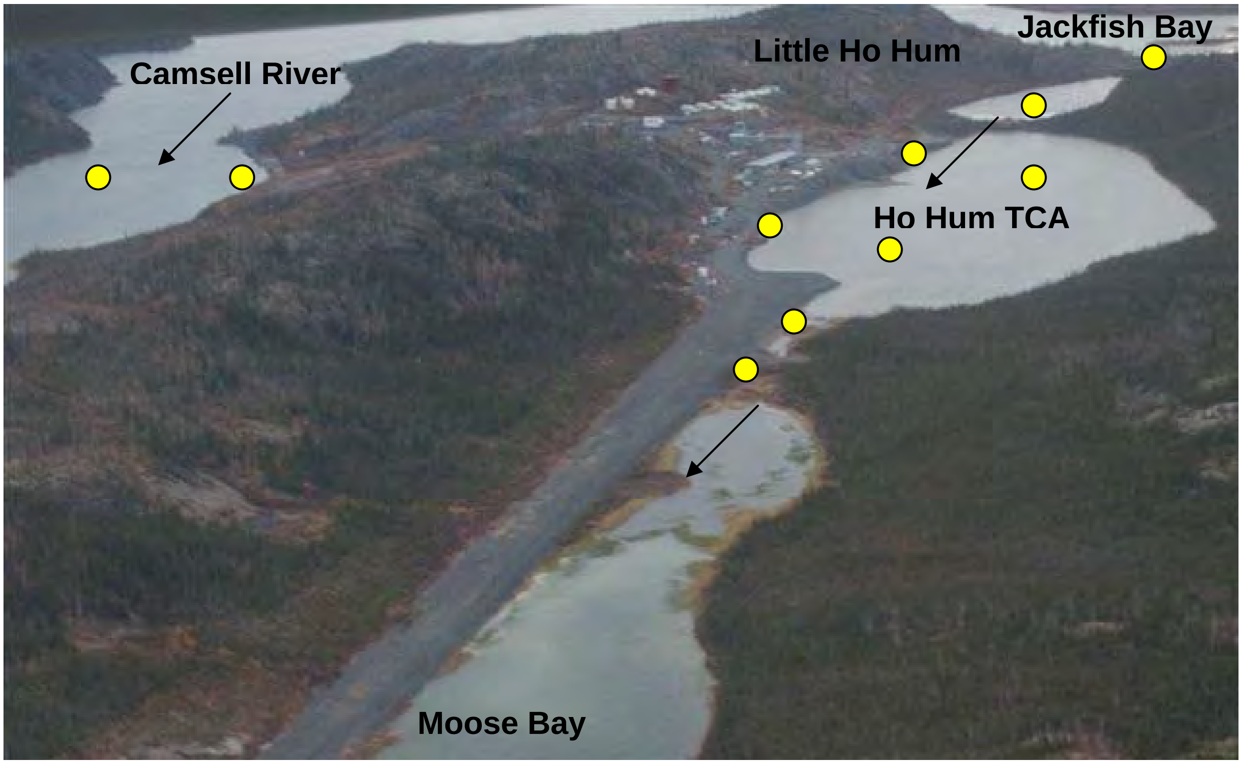
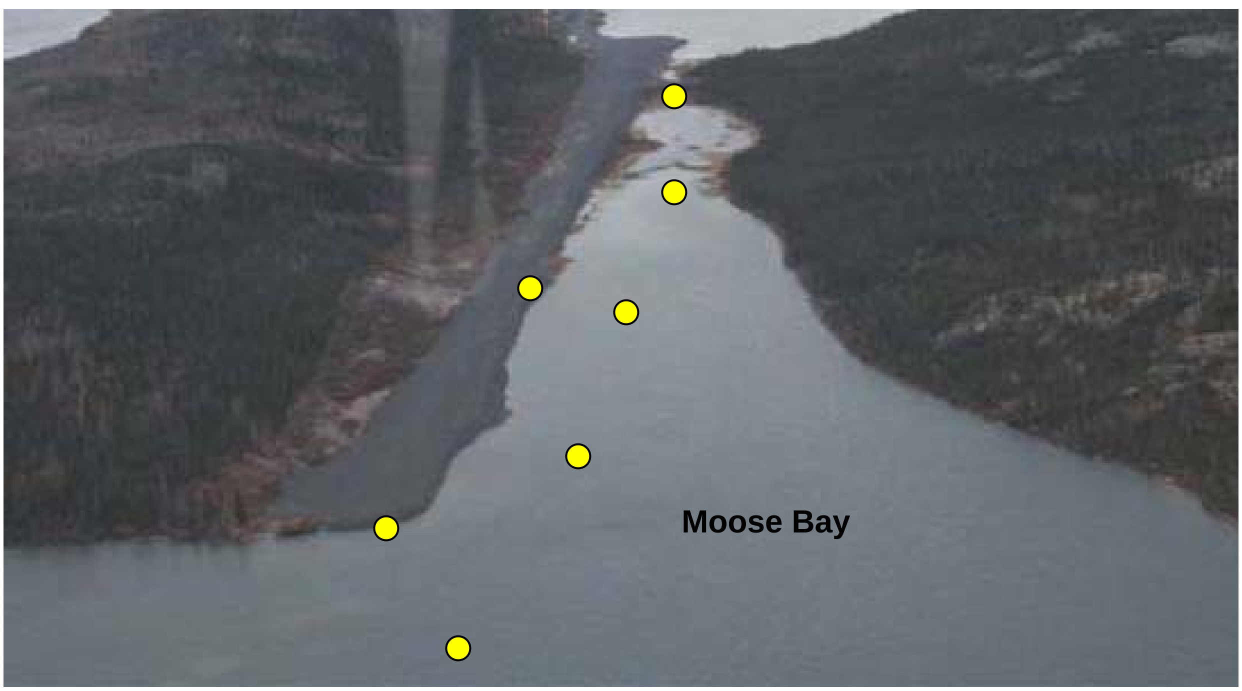


FIGURE 3.4.4
TERRA PROPOSED WATER QUALITY SAMPLING STATIONS (2)



3.4.5 Norex Mine

Seepage from the adit and waste rock dump are the primary concerns at the Norex site. In addition to these potential waste streams, the Long-Term Monitoring Program has been designed to include local receiving waters. Based on historic results and anticipated post-remediation conditions, ongoing monitoring in the Xeron Pond *1* Graham Vein is not necessary.

<u>Receiving Waters - Open Water</u>

None required.

<u>Receiving Waters - Shoreline</u>

Surface grab sampling of water bodies receiving site drainage:

- <u>Rainy Lake (Camsell River):</u> One station at the point of discharge of drainage from the Norex site.

<u>Site Drainage</u>

The extent to which drainage or standing water remains after remediation has yet to be determined. For example, it is unknown whether seepage from the waste rock dump will continue after diversion of drainage from the adit. However, for planning purposes, it is recommended that the following stations be incorporated into the Long-Term Monitoring Program:

- <u>Adit drainage</u>: One station.
- <u>Waste rock seepage</u>: Up to two stations (e.g., Norex-2 and 3 from previous assessments).
- <u>Site Drainage</u>: One station downstream of the confluence between adit drainage and waste rock seepage.

FIGURE 3.4-5
NOREX PROPOSED WATER QUALITY SAMPLING STATIONS

3.4.6 Smallwood Mine

The only surface water at this site is Smallwood Lake itself. Further, there have been no observations of seepage from the waste rock piles, or from the adit on prior visits. There are no indications that ore was ever milled at this site, nor is there any evidence of tailings deposited in the area.

Receiving Waters - Open Water

Previous sampling in Smallwood Lake has determined that water quality is relatively good. With the exception of copper, which is often naturally elevated within this region, concentrations of metals at Open Water stations were below applicable CCME FAL criteria. Taking into consideration historic water quality and access, Open Water sampling of Smallwood Lake is not considered necessary. However, if access is by float plane, a single Open Water station could be sampled to provide assurances that significant impacts are not occurring.

- Smallwood Lake: One Open Water surface grab sample (subject to mode of access).

Receiving Waters – Shoreline

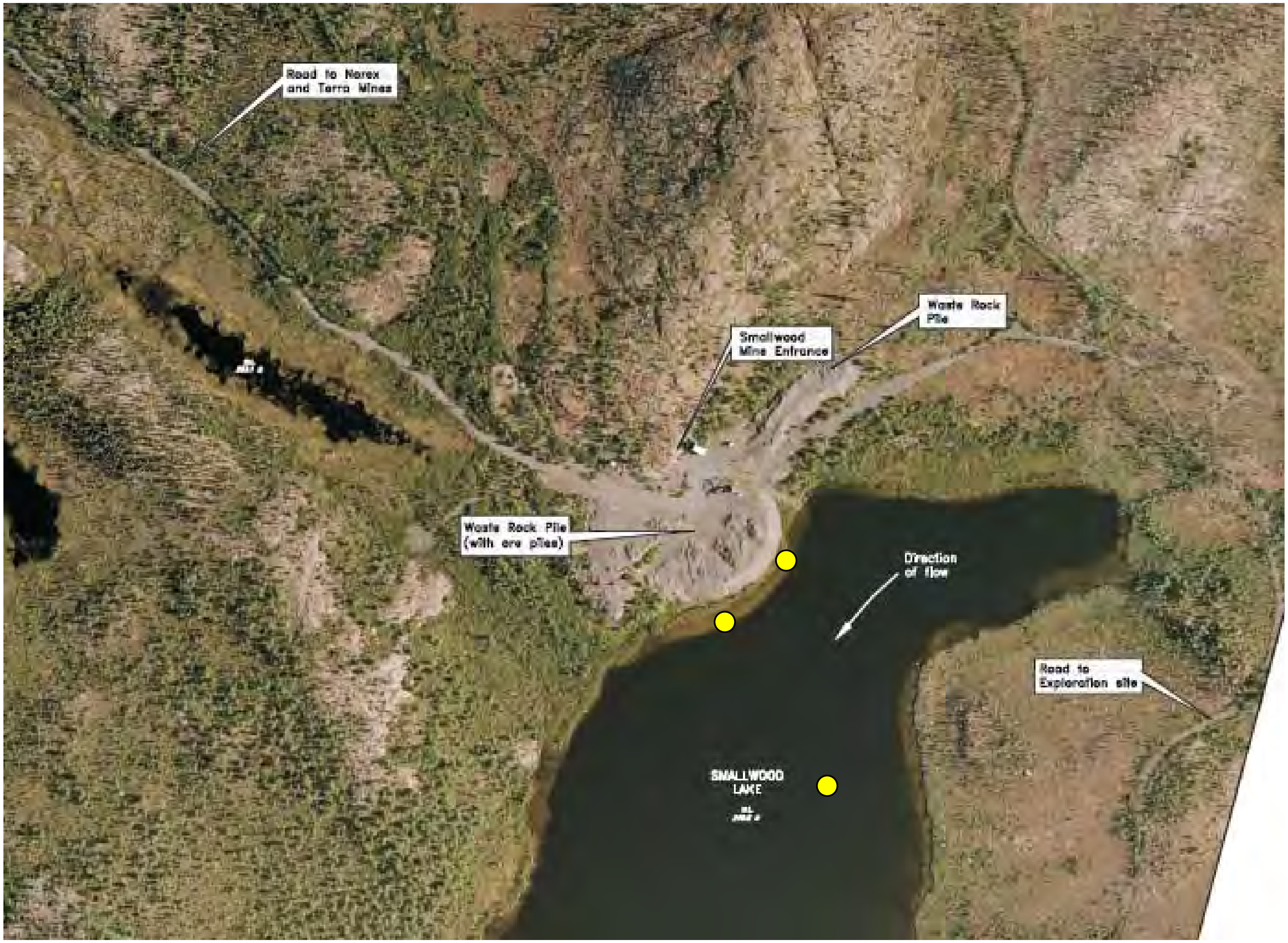
Surface grab samples are to be collected from locations in the vicinity of previously impacted areas including:

- Smallwood Lake: Two stations adjacent to the waste rock pile.

Site Drainage

None required.

FIGURE 3.4-6
SMALLWOOD PROPOSED WATER QUALITY SAMPLING STATIONS



3.4.7 Northrim Mine

Assessments have confirmed that tailings are present in Hermandy Lake and a small muskeg area. Outflow from the lake is currently through the muskeg area and leachate pond toward the Camsell River. Remediation will involve re-establishing the original drainage pathway directly to the Camsell River. Drainage from the leachate pond will be blocked, thereby eliminating discharges from this pathway.

For the purposes of program design, the only receiving waters are considered to be the Camsell River. Hermandy Lake and any standing water/drainage remaining after remediation have been classified as on-site drainage.

Receiving Waters - Open Water

- Camsell River: Sampling from one water grab station in the Camsell River immediately downstream of Northrim and Norex (refer to Figure 3.4-7).

Receiving Waters – Shoreline

Surface grab samples are to be collected from locations in the vicinity of:

- Camsell River: One station at the new discharge from Hermandy Lake (post remediation), one station in the vicinity of the partially submerged dock and one station immediately downstream of the camp area.

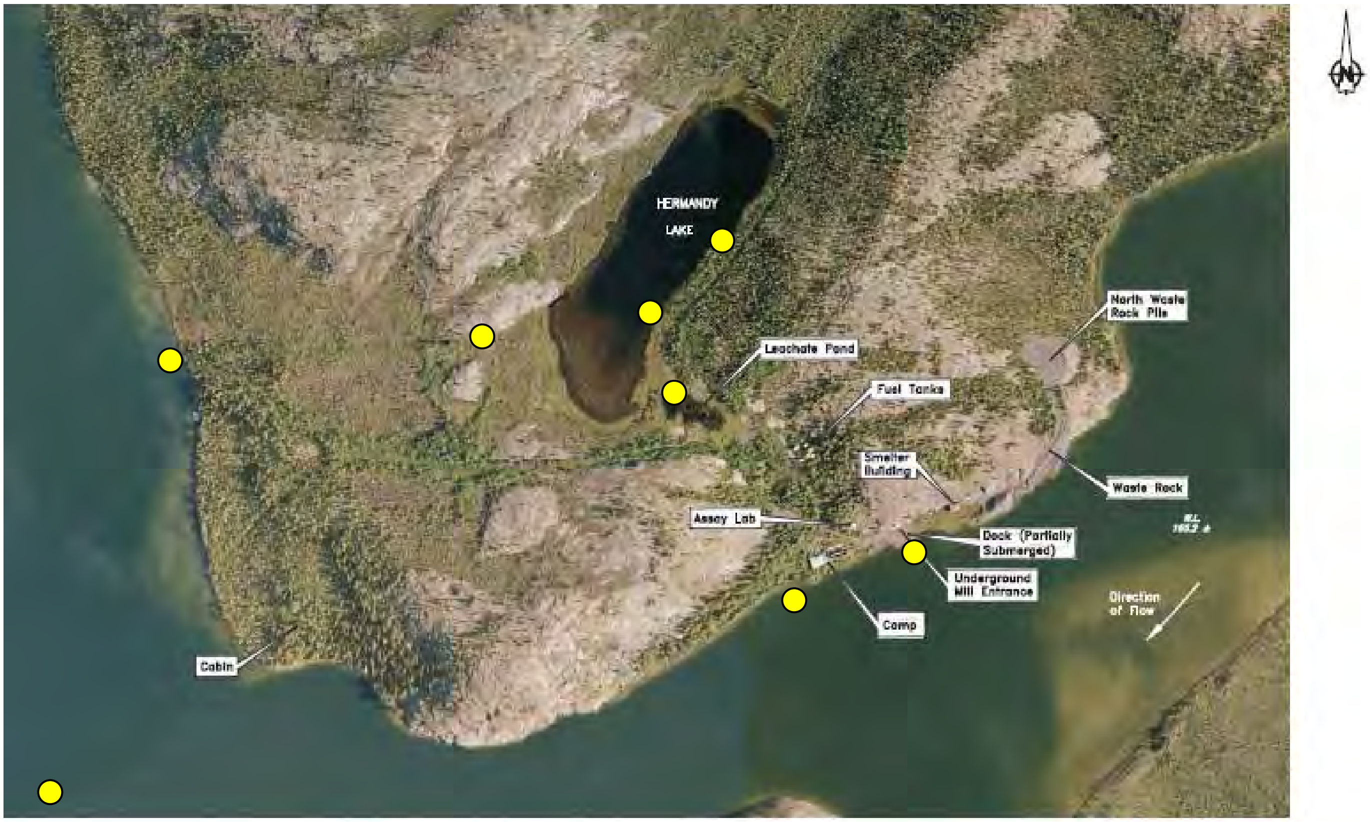
Site Drainage

Some metals have been observed at elevated concentrations in Hermandy Lake (e.g., arsenic, copper, lead and silver). However, these elevated concentrations do not appear to be having an impact on Camsell River water quality. Given the logistical challenges associated with Open Water sampling in Hermandy Lake and the absence of impacts in receiving waters, SENES proposes to monitor conditions in the Lake through shoreline sampling.

In addition, limited drainage and standing water is anticipated to be present following remediation. Any drainage that does exist will be subject to final grades and seasonal conditions. Within this context, an allowance for potential sampling of surface waters has been included in the program.

- Hermandy Lake: Shoreline grab sampling at two stations.
- Hermandy Lake Outflow Channel: Grab sampling from one station.
- Leachate Pond: Grab sampling from one station.
- Site Drainage: Allowance for four stations, subject to post-remediation site conditions (locations to be determined).

FIGURE 3.4-7
NORTHRIM PROPOSED WATER QUALITY SAMPLING STATIONS



3.4.8 Miscellaneous Areas

Previous monitoring at the Silver Bear sites included sampling from miscellaneous areas associated with the former mines (examples include ponded water near the landfill and the "scummy pond"). Similar to standing water and seepage present at the mine sites, remediation will address many of these areas. However, depending on final site conditions (e.g., contouring and permeability) some isolated areas of standing water and/or seepage are likely to remain after remediation. Although the environmental risks associated with these areas are expected to be minimal, provisions for a limited number of additional sampling stations should be incorporated into the Long-Term Monitoring Program. The locations of these stations can be determined following remediation.

TABLE 3.4-1
SUMMARY OF WATER QUALITY MONITORING STATIONS AND ANALYTICAL REQUIREMENTS

<table>
<tr><th>Station ID</th><th>Sample Type</th><th>Water Body</th><th>General Description, Location and Depth</th><th>Latitude</th><th>Longitude</th><th>General Chemistry</th><th>Total Metals</th><th>Dissolved Metals</th><th>Radionuclides</th><th>PHCs</th></tr>
<tr><td colspan="11">CONTACT LAKE MINE</td></tr>
<tr><td>TBD</td><td>Open Water - Grab</td><td>Contact Lake</td><td>Offshore, in vicinity of mine</td><td>TBD</td><td>TBD</td><td>√</td><td>√</td><td rowspan="7">At least 10% of stations</td><td>√</td><td></td></tr>
<tr><td>TBD</td><td>Open Water - Grab</td><td>Contact Lake</td><td>Extreme west end of the lake</td><td>TBD</td><td>TBD</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>TBD</td><td>Open Water - Grab</td><td>Great Bear Lake</td><td>Downstream of former fuel storage area</td><td>TBD</td><td>TBD</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>TBD</td><td>Open Water - Grab</td><td>Thompson Lake</td><td>Regional background</td><td>TBD</td><td>TBD</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>TBD</td><td>Shoreline – Grab</td><td>Contact Lake</td><td>Discharge of drainage from the mine site</td><td>TBD</td><td>TBD</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>TBD</td><td>Shoreline - Grab</td><td>Contact Lake</td><td>Near Contact Lake dock</td><td>TBD</td><td>TBD</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>TBD</td><td>Shoreline - Grab</td><td>Contact Lake</td><td>Approx. 500 m east of discharge from the mine site</td><td>TBD</td><td>TBD</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>TBD</td><td>Shoreline - Grab</td><td>Great Bear Lake</td><td>In the area of the former dock</td><td>TBD</td><td>TBD</td><td>√</td><td>√</td><td></td><td></td><td>√</td></tr>
<tr><td>TBD</td><td>Site Drainage - Grab</td><td>Contact TCA</td><td>Two shoreline stations</td><td>TBD</td><td>TBD</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td></tr>
</table>

TABLE 3.4-1 (Cont'd)
SUMMARY OF WATER QUALITY MONITORING STATIONS AND ANALYTICAL REQUIREMENTS

Station ID	Sample Type	Water Body	General Description, Location and Depth	Latitude	Longitude	General Chemistry	Total Metals	Dissolved Metals	Radionuclides	PHCs
TBD	Site Drainage	Main mine site	Limited surface water anticipated, however, allow for 5 stations, subject to post-remediation conditions.	TBD	TBD	√	√	√	√	
TBD	Ground Water	Fuel storage area	Subject to finalization of remediation details. Allow for 3 stations.	TBD	TBD	TBD	TBD	TBD	TBD	TBD
EL BONANZA MINE										
TBD	Open Water – Grab	Mile Lake	One station, well removed from the site, at a location where sediments can also be collected	TBD	TBD	√	√	At least 10% of stations.		
TBD	Open Water - Grab	Great Bear Lake	In shallow water adjacent to the "airstrip" beach	TBD	TBD	√	√			
TBD	Shoreline – Grab	Mile Lake	To the immediate east of the main mine site	TBD	TBD	√	√			
TBD	Shoreline – Grab	Silver Lake	At the discharge point from Mile Lake	TBD	TBD	√	√			√
TBD	Shoreline – Grab	Silver Lake	At the toe of the waste rock pile	TBD	TBD	√	√			√
TBD	Shoreline – Grab	Stream from Silver Lake	Immediately downstream of Silver Lake	TBD	TBD	√	√			√

TABLE 3.4-1 (Cont'd)
SUMMARY OF WATER QUALITY MONITORING STATIONS AND ANALYTICAL REQUIREMENTS

Station ID	Sample Type	Water Body	General Description, Location and Depth	Latitude	Longitude	General Chemistry	Total Metals	Dissolved Metals	Radionuclides	PHCs
TERRA MINE										
TBD	Open Water - Column	Moose Bay	Five stations along a transect of the discharge from the Ho Hum TCA towards the main stem of the Camsell River	TBD	TBD	√	√	At least 10% of stations.		
TBD	Open Water - Grab	Rainy Lake	Offshore from the current dock	TBD	TBD	√	√			
TBD	Open Water - Grab	Little Ho Hum Lake	Could be a shoreline sample if access is prohibitive	TBD	TBD	√	√			
TBD	Open Water - Grab	Tutcho Lake	Background station - could be a shoreline sample if access is prohibitive	TBD	TBD	√	√			
TBD	Open Water - Grab	Camsell River	Background station - upstream of all Silver Bear sites	TBD	TBD	√	√			
TBD	Shoreline – Grab	Moose Bay	Two stations along the airstrip	TBD	TBD	√	√			√
TBD	Shoreline – Grab	Jackfish Bay	Shoreline	TBD	TBD	√	√			
TBD	Shoreline – Grab	Rainy Lake	In the vicinity of the current dock	TBD	TBD	√	√			
TBD	Site Drainage – Open Water Column	Ho Hum TCA	Open water column sampling at two stations	TBD	TBD	√	√	√		√
TBD	Site Drainage – Grab	Ho Hum TCA	Two shoreline stations	TBD	TBD	√	√	√		√
TBD	Site Drainage - Grab	Ho Hum Wetland	Two wetland stations	TBD	TBD	√	√	√		√
TBD	Site Drainage – Grab	Main mine site	Limited surface water	TBD	TBD	√	√	√		√

TABLE 3.4-1 (Cont'd)
SUMMARY OF WATER QUALITY MONITORING STATIONS AND ANALYTICAL REQUIREMENTS

Station ID	Sample Type	Water Body	General Description, Location and Depth	Latitude	Longitude	General Chemistry	Total Metals	Dissolved Metals	Radionuclides	PHCs
			anticipated, however, allow for 5 stations, subject to post-remediation conditions.							
TBD	Groundwater	TBD	Subject to finalization of remediation details	TBD	TBD	TBD	TBD	TBD	TBD	TBD
NOREX MINE										
TBD	Shoreline - Grab	Rainy Lake	At the point of discharge of drainage from the site	TBD	TBD	√	√	√		
TBD	Site Drainage - Grab	Main mine site	Adit drainage	TBD	TBD	√	√	√		
TBD	Site Drainage – Grab	Main mine site	Up to two stations for waste rock seepage	TBD	TBD	√	√	√		
TBD	Site Drainage – Grab	Main mine site	Downstream of confluence between adit drainage and waste rock seepage	TBD	TBD	√	√	√		
SMALLWOOD MINE										
TBD	Open Water - Grab	Smallwood Lake	Mid-lake (subject to access)	TBD	TBD	√	√	√		√
TBD	Shoreline - Grab	Smallwood Lake	Two stations adjacent to the waste rock pile	TBD	TBD	√	√	√		√

TABLE 3.4-1 (Cont'd)
SUMMARY OF WATER QUALITY MONITORING STATIONS AND ANALYTICAL REQUIREMENTS

Station ID	Sample Type	Water Body	General Description, Location and Depth	Latitude	Longitude	General Chemistry	Total Metals	Dissolved Metals	Radionuclides	PHCs
NORTHRIM MINE										
TBD	Open Water - Grab	Camsell River	Immediately downstream of Northrim and Norex	TBD	TBD	√	√	At least 10% of stations.		√
TBD	Shoreline - Grab	Camsell River	At location of new discharge from Hermandy Lake	TBD	TBD	√	√			
TBD	Shoreline - Grab	Camsell River	In the vicinity of current partially submerged dock	TBD	TBD	√	√			√
TBD	Shoreline - Grab	Camsell River	Immediately downstream of the camp area	TBD	TBD	√	√			√
TBD	Site Drainage - Grab	Hermandy Lake	Two shoreline grab stations	TBD	TBD	√	√	√		
TBD	Site Drainage - Grab	Hermandy Outflow Channel	From newly constructed channel	TBD	TBD	√	√	√		
TBD	Site Drainage - Grab	Leachate Pond	One shoreline grab	TBD	TBD	√	√	√		
TBD	Site Drainage	Main mine site	Post remediation surface water should be significantly reduced. However, allow for <u>4 stations</u>, subject to post-remediation conditions.	TBD	TBD	√	√	√		
TBD	Ground Water	TBD	Subject to finalization of remediation details.	TBD	TBD	TBD	TBD	TBD	TBD	TBD

3.5 SAMPLING METHODS

3.5.1 Sample Collection

All sampling and sample handling is to be conducted wearing latex gloves to minimize the potential for contamination. Samples should be collected in single-use, pre-washed bottles appropriate for the nature of the test being performed. Sample bottles should be field rinsed at least twice prior to sample collection.

Open water and shoreline grab samples are to be collected by submerging bottles under the water surface. Due to the highly volatile nature of PHC compounds, every attempt should be made to collect PHC samples with no headspace. Water column sampling is to be performed using an appropriate sampling apparatus (e.g., Van Dorn or Kemerer bottles).

3.5.2 Filtration

Previous GBL monitoring programs have typically used field filtration for dissolved metal samples. To minimize the potential for field contamination, samples should be injected through a 0.45-µm polyethersulfone disposable filter using a polypropylene syringe. The syringe and filter should be flushed with sample several times prior to sample collection. A new filter and syringe are to be used for each station. While this is the preferred technique for field filtration, the syringes, filters and additional handling have been shown to be potential sources of sample contamination.[11] However, such contamination can occur with other filter media and techniques. Evidence of filter contamination has not been identified in the vast majority of our field programs that have used the disposable filters. In general, the approach is an efficient and effective method that has provided quality results. This is attributed to the lack of handling and contact associated with the technique. Taking into consideration the drawbacks of other filtration methods, SENES does not recommend modifying the proposed approach.

An alternative to field filtering is to have the analytical laboratory perform the filtration. The theoretical draw-back of laboratory filtration is the potential for metal transfer between the solid and dissolved phases prior to filtration. However, in 2007 monitoring conducted by SENES at Port Radium, samples were filtered in the field or laboratory with no appreciable differences between the two techniques. Taking into consideration the additional risks of sample contamination, as well as the associated logistical/time requirements, SENES recommends that laboratory filtration be used for future monitoring work at the GBL sites. This recommendation applies only if samples can be kept cool and are transferred to the laboratory within several days of collection.

[11] For example, the filtration media in disposable filters was confirmed to be the source of consistently elevated results of some metals observed during a previous sampling campaign at one of the GBL sites.

3.5.3 Sample Preservation

Requirements for acidification should be determined in consultation with the analytical laboratory and applied consistently for all sampling campaigns (typically nitric or sulphuric acid are used, depending on the parameter being analyzed and analytical technique).

Water samples are to be kept cool (<I0 "C) in field coolers using ice packs until shipment to the analytical laboratory. In accordance with QA/QC protocols, duplicate samples are to be obtained at a minimum rate of 10%. The percent difference in parameter concentrations between duplicate field samples is expected to be less than 25%.

Each site should have at least one set of travel and field blanks (i.e., one set for Contact Lake, one for El Bonanza and one for Silver Bear). The field blanks are used to assess the potential for contamination arising from the sample collection method including the equipment used, procedures, environmental conditions, etc. The travel blanks are to be prepared and provided by the laboratory. The intent of the travel blank is to assess the potential for contamination arising from sample handling procedures such as storage methods, use of gloves, etc.

3.5.4 Quality Assurance

Consistent with standard practices, analytical results below detection limits are to be assigned values equal to one-half the detection limit (DL) for the calculation of mean values and other statistical tests. Where >50% of the samples in a group are below detection, the mean should be stated as <DL. Elements that are below detection in a large proportion of samples are to be removed from the data set prior to any statistical analysis.

It should be noted that, in situations where sample concentrations were below detection, previous statistical analyses for the Silver Bear sites used 100% of the DL. Any comparisons between historic and future monitoring results should take this into consideration.

3.6 LOGISTICAL REQUIREMENTS

As indicated previously, it has been assumed that monitoring at all of the GBL sites would be integrated into one field campaign for all of the sites and a second campaign exclusively for Terra. The duration of the larger program is estimated to be five days per annual campaign. The second program at Terra is expected to require a total of two days. For planning purposes, it can be assumed that the field programs will require four individuals: two scientists, a wildlife monitor and a pilot.

Several options exist for camp support. These include: a) leaving tent frames or a structure at the Terra Mine; b) staying at other facilities in the vicinity of Great Bear Lake (e.g., Plummer's

Lodge); or c) travelling daily from Yellowknife or Deline. Further analysis is required to determine the preferred approach. However, based on similar work conducted at Port Radium, the first option is likely to be the most appropriate. The following logistical details are based on that assumption.

The sampling program will require on-going support from a light aircraft on floats to move personnel, equipment and samples between sites. The aircraft can also be used to conduct Open Water sampling at the Contact Lake Mine, El Bonanza Mine and reference lakes. Based on the size and nature of the Silver Bear program, Open Water sampling would be more efficient with a boat instead of the aircraft. A "Zodiac" would be sufficient if an aluminum boat is not left on site permanently.

Given the magnitude of the monitoring program, the convenience of having vehicles to support the field program should be weighed against the associated costs. The post-remediation condition of the roads also needs to be considered. In the case of Contact Lake and El Bonanza, there are no requirements for vehicles and the programs can be implemented on foot. For the Terra Mine, two quads with trailers would be adequate to support sampling at that site. The quads could also be used to access the smaller sites at Silver Bear, with the exception of the Northrim Mine which is on the opposite side of the Camsell River. INAC has indicated it will consider locating a quad at Northrim for the purpose of supporting sampling efforts at that site.

3.7 REGULATORY

It is unlikely that the monitoring program will trigger the regulatory requirements of the Sahtu Land and Water Board (SLWB). It is, however, recommended that the SLWB, Environment Canada and the Department of Fisheries and Oceans be given an opportunity to provide feedback on the proposed monitoring plan.

The work associated with the GBL Long-Term Monitoring Program is classified as "research" under the *Northwest Territories Scientists Act.* As a consequence, a Scientific Research Licence will need to be obtained from the Aurora Research Institute prior to implementation of the program.

3.8 ABORIGINAL INVOLVEMENT

Approximately 15 residents from the community of Deline have previously worked on environmental site assessment and monitoring projects at the GBL sites. Services have typically included wildlife monitoring, .general field support and camp operations. All of these services are likely to be required for the Long-Term Monitoring Program and should be incorporated into the program as much as possible.

Deline leadership has expressed a firm interest in being responsible for the implementation of future environmental assessment and monitoring work within their district. They have also acknowledged that the community currently lacks some of the expertise necessary to take on this role (e.g., scientific and project management capacity).

SENES believes that the Long-Term Monitoring Program has the potential to serve as an excellent opportunity for Deline to develop the required capacity. Specifically, we recommend that a formal objective of the program should be to transfer the responsibility for the management of the program to a community-based organization by the end of the first five-year phase. This will require a comprehensive transition plan, training and appropriate financial resources.

4.0 PROPOSED STATE OF THE ENVIRONMENT PROGRAM

4.1 OBJECTIVE AND BACKGROUND

The following section presents a proposed *State of the Environment (SOE) Program* for the GBL sites. The overall objective of the SOE Program is to confirm the ongoing health of the environments surrounding the sites after remediation has been implemented. This will be achieved by consolidating and analyzing the findings of the five year Long-Term Monitoring Program (refer to Section 3.0) and conducting additional investigations into ecological trends. Subsequent monitoring programs may be modified based on the findings of the SOE Program.

4.2 MONITORING FREQUENCY AND TIMING

SOE reporting for operating mine sites is typically conducted on five-year intervals. This allows sufficient time for the collection of a data set that can be analyzed statistically and for potential changes in environmental conditions to be detected. A five-year monitoring cycle was also selected for the former Port Radium Mine and is recommended for the GBL sites.

As noted above, the SOE Program will require that additional ecological information be collected to supplement the annual water quality monitoring data set. This additional information would be collected in the final year of each five-year cycle, with the first cycle beginning following remediation of all GBL sites.

A variety of factors need to be considered when determining the preferred timing of additional field programs. For example, SENES is proposing that the SOE program collect information on vegetation, soil, sediment, benthic invertebrates and several species of fish. While Lake Trout may be present in the vicinity of the sites early in the open-water season, new vegetation will not and populations of benthic invertebrates will be low. The situation may reverse later in the season. There are also scientific and logistical advantages to conducting ecological sampling at the same time as water quality monitoring. Based on these factors, decisions on the timing of sampling should be deferred until the technical scope of the program is finalized.

4.3 MONITORING COMPONENTS

4.3.1 Sediment

4.3.1.1 Sediment - Collection Methodology

Depending on historic concerns at individual sites and stations, sediment samples will be collected for the analysis of metals, petroleum hydrocarbons (PHCs) and radionuclides.

Sediment collection should use a standard sampling apparatus such as an Eckman or Petite Ponar dredge. The recommended sediment sampling protocol involves the use of clean latex gloves for sub-sampling and thorough rinsing of all sampling equipment (e.g., dredge and sub-sampling receptacles) to avoid cross-contamination between samples. To reduce any bias associated with non-homogeneous concentrations, samples for metals analysis are to be collected in triplicate from each station using separate dredge grabs. Metal concentrations should be evaluated based on the average of the triplicate results.

Single samples for PHC and radionuclide analysis are adequate. However, in accordance with QAIQC protocols, duplicate samples for PHC and radionuclide analysis are to be obtained at a minimum rate of 10%. Duplicate sampling for metals analysis is not required since samples are already being collected in triplicate.

4.3.1.2 Sediment - Analytical Parameters and Criteria

Metals

The parameters recommended for analysis of metals in sediments are as follows:

Aluminum	Iron	Sodium
Antimony	Lead	Strontium
Arsenic	Magnesium	Thallium
Barium	Manganese	Tin
Beryllium	Mercury	Titanium
Bismuth	Molybdenum	Uranium
Cadmium	Nickel	Vanadium
Calcium	Phosphorous	Zinc
Chromium	Potassium	Zirconium
Cobalt	Selenium	
Copper	Silver	

The recommended analytical technique for metals is Inductively Coupled Plasma Mass Spectrometry (ICP-MS) following a high temperature nitric acid digestion as described by the U.S. EPA method 200.8. Currently, the Taiga Environmental Laboratory does not analyze sediments.

Concentrations of metals in sediments should be compared against applicable guidelines. In the absence of criteria that are specific to the Northwest Territories, SENES recommends that the Interim Sediment Quality Guidelines (ISQGs) and Probable Effect Levels (PELS) developed by the Canadian Council of Ministers of the Environment (CCME) be applied. Sediment toxicity benchmarks (Lowest Effects Levels (LEL) and Severe Effects Level (SEL)) from Thompson et al. (2005) should also be used. These benchmarks were developed for mining industry applications in northern Saskatchewan and cover a greater number of constituents than those proposed by the CCME.

Petroleum Hydrocarbons

The parameters recommended for analysis of hydrocarbons in sediments is as follows:

Benzene	Fraction F1 (C_6-C_{10})
Ethylbenzene	Fraction F2 (C_{10}-C_{16})
Toluene	Fraction F3 (C_{16}-C_{34})
Total Xylene	Fraction F4 (C_{34}-C_{50})

The recommended analytical techniques for petroleum hydrocarbons in sediments are Purge and Trap Gas Chromatography with a mass spectrometer (GC-MS) detection for low fractions and flame ionization (GC-FID) for high fractions (as described by the US EPA 8260B and CCME Soil Tier 1 methods).

Guidelines for PHCs in sediments have not been developed. However, soil guidelines for PHCs have been developed by the CCME that are protective of soil invertebrates. While not directly applicable to sediments, the comparison to values that are protective of soil invertebrates may provide some perspective on the magnitude of the measured PHC concentrations in sediments. In addition, sampling for benthic invertebrates in the vicinity of areas impacted by PHCs will assist in determining whether impacts to the local environment are occurring. For reference, assessment work previously conducted at the GBL sites has concluded that PHCs in sediments are not having an adverse impact on benthic invertebrates (e.g., in the East Ann of Great Bear Lake at the Contact Lake Mine site).

Radionuclides

Following sample dissolution and treatment to separate the radionuclides, radium-226 and lead-210 levels in sediments should be determined using Alpha Spectrometry and Beta Counting, respectively.

Sediment quality guidelines for radionuclides based on the working reference values have been developed by the Canadian Nuclear Safety Commission (CNSC). SENES recommends that these guidelines, which include criteria for Lowest Effects Level (LEL) and Severe Effects Level (SEL), be used for the SOE Program.

TABLE 4.3-1
SEDIMENT QUALITY GUIDELINES FOR RADIONUCLIDES

Radionuclide	LEL (Bq/g)[a]	SEL (Bq/g)[a]
Ra-226	0.6	14.4
Pb-210	0.9	20.8

a – Thompson *et al.* 2005

4.3.2 Benthic Surveys

Based on previous site characterization work, a limited number of receiving environments at the GBL sites have sediment and/or water concentrations of potential contaminants at levels that are elevated relative to background locations (e.g., Moose Bay). However, studies of fish and benthic invertebrates in the vicinity of these areas have concluded that impacts to local species are not significant.

Although benthic concerns have not been identified to date, post-remediation surveys are recommended for some locations. These follow-up benthic surveys will assist in confirming the ongoing quality of the aquatic environment. Based on the results of previous studies (e.g., Contact Lake), sediment bio-assays are not considered necessary.

4.3.2.1 Benthic Surveys - Collection Methodology

Sample collection techniques for benthic surveys are to follow the same methods described in Section 4.3.1.1 for sediments. To facilitate comparisons between benthic communities and potential contaminant concentrations, benthic surveys and sediment sampling should occur at the same stations.

At each sediment sampling station, five replicate benthic samples should be collected, with each of these samples consisting of a composite of 10 Ekman dredges, as per the Metal Mining Guidance Document (Environment Canada 2002) for Environmental Effects Monitoring (EEM). The five replicate benthic samples should be spaced approximately 20 m apart. Samples of benthic organisms are to be preserved in 10% buffered forrmalin solution. Benthos from appropriate background locations should also be collected in order to establish baseline conditions for comparison.

Immediately following collection, the benthic samples should be placed in a field cooler and kept as cool as possible until shipment for laboratory analysis.

4.3.2.2 Benthic Surveys – Analysis

In general, effects from mining activities are characterized by a reduction in diversity (richness) and an increase in abundance of some taxa. Environmental stress has inhibitive effects on the survival and growth of intolerant taxa whereas organic enrichment has the tendency to encourage tolerant taxa.

For the GBL sites, identification of benthos is to be conducted down to the genus and species level, whenever possible. All methods for analysis of the benthos should follow protocols recommended for the metal mining Environmental Effects Monitoring program in the Metal Mining Guidance Document (Environment Canada 2002).

Basic statistical analysis should be carried out on the invertebrate data collected during the invertebrate survey. Arithmetic mean, median, standard deviation, standard error and minimum and maximum values are to be calculated for a number of endpoints including Taxon Richness, Total Density, EPT (number of taxa of Ephemeroptera, Plecoptera, and Tricoptera), and the density of major taxonomic groups (Oligochaeta, Crustacea, etc.) and taxon presence/absence. These endpoints are simple and useful in condensing complex benthic data and are easily interpretable.

4.3.3 Fish

Similar to benthic surveys, fisheries assessments previously conducted at the GBL sites have identified no evidence of contamination in fish tissue. Nonetheless, focused fish studies for several of the GBL sites have been included in the proposed SOE program. The overall objective of the fisheries assessments is to assist in confirming the ongoing health of the environment and food sources. This will be achieved by testing for the presence of relationships between the concentration of potential contaminants and body size/age of the fish.

4.3.3.1 Fish - Collection Methodology

The sampling goal for each site is to collect an adequate sample size (estimated to be 10 of each) of a predator fish species (e.g., lake trout or pike) and one other common species that represents a different ecological niche within the water body under investigation (e.g., whitefish).

Based on previous assessments and the lack of suitable habitat for other non-selective fishing methods such as seine nets and electro-fishing, gill nets are considered to be the best method for collecting fish. Net types, sizes and set locations should be determined in consultation with individuals familiar with local conditions and fish behaviour (e.g., residents of Deline). Previous studies at the GBL sites have used single size mesh (3.0" and 4.5") andlor multi-panel nets (5", 4", 2.5", 0.75" and 2″, 1.75", 1.5", l", and 0.75") to ensure collection of a wide range of fish sizes. Nets were set at various sites, depths and lake bottom types to increase the chances of collecting a predatory species and at least one other species. Angling has also been attempted with varying degrees of success.

Nets have previously been set for about six hours on the first day to roughly determine the Catch Per Unit Effort (CPUE). Because of the presence of lake trout in most habitats and the potential to overfish the species, smaller nets were used in preference to larger mesh which could collect a large number of lake trout. If a small number of fish were collected after a six hour set, nets were reset and left overnight in a new area. However, to the extent possible, nets were not left overnight because of the likelihood of catching too many lake trout and because daily transportation to the site by small float plane was uncertain, making it difficult to know if it would be possible to remove nets the next day. Similar approaches are recommended for the SOE program.

4.3.3.2 Fish - Analytical Parameters and Criteria

Sample Collection and Physical Parameters

Fish are to be measured for fork length and weight. Depending on the species, otoliths, fin rays and scales should be retained for ageing. Muscle and liver samples are to be collected from each fish for laboratory analysis of metals. If large enough, gut contents should also collected and frozen for subsequent analysis.

Analysis

Liver, muscle and gut content samples are to be submitted to an accredited laboratory for sample preparation, homogenizing, moisture measurement and the determination of metals by ICP-MS high resolution scan. Fish tissues should also be analyzed for mercury using cold vapour techniques. All analyses should follow standard analytical protocols (e.g., U.S. EPA Method Number SW846 3050B Revision 2 for metals and U.S. EPA method 7470A for mercury). Methods include analytical blanks, spiked samples, and standard reference materials. The rationale and minimum required procedures for rigorous quality control are clearly defined in documentation supporting the methods. The QA/QC program is designed to ensure data of known quality which can withstand scientific and legal challenges and is deemed suitable for the current project.

Regression analysis should be conducted using logged fork length and logged metal concentration in both tissues (liver and muscle) for all elements.

4.3.4 Soils and Vegetation

Pre-remediation soil and vegetation studies have been conducted at some of the GBL sites to assess the significance of the terrestrial exposure pathway of inorganic contaminants. The studies were used to assist with the identification of contaminants of potential concern and to delineate areas affected by contamination (e.g., tailings and waste rock impacts). This information was subsequently used in the selection of remedial approaches for the sites.

Remediation measures and activities at some of the GBL sites have the potential to reduce the impact of contaminants on soil and vegetation. For example, the removal or covering of contaminant sources (tailings, PHC-impacted soils, etc.) is being implemented to limit releases to the environment and exposures to terrestrial wildlife. Post-remediation evaluations of soil and vegetation on and in the vicinity of the GBL sites are therefore required to determine changes/trends in terrestrial exposure pathways.

The basis of the plant sampling design is that ingestion of the plant materials by wildlife or humans could lead to elevated exposures to contaminants of concern. Evidence of browsing by large herbivores on several plant species at the GBL sites supports this approach.

4.3.4.1 Soils and Vegetation - Collection Methodology

The proposed soil and vegetation studies for the SOE Program are consistent with the approaches used for similar assessments at the GBL sites and other northern contaminated sites. Soil and vegetation sampling are conducted in tandem at the same stations to assist in identifying contaminant correlations. Sampling stations are selected on or in the vicinity of areas disturbed by the original mining operations and/or remedial works. These typically include waste rock dumps, tailings, solid waste dumps and PHC-impacted soils. Potential sites of contamination are also identified by surface water drainage patterns or by diverse plant communities adjacent to waste rock or tailings with known metal or radionuclide contamination. Background sites are to be selected well away from disturbed areas and should demonstrate diverse plant communities that are unlikely to receive drainage from local sources, such as rock outcrops. Duplicate sampling and analysis should be performed at a rate of at least ten percent.

Following removal of leaf litter and extraneous material, soil samples are collected from the upper two cm of soil using a stainless steel trowel. A sub-surface sample is also collected from each station at a depth of approximately 15 cm.

For vegetation, terminal leaves and twigs from several plant species in the area are collected for analysis. Plant species such as birch and willow are known to accumulate inorganic contaminants from contaminated soils in terminal leaves and twigs and may provide a significant exposure pathway to browsing wildlife. Labrador tea has been shown to be particularly useful for assessing spatial distributions of contaminants on large mine sites because of the large surface area of the leaves and its ability to collect dust fall. When present, opportunistic sampling of edible berries should also be performed.

All soil and vegetation samples are to be kept in sealed containers/bags and kept frozen until analyses can be performed.

4.3.4.2 Soil and Vegetation -Analytical Parameters and Criteria

The analytical methods and analytes for soil and vegetation are to be the same as those described for fish (Section 4.3.3.1). The methods are presented in detail in the manual from the U.S. Environmental Protection Agency relating to analytical methods.

All analytical data should be evaluated statistically to determine average concentrations and distributions for soil and individual vegetation species. Potential correlations between soil and plant species should also be ascertained.

Appropriate environmental criteria have not been established for vegetation. Instead, areas of potential concern are to be identified through statistical comparisons and results obtained from background sites.

4.3.5 Small Terrestrial Species

Risk assessments have determined that some of the GBL sites may pose risks of adverse effects to small terrestrial species that have a limited home range. However, given the limited spatial extent of the impacted areas, the number of potentially affected individuals within a given species is anticipated to be very small relative to regional populations. Within this context, harvesting small terrestrial species for the purposes of SOE monitoring may have a greater impact on the species than elevated concentrations of potential contaminants. Notwithstanding this possibility, Aboriginal stakeholders have requested that small terrestrial species be incorporated into the SOE program as a means of confirming the health of the traditional food web.

As with similar assessments conducted at Port Radium, SENES recommends that species be harvested opportunistically (i.e., species are to be harvested only if they are observed in the course of implementing other components of the program). The focus of the program should be limited to small terrestrial species with a limited home range. In general, the traditional food web species best suited to this requirement are assumed to be hare and grouse.

Harvesting of large herbivores (e.g., caribou and moose) and all carnivores is not considered justified given the limited probability that individuals will have been impacted by the mine sites (due to their large home range). Instead, general observations of such species should be collected throughout the Long-Term and SOE monitoring programs (e.g., presence/absence, abundance, condition). While the SOE program should exclude large terrestrial species, any problem animals (e.g., bears) euthanized during the implementation of remediation or monitoring work at the sites should be sampled.

Regarding the number of animals to be harvested, this decision should be based on the perceived abundance of a species at a given site. To minimize local population impacts, no more than three individuals from any given species should be harvested for the first round of SOE monitoring.

Given the opportunistic nature of the terrestrial program, a detailed sampling plan indicating harvesting locations and specific species to be collected is not presented in the following sections. In general, the sampling and analytical procedures would be comparable to those described for fish. Muscle and liver tissues should be sampled from any harvested animals and analyzed for metals. Any animals harvested from the Contact Lake site should also be analyzed for radionuclides.

4.4 MONITORING STATIONS AND ANALYTICAL REQUIREMENTS

4.4.1 Contact Lake Mine

4.4.1.1 Sediment

Sediments in the small "tailings pond" at the Contact Lake Mine have been shown to have elevated concentrations of metals and radionuclides. A risk assessment conducted by SENES in 2006 (SENES 2007d) concluded that sediments in the tailings pond represent a potential exposure pathway. Further, remediation works at the site (e.g., collection and or covering of surface tailings) has the potential to change the deposition regime in the pond. Taking these factors into consideration, analysis of sediments from the tailings pond should be incorporated into the SOE program.

The tailings pond is small and collection of samples from two stations is considered adequate. Samples should be analyzed for metals and radionuclides.

Contact Lake

Based on assessments conducted to date, there is no compelling evidence to suggest that sediments in Contact Lake have been impacted by the mine. However, for the purposes of confirming the ongoing health of the receiving environment, the SOE should include sediment sampling within Contact Lake.

Samples are to be collected from two stations: one at the discharge point of the stream draining from the tailings pond and one at location likely to be representative of background conditions (e.g., at the far west end of the lake). Samples should be analyzed for metals and radionuclides.

Great Bear Lake - Fuel Storage Area

Near shore sediments at the former fuel storage area on Great Bear Lake have elevated concentrations of metals, radionuclides and PHCs (relative to background). The elevated concentrations have a limited spatial extent and, with few exceptions, are below applicable environmental criteria. Similarly, a benthic survey of the area has concluded that any impacts associated with the elevated concentrations are negligible. However, similar to Contact Lake, SENES recommends that a focused sediment sampling program be incorporated in the first SOE cycle.

Based on testing conducted in 2007 (SENES 2008a) concentrations of potential contaminants were greatest along a transect of five stations parallel to the shoreline. The same five stations should be evaluated by the SOE. For the purposes of comparison, it is also recommended that the program include the five station background transect evaluated in 2007. To summarize, the stations are to include:

- *Fuel Storage Area Stations:* CL-T1-1-EA, CL-T1-2-EA, CL-T1-3-EA, CL-T1-4-EA and CL-T1-5-EA.
- *Background stations:* CL-B-1-EA, CL-B-2-EA, CL-B-3-EA, CL-B-4-EA and CL-B-5-EA.

Metals and PHCs were analyzed during the 2007 program and SENES recommends that the same analytes be carried forward to the SOE program.

4.4.1.2 Benthic Surveys

As described above, the SOE program should include sampling for sediments at stations in the tailings pond, Contact Lake and Great Bear Lake in the vicinity of the former fuel storage area. Sampling for analysis of benthos is also recommended at the same stations, following the methods described in Section 4.3.2.1.

4.4.1.3 Fish Sampling

Contact Lake

The 2006 Site Assessment of the Contact Lake Mine (SENES 2007a) included a fisheries assessment in Contact Lake. Although the 2006 fish assessment did not identify any concerns, a similar post-remediation assessment is recommended for the first cycle of the SOE program. The assessment should follow the methods described in Section 4.3.3.2.

Great Bear Lake - Fuel Storage Area

In addition to Contact Lake, SENES recommends that the fish sampling program be extended to include Great Bear Lake in the vicinity of the former fuel storage area. The 2006 site assessment did not involve the collection and analysis of fish from this location. However, fish studies conducted in Echo Bay as part of the 2004 Port Radium site characterization program will likely serve as an adequate pre-remediation baseline.

It should be noted that the results of any fish assessments conducted in Echo Bay are potentially relevant to the SOE programs for the GBL sites (i.e., the Contact Lake Mine) and Port Radium. To capitalize on common elements, SENES recommends that INAC consider having a single post-remediation fish sampling campaign in Echo Bay that would provide input to both SOE programs.

Analysis

Fish collected from both Contact Lake and Great Bear Lake should be analyzed for metals. For consistency with previous studies and to assist in building the regional data set, SENES also recommends that samples be analyzed for radionuclides (as per protocols described in SENES 2007a).

4.4.1.4 Soil and Vegetation

The proposed approach for SOE monitoring of soil and vegetation at the Contact Lake Mine is to sample all stations that were evaluated during the 2006 and 2008 site assessment campaigns (SENES 2007a; the 2008 assessment report has yet to be finalized). Sampling, the same sites before and after remediation will assist in determining changes (if any) to the terrestrial exposure pathways at the site.

Soil and vegetation sampling conducted at the site in 2006 and 2008 included nine on-site stations and six background stations. The same stations, as listed below, are to be sampled during the first five-year cycle of SOE monitoring.

- *On-Site stations*:[12] CL06-Site 1, CL06-Site 2, CL06-Site 3, CL06-Site 4, CL06-Site 5,CL06-Site 8, CL06-Site 9, CL08-Site 1 and CL06-Site 2.

[12] The "06" and "08" in the soil and vegetation sample nomenclature denotes the original year of sampling. Separate site numbering systems were used for the 2006 and 2008 programs. Repeated "Site" numbers therefore represent different stations (e.g., CL06-Site 1 and CL08-Site 1 are not the same station).

- *Background stations:* CL06-Site *6*, CLOG-Site 7, CL08-Site 3, CL08-Site 4, CL08-Site 5 and CLO6-Site 6.

The stations noted above are terrestrial. However, subject to availability; collection of aquatic vegetation from the tailings pond should be included in the SOE program (note: sampling for aquatic vegetation was not conducted during site assessment work). Sampling from two stations in the pond and a background station (e.g., Upper Lake) are considered sufficient.

All soil and vegetation samples from the Contact Lake Mine are to be analyzed for metals and radionuclides.

4.4.2 El Bonanza Mine

4.4.2.1 Sediment

Mile Lake

Sediment sampling conducted at El Bonanza in 2006 and 2007 (SENES 2007b; SENES 2008c) identified elevated concentrations of some metals in Mile Lake and applicable criteria were exceeded at some stations. Samples from Mile Lake also showed evidence of PHC contamination (F3). All of the elevated results were from stations in the near vicinity of the mine (samples could not be obtained elsewhere in the lake).

SENES recommends that the SOE include ongoing monitoring of sediments in Mile Lake. The two sampling stations from the assessment program should be maintained (ELB-4-ML and ELB-10-ML) and efforts should be made to establish a third station at a location distant from the mine. Samples should be analyzed for metals and petroleum hydrocarbons.

Silver Lake

Sediment sampling in 2006 and 2007 (SENES 2007b; SENES 2008c) in Silver Lake identified metal concentrations above applicable guidelines at two of three stations (no exceedances were reported for the station nearest the outflow, ELB-8-SL). Sampling also identified the presence of BTEX, F1 and/or F3 PHC fractions at one or more of the stations.

All three of the sediment sampling stations previously established in Silver Lake should be incorporated into the SOE program (i.e., ELB-5-SLY ELB-6-SL and ELB-8-SL). Samples should be analyzed for metals and petroleum hydrocarbons.

Stream from Silver Lake

Previous assessment work has not included sediment sampling in the stream that discharges from Silver Lake. Although no concerns are anticipated, a single sediment sampling station should be established in the stream for the SOE program. It should be noted that, based on visual observations, the sediment matrix of the stream bed is dominated by pebbles that are not amenable to analysis. However, if fine grained sediments are identified, they should be analyzed for metals and hydrocarbons.

Great Bear Lake and Whale Lake

Previous investigations into the quality of Great Bear Lake sediments in the vicinity of the airstrip identified no concerns. Similarly, there are no credible sources of contamination in Whale Lake, adjacent to the Bonanza Mine. On this basis, SENES does not consider SOE sediment sampling at either of these locations to be justified.

4.4.2.2 Benthic Surveys

As described above, the SOE program should include sampling for sediments at stations in Mile Lake, Silver Lake and the stream flowing from Silver Lake. Sampling for analysis of benthos is also recommended at the same stations, following the methods described in Section 4.3.2.1.

4.4.2.3 Fish Sampling

Mile Lake

Based on site assessment and monitoring reports conducted in 2006, 2007 and 2008 (SENES 2007b; SENES 2008c; reporting for 2008 has yet to be finalized) the El Bonanza Mine does not appear to be having an impact on the water quality of Mile Lake. Although sediment sampling has identified some evidence of localized impacts to Mile Lake, the magnitude and spatial extent of the impacts is considered minor in relation to the rest of the lake.

In the absence of substantive impacts to water and sediment, it is unlikely that fish living in Mile Lake are being affected by the El Bonanza Mine. However, based on consultations with the federal Department of Fisheries and Oceans, INAC has indicated that fish sampling in Mile Lake should be incorporated into the SOE program. The assessment should follow the methods described in Section 4.3.3.2.

Fish collected from Mile Lake should be analyzed for metals. Due to the absence of uranium mining at El Bonanza, analysis for radionuclides *is not* required.

Silver Lake and Discharge Stream

Although no water quality issues have been identified, PHCs and elevated metal concentrations have been detected in sediments at several locations in Silver Lake. Based on the observed concentrations, impacts to fish are not anticipated. However, to address potential concerns regarding impacts to higher trophic levels, fish sampling in Silver Lake should be incorporated into the SOE program.

In designing the fish sampling program for Silver Lake the unique characteristics of the water body need to be considered. First, Silver Lake is better described as a pond; care should be taken to ensure that fish sampling does not have a significant impact on the resident fish population. Second, while adult fish have not been observed in the lake, fry are regularly present in the discharge stream. Taking these factors into consideration, the SOE fish assessment for Silver Lake should: 1) include the discharge stream; 2) focus on smaller fish; and 3) minimize the fish catch.

Samples should be analyzed for metals only.

Great Bear Lake and Whale Lake

Great Bear Lake sampling in the vicinity of the airstrip has found no evidence of contamination in water or sediments. While fish sampling at this location is not required, studies from other regional locations on Great Bear Lake (e.g., Port Radium and Echo Bay) can provide an indication of fish quality.

Available information suggests there are no contaminant concerns associated with Whale Lake. On this basis, SOE fish sampling in Whale Lake is not considered necessary.

4.4.2.4 Soil and Vegetation

Similar to Contact Lake, the proposed approach for SOE monitoring of soil and vegetation at El Bonanza is to sample all stations that were evaluated during the 2006 and 2008 site assessment campaigns ((SENES 2007b; reporting for 2008 has yet to be finalized). Previous soil and vegetation sampling has included eleven on-site stations and five background stations. The same stations, as listed below, are to be sampled during the first five-year cycle of SOE monitoring.

- *On-Site Stations*:[13] EB06-Sites 1 to 11
- *Background stations*: EB08-Sites 1 to 5

[13] The "06" and "08" in the soil and vegetation sample nomenclature denotes the original year of sampling. Separate site numbering systems were used for the 2006 and 2008 programs. Repeated "Site" numbers therefore represent different stations (e.g., EB06-Site 1 and EB08-Site 1 are not the same station).

The stations noted above are terrestrial. However, subject to availability, collection of aquatic vegetation from Silver Lake and the discharge stream should be included in the SOE program (note: sampling for aquatic vegetation was not conducted during site assessment work). Sampling from two stations in Silver Lake and one in the discharge stream are considered sufficient. Although options in the vicinity of the mine are limited, efforts should also be made to collect a single sample from a suitable reference location.

All soil and vegetation samples from El Bonanza are to be analyzed for metals.

4.4.3 Terra Mine

4.4.3.1 Sediment

<u>Ho Hum TCA</u>

The Ho Hum TCA represents an ongoing receiver and source of site contamination. As site conditions change following remediation (e.g., site drainage, raising/lowering of TCA water levels), there is a potential that sediment deposition will be affected. Similarly, contaminant loadings from sediments to the water column may also change.

In an effort to track conditions in the TCA, sediment monitoring should form an integral part of the SOE program. Two sampling stations, corresponding to stations for water quality monitoring, are considered adequate.

<u>Wetland</u>

Subject to its final configuration, two sediment sampling stations should be established in the wetland at the same locations where water quality is to be monitored. The locations should be selected to minimize the possibility of disturbance while accessing/sampling the sites.

<u>Moose Bay</u>

SENES has proposed that five water quality stations be sampled during the Long-Term Monitoring Program. Three of these stations should also be sampled for sediments under the SOE Program.

<u>Camsell River</u>

Sediment samples should be collected from two locations in the Camsell River: 1) at the open water sampling station in Rainy Lake (offshore from the current dock); and 2) at a background station, upstream of all of the Silver Bear sites.

All sediment samples from Terra should be analyzed for metals.

4.4.3.2 Benthic Surveys

As described above, the SOE program is to include sampling for sediments at stations in the Ho Hum TCA, the wetland, Moose Bay and the Camsell River. Sampling for analysis of benthos is also recommended at the same stations, following the methods described in Section 4.3.2.1.

4.4.3.3 Fish Sampling

Ho Hum TCA

Previous efforts to catch fish in the Ho Hum TCA have been unsuccessful. However, over the last several years, several individuals have made visual observations of fish presence. On the basis of these observations, it is therefore recommended that the SOE include a fish sampling program within the TCA. In addition, INAC is conducting a pre-remediation fish assessment to confirm what species are present and establish a baseline for future reference. This is particularly important given the theoretical potential for fish movement between the TCA and Moose Bay.

Camsell River Regional Sampling

With the exception of a limited number of metal parameters that are slightly elevated in the water quality of Moose Bay, there is no evidence to suggest that the aquatic environments surrounding the Silver Bear sites have been adversely affected. In this context, impacts to fish within receiving bodies are not anticipated. However, to address potential concerns regarding impacts to higher trophic levels, SENES recommends that the SOE Program include post-remediation sampling for fish at strategic locations within local receiving waters.

In most cases, the species to be sampled (e.g., trout, pike and whitefish) have home ranges that would expose them to multiple sites in the Silver Bear group of sites. On this basis, an integrated fish sampling program in the Camsell River is considered appropriate to characterize conditions at all of the sites.

While detailed design of the fish sampling program is beyond the scope of the current document, the following general considerations should be incorporated into the program. Fish sampling stations should be selected based on areas with some potential for localized impacts. These are considered to include Moose Bay, Rainy Lake and the area immediately downstream of Norex and Northrim. A background station upstream in the Camsell River should also be incorporated into the program.

Final decisions on net locations should be determined in the field, ideally in consultation with individuals familiar with local habitats and conditions.

Samples should be analyzed for metals only.

4.4.3.4 Soil and Vegetation

Sampling the same sites before and after remediation will assist in determining changes (if any) to the environment and exposure pathways. While some baseline soil and vegetation sampling has occurred at the Terra Mine, the scope of assessments has been less comprehensive than at the Contact Lake and El Bonanza Mines.

To adequately characterize site conditions (and be consistent with the other sites in the GBL group) INAC will conduct additional baseline soil and vegetation assessment work at Terra during the summer of 2009. This would include sampling of sufficient impacted and reference sites to characterize terrestrial exposure pathways. Based on a preliminary review of previous work, sampling at approximately 8 new sites would likely be sufficient. Although specific sampling stations are best determined while in the field, locations should be selected based on potential impacts (e.g., the presence of tailings, waste rock or PHC impacts).

If INAC wishes to proceed with additional baseline sampling, SENES will investigate the requirements more thoroughly. Subject to this decision, all soil and vegetation sites evaluated prior to remediation should be sampled during the first five-year cycle of SOE monitoring.

The discussion above pertains to terrestrial soil and vegetation. However, subject to availability, collection of aquatic vegetation from the Ho Hum TCA (two stations), wetland (two stations), Moose Bay (2 stations) and a representative reference site (1 station) should also be incorporated into the program.

All soil and vegetation samples from Terra are to be analyzed for metals.

4.4.4 Northrim Mine

4.4.4.1 Sediment

<u>Hermandy Lake</u>

Following remediation, significant changes to the sediment quality of Hermandy Lake are not anticipated. Nonetheless, to confirm environmental conditions, two sediment sampling stations have been incorporated into the program.

Camsell River

SOE sediment sampling is to occur in the vicinity of water discharge points and areas that may have otherwise been impacted. These include the discharge from the new channel from Hermandy Lake (one station) and the shoreline near the waste rock pile (one station).

All sediment samples from Northrim should be analyzed for metals. Selected samples should be analyzed for petroleum hydrocarbons (e.g., in the vicinity of the dock).

4.4.4.2 Benthic Surveys

As described above, the SOE program is to include sampling for sediments at stations in Hermandy Lake and the Camsell River (total of four stations). Benthic sampling is also recommended at the same stations, following the methods described in Section 4.3.2.1.

4.4.4.3 Fish Sampling

The fish sampling program described in Section 4.4.3.3 will assist in characterizing potential impacts to fish in the vicinity of the Northrim Mine. Additional fish assessments in the Camsell River are not required and sampling in Hermandy Lake is not considered necessary (no fish were collected in the lake during the previous assessment).

4.4.4.4 Soil and Vegetation

Similar to Terra, baseline soil and vegetation conditions at Northrim have not been characterized to the same extent as Contact Lake and El Bonanza. INAC intends to conduct additional studies in the summer of 2009 to ensure a consistent approach is followed at all of the sites. This would include sampling of a sufficient number of impacted and reference sites to characterize terrestrial exposure pathways.

Based on a preliminary review of previous work, sampling at approximately 6 new stations is believed to be sufficient. Similar to the other GBL sites, all soil and vegetation sites evaluated at Northrim prior to remediation should be included in the first five-year cycle of SOE monitoring.

All soil and vegetation samples from Northrim are to be analyzed for metals.

4.4.5 Norex

4.4.5.1 Sediment

Camsell River

The only location at the Norex Mine that justifies sediment sampling is the Camsell River at the discharge point of drainage from the site. A single station with analysis for metals is sufficient.

4.4.5.2 Benthic Surveys

The SOE program for Norex should include sampling for benthos at the Camsell River sediment sampling station noted above.

4.4.5.3 Fish Sampling

The fish sampling program described in Section 4.4.3.3 will assist in characterizing potential impacts to fish in the vicinity of the Norex Mine. Additional fish assessments in the Camsell River are not required.

4.4.5.4 Soil and Vegetation

INAC intends to conduct additional soil and vegetation studies at the Norex site in the summer of 2009. Based on a preliminary review of previous work, sampling at approximately 5 new sites is believed to be sufficient. SENES recommends that all soil and vegetation sites evaluated at Norex prior to remediation be included in the first five-year cycle of SOE monitoring. Samples should be analyzed for metals.

4.4.6 Smallwood

4.4.6.1 Sediment

Smallwood Lake

Two stations are considered sufficient to characterize sediment conditions in Smallwood Lake.

4.4.6.2 Benthic Surveys

The SOE program for Smallwood should include sampling for benthos at the two Smallwood Lake sediment sampling stations noted above.

4.4.6.3 Fish Sampling

The fish sampling program described in Section 4.4.3.3 will assist in characterizing potential impacts of the Smallwood Mine on fish in the Camsell River. With regard to Smallwood Lake, the previous fish assessment did identify the presence of Lake Trout, Round Whitefish and Long-nose Sucker. INAC is in the process of determining whether fish sampling in Smallwood Lake will be incorporated into the SOE.

4.4.6.4 Soil and Vegetation

INAC intends to conduct additional soil and vegetation studies at the Smallwood site in the summer of 2009. Based on a preliminary review of previous work, sampling at approximately 5 new sites is believed to be sufficient. SENES recommends that all soil and vegetation sites evaluated at Smallwood prior to remediation be included in the first five-year cycle of SOE monitoring. Samples should be analyzed for metals.

TABLE 4.4-1
SUMMARY OF SOE MONITORING STATIONS AND ANALYTICAL REQUIREMENTS

Site	General Areas	Soil	Terr. Veg.	Sediment	Benthics	Aqu. Veg.	Fish	Water
Contact Lake	Tailings Pond			2 - M, R	2	2 - M, R		
	Contact Lake			2 - M, R	2		Yes – M, R	
	East Arm			5 - M, P	5		Yes – M, R	
	Terrestrial	9 - M, R	9 - M, R					
	Aquatic Background			5 - M, P	5	1 - M,R	other studies	
	Terrestrial Background	6 - M, R	6 - M, R					
El Bonanza	Mile Lake			3 - M, P	3			
	Silver Lake			3 - M, P	3	3 - M	Yes - M	
	Silver Lake Stream			1 - M, P	1			
	GBL at Airstrip						other studies	
	Whale Lake							2 - M
	Terrestrial	11 - M	11 - M					
	Aquatic Background					1 - M		
	Terrestrial Background	5 - M	5 - M					
Terra	Ho Hum TCA			2 - M	2	2 - M	Yes	
	Wetland			2 - M	2	2 - M		
	Moose Bay			3 - M	3	2 - M	Yes	
	Camsell River			1 - M	1		Yes	
	Terrestrial	10 - M	10 - M					
	Aquatic Background			1 - M	1	1 - M	other studies	
	Terrestrial Background	2 - M	2 - M					
Northrim	Aquatic			4 - M	4			
	Terrestrial	6 - M	6- M					
Norex	Aquatic			2 - M	2			
	Terrestrial	5 - M	5 - M					
Smallwood	Aquatic			2 - M	2			
	Terrestrial	5 - M	5 - M					

M = Metals, R = Rads, P = PHC

5.0 PROPOSED CONSTRUCTION MONITORING PROGRAM

5.1 OBJECTIVE AND BACKGROUND

INAC has developed Remedial Action Plans (RAPS) to address environmental, human health and aesthetic concerns at the GBL sites. Based on current planning, "construction" at the sites is scheduled to begin in 2009 and is likely to extend until at least 2013. Some of the activities associated with remedial works have the potential to impact the aquatic environment.

A *Construction Monitoring Program* will be implemented to assist INAC in identifying remediation activities that may be having an adverse impact on the natural environment. The program will focus on potential discharges to receiving waters in the vicinity of the sites.

The Construction Monitoring Program is one component of INAC's overall strategy to protect the environmental quality at the GBL sites. As described in Sections 3.0 and 4.0, INAC will also be conducting long-term monitoring after remediation has been implemented to confirm that this objective has been met.

5.2 OVERVIEW OF APPROACH

SENES recommends that construction monitoring be divided into the following two major categories:

1) *Baseline Construction Monitoring* **-** Regular monitoring of water quality on and surrounding the GBL sites. The sampling frequency, locations and analytes would remain constant with time. Monitoring data would assist in identifying overall water quality trends. Anomalous results, if any, would trigger more comprehensive sampling and analysis.
2) *Construction Activity Monitoring* **-** Targeted sampling to evaluate water quality in the near vicinity of specific construction activities. Sampling would occur only on an "as-needed" basis to verify that activities are not having a significant adverse impact on receiving environments. Excavation of the shoreline is an example of an activity that would trigger such monitoring.

The proposed Construction Monitoring Program is structured on this basis.

5.3 BASELINE CONSTRUCTION MONITORING

The Long-Term Monitoring Program described in Section 3.0 will be implemented after site remediation has been completed. The objective of that program is the same as Baseline Construction Monitoring, namely to track the overall quality of the receiving environment.

Given the common objectives of Long-Term and Baseline Construction Monitoring, most aspects of the two programs are transferrable. These include: sampling stations, parameters to be analyzed and sampling protocols. The only exception is that the remediation phase of the project warrants more regular monitoring to detect any emerging issues. Baseline Construction Monitoring should therefore be conducted on a more frequent basis than Long-Term Monitoring.

SENES recommends that Baseline Construction Monitoring be implemented on the following schedule throughout the remediation phase:

1) *Active Sites* **-** Baseline monitoring should be conducted once monthly at any sites where remediation is actively occurring during the open-water season. The sampling period should begin two weeks prior to remediation activities and a follow-up campaign should be conducted two weeks following active work.
2) *In-Active Sites* **-** Remediation of all GBL sites is estimated to require at least three calendar years. However, in some cases, construction activities at individual sites will likely be completed within a single field season (Terra is the only notable exception). These sites will remain "in-active" for the balance of the GBL remediation project. A single annual monitoring campaign is considered sufficient for in-active sites, both before and after remediation has been implemented.

To summarize, SENES recommends that the Long-Term Monitoring Program also be applied during the remediation phase of the GBL sites. The only difference between the two monitoring programs will be more frequent sampling at sites where remediation is actively occurring.

5.4 CONSTRUCTION ACTIVITY MONITORING

5.4.1 Monitoring Approach

Baseline Construction Monitoring is intended to detect overall trends in the regional aquatic environment that may be attributable to site remediation. However, the sampling frequency and spatial scope of baseline monitoring are not designed to capture individual events of a short duration that are associated with construction activities or upsets. Instead, such events are best evaluated by monitoring receiving environments in the near vicinity of specific construction activities at the time they are occurring.

For context, a number of mechanisms already exist to control and monitor construction-related releases to the environment. These include:

1) *Regulatory Authorizations* - At least one Land Use Permit, Water Licence and Quarry Permit will be issued for the project. These authorizations will identify controls necessary to mitigate potentially adverse environmental impacts (e.g., use of silt curtains to control suspended sediments). These regulatory authorizations will also specify criteria for the release of potential contaminants to the receiving environment (e.g., for wastewater discharge) and reporting requirements for inadvertent releases (e.g., spill reporting).

2) *Contractual Measures* - As "proponent" and licensee, INAC will be responsible for ensuring compliance with all regulatory authorizations. At a functional level, this responsibility will be transferred to the remediation contractor through contractual obligations. An example of a general measure to be imposed on the contractor is:

    > *"Comply with all applicable environmental laws, regulations and requirements of Federal, Territorial and other regional authorities, and acquire and comply with such permits, approvals and authorizations as may be required.* "

    A more specific example is:

    > *"Provide an erosion and sediment control plan that identifies the type and location of erosion and sediment controls to be provided. Plan to include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Territorial, and Municipal laws and regulations"*

    The Resident Engineer will oversee the implementation of these obligations. This will include the authority to approve any monitoring requirements specific to individual construction activities. Throughout this process, INAC will be given opportunities to comment on the monitoring requirements. Compliance with the authorizations will also be monitored and enforced by INAC's Land Use Inspectors.

3) *Environment, Health and Safety Procedures* - The remediation contractor will be required to submit a comprehensive Environment, Health and Safety Plan that will identify procedures to control and address potential impacts to the environment. Where appropriate, these procedures will include provisions for environmental monitoring. For example, in the event of a fuel spill, the procedures will define emergency response and remedial approaches that are to be followed. The Crown's Resident Engineer will have the responsibility and discretion to define requirements for confirmatory sampling which could include sampling within the receiving environment.

4) *Standing Regulation* - In addition to project-specific authorizations, environmental legislation of general application will also be enforced during the remediation project. Examples of such legislation include the *Fisheries Act, Species at Risk Act,* the *Canadian Environmental Protection Act* and the *Northwest Territories Environmental Protection Act.* Appropriate regulatory agencies including the Department of Fisheries and Oceans, Environment Canada and the Government of the Northwest Territories will have the authority to inspect and enforce against these pieces of legislation.

As evidenced above, a number of measures are in place to ensure that individual construction activities are not having a deleterious effect on the receiving environment. Where appropriate, there are also provisions for targeted monitoring activities. Within this context, SENES believes that monitoring for the majority of potential impacts associated with construction activities can be addressed through the existing regulatory and contracting frameworks.

Notwithstanding the conclusion above, there remains a possibility that limited additional monitoring will be required during the implementation of remediation. While it is difficult to predict the nature and scope of these requirements (e.g., sampling locations and required analyses), responsibilities for identifying such requirements should be clearly assigned.

Prior to deciding how to implement any construction activity monitoring, the realities of operating at a remote field location need to be considered. Specifically, the schedules of individual construction activities are typically very fluid, as are the nature and timing of potential environmental concerns. It is therefore very difficult to anticipate when and what monitoring requirements will arise.

In this context, SENES recommends that the Resident Engineer be given authority to request that the remediation contractor conduct additional monitoring on an "as and when needed" basis to address potential environmental concerns if they arise. Collectively, these requirements are expected to be minimal. However, to ensure timeliness and flexibility, contractual and financial provisions should be in place to allow for this possibility.

5.4.2 Generic Requirements

As indicated previously, the full scope of the GBL remediation project has yet to be finalized. As a consequence, it is premature to incorporate the specific locations of construction activities and contaminants of concern into the Construction Monitoring Program. Despite this uncertainty, the following generic monitoring expectations are recommended for the typical construction activities that are likely to be associated with the project. These expectations should be compared against applicable regulatory authorizations, once received (e.g., the Land Use Permit, Water License, Quarry Permit and any authorizations under the *Fisheries Act*).

As a general guide, construction activity monitoring should take place at locations whenever an activity has a reasonable potential of causing adverse impacts to the receiving environment. Examples of such activities include:

a) *<u>Shoreline Excavations and Modifications</u>* – The following remediation activities will occur in and adjacent to water bodies:

   - removal of dock structures and excavation of PHC-contaminated soils (Northrim, Smallwood, Terra and Contact Lake);
   - removal of culverts (Silver Bear roadways and El Bonanza);
   - excavation / cover of tailings in the vicinity of water bodies (Ho Hum TCA, Hermandy Lake and Contact Lake TCA);
   - spillway upgrades and wetland enhancement (Terra);
   - excavation of dump area in the vicinity of Jackfish Bay (road from Terra to Norex).

   Although mitigation will be implemented to limit potential releases to the environment (e.g., silt curtains and surface booms), monitoring is required to confirm that impacts are not occurring.

b) *<u>Planned Discharges to Receiving Waters</u>* – There is a potential the project will include controlled discharges to receiving waters. Such discharges will be identified in the Contractor's plan.

c) *<u>Permanent Changes to the Hydrological Regime</u>* – The remediation project will result in localized changes to hydrology. Most notably, the original discharge from Hermandy Lake will be restored.

d) *<u>Potential Discharges to Receiving Waters</u>* – In addition to activities immediately adjacent to water bodies, other activities have the potential to cause impacts to the aquatic environment if there is a credible contaminant pathway. Examples include excavation of PHC impacted areas within 50 m of the shoreline, demolition/consolidation of fuel tanks and drums located near water bodies (e.g., Terra and Contact Lake at the East Arm of GBL) fuel spills and surface erosion of impacted areas.

5.4.2.1 Construction Activity Monitoring Schedule and Duration

To the extent possible, construction activity monitoring should occur prior to, during and after any activities that have the potential to impact the aquatic environment. However, as noted previously, the schedules of individual construction activities are typically very fluid and it is difficult to anticipate exactly when monitoring will be required. Despite this limitation, the following generic guidance for the schedule and duration of monitoring is provided.

Through regular reporting structures, the Contractor will inform the Resident Engineer of all anticipated work within the upcoming period. Based on the anticipated activities, the Resident Engineer will inform the Contractor of any associated monitoring requirements. For example, prior to the removal of a dock structure the Resident Engineer would be informed of the upcoming activity and request that the Contractor sample water quality before initiating work.

The sampling frequency during implementation of the activity should be determined on a case-by-case basis. A default frequency of once per day is recommended unless an alternate frequency can be justified.

Post-activity monitoring should continue until confirmation is received that the receiving environment has returned to its pre-activity condition. The frequency of sampling during this period can be reduced if daily monitoring is unlikely to detect significant changes in the concentrations of potential contaminants.

5.4.2.2 Contaminants of Concern

Construction activity monitoring should be designed to address the specific contaminants associated with the activity. Typically, the contaminants of concern will be self-evident based on the activity being performed. For example, monitoring during the excavation of shoreline materials impacted with petroleum hydrocarbons would focus on the relevant PHC fractions and suspended sediments. Similarly, work involving tailings would require monitoring of total metal, dissolved metal and suspended sediments.

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Table 2.2-1
Stations Sampled During Past Monitoring Programs at Contact Lake Mine (1992)

STATION	GENERAL LOCATION	EBA[1]
Surface Water		1992
W-1	spring	X
W-2	downgradient of spring	X
W-5	mine adit	X
W-6	waste rock pile runoff	X
W-7	wetland	X
W-8 (W-12)	tailings pond, north shore, east end	X
W-9 (W-10)	tailings pond, north shore, west end	X
W-11	stream, upstream of Tailings Pond	X
W-15	Upper Lake	X
W16	stream, downstream of Tailings Pond	X

Notes:

[1] Sampled by EBA Consultants Limited; summarized in Gartner Lee (2005).

Stations in parenthesis are replicate samples.

Table 2.2-2
Stations Sampled During Past Monitoring Programs at Contact Lake Mine (2002-2008)

STATION	WATER TYPE & DEPTH	GENERAL LOCATION	WRD[1] 2002	WRD[1] 2003	WRD[1] 2004	WRD[2] 2005	SENES[3] 2006	SENES[4] 2007	SENES[5] 2008
Receiving Waterbodies									
Contact Lake									
CL-4	Shoreline (surface)	east of dock area	X	X	-	X	X	-	-
CL-5	Shoreline (surface)	at stream inflow	-	-	X1, X2	X	X	X	X
CL-9 (backgd)	Shoreline (surface)	700 m southeast of main mine site	-	-	-	-	X	X	X
CL-24	Shoreline (surface)	west of dock area in small bay	-	-	-	-	-	X	X
CL-6	Open Water (surface)	northwest of island midway across from dock area	-	-	-	X	X	X	X
	Open Water (middle)		-	-	-	X	X	-	-
	Open Water (bottom)		-	-	-	X	X	X	X
CL-8 (backgd)	Open Water (surface)	4.5 km from main mine site in far northwest bay of lake	-	-	-	-	X	X	X
	Open Water (bottom)		-	-	-	-	X	X	X
CL-11	Open Water (surface)	1.5 km directly south of main mine site	-	-	-	-	-	X	X
	Open Water (bottom)		-	-	-	-	-	X	X
CL-12	Open Water (surface)	3.5 km northwest of main mine site	-	-	-	-	-	X	X
	Open Water (bottom)		-	-	-	-	-	-	X
CL-13	Open Water (surface)	2.5 km west of maim mine site	-	-	-	-	-	X	X
	Open Water (bottom)		-	-	-	-	-	X	X
CL-14	Open Water (surface)	1.6 km southeast of main mine site	-	-	-	-	-	X	X
	Open Water (bottom)		-	-	-	-	-	-	X
CL-26	Open Water (surface)	at outflow stream running from	-	-	-	-	-	X	X
	Open Water (bottom)		-	-	-	-	-	-	X
East Arm - Great Bear Lake									
CL-7-EA	Shoreline (surface)	dock at fuel storage area	-	-	-	-	X	X	X
	Shoreline (bottom)		-	-	-	-	X	X	-
CL-27-EA	Shoreline (surface)	at point east of dock	-	-	-	-	-	-	X
CL-16-EA	Open Water (surface)	200 m northeast of dock	-	-	-	-	-	X	-
CL-20-EA	Open Water (surface)	250 m southeast of dock	-	-	-	-	-	X	-
On-land Sampling									
Upper Lake									
CL-1	Shoreline (surface)	south side	X	-	-	X	X	X	X
	Shoreline (bottom)		-	-	-	-	X	-	-
Tailings Pond									
CL-3	Open Water (surface)	center	X	X	X1, X2	X	X	-	-
	Open Water (bottom)		-	-	-	X	X	-	-
	Shoreline (surface)	at outflow along south shore	-	-	-	-	-	X	X
Other Locations									
CL-2	Waste stream (surface)	toe of waste rock	X	X	X1, X2	X	X	X	X
CL-2a	Wetland (surface)	south end of tailings wetland	-	-	-	-	X	X	X
CL-2b	Stream (surface)	stream flowing from TCA towards Contact Lake	-	-	-	-	X	X	X
CL-15	Stream (surface)	just upstream of inflow to Tailings Pond	-	-	-	-	-	X	-
	Shoreline (surface)	in Tailings Pond at inflow	-	-	-	-	-	-	X
CL-17	Bog (surface)	bog water upstream of CL-2	-	-	-	-	-	X	X
Reference Waterbodies									
Tutcho Lake	Open Water (surface)	center	-	-	-	X	-	-	-
Regional Lake 1									
CL-RL-1A	Open Water (surface)	southeast end	-	-	-	-	-	X	X
CL-RL-1B	Open Water (surface)	northwest end	-	-	-	-	-	X	X
Regional Lake 2									
CL-RL-2A	Open Water (surface)	northwest end	-	-	-	-	-	X	X
CL-RL-2B	Open Water (surface)	southeast end	-	-	-	-	-	X	X
Regional Lake 3									
CL-RL-3A	Open Water (surface)	east end	-	-	-	-	-	X	X
CL-RL-3B	Open Water (surface)	west end	-	-	-	-	-	X	X
Regional Lake 4									
CL-RL-4A	Open Water (surface)	east end	-	-	-	-	-	X	X
CL-RL-4B	Open Water (surface)	west end	-	-	-	-	-	X	X

Notes:

[1] Sampled by INAC's Water Resources Division; summarized in Gartner Lee (2005).

[2] Sampled by INAC's Water Resources Division; summarized in INAC (2006a).

[3] Sampled by SENES Consultants Limited; summarized in SENES (2007a).

[4] Sampled by SENES Consultants Limited; summarized in SENES (2008a).

[5] Sampled by SENES Consultants Limited; summarized in SENES (2008b).

X - sampled

X1 - sampled in August 2004.

X2 - sampled in September 2004.

"-" - not sampled.

backgd - background

Table 2.2-3

Samples Collected During Past Monitoring Programs at Contact Lake Mine (2002-2008)

STATION	WATER TYPE/DEPTH	2002					2003					2004					2005					2006					2007							2008					
		FM	GC	TM	DM	R	FM	GC	TM	DM	R	FM	GC	TM	DM	R	FM	GC	TM	DM	R	FM	GC	TM	DM	R	FM	GC	TM*	DM*	R	THg	PHC	FM	GC	TM	DM	R	PHC
Receiving Waterbodies																																							
Contact Lake																																							
CL-4	Shoreline (surface)	-	X	X	X	X	-	X	X	X	X	-	-	-	-	-	-	X	X	-	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
CL-5	Shoreline (surface)	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-	X	X	-	X	X	X	X	X	X	-	X	X	X	X	-	-	X	X	X	X	X	X
CL-9 (backgd)	Shoreline (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CL-24	Shoreline (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X
CL-6	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	-	-	X	X	X	X	X	X
	Open Water (middle)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	X	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
	Open Water (bottom)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	X	X	X	X	X	X	X	X	X	-	-	-	X	X	X	X	-	-
CL-8 (backgd)	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	**X**	**X**	**X**	**X**	X	X	X	X	X	X	X	X	X	X	X	X	X
	Open Water (bottom)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	-	-	-	X	X	X	X	-	-
CL-11	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	-
	Open Water (bottom)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**X**	**X**	**X**	**X**	X	X	X	X	X	X	X	-	-
CL-12	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-	-	X	X	X	X	X	-
	Open Water (bottom)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-	-
CL-13	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-	-	X	X	X	X	X	-
	Open Water (bottom)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-	-	X	X	X	X	-	-
CL-14	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-	-	X	X	X	X	X	-
	Open Water (bottom)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-	-
CL-26	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**X**	**X**	**X**	**X**	**X**	**X**	**X**	X	X	X	X	X	-
	Open Water (bottom)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-	-
East Arm - Great Bear Lake																																							
CL-7-EA	Shoreline (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	**X**	**X**	-	**X**	-	X	X	X	X	X	X	X	**X**	**X**	**X**	X	**X**
	Shoreline (bottom)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	**X**	**X**	**X**	-	-	**X**	**X**	**X**	-	-	-	-	-	-	-	-	-
CL-27-EA	Shoreline (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X
CL-16-EA	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-
CL-20-EA	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-
On-land Sampling																																							
Upper Lake																																							
CL-1	Shoreline (surface)	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	X	X	X	X	-	X	X	X	X	-	-	X	X	X	X	X	-
	Shoreline (bottom)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Tailings Pond																																							
CL-3	Shoreline (surface)	-	**X**	**X**	**X**	**X**	-	**X**	**X**	**X**	**X**	-	X	X	X	X	X	X	X	-	X	X	X	X	X	X	-	**X**	**X**	**X**	**X**	-	-	X	X	X	X	X	-
	Shoreline (bottom)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Locations																																							
CL-2	On-land (surface)	-	X	X	X	X	-	X	X	X	X	-	X	X	X	X	-	X	X	-	X	X	X	X	-	X	-	X	X	X	X	-	-	-	-	-	-	-	-
CL-2a	On-land (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	-	X	X	X	X	-	-	-	-	-	-	-	-
CL-2b	On-land (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	-	X	X	X	X	-	-	-	-	-	-	-	-
CL-15	On-land (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-	-	-	-	-	-	-	-
CL-17	On-land (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-	-	-	-	-	-	-	-
Reference Waterbodies																																							
Tutcho Lake	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Regional Lake 1																																							
CL-RL-1A	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-	X	X	X	X	X	-
CL-RL-1B	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-	X	X	X	X	-	-
Regional Lake 2																																							
CL-RL-2A	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-	X	X	X	X	X	-
CL-RL-2B	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-	X	X	X	X	-	-
Regional Lake 3																																							
CL-RL-3A	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-	X	X	X	X	X	-
CL-RL-3B	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-	X	X	X	X	-	-
Regional Lake 4																																							
CL-RL-4A	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-	-	X	X	X	X	X	-
CL-RL-4B	Open Water (surface)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-	X	X	X	X	-	-

Notes:

FM - field measurements.

GC - general chemistry

TM - total metals including mercury

TM* - total metals excluding mercury

DM - dissolved metals including mercury

DM* - dissolved metals excluding mercury

R - radionuclides

THg - total mercury

PHC - petroleum hydrocarbons; BTEX - F1 and F2 - F4 collected in two separate samples

X (bold) - indiates that a duplicate sample was taken

Table 2.2-4
Analytes Measured During Past Monitoring Programs at Contact Lake Mine (2002-2008)

SAMPLE TYPE	WRD 2002-2005	SENES 2006-2008
Field Measurements	temperature [2], pH [2], percent dissolved oxygen [2], dissolved oxygen [2], turbidity [2], specific conductivity [2], total dissolved solids [2]	temperature, pH, dissolved oxygen, turbidity, specific conductivity
General Chemistry	ammonia, nitrate, nitrite, dissolved oraginc carbon, total organic carbon, ortho-phosphate, dissolved phosphorous, total phosphorous, total cyanide [1], alkalinity, colour [1], specific conductivity, pH, total dissolved solids, total suspended solids, trubidity, calcium, chloride, hardness, magnesium, potassium, sodium, sulphate, sulphide [1], fluoride [2], nitrate+nitrite [2], reactive silica [2]	total alkalinity, pH, total dissolved solids, total suspended solids, dissolved organic carbon, calcium, chloride, hardness, magnesium, potassium, sodium, sulphate
Total & Dissolved Metals	aluminum, antimony, arsenic, barium, beryllium, cadmium, cesium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, rubidium, selenium, silver, strontium, thallium, tin[1], titanium, uranium, vanadium, zinc	aluminum, antimony, arsenic, barium, beryllium, cadmium, cesium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury[3], molybdenum, nickel, rubidium, selenium, silver, strontium, thallium, titanium, uranium, vanadium, zinc
Radionuclides	actinium-228, bismuth-212, bismuth-214, lead-210, lead-211, lead-212, lead-214, polonium-210, potassium-40, radium-223, radium-226, radium-228, radon-219, radon-220 [1], thallium-208, thorium-227, thorium-228, thorium-230, thorium-232, thorium-234, uranium-235	radium-226, lead-210
Petroleum Hydrocarbons	not sampled	BTEX - benzene, toluene, ethylbenzene, total xylene F1, F2, F3, F4

Notes:

[1] Sampled sometime between 2002 to 2004 only.

[2] Sampled in 2005 only.

[3] A separate sample was collected for mercury in 2007 which was analyzed by CVAAS for total mercury only (i.e. no dissolved sample); remaining metals were

analyzed by ICP-MS

Table 2.2-5
Stations Sampled During Past Monitoring Programs at El Bonanza Mine (2004, 2006-2008)

STATION	WATER TYPE & DEPTH	GENERAL LOCATION	SENES[1] 2006	SENES[2] 2007	SENES[3] 2008
Receiving Waterbodies					
Great Bear Lake					
ELB-1-GBL	Open Water (surface)	at airstrip at north end of bay	X	X	X
	Open Water (bottom)		X	-	-
ELB-2-GBL	Open Water (surface)	at airstrip at south end of bay	X	X	X
	Open Water (bottom)		X	-	-
ELB-9-GBL	Open Water (surface)	approximately 200 m from shore	-	X	-
Mile Lake					
ELB-3-ML	Open Water (surface)	base of cliff face southeast of mine	X	X	X
	Open Water (bottom)		X	X	X
ELB-4-ML	Open Water (surface)	directly east of mine	X	X	X
	Open Water (bottom)		-	-	X
ELB-10-ML	Open Water (surface)	narrows of small bay east of mine site	-	X	-
ELB-11-ML	Open Water (surface)	at small island near docking area	-	X	-
Silver Lake					
ELB-5-SL	Open Water (surface)	just east of culvert closer to south shore	X	X	X
	Open Water (bottom)		X	X	X
ELB-6-SL	Shoreline (surface)	at inflow from Mile Lake	X	X	X
	Shoreline (bottom)		-	-	X
ELB-7-SL	Shoreline (surface)	approximately 4 m from shore at tip of waste rock	X	X	X
	Shoreline (bottom)		-	-	X
ELB-8-SL	Shoreline (surface)	approximately 1 m from shore at outflow	X	X	X
	Shoreline (bottom)		-	-	X
On-land Sampling					
ELB-SW-1	Stream (surface)	small stream flowing out of Silver Lake; 2 m from lake	X	X	X
ELB-SW-2	Stream (surface)	small stream flowing out of Silver Lake; 50 m from lake	X	X	X
Reference Waterbodies					
Vicinity Lake 1					
BON-SW-1	Shoreline (surface)	Whale Lake at Bonanza Mine	X	X	X
Vicinity Lake 2					
ELB-RL-2-A	Shoreline (surface)	southeast of Bonanza Mine on west shore of lake	-	X	X
Vicinity Lake 3					
ELB-RL-3-A	Shoreline (surface)	southeast of Bonanza Mine on northwest shore of lake	-	X	X
Vicinity Lake 4					
ELB-RL-4-A	Shoreline (surface)	Small lake to south road to airstrip on west shore	-	X	X

Notes:

[1] Sampled by SENES Consultants Limited; summarized in SENES (2007b).
[2] Sampled by SENES Consultants Limited; summarized in SENES (2007c).
[3] Sampled by SENES Consultants Limited; summarized in SENES (2008b).
X - sampled.
"-" - not sampled.

Table 2.2-6
Samples Collected During Past Monitoring Programs at El Bonanza Mine (2002-2008)

STATION	WATER TYPE & DEPTH	2006					2007						2008					
		FM	GC	TM	DM	R	FM	GC	TM	DM	R	PHC	FM	GC	TM	DM	R	PHC
Receiving Waterbodies																		
Great Bear Lake																		
ELB-1-GBL	Open Water (surface)	X	X	X	X	X	-	X	X	X	-	-	X	X	X	X	-	X
	Open Water (bottom)	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
ELB-2-GBL	Open Water (surface)	X	X	**X**	**X**	X	-	X	X	X	X	X	X	X	X	X	-	-
	Open Water (bottom)	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
ELB-9-GBL	Open Water (surface)	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-
Mile Lake																		
ELB-3-ML	Open Water (surface)	X	**X**	**X**	**X**	-	X	X	X	X	X	X	X	X	X	X	-	X
	Open Water (bottom)	X	**X**	**X**	**X**	-	X	**X**	**X**	**X**	-	-	-	-	-	-	-	-
ELB-4-ML	Open Water (surface)	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X	-	-
	Open Water (bottom)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ELB-10-ML	Open Water (surface)	-	-	-	-	-	X	X	X	X	-	-	-	-	-	-	-	-
ELB-11-ML	Open Water (surface)	-	-	-	-	-	X	X	X	X	-	-	-	-	-	-	-	-
Silver Lake																		
ELB-5-SL	Open Water (surface)	X	X	X	X	X	X	**X**	**X**	**X**	**X**	**X**	X	X	X	X	-	X
	Open Water (bottom)	X	X	X	X	-	X	X	X	X	-	-	X	X	X	X	-	-
ELB-6-SL	Shoreline (surface)	X	X	X	-	-	X	X	X	X	-	-	X	X	X	X	-	-
	Shoreline (bottom)	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-	-
ELB-7-SL	Shoreline (surface)	X	**X**	**X**	**X**	X	X	X	X	X	-	-	X	X	X	X	-	-
	Shoreline (bottom)	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-	-
ELB-8-SL	Shoreline (surface)	X	X	X	X	X	X	X	X	X	-	-	X	X	X	X	-	-
	Shoreline (bottom)	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-	-
On-land Sampling																		
ELB-SW-1	Stream (surface)	X	X	X	-	-	-	X	X	X	X	-	X	X	X	X	-	-
ELB-SW-2	Stream (surface)	X	X	X	-	-	-	X	X	X	-	-	X	X	X	X	-	-
Reference Waterbodies																		
Vicinity Lake 1																		
BON-SW-1	Shoreline (surface)	X	X	X	-	-	-	X	X	X	X	-	X	X	X	X	-	-
Vicinity Lake 2																		
ELB-RL-2-A	Shoreline (surface)	-	-	-	-	-	-	X	X	X	-	-	X	X	X	X	-	-
Vicinity Lake 3																		
ELB-RL-3-A	Shoreline (surface)	-	-	-	-	-	-	X	X	X	-	-	X	X	X	X	-	-
Vicinity Lake 4																		
ELB-RL-4-A	Shoreline (surface)	-	-	-	-	-	-	X	X	X	-	-	X	X	X	X	-	-

Notes:

FM - field measurements.

GC - general chemistry

TM - total metals including mercury

DM - dissolved metals including mercury

R - radionuclides

PHC - petroleum hydrocarbons; BTEX - F1 and F2 - F4 collected in two separate samples

X (bold) - indiates that a duplicate sample was taken

Table 2.2-7
Stations Sampled During Past Monitoring Programs at Silver Bear Mines (2002-2008)

STATION	DEPTH	GENERAL LOCATION	WRD[1]															
			2002[2]	2003[2]	2004[2]			2005[3]			2006[4]			2007[5]			2008[6]	
			Sep	Jun	Jun	Aug	Sep	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Aug
Terra Mine																		
Little Ho-Hum Lake																		
T-2	Surface	shoreline, east end	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ho-Hum Lake																		
T-3	Surface	shoreline, east end, north shore at tailings beach	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T-5	Surface	shoreline, west end, north shore below mill	X	-		X	X	X	X	X	X	X	X	X	X	X	X	X
T-9	Surface	shoreline, west end, at outlet weir	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T-7	Surface (A)	open water, east end, middle of lake	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Bottom (B)		-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-
T-16	Surface (A)	open water, middle, in line with tailings beach pipe	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X
	Bottom (B)		-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
T-8	Surface (A)	open water, west end, middle of lake	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Middle (B)		-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X
	Bottom (C)		-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Camsell River																		
T-1	Surface	Jackfish Bay	X															
T-4	Surface	Rainy Lake, south shore at Terra dock	X	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X
T-6	Surface	Moose Bay, Ho-Hum Lake discharge	X	-	-	X	-	X	X	X	X	X	X	X	X	X	X	X
T-10	Surface	Moose Bay, halfway down airstrip	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T-11	Surface	Moose Bay, middle	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T-12	Surface	Moose Bay, west end, end of airstrip	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-
T-13	Surface	Camsell River, upstream of Moose Bay	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HHO-1	Surface	wetland, corner of airstrip and weir	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-
HHO-2	Surface	wetland, seepage/flow from airstrip	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-
HHO-3	Surface	wetland, water along weir	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-
On-land Water																		
T-17	Surface	culvert past landfill, draining to Jackfish Bay	-	-	-	X	X	X	-*	-*	X	X	X	X	-*	-*	X	X
T-18	Surface	boggy seep from landfill (scummy pond)	-	-	-	X	-	X	-*	X	X	X	X	X	-*	-*	X	X
T-25	Surface	pool below landfill	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X
T-1B	Surface	Jackfish (Dump) Creek at outlet to Jackfish Bay	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X
T-1C	Surface	Jackfish Bay adjacent to "dry" dump	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T-19	Surface	northwest adit, uphill from open pit adit, along trail	-	-	-	X	X	X	X	X	X	X	X	X	-	-	X	X
T-20	Surface	north zone adit, upstream of Terra dock	-	-	-	X	X	X	X	X	X	X	X	X	-	-	X	X
T-21	Surface	standing water in adit in open pit	-	-	-	-	X	X	X	X	X	X	X	X	-	-	X	X
T-22	Surface	standing water in adit near airstrip	-	-	-	-	X	-*	-*	-*	-*	X	X	-*	-	-	X	X
W-4	Surface	flooded vent shaft	-	-	-	-	-	-	X	X	-	X	X	X	-	-	X	X
Wells																		
T-14	Porewater	Ho-Hum Lake tailings beach	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
T-15	Porewater	Ho-Hum Lake tailings beach	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
Well #1	Porewater	Ho-Hum Lake tailings beach, on spit of land	-	-	-	-	-	-	X	-	-	X	X	X	-	-	X	-
Well #2	Porewater	Ho-Hum Lake tailings beach, at base of waste rock pile	-	-	-	-	-	-	X	-	-	X	X	X	-	-	-*	X
Well #3	Groundwater	back of landfill	-	-	-	-	-	-	-	-	-	X	X	X	-	-	X	-
TMW-01	Porewater	waste rock beside Ho-Hum Lake, middle	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-*	-
TMW-02	Porewater	waste rock beside Ho-Hum Lake, east end	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-*	-
TMW-03	Porewater	waste rock beside Ho-Hum Lake, west end	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-*	-
TMW-04	Groundwater	airstrip along Moose Bay	-	-	-	-	-	-	-	-	-	-	-	X	-	X*	X	-
TMW-05	Groundwater	near Camsell River dock	-	-	-	-	-	-	-	-	-	-	-	X	-	X*	X	-
TMW-06	Groundwater	near Camsell River dock	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-
TMW-07	Groundwater	near Camsell River dock	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-*	-
Norex Mine																		
Adit Drainage																		
NX-1	Surface	outflow from adit	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NX-1B	Surface	pooled water	-	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X
Waste Rock Pile Seeps																		
NX-2	Surface	waste rock pile, east seep	X	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X
NX-3	Surface	waste rock pile, west seep	X	X	X	X	X	X	-	X	-	X	X	X	X	X	X	X
Graham Vein Mine																		
NX-4	Surface	shoreline, south side of small pond hydrologically connected to Xeron Pond	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-
NX-6	Surface		-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
MX-1	Surface (A)	open water, center of small pond hydrologically connected to Xeron Pond	-	-	-	-	-	-	-	-	X	-	X	X	-	-	-	-
	Bottom (B)		-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-
MX-2	Surface	shoreline, edge of small pond hydrologically connected to Xeron Pond	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
NX-8	Surface (A)	Xeron Pond	-	-	-	-	-	X	X	X	X	-	X	-	-	-	-	-
	Bottom (B)		-	-	-	-	-	X	-	X	X	-	X	-	-	-	-	-
NX-9	Surface	Xeron Pond	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
NX-10	Surface	Xeron Pond	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
NX-5	Surface	standing water at Graham Vein	-	X	X	X	X	X	X	X	X	X	-*	-*	-*	-*	-	-
Smallwood Mine																		
Wetland																		
SM-3	Surface	Tinder Slough wetland	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Smallwood Lake																		
SM-1	Surface	shoreline, below waste rock pile, west side	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SM-2	Surface	shoreline, below waste rock pile, east side	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-
SM-5	Surface	shoreline, where path is stained with oxidation	-	-	-	-	-	X	-	-	-	-	-	X	X	X	X	X
SM-4	Surface	open water, out from waste rock pile	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-
SM-6	Surface (A)	open water, north end	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X
	Bottom (B)		-	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-
SM-7	Surface (A)	open water, south end	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X
	Middle (B)		-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X
	Bottom (C)		-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X
Northrim Mine																		
Hermandy Lake																		
NO-3	Surface	outlet	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-
NO-7	Surface (A)	southwest end	-	-	X	-	-	X	-	X	X	X	X	X	X	X	X	X
	Bottom (B)		-	-	X	-	-	X	-	X	-	-	-	-	-	-	-	-
NO-11	Surface (A)	north end, above submerged tailings	-	-	-	-	-	X	-	X	X	X	X	X	X	X	X	X
	Middle (B)		-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X
	Bottom (C)		-	-	-	-	-	X	-	X	X	X	X	X	X	X	X	X
Hermandy Lake Outlet Stream																		
NO-4/NO-8	Surface	outlet stream	X	X	X	X	-	X	-	X	X	X	-	X	-*	-	X	X
Leachate Ponds																		
NO-2	Surface	north shore	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X
Wells																		
NO-10	Porewater	tailings beach north side of Hermandy Lake	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
NRMW-1	Groundwater	adjacent to dock	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-*	-
NRMW-2	Groundwater	in front of adit	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-
Adit Drainage																		
NO-1	Surface	standing water below adit	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X
NO-9	Surface	standing water in adit	-	-	-	X	-	-*	X	X	-	X	X	-*	-*	-*	X	X
Camsell River																		
NO-5	Surface	at Northrim dock	-	X	-	-	-	-	-	-	-	-	-	X	X	X	-	-
NO-6	Surface	suspected entry point of NO-4	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Reference Waterbodies																		
R-1	Surface	Camsell River at Clut Lake outlet	X	X	-	-	-	-	X	X	X	X	X	-	X	X	X	X
R-2	Surface	Camsell River at Balachey Lake outlet	-	X	X	-	X	-	X	X	X	X	X	-	X	X	X	X
R-4	Surface	Camsell River upstream of Northrim Mine	-	-	-	-	-	-	X	X	X	X	X	-	X	X	X	X
R-3	Surface	Tuicho Lake	-	-	X	-	X	X	X	X	X	X	X	X	X	X	X	X

Notes:
[1] WRD - Water Resources Division
[2] Sampled by INAC's Water Resources Division, summarized in INAC (2005)
[3] Sampled by INAC's Water Resources Division, summarized in INAC (2006b)
[4] Sampled by INAC's Water Resources Division, summarized in INAC (2007)
[5] Sampled by INAC's Water Resources Division, summarized in INAC (2008)
[6] Based on sampling plan
X - sampled
X* - sampled for radionuclides only
X (bold) - general chemistry and/or total metals sampled in triplicate
"-" - not sampled
"-*" - not sampled because dry, water level or flow too low, no standing water outside flooded adit

Table 2.2-8
Stations Sampled During Past Monitoring Programs at Silver Bear Mines (2005-2008)

STATION	2005 June GC	TM	DM	TEH	CN	2005 July GC	TM	DM	TEH	CN	2005 August GC	TM	DM	TEH	CN	2006 June GC	TM	DM	TEH	CN	2006 July GC	TM	DM	TEH	CN	2006 August GC	TM	DM	TEH	CN	2007 June GC	TM	DM	TEH	CN	2007 July GC	TM	DM	TEH	CN	2007 August GC	TM	DM	TEH	CN	R	2008 June[1] GC	TM	DM	TEH	CN	R	2008 August[1] GC	TM	DM	TEH	CN
Terra Mine																																																									
Lake Ho-Hum Lake																																																									
T-2	X	X				X	X				X	X					X				X	X				X	X				X	X				X	X				X	X					X	X					X	X	X	X	X
Ho-Hum Lake																																																									
T-3	X	X				X	X				X	X					X				X	X					X				X	X		X		X	X	X			X	X					X	X		X			X	X		X	
T-5	X	X				X	X				X	X					X				X	X		X			X				X	X				X	X	X			X	X					X	X		X	X		X	X	X	X	X
T-9	X	X		X		X	X		X		X	X		X			X				X	X					X				X	X				X	X				X	X	X				X	X		X			X	X		X	
T-7(A)	X	X				X	X				X	X					X				X	X				X	X				X	X				X	X	X			X	X					X	X					3X	3X	3X	3X	
T-7(B)																	X				X	X					X				X	X																									
T-10(A)	X	X				X	X				X	X					X				X	X					X				X	X				X	X	X			X	X					X	X		X	X		X	X	X	X	X
T-10(B)					X					X					X					X	X	2X		2X	2X	3X	3X			X	X	X	X		X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
T-8(A)	X	X			X	X	X			X	X	X			X		X			X	X	X		X	X	3X	3X			X	X	X	X		X	X	X	X		X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X
T-8(B)	X	X			X	X	X			X	X	X			X		X			X	X	X		X	X	3X	3X			X	X	X	X		X	X	X	X		X	X	X		X	X		X	X		X	X		X	X	X	X	X
T-8(C)	X	X			X	X	X			X	X	X			X		X			X	X	X																																			
Camsell River																																																									
T-1	X	X				X	X				X	X					X				X	X					X				X	X	X			X	X	X			X	X	X				X	X	X	X			X	X	X	X	
T-4	X	X				X	X				X	X					X				X	X				X	X				X	X	X			X	X	X			X	X					X	X				X	X	X	X	X	
T-6	X	X				X	X				X	X					X				X	X					X				X	X				X	X				X	X	X				X	X					X	X		X	
T-10	X	X				X	X																				X				X	X				X	X	X			X	X					X	X					X	X		X	
T-11											X	X					X				X	X															X					X						X					X	X			
T-12	X	X				X	X																														X											X					X	X			
T-13																																					X					X						X					X	X			
HH-1																																																									
HH-2																																																									
HH-3																																															X	X					X	X		X	
On-land Water																																																									
T-17	X	X															X				X	X					X				X	X															X	X					X	X	X	X	
T-18	X	X									X	X					X				X	X					X				X	X				X	X				X	X				X	X	X	X	X		X	X	X	X	X	
T-25	X	X		X		X	X				X	X		X			X				X	X				X	X				X	X				X	X				X	X					X	X					X	X	X	X	
T-1B																																															X	X					X	X	X	X	
T-1C																	X				X	X					X					X																X						X			
T-19	X	X				X	X				X	X					X				X	X					X					X																X						X			
T-20	X	X				X	X				X	X					X				X	X					X					X																X						X			
T-21	X	X				X	X		X		X	X									X	X					X																											X			
T-22									X		X	X		X							X	X					X																														
W-4																																																									
Wells																																																									
T-14																																																		X							
T-15						X	X		X		X	X		X	X							X						X					X																	X		X			X	X	
Well #1							X		X			X										X					X						X																								
Well #2												X										X						X					X																	X							
Well #3																																	X																								
TMW-01																																	X																								
TMW-02																																	X														X			X					X		
TMW-03																																	X														X			X		X			X		
TMW-04																																	X																	X					X		
TMW-05																																	X																								
TMW-06																																	X																								
TMW-07																																																									
Norex Mine																																																									
Adit Drainage																																																									
NX-1	X	X		X		X	X				X	X					X		X		X	X					X				X	X				X	X				X	X				X	X	X	X	X		X	X	X	X	X	
NX-1B	X	X		X		X	X				X	X					X		X		X	X					X				X	X				X	X				X	X											X	X	X	X	
Waste Rock Pile Seeps																																																									
NX-2	X	X		X		X	X				X	X					X		X		X	X				X	X				X	X				X	X				X	X					X	X					X	X	X	X	
NX-3	X	X		X		X	X				X	X					X		X		X	X					X				X	X				X	X				X	X					X	X					X	X	X	X	
Graham Vein Mine																																																									
NX-4																	X				X	X				X	X																														
NX-6																										X	X				X	X																									
MX-1(A)																	X										X																														
MX-1(B)																	X										X																														
MX-2																	X				X	X				X	X																														
NX-8(A)	X	X				X	X				X	X					X									X	X																														
NX-8(B)	X	X									X	X					X										X																														
NX-9																											X																														
NX-10																	X				X	X																																			
NX-5	X	X				X	X				X	X																																													
Smallwood Mine																																																									
Wetland																																																									
SM-3																																															X	X					X	X		X	
Smallwood Lake																																																									
SM-1	X	X				X	X				X	X					X				X	X					X				X	X				X	X				X			X			X	X					3X	3X	3X	3X	
SM-2																															X	X				X	X				X			X			X	X									
SM-5	X	X																																		X	X				X			X			X	X					X	X		X	
SM-4																	X				X	X					X				3X	3X				X	X				X			X			X	X									
SM-6(A)	X	X				X	X				X	X																			X	X														X	X	X					X	X	X	X	
SM-6(B)	X	X				X	X				X	X					X				X	X				X	X				X	X				X	X	X			X												X	X	X	X	
SM-7(A)	X	X				X	X				X	X									X	X					X				X	X				X	X	X			X												X	X	X	X	
SM-7(B)	X	X				X	X				X	X									X	X					X				X	X				X	X	X			X						X	X									
SM-7(C)	X	X				X	X				X	X																																													
Northrim Mine																																																									
Hermandy Lake																																																									
NO-3																					X	X					X				X	X				X	X	X			X	X					X	X					X	X		X	
NO-7(A)	X	X				X	X				X	X					X				X	X																			3X	3X		X		X	X	X	X			X	X	X	X	X	
NO-7(B)	X	X															X				X	X				X	X				X	X	X			X	X	X			X	X											X	X	X	X	
NO-11(A)	X	X				X	X				X	X					X																			X	X	X			X	X					X	X					X	X	X	X	
NO-11(B)																					X	X				X	X				X	X	X			X	X	X			X	X															
NO-11(C)	X	X				X	X				X	X					X																																								
Hermandy Lake Outlet Stream																																																									
NO-4/NO-8	X	X									X	X					X				X	X		X							X	X															X	X				X	X	X	X	X	X
Leachate Ponds																																																									
NO-2	X	X									X	X					X				X	X					X									X	X				X	X					X	X									
Wells																																																									
NO-10																																			X																	X					
NRMW-1																																			X																						
NRMW-2																																																									
Adit Drainage																																																									
NO-1	X	X				X	X				X	X					X				X	X					X				X	X				X	X				X	X			X		X		X			X	X	X		X	
NO-9						X	X				X	X									X	X					X																					X						X			
Camsell River																																																									
NO-5																															X	X		X		X	X				X	X		X			X	X	X	X			X	X	X	X	
NO-6	X	X				X	X				X	X					X				X	X				X	X		X		X	X		X		X	X				X	X															
Reference Waterbodies																																																									
R-1	X	X				X	X				X	X					X				X	X				X	X				X	X				X	X	X			X	X	X	X		X	X	X		X			X	X	X	X	
R-2	X	X				X	X				X	X					X				X	X				X	X				X	X				X	X	X			X	X					X	X					X	X	X	X	
R-4						X	X				X	X					X				X	X				X	X				X	X				X	X	X			X	X					X	X					X	X	X	X	
R-3	X	X				X	X				X	X					X				X	X				X	X				X	X				X	X	X			X	X	X	X		X	X	X		X		X	X	X	X	X	

Notes:
[1] Based on proposed sampling plan
GC - general chemistry, includes routine parameters and nutrients
TM - total metals
DM - dissolved metals including mercury
TEH - total extractable hydrocarbons
CN - may include cyanide (total, WAD, and/or SAD) and/or thiocyanate
R - radionuclides
X (bold) - indicates that a replicate sample was taken
Field measurements were typically taken at stations where more than one depth was sampled; measurements were taken at 1-m intervals to obtain depth profiles

Table 2.2-9
Analytes Measured During Past Monitoring Programs at Silver Bear Mines (2002-2008)

SAMPLE TYPE	WRD [1] 2002-2008
Field Measurements [2]	temperature, pH, dissolved oxygen, turbidity, specific conductivity
General Chemistry (Physicals, Major Ions, & Nutrients)	alkalinity, conductivity, colour [6], pH, turbidity, total dissolved soilds, total suspended solids calcium, chloride, total hardness, magnesium, potassium, sodium, sulphate, sulphide ammonia, ortho-phosphate, dissolved phosphorous, total phosphorous, nitrate+nitrite, nitrate, nitrite, total organic carbon, dissolved organic carbon, reactive silica [7]
Organics [3]	benzene [8], ethylbenzene [8], toluene [8], m/p/o-xylene [8], total purgeable hydrocarbons [8] total extractable hydrocarbons, total cyanide, WAD cyanide, thiocyanate
Total & Dissolved [4] Metals	aluminum, antimony, arsenic, barium, beryllium, cadmium, cesium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, rubidium, selenium, silver, strontium, thallium, tin, titanium, uranium, vanadium, zinc
Radionuclides [5]	lead-210 [9], radium-226 [9] **Full suite** [10]: actinium-228, bismuth-212, bismuth-214, lead-210, lead-211, lead-212, lead-214, polonium-210, potassium-40, radium-223, radium-226, radium-228, radon-219, thallium-208, thorium-227, thorium-228, thorium-230, thorium-232, thorium-234, uranium-235

Notes:
[1] WRD - Water Resources Division.
[2] Field measurements were only taken for depth profiles.
[3] Organics were only sampled at a few stations during each sampling period.
[4] Samples for dissolved metals were collected from 2002 to 2004 at most stations and at select stations in 2007 (T-8A,B,C; T3; T5; T7; T16).
[5] Samples for radionuclides were collected in August 2007 only with at least one sample from each mine site (T-6; T-8A,B,C; T-16; T-18; TMW-04; TMW-05; Norex-1; SM-7; NO-1; NP-11A; R-1; R-3).
[6] Colour was only determined in June 2003.
[7] Sampled in 2007 only.
[8] Samples for BTEX and total purgeable hydrocarbons were only collected from 2002 to 2004.
[9] Sampled at all stations listed under note 4.
[10] Sampled at T-8A, T-8B and T-8C only.

SAMPLE ONLY

Project Quality Notes

Project: 34336-86 Contact Lake, El Bonanza and Silver Bear Mines - Long-term and Construction Monitoring (INAC)

Note: EACH worksheet, excluding outputs generated or transferred from a computer model, must be clearly identified on the sheet itself as to what the worksheet is being used for.
Identification can be through either a comment line or through a Table Title.. I

Prepared:
By: HM
Date: 27-Oct-08

Initial Review:
By:
Date:

Worksheets Reviewed

	Comments Provided	
	Yes	*No*
CL Stations (1992)		
CL Stations (2002-08)		
CL Samples (2002-08)		
CL Analytes (2002-08)		
ELB Stations (2006-08)		
ELB Samples (2006-08)		
SB Stations (2002-08)		
SB Analytes (2002-08)		

Review Comments: Comments are provided in individual tabs

Revised:
By:
Date:

Revisions made:

Final Review
By:
Date:

Review Comments

34336-86 GBL Long-Term Monitoring Tables for Section 2

QAQC Notes

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