steer environmental
associates ltd.

PRELIMINARY QUANTITATIVE RISK ASSESSMENT

TIN CAN HILL

YELLOWKNIFE, NT

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EXECUTIVE SUMMARY

This report presents the findings of a Preliminary Quantitative Risk Assessment (PQRA) prepared by Steer Environmental Associates Ltd. (SEA) on behalf of Associated Environmental and the Government of the Northwest Territories for a property known as Tin Can Hill, located in Yellowknife, NT (the Site). The PQRA was conducted to determine if contamination identified in Site media poses an unacceptable risk to human health or the environment. It is understood that the results of the PQRA will be used in decision making related to the construction of a polytechnic university on the Site.

Human Health Risks

Based on the available data, arsenic in soil at the Site poses an unacceptable health risk to residents of a future university as well as regular (>3 days per week) toddler-aged (<5 years old) patrons of a university daycare. Contaminants in soil do not pose an unacceptable health risk to non-resident university students, faculty, staff, or full-time child-aged (>5 years old) university daycare patrons. These findings are based on soil data collected from the proposed university footprint.

Contaminants in soil do not pose an unacceptable health risk to members of the general public that periodically (no more than 2 days per week) use the Site for recreational purposes. This finding is based on data collected from soils across the Site, including the Old Mine Road.

The uncertainty in these findings is moderate for the COPCs identified in Site soil with a high likelihood that risks have been overestimated.

Ecological Risks

A potential risk to soil invertebrate and plant communities, insectivorous mammal and bird populations, including insectivorous listed mammal and bird species, was identified based on the available data. There is moderate to high uncertainty in this finding given that risk estimates were modelled based solely on soil chemistry, which is likely to have resulted in risks being overestimated.

Recommendations

Remediation and risk management options to mitigate risks identified for university residents and toddler-aged university daycare patrons should be considered. Characterization of soil quality within the section of the Old Mine Road that crosses the proposed university footprint is recommended to confirm human health risk estimates for people that will spend time at the university.

Additional data collection (e.g., soil invertebrate and plant tissue chemistry) is recommended to refine the risk estimates presented for soil invertebrates, plants, and wildlife.

The preliminary HHRA and ERA were limited to exposures to contaminants in Site soil. The degree to which contact with other media at the Site (e.g., seasonal surface water, plant tissues, wildlife tissues, vapours) could contribute to contaminant exposures by people, plants and animals should be investigated with findings incorporated into the PQRA.

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1 INTRODUCTION

This report presents the findings of a Preliminary Quantitative Risk Assessment (PQRA) prepared by Steer Environmental Associates Ltd. (SEA) on behalf of Associated Environmental (Associated) and the Government of Northwest Territories (GNWT) for a property known as Tin Can Hill, located in Yellowknife, NT (the Site). The PQRA was conducted to determine if contamination identified in Site media (i.e., soil, water) poses an unacceptable risk to human health or the environment. It is understood that the results of the PQRA will be used in decision making related to the construction of a polytechnic university on the Site.

1.1 Site History

According to Associated (2023a), the Site was largely undeveloped, forested and used for recreational purposes circa 1937, the earliest records reviewed. The existing road (Old Mine Road ("OMR")) that runs along the Site's west boundary and transecting the northwest portion of the Site was constructed between 1937 and 1946 to provide access to the former Con Mine. With the exception of the OMR, the remainder of the Site is currently undeveloped greenspace with hiking trails used by the public for recreation activities. Surrounding lands were undeveloped and forested until the 1930s. The former Con Mine opened in 1938 adjacent the Site to the south and operated until 2003. The City of Yellowknife water treatment plant was constructed north of the Site in recent years.

1.2 Previous Environmental Site Assessments

The following Environmental Site Assessment (ESA) reports were prepared recently by Associated:

- Associated, 2023a. *Advanced Phase I Environmental Site Assessment, Tin Can Hill, Yellowknife, NT.* Prepared for the Government of Northwest Territories by Associated Environmental. Dated March 2023.
- Associated, 2023b. *Phase II Environmental Site Assessment, Tin Can Hill, Yellowknife, NT (DRAFT).* Prepared for the Government of Northwest Territories by Associated Environmental. Dated January 2024.

The key findings of these assessments are summarized in the following sections.

1.2.1 Advanced Phase I Environmental Site Assessment (Associated, 2023a)

Associated conducted an Advanced Phase I ESA to identify current or historical activities at the Site and on surrounding properties that could have resulted in the chemical contamination of Site media. The Phase I ESA considered the results of a Site inspection, a drone survey, interviews, reviews of historical records regarding past uses and activities on the Site and surrounding properties, and reviews of previous investigation and remediation reports. The Phase I ESA concluded there to be moderate potential for the following Areas of Potential Environmental Concern (APECs) to have resulted in contamination in Site media:

- Dust emissions from former off-Site mines;
- Possible mine waste material used to construct the OMR; and,
- Waste present across the Site.

Associated (2023a) recommended that a Phase II ESA be conducted to assess soil and water quality at the Site.

1.2.2 Phase II Environmental Site Assessment (Associated, 2023b)

Associated's (2023b) Phase II/III[1] ESA documents the work conducted to quantitatively assess the level of contamination at the Site, based on the APECs identified by the Advanced Phase I ESA. The Phase II/III ESA was also conducted to support the present PQRA and a remedial options evaluation for the Site. The scope of the Phase II/III ESA consisted of the following:

- Collection of soil samples at 37 locations across the Site from surface to 0.5m below ground surface (mbgs) for laboratory analysis of potential contaminants of concern (PCOCs);
- Laboratory analysis of 10 soil samples for arsenic and lead bioaccessibility;
- Collection of five soil and/or gravel samples along the OMR from surface to 0.5 mbgs for laboratory analysis of PCOCs;
- Collection of one surface water sample from both Rat Lake and Great Slave Lake for laboratory analysis of PCOCs;
- Comparison of soil and water analytical data to applicable guidelines; and,
- Documentation of ESA findings in a report.

[1] The report title indicates a Phase II ESA while the body of the report refers to a Phase II/III ESA. The report is referred to as a Phase II/III herein.

The key findings of the Phase II ESA are described in the following sections.

1.2.2.1 Applicable Guidelines

Associated compared soil analytical results to the residential/parkland (RL/PL) guidelines of The Environmental Guideline for Contaminated Site Remediation (EGCSR, 2003), including the 2023 draft updated guidelines. The most stringent guidelines among those available for the following exposure pathways were applied:

- Ingestion and dermal contact of soils;
- Vapour inhalation (indoor);
- Protection of potable groundwater;
- Protection of groundwater for aquatic life;
- Nutrient cycling; and
- Ecological soil contact.

Given the presence of naturally elevated arsenic concentrations in soils within the Yellowknife area, the remediation objective established for arsenic for residential land use by the EGCSR (160 mg/kg; 120 mg/kg in 2023 draft update) was applied rather than the default EGCSR guideline.

In the absence of GNWT guidelines for surface water, Associated compared surface water analytical results to the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2023).

1.2.2.2 Contamination

Contaminants identified in Site soil and nearby surface water in Rat Lake and Great Slave Lake, located off-Site to the west and east, respectively, are identified below in Tables 1-1 and 1-2. Figures showing sample locations and analytical results are provided in Appendix A. Analytical tables are presented in Appendix B.

Table 1-1 Summary of On-Site Soil Contamination

Contaminants	Maximum Concentration (mg/kg)
Antimony	36
Arsenic	1,850
Barium	2,770
Boron	32.5
Cobalt	40.6
Copper	145

Contaminants	Maximum Concentration (mg/kg)
Selenium	3.23
Vanadium	55.1
Zinc	768

Notes:
mg/kg = milligrams per kilogram

Table 1-2 Summary of Off-Site Surface Water Contamination

Contaminants	Maximum Concentration (mg/L)
Aluminum	0.783
Arsenic	0.401
Chromium	0.00414
Copper	0.041
Fluoride	0.228
Iron	1.28
Lead	0.00784
Zinc	0.0224

Notes:
mg/L = milligrams per litre

Other key findings of the Phase II/III ESA are as follows:

- Ten of 37 soil samples and four of five OMR soil samples contained arsenic at concentrations exceeding the 2023 Draft EGCSR RL background concentration (120 mg/kg). Elevated arsenic concentrations were identified primarily along the perimeter of the Site with highest concentrations detected on the southwestern portion of the Site. Elevated arsenic concentrations in Site soils were primarily comprised by arsenic (V).
- Up to 17 of 37 soil samples contained other metals (antimony, barium, boron, cobalt, copper, selenium, vanadium, zinc) at concentrations exceeding the 2023 Draft EGCSR guidelines with elevated concentrations distributed across the Site. With the exception of vanadium and arsenic, metals did not exceed guidelines in soils of the OMR.
- Total metals concentrations in surface water exceeding applicable guidelines were identified in Rat Lake (aluminum, arsenic, chromium, copper, fluoride, iron, lead and zinc) and Great Slave Lake (chromium only).
- Dissolved metals concentrations exceeding applicable guidelines were limited to arsenic in Rat Lake.
- Concentrations of other PCOCs were less than applicable guidelines in on-Site soil and off-Site surface water in the samples collected.

1.3 Risk Assessment Approach

The potential for human health or ecological risk to exist from chemicals in the environment is predicated on the co-existence of three elements: 1) chemicals must be present at hazardous

levels, 2) receptors must be present, and 3) exposure pathways must exist between the source of the chemicals and receptors. In the absence of any one of the three components, human health and/or environmental risks do not exist. The presence of all three elements indicates a potential for risk but does not indicate the magnitude of risk. A risk assessment is conducted to determine the magnitude of risk and whether the risk is acceptable or unacceptable.

The risk assessment framework applied herein is consistent with Canadian federal guidance and consists of four steps: 1) Problem Formulation; 2) Exposure Assessment, 3) Effects Assessment, and 4) Risk Characterization. In the Problem Formulation step, a conceptual exposure model is developed which describes the contaminants of potential concern, the human and ecological receptors, and potentially complete exposure pathways between the contaminants and receptors. In Exposure Assessment, the frequency, magnitude and duration of contaminant exposure is estimated for each receptor. In Effects Assessment, the adverse effects that exposures to the contaminants could cause in the receptors are identified, and toxicity reference values are selected. During the Risk Characterization phase, the results of the Exposure and Effects Assessments are integrated and interpreted into descriptions of human health and ecological risk.

The primary guidance documents used to conduct the PQRA were:

- Federal Contaminated Site Risk Assessment in Canada: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Version 3.0. (Health Canada, 2021a).
- Federal Contaminated Site Risk Assessment in Canada: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors. Version 3.0. (Health Canada, 2021b).
- Ecological Risk Assessment Guidance Document (CCME, 2020).
- FCSAP Ecological Risk Assessment Guidance (Government of Canada, 2012).

The PQRA focusses on the risks posed by the contaminants identified in Site soil only. Risks associated with the contaminants identified in Rat Lake and Great Slave Lake surface water were not assessed because these water bodies are located off-Site and, according to Associated (2023b), the surface water contamination identified is unlikely to be related to Site activities. Consequently, Site soil quality is more relevant to decision making related to the construction of a polytechnic university on the Site.

When data permitted, analysis that would be more accurately characterized as Detailed Quantitative Risk Assessment was incorporated into the PQRA. For example, the available

arsenic bioaccessibility data for Site soils was incorporated into the human health risk assessment. Similarly, professional judgement was used in assumptions regarding human exposure times, frequencies, and durations that in some cases deviated from default Health Canada (2021) PQRA guidance.

The findings of the Phase I ESA and Phase II/III ESA prepared by Associated was the primary basis for the PQRA.

1.4 Report Organization

The remainder of this PQRA report consists of the following sections:

- Problem Formulation (Section 2)
- Preliminary Human Health Risk Assessment (Section 3)
- Preliminary Ecological Risk Assessment (Section 4)
- Conclusions and Recommendations (Section 5)
- Statement of Limitations (Section 6)
- Professional Statement (Section 7)
- References (Section 8)

2 PROBLEM FORMULATION

Problem formulation is the scoping phase of the PQRA where the conceptual exposure model is developed. The problem formulation consists of the following components:

- Exposure Setting (Section 2.1)
- Contaminants of Potential Concern (Section 2.2)
- Receptors and Exposure Pathways (Section 2.3)
- Study Endpoints (Section 2.4)

2.1 Exposure Setting

This section describes Site characteristics that influence how human and ecological receptors may contact the contamination identified in Site soil. The Advanced Phase I ESA and Phase II ESA reports completed by Associated were relied upon for information presented in this section.

2.1.1 Site Description

Basic Site information is presented in Table 2-1.

Table 2-1 Basic Site Information

Civic Address	Tin Can Hill, Yellowknife, NT
Legal Land Description	Lot 10, Block 203, Plan 4460
Site Area	325,079 m^{2*}
Owner	City of Yellowknife

Notes:
This area was presented in the Advanced Phase I ESA report and comprises a different Site footprint than that presented in the Phase II/III ESA report. The PQRA was conducted based on the Site boundaries presented in the Phase II/III ESA report.

The Site is predominantly undeveloped, vegetated and used by the public for recreational purposes including walking and cross-country skiing. Cleared dirt trails and a constructed boardwalk trail are present over boggy/marshy areas on the southwest portion of the Site. A dirt roadway (the OMR) crosses the northwestern portion of the Site and runs along the Site's western perimeter. Aerial photographs of the Site are provided in Appendix A.

The concept plan for the polytechnic university development (see Appendix C) under consideration shows the university located in the northern portion of the Site with the following elements:

- Natural areas;
- Developed areas for residential use, academic use, light industrial use, parking and roadways;

and,

- Walking trails accessible by the public

The southern portion of the Site is to be maintained in its current state and reserved for university expansion in the future.

2.1.2 Surrounding Lands

Properties surrounding the Site are predominantly residential and commercial, with recreational areas (e.g. trails, parks) also present to the north, south, southwest, and west of the Site. The City of Yellowknife water treatment plant borders the Site to the north.

2.1.3 Topography and Surficial Geology.

The Site slopes to the south, southeast, and west. Surficial geology at the Site is characterized by rock outcrops and soils, where present, was observed to be limited in thickness. Soil was observed to consist of peat, predominantly mineral soil, and mixtures of peat and silt. The OMR was observed to consist of imported sand and gravel.

2.1.4 Hydrogeology

Based on regional topography, groundwater beneath the Site is inferred to flow in a general southeasterly direction, toward Great Slave Lake.

2.1.5 Local Drinking Water Supply

The drinking water supply for the residents of Yellowknife is sourced mainly from the Yellowknife River. Some residents may also obtain water from other lakes in the area (Kam Lake, Frame Lake, Rat Lake, Peg Lake, meg Lake, Jackfish Lake, Fox Lake, Handle Lake, Gar Lake, David Lake, as well as others) for personal use (GNWT, 2019).

2.1.6 Climate

The Site is located approximately 400km south of the Arctic circle, within the continental sub-Arctic climate. The continental sub-Arctic climate is characterized by long, cold winters and short, cool summers. Climate data recorded at the Yellowknife Airport between 2013 and 2022 indicate temperatures ranging from -30°C (daily minimum) in January to 22°C in July (daily maximum). The mean annual precipitation recorded is 288.6 mm, with 170.7 mm failing as rain and the remainder falling as snow.

2.1.7 Ecology

The Site is located within the Great Slave Lowland portion of the Taiga Shield High-Boreal (HB) ecoregion, a low-elevation nearly level bedrock plain with silty discontinuous till and lacustrine deposits between outcrops and a diverse array of forest types and wetlands. This portion of the HB ecoregion occupies the low-elevation terrain adjacent to the north arm of Great Slave Lake. Forests in the region, typically consisting of jack pine, aspen, white spruce and birch, are discontinuous and occur between or on rock outcrops where there is a sufficiently thick mineral or organic substrate (GNWT, 2008).

Marsh and boggy areas are present on the southwest portion of the Site. Surface water bodies proximate to the Site include Rat Lake and Great Slave Lake. Rat Lake is located approximately 170m to the west of and hydraulically upgradient from the Site. Great Slave Lake borders the Site to the east and is inferred to be hydraulically downgradient.

2.2 Contaminants of Potential Concern

To identify contaminants of potential concern (COPCs) to human and ecological health, the maximum concentrations of contaminants identified in soil in Table 1-1 were compared with receptor-specific screening levels, as described in the following sections.

2.2.1 Soil

2.2.1.1 Human Health

COPCs to human health in Site soil were identified by comparing contaminant concentration with the following screening levels relevant to human health protection:

- GNWT, 2023 Draft 2023 Environmental Guideline for Contaminated Site Remediation Tier 2 Pathway Specific Soil Criteria for Residential Land Use – Human Health (Soil Contact/Ingestion)

Various concentration statistics for the soil contaminants are compared with these screening levels in Table 2-2.

Table 2-2 Screening for COPCs in Soil – Human Health

Contaminant	95% UCLM Concentration (mg/kg)	90th Percentile Concentration (mg/kg)	Maximum Concentration (mg/kg)	Human Health Screening (mg/kg)
Antimony	***10.8***	***16.8***	***36***	7.5
Arsenic	***313***	***468***	***1850***	31
Barium	147	172	2770	10000
Boron	11.6	22.5	32.5	7500
Cobalt	9.2	13.2	***40.6***	25
Copper	40.3	65	145	1100
Selenium	0.74	1.3	3.23	80
Vanadium	22.4	44	55.1	200
Zinc	66.4	76	768	10000

Notes:
mg/kg = milligrams per kilogram; 95% UCLM = 95th percent upper confidence limit of the mean
***Bold**: concentration exceeds screening level*

Antimony and arsenic were retained as COPCs to human health in soil since 95% UCLM, 90th percentile and maximum concentrations exceeded screening levels relevant to human health protection.

The maximum concentration of cobalt exceeded the screening level but was not retained as a COPC to human health in soil since 95% UCLM and 90th percentile concentrations were less than the screening level, indicating few screening level exceedances of relatively low magnitude.

The remaining soil contaminants were not retained as COPCs to human health since their maximum concentrations do not exceed the screening level.

2.2.1.2 Soil Invertebrates and Plants

COPCs to soil invertebrates and plants in soil were contaminants with concentrations exceeding the following screening levels:

- GNWT, 2023 Draft 2023 Environmental Guideline for Contaminated Site Remediation Tier 2 Pathway Specific Soil Criteria for Residential Land Use – Ecological Health (Direct Soil Contact – Protection of Soil Invertebrates and Plants)

Various concentration statistics for the soil contaminants are compared with these screening levels in Table 2-3.

Table 2-3 Screening for COPCs in Soil – Soil Invertebrates and Plants

Contaminant	95% UCLM Concentration (mg/kg)	90th Percentile Concentration (mg/kg)	Maximum Concentration (mg/kg)	Soil Invertebrate / Plant Screening (mg/kg)
Antimony	10.8	16.8	***36***	20

Contaminant	95% UCLM Concentration (mg/kg)	90th Percentile Concentration (mg/kg)	Maximum Concentration (mg/kg)	Soil Invertebrate / Plant Screening (mg/kg)
Arsenic	***313***	***468***	***1850***	17
Barium	147	172	2770	200000
Boron	***11.6***	***22.5***	***32.5***	3.3
Cobalt	9.2	13.2	***40.6***	20
Copper	40.3	***65***	***145***	63
Selenium	0.74	***1.3***	***3.23***	1
Vanadium	22.4	44	55.1	130
Zinc	66.4	76	***768***	250

Notes:
mg/kg = milligrams per kilogram; 95% UCLM = 95th percent upper confidence limit of the mean
***Bold**: concentration exceeds screening level*

Arsenic, boron, copper, and selenium were retained as COPCs to soil invertebrate and plants in soil since 90th percentile and maximum concentrations exceeded screening levels relevant to soil invertebrate and plant protection.

The maximum concentrations of antimony, cobalt and zinc exceeded the screening levels but were not retained as COPCs to soil invertebrates and plants in soil since 95% UCLM and 90th percentile concentrations were less than screening levels, indicating few screening level exceedances of relatively low magnitude.

The remaining soil contaminants were not retained as COPCs to soil invertebrates and plants since their maximum concentrations do not exceed screening levels.

2.2.1.3 Wildlife

COPCs to wildlife in soil were contaminants with concentrations exceeding the following screening levels:

- GNWT, 2023 Draft 2023 Environmental Guideline for Contaminated Site Remediation Tier 2 Pathway Specific Soil Criteria for Residential Land Use – Ecological Health (Soil and Food Ingestion – Protection of Wildlife (Birds and Mammals))

Various concentration statistics of the soil contaminants are compared with these screening levels in Table 2-4.

Table 2-4 Screening for COPCs in Soil – Wildlife

Contaminant	95% UCLM Concentration (mg/kg)	90th Percentile Concentration (mg/kg)	Maximum Concentration (mg/kg)	Wildlife Screening (mg/kg)
Antimony	10.8	16.8	***36***	25

Contaminant	95% UCLM Concentration (mg/kg)	90th Percentile Concentration (mg/kg)	Maximum Concentration (mg/kg)	Wildlife Screening (mg/kg)
Arsenic	313	***468***	***1850***	380
Barium	147	172	**2770**	390
Boron	11.6	22.5	32.5	NV
Cobalt	9.2	13.2	40.6	180
Copper	40.3	65	145	300
Selenium	0.74	1.3	3.23	4.5
Vanadium	***22.4***	***44***	***55.1***	18
Zinc	66.4	76	768	960

Notes:
mg/kg = milligrams per kilogram; NV = no value; 95% UCLM = 95th percent upper confidence limit of the mean
***Bold**: concentration exceeds screening level*

Arsenic and vanadium were retained as COPCs to wildlife in soil since 90th percentile and maximum concentrations exceeded screening levels relevant to wildlife protection.

The maximum concentrations of antimony and barium exceeded the screening levels but were not retained as COPCs to wildlife since 95% UCLM and 90th percentile concentrations were less than screening levels, indicating few screening level exceedances of relatively low magnitude.

The remaining soil contaminants were not retained as COPCs to wildlife since their maximum concentrations do not exceed screening levels.

2.3 Receptors and Exposure Pathways

This section identifies the human and ecological receptors of potential concern (ROPCs) for the Site and the exposure pathways through which they could be exposed to the COPCs, under current and anticipated future uses and conditions.

2.3.1 Human

The Site is currently vacant, open to public access and used for recreational purposes (e.g., walking, cross-country skiing). The general public are ROPCs for the current scenario. Following redevelopment of the Site as a university, human ROPCs include students, faculty, residents, visitors, and workers. Construction workers are ROPCs during the construction of the university.

Under both the current and future scenarios, human ROPCs could be exposed to the COPCs in soil (antimony, arsenic) by incidental soil ingestion, dermal contact, and dust inhalation. It is unknown whether people obtain and consume vegetation or wildlife from the Site and therefore these exposure pathways were not assessed. A conceptual exposure model (CEM) summarizing the potential for interaction between the COPCs identified in Site soil by human ROPCs is

presented below in Figure A.

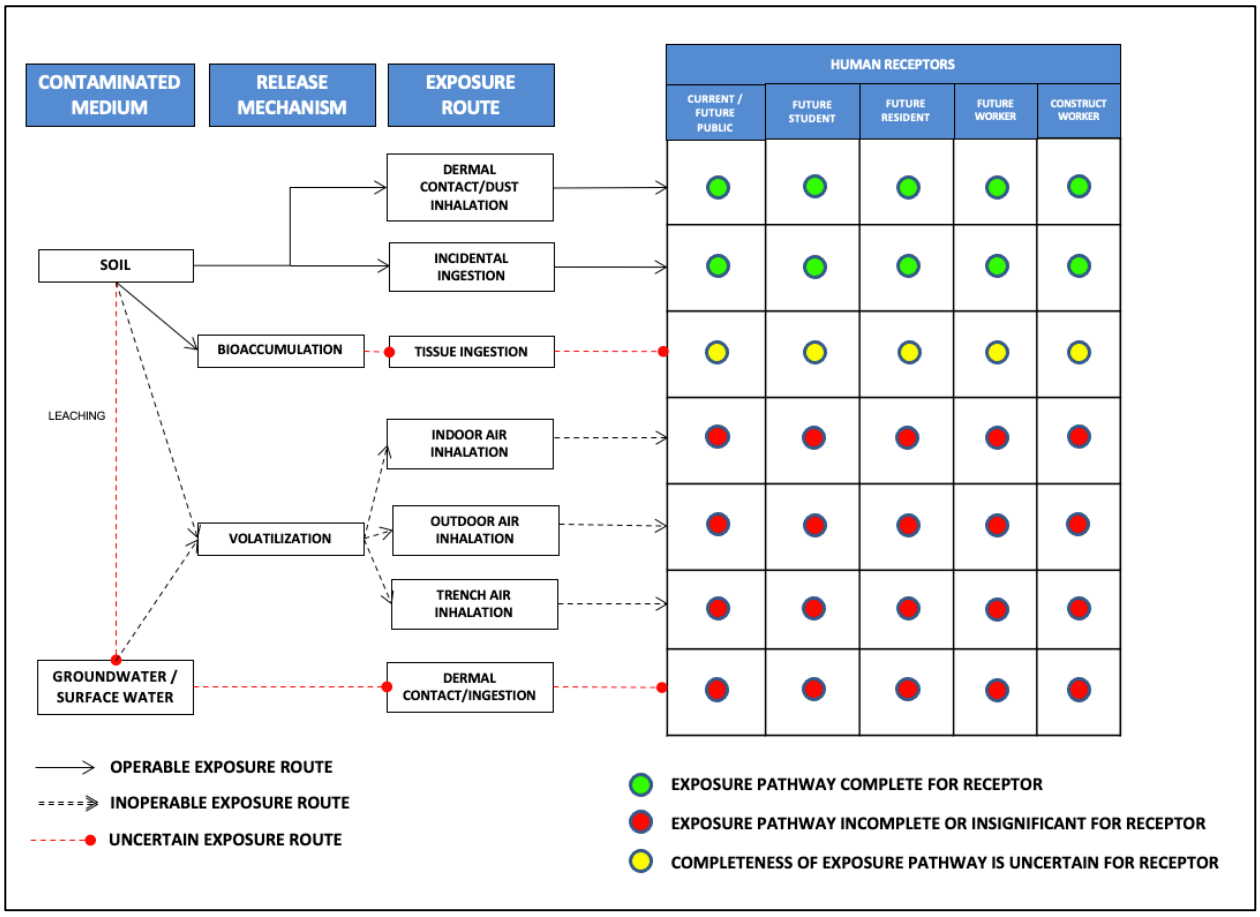

Figure A Conceptual Exposure Model – Human

2.3.2 Ecological

Mammals of the Taiga Shield HB Ecoregion include barren-ground caribou[2], woodland caribou, wood bison, moose, muskoxen, black bear, grizzly bear, lynx, timber wolf, tundra wolf, coyote, red fox, Arctic fox, marten, mink, otter, wolverine, least weasel, short-tailed weasel, striped skunk, beaver, muskrat, porcupine, red squirrel, northern flying squirrel, arctic ground squirrel, deer mouse, meadow jumping mouse, meadow vole, heather vole, taiga vole, northern red-backed vole, southern red-backed vole, northern bog lemming, showshoe hare, masked shrew, water shrew, Arctic shrew, pygmy shrew, dusky shrew, hoary bat[3], little brown bat[3], big brown bat, northern long-eared bat (GNWT, 2008).

Birds of the Taiga Shield HB Ecoregion include osprey, bald eagle, northern goshawk, sharp-

[2] Species listed as Threatened, Special Concern, Endangered or Under Consideration by Northwest Territories, COSEWIC or Species at Risk Act.

shinned hawk, red-tailed hawk, American kestrel, merlin, northern harrier, rough-legged hawk, gyrfalcon, snowy owl, boreal owl, northern hawk owl, sandhill crane, sora rail, American coot, American bittern, red-winged blackbird, loon, Harlequin duck, tundra swan, upland sandpiper, short-billed dowitcher, Wilson's phalarope, marbled godwit, willet, American avocet, semipalmated plover, killdeer, lesser yellowlegs[3], spotted sandpiper, least sandpiper, common snipe, red-necked phalaropes[3], new gull, California gull, herring gull, common tern, Arctic tern, Caspian tern, spruce grouse, yellow-bellied flycatcher, boreal chickadee, Swainson's thrush, magnolia warbler, Tennessee warbler, purple finch, pine grosbeak, red-winged crossbill, white-winged cross-bill, western tanager, flycatchers, vireos, horned grebe[3], common nighthawk[3], short-eared owl[3], alder flycatcher, common yellowthroat, swamp sparrow, palm warbler, yellow-rumped warbler, yellow warbler, rusty blackbird[3], chipping sparrow, northern waterthrush, willow ptarmigan, common goldeneye, common merganser, bufflehead, sharp-tailed grouse, northern flicker, olive-sided flycatcher[3], hermit thrush, savannah sparrow, three-toed woodpecker, black-beaked woodpecker, American robin, Canada jay, white-crowned sparrow, common redpoll, common raven, black-billed magpie, house sparrow, barn swallow[3], bank swallow[3].

Other listed species with geographical distributions that may overlap with the Site are provided in Appendix C and include eastern red bat, evening grosbeak, Harris' sparrow, yellow rail, transverse lady beetle, and yellow-banded bumble bee.

Terrestrial invertebrates and vegetation at the Site could be exposed to COPCs in soil (arsenic, boron, copper and selenium) by direct contact. Predatory invertebrates could also be exposed through the consumption of other invertebrates.

Birds and mammals could be exposed to COPCs in soil (arsenic and vanadium) through the ingestion of vegetation, prey (invertebrates, other vertebrates) and through the incidental or purposeful ingestion of soil.

A conceptual exposure model (CEM) summarizing the potential for interaction between the COPCs identified in Site soil by ecological ROPCs is presented below in Figure B.

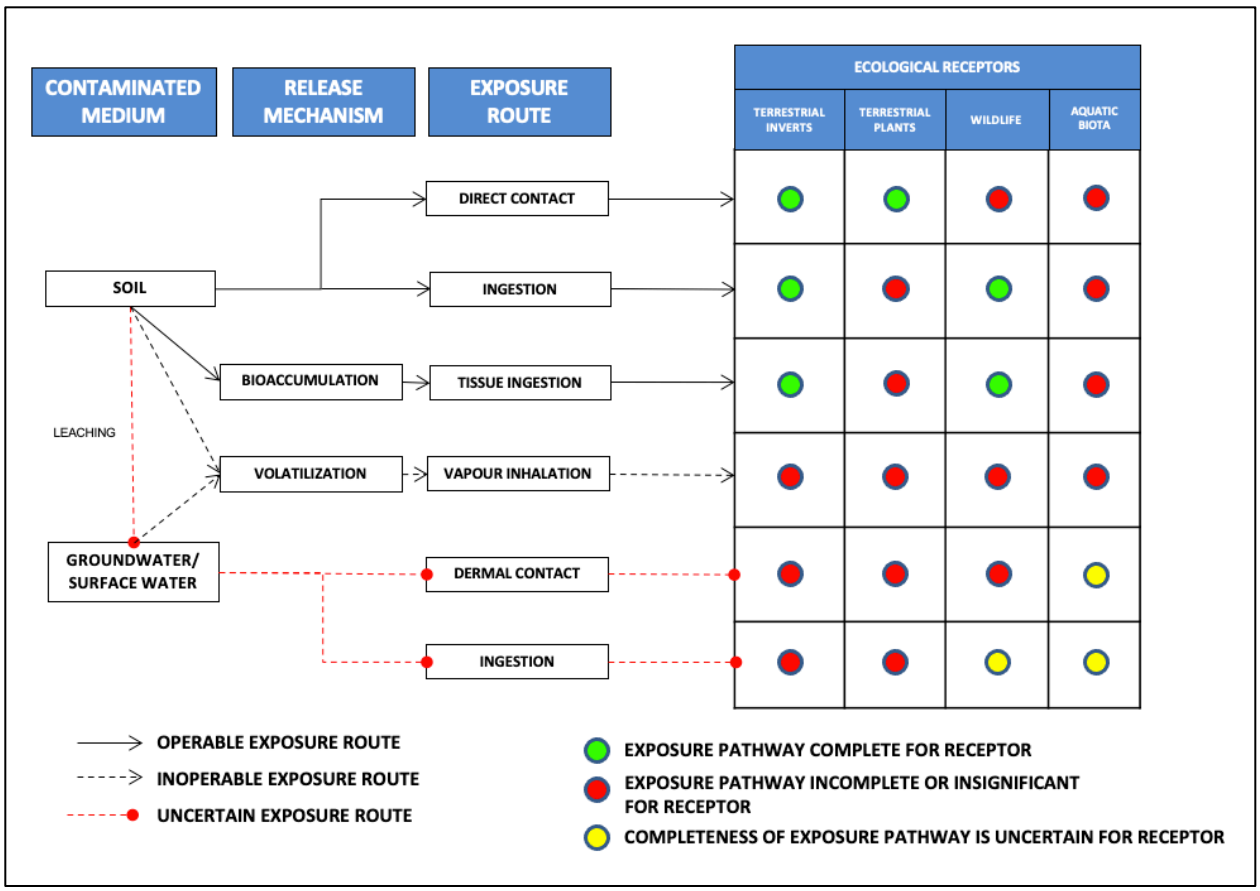

Figure B Conceptual Exposure Model – Ecological

2.4 Study Endpoints

2.4.1 Assessment Endpoints

Assessment endpoints are explicit expressions of values to be protected at a contaminated site. The assessment endpoints employed for this PQRA are as follows:

- Health of people that use the Site;
- Abundance of common wildlife populations that use the Site;
- Survival, growth and reproductive output of listed wildlife species that use the Site; and,
- Abundance and diversity of invertebrate and plant communities present on the Site.

2.4.2 Measures of Exposure and Effect

Measures were employed in the PQRA to estimate human and ecological exposures (“Measures of Exposure”) and to determine the nature and potential magnitude of adverse effects (“Measures of Effect”).

The measures of exposure used in the PQRA include:

- Soil chemistry
- Human and ecological receptor characteristics

The measures of effect used in the PQRA were toxicity reference values (TRVs) reported by national health agencies or in the scientific literature.

2.4.3 Approach to Risk Characterization

Human health risks were characterized based on guidance provided by Health Canada (2021a). For COPCs that are not carcinogenic, characterization of human health risks was based on the Hazard Quotient (HQ) method. HQs are ratios of estimated daily COPC doses or exposure concentrations, and TRVs that represent doses or concentrations that can occur over a lifetime without unacceptable adverse health effects occurring. Per the Draft 2023 Environmental Guideline for Contaminated Site Remediation (GNWT, 2023), an HQ greater 0.2 was considered indicative of an unacceptable risk. For carcinogenic substances, risk is based on the product of an estimated lifetime average dose or concentration and a cancer potency factor which gives the incremental lifetime cancer risk (ILCR) of exposure to a COPC. Per GNWT (2023), an ILCR exceeding 1 in 100,000 was considered indicative of an unacceptable risk. The preliminary ecological risk assessment also characterized risks using the HQ method. Per GNWT (2023), an HQ of less than one (1) was considered indicative of a low risk.

3 PRELIMINARY HUMAN HEALTH RISK ASSESSMENT

The preliminary Human Health Risk Assessment (HHRA) evaluated the potential for antimony and arsenic in soil at the Site to negatively impact the health of people. The three main components of the preliminary HHRA are exposure assessment, effects assessment, and risk characterization.

3.1 Exposure Assessment

Exposure assessment is the process of estimating the potential magnitude, frequency, and duration of COPC exposure for a ROPC.

3.1.1 Receptors and Exposure Characteristics

The receptors evaluated for the Site were current members of the general public (all lifestages) and future residents (all lifestages) and non-resident adult students, faculty and staff of the university.

For the general public receptor and university resident receptor, the toddler lifestage was used to assess the risks of non-cancer health effects and the adult lifestage was used to assess cancer risk. The toddler lifestage was used to assess non-cancer risks for the general public and university resident because non-cancer risks are based in part on daily contaminant intakes and toddlers have the highest daily intake rate per unit body weight among the lifestages. The adult lifestage was used to assess cancer risks because cancer risks are based in part on contaminant doses averaged over a lifetime and the adult lifestage is by far the longest among the lifestages.

Exposure characteristics assumed for the receptors were taken primarily from Health Canada (2021a) and are summarized below in Tables 3-1 through 3-5.

Table 3-1 Assumed Exposure Characteristics – General Public (Toddler)

Exposure Characteristic	Assumed Value	Source
Age	6 months to <5 years	Health Canada, 2021a
Hours per day on Site	2	Professional Judgement
Days per week on Site	1	Professional Judgement
Weeks per year on Site	26	Portion of year that Site surface is exposed*
Years on Site	4.5	Health Canada, 2021a
Life Expectancy (years)	80	Health Canada, 2021a

Exposure Characteristic	Assumed Value	Source
Body Weight (kg)	16.5	Health Canada, 2021a
Soil Ingestion Rate (kg/day)	0.00008	Health Canada, 2021a
Inhalation Rate (m^3/day)	8.3	Health Canada, 2021a
Skin Surface Area – Hands (cm^2)	430	Health Canada, 2021a
Skin Surface Area – Arms (upper and lower; cm^2)	890	Health Canada, 2021a
Soil Loading to Exposed Skin (kg/cm^2-event)	Hands ($1x10^{-7}$) Arms ($1x10^{-8}$)	Health Canada, 2021a

Notes:
**Snow depth at Yellowknife is at least 5cm 178 days per year on average (Current Results, 2024)*

Table 3-2 Assumed Exposure Characteristics – General Public (Adult)

Exposure Characteristic	Assumed Value	Source
Age	>20 years	Health Canada, 2021a
Hours per day on Site	2	Professional Judgement
Days per week on Site	1	Professional Judgement
Weeks per year on Site	26	Portion of year that Site surface is exposed
Years on Site	60	Health Canada, 2021a
Life Expectancy (years)	80	Health Canada, 2021a
Body Weight (kg)	70.7	Health Canada, 2021a
Soil Ingestion Rate (kg/day)	0.00002	Health Canada, 2021a
Inhalation Rate (m^3/day)	16.6	Health Canada, 2021a
Skin Surface Area – Hands (cm^2)	890	Health Canada, 2021a
Skin Surface Area – Arms (upper and lower; cm^2)	2500	Health Canada, 2021a
Soil Loading to Exposed Skin (kg/cm^2-event)	Hands ($1x10^{-7}$) Arms ($1x10^{-8}$)	Health Canada, 2021a

Notes:
**Snow depth at Yellowknife is at least 5cm 178 days per year on average (Current Results, 2024)*

Table 3-3 Assumed Exposure Characteristics – University Resident (Toddler)

Exposure Characteristic	Assumed Value	Source
Age	6 months to <5 years	Health Canada, 2021a
Hours per day on Site	24	Health Canada, 2021a
Days per week on Site	7	Health Canada, 2021a
Weeks per year on Site	26	Portion of year that Site surface is exposed*

Exposure Characteristic	Assumed Value	Source
Years on Site	4.5	Health Canada, 2021a
Life Expectancy (years)	80	Health Canada, 2021a
Body Weight (kg)	16.5	Health Canada, 2021a
Soil Ingestion Rate (kg/day)	0.00008	Health Canada, 2021a
Inhalation Rate (m^3/day)	8.3	Health Canada, 2021a
Skin Surface Area – Hands (cm^2)	430	Health Canada, 2021a
Skin Surface Area – Arms (upper and lower; cm^2)	890	Health Canada, 2021a
Soil Loading to Exposed Skin (kg/cm^2-event)	Hands ($1x10^{-7}$) Arms ($1x10^{-8}$)	Health Canada, 2021a

Notes:
**Snow depth at Yellowknife is at least 5cm 178 days per year on average (Current Results, 2024)*

Table 3-4 Assumed Exposure Characteristics – University Resident (Adult)

Exposure Characteristic	Assumed Value	Source
Age	>20 years	Health Canada, 2021a
Hours per day on Site	24	Health Canada, 2021a
Days per week on Site	7	Health Canada, 2021a
Weeks per year on Site	26	Portion of year that Site surface is exposed*
Years on Site	60	Health Canada, 2021a
Life Expectancy (years)	80	Health Canada, 2021a
Body Weight (kg)	70.7	Health Canada, 2021a
Soil Ingestion Rate (kg/day)	0.00002	Health Canada, 2021a
Inhalation Rate (m^3/day)	16.6	Health Canada, 2021a
Skin Surface Area – Hands (cm^2)	890	Health Canada, 2021a
Skin Surface Area – Arms (upper and lower; cm^2)	2500	Health Canada, 2021a
Soil Loading to Exposed Skin (kg/cm^2-event)	Hands ($1x10^{-7}$) Arms ($1x10^{-8}$)	Health Canada, 2021a

Notes:
**Snow depth at Yellowknife is at least 5cm 178 days per year on average (Current Results, 2024)*

Table 3-5 Assumed Exposure Characteristics – Non-Resident University Student /Faculty/Staff (Adult)

Exposure Characteristic	Assumed Value	Source
Age	>20 years	Health Canada, 2021a

Exposure Characteristic	Assumed Value	Source
Hours per day on Site	10	Health Canada, 2021a
Days per week on Site	5	Health Canada, 2021a
Weeks per year on Site	26	Portion of year that Site surface is exposed*
Years on Site	60	Health Canada, 2021a
Life Expectancy (years)	80	Health Canada, 2021a
Body Weight (kg)	70.7	Health Canada, 2021a
Soil Ingestion Rate (kg/day)	0.00002	Health Canada, 2021a
Inhalation Rate (m^3/day)	16.6	Health Canada, 2021a
Skin Surface Area – Hands (cm^2)	890	Health Canada, 2021a
Skin Surface Area – Arms (upper and lower; cm^2)	2500	Health Canada, 2021a
Soil Loading to Exposed Skin (kg/cm^2-event)	Hands ($1x10^{-7}$) Arms ($1x10^{-8}$)	Health Canada, 2021a

Notes:
**Snow depth at Yellowknife is at least 5cm 178 days per year on average (Current Results, 2024)*

3.1.2 Exposure Point Concentrations

Exposure point concentrations (EPCs) are estimates of the reasonable maximum COPC concentrations that a receptor could be exposed to at a contaminated site. The preliminary HHRA assumed that the general public could be exposed chronically to 95% UCLM concentrations of antimony and arsenic detected in soils across the Site and that university residents and non-resident students, faculty and staff could be exposed chronically to 95% UCLM antimony and arsenic concentrations detected within the footprint of the university.

Assumed EPCs are identified in Table 3-6. Statistical summaries of the antimony and arsenic soil datasets are provided in Appendix E.

Table 3-6 Assumed Exposure Point Concentrations of COPCs in Soil

Contaminant	Exposure Point Concentration for General Public (mg/kg)	Exposure Point Concentration for University Resident and Non-Resident Students/Faculty/Staff (mg/kg)
Antimony	10.8	17.6
Arsenic	313	188

Notes:
mg/kg = milligrams per kilogram

3.1.3 Bioavailability Factors

Chemicals have properties that influence their capacity to cross biological barriers (e.g., skin,

respiratory/digestive tract tissue). Chemicals that enter the blood stream are available to cause adverse effects to a receptor at a target location (organ or system). Relative Absorption Factors used to estimate COPC exposures by the human ROPCs were generally obtained from Health Canada (2021a and 2021b). The Site-specific bioaccessibility of arsenic in soil was determined through laboratory testing of Site soils. The bioavailability factors assumed for the PQRA are presented in Table 3-7.

Table 3-7 Relative Absorption Factors

Contaminant	RAF_{Oral}	RAF_{Dermal}	$RAF_{Inhalation}$
Antimony	1[3]	1[3]	1[1]
Arsenic	0.22[4]	0.03[2]	1[1]

Notes:
mg/kg = milligrams per kilogram; RAF = Relative Absorption Factor
1: Health Canada, 2021a
2: Health Canada, 2021b
3: Conservative assumption in absence of value from Health Canada
4: Mean bioaccessibility value determined in laboratory testing of Site soils

3.1.4 Estimation of Contaminant Intakes

Contaminant intakes were calculated using equations provided by Health Canada (2021a). Sample calculations are provided in Appendix F.

3.2 Effects Assessment

Effects assessment involves identification of the potential toxic effects of substances, the amount of a substance that a receptor can be exposed to without adverse effects occurring, and carcinogenic potency for substances that can cause cancer.

3.2.1 COPC Carcinogenicity

Carcinogenicity classifications from Health Canada, the International Agency for Research on Cancer and the United States Environmental Protection Agency were considered in determining the degree to which antimony or arsenic have potential to cause cancer. Carcinogenicity classifications reported by these agencies for the COPCs are presented in Table 3-8.

Table 3-8 Carcinogenicity Classifications

COPC	Health Canada	IARC	US EPA	Assessed as Carcinogenic?
Antimony	NE	2A[1]/3[2]	NE	No
Arsenic	I	1	A	Yes

Notes:
COPC = contaminant of potential concern; IARC = International Agency for Research on Cancer; NE = not evaluated; US EPA = United States Environmental Protection Agency

Health Canada Classifications: 1 = carcinogenic to humans
IARC Classifications: 1 = carcinogenic to humans; 2A = probably carcinogenic to humans; 3 = not classifiable as to its carcinogenicity to humans
US EPA Classifications: A = human carcinogen
1: trivalent antimony
2: pentavalent antimony

Based on this evaluation, both the carcinogenic and non-carcinogenic health risks of arsenic were assessed while only the non-carcinogenic health risks of antimony were assessed.

3.2.2 Toxicity Reference Values

The toxicity reference values (TRVs) used in the preliminary HHRA were obtained from Health Canada (2021b). In cases where applicable TRVs were not available from Health Canada, values from the US EPA Integrated Risk Information System database were used. The TRVs selected for use are presented below in Table 3-9.

Table 3-9 Toxicity Reference Values

COPC	TRV	TRV Source	TRV Type	Critical Effect
Antimony	0.0004 mg/kg-day	US EPA IRIS	Oral Reference Dose	Longevity, blood glucose and cholesterol
Arsenic	0.0003 mg/kg-day	US EPA IRIS	Oral Reference Dose	Hyperpigmentation, keratosis, vascular complications
	1.8 $(mg/kg\text{-}day)^{-1}$	Health Canada, 2021b	Oral Slope Factor	Bladder, lung, liver cancer
	6.4 $(mg/m^3)^{-1}$	Health Canada, 2021b	Inhalation Unit Risk	Lung cancer

Notes:
COPC = contaminant of potential concern; IRIS = Integrated Risk Information System; NR = Not Reported; RfC = Reference Concentration; TRV = Toxicity Reference Value; mg/kg-day = milligrams per kilogram per day; mg/m^3 = milligrams per cubic metre

3.3 Risk Characterization

Risk characterization involves the integration of the information from the exposure assessment, the effects assessment, and an uncertainty analysis to facilitate an overall conclusion regarding the potential for a COPC to cause adverse human health effects.

3.3.1 Risk Estimation

3.3.1.1 Non-Carcinogenic Health Risks

Non-carcinogenic health risks were estimated using the following formula:

$$HQ = CDD / RfD$$

Where:

HQ = Hazard Quotient (unitless)

CDD = Chronic Daily Dose (mg/kg-day)

RfD = Reference Dose (mg/kg-day)

An HQ greater than 0.2 was considered to be indicative of an unacceptable risk, per GNWT (2023). HQs for the receptors are presented below in Tables 3-10 to 3-12, respectively. Sample calculations are presented in Appendix F.

Table 3-10 Non-Carcinogenic Risk Estimates – General Public (Toddler)

COPC	HQ_{oral}	HQ_{dermal}	$HQ_{inhalation}$	HQ_{Total}
Antimony	0.009	0.0002	0.00000006	0.009
Arsenic	0.1	0.007	0.000002	0.1

Notes:
COPC = contaminant of potential concern; HQ = Hazard Quotient
***Bold**: HQ exceeds GNWT guideline*

The total HQ for a toddler-aged member of the general public is less than 0.2 for both antimony and arsenic indicating an acceptable risk.

Table 3-11 Non-Carcinogenic Risk Estimates – University Resident (Toddler)

COPC	HQ_{oral}	HQ_{dermal}	$HQ_{inhalation}$	HQ_{Total}
Antimony	0.11	0.002	0.000008	0.13
Arsenic	***0.33***	0.03	0.0001	***0.33***

Notes:
COPC = contaminant of potential concern; HQ = Hazard Quotient
***Bold**: HQ exceeds GNWT guideline*

The total HQ for a toddler-aged resident of a future university marginally exceeds 0.2 for arsenic indicating an unacceptable risk. The elevated HQ is driven by exposures through the incidental ingestion of soil.

Table 3-12 Non-Carcinogenic Risk Estimates – Non-Resident University Student/Faculty/Staff (Adult)

COPC	HQ_{oral}	HQ_{dermal}	$HQ_{inhalation}$	HQ_{Total}
Antimony	0.004	0.0008	0.000001	0.005
Arsenic	0.01	0.01	0.00002	0.02

Notes:
COPC = contaminant of potential concern; HQ = Hazard Quotient
***Bold**: HQ exceeds GNWT guideline*

The total HQ for a non-resident university student, faculty and staff is less than 0.2 for both antimony and arsenic indicating an acceptable risk.

3.3.1.2 Carcinogenic Health Risks

Carcinogenic health risks for arsenic were estimated using the following formulae:

$$ILCR = LAD \times SF$$

or

$$ILCR = LAAC \times UR$$

Where:

ILCR = Incremental Lifetime Cancer Risk (unitless)

LAD = Lifetime Average Dose (mg/kg-day)

LAAC = Lifetime Average Air Concentration (mg/m^3)

SF = Oral Slope Factor $(mg/kg\text{-}day)^{-1}$

UR = Inhalation Unit Risk $(mg/m3)^{-1}$

Cancer risks for the current public adult, future university resident adult and non-resident university student, faculty and staff are presented below in Tables 3-13 to 3-15, respectively. Sample calculations are presented in Appendix F.

Table 3-13 Carcinogenic Risk Estimates – General Public (Adult)

COPC	$ILCR_{Oral}$	$ILCR_{Dermal}$	$ILCR_{Dust\ Inhalation}$	Total ILCR
Arsenic	3.3E-06	1.5E-06	6.8E-09	4.8E-06

Notes:
COPC = contaminant of potential concern; ILCR = Incremental Lifetime Cancer Risk
***Bold**: ILCR exceeds Health Canada Guideline*

The total ILCR for an adult-aged member of the general public is less than 1 in 100,000 for arsenic indicating an acceptable risk.

Table 3-14 Carcinogenic Risk Estimates – University Resident (Adult)

COPC	$ILCR_{Oral}$	$ILCR_{Dermal}$	$ILCR_{Dust\ Inhalation}$	Total ILCR
Arsenic	7.9E-06	6.1E-06	3.4E-07	***1.4E-05***

Notes:
COPC = contaminant of potential concern; ILCR = Incremental Lifetime Cancer Risk
***Bold**: ILCR exceeds Health Canada Guideline*

The total ILCR for an adult-aged resident of a future university marginally exceeds 1 in 100,000

for arsenic indicating an unacceptable risk. The elevated ILCR is driven by exposures through incidental ingestion of soil and dermal contact with soil.

Table 3-15 Carcinogenic Risk Estimates – Non-Resident University Student/Faculty/Staff (Adult)

COPC	$ILCR_{Oral}$	$ILCR_{Dermal}$	$ILCR_{Dust\ Inhalation}$	Total ILCR
Arsenic	5.6E-06	4.4E-06	1.0E-07	1.0E-05

Notes:
COPC = contaminant of potential concern; ILCR = Incremental Lifetime Cancer Risk
***Bold**: ILCR exceeds GNWT Guideline*

The total ILCR for a non-resident university student, faculty and staff does not exceed 1 in 100,000 for arsenic indicating an acceptable risk.

3.3.2 Uncertainty Analysis

Some degree of uncertainty is inherent in any risk assessment process and as such risk assessments incorporate conservatism to ensure that risks are not underestimated. Table 3-16 summarizes the primary uncertainties identified in the preliminary HHRA and whether the manner in which these uncertainties were addressed contributed to an over- or underestimate of risk.

Table 3-16 HHRA Uncertainties

Uncertainty	Implications of Uncertainty	How Uncertainty Was Addressed	Effect on Risk Estimates
Actual exposure time, frequencies, and durations that ROPCs spend on Site and exposed to the COPC are unknown.	Contributes uncertainty to accuracy of the exposure and risk estimates.	The HHRA made conservative assumptions regarding the time spent on Site and exposed to COPCs under the current recreational scenario (2 hours per day, 1 day per week, 26 weeks per year, 60 years), future resident university scenario (24 hours per day, 7 days per week, 26 weeks per year, 60 years) and non-resident university scenario (10 hours per day, 5 days per week, 26 weeks per year, 60 years). The surface of the Site is largely comprised of bedrock outcrops with limited areas of exposed soil. The PQRA essentially assumes that exposed soils cover the entire Site.	Contributes to overestimation of risk

Uncertainty	Implications of Uncertainty	How Uncertainty Was Addressed	Effect on Risk Estimates
Actual COPC exposure point concentrations are unknown.	Contributes uncertainty to the accuracy of the exposure and risk estimates.	ROPCs were assumed to be exposed continuously to antimony and arsenic at 95% UCLM concentrations detected in Site soil.	Contributes to overestimation of risk
The actual level of protection provided by the toxicity reference values applied in the assessment is uncertain.	Contributes uncertainty to the accuracy of the risk estimates.	The TRVs applied were obtained from recognized national health agencies. These TRVs incorporate safety factors to ensure that they are protective of human health.	Contributes to overestimation of risk

Based on the foregoing, it is expected that the risk estimates presented above for soil exposures overestimate actual human health risks for receptors at the Site.

The available chemistry data was limited to Site soils and off-Site surface water. Uncertainty remains as to the degree of contaminant exposure that people could experience through contact with other media at the Site such as:

- Ingestion of edible plants;
- Ingestion of wildlife;
- Contact with surface water; and,
- Inhalation of soil vapour.

3.3.3 Risk Description

Based on the available data, arsenic in soil at the Site poses an unacceptable health risk to residents of a future university. By inference, an unacceptable health risk is also predicted for regular (>3 days per week) toddler-aged (<5 years old) patrons of a university daycare. Antimony and arsenic in soil do not pose an unacceptable health risk to non-resident university students, faculty, staff or full-time child-aged (>5 years old) daycare patrons. These findings are based on soil data collected from the proposed university footprint.

Arsenic and antimony in soil do not pose an unacceptable health risk to members of the general public that periodically (no more than 2 days per week) use the Site for recreational purposes. This finding is based on data collected from soils across the Site, including the OMR.

4 PRELIMINARY ECOLOGICAL RISK ASSESSMENT

The Preliminary Ecological Risk Assessment (ERA) evaluated the potential for the COPCs identified in surface soil at the Site to cause adverse effects on soil invertebrate and plant communities, wildlife populations and listed species. The preliminary ERA used the deterministic Hazard Quotient method.

4.1 Surrogate Wildlife Receptors

The wildlife ROPC groups retained for the Site are:

- Herbivorous mammals;
- Insectivorous mammals;
- Herbivorous birds; and,
- Insectivorous birds.

Herbivorous and insectivorous mammals and birds were selected for assessment for the following reasons:

- They are likely to capture COPC exposures by omnivorous mammals and birds; and,
- They are likely to experience a higher level of exposure than carnivorous birds and mammals since the wildlife COPCs (arsenic and vanadium) do not biomagnify.

To simplify the preliminary ERA, the following surrogate wildlife species were used to evaluate risks for these groups:

- Herbivorous mammals: meadow vole (*Microtus pennsylvanicus*);
- Insectivorous mammals: masked (common) shrew (*Sorex cinereus*);
- Herbivorous Birds: spruce grouse (*Dendragapus canadensis*); and,
- Insectivorous Birds: barn swallow (*Hirundo rustica*)

These surrogate species have potential to occur at the Site (see Section 2.3.2). In addition, Environment Canada (2012) has published physical and dietary characteristics for these species which are needed to estimate COPC exposure and risk.

4.2 Exposure Assessment

In this section, COPC exposure point concentrations (EPCs) for invertebrates and plants are

identified and daily COPC doses for the surrogate wildlife species are estimated.

4.2.1 Soil Invertebrates and Plants

COPC exposures by soil invertebrates and plants were estimated based on surface soil (<1m depth) concentrations collected across the Site. Sample data from the OMR were excluded since the OMR is not expected to serve as ecological habitat. A statistical concentration summary of the COPCs identified in surface soil across the Site is presented in Appendix E. Since the goal is to ensure the protection of soil invertebrates and plants at the community level across the Site, the EPCs to which they were assumed to be exposed were 95% UCLM COPC concentrations, as presented below in Table 4-1.

Table 4-1 Exposure Point Concentrations - Soil Invertebrate and Plants

COPC	EPC in Soil (mg/kg)
Arsenic	193
Boron	20
Copper	41
Selenium	1.3

Notes:
COPC = contaminant of potential concern; EPC = Exposure Point Concentration; mg/kg = milligrams per kilogram

4.2.2 Wildlife

For birds and mammals, exposures were quantified as total daily oral COPC doses using the following model, based on that described by Suter (2007).

$$TDOD = EA / HR\left[\sum_{i=1}^{m}\sum_{k=1}^{n} P_{ik}(IR_i \times EPC_{ijk})\right]$$

Where:

$TDOD_j$ = Total daily oral dose of COPC (j) (mg/kg-day)

EA = Exposure Area (ha)

HR = Home range (ha)

m = Total number of ingested media (e.g., food, soil) (unitless)

n = Number of types of medium (i) consumed (unitless)

IR_i = Ingestion rate for medium (i) (kg/kg BW/day)

P_{ik} = Proportion of type (k) of medium (i) consumed (unitless)

EPC_{ijk} = Exposure point concentration of contaminant (j) in type (k) of medium (i) (mg/kg)

The receptor characteristics used as inputs to the exposure model were those published by the Government of Canada (2012) and are provided in Table 4-2.

Table 4-2 Exposure Characteristics – Bird and Mammal Surrogate Species

Receptor	Food Ingestion Rate (kg/kg-day ww)	Site Use Factor[1] (unitless)	Soil Ingestion Rate[5] (%)	Dietary Composition (%)	
				Invertebrates	Vegetation
Common Shrew	1.7[4]	1	2[2]	100[3]	0
Meadow Vole	0.33	1	2.4	0	100
Barn Swallow	1.3[4]	1	2[6]	99	1
Spruce Grouse	0.35[4]	1	2[6]	5	95

Notes:
kg = kilogram; ww = wet weight
1: Exposure Area (EA)/Home Range (HR) assumed to be 1 (i.e., 100%) to be conservative
2: value for deer mouse applied in absence of value for shrew
3: 95% invertebrates and 5% 'other'. Tissue COPC concentrations of 'other' assumed to be equivalent to invertebrates.
4: converted from dry weight ingestion rate assuming 80% moisture content in dietary components
5: expressed as percentage of dry food ingestion rate
6: assumed

The other input parameters required for the wildlife exposure model are EPCs for soil and the dietary components (i.e., vegetation, invertebrates) of each wildlife receptor. Birds and mammals are mobile and therefore are likely to average their exposures to contaminated soils, vegetation, and invertebrate prey in space and time. Thus, 95% UCLM COPC concentrations in soil Site wide (excluding concentrations measured in the OMR) were assumed as EPCs for these media. EPCs in soil for wildlife are presented below in Table 4-3.

Table 4-3 Exposure Point Concentrations in Soil - Wildlife

COPC	EPCs in Soil (mg/kg)
Arsenic	193
Vanadium	19.5

Notes:
COPC = contaminant of potential concern; EPC = exposure point concentration; mg/kg = milligrams per kilogram

In the absence of measured tissue concentrations in plants at the Site, contaminant concentrations in plant tissues were estimated by multiplying the 95% UCLM concentrations of the COPCs in surface soil by soil-to-wet plant bioconcentration factors (BCFs) reported by the Risk Assessment Information System (RAIS, 2024). The modelled EPCs in plant tissues and associated uptake factors are presented in Table 4-4.

Table 4-4 Exposure Point Concentrations in Plant Tissue

COPC	EPC in Soil (mg/kg dw)	Soil-to-Plant Tissue BCF (mg COPC/kg ww tissue / mg COPC/kg dw soil)	EPC in Plant Tissue (mg/kg ww)
Arsenic	193	0.01	1.9
Vanadium	19.5	0.00137	0.03

Notes:
BCF = bioconcentration factor; COPC = contaminant of potential concern; dw = dry weight; EPC = exposure point concentration; mg/kg = milligrams per kilogram; ww = wet weight

In the absence of measured tissue concentrations in soil invertebrates at the Site, contaminant concentrations in soil invertebrate tissues were estimated by multiplying the 95% UCLM concentrations of the COPCs in surface soil by the soil-to-soil invertebrate BCFs reported by the US EPA (1999). The modelled EPCs in soil invertebrate tissues and associated uptake factors are presented in Table 4-5.

Table 4-5 Exposure Point Concentrations in Soil Invertebrate Tissue

COPC	EPC in Soil (mg/kg dw)	Soil-to-Soil Invertebrate Tissue BCF (mg COPC/kg ww tissue / mg COPC/kg dw soil)	EPC in Soil Invertebrate Tissue (mg/kg ww)
Arsenic	193	0.11	21.2
Vanadium	19.5	0.22	4.3

Notes:
BCF = bioconcentration factor; COPC = contaminant of potential concern; dw = dry weight; EPC = exposure point concentration; mg/kg = milligrams per kilogram; ww = wet weight
1: BCF not provided for vanadium. Arithmetic mean BCF for other metals assumed.

A sample calculation detailing how daily COPC doses were estimated for wildlife is presented in Appendix F.

4.3 Effects Assessment

The effects assessment identified toxicity reference values (TRVs) for each COPC/ROPC combination. In the risk characterization section that follows, TRVs are compared to the exposure estimates derived in the Exposure Assessment to derive hazard quotients which represent numeric estimates of the risk to each ROPC.

4.3.1 Toxicity Reference Values

TRV used for the effects of COPCs on soil invertebrates and plants communities at the Site were the Tier 2 pathway specific soil criteria for residential land use for direct soil contact by soil

invertebrates and plants (GNWT, 2023).

TRVs used for the effects of COPCs on mammals and birds were obtained from the US EPA Ecological Soil Screening Level (Eco-SSL) documents. The TRVs selected were 'no observed adverse effects levels (NOAEL) for reproduction, growth and/or survival. TRVs associated with no adverse effects were selected for use given the potential presence of listed wildlife species at the Site.

The TRVs used in the ERA for the effects of COPCs on soil invertebrates and plants, mammals and birds are presented in Tables 4-6 to 4.9.

Table 4-6 Toxicity Reference Values – Soil Invertebrates and Plants

COPC	TRV (mg/kg)
Arsenic	17
Boron	3.3
Copper	63
Selenium	1

Notes:
COPC = contaminant of potential concern; mg/kg = milligrams per kilogram

Table 4-7 Toxicity Reference Values – Mammals

COPC	TRV (mg COPC/kg bw/day)	Type of Effect	Magnitude of Effect	Source
Arsenic	1.04	reproduction, growth, survival	0	USEPA 2005a
Vanadium	4.16	reproduction, growth, survival	0	USEPA 2005b

Notes:
COPC = contaminant of potential concern; mg COPC/kg bw/day = milligrams of contaminant of potential concern per kilogram body weight per day; TRV = Toxicity Reference Value

Table 4-8 Toxicity Reference Values – Birds

COPC	TRV (mg COPC/kg bw/day)	Type of Effect	Magnitude of Effect	Source
Arsenic	2.24	reproduction, growth, survival	0	USEPA 2005a
Vanadium	0.344	reproduction, growth, survival	0	USEPA 2005b

Notes:
COPC = contaminant of potential concern; mg COPC/kg bw/day = milligrams of contaminant of potential concern per kilogram body weight per day; TRV = Toxicity Reference Value

4.4 Risk Characterization

Risk characterization involves the integration of the findings of the exposure and effects assessment to facilitate a determination of the likelihood of the Site COPCs causing adverse effects on ecological receptors. The three components of risk characterization are risk estimation, uncertainty analysis, and risk description.

4.4.1 Risk Estimation

Hazard Quotients (HQs) for each COPC/ROPC combination were calculated by dividing the exposure estimates by the appropriate TRV as follows:

Invertebrates and Plants

$$HQ = \frac{EPC}{TRV}$$

Birds and Mammals

$$HQ = \frac{TDOD}{TRV}$$

Where:

HQ = Hazard Quotient (unitless)
EPC = Exposure Point Concentration (mg/kg)
TDOD = Total Daily Oral Dose (mg/kg-day)
TRV = Toxicity Reference Value (mg/kg or mg/kg-day)

HQs of less than or equal to one (1) are indicative of low risk, while HQs greater than one (1) suggest that adverse effects could potentially occur at the estimated exposure level. Estimated HQs for each COPC/ROPC combination are presented below in Tables 4-9 through 4-13. Sample calculations are provided in Appendix F.

Table 4-9 Hazard Quotients – Soil Invertebrates and Plants

COPC	Soil EPC (mg/kg)	TRV (mg/kg)	HQ
Arsenic	193	17	***11***
Boron	20	3.3	***6.1***
Copper	41	63	0.7
Selenium	1.3	1	***1.3***

Notes:
COPC = contaminant of potential concern; HQ = hazard quotient; mg/kg = milligrams per kilogram; TRV = toxicity reference value
***Bold**: HQ exceeds risk threshold of one (1)*

HQs calculated for soil invertebrates and plants were greater than the risk threshold of one (1) for arsenic, boron and selenium indicating a potential risk. The estimated HQ for copper was less than one (1).

Table 4-10 Hazard Quotients – Insectivorous Mammals

COPC	TDOD (mg/kg-day)	TRV (mg/kg-day)	HQ
Arsenic	37.4	1.04	***36***
Vanadium	7.4	4.16	***1.8***

Notes:
COPC = contaminant of potential concern; HQ = hazard quotient; mg/kg-day = milligrams per kilogram body weight per day; TDOD = total daily oral dose; TRV = toxicity reference value
***Bold**: HQ exceeds risk threshold of one (1)*

HQs calculated for insectivorous mammals were greater than the risk threshold of one (1) for arsenic and vanadium indicating a potential risk.

Table 4-11 Hazard Quotients – Herbivorous Mammals

COPC	TDOD (mg/kg-day)	TRV (mg/kg-day)	HQ
Arsenic	0.9	1.04	0.9
Vanadium	0.04	4.16	0.01

Notes:
COPC = contaminant of potential concern; HQ = hazard quotient; mg/kg-day = milligrams per kilogram body weight per day; TDOD = total daily oral dose; TRV = toxicity reference value
***Bold**: HQ exceeds risk threshold of one (1)*

HQs calculated for herbivorous mammals were less than the risk threshold of one (1) for arsenic and vanadium indicating a low risk.

Table 4-12 Hazard Quotients – Insectivorous Birds

COPC	TDOD (mg/kg-day)	TRV (mg/kg-day)	HQ
Arsenic	28.3	2.24	**13**
Vanadium	5.6	0.344	**16**

Notes:
COPC = contaminant of potential concern; HQ = hazard quotient; mg/kg-day = milligrams per kilogram body weight per day; TDOD = total daily oral dose; TRV = toxicity reference value
***Bold**: HQ exceeds risk threshold of one (1)*

HQs calculated for insectivorous birds were greater than the risk threshold of one (1) for arsenic and vanadium indicating a potential risk.

Table 4-13 Hazard Quotients – Herbivorous Birds

COPC	TDOD (mg/kg-day)	TRV (mg/kg-day)	HQ
Arsenic	1.3	2.24	0.6
Vanadium	0.1	0.344	0.3

Notes:
COPC = contaminant of potential concern; HQ = hazard quotient; mg/kg-day = milligrams per kilogram body weight per day; TDOD = total daily oral dose; TRV = toxicity reference value
***Bold**: HQ exceeds risk threshold of one (1)*

HQs calculated for herbivorous birds were less than the risk threshold of one (1) for arsenic and vanadium indicating a low risk.

4.4.2 Uncertainty Analysis

Some degree of uncertainty is inherent in any risk assessment process and as such risk assessments typically incorporate conservatism to ensure that risks are not underestimated. The following section summarizes uncertainties identified in the Preliminary ERA and whether the manner in which these uncertainties were addressed contributed to an over- or under-estimate of risk.

- Actual COPC exposures that ecological receptors may be subject to at the Site are uncertain. Receptors were assumed to be present on the Site 100% of the time and exposed chronically to 95% UCLM COPC concentrations measured in surface soil and predicted in soil invertebrate and plant tissues across the Site. These assumptions are expected to be conservative.
- In the absence of measured concentrations in plant and invertebrate tissues from the Site,

exposure concentrations in plants and soil invertebrates (as food for wildlife) were estimated using conservative uptake factors obtained from the literature. This approach is expected to be conservative and overpredict actual COPC concentrations in plant and invertebrate tissues.

- The actual bioavailability of the COPCs in Site media is uncertain. Exposure estimates for ecological ROPCs assume that COPCs at the Site have similar bioavailability to the chemical forms used in the toxicity studies upon which the TRVs are based. This is likely to be a conservative assumption given that toxicity studies typically use highly bioavailable chemical formulations.
- The actual level of protection provided by the toxicity reference values applied in the assessment is somewhat uncertain. The TRVs applied were GNWT guidelines (soil invertebrates and plants), and no observed adverse effects levels obtained from recognized government sources (wildlife). There is little uncertainty that the TRVs applied satisfy the protection goals for common and listed wildlife species.

Considering the above, it is expected that the risk estimates calculated for the ecological ROPCs overestimate actual risks, due to the multiple conservative assumptions made when estimating COPC exposures and the conservatism in the TRVs.

The available chemistry data was limited to Site soils and off-Site surface water. Uncertainty remains as to the degree of contaminant exposure that ecological receptors could experience through contact with other Site media such as surface water present seasonally on the Site.

4.4.3 Risk Description

In this section risks posed to the ecological ROPCs are described based on the risk estimates and the uncertainty analysis.

4.4.3.1 Soil Invertebrates

A potential risk to the soil invertebrate community at the Site was identified, based on Hazard Quotients exceeding one (1) for several COPCs. The uncertainty in this conclusion is considered moderate with a high likelihood that risks have been overestimated.

4.4.3.2 Plants

A potential risk to the plant community at the Site was identified, based on Hazard Quotients exceeding one (1) for several COPCs. The uncertainty in this conclusion is considered moderate

with a high likelihood that risks have been overestimated.

4.4.3.3 Mammals

A potential risk to insectivorous mammal populations at the Site, including listed species, was identified based on Hazard Quotients exceeding one (1) for arsenic and vanadium. The uncertainty in this conclusion is considered moderate with a high likelihood that risks have been overestimated. The risk to herbivorous mammal populations, including listed species, is considered to be low.

4.4.3.4 Birds

A potential risk to insectivorous bird populations at the Site, including listed species, was identified based on Hazard Quotients exceeding one (1) for arsenic and vanadium. The uncertainty in this conclusion is considered moderate with a high likelihood that risks have been overestimated. The risk to herbivorous bird populations, including listed species, is considered to be low.

5 CONCLUSIONS AND RECOMMENDATIONS

The PQRA was conducted to determine if contamination identified in Site soils poses an unacceptable risk to human health or the environment under existing and anticipated future uses and conditions.

5.1 Human Health Risks

Based on the available data, arsenic in soil at the Site poses an unacceptable health risk to residents of a future university as well as regular (>3 days per week) toddler-aged (<5 years old) patrons of a university daycare. Antimony and arsenic in soil do not pose an unacceptable health risk to non-resident university students, faculty, staff or full-tiime child-aged (>5 years old) university daycare patrons. These findings are based on soil data collected from the proposed university footprint shown in Appendix C.

Arsenic and antimony in soil do not pose an unacceptable health risk to members of the general public that periodically (no more than 2 days per week) use the Site for recreational purposes. This finding is based on data collected from soils across the Site, including the OMR.

The uncertainty in these findings is moderate for the COPCs identified in soil with a high likelihood that risks have been overestimated.

5.2 Ecological Risks

A potential risk to soil invertebrate and plant communities, insectivorous mammal and bird populations, including listed species of this type, was identified based on the available data. There is moderate to high uncertainty in this finding given that risk estimates were modelled based solely on soil chemistry which is likely to have resulted in risks being overestimated.

5.3 Recommendations

Remediation and risk management options to mitigate risks identified for university residents and toddler-aged university daycare patrons should be considered. Characterization of soil quality within the section of the Old Mine Road that crosses the proposed university footprint is recommended to confirm human health risk estimates for people that will spend time at the university.

Additional data collection (e.g., soil invertebrate and plant tissue chemistry) is recommended to

refine the risk estimates presented for soil invertebrates, plants, and wildlife.

The preliminary HHRA and ERA were limited to exposures to contaminants in Site soil. The degree to which contact with other media at the Site (e.g., seasonal surface water, plant tissues, wildlife tissues, vapours) could contribute to contaminant exposures by people, plants and animals should be investigated with findings incorporated into the PQRA.

6 STATEMENT OF LIMITATIONS

This report has been prepared solely for the use of Associated Environmental (Associated) and the Government of the Northwest Territories (GNWT). By using this report, Associated and GNWT agree that they will review and use the report in its entirety. Any use which other parties make of this report, or any reliance on, or decision made based on it, are the responsibility of such parties. Steer Environmental Associates Ltd. accepts no responsibility for damages, if any, suffered by other parties as a result of decisions made or actions based on this report.

The services performed as described in this report were conducted in a manner consistent with the level of care and skill normally exercised by other members of the environmental science profession currently practicing under similar conditions, subject to the time limits, and financial and physical constraints applicable to the services.

The findings of this assessment are based on information collected during previous Site investigations, our present understanding of the Site conditions, and our professional judgement in light of such information at the time the report was prepared. This report provides a professional opinion and, therefore, no warranty is expressed, implied, or made as to the conclusions, advice, and recommendations presented in this report.

The findings and conclusions of the assessment are specific to the information and assumptions upon which they are based.

7 PROFESSIONAL STATEMENT

I declare that I am a qualified professional with the required knowledge, skills and experience to provide expert information, advice and/or recommendations in relation to the specific work described above.

Sincerely,

STEER ENVIRONMENTAL ASSOCIATES LTD.

Scott Steer, R.P.Bio., CSAP
Environmental Toxicologist

8 REFERENCES

Associated, 2023a. Advanced Phase I Environmental Site Assessment, Tin Can Hill, Yellowknife, NT. Prepared for the Government of Northwest Territories by Associated Environmental. Dated March 2023.

Associated, 2023b. Phase II Environmental Site Assessment, Tin Can Hill, Yellowknife, NT (DRAFT). Prepared for the Government of Northwest Territories by Associated Environmental. Dated January 2024.

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GNWT, 2008. Ecosystem Classification Group. Ecological Regions of the Northwest Territories - Taiga Shield. Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT, Canada.

Health Canada, 2021a. Federal Contaminated Site Risk Assessment in Canada: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Version 3.0. Health Canada. March 2021.

APPENDIX A

PHASE II/III ESA FIGURES & AERIAL PHOTOGRAPHS

ALTHOUGH ASSOCIATED HAS TAKEN THE EFFORT AND DUE CARE TO ENSURE THE ACCURACY OF THE INFORMATION DISPLAYED AT THE DATE OF PRODUCTION, THE USER ACKNOWLEDGES THAT CHANGES OVER TIME AND THE CURRENCY OF THE DATASET(S) MAY IMPACT THE ACCURACY OF THE INFORMATION WITHOUT NOTICE. ASSOCIATED SHALL NOT BE HELD LIABLE TOWARDS THE RESULTS OBTAINED FROM THE USE OF THIS INFORMATION. SCALE(S) SHOWN ARE INTENDED FOR LETTER (8.5X11) SIZE ONLY.

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Associated Environmental

AE PROJECT NO.	2023-8451
SCALE	1:100,000
COORD. SYSTEM	NAD 1983 UTM ZONE 11N
DATE	2023-12-15
REV	00
DRAWN BY	BDJ
CHECKED BY	TR

FIGURE 1: SITE LOCATION PLAN

GOVERNMENT OF NORTHWEST TERRITORIES

PHASE II/III ESA – TIN CAN HILL, YELLOWKNIFE, NT

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Associated Environmental

- Test Pit - Peat
- Test Pit - Sand & Gravel
- Test Pit - Silt
- Test Pit - Silt / Peat
- Surface Water Sample
- Proposed Sampling Point - No Soil
- Proposed Sampling Point - No Surface Water
- Subject Property
- Parcel Boundary

AE PROJECT NO.	2023-8451
SCALE	1:3,800
COORD. SYSTEM	NAD 1983 UTM ZONE 11N
DATE	2023-12-18
REV	00
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CHECKED BY	TR

FIGURE 2: SAMPLING LOCATION PLAN

GOVERNMENT OF NORTHWEST TERRITORIES

PHASE II/III ESA – TIN CAN HILL, YELLOWKNIFE, NT

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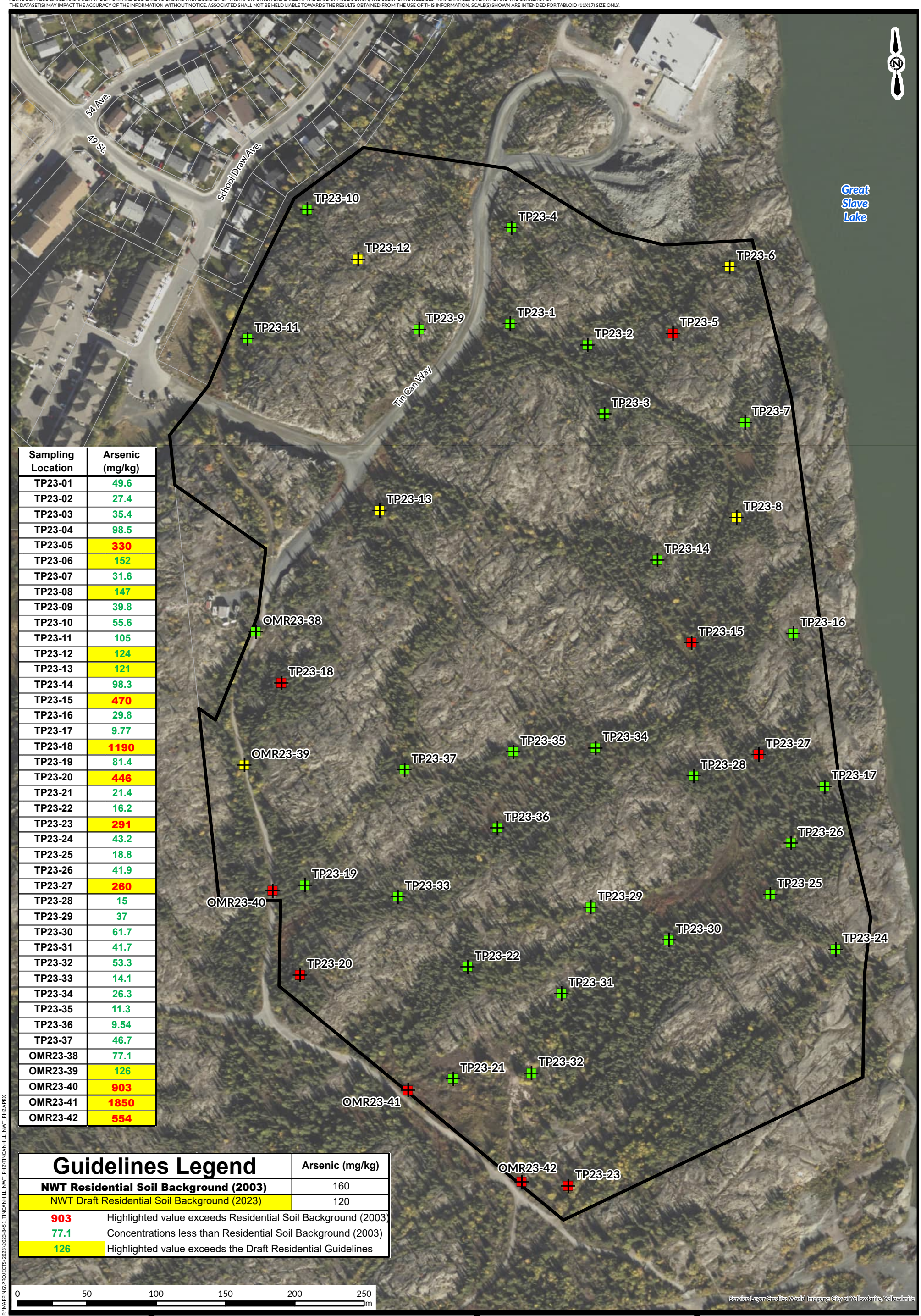

Sampling Location	Arsenic (mg/kg)
TP23-01	49.6
TP23-02	27.4
TP23-03	35.4
TP23-04	98.5
TP23-05	330
TP23-06	152
TP23-07	31.6
TP23-08	147
TP23-09	39.8
TP23-10	55.6
TP23-11	105
TP23-12	124
TP23-13	121
TP23-14	98.3
TP23-15	470
TP23-16	29.8
TP23-17	9.77
TP23-18	1190
TP23-19	81.4
TP23-20	446
TP23-21	21.4
TP23-22	16.2
TP23-23	291
TP23-24	43.2
TP23-25	18.8
TP23-26	41.9
TP23-27	260
TP23-28	15
TP23-29	37
TP23-30	61.7
TP23-31	41.7
TP23-32	53.3
TP23-33	14.1
TP23-34	26.3
TP23-35	11.3
TP23-36	9.54
TP23-37	46.7
OMR23-38	77.1
OMR23-39	126
OMR23-40	903
OMR23-41	1850
OMR23-42	554

Guidelines Legend	Arsenic (mg/kg)
NWT Residential Soil Background (2003)	160
NWT Draft Residential Soil Background (2023)	120
903	Highlighted value exceeds Residential Soil Background (2003)
77.1	Concentrations less than Residential Soil Background (2003)
126	Highlighted value exceeds the Draft Residential Guidelines

Associated Environmental

Subject Property

Parcel Boundary

Test Pits

- Concentrations less than Residential Soil Background (2003)
- Exceeds the Draft Residential Guidelines
- Exceeds Residential Soil Background (2003) and the Draft Residential Guidelines

AE PROJECT NO.	2023-8451
SCALE	1:2,500
COORD. SYSTEM	NAD 1983 UTM ZONE 11N
DATE	2023-12-15
REV	00
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FIGURE 3: SOIL ANALYTICAL RESULTS – ARSENIC

GOVERNMENT OF NORTHWEST TERRITORIES

PHASE II/III ESA – TIN CAN HILL, YELLOWKNIFE, NT

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Guidelines Legend	Antimony	Barium	Cobalt	Copper	Selenium	Vanadium	Zinc
NWT Tier 1 RL/PL CS/FS	20	500	50	63	1	130	200

Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use for coarse-grained and fine-grained soil

903 Highlighted value exceeds NWT Tier 1 RL/PL CS/FS guidelines

77.1 Concentrations less than NWT Tier 1 RL/PL CS/FS guidelines

Units for all parameters are mg/kg

NG - no guideline

Parameter	TP23-01	TP23-02	TP23-03	TP23-04	TP23-05	TP23-06	TP23-07	TP23-08	TP23-09	TP23-10	TP23-11	TP23-12	TP23-13	TP23-14	TP23-15	TP23-16	TP23-17	TP23-18	TP23-19	TP23-20	TP23-21
Antimony	1.14	6.52	3.42	17.1	9.03	**27**	7.45	1.34	1.89	**36**	2.66	**27.4**	7.15	9.08	4.16	2.84	3.11	16.9	12.2	15.7	1.72
Barium	93.1	22.5	32.7	51.7	102	10.6	37.3	74.6	9.83	30	68.2	54.9	53.2	292	43.8	84.5	80.7	112	31	212	169
Cobalt	13.2	1.67	1.29	6.04	23.5	1.1	1.84	12.9	0.28	4.14	12.3	5.32	2.88	40.6	6.92	1.92	1.42	4.4	4.25	13.8	11
Copper	**68.8**	12.4	7.71	18.8	30.8	16	14.3	17.4	3.63	32.2	15.5	18.4	7.4	35.4	22.7	15.1	21.2	20.3	28	25.9	31.6
Selenium	0.49	<0.37	<0.38	<0.38	<0.37	<0.38	0.43	<0.37	<0.37	0.42	<0.37	<0.37	<0.30	<0.30	<0.30	0.49	**1.14**	<0.30	<0.30	<0.30	0.27
Vanadium	41	1.78	1.66	4.05	44.3	4.25	2.45	45.6	0.77	3.45	42.7	10.7	9.9	7.89	26.3	3.81	3.44	9.84	9.73	26	55.1
Zinc	40.1	5.8	4.1	20.5	76.5	16.6	16.9	30.4	8.1	25	86.6	26.3	13.7	94.7	19.2	30.9	9.7	23.4	21.2	59.7	53.6

Parameter	TP23-22	TP23-23	TP23-24	TP23-25	TP23-26	TP23-27	TP23-28	TP23-29	TP23-30	TP23-31	TP23-32	TP23-33	TP23-34	TP23-35	TP23-36	TP23-37	OMR23-38	OMR23-39	OMR23-40	OMR23-41	OMR23-42
Antimony	0.52	12	10.8	3.83	3.93	14.8	6.91	12.4	9.19	14	10.8	1.62	1.69	4.92	3.7	12.1	0.86	1.16	3.17	3.56	6.04
Barium	192	**2770**	51.3	71.3	126	81.3	59.2	42.5	77.9	46.8	79.1	172	91.4	172	98	50.4	39.6	47.4	30.6	24.5	53.2
Cobalt	11	12.4	2.62	2.4	3.36	2.32	1.93	3.27	3.72	2.67	1.88	5.86	2.55	2.72	1.27	2.06	8.62	9.33	12.8	19.1	12.3
Copper	22.3	35.3	18.6	13.6	25.8	8.17	**145**	**76.7**	45.6	**66.6**	23.6	41.9	33.5	**121**	50.3	15.2	21.8	26.7	44	52	32.4
Selenium	<0.20	0.31	<0.30	0.56	0.69	<0.30	**1.54**	**1.31**	**1.09**	**1.42**	0.63	**1.16**	**1.05**	**3.23**	**2.27**	0.46	<0.20	<0.20	<0.20	<0.20	<0.20
Vanadium	50.6	42.8	5.58	1.45	1.73	4.59	4.3	4.08	3.81	3.58	3.33	29.4	12.2	7.41	1.99	4.24	32.2	34	39	51.5	39.4
Zinc	50.2	**768**	60.9	33	57	49.4	60.4	28.8	26.3	83.6	68	17.1	13.7	5.2	19.1	13.4	41.4	47.8	48	49.9	50.4

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Associated Environmental

Subject Property

Parcel Boundary

Test Pits

Concentrations less than NWT Tier 1 RL/PL CS/FS guidelines

Concentrations greater than NWT Tier 1 RL/PL CS/FS guidelines

AE PROJECT NO.	2023-8451
SCALE	1:3,000
COORD. SYSTEM	NAD 1983 UTM ZONE 11N
DATE	2023-12-19
REV	00
DRAWN BY	BDJ
CHECKED BY	TR

FIGURE 4: SOIL ANALYTICAL RESULTS – OTHER METALS

GOVERNMENT OF NORTHWEST TERRITORIES

PHASE II/III ESA – TIN CAN HILL, YELLOWKNIFE, NT

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Guidelines Legend	Antimony	Barium	Boron	Cobalt	Copper	Selenium	Vanadium	Zinc
2023 Draft Residential Guidelines	7.5	390	3.3	20	63	1	18	250

NWT Draft 2023 Environmental Guideline for Contaminated Site Remediation

77.1 Concentrations less than the 2023 Draft Residential Guidelines

126 Highlighted value exceeds the 2023 Draft Residential Guidelines

<5.0 Detection limit is greater than the guideline

Units for all parameters are mg/kg

Parameter	TP23-01	TP23-02	TP23-03	TP23-04	TP23-05	TP23-06	TP23-07	TP23-08	TP23-09	TP23-10	TP23-11	TP23-12	TP23-13	TP23-14	TP23-15	TP23-16	TP23-17	TP23-18	TP23-19	TP23-20	TP23-21
Antimony	1.14	6.52	3.42	17.1	9.03	27	7.45	1.34	1.89	36	2.66	27.4	7.15	9.08	4.16	2.84	3.11	16.9	12.2	15.7	1.72
Barium	93.1	22.5	32.7	51.7	102	10.6	37.3	74.6	9.83	30	68.2	54.9	53.2	292	43.8	84.5	80.7	112	31	212	169
Boron	<9.3	<9.3	<9.4	<9.4	<9.3	<9.4	<9.4	<9.4	<9.4	<9.4	<9.4	<9.4	<7.5	<7.4	<7.5	9.1	22.6	<7.5	<7.4	<7.4	8.4
Cobalt	13.2	1.67	1.29	6.04	23.5	1.1	1.84	12.9	0.28	4.14	12.3	5.32	2.88	40.6	6.92	1.92	1.42	4.4	4.25	13.8	11
Copper	68.8	12.4	7.71	18.8	30.8	16	14.3	17.4	3.63	32.2	15.5	18.4	7.4	35.4	22.7	15.1	21.2	20.3	28	25.9	31.6
Selenium	0.49	<0.37	<0.38	<0.38	<0.37	<0.38	0.43	<0.37	<0.37	0.42	<0.37	<0.37	<0.30	<0.30	<0.30	0.49	1.14	<0.30	<0.30	<0.30	0.27
Vanadium	41	1.78	1.66	4.05	44.3	4.25	2.45	45.6	0.77	3.45	42.7	10.7	9.9	7.89	26.3	3.81	3.44	9.84	9.73	26	55.1
Zinc	40.1	5.8	4.1	20.5	76.5	16.6	16.9	30.4	8.1	25	86.6	26.3	13.7	94.7	19.2	30.9	9.7	23.4	21.2	59.7	53.6

Parameter	TP23-22	TP23-23	TP23-24	TP23-25	TP23-26	TP23-27	TP23-28	TP23-29	TP23-30	TP23-31	TP23-32	TP23-33	TP23-34	TP23-35	TP23-36	TP23-37	OMR23-38	OMR23-39	OMR23-40	OMR23-41	OMR23-42
Antimony	0.52	12	10.8	3.83	3.93	14.8	6.91	12.4	9.19	14	10.8	1.62	1.69	4.92	3.7	12.1	0.86	1.16	3.17	3.56	6.04
Barium	192	2770	51.3	71.3	126	81.3	59.2	42.5	77.9	46.8	79.1	172	91.4	172	98	50.4	39.6	47.4	30.6	24.5	53.2
Boron	10.4	<7.4	8.5	10.2	13.6	<7.5	8.5	25.3	24.8	29.2	32.5	6.2	12.8	17.9	21.4	<7.4	<5.0	<5.0	<5.0	<5.0	<5.0
Cobalt	11	12.4	2.62	2.4	3.36	2.32	1.93	3.27	3.72	2.67	1.88	5.86	2.55	2.72	1.27	2.06	8.62	9.33	12.8	19.1	12.3
Copper	22.3	35.3	18.6	13.6	25.8	8.17	145	76.7	45.6	66.6	23.6	41.9	33.5	121	50.3	15.2	21.8	26.7	44	52	32.4
Selenium	<0.20	0.31	<0.30	0.56	0.69	<0.30	1.54	1.31	1.09	1.42	0.63	1.16	1.05	3.23	2.27	0.46	<0.20	<0.20	<0.20	<0.20	<0.20
Vanadium	50.6	42.8	5.58	1.45	1.73	4.59	4.3	4.08	3.81	3.58	3.33	29.4	12.2	7.41	1.99	4.24	32.2	34	39	51.5	39.4
Zinc	50.2	768	60.9	33	57	49.4	60.4	28.8	26.3	83.6	68	17.1	13.7	5.2	19.1	13.4	41.4	47.8	48	49.9	50.4

Associated Environmental

Subject Property

Parcel Boundary

Test Pits

Concentrations less than the 2023 Draft Residential Guidelines

Concentrations less than the 2023 Draft Residential Guidelines and detection limit is greater than the guideline

Concentrations greater than the 2023 Draft Residential Guidelines

AE PROJECT NO.	2023-8451
SCALE	1:3,000
COORD. SYSTEM	NAD 1983 UTM ZONE 11N
DATE	2023-12-19
REV	00
DRAWN BY	BDJ
CHECKED BY	TR

FIGURE 5: SOIL ANALYTICAL RESULTS – OTHER METALS, DRAFT GUIDELINES

GOVERNMENT OF NORTHWEST TERRITORIES

PHASE II/III ESA – TIN CAN HILL, YELLOWKNIFE, NT

F:\MAPPING\PROJECTS\2023\2023-8451_TINCANHILL_NWT_PH2\TINCANHILL_NWT_PH2.APRX

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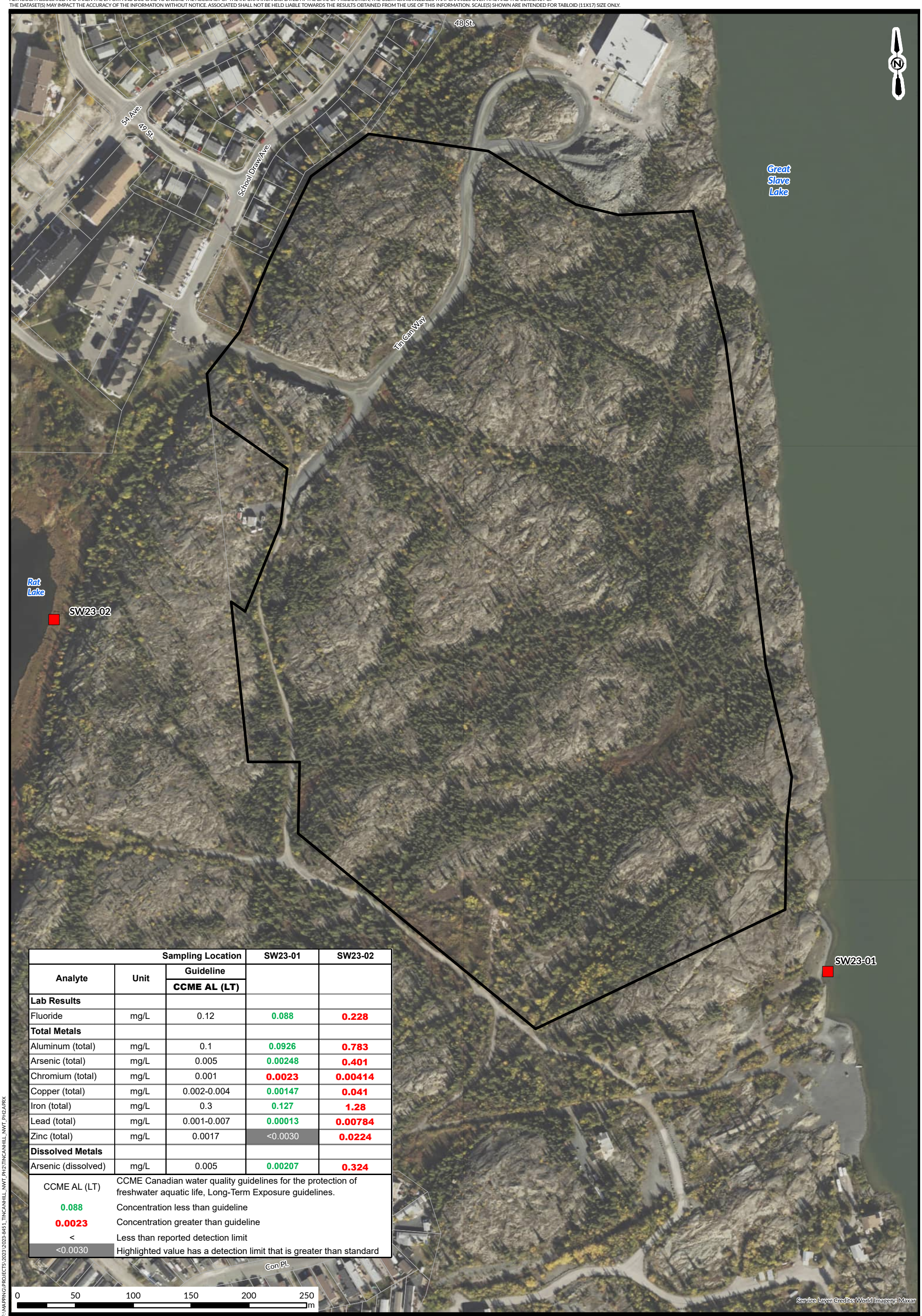

Analyte	Unit	Sampling Location / Guideline CCME AL (LT)	SW23-01	SW23-02
Lab Results				
Fluoride	mg/L	0.12	0.088	**0.228**
Total Metals				
Aluminum (total)	mg/L	0.1	0.0926	**0.783**
Arsenic (total)	mg/L	0.005	0.00248	**0.401**
Chromium (total)	mg/L	0.001	**0.0023**	**0.00414**
Copper (total)	mg/L	0.002-0.004	0.00147	**0.041**
Iron (total)	mg/L	0.3	0.127	**1.28**
Lead (total)	mg/L	0.001-0.007	0.00013	**0.00784**
Zinc (total)	mg/L	0.0017	<0.0030	**0.0224**
Dissolved Metals				
Arsenic (dissolved)	mg/L	0.005	0.00207	**0.324**

CCME AL (LT)	CCME Canadian water quality guidelines for the protection of freshwater aquatic life, Long-Term Exposure guidelines.
0.088	Concentration less than guideline
0.0023	Concentration greater than guideline
<	Less than reported detection limit
<0.0030	Highlighted value has a detection limit that is greater than standard

Associated Environmental

- Subject Property
- Parcel Boundary

Water Sample Locations

- Concentration less than guideline
- Concentration greater than guideline

AE PROJECT NO.	2023-8451
SCALE	1:3,000
COORD. SYSTEM	NAD 1983 UTM ZONE 11N
DATE	2023-12-18
REV	00
DRAWN BY	BDJ
CHECKED BY	TR

FIGURE 6: SURFACE WATER ANALYTICAL RESULTS

GOVERNMENT OF NORTHWEST TERRITORIES

PHASE II/III ESA – TIN CAN HILL, YELLOWKNIFE, NT

F:\MAPPING\PROJECTS\2023\2023-8451_TINCANHILL_NWT_PH2\TINCANHILL_NWT_PH2.APRX

View of the Site from the west

View of the Site from the northeast

View of the Site from the north

View of the northern portion of the Site from the south

APPENDIX B

PHASE II/III ESA TABLES

Table 1: Summary of Soil Analytical Results - Particle Size

			Sampling Location	OMR23-38-0.1	OMR23-39-0.1	OMR23-40-0.1	OMR23-41-0.1	OMR23-42-0.1	TP23-01-0.2	TP23-11-0.1	TP23-21-0.3	TP23-22-0.2
			Date Sampled	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	27-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23
			Lab Sample ID	EO2309073-038	EO2309073-039	EO2309073-040	EO2309073-041	EO2309073-042	EO2309073-001	EO2309073-011	EO2309073-021	EO2309073-022
			Soil Type	Sand & Gravel	Sand & Gravel	Sand & Gravel	Sand & Gravel	Sand & Gravel	Silt	Silt/Peat	Silt/Peat	Silt
			Sample Depth (m)	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.2	0-0.1	0-0.3	0-0.2
			Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Analyte	**Unit**	**Guideline**										
		NWT Tier 1 RL/PL CS	NWT Tier 1 RL/PL FS									
Lab Results												
Particle Size												
Fines (<0.075mm)	%	NG	NG	19.5	25.7	22.0	25.2	26.6	53.2	62.2	84.0	82.7
Sand (>0.075mm)	%	NG	NG	80.5	74.3	78.0	74.8	73.4	46.8	37.8	16.0	17.3
Texture		NG	NG	Coarse	Coarse	Coarse	Coarse	Coarse	Fine	Fine	Fine	Fine

Accompanying lab reports: **ALS - E02309073**

NWT Tier 1 RL/PL CS	Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use and Coarse-grained Soil
NWT Tier 1 RL/PL FS	Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use and Fine-grained Soil
NWT Tier 1 RL/PL CS	Highlighted value exceeds NWT Tier 1 RL/PL CS
NWT Tier 1 RL/PL FS	Highlighted value exceeds NWT Tier 1 RL/PL FS
-	Not analyzed
<	Less than reported detection limit
NG	No guideline
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 2: Summary of Soil Analytical Results - Metals

Analyte	Unit	Guideline: NWT Tier 1 RL/PL CS/FS	Guideline: 2023 Draft Residential Guidelines	Sampling Location	OMR23-38-0.1	OMR23-39-0.1	OMR23-40-0.1	OMR23-41-0.1	OMR23-42-0.1	TP23-01-0.2	TP23-02-0.2	TP23-03-0.1	TP23-04-0.1	TP23-04-0.1	Relative Percent Difference	TP23-05-0.1	TP23-06-0.1	TP23-07-0.1
				Date Sampled	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	27-Sep-23	27-Sep-23	27-Sep-23	28-Sep-23	28-Sep-23		28-Sep-23	28-Sep-23	28-Sep-23
				Lab Sample ID	EO2309073-038	EO2309073-039	EO2309073-040	EO2309073-041	EO2309073-042	EO2309073-001	EO2309073-002	EO2309073-003	EO2309073-004	EO2309073-043		EO2309073-005	EO2309073-006	EO2309073-007
				Soil Type	Sand & Gravel	Sand & Gravel	Sand & Gravel	Sand & Gravel	Sand & Gravel	Silt	Peat	Peat	Peat	Peat		Silt/Peat	Peat	Peat
				Sample Depth (m)	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.2	0-0.2	0-0.1	0-0.1	0-0.1		0-0.1	0-0.1	0-0.1
				Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Duplicate		Normal	Normal	Normal
															RPD %			
Lab Results																		
General																		
pH (in 2:1 water:soil mixture)		6 - 8	6 - 8		7.46	8.05	8.04	7.89	8.29	7.24	5.38	5.66	4.37	4.60	5.1%	5.11	5.97	5.84
Metals																		
Aluminum	mg/kg	NG	NG		9810	10600	11500	16100	12100	13300	1200	755	2420	1700	35.0%	11000	1150	1280
Antimony	mg/kg	20	7.5		0.86	1.16	3.17	3.56	6.04	1.14	6.52	3.42	17.1	16.8	1.8%	9.03	27.0	7.45
Arsenic (inorganic)	mg/kg	12 [1.1,2.1]	17		77.1	126	903	1850	554	49.6	27.4	35.4	98.4	98.5	0.1%	330	152	31.6
Arsenic (inorganic)	mg/kg	160 [1.2,2.2]	120		77.1	126	903	1850	554	49.6	27.4	35.4	98.4	98.5	0.1%	330	152	31.6
Barium	mg/kg	500	390		39.6	47.4	30.6	24.5	53.2	93.1	22.5	32.7	51.7	45.2	13.4%	102	10.6	37.3
Beryllium	mg/kg	4	5		0.18	0.18	0.16	0.14	0.19	0.37	<0.19	<0.19	<0.19	<0.15	*	0.23	<0.19	<0.19
Bismuth	mg/kg	NG	NG		<0.20	<0.20	<0.20	0.27	0.22	<0.37	<0.37	<0.38	<0.38	<0.30	*	<0.37	<0.38	<0.38
Boron	mg/kg	NG	3.3		<5.0	<5.0	<5.0	<5.0	<5.0	<9.3	<9.3	<9.4	<9.4	<7.5	*	<9.3	<9.4	<9.4
Cadmium	mg/kg	10	1.4		0.071	0.096	0.091	0.098	0.143	0.117	0.293	0.250	0.417	0.308	30.1%	1.10	0.104	0.443
Calcium	mg/kg	NG	NG		2550	5750	9430	24400	6580	13900	6800	5260	6620	5530	17.9%	7580	5760	23200
Chromium (total)	mg/kg	64	64		35.5	41.1	35.7	44.6	44.2	40.4	1.50	1.20	3.28	2.63	22.0%	32.5	3.29	1.72
Cobalt	mg/kg	50	20		8.62	9.33	12.8	19.1	12.3	13.2	1.67	1.29	6.04	4.06	39.2%	23.5	1.10	1.84
Copper	mg/kg	63	63		21.8	26.7	44.0	52.0	32.4	68.8	12.4	7.71	18.8	14.8	23.8%	30.8	16.0	14.3
Iron	mg/kg	NG	NG		17000	18400	21800	30300	20700	22100	1360	999	3140	2190	35.6%	19100	1970	1170
Lead	mg/kg	140	70		8.93	16.4	14.7	20.1	37.5	5.80	1.54	<0.94	6.11	10.1	49.2%	28.3	1.76	1.68
Lithium	mg/kg	NG	NG		18.3	20.4	19.8	29.0	24.2	23.3	<3.7	<3.8	<3.8	<3.0	*	20.4	<3.8	<3.8
Magnesium	mg/kg	NG	NG		6390	7650	9120	15400	9010	8210	964	1120	984	756	26.2%	5760	1180	1870
Manganese	mg/kg	NG	NG		195	227	299	502	256	404	74.0	71.2	143	139	2.8%	1370	72.8	330
Mercury (inorganic)	mg/kg	6.6	6.6		<0.0050	<0.0050	<0.0050	0.0086	0.0220	0.0252	0.0652	0.0390	0.0910	0.111	19.8%	0.0778	0.0550	0.0865
Molybdenum	mg/kg	10	4		0.36	0.37	0.44	0.42	0.42	0.30	0.49	0.43	0.29	0.20	36.7%	0.31	0.24	0.71
Nickel	mg/kg	50	45		23.8	30.7	32.4	42.0	33.2	33.8	3.05	2.29	8.41	6.37	27.6%	28.8	4.34	5.75
Phosphorus	mg/kg	NG	NG		448	571	495	357	411	594	373	239	646	438	38.4%	330	363	364
Potassium	mg/kg	NG	NG		1450	1870	1090	840	2260	1630	220	<190	400	290	31.9%	470	250	<190
Selenium	mg/kg	1	1		<0.20	<0.20	<0.20	<0.20	<0.20	0.49	<0.37	<0.38	<0.38	<0.30	*	<0.37	<0.38	0.43
Silver	mg/kg	20	20		0.12	<0.10	0.22	0.16	0.23	<0.19	<0.19	<0.19	<0.19	<0.15	*	<0.19	<0.19	<0.19
Sodium	mg/kg	NG	NG		136	138	162	146	151	178	<93	<94	<94	<75	*	<93	<94	<94
Strontium	mg/kg	NG	NG		5.22	7.75	9.98	17.0	7.68	17.2	13.7	12.8	11.9	8.78	30.2%	15.2	8.41	25.0
Sulphur	mg/kg	NG	NG		<1000	<1000	<1000	1200	<1000	<1900	<1900	<1900	<1900	<1500	*	<1900	<1900	<1900
Thallium	mg/kg	1	1		0.072	0.073	0.060	<0.050	0.096	0.098	<0.093	<0.094	<0.094	<0.075	*	<0.093	<0.094	<0.094
Tin	mg/kg	50	NG		<2.0	<2.0	<2.0	<2.0	<2.0	<3.7	<3.7	<3.8	<3.8	<3.0	*	<3.7	<3.8	<3.8
Titanium	mg/kg	NG	NG		367	349	341	231	428	436	5.6	11.0	23.8	28.9	19.4%	256	8.2	7.2
Tungsten	mg/kg	NG	NG		<0.50	0.64	0.64	0.68	0.59	<0.93	<0.93	<0.94	<0.94	<0.75	*	<0.93	<0.94	<0.94
Uranium	mg/kg	NG	23		0.774	0.633	0.621	0.445	0.699	2.21	0.529	0.331	0.389	0.261	39.4%	0.474	0.122	0.514
Vanadium	mg/kg	130	18		32.2	34.0	39.0	51.5	39.4	41.0	1.78	1.66	4.05	3.37	18.3%	44.3	4.25	2.45
Zinc	mg/kg	200	250		41.4	47.8	48.0	49.9	50.4	40.1	5.8	4.1	20.5	15.4	28.4%	76.5	16.6	16.9
Zirconium	mg/kg	NG	NG		<1.0	<1.0	<1.0	<1.0	2.1	4.4	<1.9	<1.9	<1.9	<1.5	*	<1.9	<1.9	<1.9

Accompanying lab reports: **ALS - E02309073**

NWT Tier 1 RL/PL CS/FS	Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use for coarse-grained soil/fine-grained soil
NWT Tier 1 RL/PL CS/FS	Highlighted value exceeds NWT Tier 1 RL/PL CS/FS
2023 Draft Residential Guidelines	Highlighted value exceeds the Draft 2023 Environmental Residential Guideline for Contaminated Site Remediation
-	Not analyzed
<	Less than reported detection limit
NG	No guideline
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 2: Summary of Soil Analytical Results - Metals

Analyte	Unit	Guideline: NWT Tier 1 RL/PL CS/FS	Guideline: 2023 Draft Residential Guidelines	Sampling Location	TP23-08-0.2	TP23-08-0.2	Relative Percent Difference	TP23-09-0.2	TP23-10-0.1	TP23-11-0.1	TP23-12-0.1	TP23-13-0.1	TP23-14-0.1	TP23-15-0.1	TP23-16-0.1	TP23-17-0.3	TP23-18-0.1	TP23-19-0.1
				Date Sampled	28-Sep-23	28-Sep-23		28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23
				Lab Sample ID	EO2309073-008	EO2309073-044		EO2309073-009	EO2309073-010	EO2309073-011	EO2309073-012	EO2309073-013	EO2309073-014	EO2309073-015	EO2309073-016	EO2309073-017	EO2309073-018	EO2309073-019
				Soil Type	Silt/Peat	Silt/Peat		Peat	Peat	Silt/Peat	Peat	Peat	Peat	Peat	Peat	Silt/Peat	Peat	Peat
				Sample Depth (m)	0-0.2	0-0.2		0-0.2	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.3	0-0.1	0-0.1
				Sample Type	Normal	Duplicate		Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Lab Results							RPD %											
General																		
pH (in 2:1 water:soil mixture)		6 - 8	6 - 8		4.89	4.58	6.5%	4.30	6.15	6.07	5.45	4.15	5.36	5.01	6.78	6.94	4.52	6.34
Metals																		
Aluminum	mg/kg	NG	NG		10400	11600	10.9%	257	1840	15500	4880	2760	3050	6790	1070	1120	3000	3100
Antimony	mg/kg	20	7.5		1.34	1.33	0.7%	1.89	36.0	2.66	27.4	7.15	9.08	4.16	2.84	3.11	16.9	12.2
Arsenic (inorganic)	mg/kg	12 [1.1,2.1]	17		134	147	9.3%	39.8	55.6	105	124	121	98.3	470	29.8	9.77	1190	81.4
Arsenic (inorganic)	mg/kg	160 [1.2,2.2]	120		134	147	9.3%	39.8	55.6	105	124	121	98.3	470	29.8	9.77	1190	81.4
Barium	mg/kg	500	390		71.2	74.6	4.7%	9.83	30.0	68.2	54.9	53.2	292	43.8	84.5	80.7	112	31.0
Beryllium	mg/kg	4	5		<0.19	0.17	*	<0.19	<0.19	0.26	0.20	<0.15	0.22	0.18	<0.15	<0.15	<0.15	<0.15
Bismuth	mg/kg	NG	NG		<0.37	<0.29	*	<0.37	<0.37	<0.37	<0.37	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Boron	mg/kg	NG	3.3		<9.4	<7.4	*	<9.4	<9.4	<9.4	<9.4	<7.5	<7.4	<7.5	9.1	22.6	<7.5	<7.4
Cadmium	mg/kg	10	1.4		0.234	0.293	22.4%	0.118	0.617	0.158	0.360	0.153	1.33	0.927	0.417	0.308	0.465	0.244
Calcium	mg/kg	NG	NG		7270	8660	17.5%	946	27000	6100	16600	3120	11900	11000	39200	46500	7560	19700
Chromium (total)	mg/kg	64	64		34.9	39.4	12.1%	<0.94	3.50	46.9	9.49	9.66	5.41	17.1	1.99	2.49	9.02	11.0
Cobalt	mg/kg	50	20		12.5	12.9	3.1%	0.28	4.14	12.3	5.32	2.88	40.6	6.92	1.92	1.42	4.40	4.25
Copper	mg/kg	63	63		15.9	17.4	9.0%	3.63	32.2	15.5	18.4	7.40	35.4	22.7	15.1	21.2	20.3	28.0
Iron	mg/kg	NG	NG		18100	18500	2.2%	474	2030	20700	5290	4820	4480	10900	1380	1180	5280	5390
Lead	mg/kg	140	70		9.04	6.93	26.4%	<0.94	2.24	13.2	30.1	10.9	14.5	12.6	2.11	1.06	48.0	19.2
Lithium	mg/kg	NG	NG		17.3	17.1	1.2%	<3.7	<3.7	25.5	<3.7	<3.0	<3.0	6.9	<3.0	<3.0	<3.0	4.2
Magnesium	mg/kg	NG	NG		4340	5390	21.6%	282	1520	6380	1810	1470	1350	2780	1540	1430	1880	2300
Manganese	mg/kg	NG	NG		191	211	10.0%	21.0	476	378	786	42.6	3330	376	365	332	201	172
Mercury (inorganic)	mg/kg	6.6	6.6		0.0243	0.0295	19.3%	0.0365	0.0482	0.0283	0.177	0.0897	0.128	0.0568	0.0555	0.0427	0.143	0.0872
Molybdenum	mg/kg	10	4		0.34	0.33	3.0%	<0.19	0.46	0.23	0.29	0.46	0.37	0.20	0.51	0.33	0.39	1.54
Nickel	mg/kg	50	45		23.0	22.5	2.2%	<0.94	12.0	30.0	9.91	7.27	26.6	13.0	5.45	7.76	13.0	13.5
Phosphorus	mg/kg	NG	NG		201	285	34.6%	123	518	250	835	310	705	378	407	565	490	449
Potassium	mg/kg	NG	NG		240	310	25.5%	<190	290	320	460	740	510	260	210	<150	660	410
Selenium	mg/kg	1	1		<0.37	0.31	*	<0.37	0.42	<0.37	<0.37	<0.30	<0.30	<0.30	0.49	1.14	<0.30	<0.30
Silver	mg/kg	20	20		<0.19	<0.15	*	<0.19	<0.19	<0.19	<0.19	<0.15	0.25	<0.15	<0.15	<0.15	<0.15	<0.15
Sodium	mg/kg	NG	NG		141	137	2.9%	<94	<94	<94	<94	<75	91	<75	<74	<75	<75	<74
Strontium	mg/kg	NG	NG		9.29	10.3	10.3%	2.98	19.4	10.5	14.4	8.71	26.9	8.48	29.1	37.4	15.7	13.1
Sulphur	mg/kg	NG	NG		<1900	<1500	*	<1900	<1900	<1900	<1900	<1500	<1500	<1500	<1500	2800	<1500	<1500
Thallium	mg/kg	1	1		<0.094	<0.074	*	<0.094	<0.094	<0.094	<0.094	<0.075	0.093	<0.075	<0.074	<0.075	<0.075	<0.074
Tin	mg/kg	50	NG		<3.7	<2.9	*	<3.7	<3.7	<3.7	<3.7	4.8	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Titanium	mg/kg	NG	NG		334	506	41.0%	5.8	22.8	383	42.8	123	54.4	220	36.2	23.9	111	75.4
Tungsten	mg/kg	NG	NG		<0.94	<0.74	*	<0.94	<0.94	<0.94	<0.94	<0.75	<0.74	<0.75	<0.74	<0.75	<0.75	<0.74
Uranium	mg/kg	NG	23		0.930	1.07	14.0%	<0.094	0.462	0.642	1.13	0.437	0.289	0.340	3.70	5.11	0.308	0.336
Vanadium	mg/kg	130	18		42.4	45.6	7.3%	0.77	3.45	42.7	10.7	9.90	7.89	26.3	3.81	3.44	9.84	9.73
Zinc	mg/kg	200	250		30.4	30.4	0.0%	8.1	25.0	86.6	26.3	13.7	94.7	19.2	30.9	9.7	23.4	21.2
Zirconium	mg/kg	NG	NG		<1.9	1.8	*	<1.9	<1.9	<1.9	<1.9	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5

Accompanying lab reports: **ALS - E02309073**

NWT Tier 1 RL/PL CS/FS	Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use for coarse-grained soil/fine-grained soil
NWT Tier 1 RL/PL CS/FS	Highlighted value exceeds NWT Tier 1 RL/PL CS/FS
2023 Draft Residential Guidelines	Highlighted value exceeds the Draft 2023 Environmental Residential Guideline for Contaminated Site Remediation
-	Not analyzed
<	Less than reported detection limit
NG	No guideline
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 2: Summary of Soil Analytical Results - Metals

Analyte	Unit	Guideline: NWT Tier 1 RL/PL CS/FS	Guideline: 2023 Draft Residential Guidelines	Sampling Location	TP23-20-0.1	TP23-21-0.3	TP23-22-0.2	TP23-23-0.1	TP23-24-0.2	TP23-25-0.1	TP23-26-02	TP23-27-0.1	TP23-28-0.2	TP23-29-0.3	TP23-30-0.4	TP23-30-0.4	Relative Percent Difference	TP23-31-0.3
				Date Sampled	28-Sep-23	28-Sep-23	28-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23		29-Sep-23
				Lab Sample ID	EO2309073-020	EO2309073-021	EO2309073-022	EO2309073-023	EO2309073-024	EO2309073-025	EO2309073-026	EO2309073-027	EO2309073-028	EO2309073-029	EO2309073-030	EO2309073-045		EO2309073-031
				Soil Type	Peat	Silt/Peat	Silt	Peat	Silt/Peat	Silt/Peat	Silt/Peat	Silt/Peat	Silt/Peat	Silt	Silt	Silt		Silt
				Sample Depth (m)	0-0.1	0-0.3	0-0.2	0-0.1	0-0.2	0-0.1	0-0.2	0-0.1	0-0.2	0-0.3	0-0.4	0-0.4		0-0.3
				Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Duplicate		Normal
																	RPD %	
Lab Results																		
General																		
pH (in 2:1 water:soil mixture)		6 - 8	6 - 8		5.68	7.25	7.81	6.04	5.99	6.44	6.69	4.85	5.71	6.25	6.45	6.34	1.7%	6.36
Metals																		
Aluminum	mg/kg	NG	NG		8100	18700	20400	9330	1090	1110	1700	933	1140	860	1440	1060	30.4%	978
Antimony	mg/kg	20	7.5		15.7	1.72	0.52	12.0	10.8	3.83	3.93	14.8	6.91	12.4	8.32	9.19	9.9%	14.0
Arsenic (inorganic)	mg/kg	12 [1.1,2.1]	17		446	21.4	16.2	291	43.2	18.8	41.9	260	15.0	37.0	61.7	38.0	47.5%	41.7
Arsenic (inorganic)	mg/kg	160 [1.2,2.2]	120		446	21.4	16.2	291	43.2	18.8	41.9	260	15.0	37.0	61.7	38.0	47.5%	41.7
Barium	mg/kg	500	390		212	169	192	2770	51.3	71.3	126	81.3	59.2	42.5	66.7	77.9	15.5%	46.8
Beryllium	mg/kg	4	5		0.23	0.64	0.78	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	*	<0.15
Bismuth	mg/kg	NG	NG		<0.30	0.29	0.28	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	*	<0.29
Boron	mg/kg	NG	3.3		<7.4	8.4	10.4	<7.4	8.5	10.2	13.6	<7.5	8.5	25.3	19.3	24.8	24.9%	29.2
Cadmium	mg/kg	10	1.4		0.641	0.139	0.064	1.02	1.05	0.333	0.472	1.02	0.654	0.415	0.278	0.264	5.2%	0.577
Calcium	mg/kg	NG	NG		12400	8030	7250	10700	21800	43900	52000	11800	35500	28800	40400	49300	19.8%	27200
Chromium (total)	mg/kg	64	64		23.4	56.3	51.3	34.5	2.73	1.81	2.35	2.79	2.17	1.98	2.77	2.12	26.6%	2.60
Cobalt	mg/kg	50	20		13.8	11.0	11.0	12.4	2.62	2.40	3.36	2.32	1.93	3.27	3.72	3.54	5.0%	2.67
Copper	mg/kg	63	63		25.9	31.6	22.3	35.3	18.6	13.6	25.8	8.17	145	76.7	39.2	45.6	15.1%	66.6
Iron	mg/kg	NG	NG		13400	24700	27100	17000	1460	977	1120	1660	1020	1610	2370	2420	2.1%	3830
Lead	mg/kg	140	70		26.8	7.17	7.80	68.9	9.96	1.49	0.99	14.0	3.80	10.5	4.53	1.68	*	2.48
Lithium	mg/kg	NG	NG		10.7	32.0	33.6	15.5	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	*	<2.9
Magnesium	mg/kg	NG	NG		4780	9290	9650	6540	1300	1870	1770	975	844	1070	1440	1280	11.8%	1220
Manganese	mg/kg	NG	NG		1740	236	376	531	408	687	2080	335	235	40.9	215	137	44.3%	37.7
Mercury (inorganic)	mg/kg	6.6	6.6		0.139	0.0134	0.0102	0.108	0.119	0.0605	0.0601	0.154	0.0901	0.0664	0.0669	0.0546	20.2%	0.0717
Molybdenum	mg/kg	10	4		0.58	0.84	0.50	0.39	0.92	0.57	0.65	0.89	0.41	1.28	0.63	0.32	65.3%	1.64
Nickel	mg/kg	50	45		26.4	34.1	31.3	25.2	9.64	6.28	14.9	3.90	35.0	16.8	12.9	13.1	1.5%	27.0
Phosphorus	mg/kg	NG	NG		601	500	480	460	630	699	636	579	420	339	578	406	35.0%	355
Potassium	mg/kg	NG	NG		840	3090	3740	470	600	180	180	700	300	<150	<150	<150	*	<150
Selenium	mg/kg	1	1		<0.30	0.27	<0.20	0.31	<0.30	0.56	0.69	<0.30	1.54	1.31	0.75	1.09	37.0%	1.42
Silver	mg/kg	20	20		0.28	<0.10	<0.10	0.24	<0.15	<0.15	<0.15	0.16	<0.15	<0.15	<0.15	<0.15	*	<0.15
Sodium	mg/kg	NG	NG		<74	306	347	87	<74	<74	<74	<75	<75	<74	<74	<74	*	<74
Strontium	mg/kg	NG	NG		24.7	26.0	34.1	74.6	29.8	44.5	56.0	26.1	28.6	33.5	42.5	51.4	19.0%	31.4
Sulphur	mg/kg	NG	NG		<1500	<1000	<1000	<1500	<1500	1700	1700	<1500	<1500	7400	5100	6200	19.5%	8100
Thallium	mg/kg	1	1		0.093	0.204	0.210	<0.074	<0.074	<0.074	<0.074	<0.075	<0.075	<0.074	<0.074	<0.074	*	<0.074
Tin	mg/kg	50	NG		4.5	<2.0	<2.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	*	<2.9
Titanium	mg/kg	NG	NG		222	810	757	374	23.6	9.2	22.2	26.6	14.8	23.5	28.3	17.6	46.6%	22.9
Tungsten	mg/kg	NG	NG		<0.74	<0.50	<0.50	<0.74	<0.74	<0.74	<0.74	<0.75	<0.75	<0.74	<0.74	<0.74	*	<0.74
Uranium	mg/kg	NG	23		0.473	3.27	1.17	0.763	0.687	0.764	0.824	1.06	4.44	5.97	2.93	3.93	29.2%	5.56
Vanadium	mg/kg	130	18		26.0	55.1	50.6	42.8	5.58	1.45	1.73	4.59	4.30	4.08	3.81	2.81	30.2%	3.58
Zinc	mg/kg	200	250		59.7	53.6	50.2	768	60.9	33.0	57.0	49.4	60.4	28.8	26.3	14.2	*	83.6
Zirconium	mg/kg	NG	NG		<1.5	20.3	18.8	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	*	<1.5

Accompanying lab reports: **ALS - E02309073**

NWT Tier 1 RL/PL CS/FS	Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use for coarse-grained soil/fine-grained soil
NWT Tier 1 RL/PL CS/FS	Highlighted value exceeds NWT Tier 1 RL/PL CS/FS
2023 Draft Residential Guidelines	Highlighted value exceeds the Draft 2023 Environmental Residential Guideline for Contaminated Site Remediation
-	Not analyzed
<	Less than reported detection limit
NG	No guideline
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 2: Summary of Soil Analytical Results - Metals

Analyte	Unit	Guideline: NWT Tier 1 RL/PL CS/FS	Guideline: 2023 Draft Residential Guidelines	Sampling Location	TP23-32-0.3	TP23-33-0.1	TP23-34-0.2	TP23-34-0.2	Relative Percent Difference	TP23-35-0.2	TP23-36-0.2	TP23-37-0.1
				Date Sampled	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23		29-Sep-23	29-Sep-23	29-Sep-23
				Lab Sample ID	EO2309073-032	EO2309073-033	EO2309073-034	EO2309073-046		EO2309073-035	EO2309073-036	EO2309073-037
				Soil Type	Silt	Silt/Peat	Peat	Peat		Silt/Peat	Silt	Silt/Peat
				Sample Depth (m)	0-0.3	0-0.1	0-0.2	0-0.2		0-0.2	0-0.2	0-0.1
				Sample Type	Normal	Normal	Normal	Duplicate		Normal	Normal	Normal
Lab Results												
General												
pH (in 2:1 water:soil mixture)		6 - 8	6 - 8		6.42	6.93	6.52	6.44	1.2%	6.85	6.74	5.19
Metals												
Aluminum	mg/kg	NG	NG		609	8650	4050	4900	19.0%	2280	1180	2240
Antimony	mg/kg	20	7.5		10.8	1.62	1.61	1.69	4.8%	4.92	3.70	12.1
Arsenic (inorganic)	mg/kg	12 [1.1,2.1]	17		53.3	14.1	25.5	26.3	3.1%	11.3	9.54	46.7
Arsenic (inorganic)	mg/kg	160 [1.2,2.2]	120		53.3	14.1	25.5	26.3	3.1%	11.3	9.54	46.7
Barium	mg/kg	500	390		79.1	172	91.3	91.4	0.1%	172	98.0	50.4
Beryllium	mg/kg	4	5		<0.15	0.41	<0.15	<0.15	*	<0.15	<0.15	<0.15
Bismuth	mg/kg	NG	NG		<0.30	<0.20	<0.29	<0.30	*	<0.30	<0.29	<0.30
Boron	mg/kg	NG	3.3		32.5	6.2	12.8	12.1	5.6%	17.9	21.4	<7.4
Cadmium	mg/kg	10	1.4		0.304	0.163	0.208	0.187	10.6%	0.436	0.441	0.300
Calcium	mg/kg	NG	NG		40200	27000	48400	49100	1.4%	64500	51300	17700
Chromium (total)	mg/kg	64	64		1.59	22.8	10.4	12.7	19.9%	3.35	2.25	3.68
Cobalt	mg/kg	50	20		1.88	5.86	2.27	2.55	11.6%	2.72	1.27	2.06
Copper	mg/kg	63	63		23.6	41.9	33.5	33.1	1.2%	121	50.3	15.2
Iron	mg/kg	NG	NG		1400	13900	5880	6910	16.1%	1480	885	2260
Lead	mg/kg	140	70		5.04	3.28	1.65	1.60	3.1%	<0.74	1.19	9.76
Lithium	mg/kg	NG	NG		<3.0	11.8	4.0	4.7	16.1%	<3.0	<2.9	<3.0
Magnesium	mg/kg	NG	NG		1220	4200	2210	2710	20.3%	970	931	902
Manganese	mg/kg	NG	NG		831	185	142	146	2.8%	559	178	81.7
Mercury (inorganic)	mg/kg	6.6	6.6		0.110	0.0373	0.0507	0.0492	3.0%	0.0589	0.0629	0.104
Molybdenum	mg/kg	10	4		0.52	0.32	0.37	0.42	12.7%	0.24	0.29	0.41
Nickel	mg/kg	50	45		10.4	20.3	11.0	12.0	8.7%	16.4	13.9	6.70
Phosphorus	mg/kg	NG	NG		618	465	662	680	2.7%	1010	690	736
Potassium	mg/kg	NG	NG		<150	840	180	200	10.5%	<150	<150	400
Selenium	mg/kg	1	1		0.63	1.16	1.01	1.05	3.9%	3.23	2.27	0.46
Silver	mg/kg	20	20		<0.15	0.19	<0.15	<0.15	*	0.20	<0.15	<0.15
Sodium	mg/kg	NG	NG		<74	116	<74	<74	*	<74	<74	<74
Strontium	mg/kg	NG	NG		44.7	32.1	42.8	43.3	1.2%	44.9	47.0	16.7
Sulphur	mg/kg	NG	NG		5200	1500	2900	2700	7.1%	1900	2600	2300
Thallium	mg/kg	1	1		<0.074	0.052	<0.074	<0.074	*	<0.074	<0.074	<0.074
Tin	mg/kg	50	NG		<3.0	<2.0	<2.9	<3.0	*	<3.0	<2.9	<3.0
Titanium	mg/kg	NG	NG		12.5	239	61.6	77.5	22.9%	19.0	11.1	21.2
Tungsten	mg/kg	NG	NG		<0.74	<0.50	<0.74	<0.74	*	<0.74	<0.74	<0.74
Uranium	mg/kg	NG	23		1.66	5.92	8.94	9.48	5.9%	4.32	3.53	0.574
Vanadium	mg/kg	130	18		3.33	29.4	11.1	12.2	9.4%	7.41	1.99	4.24
Zinc	mg/kg	200	250		68.0	17.1	13.0	13.7	5.2%	5.2	19.1	13.4
Zirconium	mg/kg	NG	NG		<1.5	7.0	<1.5	<1.5	*	1.6	<1.5	<1.5

Accompanying lab reports: **ALS - E02309073**

NWT Tier 1 RL/PL CS/FS	Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use for coarse-grained soil/fine-grained soil
NWT Tier 1 RL/PL CS/FS	Highlighted value exceeds NWT Tier 1 RL/PL CS/FS
2023 Draft Residential Guidelines	Highlighted value exceeds the Draft 2023 Environmental Residential Guideline for Contaminated Site Remediation
-	Not analyzed
<	Less than reported detection limit
NG	No guideline
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 3: Summary of Soil Analytical Results - Speciated Arsenic and IVBA (PBET)

		Sampling Location	OMR23-39-0.1	OMR23-40-0.1	OMR23-41-0.1	OMR23-42-0.1	TP23-05-0.1	TP23-06-0.1	TP23-08-0.2	TP23-15-0.1	TP23-18-0.1	TP23-20-0.1	TP23-23-0.1	TP23-27-0.1
		Date Sampled	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	29-Sep-23	29-Sep-23
		Lab Sample ID	EO2309073-039	EO2309073-040	EO2309073-041	EO2309073-042	EO2309073-005	EO2309073-006	EO2309073-008	EO2309073-015	EO2309073-018	EO2309073-020	EO2309073-023	EO2309073-027
		Soil Type	Sand & Gravel	Sand & Gravel	Sand & Gravel	Sand & Gravel	Silt/Peat	Peat	Silt/Peat	Peat	Peat	Peat	Peat	Silt/Peat
		Sample Depth (m)	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.2	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1
		Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Analyte	**Unit**	**Guideline** NWT Tier 1 RL/PL CS/FS												
Lab Results														
Arsenic (inorganic)	mg/kg	12 [1.1,2.1]	126	903	1850	554	330	152	134	470	1190	446	291	260
Arsenic (inorganic)	mg/kg	160 [1.1,2.1]	126	903	1850	554	330	152	134	470	1190	446	291	260
Arsenic III	µg/g	NG	-	1.65	3.37	2.47	1.55	88.8	5.96	0.911	219	5.96	6.67	-
Arsenic V	µg/g	NG	-	28.5	68.3	23.7	25.9	4.52	12	21.9	7.8	22.8	9.75	-
Arsenic, IVBA (%)	%	NG	29.1	12.9	18.2	19.2	21.7	-	-	29.8	5.6	25.3	23.9	38.5
Arsenic, IVBA (leachate)	mg/L	NG	0.37	1.20	3.44	1.10	0.68	0.20	0.60	1.45	0.67	1.12	0.72	1.00
Arsenic, IVBA (leachate) (mass/mass)	µg/g	NG	37	116	336	106	72	21	58	140	66	113	70	100
Cacodylic acid	µg/g	NG	-	<0.01	<0.01	<0.01	0.0904	0.0353	0.0401	0.0246	0.154	0.191	0.0835	-
Lead	mg/kg	140	16.4	14.7	20.1	37.5	28.3	1.76	9.04	12.6	48.0	26.8	68.9	14.0
Lead, IVBA (%)	%	NG	66.5	72.6	68.0	80.0	59.4	-	-	<1.0	72.1	52.7	78.6	<1.0
Lead, IVBA (leachate)	mg/L	NG	0.11	0.11	0.14	0.31	0.16	0.13	<0.10	<0.10	0.35	0.14	0.56	<0.10
Lead, IVBA (leachate) (mass/mass)	µg/g	NG	11	11	14	30	17	14	<10	<10	35	14	54	<10
Monomethylarsonic acid	µg/g	NG	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.0258	<0.02	0.0389	-
pH, IVBA final		NG	1.51	1.58	1.68	1.58	1.54	1.57	1.53	1.54	1.54	1.54	1.55	1.55
pH, IVBA Initial		NG	1.50	1.53	1.58	1.54	1.50	1.52	1.51	1.50	1.52	1.52	1.51	1.54
Final volume	ml	NG	100	100	100	100	100	100	100	100	100	100	100	100
Weight, extraction (dry)	g	NG	1.009	1.031	1.024	1.033	0.951	0.957	1.031	1.036	1.011	0.992	1.034	1.000

Accompanying lab reports: **ALS - E02309073**

NWT Tier 1 RL/PL CS/FS	Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/Parkland Land Use for coarse-grained soil/fine-grained soil
NWT Tier 1 RL/PL CS/FS	Highlighted value exceeds NWT Tier 1 RL/PL CS/FS
-	Not analyzed
<	Less than reported detection limit
NG	No guideline
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 4: Summary of Soil Analytical Results - Toxicity Characteric Leaching Procedure

		Sampling Location	OMR23-38-0.1	OMR23-39-0.1	OMR23-40-0.1	OMR23-41-0.1	OMR23-42-0.1	TP23-01-0.2	TP23-02-0.2	TP23-03-0.1	TP23-04-0.1	TP23-04-0.1	Relative
		Date Sampled	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	27-Sep-23	27-Sep-23	27-Sep-23	28-Sep-23	28-Sep-23	Percent
		Lab Sample ID	EO2309073-038	EO2309073-039	EO2309073-040	EO2309073-041	EO2309073-042	EO2309073-001	EO2309073-002	EO2309073-003	EO2309073-004	EO2309073-043	Difference
		Soil Type	Sand & Gravel	Sand & Gravel	Sand & Gravel	Sand & Gravel	Sand & Gravel	Silt	Peat	Peat	Peat	Peat	
		Sample Depth (m)	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.2	0-0.2	0-0.1	0-0.1	0-0.1	
		Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Duplicate	
Analyte	**Unit**	**Standard**											**RPD %**
		Schedule IV											
Lab Results													
Metals in TCLP Leachate													
Antimony - leachate (TCLP)	mg/L	NS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	*
Arsenic - leachate (TCLP)	mg/L	2.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	*
Barium - leachate (TCLP)	mg/L	NS	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	*
Beryllium - leachate (TCLP)	mg/L	NS	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	*
Boron - leachate (TCLP)	mg/L	NS	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	*
Cadmium - leachate (TCLP)	mg/L	0.5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*
Calcium - leachate (TCLP)	mg/L	NS	63	87	223	619	112	148	162	161	46	40	14.0%
Chromium - leachate (TCLP)	mg/L	5	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	*
Cobalt - leachate (TCLP)	mg/L	NS	<0.050	<0.050	<0.050	0.103	0.069	<0.050	<0.050	<0.050	<0.050	<0.050	*
Copper - leachate (TCLP)	mg/L	NS	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*
Iron - leachate (TCLP)	mg/L	NS	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*
Lead - leachate (TCLP)	mg/L	600	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	*
Magnesium - leachate (TCLP)	mg/L	NS	6.4	9.2	12.8	9.1	14.5	19.5	14.8	19.8	10.5	9.4	11.1%
Nickel - leachate (TCLP)	mg/L	NS	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	*
Selenium - leachate (TCLP)	mg/L	NS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	*
Silver - leachate (TCLP)	mg/L	5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*
Thallium - leachate (TCLP)	mg/L	NS	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	*
Uranium - leachate (TCLP)	mg/L	NS	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	*
Vanadium - leachate (TCLP)	mg/L	NS	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	*
Zinc - leachate (TCLP)	mg/L	500	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	*
Zirconium - leachate (TCLP)	mg/L	NS	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	*
Non-Volatile Extraction Details in TCLP Leachate													
TCLP final extract pH		NS	6.34	5.09	5.45	5.50	5.56	5.10	5.14	5.24	5.02	4.89	2.6%
TCLP initial extract pH		NS	4.94	4.94	4.90	4.90	4.90	4.90	4.90	4.90	4.90	4.94	0.8%
pH, TCLP 1st preliminary		NS	8.32	8.22	8.96	9.25	9.21	7.88	6.00	6.31	5.10	5.49	7.4%
pH, TCLP 2nd preliminary		NS	1.37	1.41	1.38	1.54	1.55	1.36	1.58	1.49	1.36	1.59	15.6%

Accompanying lab reports: **ALS - E02309073**

Schedule IV	Standards for Solid Waste/Process Residuals Suitable for Landfill
-	Not analyzed
<	Less than reported detection limit
NS	No standard
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 4: Summary of Soil Analytical Results - Toxicity Characteric Leaching Procedure

		Sampling Location	OMR23-38-0.1	TP23-05-0.1	TP23-06-0.1	TP23-07-0.1	TP23-08-0.2	TP23-08-0.2	Relative	TP23-09-0.2	TP23-10-0.1	TP23-11-0.1	TP23-12-0.1
		Date Sampled	29-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	Percent	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23
		Lab Sample ID	EO2309073-038	EO2309073-005	EO2309073-006	EO2309073-007	EO2309073-008	EO2309073-044	Difference	EO2309073-009	EO2309073-010	EO2309073-011	EO2309073-012
		Soil Type	Sand & Gravel	Silt/Peat	Peat	Peat	Silt/Peat	Silt/Peat		Peat	Peat	Silt/Peat	Peat
		Sample Depth (m)	0-0.1	0-0.1	0-0.1	0-0.1	0-0.2	0-0.2		0-0.2	0-0.1	0-0.1	0-0.1
		Sample Type	Normal	Normal	Normal	Normal	Normal	Duplicate		Normal	Normal	Normal	Normal
Analyte	**Unit**	**Standard**											
		Schedule IV							**RPD %**				
Lab Results													
Metals in TCLP Leachate													
Antimony - leachate (TCLP)	mg/L	NS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	*	<0.10	<0.10	<0.10	<0.10
Arsenic - leachate (TCLP)	mg/L	2.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	*	<1.0	<1.0	<1.0	<1.0
Barium - leachate (TCLP)	mg/L	NS	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	*	<2.5	<2.5	<2.5	<2.5
Beryllium - leachate (TCLP)	mg/L	NS	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	*	<0.025	<0.025	<0.025	<0.025
Boron - leachate (TCLP)	mg/L	NS	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	*	<0.50	<0.50	<0.50	<0.50
Cadmium - leachate (TCLP)	mg/L	0.5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*	<0.050	<0.050	<0.050	<0.050
Calcium - leachate (TCLP)	mg/L	NS	63	69	170	204	64	45	34.9%	42	210	54	147
Chromium - leachate (TCLP)	mg/L	5	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	*	<0.25	<0.25	<0.25	<0.25
Cobalt - leachate (TCLP)	mg/L	NS	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*	<0.050	<0.050	<0.050	<0.050
Copper - leachate (TCLP)	mg/L	NS	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*	<0.050	<0.050	<0.050	<0.050
Iron - leachate (TCLP)	mg/L	NS	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*	<5.0	<5.0	<5.0	<5.0
Lead - leachate (TCLP)	mg/L	600	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	*	<0.25	<0.25	<0.25	<0.25
Magnesium - leachate (TCLP)	mg/L	NS	6.4	8.2	14.3	26.6	7.8	6.2	22.9%	5.6	20.7	3.6	13.8
Nickel - leachate (TCLP)	mg/L	NS	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	*	<0.25	<0.25	<0.25	<0.25
Selenium - leachate (TCLP)	mg/L	NS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	*	<0.10	<0.10	<0.10	<0.10
Silver - leachate (TCLP)	mg/L	5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*	<0.050	<0.050	<0.050	<0.050
Thallium - leachate (TCLP)	mg/L	NS	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	*	<1.0	<1.0	<1.0	<1.0
Uranium - leachate (TCLP)	mg/L	NS	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	*	<0.20	<0.20	<0.20	<0.20
Vanadium - leachate (TCLP)	mg/L	NS	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	*	<0.15	<0.15	<0.15	<0.15
Zinc - leachate (TCLP)	mg/L	500	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	*	<0.50	<0.50	<0.50	<0.50
Zirconium - leachate (TCLP)	mg/L	NS	<10	<10	<10	<10	<10	<10	*	<10	<10	<10	<10
Non-Volatile Extraction Details in TCLP Leachate													
TCLP final extract pH		NS	6.34	5.02	5.07	5.02	5.00	4.94	1.2%	5.09	5.12	5.16	5.20
TCLP initial extract pH		NS	4.94	4.90	4.90	4.90	4.90	4.94	0.8%	4.90	4.90	4.90	4.90
pH, TCLP 1st preliminary		NS	8.32	5.58	6.25	6.38	4.53	6.58	36.9%	5.03	6.42	6.53	5.97
pH, TCLP 2nd preliminary		NS	1.37	1.42	1.61	1.69	1.31	1.63	21.8%	1.45	1.63	1.24	1.57

Accompanying lab reports: **ALS - E02309073**

Schedule IV	Standards for Solid Waste/Process Residuals Suitable for Landfill
-	Not analyzed
<	Less than reported detection limit
NS	No standard
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 4: Summary of Soil Analytical Results - Toxicity Characteric Leaching Procedure

		Sampling Location	OMR23-38-0.1	TP23-13-0.1	TP23-14-0.1	TP23-15-0.1	TP23-16-0.1	TP23-17-0.3	TP23-18-0.1	TP23-19-0.1	TP23-20-0.1	TP23-21-0.3	TP23-22-0.2
		Date Sampled	29-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23
		Lab Sample ID	EO2309073-038	EO2309073-013	EO2309073-014	EO2309073-015	EO2309073-016	EO2309073-017	EO2309073-018	EO2309073-019	EO2309073-020	EO2309073-021	EO2309073-022
		Soil Type	Sand & Gravel	Peat	Peat	Peat	Peat	Silt/Peat	Peat	Peat	Peat	Silt/Peat	Silt
		Sample Depth (m)	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.3	0-0.1	0-0.1	0-0.1	0-0.3	0-0.2
		Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Analyte	**Unit**	**Standard**											
		Schedule IV											
Lab Results													
Metals in TCLP Leachate													
Antimony - leachate (TCLP)	mg/L	NS	<0.10	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic - leachate (TCLP)	mg/L	2.5	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Barium - leachate (TCLP)	mg/L	NS	<2.5	<5.0	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Beryllium - leachate (TCLP)	mg/L	NS	<0.025	<0.050	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Boron - leachate (TCLP)	mg/L	NS	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Cadmium - leachate (TCLP)	mg/L	0.5	<0.050	<0.100	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Calcium - leachate (TCLP)	mg/L	NS	63	23	64	86	273	173	23	239	87	70	97
Chromium - leachate (TCLP)	mg/L	5	<0.25	<0.50	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Cobalt - leachate (TCLP)	mg/L	NS	<0.050	<0.100	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Copper - leachate (TCLP)	mg/L	NS	<0.050	<0.100	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Iron - leachate (TCLP)	mg/L	NS	<5.0	<10.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Lead - leachate (TCLP)	mg/L	600	<0.25	<0.50	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Magnesium - leachate (TCLP)	mg/L	NS	6.4	8.5	9.2	10.9	23.8	10.5	11.4	14.2	16.2	10.9	15.0
Nickel - leachate (TCLP)	mg/L	NS	<0.25	<0.50	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Selenium - leachate (TCLP)	mg/L	NS	<0.10	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Silver - leachate (TCLP)	mg/L	5	<0.050	<0.100	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Thallium - leachate (TCLP)	mg/L	NS	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Uranium - leachate (TCLP)	mg/L	NS	<0.20	<0.40	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Vanadium - leachate (TCLP)	mg/L	NS	<0.15	<0.30	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Zinc - leachate (TCLP)	mg/L	500	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Zirconium - leachate (TCLP)	mg/L	NS	<10	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10
Non-Volatile Extraction Details in TCLP Leachate													
TCLP final extract pH		NS	6.34	4.93	5.00	4.98	5.24	5.10	4.85	5.09	4.99	6.78	6.19
TCLP initial extract pH		NS	4.94	4.90	4.90	4.90	4.90	4.94	4.94	4.94	4.94	4.94	4.94
pH, TCLP 1st preliminary		NS	8.32	4.15	5.86	5.29	7.05	7.82	4.83	7.05	6.25	8.03	8.36
pH, TCLP 2nd preliminary		NS	1.37	1.34	1.37	1.37	1.88	1.67		2.39	1.46	1.39	1.39

Accompanying lab reports: **ALS - E02309073**

Schedule IV	Standards for Solid Waste/Process Residuals Suitable for Landfill
-	Not analyzed
<	Less than reported detection limit
NS	No standard
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 4: Summary of Soil Analytical Results - Toxicity Characteric Leaching Procedure

		Sampling Location	OMR23-38-0.1	TP23-23-0.1	TP23-24-0.2	TP23-25-0.1	TP23-26-02	TP23-27-0.1	TP23-28-0.2	TP23-29-0.3	TP23-30-0.4	TP23-30-0.4	Relative
		Date Sampled	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	Percent
		Lab Sample ID	EO2309073-038	EO2309073-023	EO2309073-024	EO2309073-025	EO2309073-026	EO2309073-027	EO2309073-028	EO2309073-029	EO2309073-030	EO2309073-045	Difference
		Soil Type	Sand & Gravel	Peat	Silt/Peat	Silt/Peat	Silt/Peat	Silt/Peat	Silt/Peat	Silt	Silt	Silt	
		Sample Depth (m)	0-0.1	0-0.1	0-0.2	0-0.1	0-0.2	0-0.1	0-0.2	0-0.3	0-0.4	0-0.4	
		Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Duplicate	
Analyte	**Unit**	**Standard**											**RPD %**
		Schedule IV											
Lab Results													
Metals in TCLP Leachate													
Antimony - leachate (TCLP)	mg/L	NS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	*
Arsenic - leachate (TCLP)	mg/L	2.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	*
Barium - leachate (TCLP)	mg/L	NS	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	*
Beryllium - leachate (TCLP)	mg/L	NS	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	*
Boron - leachate (TCLP)	mg/L	NS	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	*
Cadmium - leachate (TCLP)	mg/L	0.5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*
Calcium - leachate (TCLP)	mg/L	NS	63	81	176	250	232	142	193	136	159	151	5.2%
Chromium - leachate (TCLP)	mg/L	5	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	*
Cobalt - leachate (TCLP)	mg/L	NS	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*
Copper - leachate (TCLP)	mg/L	NS	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*
Iron - leachate (TCLP)	mg/L	NS	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*
Lead - leachate (TCLP)	mg/L	600	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	*
Magnesium - leachate (TCLP)	mg/L	NS	6.4	21.9	17.1	22.8	16.8	19.6	11.1	6.9	9.9	9.8	1.0%
Nickel - leachate (TCLP)	mg/L	NS	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	*
Selenium - leachate (TCLP)	mg/L	NS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	*
Silver - leachate (TCLP)	mg/L	5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*
Thallium - leachate (TCLP)	mg/L	NS	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	*
Uranium - leachate (TCLP)	mg/L	NS	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	*
Vanadium - leachate (TCLP)	mg/L	NS	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	*
Zinc - leachate (TCLP)	mg/L	500	<0.50	1.37	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	*
Zirconium - leachate (TCLP)	mg/L	NS	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	*
Non-Volatile Extraction Details in TCLP Leachate													
TCLP final extract pH		NS	6.34	5.02	5.02	5.10	5.11	5.03	5.05	5.08	5.06	5.08	0.4%
TCLP initial extract pH		NS	4.94	4.94	4.94	4.94	4.94	4.93	4.93	4.93	4.93	4.94	0.2%
pH, TCLP 1st preliminary		NS	8.32	6.48	6.73	6.97	6.90	5.99	6.18	6.62	6.85	6.63	3.3%
pH, TCLP 2nd preliminary		NS	1.37	1.38	1.77	2.57	2.20	1.87	1.78	1.76	1.78	1.95	9.1%

Accompanying lab reports: **ALS - E02309073**

Schedule IV	Standards for Solid Waste/Process Residuals Suitable for Landfill
-	Not analyzed
<	Less than reported detection limit
NS	No standard
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 4: Summary of Soil Analytical Results - Toxicity Characteric Leaching Procedure

		Sampling Location	OMR23-38-0.1	TP23-31-0.3	TP23-32-0.3	TP23-33-0.1	TP23-34-0.2	TP23-34-0.2	Relative	TP23-35-0.2	TP23-36-0.2	TP23-37-0.1
		Date Sampled	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	Percent	29-Sep-23	29-Sep-23	29-Sep-23
		Lab Sample ID	EO2309073-038	EO2309073-031	EO2309073-032	EO2309073-033	EO2309073-034	EO2309073-046	Difference	EO2309073-035	EO2309073-036	EO2309073-037
		Soil Type	Sand & Gravel	Silt	Silt	Silt/Peat	Peat	Peat		Silt/Peat	Silt	Silt/Peat
		Sample Depth (m)	0-0.1	0-0.3	0-0.3	0-0.1	0-0.2	0-0.2		0-0.2	0-0.2	0-0.1
		Sample Type	Normal	Normal	Normal	Normal	Normal	Duplicate		Normal	Normal	Normal
Analyte	**Unit**	**Standard** Schedule IV							**RPD %**			
Lab Results												
Metals in TCLP Leachate												
Antimony - leachate (TCLP)	mg/L	NS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	*	<0.10	<0.10	<0.10
Arsenic - leachate (TCLP)	mg/L	2.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	*	<1.0	<1.0	<1.0
Barium - leachate (TCLP)	mg/L	NS	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	*	<2.5	<2.5	<2.5
Beryllium - leachate (TCLP)	mg/L	NS	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	*	<0.025	<0.025	<0.025
Boron - leachate (TCLP)	mg/L	NS	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	*	<0.50	<0.50	<0.50
Cadmium - leachate (TCLP)	mg/L	0.5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*	<0.050	<0.050	<0.050
Calcium - leachate (TCLP)	mg/L	NS	63	142	164	220	205	201	2.0%	299	195	108
Chromium - leachate (TCLP)	mg/L	5	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	*	<0.25	<0.25	<0.25
Cobalt - leachate (TCLP)	mg/L	NS	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*	<0.050	<0.050	<0.050
Copper - leachate (TCLP)	mg/L	NS	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*	<0.050	<0.050	<0.050
Iron - leachate (TCLP)	mg/L	NS	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*	<5.0	<5.0	<5.0
Lead - leachate (TCLP)	mg/L	600	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	*	<0.25	<0.25	<0.25
Magnesium - leachate (TCLP)	mg/L	NS	6.4	9.4	9.4	13.3	8.4	7.6	10.0%	11.8	7.7	8.9
Nickel - leachate (TCLP)	mg/L	NS	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	*	<0.25	<0.25	<0.25
Selenium - leachate (TCLP)	mg/L	NS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	*	<0.10	<0.10	<0.10
Silver - leachate (TCLP)	mg/L	5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	*	<0.050	<0.050	<0.050
Thallium - leachate (TCLP)	mg/L	NS	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	*	<1.0	<1.0	<1.0
Uranium - leachate (TCLP)	mg/L	NS	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	*	<0.20	<0.20	<0.20
Vanadium - leachate (TCLP)	mg/L	NS	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	*	<0.15	<0.15	<0.15
Zinc - leachate (TCLP)	mg/L	500	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	*	<0.50	<0.50	<0.50
Zirconium - leachate (TCLP)	mg/L	NS	<10	<10	<10	<10	<10	<10	*	<10	<10	<10
Non-Volatile Extraction Details in TCLP Leachate												
TCLP final extract pH		NS	6.34	5.08	5.09	5.50	5.09	5.11	0.4%	5.19	5.12	4.93
TCLP initial extract pH		NS	4.94	4.93	4.93	4.90	4.93	4.94	0.2%	4.93	4.93	4.93
pH, TCLP 1st preliminary		NS	8.32	6.78	6.78	7.57	6.52	5.18	22.9%	7.22	7.15	5.88
pH, TCLP 2nd preliminary		NS	1.37	1.81	1.94	1.49	2.19	2.55	15.2%	2.66	2.09	2.11

Accompanying lab reports: **ALS - E02309073**

Schedule IV	Standards for Solid Waste/Process Residuals Suitable for Landfill
-	Not analyzed
<	Less than reported detection limit
NS	No standard
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 5: Summary of Soil Analytical Results - General Parameters

Analyte	Unit	Guideline	Sampling Location	OMR23-38-0.1	OMR23-39-0.1	OMR23-40-0.1	OMR23-41-0.1	OMR23-42-0.1	TP23-01-0.2	TP23-02-0.2	TP23-03-0.1	TP23-04-0.1
			Date Sampled	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	27-Sep-23	27-Sep-23	27-Sep-23	28-Sep-23
			Lab Sample ID	EO2309073-038	EO2309073-039	EO2309073-040	EO2309073-041	EO2309073-042	EO2309073-001	EO2309073-002	EO2309073-003	EO2309073-004
			Soil Type	Sand & Gravel	Sand & Gravel	Sand & Gravel	Sand & Gravel	Sand & Gravel	Silt	Peat	Peat	Peat
			Sample Depth (m)	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.2	0-0.2	0-0.1	0-0.1
			Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Lab Results												
General												
Moisture	% wet	NG		3.33	3.77	4.81	6.29	7.10	16.1	47.0	43.8	38.1
Available ammonium (as N)	µg/g	NG		<1.0	<1.0	<1.0	<1.1	<1.1	8.9	25.0	19.2	13.6
Total carbon (percent)	%	NG		0.573	1.09	1.11	1.72	1.00	7.77	45.6	48.4	46.2
Inorganic carbon (as CaCO3 equivalent) (percent)	%	NG		0.62	1.23	2.06	7.83	1.11	1.87	3.26	3.03	1.51
Calcium (in saturated paste)	mg/L	NG		31.9	33.3	36.9	324	156	67.6	41.1	25.6	17.3
Calcium (in saturated paste) (mass/mass)	mg/kg	NG		8.9	14.3	11.7	119	57.4	51.0	258	176	113
Inorganic carbon (percent)	%	NG		0.075	0.148	0.248	0.939	0.133	0.225	0.391	0.364	0.182
Total organic carbon (percent)	%	NG		0.498	0.942	0.862	0.781	0.867	7.54	45.2	48.0	46.0
Chloride (in saturated paste) (mass/mass)	mg/kg	NG		<10	<10	<10	<10	<10	<15	<126	<138	<131
Chloride (in saturated paste)	mg/L	NG		<20	<20	<20	<20	<20	<20	<20	<20	<20
Conductivity (in saturated paste)	dS/m	2		0.171	0.209	0.172	1.34	0.997	0.274	0.172	0.113	0.142
Magnesium (in saturated paste)	mg/L	NG		<5.0	6.8	<5.0	29.4	27.0	9.2	5.1	<5.0	5.4
Magnesium (in saturated paste) (mass/mass)	mg/kg	NG		<5.0	<5.0	<5.0	10.8	9.9	6.9	32.0	<34.4	35.4
Moisture	% wet	NG		3.33	3.77	4.81	6.29	7.10	16.1	47.0	43.8	38.1
Potassium (in saturated paste)	mg/L	NG		5.8	26.9	6.0	16.3	46.4	<5.0	9.3	<5.0	12.2
Potassium (in saturated paste) (mass/mass)	mg/kg	NG		<5.0	11.5	<5.0	6.0	17.1	<5.0	58.4	<34.4	80.0
Percent saturation	%	NG		27.9	42.9	31.8	36.8	36.8	75.5	628	688	656
Sodium (in saturated paste) (mass/mass)	mg/kg	NG		<5.0	<5.0	<5.0	<5.0	5.5	<5.0	<31.4	<34.4	<32.8
Sodium (in saturated paste)	mg/L	NG		<5.0	<5.0	<5.0	<5.0	15.0	<5.0	<5.0	<5.0	<5.0
Sodium adsorption ratio		5		<0.10	<0.10	<0.10	<0.10	0.29	<0.10	<0.10	<0.10	<0.10
Available sulphate - as sulphur	µg/g	NG		<6.0	<6.0	6.4	155	51.7	<15.0	<29.7	<30.5	<29.7
Sulphate (in saturated paste) (mass/mass)	mg/kg	NG		<8.0	<8.0	9.4	269	150	34.4	179	49.5	112
Sulphate (in saturated paste)	mg/L	NG		21.6	17.7	29.7	731	407	45.5	28.5	7.2	17.1
Temperature, oven	°C	NG		<38	<38	<38	<38	<38	<38	<38	<38	<38

Accompanying lab reports: **ALS - E02309073**

NWT Tier 1 RL/PL CS/FS	Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use for coarse-grained soil/fine-grained soil
NWT Tier 1 RL/PL CS/FS	Highlighted value exceeds NWT Tier 1 RL/PL CS/FS
<	Less than reported detection limit
NG	No guideline
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 5: Summary of Soil Analytical Results - General Parameters

Analyte	Unit	Guideline	Sampling Location	TP23-04-0.1	Relative	TP23-05-0.1	TP23-06-0.1	TP23-07-0.1	TP23-08-0.2	TP23-08-0.2	Relative	TP23-09-0.2
			Date Sampled	28-Sep-23	Percent	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	Percent	28-Sep-23
			Lab Sample ID	EO2309073-043	Difference	EO2309073-005	EO2309073-006	EO2309073-007	EO2309073-008	EO2309073-044	Difference	EO2309073-009
			Soil Type	Peat		Silt/Peat	Peat	Peat	Silt/Peat	Silt/Peat		Peat
			Sample Depth (m)	0-0.1		0-0.1	0-0.1	0-0.1	0-0.2	0-0.2		0-0.2
			Sample Type	Duplicate		Normal	Normal	Normal	Normal	Duplicate		Normal
		NWT Tier 1 RL/PL CS/FS			RPD %						RPD %	
Lab Results												
General												
Moisture	% wet	NG		47.7	22.4%	41.7	50.6	45.1	22.1	17.5	23.2%	40.4
Available ammonium (as N)	µg/g	NG		39.4	*	32.6	25.5	25.3	8.3	8.9	7.0%	13.7
Total carbon (percent)	%	NG		41.9	9.8%	31.2	42.8	45.3	23.9	16.2	38.4%	47.7
Inorganic carbon (as CaCO3 equivalent) (percent)	%	NG		1.23	20.4%	2.02	3.48	3.80	1.07	1.38	25.3%	1.80
Calcium (in saturated paste)	mg/L	NG		22.0	23.9%	27.4	41.0	27.2	32.7	20.0	48.2%	10.0
Calcium (in saturated paste) (mass/mass)	mg/kg	NG		99.0	13.2%	77.5	276	191	70.6	112	45.3%	71.1
Inorganic carbon (percent)	%	NG		0.148	20.6%	0.242	0.418	0.456	0.129	0.166	25.1%	0.216
Total organic carbon (percent)	%	NG		41.8	9.6%	31.0	42.4	44.8	23.8	16.0	39.2%	47.5
Chloride (in saturated paste) (mass/mass)	mg/kg	NG		<90	*	<57	<134	<140	<43	<112	*	<142
Chloride (in saturated paste)	mg/L	NG		<20	*	<20	<20	<20	<20	<20	*	<20
Conductivity (in saturated paste)	dS/m	2		0.156	9.4%	0.151	0.193	0.131	0.136	0.107	23.9%	0.069
Magnesium (in saturated paste)	mg/L	NG		5.2	3.8%	5.1	5.4	<5.0	<5.0	<5.0	*	<5.0
Magnesium (in saturated paste) (mass/mass)	mg/kg	NG		23.4	40.8%	14.4	36.3	<35.1	<10.8	<27.9	*	<35.6
Moisture	% wet	NG		47.7	22.4%	41.7	50.6	45.1	22.1	17.5	23.2%	40.4
Potassium (in saturated paste)	mg/L	NG		14.4	16.5%	7.0	9.5	<5.0	<5.0	7.8	*	<5.0
Potassium (in saturated paste) (mass/mass)	mg/kg	NG		64.8	21.0%	19.8	63.8	<35.1	<10.8	43.5	*	<35.6
Percent saturation	%	NG		450	37.3%	283	672	702	216	558	88.4%	711
Sodium (in saturated paste) (mass/mass)	mg/kg	NG		<22.5	*	<14.2	<33.6	<35.1	<10.8	<27.9	*	<35.6
Sodium (in saturated paste)	mg/L	NG		<5.0	*	<5.0	<5.0	<5.0	<5.0	<5.0	*	<5.0
Sodium adsorption ratio		5		<0.10	*	<0.10	<0.10	<0.10	<0.10	<0.10	*	<0.10
Available sulphate - as sulphur	µg/g	NG		<29.9	*	<29.5	<30.2	<30.7	<29.3	<14.8	*	<29.6
Sulphate (in saturated paste) (mass/mass)	mg/kg	NG		78.3	35.4%	50.9	202	84.2	28.5	48.5	*	51.2
Sulphate (in saturated paste)	mg/L	NG		17.4	1.7%	18.0	30.0	12.0	13.2	8.7	41.1%	7.2
Temperature, oven	°C	NG		<38	*	<38	<38	<38	<38	<38	*	<38

Accompanying lab reports: **ALS - E02309073**

NWT Tier 1 RL/PL CS/FS	Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use for coarse-grained soil/fine-grained soil
NWT Tier 1 RL/PL CS/FS	Highlighted value exceeds NWT Tier 1 RL/PL CS/FS
<	Less than reported detection limit
NG	No guideline
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 5: Summary of Soil Analytical Results - General Parameters

Analyte	Unit	Guideline	Sampling Location	TP23-10-0.1	TP23-11-0.1	TP23-12-0.1	TP23-13-0.1	TP23-14-0.1	TP23-15-0.1	TP23-16-0.1	TP23-17-0.3	TP23-18-0.1
			Date Sampled	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23
			Lab Sample ID	EO2309073-010	EO2309073-011	EO2309073-012	EO2309073-013	EO2309073-014	EO2309073-015	EO2309073-016	EO2309073-017	EO2309073-018
			Soil Type	Peat	Silt/Peat	Peat	Peat	Peat	Peat	Peat	Silt/Peat	Peat
			Sample Depth (m)	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.3	0-0.1
			Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Lab Results												
General												
Moisture	% wet	NG		42.3	7.72	30.3	34.0	15.3	27.5	41.3	71.4	35.1
Available ammonium (as N)	µg/g	NG		24.8	<5.4	29.3	9.0	34.4	7.0	25.7	24.4	31.1
Total carbon (percent)	%	NG		41.6	3.38	36.7	42.3	30.7	23.2	39.3	39.0	41.2
Inorganic carbon (as CaCO3 equivalent) (percent)	%	NG		4.49	0.61	2.98	0.83	2.54	1.40	5.30	5.95	1.79
Calcium (in saturated paste)	mg/L	NG		43.7	22.1	17.0	24.5	26.7	23.8	47.5	42.9	33.7
Calcium (in saturated paste) (mass/mass)	mg/kg	NG		227	16.6	109	96.5	129	106	237	227	236
Inorganic carbon (percent)	%	NG		0.539	0.073	0.357	0.099	0.305	0.168	0.635	0.713	0.215
Total organic carbon (percent)	%	NG		41.1	3.31	36.3	42.2	30.4	23.0	38.7	38.3	41.0
Chloride (in saturated paste) (mass/mass)	mg/kg	NG		<104	<15	<129	83	<96	<89	<100	<106	<140
Chloride (in saturated paste)	mg/L	NG		<20	<20	<20	21	<20	<20	<20	<20	<20
Conductivity (in saturated paste)	dS/m	2		0.181	0.099	0.102	0.242	0.284	0.119	0.174	0.160	0.150
Magnesium (in saturated paste)	mg/L	NG		5.4	<5.0	<5.0	10.5	5.4	<5.0	5.3	<5.0	5.0
Magnesium (in saturated paste) (mass/mass)	mg/kg	NG		28.1	<5.0	<32.2	41.4	26.0	<22.4	26.4	<26.5	<35.0
Moisture	% wet	NG		42.3	7.72	30.3	34.0	15.3	27.5	41.3	71.4	35.1
Potassium (in saturated paste)	mg/L	NG		9.1	<5.0	6.5	45.4	15.9	6.9	5.4	<5.0	7.2
Potassium (in saturated paste) (mass/mass)	mg/kg	NG		47.3	<5.0	41.9	179	76.6	30.8	26.9	<26.5	50.5
Percent saturation	%	NG		520	74.9	644	394	482	447	499	530	701
Sodium (in saturated paste) (mass/mass)	mg/kg	NG		<26.0	<5.0	<32.2	<19.7	41.4	<22.4	<24.9	<26.5	<35.0
Sodium (in saturated paste)	mg/L	NG		<5.0	<5.0	<5.0	<5.0	8.6	<5.0	<5.0	<5.0	<5.0
Sodium adsorption ratio		5		<0.10	<0.10	<0.10	<0.10	0.40	<0.10	<0.10	<0.10	<0.10
Available sulphate - as sulphur	µg/g	NG		<29.7	<14.9	<30.5	<30.0	<29.8	<29.9	<30.6	62.7	44.4
Sulphate (in saturated paste) (mass/mass)	mg/kg	NG		131	8.1	75.3	88.6	121	56.3	67.4	168	200
Sulphate (in saturated paste)	mg/L	NG		25.2	10.8	11.7	22.5	25.2	12.6	13.5	31.8	28.5
Temperature, oven	°C	NG		<38	<38	<38	<38	<38	<38	<38	<38	<38

Accompanying lab reports: **ALS - E02309073**

NWT Tier 1 RL/PL CS/FS	Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use for coarse-grained soil/fine-grained soil
NWT Tier 1 RL/PL CS/FS	Highlighted value exceeds NWT Tier 1 RL/PL CS/FS
<	Less than reported detection limit
NG	No guideline
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 5: Summary of Soil Analytical Results - General Parameters

Analyte	Unit	Guideline	Sampling Location	TP23-19-0.1	TP23-20-0.1	TP23-21-0.3	TP23-22-0.2	TP23-23-0.1	TP23-24-0.2	TP23-25-0.1	TP23-26-02	TP23-27-0.1
			Date Sampled	28-Sep-23	28-Sep-23	28-Sep-23	28-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23
			Lab Sample ID	EO2309073-019	EO2309073-020	EO2309073-021	EO2309073-022	EO2309073-023	EO2309073-024	EO2309073-025	EO2309073-026	EO2309073-027
			Soil Type	Peat	Peat	Silt/Peat	Silt	Peat	Silt/Peat	Silt/Peat	Silt/Peat	Silt/Peat
			Sample Depth (m)	0-0.1	0-0.1	0-0.3	0-0.2	0-0.1	0-0.2	0-0.1	0-0.2	0-0.1
			Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
		NWT Tier 1 RL/PL CS/FS										
Lab Results												
General												
Moisture	% wet	NG		40.0	16.1	14.2	12.7	18.9	39.7	43.3	58.4	40.4
Available ammonium (as N)	µg/g	NG		27.8	12.4	<6.6	<5.7	<6.3	19.5	22.9	21.9	24.8
Total carbon (percent)	%	NG		34.6	22.0	7.33	1.74	12.5	44.1	41.4	39.2	27.3
Inorganic carbon (as CaCO3 equivalent) (percent)	%	NG		3.82	1.78	1.52	1.13	1.51	3.90	5.46	6.14	3.16
Calcium (in saturated paste)	mg/L	NG		67.0	37.6	98.6	53.2	26.6	39.8	64.4	80.6	51.7
Calcium (in saturated paste) (mass/mass)	mg/kg	NG		372	153	48.7	23.7	166	224	216	361	366
Inorganic carbon (percent)	%	NG		0.458	0.213	0.183	0.136	0.182	0.468	0.656	0.736	0.380
Total organic carbon (percent)	%	NG		34.1	21.8	7.15	1.60	12.3	43.6	40.7	38.5	26.9
Chloride (in saturated paste) (mass/mass)	mg/kg	NG		<111	<82	<10	<10	<125	<113	<67	<90	<141
Chloride (in saturated paste)	mg/L	NG		<20	<20	<20	<20	<20	<20	<20	<20	<20
Conductivity (in saturated paste)	dS/m	2		0.257	0.192	0.541	0.251	0.140	0.184	0.218	0.285	0.237
Magnesium (in saturated paste)	mg/L	NG		6.3	10.0	16.2	7.7	8.1	5.9	7.4	8.0	8.5
Magnesium (in saturated paste) (mass/mass)	mg/kg	NG		35.0	40.8	8.0	<5.0	50.5	33.3	24.8	35.8	60.1
Moisture	% wet	NG		40.0	16.1	14.2	12.7	18.9	39.7	43.3	58.4	40.4
Potassium (in saturated paste)	mg/L	NG		15.4	17.6	<5.0	<5.0	8.0	18.4	5.2	<5.0	26.2
Potassium (in saturated paste) (mass/mass)	mg/kg	NG		85.6	71.8	<5.0	<5.0	49.9	104	17.4	<22.4	185
Percent saturation	%	NG		556	408	49.4	44.6	624	564	335	448	707
Sodium (in saturated paste) (mass/mass)	mg/kg	NG		<27.8	<20.4	<5.0	<5.0	<31.2	<28.2	<16.8	<22.4	<35.3
Sodium (in saturated paste)	mg/L	NG		<5.0	<5.0	5.9	5.2	<5.0	<5.0	<5.0	<5.0	<5.0
Sodium adsorption ratio		5		<0.10	<0.10	0.14	0.18	<0.10	<0.10	<0.10	<0.10	<0.10
Available sulphate - as sulphur	µg/g	NG		33.5	<30.8	39.2	7.4	<29.9	<30.0	<29.8	82.0	<29.6
Sulphate (in saturated paste) (mass/mass)	mg/kg	NG		177	91.8	76.6	20.4	74.9	94.8	77.4	366	178
Sulphate (in saturated paste)	mg/L	NG		31.8	22.5	155	45.8	12.0	16.8	23.1	81.8	25.2
Temperature, oven	°C	NG		<38	<38	<38	<38	<38	<38	<38	<38	<38

Accompanying lab reports: **ALS - E02309073**

NWT Tier 1 RL/PL CS/FS	Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use for coarse-grained soil/fine-grained soil
NWT Tier 1 RL/PL CS/FS	Highlighted value exceeds NWT Tier 1 RL/PL CS/FS
<	Less than reported detection limit
NG	No guideline
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 5: Summary of Soil Analytical Results - General Parameters

Analyte	Unit	Guideline	Sampling Location	TP23-28-0.2	TP23-29-0.3	TP23-30-0.4	TP23-30-0.4	Relative	TP23-31-0.3	TP23-32-0.3	TP23-33-0.1	TP23-34-0.2
			Date Sampled	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23	Percent	29-Sep-23	29-Sep-23	29-Sep-23	29-Sep-23
			Lab Sample ID	EO2309073-028	EO2309073-029	EO2309073-030	EO2309073-045	Difference	EO2309073-031	EO2309073-032	EO2309073-033	EO2309073-034
			Soil Type	Silt/Peat	Silt	Silt	Silt		Silt	Silt	Silt/Peat	Peat
			Sample Depth (m)	0-0.2	0-0.3	0-0.4	0-0.4		0-0.3	0-0.3	0-0.1	0-0.2
			Sample Type	Normal	Normal	Normal	Duplicate		Normal	Normal	Normal	Normal
		NWT Tier 1 RL/PL CS/FS						RPD %				
Lab Results												
General												
Moisture	% wet	NG		44.3	75.2	72.3	73.2	1.2%	74.3	74.0	24.0	53.0
Available ammonium (as N)	µg/g	NG		30.9	18.7	23.0	17.6	26.6%	14.0	17.3	10.3	21.1
Total carbon (percent)	%	NG		42.7	41.6	39.2	36.6	6.9%	37.4	39.1	13.7	38.5
Inorganic carbon (as CaCO3 equivalent) (percent)	%	NG		5.40	5.42	5.87	5.57	5.2%	4.80	5.37	2.92	4.97
Calcium (in saturated paste)	mg/L	NG		44.6	80.4	111	100	10.4%	138	147	63.8	44.3
Calcium (in saturated paste) (mass/mass)	mg/kg	NG		239	526	720	467	42.6%	970	1120	82.9	190
Inorganic carbon (percent)	%	NG		0.648	0.650	0.704	0.669	5.1%	0.576	0.644	0.351	0.597
Total organic carbon (percent)	%	NG		42.0	41.0	38.5	35.9	7.0%	36.8	38.4	13.3	37.9
Chloride (in saturated paste) (mass/mass)	mg/kg	NG		<107	<131	<130	<93	*	<141	<153	<26	<86
Chloride (in saturated paste)	mg/L	NG		<20	<20	<20	<20	*	<20	<20	<20	<20
Conductivity (in saturated paste)	dS/m	2		0.164	0.297	0.571	0.468	19.8%	0.685	0.682	0.225	0.150
Magnesium (in saturated paste)	mg/L	NG		<5.0	6.0	10.6	9.0	16.3%	12.3	11.1	5.9	<5.0
Magnesium (in saturated paste) (mass/mass)	mg/kg	NG		<26.8	39.2	68.8	42.0	48.4%	86.5	84.7	7.7	<21.5
Moisture	% wet	NG		44.3	75.2	72.3	73.2	1.2%	74.3	74.0	24.0	53.0
Potassium (in saturated paste)	mg/L	NG		8.2	<5.0	<5.0	<5.0	*	<5.0	<5.0	<5.0	<5.0
Potassium (in saturated paste) (mass/mass)	mg/kg	NG		43.9	<32.7	<32.4	<23.3	*	<35.2	<38.2	<6.5	<21.5
Percent saturation	%	NG		535	654	649	467	32.6%	703	763	130	430
Sodium (in saturated paste) (mass/mass)	mg/kg	NG		<26.8	<32.7	<32.4	<23.3	*	<35.2	<38.2	<6.5	<21.5
Sodium (in saturated paste)	mg/L	NG		<5.0	<5.0	<5.0	<5.0	*	<5.0	<5.0	<5.0	<5.0
Sodium adsorption ratio		5		<0.10	<0.10	<0.10	<0.10	*	<0.10	<0.10	<0.10	<0.10
Available sulphate - as sulphur	µg/g	NG		<30.6	119	253	219	14.4%	452	258	<15.1	<30.3
Sulphate (in saturated paste) (mass/mass)	mg/kg	NG		80.2	759	1540	761	67.7%	2150	2110	30.4	67.1
Sulphate (in saturated paste)	mg/L	NG		15.0	116	237	163	37.0%	306	277	23.4	15.6
Temperature, oven	°C	NG		<38	<38	<38	<38	*	<38	<38	<38	<38

Accompanying lab reports: **ALS - E02309073**

NWT Tier 1 RL/PL CS/FS	Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use for coarse-grained soil/fine-grained soil
NWT Tier 1 RL/PL CS/FS	Highlighted value exceeds NWT Tier 1 RL/PL CS/FS
<	Less than reported detection limit
NG	No guideline
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Table 5: Summary of Soil Analytical Results - General Parameters

Analyte	Unit	Guideline	Sampling Location	TP23-34-0.2	Relative	TP23-35-0.2	TP23-36-0.2	TP23-37-0.1
			Date Sampled	29-Sep-23	Percent	29-Sep-23	29-Sep-23	29-Sep-23
			Lab Sample ID	EO2309073-046	Difference	EO2309073-035	EO2309073-036	EO2309073-037
			Soil Type	Peat		Silt/Peat	Silt	Silt/Peat
			Sample Depth (m)	0-0.2		0-0.2	0-0.2	0-0.1
			Sample Type	Duplicate		Normal	Normal	Normal
		NWT Tier 1 RL/PL CS/FS			RPD %			
Lab Results								
General								
Moisture	% wet	NG		55.1	3.9%	43.2	66.7	46.1
Available ammonium (as N)	µg/g	NG		27.5	26.3%	22.8	19.9	19.4
Total carbon (percent)	%	NG		37.8	1.8%	39.3	40.8	41.5
Inorganic carbon (as CaCO3 equivalent) (percent)	%	NG		6.30	23.6%	7.11	6.32	2.95
Calcium (in saturated paste)	mg/L	NG		43.6	1.6%	55.7	48.0	15.8
Calcium (in saturated paste) (mass/mass)	mg/kg	NG		144	27.5%	238	289	81.0
Inorganic carbon (percent)	%	NG		0.756	23.5%	0.853	0.758	0.354
Total organic carbon (percent)	%	NG		37.0	2.4%	38.4	40.0	41.1
Chloride (in saturated paste) (mass/mass)	mg/kg	NG		<66	*	<85	<120	<102
Chloride (in saturated paste)	mg/L	NG		<20	*	<20	<20	<20
Conductivity (in saturated paste)	dS/m	2		0.139	7.6%	0.202	0.170	0.078
Magnesium (in saturated paste)	mg/L	NG		<5.0	*	<5.0	<5.0	<5.0
Magnesium (in saturated paste) (mass/mass)	mg/kg	NG		<16.6	*	<21.4	<30.1	<25.6
Moisture	% wet	NG		55.1	3.9%	43.2	66.7	46.1
Potassium (in saturated paste)	mg/L	NG		<5.0	*	<5.0	<5.0	<5.0
Potassium (in saturated paste) (mass/mass)	mg/kg	NG		<16.6	*	<21.4	<30.1	<25.6
Percent saturation	%	NG		331	26.0%	427	602	513
Sodium (in saturated paste) (mass/mass)	mg/kg	NG		<16.6	*	<21.4	<30.1	<25.6
Sodium (in saturated paste)	mg/L	NG		<5.0	*	<5.0	<5.0	<5.0
Sodium adsorption ratio		5		<0.10	*	<0.10	<0.10	<0.10
Available sulphate - as sulphur	µg/g	NG		<29.6	*	<30.4	<29.6	<29.8
Sulphate (in saturated paste) (mass/mass)	mg/kg	NG		58.6	13.5%	50.0	141	52.3
Sulphate (in saturated paste)	mg/L	NG		17.7	12.6%	11.7	23.4	10.2
Temperature, oven	°C	NG		<38	*	<38	<38	<38

Accompanying lab reports: **ALS - E02309073**

NWT Tier 1 RL/PL CS/FS	Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use for coarse-grained soil/fine-grained soil
NWT Tier 1 RL/PL CS/FS	Highlighted value exceeds NWT Tier 1 RL/PL CS/FS
<	Less than reported detection limit
NG	No guideline
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
51%	RPD value greater than the target criteria of 50% for soil

Guideline Notes for Reports for 2023-8451 Tin Can Hill Soil Quality Results

1. Notes for Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use and Coarse-grained Soil (NWT Tier 1 RL/PL CS)

General Notes:

Tier 1 criteria-based approach was used. Reference: Table A1 and Table A7, Guideline for Contaminated Site Remediation, November 2003 by Environment Division, Government of the Northwest Territories.

Note 1.1 for Arsenic (inorganic):

The site-specific human health-based soil quality remediation objective for arsenic in Yellowknife area soils for industrial land use is 340 mg/kg and 160 mg/kg for residential.

2. Notes for Northwest Territories Tier 1 Soil Remediation Guidelines for Residential/ Parkland Land Use and Fine-grained Soil (NWT Tier 1 RL/PL FS)

General Notes:

Tier 1 criteria-based approach was used. Reference: Table A1 and Table A7, Guideline for Contaminated Site Remediation, November 2003 by Environment Division, Government of the Northwest Territories.

Table A1 “Summary of Tier 1 levels for PHCs in surface soil” contains multiple guidelines for Fraction 1 (F1-BTEX) and Fraction 2 (F2) petroleum hydrocarbons depending on site specific factors. The most stringent guidelines for fine-grained soil for F1-BTEX and F2 were used in this criteria set.

Note 2.1 for Arsenic (inorganic):

The site-specific human health-based soil quality remediation objective for arsenic in Yellowknife area soils for industrial land use is 340 mg/kg and 160 mg/kg for residential.

Table 6: Summary of Groundwater Analytical Results - Total Metals

Analyte	Unit	Guideline		Sampling Location	SW23-01	SW23-01	Relative	SW23-02
				Date Sampled	29-Sep-23	29-Sep-23	Percent	29-Sep-23
				Lab Sample ID	EO2309073-047	EO2309073-049	Difference	EO2309073-048
				Sample Type	Normal	Duplicate		Normal
		CCME AL (LT)	CCME AL (ST)				RPD %	
Lab Results								
pH		6.5 - 9	NG		8.07	8.09	0.2%	8.02
Hardness (as CaCO3), dissolved	mg/L	NG	NG		71.9	73.6	2.3%	301
Total Metals								
Aluminum (total)	mg/L	Calc [1.6]	NG		0.0910	0.0926	1.7%	0.783
Antimony (total)	mg/L	NG	NG		0.00017	0.00017	0.0%	0.0205
Arsenic (total)	mg/L	0.0050 [1.7]	NG		0.00243	0.00248	2.0%	0.401
Barium (total)	mg/L	NG	NG		0.0363	0.0360	0.8%	0.0698
Beryllium (total)	mg/L	NG	NG		<0.000020	<0.000020	*	0.000031
Bismuth (total)	mg/L	NG	NG		<0.000050	<0.000050	*	<0.000050
Boron (total)	mg/L	1.5 [1.8]	29		0.014	0.014	0.0%	0.070
Cadmium (total)	mg/L	Calc [1.9]	Calc [2.2]		0.0000080	0.0000071	11.9%	0.0000871
Calcium (total)	mg/L	NG	NG		21.8	21.7	0.5%	91.2
Cesium (total)	mg/L	NG	NG		0.000013	0.000012	8.0%	0.000117
Chromium (total)	mg/L	0.0010 [1.10]	NG		0.00230	0.00182	23.3%	0.00414
Cobalt (total)	mg/L	NG	NG		<0.00010	<0.00010	*	0.00159
Copper (total)	mg/L	Calc [1.11]	NG		0.00147	0.00143	2.8%	0.0410
Iron (total)	mg/L	0.300	NG		0.127	0.113	11.7%	1.28
Lead (total)	mg/L	Calc [1.12]	NG		0.000130	0.000130	0.0%	0.00784
Lithium (total)	mg/L	NG	NG		0.0047	0.0039	18.6%	0.0154
Magnesium (total)	mg/L	NG	NG		5.49	5.61	2.2%	24.8
Manganese (total)	mg/L	Calc [1.13]	Calc [2.3]		0.00476	0.00509	6.7%	0.123
Molybdenum (total)	mg/L	0.073	NG		0.000694	0.000659	5.2%	0.000984
Nickel (total)	mg/L	Calc [1.14]	NG		0.00169	0.00152	10.6%	0.00792
Phosphorus (total, by ICPMS/ICPOES)	mg/L	N [1.15]	NG		<0.050	<0.050	*	0.266
Potassium (total)	mg/L	NG	NG		1.20	1.22	1.7%	14.1
Rubidium (total)	mg/L	NG	NG		0.00129	0.00131	1.5%	0.0109
Selenium (total)	mg/L	0.0010	NG		0.000168	0.000134	22.5%	0.000220
Silicon (total, as Si)	mg/L	NG	NG		1.16	1.18	1.7%	2.95
Silver (total)	mg/L	0.00025	NG		<0.000010	<0.000010	*	0.000103
Strontium (total)	mg/L	NG	NG		0.110	0.110	0.0%	0.266
Sulphur (total)	mg/L	NG	NG		6.51	6.86	5.2%	76.0
Tellurium (total)	mg/L	NG	NG		<0.00020	<0.00020	*	<0.00020
Thallium (total)	mg/L	0.0008	NG		<0.000010	<0.000010	*	0.000011
Thorium (total)	mg/L	NG	NG		<0.00010	<0.00010	*	0.00010
Tin (total)	mg/L	NG	NG		0.00011	0.00011	0.0%	0.00012
Titanium (total)	mg/L	NG	NG		0.00281	0.00300	6.5%	0.0220
Tungsten (total)	mg/L	NG	NG		<0.00010	<0.00010	*	0.00030
Uranium (total)	mg/L	0.015 [1.16]	0.033 [2.4]		0.000371	0.000390	5.0%	0.000833
Vanadium (total)	mg/L	NG	NG		<0.00050	0.00067	*	0.00269
Zinc (total)	mg/L	0.0017 [1.17]	Calc [2.5]		<0.0030	<0.0030	*	0.0224
Zirconium (total)	mg/L	NG	NG		<0.00020	<0.00020	*	<0.00020

Accompanying lab reports: **ALS - E02309073**

CCME AL (LT)	CCME. Canadian water quality guidelines for the protection of freshwater aquatic life, Long-Term Exposure guidelines.
CCME AL (ST)	CCME. Canadian water quality guidelines for the protection of freshwater aquatic life, Short-Term Exposure guidelines.
CCME AL (LT)	Highlighted value exceeds CCME AL (LT)
CCME AL (ST)	Highlighted value exceeds CCME AL (ST)
<	Less than reported detection limit
Calc	Standard dependent on hardness and calculated from a table.
NS	No Standard
	Highlighted value has a detection limit that is greater than standard
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
26%	RPD value greater than the target criteria of 25% for water

Table 7: Summary of Groundwater Analytical Results - Dissolved Metals

Analyte	Unit	Guideline		Sampling Location	SW23-01	Relative	SW23-02
				Date Sampled	29-Sep-23	Percent	29-Sep-23
				Lab Sample ID	EO2309073-047	Difference	EO2309073-048
				Sample Type	Normal	Duplicate	Normal
		CCME AL (LT)	CCME AL (ST)			RPD %	
Lab Results							
pH		6.5 - 9	NG	8.07	8.09	0.2%	8.02
Hardness (as CaCO3), dissolved	mg/L	NG	NG	71.9	73.6	2.3%	301
Dissolved Metals							
Aluminum (dissolved)	mg/L	Calc [1.18]	NG	0.0139	0.0144	3.5%	0.0075
Antimony (dissolved)	mg/L	NG	NG	0.00013	0.00013	0.0%	0.0105
Arsenic (dissolved)	mg/L	0.0050 [1.19]	NG	0.00200	0.00207	3.4%	0.324
Barium (dissolved)	mg/L	NG	NG	0.0341	0.0343	0.6%	0.0444
Beryllium (dissolved)	mg/L	NG	NG	<0.000020	<0.000020	*	<0.000020
Bismuth (dissolved)	mg/L	NG	NG	<0.000050	<0.000050	*	<0.000050
Boron (dissolved)	mg/L	1.5 [1.20]	29	0.018	0.016	11.8%	0.066
Cadmium (dissolved)	mg/L	Calc [1.21]	Calc [2.6]	<0.0000050	<0.0000050	*	<0.0000050
Calcium (dissolved)	mg/L	NG	NG	20.7	21.3	2.9%	84.1
Cesium (dissolved)	mg/L	NG	NG	<0.000010	<0.000010	*	0.000020
Chromium (dissolved)	mg/L	0.0010 [1.22]	NG	<0.00050	<0.00050	*	<0.00050
Cobalt (dissolved)	mg/L	NG	NG	<0.00010	<0.00010	*	<0.00010
Copper (dissolved)	mg/L	Calc [1.23]	NG	0.00116	0.00117	0.9%	0.00174
Iron (dissolved)	mg/L	0.300	NG	<0.010	<0.010	*	<0.010
Lead (dissolved)	mg/L	Calc [1.24]	NG	<0.000050	<0.000050	*	0.000057
Lithium (dissolved)	mg/L	NG	NG	0.0035	0.0034	2.9%	0.0130
Magnesium (dissolved)	mg/L	NG	NG	4.90	4.95	1.0%	22.1
Manganese (dissolved)	mg/L	Calc [1.25]	Calc [2.7]	0.00087	0.00086	1.2%	0.0213
Molybdenum (dissolved)	mg/L	0.073	NG	0.000619	0.000570	8.2%	0.000683
Nickel (dissolved)	mg/L	Calc [1.26]	NG	0.00088	0.00085	3.5%	0.00174
Phosphorus (dissolved, by ICPMS/ICPOES)	mg/L	N [1.27]	NG	<0.050	<0.050	*	<0.050
Potassium (dissolved)	mg/L	NG	NG	1.17	1.17	0.0%	14.0
Rubidium (dissolved)	mg/L	NG	NG	0.00110	0.00113	2.7%	0.00981
Selenium (dissolved)	mg/L	0.0010	NG	0.000142	0.000140	1.4%	0.000050
Silicon (dissolved, as Si)	mg/L	NG	NG	0.993	1.01	1.7%	2.06
Silver (dissolved)	mg/L	0.00025	NG	<0.000010	<0.000010	*	<0.000010
Strontium (dissolved)	mg/L	NG	NG	0.111	0.106	4.6%	0.248
Sulphur (dissolved)	mg/L	NG	NG	6.63	6.44	2.9%	73.6
Tellurium (dissolved)	mg/L	NG	NG	<0.00020	<0.00020	*	<0.00020
Thallium (dissolved)	mg/L	0.0008	NG	<0.000010	<0.000010	*	<0.000010
Thorium (dissolved)	mg/L	NG	NG	<0.00010	<0.00010	*	<0.00010
Tin (dissolved)	mg/L	NG	NG	<0.00010	<0.00010	*	<0.00010
Titanium (dissolved)	mg/L	NG	NG	<0.00030	0.00030	*	<0.00030
Tungsten (dissolved)	mg/L	NG	NG	<0.00010	<0.00010	*	0.00010
Uranium (dissolved)	mg/L	0.015 [1.28]	0.033 [2.8]	0.000332	0.000312	6.2%	0.000197
Vanadium (dissolved)	mg/L	NG	NG	<0.00050	<0.00050	*	<0.00050
Zinc (dissolved)	mg/L	0.0017 [1.29]	Calc [2.9]	<0.0010	<0.0010	*	<0.0010
Zirconium (dissolved)	mg/L	NG	NG	<0.00030	<0.00030	*	<0.00030

Accompanying lab reports: **ALS - E02309073**

CCME AL (LT)	CCME. Canadian water quality guidelines for the protection of freshwater aquatic life, Long-Term Exposure guidelines.
CCME AL (ST)	CCME. Canadian water quality guidelines for the protection of freshwater aquatic life, Short-Term Exposure guidelines.
CCME AL (LT)	Highlighted value exceeds CCME AL (LT)
CCME AL (ST)	Highlighted value exceeds CCME AL (ST)
-	Not analyzed
<	Less than reported detection limit
Calc	Standard dependent on hardness and calculated from a table.
NS	No Standard
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
26%	RPD value greater than the target criteria of 25% for water

Table 8: Summary of Groundwater Analytical Results - Speciated Arsenic

			Sampling Location	SW23-01	SW23-02
			Date Sampled	31-Oct-23	31-Oct-23
			Lab Sample ID	YL2301551-001	YL2301551-002
			Sample Type	Normal	Normal
Analyte	**Unit**	**Guideline**			
		CCME AL (LT)	CCME AL (ST)		
Lab Results					
Speciated Metals					
Arsenate [As V]	mg/L	NG	NG	0.000850	0.196
Arsenite [As III]	mg/L	NG	NG	0.000240	<0.00100
Arsenobetaine [AsB], (as As)	mg/L	NG	NG	<0.000050	<0.00250
Dimethylarsinic acid [DMA], (as As)	mg/L	NG	NG	0.000029	<0.00100
Monomethylarsonic acid [MMA], (as As)	mg/L	NG	NG	<0.000020	<0.00124

Accompanying lab reports: **ALS - TL2301551**

CCME AL (LT)	CCME. Canadian water quality guidelines for the protection of freshwater aquatic life, Long-Term Exposure guidelines.
CCME AL (ST)	CCME. Canadian water quality guidelines for the protection of freshwater aquatic life, Short-Term Exposure guidelines.
CCME AL (LT)	Highlighted value exceeds CCME AL (LT)
CCME AL (ST)	Highlighted value exceeds CCME AL (ST)
-	Not analyzed
<	Less than reported detection limit
Calc	Standard dependent on hardness and calculated from a table.
NS	No Standard
	Highlighted value has a detection limit that is greater than standard
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
26%	RPD value greater than the target criteria of 25% for water

Table 9: Summary of Groundwater Analytical Results - General Parameters

Analyte	Unit	Guideline		Sampling Location	SW23-01	SW23-01	Relative	SW23-02
				Date Sampled	29-Sep-23	29-Sep-23	Percent	29-Sep-23
				Lab Sample ID	EO2309073-047	EO2309073-049	Difference	EO2309073-048
				Sample Type	Normal	Duplicate		Normal
		CCME AL (LT)	CCME AL (ST)				RPD %	
Lab Results								
General and Inorganic Parameters								
Alkalinity (total, as CaCO3)	mg/L	NG	NG		66.9	68.5	2.4%	83.1
Ammonia (total, as N)	mg/L	Calc [1.1]	NG		0.0139	0.0180	25.7%	0.0840
Bicarbonate (HCO3)	mg/L	NG	NG		81.6	83.6	2.4%	101
Dissolved organic carbon	mg/L	NG	NG		4.96	5.68	13.5%	24.7
Total organic carbon	mg/L	NG	NG		5.70	5.64	1.1%	39.8
Carbonate (CO3)	mg/L	NG	NG		<1.0	<1.0	*	<1.0
Chloride	mg/L	120 [1.2]	640		5.47	5.46	0.2%	62.6
Conductivity	µS/cm	NG	NG		192	192	0.0%	813
Fluoride	mg/L	0.120 [1.3]	NG		0.088	0.088	0.0%	0.228
Hardness (as CaCO3), dissolved	mg/L	NG	NG		71.9	73.6	2.3%	301
Hydroxide (OH)	mg/L	NG	NG		<1.0	<1.0	*	<1.0
Nitrate (as N)	mg/L	3.0 [1.4]	124 [2.1]		0.030	0.029	3.4%	0.160
Nitrate + Nitrite (as N)	mg/L	3.0 [1.5]	NG		0.0300	<0.0300	*	0.160
Nitrite (as N)	mg/L	0.060	NG		<0.010	<0.010	*	<0.010
pH		6.5 - 9	NG		8.07	8.09	0.2%	8.02
Sodium (dissolved)	mg/L	NG	NG		6.54	6.55	0.2%	33.8
Sodium (total)	mg/L	NG	NG		6.57	6.52	0.8%	32.4
Total dissolved solids (computed)	mg/L	NG	NG		104	106	1.9%	499
Sulphate	mg/L	NG	NG		16.9	17.0	0.6%	201
Ion Balance								
Total anions	meq/L	NG	NG		1.85	1.88	1.6%	7.63
Total cations	meq/L	NG	NG		1.75	1.79	2.3%	7.85
Ion balance (% difference, APHA)	%	NG	NG		-2.78	-2.45	12.6%	1.42
Ion balance (cations/anions)	%	NG	NG		94.6	95.2	0.6%	103

Accompanying lab reports: **ALS - E02309073**

CCME AL (LT)	CCME. Canadian water quality guidelines for the protection of freshwater aquatic life, Long-Term Exposure guidelines.
CCME AL (ST)	CCME. Canadian water quality guidelines for the protection of freshwater aquatic life, Short-Term Exposure guidelines.
CCME AL (LT)	Highlighted value exceeds CCME AL (LT)
CCME AL (ST)	Highlighted value exceeds CCME AL (ST)
-	Not analyzed
<	Less than reported detection limit
Calc	Standard dependent on hardness and calculated from a table.
NS	No Standard
	Highlighted value has a detection limit that is greater than standard
*	RPDs are not calculated when parameter concentrations are within five times the method detection limit.
26%	RPD value greater than the target criteria of 25% for water

Guideline Notes for Reports for 2023-8451 Tin Can Hill Water Quality Results

1. Notes for CCME. Canadian water quality guidelines for the protection of freshwater aquatic life, Long-Term Exposure guidelines. (CCME AL (LT))

General Notes:

The CCME Canadian water quality guidelines for the protection of freshwater aquatic life provide both a Long-Term Exposure guideline, and Short-Term Exposure guideline for some analytes. Only the Long-Term Exposure guidelines are included in this criteria set.

Note 1.1 for Ammonia (total, as N):

The guideline for ammonia varies as a function of pH and temperature. For a pH of 8.0, the standard ranges from 2.33 mg/L for a water temperature of 0 °C down to 0.256 for a water temperature of 30 °C.

Note 1.2 for Chloride:

The Short-Term Exposure Guideline is 640 mg/L. The Long-Term Exposure Guideline is 120 mg/L.

Note 1.3 for Fluoride:

The interim guideline for the protection of freshwater aquatic life for total inorganic fluorides is 0.12 mg/L

Note 1.4 for Nitrate (as N):

The Short-Term Exposure Guideline is 124 mg/L. The Long-Term Exposure Guideline is 3.0 mg/L. The guidelines for nitrate are for protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrophication.

The Long Term guideline is derived from toxicity tests utilizing $NaNO_3$. The Long Term guideline is derived with mostly no- and some low-effect data and are intended to protect against negative effects to aquatic ecosystem structure and function during indefinite exposures (e.g. abide by the guiding principle as per CCME 2007).

Note 1.5 for Nitrate + Nitrite (as N):

Long-Term Exposure Guideline for Nitrate (as N) is 3.0 mg/L

Note 1.6 for Aluminum (total):

The guideline for aluminum is:

5 µg/L when pH is less than 6.5

100 µg/L when pH is greater than or equal to 6.5

Note 1.7 for Arsenic (total):

Guideline is for total arsenic.

Note 1.8 for Boron (total):

The Short-Term Exposure Guideline is 29 mg/L. The Long-Term Exposure Guideline is 1.5 mg/L.

Note 1.9 for Cadmium (total):

The long-term guideline for cadmium is determined on a site-specific basis according to the local water hardness. The guideline for total cadmium in µg/L is determined as follows for long-term exposure:

1. If hardness (as $CaCO_3$) is less than 17 mg/L then maximum is 0.04 µg/L
2. If hardness (as $CaCO_3$) is from 17 to 280 mg/L then maximum is based on equation:

10 raised to the power of {0.83[log(hardness)] - 2.46}

3. If hardness (as $CaCO_3$) is greater than 280 mg/L then maximum is 0.37 µg/L.

Note 1.10 for Chromium (total):

CCME guideline for freshwater aquatic life is 0.0010 mg/L for chromium VI. CCME interim guideline for freshwater aquatic life is 0.0089 mg/L for chromium III. The guideline of 0.0010 mg/L was used, in this report, to identify exceedances for dissolved chromium, and total chromium as a means for determining the potential for exceeding the chromium VI and/or chromium III guidelines.

Note 1.11 for Copper (total):

The guideline for copper in µg/L is determined as follows:

When the water hardness is 0 to < 82 mg/L, the CWQG is 2 µg/L

At hardness ≥82 to ≤180 mg/L the CWQG is calculated using the equation:

e raised to the power of {0.8545[ln(hardness)]-1.465} * 0.2 µg/L

At hardness >180 mg/L, the CWQG is 4 µg/L

Where water hardness is reported as mg/L $CaCO_3$.

If the water hardness is unknown, the CWQG is 2 µg/L

Note 1.12 for Lead (total):

The guideline for lead in µg/L is determined as follows:

When the hardness is 0 to ≤ 60 mg/L, the CWQG is 1 µg/L

At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using the equation:

e raised to the power of {1.273[ln(hardness)] - 4.705}

At hardness >180 mg/L, the CWQG is 7 µg/L

Where water hardness is reported as mg/L $CaCO_3$.

If the water hardness is unknown, the CWQG is 1 µg/L

Note 1.13 for Manganese (total):

The guideline for dissolved manganese varies as a function of pH and hardness (as $CaCO_3$). The guideline for dissolved manganese was used to identify exceedances for total manganese as a means for determining the potential for exceeding the guideline for dissolved manganese.

The lookup table is based on results for “Hardness, Total (total as $CaCO_3$)”. (CCME Update 2019)

Note 1.14 for Nickel (total):

The guideline for nickel in µg/L is determined as follows:

When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 25 µg/L

At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using the equation:

e raised to the power of {0.76[ln(hardness)] + 1.06}

At hardness >180 mg/L, the CWQG is 150 µg/L

Where water hardness is reported as mg/L $CaCO_3$.

If the water hardness is unknown, the CWQG is 25 µg/L

Note 1.15 for Phosphorus (total, by ICPMS/ICPOES):

Canadian Guidance Framework for Phosphorus is for developing phosphorus guidelines (does not provide guidance on other freshwater nutrients). It provides Trigger Ranges for Total Phosphorus (see Guidance Framework for Phosphorus factsheet):

ultra-oligotrophic <4 µg/L;

oligotrophic 4-10 µg/L;

mesotrophic 10-20 µg/L;

meso-eutrophic 20-35 µg/L;

eutrophic 35-100 µg/L;

hyper-eutrophic >100 µg/L

Note 1.16 for Uranium (total):

The Short-Term Exposure Guideline is 33 µg/L. The Long-Term Exposure Guideline is 15 µg/L. The guidelines are for total recoverable, unfiltered analyses.

Note 1.17 for Zinc (total):
The long-term CWQG is for dissolved zinc (µg/L) and is calculated using the following equation: CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625). The CWQG equation is valid between hardness 23.4 and 399 mg CaCO3·L−1, pH 6.5 and 8.13 and DOC 0.3 to 22.9 mg·L−1.
The guideline value of 1.7 µg/L in this criteria set is based on assumed water quality of 23.4 mg CaCO3·L−1 hardness, pH of 8.13 and 0.3 mg·L−1 DOC, which are the limits for the equation that provide the most stringent guideline value.
The guideline of 1.7 µg/L was used to identify exceedances for total zinc as a means for determining the potential for exceeding the guideline for dissolved zinc. (CCME Update 2018)
Note 1.18 for Aluminum (dissolved):
The guideline for aluminum is:
5 µg/L when pH is less than 6.5
100 µg/L when pH is greater than or equal to 6.5
Note 1.19 for Arsenic (dissolved):
Guideline is for total arsenic.
Note 1.20 for Boron (dissolved):
The Short-Term Exposure Guideline is 29 mg/L. The Long-Term Exposure Guideline is 1.5 mg/L.
Note 1.21 for Cadmium (dissolved):
The long-term guideline for cadmium is determined on a site-specific basis according to the local water hardness. The guideline for total cadmium in µg/L is determined as follows for long-term exposure:
1. If hardness (as CaCO3) is less than 17 mg/L then maximum is 0.04 µg/L
2. If hardness (as CaCO3) is from 17 to 280 mg/L then maximum is based on equation:
10 raised to the power of {0.83[log(hardness)] - 2.46}
3. If hardness (as CaCO3) is greater than 280 mg/L then maximum is 0.37 µg/L.
Note 1.22 for Chromium (dissolved):
CCME guideline for freshwater aquatic life is 0.0010 mg/L for chromium VI. CCME interim guideline for freshwater aquatic life is 0.0089 mg/L for chromium III. The guideline of 0.0010 mg/L was used, in this report, to identify exceedances for dissolved chromium, and total chromium as a means for determining the potential for exceeding the chromium VI and/or chromium III guidelines.
Note 1.23 for Copper (dissolved):
The guideline for copper in µg/L is determined as follows:
When the water hardness is 0 to < 82 mg/L, the CWQG is 2 µg/L
At hardness ≥82 to ≤180 mg/L the CWQG is calculated using the equation:
e raised to the power of {0.8545[ln(hardness)]-1.465} * 0.2 µg/L
At hardness >180 mg/L, the CWQG is 4 µg/L
Where water hardness is reported as mg/L CaCO3.
If the water hardness is unknown, the CWQG is 2 µg/L
Note 1.24 for Lead (dissolved):
The guideline for lead in µg/L is determined as follows:
When the hardness is 0 to ≤ 60 mg/L, the CWQG is 1 µg/L
At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using the equation:
e raised to the power of {1.273[ln(hardness)] - 4.705}
At hardness >180 mg/L, the CWQG is 7 µg/L
Where water hardness is reported as mg/L CaCO3.
If the water hardness is unknown, the CWQG is 1 µg/L
Note 1.25 for Manganese (dissolved):
The guideline for dissolved manganese varies as a function of pH and hardness (as CaCO3). The lookup table is based on results for Hardness, Total (dissolved as CaCO3). / (CCME Update 2019)
Note 1.26 for Nickel (dissolved):
The guideline for nickel in µg/L is determined as follows:
When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 25 µg/L
At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using the equation:
e raised to the power of {0.76[ln(hardness)] + 1.06}
At hardness >180 mg/L, the CWQG is 150 µg/L
Where water hardness is reported as mg/L CaCO3.
If the water hardness is unknown, the CWQG is 25 µg/L
Note 1.27 for Phosphorus (dissolved, by ICPMS/ICPOES):
Canadian Guidance Framework for Phosphorus is for developing phosphorus guidelines (does not provide guidance on other freshwater nutrients). It provides Trigger Ranges for Total Phosphorus (see Guidance Framework for Phosphorus factsheet):
ultra-oligotrophic <4 µg/L;
oligotrophic 4-10 µg/L;
mesotrophic 10-20 µg/L;
meso-eutrophic 20-35 µg/L;
eutrophic 35-100 µg/L;
hyper-eutrophic >100 µg/L
Note 1.28 for Uranium (dissolved):
The Short-Term Exposure Guideline is 33 µg/L. The Long-Term Exposure Guideline is 15 µg/L. The guidelines are for total recoverable, unfiltered analyses.
Note 1.29 for Zinc (dissolved):
The long-term CWQG is for dissolved zinc (µg/L) and is calculated using the following equation: CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625). The CWQG equation is valid between hardness 23.4 and 399 mg CaCO3·L−1, pH 6.5 and 8.13 and DOC 0.3 to 22.9 mg·L−1.
The guideline value of 1.7 µg/L in this criteria set is based on assumed water quality of 23.4 mg CaCO3·L−1 hardness, pH of 8.13 and 0.3 mg·L−1 DOC, which are the limits for the equation that provide the most stringent guideline value. (CCME Update 2018)
2. Notes for CCME. Canadian water quality guidelines for the protection of freshwater aquatic life, Short-Term Exposure guidelines. (CCME AL (ST))
General Notes:
The CCME Canadian water quality guidelines for the protection of freshwater aquatic life provide both a Long-Term Exposure guideline, and Short-Term Exposure guideline for some analytes. Only the Short-Term Exposure guidelines are included in this criteria set.
Note 2.1 for Nitrate (as N):
The guidelines for nitrate are for protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrophication.
The Short Term guideline is derived from toxicity tests utilizing NaNO3. The Short Term guideline is derived with severe-effects data (such as lethality) and are not intended to protect all components of aquatic ecosystem structure and function but rather to protect most species against lethality during severe but transient events (e.g. inappropriate application or disposal of the substance of concern).

Note 2.2 for Cadmium (total):
The short-term benchmark for cadmium is determined on a site-specific basis according to the local water hardness. The benchmark for total cadmium in µg/L is determined as follows for short-term exposure:
1. If hardness (as CaCO3) is less than 5.3 mg/L then maximum is 0.11 µg/L
2. If hardness (as CaCO3) is from 5.3 to 360 mg/L then maximum is based on equation:
10 raised to the power of {1.016[log(hardness)] - 1.71}
3. If hardness (as CaCO3) is greater than 360 mg/L then maximum is 7.7 µg/L.
Note 2.3 for Manganese (total):
The short-term benchmark for dissolved manganese in µg/L is calculated using the equation: e raised to the power of { 0.878[ln(hardness)] + 4.76 }
Where water hardness is reported as mg/L CaCO3.
The benchmark equation is valid between hardness 25 and 250 mg/L.
When the hardness is 0 to < 25 mg/L, the benchmark is 1,970 µg/L.
At hardness >250 mg/L, the benchmark is 14,882 µg/L.
The guideline for dissolved manganese was used to identify exceedances for total manganese as a means for determining the potential for exceeding the guideline for dissolved manganese.

Note 2.4 for Uranium (total):
The guideline is for total recoverable, unfiltered analyses.
Note 2.5 for Zinc (total):
The guideline does not apply to total zinc. The short-term benchmark equation for dissolved zinc was used to identify exceedances for total zinc, as a means for determining the potential for exceeding the guideline for dissolved zinc. Where guideline users have only water sample concentrations expressed as total zinc, CCME recommends first comparing these samples to the dissolved guideline. Should an exceedance occur, re-sample for a dissolved concentration for direct comparison to the guideline.
The short-term benchmark is for dissolved zinc (µg/L) and is calculated using the following equation: Short-term benchmark= exp(0.833[ln(hardness (as CaCO3) mg/L)] + 0.240[ln(DOC mg/L)] + 0.526).
The short-term benchmark equation is valid between hardness (as CaCO3) 13.8 and 250.5 mg/L and from DOC 0.3 to 17.3 mg/L. If results are outside these equation limits, then the value of the closest equation limit is used in the formula calculation.
Note 2.6 for Cadmium (dissolved):
The short-term benchmark for cadmium is determined on a site-specific basis according to the local water hardness. The benchmark for total cadmium in µg/L is determined as follows for short-term exposure:
1. If hardness (as CaCO3) is less than 5.3 mg/L then maximum is 0.11 µg/L
2. If hardness (as CaCO3) is from 5.3 to 360 mg/L then maximum is based on equation:
10 raised to the power of {1.016[log(hardness)] - 1.71}
3. If hardness (as CaCO3) is greater than 360 mg/L then maximum is 7.7 µg/L.
Note 2.7 for Manganese (dissolved):
The short-term benchmark for dissolved manganese in µg/L is calculated using the equation: e raised to the power of { 0.878[ln(hardness)] + 4.76 }
Where water hardness is reported as mg/L CaCO3.
The benchmark equation is valid between hardness 25 and 250 mg/L.
When the hardness is 0 to < 25 mg/L, the benchmark is 1,970 µg/L.
At hardness >250 mg/L, the benchmark is 14,882 µg/L.

Note 2.8 for Uranium (dissolved):
The guideline is for total recoverable, unfiltered analyses.
Note 2.9 for Zinc (dissolved):
The short-term benchmark is for dissolved zinc (µg/L) and is calculated using the following equation: Short-term benchmark= exp(0.833[ln(hardness (as CaCO3) mg/L)] + 0.240[ln(DOC mg/L)] + 0.526).
The short-term benchmark equation is valid between hardness (as CaCO3) 13.8 and 250.5 mg/L and from DOC 0.3 to 17.3 mg/L. If results are outside these equation limits, then the value of the closest equation limit is used in the formula calculation.

APPENDIX C

CONCEPT PLAN FOR POLYTECHNIC UNIVERSITY

YELLOWKNIFE NORTH SLAVE CAMPUS

7. Yellowknife North Slave Campus

7.1. Master Planning Vision

In this location, where there are no College-owned facilities as a foundation for the polytechnic university, the development of a new campus offers a blank slate for establishing and embodying the values of the transformed institution. This campus offers an opportunity to realize, and also actualize, a vision for an educational community environment, specific to the unique context of the NWT.

The Yellowknife North Slave Campus will welcome students, staff and researchers from across the territory and from elsewhere. The campus is envisioned as a vibrant, supportive community, built with a dual focus on student safety and an inspiring learning environment. Its grounds and facilities will be designed to celebrate Indigenous ways of being, knowing and doing. The campus environment will be integrated with the natural landscape, supportive of land-based learning, and centred around cultural safety and diversified supports.

The campus grounds will be a defining feature, populated by outdoor learning and gathering spaces, and animated by community use. The Yellowknife North Slave campus will benefit from access to the nearby city amenities and services, while being grounded in the quiet expanse of the surrounding natural environment, bridging both.

Welcoming and supportive to students from remote Northern communities and from elsewhere, this campus environment will be designed to bring people together and to excite possibilities, while celebrating the character of the sub-arctic landscape, waters and skies.

7.2. Existing Facilities

Aurora College does not currently own facilities in Yellowknife. Academic functions and student residences are accommodated in a series of leased buildings, at the edges of downtown Yellowknife and near the territorial hospital.

The largest space being used by the College is inside the mixed-use and multi-tenant building called Northern United Place (NUP). The lower three floors of NUP's southeast wing were renovated in 2002 to accommodate administrative and academic functions for Aurora College. The annex side of the building has since been renovated to house additional offices, a nursing simulator and nursing lab. By 2006, these spaces were assessed as inadequate for the uses of the institution.

On the eighth and eleventh floors of the same building, one-bedroom and two-bedroom units are leased for student housing. Regarding this arrangement, issues cited by staff at the Yellowknife North Slave campus include a lack of control by the College over building maintenance, quality, security and regulations.

The ground floor of the Tallah Building (roughly 1km east of NUP) is also leased and primarily accommodates the Early Childhood Education program. This space has similarly been described by key stakeholders as deficient for its current use in terms of both size and layout. Additional space has been leased for offices, classrooms and a multi-functional lab on the 11th floor of the Precambrian Building, beginning in 2022.

Near Stanton Territorial Hospital, the College leases residential units in the multi-family buildings known as Beck Court and Stanton Suites. This housing is intended specifically for students in the Nursing program, who participate in work placements at the hospital. The close proximity of these units to the hospital is convenient for upper-year nursing students. The institution could consider retaining these leases as part of the polytechnic university's

housing portfolio, in the short-term or interim phases before the full requirements for new student housing are constructed.

Aside from housing dedicated to the Nursing program, the remainder of the College's leased space has been assessed as inadequately sized and unsuitable. Leased spaces are to be replaced with a purpose-built campus that meets the standards of a polytechnic university, and embodies the principles and vision outlined for the institution.

Table 4. Existing facilities at Yellowknife North Slave Campus

Facility	Size	Year built	Ownership	Adequacy
Academic and trades	**Area (m^2)**			
Northern United Place	2,468	1976	Lease	Inadequate size and unsuitable layout for current and future programming
Tallah Building	318	--	Lease	
Precambrian Building	--	--	Lease	To be leased in 2023
Residential	**# beds**			
Northern United Place	51	1976	Lease	Inadequate number of beds
Beck Court	8	--	Lease	Suites are adequate but distant from the campus.
Stanton Suites	32	--	Lease	

7.3. Space Requirements for a New Campus

With the academic facility at the new Yellowknife North Slave campus, a new building typology is being proposed – one without a precedent in the NWT.

Teaching, learning and research activities at the polytechnic university will be supported by a different ratio of spaces than the educational facilities that currently exist in the territory. An emphasis is to be placed on specialized research laboratories, faculty offices and additional spaces that support the student experience, as opposed to an emphasis on standard classroom spaces. Expanded academic spaces, as listed in Table 5, are required as part of a shift to supporting the academic freedom of researchers and faculty, which is a key criteria for meeting the standards of accreditation as a university. Further to this, additional programming is to be accommodated for student services and supports (see Table 6).

The space allocation recommendations in this report assume an increase to 175% of current full-time students at this campus, and are currently based on non-specific programming. To refine the proposed approach for this campus and define a functional program, the next step will be to finalize the academic programming. From here, the allocated space can be worked into a more specific and specialized set of functions that correspond to the programs offered at this campus.

For the full description of space allocation guidelines and formulas, see the polytechnic university's capital space standards and guidelines. Summary tables are included on the following page.

Table 5. Space allocation summary

Building program	Area (m^2) (est.)
Academic and student support	
Academic and research facilities	10,939
Student services centre	4,017
Residential	
Single student housing	2,616
Family student housing	14,121
Staff and faculty housing	411

Table 6. Overview of space allocation within academic facilities

Program category and description	Area (m2)	% of total bldg
Administrative functions	**522**	**4.8%**
Includes: Executive offices; Campus Director and supporting team offices; Reception, waiting rooms; Meeting rooms; Storage		
Faculty spaces	**1,413**	**12.9%**
Includes: Department chair office; Faculty offices; Reception; Meeting rooms; Storage and support space		
Laboratory and research spaces	**1,641**	**15.0%**
Spaces will be program-dependent. May include: Wet labs – with equipment storage, cold rooms, chemical storage; Dry labs – with secure procedural library, collection storage; Additional specialized spaces; Supporting offices		
Lecture halls and classrooms	**2,267**	**20.7%**
Includes: Large lecture hall / auditorium space; Assortment of large, medium, small classrooms; Computer labs; Conference rooms; Study rooms (medium, small, and individual)		
Library	**1,207**	**11.0%**
Includes: Library stacks, study carrels, computer stations; Display area; Reception, circulation; Meeting rooms and study rooms; Library administration offices; Storage		
General	**3,888**	**35.5%**
Includes: Circulation; Building systems; General storage; Washrooms; Interior partitions; Building structure		
Total	**10,939**	**100.0%**

Table 7. Overview of space allocation within student services centre

Program category and description	Area (m2)	% of bldg
Student commons	**1,264**	**31.5%**
Includes: Large gathering space; Kitchen; Canteen; Retail space (campus book store); Workshops/activities/events space; Exercise room/gym and changerooms; Storage; Loading dock		
Daycare	**962**	**23.9%**
Includes: Play area; Nap space; Office; Kitchen; Meeting/private room; Storage		
Student wellness supports	**108**	**2.7%**
Includes: Flexible counseling space; Reception; Private waiting area; Storage		
Health centre	**258**	**6.4%**
Includes: Practitioner's office; Examination/consultation rooms; Reception; Private waiting area; Storage		
General	**1,425**	**35.5%**
Includes: Circulation; Building systems; General storage; Washrooms; Interior partitions; Building structure		
Total	**4,017**	**100%**

Residential facility requirements for the Yellowknife North Slave Campus

Housing is a serious need at all three campuses. In Yellowknife, however, it is assumed that some students will be able to find accommodations within the larger housing market – more so than in Fort Smith and Inuvik. The existing NWT College Facilities Capital Standards and Criteria (2007) suggests that housing should be provided for 57% of enrolled students in Yellowknife, as opposed to approximately 95% in the other two campus communities.

The Facilities Master Plan brings forward the same assumption for Yellowknife. On-campus housing is proposed to accommodate 57% of the targeted enrolment numbers at this campus, understanding that approximately a third of the student body should be able to secure off-campus housing. Of the students accessing on-campus housing, 60% are assumed to have family members with them, based on current trends.

Following from these assumptions, student residences are proposed to accommodate 89 single student bedrooms and 134 family housing units. In addition, nine units are proposed as short-term accommodations for staff, faculty, and visiting researchers. Due to the high volume of new units being proposed, the construction of housing will occur in phases. 40% of total required student housing is proposed to be built in the first, immediate, phase of work.

Student housing is to be built on the campus site. This approach supports the vision for the polytechnic university by fostering an engaging student experience and a sense of community, while ensuring that students have ready access to services and supports provided by the institution.

7.4. Site Selection Criteria for a New Campus in Yellowknife

Key criteria for the campus site were established through targeted early engagement sessions, in combination with precedent studies and background research. Three minimum requirements for the site, based on this process, are summarized below.

A natural setting with access to the land

Yellowknife North Slave Campus should have a natural character and be equipped with ready access to the land. Reasons for this include the following:

- The student population at Aurora College, and likely at the new polytechnic university, is majority Indigenous. The campus should be designed to support and celebrate Indigenous ways of being, knowing and doing. Connection to the land is of paramount importance.
- To offer an experience of cultural safety, access should be provided to outdoor gathering areas, ceremonial spaces and outdoor work spaces. These places should be grounded within a natural setting.
- On-the-land educational programming has been cited as a key opportunity and interest by stakeholders. The campus should be equipped to support land-based learning.
- The campus should feel welcoming, safe and supportive to residents from smaller NWT communities who might travel to Yellowknife for post-secondary education. For these students, a quiet, compact community environment, set inside the landscape, would offer a comfortable and familiar setting.
- As the polytechnic university grows, it will support students and faculty from outside of the territory. A striking educational environment, responsive to the natural beauty of the NWT, will help attract students and staff to the institution. This, in turn, will establish the critical mass required to offer an engaging and high-quality post-secondary experience for Northerners.

Enough space to get established and then to expand

Including academic and research facilities, a student services centre and housing, the short-term vision for the campus requires a total building area of approximately 32,500 m^2. To create an experience that responds to the natural setting (as outlined above), these facilities are envisioned to be no more than 2-3 storeys in height. Accordingly, the buildings would occupy a total footprint between 11,000 and 16,000 m^2. This area accounts only for the footprints of facilities; parking, outdoor learning space and outdoor circulation space is additional. The campus also requires space for future expansion in coming decades as student enrolment increases. Ideally this expansion will take place on the same site; room to grow needs to be planned.

Based on the approximate numbers above, a suitable site is recommended to be an absolute minimum of 22,000 m^2, and preferably larger.

Ready for development

The new campus is intended to be in development within three years. A suitable site for the campus must be ready and available for development by 2025.

7.5. Site Selection Methodology + Findings

Subject matter experts looked at how campuses across Canada and around the world are chosen and developed. They also heard through engagement about what elements were most important when looking at the best location for the future campus Three potential scenarios were considered for the desired typology of the campus setting and its relationship to the community of Yellowknife. These three scenarios are:

- **Central + Integrated** — This campus is embedded in the central core of a larger community, with buildings dispersed throughout the city
- **Central + Distinct** — Centrally-located to the larger community, but comparatively self-contained, with a sense of being distinct from the city
- **Peripheral + Distinct** — Located on the periphery of the community, and distinct from the city

Each model has different characteristics that shape the utility, learning experience and potential for growth. There are common campus design considerations among institutions in Canada that are reflected in the site selection considerations for the new Yellowknife campus. These considerations are reflected in Figure 8.

Figure 8

Considerations	Central Integrated	Central Distinct	Peripheral Distinct
Flexibility to accomodate and manage growth	○	◑	●
Critical mass to support complete campus	●	◑	○
Ability to establish campus identity	○	●	●
Presence of hard infrastructure	●	●	?
Accessible by public transit	●	◑	○
Options for parking	◑	●	●
Proximity to existing and future housing	◑	●	?
Proximity to community amenities	?	●	○
Proximity to potential academic partners	?	?	?
Potential for local economic impact	●	◑	○

● Strength
◑ Sufficient
○ Weakness
? Unknowns

A review of Yellowknife and surrounding land identified sites that met the technical requirements of a new campus, and these sites were organized under each campus model as seen in the Table 8.1 and 8.2.

Upon further review, c**entral integrated sites** provided only the minimal space and would present many of the same challenges to growth experienced by the current Yellowknife campus. **Peripheral distinct sites** were deemed to have potential, but an initial review suggested they would be more costly and would not draw students or provide a genuine university experience relative to the other two models.**Central distinct sites** were shown to balance land availability with the potential for an attractive and fully functional campus that can grow incrementally. This was determined to be the most appropriate approach.

The next step was to examine the sites associated with that model and work through the potential of each site. Sites included:

- Old Airport Road/Frame Lake: This site was taken out of consideration because the availability of land in the area is limited by an interim land withdraw.
- Niven Phase III: This site was taken out of consideration by the land owner(s).
- Con Mine: This site was taken out of consideration due to potential environmental liabilities and timing of availability.
- Taylor Road South: This site was taken out of consideration due to location. It is surrounded by old tailings ponds from Con Mine that significantly limit the potential for establishing a campus.

Figure 8.1 ***(see 8.2 for mapping of locations)***

Central Inegrated Site Options:
Site 1. City Geteway/Visitors Centre
Site 2. Block 38 (51st and 50th Ave)
Site 3. Akaitcho Hall

Cental Distinct Site Options:
Site 4. Tin Can Hill
Site 5. Con Mine
Site 6. Taylor Road South
Site 7. Niven Phase III
Site 8: Old Airport Road/Frame Lake

Peripheral Distinct Site Options:
Site 9: Airport Area
Site 10: by Giant Mine
Site 11: Former Treatment Plant

Figure 8.2

- Tin Can Hill: This site was reviewed multiple times and considered in the context of technical requirement, design limitations and opportunities for future expansion. Based on these considerations, it was identified as the most optimal. The significant benefits to this site include:
- **Size:** This property is large enough to accommodate all required campus facilities, campus grounds, and an expansion of the campus facilities in future, while also establishing and maintaining a sizable natural preserve on site.
- **Character:** Tin Can Hill is an undeveloped site exemplifying the rocky, treed landscape of the subarctic Canadian Shield, and occupies a wide waterfront with unencumbered views and direct access to Great Slave Lake. There is a great opportunity to develop a striking and unique campus identity here, one that communicates intimately with the landscape of the North Slave Region. The site creates a feeling of being embedded in nature, and even being remote to the city making it an ideal locale for establishing a peaceful and secure environment.
- **Location:** The downtown core of Yellowknife is a ten-minute walk from Tin Can Hill. Services and amenities such as grocery stores, restaurants, retail, banks, and government services are all within walking distance from the site. In addition, an existing transit line runs down School Draw Avenue (directly adjacent to the site) and could be extended to the new campus. Through engagements, we have heard that students from across the NWT should feel at home at the polytechnic university, and that access to services and amenities for themselves and their families is important. For students with families, there are two high schools and three elementary schools within a 1.5km radius.
- **Current Use/Ownership:** The site is currently owned by the City of Yellowknife and is primarily used as a recreational site by dog-walkers and skiers. This use can be maintained and potentially enhanced on the natural preserve that is intended to occupy a large portion of the new campus grounds.

The existing conditions of the site are shown in Figure 10.

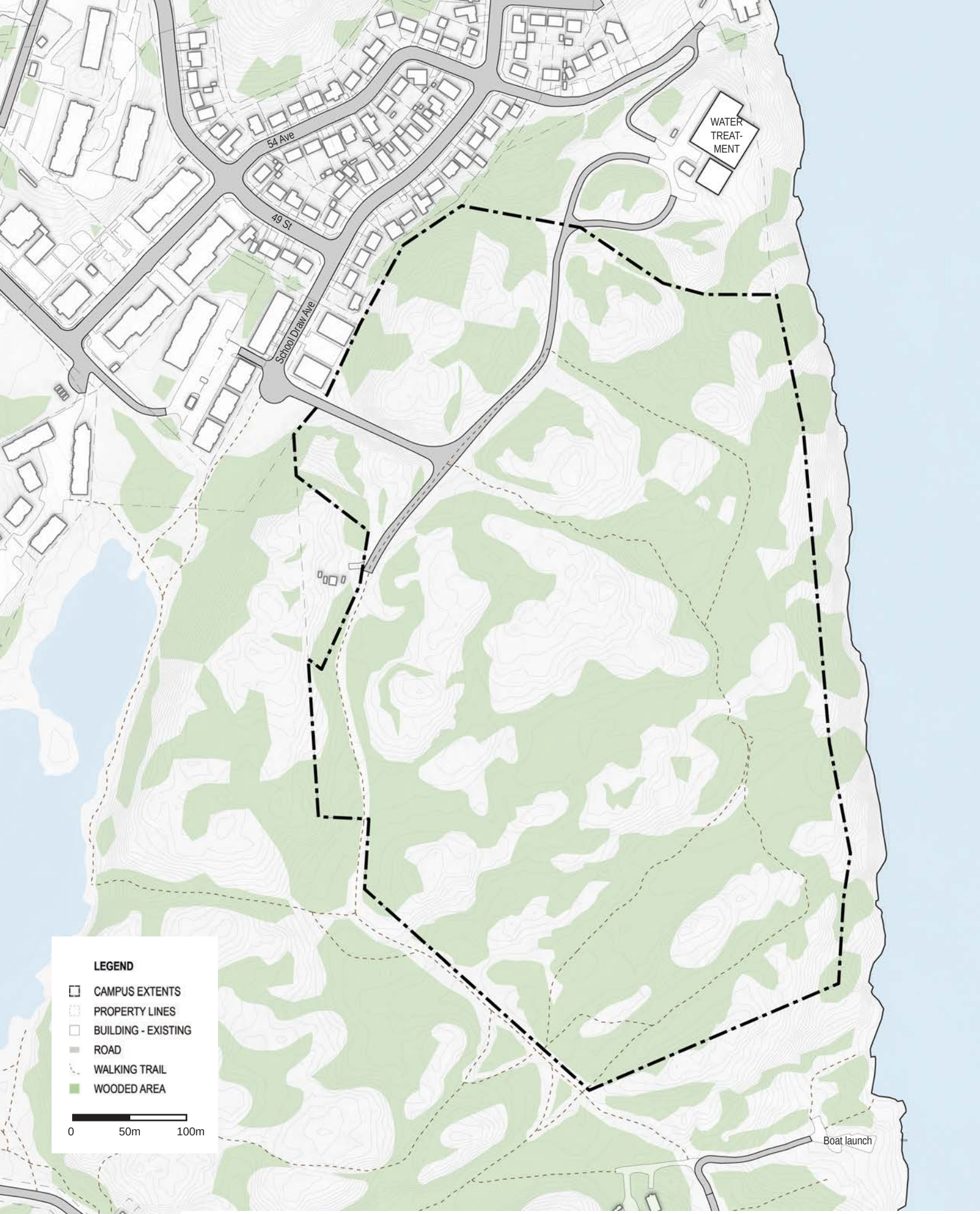

Figure 10. Existing Site Conditions

7.6. Guiding Principles and Opportunities

The following key principles have been applied specifically to the site planning approach for the new Yellowknife North Slave Campus.

Safety: Safety on campus incorporates a wide spectrum of issues; these may include barrier free accessibility, vehicular/traffic safety and personal safety concerns. In a practical sense, several steps can be taken at the campus planning stage to lay the groundwork for a safe campus:

- Separate vehicular traffic from pedestrian circulation. Parking should be removed from building entrances and buffered from the pedestrian-friendly core of the campus
- Ensure openness, transparency and lines of sight are afforded – both within buildings and throughout the outdoor site planning
- Gradual elevation changes across circulation routes are preferable
- Ensure vehicular access to buildings for emergency vehicles and servicing

Northern and Indigenous Experiences: There is a wide diversity of Northern and Indigenous experiences and cultures across the NWT. Common among these experiences is the importance of being connected to the land. This principle can be supported by integrating campus buildings with the surrounding environment, creating direct access to the land, and establishing space for land-based activities and gathering spaces.

- Integrate the built environment with the natural landscape
- Create access to an on-the-land experience
- Designate appropriate spaces for outdoor gathering spaces and land-based activities
- Foster a sense of community, and an identity for the campus where Northern students will feel comfortable, empowered and at ease

Preservation and enhancement of the natural setting: The existing natural environment should remain, and be enhanced, as an integral part of the campus development.

- Where possible, leverage visual and physical access to the waterfront
- Minimize the development footprint – e.g. leaving bedrock and forest preserved and traversed by footpaths, rather than blasting and paving large portions
- Design elements of the campus (buildings, parking, pathways) to respond cohesively to the natural site contours, materiality, climate, and features specific to the site.

Economical site development: With the development of a large new site, a balance should be considered. The up-front cost for the first phase of site development should be minimized. At the same time, the groundwork should be laid for future expansion in a way that allows new facilities to build sensibly on the initially-established infrastructure.

- Consider both short-term and long-term sustainability in the initial development plan
- Be frugal with proposed placement of roads, and with all blasting, grading, and paving
- Encourage synergies with other institutions and with nearby amenities as applicable.

Preservation of flexible opportunities for long-term growth: A significant section of the site should be protected for long-term expansion in a way that serves the future needs of the institution.

- Designate a protected area for long-term expansion
- Establish a framework with intentionality about the location of parking areas, access points and key connections
- Outline and protect the opportune areas for future development sites, while maintaining flexibility of each site to accommodate various development types

7.7. Development Framework

Guidelines for development on Tin Can Hill

Following from the planning principles for the new campus, and an assessment of the site conditions, character and opportunities presented, the following set of parameters are intended to guide the development of campus infrastructure on Tin Can Hill:

- **Respect the site topography:**
  - » Building sites follow the lines of the land rather than manufacturing a new development pattern
  - » Development of hard infrastructure is minimized: all facilities hinge off a single, simple vehicular circulation route – which builds on the existing road through the site
- **Maintain a natural, treed horizon:**
  - » Where facing the waterfront, buildings are nestled into the low points in the landscape rather than dominating the skyline
  - » A wide buffer is maintained between the new residential developments and the existing neighbourhood on School Draw Avenue
- **Celebrate the experience of the land and water:**
  - » Green space is preserved between every development parcel to maintain sense of being on (or close to) the land
  - » Existing vegetation, where possible, is maintained
  - » Views over the waterfront are afforded to developments that face the site's eastern edge
- **Create vibrant outdoor spaces through a pedestrian-focused approach:**
  - » Parking is maintained at some distance from the main academic buildings, encouraging an approach to facilities on foot
  - » Landscaped grounds are established as a central defining element of the campus
  - » Existing walking trails through the site are maintained, and remain accessible to the public
- **Distinct experience between public, semi-public and private:**
  - » Academic developments are accessed primarily on foot and face the waterfront
  - » Residences are clustered into neighbourhoods and buffered (by forested space) from the academic area, and from city streets
  - » Residential and academic sites are afforded separate access points and parking

Defining each component of the campus

Figure 11 illustrates an approach to the location, orientation and key access points for each main component of the campus.

- **Academic development sites** reach from the main access road towards the waterfront, stepping down the low areas in the natural topography. These sites are accessible by a

service loop, but the main approach is on foot.

- **Parking areas for academic functions** are maintained at a distance from the academic facilities. Main parking for the academic campus is located at the west edge of the site. A key pedestrian path is established between this parking lot and the phase 1 academic facility.
- **Equipment storage / light industrial sites** are provided in two locations, both of which are discrete (less visible from the water or from the main access road) but accessible by vehicular routes.
- **Residential development sites** in the framework diagram include private parking areas for the student residences. These development sites are accessible from the main road, while distinct from the more public academic areas. Residences are envisioned to take the form of small-scale buildings clustered together in neighbourhoods.
- **Natural preserve** sites are intended to be preserved in its natural state, unless outlined as one of the above development areas. These areas are preserved because:
  A) Some of the land is intended to be used for a variety of land-based programming, not requiring hard infrastructure.
  B) A natural buffer of treed landscape is to be maintained between each built component. For example, between the existing houses on School Draw Ave and the buildings on Tin Can Hill; between the new residential developments and the new academic developments; and between the two main academic facility sites.
  C) Some areas are impractical for development, due either to steep/uneven topography, or to distance/inaccessibility from servicing infrastructure.
- **"Maintained as is": area for long-term expansion:**
  The southern half of the site is to be protected by the institution until the polytechnic university grows beyond the maximum capacity of the outlined development areas. In its current state, this recreation site is an important community space and is well-used by the public. Preserving the area, with the existing walking trails intact, will facilitate community access to and interaction with the campus grounds, while at the same time, maintaining a distinct separation from private and semi-public areas on site.
  This massive natural preserve is an important component of the campus in its first phases of establishment. The natural site increases the attractiveness of the campus to students and staff, offers access to land, and can facilitate a sympathetic relationship between the campus grounds and city residents.
  To the greatest extent possible, trails will be maintained or expanded to preserve accessibility by the broader community.

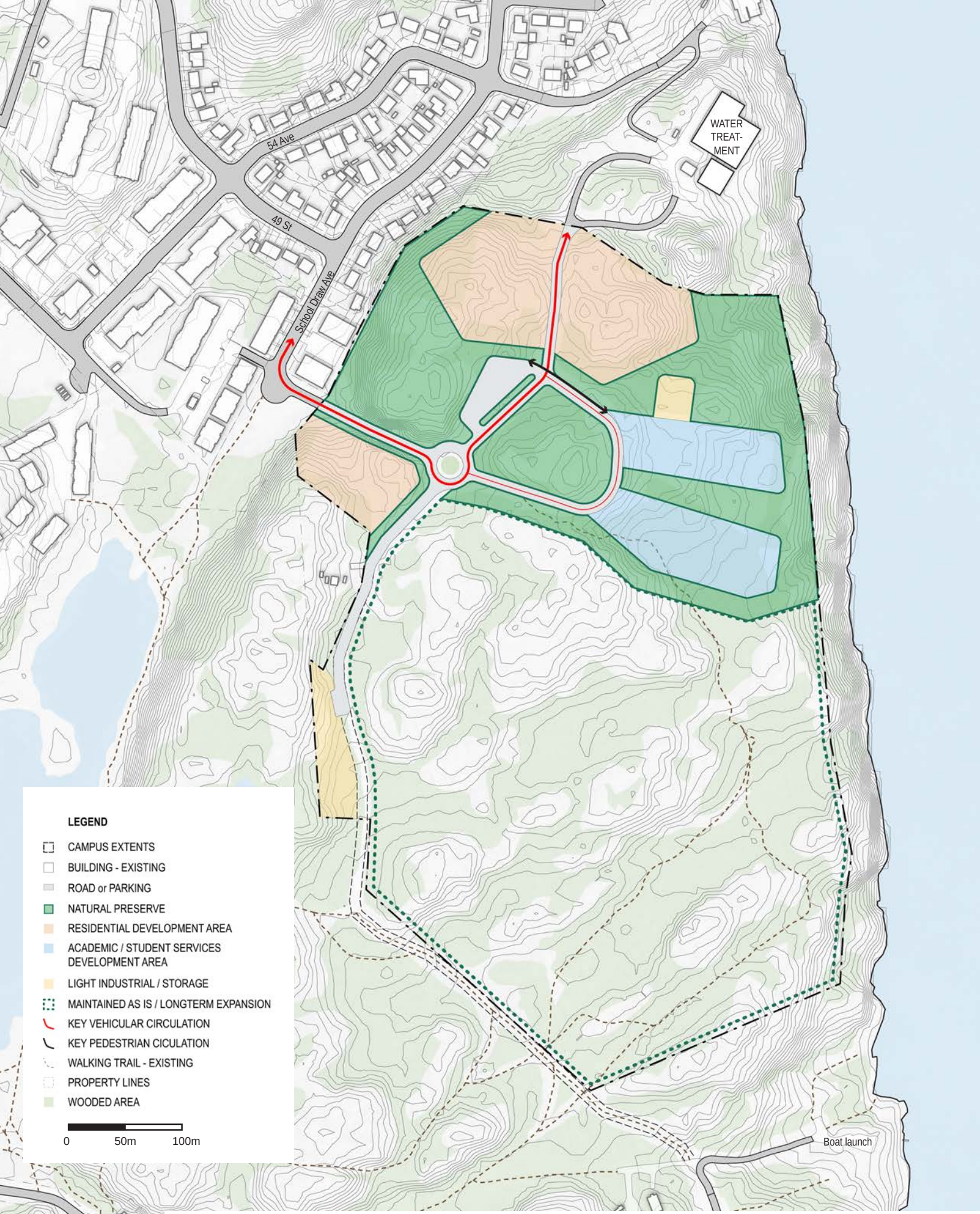

Figure 11. Yellowknife North Slave Campus: Development Framework

7.8. Campus Development Scenarios

Figures 12 to 14 illustrate a phased series of development scenarios for the Yellowknife North Slave Campus. The building areas shown on these plans correspond to the space requirements detailed in Section 8.3 and attached appendices.

The academic and research functions are housed in a single facility, set within a low point in the site topography, with prominent views toward Great Slave Lake. Ancillary buildings for academic functions include a storage shed to support land-based programming and a vehicle maintenance garage situated on the main access road.

Just north of the academic building is the student services centre, which is proposed to be built in two phases. Phase 2 assumes an expansion of the daycare function and of the student commons, as enrolment increases. Future needs assessments should also be undertaken to confirm the programming requirements for any facility expansions.

The academic and student services building share a large central courtyard which overlooks the water and ties into the existing public trail system. Green roofs on these buildings will lend them a natural and humble presence when viewed from the lake.

Phase 1 student residences are near the student services centre, though separated by a forested area. The student housing is conceived of as a series of small-scale multi-unit residential buildings, each sharing a neighbourhood courtyard. The intent is to cultivate a natural (rather than urban) setting, and offer a comfortable home environment for students from smaller communities. Residential facilities would be two or three storeys in height, depending on the topography: if occupying a low point, the building could be taller, without imposing on the site or its surroundings. During the design phases for these facilities, care should be taken to ensure the buildings are oriented to capture sunlight and shelter the courtyards from prevailing winds.

The Phase 1 plan shows 40% of student housing requirements, with another 40% built in Phase 2 and the remainder as Phase 3. These phases might be combined, further broken down or may be further considered as student enrolment increases. Each cluster of residences is provided a private parking lot. Parking is adjacent to the main access road rather than adjacent to each building to minimize the presence of roads or paving on site.

All buildings on campus are connected by a network of pathways. These are intended primarily for pedestrian usage, but should be wide enough to accommodate a service vehicle as required. This network will take the form of boardwalk-style pathways, which may be concrete, rather than asphalt. On the southern portion of the site, the existing public trail system is unimpacted, but could be expanded pending further community engagement.

Energy Systems Recommendations

The area calculations in Appendix C assume that each building will be served by its own heating plant. However, the potential exists to establish a district energy system for the campus. This approach would consolidate maintenance and space requirements to a single heating plant, would create opportunities for the campus to be heated with renewable energy, and would make the campus future-flexible, capable of changing over to new renewable and efficient heating options as they become available.

Initially, a district heating plant could be fueled with a biomass (wood-pellet) combustion boiler, which is the most common and cost-effective renewable heating system in Yellowknife.

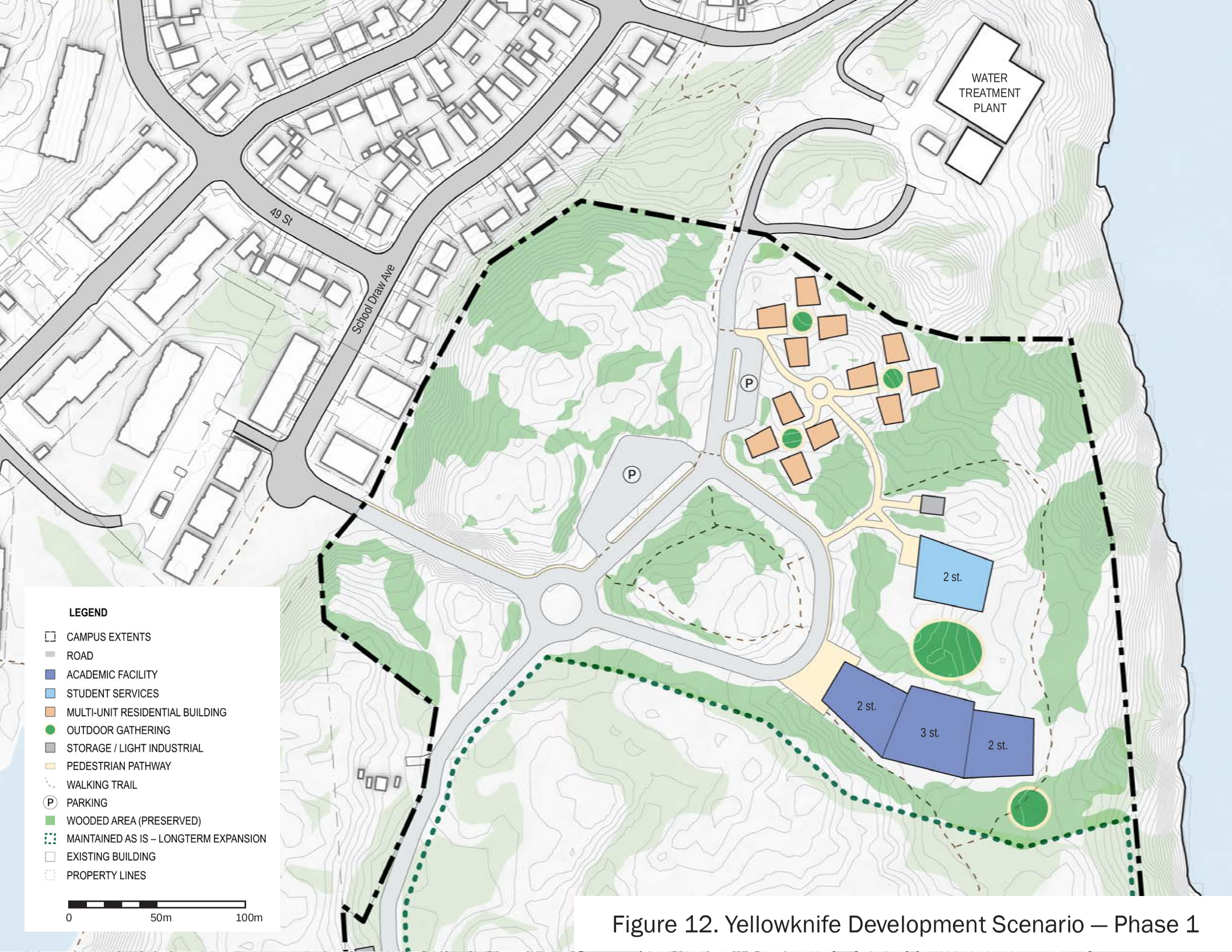

Figure 12. Yellowknife Development Scenario — Phase 1

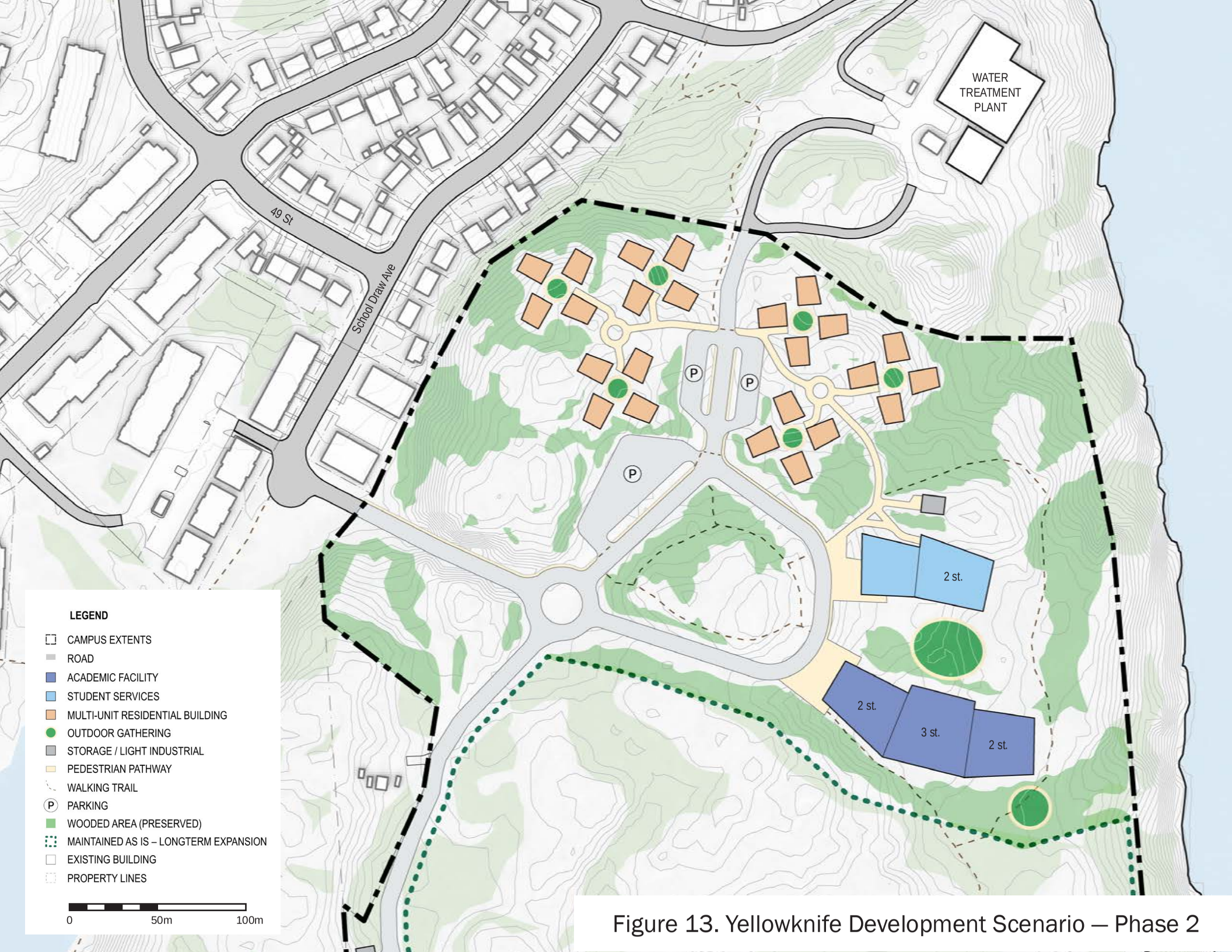

Figure 13. Yellowknife Development Scenario — Phase 2

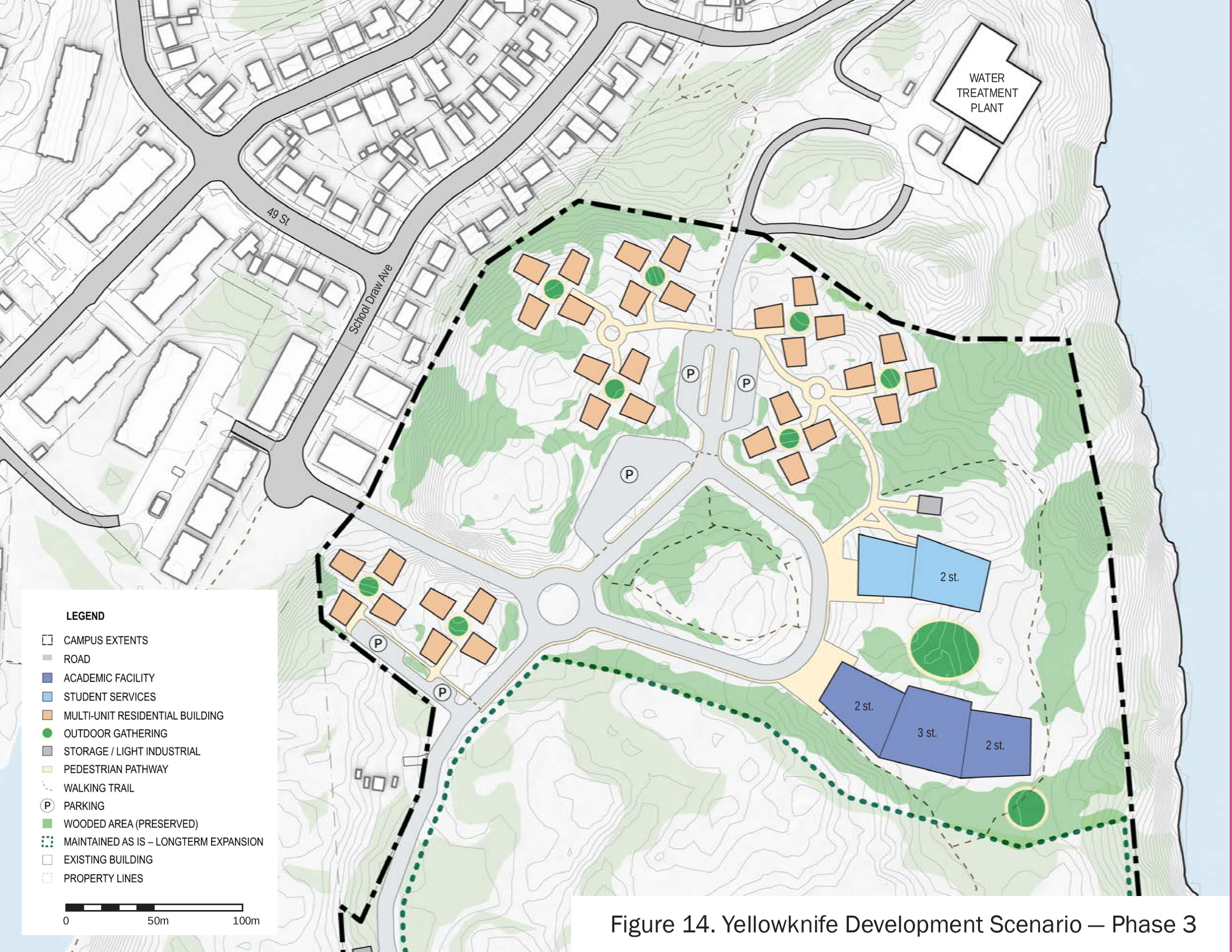

Figure 14. Yellowknife Development Scenario — Phase 3

A standard biomass combustion heating system would also accomplish a reduction in carbon footprint compared to conventional systems, reduce dependence on fossil fuels, and create operational cost savings compared to conventional oil and gas heating systems.

The heating load anticipated for the new campus could also be well suited to newer energy technologies, such as a Pyrolysis Carbon Capture and Storage (PyCCS) heating system. PyCCS heating has a carbon negative effect as it takes biomass fuel such as wood pellets or chips, and converts them to heat and to bio-char, which is a carbon capturing solid byproduct that can be used as a soil amendment in agriculture, mine remediation or other industrial uses. Planning for a carbon neutral option for heating, using available technology such as PyCCS, would make the campus demonstration project for renewable energy technology, thereby attracting further academic and research interests from within and outside of the territory.

It is recommended that a district energy system, with a central heating plant of biomass combustion boilers or PyCCS boilers, be included in the next phase of campus planning. A district energy system will centralize and consolidate maintenance, provide a single point backup and redundancy of heating systems, and offer the added benefit of being easily upgraded to accommodate future advances in heating technologies. Given the scale of this development and the energy prices in Yellowknife, an investment in cost-efficient renewable energy systems is likely to deliver a significant return in the coming decades.

7.9. Potential Co-location Partners in Yellowknife

At the outset of the facilities master planning process, specific potential co-location partners were identified. They were engaged as part of the planning process. Additional work is needed to solidify co-location plans, including funding arrangements. The space requirements for these partners have not been included in the space estimates in the FMP. The current understanding of their projected needs is summarized below.

Collège Nordique Francophone

Collège Nordique Francophone is an educational institution offering language courses, post-secondary education, professional development, and community workshops in French. The institution is interested in co-location with the polytechnic university. International students are a growth market, and the institution hopes to grow to have 50-100 full-time students over the next 20 years. To enable this growth, access to student housing for international students is a priority, with 10 units as a desired start. These students may also require access to daycare.

With their current student population, it may be possible to share teaching spaces with the polytechnic university, as many of their courses are offered outside of standard business hours. There is also interest in leveraging specialised teaching spaces, such as lab spaces for nursing and early childhood education. Collège Nordique is offering college level Early Childhood Education program through Collège La Cité this fall, and sees growth in Business Administration and Communications programs. Co-location would require that signage and wayfinding markers on campus reflect a linguistic duality or plurality within the specific context of the NWT's official languages. It may be that some common areas and student services areas, when shared, would also need to be mindful of this dynamic. Furthermore, spaces for Collège Nordique would need to be grouped to foster a Francophone space within the campus where most activities could be conducted in French (offices, student common room and teaching spaces) while also respecting any eventual bilingual or multi-lingual conventions.

At this point, Collège Nordique does not expect to have a presence in the polytechnic

university outside of the Yellowknife campus. They have had limited virtual students from Inuvik and Fort Smith.

Dechinta Centre for Research and Learning

Dechinta Centre for Research and Learning (Dechinta) is an Indigenous-led fully land-based educational centre. Dechinta's priorities are maintaining autonomy and self-determination. There is opportunity in collocating with the polytechnic university. Dechinta is currently offering programming in different areas of the NWT and would have a presence at the campuses and some community learning centres.

In Yellowknife, Dechinta currently requires an office with breakout spaces, co-working space for 10 staff, a six-car garage, two sea cans, and five parking stalls for trailers and snowmobiles. Both heated and cold storage is needed. With a purpose-built space, it is a priority for it to be reliable and accessible. Programming would utilize both accessible outdoor space on campus, and access to the water and snowmobile trails for land-based programs off-campus. Students would benefit from access to dorm-style student housing and shower facilities before and after their land-based programs – estimated at 20 beds.

In NWT's smaller communities, there is also the opportunity for Dechinta to use the community learning centres as a starting point for land-based programs. There is a need for internet access, space to host gatherings, and flexible teaching and office space. Currently, Dechinta's programming is growing in the Beaufort Delta with a presence in Aklavik, Tuktoyaktuk and Inuvik. Of note, programming shifts based on community champions and opportunities, so it is expected that regional programming will shift over time. Dechinta also has interest from visiting researchers.

Wilfrid Laurier University

Wilfrid Laurier University (Laurier) currently has 74 active projects across 48 research sites in the NWT. Laurier has an office in Yellowknife that has permanent staff and hosts visiting researchers. Laurier also leases space across the territory depending on specific project needs. Co-location with the polytechnic university is an interest. For the Yellowknife campus, the needs are office space, open workspace, access to lab space and a variety of storage for a range of needs from vehicles to water samples. There is an opportunity to build relationships in NWT communities between Laurier and the CLCs.

Taiga Labs

Taiga Environmental Laboratory is a government-run full-service analytical laboratory that performs a wide range of organic and inorganic chemical analyses on water. There is the opportunity to potentially collocate with the polytechnic university at the Yellowknife campus and provide opportunities for students to have placements in the lab. Taiga Labs has exceeded its current capacity in all areas including lab space, office space and storage. There are specific facilities considerations for Taiga Labs. It requires dedicated lab space and a dedicated entrance for clients to drop-off samples.

7.10. Other Partnership Opportunities

An interest has been identified to create opportunities to support local entrepreneurship and connect with existing infrastructure. There are many potential partners that would fit this category across the territory. Additional partnerships will continue to be explored and will be established between Aurora College and NWT communities.

7.11. Cost Estimates for Priority Developments

These cost estimates have been generated based on the area calculations attached as Appendix C. Assumptions and limitations on the cost estimates as well as detailed construction cost estimates for each involvement are also attached. Project costs have been calculated by adding 25% for soft costs onto the construction estimate.

Table 9. Class D Cost Estimates for Priority Developments (Yellowknife North Slave Campus)

Priority	Building program	Area (m^2) (est.)	Construction Cost ($) (est.)	Project Cost ($) (est.)
A.1	Site development and servicing at Tin Can Hill	--	30,803,915	38,504,894
	Academic and research facilities	10,939	74,038,841	92,548,551
	Phase 1 of student services centre	2,611	36,842,387	46,052,983
R.1	Phase 1 of student housing	6,859	49,815,312	62,269,140
A.2	Phase 2 of student services centre	1,406	19,838,208	24,797,760
R.2	Phases 2-3 of student housing	10,289	74,722,969	93,403,711
	Staff, faculty, and researcher housing	411	5,623,464	7,029,330

APPENDIX D

LISTED SPECIES SEARCH RESULTS

Animal/Plant	Species	NWT Status		Canada Status		Distribution Overlap with Site?	Retained as ROPC?	Feeding Guild
		SARC	NWT List	COSEWIC	Federal List			
Mammals								
Barren-ground Caribou	Rangifer tarandus groenlandicus	Threatened	Threatened	Threatened	Under Consideration	Yes	Yes	herbivore
Eastern Red Bat	Lasiurus borealis	Not Assessd	No Status	Endangered	Under Consideration		Yes	invertivore
Hoary Bat	Lasiurus cinereus	Not Assessd	No Status	Endangered	Under Consideration		Yes	invertivore
Little Brown Myotis	Myotis lucifugus	Special Concern	Special Concern	Endangered	Endangered	Yes	Yes	invertivore
Wolverine	Gulo gulo	Not At Risk	No Status	Special Concern	Special Concern	Yes	Yes	carnivore
Birds								
Bank Swallow	Riparia riparia	Not Applicable	Not Applicable	Threatened	Threatened	Yes	Yes	insectivore
Barn Swallow	Hirundo rustica	Not Applicable	Not Applicable	Special Concern	Threatened	Yes	Yes	insectivore
Common Nighthawk	Chordeiles minor	Not Applicable	Not Applicable	Special Concern	Special Concern	Yes	Yes	insectivore
Evening Grosbeak	Coccothraustes vespertinus	Not Applicable	Not Applicable	Special Concern	Special Concern	Yes	Yes	herbivore
Harris's Sparrow	Zonotrichia querula	Not Applicable	Not Applicable	Special Concern	Special Concern	Yes	Yes	omnivore
Horned Grebe	Podiceps auritus	Not Applicable	Not Applicable	Special Concern	Special Concern	Yes	Yes	carnivore
Lesser Yellowlegs	Tringa flavipes	Not Applicable	Not Applicable	Threatened	Under Consideration	Yes	Yes	carnivore
Olive-sided Flycatcher	Contopus cooperi	Not Applicable	Not Applicable	Special Concern	Special Concern	Yes	Yes	insectivore
Red-necked Phalarope	Phalaropus lobatus	Not Applicable	Not Applicable	Special Concern	Special Concern	Yes	Yes	invertivore
Rusty Blackbird	Euphagus carolinus	Not Assessed	No Status	Special Concern	Special Concern	Yes	Yes	insectivore
Short-eared Owl	Asio flammeus	Not Assessed	No Status	Threatened	Special Concern	Yes	Yes	carnivore
Yellow Rail	Coturnicops noveboracensis	Not Applicable	Not Applicable	Special Concern	Special Concern	Yes	Yes	omnivore
Insects								
Transverse Lady Beetle	Coccinella transversoguttata	Not Assessed	No Status	Special Concern	Special Concern	Yes	Yes	
Yellow-banded Bumble Bee	Bombus terricola	Not At Risk	No Status	Special Concern	Special Concern	Yes	Yes	

Source an Search Parameters
nwtspeciesat risk.ca
North Slave/Tlicho Region

APPENDIX E

SOIL CONCENTRATION STATISTICS

General Statistics - Site Wide Soil Data

Date/Time of Computation	ProUCL 5.2 1/16/2024 3:25:15 PM
User Selected Optior	
From File	Stats Input_Tin Can Hill.xls
Full Precision	OFF

From File: Stats Input_Tin Can Hill.xls

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness	CV
Antimony	42	0	0.52	36	8.376	5.385	7.869	1.214	6.701	1.698	0.939
Arsenic	42	0	9.54	1850	194.3	73.59	356.8	55.05	59.15	3.305	1.836
Barium	42	0	9.83	2770	143.9	68.1	419.3	64.7	40.1	6.284	2.915
Boron	42	0	5	32.5	11.09	9.739	6.737	1.04	2.669	1.871	0.607
Cobalt	42	0	0.28	40.6	7.023	4.395	7.589	1.171	3.239	2.515	1.081
Copper	42	0	3.63	145	32.94	25.29	28.19	4.349	13.86	2.442	0.856
Selenium	42	0	0.2	3.23	0.616	0.459	0.611	0.0942	0.141	2.657	0.992
Vanadium	42	0	0.77	55.1	17.43	8.961	18	2.777	8.05	0.817	1.033
Zinc	42	0	4.1	768	54.16	30.72	115.3	17.79	25.65	6.059	2.129

Percentiles for Uncensored Data Sets

Variable	NumObs	# Missing	10%ile	20%ile	25%ile(Q1	50%ile(Q2	75%ile(Q3	80%ile	90%ile	95%ile	99%ile
Antimony	42	0	1.368	2.044	2.908	6.28	12.08	12.36	16.78	26.51	32.47
Arsenic	42	0	15.12	26.52	30.25	54.45	141.8	238.4	467.6	885.5	1579
Barium	42	0	30.06	37.76	42.83	63.7	96.78	110	172	211	1754
Boron	42	0	5.12	7.4	7.425	9.3	10	12.32	22.48	25.28	31.15
Cobalt	42	0	1.445	1.922	2.125	3.93	11	12.3	13.17	18.84	33.59
Copper	42	0	12.52	15.26	16.35	24.7	35.38	43.58	65.14	76.31	135.2
Selenium	42	0	0.2	0.3	0.3	0.37	0.613	0.978	1.295	1.534	2.836
Vanadium	42	0	1.801	3.442	3.638	7.65	33.55	39.32	44.15	50.35	53.62
Zinc	42	0	10.07	16.66	17.6	30.65	52.8	59.16	75.65	86.45	491.9

Site Wide Soil 95% UCLM

User Selected Options	
Date/Time of Computation	ProUCL 5.2 1/16/2024 3:26:30 PM
From File	Stats Input_Tin Can Hill.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony

General Statistics

Total Number of Observations	42	Number of Distinct Observations	41
		Number of Missing Observations	0
Minimum	0.52	Mean	8.376
Maximum	36	Median	6.28
SD	7.869	Std. Error of Mean	1.214
Coefficient of Variation	0.939	Skewness	1.698

Normal GOF Test

Shapiro Wilk Test Statistic	0.791	**Shapiro Wilk GOF Test**
1% Shapiro Wilk Critical Value	0.922	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.159	**Lilliefors GOF Test**
1% Lilliefors Critical Value	0.157	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	10.42	95% Adjusted-CLT UCL (Chen-1995)	10.71
		95% Modified-t UCL (Johnson-1978)	10.47

Gamma GOF Test

A-D Test Statistic	0.331	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.772	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.106	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level

38	**Detected data appear Gamma Distributed at 5% Significance Level**											
39												
40	**Gamma Statistics**											
41						k hat (MLE)	1.272			k star (bias corrected MLE)	1.197	
42						Theta hat (MLE)	6.584			Theta star (bias corrected MLE)	6.996	
43						nu hat (MLE)	106.9			nu star (bias corrected)	100.6	
44						MLE Mean (bias corrected)	8.376			MLE Sd (bias corrected)	7.655	
45										Approximate Chi Square Value (0.05)	78.44	
46						Adjusted Level of Significance	0.0443			Adjusted Chi Square Value	77.74	
47												
48	**Assuming Gamma Distribution**											
49						95% Approximate Gamma UCL	10.74			95% Adjusted Gamma UCL	10.84	
50												
51	**Lognormal GOF Test**											
52						Shapiro Wilk Test Statistic	0.924			**Shapiro Wilk Lognormal GOF Test**		
53						10% Shapiro Wilk Critical Value	0.951			Data Not Lognormal at 10% Significance Level		
54						Lilliefors Test Statistic	0.0993			**Lilliefors Lognormal GOF Test**		
55						10% Lilliefors Critical Value	0.124			Data appear Lognormal at 10% Significance Level		
56	**Data appear Approximate Lognormal at 10% Significance Level**											
57												
58	**Lognormal Statistics**											
59						Minimum of Logged Data	-0.654			Mean of logged Data	1.684	
60						Maximum of Logged Data	3.584			SD of logged Data	1.016	
61												
62	**Assuming Lognormal Distribution**											
63						95% H-UCL	13.16			90% Chebyshev (MVUE) UCL	13.75	
64						95% Chebyshev (MVUE) UCL	15.97			97.5% Chebyshev (MVUE) UCL	19.04	
65						99% Chebyshev (MVUE) UCL	25.08					
66												
67	**Nonparametric Distribution Free UCL Statistics**											
68	**Data appear to follow a Discernible Distribution**											
69												
70	**Nonparametric Distribution Free UCLs**											
71						95% CLT UCL	10.37			95% BCA Bootstrap UCL	10.66	
72						95% Standard Bootstrap UCL	10.41			95% Bootstrap-t UCL	10.97	
73						95% Hall's Bootstrap UCL	11.08			95% Percentile Bootstrap UCL	10.56	
74						90% Chebyshev(Mean, Sd) UCL	12.02			95% Chebyshev(Mean, Sd) UCL	13.67	

75			97.5% Chebyshev(Mean, Sd) UCL		15.96			99% Chebyshev(Mean, Sd) UCL			20.46	
76												
77					**Suggested UCL to Use**							
78			95% Adjusted Gamma UCL		10.84							
79												
80					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
81					Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.							
82					However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.							
83												
84												
85	**Arsenic**											
86												
87					**General Statistics**							
88			Total Number of Observations		42			Number of Distinct Observations			42	
89								Number of Missing Observations			0	
90			Minimum		9.54			Mean			194.3	
91			Maximum		1850			Median			54.45	
92			SD		356.8			Std. Error of Mean			55.05	
93			Coefficient of Variation		1.836			Skewness			3.305	
94												
95					**Normal GOF Test**							
96			Shapiro Wilk Test Statistic		0.54			**Shapiro Wilk GOF Test**				
97			1% Shapiro Wilk Critical Value		0.922			Data Not Normal at 1% Significance Level				
98			Lilliefors Test Statistic		0.333			**Lilliefors GOF Test**				
99			1% Lilliefors Critical Value		0.157			Data Not Normal at 1% Significance Level				
100					**Data Not Normal at 1% Significance Level**							
101												
102					**Assuming Normal Distribution**							
103			**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**				
104			95% Student's-t UCL		287			95% Adjusted-CLT UCL (Chen-1995)			314.9	
105								95% Modified-t UCL (Johnson-1978)			291.6	
106												
107					**Gamma GOF Test**							
108			A-D Test Statistic		2.223			**Anderson-Darling Gamma GOF Test**				
109			5% A-D Critical Value		0.801			Data Not Gamma Distributed at 5% Significance Level				
110			K-S Test Statistic		0.193			**Kolmogorov-Smirnov Gamma GOF Test**				
111			5% K-S Critical Value		0.143			Data Not Gamma Distributed at 5% Significance Level				

112	**Data Not Gamma Distributed at 5% Significance Level**											
113												
114	**Gamma Statistics**											
115						k hat (MLE)	0.632			k star (bias corrected MLE)	0.602	
116						Theta hat (MLE)	307.7			Theta star (bias corrected MLE)	322.6	
117						nu hat (MLE)	53.05			nu star (bias corrected)	50.6	
118						MLE Mean (bias corrected)	194.3			MLE Sd (bias corrected)	250.4	
119										Approximate Chi Square Value (0.05)	35.26	
120						Adjusted Level of Significance	0.0443			Adjusted Chi Square Value	34.81	
121												
122	**Assuming Gamma Distribution**											
123						95% Approximate Gamma UCL	278.8			95% Adjusted Gamma UCL	282.5	
124												
125	**Lognormal GOF Test**											
126						Shapiro Wilk Test Statistic	0.912			**Shapiro Wilk Lognormal GOF Test**		
127						10% Shapiro Wilk Critical Value	0.951			Data Not Lognormal at 10% Significance Level		
128						Lilliefors Test Statistic	0.107			**Lilliefors Lognormal GOF Test**		
129						10% Lilliefors Critical Value	0.124			Data appear Lognormal at 10% Significance Level		
130	**Data appear Approximate Lognormal at 10% Significance Level**											
131												
132	**Lognormal Statistics**											
133						Minimum of Logged Data	2.255			Mean of logged Data	4.299	
134						Maximum of Logged Data	7.523			SD of logged Data	1.327	
135												
136	**Assuming Lognormal Distribution**											
137						95% H-UCL	313.4			90% Chebyshev (MVUE) UCL	303.3	
138						95% Chebyshev (MVUE) UCL	363.3			97.5% Chebyshev (MVUE) UCL	446.5	
139						99% Chebyshev (MVUE) UCL	609.9					
140												
141	**Nonparametric Distribution Free UCL Statistics**											
142	**Data appear to follow a Discernible Distribution**											
143												
144	**Nonparametric Distribution Free UCLs**											
145						95% CLT UCL	284.9			95% BCA Bootstrap UCL	316.4	
146						95% Standard Bootstrap UCL	283.6			95% Bootstrap-t UCL	380.2	
147						95% Hall's Bootstrap UCL	387.1			95% Percentile Bootstrap UCL	291.6	
148						90% Chebyshev(Mean, Sd) UCL	359.5			95% Chebyshev(Mean, Sd) UCL	434.3	

149				97.5% Chebyshev(Mean, Sd) UCL	538.1				99% Chebyshev(Mean, Sd) UCL	742.1		
150												
151					**Suggested UCL to Use**							
152				95% H-UCL	313.4							
153												
154					**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.**							
155					**Please verify the data were collected from random locations.**							
156					**If the data were collected using judgmental or other non-random methods,**							
157					**then contact a statistician to correctly calculate UCLs.**							
158												
159					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
160					Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.							
161					However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.							
162												
163												
164	**Barium**											
165												
166					**General Statistics**							
167				Total Number of Observations	42				Number of Distinct Observations	40		
168									Number of Missing Observations	0		
169				Minimum	9.83				Mean	143.9		
170				Maximum	2770				Median	63.7		
171				SD	419.3				Std. Error of Mean	64.7		
172				Coefficient of Variation	2.915				Skewness	6.284		
173												
174					**Normal GOF Test**							
175				Shapiro Wilk Test Statistic	0.254				**Shapiro Wilk GOF Test**			
176				1% Shapiro Wilk Critical Value	0.922				Data Not Normal at 1% Significance Level			
177				Lilliefors Test Statistic	0.388				**Lilliefors GOF Test**			
178				1% Lilliefors Critical Value	0.157				Data Not Normal at 1% Significance Level			
179					**Data Not Normal at 1% Significance Level**							
180												
181					**Assuming Normal Distribution**							
182					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
183				95% Student's-t UCL	252.7				95% Adjusted-CLT UCL (Chen-1995)	317.3		
184									95% Modified-t UCL (Johnson-1978)	263.2		
185												

186	**Gamma GOF Test**										
187			A-D Test Statistic		4.201	**Anderson-Darling Gamma GOF Test**					
188			5% A-D Critical Value		0.787	Data Not Gamma Distributed at 5% Significance Level					
189			K-S Test Statistic		0.247	**Kolmogorov-Smirnov Gamma GOF Test**					
190			5% K-S Critical Value		0.142	Data Not Gamma Distributed at 5% Significance Level					
191	**Data Not Gamma Distributed at 5% Significance Level**										
192											
193	**Gamma Statistics**										
194			k hat (MLE)		0.794		k star (bias corrected MLE)				0.753
195			Theta hat (MLE)		181.1		Theta star (bias corrected MLE)				190.9
196			nu hat (MLE)		66.72		nu star (bias corrected)				63.29
197			MLE Mean (bias corrected)		143.9		MLE Sd (bias corrected)				165.7
198							Approximate Chi Square Value (0.05)				45.99
199			Adjusted Level of Significance		0.0443		Adjusted Chi Square Value				45.46
200											
201	**Assuming Gamma Distribution**										
202			95% Approximate Gamma UCL		198		95% Adjusted Gamma UCL				200.3
203											
204	**Lognormal GOF Test**										
205			Shapiro Wilk Test Statistic		0.884	**Shapiro Wilk Lognormal GOF Test**					
206			10% Shapiro Wilk Critical Value		0.951	Data Not Lognormal at 10% Significance Level					
207			Lilliefors Test Statistic		0.118	**Lilliefors Lognormal GOF Test**					
208			10% Lilliefors Critical Value		0.124	Data appear Lognormal at 10% Significance Level					
209	**Data appear Approximate Lognormal at 10% Significance Level**										
210											
211	**Lognormal Statistics**										
212			Minimum of Logged Data		2.285		Mean of logged Data				4.221
213			Maximum of Logged Data		7.927		SD of logged Data				0.934
214											
215	**Assuming Lognormal Distribution**										
216			95% H-UCL		147		90% Chebyshev (MVUE) UCL				155.4
217			95% Chebyshev (MVUE) UCL		178.8		97.5% Chebyshev (MVUE) UCL				211.2
218			99% Chebyshev (MVUE) UCL		274.9						
219											
220	**Nonparametric Distribution Free UCL Statistics**										
221	**Data appear to follow a Discernible Distribution**										
222											

223	**Nonparametric Distribution Free UCLs**										
224			95% CLT UCL	250.3			95% BCA Bootstrap UCL	347.6			
225			95% Standard Bootstrap UCL	253			95% Bootstrap-t UCL	788.7			
226			95% Hall's Bootstrap UCL	658.4			95% Percentile Bootstrap UCL	274.3			
227			90% Chebyshev(Mean, Sd) UCL	338			95% Chebyshev(Mean, Sd) UCL	425.9			
228			97.5% Chebyshev(Mean, Sd) UCL	547.9			99% Chebyshev(Mean, Sd) UCL	787.6			
229											
230	**Suggested UCL to Use**										
231			95% H-UCL	147							
232											
233	**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.**										
234	**Please verify the data were collected from random locations.**										
235	**If the data were collected using judgmental or other non-random methods,**										
236	**then contact a statistician to correctly calculate UCLs.**										
237											
238	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
239	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.										
240	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.										
241											
242	**Boron**										
243											
244	**General Statistics**										
245			Total Number of Observations	42			Number of Distinct Observations	20			
246			Number of Detects	16			Number of Non-Detects	26			
247			Number of Distinct Detects	15			Number of Distinct Non-Detects	5			
248			Minimum Detect	6.2			Minimum Non-Detect	5			
249			Maximum Detect	32.5			Maximum Non-Detect	9.4			
250			Variance Detects	71.99			Percent Non-Detects	61.9%			
251			Mean Detects	16.34			SD Detects	8.485			
252			Median Detects	13.2			CV Detects	0.519			
253			Skewness Detects	0.582			Kurtosis Detects	-1.073			
254			Mean of Logged Detects	2.664			SD of Logged Detects	0.529			
255											
256	**Normal GOF Test on Detects Only**										
257			Shapiro Wilk Test Statistic	0.894			**Shapiro Wilk GOF Test**				
258			1% Shapiro Wilk Critical Value	0.844			Detected Data appear Normal at 1% Significance Level				
259			Lilliefors Test Statistic	0.195			**Lilliefors GOF Test**				

1% Lilliefors Critical Value	0.248	Detected Data appear Normal at 1% Significance Level		
Detected Data appear Normal at 1% Significance Level				
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs				
KM Mean	9.625	KM Standard Error of Mean	1.187	
90KM SD	7.361	95% KM (BCA) UCL	11.48	
95% KM (t) UCL	11.62	95% KM (Percentile Bootstrap) UCL	11.51	
95% KM (z) UCL	11.58	95% KM Bootstrap t UCL	12.1	
90% KM Chebyshev UCL	13.19	95% KM Chebyshev UCL	14.8	
97.5% KM Chebyshev UCL	17.04	99% KM Chebyshev UCL	21.43	
Gamma GOF Tests on Detected Observations Only				
A-D Test Statistic	0.599	**Anderson-Darling GOF Test**		
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level		
K-S Test Statistic	0.186	**Kolmogorov-Smirnov GOF**		
5% K-S Critical Value	0.216	Detected data appear Gamma Distributed at 5% Significance Level		
Detected data appear Gamma Distributed at 5% Significance Level				
Gamma Statistics on Detected Data Only				
k hat (MLE)	4.029	k star (bias corrected MLE)	3.315	
Theta hat (MLE)	4.055	Theta star (bias corrected MLE)	4.928	
nu hat (MLE)	128.9	nu star (bias corrected)	106.1	
Mean (detects)	16.34			
Gamma ROS Statistics using Imputed Non-Detects				
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs				
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)				
For such situations, GROS method may yield incorrect values of UCLs and BTVs				
This is especially true when the sample size is small.				
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates				
Minimum	0.01	Mean	7.028	
Maximum	32.5	Median	2.914	
SD	9.179	CV	1.306	
k hat (MLE)	0.281	k star (bias corrected MLE)	0.277	
Theta hat (MLE)	25.03	Theta star (bias corrected MLE)	25.41	
nu hat (MLE)	23.59	nu star (bias corrected)	23.24	
Adjusted Level of Significance (β)	0.0443			

297				Approximate Chi Square Value (23.24, α)		13.27			Adjusted Chi Square Value (23.24, β)		13	
298				95% Gamma Approximate UCL		12.31			95% Gamma Adjusted UCL		12.56	
299												
300				**Estimates of Gamma Parameters using KM Estimates**								
301				Mean (KM)		9.625			SD (KM)		7.361	
302				Variance (KM)		54.19			SE of Mean (KM)		1.187	
303				k hat (KM)		1.71			k star (KM)		1.603	
304				nu hat (KM)		143.6			nu star (KM)		134.7	
305				theta hat (KM)		5.63			theta star (KM)		6.003	
306				80% gamma percentile (KM)		14.78			90% gamma percentile (KM)		19.73	
307				95% gamma percentile (KM)		24.52			99% gamma percentile (KM)		35.29	
308												
309				**Gamma Kaplan-Meier (KM) Statistics**								
310				Approximate Chi Square Value (134.69, α)		108.9			Adjusted Chi Square Value (134.69, β)		108	
311				95% KM Approximate Gamma UCL		11.91			95% KM Adjusted Gamma UCL		12	
312												
313				**Lognormal GOF Test on Detected Observations Only**								
314				Shapiro Wilk Test Statistic		0.925			**Shapiro Wilk GOF Test**			
315				10% Shapiro Wilk Critical Value		0.906			Detected Data appear Lognormal at 10% Significance Level			
316				Lilliefors Test Statistic		0.167			**Lilliefors GOF Test**			
317				10% Lilliefors Critical Value		0.196			Detected Data appear Lognormal at 10% Significance Level			
318				**Detected Data appear Lognormal at 10% Significance Level**								
319												
320				**Lognormal ROS Statistics Using Imputed Non-Detects**								
321				Mean in Original Scale		8.66			Mean in Log Scale		1.794	
322				SD in Original Scale		8.104			SD in Log Scale		0.852	
323				95% t UCL (assumes normality of ROS data)		10.76			95% Percentile Bootstrap UCL		10.7	
324				95% BCA Bootstrap UCL		10.85			95% Bootstrap t UCL		11.28	
325				95% H-UCL (Log ROS)		11.59						
326												
327				**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**								
328				KM Mean (logged)		2.06			KM Geo Mean		7.844	
329				KM SD (logged)		0.585			95% Critical H Value (KM-Log)		1.962	
330				KM Standard Error of Mean (logged)		0.0974			95% H-UCL (KM -Log)		11.13	
331				KM SD (logged)		0.585			95% Critical H Value (KM-Log)		1.962	
332				KM Standard Error of Mean (logged)		0.0974						
333												

334	**DL/2 Statistics**										
335	**DL/2 Normal**					**DL/2 Log-Transformed**					
336			Mean in Original Scale		8.658			Mean in Log Scale		1.847
337			SD in Original Scale		7.996			SD in Log Scale		0.747
338			95% t UCL (Assumes normality)		10.73			95% H-Stat UCL		10.71
339	**DL/2 is not a recommended method, provided for comparisons and historical reasons**										
340											
341	**Nonparametric Distribution Free UCL Statistics**										
342	**Detected Data appear Normal Distributed at 1% Significance Level**										
343											
344	**Suggested UCL to Use**										
345			95% KM (t) UCL		11.62						
346											
347	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
348	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.										
349	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.										
350											
351											
352	**Cobalt**										
353											
354	**General Statistics**										
355			Total Number of Observations		42			Number of Distinct Observations		40
356								Number of Missing Observations		0
357			Minimum		0.28			Mean		7.023
358			Maximum		40.6			Median		3.93
359			SD		7.589			Std. Error of Mean		1.171
360			Coefficient of Variation		1.081			Skewness		2.515
361											
362	**Normal GOF Test**										
363			Shapiro Wilk Test Statistic		0.708	**Shapiro Wilk GOF Test**					
364			1% Shapiro Wilk Critical Value		0.922	Data Not Normal at 1% Significance Level					
365			Lilliefors Test Statistic		0.207	**Lilliefors GOF Test**					
366			1% Lilliefors Critical Value		0.157	Data Not Normal at 1% Significance Level					
367	**Data Not Normal at 1% Significance Level**										
368											
369	**Assuming Normal Distribution**										
370	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**					

371				95% Student's-t UCL		8.993			95% Adjusted-CLT UCL (Chen-1995)			9.434
372									95% Modified-t UCL (Johnson-1978)			9.069
373												
374						**Gamma GOF Test**							
375				A-D Test Statistic		0.969			**Anderson-Darling Gamma GOF Test**			
376				5% A-D Critical Value		0.773			Data Not Gamma Distributed at 5% Significance Level			
377				K-S Test Statistic		0.135			**Kolmogorov-Smirnov Gamma GOF Test**			
378				5% K-S Critical Value		0.14			Detected data appear Gamma Distributed at 5% Significance Level			
379						**Detected data follow Appr. Gamma Distribution at 5% Significance Level**						
380												
381						**Gamma Statistics**						
382				k hat (MLE)		1.206			k star (bias corrected MLE)			1.136
383				Theta hat (MLE)		5.821			Theta star (bias corrected MLE)			6.181
384				nu hat (MLE)		101.3			nu star (bias corrected)			95.44
385				MLE Mean (bias corrected)		7.023			MLE Sd (bias corrected)			6.588
386									Approximate Chi Square Value (0.05)			73.91
387				Adjusted Level of Significance		0.0443			Adjusted Chi Square Value			73.23
388												
389						**Assuming Gamma Distribution**							
390				95% Approximate Gamma UCL		9.069			95% Adjusted Gamma UCL			9.152
391												
392						**Lognormal GOF Test**							
393				Shapiro Wilk Test Statistic		0.921			**Shapiro Wilk Lognormal GOF Test**			
394				10% Shapiro Wilk Critical Value		0.951			Data Not Lognormal at 10% Significance Level			
395				Lilliefors Test Statistic		0.105			**Lilliefors Lognormal GOF Test**			
396				10% Lilliefors Critical Value		0.124			Data appear Lognormal at 10% Significance Level			
397						**Data appear Approximate Lognormal at 10% Significance Level**						
398												
399						**Lognormal Statistics**						
400				Minimum of Logged Data		-1.273			Mean of logged Data			1.481
401				Maximum of Logged Data		3.704			SD of logged Data			1.005
402												
403						**Assuming Lognormal Distribution**							
404				95% H-UCL		10.55			90% Chebyshev (MVUE) UCL			11.05
405				95% Chebyshev (MVUE) UCL		12.82			97.5% Chebyshev (MVUE) UCL			15.26
406				99% Chebyshev (MVUE) UCL		20.07						
407												

408	**Nonparametric Distribution Free UCL Statistics**										
409	**Data appear to follow a Discernible Distribution**										
410											
411	**Nonparametric Distribution Free UCLs**										
412			95% CLT UCL		8.949			95% BCA Bootstrap UCL		9.358	
413			95% Standard Bootstrap UCL		8.902			95% Bootstrap-t UCL		9.885	
414			95% Hall's Bootstrap UCL		10.84			95% Percentile Bootstrap UCL		9.034	
415			90% Chebyshev(Mean, Sd) UCL		10.54			95% Chebyshev(Mean, Sd) UCL		12.13	
416			97.5% Chebyshev(Mean, Sd) UCL		14.34			99% Chebyshev(Mean, Sd) UCL		18.67	
417											
418	**Suggested UCL to Use**										
419			95% Adjusted Gamma UCL		9.152						
420											
421	**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.**										
422	**Please verify the data were collected from random locations.**										
423	**If the data were collected using judgmental or other non-random methods,**										
424	**then contact a statistician to correctly calculate UCLs.**										
425											
426	When a data set follows an approximate distribution passing only one of the GOF tests,										
427	it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL										
428											
429	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
430	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.										
431	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.										
432											
433											
434	**Copper**										
435											
436	**General Statistics**										
437			Total Number of Observations		42			Number of Distinct Observations		42	
438								Number of Missing Observations		0	
439			Minimum		3.63			Mean		32.94	
440			Maximum		145			Median		24.7	
441			SD		28.19			Std. Error of Mean		4.349	
442			Coefficient of Variation		0.856			Skewness		2.442	
443											
444	**Normal GOF Test**										

445				Shapiro Wilk Test Statistic	0.725	**Shapiro Wilk GOF Test**						
446				1% Shapiro Wilk Critical Value	0.922	Data Not Normal at 1% Significance Level						
447				Lilliefors Test Statistic	0.227	**Lilliefors GOF Test**						
448				1% Lilliefors Critical Value	0.157	Data Not Normal at 1% Significance Level						
449				**Data Not Normal at 1% Significance Level**								
450												
451				**Assuming Normal Distribution**								
452				**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**						
453				95% Student's-t UCL	40.26	95% Adjusted-CLT UCL (Chen-1995)	41.85					
454						95% Modified-t UCL (Johnson-1978)	40.54					
455												
456				**Gamma GOF Test**								
457				A-D Test Statistic	0.733	**Anderson-Darling Gamma GOF Test**						
458				5% A-D Critical Value	0.759	Detected data appear Gamma Distributed at 5% Significance Level						
459				K-S Test Statistic	0.13	**Kolmogorov-Smirnov Gamma GOF Test**						
460				5% K-S Critical Value	0.138	Detected data appear Gamma Distributed at 5% Significance Level						
461				**Detected data appear Gamma Distributed at 5% Significance Level**								
462												
463				**Gamma Statistics**								
464				k hat (MLE)	2.042	k star (bias corrected MLE)	1.912					
465				Theta hat (MLE)	16.13	Theta star (bias corrected MLE)	17.23					
466				nu hat (MLE)	171.5	nu star (bias corrected)	160.6					
467				MLE Mean (bias corrected)	32.94	MLE Sd (bias corrected)	23.82					
468						Approximate Chi Square Value (0.05)	132.3					
469				Adjusted Level of Significance	0.0443	Adjusted Chi Square Value	131.4					
470												
471				**Assuming Gamma Distribution**								
472				95% Approximate Gamma UCL	39.99	95% Adjusted Gamma UCL	40.27					
473												
474				**Lognormal GOF Test**								
475				Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**						
476				10% Shapiro Wilk Critical Value	0.951	Data Not Lognormal at 10% Significance Level						
477				Lilliefors Test Statistic	0.0843	**Lilliefors Lognormal GOF Test**						
478				10% Lilliefors Critical Value	0.124	Data appear Lognormal at 10% Significance Level						
479				**Data appear Approximate Lognormal at 10% Significance Level**								
480												
481				**Lognormal Statistics**								

482				Minimum of Logged Data	1.289				Mean of logged Data	3.23	
483				Maximum of Logged Data	4.977				SD of logged Data	0.729	
484											
485				**Assuming Lognormal Distribution**							
486				95% H-UCL	41.85				90% Chebyshev (MVUE) UCL	44.87	
487				95% Chebyshev (MVUE) UCL	50.37				97.5% Chebyshev (MVUE) UCL	57.99	
488				99% Chebyshev (MVUE) UCL	72.98						
489											
490				**Nonparametric Distribution Free UCL Statistics**							
491				**Data appear to follow a Discernible Distribution**							
492											
493				**Nonparametric Distribution Free UCLs**							
494				95% CLT UCL	40.1				95% BCA Bootstrap UCL	41.72	
495				95% Standard Bootstrap UCL	39.95				95% Bootstrap-t UCL	43.6	
496				95% Hall's Bootstrap UCL	46.5				95% Percentile Bootstrap UCL	40.45	
497				90% Chebyshev(Mean, Sd) UCL	45.99				95% Chebyshev(Mean, Sd) UCL	51.9	
498				97.5% Chebyshev(Mean, Sd) UCL	60.1				99% Chebyshev(Mean, Sd) UCL	76.22	
499											
500				**Suggested UCL to Use**							
501				95% Adjusted Gamma UCL	40.27						
502											
503				Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
504				Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.							
505				However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.							
506											
507	**Selenium**										
508											
509				**General Statistics**							
510				Total Number of Observations	42				Number of Distinct Observations	22	
511				Number of Detects	20				Number of Non-Detects	22	
512				Number of Distinct Detects	18				Number of Distinct Non-Detects	4	
513				Minimum Detect	0.27				Minimum Non-Detect	0.2	
514				Maximum Detect	3.23				Maximum Non-Detect	0.38	
515				Variance Detects	0.556				Percent Non-Detects	52.38%	
516				Mean Detects	0.964				SD Detects	0.746	
517				Median Detects	0.66				CV Detects	0.774	
518				Skewness Detects	1.77				Kurtosis Detects	3.576	

519				Mean of Logged Detects	-0.276				SD of Logged Detects	0.695		
520												
521				**Normal GOF Test on Detects Only**								
522				Shapiro Wilk Test Statistic	0.811			**Shapiro Wilk GOF Test**				
523				1% Shapiro Wilk Critical Value	0.868			Detected Data Not Normal at 1% Significance Level				
524				Lilliefors Test Statistic	0.193			**Lilliefors GOF Test**				
525				1% Lilliefors Critical Value	0.223			Detected Data appear Normal at 1% Significance Level				
526				**Detected Data appear Approximate Normal at 1% Significance Level**								
527												
528				**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**								
529				KM Mean	0.57			KM Standard Error of Mean	0.0994			
530				90KM SD	0.627			95% KM (BCA) UCL	0.738			
531				95% KM (t) UCL	0.737			95% KM (Percentile Bootstrap) UCL	0.733			
532				95% KM (z) UCL	0.733			95% KM Bootstrap t UCL	0.808			
533				90% KM Chebyshev UCL	0.868			95% KM Chebyshev UCL	1.003			
534				97.5% KM Chebyshev UCL	1.19			99% KM Chebyshev UCL	1.558			
535												
536				**Gamma GOF Tests on Detected Observations Only**								
537				A-D Test Statistic	0.535			**Anderson-Darling GOF Test**				
538				5% A-D Critical Value	0.751			Detected data appear Gamma Distributed at 5% Significance Level				
539				K-S Test Statistic	0.151			**Kolmogorov-Smirnov GOF**				
540				5% K-S Critical Value	0.196			Detected data appear Gamma Distributed at 5% Significance Level				
541				**Detected data appear Gamma Distributed at 5% Significance Level**								
542												
543				**Gamma Statistics on Detected Data Only**								
544				k hat (MLE)	2.246			k star (bias corrected MLE)	1.943			
545				Theta hat (MLE)	0.429			Theta star (bias corrected MLE)	0.496			
546				nu hat (MLE)	89.84			nu star (bias corrected)	77.7			
547				Mean (detects)	0.964							
548												
549				**Gamma ROS Statistics using Imputed Non-Detects**								
550				GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs								
551				GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)								
552				For such situations, GROS method may yield incorrect values of UCLs and BTVs								
553				This is especially true when the sample size is small.								
554				For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates								
555				Minimum	0.01			Mean	0.465			

556				Maximum	3.23				Median	0.0244		
557				SD	0.7				CV	1.505		
558				k hat (MLE)	0.38				k star (bias corrected MLE)	0.369		
559				Theta hat (MLE)	1.222				Theta star (bias corrected MLE)	1.26		
560				nu hat (MLE)	31.94				nu star (bias corrected)	30.99		
561				Adjusted Level of Significance (β)	0.0443							
562				Approximate Chi Square Value (30.99, α)	19.27				Adjusted Chi Square Value (30.99, β)	18.94		
563				95% Gamma Approximate UCL	0.747				95% Gamma Adjusted UCL	0.76		
564												
565				**Estimates of Gamma Parameters using KM Estimates**								
566				Mean (KM)	0.57				SD (KM)	0.627		
567				Variance (KM)	0.393				SE of Mean (KM)	0.0994		
568				k hat (KM)	0.826				k star (KM)	0.783		
569				nu hat (KM)	69.35				nu star (KM)	65.73		
570				theta hat (KM)	0.69				theta star (KM)	0.728		
571				80% gamma percentile (KM)	0.932				90% gamma percentile (KM)	1.392		
572				95% gamma percentile (KM)	1.863				99% gamma percentile (KM)	2.975		
573												
574				**Gamma Kaplan-Meier (KM) Statistics**								
575				Approximate Chi Square Value (65.73, α)	48.07				Adjusted Chi Square Value (65.73, β)	47.54		
576				95% KM Approximate Gamma UCL	0.779				95% KM Adjusted Gamma UCL	0.788		
577												
578				**Lognormal GOF Test on Detected Observations Only**								
579				Shapiro Wilk Test Statistic	0.954				**Shapiro Wilk GOF Test**			
580				10% Shapiro Wilk Critical Value	0.92				Detected Data appear Lognormal at 10% Significance Level			
581				Lilliefors Test Statistic	0.135				**Lilliefors GOF Test**			
582				10% Lilliefors Critical Value	0.176				Detected Data appear Lognormal at 10% Significance Level			
583				**Detected Data appear Lognormal at 10% Significance Level**								
584												
585				**Lognormal ROS Statistics Using Imputed Non-Detects**								
586				Mean in Original Scale	0.529				Mean in Log Scale	-1.258		
587				SD in Original Scale	0.66				SD in Log Scale	1.137		
588				95% t UCL (assumes normality of ROS data)	0.701				95% Percentile Bootstrap UCL	0.697		
589				95% BCA Bootstrap UCL	0.723				95% Bootstrap t UCL	0.771		
590				95% H-UCL (Log ROS)	0.847							
591												
592				**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**								

593				KM Mean (logged)	-0.949					KM Geo Mean	0.387
594				KM SD (logged)	0.799					95% Critical H Value (KM-Log)	2.149
595				KM Standard Error of Mean (logged)	0.128					95% H-UCL (KM -Log)	0.696
596				KM SD (logged)	0.799					95% Critical H Value (KM-Log)	2.149
597				KM Standard Error of Mean (logged)	0.128						
598											
599					**DL/2 Statistics**						
600				**DL/2 Normal**						**DL/2 Log-Transformed**	
601				Mean in Original Scale	0.537					Mean in Log Scale	-1.141
602				SD in Original Scale	0.654					SD in Log Scale	0.977
603				95% t UCL (Assumes normality)	0.707					95% H-Stat UCL	0.735
604					**DL/2 is not a recommended method, provided for comparisons and historical reasons**						
605											
606					**Nonparametric Distribution Free UCL Statistics**						
607					**Detected Data appear Approximate Normal Distributed at 1% Significance Level**						
608											
609					**Suggested UCL to Use**						
610				95% KM (t) UCL	0.737						
611											
612					When a data set follows an approximate distribution passing only one of the GOF tests,						
613					it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL						
614											
615					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.						
616					Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.						
617					However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.						
618											
619											
620	**Vanadium**										
621											
622					**General Statistics**						
623				Total Number of Observations	42					Number of Distinct Observations	41
624										Number of Missing Observations	0
625				Minimum	0.77					Mean	17.43
626				Maximum	55.1					Median	7.65
627				SD	18					Std. Error of Mean	2.777
628				Coefficient of Variation	1.033					Skewness	0.817
629											

630	**Normal GOF Test**											
631			Shapiro Wilk Test Statistic		0.738	**Shapiro Wilk GOF Test**						
632			1% Shapiro Wilk Critical Value		0.922	Data Not Normal at 1% Significance Level						
633			Lilliefors Test Statistic		0.265	**Lilliefors GOF Test**						
634			1% Lilliefors Critical Value		0.157	Data Not Normal at 1% Significance Level						
635	**Data Not Normal at 1% Significance Level**											
636												
637	**Assuming Normal Distribution**											
638	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
639			95% Student's-t UCL		22.1	95% Adjusted-CLT UCL (Chen-1995)				22.37		
640						95% Modified-t UCL (Johnson-1978)				22.16		
641												
642	**Gamma GOF Test**											
643			A-D Test Statistic		1.99	**Anderson-Darling Gamma GOF Test**						
644			5% A-D Critical Value		0.783	Data Not Gamma Distributed at 5% Significance Level						
645			K-S Test Statistic		0.193	**Kolmogorov-Smirnov Gamma GOF Test**						
646			5% K-S Critical Value		0.141	Data Not Gamma Distributed at 5% Significance Level						
647	**Data Not Gamma Distributed at 5% Significance Level**											
648												
649	**Gamma Statistics**											
650			k hat (MLE)		0.881	k star (bias corrected MLE)				0.834		
651			Theta hat (MLE)		19.77	Theta star (bias corrected MLE)				20.89		
652			nu hat (MLE)		74.03	nu star (bias corrected)				70.07		
653			MLE Mean (bias corrected)		17.43	MLE Sd (bias corrected)				19.08		
654						Approximate Chi Square Value (0.05)				51.8		
655			Adjusted Level of Significance		0.0443	Adjusted Chi Square Value				51.24		
656												
657	**Assuming Gamma Distribution**											
658			95% Approximate Gamma UCL		23.57	95% Adjusted Gamma UCL				23.83		
659												
660	**Lognormal GOF Test**											
661			Shapiro Wilk Test Statistic		0.85	**Shapiro Wilk Lognormal GOF Test**						
662			10% Shapiro Wilk Critical Value		0.951	Data Not Lognormal at 10% Significance Level						
663			Lilliefors Test Statistic		0.161	**Lilliefors Lognormal GOF Test**						
664			10% Lilliefors Critical Value		0.124	Data Not Lognormal at 10% Significance Level						
665	**Data Not Lognormal at 10% Significance Level**											
666												

667	**Lognormal Statistics**										
668				Minimum of Logged Data	-0.261			Mean of logged Data	2.193		
669				Maximum of Logged Data	4.009			SD of logged Data	1.245		
670											
671	**Assuming Lognormal Distribution**										
672				95% H-UCL	32.52			90% Chebyshev (MVUE) UCL	32.3		
673				95% Chebyshev (MVUE) UCL	38.39			97.5% Chebyshev (MVUE) UCL	46.84		
674				99% Chebyshev (MVUE) UCL	63.44						
675											
676	**Nonparametric Distribution Free UCL Statistics**										
677	**Data do not follow a Discernible Distribution**										
678											
679	**Nonparametric Distribution Free UCLs**										
680				95% CLT UCL	21.99			95% BCA Bootstrap UCL	22.4		
681				95% Standard Bootstrap UCL	21.86			95% Bootstrap-t UCL	22.3		
682				95% Hall's Bootstrap UCL	21.99			95% Percentile Bootstrap UCL	21.88		
683				90% Chebyshev(Mean, Sd) UCL	25.76			95% Chebyshev(Mean, Sd) UCL	29.53		
684				97.5% Chebyshev(Mean, Sd) UCL	34.77			99% Chebyshev(Mean, Sd) UCL	45.06		
685											
686	**Suggested UCL to Use**										
687				95% Student's-t UCL	22.1						
688											
689	**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.**										
690	**Please verify the data were collected from random locations.**										
691	**If the data were collected using judgmental or other non-random methods,**										
692	**then contact a statistician to correctly calculate UCLs.**										
693											
694	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
695	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.										
696	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.										
697											
698											
699	**Zinc**										
700											
701	**General Statistics**										
702				Total Number of Observations	42			Number of Distinct Observations	40		
703								Number of Missing Observations	0		

704				Minimum	4.1					Mean	54.16	
705				Maximum	768					Median	30.65	
706				SD	115.3					Std. Error of Mean	17.79	
707				Coefficient of Variation	2.129					Skewness	6.059	
708												
709				**Normal GOF Test**								
710				Shapiro Wilk Test Statistic	0.317	**Shapiro Wilk GOF Test**						
711				1% Shapiro Wilk Critical Value	0.922	Data Not Normal at 1% Significance Level						
712				Lilliefors Test Statistic	0.342	**Lilliefors GOF Test**						
713				1% Lilliefors Critical Value	0.157	Data Not Normal at 1% Significance Level						
714				**Data Not Normal at 1% Significance Level**								
715												
716				**Assuming Normal Distribution**								
717				**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**		
718				95% Student's-t UCL	84.1					95% Adjusted-CLT UCL (Chen-1995)	101.2	
719										95% Modified-t UCL (Johnson-1978)	86.87	
720												
721				**Gamma GOF Test**								
722				A-D Test Statistic	2.042	**Anderson-Darling Gamma GOF Test**						
723				5% A-D Critical Value	0.778	Data Not Gamma Distributed at 5% Significance Level						
724				K-S Test Statistic	0.183	**Kolmogorov-Smirnov Gamma GOF Test**						
725				5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level						
726				**Data Not Gamma Distributed at 5% Significance Level**								
727												
728				**Gamma Statistics**								
729				k hat (MLE)	1.016					k star (bias corrected MLE)	0.959	
730				Theta hat (MLE)	53.31					Theta star (bias corrected MLE)	56.46	
731				nu hat (MLE)	85.34					nu star (bias corrected)	80.58	
732				MLE Mean (bias corrected)	54.16					MLE Sd (bias corrected)	55.3	
733										Approximate Chi Square Value (0.05)	60.89	
734				Adjusted Level of Significance	0.0443					Adjusted Chi Square Value	60.28	
735												
736				**Assuming Gamma Distribution**								
737				95% Approximate Gamma UCL	71.66					95% Adjusted Gamma UCL	72.39	
738												
739				**Lognormal GOF Test**								
740				Shapiro Wilk Test Statistic	0.911	**Shapiro Wilk Lognormal GOF Test**						

741				10% Shapiro Wilk Critical Value		0.951		Data Not Lognormal at 10% Significance Level				
742				Lilliefors Test Statistic		0.0904		**Lilliefors Lognormal GOF Test**				
743				10% Lilliefors Critical Value		0.124		Data appear Lognormal at 10% Significance Level				
744				**Data appear Approximate Lognormal at 10% Significance Level**								
745												
746				**Lognormal Statistics**								
747				Minimum of Logged Data		1.411				Mean of logged Data		3.425
748				Maximum of Logged Data		6.644				SD of logged Data		0.935
749												
750				**Assuming Lognormal Distribution**								
751				95% H-UCL		66.38				90% Chebyshev (MVUE) UCL		70.17
752				95% Chebyshev (MVUE) UCL		80.74				97.5% Chebyshev (MVUE) UCL		95.4
753				99% Chebyshev (MVUE) UCL		124.2						
754												
755				**Nonparametric Distribution Free UCL Statistics**								
756				**Data appear to follow a Discernible Distribution**								
757												
758				**Nonparametric Distribution Free UCLs**								
759				95% CLT UCL		83.42				95% BCA Bootstrap UCL		110.4
760				95% Standard Bootstrap UCL		83.89				95% Bootstrap-t UCL		167.8
761				95% Hall's Bootstrap UCL		200.1				95% Percentile Bootstrap UCL		89.14
762				90% Chebyshev(Mean, Sd) UCL		107.5				95% Chebyshev(Mean, Sd) UCL		131.7
763				97.5% Chebyshev(Mean, Sd) UCL		165.3				99% Chebyshev(Mean, Sd) UCL		231.2
764												
765				**Suggested UCL to Use**								
766				95% H-UCL		66.38						
767												
768				**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.**								
769				**Please verify the data were collected from random locations.**								
770				**If the data were collected using judgmental or other non-random methods,**								
771				**then contact a statistician to correctly calculate UCLs.**								
772												
773				Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.								
774				Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.								
775				However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.								

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.2 2024-02-07 12:49:32 PM
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony - University Footprint

General Statistics

Total Number of Observations	16	Number of Distinct Observations	16
		Number of Missing Observations	1
Minimum	1.14	Mean	10.26
Maximum	36	Median	6.835
SD	10.79	Std. Error of Mean	2.698
Coefficient of Variation	1.052	Skewness	1.426

Normal GOF Test

Shapiro Wilk Test Statistic	0.784	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk Critical Value	0.844	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.294	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.248	Data Not Normal at 1% Significance Level	

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	14.99	95% Adjusted-CLT UCL (Chen-1995)	15.73
		95% Modified-t UCL (Johnson-1978)	15.15

Gamma GOF Test

A-D Test Statistic	0.474	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.761	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.172	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.221	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.109	k star (bias corrected MLE)	0.943
Theta hat (MLE)	9.253	Theta star (bias corrected MLE)	10.89
nu hat (MLE)	35.49	nu star (bias corrected)	30.17
MLE Mean (bias corrected)	10.26	MLE Sd (bias corrected)	10.57
		Approximate Chi Square Value (0.05)	18.62
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	17.6

Assuming Gamma Distribution

95% Approximate Gamma UCL	16.62	95% Adjusted Gamma UCL	17.59

51	**Lognormal GOF Test**										
52	Shapiro Wilk Test Statistic			0.958	**Shapiro Wilk Lognormal GOF Test**						
53	10% Shapiro Wilk Critical Value			0.906	Data appear Lognormal at 10% Significance Level						
54	Lilliefors Test Statistic			0.108	**Lilliefors Lognormal GOF Test**						
55	10% Lilliefors Critical Value			0.196	Data appear Lognormal at 10% Significance Level						
56	**Data appear Lognormal at 10% Significance Level**										
57											
58	**Lognormal Statistics**										
59	Minimum of Logged Data			0.131	Mean of logged Data						1.814
60	Maximum of Logged Data			3.584	SD of logged Data						1.074
61											
62	**Assuming Lognormal Distribution**										
63	95% H-UCL			23.87	90% Chebyshev (MVUE) UCL						19.63
64	95% Chebyshev (MVUE) UCL			23.82	97.5% Chebyshev (MVUE) UCL						29.64
65	99% Chebyshev (MVUE) UCL			41.08							
66											
67	**Nonparametric Distribution Free UCL Statistics**										
68	**Data appear to follow a Discernible Distribution**										
69											
70	**Nonparametric Distribution Free UCLs**										
71	95% CLT UCL			14.7	95% BCA Bootstrap UCL						15.53
72	95% Standard Bootstrap UCL			14.65	95% Bootstrap-t UCL						17.17
73	95% Hall's Bootstrap UCL			14.92	95% Percentile Bootstrap UCL						15.01
74	90% Chebyshev(Mean, Sd) UCL			18.36	95% Chebyshev(Mean, Sd) UCL						22.02
75	97.5% Chebyshev(Mean, Sd) UCL			27.11	99% Chebyshev(Mean, Sd) UCL						37.11
76											
77	**Suggested UCL to Use**										
78	95% Adjusted Gamma UCL			17.59							
79											
80	**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.**										
81	**Please verify the data were collected from random locations.**										
82	**If the data were collected using judgmental or other non-random methods,**										
83	**then contact a statistician to correctly calculate UCLs.**										
84											
85	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
86	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.										
87	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.										

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.2 2024-02-06 12:24:06 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic - University Footprint

General Statistics

Total Number of Observations	16	Number of Distinct Observations	16
		Number of Missing Observations	1
Minimum	27.4	Mean	119.7
Maximum	470	Median	98.4
SD	120.2	Std. Error of Mean	30.05
Coefficient of Variation	1.004	Skewness	2.124

Normal GOF Test

Shapiro Wilk Test Statistic	0.727	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk Critical Value	0.844	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.269	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.248	Data Not Normal at 1% Significance Level	

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	172.4	95% Adjusted-CLT UCL (Chen-1995)	186.2
		95% Modified-t UCL (Johnson-1978)	175

Gamma GOF Test

A-D Test Statistic	0.616	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.755	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.158	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.219	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.521	k star (bias corrected MLE)	1.278
Theta hat (MLE)	78.67	Theta star (bias corrected MLE)	93.66
nu hat (MLE)	48.69	nu star (bias corrected)	40.89
MLE Mean (bias corrected)	119.7	MLE Sd (bias corrected)	105.9
		Approximate Chi Square Value (0.05)	27.24
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	25.97

Assuming Gamma Distribution

95% Approximate Gamma UCL	179.7	95% Adjusted Gamma UCL	188.4

51	**Lognormal GOF Test**										
52	Shapiro Wilk Test Statistic			0.933	**Shapiro Wilk Lognormal GOF Test**						
53	10% Shapiro Wilk Critical Value			0.906	Data appear Lognormal at 10% Significance Level						
54	Lilliefors Test Statistic			0.14	**Lilliefors Lognormal GOF Test**						
55	10% Lilliefors Critical Value			0.196	Data appear Lognormal at 10% Significance Level						
56	**Data appear Lognormal at 10% Significance Level**										
57											
58	**Lognormal Statistics**										
59	Minimum of Logged Data			3.311	Mean of logged Data						4.422
60	Maximum of Logged Data			6.153	SD of logged Data						0.853
61											
62	**Assuming Lognormal Distribution**										
63	95% H-UCL			207.2	90% Chebyshev (MVUE) UCL						196.6
64	95% Chebyshev (MVUE) UCL			233	97.5% Chebyshev (MVUE) UCL						283.5
65	99% Chebyshev (MVUE) UCL			382.6							
66											
67	**Nonparametric Distribution Free UCL Statistics**										
68	**Data appear to follow a Discernible Distribution**										
69											
70	**Nonparametric Distribution Free UCLs**										
71	95% CLT UCL			169.1	95% BCA Bootstrap UCL						186.6
72	95% Standard Bootstrap UCL			166.9	95% Bootstrap-t UCL						230.2
73	95% Hall's Bootstrap UCL			442.5	95% Percentile Bootstrap UCL						170.7
74	90% Chebyshev(Mean, Sd) UCL			209.8	95% Chebyshev(Mean, Sd) UCL						250.7
75	97.5% Chebyshev(Mean, Sd) UCL			307.4	99% Chebyshev(Mean, Sd) UCL						418.7
76											
77	**Suggested UCL to Use**										
78	95% Adjusted Gamma UCL			188.4							
79											
80	**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.**										
81	**Please verify the data were collected from random locations.**										
82	**If the data were collected using judgmental or other non-random methods,**										
83	**then contact a statistician to correctly calculate UCLs.**										
84											
85	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
86	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.										
87	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.										
88											
89											
90	**Arsenic - Site Wide without Old Mine Road Data**										
91											
92	**General Statistics**										
93	Total Number of Observations			37	Number of Distinct Observations						37
94					Number of Missing Observations						1
95	Minimum			9.54	Mean						125.7
96	Maximum			1190	Median						46.7
97	SD			214.3	Std. Error of Mean						35.23
98	Coefficient of Variation			1.705	Skewness						3.802
99											
100	**Normal GOF Test**										

101				Shapiro Wilk Test Statistic	0.545	**Shapiro Wilk GOF Test**						
102				1% Shapiro Wilk Critical Value	0.814	Data Not Normal at 1% Significance Level						
103				Lilliefors Test Statistic	0.294	**Lilliefors GOF Test**						
104				1% Lilliefors Critical Value	0.168	Data Not Normal at 1% Significance Level						
105	**Data Not Normal at 1% Significance Level**											
106												
107	**Assuming Normal Distribution**											
108	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
109				95% Student's-t UCL	185.2					95% Adjusted-CLT UCL (Chen-1995)	207.2	
110										95% Modified-t UCL (Johnson-1978)	188.9	
111												
112	**Gamma GOF Test**											
113				A-D Test Statistic	1.633	**Anderson-Darling Gamma GOF Test**						
114				5% A-D Critical Value	0.787	Data Not Gamma Distributed at 5% Significance Level						
115				K-S Test Statistic	0.188	**Kolmogorov-Smirnov Gamma GOF Test**						
116				5% K-S Critical Value	0.151	Data Not Gamma Distributed at 5% Significance Level						
117	**Data Not Gamma Distributed at 5% Significance Level**											
118												
119	**Gamma Statistics**											
120				k hat (MLE)	0.782					k star (bias corrected MLE)	0.737	
121				Theta hat (MLE)	160.7					Theta star (bias corrected MLE)	170.6	
122				nu hat (MLE)	57.9					nu star (bias corrected)	54.54	
123				MLE Mean (bias corrected)	125.7					MLE Sd (bias corrected)	146.4	
124										Approximate Chi Square Value (0.05)	38.57	
125				Adjusted Level of Significance	0.0431					Adjusted Chi Square Value	37.99	
126												
127	**Assuming Gamma Distribution**											
128				95% Approximate Gamma UCL	177.8					95% Adjusted Gamma UCL	180.5	
129												
130	**Lognormal GOF Test**											
131				Shapiro Wilk Test Statistic	0.961	**Shapiro Wilk Lognormal GOF Test**						
132				10% Shapiro Wilk Critical Value	0.946	Data appear Lognormal at 10% Significance Level						
133				Lilliefors Test Statistic	0.113	**Lilliefors Lognormal GOF Test**						
134				10% Lilliefors Critical Value	0.132	Data appear Lognormal at 10% Significance Level						
135	**Data appear Lognormal at 10% Significance Level**											
136												
137	**Lognormal Statistics**											
138				Minimum of Logged Data	2.255					Mean of logged Data	4.073	
139				Maximum of Logged Data	7.082					SD of logged Data	1.17	
140												
141	**Assuming Lognormal Distribution**											
142				95% H-UCL	193					90% Chebyshev (MVUE) UCL	191.7	
143				95% Chebyshev (MVUE) UCL	227.4					97.5% Chebyshev (MVUE) UCL	276.9	
144				99% Chebyshev (MVUE) UCL	374							
145												
146	**Nonparametric Distribution Free UCL Statistics**											
147	**Data appear to follow a Discernible Distribution**											
148												
149	**Nonparametric Distribution Free UCLs**											
150				95% CLT UCL	183.7					95% BCA Bootstrap UCL	209.5	

151				95% Standard Bootstrap UCL		181.5				95% Bootstrap-t UCL		246.2
152				95% Hall's Bootstrap UCL		397.1				95% Percentile Bootstrap UCL		184.7
153				90% Chebyshev(Mean, Sd) UCL		231.4				95% Chebyshev(Mean, Sd) UCL		279.3
154				97.5% Chebyshev(Mean, Sd) UCL		345.7				99% Chebyshev(Mean, Sd) UCL		476.2
155												
156						**Suggested UCL to Use**							
157					95% H-UCL	193						
158												
159												
160												
161												
162												
163												
164												
165												
166												

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods,

then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.2 2024-02-07 12:37:54 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Boron - Site Wide without Old Mine Road Data

General Statistics

Total Number of Observations	16	Number of Distinct Observations	15
		Number of Missing Observations	22
Minimum	6.2	Mean	16.34
Maximum	32.5	Median	13.2
SD	8.485	Std. Error of Mean	2.121
Coefficient of Variation	0.519	Skewness	0.582

Normal GOF Test

Shapiro Wilk Test Statistic	0.894	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk Critical Value	0.844	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.195	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.248	Data appear Normal at 1% Significance Level	

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	20.06	95% Adjusted-CLT UCL (Chen-1995)	20.16
		95% Modified-t UCL (Johnson-1978)	20.11

Gamma GOF Test

A-D Test Statistic	0.599	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.186	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.216	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.029	k star (bias corrected MLE)	3.315
Theta hat (MLE)	4.055	Theta star (bias corrected MLE)	4.928
nu hat (MLE)	128.9	nu star (bias corrected)	106.1
MLE Mean (bias corrected)	16.34	MLE Sd (bias corrected)	8.973
		Approximate Chi Square Value (0.05)	83.31
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	81.02

Assuming Gamma Distribution

95% Approximate Gamma UCL	20.8	95% Adjusted Gamma UCL	21.39

Lognormal GOF Test											
Shapiro Wilk Test Statistic					0.925	**Shapiro Wilk Lognormal GOF Test**					
10% Shapiro Wilk Critical Value					0.906	Data appear Lognormal at 10% Significance Level					
Lilliefors Test Statistic					0.167	**Lilliefors Lognormal GOF Test**					
10% Lilliefors Critical Value					0.196	Data appear Lognormal at 10% Significance Level					
Data appear Lognormal at 10% Significance Level											
Lognormal Statistics											
Minimum of Logged Data					1.825	Mean of logged Data					2.664
Maximum of Logged Data					3.481	SD of logged Data					0.529
Assuming Lognormal Distribution											
95% H-UCL					21.93	90% Chebyshev (MVUE) UCL					23.06
95% Chebyshev (MVUE) UCL					26.1	97.5% Chebyshev (MVUE) UCL					30.32
99% Chebyshev (MVUE) UCL					38.6						
Nonparametric Distribution Free UCL Statistics											
Data appear to follow a Discernible Distribution											
Nonparametric Distribution Free UCLs											
95% CLT UCL					19.83	95% BCA Bootstrap UCL					19.98
95% Standard Bootstrap UCL					19.73	95% Bootstrap-t UCL					20.36
95% Hall's Bootstrap UCL					19.79	95% Percentile Bootstrap UCL					19.77
90% Chebyshev(Mean, Sd) UCL					22.7	95% Chebyshev(Mean, Sd) UCL					25.58
97.5% Chebyshev(Mean, Sd) UCL					29.58	99% Chebyshev(Mean, Sd) UCL					37.44
Suggested UCL to Use											
95% Student's-t UCL					20.06						
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.											
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
Copper - Site Wide Without Old Mine Road Data											
General Statistics											
Total Number of Observations					37	Number of Distinct Observations					37
						Number of Missing Observations					1
Minimum					3.63	Mean					32.61
Maximum					145	Median					22.7
SD					29.78	Std. Error of Mean					4.895
Coefficient of Variation					0.913	Skewness					2.403
Normal GOF Test											
Shapiro Wilk Test Statistic					0.729	**Shapiro Wilk GOF Test**					
1% Shapiro Wilk Critical Value					0.814	Data Not Normal at 1% Significance Level					
Lilliefors Test Statistic					0.247	**Lilliefors GOF Test**					
1% Lilliefors Critical Value					0.168	Data Not Normal at 1% Significance Level					
Data Not Normal at 1% Significance Level											

Assuming Normal Distribution											
95% Normal UCL						**95% UCLs (Adjusted for Skewness)**					
95% Student's-t UCL					40.88	95% Adjusted-CLT UCL (Chen-1995)					42.73
						95% Modified-t UCL (Johnson-1978)					41.2
Gamma GOF Test											
A-D Test Statistic					0.862	**Anderson-Darling Gamma GOF Test**					
5% A-D Critical Value					0.761	Data Not Gamma Distributed at 5% Significance Level					
K-S Test Statistic					0.144	**Kolmogorov-Smirnov Gamma GOF Test**					
5% K-S Critical Value					0.147	Detected data appear Gamma Distributed at 5% Significance Level					
Detected data follow Appr. Gamma Distribution at 5% Significance Level											
Gamma Statistics											
k hat (MLE)					1.856	k star (bias corrected MLE)					1.724
Theta hat (MLE)					17.57	Theta star (bias corrected MLE)					18.92
nu hat (MLE)					137.4	nu star (bias corrected)					127.6
MLE Mean (bias corrected)					32.61	MLE Sd (bias corrected)					24.84
						Approximate Chi Square Value (0.05)					102.5
Adjusted Level of Significance					0.0431	Adjusted Chi Square Value					101.5
Assuming Gamma Distribution											
95% Approximate Gamma UCL					40.6	95% Adjusted Gamma UCL					40.99
Lognormal GOF Test											
Shapiro Wilk Test Statistic					0.981	**Shapiro Wilk Lognormal GOF Test**					
10% Shapiro Wilk Critical Value					0.946	Data appear Lognormal at 10% Significance Level					
Lilliefors Test Statistic					0.0949	**Lilliefors Lognormal GOF Test**					
10% Lilliefors Critical Value					0.132	Data appear Lognormal at 10% Significance Level					
Data appear Lognormal at 10% Significance Level											
Lognormal Statistics											
Minimum of Logged Data					1.289	Mean of logged Data					3.192
Maximum of Logged Data					4.977	SD of logged Data					0.761
Assuming Lognormal Distribution											
95% H-UCL					42.62	90% Chebyshev (MVUE) UCL					45.49
95% Chebyshev (MVUE) UCL					51.51	97.5% Chebyshev (MVUE) UCL					59.88
99% Chebyshev (MVUE) UCL					76.31						
Nonparametric Distribution Free UCL Statistics											
Data appear to follow a Discernible Distribution											
Nonparametric Distribution Free UCLs											
95% CLT UCL					40.67	95% BCA Bootstrap UCL					43.53
95% Standard Bootstrap UCL					40.45	95% Bootstrap-t UCL					44.9
95% Hall's Bootstrap UCL					47.81	95% Percentile Bootstrap UCL					40.69
90% Chebyshev(Mean, Sd) UCL					47.3	95% Chebyshev(Mean, Sd) UCL					53.95
97.5% Chebyshev(Mean, Sd) UCL					63.18	99% Chebyshev(Mean, Sd) UCL					81.32

Suggested UCL to Use				
95% Adjusted Gamma UCL	40.99			
When a data set follows an approximate distribution passing only one of the GOF tests,				
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL				
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.				
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.				
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.				
Selenium - Site Wide without Old Mine Road Data				
General Statistics				
Total Number of Observations	20	Number of Distinct Observations	18	
		Number of Missing Observations	18	
Minimum	0.27	Mean	0.964	
Maximum	3.23	Median	0.66	
SD	0.746	Std. Error of Mean	0.167	
Coefficient of Variation	0.774	Skewness	1.77	
Normal GOF Test				
Shapiro Wilk Test Statistic	0.811	**Shapiro Wilk GOF Test**		
1% Shapiro Wilk Critical Value	0.868	Data Not Normal at 1% Significance Level		
Lilliefors Test Statistic	0.193	**Lilliefors GOF Test**		
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level		
Data appear Approximate Normal at 1% Significance Level				
Assuming Normal Distribution				
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**		
95% Student's-t UCL	1.252	95% Adjusted-CLT UCL (Chen-1995)	1.308	
		95% Modified-t UCL (Johnson-1978)	1.263	
Gamma GOF Test				
A-D Test Statistic	0.535	**Anderson-Darling Gamma GOF Test**		
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level		
K-S Test Statistic	0.151	**Kolmogorov-Smirnov Gamma GOF Test**		
5% K-S Critical Value	0.196	Detected data appear Gamma Distributed at 5% Significance Level		
Detected data appear Gamma Distributed at 5% Significance Level				
Gamma Statistics				
k hat (MLE)	2.246	k star (bias corrected MLE)	1.943	
Theta hat (MLE)	0.429	Theta star (bias corrected MLE)	0.496	
nu hat (MLE)	89.84	nu star (bias corrected)	77.7	
MLE Mean (bias corrected)	0.964	MLE Sd (bias corrected)	0.691	
		Approximate Chi Square Value (0.05)	58.39	
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	57.07	
Assuming Gamma Distribution				
95% Approximate Gamma UCL	1.282	95% Adjusted Gamma UCL	1.312	

201											
202	**Lognormal GOF Test**										
203	Shapiro Wilk Test Statistic				0.954	**Shapiro Wilk Lognormal GOF Test**					
204	10% Shapiro Wilk Critical Value				0.92	Data appear Lognormal at 10% Significance Level					
205	Lilliefors Test Statistic				0.135	**Lilliefors Lognormal GOF Test**					
206	10% Lilliefors Critical Value				0.176	Data appear Lognormal at 10% Significance Level					
207	**Data appear Lognormal at 10% Significance Level**										
208											
209	**Lognormal Statistics**										
210	Minimum of Logged Data				-1.309	Mean of logged Data					-0.276
211	Maximum of Logged Data				1.172	SD of logged Data					0.695
212											
213	**Assuming Lognormal Distribution**										
214	95% H-UCL				1.379	90% Chebyshev (MVUE) UCL					1.426
215	95% Chebyshev (MVUE) UCL				1.641	97.5% Chebyshev (MVUE) UCL					1.938
216	99% Chebyshev (MVUE) UCL				2.523						
217											
218	**Nonparametric Distribution Free UCL Statistics**										
219	**Data appear to follow a Discernible Distribution**										
220											
221	**Nonparametric Distribution Free UCLs**										
222	95% CLT UCL				1.238	95% BCA Bootstrap UCL					1.304
223	95% Standard Bootstrap UCL				1.235	95% Bootstrap-t UCL					1.388
224	95% Hall's Bootstrap UCL				1.58	95% Percentile Bootstrap UCL					1.25
225	90% Chebyshev(Mean, Sd) UCL				1.464	95% Chebyshev(Mean, Sd) UCL					1.69
226	97.5% Chebyshev(Mean, Sd) UCL				2.005	99% Chebyshev(Mean, Sd) UCL					2.622
227											
228	**Suggested UCL to Use**										
229	95% Student's-t UCL				1.252						
230											
231	When a data set follows an approximate distribution passing only one of the GOF tests,										
232	it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL										
233											
234	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
235	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.										
236	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.										

APPENDIX F

SAMPLE CALCULATIONS

SAMPLE HUMAN INTAKE AND RISK CALCULATIONS

NON-CANCER RISKS

Sample Scenario

- Receptor: Toddler Site Resident (Future "University" Scenario)
- COPC: Arsenic in surface soil (188 mg/kg)
- Exposure pathways:
    - soil particulate inhalation
    - incidental soil ingestion
    - dermal soil contact

Soil Particulate Inhalation Pathway

The chronic daily dose of arsenic via the inhalation of soil particulates was calculated for the toddler Site resident as follows:

$$CDD = \frac{C_s * P_{air} * IR_a * RAF_{inh} * D_1 * D_2 * D_3}{BW}$$

Where:

CDD	=	Chronic Daily Dose (mg/kg-day)
C_s	=	soil concentration (arsenic): 188 mg/kg
P_{air}	=	particulate concentration in air: 7.6E-10 kg/m^3
IR_a	=	inhalation rate: 8.3 m^3/day
RAF_{Inh}	=	relative absorption factor by inhalation: 1
D_1	=	hours per day exposed: 24 hours / 24 hours
D_2	=	days per week exposed: 7 days / 7 days
D_3	=	weeks per year exposed: 26 weeks / 52 weeks
BW	=	body weight: 16.5 kg

$$CDD = \frac{188\ mg/kg * 7.6E\text{-}10\ kg/m^3 * 8.3\ m^3/day * 1 * 24\ hrs/24\ hrs * 7\ days/7\ days * 26\ wks/52\ wks}{16.5kg}$$

CDD= 4.0E-08 mg/kg-day

A Hazard Quotient was calculated for this exposure pathway as follows:

HQ = CDD/TRV

Where:

CDD = 4.0E-08 mg/kg-day
TRV = 3.0E-04 mg/kg-day

$HQ_{arsenic}$= 4.0E-08 mg/kg-day/3.0E-04 mg/kg-day = 0.0001

Soil Ingestion Pathway

The chronic daily dose of arsenic via the incidental ingestion of shallow soil were calculated for the toddler Site resident as follows:

$$CDD = \frac{C_s * IR_S * RAF_{oral} * D_2 * D_3}{BW}$$

Where:

CDD	=	Chronic Daily Dose (mg/kg-day)
C_S	=	soil concentration (arsenic): 188 mg/kg
IR_S	=	soil ingestion rate: 8.0E-05 kg soil/day
RAF_{oral}	=	relative absorption factor by GI tract: 0.22
D_2	=	days per week exposed: 7 days / 7 days
D_3	=	weeks per year exposed: 26 weeks / 52 weeks
BW	=	body weight: 16.5 kg

$$CDD = \frac{188\ mg/kg * 8E\text{-}05\ kg\ soil/day * 0.22 * 7\ days/7\ days * 26\ wks/52\ wks}{16.5kg}$$

CDD = 1.0E-04 mg/kg-day

A Hazard Quotient was calculated for this exposure pathway as follows:

HQ = CDD/TRV

Where:

CDD = 1.0E-04 mg/kg-day
TRV = 3.0E-04 mg/kg-day

$HQ_{arsenic}$= 1.0E-04 mg/kg-day/3.0E-04 mg/kg-day = 0.33

Soil Dermal Pathway

The chronic daily dose of arsenic via dermal contact with shallow soil was calculated for the toddler Site resident as follows:

$$CDD = \frac{(C_s * ((SA_h * SL_h) + (SA_a * SL_a))) * nEv * RAF_{derm} * D_2 * D_3}{BW}$$

Where:

CDD	=	Chronic Daily Dose (mg/kg-day)
C_s	=	soil concentration: 188 mg/kg
SA_a	=	exposed skin surface area (arms): 890 cm^2
SA_h	=	exposed skin surface area (hands): 430 cm^2
SL_a	=	soil loading to exposed skin (arms): 1.0E-08 kg/cm^2/event
SL_h	=	soil loading to exposed skin (hands): 1.0E-07 kg/cm^2/event
nEv	=	number of dermal exposure events/day: 1
RAF_{derm}	=	relative dermal absorption factor: 0.03
D_2	=	days per week exposed: 7 days/7 days
D_3	=	weeks per year exposed: 26 weeks/52 weeks
BW	=	body weight: 16.5 kg

$$CDD = \frac{188mg/kg * ((430cm^2 * 1E\text{-}07kg/cm^2/ev) + (890cm^2 * 1E\text{-}08kg/cm^2/ev))) * 1 * 0.03 * 7days/7days * 26wks/52wks}{16.5kg}$$

CDD = 8.9E-06 mg/kg-day

A Hazard Quotient was calculated for this exposure pathway as follows:

HQ = CDD/TRV

Where:

CDD = 8.9E-06 mg/kg-day
TRV = 3.0E-04 mg/kg-day

$HQ_{arsenic}$= 8.9E-06/3.0E-04 = 0.03

TOTAL $HQ_{arsenic} = HQ_{dust\ inhalation} + HQ_{soil\ ingestion} + HQ_{dermal}$
= 0.0001 + 0.33 + 0.03
= 0.33

CANCER RISKS

Sample Scenario

- Receptor: Adult Site Resident (Future "University" Scenario)
- COPC: Arsenic in surface soil (188 mg/kg)
- Exposure pathways:
    - soil particulate inhalation
    - incidental soil ingestion
    - dermal soil contact

Soil Particulate Inhalation Pathway

The lifetime average air concentration of arsenic via the inhalation of soil particulates was calculated for the adult Site resident as follows:

$LAAC = C_s * P_{air} * RAF_{inh} * D_1 * D_2 * D_3 * D_4/LE$

Where:

LAAC	=	Lifetime average air concentration (mg/m^3)
C_s	=	soil concentration (arsenic): 188 mg/kg
P_{air}	=	particulate concentration in air: 7.6E-10 kg/m^3
RAF_{Inh}	=	relative absorption factor by inhalation: 1
D_1	=	hours per day exposed: 24 hours / 24 hours
D_2	=	days per week exposed: 7 days / 7 days
D_3	=	weeks per year exposed: 26 weeks / 52 weeks
D_4	=	years exposed: 60 years
LE	=	life expectancy: 80 years

LAAC = 188mg/kg * 7.6E-10kg/m^3 * 1 * 24hrs/24hrs * 7days/7days * 26wks/52wks * 60yrs/80yrs

LAAC = 5.0E-08 mg/kg-day

An Incremental Lifetime Cancer Risk was calculated for this exposure pathway as follows:

ILCR = LAAC x TRV

Where:

LAAC = 5.0E-08 mg/m^3
TRV = 6.4 $(mg/m^3)^{-1}$

$ILCR_{arsenic}$= 5.0E-08 * 6.4 = 3.4E-07

Soil Ingestion Pathway

The lifetime average dose of arsenic via the incidental ingestion of shallow soil were calculated for the adult Site resident as follows:

$$LAD = \frac{C_s * IR_S * RAF_{oral} * D_2 * D_3 * D_4}{BW * LE}$$

Where:

LAD	=	Lifetime Average Dose (mg/kg-day)
C_S	=	soil concentration (arsenic): 188 mg/kg
IR_S	=	soil ingestion rate: 2.0E-05 kg soil/day
RAF_{oral}	=	relative absorption factor by GI tract: 0.22
D_2	=	days per week exposed: 7 days / 7 days
D_3	=	weeks per year exposed: 26 weeks / 52 weeks
D_4	=	years exposed: 60 years
BW	=	body weight: 70.7 kg
LE	=	life expectancy: 80 years

$$LAD = \frac{188\ mg/kg * 2E\text{-}05\ kg\ soil/day * 0.22 * 7\ days/7days * 26\ wks/52\ wks * 60\ years}{70.7\ kg * 80\ years}$$

LAD = 4.4E-06 mg/kg-day

An Incremental Lifetime Cancer Risk was calculated for this exposure pathway as follows:

ILCR = LAD * TRV

Where:

LAD = 4.4E-06 mg/kg-day
TRV = 1.8 $(mg/kg\text{-}day)^{-1}$

$ILCR_{arsenic}$= 4.4E-06 mg/kg-day * 1.8 mg/kg-day = 7.9E-06

Soil Dermal Pathway

The lifetime average dose of arsenic via dermal contact with shallow soil was calculated for the adult Site resident as follows:

$$CDD = \frac{(C_s * ((SA_h * SL_h) + (SA_a * SL_a))) * nEv * RAF_{derm} * D_2 * D_3 * D_4}{BW * LE}$$

Where:

LAD	=	Lifetime Average Dose (mg/kg-day)
C_s	=	soil concentration: 188 mg/kg
SA_a	=	exposed skin surface area (arms): 2500 cm^2
SA_h	=	exposed skin surface area (hands): 890 cm^2
SL_a	=	soil loading to exposed skin (arms): 1.0E-08 kg/cm^2/event
SL_h	=	soil loading to exposed skin (hands): 1.0E-07 kg/cm^2/event
nEv	=	number of dermal exposure events/day: 1
RAF_{derm}	=	relative dermal absorption factor: 0.03
D_2	=	days per week exposed: 7 days/7 days
D_3	=	weeks per year exposed: 26 weeks/52 weeks
D_4	=	years exposed: 60 years
BW	=	body weight: 70.7 kg
LE	=	life expectancy: 80 years

$$LAD = \frac{188mg/kg*((890cm^2*1E\text{-}07kg/cm^2/ev)+(2500cm^2*1E\text{-}08kg/cm^2/ev)))*1*0.03*7days/7days * 26wks/52wks * 60\ years}{70.7kg * 80\ years}$$

LAD = 3.4E-06 mg/kg-day

An Incremental Lifetime Cancer Risk was calculated for this exposure pathway as follows:

ILCR = LAD * TRV

Where:

LAD = 3.4E-06 mg/kg-day
TRV = 1.8 $(mg/kg\text{-}day)^{-1}$

$ILCR_{arsenic}$= 3.4E-06 * 1.8 = 6.1E-06

TOTAL $ILCR_{arsenic}$ = $ILCR_{dust\ inhalation}$ + $ILCR_{soil\ ingestion}$ + $ILCR_{dermal}$
= 3.4E-07 + 7.9E-06 + 6.1E-06
= 1.4E-05