June 26, 2024

Attention: Nunavut Water Board

To: Karén Kharatyan <karen.kharatyan@nwb-oen.ca>

VIA EMAIL

Subject: Type A Water Licence (8AC-EUR2331) Request to use Site Specific Target Levels for Remediation

Dear Karén Kharatyan,

Environment Canada and Climate Change ("ECCC" or the Permit Holder) submits this request to Nunavut Water Board ("NWB") to approve the 2023 Remedial Action Plan (RAP) including the Site Specific Target Levels ("SSTLs") and 'Amendment to the Updated RAP' (**Attachment A)** as treatment objectives and associated activities for the Eureka High Arctic Weather Station (HAWS). Also enclosed is the Human Heath and Ecological Risk Assessment (HHERA) (**Attachment B**). The HHERA provides the basis for SSTLs formulation, and the Amendment summarizes the recommendations from the RAP, the proposed application of SSTLs to site soils and sediments, and the placement of sediments and soils that meet the SSTLs at Johnny's Hole.

Background

ECCC submitted the RAP to the NWB in the 2021 Annual Report. The RAP was revised and resubmitted to NWB on March 31, 2023, which replaced the 2021 version.

The 2023 RAP establishes SSTLs for contaminants present in sediments and soils at the site. Based on recommendations in the HHERA, these SSTLs have been formulated using the Tier 3 risk-based methodology recommended by the Canadian Council of Ministers of the Environment (CCME).

This decision to implement SSTLs rather than adhere to generic criteria is driven by the need to tailor remediation efforts to the unique environmental and ecological dynamics of the site. It takes into consideration specific local conditions, such as varying exposure pathways and the presence of sensitive receptors, which are detailed within the HHERA. The SSTLs enable a more precise and context-sensitive response to the contamination.

Existing Nunavut Planning Commission Regulatory Approvals:

The Nunavut Planning Commission (NPC) issued a positive conformity determination on November 2, 2021, and made exempt from Nunavut Impact Review Board (NIRB) screening the activity of reusing or storing soils that are below the SSTLs as identified in the RAP. Below is the related Project description from this NPC application (File No. 149617) which discusses the RAP and the SSTLs being used as the treatment objectives (see in **Bold**):

> *The water and sewage projects and solid waste non-hazardous facility have been delayed and are scheduled to begin in summer of 2022 and summer of 2023 respectively. The modification increases the capacity of the landfarm from 6,000 m3 to 10,000 m3. This will allow for a contingency of 4000 m3 for potentially contaminated soils found at the west side of the Eureka HAWS. Included within this estimate is the excavation of up to 1600 m3 of soil to support the water and sewage infrastructure project. The landfarm conceptual design is expected to be completed in 2022. Prior to the construction of the Landfarm, contaminated soils are to be stored temporarily in two lined stockpiles. There is an existing temporary stockpile approved by the Nunavut Water Board and CIRNAC under the current Water Licence and Land Use Permit, respectively. The modification adds an additional temporary stockpile placed adjacent to the existing temporary stockpile. Design details of the temporary stockpile will be provided to the Nunavut Water Board. The total capacity of both temporary stockpiles is 10,000 m3.* ***A Remedial Action Plan and Risk Assessment (RAPRA) completed for the site will be shared with the Nunavut Water Board as required by the current Water Licence. Excavated soils with concentration levels below the Site Specific Target Levels (as identified in the RAPRA) will be used as fill in non-environmentally sensitive locations.***

*Note: "RAPRA" refers to both the Remedial Action Plan (submitted to NWB on March 31, 2023) and the Human Health and Ecological Risk Assessment (**Attachment B**).

<u>Request</u>

The Permit Holder is seeking approval for the SSTLs and related activities concerning progressive site remediation. It is our understanding that NWB will facilitate Government of Nunavut Environmental Protection Service's (GNEPS) review if required. These SSTLs and related activities are detailed in the RAP submitted to the Board on March 31, 2023, and the Amendment to the Updated RAP, and are in line with existing NPC approvals. The specific requests are as follows:

- **Approval of SSTLs:** The SSTLs outlined in the RAP and HHERA should be approved as the remedial objectives for soil and sediment on site. The SSTLs should be confirmed as acceptable by the GNEPS / Department of Environment and Inspector to ensure that Part E, Item 17 and Part J, Item 5 of the Water Licence (8AC-EUR2331) is met prior to the future reuse of treated soils, and to confirm soils that are below the SSTLs don't require reclamation or treatment (i.e., can be left in-place).
- **Placement of Soils at Johnny`s Hole:** As per the RAP, some soils that meet SSTLs, but not the generic Tier 1 criteria, may be placed at Johnny's Hole. Main Station SSTLs derived in the HHERA will apply to Johnny`s Hole, as supported by Amendment to the Updated RAP in **Attachment A**. Johnny's Hole presents an ideal location because of its proximity to the New Landfarm, flat terrain, adequate distance from any water body or stream, and the area is pre-disturbed.
- **Landfarm Treatment**: The landfarm should be allowed to treat soils to the SSTLs. Once treated, these materials could either a) remain in the landfarm, b) be relocated to Johnny's Hole, or c) be relocated to another location that is not environmentally sensitive and where the SSTLs would still be met.
- **Retention of Below SSTLs Soils or Sediments:** Impacted soils or sediments that meet the SSTLs should not require reclamation (i.e., through treatment or disposal). Impacted soils or sediments that meet the SSTLs should be permitted to be left in-place.

Sincerely,

Jean-Philippe Cloutier-Dussault
Property Manager, Assets, Real Property and Security Directorate
Environment and Climate Change Canada / Government of Canada
Jean-Philippe.Cloutier-dussault@ec.gc.ca / Tel : 514-641-8753

Cc: Government of Nunavut Environmental Protection Branch - environment@gov.nu.ca

Appendix A

Amendment to the Updated RAP

NUQSANA Inc.	AMENDMENT	outcome CONSULTANTS

TO	Ms. Alix Rive, Senior Environmental Specialist Public Services and Procurement Canada	**DATE**	June 21, 2024
CC			
FROM	Don Plenderleith, P.Eng. (NU)	**PROJECT No.**	NP2024-12

AMENDMENT TO THE UPDATED RAP (2023) EUREKA HIGH ARCTIC WEATHER STATION

Introduction

Nuqsana-Outcome Joint Venture (NOJV) has developed this Memo for Public Services and Procurement Canada (PSPC) and Environment and Climate Change Canada (ECCC) with recommendations for the use of an area at the Eureka High Arctic Weather Station (HAWS) that is planned for excess soil that is impacted at concentrations exceeding the applicable generic Tier 1 CCME Soil Quality Guidelines (residential/parkland) but below the CCME Tier 3 derived Site Specific Target Levels (SSTLs). This Memo is an addendum to the updated Remedial Action Plan (RAP) at the Eureka HAWS, by Dillon-Outcome, dated March 2023.

Derivation of SSTLs

In 2022 two distinct sets of Site Specific Target Levels were developed for Eureka HAWS for **i) the Main Station Area** and **ii) the Runway Area.**

The SSTLs were the output of a Human Health and Environmental Risk Assessment (HHERA) conducted by Dillon-Outcome Joint Venture (DOJV) and our specialist sub-consultant, CanNorth Environmental Services (DOJV, 2022). Different human exposure situations at that time were the reason that two differed SSTLs were deemed appropriate. In particular, a longer duration of outdoor work per day (10-12hrs) for the construction workers who were performing work at the runway during the upgrade project was incorporated in the derivation of the Runway Area SSTLS.

With the runway upgrade now complete, that scenario is no longer present and the SSTLs derived for the Runway Area are no longer applicable. The SSTLs which were derived for the Main Station Area are considered applicable sitewide for the entire Eureaka HAWS and will be referred to as Site-wide Eureka SSTLs.

The derivation of SSTLs is presented in the report: Updated Human Health and Ecological Risk Assessment at the Eureka High Arctic Weather Station, Nunavut (DOJV, 2022). The Site-wide Eureka SSTLs are tabulated in Table 1 below:

Table 1 - SSTLs for Site-wide Application at Eureka HAWS, including Johnny's Hole (DOJV, 2022)

COPC	Proposed SSTL (mg/kg)	Rationale
Metals		
Arsenic	40	Based on human health risk-based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Boron, hot water soluble	6	Based on site-specific considerations. Represents maximum measured plus 20% for sample variability, which is higher than the benchmark
Boron	30	Based on site-specific considerations. Maximum measured concentration plus 20% for sample variability
Copper	1100	Human Health component of copper guideline. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Lead	360	Based on ecological risk-based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Nickel	78	Based on site-specific considerations. Maximum measured concentration plus 20% for sample variability
Zinc	10,000	Based on protection of human health
BTEX		
Benzene	2	Based on human health component of the guideline
Ethylbenzene	110	Based on ecological component of the guideline
Toluene	120	Based on ecological component of the guideline
Xylenes	65	Based on ecological component of the guideline
Petroleum Hydrocarbons (PHC)		
PHC F1 (C_6-C_{10})	7800	Based on human health risk-based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
PHC F2 (C_{10}-C_{16})	4100	Based on human health risk-based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
PHC F3 (C_{16}-C_{34})	15000	Human Health component of PHC F3 guideline. Due to the disturbed soils, the plant benchmark is not appropriate
Polycyclic Aromatic Hydrocarbons (PAH)		
1-Methylnaphthalene	70	Based on human health risk-based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
2-Methylnaphthalene	110	Based on human health risk-based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Acenaphthylene	8	Based on human health risk-based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Acridine	3	Based on CCME guideline for similar structure- anthracene
Naphthalene	60	Human health component of the guideline
Perylene	10	Based on CCME guideline for similar structure- pyrene

Soil Management at Johnny's Hole

The location that is intended to be used for soil that that exceeds the generic Tier 1 CCME guidelines but is below the SSTLs is "Johnny's Hole", shown on Figure 2. This location is east of the runway, on the south side of the haul road leading to the borrow supply area. This location has the desirable characteristics of being pre-disturbed and located on a non-steeply inclined area and meets the required distance from any surface water bodies.

The soil that will be placed in this area is expected to derive from either excavated material that is not contaminated to the degree that it must be treated in the Soil Treatment Facility (STF), and is not suitable or needed for beneficial re-use, or soil that has already been treated in the STF and now meets the SSTLs.

References:

CCME. 2020. Canadian Environmental Quality Guidelines summary table. Website: http://st-ts.ccme.ca/

Dillon-Outcome Joint-Venture, *Updated Human Health and Ecological Risk Assessment at the Eureka High Arctic Weather Station, Nunavut (PSPC Project R.112801.001), March 2022* (DOJV, 2022)

Dillon-Outcome Joint Venture, *Updated Remedial Action Plan (RAP) at the Eureka High Arctic Weather Station, Eureka, Nunavut* (PSPC Project R.117995.002), March 2023 (DOJV, 2023).

Attachment A

Figures 1 Eureka Key Map

Figure 2 Johnny’s Hole Location

GENERAL NOTES

1. ALL MEASUREMENTS IN METRES UNLESS OTHERWISE NOTED
2. COORDINATE SYSTEM IS UTM 16N NAD 83.

LEGEND

▭	LOCATION OF WORK SITE

STAMP/SEAL

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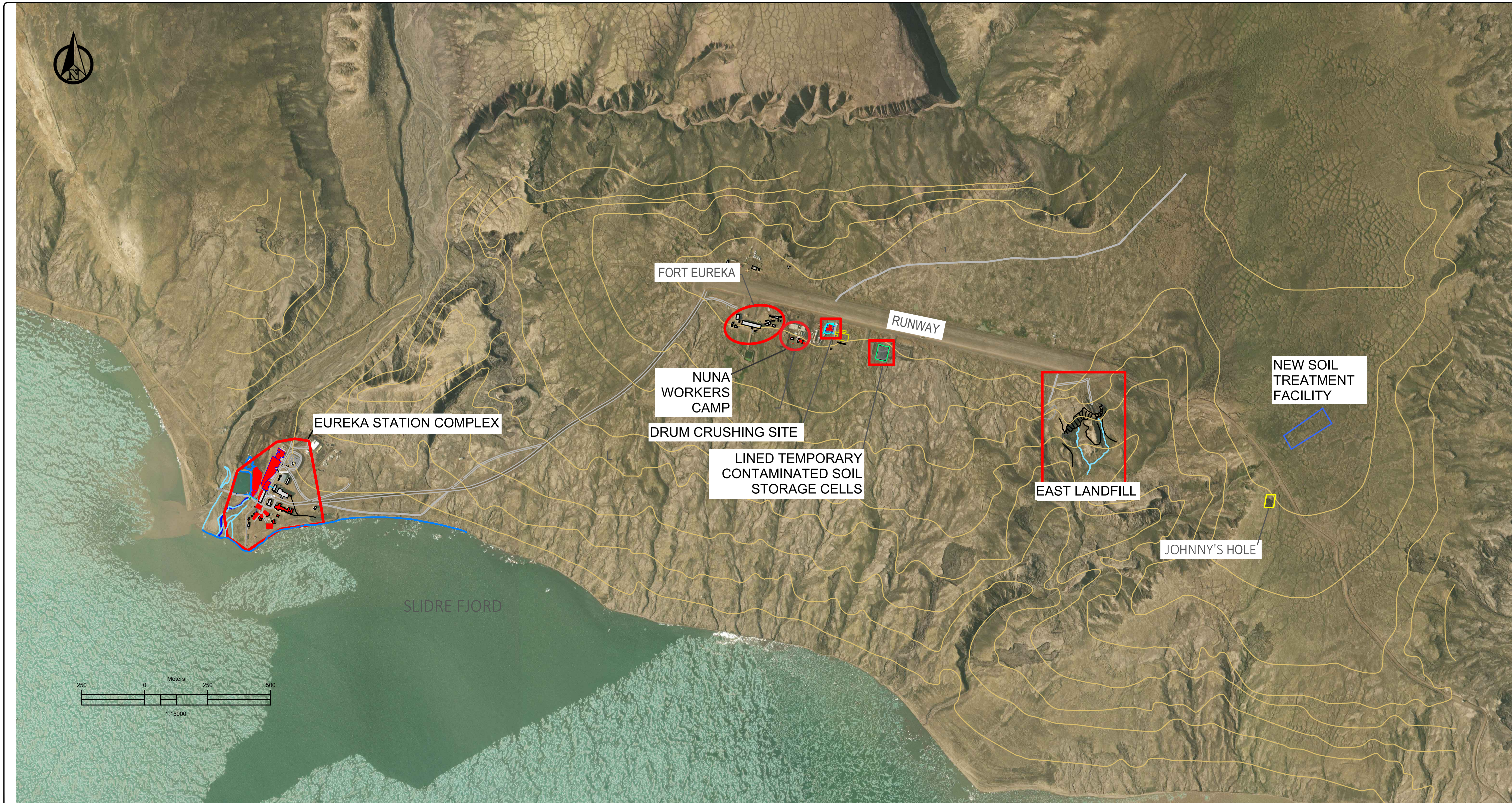
EUREKA HIGH ARCTIC WEATHER STATION
2023 REMEDIAL ACTION PLAN
EUREKA, NUNAVUT
KEYMAP

OUTCOME PROJECT NUMBER:	DRAWN BY:	SCALE:
P2021-16	J.MILLS	N.T.S.
CLIENT PROJECT NUMBER:	CHECKED BY:	PUBLISH DATE:
----	K.VEITCH	2023-03-14

DRAWING NAME:	SHEET NUMBER:	REV:
P2021-16 PSPC 2022 REMEDIAL ACTION PLAN (230314).dwg	01 OF 07	02



GENERAL NOTES

1. ALL MEASUREMENTS IN METRES UNLESS OTHERWISE NOTED
2. COORDINATE SYSTEM IS UTM 16N NAD 83.

LEGEND

Red box	WORK AREAS
Yellow box	OVER GENERIC UNDER SSTL SOIL AREA
Blue box	NEW SOIL TREATMENT FACILITY

Note: Human Health and Ecological Risk based Site-Specific Target Levels apply site-wide at Eureka

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EUREKA HIGH ARCTIC WEATHER STATION
2023 REMEDIAL ACTION PLAN
EUREKA, NUNAVUT
JOHNNY'S HOLE LOCATION

OUTCOME PROJECT NUMBER:	DRAWN BY:	SCALE:
P2021-16	J.MILLS	1:15000
CLIENT PROJECT NUMBER:	CHECKED BY:	PUBLISH DATE:
----	K.VEITCH	2024-06-21

DRAWING NAME:	SHEET NUMBER:	REV:
P2021-16 PSPC 2022 REMEDIAL ACTION PLAN (230314).dwg	02 OF 07	02

Appendix B

Human Health and Ecological Risk Assessment

PUBLIC SERVICES AND PROCUREMENT CANADA
ENVIRONMENT AND CLIMATE CHANGE CANADA

Updated Human Health and Ecological Risk Assessment at the Eureka High Arctic Weather Station, Nunavut

PSPC Project R.117995.002

Final Report

March 2022

P2020-18

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Appendices

List of Acronyms

BG	Background
CCME	Canadian Council of Ministers of the Environment
COPC	Contaminant of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSM	Conceptual Site Model
DQRA	Detailed Quantitative Risk Assessment
ECCC	Environment and Climate Change Canada
Eco-SSL	Ecological Soil Screening Level
ECOTOX	U.S. EPA ECOTOXicology database
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
HAWS	High Arctic Weather Station
HHERA	Human Health and Ecological Risk Assessment
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
IRIS	Integrated Risk Information System
ISQG	Interim Sediment Quality Guidelines
LOAEL	Lowest Observable Adverse Effects Level
LOE	Lines of Evidence
LOEC	Lowest Observable Effect Concentration
MDL	Method Detection Limit
MOECC	Ontario Ministry of the Environment and Climate Change
NOAEL	No Observable Adverse Effects Level
NOEC	No Observable Effect Concentration
PSPC	Public Services and Procurement Canada
PQRA	Preliminary Quantitative Risk Assessment
RAF	Relative absorption factor
RfC	Reference Concentration
RfD	Reference Dose
SARA	Species at Risk Act
SSD	Species Sensitivity Distribution
SF	Slope Factor
SI	Screening Index
TF	Transfer Factor
TRV	Toxicity Reference Value
UCLM	Upper Confidence Level of the Mean (95% 1-sided)
WHO	World Health Organization
WOE	Weight of Evidence

Glossary

Term	Description
Assessment Endpoint	A quantitative or quantifiable expression of the environmental value considered to be at risk in a risk assessment.
Background	The typical level of a chemical present in naturally occurring or uncontaminated areas.
Benchmark	A standard by which something can be measured or judged.
Biota	The animal and plant life of a region.
Cancer	A disease that happens when cells in the body begin to grow and multiply out of control.
Cancer Risk Level	A term uses to describe the likelihood that someone will develop cancer over a 70-year lifetime.
Carcinogen	An agent that has the potential to cause cancer.
Cautious	As used in the term cautious estimates, this is considered a pessimistic or an over-estimate of the level, effect or hazard, as the case may be.
Contaminant	An anthropogenic substance that has the potential to alter the natural composition of air, water or soil.
Dermal	Refers to skin.
Dose	The amount of a substance to which a person or ecological receptor is exposed over some time period. Dose is a measurement of exposure.
Ecological Risk Assessment	The application of a formal framework, analytical process, or model to estimate the effects of human actions(s) on a natural resource and to interpret the significance of those effects in light of the uncertainties identified in each component of the assessment process. Such analysis includes initial hazard identification, exposure and dose-response assessments, and risk characterization.
Environmental Impact	A change in environmental conditions resulting from an action or development, which may be negative, positive, or neutral.
Exposure	The amount of a pollutant (chemical) present in a given environment that represents a potential health threat to living organisms.
Exposure Pathway	The path from sources of COPC via air, soil, water, or food to man and other species or settings.

Hazard	Potential for exposure to radiation, a chemical, or other COPC to cause illness or injury to humans or ecological receptors. Hazard identification of a given substances is an informed judgment based on verifiable toxicity data from animal models or human studies.
Hazard Assessment	Evaluating the effects of a COPC or determining a margin of safety for an organism by comparing the concentration, which causes toxic effects with an estimate of exposure to the organism.
Hazard Quotient	The ratio of estimated site-specific exposure to a single chemical from a site over a specified period to the estimated daily exposure level at which no adverse health effects are likely to occur.
Human Health Risk Assessment	The evaluation of whether there is likely to be an adverse health effect caused by the potential exposure to COPC in the environment.
Incremental	Increase in a concentration of some chemical or radionuclide over background conditions as a result of human activities.
Ingestion	Refers to swallowing.
Inhalation	Refers to breathing in air into the lungs.
Lifetime receptor	A theoretical person representing all life stages from infant to an adult, which is used to assess the risk of developing cancer. The lifetime receptor is used because often it takes a long time between exposure to a chemical and the development of cancer.
Line of evidence (LOE)	Any pairing of exposure and effects measures that provides evidence for the evaluation of a specific assessment endpoint.
Lowest Observed Adverse Effect Level (LOAEL)	The lowest concentration or amount of a substance, found by experiment or observation, which cause an adverse effect in a target organism distinguishable from normal (control) organisms of the same species and strain.
Measurement Endpoint	A quantitative summary of the results of a toxicity test, a biological monitoring study, or other activity intended to reveal the effects of a substance.
Modelling	Using mathematical principles, information is arranged in a computer program to model conditions in the environment and to predict the outcome of certain operations.
Negligible	Refers to a level of risk that is not expected to result in an adverse health effect.

No Observed Adverse Effects Level (NOAEL)	The highest tested dose of a substance that has been reported to have no harmful effects on people or animals.
Oral	Refers to the mouth.
Permissible Dose	Considered to be a safe level of exposure as it is the amount of a chemical that someone can be exposed to over a lifetime that does not result in an adverse health effect.
Pathway	The physical course a chemical or pollutant takes from its source to the exposed organism.
Pathways Analysis	A method of estimating the transfer of chemicals (i.e., radionuclides released in water) and subsequent accumulation up the food chain to fish, vegetation, mammals and humans and the resulting dose to humans.
Receptor	A human or ecological entity exposed to a COPC released to the environment.
Risk	A measure of the probability that damage to life, health, property, and/or the environment will occur as a result of a given hazard.
Risk Assessment	Qualitative and quantitative evaluation of the risk posed to human health and/or the environment by the actual or potential presence and/or use of specific COPC.
Safe	Implies low or negligible risk.
Toxicological Reference Value	A value/criterion used to judge whether a predicted exposure may potentially have an adverse effect on human and/or ecological species.
Transfer Factor (TF)	An empirical value that provides a measure of the partitioning behaviour of a chemical or substance between two environmental media that is used to estimate concentrations in one environmental medium based on concentrations in another.
Trophic Level	The position an organism occupies on the food chain.
Uncertainty	A quantitative expression of error.
Uptake	The process/act by which a chemical enters a biological organism (e.g., inhalation, ingestion by humans, etc.).
Weight-of-Evidence	An approach for interpreting and integrating scientific information from different lines of investigation.

1.0 Introduction

Dillon Consulting Limited and Outcome Consultants in joint venture (Dillon-Outcome) and their risk assessment team, CanNorth Environmental Services, was retained by Public Services and Procurement Canada (PSPC) on behalf of Environment and Climate Change Canada (ECCC) to perform services ("Services" or "Project") associated with the conduct of a Human Health and Ecological Risk Assessment ("HHERA") of the Eureka High Arctic Weather Station (HAWS, or "the Station"). The first part of the project involved the completion of a Data Review and Gap Analysis. The second part of the project involved the development of the Problem Formulation for the HHERA. This risk assessment report represents the ultimate deliverable for the project and incorporates feedback received on the Problem Formulation. The HHERA also takes into account a number of infrastructure improvement projects that are occurring at the HAWS such as the upgrading of the runway, the construction of a new drinking water reservoir and sewage and wastewater system upgrades and the decommissioning of a number of buildings. This updated report considers sampling conducted in areas of the site in 2021. Some of these areas have never been sampled previously.

2.0 Background

Eureka HAWS is operated by Environment and Climate Change Canada (ECCC) under the Meteorological Service of Canada (MSC) and has been in operation since 1947. The HAWS is an operational weather monitoring station as well as serving as a hub for a number of different agencies carrying out different activities. It is a remote location on the north side of the Slidre Fjord, at the north-western tip of Fosheim Peninsular on Ellesmere Island, Nunavut (Figure 1). The Station is used for government sponsored scientific research. The Station consists of an Airstrip Area, the Main Station Area, a Department of National Defense (DND) summer camp (Fort Eureka) as well as the Arctic Stratospheric Observatory (ASTRO) laboratory (Figure 2). The area occupied by the Airstrip Area (1.5 km north of the main site) and the Main Station Area is approximately 2.23 hectares.

The Main Station Area is east of Station Creek and includes a number of buildings and infrastructure including an operations/residence complex, garages, powerhouse, warehouses, electrical building, carpentry shop, transient quarters, miscellaneous small buildings, sealift landing area, active landfill; closed landfills; contaminated soil treatment facilities; roads; water reservoir; sewage lagoon; tank farm and fuel pipeline.

The main building in the Main Station Area was constructed in 2005 and contains the living quarters and operational areas for the weather station. Heat and electricity for the station is supplied by the Powerhouse which is attached to an equipment maintenance warehouse and water storage area. Fuel for the Powerhouse is stored in a tank farm north of the facility (Figure 3).

Environmental investigations have been conducted at the HAWS from 1995 through 2012. These investigations have identified the presence of contaminants of concern, identified areas of potential concern, and evaluated the risks for human health and ecological receptors. In addition, there is a Long Term Monitoring Program being conducted at the HAWS and activities have been completed since 2013 and there have been 4 years of monitoring (2013, 2015, 2017 and 2019). Additional data collected in 2021 at some areas of the side that had not been previously sampled and in the Drainage Pond were considered.

In March 2020, Dillon-Outcome produced a risk review and remedial action plan for the drainage pond area. The review identified that PHC-F2 is the major issue in the soils at the site. The review also determined that the SSTLs for sediments were not effects-based values and not derived on sound science and should be re-visited.

Therefore, ECCC requested an updated HHERA for the entire site with consideration of the various construction and remediation activities planned or occurring at the Site including:

- Runway Recapitalization Project
- Water and Wastewater Treatment Project
- Fuel Tank Inspections

- Building Decommissioning Project

2.1 Definition of a Human Health and Ecological Risk Assessment

A Human Health and Ecological Risk Assessment (HHERA) is a scientific process used to describe and estimate the likelihood of potential risks (i.e., adverse health effects) to humans and ecological receptors resulting from exposure to environmental contaminants. Figure 4 demonstrates that HHERA is a stepwise process to answer:

- What are we concerned about? – what are the contaminants of potential concern (COPC).
- Who is being exposed? – people, wildlife, or vegetation.
- How are they being exposed? – what are the exposure pathways.

All three of these components must be present in order for there to be a risk. It should be noted that the Human Health Risk Assessment (HHRA) does not provide a direct assessment of cause and effect concerning current health problems or effects. Any link between exposure and actual health effects comes from epidemiological studies, which include surveys of health problems in a community, and compares them to health problems in other cities and populations where the same type of exposure does not occur.

3.0 Objectives and Scope

The objective of the HHERA is to quantify the risk for people, wildlife and vegetation at the Eureka HAWS arising from exposure to COPC present in the soil, surface water and sediments. The HHERA considers the current conditions at the HAWS and background exposures are also taken account in the assessment.

A multi-media approach was taken for the HHRA that considered exposure from all relevant environmental components such as soil, water, indoor and outdoor air. This risk assessment was conducted as a Detailed Quantitative Risk Assessment (DQRA) since it relied on a substantial database of available monitoring data at the Eureka HAWS. The risk assessment followed guidance outlined by Health Canada (Health Canada 2010a).

For the Ecological Risk Assessment (ERA) a Preliminary Quantitative Risk Assessment (PQRA) was undertaken as data were not available for some media such as vegetation and prey. The risk assessment followed guidance outlined by Environment Canada from their Federal Contaminated Sites Action Plan (FCSAP) Ecological Risk Assessment guidance document (FCSAP 2012a). A number of different ecological receptors were selected ranging from small animals that have small home ranges, such as a hare, to larger animals that could roam across the HAWS, such as the arctic fox. Very large animals such as caribou, wolf and muskox were not considered as the Eureka HAWS only occupies a very small area where they roam, and previous assessments indicated that they were not at risk. Fish, aquatic plants, and various that may be present in the water and sediment of the Drainage Pond and Stream Area were also considered.

4.0 Site Characterization

4.1 Site Location and General Descriptions

Eureka High Arctic Weather Station (HAWS) is located on the north side of Slidre Fjord, at the north-western tip of Fosheim Peninsula on Ellesmere Island in Nunavut (Figure 1). According to the Directory of Federal Real Property, its central coordinates are 79.988538 degrees North, and 85.902002 degrees West. Eureka HAWS is currently operated by Meteorological Services of Canada (MSC) of Environment and Climate Change Canada (ECCC) used for government-sponsored scientific research. The site is primarily accessed by air. The all-season Airstrip is located about 1.5 km northeast of the main living quarters and operational areas ("the Main Station Area") (Figure 2) and is the primary way for accessing the HAWS year-round.

The HAWS occupies an area of approximately 5,000 hectares of the Indigenous and Northern Affairs Canada's land reserve #1021. Besides the Airstrip and the Main Station Area, the site also consists of a Department of National Defence (DND) camp known as Fort Eureka, and an experimental Arctic Stratospheric Observatory (ASTRO) laboratory. Fort Eureka is south of the Airstrip and is only occupied for about three weeks a year (typically in July) (ARCADIS 2016). Most of the facilities are located on a relatively flat area downslope of the Airstrip before dipping into the fjord. From September through June, the fjord is covered with ice. Most of the activities and research work at the HAWS is carried out during the summer months of July and August (ARCADIS 2016). The closest Inuit community is the hamlet of Grise Fjord which is located about 400 km south of the HAWS at the southern end of Ellesmere Island.

4.2 Site History

Eureka HAWS has been owned and operated by MSC since April, 1947 as an operational weather monitoring facility. It was the first "Joint Arctic Weather Station" established under a joint project with the United States Weather Bureau. The Airstrip was constructed three months later for transportation purposes and in the event of a medical emergency. Support from the US was withdrawn in 1970, and the station was renamed the Eureka HAWS as it was completely under the control of the Canadian Government. Besides ECCC, the DND and the Polar Continental Shelf Project (PCSP) also conduct activities on site. There are a number of buildings and other facilities at the site which will be further discussed in Section 4.3. The DND operates the facilities south of the Airstrip. Further east of the DND facilities, three abandoned First Air Services buildings are also located south of the Airstrip.

Around the Airstrip there are a number of areas that have been identified as areas of concern including the landfills, the ex-situ Biotreatment Cell and the former First Air Lease. These areas are not under the control of DND. There is a barrel crushing area controlled by DND in this area as well as Fort Eureka. Recent work being carried out to rehabilitate the Airstrip has resulted in identification of petroleum hydrocarbons in the excavated materials. There are multiple gullies running through the landfill area towards Slidre Fjord which may result in surface water flow during snowmelt. A portion of the landfill area is still under active use.

The new living quarters and operation facility at the Main Station Area was constructed and first occupied in 2005. It is a two-storey building with a crawl space, but no basement. The first floor is where the main activities occur and the second floor contains the living quarters for staff and visitors to the HAWS.

The rest of the buildings are slab on grade which include the powerhouse and garage buildings. The powerhouse building supplies heat and energy and an equipment warehouse is attached to the powerhouse. The height of the buildings such as the powerhouse and garages are around 5.5m and the height of the equipment warehouse is 7m.

Currently, the station is fuelled by a new tank farm established in 1992 located north of the Main Station Area. The former fuel storage area was located at the west of the Main Station Area and at the west end of Station Creek. During the operation of the HAWS there have been several petroleum hydrocarbon spills. At the former fuel storage area the spills have resulted in an estimated 21,000 cubic meters of contaminated soil. There are also demolished buildings, waste disposal sites, fuel barrels, abandoned vehicles and sewage.

The water reservoir is the source of domestic water for the HAWS and is filled annually by pumping water from Station Creek during spring runoff. Water from the domestic reservoir seeps into the Drainage Pond which is a lower lying area.

4.3 Study Area and Subareas

The site has been broken up into two distinct areas during a number of site investigations that have occurred over a number of years; the Main Station Area and the Airstrip Area. The Main Station Area has been further broken up into the Delta, Powerhouse and Maintenance and the Landfarm area (Figure 3). The Drinking Water Reservoir, Drainage Pond and Stream Area are also considered in this area (Figure 3). The Airstrip area is about 1.5 km from the main facility and encompasses the Former First Air Lease, the Ex-situ Biotreatment Cell, the landfill areas, the barrel crushing area and the battery dump areas. Some of these areas namely the barrel crushing area and the battery dump area are not under the control of ECCC.

Main Station Area Subareas

The Delta Area is located next to the Slidre Fjord and south of the main Eureka complex. There are a number of buildings located in the Delta area including, the carpentry/plumbing shop, the former bunkhouse, the old transient barracks, a greenhouse, storage shed and the original Quonset hut. Building #17 was within this area but it burned down in 2019 and the area where the fire occurred has been remediated.

The Powerhouse and Maintenance Area is located between the Delta and Main Complex. The Powerhouse/New Garage building and the Old Garage are in this area. This area is adjacent and hydraulically upgradient of the Drainage Pond and Drinking Water Reservoir.

The Landfarm Area is located to the northwest of the Main Complex, and includes both the Landfarm and downgradient areas. The Landfarm is north of the Powerhouse/New Garage. There is a sharp grade to the west of the Landfarm, and a low-lying area near the Drainage Pond. The tankfarm area is North West of the Landfarm area.

The Drainage Pond is immediately west and downgradient of the Powerhouse/New Garage. To the west of the Drainage Pond is the Drinking Water reservoir, which is upgradient. During the spring thaw, water from Station Creek reportedly flows through the Drainage Pond into Slidre Fjord; however, this is an intermittent flow path and in 2017 and 2019 site visits, the drainage pond was totally cut off from Station Creek. Fish are not present in the Drainage Pond but have been observed in the brackish discharge zone (ARCADIS 2016). The Drainage Pond drains to Slidre Fjord through the Stream Area. The Stream travels across a low-lying area west of the pipeline. The course of the Stream has changed since 2015.

Airstrip Subareas

The Former First Air Lease, also known at the site as the Bradley Buildings, is south of the Airstrip and to the east of Fort Eureka. There are three abandoned buildings in the area, which were once used as the offices of Bradley Air Services, now First Air. The buildings contain discarded furniture and debris, and were reportedly home to wolves at some point.

The Ex Situ Biotreatment Cell is south of the Airstrip and east of Fort Eureka. It is approximately 50 m by 20 m. According to the Feasibility Study (Franz and SENES, 2013d), the cell was constructed in 1999 from site clay. Approximately 350 m^3 of petroleum hydrocarbon impacted soil was transferred from the main complex area to the Biotreatment Cell.

The Eureka Landfill is east of the site Airstrip. It is currently used by the Station for disposal of waste materials. Some items are burned before disposal. Landfill cover is maintained by Station staff. Surface water runs off the face of the landfill in gullies during rain events and spring freshet. No water was present in gullies during the Dillon-Outcome site visit in August 2019 (Dillon-Outcome 2020).

The Barrel Crushing Area is located south of the central portion of the Airstrip and is used to burn, crush and bury empty fuel barrels. The area is generally flat with gradual slope to the south. The Battery Dump Area is at the north eastern end of the Airstrip about 2 km north of the Slidre Fjord. Batteries used in the relay towers and in vehicles have been disposed of in this area. In 2008 it was found that this area was capped and backfilled and there was no visible evidence of any use.

As indicated previously, there are a number of different projects occurring at the HAWS. Currently there is on-going work on the rehabilitation of the Airstrip in order to improve functionality and service to the HAWS and Fort Eureka. A worker camp has been constructed for the duration of this work and is located east of Fort Eureka and west of the existing drum crushing site, near to the former First Air Lease (see Figure 5). There are a number of proposed locations for the camp to house construction workers who will be constructing the new drinking water reservoir and the water and sewage project as well as carrying out demolition work at the HAWS. Two of the proposed camp locations are shown in Figure 6.

4.4 Climate Conditions

Under the influence of hemispherical air circulation, the climate around Eureka is dry and cold. The area is classified as a desert and snow is the predominant form of the precipitation. Mean Annual precipitation is around 79.1 mm a year (ARCADIS 2016). For ten months of a year (September to June), the ground is covered by snow. The annual precipitation can range from 50 to 150 mm. The average temperature variation is from -30.5°C to 0.5°C.

Due to the high latitude of the site, 24 hours of daylight lasts from about April 13 to August 28, while winters are characterized by 24 hours of darkness from October 21 to February 20. The sun does not rise high above the ground and its energy are dispersed as reaching the surface during the daylight months. Therefore, the summer is only heated a little by the sun, and the winter is significantly cooler.

Surface wind speeds at the HAWS average around 17km/h and are greatest in the summer months. Surface winds are generally from the west in the late Spring and Summer and from the east to southeast for the remainder of the year (ARCADIS 2016).

4.5 Local Topography

The HAWS has an average elevation of 100-200 m above sea level (asl), which is generally low in the region. It sits in the Eureka Hills Ecoregion, within the Northern Arctic Ecozone. The majority of the terrain is moderate relief with rolling and ridged topography in the study area, with a maximum elevation of approximately 1000 m asl (ARCADIS 2016).

4.6 Site Geology

The bedrock of the site is dominantly composed of the Paleocene Lowermost Eureka Sound Group (Franz/Senes 2011). This area is a broad geologically stable zone of flat-lying sedimentary rock. Cliffs and Hillsides are composed of successive layers of limestone, dolomites, shale and other sediments. The land surface is generally weathered bedrock and glacial deposits. Rose rocks and calcite formations are abundant throughout the site area, which are unique to arctic conditions.

A lack of chemical weathering and plant presence in the arctic environment results in a poor soil profile. Thus the soils at the HAWS are generally composed of glacial deposits of sand and gravel underlain by silty sandy clays. Site investigations generally did not find native sand and gravel but silty clay was mainly found at all sampling locations except for the ones in the Landfarm area where gravel and cobble was observed (Franz/Senes 2011). Based on grain size analysis, the HAWS was concluded to have fine grained soil.

4.7 Hydrology and Hydrogeology

Station Creek flows seasonally in early June from north to south on the west side of the Main Station Area (Figure 3), which serves as the main natural source of surface fresh water. The creek discharges into the Slidre Fjord and further into Eureka Sound and the Arctic Ocean. The drainage area of Station Creek at the HAWS is approximately 109.6 km^2 (ARCADIS 2016).

The station is located in a zone of continuous permafrost. The permafrost is at approximately 0.6 mbg in high and dry areas, while it is encountered at approximately 0.8 mbg in wet and low areas. The active layer can reach a depth of approximately 1.2 m on the south facing slopes (Franz/Senes 2011). Due to the fact that groundwater flows on top of the shallow permafrost layer, the velocity and direction of flow are complex and likely controlled by topography.

Drainage only occurs in the spring and summer as water at the HAWS is in the form of snow and ice for the majority of the year. Precipitation on slopes is influenced by wind and snow accumulation. Melt water runoff generally occurs downgradient of deep snow banks. Water forms in gullies and seasonal creeks that drain into the Slidre Fjord.

4.8 Biological Environment

There are no available surveys on the plant community at the HAWS. The HAWS is located in Ecodistrict 21 within the Eureka Hills Ecoregion of the Northern Arctic ecozone. Plant communities in this region are generally low growing herbs and shrubs such as purple saxifrage, *Dryas spp.*, arctic willow, arctic poppy, and sedge.

Due to the extreme climate, the ecological recovery at disturbed sites at the HAWS is impaired. The very low ambient temperatures and long nights with no light as well as lack of nutrients and moisture limit plant productivity. There are only 16 effective growing days a year at the HAWS when the temperature is above 5^{o}C adjusted for day length (ARCADIS 2016).

There are also no available wildlife surveys; however, wildlife sightings are reported weekly at the HAWS. Muskox, arctic hare, and wolves are the most commonly observed species at the HAWS. Polar bears have also been observed but not close to the HAWS. Waterfowl such as red-neck loons have been observed on the Fjord. Snow buntings have been observed near the Drinking Water Reservoir. Lapland longspurs were seen near the fuel tanks. From other surveys in the Arctic, rock ptarmigan, raven and snowy owl have been reported. Lemmings and arctic fox are also reported to be present in the Arctic environment (ARCADIS 2016).

4.8.1 Rare and Endangered Species

There is not much available information about rare and endangered species found at the HAWS. However, there are a number of species that have been identified in the Arctic environment that have been assigned heightened conservation status under the Species at Risk (SARA) Legislation and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) such as:

- Ivory Gull – medium size marine gull that breeds in several areas of the Canadian Arctic. The species is listed as Near Threatened by the International Union for Conservation of Nature (IUCN). This species is designated as being of Endangered by both SARA and COSEWIC.
- Red-knot – medium sized shore bird that breeds in the Arctic. Known to nest in the area north of Ellesmere Island. This species is designated as being of Special Concern by both SARA and COSEWIC.
- Peary Caribou – Barren-ground caribou that is distributed across the Canadian Arctic Archipelago. Threats to the population are associated with over hunting and extreme weather events which may make foraging difficult. It is designated as endangered by SARA and Threatened by COSEWIC.
- Wolverine – Found in the Canadian Arctic but a very low density on Ellesmere Island. . Has a slow reproductive rate and needs a large undisturbed range for a stable population. Designated as Special Concern from SARA and COSEWIC.
- Polar Bear – Polar bears have been observed at a distance (5.6 km) from the HAWS and are present throughout the Canadian Arctic. They rely on land fast ice to access ringed seals that are their major food source. Designated as Special Concern from SARA and COSEWIC.

5.0 Data Summaries

This section provides an overall summary of the available data in soils, surface water, sediments and drinking water across the entire HAWS. The summaries include data from 2008 to 2019. Data for background areas are also summarized.

Values below the Method Detection Limit (MDL) were converted to ½ the MDL before calculating summary statistics (e.g., average and standard deviation). Antweiler (2015) and (Ogden 2010) indicate that, for datasets with a low degree of "censoring" (i.e., less than 25% of measurements below the MDL) and a total number of observations between 20 and 100, the substitution of non-detects with a value of ½ the MDL shows "fairly modest bias in the 95th percentile or the mean, and the imprecisions of these estimates are only slightly worse than the optimum method of data treatment" (Ogden 2010).

5.1 Summary of Previous Investigations

In order to complete the risk assessment a number of different reports which provide data, background material and summaries of studies conducted for the Eureka HAWS were reviewed. As part of the review it was assumed that data collected prior to 2010 were captured in the 2011 risk assessment (Franz/Senes 2011). Historical data for areas around the Airstrip which are under the control of DND and not used within the previous risk assessment were also reviewed. Reports and figures associated with the planned new water reservoir were also reviewed. The reports that were reviewed (in chronological order) are:

- National Research Council Canada 2008. *Detailed Characterization and Econet Update of Multiple Sites at CFS Eureka and CFS Alert, Nunavut. Volume 3 – CFS-Eureka.* (NRCC 2008)
- Franz Environmental Inc. 2010. *Phase II Environmental Site Assessment Eureka High Arctic Weather Station, Nunavut Canada.* January. (Franz 2010)
- Franz Environmental Inc. and SENES Consultants Limited 2013. *2012 Supplemental Investigation Eureka High Arctic Weather Station, Nunavut.* (Franz/SENES 2013a)
- Franz Environmental Inc. and SENES Consultants Limited 2013. *Remedial Action Plan Eureka High Arctic Weather Station.* (Franz/SENES 2013b)
- Franz Environmental Inc. and SENES Consultants Limited 2013. *Long-Term Monitoring Plan AEC A, Eureka High Arctic Weather Station.* (Franz/SENES 2013c)
- Franz Environmental Inc. and SENES Consultants Limited 2013. *Remediation Planning and Remedial Action Plan-Feasibility Study, Eureka High Arctic Weather Station FY12/13*. (Franz/SENES 2013d)
- AECOM 2013. *Demolition Waste Audit for Select Buildings and Infrastructure Environment Canada Eureka High Arctic Weather Station, Nunavut.* April. (AECOM 2013)
- Worley Parsons 2013. *Consulting Services-Water Reservoir- Eureka Station, Eureka NU.* June. (Worley Parson 2013)
- Franz Environmental Inc. and SENES Consultants Limited 2014. *Eureka High Arctic Weather Station Long-term Monitoring Program 2013 – Year 1.* (Franz/SENES 2014)

- SENES Consultants Limited and ARCADIS Canada Inc. 2014. *Subsurface Investigation, Fuel Pipeline, Eureka, NU*. (SENES/ARCADIS 2014)
- ARCADIS Canada Inc. 2016. *Environmental Impact Assessment.* (ARCADIS 2016)
- ARCADIS Canada Inc. 2017. *Eureka High Arctic Weather Station and Airstrip 2015 Long-Term Monitoring Program 2013 – Year 3.* (ARCADIS 2017)
- Dillon-Outcome Joint Venture (JV) 2018. *Long-Term Monitoring Program Eureka High Arctic Weather Station and Airstrip.* (Dillon/Outcome 2018)
- Quantum Murray 2019. *Eureka High Arctic Weather Station, Building 17 Remediation Program, Ellesmere Island, Nunavut, CA.* (Quantum Murray 2019)
- Dillon-Outcome JV 2020. *Long-Term Monitoring Program Eureka High Arctic Weather Station and Airstrip.* (Dillon/Outcome 2020a)
- Dillon-Outcome JV 2020. *Risk Review and Remedial Action Plan – Drainage Pond Area.* (Dillon/Outcome 2020b)

The documents above were reviewed with respect to environmental data for indoor air, surface water, drinking water, sediment, soil, vapour migration, and data were summarized. The data were input into a useable database format. Available data were summarized from 2008 to 2019. During this time period it is expected that metal concentrations would not change; however it is likely that organic chemicals would undergo weathering and concentrations will decrease.

Background samples were collected in 2008, 2009, 2010 and 2012. In 2012, a targeted background sampling program was conducted to try to obtain a sufficient number of samples to provide a reliable representation of background conditions (Franz/SENES 2013a).

Additional data collected at the site in 2021 were also considered in the assessment.

5.2 Soil Data

Soil samples were summarized from across the HAWS site including the Airstrip area. Table 1 provides the summary statistics for soil samples collected at the HAWS site from 2008 to 2021.

Table 1. Summary Statistics for Soil Samples at Eureka HAWS

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Metals						
Aluminum	116	0	2400	5082	9800	1671
Antimony	301	203	<0.2	0.27	2.5	0.23
Arsenic	301	0	2.6	11.1	32	4.0
Barium	301	0	14	44.2	138	22.1
Beryllium	301	138	<0.4	0.51	1	0.19
Bismuth	116	114	<0.1	0.48	0.50	0.08
Boron	111	3	<5	9.8	27	4.6
Cadmium	301	239	<0.05	0.16	0.94	0.12
Calcium	116	0	720	4006	15000	2865
Chromium	301	0	4.2	17.3	72	9.4

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Cobalt	301	0	2.5	9.0	20	2.6
Copper	301	0	6.1	26.8	1040	76.9
Iron	116	0	13000	27961	51000	8153
Lead	306	7	<0.3	13.5	310	22.4
Magnesium	116	0	1000	2820	9800	1293
Manganese	116	0	68	288	550	93.3
Mercury	301	171	<0.05	0.049	0.37	0.037
Molybdenum	301	78	<0.4	1.2	3.2	0.62
Nickel	301	0	6.6	22.1	65	7.8
Phosphorus	116	0	200	434	790	106
Potassium	116	0	300	1003	2000	371
Selenium	301	140	<0.05	0.42	1.1	0.21
Silver	301	291	0.051	0.35	1.6	0.21
Sodium	116	2	<50	659	7630	1139
Strontium	116	1	<10	31.2	80	15.9
Thallium	301	216	<0.05	0.28	0.5	0.20
Tin	301	289	0.14	1.8	20	1.5
Uranium	301	179	0.25	0.77	1.7	0.26
Vanadium	301	0	9.3	34.4	68	9.9
Zinc	301	0	19	68.0	1570	124
BTEX						
Benzene	165	140	<0.005	0.012	0.73	0.065
Toluene	165	104	<0.01	0.12	2.5	0.44
Ethylbenzene	165	112	<0.01	0.14	3.9	0.57
Xylenes	165	105	<0.02	1.3	27	4.6
Petroleum Hydrocarbons (PHCs)						
PHC F1 (C_6-C_{10})	207	158	<5	81.1	2100	229
PHC F2 (C_{10}-C_{16})	456	168	<10	2045	51000	4636
PHC F3 (C_{16}-C_{34})	456	137	<50	309	5800	658
PHC F4 (C_{34}-C_{50})	456	370	<50	64.9	2300	200
Polycyclic Aromatic Hydrocarbons (PAHs)						
1-methylnaphthalene	86	29	<0.005	1.3	25	5.0
2-methylnaphthalene	136	25	<0.005	2.1	56	8.7
Acenaphthene	112	91	<0.005	0.041	0.68	0.13
Acenaphthylene	112	100	<0.005	0.020	0.31	0.056
Acridine	103	88	<0.01	0.023	0.41	0.059
Anthracene	112	93	<0.004	0.013	0.67	0.042
Benzo(a)anthracene	136	74	<0.005	0.012	0.18	0.024
Benzo(a)pyrene	136	80	<0.005	0.009	0.07	0.009
Benzo(b&j)fluoranthene	136	20	<0.005	0.023	0.13	0.024
Benzo(g,h,i)perylene	112	8	<0.005	0.020	0.074	0.015
Benzo(k)fluoranthene	136	104	<0.005	0.0055	0.035	0.0053
Chrysene	112	51	<0.005	0.013	0.2	0.024
Dibenzo(a,h)anthracene	136	127	<0.005	0.004	0.025	0.003
Fluoranthene	112	25	<0.005	0.045	1.2	0.14
Fluorene	112	62	<0.005	0.062	0.97	0.18
Indeno(1,2,3-c,d)pyrene	136	75	<0.005	0.013	0.65	0.055

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Naphthalene	136	49	<0.005	1.1	31	5.0
Perylene	103	1	0.013	0.17	0.79	0.17
Phenanthrene	136	11	<0.01	0.093	2.9	0.27
Pyrene	136	21	<0.005	0.044	0.85	0.09
Quinoline	131	129	<0.01	0.036	0.95	0.12
Polychlorinated Biphenyls (PCBs)						
Aroclor 1016	22	22	<0.01	-	-	-
Aroclor 1221	22	22	<0.01	-	-	-
Aroclor 1232	22	22	<0.01	-	-	-
Aroclor 1242	22	22	<0.01	-	-	-
Aroclor 1248	22	22	<0.01	-	-	-
Aroclor 1254	22	20	<0.01	0.017	0.16	0.039
Aroclor 1260	22	21	<0.01	0.005	0.01	0.001
Aroclor 1262	22	22	<0.01	-	-	-
Aroclor 1268	22	22	<0.01	-	-	-
Total PCBs	22	20	<0.05	0.035	0.16	0.034

Notes: N – number of samples. Values are in mg/kg. Measurements below the MDL were set equal to ½ MDL for calculation of summary statistics.

5.2.1 Background Soil Data

Background samples were collected in 2008, 2009, 2010 and 2012 north of the HAWS around the Station Creek area. The statistics for the background soil samples are shown in Table 2. Background soil data are only available for metals.

Table 2. Summary of Background Soil Data at the Eureka HAWS

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Metals						
Aluminum	13	0	1700	8662	25000	6325
Antimony	13	13	<0.2	-	-	-
Arsenic	13	0	2.5	8.7	17	4.4
Barium	13	0	19	49.5	130	35.8
Beryllium	13	3	<0.4	0.49	0.94	0.25
Bismuth	13	13	<1	-	-	-
Boron	13	0	2.2	9.5	22	5.5
Cadmium	13	11	<0.1	0.058	0.1	0.019
Calcium	13	0	2000	5785	20000	5411
Chromium	13	0	4.4	12.1	20	5.0
Cobalt	13	0	4.7	10.2	25	6.8
Copper	13	0	5.7	18.9	28	5.6
Iron	13	0	8700	30208	51000	14728
Lead	13	0	2.1	7.8	12	2.9
Magnesium	13	0	1600	4262	13000	3723
Manganese	13	0	80	324	670	194
Mercury	13	11	<0.05	0.032	0.073	0.016
Molybdenum	13	2	<0.4	0.81	1.6	0.42

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Nickel	13	0	9.4	19.7	29	5.8
Phosphorus	13	0	190	641	2000	525
Potassium	13	0	330	1537	4400	1208
Selenium	13	10	<0.5	0.33	0.82	0.18
Silver	13	13	<0.2	-	-	-
Sodium	13	0	57	1531	5100	1850
Strontium	13	0	15	41.4	76	23.2
Thallium	13	13	<0.05	-	-	-
Tin	13	13	<0.3	-	-	-
Uranium	13	12	0.41	0.49	0.41	0.025
Vanadium	13	0	13	44.8	140	37.7
Zinc	13	0	24	45.8	60	10.9

Notes: N – number of samples. Values are in mg/kg. Measurements below the MDL were set equal to ½ MDL for calculation of summary statistics.

5.3 Surface Water Data

Surface water samples have been collected at the Drainage Pond and the Stream. The summary statistics for these samples are provided in Table 3. A number of contaminants such as mercury, tungsten, zirconium, BTEX, and Petroleum Hydrocarbon (PHC) fractions are measured at the MDLs. Only five Polycyclic Aromatic Hydrocarbons (PAHs) are measured in surface water (acenaphthene, fluoranthene, fluorene, naphthalene, and phenanthrene).

Table 3. Summary Statistics for Surface Water Samples at Eureka HAWS

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Metals						
Aluminum	47	4	<0.01	0.059	0.288	0.071
Antimony	47	31	$<2.0\times10^{-5}$	1.4×10^{-4}	4.5×10^{-4}	1.2×10^{-4}
Arsenic	47	7	$<1.0\times10^{-4}$	6.3×10^{-4}	0.002	6.1×10^{-4}
Barium	47	0	0.0158	0.021	0.043	0.0043
Beryllium	47	45	$<1.0\times10^{-5}$	1.4×10^{-5}	2.0×10^{-5}	9.4×10^{-6}
Bismuth	5	4	$<5.0\times10^{-5}$	2.2×10^{-4}	0.001	4.4×10^{-4}
Boron	47	0	0.082	0.13	0.51	0.077
Cadmium	47	34	$<5.0\times10^{-5}$	0.0026	0.045	0.0075
Calcium	47	0	99.5	147	360	44
Chromium	47	29	$<1.0\times10^{-4}$	0.0011	0.006	0.0015
Cobalt	47	25	$<5.0\times10^{-5}$	3.0×10^{-4}	4.2×10^{-4}	4.0×10^{-4}
Copper	47	3	$<1.0\times10^{-4}$	0.0012	0.0025	7.0×10^{-4}
Iron	47	0	0.0655	0.37	1.97	0.35
Lead	47	20	$<5.0\times10^{-5}$	1.6×10^{-4}	9.1×10^{-4}	2.0×10^{-4}
Lithium	47	0	0.022	0.030	0.081	0.01
Magnesium	47	0	61.4	90.8	430	59.6
Manganese	47	0	0.0045	0.094	0.25	0.060
Mercury	12	12	$<1.0\times10^{-5}$	-	-	-

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Molybdenum	47	24	$<1.0x10^{-4}$	$7.3x10^{-4}$	$9.5x10^{-4}$	0.001
Nickel	47	5	$<1.0x10^{-4}$	0.0014	0.0032	$8.4x10^{-4}$
Phosphorus	23	15	<0.005	0.023	0.039	0.022
Potassium	47	0	7.3	11.2	74	11.1
Selenium	47	21	$<2.0x10^{-4}$	$2.8x10^{-4}$	$7.8x10^{-4}$	$3.3x10^{-4}$
Silicon	36	1	<0.1	0.62	1.3	0.30
Silver	47	45	$<5.0x10^{-6}$	$4.1x10^{-5}$	$2.3x10^{-4}$	$6.3x10^{-5}$
Sodium	47	0	157	277	2100	319
Strontium	36	0	0.407	0.59	1.90	0.27
Sulphur	30	1	$<1.0x10^{-4}$	169	447	82
Thallium	47	24	$<5.0x10^{-6}$	$3.4x10^{-5}$	$1.2x10^{-4}$	$4.1x10^{-5}$
Tin	47	46	$<1.0x10^{-4}$	0.006	$2.7x10^{-4}$	0.011
Titanium	47	27	$<5.0x10^{-4}$	0.0014	0.0072	0.0017
Tungsten	5	5	$<1.0x10^{-4}$	-	-	-
Uranium	47	0	$3.3x10^{-4}$	$4.6x10^{-4}$	0.0016	$2.2x10^{-4}$
Vanadium	47	39	$<2.0x10^{-4}$	$4.4x10^{-4}$	0.002	$4.4x10^{-4}$
Zinc	47	18	$<5.0x10^{-4}$	0.0066	0.027	0.007
Zirconium	5	5	$<1.0x10^{-4}$	-	-	-
BTEX						
Benzene	34	34	<0.0002	-	-	-
Toluene	34	34	<0.0002	-	-	-
Ethylbenzene	34	34	<0.0002	-	-	-
Xylenes	34	34	<0.0004	-	-	-
Petroleum Hydrocarbons (PHCs)						
PHC F1 (C_6-C_{10})	39	39	<0.025	-	-	-
PHC F2 (C_{10}-C_{16})	39	39	<0.05	-	-	-
PHC F3 (C_{16}-C_{34})	24	24	<0.05	-	-	-
PHC F4 (C_{34}-C_{50})	24	24	<0.05	-	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)						
Acenaphthene	5	4	$<1.0x10^{-5}$	$8.8x10^{-6}$	$2.4x10^{-5}$	$8.5x10^{-6}$
Acridine	5	5	$<1.0x10^{-5}$	-	-	-
Anthracene	5	5	$<1.0x10^{-5}$	-	-	-
Benzo(a)anthracene	5	5	$<1.0x10^{-5}$	-	-	-
Benzo(a)pyrene	5	5	$<1.0x10^{-5}$	-	-	-
Benzo(b&j)fluoranthene	5	5	$<1.0x10^{-5}$	-	-	-
Benzo(k)fluoranthene	5	5	$<1.0x10^{-5}$	-	-	-
Chrysene	5	5	$<1.0x10^{-5}$	-	-	-
Dibenzo(a,h)anthracene	5	5	$<1.0x10^{-5}$	-	-	-
Fluoranthene	5	3	$<1.0x10^{-5}$	$9.6x10^{-6}$	$2.0x10^{-5}$	$6.8x10^{-6}$
Fluorene	5	3	$<1.0x10^{-5}$	$1.2x10^{-5}$	$2.8x10^{-5}$	$1.0x10^{-5}$
Indeno(1,2,3-c,d)pyrene	5	5	$<1.0x10^{-5}$	-	-	-
Naphthalene	5	4	$<1.0x10^{-5}$	$1.2x10^{-5}$	$4.1x10^{-5}$	$1.6x10^{-5}$
Phenanthrene	5	2	$<1.0x10^{-5}$	$3.2x10^{-5}$	$7.8x10^{-5}$	$3.3x10^{-5}$
Pyrene	5	5	$<1.0x10^{-5}$	-	-	-
Quinoline	5	5	$<1.0x10^{-5}$	-	-	-

Notes: N – number of samples. Values are in mg/L. Measurements below the MDL were set equal to ½ MDL for calculation of summary statistics.

5.3.1 Background Surface Water Data

Background surface water samples were collected in 2008, 2009, 2010 and 2012 from Blacktop Creek. The statistics for the background surface water samples are shown in Table 4. Antimony, beryllium, tin, PHCs, and PAHs are measured at the MDLs.

Table 4. Summary of Background Surface Water Data at the HAWS

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Metals						
Aluminum	13	0	0.092	2	4.7	2
Antimony	13	13	$<1.0x10^{-4}$	-	-	-
Arsenic	13	1	$<1.0x10^{-4}$	0.0018	0.0067	0.0019
Barium	13	0	0.033	0.049	0.064	0.0077
Beryllium	13	13	$<5.0x10^{-5}$	-	-	-
Boron	13	2	<0.05	0.043	0.058	0.011
Cadmium	13	6	$<5.0x10^{-6}$	$6.1x10^{-5}$	$1.3x10^{-4}$	$5.3x10^{-5}$
Calcium	13	0	113	147	210	39
Chromium	13	7	$<5.0x10^{-4}$	0.0027	0.0092	0.0025
Cobalt	13	5	$<5.0x10^{-5}$	0.0059	0.014	0.0061
Copper	13	1	$<1.0x10^{-4}$	0.0075	0.02	0.0073
Iron	13	0	0.065	4	15	4
Lead	13	5	$<5.0x10^{-5}$	0.0027	0.0083	0.0028
Lithium	13	10	0.01	0.011	0.013	0.0012
Magnesium	13	0	39	58	93	24
Manganese	13	0	0.0108	0.17	0.4	0.18
Molybdenum	13	10	$<1.0x10^{-4}$	$5.5x10^{-4}$	$8.7x10^{-4}$	$8.9x10^{-4}$
Nickel	13	0	0.002	0.014	0.034	0.013
Phosphorus	13	5	<0.005	0.18	0.43	0.15
Potassium	13	0	3	4.2	5.8	1.1
Selenium	13	1	$<2.0x10^{-4}$	0.0014	0.0023	$7.7x10^{-4}$
Silicon	13	0	0.83	2.5	7.1	1.9
Silver	13	12	$<1.0x10^{-5}$	$5.7x10^{-5}$	$1.9x10^{-4}$	$4.2x10^{-5}$
Sodium	13	0	57	88	170	48
Strontium	13	0	0.36	0.5	0.83	0.2
Sulphur	13	0	110	170	250	69
Thallium	13	12	$<5.0x10^{-6}$	$9.1x10^{-5}$	$1.3x10^{-4}$	$3.2x10^{-5}$
Tin	13	13	$<1.0x10^{-4}$	-	-	-
Titanium	13	1	$<5.0x10^{-4}$	0.029	0.09	0.026
Uranium	13	0	$7.0x10^{-4}$	0.0011	0.0014	$2.4x10^{-4}$
Vanadium	13	5	$<5.0x10^{-4}$	0.007	0.024	0.0075
Zinc	13	3	$<5.0x10^{-4}$	0.33	2.4	0.6
Petroleum Hydrocarbons (PHCs)						
PHC F1 (C_6-C_{10})	2	2	<0.1	-	-	-
PHC F2 (C_{10}-C_{16})	2	2	<0.25	-	-	-
PHC F3 (C_{16}-C_{34})	2	2	<0.25	-	-	-

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
PHC F4 (C_{34}-C_{50})	2	2	<0.25	-	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)						
Acenaphthene	2	2	$<1.0\times10^{-5}$	-	-	-
Acridine	2	2	$<1.0\times10^{-5}$	-	-	-
Anthracene	2	2	$<1.0\times10^{-5}$	-	-	-
Benzo(a)anthracene	2	2	$<1.0\times10^{-5}$	-	-	-
Benzo(a)pyrene	2	2	$<1.0\times10^{-5}$	-	-	-
Benzo(b&j)fluoranthene	2	2	$<1.0\times10^{-5}$	-	-	-
Benzo(k)fluoranthene	2	2	$<1.0\times10^{-5}$	-	-	-
Chrysene	2	2	$<1.0\times10^{-5}$	-	-	-
Dibenzo(a,h)anthracene	2	2	$<1.0\times10^{-5}$	-	-	-
Fluoranthene	2	2	$<1.0\times10^{-5}$	-	-	-
Fluorene	2	2	$<1.0\times10^{-5}$	-	-	-
Indeno(1,2,3-c,d)pyrene	2	2	$<1.0\times10^{-5}$	-	-	-
Naphthalene	2	2	$<1.0\times10^{-5}$	-	-	-
Phenanthrene	2	2	$<1.0\times10^{-5}$	-	-	-
Pyrene	2	2	$<1.0\times10^{-5}$	-	-	-
Quinoline	2	2	$<1.0\times10^{-5}$	-	-	-

Notes: N – number of samples. Values are in mg/L. Measurements below the MDL were set equal to ½ MDL for calculation of summary statistics.

5.4 Sediment Data

Sediment samples in the Drainage Pond and stream have been collected since 2008. Additional data from 2021 is included in the summary statistics for the sediment samples provided in Table 5. Bismuth, silver and tin are measured at the MDLs. Aroclor 1254 is the only PCB measured above the MDL in sediments.

Table 5. Summary Statistics for Sediment Samples at Eureka HAWS

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Metals						
Aluminum	48	0	1300	5308	12000	2247
Antimony	64	41	<0.2	0.23	0.57	0.15
Arsenic	64	0	1.0	10.3	22.2	4.1
Barium	64	0	11	38.6	74	13.8
Beryllium	64	16	<0.2	0.46	0.91	0.18
Bismuth	48	48	<1.0	-	-	-
Boron	48	7	<5	9.6	26	4.9
Cadmium	64	57	<0.1	0.085	0.25	0.073
Calcium	48	0	280	6166	14000	3164
Chromium	64	0	2	14.8	49	8.9
Cobalt	64	0	1.7	8.7	15	3.2
Copper	64	0	1.8	16.8	29	6.9
Iron	48	0	7800	25935	60000	10114
Lead	64	0	2.00	9.9	17	3.5

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Magnesium	48	0	2000	3419	5900	943
Manganese	48	0	130	505	1900	368
Mercury	64	39	<0.05	0.043	0.165	0.027
Molybdenum	64	14	<0.5	0.87	2.4	0.44
Nickel	64	0	4.9	21.3	43	8.8
Phosphorus	48	0	48	397	1100	168
Potassium	49	2	<200	1033	2300	552
Selenium	63	45	<0.5	0.34	0.7	0.14
Silver	63	63	<0.2	-	-	-
Sodium	48	1	<50	384	1500	286
Strontium	48	1	<10	30.6	49	9.1
Thallium	64	30	<0.05	0.16	0.5	0.15
Tin	64	64	<1	-	-	-
Uranium	64	19	0.11	0.58	1	0.25
Vanadium	64	0	5	29.5	51	10.5
Zinc	64	0	13	74.0	340	56.1
BTEX						
Benzene	80	56	<0.005	0.064	1.2	0.19
Toluene	80	63	<0.02	0.027	0.4	0.055
Ethylbenzene	80	51	<0.01	0.71	16	2.5
Xylenes	80	49	<0.02	0.94	20	3.2
Petroleum Hydrocarbons (PHCs)						
PHC F1 (C_6-C_{10})	80	50	<5	154	5900	728
PHC F2 (C_{10}-C_{16})	80	17	<10	1606	19000	3814
PHC F3 (C_{16}-C_{34})	80	17	<50	333	4200	593
PHC F4 (C_{34}-C_{50})	80	58	<50	39.0	270	45.5
Polycyclic Aromatic Hydrocarbons (PAHs)						
1-methylnaphthalene	60	1	<0.005	1.9	55	7.6
2-methylnaphthalene	73	4	<0.005	2.4	100	12.1
Acenaphthene	52	28	<0.005	0.050	0.89	0.15
Acenaphthylene	52	40	<0.005	0.015	0.24	0.042
Acridine	41	34	<0.01	0.022	0.23	0.056
Anthracene	52	46	<0.004	0.0056	0.052	0.011
Benzo(a)anthracene	73	49	<0.005	0.0052	0.017	0.0032
Benzo(a)pyrene	73	50	<0.005	0.006	0.11	0.013
Benzo(b&j)fluoranthene	73	22	<0.005	0.013	0.052	0.010
Benzo(g,h,i)perylene	52	10	<0.005	0.016	0.041	0.010
Benzo(k)fluoranthene	73	72	<0.005	0.0031	0.0075	0.0012
Chrysene	52	24	<0.005	0.008	0.032	0.0063
Dibenzo(a,h)anthracene	73	71	<0.005	0.0032	0.0075	0.0013
Fluoranthene	52	15	<0.005	0.013	0.04	0.010
Fluorene	52	19	<0.005	0.067	0.93	0.17
Indeno(1,2,3-c,d)pyrene	73	47	<0.005	0.0053	0.015	0.0031
Naphthalene	73	4	<0.005	1.1	44	5.4
Perylene	41	1	<0.005	0.12	0.38	0.10
Phenanthrene	73	3	<0.005	0.074	0.43	0.089
Pyrene	73	12	<0.005	0.023	0.081	0.019

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Quinoline	56	52	<0.005	0.048	1.5	0.21
Polychlorinated Biphenyls (PCBs)						
Aroclor 1016	3	3	<0.01	-	-	-
Aroclor 1221	3	3	<0.01	-	-	-
Aroclor 1232	3	3	<0.01	-	-	-
Aroclor 1242	3	3	<0.01	-	-	-
Aroclor 1248	3	3	<0.01	-	-	-
Aroclor 1254	3	2	<0.01	0.01	0.2	0.009
Aroclor 1260	3	3	<0.01	-	-	-
Aroclor 1262	3	3	<0.01	-	-	-
Aroclor 1268	3	3	<0.01	-	-	-
Total PCBs	3	3	<0.05	-	-	-

Notes: N – number of samples. Values are in mg/kg. Measurements below the MDL were set equal to ½ MDL for calculation of summary statistics.

5.4.1 Background Sediment Data

Background sediment samples were collected in 2008, 2009, 2010 and 2012 from Blacktop Creek. The statistics for the background sediment samples are shown in Table 6. Bismuth, silver, tin, BTEX, and PHCs are measured at the MDLs. 1-methylnaphthalene and 2-methylnaphthalene are the only two PAHs measured above the MDLs.

Table 6. Summary of Background Sediment Data at the HAWS

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Metals						
Aluminum	11	0	3700	7418	13000	3119
Antimony	13	11	<0.2	0.48	0.63	0.12
Arsenic	13	0	6.1	12.6	29	6.5
Barium	13	0	28	44.0	67	12.1
Beryllium	13	2	0.3	0.67	1.2	0.29
Bismuth	11	11	<1	-	-	-
Boron	11	1	<5	11.5	18	4.8
Cadmium	13	9	<0.1	0.11	0.21	0.079
Calcium	11	0	3400	6627	9800	2308
Chromium	13	0	11	16.7	27	5.6
Cobalt	13	0	5.9	9.4	13.4	2.9
Copper	13	0	16	26.9	37	7.5
Iron	11	0	16000	23636	34000	5732
Lead	13	0	7.4	11.5	16.8	3.1
Magnesium	11	0	2600	3964	5300	887
Manganese	11	0	130	222	300	59.3
Mercury	13	10	<0.05	0.046	0.158	0.045
Molybdenum	13	0	0.7	1.51	4.6	1.11
Nickel	13	0	17	24.8	35.1	6.4
Phosphorus	11	0	280	412	630	127

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Potassium	11	0	690	1293	2000	438
Selenium	13	7	<0.5	0.47	1.2	0.31
Silver	13	13	<0.2	-	-	-
Sodium	11	6	<50	106	250	99
Strontium	11	0	18	49.4	83	20.8
Thallium	13	12	0.07	0.20	0.07	0.14
Tin	13	13	<1	-	-	-
Uranium	13	9	<1	0.71	1	0.25
Vanadium	13	0	18	38.6	98	21.8
Zinc	13	0	37	56.2	76	10.7
BTEX						
Benzene	3	3	<0.002	-	-	-
Toluene	3	3	<0.002	-	-	-
Ethylbenzene	3	3	<0.002	-	-	-
Xylenes	3	3	<0.002	-	-	-
Petroleum Hydrocarbons (PHCs)						
PHC F1 (C_6-C_{10})	3	3	<10	-	-	-
PHC F2 (C_{10}-C_{16})	3	3	<10	-	-	-
PHC F3 (C_{16}-C_{34})	3	3	<10	-	-	-
PHC F4 (C_{34}-C_{50})	3	3	<10	-	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)						
1-methylnaphthalene	1	0	0.014	0.014	0.014	-
2-methylnaphthalene	1	0	0.019	0.019	0.019	-
Benzo(a)anthracene	1	1	<0.005	-	-	-
Benzo(a)pyrene	1	1	<0.005	-	-	-
Benzo(b&j)fluoranthene	1	1	<0.005	-	-	-
Benzo(k)fluoranthene	1	1	<0.005	-	-	-
Dibenzo(a,h)anthracene	1	1	<0.005	-	-	-
Indeno(1,2,3-c,d)pyrene	1	1	<0.005	-	-	-
Naphthalene	1	0	0.011	0.011	0.011	-
Phenanthrene	1	0	0.016	0.016	0.016	-
Pyrene	1	0	0.009	0.009	0.009	-

Notes: N – number of samples. Values are in mg/kg. Measurements below the MDL were set equal to ½ MDL for calculation of summary statistics.

5.5 Drinking Water Data

The Drinking Water Reservoir is the source of the drinking water supply for the station. It is replenished yearly by pumping water from the nearby Station Creek during spring run-off. The reservoir is unlined and water may be seeping from this area into the adjacent Drainage Pond. Drinking water samples from the drinking water reservoir were collected in 2008, 2009, 2010 and 2019. Summary Statistics for the drinking water samples are presented in Table 7. Antimony, beryllium, bismuth, mercury, silver, tin, tungsten, PHCs, and PCBs are measured below the MDLs. Fluoranthene, naphthalene, and phenanthrene were measured in the two pumphouse samples in 2008.

Table 7. Summary Statistics for Drinking Water Samples at Eureka HAWS

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Metals						
Aluminum	7	0	0.048	0.18	0.76	0.26
Antimony	7	7	<1.0x10^{-4}	-	-	-
Arsenic	7	1	<1.0x10^{-4}	3.5x10^{-4}	6.0x10^{-4}	2.6x10^{-4}
Barium	7	0	0.015	0.018	0.020	0.0018
Beryllium	7	7	<5.0x10^{-5}	-	-	-
Bismuth	3	3	<5.0x10^{-5}	-	-	-
Boron	7	4	<0.05	0.032	0.042	0.0086
Cadmium	7	4	1.0x10^{-5}	4.0x10^{-5}	1.0x10^{-5}	4.2x10^{-5}
Calcium	7	0	49.8	59	63.4	6
Chromium	7	5	<5.0x10^{-4}	0.0030	0.008	0.0033
Cobalt	7	5	<5.0x10^{-5}	5.9x10^{-4}	8.0x10^{-5}	5.1x10^{-4}
Copper	7	0	0.0004	0.0023	0.011	0.0039
Iron	7	0	0.056	0.18	0.48	0.15
Lead	7	0	0.00	4.7x10^{-4}	0.0026	9.4x10^{-4}
Lithium	7	2	<0.01	0.008	0.01	0.0023
Magnesium	7	0	21.1	25.1	27.6	2.8
Manganese	7	0	0.0073	0.012	0.019	0.004
Mercury	7	7	<1.0x10^{-5}	-	-	-
Molybdenum	7	4	1.0x10^{-4}	0.0015	1.0x10^{-4}	0.0013
Nickel	7	2	0.001	0.0037	0.017	0.0059
Phosphorus	3	0	0.005	0.007	0.009	0.002
Potassium	7	0	2.65	3.2	3.6	0.4
Selenium	7	2	4.0x10^{-4}	5.9x10^{-4}	5.0x10^{-4}	2.9x10^{-4}
Silicon	3	0	0.368	0.37	0.375	0.0036
Silver	7	7	<1.0x10^{-5}	-	-	-
Sodium	7	0	38.7	48.8	56.3	7.6
Strontium	3	0	0.27	0.27	0.27	0.002
Thallium	7	6	<5.0x10^{-6}	3.0x10^{-5}	1.0x10^{-5}	2.5x10^{-5}
Tin	7	7	<1.0x10^{-4}	-	-	-
Titanium	7	1	<5.0x10^{-4}	0.0014	0.003	0.0011
Tungsten	3	3	<1.0x10^{-4}	-	-	-
Uranium	7	0	3.0x10^{-4}	3.3x10^{-4}	4.0x10^{-4}	3.4x10^{-5}
Vanadium	7	5	<5.0x10^{-4}	9.6x10^{-4}	0.003	0.001
Zinc	7	3	<5.0x10^{-4}	0.019	0.12	0.044
Zirconium	3	1	<1.0x10^{-4}	8.3x10^{-5}	1.0x10^{-4}	2.9x10^{-5}
Petroleum Hydrocarbons (PHCs)						
PHC F1 (C_6-C_{10})	4	4	<0.1	-	-	-
PHC F2 (C_{10}-C_{16})	4	4	<0.05	-	-	-
PHC F3 (C_{16}-C_{34})	4	4	<0.05	-	-	-
PHC F4 (C_{34}-C_{50})	4	4	<0.05	-	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)						
Acenaphthene	4	4	<1.0x10^{-5}	-	-	-
Acridine	4	4	<1.0x10^{-5}	-	-	-
Anthracene	4	4	<1.0x10^{-5}	-	-	-

Contaminant	N	N<MDL	Minimum	Average	Maximum	Standard Deviation
Benzo(a)anthracene	4	4	$<1.0x10^{-5}$	-	-	-
Benzo(a)pyrene	4	4	$<1.0x10^{-5}$	-	-	-
Benzo(b&j)fluoranthene	4	4	$<1.0x10^{-5}$	-	-	-
Benzo(k)fluoranthene	4	4	$<1.0x10^{-5}$	-	-	-
Chrysene	4	4	$<1.0x10^{-5}$	-	-	-
Dibenzo(a,h)anthracene	4	4	$<1.0x10^{-5}$	-	-	-
Fluoranthene	4	3	$<1.0x10^{-5}$	$7.5x10^{-6}$	$1.0x10^{-5}$	$2.9x10^{-6}$
Fluorene	4	4	$<1.0x10^{-5}$	-	-	-
Indeno(1,2,3-c,d)pyrene	4	4	$<1.0x10^{-5}$	-	-	-
Naphthalene	4	2	$<1.0x10^{-5}$	$2.0x10^{-4}$	$7.7x10^{-4}$	$3.8x10^{-4}$
Phenanthrene	4	2	$<1.0x10^{-5}$	$1.8x10^{-5}$	$3.0x10^{-5}$	$1.4x10^{-5}$
Pyrene	4	4	$<1.0x10^{-5}$	-	-	-
Quinoline	4	4	$<1.0x10^{-5}$	-	-	-
Polychorinated Biphenyls (PCBs)						
Aroclor 1016	2	2	$<2.0x10^{-5}$	-	-	-
Aroclor 1221	2	2	$<2.0x10^{-5}$	-	-	-
Aroclor 1232	2	2	$<2.0x10^{-5}$	-	-	-
Aroclor 1242	2	2	$<2.0x10^{-5}$	-	-	-
Aroclor 1248	2	2	$<2.0x10^{-5}$	-	-	-
Aroclor 1254	2	2	$<2.0x10^{-5}$	-	-	-
Aroclor 1260	2	2	$<2.0x10^{-5}$	-	-	-
Aroclor 1262	2	2	$<2.0x10^{-5}$	-	-	-
Aroclor 1268	2	2	$<2.0x10^{-5}$	-	-	-
Total PCBs	2	2	$<1.0x10^{-4}$	-	-	-

Notes: N – number of samples. Values are in mg/L. Measurements below the MDL were set equal to ½ MDL for calculation of summary statistics.

6.0 Screening for Contaminants of Potential Concern

A tiered process was carried out to identify COPC in soil, surface water, and sediment at the HAWS. The general approach that was followed for selecting the COPC for consideration in the HHERA involved using measured soil, surface water, and sediment concentrations discussed in Section 5.0 using the approach illustrated in Figure 7. Contaminants with the majority of values (i.e., 90% or more) below the MDL were not considered further as they were considered highly censored meaning that the contaminant is not considered to be present at the HAWS. Of the remaining contaminants, maximum measured concentrations were then compared to soil, water, and sediment quality guidelines. A concentration above a guideline does not mean that there is an actual risk to human health or the environment. A comparison to background concentrations was also done. Only contaminants present in soils, surface water, or sediment above guidelines or background were selected to be evaluated in the risk assessment.

6.1 Soil Screening

The soil COPC screen was based on soil concentrations across the HAWS. Most of the maximum concentrations were based on samples collected from 2013 to 2019; however, a number of metal samples had maximum concentrations measured in 2008. The 2008 data were considered to be appropriate for metals as metal concentrations in soil do not decrease due to weathering like organic compounds do over time. Since organic contaminant concentrations can decrease over time as a result of weathering, the concentrations from 2013 to 2019 were considered to be a better representation of the current soil conditions at the HAWS. In the soil screening process, samples at all measured depths were considered. Figure 8 provides the soil sampling locations from 2013 to 2019. The additional soil sampling locations in the Old Tank Farm area are provided in Appendix G.

For the soil COPC screen, the residential/parkland soil guidelines from the Canadian Council of Ministers of the Environment (CCME 2020) were considered appropriate even though the HAWS is a commercial working site. The use of the restrictive residential/parkland criteria ensures that all potential COPC are captured within the screening process. In the absence of CCME guideline values, the generic site condition standards for fine textured soil and residential/parkland land use in a potable water scenario from the Ontario Ministry of the Environment, Conservation and Parks (MOE 2011) were used since the grain size of soils at the HAWS was determined to be fine (Franz/Senes 2011). In the screening process, the Ontario Ministry soil guidelines were used for boron and a number of PAHs (1-methylnaphthalene, 2-methylnaphthalene, acenaphthene, acenaphthylene, benzo(g,h,i)perylene, chrysene, and fluorene). A summary of the soil screening process is shown in Table 8.

Following the screening procedure outlined in Figure 7, the first step of the soil COPC screen identified bismuth, hexavalent chromium, silver, tin, benzo(c)phenanthrene, dibenzo(a,h)anthracene, quinolone, and PCBs as having more than 90% of measurements below the MDL. These contaminants were therefore not considered further.

Table 8. Selection of Contaminants of Potential Concern in Soil for the HHERA

Contaminant	Unit	Guideline (Residential/ parkland)	Background Average	N	N<MDL	Minimum	Maximum	Average	COPC?	Rationale
Aluminum	mg/kg	-	14400	116	0	2400	9800	5082	N	Average ≤ Background average
Antimony	mg/kg	20	0.5	301	203	<0.2	2.5	0.27	N	Max ≤ Guideline
Arsenic	mg/kg	12	10	301	0	2.6	32	11	Y	-
Barium	mg/kg	500	70	301	0	14	138	44	N	Max ≤ Guideline
Beryllium	mg/kg	4	0.5	301	138	<0.4	1.0	0.51	N	Max ≤ Guideline
Bismuth	mg/kg	-	0.5	116	114	<0.1	0.50	0.48	N	Heavily censored (90% or more < MDL)
Boron, total	mg/kg	-	9.5	111	3	<5	27	9.8	Y	-
Boron, hot water soluble	mg/kg	1.5[a]	-	45	0	0.38	4.8	1.2	Y	-
Cadmium	mg/kg	10	0.05	301	239	0.03	0.94	0.16	N	Max ≤ Guideline
Calcium	mg/kg	-	8650	116	0	720	15000	4006	N	Average ≤ Background average
Chromium	mg/kg	64	10	301	0	4.2	72	17	N	Only one sample exceeds the guideline
Chromium, hexavalent	mg/kg		-	45	45	<0.08	<0.08	<0.08	N	Heavily censored (90% or more < MDL)
Cobalt	mg/kg	50	17	301	0	2.5	20	9.0	N	Max ≤ Guideline
Copper	mg/kg	63	18	301	0	6.1	1040	27	Y	-
Iron	mg/kg	-	43500	116	0	13000	51000	27961	N	Average ≤ Background average
Lead	mg/kg	140	6	306	7	0.15	310	14	Y	-
Magnesium	mg/kg	-	6900	116	0	1000	9800	2820	N	Average ≤ Background average
Manganese	mg/kg	-	455	116	0	68	550	288	N	Average ≤ Background average
Mercury	mg/kg	6.6	0.025	301	170	<0.05	0.37	0.05	N	Max ≤ Guideline
Molybdenum	mg/kg	10	0.7	301	78	<0.4	3.2	1.2	N	Max ≤ Guideline
Nickel	mg/kg	45	23	301	0	7	65	22	N	Average ≤ Background average
Phosphorus	mg/kg	-	1095	116	0	200	790	434	N	Average ≤ Background average
Potassium	mg/kg	-	1895	116	0	300	2000	1003	N	Average ≤ Background average
Selenium	mg/kg	1	0.3	301	139	<0.05	1.1	0.42	N	Only one sample exceeds the guideline
Silver	mg/kg	20	0.5	301	291	0.05	1.6	0.35	N	Heavily censored (90% or more < MDL)

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Contaminant	Unit	Guideline (Residential/ parkland)	Background Average	N	N<MDL	Minimum	Maximum	Average	COPC?	Rationale
Sodium	mg/kg	-	2685	116	2	<50	7630	659	N	Average ≤ Background average
Strontium	mg/kg	-	47	116	1	<10	80	30	N	Average ≤ Background average
Thallium	mg/kg	1	0.2	301	215	<0.05	0.50	0.28	N	Max ≤ Guideline
Tin	mg/kg	50	0.5	301	289	0.1	20	1.8	N	Heavily censored (90% or more < MDL)
Uranium	mg/kg	23	0.5	301	179	0.3	1.7	0.77	N	Max ≤ Guideline
Vanadium	mg/kg	130	87	301	0	9	68	34	N	Max ≤ Guideline
Zinc	mg/kg	250	48	301	0	19	1570	68	Y	-
Benzene	mg/kg	0.0068	-	152	129	<0.005	0.7	0.01	Y	-
Toluene	mg/kg	0.08	-	152	96	<0.01	2.5	0.13	Y	-
Ethylbenzene	mg/kg	0.018	-	152	101	<0.01	3.9	0.15	Y	-
Xylenes	mg/kg	2.4	-	152	97	<0.02	27	1.4	Y	-
PHC F1 (C_6-C_{10})	mg/kg	30	-	44	37	<5	2100	86	Y	-
PHC F2 (C_{10}-C_{16})	mg/kg	150	-	394	137	<10	51000	2078	Y	-
PHC F3 (C_{16}-C_{34})	mg/kg	300	-	394	136	<50	5800	330	Y	-
PHC F4 (C_{34}-C_{50})	mg/kg	2800	-	394	350	<50	2300	70	N	Max ≤ Guideline
1-Methylnaphthalene	mg/kg	3.4[a]	-	62	14	<0.005	25	1.8	Y	-
2-Methylnaphthalene	mg/kg	3.4[a]	-	112	9	<0.005	56	2.6	Y	-
Acenaphthene	mg/kg	58[a]	-	112	91	<0.005	0.68	0.04	N	Max ≤ Guideline
Acenaphthylene	mg/kg	0.17[a]	-	112	100	<0.005	0.31	0.02	Y	-
Acridine	mg/kg	-	-	103	88	<0.01	0.41	0.02	Y	No available guideline
Anthracene	mg/kg	2.5	-	112	92	<0.004	0.67	0.01	N	Max ≤ Guideline
Benzo(a)anthracene	mg/kg	1	-	112	55	<0.005	0.18	0.01	N	Max ≤ Guideline
Benzo(a)pyrene	mg/kg	20	-	112	60	<0.005	0.07	0.01	N	Max ≤ Guideline
Benzo(b&j)fluoranthene	mg/kg	1	-	112	8	<0.005	0.13	0.02	N	Max ≤ Guideline
Benzo(c)phenanthrene	mg/kg	-	-	103	100	<0.005	0.025	0.003	N	Heavily censored (90% or more < MDL)
Benzo(g,h,i)perylene	mg/kg	7.8[a]	-	112	8	<0.005	0.074	0.02	N	Max ≤ Guideline
Benzo(k)fluoranthene	mg/kg	1	-	112	80	<0.005	0.035	0.006	N	Max ≤ Guideline
Chrysene	mg/kg	7.8[a]	-	112	51	<0.005	0.2	0.01	N	Max ≤ Guideline

Contaminant	Unit	Guideline (Residential/ parkland)	Background Average	N	N<MDL	Minimum	Maximum	Average	COPC?	Rationale
Dibenzo(a,h)anthracene	mg/kg	1	-	112	102	<0.005	0.025	0.003	N	Heavily censored (90% or more < MDL)
Fluoranthene	mg/kg	50	-	112	25	<0.005	1.2	0.05	N	Max ≤ Guideline
Fluorene	mg/kg	69[a]	-	112	62	<0.005	0.97	0.06	N	Max ≤ Guideline
Indeno(1,2,3-cd)pyrene	mg/kg	1	-	112	53	<0.005	0.65	0.02	N	Max ≤ Guideline
Naphthalene	mg/kg	0.013	-	112	28	<0.005	31	1.2	**Y**	-
Perylene	mg/kg	-	-	103	1	0.013	0.79	0.17	**Y**	No available guideline
Phenanthrene	mg/kg	5	-	112	0	0.006	2.9	0.11	N	-
Pyrene	mg/kg	10	-	112	10	<0.005	0.85	0.05	N	Max ≤ Guideline
Quinoline	mg/kg	-	-	107	106	<0.01	0.95	0.04	N	Heavily censored (90% or more < MDL)
Total PCBs	mg/kg	1.3	-	22	20	<0.1	0.16	0.04	N	Heavily censored (90% or more < MDL)

Notes: Unless otherwise noted, guideline values are from the Canadian Council of Ministers of the Environment (CCME 2020) Residential/Parkland Land Use; values below the MDL were set equal to ½MDL for calculation of summary statistics.
[a] Values are from the Ontario Ministry of the Environment, Conservation and Parks (MOE 2011) Soil, ground water and sediment standards for use under Part XV.1 of the Environmental Protection Act. Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition, Residential/parkland/institutional land use, fine-medium textured soil.

The second step involved comparison of maximum measured concentrations from the Eureka HAWS to CCME residential/parkland guidelines. As shown in Table 8, this step results in a number of contaminants with maximum measured concentrations below the guidelines indicating that these contaminants are not a cause for concern at the Eureka HAWS. Thus antimony, barium, beryllium, cadmium, cobalt, mercury, molybdenum, thallium, uranium, vanadium, PHC F4, acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene are not a concern at the HAWS site. There is only 1 out of the 302 chromium and selenium samples where the guideline was exceeded and thus chromium and selenium have been judged not to be a cause for concern at the Eureka HAWS.

The third step was the comparison of the average of measured concentrations to average background soil concentrations. The average background soil concentrations are summarized in Table 2. The comparison of the average concentrations results in the comparison of similar dataset statistics. This step of the process identified that aluminium, calcium, iron, magnesium, manganese, nickel, phosphorus, potassium, sodium, and strontium are all at background levels.

The COPC identified in the soil screening process were arsenic, boron (total and hot water soluble), copper, lead, zinc, benzene, toluene, ethylbenzene, xylenes, PHC F1, PHC F2, PHC F3, 1-methylnaphthalene, 2-methylnaphthalene, acenaphthylene, acridine (no guideline), naphthalene, and perylene (no guideline).

The last step of the soil screening process was a secondary screen to determine which COPC are identified for quantification in the human health risk assessment (HHRA) and which COPC for the ecological risk assessment (ERA). For human health, this step of the process involved comparison to the human health components of the CCME guideline or the human health components of the Ontario Ministry guidelines. These are generic components that are protective of human health. COPC with maximum concentrations below these health-based components do not represent a human health risk. Table 9 provides a summary of the screening process for human health. As seen from Table 9 only arsenic, lead, PHC F1, and PHC F2 have been identified as COPC for a quantitative assessment for human health. Acridine and perylene, do not have human health components or toxicity data and thus cannot be evaluated quantitatively. The chemical structure of acridine is similar to that of anthracene with just an N replaced on the central CH ring. Comparing the maximum measured concentration of acridine in soil of 0.048 mg/kg to the anthracene guideline (2.5 mg/kg) indicates that the maximum is below the guideline. Similarly, the structure of perylene is similar to pyrene and a comparison to the perylene guideline also shows that the maximum (0.79 mg/kg) is below the guideline of 10 mg/kg. Thus neither of these two COPC are considered to pose a human health risk.

Table 9. Selection of Soil COPC for the HHRA

Contaminant	Unit	Guideline (Residential/ parkland)	Maximum	Human Health Component: Direct Soil Contact (Ingestion)	Human Health Component: Vapour Inhalation (Slab-on-grade)	COPC?	Rationale
Arsenic	mg/kg	12	32	**12**	-	**Y**	-
Boron, total	mg/kg	1.5[ab]	27	4300[a]	-	N	Max ≤ Direct Contact Component
Copper	mg/kg	63	1040	1100	-	N	Max ≤ Direct Contact Component
Lead	mg/kg	140	310	**140**	-	**Y**	-
Zinc	mg/kg	250	1570	10000	-	N	Max ≤ Direct Contact Component
Benzene	mg/kg	0.0068	0.73	110	2.1	N	Max ≤ Direct Contact Component
Toluene	mg/kg	0.08	2.5	22000	2700	N	Max ≤ Direct Contact Component
Ethylbenzene	mg/kg	0.018	3.9	10000	1300	N	Max ≤ Direct Contact Component
Xylenes	mg/kg	2.4	27	150000	320	N	Max ≤ Direct Contact Component
PHC F1 (C_6-C_{10})	mg/kg	30	2100	12000	**610**	**Y**	-
PHC F2 (C_{10}-C_{16})	mg/kg	150	51000	**6800**	**3100**	**Y**	-
PHC F3 (C_{16}-C_{34})	mg/kg	300	5800	15000	-	N	Max ≤ Direct Contact Component
1-Methylnaphthalene	mg/kg		25	72[a]	-	N	Max ≤ Direct Contact Component
2-Methylnaphthalene	mg/kg	3.4[a]	56	110[a]	-	N	Max ≤ Direct Contact Component
Acenaphthylene	mg/kg		0.31	7.8[a]	-	N	Max ≤ Direct Contact Component
Acridine	mg/kg	-	0.41	-	-	**Y**	No HH components and toxicity values
Naphthalene	mg/kg	0.013	31	360[a]	57[b]	N	-
Perylene	mg/kg	-	0.79	-	-	**Y**	No HH components and toxicity values
Phenanthrene	mg/kg	0.046	2.9	-	-	**Y**	No HH components and toxicity values

Notes: Unless otherwise noted, guideline and human health component values are from the Canadian Council of Ministers of the Environment (CCME 2020).
[a] Values taken from the Ontario Ministry of the Environment, Conservation and Parks (MOE 2011) Soil, ground water and sediment standards for use under Part XV.1 of the Environmental Protection Act. Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition, Residential/parkland/institutional land use, fine textured soil.
[b] Value for hot water soluble boron.

Table 10 provides the soil screening table for the ERA. In this step, generic components of the CCME and MOE guidelines that are protective of ecological health are used. From this step, arsenic, boron, copper, lead, zinc, PHC F1, PHC F2, PHC F3, and naphthalene are identified for quantitative assessment in the ERA. 1-methylnaphthalene, 2-methylnaphthalene, acenaphthylene, acridine, and perylene cannot be evaluated quantitatively. The chemical structure of acridine is similar to that of anthracene with just an N replaced on the central CH ring. Comparing the maximum measured concentration of acridine in soil of 0.048 mg/kg to the anthracene guideline (2.5 mg/kg) indicates that the maximum is below the guideline. Similarly, the structure of perylene is similar to pyrene and a comparison to the perylene guideline also shows that the maximum (0.79 mg/kg) is below the guideline of 10 mg/kg. Thus neither of these two COPC are considered to pose an ecological risk. The guideline used for acenaphthylene of 0.17 mg/kg was based on the protection of leaching into groundwater. This pathway is not relevant at the Eureka HAWS. The structure of acenaphthylene is similar to acenaphthene and a comparison of the maximum measured concentration of acenaphthylene (0.31 mg/kg) to the acenaphthene guideline of 58 mg/kg indicates that there are not expected to be any ecological risks associated with acenaphthylene present at the Eureka HAWS. 1-methylnaphthalene and 2-methylnaphthalene are similar to naphthalene and the effects on ecological species will be discussed in the ERA (Section 8).

Table 10. Selection of Soil COPC for the ERA

Contaminant	Unit	Guideline (Residential/ parkland)	Maximum	Eco Component - Direct Soil Contact	COPC?	Rationale
Arsenic	mg/kg	12	32	**17**	**Y**	-
Boron	mg/kg		27		**Y**	No Eco guidelines/toxicity values
Boron, hot water soluble	mg/kg	1.5[a]	4.8	**1.5[a]**	**Y**	-
Copper	mg/kg	63	1040	**63**	**Y**	-
Lead	mg/kg	140	310	**300**	**Y**	-
Zinc	mg/kg	250	1570	**250**	**Y**	-
Benzene	mg/kg	0.0068	0.73	60	N	Max < Direct Contact Component
Toluene	mg/kg	0.08	2.5	110	N	Max < Direct Contact Component
Ethylbenzene	mg/kg	0.018	3.9	120	N	Max < Direct Contact Component
Xylenes	mg/kg	2.4	27	65	N	Max < Direct Contact Component
PHC F1 (C_6-C_{10})	mg/kg	30	2100	**210**	**Y**	-
PHC F2 (C_{10}-C_{16})	mg/kg	150	51000	**150**	**Y**	-
PHC F3 (C_{16}-C_{34})	mg/kg	300	5800	**1300**	**Y**	-
1-Methylnaphthalene	mg/kg	3.4[a]	25	-	**Y**	No Eco guidelines/toxicity values
2-Methylnaphthalene	mg/kg	3.4[a]	56	-	**Y**	No Eco guidelines/toxicity values
Acenaphthylene	mg/kg	0.17[a]	0.31	-	**Y**	No Eco guidelines/toxicity values
Acridine	mg/kg	-	0.41	-	**Y**	No Eco guidelines/toxicity values
Naphthalene	mg/kg	0.013	31	**0.75[a]**	**Y**	-
Perylene	mg/kg	-	0.79	-	**Y**	No Eco guidelines/toxicity values
Phenanthrene	mg/kg	0.046	2.9	7.8[a]	N	Max < Direct Contact Component

Notes: Unless otherwise noted, guideline and ecological component values are from the Canadian Council of Ministers of the Environment (CCME 2020).
[a] Values taken from the Ontario Ministry of the Environment, Conservation and Parks (MOE 2011) Soil, ground water and sediment standards for use under Part XV.1 of the Environmental Protection Act. Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition, Residential/parkland/institutional land use, fine textured soil.

6.2 Surface Water Screening

The surface water COPC screening process identified the COPC in the Drainage Pond and Stream Area that needed to be taken forward for quantitative evaluation in the aquatic ERA. These two areas are not the source of drinking water at the HAWS. In this screen the CCME (2020) Guidelines for the Protection of Aquatic Life were used as the screening criteria. Table 11 summarizes the screening process. As seen from the table only cadmium was identified for further quantitative evaluation in the HHERA. Contaminants without any guidelines will be discussed qualitatively. All other contaminants had concentrations similar to background or below guidelines and thus do not represent a cause for concern at the Eureka HAWS.

Table 11. Selection of Contaminants of Potential Concern in Surface Water for the HHERA

Contaminant	Unit	Guideline (Freshwater, long-term)	Background Average	N	N<MDL	Minimum	Maximum	Average	COPC?	Rationale
Aluminum	mg/L	0.1	1.6	29	0	0.0099	0.26	0.1	N	Average ≤ Background average
Antimony	mg/L	-	0.0003	29	13	<0.00002	0.0005	0.0001	N	Average ≤ Background average
Arsenic	mg/L	0.005	0.002	29	0	0.0002	0.0007	0.0004	N	Max ≤ Guideline
Barium	mg/L	-	0.05	29	0	0.02	0.04	0.02	N	Average ≤ Background average
Beryllium	mg/L	-	0.0005	29	27	<0.00001	0.00002	0.000263	N	Heavily censored (90% or more < MDL)
Boron	mg/L	1.5	0.04	29	0	0.08	0.51	0.12	N	Max ≤ Guideline
Cadmium	mg/L	0.000018	0.00006	29	16	<0.000005	0.045	0.003	Y	-
Calcium	mg/L	-	147	29	0	100	360	149	N	No guideline, part of earth's crust and similar to background
Chromium	mg/L	-	0.003	29	13	<0.0001	0.005	0.001	N	Average ≤ Background average
Cobalt	mg/L	-	0.006	29	7	0.00007	0.0004	0.0001	N	Average ≤ Background average
Copper	mg/L	0.002	0.008	29	0	0.0005	0.0019	0.0009	N	Max ≤ Guideline
Iron	mg/L	0.3	3.8	29	0	0.07	2.0	0.41	N	Average ≤ Background average
Lead	mg/L	0.0001	0.003	29	6	0.00003	0.0009	0.0002	N	Average ≤ Background average
Lithium	mg/L	-	0.01	29	0	0.02	0.08	0.03	N	No guideline or toxicity data available
Magnesium	mg/L	-	58	29	0	61	430	93	N	No guideline and part of earth's crust
Manganese	mg/L	-	0.17	29	0	0.005	0.25	0.09	N	Average ≤ Background average
Molybdenum	mg/L	0.073	0.0006	29	6	<0.0002	0.001	0.0002	N	Max ≤ Guideline
Nickel	mg/L	0.025	0.01	29	0	0.0007	0.003	0.001	N	Max ≤ Guideline
Phosphorus	mg/L	0.035	0.18	16	8	<0.1	0.039	0.032	N	Average ≤ Background average
Potassium	mg/L	-	4.2	29	0	7.5	74	11.7	N	No guideline and part of earth's crust
Selenium	mg/L	0.001	0.001	29	3	0.0001	0.0008	0.0002	N	Max ≤ Guideline
Silicon	mg/L	-	2.5	29	1	<0.1	1.3	0.67	N	Average ≤ Background average
Sodium	mg/L	-	88	29	0	157	2100	287	N	No guideline or toxicity data and part of earth's crust
Strontium	mg/L	2.5[a]	0.55	29	0	0.4	1.9	0.6	N	Max ≤ Guideline
Sulphur	mg/L	-	170	29	0	122	447	174	N	Average is similar to background average
Thallium	mg/L	0.0008	0.00009	29	8	0.000003	0.00002	0.00003	N	Max ≤ Guideline

Contaminant	Unit	Guideline (Freshwater, long-term)	Background Average	N	N<MDL	Minimum	Maximum	Average	COPC?	Rationale
Tin	mg/L	-	0.004	29	28	<0.0002	0.0003	0.0003	N	Heavily censored (90% or more < MDL)
Titanium	mg/L	-	0.029	29	12	<0.0005	0.007	0.002	N	Average ≤ Background average
Uranium	mg/L	0.015	0.001	29	0	0.0003	0.002	0.0005	N	Average ≤ Background average
Vanadium	mg/L	-	0.007	29	25	<0.0002	0.001	0.0003	N	Average ≤ Background average
Zinc	mg/L	0.03	0.33	29	10	0.0007	0.02	0.005	N	Max ≤ Guideline
Benzene	mg/L	0.37	-	29	29	<0.0002	-	-	N	Max ≤ Guideline
Toluene	mg/L	0.002	-	29	29	<0.0002	-	-	N	Max ≤ Guideline
Ethylbenzene	mg/L	0.09	-	29	29	<0.0002	-	-	N	Max ≤ Guideline
Xylenes	mg/L	-	-	29	29	<0.0004	-	-	N	Heavily censored (90% or more < MDL)
PHC F1 (C_6-C_{10})	mg/L	-	0.10	29	29	<0.025	-	-	N	Heavily censored (90% or more < MDL)
PHC F2 (C_{10}-C_{16})	mg/L	-	0.25	29	29	<0.1	-	-	N	Heavily censored (90% or more < MDL)
PHC F3 (C_{16}-C_{34})	mg/L	-	0.25	14	14	<0.2	-	-	N	Heavily censored (90% or more < MDL)
PHC F4 (C_{34}-C_{50})	mg/L	-	0.25	14	14	<0.2	-	-	N	Heavily censored (90% or more < MDL)
Acenaphthene	mg/L	-	-	5	4	<0.00001	0.00002	0.00001	N	Only one measured data above MDL so heavily censored
Fluoranthene	mg/L	0.00004	-	5	3	<0.00001	0.00002	0.00001	N	Max ≤ Guideline
Fluorene	mg/L	0.003	-	5	3	<0.00001	0.00003	0.00001	N	Max ≤ Guideline
Naphthalene	mg/L	0.0011	-	5	4	<0.00001	0.00004	0.00001	N	Max ≤ Guideline
Phenanthrene	mg/L	0.0004	-	5	2	<0.00001	0.00008	0.00003	N	Max ≤ Guideline

Notes: Unless otherwise noted, guideline values are for the Protection of Aquatic Life from the Canadian Council of Ministers of the Environment (CCME 2020); values below the MDL were set equal to ½MDL for calculation of summary statistics.
[a] Value is a Federal Environmental Quality Guideline (FEQG).

6.3 Drinking Water Screening

The water samples collected in the drinking water reservoir were compared to the Health Canada (2020) Guidelines for Canadian Drinking Water Quality (CDWG). The World Health Organization (WHO 2017) drinking water guidelines were used in the absence of Canadian Guidelines. Maximum concentrations measured below these criteria do not represent a risk to human health. As seen from Table 12, many of the contaminants in the drinking water reservoir had concentrations below MDLs. In other cases the concentrations were similar to background or below guidelines. This is not surprizing as Station Creek is the source of the water that goes into the reservoir. A few PAHs were measured in the water samples taken in the pumphouse in 2008 and will be discussed qualitatively as no toxicity data exist.

Table 12. Selection of Contaminants of Potential Concern in Drinking Water for the HHERA

Contaminant	Unit	Guideline	Background Average (Surface Water)	N	N<MDL	Minimum	Maximum	Average	COPC?	Rationale
Aluminum	mg/L	0.1	1.6	9	1	<0.0006	0.76	0.1	N	Average ≤ Background average
Antimony	mg/L	0.006	0.0003	9	8	<0.0001	0.0001	0.0001	N	Heavily censored (90% or more < MDL)
Arsenic	mg/L	0.01	0.002	9	2	<0.0001	0.0006	0.0003	N	Max ≤ Guideline
Barium	mg/L	2	0.05	9	1	<0.0001	0.02	0.02	N	Max ≤ Guideline
Beryllium	mg/L	-	0.0005	9	9	<0.00005	-	-	N	Heavily censored (90% or more < MDL)
Bismuth	mg/L	-	-	3	3	<0.00005	-	-	N	Heavily censored (90% or more < MDL)
Boron	mg/L	5	0.043	7	4	<0.05	0.04	0.03	N	Max ≤ Guideline
Cadmium	mg/L	0.007	0.00006	9	5	0.00001	0.00004	0.00004	N	Max ≤ Guideline
Calcium	mg/L	-	147	9	0	0.2	199	68	N	Average ≤ Background average
Chromium	mg/L	0.05	0.003	9	6	<0.0001	0.008	0.002	N	Max ≤ Guideline
Cobalt	mg/L	-	0.006	9	6	<0.00005	0.0001	0.00006[b]	N	Average ≤ Background average
Copper	mg/L	2	0.008	9	0	0.0004	0.022	0.006	N	Max ≤ Guideline
Iron	mg/L	0.3	3.8	9	1	<0.005	0.5	0.1	N	Average ≤ Background average
Lead	mg/L	0.005	0.003	9	0	0.00007	0.003	0.0005	N	Max ≤ Guideline
Lithium	mg/L	-	0.011	9	2	0.0002	0.055	0.013	N	Average ≤ Background average
Magnesium	mg/L	-	58	9	1	0.1	99	31	N	Average ≤ Background average
Manganese	mg/L	0.12	0.17	9	1	0.0001	0.02	0.01	N	Max ≤ Guideline
Molybdenum	mg/L	-	0.0006	9	5	<0.0001	0.0004	0.0002[b]	N	Average ≤ Background average
Nickel	mg/L	0.07[a]	0.014	9	2	0.0002	0.017	0.004	N	Max ≤ Guideline
Phosphorus	mg/L	-	0.18	3	0	0.005	0.009	0.007	N	Average ≤ Background average
Potassium	mg/L	-	4.2	7	0	3	4	3	N	Average ≤ Background average
Selenium	mg/L	0.05	0.001	9	3	0.00015	0.0009	0.0006	N	Max ≤ Guideline
Silver	mg/L	-	0.00006	9	9	<0.00001	-	-	N	Heavily censored (90% or more < MDL)
Sodium	mg/L	200	88	9	0	4	217	63	N	Max ≤ Guideline
Strontium	mg/L	7	0.55	5	1	0.0	0.8	0.3	N	Max ≤ Guideline
Thallium	mg/L	-	0.00009	9	8	<0.000005	0.0001	0.00003	N	Average ≤ Background average
Titanium	mg/L	-	0.029	9	2	<0.0001	0.003	0.001	N	Average ≤ Background average

Contaminant	Unit	Guideline	Background Average (Surface Water)	N	N<MDL	Minimum	Maximum	Average	COPC?	Rationale
Uranium	mg/L	0.02	0.0011	9	1	<0.0001	0.001	0.0004	N	Max ≤ Guideline
Vanadium	mg/L	-	0.007	9	6	<0.0001	0.003	0.0008	N	Average ≤ Background average
Zinc	mg/L	5	0.33	9	3	<0.0005	0.25	0.046	N	Max ≤ Guideline
PHC F1 (C_6-C_{10})	mg/L	-	-	4	4	<0.1	-	-	N	Heavily censored (90% or more < MDL)
PHC F2 (C_{10}-C_{16})	mg/L	-	-	4	4	<0.05	-	-	N	Heavily censored (90% or more < MDL)
PHC F3 (C_{16}-C_{34})	mg/L	-	-	4	4	<0.05	-	-	N	Heavily censored (90% or more < MDL)
PHC F4 (C_{34}-C_{50})	mg/L	-	-	4	4	<0.05	-	-	N	Heavily censored (90% or more < MDL)
Fluoranthene	mg/L	-	-	4	3	<0.00001	0.00001	0.000008	**Y**	No available guideline
Naphthalene	mg/L	-	-	4	2	<0.00001	0.0008	0.0002	**Y**	No available guideline
Phenanthrene	mg/L	-	-	4	2	<0.00001	0.00003	0.00002	**Y**	No available guideline

Notes: Unless otherwise noted, guideline values are Health Canada (2020) Guidelines for Canadian Drinking Water Quality (CDWG); values below the MDL were set equal to ½MDL for calculation of summary statistics.

[a] Value is guideline for drinking water quality from World Health Organization (WHO 2017).

[b] Older elevated MDLs not considered in the calculation of averages.

6.4 Sediment Screening

The sediment screening process is summarized in Table 13. For the screening process the CCME (2020) Interim Sediment Quality Guidelines (ISQGs) for the protection of benthic invertebrates were used as the screening criteria. Human health exposure is not considered for sediments. Contaminants for which sediment screening criteria were not available were compared to background. The concentrations from sediments in the Drainage Pond and Stream Area from 2013 to 2021 were used in this process. In 2021, sampling was only conducted in the Drainage Pond. As seen in the table, ISQGs do not exist for a number of contaminants. In terms of metals, only manganese and zinc maximum concentrations exceed the ISQGs and will be considered further in the ERA. All other metals in sediments were either below guidelines or similar to background with the exception of iron and sodium which have no guidelines and will be discussed qualitatively. For BTEX and PHCs there are no available guidelines. Benzene, ethylbenzene, xylenes, PHC F1, PHC F2, and PHC F3 were carried forward for a qualitative discussion in the ERA. There are a number of PAHs with maximum measured concentrations above the ISQGs and these are carried forward to the ERA. Acridine and anthracene only have 4 or 5 measured concentrations and thus a qualitative assessment was undertaken. Benzo(b&j)fluoranthene, benzo(g,h,i)perylene, and perylene were also addressed qualitatively as there are no available toxicity information.

6.5 Summary of COPC from Screening Process for Quantitative Analysis

From a Human Health perspective, soil was the only medium where COPC were identified for evaluation within a quantitative HHRA. The identified COPC for human health are:

- Arsenic, lead, PHC F1, and PHC F2

From an ecological perspective, the screening process in soil, surface water and sediments identified a number of COPC to be carried through a quantitative ERA. From the soil screening process the following COPC are identified for quantitative analysis in the ERA:

- Arsenic, boron, boron (hot water soluble), copper, lead, zinc, PHC F1, PHC F2, PHC F3 and naphthalene

From the surface water screening process the following COPC are identified for quantitative analysis in the ERA:

- Cadmium

From the sediment screening process the following COPC are identified for further analysis in the ERA:

- Manganese and zinc
- Benzene, ethylbenzene, xylenes and PHC F1, PHC F2 and PHC F3
- PAHs – acenaphthene, acenaphthylene, benzo(a)pyrene, fluorene, 1-methylnaphthalene, 2-methynaphthalene, naphthalene, phenanthrene and pyrene

Table 13. Selection of Contaminants of Potential Concern in Sediments

Contaminant	Unit	Guideline	Background Average	N	N<MDL	Minimum	Maximum	Average	COPC?	Rationale
Aluminum	mg/kg	-	7418	42	0	2000	12000	5469	N	Average ≤ Background average
Antimony	mg/kg	-	0.5	48	30	<0.2	0.5	0.26	N	Average ≤ Background average
Arsenic	mg/kg	5.9	13	48	0	1.2	21	10	N	Average ≤ Background average
Barium	mg/kg	-	44	48	0	16	74	40	N	Average ≤ Background average
Beryllium	mg/kg	-	0.7	48	4	<0.2	0.91	0.47	N	Average ≤ Background average
Boron	mg/kg	-	12	42	4	<5	26	10	N	Average ≤ Background average
Cadmium	mg/kg	0.6	0.11	48	41	<0.1	0.11	0.05	N	Max ≤ Guideline
Calcium	mg/kg	-	6627	42	0	280	14000	6183	N	Average ≤ Background average
Chromium	mg/kg	37.3	17	48	0	2.4	49	16	N	Average ≤ Background average
Cobalt	mg/kg	-	9	48	0	1.8	15	9.0	N	Average ≤ Background average
Copper	mg/kg	35.7	27	48	0	1.8	29	17	N	Average ≤ Background average
Iron	mg/kg	-	23636	42	0	7800	60000	26890	N	No guideline or toxicity data available
Lead	mg/kg	35.7	11	48	0	2.0	17	9.9	N	Max ≤ Guideline
Magnesium	mg/kg	-	3964	42	0	2000	5900	3460	N	Average ≤ Background average
Manganese	mg/kg	460[a]	222	42	0	130	1900	523	Y	-
Mercury	mg/kg	0.17	0.05	48	26	<0.05	0.095	0.04	N	Max ≤ Guideline
Molybdenum	mg/kg	-	1.5	48	5	<0.5	2.4	0.9	N	Average ≤ Background average
Nickel	mg/kg	-	25	48	0	5	43	22	N	Average ≤ Background average
Phosphorus	mg/kg	-	412	42	0	48	1100	409	N	Average ≤ Background average
Potassium	mg/kg	-	1293	42	0	65	2300	1116	N	Average ≤ Background average
Selenium	mg/kg	-	0.5	48	39	<0.5	0.7	0.32	N	Average ≤ Background average
Sodium	mg/kg	-	106	42	1	<50	1500	389	N	No guideline or toxicity data and part of earth's crust
Strontium	mg/kg	-	49	42	1	<10	49	31	N	Average ≤ Background average
Thallium	mg/kg	-	0.2	48	18	<0.05	0.25	0.10	N	Average ≤ Background average
Uranium	mg/kg	-	0.7	48	9	0.15	0.96	0.51	N	Average ≤ Background average
Vanadium	mg/kg	-	39	48	0	5	51	31	N	Average ≤ Background average
Zinc	mg/kg	123	56	48	0	13	340	72	Y	-
Benzene	mg/kg	-	0.002	52	38	<0.005	0.39[d]	0.037	Y	No available guideline
Toluene	mg/kg	-	0.005	52	48	<0.02	0.098	0.02	N	Heavily censored (90% or more < MDL)
Ethylbenzene	mg/kg	-	0.017	52	37	<0.01	3.6[e]	0.50	Y	No available guideline
Xylenes	mg/kg	-	0.034	52	39	<0.02	20	0.53	Y	No available guideline
PHC F1 (C_6-C_{10})	mg/kg	-	5	52	37	<10	5900	131	Y	No available guideline

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Contaminant	Unit	Guideline	Background Average	N	N<MDL	Minimum	Maximum	Average	COPC?	Rationale
PHC F2 (C_{10}-C_{16})	mg/kg	-	8	52	12	<10	19000	1091	Y	No available guideline
PHC F3 (C_{16}-C_{34})	mg/kg	-	8	52	15	<50	1600	222	Y	No available guideline
PHC F4 (C_{34}-C_{50})	mg/kg	-	8	52	48	<50	75	29	N	Heavily censored (90% or more < MDL)
1-Methylnaphthalene	mg/kg	0.0202	0.01	41	1	<0.005	17[e]	2.3	Y	-
2-Methylnaphthalene	mg/kg	0.0202	0.02	52	1	<0.005	22[e]	3.1	Y	-
Acenaphthene	mg/kg	0.00671	-	52	28	<0.005	0.89	0.050	Y	-
Acenaphthylene	mg/kg	0.00587	-	52	40	<0.005	0.24	0.015	Y	-
Acridine	mg/kg	0.0212[b]	-	41	34	<0.01	0.23	0.022	Y	Only 4 samples with measured data
Anthracene	mg/kg	0.0469	-	52	46	<0.004	0.052	0.006	Y	Only 5 samples with measured data-
Benzo(a)anthracene	mg/kg	0.0317	0.0025	52	30	<0.005	0.017	0.005	N	Max ≤ Guideline
Benzo(a)pyrene	mg/kg	0.0319	0.0025	52	31	<0.005	0.11	0.007	Y	-
Benzo(b&j)fluoranthene	mg/kg	0.0319[c]	0.0025	52	8	<0.005	0.052	0.015	Y	-
Benzo(g,h,i)perylene	mg/kg	0.0319[c]	-	52	10	<0.005	0.041	0.016	Y	-
Benzo(k)fluoranthene	mg/kg	0.0319[c]	0.0025	52	51	<0.005	0.0075	0.003	N	Heavily censored (90% or more < MDL)
Chrysene	mg/kg	0.0571	-	52	24	<0.005	0.032	0.008	N	Max ≤ Guideline
Dibenzo(a,h)anthracene	mg/kg	0.00622	0.0025	52	51	<0.005	0.0075	0.003	N	Heavily censored (90% or more < MDL)
Fluoranthene	mg/kg	0.111	-	52	15	<0.005	0.04	0.013	N	Max ≤ Guideline
Fluorene	mg/kg	0.0212	-	52	19	<0.005	0.93	0.067	Y	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.0212[b]	0.0025	52	29	<0.005	0.015	0.005	N	Max ≤ Guideline
Naphthalene	mg/kg	0.0346	0.011	52	1	<0.005	13[e]	1.5	Y	-
Perylene	mg/kg	0.0212[b]	-	41	1	<0.005	0.38	0.12	Y	-
Phenanthrene	mg/kg	0.0419	0.016	52	1	<0.005	0.43	0.07	Y	-
Pyrene	mg/kg	0.053	0.009	52	6	<0.005	0.081	0.02	Y	-
Quinoline	mg/kg	0.0212[b]	-	41	37	<0.005	1.5	0.06	N	Heavily censored (90% or more < MDL)
Benz[a]pyrene equivalency (calculated)	mg/kg	0.0319[c]	-	52	39	0.004	0.02[f]	0.03	N	Max ≤ Guideline
Aroclor 1254	mg/kg	0.06	-	3	2	<0.01	0.02	0.01	N	Max ≤ Guideline

Notes: Unless otherwise noted, guideline values are Interim Sediment Quality Guidelines from the Canadian Council of Ministers of the Environment (CCME 2020); values below the MDL were set equal to ½MDL for calculation of summary statistics.

[a] Value is from the Ontario Ministry of Environment (MOEE 1993).
[b] Used the guideline value of fluorene.
[c] Used the guideline value of benzo(a)pyrene.
[d] Maximum excluded the duplicate sample.
[e] Used the second highest value, which represents more current measurement at the site at a given location.
[f] Maximum is highest detected value.
[g] Aroclor 1254 measurements from 2008

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7.0 Human Health Risk Assessment

The HHRA provides a realistic defensible and representative estimate of the risks to people who work at the Eureka HAWS. The HHRA follows the typical risk assessment paradigm and consists of a problem formulation which identifies the receptors and pathways and the COPC to be evaluated at the HAWS. An exposure assessment, toxicity assessment and risk characterization are the other steps within the HHRA.

7.1 Problem Formulation

The problem formulation involved reviewing available data from all studies at the Eureka HAWS. This review helped to focus the approach of the study and lay the foundation for the HHRA. The following sections describe the different parts of the problem formulation for the HHRA.

7.1.1 Hazard Identification

The results of the screening process to identify COPC in soil and water for the HHRA was described in Section 6.0. Based on that process the identified COPC for human health are:

- Arsenic, lead, PHC F1, and PHC F2

A quantitative assessment was carried out for these COPC in the HHRA. Background concentrations for these COPC which were provided in Section 5.0 were also considered in the assessment.

7.1.2 Receptor Identification

Human receptors at the Main Station Area include HAWS atmospheric scientists and staff (office workers), operations and maintenance (O&M) workers, and other seasonal visitors who stay at the residential complex and main facilities. Office workers and O&M workers represent the typical activities and potential exposures at the HAWS. These are adults who live at the station and would encompass the exposure of any other potential human receptor such as the seasonal visitors.

Based on charter schedule information, it appears that atmospheric scientists and staff at the HAWS work for 12 weeks and then leave for 24 weeks and return for another 12 week stint. Thus over the course of a year, these office workers could be present for a maximum of 24 weeks at the HAWS. ATCO (O&M) workers are present at the HAWS on an 8 week on and 8 week off schedule. Therefore in a given year they can be present at the site for 32 weeks. O&M workers work during the summer in the powerhouse building, located 25 m away from the residential complex, whereas office workers work and spend the majority of their time in the residential complex. Office workers and O&M workers also spend time at the Airstrip doing daily checks and picking up people and supplies arriving at the HAWS.

A construction worker is also considered as there are a number of remediation and rehabilitation activities currently on-going at the HAWS and this will be the case for the next four years. There is also currently on-going rehabilitation work at the Airstrip. The water/sewer and demolition projects will be completed over three (3) construction seasons and the site administration contract will occur over four (4) construction seasons. Thus two different construction workers were considered; one working on the Airstrip rehabilitation and one working on the water/sewer and demolition projects at the Main station.

Pregnant women may be of special concern as some chemicals may be transferred via the placenta and affect the developing foetus. Although women of childbearing age could be employed at the HAWS, it was considered that due to the remote nature of the station that it is unlikely that pregnant workers would be present at the HAWS. In addition given the short-term exposure at the HAWS, this receptor was not considered appropriate.

In 2021, data were collected around the Old Tank Farm where there are CANDAC trailers. The implication of these analytical data on the risk to CANDAC workers is addressed in Appendix G.

7.1.3 Pathways of Exposure

Exposure pathways consider the ways in which people working at the HAWS can be exposed to COPC. The exposure pathways identified in the previous DQRA (Franz/Senes 2011) were reviewed to see if the pathways were still relevant. The pathways that are relevant include:

- Ingestion of water from the drinking water reservoir
- Incidental soil ingestion
- Dermal contact with contaminated soil
- Inhalation of particulate matter
- Inhalation of vapours in outdoor air
- Inhalation of vapours in indoor air

For the indoor air exposure, it was assumed that the office worker spent the majority of their time in the residential complex where no known contamination exists. It is assumed that they spend some time outdoors (approximately 2 hours) doing outdoor activities such as checking instrumentation, releasing meteorological balloons and going out to the Airstrip. In addition the crawl space in the building would dissipate any potential vapours coming from the soil and thus the indoor exposure in the residential complex is an incomplete pathway. For the O&M worker who works in the powerhouse and garage buildings there is a potential for vapour intrusion in these slab-on-grade buildings. It is assumed that they spend most of their working day inside the buildings and about 2 hours outdoors doing various activities. There has been indoor air and vapour monitoring conducted in these areas which will be considered in the risk assessment. For the construction workers, indoor air exposure during their time at the different proposed camp locations (in the Airstrip area) is considered in addition to their time outdoors working on the various projects. The selection of the receptors and the time indoors and outdoors cover other potential exposures that may occur at the HAWS.

7.1.4 Locations of Exposure

For the purposes of the HHERA, the office worker and O&M worker were evaluated in the Main Station Area. Since these workers may also have some trips to the Airstrip area, two (2) separate O&M workers were evaluated, one who spends all of their time at the Main Station and one who spends most of their time at the Main Station but also spends about two (2) hours a day outdoors in the Airstrip Area. These three receptors would cover all the potential exposures of the office workers and O&M workers at the HAWS.

The construction worker was evaluated at the Airstrip area as well as the Main Station Area as there is rehabilitation work occurring at the Airstrip and water/sewer works and demolition activities that will occur in the Main Station Area. It is assumed that the construction workers will be housed in two different camps in the Airstrip Area. There is currently a NUNA camp near the former First Air lease that houses workers who are doing rehabilitation on the Airstrip. The water and sewage workers will be housed at a different camp on the other side of Fort Eureka. Two potential locations of these camps are provided in Figures 5 and 6. These camps may be moved closer to the Main Station depending on the final plans. There are no soil samples available at any of the potential camp locations as there have been minimal contaminating activities in these areas and thus the soil samples associated with the NUNA camp are considered representative of potential exposures at any of the potential camp locations.

7.1.5 Conceptual Site Model

The Conceptual Site Model (CSM; Figure 9) for the HAWS provides a visual representation of the different pathways that are being evaluated in the risk assessment as well as the ways that the COPC move from the soil, sediment, and water and are taken up by plants, fish, and other animals. As seen in the figure, there is possible migration of the contaminants from the land into air and surface water as well as infiltration into groundwater. Overland flow of water is also indicated. The figure also shows uptake into animals and plants and finally to humans.

7.2 Exposure Assessment

Several different characteristics of individuals influence their exposure. These characteristics include how much they breathe, their body weight, how much water they drink, and how much time they spend outdoors, to name a few.

The exposure assessment involves the estimation of the intake of COPC for the staff, O&M workers and construction workers at the HAWS using an approach that tends to overestimate exposures. The total intake for a COPC is the sum of the intakes calculated for each of the exposure pathways including air, soil and water. Calculating the intake rate of COPC uses the measured concentrations in indoor air, water and soil and combines them with the intake rates for each of the pathways. These intake rates are obtained from values provided by Health Canada.

7.2.1 Receptor Characteristics

Information on human receptor characteristics must also be considered, such as body weight, soil ingestion rates, drinking water ingestion rates, time spent outside, areas from which exposure occurs, etc.

This section provides an overview of the characteristics assumed for the human receptors. The receptor characteristics were obtained from Health Canada (2012). Time spent indoors and outdoors was based on a 12 hour work day. It was assumed the construction workers would spend 12 hours outdoors and the rest of their time indoors at their camp when they were not working. For staff working at the Main Station Area, it was assumed that they would spend about 2 hrs of their time outdoors either at the Main Station Area or at the Airstrip Area. O&M workers were assumed to spend 10 hours of their time indoor at the Power and Maintenance building or at the garages and another 2 hours outdoors. Table 14 provides a summary of the receptor characteristics.

Table 14. Human Health Receptor Characteristics for the HHERA

Receptor Characteristic	Office Worker	Operations and Maintenance Worker	Construction worker
Age	≥ 20 years	≥ 20 years	≥ 20 years
Body Weight (kg)	70.7	70.7	70.7
Soil Ingestion Rate (g/d)	0.02	0.02	0.1
Inhalation Rate (m^3/d)	16.6	16.6	1.4 m^3/hr
Water Ingestion Rate (l/d)	1.5	1.5	1.5
Time Spent Indoors (hr/d)	-	10	12
Time spent outdoors (hr/d)	2	2	12
Skin Surface area (cm^2)			
Hands	890	890	890
Arms	2500	2500	2500
Legs	5720	5720	5720
Total	17460	17460	17460
Soil Loading to exposed skin (kg/cm^2/event)			
Hands	1×10^{-7}	1×10^{-7}	1×10^{-6}
Surfaces other than hands	1×10^{-8}	1×10^{-8}	1×10^{-7}

Notes: Values obtained from Health Canada (2012), unless otherwise stated.
Time spent Indoors for the Operations and Maintenance Worker is assumed to be in the Powerhouse or Garage. The Operations and Maintenance worker spends another 12 hours at the residential complex which is not in a contaminated area.
The Office worker spends 22 hours indoors at the residential complex which is not in a contaminated area.

The exposure assessment also considers how often and how long people are exposed to COPC by the different pathways identified above. Exposure frequency refers to how often a person is exposed via a particular pathway, while exposure duration refers to how long over a year that the behaviour occurs. Table 15 provides the assumptions for exposure frequency and duration which were based on information related to scheduling times for workers at the HAWS.

Table 15. Exposure Duration and Frequency Assumptions

Receptor Characteristic	Office Worker	Operations and Maintenance Worker	Construction worker
Hours on Site per day	24	24	24
Days on site per week	7	7	7
Weeks on site per year	24	32	16
Years Exposed	10	10	1
Life Expectancy (years)*	60	60	60

Notes: * Life expectancy is the number of years in the adult life stage. Results in a total life expectancy of 80 years (20 yr+ 60 yr)

7.2.2 Exposure Point Concentrations

Exposure Point Concentrations (EPCs) are the concentrations of each COPC in each media in the environment that are used in the assessment. They are set to provide a reasonable yet cautious representation of the actual conditions in the environment that humans may experience. The EPCs used in this assessment for soils and surface water were represented by the 95th percentile upper confidence of the mean (95%UCLM) which is considered to represent a reasonable maximum exposure scenario. The 95% UCLM values were calculated using the ProUCL software available from the United States Environmental Protection Agency (U.S. EPA).

7.2.2.1 Exposure Point Concentrations for Soils

Given that the HAWS is separated into the Main Station area and the Airstrip area, EPCS for soil were developed for those two different areas. Table 16 provides the EPCs for the Main Station area and the Airstrip area. As seen in Table 16, an EPC for PHC F1 was not derived for the Airstrip area since all the available samples had concentrations below the detection limit except for one sample in the landfill area in 2013 where the concentration was 2100 mg/kg at LTM-60. Subsequent measurements at this location found PHC F1 below detection limits.

Table 16. HHRA Exposure Point Concentrations for Soils

COPC	UCLM	
	Main Station	Airstrip
Arsenic	12.2	7.6
Lead	19.6	12.9
PHC F1 (C_6-C_{10})	143	-[a]
PHC F2 (C_{10}-C_{16})	3402	1360

Notes: Values are in mg/kg. Used the 95% BCA Bootstrap UCL calculated by ProUCL.
[a] Only one measurement from 2013 at LTM-60 was available for PHC F1. All other measured concentrations at that location in subsequent years were below the MDL.

7.2.2.2 Exposure Point Concentrations for Indoor Air

For some organic COPC, soil contamination near buildings may result in elevated levels in the indoor air of those buildings. In order to evaluate the indoor air exposure pathway, these indoor air concentrations were estimated. Samples around the Powerhouse and Garage areas were evaluated to determine the level of PHC contamination near these buildings where workers would spend a large part of their day. The soil samples that were considered in determining potential indoor air exposure were LTM-15, LTM-16, LTM-17 and LTM-18 (see Figure 8). From these samples, the PHC F1 fraction was found at very low values or at the detection limit and thus only the PHC F2 fraction was considered for exposure into indoor air.

In addition there are the various camp areas near the Airstrip Area where there could be a potential for indoor air exposure for construction workers from PHC F2 contamination in the soils. Figures 5 and 6 show the locations of the NUNA camp and two of the potential locations for camp to house the water/sewage and demolition workers. Figures 10 and 11 show the soil samples that are used to determine the potential indoor air concentrations at two of the camp locations. The NUNA camp is located near the former First Air Lease and therefore samples LTM-41, LTM-42-LTM-43-LTM-44 and LTM-45 were considered to be representative of a potential exposure scenario at the NUNA camp. Data from 2015 to 2019 were used in this evaluation as the 2013 data at these locations were substantially higher and subsequent measurements at the same locations were lower and indicative of the weathering that has occurred. Potential Camp 1 for the water/sewage construction workers may be located on the north side of the Airstrip. The only available samples in that vicinity are from 2007 and are associated with samples 07NA01 13, 07NA01 15, 07NA01 17 which are north of the Airstrip. The maximum concentration at those locations occurs at 07NA01 15 and is used in the evaluation. There are no samples to evaluate indoor exposure at potential Camp 2 as there have been no contaminating activities in that area. In the absence of data, the results from the NUNA camp and potential Camp 1 act as surrogates for the potential indoor air exposure of Camp 2 and any other camps that would be located along the road closer to the Main Station Area.

The PHC F2 soil EPCs representative of indoor air exposure are presented below in Table 17.

Table 17. PHC F2 Exposure Point Concentrations for Soils – Building Specific

Location	UCLM	Comment
Main Station Buildings	1678	UCLM of soil samples (LTM-15, LTM-16, LTM-17 and LTM-18) near Maintenance and Garage buildings
NUNA Airstrip Camp	439	UCLM of soil samples LTM-41, LTM-42-LTM-43-LTM-44 and LTM-45 near NUNA camp
Potential Airstrip Camp for Water and Sewage Workers	5.1	Maximum concentration of samples 07NA01 13, 07NA01 15, 07NA01 17 from north Airstrip Apron

Notes: Values are in mg/kg. Used the 95% BCA Bootstrap UCL calculated by ProUCL.

These building-specific soil PHC EPCs were used as inputs to the Johnson and Ettinger (J&E) Model as described in Section 7.2.3 to estimate indoor air concentrations based on vapour intrusion. The inputs and calculations are provided in Appendix A. The predicted indoor-air concentrations are presented below for the various PHC F2 fractions in Table 18, Table 19 and Table 20.

Table 18. Predicted Indoor Air Exposure Point Concentrations for Powerhouse and Garage Buildings

COPC	Predicted Indoor Air Concentration (mg/m^3)	Predicted Fraction Breakdown
PHC F2 - Aliphatic C>10-C12	0.26	59.3%
PHC F2 - Aliphatic C>12-C16	0.03	5.7%
PHC F2 - Aromatic C>10-C12	0.13	30.5%
PHC F2 - Aromatic C>12-C16	0.02	4.5%
Total PHC F2	0.43	100%

Notes: Indoor air concentrations predicted using the J&E Model (see Section 7.2.3).

Table 19. Predicted Indoor Air Exposure Point Concentrations for NUNA Camp Buildings

COPC	Predicted Indoor Air Concentration (mg/m^3)	Predicted Fraction Breakdown
PHC F2 - Aliphatic C>10-C12	0.43	79.2%
PHC F2 - Aliphatic C>12-C16	0.042	7.7%
PHC F2 - Aromatic C>10-C12	0.058	10.6%
PHC F2 - Aromatic C>12-C16	0.013	2.5%
Total PHC F2	0.54	100%

Notes: Indoor air concentrations predicted using the J&E Model (see Section 7.2.3).

Table 20. Predicted Indoor Air Exposure Point Concentrations for Potential Camp 1 Buildings

COPC	Predicted Indoor Air Concentration (mg/m^3)	Predicted Fraction Breakdown
PHC F2 - Aliphatic C>10-C12	0.02	76.4%
PHC F2 - Aliphatic C>12-C16	0.006	20.8%
PHC F2 - Aromatic C>10-C12	0.001	2.3%
PHC F2 - Aromatic C>12-C16	0.0002	0.5%
Total PHC F2	0.029	100%

Notes: Indoor air concentrations predicted using the J&E Model (see Section 7.2.3).

In addition to using soil levels to estimate indoor air PHC F2 concentrations in the Main Station buildings, measured sub-slab vapour PHC F2 concentrations as well as indoor air concentrations are available for some of the buildings in the Main Station area. Sub-slab vapour concentrations have been measured in the old garage building in 2012, 2013, 2015, 2017 and 2019. PHC F2 concentrations measured in the vapour probes have been decreasing since 2013. The CCME (2014) recommends an attenuation factor of 0.01 be applied to soil vapour measurements to derive indoor air concentrations for commercial/industrial buildings. Sub-slab PHC F2 vapour measurements and the predicted air concentrations for the old garage building are presented below in Table 21. The arithmetic average of the indoor air concentration was selected as an additional line of evidence to consider for the potential exposure for O&M workers at the Main Station area. This represents a conservative estimate of the indoor air concentrations at the old garage building as the predicted concentrations in 2015, 2017 and 2019 are below this value. This value is actually lower than the PHC F2 indoor air concentration predicted using the J&E Model based on soil concentrations in the area (0.43 mg/m^3).

Table 21. PHC F2 Sub-slab Vapor and Predicted Air Concentrations for Old Garage Building

	Air Concentration (mg/m^3)					
	2012	**2013**	**2015**	**2017**	**2019**	**Average**
Subslab vapour measurement	24	59.8	2.13	1.23	0.19	17.5
Predicted indoor air concentration based on attenuation factor of 0.01	0.24	0.6	0.02	0.01	0.002	0.2

Another line of evidence for indoor air concentrations are available from actual indoor air measurements in the new garage building (building and crawl space) as well as the old garage building. The measurements have been carried out at the same times as the sub-slab vapour measurements. It is noted in the LTM reports that the indoor air measurements have additional sources of vapours based on different activities occurring in the buildings (fuel storage, machinery, etc.). Since 2013, indoor air measurements have only been collected from the old and new Garage locations. This was evidenced in 2015 in the old garage where the indoor air PHC F2 concentrations exceeded the site specific criterion. Since then the concentrations have decreased. Table 22 provides the average measured indoor air concentrations in the two buildings over the monitoring period. As seen from the table the overall average measured concentration in the buildings are above the predicted indoor air concentrations based on the sub-slab vapour concentrations but is similar to the PHC F2 indoor air concentration predicted using the J&E Model based on soil concentrations in the area (0.43 mg/m^3).

Table 22. Average Measured PHC F2 Indoor Air Concentrations for New and Old Garage Buildings

COPC	Average Measured Indoor Air Concentration (mg/m^3)				
	N	**Old Garage**	**New Garage Building**	**New Garage Crawlspace**	**Overall**
PHC F2	5	0.93	0.36	0.08	0.46

Notes: N – number of samples; Based on indoor air measurements in 2012, 2013, 2015, 2017 and 2019.

7.2.3 Exposure Estimation

The exposure assessment uses all the available information for the staff, O&M workers and construction workers as well as the measured concentrations in soil and predicted indoor air concentrations as well as soil vapour concentrations and indoor air measurements to quantify exposure.

The ingestion and inhalation pathways were calculated using equations provided by Health Canada (2012). Long term exposures were considered in the assessment and background exposures are implicitly considered through the use of measured data. A modified Version of the Health Canada

Preliminary Quantitative Risk Assessment spreadsheet was used to calculate the exposure estimates for the various receptors using the equations discussed below. It is acknowledged that this spreadsheet is not supported by Health Canada; however, the parts of the spreadsheet that were used were the inhalation and ingestion pathways calculations and the calculation of outdoor air exposure for PHC. None of these equations or parameters have changed since the spreadsheet was developed. The toxicity values in the spreadsheet were modified to represent current values. The indoor air concentrations were determined outside of the spreadsheet using the Johnson & Ettinger Model and those concentrations were then input into the spreadsheet to determine the inhalation exposure.

7.2.3.1 Inhalation Exposure

The total inhalation intake of vapours and particulates by human receptors was calculated using equation 1 for the air pathway:

$$I_{inh} = \frac{C_{air} \times IR_{inh} \times AF_{inh} \times D_1 \times D_2 \times D_3 \times D_4}{BW \times LE} \qquad \text{Equation 1}$$

Where:

I_{inh}	=	dose to COPC through the inhalation pathway [mg/(kg-d)]
C_{air}	=	air concentration [mg/m^3] {equations 2 to 13}
IR_{inh}	=	inhalation rate [m^3/d] {Table 14}
AF_{inh}	=	inhalation absorption factor [-] {assumed to be 1}
D_1	=	hours per day exposed/24 hours [hrs/hrs] {Table 15}
D_2	=	days per week exposed/7 days [d/d] {Table 15}
D_3	=	weeks per year exposed/52 weeks [wk/wk] {Table 15}
D_4	=	total years exposed to site [y] {for carcinogenic COPC only, Table 15}
BW	=	body weight [kg] {Table 14}
LE	=	life expectancy [y] {for carcinogenic COPC only, Table 15}

Estimation of Dust Concentrations

In general, this pathway of exposure is insignificant relative to direct ingestion of soil and to dermal absorption (Health Canada 2012); however, it is included in the risk assessment as a conservative measure. In the absence of measured air concentrations, concentrations of COPC associated with particulate in ambient air can be estimated from soil data using an assumed respirable (< 10 µm aerodynamic diameter) particulate concentration. For the outdoor maintenance worker, a respirable particulate concentration (Pa) of 0.76 µg/m^3 (or 7.6×10^{-10} kg/m^3) was used as provided by Health Canada (2012) for areas with no construction activities. For the construction workers who may be exposed to a higher concentration of particulates as a result of soil resuspension during typical activities, a value of 60 µg/m^3 (or 6.0×10^{-8} kg/m^3) was used (MOE 2011).

For inorganic chemicals or chemicals for which required chemical parameters (Henry's Law Constant and K_{oc} (or organic carbon partition coefficient)) are not available, the adsorbed concentration is assumed to be equal to the total soil concentration. For volatile chemicals, the concentration adsorbed to the particulate phase is calculated as:

$$C_p = C_{soil} - \frac{C_{soil}\theta_w}{K_d \rho_b + \theta_w + H'\theta_a} - \frac{C_{soil} H'\theta_a}{K_d \rho_b + \theta_w + H'\theta_a} \qquad \text{Equation 2}$$

Where:

C_p = chemical concentration adsorbed to particulate phase [mg/kg]

C_{soil} = maximum measured soil concentration (adsorbed + dissolved + vapour) [mg/kg]

K_d = distribution coefficient [cm^3/g]

θ_w = water filled porosity [-]

θ_a = air-filled porosity [-]

ρ_b = soil bulk density in contaminant partitioning zone [g/cm^3]

The estimated particulate in air concentration (equation 3) is then calculated as follows:

$$C_{air,p} = \left(C_s \text{ or } C_p\right) \times P_{air} \qquad \text{Equation 3}$$

Where:

$C_{air,p}$ = particulate air concentration [mg/m^3]

C_s = Concentration of COPC in soil [mg/kg]

C_p = chemical concentration adsorbed to particulate phase [mg/kg]

P_{air} = particulate concentration in ambient air [7.6×10^{-10} kg /m^3 or 6.0×10^{-8} kg/m^3]

Estimation of Indoor Air Concentrations

Indoor air levels of volatile COPC were estimated using two different approaches; first using sub-slab vapour measurements and then looking at vapour intrusion based on soil concentrations.

Estimation of Indoor Air Concentrations from Sub-Slab Vapour

Site-specific soil vapour and sub-slab vapour data are available at the HAWS for the Power and Maintenance Building and the garages. However there are no measurements for the camp locations and as an additional line of evidence for the buildings where the O&M workers spend most of their time, indoor air concentrations of volatile vapours originating from soil were estimated by multiplying the source vapour concentration (C_{source}) below a building by an indoor attenuation coefficient (α) as shown in equation 4:

$$C_a = C_{source} \times \alpha \qquad \text{Equation 4}$$

Where:

C_a	=	Concentration of volatile COPC in indoor air [mg/m^3]
C_{source}	=	Concentration of volatile COPC below building foundation [mg/m^3]
α	=	Indoor air attenuation coefficient [-]

Determination of volatility was based on the methodology outlined by the U.S. EPA (1991) for the determining volatility of contaminants for assessment in the Superfund program. This approach states that the Henry's Law constant has to be greater than 1 Pa.m^3/mol and the molecular weight less than 200 g/mol to be considered a volatile COPC.

Estimation of Indoor Air Concentrations from Soil

The source vapour concentrations (C_{source}) originating from soil were estimated using the Johnson & Ettinger (J&E) Model for Soil Contamination for evaluating subsurface vapour intrusion into buildings, available for download as an Excel spreadsheet from the U.S. EPA (SL-ADV, Version 3.1, February 2004).

The volatile COPC concentrations below the building foundation originating from soil were estimated according to equation 5:

$$C_{source} = \frac{C_S \times H'_{TS} \times \rho_b}{\theta_w + (K_d \times \rho_b) + (H'_{TS} \times \theta_a)} \times 1000 \qquad \text{Equation 5}$$

Where:

C_{source}	=	Concentration of volatile COPC below building foundation [mg/m^3]
C_s	=	Concentration of COPC in soil [mg/kg] {Table 24, Table 25, and Table 26}
H'_{TS}	=	Dimensionless Henry's law constant of COPC at average soil/groundwater temperature (noted in Table 23) [-] {Table 24, Table 25, and Table 26}
ρ_b	=	Dry bulk density of soil below building foundation [g/cm^3] {Table 23}
$\theta_{a/w}$	=	Air- ('a') or water ('w')-filled porosity of soil below building foundation [cm^3/cm^3] {Table 23}
K_d	=	Soil-water partition coefficient of COPC [cm^3/g] {Table 24, Table 25, and Table 26}
1000	=	Unit conversion for dry bulk density to kg/m^3

The dimensionless Henry's Law constants corrected for the soil temperature of 5°C were obtained from the Ontario Ministry of Environment, Conservation and Parks (MOECC 2016).

If the soil concentration (C_s) of a COPC based on measured data was above the soil saturation concentration (calculated within the J&E model), then the saturation concentration was used in the above equation.

The site-specific indoor air attenuation coefficient for soil was also estimated using the J&E Model, which accounts for vapour migration from the source through up to three soil layers and through the building foundation. For this assessment, the depth below grade to the top of the contamination (L_t) was conservatively assumed to be immediately beneath the gravel crush layer below the building foundation (i.e., 41.25 cm for a slab-on-grade building). For a slab-on-grade building, the 41.25 cm comprises an 11.25 cm floor foundation and a 30 cm gravel crush layer.

The attenuation factor, α, is calculated according to equation 6:

$$\alpha = \frac{\left(\frac{D_{eff,T} \times A_b}{Q_b \times L_t}\right) exp\left(\frac{Q_{soil} \times L_{crack}}{D_{crack} \times A_{crack}}\right)}{exp\left(\frac{Q_{soil} \times L_{crack}}{D_{crack} \times A_{crack}}\right) + \left(\frac{D_{eff,T} \times A_b}{Q_b \times L_t}\right) + \left(\frac{D_{eff,T} \times A_b}{Q_{soil} \times L_t}\right)\left[exp\left(\frac{Q_{soil} \times L_{crack}}{D_{crack} \times A_{crack}}\right) - 1\right]} \quad \text{Equation 6}$$

Where:

α	=	Indoor air attenuation coefficient [-]
$D_{eff,T}$	=	Overall effective diffusion coefficient in soil [cm^2/s]
A_b	=	Area of enclosed space below grade [cm^2] {Table 23}
Q_b	=	Building ventilation rate [cm^3/s] {Table 23}
L_t	=	Depth below grade to top of contamination (i.e., sum of individual soil layer thicknesses) [cm] {Table 23}
Q_{soil}	=	Volumetric flow rate of soil gas into the building [cm^3/s] {Table 23}
L_{crack}	=	Thickness of building foundation [cm] {Table 23}
D_{crack}	=	Effective diffusion coefficient through the foundation; assumed to be equal to the effective diffusion coefficient through upper soil layer [cm^2/s]
A_{crack}	=	Total area of cracks through which vapours enter building [cm^2] {Table 23}

The overall effective diffusion coefficient in soil, $D_{eff,T}$, is calculated as follows:

$$D_{eff,T} = \frac{L_t}{\sum \frac{h_i}{D_{eff,i}}} \quad \text{Equation 7}$$

Where:

$D_{eff,T}$	=	Overall effective diffusion coefficient in soil [cm^2/s]
L_t	=	Depth below grade to top of contamination (i.e., sum of individual soil layer thicknesses) [cm] {Table 23}
h_i	=	Thickness of soil layer 'i' [cm] {Table 23}
$D_{eff,i}$	=	Effective diffusion coefficient through soil layer 'i' [cm^2/s]

The effective diffusion coefficient through each soil layer 'i' ($D_{eff,i}$) is calculated according to the following equation:

$$D_{eff,i} = D_a \frac{(\theta_{a,i})^{10/3}}{(n_i)^2} + \frac{D_w}{H'_{TS}} \frac{(\theta_{w,i})^{10/3}}{(n_i)^2} \quad \text{Equation 8}$$

Where:

$D_{eff,i}$ = Effective diffusion coefficient through soil layer 'i' [cm^2/s]

$D_{a/w}$ = Diffusivity of COPC in air ('a') or water ('w') [cm^2/s] {Table 24, Table 25, and Table 26}

$\theta_{a/w,i}$ = Air- ('a') or water ('w')-filled porosity of soil layer 'i' [cm^3/cm^3] {Table 23}

n_i = Total effective porosity of soil layer 'i' [cm^3/cm^3] {Table 23}

H'_{TS} = Dimensionless Henry's law constant of COPC at average soil/groundwater temperature (noted in Table 23) [-] {Table 24, Table 25, and Table 26}

The variables used in the above-detailed equations are obtained from the Ontario Ministry of Environment, Conservation and Parks are summarized in Table 23. Values for chemical-specific variables were also obtained from the Ontario Ministry of Environment, Conservation and Parks (MOECC 2016). The estimated source vapour concentrations from soil are presented in Table 24, Table 25, and Table 26 along with other variables used to determine the indoor air concentrations associated with volatile COPC in soil.

Table 23. Variables Used to Estimate Indoor Air Concentrations from Soil

<table>
<tr><th>Variable</th><th>Description</th><th>Units</th><th>Slab-On-Grade Building</th><th colspan="2">Comment</th></tr>
<tr><td>Q_b</td><td>Building ventilation rate</td><td>cm^3/s</td><td>$2.5x10^5$</td><td colspan="2">Calculated within J&E Model; default MECP building specifications</td></tr>
<tr><td>Q_{soil}</td><td>Average vapour flow rate into building</td><td>cm^3/s</td><td>25</td><td colspan="2">Default for slab-on-grade building, medium/fine soil</td></tr>
<tr><td>K_v</td><td>Soil vapour permeability</td><td>Cm^2</td><td>$2.5x10^{-9}$</td><td colspan="2">Default for slab-on-grade building, medium/fine soil</td></tr>
<tr><td>T_{avg}</td><td>Average soil temperature</td><td>°C</td><td>5</td><td colspan="2">Conservatively assumed</td></tr>
<tr><td>L_{crack}</td><td>Thickness of building foundation</td><td>cm</td><td>11.25</td><td colspan="2">Default for slab-on-grade building</td></tr>
<tr><td>A_b</td><td>Area of enclosed space below grade</td><td>cm^2</td><td>$3.0x10^6$</td><td colspan="2"></td></tr>
<tr><td>A_{crack}</td><td>Total area of cracks</td><td>cm^2</td><td>700</td><td colspan="2">Calculated within J&E model; default</td></tr>
<tr><td>L_t</td><td>Depth below grade to top of contamination</td><td>cm</td><td>41.25</td><td colspan="2">Assumed maximum concentration begins immediately below the gravel crush layer</td></tr>
<tr><td>ρ_b</td><td>Soil dry bulk density</td><td>g/cm^3</td><td>1.6</td><td colspan="2">Default for underlying gravel crush layer (MOE 2010)</td></tr>
<tr><td rowspan="2">h_i</td><td rowspan="2">Thickness of soil layer 'i'</td><td rowspan="2">cm</td><td>11.25</td><td colspan="2">Default depth below grade to bottom of foundation</td></tr>
<tr><td>30</td><td colspan="2">Default underlying gravel crush</td></tr>
<tr><td rowspan="2">n_i</td><td rowspan="2">Total effective porosity of soil layer 'i'</td><td rowspan="2">cm^3/cm^3</td><td>0.47</td><td colspan="2">Default for upper medium/fine soil</td></tr>
<tr><td>0.4</td><td colspan="2">Default for gravel crush (MOE 2010)</td></tr>
<tr><td rowspan="2">$\theta_{w,i}$</td><td rowspan="2">Water-filled porosity of soil layer 'i'</td><td rowspan="2">cm^3/cm^3</td><td>0.168</td><td colspan="2">Default for upper medium/fine soil</td></tr>
<tr><td>0.01</td><td colspan="2">Default for gravel crush (MOE 2010)</td></tr>
<tr><td rowspan="2">$\theta_{a,i}$</td><td rowspan="2">air-filled porosity of soil layer 'i'</td><td rowspan="2">cm^3/cm^3</td><td>0.302</td><td rowspan="2">$= n_i-\theta_{w,i}$</td><td>Upper medium/fine soil</td></tr>
<tr><td>0.390</td><td>Gravel crush</td></tr>
</table>

Notes: Default values as per the MGRA (MOECC 2016), unless otherwise specified.

The complete U.S. EPA (2004) J&E spreadsheet inputs and calculations are provided in Appendix A. Default values were generally used including those for soil vapour permeability and average vapour flow rate into the buildings (MOECC 2016). Average soil temperature was adjusted to 5 °C and the enclosed space height was set to 5 m for the garage and maintenance buildings (based on a reported total height of ~5.5 m) and the enclosed space height for the NUNA Camp and Potential Camp 1 was left at 3 m (based on a reported total height of ~3.5 m for the NUNA Camp). The spreadsheet tool was run separately for each PHC F2 sub-fraction, soil concentrations for each of these sub-fractions were calculated using the default soil PHC F2 breakdown provided in the PQRA calculation spreadsheet (Health Canada 2009).

Table 24. Chemical Specific Values Used to Estimate Indoor Air Concentrations from Soil for Main Station Buildings

Parameter	Soil EPC	Diffusivity in air	Diffusivity in Water	Henry's Law Constant	Soil Sat. Conc.	Soil water partition coefficient	Source Vapour Conc.	Indoor attenuation coefficient	Indoor air concentration[a]	Indoor air concentration breakdown
	µg/kg	cm²/s	cm²/s	unitless	µg/kg	cm³/g	µg/m³	unitless	µg/m³	%
	C_s	D_a	D_w	H'_{TS}	C_{sat}	K_d	C_{source}	α	$C_{building}$	-
PHC F2										
Aliphatic $C_{>10}$-C_{12}	604,080	0.05	6.00E-06	129	35,228	1,005	4,374,048	0.00006	258 [b]	59.3
Aliphatic $C_{>12}$-C_{16}	738,320	0.05	6.00E-06	557	15,339	20,047	423,682	0.00006	25 [b]	5.7
Aromatic $C_{>10}$-C_{12}	151,020	0.05	6.00E-06	0.15	252,260	10	2,246,355	0.00006	132	30.5
Aromatic $C_{>12}$-C_{16}	184,580	0.05	6.00E-06	0.06	116,392	20	329,555	0.00006	19	4.5
Total PHC F2	1,678,000	-	-	-	-	-	-	-	434	100

Notes: Chemical-specific parameters obtained from the Ontario Ministry of the Environment, Conservation and Parks (MOECC 2016)

[a] Estimated using the Johnson & Ettinger Model spreadsheet from the U.S. EPA.

[b] Based on saturation concentration, which is below estimate based on EPC soil concentration.

Table 25. Chemical Specific Values Used to Estimate Indoor Air Concentrations from Soil for NUNA Camp

Parameter	Soil EPC	Diffusivity in air	Diffusivity in Water	Henry's Law Constant	Soil Sat. Conc.	Soil water partition coefficient	Source Vapour Conc.	Indoor attenuation coefficient	Indoor air concentration[a]	Indoor air concentration breakdown
	µg/kg	cm²/s	cm²/s	unitless	µg/kg	cm³/g	µg/m³	unitless	µg/m³	%
	C_s	D_a	D_w	H'_{TS}	C_{sat}	K_d	C_{source}	α	$C_{building}$	-
PHC F2										
Aliphatic $C_{>10}$-C_{12}	158,040	0.05	6.00E-06	129	35,228	1,005	4,374,048	0.00010	430 [b]	79.2
Aliphatic $C_{>12}$-C_{16}	193,160	0.05	6.00E-06	557	15,339	20,047	423,682	0.00010	42 [b]	7.7
Aromatic $C_{>10}$-C_{12}	39,510	0.05	6.00E-06	0.15	252,260	10	587,694	0.00010	58	10.6
Aromatic $C_{>12}$-C_{16}	48,290	0.05	6.00E-06	0.06	116,392	20	136,729	0.00010	13	2.5
Total PHC F2	439,000	-	-	-	-	-	-	-	542	100

Notes: Chemical-specific parameters obtained from the Ontario Ministry of the Environment, Conservation and Parks (MOECC 2016)

[a] Estimated using the Johnson & Ettinger Model spreadsheet from the U.S. EPA.

[b] Based on saturation concentration, which is below estimate based on EPC soil concentration.

Table 26. Chemical Specific Values Used to Estimate Indoor Air Concentrations from Soil for Potential Camp 1

Parameter	Soil EPC	Diffusivity in air	Diffusivity in Water	Henry's Law Constant	Soil Sat. Conc.	Soil water partition coefficient	Source Vapour Conc.	Indoor attenuation coefficient	Indoor air concentration[a]	Indoor air concentration breakdown
	µg/kg	cm^2/s	cm^2/s	unitless	µg/kg	cm^3/g	µg/m^3	unitless	µg/m^3	%
	C_s	D_a	D_w	H'_{TS}	C_{sat}	K_d	C_{source}	α	$C_{building}$	-
PHC F2										
Aliphatic $C_{>10}$-C_{12}	1,836	0.05	6.00E-06	129	35,228	1,005	227,965	0.00010	22	76.4
Aliphatic $C_{>12}$-C_{16}	2,244	0.05	6.00E-06	557	15,339	20,047	61,981	0.00010	6.1	20.8
Aromatic $C_{>10}$-C_{12}	459	0.05	6.00E-06	0.15	252,260	10	6,827	0.00010	0.7	2.3
Aromatic $C_{>12}$-C_{16}	561	0.05	6.00E-06	0.06	116,392	20	1,588	0.00010	0.2	0.5
Total PHC F2	5,100	-	-	-	-	-	-	-	29	100

Notes: Chemical-specific parameters obtained from the Ontario Ministry of the Environment, Conservation and Parks (MOECC 2016)

[a] Estimated using the Johnson & Ettinger Model spreadsheet from the U.S. EPA.

[b] Based on saturation concentration, which is below estimate based on EPC soil concentration.

For the cases where exposure to J&E calculated indoor air was considered, the total predicted PHC F2 (from Table 24, Table 25, and Table 26) was used as an input into the PQRA spreadsheet and then the corresponding PHC F2 vapour sub-fraction breakdown was updated from the default to reflect the predicted breakdown shown in Table 24, Table 25, and Table 26.

Estimation of Outdoor Air Concentrations

The method for calculating volatilization from soil to ambient (outdoor) air used in the PQRA spreadsheet (Health Canada 2009) has been adapted from the methodology of ASTM International ASTM (1998)[1]. The vapour concentration in the ambient air ($C_{air,v}$) is calculated by applying a volatilization factor (VF) to the soil concentration (equations 9 to 12).

Volatilization from surficial soils (<1.5 m) to ambient air is estimated by using the lower of the two below calculations (equations 9 and 10):

$$VF_{ss,amb} = \frac{\rho_b}{DF_{amb}} \sqrt{\frac{4D^T_{eff}}{\pi\tau 31536000 s/y} \frac{H'}{K_d \rho_b}} \qquad \text{Equation 9}$$

$$VF_{ss,amb} = \frac{L_{ss}\rho_b}{DF_{amb}\tau 31536000 s/y} \qquad \text{Equation 10}$$

Where:

$VF_{ss,amb}$	=	volatilization factor from surficial soils to ambient air [-]
D^T_{eff}	=	effective diffusion coefficient from source to ambient air [cm²/s]
L_{ss}	=	depth to soil contamination [m]
DF_{amb}	=	dispersion factor for ambient air [cm/s] – see below
K_d	=	soil to water partition coefficient [mL/g]
H'	=	dimensionless Henry's Law Constant [-]
ρ_b	=	soil dry bulk density [g/cm³]
τ	=	averaging time for surface emission vapour flux [years] = 1 y

The dispersion factor for ambient air (DF_{amb}) is estimated as:

$$DF_{amb} = \frac{U_{air} W \delta_{air}}{A} \qquad \text{Equation 11}$$

Where:

[1] The active standard is E2081-00(2015), although the methodology is the same.

U_{air} = ambient air velocity in mixing zone [cm/s] = 225

W = width of source-zone area [cm] = smallest source dimension

δ_{air} = mixing zone height [cm] = 200

A = source-zone area [cm^2]

Finally, the ambient air concentration (in mg/m^3) of the volatile COPC is estimated as:

$$C_{air,y} = C_{soil} * VF_{ss,amb} \qquad \text{Equation 12}$$

The default values in the PQRA spreadsheet for fine-textured soil were used in the assessment (bulk density of 1.4 g/cm^3, porosity of 0.472, water-filled porosity of 0.168, air-filled porosity of 0.304), along with the physio-chemical properties (e.g. Henry's Law constant) and the default source dimensions. These values are shown in Appendix B.

7.2.3.2 Soil Dermal Contact Pathway

Dermal exposure for human receptors was calculated using equation 13 for soil contact:

$$I^{s}_{dermal} = \frac{C_{soil} \times (SA_H \times SL_H + SA_A \times SL_O) \times RAF \times EF \times D_1 \times D_2 \times D_3}{BW \times LE} \qquad \text{Equation 13}$$

Where:

I^{s}_{dermal} = exposure to COPC in soil through the dermal pathway [mg/(kg-d)]

C_{soil} = soil concentration [mg/(kg dw)]

SA_H = skin surface area – hands [cm^2]

SL_H = loading to exposed skin - hands [(kg dw)/(cm^2 event)]

SA_A = skin surface area – arms [cm^2]

SL_O = loading to exposed skin – surfaces other than hands [(kg dw)/(cm^2 event)]

RAF = dermal absorption factor [-]

EF = exposure frequency [events/d] {assumed to be 1 event per day}

D_1 = days per week exposed/7 days [d/d]

D_2 = weeks per year exposed/52 weeks [wk/wk]

D_3 = total years exposed to site [y] {for carcinogenic COPC only}

BW = body weight [kg]

LE = life expectancy [y] {for carcinogenic COPC only}

The receptor characteristics that go into equation 13 are presented above in Table 14 and Table 15. The value for the soil loading to exposed skin is based on the soil adherence value, which represents the amount of soil retained on the skin, and the skin surface area. Several studies have attempted to determine the soil adherence value and are summarized in the U.S. EPA (2011) Exposure Factors Handbook. Values used in this assessment are from the MECP (MOECC 2016).

7.2.3.3 Soil Ingestion Pathway

Ingestion intake by human receptors was calculated using equation 14 for the soil pathway:

$$I_{soil} = \frac{C_{soil} \times IR_{soil} \times AF_{ing} \times D_1 \times D_2 \times D_3 \times CF}{BW \times LE} \qquad \text{Equation 14}$$

Where:

I_{soil}	=	exposure to COPC through the ingestion of soil pathway [mg/(kg-d)]
C_{soil}	=	soil concentration [mg/(kg dw)]
IR_{soil}	=	soil ingestion rate [(g dw)/d]
AF_{ing}	=	ingestion absorption factor [-] {assumed to be 1}
D_1	=	days per week exposed/7 days [d/d]
D_2	=	weeks per year exposed/52 weeks [wk/wk]
D_3	=	total years exposed to site [y] {for carcinogenic COPC only}
BW	=	body weight [kg]
LE	=	life expectancy [y] {for carcinogenic COPC only}
CF	=	conversion factor 1.0×10^{-3} [kg/g]

The receptor characteristics that go into equation 14 are presented above in Table 14 and Table 15.

7.2.4 Exposure Results

The total intake of each COPC by the human receptor was calculated using the equations provided above, which are in the Health Canada PQRA spreadsheets (Health Canada 2009). The PQRA spreadsheets are presented in Appendix B. The exposure estimates for the soil ingestion, dermal contact and inhalation pathways for the staff (office workers), O&M workers, and construction workers are provided below in Table 27.

Table 27. Calculated COPC Intakes for Human Receptors

Receptor	Exposure Details	Pathway	Intake (mg/kg-d)			
			Arsenic	Lead	PHC F1	PHC F2
Office Worker	The office worker spends most of their time indoors in an uncontaminated area and 2 hours of their time outdoors	Ingestion (soil)	2.7×10^{-7}	2.6×10^{-6}	1.9×10^{-5}	4.4×10^{-4}
		Inhalation	8.4×10^{-11}	1.4×10^{-10}	1.8×10^{-4}	2.0×10^{-3}
		Dermal (soil)	3.6×10^{-7}	7.0×10^{-7}	1.7×10^{-4}	4.1×10^{-3}
		Total	$\mathbf{6.3 \times 10^{-7}}$	$\mathbf{3.3 \times 10^{-6}}$	$\mathbf{3.7 \times 10^{-4}}$	$\mathbf{6.5 \times 10^{-3}}$
Operations and Maintenance Worker	This O&M worker spends all their time working indoors in the Powerhouse and Maintenance buildings and the garage and spends 2 hours a day outside at the Main Station area.	Ingestion (soil)	3.5×10^{-7}	3.4×10^{-6}	2.5×10^{-5}	5.9×10^{-4}
		Inhalation [a]	1.1×10^{-10}	1.8×10^{-10}	2.5×10^{-4}	2.9×10^{-2}
		Dermal (soil)	4.8×10^{-7}	9.3×10^{-7}	2.3×10^{-4}	5.4×10^{-3}
		Total	$\mathbf{8.4 \times 10^{-7}}$	$\mathbf{4.3 \times 10^{-6}}$	$\mathbf{5.0 \times 10^{-4}}$	$\mathbf{3.5 \times 10^{-2}}$
	This O&M worker spends all their time working indoors in the Powerhouse and Maintenance buildings and the garage and spends 2 hours a day outside at the Airstrip area doing various activities.	Ingestion (soil)	2.2×10^{-7}	2.2×10^{-6}	N/A [b]	2.4×10^{-4}
		Inhalation [a]	7.0×10^{-11}	1.2×10^{-10}	N/A [b]	2.7×10^{-2}
		Dermal (soil)	3.0×10^{-7}	6.1×10^{-7}	N/A [b]	2.2×10^{-3}
		Total	$\mathbf{5.2 \times 10^{-7}}$	$\mathbf{2.9 \times 10^{-6}}$	**N/A [b]**	$\mathbf{2.9 \times 10^{-2}}$
Construction Worker	This is a water/sewage construction worker at the Main Station area who stays at Potential Camp 1.	Ingestion (soil)	8.9×10^{-8}	8.5×10^{-6}	6.2×10^{-5}	1.5×10^{-3}
		Inhalation	4.0×10^{-8}	6.4×10^{-8}	1.1×10^{-3}	1.4×10^{-2}
		Dermal (soil)	2.4×10^{-7}	4.7×10^{-6}	1.1×10^{-3}	2.7×10^{-2}
		Total	$\mathbf{3.7 \times 10^{-7}}$	$\mathbf{1.3 \times 10^{-5}}$	$\mathbf{2.3 \times 10^{-3}}$	$\mathbf{4. \times 10^{-2}}$
	This is a construction worker doing rehabilitation work at the Airstrip who stays at the NUNA camp	Ingestion (soil)	5.5×10^{-8}	5.6×10^{-6}	N/A [b]	5.9×10^{-4}
		Inhalation	2.5×10^{-8}	4.2×10^{-8}	N/A [b]	3.4×10^{-2}
		Dermal (soil)	1.5×10^{-7}	3.1×10^{-6}	N/A [b]	1.1×10^{-2}
		Total	$\mathbf{2.3 \times 10^{-7}}$	$\mathbf{8.7 \times 10^{-6}}$	**N/A [b]**	$\mathbf{4.6 \times 10^{-2}}$

Notes:

[a] Indoor air concentration calculated using J&E calculations for estimating soil vapour intrusion. Intakes calculated using indoor air concentrations based on sub-slab vapour data are included in Appendix B.

[b] PHC F1 not a COPC at the Airstrip and not present at detectable levels near the Airstrip or Main Station buildings.

7.3 Toxicity Assessment

Toxicity refers to the ability of a COPC to cause temporary or permanent adverse effects in the body. Toxicity depends on several factors such as form of the chemical, the amount of exposure and the duration of exposure.

For COPC that do not cause cancer, there is a permissible (safe) level or threshold dose below which adverse health effects are not expected to occur. These permissible levels are set by regulatory agencies such as Health Canada and the U.S. EPA based on scientific studies from laboratory animal tests or on human epidemiological studies or workplace exposure investigations. These studies are reviewed by a number of experienced scientists in a wide range of scientific disciplines in order to determine the maximum dose that a human can be exposed to without having an adverse health effect. Permissible doses are usually reported as the amount of chemical per unit body weight per unit time that a person may be exposed to every day of their entire life that will not cause adverse health effects. It should be noted that exposure above a permissible level does not mean that an effect will occur, but instead means that there is an increased risk of an adverse effect occurring. Lead and petroleum hydrocarbons do not cause cancer.

A Toxicity Reference Value (TRV) is defined as an exposure concentration or dose for a COPC below which adverse effects in a receptor are not observed. Toxicity Reference Values (TRVs) are intended to protect the most sensitive individuals (e.g., the elderly, pregnant women, children, etc.) as well as people with compromised health such as asthmatics. The values selected for humans in the HHERA are summarized in Table 28 for non-carcinogenic COPC and Table 29 for carcinogenic COPC (i.e., arsenic). The tables summarize TRVs for exposure via direct contact (i.e., oral TRVs) and inhalation.

Table 28. Summary of Non-carcinogenic TRVs for Humans

COPC	Oral Toxicity Reference Value			Inhalation Toxicity Reference Value		
	Value mg/(kg-d)	Source	Endpoint	Value mg/m^3	Source	Endpoint
Arsenic	$3.0x10^{-4}$	U.S. EPA (2020; last updated 1991)	Hyperpigmentation, keratosis and possible vascular complications	-	-	-
Lead	$1.5x10^{-3}$	JECFA (FAO and WHO 2011), Wilson and Richardson (2012)	Decrease in IQ	-	-	-
PHC F1 Aliphatic C_6-C_8	5	CCME (2008)	Neurotoxicity	18.4	CCME (2008)	Neurotoxicity
PHC F1 Aliphatic C_8-C_{10}	$1.0x10^{-1}$	CCME (2008)	Hepatic and hematological changes	1	CCME (2008)	Hepatic and hematological changes
PHC F1 Aromatic C_8-C_{10}	$4.0x10^{-2}$	CCME (2008)	Decreased body weight	$2.0x10^{-1}$	CCME (2008)	Decreased body weight

COPC	Oral Toxicity Reference Value			Inhalation Toxicity Reference Value		
	Value mg/(kg-d)	Source	Endpoint	Value mg/m^3	Source	Endpoint
PHC F2 Aliphatic $C_{>10}$-C_{12}	1.0x10^{-1}	CCME (2008)	Hepatic and hematological changes	1	CCME (2008)	Hepatic and hematological changes
PHC F2 Aliphatic $C_{>12}$-C_{16}	1.0x10^{-1}	CCME (2008)	Hepatic and hematological changes	1	CCME (2008)	Hepatic and hematological changes
PHC F2 Aromatic $C_{>10}$-C_{12}	4.0x10^{-2}	CCME (2008)	Decreased body weight	2.0x10^{-1}	CCME (2008)	Decreased body weight
PHC F2 Aromatic $C_{>12}$-C_{16}	4.0x10^{-2}	CCME (2008)	Decreased body weight	2.0x10^{-1}	CCME (2008)	Decreased body weight

Arsenic is known to cause cancer. For chemicals that cause cancer, the total exposure over an entire lifespan (from birth to death) is generally calculated using a lifetime receptor; however as only adults are present at the HAWS, the cancer risks from exposure to arsenic are calculated based on the lifespan of an adult. For cancer to occur, a person needs to be exposed for a very long time to arsenic before an adverse effect is observed. The cancer-causing power of a carcinogen is represented by its cancer slope factor. These are values set by regulatory agencies such as Health Canada and the U.S. EPA based on specially designed cancer studies in humans or laboratory animals. Cancer slope factors are used in combination with the average adult lifetime exposure estimates for carcinogens to estimate cancer risks.

Table 29. Summary of Carcinogenic TRVs for Humans

COPC	Oral Toxicity Reference Value			Inhalation Toxicity Reference Value		
	Value (mg/(kg-d))$^{-1}$	Source	Endpoint	Value (mg/m^3)$^{-1}$	Source	Endpoint
Arsenic	1.8	Health Canada (2010b)	Internal cancers	6.4	Health Canada (2010b)	Lung cancer

7.4 Risk Characterization

The results of the risk characterization for the HHRA are provided in the following sections; more detailed results are provided in Appendix B.

7.4.1 Exposure to Carcinogens

Of the COPC selected for the Eureka HHRA, arsenic is the only one known to cause cancer. Any level of exposure to a cancer-causing chemical such as arsenic is associated with some level of risk. Thus, an acceptable level of risk must be set for these chemicals. Acceptable risks are provided by regulators in the form of incremental lifetime cancer risks, which are set at risk levels considered to be negligible.

Health Canada's negligible incremental lifetime cancer risk level is one-in-one hundred thousand people (1 in 100,000 or $1x10^{-5}$).

For arsenic, the risk was calculated by multiplying the average daily dose over the adult life stage by the cancer slope factor (TRV) to estimate the incremental lifetime cancer risk. The calculated incremental cancer risks due to arsenic are presented below in Table 30 for the selected receptors. As can be seen, all calculated incremental risks are below the benchmark of $1x10^{-5}$ indicating there are no potential risks due to carcinogens under the evaluated exposure scenarios.

Table 30. Summary of Incremental Cancer Risk

Receptor	Details	Arsenic Incremental Cancer Risk
Office Worker	The office worker spends most of their time indoors in an uncontaminated area and 2 hours of their time outdoors	1.1×10^{-6}
Operations and Maintenance Worker	This O&M worker spends all their time working indoors in the Powerhouse and Maintenance buildings and the garage and spends 2 hours a day outside at the Main Station area.	1.5×10^{-6}
	This O&M worker spends all their time working indoors in the Powerhouse and Maintenance buildings and the garage and spends 2 hours a day outside at the Airstrip area doing various activities.	9.4×10^{-7}
Construction Worker	This is a water/sewage construction worker at the Main Station area who stays at Potential Camp 1.	6.1×10^{-7}
	This is a construction worker doing rehabilitation work at the Airstrip who stays at the NUNA camp	3.8×10^{-7}

Notes: **Bold** values exceed benchmark of $1x10^{-5}$

7.4.2 Exposure to Non-Carcinogens

Arsenic, lead, and petroleum hydrocarbons (PHC F1 and F2 fractions) are considered to be non-carcinogens. The risk for these chemicals is determined by comparing the calculated exposure estimates to the Permissible dose or safe level. This is known as the hazard quotient. When the calculated exposure is below the safe level, adverse health effects are not expected. In this case, risks may be considered to be insignificant or negligible. If the calculated exposure estimate exceeds the safe level, then the risk of an adverse health effect cannot be ruled out.

In this assessment because all pathways are not evaluated, a HQ benchmark of 0.2 was used for determination of the potential risks from exposure to arsenic and lead. This means that only 20% of the permissible (safe) level is assumed to be associated with the soil contact and inhalation exposures. For petroleum hydrocarbons (PHCs) a HQ value of 0.5 is acceptable for evaluating exposure as most exposure to PHCs is associated with the soil and inhalation pathways. Calculated HQ values are shown below in Table 31. From the table it can be seen that no HQ values were calculated to be above the selected benchmarks, and so, there are no potential risks associated with the evaluated land use scenarios. For PHC F2, two different HQ values are provided based on the calculation of indoor air concentrations calculated using two different methods. One method uses the J&E model to calculate indoor air from soil concentrations and is generally considered to be a conservative estimate of exposure. The exposure using the J&E model results are similar to the exposures from the measured indoor air concentrations which have contributions from other indoor air sources. The sub-slab vapour concentrations are generally thought to be better representations of the realistic indoor air concentrations. Both these methods for calculating indoor air result in HQ values below the acceptable value of 0.5.

The results for the CANDAC worker exposed to PHC F1, PHC F2, and PHC F3 are provided in Appendix G as the EPCs for PHC F1 and PHC F2 in the old tank farm area are higher than the EPC values used in the assessment. Exposure to arsenic and lead are covered in the scenarios provided in Table 31. The HQ value for exposure to PHC F2 by a CANDAC worker is 0.16 and thus falls within the range of the results in Table 31; however, the HQ value for exposure to F1 by a CANDAC worker of 0.43 is higher than HQ values associated with F1 exposure presented in the table.

Table 31. Summary of HQ Values

Receptor	Details	HQ Value			
		Arsenic	Lead	PHC F1	PHC F2
Office Worker	The office worker spends most of their time indoors in an uncontaminated area and 2 hours of their time outdoors	0.01	0.002	0.002	0.07
Operations and Maintenance Worker	This O&M worker spends all their time working indoors in the Powerhouse and Maintenance buildings and the garage and spends 2 hours a day outside at the Main Station area.	0.02	0.003	0.002	0.14 (SSV) 0.36 (J&E)
	This O&M worker spends all their time working indoors in the Powerhouse and Maintenance buildings and the garage and spends 2 hours a day outside at the Airstrip area doing various activities.	0.01	0.002	NA	0.09 (SSV) 0.30 (J&E)
Construction Worker	This is a water/sewage construction worker at the Main Station area who stays at Potential Camp 1.	0.07	0.009	0.009	0.42
	This is a construction worker doing rehabilitation work at the Airstrip who stays at the NUNA camp	0.04	0.006	NA	0.29

Notes: **Bold** values exceed selected benchmark of 0.2 (0.5 for PHCs); SSV – exposure estimated using sub-slab vapour measurements to estimate indoor air; J&E – exposure estimated using J&E calculations to estimate indoor air from soil. NA – no PHC F1 fraction measured in Airstrip area.

7.4.3 Human Health Risk Summary

In summary there are no health risks from the COCs to people engaging in any types of work activities at the Eureka HAWS.

7.4.4 Uncertainties

There are several areas of uncertainty in conducting a risk assessment due to the fact that assumptions have to be made throughout the assessment either due to data gaps, environmental fate complexities, and other human characteristics. An accounting of the uncertainty is provided to be able to place a level of confidence in the results. The magnitude and type of uncertainty are important in determining the significance of results. In recognition of these uncertainties, conservative assumptions were used throughout the assessment to ensure that the potential for exposure and risks would not be underestimated. The major assumptions are outlined below.

The COPC concentrations used in the assessment were based mainly on measured data. Indoor air concentrations were evaluated using measured data, sub-slab vapour measurements and calculations from soil using the Johnson & Ettinger Model. For sub-slab vapour measurements and attenuation factor was used to determine the indoor air concentrations. Each method had inherent uncertainties due to additional sources that affected indoor measurements or various assumptions in calculating air concentrations. For the Johnson & Ettinger Model, it assumes that the PHC F1 and F2 concentrations are directly under the building when in reality they are not. The risks to humans from the indoor pathway is low and therefore the use of any methodology does not change the results of the assessment.

In terms of evaluating exposure to indoor air at the Camp locations, there were no soil samples collected directly in the area and so samples in the vicinity of where the NUNA camp is located and in the area of potential Camp 1 for the water/sewage construction workers were used to develop the indoor air concentrations. As it is expected that the NUNA camp and the other potential camp locations for the water/sewer construction workers will be located in areas of no potential contamination, the assumptions used are most likely an overestimate of exposure.

The use of reasonable maximum exposure concentrations, which were generally an upper estimate (95% UCLM) values of measured data are a realistic evaluation of the risk as people would not spend all of their time in one particular location. For the indoor air exposure for the potential Camp 1, the maximum concentration from 2007 (the only data available in this area) was used and thus may potentially overestimate exposure.

The human receptor characteristics are also a source of uncertainty. The use of single values for various characteristics to evaluate exposure may overestimate exposure. For example, it has been assumed that an adult weighs 70.7 kg, when in reality an adult is likely to weigh more, thereby reducing the daily intake on a body weight basis (Richardson and Stantec 2013).

A modified Version of the Health Canada Preliminary Quantitative Risk Assessment spreadsheet was used to calculate the exposure estimates for the various receptors. It is acknowledged that this spreadsheet is not supported by Health Canada; however, the parts of the spreadsheet that were used have changed since the spreadsheet was developed. Parameters that have changed such as the TRVs have been modified to represent current values. The indoor air concentrations were determined outside of the spreadsheet. Thus there is some uncertainty in the use of the spreadsheets. The calculation of the indoor air concentrations outside the model resulted in an overestimate of exposure. As this was the major exposure pathway, the overall outcome of the use of the spreadsheet is an overestimate of exposure.

The TRVs are obtained from authoritative sources (e.g., Health Canada, CCME); nonetheless, they are always associated with uncertainty due to the extrapolation of testing on lab species (e.g., rats, mice, etc.) to field conditions as well as a range of receptors. Additionally, toxicity information for arsenic, and lead was used regardless of its form in the test procedure, even though this may not be the same form in the environment (i.e., an oxide form compared to a more soluble form). In the derivation of cancer TRVs for arsenic, the linear extrapolation of data in the low-dose region of the dose-response curve is assumed to be sufficiently conservative to account for uncertainties related to the TRV. The use of an upper bound for the toxicity values ensures that the risk to humans is not underestimated. Currently, it is not possible or practical to develop approaches to evaluate the validity of the TRV assumptions on the overall assessment. As improvements occur in toxicological/human health research and assessments, the uncertainties may be reduced. The toxicity value for lead is currently under review by a number of agencies and thus there is uncertainty in the assessment of lead. The most current values are used in the assessment and the hazard quotient values are so low than a significant change to the toxicity value will be needed to change the conclusion of the results. In addition lead toxicity is primarily associated with decreased IQ in children and not adults.

The effect cumulative of multiple COPC on risk was not evaluated in this assessment. When dealing with toxic chemicals, there is potential interaction with other chemicals that may be found at the same location. From a human health perspective, it has been established that synergism, potentiation, antagonism or additivity of toxic effects may occurs in the environment. A quantitative assessment of these interactions is outside the scope of this study and would be constrained, as there is not an adequate base of toxicological evidence to quantify these interactions. A simple qualitative assessment looking at the non-carcinogenic endpoints for humans indicates that there are no similar endpoints and, thus, risks are not considered to be additive. Therefore, the effects of multiple COPC on the assessment are anticipated to be negligible.

Table 32 provides a summary of the uncertainties and tries to assign a value to the uncertainty. It must be noted that these are approximations; however, in general it is accepted in the risk assessment community that the conservative assumptions used in the assessment generally result in overestimates of the risks by a factor of two to five. It can be seen from the table that, in general, the uncertainties used in the assessment lead either to an overestimate of exposures. Based on Table 32, the conclusions of the assessment are considered valid and reliable for the intended purpose.

Table 32. Summary of Uncertainties in the HHRA

Uncertainty	Overestimate	Possible Underestimate or Neutral Effect	Comment
Estimation of air concentrations using soil concentrations and sub-slab vapor concentrations			Indoor air concentrations were estimated using two different sources, soil and sub-slab vapour. Based on experience the estimation of indoor air concentrations from soil tends to overestimate the concentrations. Additionally the indoor air measurements had interference from other sources inside the buildings which would overestimate exposures. Could overestimate exposure by a factor of 3 to 5.
Use of soil concentrations in the vicinity of the camps			The use of soil measurements from contaminated areas and also older data would tend to overestimate exposure. Hard to determine the magnitude.
Use of reasonable maximum exposure concentrations to characterize exposures			The use of the 95% UCLM to represent exposures for most media with the exception of food may overestimate exposures by a factor up to two.
Use of single values for human receptor characteristics such as body weight			People are different and weigh different amounts and drink various amounts of water etc. This may result in an overestimate of exposure by a factor up to two.
Use of a modified version of the Health Canada PQRA spreadsheet with external indoor air calculations.			The use of the equations in the spreadsheet was appropriate as the equations and parameters are unchanged. Indoor air calculations were calculated separately and led to an overestimate of exposure by a factor of 3 to 5.
Safety factors used by agencies in developing toxicity values			Regulatory agencies use safety factors when they develop toxicity values to try to make sure that sensitive people such as toddlers and elderly are protected. This tends to overestimate risks by a factor of three to 10.
Lead toxicity TRV			Most current values are used in the assessment. Lead toxicity is primarily associated with decreased IQ in children and not adults. A significant change to the toxicity value will be needed to change the conclusion of the results.
Synergism, potentiation, antagonism, additivity of toxic effects			Toxicity endpoints were not the same and therefore this may be a neutral effect

8.0 Ecological Risk Assessment

The ecological risk assessment (ERA) considers both the aquatic and terrestrial environments at the Eureka HAWS. For the aquatic environment, the focus is on the Drainage Pond and the Stream Area where aquatic communities could be present (see Figure 3). Ponded water in the terrestrial environment are not considered to support aquatic life. For the terrestrial environment, the Main Station area and the Airstrip Area are considered separately. These areas have been discussed in Section 4.0.

8.1 Problem Formulation

In the ERA a discussion is provided on the COPC from an ecological perspective. Relevant exposure pathways are considered within the problem formulation and all of these are considered in the ecological conceptual site model that portrays a current understanding of the contaminant sources, transport mechanisms, exposure pathways and ecological receptors.

8.1.1 Hazard Identification

The screening process to identify COPC for the ERA was described in Section 6.0. From an ecological perspective, the screening process in soil, identified the following COPC for quantitative analysis in the ERA:

- Arsenic, boron (hot water soluble), copper, lead, zinc, PHC F1, PHC F2, PHC F3, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene

From the surface water screening process, the following COPC are identified for quantitative analysis in the ERA:

- Cadmium

From the sediment screening process, the following COPC are identified for further analysis in the ERA:

- Manganese and zinc
- Benzene, ethylbenzene, xylenes and PHC F1, PHC F2 and PHC F3
- PAHs –2-methynaphthalene, acenaphthene, acenaphthylene, benzo(a)pyrene, fluorene, naphthalene, phenanthrene and pyrene

8.1.2 Receptor Identification

Ecological receptors are ecological entities exposed to a COPC. This term may refer to plants and animals (including endangered and threatened species), habitats, or ecosystems. It is neither practical, nor necessary, to individually assess each wildlife species that may potentially occupy, visit, or live on the

Eureka HAWS. Instead, a subset of terrestrial and aquatic wildlife receptors of concern were selected by selecting ecological receptors that are:

- Indigenous to the area and would be potentially exposed to COPC from the HAWS;
- Most likely to receive the greatest exposure to COPC due to their habitat, behavioral traits, and home range;
- Representative of various level in the trophic web (e.g., carnivore, herbivore); and,
- Potentially at risk because they have been classified as being rare or endangered (i.e., species of conservation concern).

Thus, an ERA evaluates one or more of the following groups of ecological receptors, depending on the types of animals that are likely to be present at the site:

- Aquatic community receptors: Fish, benthic invertebrates, plankton, aquatic plants;
- Semi-aquatic receptors: Amphibians, piscivorous birds, piscivorous mammals, plants;
- Terrestrial receptors: Insects (e.g., pollinators such as honeybees), small mammals, large mammals, birds, soil organisms (plants, soil invertebrates, soil microbes).

Ecological receptors from the previous DQRA (Franz/Senes 2011) were reviewed and modified based on considerations of wildlife found in the Arctic and those observed around the HAWS.

There are no plant community surveys at the HAWS but it is in the Ecodistrict 21 where plant communities such as low-growing herbs and shrubs such as purple saxifrage, arctic willow, sedge and arctic poppy may grow (ARCADIS 2016).

Wildlife sightings at the HAWS include muskox, arctic hare, and wolves. Waterfowl including red-neck loons have been observed on the Fjord (ARCADIS 2016). Terns, foxes, geese, snow buntings, and Lapland longspurs have also been seen at the HAWS (ARCADIS 2016). Polar bears have also been observed at a distance from the HAWS. There are no semi-aquatic receptors present at the HAWS.

Table 33 provides the ecological receptors selected in the aquatic environment. These receptors were selected to evaluate the exposure to cadmium in surface water and metals, PHC and PAHs in sediments in the Drainage Pond and Stream Area. As discussed in Section 4.8.1, the red knot is a SARA species, and so will be evaluated on an individual basis as well as on a population level.

Table 33. Ecological Receptors Selected for the Aquatic Environment

Aquatic Receptor Group	Aquatic Receptor Type	Selected Receptor
Aquatic Community in Water column	Aquatic community	Aquatic community including fish through use of a Species sensitivity distribution curve.
Benthic Invertebrates	Benthos Community	Benthic Invertebrate Infaunal Community
Mammal		No aquatic or semi-aquatic mammals on the HAWS
Bird	Herbivorous Benthivorous Piscivorous	Northern Pintail Red Knot Glaucous Gull

The results of the previous DQRA (Franz/Senes 2011) showed that large mammals such as caribou and wolves with large home ranges had very little exposure at the HAWS in proportion to their range, therefore the risks were extremely low. Muskoxen have similar home ranges to these two species will thus also experience extremely low risks from exposure at the HAWS. Therefore, the focus of this ERA was on mammals and birds with small home ranges that would potentially be the most exposed species.

Table 34 provides the ecological receptors selected for exposure to soils at the HAWS. These receptors are similar to the receptors evaluated in the previous ERA with the exception of some of the larger receptors and lemmings. The Arctic hare has the same characteristics as the lemming and thus was used as a surrogate for this species. The receptor characteristics for the selected ecological receptors is provided in Appendix C.

Table 34. Ecological Receptors Selected for the Terrestrial Environment

Terrestrial Receptor Group	Terrestrial Receptor Type	Selected Receptor
Vegetation	Vegetation Community	Vegetation Community
Mammal	Herbivorous Insectivorous Carnivorous Omnivorous	Arctic Hare None Arctic fox None
Bird	Herbivorous Omnivorous Carnivorous	Rock Ptarmigan Snow Bunting Snowy Owl

8.1.3 Pathways of Exposure

The ecological receptors selected cover a range of diets and trophic levels. Table 35 summarizes the pathways of exposure that are considered for each of the receptors.

It should be noted that dermal exposure and inhalation are two pathways that are considered complete but will not be included in the ERA. Dermal exposure (direct contact with soil and sediment and transfer through the skin) for mammals and birds is usually considered to be insignificant, as the feathers of birds and fur on mammals reduce dermal exposure by limiting the contact of the skin surface with the contaminated media (U.S. EPA 2003). With respect to inhalation, this exposure is expected to be much lower than those from other pathways such as food ingestion and is typically not included in ERAs (FCSAP 2012a).

Table 35. Exposure Pathways for the Selected Receptors

Group	Receptor	Direct Contact (water)	Direct Contact (sediment or soil)	Water Ingestion	Sediment Ingestion	Soil Ingestion	Ingestion of Food	Food items
Water column organisms	Aquatic Community	✓						
Benthic invertebrates	Benthic invertebrate community	●	✓					
Vegetation	Vegetation community		✓					
Mammals	Arctic Hare			✓		✓	✓	Vegetation
	Arctic Fox			✓		✓	✓	Vegetation Small mammals / birds Invertebrates
Birds	Northern Pintail			✓	✓		✓	Aquatic plant Benthic invertebrate
	Red Knot			✓	✓		✓	Benthic invertebrate
	Snowy Owl			✓		✓	✓	Small mammals / birds
	Glaucous Gull			✓	✓		✓	Fish
	Rock Ptarmigan			✓		✓	✓	Vegetation
	Snow Bunting			✓		✓	✓	Soil invertebrates and seeds

Notes: Direct contact with water includes absorption and uptake across surface membranes/gills, ingestion, as well as indirect pathways such as food.
Direct contact with sediment includes absorption and uptake across surface membranes, ingestion, as well as indirect pathways such as food.
● Pathway of exposure implicitly included in the assessment.
✓ Pathway of exposure explicitly included in the assessment.

8.1.4 Locations of Exposure

Ecological receptors in the aquatic environment such as water column organisms, fish, Red Knot, Northern Pintail and Glaucous Gull were evaluated in the Drainage Pond and Stream Area.

Ecological receptors in the terrestrial environment such as plants, Arctic Hare, Arctic Fox, Rock Ptarmigan, Snow Bunting and Snowy Owl were evaluated at the Main Station Area and the Airstrip Area.

8.1.5 Conceptual Site Model

The Conceptual Site Model for the HAWS provides a visual representation of the different pathways that were evaluated in the risk assessment as well as the ways that the COPC move from the soil, sediment, and water and are taken up by plants, fish, and other animals. The CSM for the terrestrial environment is provided in Figure 12. The CSM for the aquatic environment is provided in Figure 13.

8.1.6 Assessment Endpoints and Measurement Endpoints

For this ERA, specific protection goals have not been established. The assessment focusses on assessing the risk of potential adverse effects to ecological receptors that could be used in the decision-making process for the remedial actions at the HAWS as appropriate.

To determine the ecological significance of exposure to a COPC, ecological endpoints need to be selected. These endpoints are characteristics of an ecological component (such as fish mortality) that may be affected by exposure to a given constituent (Suter 1993; U.S. EPA 1992). There are two types of endpoints: assessment and measurement (Table 36). Assessment endpoints are explicit expressions of actual environmental values to be protected (U.S. EPA 1992; FCSAP 2012b). The assessment endpoints for this ERA include:

- maintenance of the health and ecological integrity of the benthic invertebrate community;
- maintenance of the health and ecological integrity of water column organisms;
- maintenance of the health and ecological integrity of the wildlife that use the aquatic resources on the site;
- maintenance of the health and ecological integrity of the vegetation community on the site; and
- maintenance of the health and ecological integrity of the wildlife that use the terrestrial areas of the site.

For determining the health and ecological integrity of receptors, consideration was given to effects at a population level. A higher level of protection is appropriate for species at risk.

Due to the difficulty in measuring direct effects on assessment endpoints, “measurement endpoints” are adopted to provide a framework for the evaluation of predicted effects. A measurement endpoint is defined as “a quantitative summary of the results of a toxicity test, a biological study, or other activity intended to reveal the effects of a substance” (Suter 1993). A measurement endpoint is a parameter that measures or describes exposure of, or an effect on, a receptor of concern (FCSAP 2012a). The measurement endpoints used in this assessment were:

- Comparison of measured concentrations in water, sediment and soil to regulatory guidelines;
- Laboratory toxicity testing of sediment and benthic community evaluation and,
- The use of a food chain model that tracks the movement of COPC through the environment and estimates the intake of COPC by wildlife. These intakes were compared to toxicity benchmarks.

Table 36. Summary of Assessment and Measurement Endpoints

Assessment Endpoint	Line of Evidence	Measurement Endpoint
Maintenance of the health and ecological integrity of the benthic invertebrate community	Sediment Chemistry	Sediment chemistry is compared to benchmarks (Interim Sediment Quality Guidelines [ISQG] and PELs from CCME and other benchmarks, if available).
	Sediment Toxicity*	Whole sediment laboratory toxicity tests on representative benthic invertebrate species (14-d *Hyalella azteca* and 10-d *Chironomus sp*).
	Benthic Community*	As a measure of the bioaccumulation, benthic invertebrate tissue data compared to data from reference locations.
Maintenance of the health and ecological integrity of water column organisms	Water Chemistry	Water chemistry is compared to toxicity benchmarks are based on endpoints such as growth, survival, and/or reproduction (generally using Species Sensitivity Distributions).
Maintenance of the health and ecological integrity of the wildlife that use the aquatic resources on the site	Food chain model	Comparison of estimated exposure to COPC from the food chain to toxicity benchmarks that are based on endpoints such as growth, survival, and reproduction.
Maintenance of the health and ecological integrity of the vegetation community on the site	Soil Chemistry	Soil chemistry is compared to the ecological component of regulatory guidelines.
Maintenance of the health and ecological integrity of the wildlife that use the terrestrial areas of the site	Food chain model	Comparison of estimated exposure to COPC from the food chain to toxicity benchmarks that are based on endpoints such as growth, survival, and reproduction.

Notes: *These lines of evidence were described in Franz/Senes (2011).

8.2 Exposure Assessment

There are many factors that go into evaluation of exposure, including receptor characteristics, receptor location, and the levels of COPC in different parts of the environment (e.g., water, soil, plants). These factors are discussed in the following sections.

The evaluation of potential effects on aquatic biota (e.g., benthic invertebrates, fish, aquatic plants) relies on water and sediment concentrations to assess direct exposure, while terrestrial plants are evaluated based on soil concentrations. For other aquatic and terrestrial receptors (i.e., mammals and birds) the exposure assessment relies on water, sediment, and soil concentrations as well as predicted concentrations for each dietary component through the food chain.

Boron, PHCs (F1, F2 and F3), 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene were not carried through the food chain model due to the fact that that food web transfer does not occur. The following paragraphs provide a discussion of these COPC.

CCME indicates that boron does not significantly bioconcentrate or biomagnify in the aquatic environment (CCME 2009). In the terrestrial environment, boron is an essential micronutrient for many plant species and thus will be evaluated for potential effects on vegetation. Wildlife can be exposed to boron and there may be a potential to accumulate in birds and mammals. However, the Agency for Toxic Substances and Disease Registry (ATSDR 2010) concluded that it is not likely that bioaccumulation is a major environmental concern for boron. In the derivation of a boron soil guideline in Alberta (Alberta Environment and Parks 2016), it was indicated that a value that is protective of plants and soil invertebrates is sufficiently protective of livestock and wildlife.

Food web transfer does not occur in the PHC F1 to F3 fractions. Most PHCs do not accumulate in animal tissues as they are metabolized by vertebrates and modified into a more readily excretable form. In addition, PHCs are not readily absorbed and accumulated into plant tissues. Therefore, the consumption of plants or other biota does not tend to constitute the major component of exposure to PHCs in wildlife (CCME 2008) and PHCs were only evaluated for their impacts on plants/earthworms and sediment dwelling benthic invertebrates.

Naphthalene and 1-methylnaphthalene, 2-methylnaphthalene (due to the similarity of characteristics), tend to be readily degraded in the environment and is easily metabolized by a wide variety of organisms. Plants do not appear to accumulate naphthalene relative to concentrations in soil (CCME 2010). The ATSDR (2005) indicates that although naphthalene may bioconcentrate to a moderate degree for brief periods, it will not significantly bioaccumulate in organisms due to metabolism. Additionally the Ontario Ministry of the Environment (MOE 2011) derived a value of 380 mg/kg for naphthalene for protection of birds and mammals. The maximum concentrations of naphthalene as well as 1-methylnaphthalene, and 2-methylnaphthalene are below this value. Thus, naphthalene as well as 1-methylnaphthalene, and 2-methylnaphthalene do not need to be considered in the food chain model and do not represent a risk to mammals or birds that would be present at the site.

The sediment evaluation involved a spatial evaluation in comparison to sediment benchmarks where they exist. In the absence of sediment benchmarks, the spatial evaluation considered high, medium and low measured concentrations.

8.2.1 Exposure Locations

Exposure locations for the aquatic receptors consist of the Drainage Pond Area and Stream Area while evaluated exposure locations for the terrestrial receptors are the Main Station Area and the Airstrip Area. For the purposes of the pathway calculations, the terrestrial wildlife were assumed to drink from the Drainage Pond.

Most receptors were assumed to spend their entire life in the selected location; however for a few receptors such as the Snowy Owl, Glaucous Gull that have large home ranges would only spend a portion of their time at the HAWS with the rest spent in nearby areas which are at background conditions. For migratory birds, it is assumed that while in the area, they reside entirely at the HAWS and are present for a sufficient time that they come into equilibrium with their surroundings; therefore, the time spent in other locations with lower concentrations is not accounted for in the assessment. This is a conservative assumption.

8.2.2 Exposure Point Concentrations

Exposure Point Concentrations (EPCs) are the concentrations of each COPC in each media in the environment that are used in the assessment. They are set to provide a reasonable yet cautious representation of the actual conditions in the environment that humans or a population of receptors may experience. The EPCs used in this assessment for soils and surface water were represented by the 95th percentile upper confidence of the mean (95%UCLM) which is considered to represent a reasonable maximum exposure scenario. The 95% UCLM values were calculated using the ProUCL software available from the United States Environmental Protection Agency (U.S. EPA). Exposure point concentrations in other media such as vegetation and prey will be derived using literature transfer factors. Transfer factors (TFs) assume that the concentration in the biota can be estimated from the concentration in the soil, water, or sediment (as appropriate).

8.2.2.1 Exposure Point Concentrations for Soil

Given that the HAWS is separated into the Main Station Area and the Airstrip Area, EPCS for soil were separated for those two different areas. Table 37 provides the soil EPCs for the Main Station Area and the Airstrip Area. As seen in Table 37, an EPC for PHC F1 was not derived since all the available samples had concentrations below the detection limit except for one sample in the landfill area in 2013 where the concentration was 2100 mg/kg at LTM-60. Subsequent measurements at this location found PHC F1 below detection limits.

Table 37. ERA Exposure Point Concentrations for Soils

COPC	EPCs	
	Main Station Area	**Airstrip Area**
Arsenic	12.2	7.6
Boron	11	10
Boron, hot water soluble	1.76	-
Copper	45.0	20.3
Lead	19.6	12.9
Zinc	101	63.4
PHC F1 (C_6-C_{10})	143	-[a]
PHC F2 (C_{10}-C_{16})	3402	1360
PHC F3 (C_{16}-C_{34})	384	540
Naphthalene	4.0	0.078

Notes: Values are in mg/kg. Used the 95% BCA Bootstrap UCL calculated by ProUCL.
[a] Only one measurement from 2013 at LTM-60 was available for PHC F1. All other measured concentrations at that location in subsequent years were below the MDL.

8.2.2.2 Exposure Point Concentrations for Water

The only COPC that was identified through the screening process in the surface water of the Drainage Pond and Stream Area was cadmium. In the last 5 years, cadmium was only measured in the Drainage Pond and Stream Area in 2015. In 2017 and 2019, cadmium was measured below the detection limit. The maximum concentrations measured in 2015 were used in this evaluation to represent a worst case scenario. The maximum measured concentration in 2015 was 0.22 µg/L in the Stream Area and 0.039 µg/L in the Drainage Pond.

While other ERA COPC were not identified specifically as COPC in water, EPCs need to be developed for these COPC to allow food chain calculations to include wildlife ingesting water. Those additional surface water EPCs are presented below in Table 38.

Table 38. Additional ERA Exposure Point Concentrations for Surface Water

COPC	EPC (mg/L)	
	Drainage Pond Area	Stream Area
Arsenic	0.0009	0.001
Copper	0.0014	0.002
Lead	0.0003	0.0003
Zinc	0.004	0.013

Notes: Used the 95% BCA Bootstrap UCL calculated by ProUCL.

8.2.2.3 Exposure Point Concentrations for Sediments

Generally, sediment COPC are somewhat mobile, as sediment moves within waterbodies, and, over time, sediment concentrations may decrease through sediment processes such as burial. The UCLM values for sediments were based on measured data in the Drainage Pond Area and Stream Area from 2015 to 2021.

Of the sediment COPC, manganese, zinc, acenaphthene, acenaphthylene, anthracene, benzo(a)pyrene, fluorene, 2-methynaphthalene, naphthalene, phenanthrene and pyrene have available sediment benchmarks from regulatory agencies. EPCs were developed for these COPC and can be seen below in Table 39. For acenaphthene, all of the measured data in the Stream Area were measured below the MDL except for 2 samples in 2017. In 2019 samples at these two locations were below the MDL. Thus from a benthic community perspective it was assumed that acenaphthene was below the MDL in the Stream Area. In addition to the comparison to regulatory benchmarks for these COPC, evaluation of direct contact with sediments for sediment-dwelling organisms was performed through spatial evaluation for those COPC where the EPC exceeded the guideline as well as a weight of evidence approach.

Table 39. ERA Exposure Point Concentrations for Sediment

COPC	EPC (mg/kg)	
	Drainage Pond Area	Stream Area
Metals		
Manganese	591	784
Zinc	72.7	131
PAHs [d]		
Acenaphthene	0.17	0.005 [a]
Acenaphthylene	0.050	0.005 [a]
Anthracene	0.052 [c]	0.005 [a]
Benzo(a)pyrene	0.020	0.009 [b]
Fluorene	0.19	0.009 [b]
2-Methynaphthalene	4.5	0.033
Naphthalene	2.4	0.017
Phenanthrene	0.14	0.023
Pyrene	0.035	0.017

Notes: Used the 95% BCA Bootstrap UCL calculated by ProUCL.
[a] All measurements < MDL, value is maximum MDL; for acenaphthene all measurements below the MDL except in 2017 when there were 2 measurements
[b] Maximum measured concentration
[c] Maximum used due to only a few data points > MDL
[d] EPCs for PAHs calculated using only data from 2015 onward as considered representative of current sediment conditions

Additional sediment EPCs were developed for the food web calculations to allow inclusion of sediment ingestion by appropriate wildlife species. The developed sediment EPCs are shown below in Table 40.

Table 40. Additional ERA Exposure Point Concentrations for Sediment

COPC	EPC (mg/kg)	
	Drainage Pond Area	Stream Area
Arsenic	10.4	12.9
Copper	18.2	19.6
Lead	10.8	11.4
Zinc	72.7	131

Notes: Used the 95% BCA Bootstrap UCL calculated by ProUCL.

8.2.2.4 Exposure Point Concentrations Representative of Background

To allow full evaluation of wildlife who have a wide home range (e.g., the gull), EPCs were developed for background conditions to be representative of conditions these receptors would experience while not at the Eureka HAWS. Background EPCs are presented in Table 41 and are average measurements from background locations.

Table 41. Exposure Point Concentrations for Background

COPC	Average Concentration		
	Soil	Sediment	Surface Water
	mg/kg	mg/kg	mg/L
Arsenic	10	13	0.002
Copper	18	27	0.008
Lead	6	11	0.003
Zinc	48	56	0.33

8.2.2.5 Other Media

The wildlife at the HAWS are assumed to eat a range of different food items that are found at the site. For most of these environmental compartments (e.g., aquatic vegetation, terrestrial vegetation, small mammals, etc.), EPCs were estimated using literature derived transfer factors or through the use of pathways calculations and intake estimates in conjunction with feed-to-flesh transfer factors. Transfer factors (TFs) assume that the concentration in the biota can be estimated from the concentration in the soil, water, or sediment (as appropriate). This is a simplistic approach that amalgamates the many factors that affect contaminant uptake into a single value. These factors can be called different names, such as Concentration Ratio (CR), Bioaccumulation Factor (BAF), or Bioconcentration Factor (BCF); for this assessment the generic term Transfer Factor (TF) is used.

It is also necessary to estimate concentrations of wildlife that are eaten by others (i.e., both the fox and the owl eat birds such as ptarmigan). For these animals, concentrations were estimated by first approximating the intakes of the COPC and then using feed-to-flesh transfer factors obtained from literature to convert the amount ingested into a flesh concentration. These trophic transfer equations and feed-to-flesh transfer factors are provided in Section 8.2.4.

<u>Water to Aquatic Vegetation Transfer Factors</u>

The selected water to aquatic vegetation transfer factors are provided below in Table 42 and aquatic vegetation concentrations calculated using these transfer factors are shown in Table 43. Equations used to calculate concentrations using transfer factors are presented below in Section 8.2.4.

Table 42. Water to Aquatic Vegetation Transfer Factors

COPC	Transfer Factor	Reference
	L/kg ww	
Arsenic	3.00E+02	PNNL 2003 Table D.14
Copper	1.00E+03	PNNL 2003 Table D.14
Lead	5.00E+04	PNNL 2003 Table D.14
Zinc	5.84E+02	ERICA Model 2014, TF for aquatic vascular plant

Table 43. Aquatic Vegetation Concentrations

COPC	Aquatic Vegetation Concentration (mg/kg ww)		
	Drainage Pond Area	Stream Area	Background
Arsenic	0.26	0.30	0.60
Copper	1.4	1.6	8.0
Lead	13.5	12.5	150
Zinc	2.4	7.6	193

Sediment to Benthic Invertebrate Transfer Factors

The selected sediment to benthic invertebrate transfer factors are provided below in Table 44 and benthic invertebrate concentrations calculated using these transfer factors are shown in Table 45. Equations used to calculate concentrations using transfer factors are presented below in Section 8.2.4.

Table 44. Sediment to Benthic Invertebrate Transfer Factors

COPC	Transfer Factor kg/kg dw	Reference
Arsenic	3.29E-01	Bechtel Jacobs 1998
Copper	2.42E+00	Bechtel Jacobs 1998
Lead	2.76E-01	Bechtel Jacobs 1998
Zinc	3.09E+00	Bechtel Jacobs 1998

Table 45. Benthic Invertebrate Concentrations

COPC	Benthic Invertebrate Concentration (mg/kg ww)		
	Drainage Pond	Stream Area	Background
Arsenic	0.83	1.1	1.1
Copper	10.2	11.9	16.4
Lead	0.72	0.79	0.76
Zinc	58	101	43

Notes: a moisture content of 75% used to convert from dw to ww

Water to Fish Transfer Factors

The selected water to fish transfer factors are provided below in Table 46 and fish concentrations calculated using these transfer factors are shown in Table 47. Equations used to calculate concentrations using transfer factors are presented below in Section 8.2.4.

Table 46. Water to Fish Transfer Factors

COPC	Transfer Factor L/kg ww	Reference
Arsenic	1.70E+03	PNNL 2003 Table D.4
Copper	2.00E+02	PNNL 2003 Table D.4
Lead	3.00E+02	PNNL 2003 Table D.4
Zinc	2.00E+03	U.S. EPA 1999

Table 47. Fish Concentrations

COPC	Fish Concentration (mg/kg ww)		
	Drainage Pond Area	Stream Area	Background
Arsenic	1.4	1.7	3.4
Copper	0.28	0.32	1.6
Lead	0.08	0.08	0.90
Zinc	8.2	26	660

Soil to Terrestrial Vegetation Transfer Factors

The selected soil to terrestrial vegetation transfer factors (in this case equations) are provided below in Table 48 and terrestrial vegetation concentrations calculated using these transfer factors are shown in Table 49. The same transfer factors were used for all vegetation types (i.e., foliage, woody vegetation, fruits, and flowers).

Table 48. Soil to Terrestrial Vegetation Transfer Factors

COPC	Transfer Factor	Reference
Arsenic	$C_p = 0.03752 * C_s$	Bechtel Jacobs 1998
Copper	$\ln(C_p) = 0.394*\ln(C_s)+0.668$	Bechtel Jacobs 1998
Lead	$\ln(C_p) = 0.561*\ln(C_s)-1.328$	Bechtel Jacobs 1998
Zinc	$\ln(C_p) = 0.554*\ln(C_s)+1.575$	Bechtel Jacobs 1998

Notes: Cs = Concentrations in soil [mg/kg]
Cp = Concentrations in plant tissue [mg/kg dw]

Table 49. Terrestrial Vegetation Concentrations

COPC	Terrestrial Vegetation Concentration (mg/kg ww)		
	Main Station Area	Airstrip Area	Background
Arsenic	0.14	0.09	0.11
Copper	2.7	1.9	1.8
Lead	0.44	0.33	0.22
Zinc	19.5	14.4	12.4

Notes: a moisture content of 70% was used to convert from dw to ww

Soil to Terrestrial Insects Transfer Factors

The selected soil to terrestrial insect transfer factors (equations for arsenic and copper) are provided below in Table 50; terrestrial insect concentrations calculated using these transfer factors are shown in Table 51. Equations used to calculate concentrations using transfer factors are presented below in Section 8.2.4.

Table 50. Soil to Terrestrial Insects Transfer Factors

COPC	Transfer Factor	Reference
Arsenic	$C_I = 0.88*\log(C_s + 1) - 0.54$	Vermeulen *et al*. 2009, woodlice
Copper	$C_I = 0.88*\log(C_s + 1) + 1.29$	Vermeulen *et al*. 2009, woodlice
Lead	3.99E-01 (kg/kg ww)	ERICA Model 2014, TF for arthropod/flying insects
Zinc	1.08E+00 (kg/kg ww)	ERICA Model 2014, TF for arthropod/flying insects

Notes: C_s = Concentrations in soil [mg/kg]
C_I = Concentrations in terrestrial insects [mg/kg ww]

Table 51. Terrestrial Insect Concentrations

COPC	Terrestrial Insect Concentration (mg/kg ww)		
	Main Station Area	Airstrip Area	Background
Arsenic	0.44	0.28	0.38
Copper	2.8	2.5	2.4
Lead	8.3	5.2	2.4
Zinc	118	68	52

Soil to Small Mammal Transfer Factors

The selected soil to small mammal tissue transfer factors (in this case equations) are provided below in Table 52 and terrestrial vegetation concentrations calculated using these transfer factors are shown in Table 53. This relationship and resulting concentrations were used for the mouse and lemming dietary components as these were not explicitly modelled through food chain transfer.

Table 52. Soil to Small Mammal Transfer Factors

COPC	Transfer Factor	Reference
Arsenic	$\ln(C_m) = 0.8188*\ln(C_s) - 4.8471$	Sample *et al*. 1998
Copper	$\ln(C_m) = 0.1444*\ln(C_s) + 2.042$	Sample *et al*. 1998
Lead	$\ln(C_m) = 0.4422*\ln(C_s) + 0.0761$	Sample *et al*. 1998
Zinc	$\ln(C_m) = 0.0.0706*\ln(C_s) + 4.3632$	Sample *et al*. 1998

Notes: C_s = Concentrations in soil [mg/kg]
C_m = Concentrations in small mammal tissue [mg/kg dw]

Table 53. Small Mammal Concentrations

COPC	Small Mammal Concentration (mg/kg ww)		
	Main Station Area	Airstrip Area	Background
Arsenic	0.019	0.013	0.017
Copper	4.3	3.8	3.7
Lead	1.3	1.1	0.76
Zinc	35	34	33

Notes: a moisture content of 68% was used to convert from dw to ww.

Feed to Flesh Transfer Factors

The selected feed-to-flesh transfer factors are provided below in Table 54 and Table 55 for mammals and birds, respectively. Some of the values selected for transfer in mammals were developed for cow and so for these transfer factors, allometric scaling was used to adjust based on relative body weights (discussed in Section 8.2.4). The rest of the values were considered to be applicable unscaled. The resulting hare and ptarmigan flesh concentrations using calculated dietary intakes for these receptors and feed-to-flesh transfer factors are shown in Table 56; the equations involved in this calculation are presented in Section 8.2.4.

Table 54. Feed-to-Flesh Transfer Factors - Mammals

COPC	Transfer Factor (d/kg ww)		Reference and comment
	Base Rate	Scaled for Hare	
Arsenic	2.30E-3	2.29E-01	PNNL 2003, value for beef
Copper	9.00E-3	8.96E-01	PNNL 2003, value for beef
Lead	4.00E-4	3.98E-02	PNNL 2003, value for beef
Zinc	6.92E+00	6.92E+00	CSA 2008, value for rabbit, used unscaled

Notes: Base rate scaled using allometric scaling as presented in Section 8.2.4.

Table 55. Feed-to-Flesh Transfer Factors - Birds

COPC	Transfer Factor (d/kg ww)	Reference and comment
	Base Rate, Used for Ptarmigan	
Arsenic	8.30E-01	PNNL 2003, value for poultry meat
Copper	5.00E-01	PNNL 2003, value for poultry meat
Lead	8.00E-01	PNNL 2003, value for poultry meat
Zinc	9.00E+00	CSA 2008, value for poultry meat

Table 56. Hare and Ptarmigan Concentrations

COPC	Flesh Concentration (mg/kg ww)		
	Main Station Area	Airstrip Area	Background
Hare			
Arsenic	0.02	0.01	0.02
Copper	0.88	0.56	0.53
Lead	0.01	0.01	0.004
Zinc	40	29	25
Ptarmigan			
Arsenic	0.06	0.04	0.05
Copper	0.29	0.18	0.17
Lead	0.12	0.08	0.04
Zinc	29	21	18

8.2.3 Receptor Characterization

Aquatic and terrestrial receptors chosen for the current assessment were selected to represent a wide range of potential exposures. Receptor characteristics for wildlife selected (as outlined in Section 8.1.2 are provided in Appendix C. These characteristics include the typical body weight, the types of food receptors eat (diet), and how much food and water they would consume in a day and the fraction of time spent at the site.

8.2.4 Exposure Estimation

Smaller organisms such as benthic invertebrates are exposed to COPC through sediment or surface water, while larger organisms, such as the wildlife species are exposed through multiple pathways.

The exposure estimation uses the EPCs in environmental media and the receptor characteristics to estimate the total intake of the COPC by the selected aquatic and ecological receptors. Exposures due to ingestion of each dietary component, as well as water and soil or sediment, were calculated using equations discussed below. Where appropriate, background exposures were taken into account in the exposure estimates.

Intakes for the selected aquatic and terrestrial receptors were estimated via a food chain. Thus, the total intake of a COPC for the selected receptors is the sum of COPC intakes from all the appropriate pathways, including the ingestion of water, sediment or soil, aquatic vegetation, benthic organisms, fish, terrestrial vegetation (e.g., woody vegetation, foliage, and berries/fruits), insects, and prey (e.g., mouse, lemming, Arctic Hare, and Rock Ptarmigan.). Equation 15 was used to calculate each of the intake routes as follows:

$$I_n = C_n \times IR_n \times f_{loc} \times CF \qquad \text{Equation 15}$$

Where:

I_n = Intake of COPC via "n" exposure pathway [mg/d]

C_n = COPC concentration in "n" medium [mg/kg or mg/L for water]

IR_n = Intake rate of "n" by the receptor [g/d, or L/d for water]

f_{loc} = Fraction of time at site

CF = Conversion factor 1.0×10^{-3} [kg/g]

The total intake was then divided by the body weight of the terrestrial receptor for comparison to the TRV which has units of mg per kg body weight per day. The receptor characteristics used to calculate the intakes are provided in Appendix C. For receptors with large home range roaming the HAWS as well as off-site areas, the background contribution to total exposure was accounted. For example, the Arctic fox was evaluated on the HAWS for 10% of the time and the remaining 90% at background concentrations.

Concentrations of various biota (i.e., aquatic vegetation, benthic invertebrates, fish, terrestrial vegetation, and insects) as well as prey which were not included explicitly as receptors (i.e., mouse and lemming) were calculated using concentrations in water, sediment, or soil and the transfer factors presented above in Section 7.2.2 and equation 16.

$$C_{biota} = C_{media} \times TF_{media-to-biota} \, [\times (1 - moisture)]^a \qquad \text{Equation 16}$$

Note: [a] [x(1-moisture)] only needed if dw/ww conversion required. Moisture contents noted in Section 8.2.2.5

Where:

C_{biota} = COPC concentration in biota (e.g., vegetation, earthworms) [mg/kg ww]

C_{media} = COPC concentration in media (i.e., water, sediment, or soil) [mg/kg or mg/L]

$TF_{soil-to-biota}$ = media-to-biota transfer factor [(mg/kg)/(mg/kg) or (mg/kg)/(mg/L)]

moisture = assumed moisture content in media

For the wildlife species that were included as receptors and are also consumed as prey (i.e., arctic hare and rock ptarmigan) tissue concentrations were calculated by estimating the amount of COPC ingested for the food sources (calculated using Equation 15) and then applying a feed-to-flesh transfer factor. Selected transfer factors for mammals and birds are shown in Table 54 and Table 55, respectively. For transfer factors developed for species of a much different size than those being evaluated here (i.e. beef factor applied to an arctic hare), transfer factors were scaled allometrically[2] using the using the body weights of the test animal and the wildlife as shown in Equation 17.

$$TF_w = TF_a \left(\frac{BW_w}{BW_a} \right)^{-0.75} \qquad \text{Equation 17}$$

Where:

TF_w	=	Feed-to-flesh transfer factor for wildlife (d/(kg ww))
TF_a	=	Transfer factor for animal available from literature (d/(kg ww))
BW_w	=	Body weight of wildlife (kg)
BW_a	=	Body weight of animal (kg)

The derived TFs are applied as shown in Equation 18 to calculate the concentration of COPC in the flesh of each ingested species (i.e., arctic hare and rock ptarmigan).

$$C_{flesh} = I_{total} \times TF_w \qquad \text{Equation 18}$$

Where:

C_{flesh}	=	COPC concentration in flesh of ingested mammal [mg/kg ww]
I_{total}	=	Intake of COPC via all pathways for ingested mammal [mg/d]

8.3 Toxicity Assessment

This toxicity or effects assessment provides the concentration (or intake) of a COPC that is associated with an adverse effect. These concentrations or intakes are referred to as toxicity reference values (TRVs) and represent the exposure that is considered to pose negligible risk of adverse effect for a given COPC. This section discusses the TRVs that are used in this assessment.

8.4 Toxicity to Terrestrial Plants and Earthworms

Potential effects from exposure to COPC in the soil for terrestrial biota were evaluated through comparison of developed soil EPCs to the plant and earthworm component of the Ontario Ministry of Environment Conservation and Parks (MOE 2011). These values are deemed appropriate because they represent the 25th percentile of the toxicity values of the literature based studies and are more recent than the CCME direct contact values; these values are presented below in Table 57. The toxicity studies were for agronomic plants such as grasses, rye, barley, lettuce and other species and different

[2] This approach is consistent with the U.S. EPA (U.S. EPA 1993) approach for developing food and water intake rates for wildlife.

earthworm species. For naphthalene, there are very little data available on the toxicity to plants and earthworms in soil. It is noted that plants exhibit a very limited ability to accumulate PAHs from soils and to translocate them into the leaves and shoots (CCME 2010). Additionally, PAHs such as naphthalene do not appear to accumulate or magnify relative to the soil concentrations (CCME 2010).

Table 57. Toxicity Reference Values for Terrestrial Plants and Earthworms

COPC	Plant and Earthworm Toxicity Values (mg/kg)
Arsenic	25
Boron, hot water soluble	1.5
Copper	180
Lead	310
Zinc	500
PHC F1 (C_6-C_{10})	210
PHC F2 (C_{10}-C_{16})	150
PHC F3 (C_{16}-C_{34})	1300
Naphthalene	0.75

Notes: Plant and Earthworm component from the Ontario Ministry of the Environment, Conservation and Parks (MOE 2011) Soil, ground water and sediment standards for use under Part XV.1 of the Environmental Protection Act. Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition, Residential/parkland/institutional land use, fine textured soil.

8.5 Toxicity Reference Values for Aquatic Environment

Potential effects from exposure to cadmium for aquatic biota (e.g. zooplankton, aquatic plants, and fish) were evaluated using a derived Species Sensitivity Distribution (SSD). This approach involves reviewing aquatic biota toxicity data from reputable sources for appropriateness at this site (e.g., include information for freshwater species only) and then using the resulting dataset to statistically fit a curve, which is a representation of the toxicity of a specific COPC, to aquatic biota. This SSD approach is used by the CCME in the development of generic water quality guidelines. Thus, this approach has been adopted for the development of aquatic toxicity thresholds used for cadmium in the ERA and is, therefore, supported by the CCME protocol (CCME 2007).

The TRVs for the aquatic organisms for cadmium is based on the Species Sensitivity Distribution (SSD) approach which is consistent with the CCME protocol (CCME 2007) developed by the Water Quality Task Group to develop the Canadian Water Quality Guidelines for the Protection of Aquatic Life. The goals of the protocol include: (i) accounting for the unique properties of COPC which influence their toxicity; and (ii) incorporating the SSD method, which uses all available toxicity data (provided these data pass quality control criteria).

The development of the SSD curve for cadmium was based on toxicity data obtained from the literature. The data used in the curve are mainly for growth and reproductive endpoints. Chronic toxicity data related to effects on 10% to 25% of the population (EC/IC_{10-25}) and the Maximum Acceptable Toxicant

Concentration (MATC) are considered to be high quality toxicity thresholds. In the absence of these preferred toxicity thresholds, No Observable Effects Concentrations (NOEC), Low Observable Effect Concentrations (LOEC) and lethal toxicity values are used if necessary to develop the curve.

The data used for cadmium were based on a U.S. EPA (2016) document for deriving the water quality guideline for cadmium and augmented with some additional data from the literature. Cadmium toxicity is sensitive to water hardness; as such the selected data were adjusted to a higher hardness level. The SSD for cadmium is shown in Figure 14 and has been adjusted to a hardness of 300 mg/L $CaCO_3$. Average hardness in the Drainage Pond was calculated to be approximately 670 mg/L $CaCO_3$ and at the Stream Area the average hardness was estimated to be 800 mg/L $CaCO_3$. Forty four (44) species are used on the curve and includes amphibians. The cadmium curve has high quality toxicity thresholds ($EC/IC_{10\text{-}25}$ and MATC values) especially in the lower part of the curve. Details on the derivation of the cadmium SSD are provided in Appendix D.

8.5.1 Sediment Toxicity Guidelines

There are only sediment toxicity guidelines for three of the identified COPC. For anthracene, manganese, and zinc. Interim Sediment Quality Guideline (ISQG) and Probable Effects Level (PEL) benchmarks developed by the Canadian Council of Ministers of the Environment (CCME 2017) and Lowest Effects Level (LEL) and Severe Effects Level (SEL) from the Ontario Ministry of the Environment (MOEE 1993) are used to evaluate potential influence on the benthic invertebrate community. A summary of the sediment benchmarks is shown in Table 58.

Table 58. Sediment Guidelines

COPC	Unit	Guideline			
		ISQG [a]	PEL [a]	LEL [b]	SEL [b]
Metals					
Manganese	mg/kg	-	-	460	1100
Zinc	mg/kg	123	315	120	820
PAHs					
Acenaphthene	mg/kg	0.00671	0.0889	-	-
Acenaphthylene	mg/kg	0.00587	0.128	-	-
Anthracene	mg/kg	0.0469	0.245	-	-
Benzo(a)pyrene	mg/kg	0.0319	0.782	-	-
Fluorene	mg/kg	0.0202	0.144	-	-
2-Methynaphthalene	mg/kg	0.0202	0.201	-	-
Naphthalene	mg/kg	0.0346	0.391	-	-
Phenanthrene	mg/kg	0.0419	0.515	-	-
Pyrene	mg/kg	0.053	0.875	-	-

Notes:
[a] Sediment quality guidelines for the protection of freshwater aquatic life for long-term exposure from the Canadian Council of Ministers of the Environment (CCME 2017). ISQG – Interim Sediment Quality Guideline; PEL – Probable Effects Level.

[b] Provincial sediment quality guidelines for metals from the Ontario Ministry of Environment (MOEE 1993). LEL - Lowest Effects Level; SEL - Severe Effects Level.

For the organic COPC such as PHC and benzene, ethyl benzene and xylenes the fraction of organic carbon (f_{oc}) in the sediments is an important component of toxicity. There are only four samples of f_{oc} collected in soil samples in the Delta area. The values are 0.0056, 0.0099, 0.0096, and 0.012. The average of these f_{oc} samples is 0.01 which has been assumed to be the same value in the sediments in the Drainage Pond and Stream Area at the HAWS. Two additional measurements (0.0019 (soil) and 0.0041 (sediment) were obtained in 2021, the average of the six values rounded up to 2 significant figures in 0.01.

For benzene, ethylbenzene and xylene, Environment Canada (Mroz et al. 2016) have derived Tier 1 screening criteria based on a f_{oc} of 0.01. These sediment quality guidelines were based on an equilibrium partitioning model which assumes that the toxicity of a chemical in sediment is a result of the chemical concentration in the surface water. The derivation is based as well on the organic carbon-water partitioning coefficient (K_{oc}) using aquatic toxicity values for surface water. The sediment benchmarks for the benzene, ethylbenzene and xylene are provided in Table 59.

Table 59. Sediment Benchmarks for BTEX Compounds

COPC	Sediment Benchmark (mg/kg)
Benzene	1.2
Ethylbenzene	1.2
xylene	1.3

Notes: based on Mroz et al. 2016.

For the evaluation of PHCs in sediment, benchmarks were derived based on a sediment toxicity study prepared for the Massachusetts Department of Environmental Protection (MADEP) by BATTELLE (BATTELLE 2007). The approach used for the PHC fractions is similar to the approach used for the BTEX whereby an equilibrium partitioning model was used. The approach for the PHC fractions involved the use of chronic toxicity values from surface water, K_{oc} and f_{oc}. Sediment partitioning benchmarks for four aliphatic and four aromatic fractions were derived based on a f_{oc} of 0.001. The four hydrocarbon fractions were C_5 to C_8, C_9 to C_{12}, C_{13} to C_{18} and C_{19} to C_{36}. For the purposes of this assessment the values were adjusted for the site-specific f_{oc} and the aromatic and aliphatic fractions were combined to derive values for the F1, F2 and F3 fractions. F1 was assumed to encompass C_5 to C_8, F2 encompassed C_{13} to C_{18} and F3 encompassed C_{19} to C_{36}. It is acknowledged that not all the carbon fractions have been accounted for in the assumption for the fractions but the major ones are covered.

Table 60. Sediment Benchmarks for PHC Compounds

COPC	Sediment Benchmark (mg/kg)
PHC F1	21
PHC F2	57
PHC F3	99

Notes: derived from information provided in BATTELLE 2007

8.6 Wildlife Toxicity Reference Values

The TRVs selected for comparison to the intake calculated for wildlife are presented in Table 61. When available, the values were derived from data provided in the U.S. EPA Eco-SSL documents or from Quebec documents (CEAEQ). The TRVs were derived from toxicological endpoints of survival, growth, and reproduction. The TRVs selected are generally Lowest Observable Adverse Effects Levels (LOAELs) and represent the geometric mean of the data.

As discussed in Section 8.2, food web transfer is not evaluated for the PHC F1 to F3 fractions, naphthalene or boron. Thus, TRVS are not provided for these COPC.

Table 61. Summary of Wildlife TRVs

COPC	Mammals			Birds		
	TRV (mg/kg-d)	Endpoint	Source	TRV (mg/kg-d)	Endpoint	Source
Arsenic	3.6	Growth and Reproduction	CEAEQ (2012)	5.6	Growth	CEAEQ (2012)
Copper	61	Growth and Reproduction	Eco-SSL (U.S. EPA 2007a)	34.9	Growth and Reproduction	(U.S. EPA 2007a)
Lead	159	Growth and Reproduction	Eco-SSL (U.S. EPA 2005)	47	Growth and Reproduction	Eco-SSL (U.S. EPA 2005)
Zinc	298	Growth and reproduction	Eco-SSL (U.S. EPA 2007b)	172	Growth and reproduction	Eco-SSL (U.S. EPA 2007b)

For the evaluation of the selected SARA wildlife (i.e., the red knot), No Observable Adverse Effects Levels (NOAELs) were also considered to allow evaluation of individual species in addition to evaluation on the population basis using the LOAELs. The selected NOAELs are presented below in Table 62.

Table 62. Summary of Wildlife TRVs - NOAELs

COPC	Birds		
	TRV (mg/kg-d)	Endpoint	Source
Arsenic	4.4	Growth	CEAEQ (2012)
Copper	19.6	Growth and Reproduction	(U.S. EPA 2007a)
Lead	7.3	Growth and Reproduction	Eco-SSL (U.S. EPA 2005)
Zinc	88	Growth and reproduction	Eco-SSL (U.S. EPA 2007b)

8.7 Risk Characterization

Risk characterization is the process of estimating the potential for an adverse effect on populations of ecological receptors based on the information obtained from the exposure and toxicity steps discussed above. The risk characterization for the ERA is discussed in the following sections. A weight of evidence approach has been taken where available to look at different lines of evidence to form a conclusion on the potential impact.

In the quantitative risk characterization step, the estimated intakes or media concentrations (EPCs) of the COPC are compared to the toxicity reference values (TRVs) to derive a screening index (SI) value as follows:

$$SI = \frac{EPC \text{ or } Intake}{TRV}$$

An SI value of 1.0 is used to determine whether there is a potential for an adverse effect. An SI value above the acceptable value (i.e., 1.0) does not necessarily indicate an effect but highlights combinations of receptors and COPC that require further consideration as there is a greater potential for an effect. A weight-of-evidence approach involving field observations and spatial considerations is used to determine whether there is the possibility of a population effect for those COPC with an SI value above 1.

8.7.1 Terrestrial Plants and Earthworms

It is not expected that earthworms would be found at the latitude of the Eureka HAWS where the ground is frozen for most of the year; however, the available benchmarks encompass toxicity data for both plants and earthworms. As discussed above, for the assessment of potential effects to terrestrial plants, a quantitative assessment was completed by comparing soil EPCs to the selected toxicity reference values (TRVs) to derive a screening index (SI) value. The calculated SI values are shown below in Table 63. As can be seen, SI values over 1 are noted for hot water soluble boron (Main Station, no data available for the Airstrip area), PHC F2 (Main Station and Airstrip), and naphthalene (Main Station).

Table 63. Terrestrial Plant SI Values

COPC	SI Value	
	Main Station Area	Airstrip Area
Arsenic	0.49	0.30
Boron, hot water soluble	**1.2**	-
Copper	0.25	0.11
Lead	0.06	0.04
Zinc	0.20	0.13
PHC F1 (C_6-C_{10})	0.68	-[a]
PHC F2 (C_{10}-C_{16})	**23**	**9.1**
PHC F3 (C_{16}-C_{34})	0.30	0.42
Naphthalene	**5.3**	0.10

Notes: **Bold/Shaded** values indicate SI Value above 1.
[a] Only one measurement from 2013 at LTM-60 was available for PHC F1. All other measured concentrations at that location in subsequent years were below the MDL.

For hot water soluble boron, eight of 24 soil measurements for the Main Station area of the Eureka HAWS are above the selected TRV of 1.5 mg/kg. No hot water soluble boron data were available from Airstrip or background locations. Total boron levels across the site are naturally occurring and similar to background. The total boron average concentrations from the exposure areas are very similar to the background with a Main Station Area average of 10.0 mg/kg, an Airstrip Area average of 9.0 mg/kg, and background average of 9.5 mg/kg. This indicates that boron levels are naturally occurring at the HAWS and likely not affecting plant communities.

PHC F2 concentrations in soil are elevated across the HAWS and above toxicity values protective of plants and earthworms. The Main Station and Airstrip Areas are locations that have disturbed areas and plant growth is minimal (see Photograph 1). There are some undisturbed areas on the site where plant growth is evident (see Photograph 2). Given the elevated PHC F2 concentrations across the HAWS it is likely that plant growth may be impaired; given that many of these elevated concentrations are in disturbed areas it is difficult to gauge the impact on terrestrial plants as there is no vegetation present. However, given the area of contamination versus the rest of the HAWS area, the chances of population effects on plants is considered to be low. In addition, PHC F2 concentrations are expected to decrease through natural attenuation over time which also would reduce any potential impacts.

Photograph 1 Former complex building south of the Main Complex

Photograph 2 – Sewage Lagoon and Pumphouse

For naphthalene in the Main Station Area, the measurements above the TRV (0.75 mg/kg) are limited to the area where the New Water Reservoir will be located. In addition, the 2021 sampling reported naphthalene concentrations above the plant TRV in the old tank farm area. Some of the samples are below 1m in depth and the old tank farm area is a disturbed area at the site. Thus it is not expected that naphthalene in soil in the Main Station Area will impact plant populations.

Since 1-methynaphthalene and 2-methylnaphthalene are similar to naphthalene, a qualitative consideration of the potential to impact plants was undertaken. There were 8 samples where the concentrations of 1-methylnaphthelene exceeded the naphthalene plant toxicity value. Most of these samples were obtained in 2021 from the old tank farm area. There is limited exposure to plants in this area. For 2-methylnaphthalene, 19 samples exceed the guideline. Over 8 samples are located in the area of the New Water Reservoir and thus no exposure pathways are present. Another 7 samples are associated with the old tank farm area and 3 samples were located around Building 17 which was destroyed by fire. There is limited exposure to plants in these areas.

Overall, while there may be some potential negative effects to terrestrial vegetation on the Eureka HAWS due to exposure to PHC F2 and naphthalene, the entire area is quite barren with very little vegetation due to the extremely harsh climate (see Photograph 3). Given the area of contamination versus the rest of the HAWS area, the chances of population effects on plants is considered to be low. In addition, concentrations are expected to decrease through natural attenuation over time which also would reduce any potential impacts.

Photograph 3 – Disturbed and Undisturbed areas at the Airstrip Area of the HAWS

8.7.2 Aquatic Biota

As discussed above in Section 8.3, for the assessment of potential effects to various species in the aquatic environment, the measured cadmium concentrations in surface water are compared to the derived aquatic SSD curve.

Cadmium toxicity is affected by hardness and thus as the hardness increases the toxicity of cadmium decreases. The derived SSD curve for cadmium was adjusted to a hardness of 300 mg/L $CaCO_3$ which is well below the hardness values measured in the Drainage Pond and Stream Area; however, there is not enough reliable data to derive an SSD curve for a higher hardness level. Since cadmium toxicity decreases with increasing hardness, the use of a SSD curve derived for 300 mg/L $CaCO_3$ is a conservative estimate of potential effects of cadmium in the aquatic environment.

In the last 5 years, cadmium was only measured in the Drainage Pond and Stream Area in 2015. In 2017 and 2019, cadmium was measured below the detection limit. The maximum concentrations measured in 2015 were used in this evaluation to represent a worst case scenario. Figure 15 shows the maximum measured cadmium water concentrations for the Drainage Pond and Stream Area plotted on the derived SSD curve. The maximum measured concentration in 2015 was 0.22 µg/L in the Stream Area and 0.039 µg/L in the Drainage Pond. These concentrations are below the lowest toxicity values and indicate that the aquatic communities in the Drainage Pond and Stream Area are fully protected from exposure to cadmium.

8.7.3 Benthic Invertebrate Community

Sediment Chemistry

The quantitative assessment of benthic invertebrate community health is performed using a comparison to regulatory sediment guideline values for PAHs, manganese, and zinc. This comparison is presented in Table 64. COPC that exceed guidelines were mapped to determine the spatial effects of the contamination.

The EPC for anthracene is above the ISQG at the Drainage Pond, however, this is because the EPC is the maximum measured concentration. For anthracene only a single measurement out of 28 available data points over the 2015-2021 period is above the ISQG at this location indicating there is likely no adverse effect on the benthic community from exposure to anthracene in the Drainage Pond.

For manganese the EPCs for both the Drainage Pond Area and Stream Area are above the LEL and SEL values while the EPC for zinc is above the ISQG/LEL for the Stream Area. Figure 16 presents a spatial representation of the sediment manganese levels measured in the Drainage Pond and Figure 17 presents similar mapping manganese and zinc in the Stream Area. These figures show average sediment concentrations by year at each station (starting in 2010), indicating which exceed the applicable benchmarks. As can be seen in the figure, there are no current exceedances of metals in the Drainage Pond down slope of the Powerhouse; however manganese exceeded the LEL benchmark in 2017 and currently exceeds the ISQG at LTM-SD10 near the Landfarm. The downward trend in manganese concentrations in the Drainage Pond is likely due to the mobility of the sediments and burial processes. Zinc and manganese sediment concentrations decrease with distance from the Drainage Pond. There are no current exceedances of guidelines in samples further down the Stream Area from LTM-SD3. There are some exceedances of the ISQG for manganese at LTM-SD4 and LTM-SD3.

Table 64. Comparison of Sediment Concentrations to Guidelines

COPC	Unit	Guideline				EPC [c]	
		ISQG [a]	PEL [a]	LEL [b]	SEL [b]	Drainage Pond	Stream Area
Metals							
Manganese	mg/kg	-	-	460	1100	**591**	**748**
Zinc	mg/kg	123	315	120	820	73	**131**
PAHs							
Acenaphthene	mg/kg	0.00671	0.0889	-	-	**0.17**	0.005 [d]
Acenaphthylene	mg/kg	0.00587	0.128	-	-	**0.050**	0.005 [d]
Anthracene	mg/kg	0.0469	0.245	-	-	**0.052** [e]	0.005 [d]
Benzo(a)pyrene	mg/kg	0.0319	0.782	-	-	0.020	0.0094[e]
Fluorene	mg/kg	0.0202	0.144	-	-	**0.19**	0.0091[e]
2-Methynaphthalene	mg/kg	0.0202	0.201	-	-	**4.5**	0.033
Naphthalene	mg/kg	0.0346	0.391	-	-	**2.4**	0.017
Phenanthrene	mg/kg	0.0419	0.515	-	-	**0.14**	0.023
Pyrene	mg/kg	0.053	0.875	-	-	0.035	0.017

Notes: **Bold** values exceed ISQG/LEL and **Bold/Shaded** values exceed PEL/SEL values. EPCs based on data from 2013 to 2021

[a] Sediment quality guidelines for the protection of freshwater aquatic life for long-term exposure from the Canadian Council of Ministers of the Environment (CCME 2017). ISQG – Interim Sediment Quality Guideline; PEL – Probable Effects Level.

[b] Provincial sediment quality guidelines for metals from the Ontario Ministry of Environment (MOEE 1993). LEL - Lowest Effects Level; SEL - Severe Effects Level.

[c] Used the 95% BCA Bootstrap UCLM calculated by ProUCL

[d] All measured concentrations were below the MDL, value is MDL

[e] Maximum used due to only a few data points > MDL

Figure 18a shows the exceedances of PAHs in the Drainage Pond considering data from 2013 to 2019. Figure 18b shows the recent PAH samples collected in 2021. There are no PAH exceedances in the Stream Area. As seen from the Figure 18a, the highest PAH contamination is down slope of the Powerhouse building. There are some exceedances of ISQG values around the Landfarm area at LTM-SD9 and LTM-SD 10 but most of them have been prior to 2019 and therefore it is unlikely that these exceedances will affect the benthic community in the Drainage Pond. The additional sediment samples collected from the Drainage Pond in 2021 were from along the western and eastern shoreline (see Figure 18b). The measured levels of PAHs in these samples are similar to levels at nearby locations and are generally below the PEL values. 2-methyl naphthalene , naphthalene and acenaphthene exceed the PEL levels at SD21-1 and SD 21-2 (Figure 18b); however these levels are lower than the values along the eastern shore between LTM-SD10 and SED12-3A/B (see Figure 18a).

Figure19 shows the spatial distribution for benzene, ethylbenzene, xylenes in sediments in the Drainage Pond. Samples reported as <MDL are not shown in Figure 19. All measurements of BTEX were below derived sediment criteria in the Stream Area. As can be seen from the mapping, there are some

exceedances of the benchmarks down slope of the Powerhouse building especially at LTM-SD7. At LTM-SD5 there were no exceedances in 2019. There are also no exceedances near the Landfarm. Additional BTEX measurements collected from the Drainage Pond in 2021 were below 2019 values.

Figures 20 and 21 show mapping indicating average PHC levels measured in sediments of the Drainage Pond and Stream Area, respectively. Similar to for BTEX, measurements which were less than the detection limit were excluded from this summary to help identify where higher levels exist. As discussed in Section 8.5.1, sediment benchmarks were derived for PHC F1, F2 and F3. Orange text in these figures indicate measurements that exceed these derived benchmarks. In the Drainage Pond area benchmarks are exceeded at sediment locations down slope of the Powerhouse building. In 2019, highest concentrations were observed at LTM-SD7 and LTM-SD5. Additional samples collected from the Drainage Pond in 2021 (Figure 20b) found elevated PHC F1, F2, and F3 along the eastern shoreline of the Drainage Pond (north of the Power House building), with the highest values noted at station SD21-1. In the Stream Area (Figure 21) there were some exceedances in 2017 but no exceedances in 2019. Thus there are likely no impacts on benthic communities in the Stream Area from exposures to PHC.

From a qualitative evaluation, acridine and quinolone are not considered to have a negative impact on the benthic community in the Stream Area as all measurements are below the MDL. In the Drainage Pond, there was one measurement in 2013 (acridine and quinoline), 3 measurements in 2015 (acridine and quinolone), and 3 measurements in 2021 (acridine), all other measurements have been below the MDL; therefore, acridine and quinoline are not a concern for the benthic community in the Drainage Pond.

Highest concentrations of benzo(b&j)fluoranthene, benzo(g,h,i)perylene, and perylene are found in the Drainage Pond at Long Term Monitoring locations SD8, SD9, and SD10 which are near the Landfarm and measurements taken in 2021 along the eastern shore and in the middle of the Drainage Pond had similarly high levels. Maximum concentration of the other PAHs are found downslope of the Powerhouse. However there have been some exceedances of other PAHs near the Landfarm area. In the Stream Area, the highest concentrations of these PAHs were found at LTM station SD1 and not at locations just south of the Powerhouse where other PAHs are found at higher concentrations. These concentrations were measured in 2019. It is noted that the SD1 location in the Stream Area seems to have been moved to the other side during 2019 and it is difficult to determine the effect of these higher PAH values in the Stream Area.

Sediment Toxicity

The previous risk assessment document (Franz/Senes 2011) reported that sediment toxicity testing was carried out from one sample in the Drainage Pond near the Powerhouse and one sample in the Stream Area near LTM-SD3. Additionally a background sediment sample was also sent for toxicity testing. The results of the toxicity testing found the sediment sample in the Drainage Pond showed evidence of potential toxicity but not the sample in the Stream Area. The sample from the Drainage Pond was sent for benthic community analysis.

Benthic Community

The assessment of the benthic community in the sediment samples from background and the Drainage Pond was to evaluate whether sediments in the Drainage Pond had a negative effect on the benthic invertebrate community. At the background location the only taxon present was *Oligochaeta*. In the Drainage Pond sample 5 taxa were found. *Diptera* (most abundant), *Oligochaeta, Ostracoda: Cypridae-, Candocyprinae* and *Nematoda.* However, there was an insufficient number of organisms in both the background and exposure locations to determine whether there was a statistical difference between the Drainage Pond sample which had a higher density of organisms than background (Franz/Senes 2011).

Weight of Evidence

Photograph 4 provides an aerial view of the Drainage Pond and Stream Area. The photograph shows that the Stream Area only has a small amount of water in it just after the berm from the Drainage Pond. Thus the Stream Area does not have continuous water present year-round.

The consideration of the three lines of evidence discussed above suggests the potential for effects in the benthic community down slope of the Powerhouse building. There may be some minor effects across the berm at the top of the Stream Area, no adverse effects are expected downstream of that area where water is present on an intermittent basis.

Photograph 4 – Aerial View Drainage Pond and Stream at the HAWS

8.7.4 Aquatic and Terrestrial Wildlife

The evaluation for aquatic and terrestrial wildlife that frequent the Eureka HAWS site is based on comparison of exposure to toxicity benchmarks using a food chain model. Only arsenic, copper, lead and zinc were carried through this evaluation.

Predicted SI values for all receptors are provided in Table 65 and detailed calculations are provided in Appendix E. As can be seen from Table 65, all calculated SI values are below 1 for considered aquatic and terrestrial wildlife, indicating that there is no potential risks to these receptors from exposure to arsenic, copper, lead and zinc at the HAWS.

Table 65. Calculated SI Values for Wildlife

Receptor	Location	SI Values			
		Arsenic	Copper	Lead	Zinc
Aquatic Species					
Glaucous Gull	Drainage Pond	0.13	0.01	<0.01	0.79
	Stream Area	0.13	0.01	<0.01	0.80
Red Knot	Drainage Pond	0.14	0.26	0.01	0.27
	Stream Area	0.17	0.28	0.02	0.48
Northern Pintail	Drainage Pond	0.02	0.03	0.06	0.03
	Stream Area	0.03	0.04	0.06	0.05
Terrestrial Species					
Snow Bunting	Main Station	0.06	0.06	0.06	0.22
	Airstrip	0.05	0.04	0.04	0.14
Arctic Fox	Main Station	<0.01	<0.01	<0.01	0.01
	Airstrip	<0.01	<0.01	<0.01	0.01
Arctic Hare	Main Station	0.02	0.01	<0.01	0.01
	Airstrip	0.01	<0.01	<0.01	0.01
Snowy Owl	Main Station	<0.01	0.01	<0.01	0.03
	Airstrip	<0.01	0.01	<0.01	0.03
Rock Ptarmigan	Main Station	0.02	0.02	<0.01	0.03
	Airstrip	0.01	0.02	<0.01	0.02

Notes: SI Values above 1 shaded

8.7.4.1 Consideration of Species at Risk

As discussed in Section 8.1.2, the SAR identified for the site, the Red Knot, was assessed directly on an individual, rather than population level. Therefore, NOAEL TRVs were used for the assessment of SAR. The results for the Red Knot, assessed using NOAELs, are presented below in Table 66. As can be seen, all calculated SI values are below the benchmark of 1. And thus the Red Knot will not experience adverse effects from exposure to COPC at the HAWS.

Table 66. Calculated SI Values for SARA Wildlife - NOAELs

Receptor	Location	SI Values			
		Arsenic	Copper	Lead	Zinc
Red Knot	Drainage Pond	0.18	0.46	0.10	0.53
	Stream Area	0.22	0.50	0.10	0.95

Note: SI Values above 1 shaded

8.7.5 Uncertainties

There are several areas of uncertainty in conducting a risk assessment due to the fact that assumptions have to be made throughout the assessment either due to data gaps, environmental fate complexities, and other human characteristics. An accounting of the uncertainty is provided to be able to place a level of confidence in the results. The magnitude and type of uncertainty are important in determining the significance of results. In recognition of these uncertainties, conservative assumptions were used throughout the assessment to ensure that the potential for exposure and risks would not be underestimated. The major assumptions are outlined below.

The COPC concentrations used in the assessment were based mainly on measured data. The use of reasonable maximum exposure concentrations, which were generally an upper estimate (95% UCLM) values of measured data are a realistic yet conservative estimates of exposure. Even with all the soil data collected there is still uncertainty with respect to appropriately representing soil that would be accessible for ecological receptors. Some of the areas are where lots of human activities occur and so may be unlikely areas for ecological exposure.

As discussed previously, sediment COPC are somewhat mobile as sediments move within waterbodies and over time through sediment processes such as burial, sediment concentrations may decrease. Thus sediment concentrations used in the assessment may not represent the potential effect on benthic communities over time. It is difficult to determine whether the assumptions used for sediment result in an over or under estimate of exposure.

Literature transfer factors were used to estimate concentrations in aquatic vegetation, benthic invertebrates, terrestrial plants, insects and prey. Thus there is uncertainty in this approach. Experience in the use of literature based transfer factors has shown that these generally lead to an overestimate of concentrations and hence exposure.

The receptor characteristics are also a source of uncertainty, as receptors adjust and vary their diet according to the food sources available. The characteristics (e.g., body weight, food, soil consumption, etc.) of ecological receptors were obtained from the literature associated with animals in captivity and may not be fully representative of free-range animals in the wild. An underestimate of exposure might result from this, but there are other conservative assumptions that may compensate (i.e., time spent in area exposed to site contamination, sufficient food available at areas of highest contamination).

TRVs are obtained from reputable sources (e.g., U.S. EPA, CCME); nonetheless, they are always associated with uncertainty due to the extrapolation of testing on lab species to field conditions as well as a range of receptors. There is uncertainty associated with the use of NOAEL and LOAEL values as TRVs, as these values are not directly related to biologically relevant thresholds and do not provide information about the actual magnitude of effects in the reported studies; however, they have widespread use in the risk assessment community, generally due to policy decisions (Allard et al. 2010).

Sediment toxicity values for BTEX and PHC were developed from regulatory agencies using the equilibrium partitioning approach. There are inherent uncertainties involved with the assumption that the water and sediment concentrations are in equilibrium; however it is difficult to determine if this results in an underestimate or overestimate of potential risks.

The effect of multiple COPC on risk was not evaluated in this assessment. When dealing with more than one COPC, there is the potential interactions. There is insufficient information available to be able to evaluate these interactions.

Table 32 provides a summary of the uncertainties and tries to assign a value to the uncertainty. It must be noted that these are approximations; however, in general it is accepted in the risk assessment community that the conservative assumptions used in the assessment generally result in overestimates of the risks by a factor of two to five. It can be seen from the table that, in general, the uncertainties used in the assessment lead either to an overestimate of exposures. Based on Table 32, the conclusions of the assessment are considered valid and reliable for the intended purpose.

Table 67. Summary of Uncertainties in the ERA

Uncertainty	Overestimate	Possible Underestimate or Neutral Effect	Comment
Use of reasonable maximum exposure concentrations to characterize exposures			The use of the 95% UCLM to represent exposures for most media with the exception of food may overestimate exposures by a factor up to two.
Use of transfer factors to determine concentrations in media where data do not exist			Literature-based transfer factors were used to determine concentrations in various media. Experience with this has shown that this may result in an overestimate of exposure by a factor up to two to five.
Receptor characteristics for wildlife are unknown for site-specific conditions			What animals eat and the amount of food is estimated based on available information. Consideration was given to local conditions but animals will change behavior depending on the habitat. Many receptors were assumed to reside entirely at the HAWS, this is expected to be an overestimate of exposure.

Uncertainty	Overestimate	Possible Underestimate or Neutral Effect	Comment
Use of TRVs and guidelines that are based on no effects levels in sediments			Exceeding a no effects level does not necessarily mean that there will be an adverse effect. The use of lowest observed effect levels for the wildlife are appropriate judge population-level effects. The use of no effects levels can overestimate risks by a factor between two and 10. .
Interactions between COPC			There may be synergism, potentiation, antagonism, or additivity of toxic effects. The use of multiple LOEs (e.g. benthic community surveys and toxicity tests) reduces the uncertainty in this knowledge gap.

8.7.6 Summary

The results of the ERA show that:

- The PHC F2 contamination at the site has the potential to cause adverse effects on plants at the HAWS; however given the area of contamination versus the rest of the HAWS area, the chances of population effects on plants is considered to be low. In addition, PHC F2 concentrations are expected to decrease through natural attenuation over time which also would reduce any potential impacts.
- Wildlife are not at risk from exposure to contamination at the HAWS.
- Water quality in the Drainage Pond and Stream Area does not result in adverse effects on the aquatic community.
- There is the potential for sediment impacts in the benthic community down slope of the Powerhouse building. Minor adverse effects may be observed just downstream of the berm within the Stream Area.

9.0 SSTL Development

Site-specific target levels (SSTLs) were derived for the HAWS based on the results of the Human Health and Ecological risk assessments. This section provides SSTLs for the identified COPC in water, sediment and soil. The surface water and sediment SSTLs are ecologically based while the soil SSTLs include a consideration of background, ecological and human risk-based values.

9.1.1 Surface Water SSTLs

Cadmium was the only COPC identified in surface water in the Drainage Pond based on a consideration of the dataset. In 2017 and 2019, cadmium was measured below the detection limit. Nonetheless, the SSTL for cadmium is based on the protection of 95% of the aquatic community in the Drainage Pond and is 1.2 µg/L.

9.1.2 Sediment SSTLs

The SSTLs for the identified PAHs and metals were based on a consideration of the CCME sediment guidelines which provide both a no effects level and a low effects level. For the purposes of deriving the SSTLs for these identified COPC, the geometric mean of the two values was selected to represent the SSTLs as shown in Table 68. For manganese there are no CCME guidelines and thus the guidelines from the Ontario Ministry of the Environment, Conservation and Parks were used to develop the SSTL. For arsenic, the background sediment measurements are all above the derived geometric mean of the arsenic sediment guidelines. Therefor a site-specific value of 20 mg/kg was derived based on the maximum concentration plus 20% for sample variability. All other SSTLs are based on the CCME guidelines.

For the BTEX and PAHs identified in sediments, the values derived from the equilibrium partitioning approach and discussed in Section 8.5.1 were used as the SSTLs as they are based on the fraction of organic carbon (f_{oc}) of 0.01 found at the HAWS. Table 69 provides the sediment SSTLs for the BTEX and PHC contaminants.

Table 68. Sediment SSTLs for PAHs and Metals

COPC	Unit	Sediment Guideline				SSTL (mg/kg)
		ISQG [a]	PEL [a]	LEL [b]	SEL [b]	Based on Geometric Mean
Metals						
Arsenic	mg/kg	5.9	17			25*
Chromium	mg/kg	37.3	90			58
Copper	mg/kg	35.7	197			84
Manganese	mg/kg	-	-	460	1100	711
Zinc	mg/kg	123	315	120	820	197
PAHs						
Acenaphthene	mg/kg	0.00671	0.0889			0.02
Acenaphthylene	mg/kg	0.00587	0.128			0.03
Acridine	mg/kg	0.0212	0.144			0.05
Anthracene	mg/kg	0.0469	0.245	-	-	0.11
Benzo(a)pyrene	mg/kg	0.0319	0.782			0.16
Benzo(b&j)fluoranthene[c]	mg/kg	0.0319	0.782			0.16
Benzo(g,h,i)perylene[c]	mg/kg	0.0319	0.782			0.16
Fluorene	mg/kg	0.0202	0.144			0.05
1-Methynaphthalene	mg/kg	0.0202	0.201			0.06
2-Methynaphthalene	mg/kg	0.0202	0.201			0.06
Naphthalene	mg/kg	0.0346	0.391			0.12
Perylene[d]	mg/kg	0.0212	0.144			0.05
Phenanthrene	mg/kg	0.0419	0.515			0.15
Pyrene	mg/kg	0.053	0.875			0.22

Notes:
[a] Sediment quality guidelines for the protection of freshwater aquatic life for long-term exposure from the Canadian Council of Ministers of the Environment (CCME 2017). ISQG – Interim Sediment Quality Guideline; PEL – Probable Effects Level.
[b] Provincial sediment quality guidelines for metals from the Ontario Ministry of Environment (MOEE 1993). LEL - Lowest Effects Level; SEL - Severe Effects Level.
[c] Used the toxicity value for benzo(a)pyrene
[d] Used the toxicity value for fluorine
*Site-specific value of the maximum plus 20% used as background arsenic in sediment concentrations are above the geometric mean of the laboratory guidelines of 10mg/kg

Table 69. Sediment SSTLs for BTEX and PAHs

COPC	SSTL (mg/kg)
Benzene	1.2
Ethylbenzene	1.2
Xylenes	1.3
PHC F1	21
PHC F2	57
PHC F3	99

9.1.3 Soil SSTLs

There were several lines of evidence considered in the derivation of the soil SSTLs for the HAWS. These lines of evidence were:

- Soil background concentrations.
- Plant toxicity benchmarks based on soil concentrations;
- Food web pathways calculations based on the most exposed receptor; and
- Human pathways calculations for the identified receptors.

For the ecological and risk based values, the following equation was used to calculate the value:

Risk Based Value = (C_{soil}/HQ or SI calculated) x Target HQ or SI

Where:

C_{soil} = EPC for soil – generally based on the 95% UCLM concentration

HQ/SI calculated = Value obtained from the risk calculations for human health and ecological risk

Target HQ/SI = Appropriate Target value. For humans it is 0.2 for the metals and 0.5 for the PHC exposures; for ecological receptors it is a value of 1

These various lines of evidence are discussed below.

The soil concentrations that are protective of plants are provided in Table 70. These values are obtained from the Ontario Ministry of the Environment, Conservation and Parks and are based on toxicity studies in plants such as grasses, rye, barley, lettuce and other species and were used in the risk assessment calculations.

Table 70. Plant Based Protection Levels

COPC	Plant Protection Level (mg/kg)
Arsenic	25
Boron, hot water soluble	1.5
Copper	180
Lead	310
Zinc	500
PHC F1 (C_6-C_{10})	210
PHC F2 (C_{10}-C_{16})	150
PHC F3 (C_{16}-C_{34})	1300
Naphthalene	0.75

For the wildlife food web calculations, the snow bunting was the most exposed terrestrial receptor. Thus the risk-based terrestrial ecological values provided in Table 71 are based on adjusting the calculated SI values from exposure at the HAWS to an SI value of 1. The terrestrial risk-based soil concentrations are the same for the Main Station and the Airstrip as the Snow Bunting is the most exposed receptor at both locations.

Table 71. Risk-Based Ecological Soil Values

COPC	Risked-Based Soil Ecological Value (mg/kg)
Arsenic	270
Copper	1920
Lead	360
Zinc	497

For the human health calculations, the risk-based soil concentrations were calculated for all the receptors evaluated. The calculated hazard quotient values were adjusted to a value of 0.2 for metals and 0.5 for PHC to derive these values shown in Table 72. The F2 SSTL values were calculated assuming indoor air concentrations within each of the buildings remain as calculated. Values shown in bold are the lowest values which are considered to be protective of human health.

Table 72. Risk-Based Human Health Soil Values

COPC	Risk-Based Human Health Soil Concentrations (mg/kg)				
	Water/Sewage Construction worker	**O&M Worker at Main Station**	**Office Worker**	**Airstrip Construction worker at NUNA Camp**	**O&M Worker with activities at the Airstrip**
Outdoor exposure:	Main Station	Main Station	Main Station	Airstrip	Airstrip
Arsenic	**36.9**	146	194	**36.9**	146
Lead	**440**	1350	1800	**440**	1350
PHC F1	**7740**	32470	43290		
PHC F2	**4060**	8640	24470	**3060**	8640

Note: Values in bold are the lowest values protective of human health.

Table 73 provides the SSTLs for the Main Station Area at the HAWS and provides a rationale for the selection. The SSTL for hot water soluble boron is based on the maximum measured across the HAWS plus 20%. Due to the disturbed nature at the HAWS and the low plant growth in the area, it was determined that the selection of SSTLs based on protection of plants would be overly conservative. Therefore the rest of the soil SSTLs are based on human health or on site specific considerations where the maximum plus 20% for sampling variability is considered. This was done for boron, hot-water soluble boron and nickel. The SSTLs have been rounded to be easily compared to monitoring data.

Table 74 provides the SSTLs for the Airstrip Area at the HAWS and provides a rationale for the selection. The human health risk based SSTLs are based on exposure at the Airstrip area. The SSTLs have been rounded to be easily compared to monitoring data.

Table 73. SSTLs for Main Station Area

COPC	Background (mg/kg)	Plant Protection Level (mg/kg)	Risk-Based Ecological Value (mg/kg)	Risk-Based Human Health Value (mg/kg)	Proposed SSTL[a] (mg/kg)	Rationale
Arsenic	10	25	270	37	40	Based on human health risk based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Boron, hot water soluble	-	1.5	NA	NA	6	Based on site-specific considerations. Represents maximum measured plus 20% for sample variability, which is higher than the benchmark
Boron	9.5	1.5	NA	NA	30	Based on site-specific considerations. Maximum measured concentration plus 20% for sample variability
Copper	18	180	1920	1100[b]	1100	Human Health component of copper guideline. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Lead	6	310	360	440	360	Based on ecological risk based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Nickel	23	45	NA	200[b]	78	Based on site-specific considerations. Maximum measured concentration plus 20% for sample variability
Zinc	48	500	497	10,000[b]	10,000	Based on protection of human health
Benzene	-	60	NA	2.1	2	Based on human health component of the guideline
Ethylbenzene	-	110	NA	2700	110	Based on ecological component of the guideline
Toluene	-	120	NA	1300	120	Based on ecological component of the guideline

COPC	Background (mg/kg)	Plant Protection Level (mg/kg)	Risk-Based Ecological Value (mg/kg)	Risk-Based Human Health Value (mg/kg)	Proposed SSTL[a] (mg/kg)	Rationale
Xylenes	-	65	NA	320	65	Based on ecological component of the guideline
PHC F1 (C_6-C_{10})	-	210	NA	7740	7800	Based on human health risk based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
PHC F2 (C_{10}-C_{16})	-	150	NA	4060	4100	Based on human health risk based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
PHC F3 (C_{16}-C_{34})	-	1300	NA	15000[b]	15000	Human Health component of PHC F3 guideline. Due to the disturbed soils, the plant benchmark is not appropriate
1-Methylnaphthalene	-	3.4[c]	NA	72[c]	70	Based on human health risk based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
2-Methylnaphthalene	-	3.4[c]	NA	110[c]	110	Based on human health risk based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Acenaphthylene	-	0.17	NA	7.8[c]	8	Based on human health risk based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Acridine	-	-	NA	2.5[d]	3	Based on CCME guideline for similar structure- anthracene
Naphthalene	-	0.75	NA	57[b]	60	Human health component of the guideline
Perylene				10[e]	10	Based on CCME guideline for similar structure- pyrene

Notes: a – SSTL values are rounded up; b – Human Health component of the CCME guidelines; c - Values taken from the Ontario Ministry of the Environment, Conservation and Parks (MOE 2011); d- based on CCME guideline for similar structure in this case anthracene; e - based on CCME guideline for similar structure in this case pyrene

Table 74. SSTLs for Airstrip Area

COPC	Background (mg/kg)	Plant Protection Level (mg/kg)	Risk-Based Ecological Value (mg/kg)	Risk-Based Human Health Value (mg/kg)	Proposed SSTL[a] (mg/kg)	Rationale
Arsenic	10	25	270	37	40	Based on human health risk based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Boron, hot water soluble	-	1.5	NA	NA	6	Represents maximum measured plus 20%, which is higher than the benchmark
Copper	18	180	1920	1100[b]	1100	Human Health component of copper guideline. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Lead	6	310	360	440	360	Based on ecological risk based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Zinc	48	500	497	10,000[b]	500	Based on ecological risk based value
Benzene	-	60	NA	2.1	2	Based on human health component of the guideline
Ethylbenzene	-	110	NA	2700	110	Based on ecological component of the guideline
Toluene	-	120	NA	1300	120	Based on ecological component of the guideline
Xylenes	-	65	NA	320	65	Based on ecological component of the guideline
PHC F2 (C_{10}-C_{16})	-	150	NA	3060	3060	Based on human health risk based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate

COPC	Background (mg/kg)	Plant Protection Level (mg/kg)	Risk-Based Ecological Value (mg/kg)	Risk-Based Human Health Value (mg/kg)	Proposed SSTL[a] (mg/kg)	Rationale
PHC F3 (C_{16}-C_{34})	-	1300	NA	15000[b]	15000	Human Health component of PHC F3 guideline. Due to the disturbed nature of the site, the plant benchmark is not appropriate
1-Methylnaphthalene	-	3.4[c]	NA	72[c]	70	Based on human health risk based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
2-Methylnaphthalene	-	3.4[c]	NA	110[c]	110	Based on human health risk based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Acenaphthylene	-	0.17	NA	7.8[c]	8	Based on human health risk based value. Due to the disturbed nature of the site, the plant benchmark is not appropriate
Acridine	-	-	NA	2.5[d]	3	Based on CCME guideline for similar structure- anthracene
Naphthalene	-	0.75	NA	57[b]	60	Human health component of the guideline
Perylene				10[e]	10	Based on CCME guideline for similar structure- pyrene

Notes: a – SSTL values are rounded up; b – Human Health component of the CCME guidelines; c - Values taken from the Ontario Ministry of the Environment, Conservation and Parks (MOE 2011); d- based on CCME guideline for similar structure in this case anthracene; e - based on CCME guideline for similar structure in this case pyrene

10.0 Summary and Conclusions

Dillon Consulting Limited and Outcome Consultants in joint venture (Dillon-Outcome) and their risk assessment team, CanNorth Environmental Services, were retained by Public Services and Procurement Canada (PSPC) on behalf of Environment and Climate Change Canada (ECCC) to perform services ("Services" or "Project") associated with the conduct of a Human Health and Ecological Risk Assessment ("HHERA") of the Eureka High Arctic Weather Station (HAWS, or "the Station"). The HHERA also takes into account a number of infrastructure improvement projects that are occurring at the HAWS such as the upgrading of the runway, the construction of a new drinking water reservoir and sewage and wastewater system upgrades as well as decommissioning of a number of buildings.

Eureka HAWS is operated by Environment and Climate Change Canada (ECCC) under the Meteorological Service of Canada (MSC) and has been in operation since 1947. The HAWS is an operational weather monitoring station as well as serving as a hub for a number of different agencies carrying out different activities. It is a remote location on the north side of the Slidre Fjord, at the north-western tip of Fosheim Peninsular on Ellesmere Island, Nunavut. The station is used for government sponsored scientific research. The area occupied by the Airstrip Area (1.5 km north of the main site) and the Main Station Area is approximately 2.23 hectares.

The Main Station Area is east of Station Creek and includes a number of buildings and infrastructure including an operations/residence complex, garages, powerhouse, warehouses, electrical building, carpentry shop, transient quarters, miscellaneous small buildings, sealift landing area, active landfill; closed landfills; contaminated soil treatment facilities; roads; water reservoir; sewage lagoon; tank farm and fuel pipeline.

Environmental investigations have been conducted at the HAWS from 1995 through 2012. These investigations have identified the presence of contaminants of concern, identified areas of potential concern, and evaluated the risks for human health and ecological receptors. In addition, there is a Long-Term Monitoring Program being conducted at the HAWS and activities have been completed since 2013 and there have been 4 years of monitoring (2013, 2015, 2017 and 2019).

The HHERA conducted for the site takes into account all the data as well as the different activities that are on-going at the HAWS as well as future construction activities.

The results of the human health risk assessment showed that there are no risks to people engaging in any types of work activities at the Eureka HAWS.

The results of the ERA show that:

- The PHC F2 contamination at the site has the potential to cause adverse effects on plants at the HAWS; however, given the area of contamination versus the rest of the HAWS area, the chances of population effects on plants is considered to be low. In addition, PHC F2 concentrations are expected to decrease through natural attenuation over time which also would reduce any potential impacts.

- Wildlife are not at risk from exposure to contamination at the HAWS.
- Water quality in the Drainage Pond and Stream Area does not result in adverse effects on the aquatic community.
- There is the potential for sediment impacts in the benthic community down slope of the Powerhouse building. Minor adverse effects may be observed just after the berm within the Stream Area. There may be an opportunity to do some remediation in these two areas.

Site Specific threshold limits were developed to aid in any remedial planning at the HAWS.

11.0 Closure

The information provided in this document lays out the HHERA at the Eureka HAWS including additional data collected in 2021. All assumptions and calculations are detailed in this HHERA report.

We trust that this updated Human Health and Ecological Risk Assessment will prove useful in planning the upcoming infrastructure projects at Eureka.

Sincerely,

DILLON-OUTCOME JOINT VENTURE

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Senior Professional

CANNORTH ENVIRONMENTAL SERVICES

Harriet Phillips, Ph.D. QP_{RA}
Senior Risk Assessor

12.0 References

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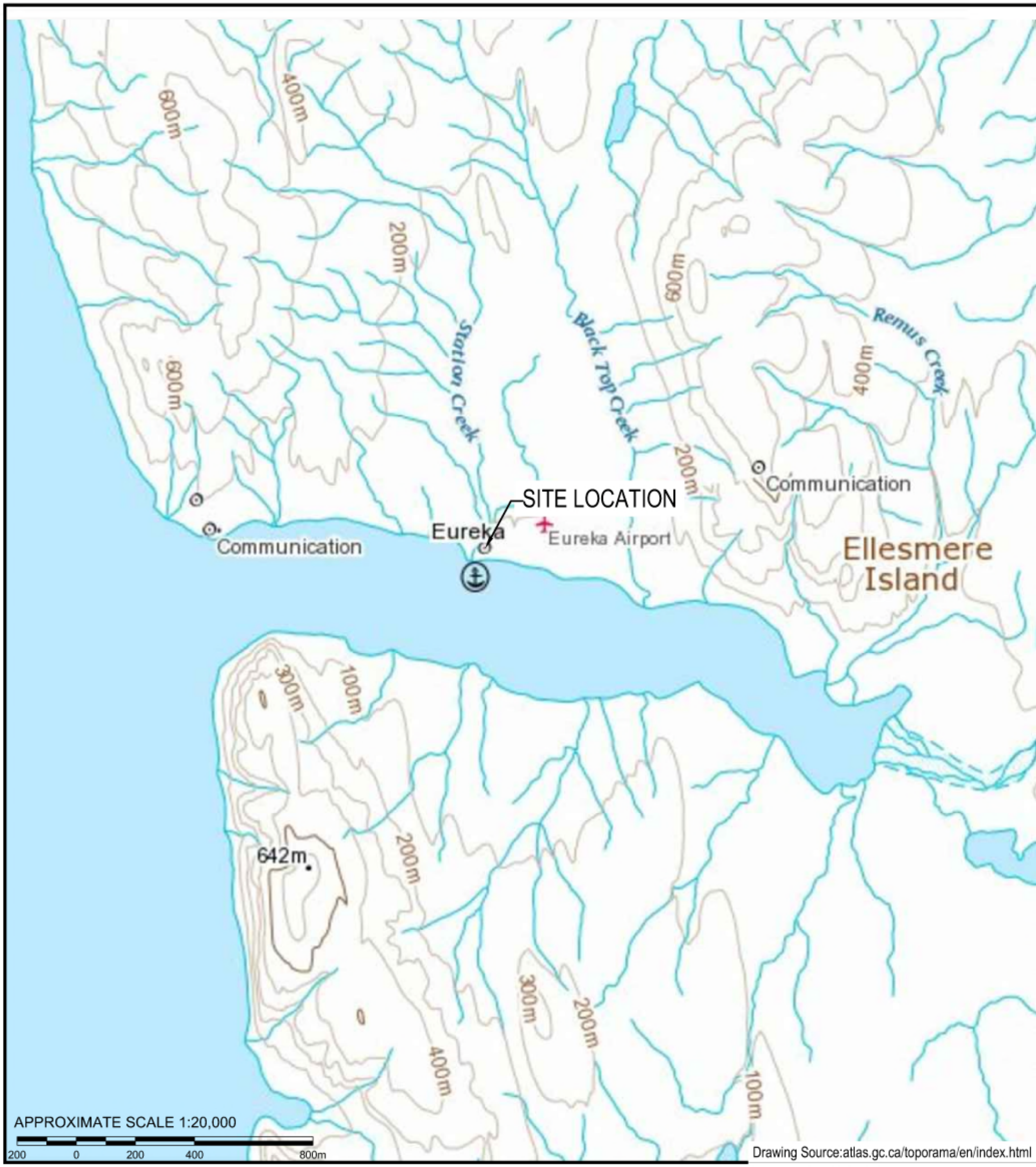
Figures



Title: SITE LOCATION

Project: SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
EUREKA HIGH ARCTIC WEATHER STATION
EUREKA, NU

Client: PSPC / ECCC

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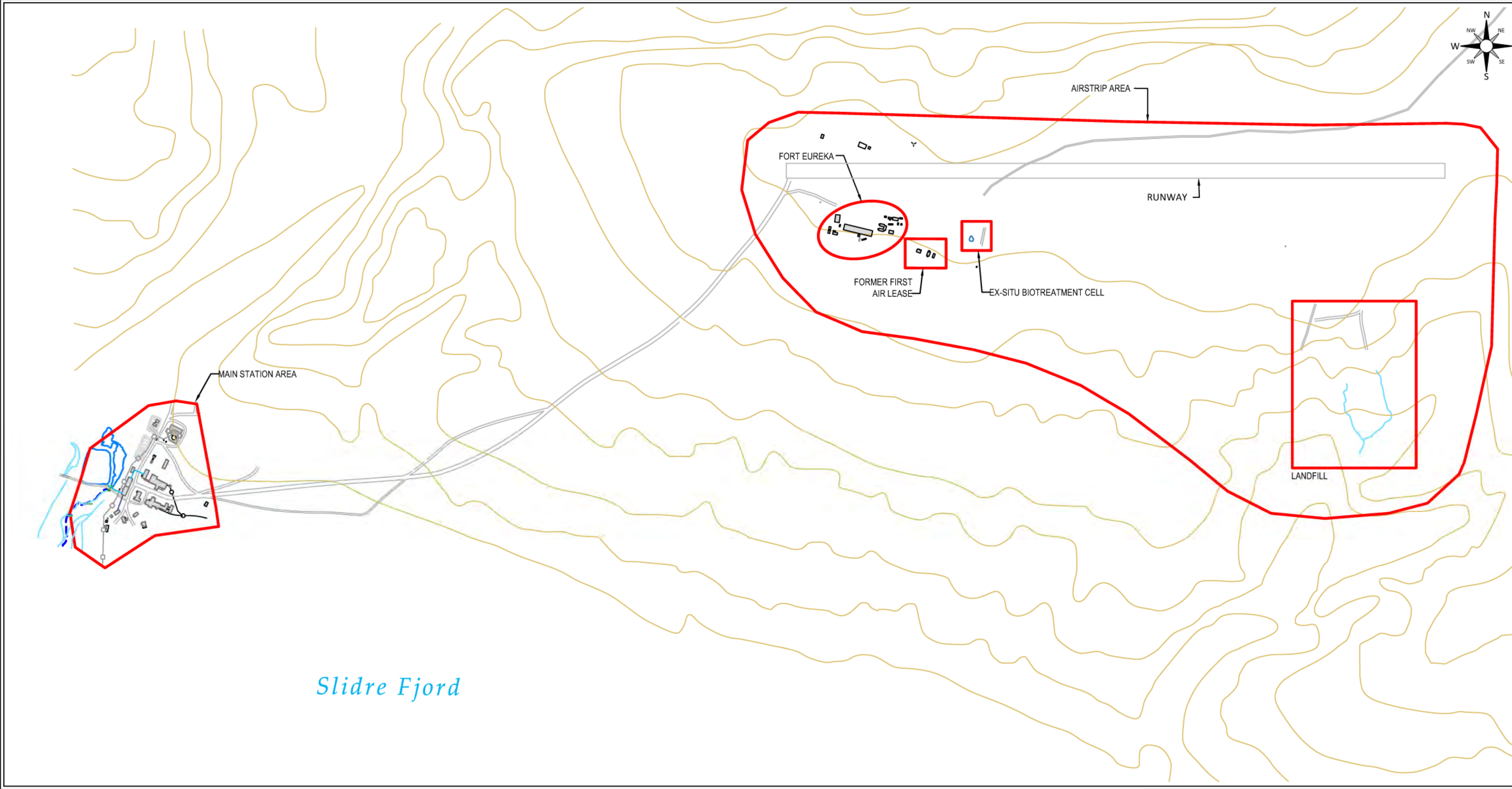
Date: DECEMBER 2020

Project No.: P2020-18

Figure 1



Legend

Long Term Monitoring Work Areas

Drawing Source: Arcadis, 2016

SCALE 1:10,000

100 0 100 200 400m

Title: EUREKA HAWS - SITE OVERVIEW

Project: SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
EUREKA HIGH ARCTIC WEATHER STATION
EUREKA, NU

Client: PSPC / ECCC

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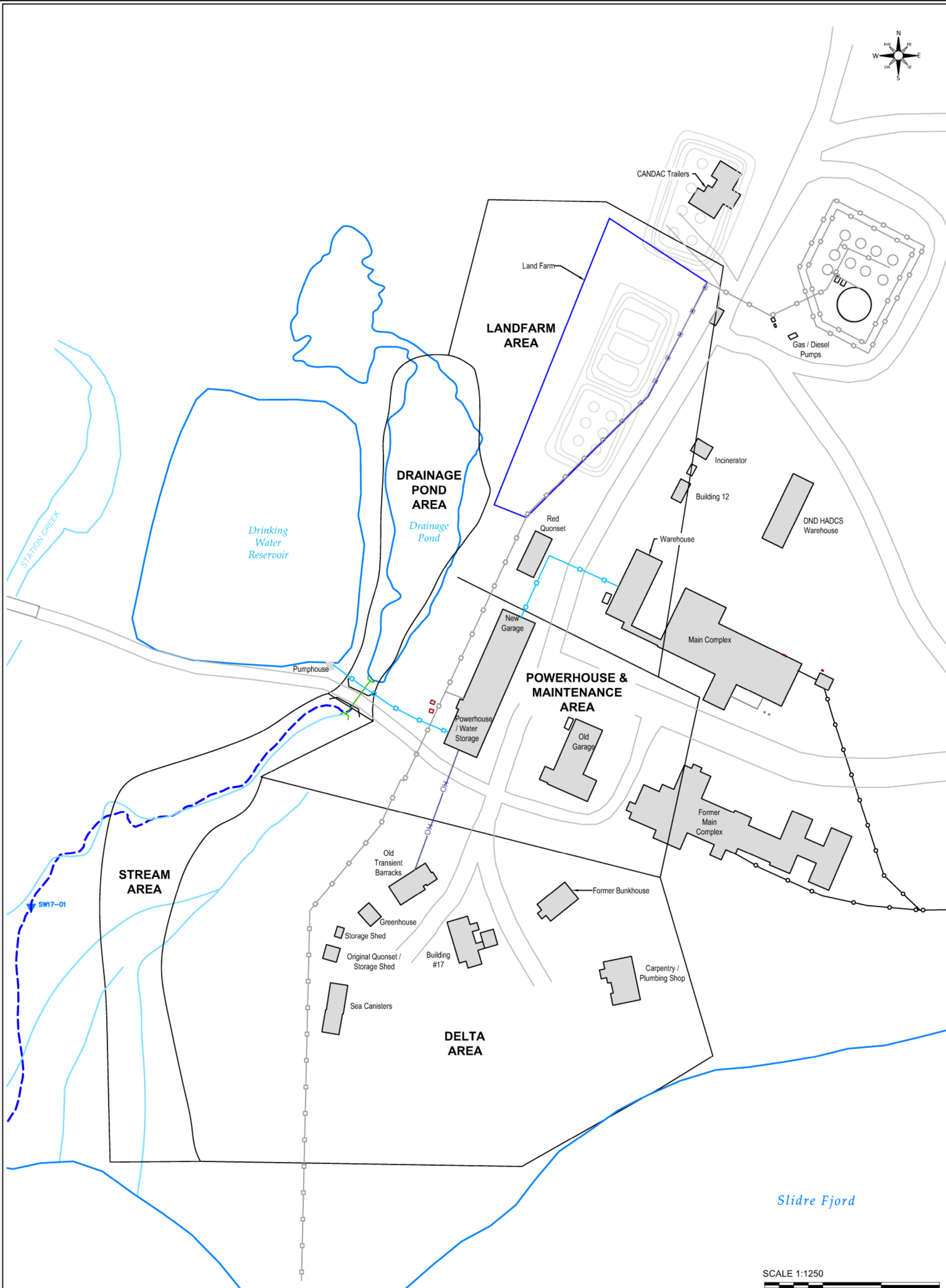
Date: DECEMBER 2020

Project No: P2020-18

FIGURE 2



LEGEND

Building	Pipeline
Tank	Hydro Overhead
Powerbox	Water Line
Land Farm	Road
Long Term Monitoring Work Areas (LTM)	Sewer
Stream Channel 2017	
Previous Stream Channel (2015 and Previous)	

Drawing Source: Arcadis, 2016

Title: EUREKA HAWS MAIN STATION ARE AND SUB AREAS

Project: SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
EUREKA HIGH ARCTIC WEATHER STATION
EUREKA, NU

Client: PSPC / ECCC

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Project No: P2020-18

FIGURE 3

Title:	SCHEMATIC OF THE RISK ASSESSMENT PROCESS
Project:	SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EUREKA HIGH ARCTIC WEATHER STATION EUREKA, NU
Client:	PSPC / ECCC
Date:	DECEMBER 2020
Project No.:	P2020-18
	Figure 4

DILLON CONSULTING

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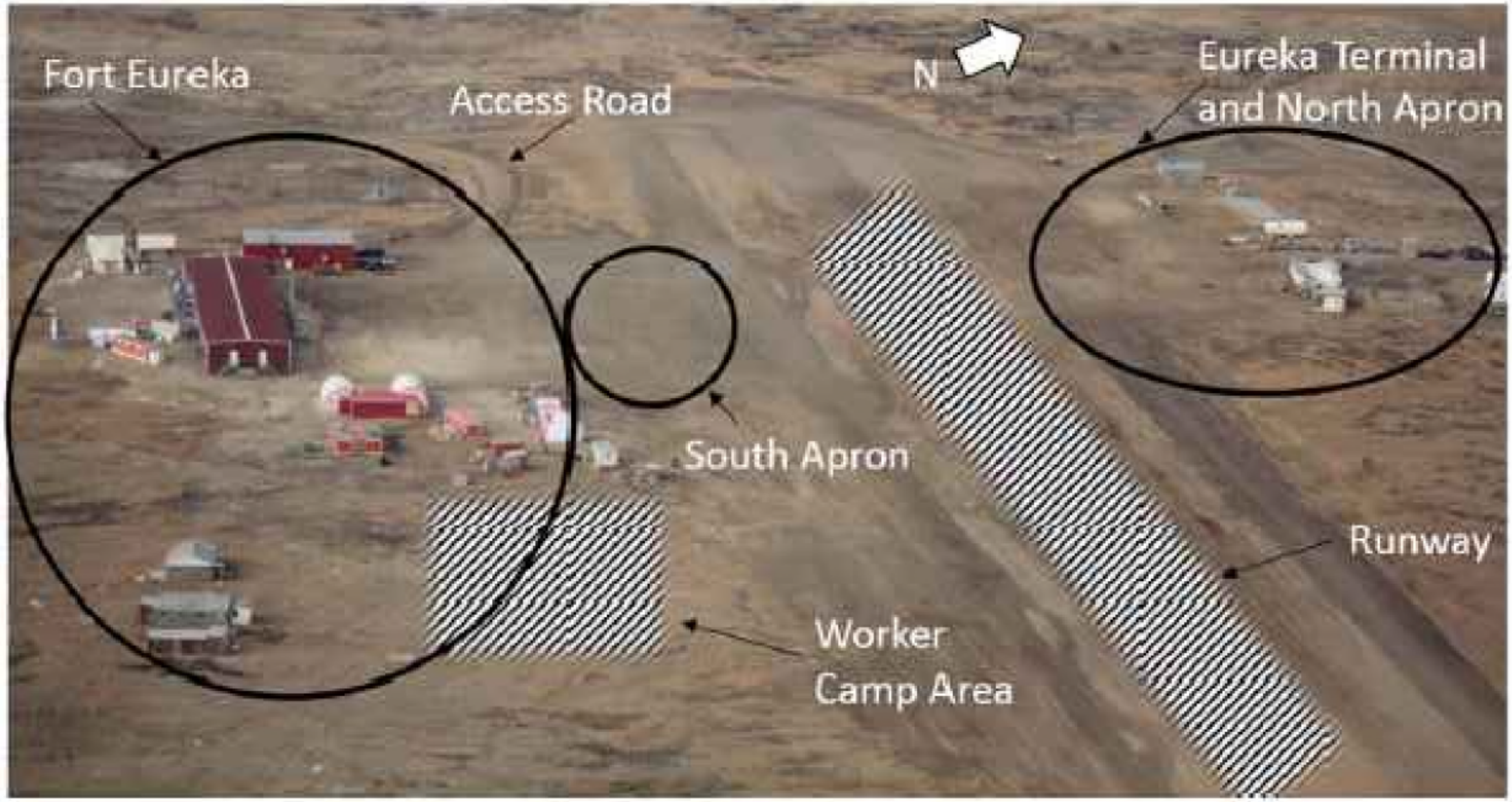

Title:	LOCATION OF WORKER CAMP NEAR AIRSTRIP
Project:	SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EUREKA HIGH ARCTIC WEATHER STATION EUREKA, NU
Client:	PSPC / ECCC
Date:	DECEMBER 2020
Project No.:	P2020-18
	Figure 5

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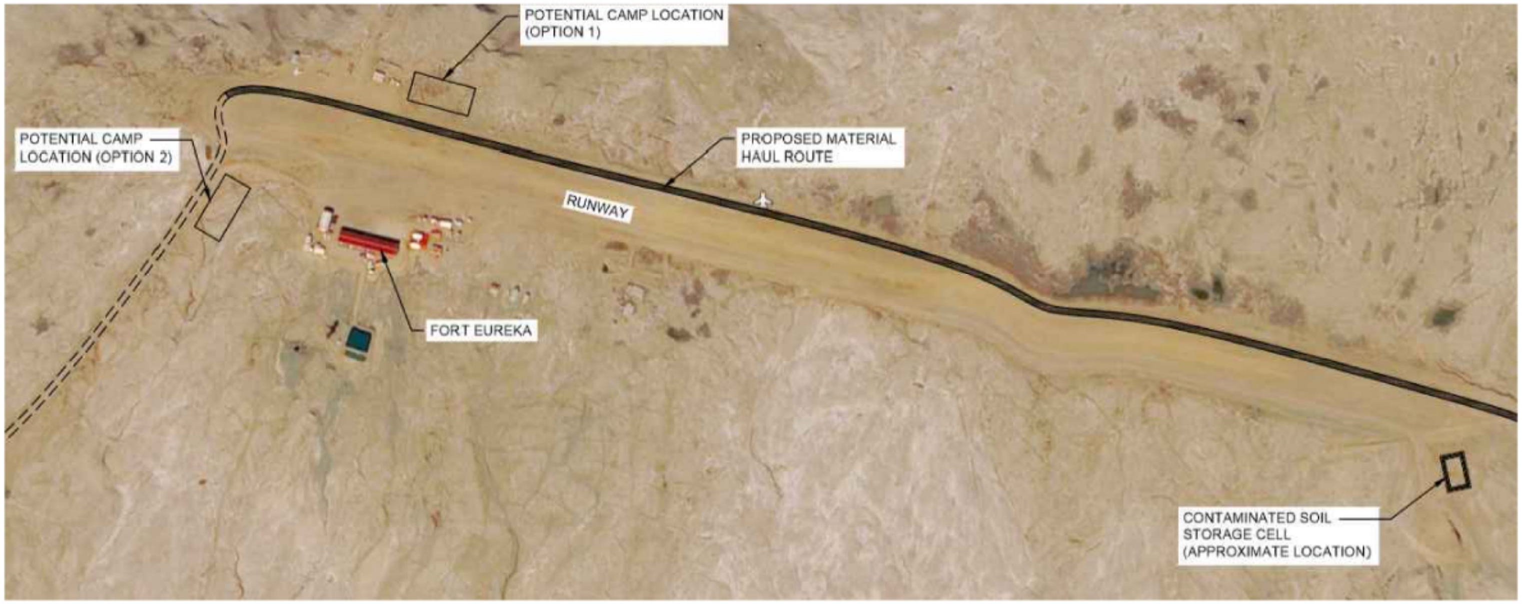

Title:	POTENTIAL LOCATION OF WORKER CAMP FOR WATER PROJECTS
Project:	SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EUREKA HIGH ARCTIC WEATHER STATION EUREKA, NU
Client:	PSPC / ECCC
Date:	DECEMBER 2020
Project No.:	P2020-18
	Figure 6

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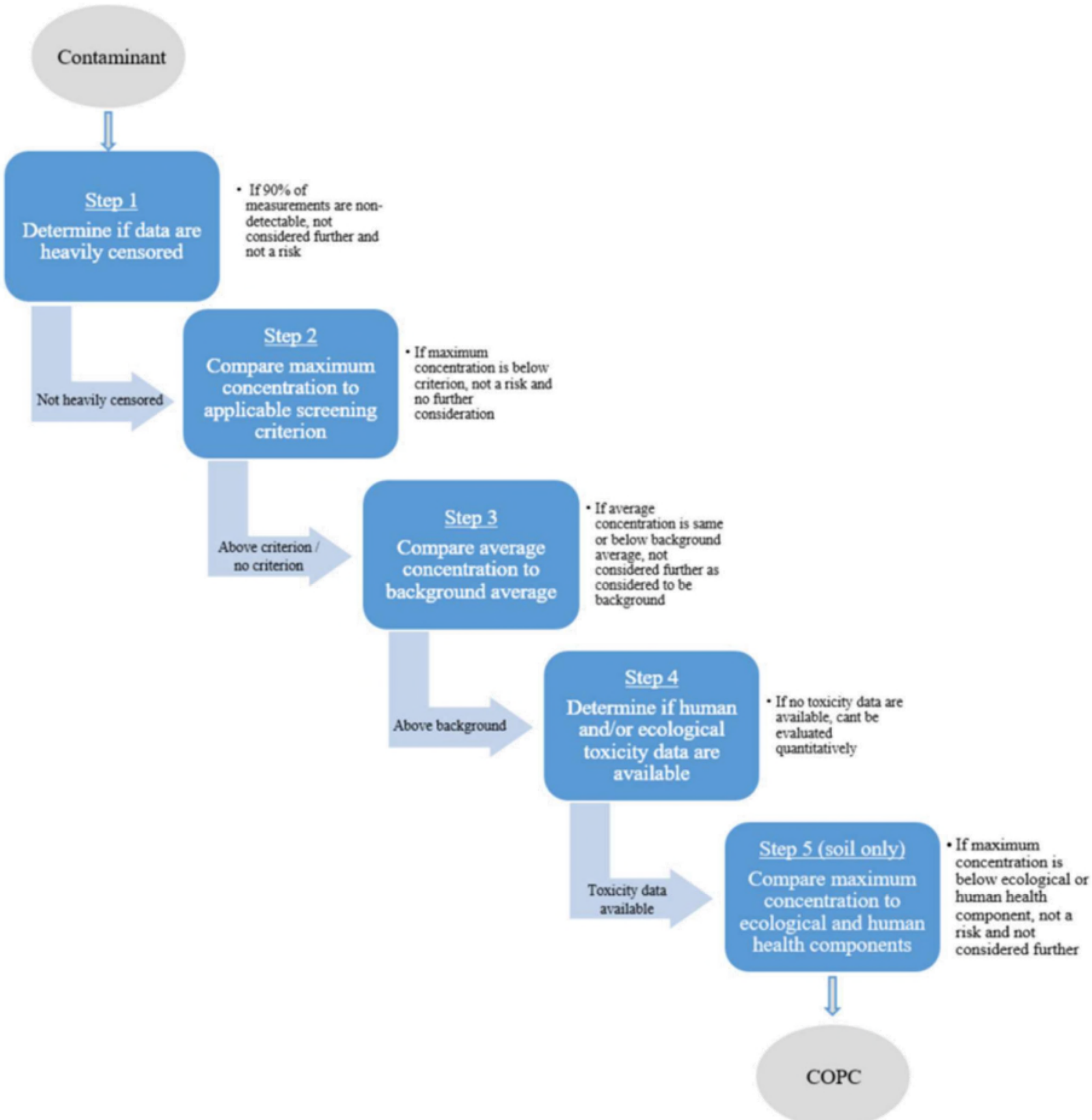
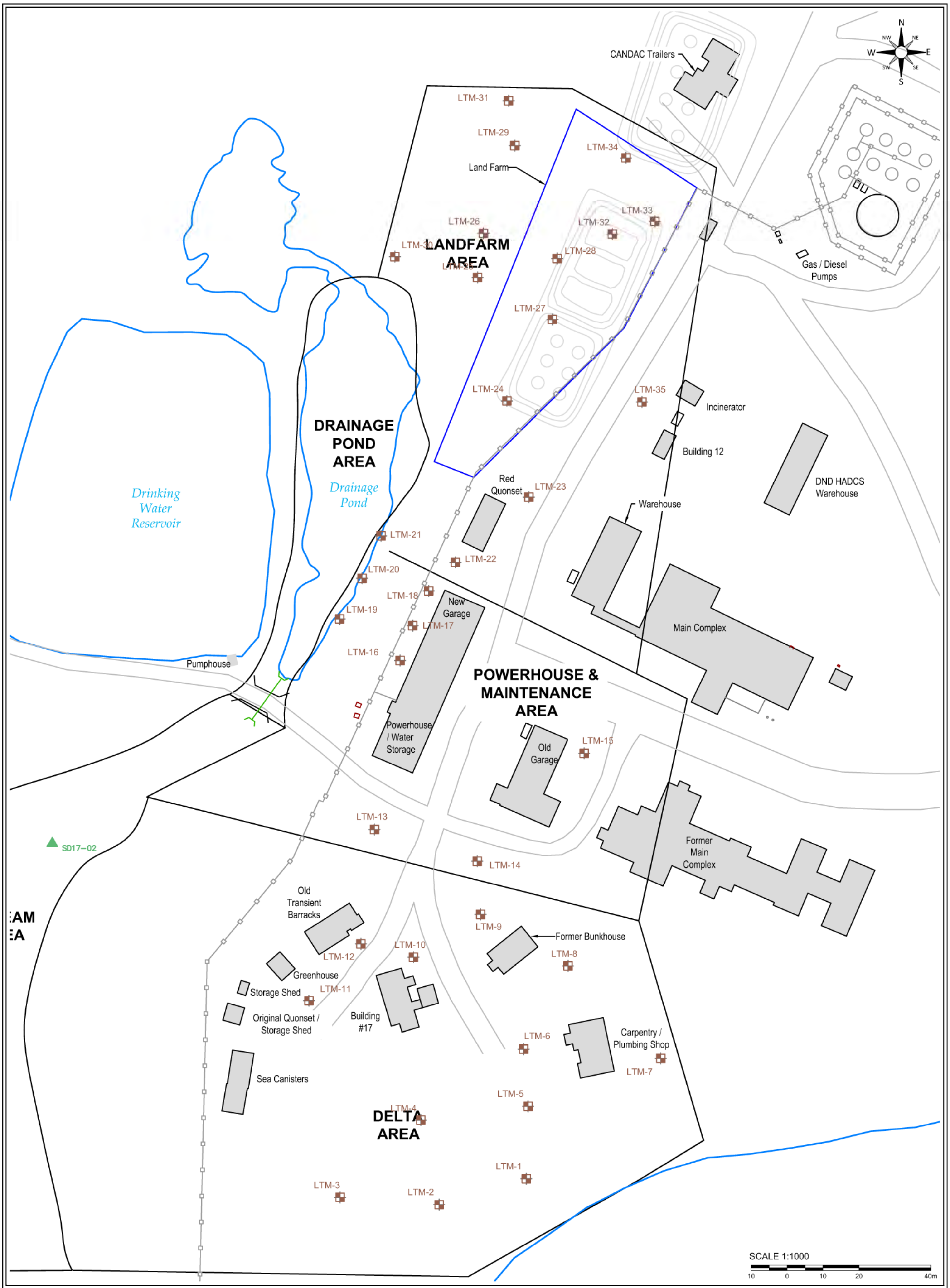


Title:	GENERAL SELECTION PROCESS FOR CONTAMINANT OF POTENTIAL CONCERN
Project:	SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EUREKA HIGH ARCTIC WEATHER STATION EUREKA, NU
Client:	PSPC / ECCC
Date:	DECEMBER 2020
Project No.:	P2020-18
	Figure 7

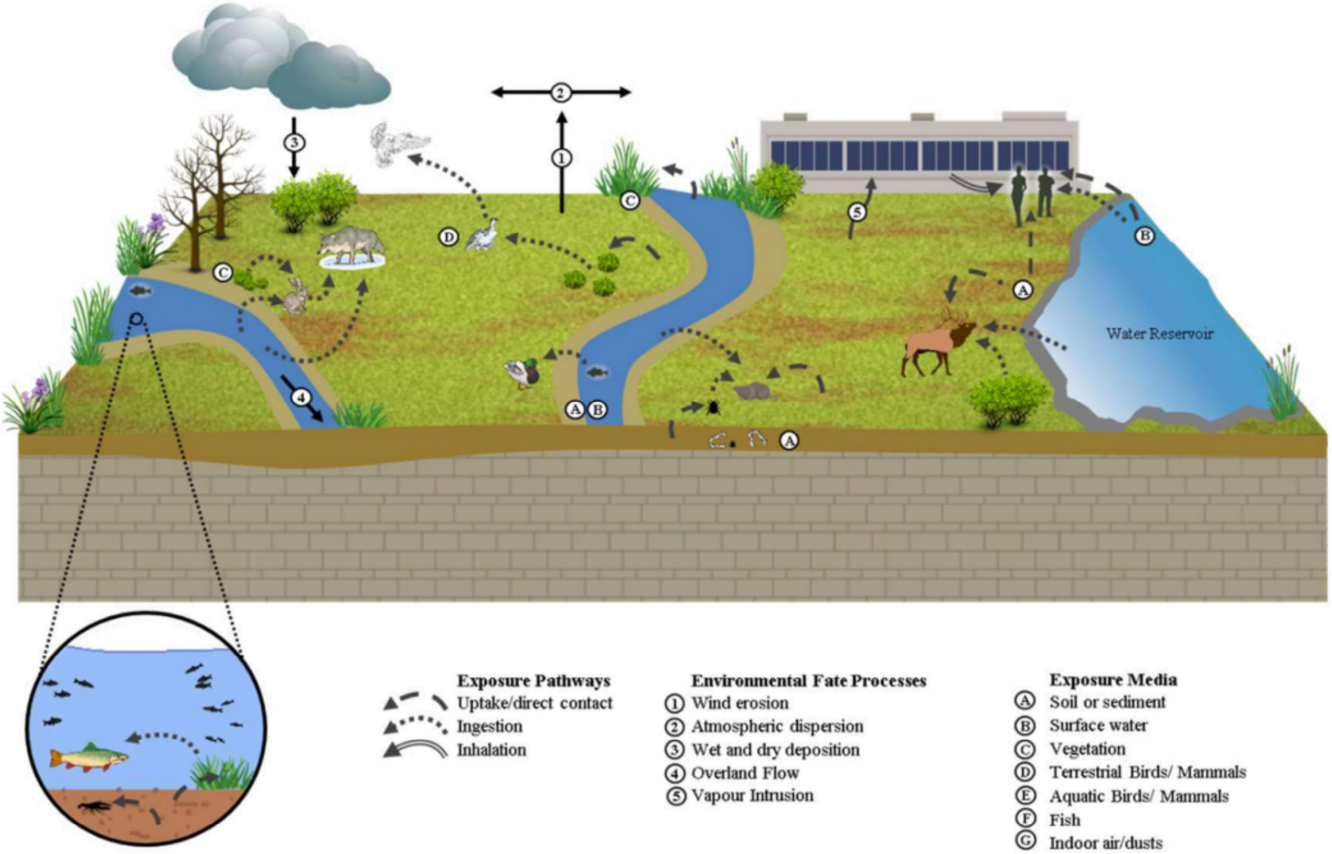


LEGEND

- Building
- Tank
- Powerbox
- Land Farm
- Long Term Monitoring Work Area (LTM)
- Road
- LTM Test Pit Locations

Drawing Source: Arcadis, 2016

Title:	SOIL SAMPLING LOCATIONS AT THE EUREKA HAWS
Project:	SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EUREKA HIGH ARCTIC WEATHER STATION EUREKA, NU
Client:	PSPC / ECCC
DILLON CONSULTING / outcome CONSULTANTS	DECEMBER 2020 FIGURE 8



Title:	CONCEPTUAL SITE MODEL FOR THE EUREKA SITE
Project:	SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EUREKA HIGH ARCTIC WEATHER STATION EUREKA, NU
Client:	PSPC / ECCC
Date:	DECEMBER 2020
Project No.:	P2020-18
	Figure 9

DILLON CONSULTING

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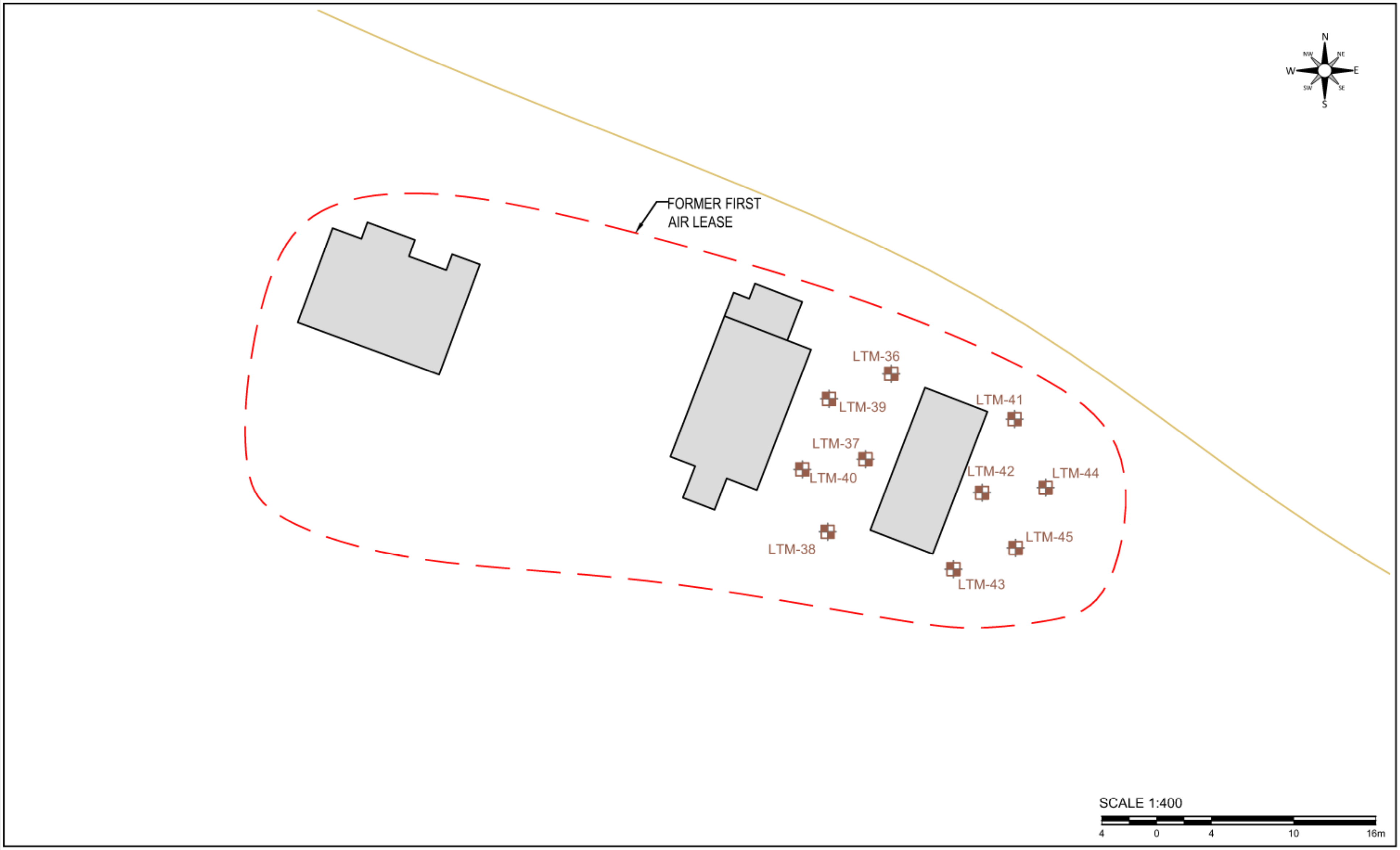

LEGEND

	Building
	Road
	APEC-FEI-0808
	LTM Test Pit Locations
LTM	Long Term Monitoring

Drawing Source: Arcadis, 2016

Title: FORMER FIRST AIR LEASE SOIL SAMPLING LOCATIONS

Project: SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
EUREKA HIGH ARCTIC WEATHER STATION
EUREKA, NU

Client: PSPC / ECCC

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Date: DECEMBER 2020

Project No.: P2020-18

Figure 10

Title:	SOIL SAMPLING LOCATIONS ON NORTH AIRSTRIP APRON
Project:	SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EUREKA HIGH ARCTIC WEATHER STATION EUREKA, NU
Client:	PSPC / ECCC
Date:	DECEMBER 2020
Project No.:	P2020-18
	Figure 11

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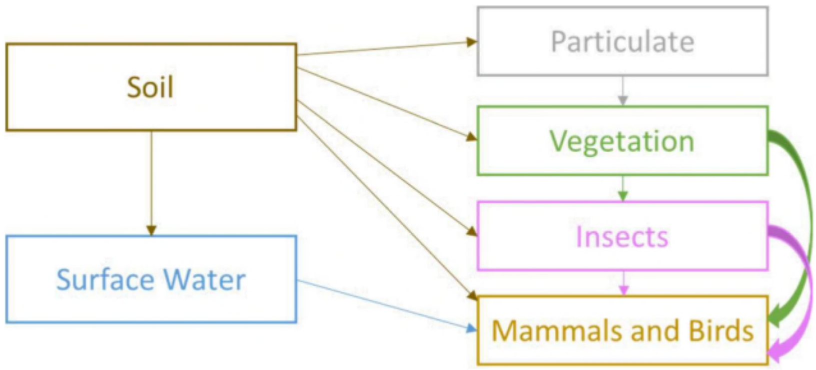

Exposure Pathway	Terrestrial Vegetation [a]	Herbivorous Birds and Mammals [b]	Insectivorous Birds [c]	Carnivorous Birds and Mammals [d]
Incidental Ingestion (soil)	--	✓	✓	✓
Dermal contact/ uptake (soil)	✓	o	o	o
Inhalation (dust)	--	o	o	o
Ingestion (vegetation)	--	✓	✓	✓
Ingestion (insects)	--	--	✓	--
Ingestion (mammal/bird)	--	--	--	✓
Ingestion (sw)	--	✓	✓	✓

[a] Vegetation community (surrogate for invertebrates)
[b] Arctic hare and rock ptarmigan
[c] Snow bunting
[d] Arctic fox and snowy owl

✓ : Potential pathway of exposure (included in assessment)
• : Implicitly included in other pathways
o : Potential pathway of exposure but expected to be negligible; not considered further in the RA
-- : Not a potential exposure pathway for this receptor

Title:	CONCEPTUAL SITE MODEL FOR THE ECOLOGICAL RISK ASSESSMENT - TERRESTRIAL ENVIRONMENT
Project:	SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EUREKA HIGH ARCTIC WEATHER STATION EUREKA, NU
Client:	PSPC / ECCC
Date:	DECEMBER 2020
Project No.:	P2020-18
	Figure 12

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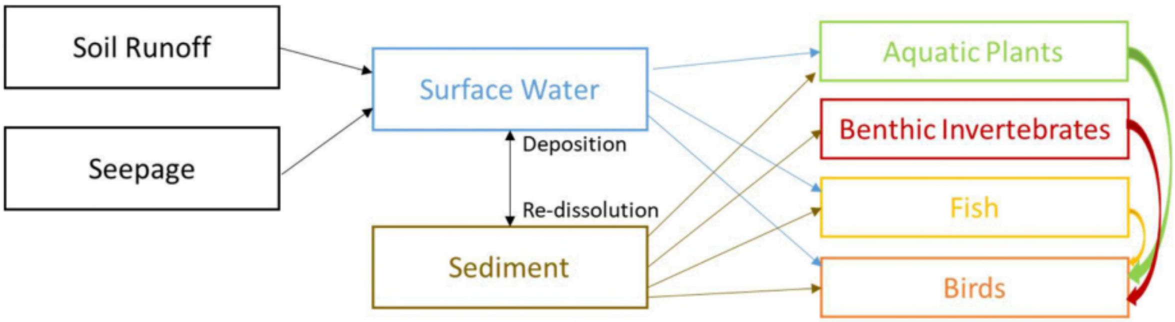

Exposure Pathway	Water Column Community [a]	Benthic Invertebrates	Herbivorous Birds [b]	Insectivorous Birds [c]	Piscivorous Birds [d]
Ingestion (sw)	•	•	✓	✓	✓
Dermal contact/ uptake (sw)	✓	•	○	○	○
Ingestion (aquatic plants)	--	--	✓	--	--
Ingestion (benthic invert)	--	--	✓	✓	--
Ingestion (fish)	--	--	--	--	✓
Ingestion (sed)	--	•	✓	✓	✓
Dermal contact / uptake (sed)	--	✓	○	○	○

[a] Includes aquatic plants, fish, and other aquatic biota
[b] Northern pintail
[c] Red knot
[d] Glaucous gull

✓ : Potential pathway of exposure (included in assessment)
• : Implicitly included in other pathways
○ : Potential pathway of exposure but expected to be negligible; not considered further in the RA
-- : Not a potential exposure pathway for this receptor

Title: CONCEPTUAL SITE MODEL FOR THE ECOLOGICAL RISK ASSESSMENT - AQUATIC ENVIRONMENT

Project: SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
EUREKA HIGH ARCTIC WEATHER STATION
EUREKA, NU

Client: PSPC / ECCC

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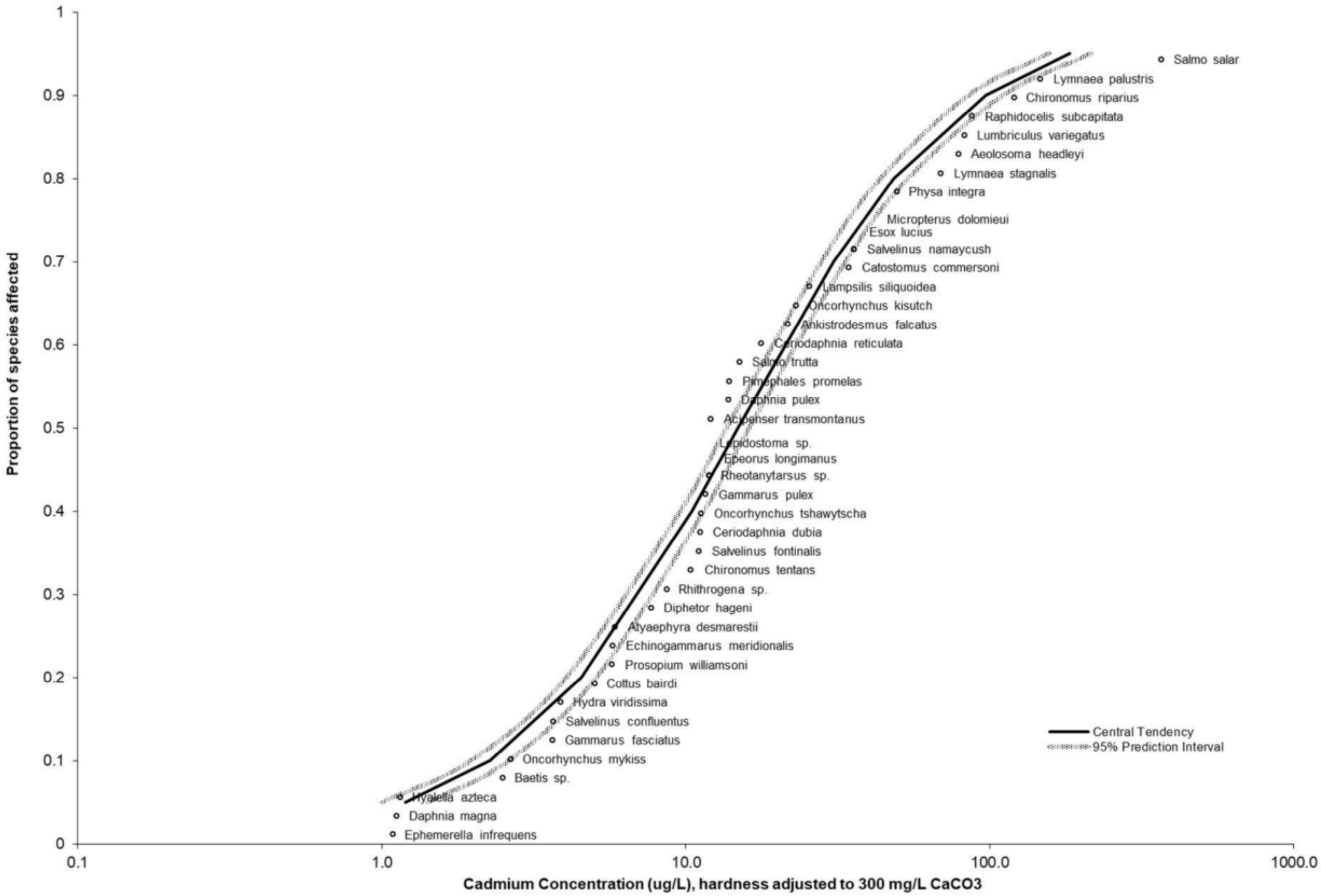
Figure 13



Title:	SPECIES SENSITIVITY DISTRIBUTION OF CADMIUM IN THE AQUATIC ENVIRONMENT
Project:	SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EUREKA HIGH ARCTIC WEATHER STATION EUREKA, NU
Client:	PSPC / ECCC
Date:	DECEMBER 2020
Project No.:	P2020-18
	Figure 14

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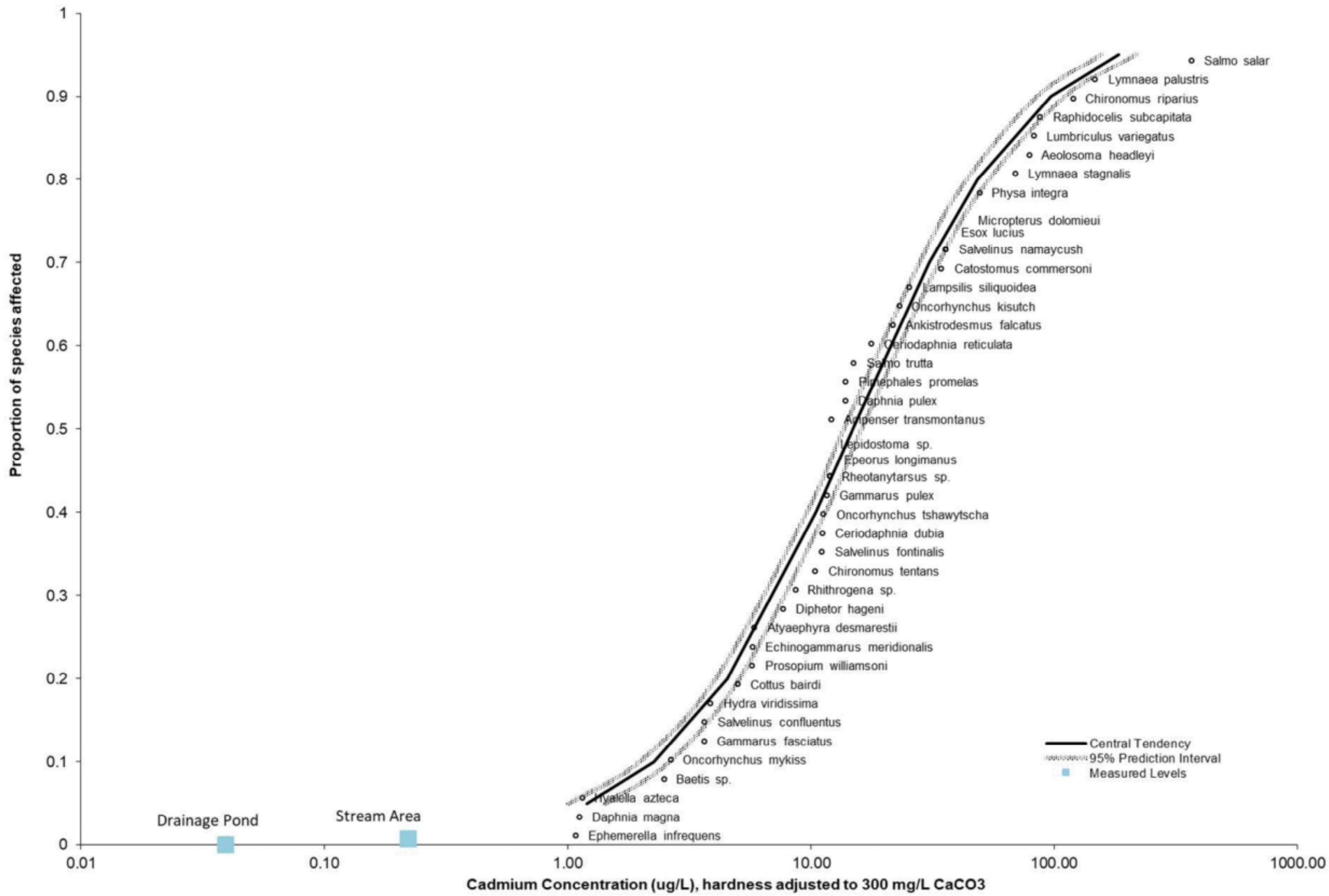

Title:	CADMIUM SSD CURVE WITH CONCENTRATIONS FROM DRAINAGE POND AND STREAM AREA
Project:	SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EUREKA HIGH ARCTIC WEATHER STATION EUREKA, NU
Client:	PSPC / ECCC
Date:	DECEMBER 2020
Project No.:	P2020-18
	Figure 15

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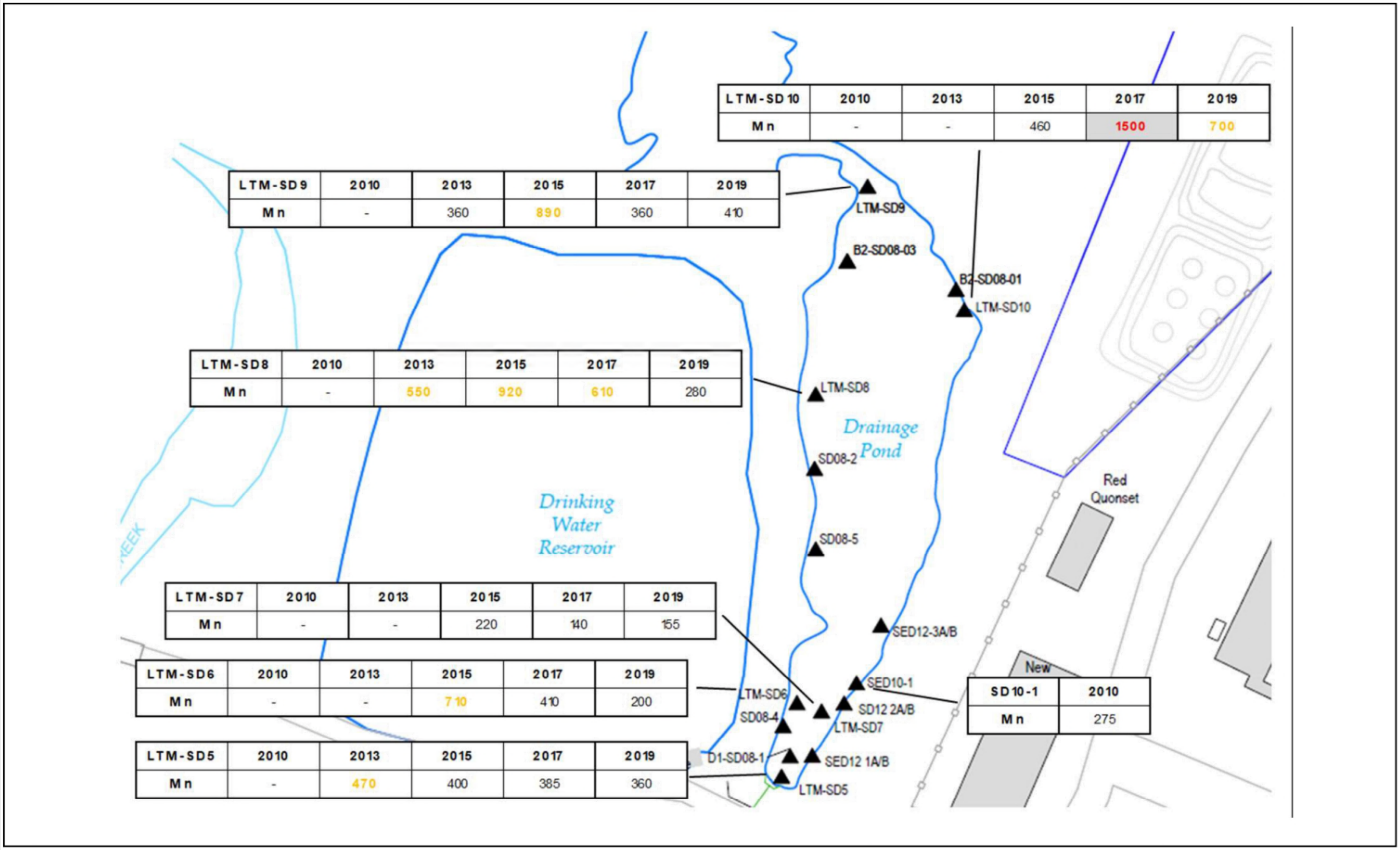

LTM-SD 10	2010	2013	2015	2017	2019
Mn	-	-	460	1500	700

LTM-SD9	2010	2013	2015	2017	2019
Mn	-	360	890	360	410

LTM-SD8	2010	2013	2015	2017	2019
Mn	-	550	920	610	280

LTM-SD7	2010	2013	2015	2017	2019
Mn	-	-	220	140	155

LTM-SD6	2010	2013	2015	2017	2019
Mn	-	-	710	410	200

LTM-SD5	2010	2013	2015	2017	2019
Mn	-	470	400	385	360

SD10-1	2010
Mn	275

LEGEND

- Building
- Tank
- Powerbox
- Land Farm
- Long Term Monitoring Work Areas (LTM)
- Stream Channel 2017
- Previous Stream Channel (2015 and Previous)
- ▲ Sediment Sampling Location

Sediment data:
presented in mg/kg
Orange – Number exceeds the ISQG/LEL
Red/Shaded – Number exceeds the PEL/SEL

Title: SEDIMENT SPATIAL EVALUATION - METALS IN THE DRAINAGE POND

Project: SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
EUREKA HIGH ARCTIC WEATHER STATION
EUREKA, NU

Client: PSPC / ECCC

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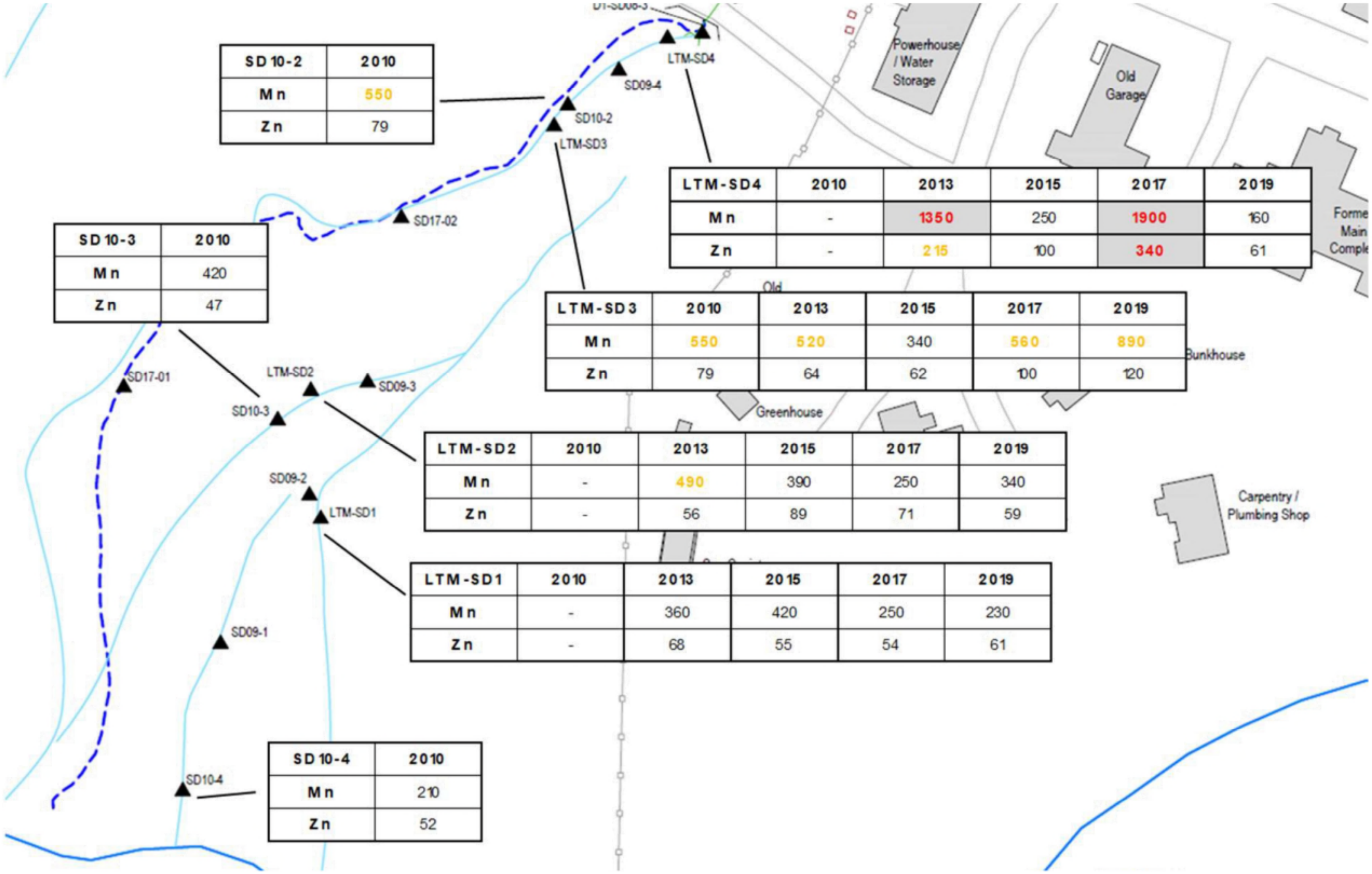
Date: DECEMBER 2020
Project No.: P2020-18
Figure 16



SD 10-2	2010
Mn	550
Zn	79

LTM-SD4	2010	2013	2015	2017	2019
Mn	-	1350	250	1900	160
Zn	-	215	100	340	61

SD 10-3	2010
Mn	420
Zn	47

LTM-SD3	2010	2013	2015	2017	2019
Mn	550	520	340	560	890
Zn	79	64	62	100	120

LTM-SD2	2010	2013	2015	2017	2019
Mn	-	490	390	250	340
Zn	-	56	89	71	59

LTM-SD1	2010	2013	2015	2017	2019
Mn	-	360	420	250	230
Zn	-	68	55	54	61

SD 10-4	2010
Mn	210
Zn	52

LEGEND

- Building
- Tank
- Powerbox
- Land Farm
- Long Term Monitoring Work Areas (LTM)
- Stream Channel 2017
- Previous Stream Channel (2015 and Previous)
- ▲ Sediment Sampling Location

Sediment data:
presented in mg/kg

Orange – Number exceeds the ISQG/LEL
Red/Shaded – Number exceeds the PEL/SEL

Title: SEDIMENT SPATIAL EVALUATION - METALS IN STREAM AREA

Project: SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
EUREKA HIGH ARCTIC WEATHER STATION
EUREKA, NU

Client: PSPC / ECCC

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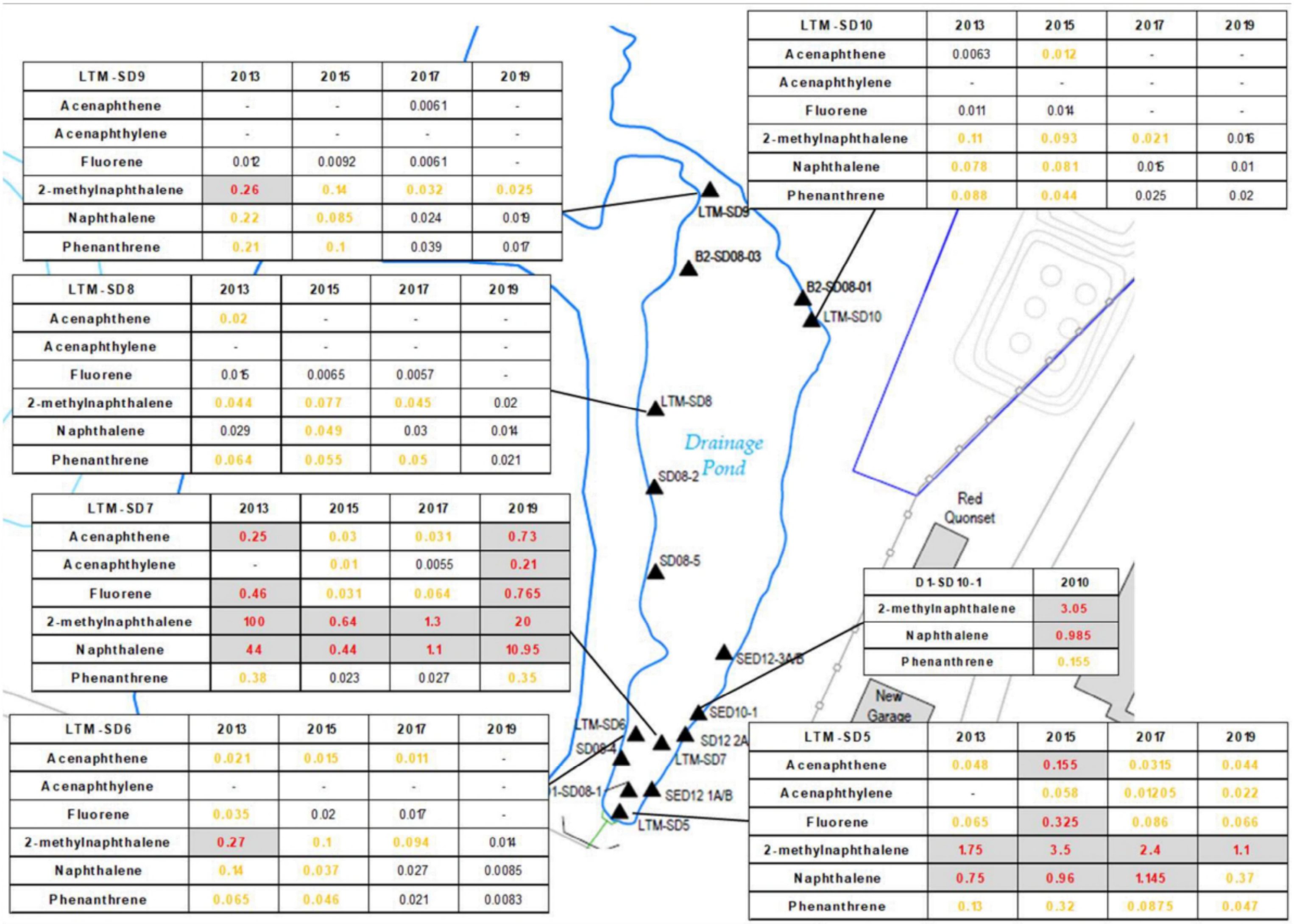
Date: DECEMBER 2020

Project No.: P2020-18

Figure 17



LTM-SD9	2013	2015	2017	2019
Acenaphthene	-	-	0.0061	-
Acenaphthylene	-	-	-	-
Fluorene	0.012	0.0092	0.0061	-
2-methylnaphthalene	0.26	0.14	0.032	0.025
Naphthalene	0.22	0.085	0.024	0.019
Phenanthrene	0.21	0.1	0.039	0.017

LTM-SD10	2013	2015	2017	2019
Acenaphthene	0.0063	0.012	-	-
Acenaphthylene	-	-	-	-
Fluorene	0.011	0.014	-	-
2-methylnaphthalene	0.11	0.093	0.021	0.016
Naphthalene	0.078	0.081	0.015	0.01
Phenanthrene	0.088	0.044	0.025	0.02

LTM-SD8	2013	2015	2017	2019
Acenaphthene	0.02	-	-	-
Acenaphthylene	-	-	-	-
Fluorene	0.015	0.0065	0.0057	-
2-methylnaphthalene	0.044	0.077	0.045	0.02
Naphthalene	0.029	0.049	0.03	0.014
Phenanthrene	0.064	0.055	0.05	0.021

LTM-SD7	2013	2015	2017	2019
Acenaphthene	0.25	0.03	0.031	0.73
Acenaphthylene	-	0.01	0.0055	0.21
Fluorene	0.46	0.031	0.064	0.765
2-methylnaphthalene	100	0.64	1.3	20
Naphthalene	44	0.44	1.1	10.95
Phenanthrene	0.38	0.023	0.027	0.35

D1-SD10-1	2010
2-methylnaphthalene	3.05
Naphthalene	0.985
Phenanthrene	0.155

LTM-SD6	2013	2015	2017	2019
Acenaphthene	0.021	0.015	0.011	-
Acenaphthylene	-	-	-	-
Fluorene	0.035	0.02	0.017	-
2-methylnaphthalene	0.27	0.1	0.094	0.014
Naphthalene	0.14	0.037	0.027	0.0085
Phenanthrene	0.065	0.046	0.021	0.0083

LTM-SD5	2013	2015	2017	2019
Acenaphthene	0.048	0.155	0.0315	0.044
Acenaphthylene	-	0.058	0.01205	0.022
Fluorene	0.065	0.325	0.086	0.066
2-methylnaphthalene	1.75	3.5	2.4	1.1
Naphthalene	0.75	0.96	1.145	0.37
Phenanthrene	0.13	0.32	0.0875	0.047

LEGEND

- Building
- Tank
- Powerbox
- Land Farm
- Long Term Monitoring Work Areas (LTM)
- Stream Channel 2017
- Previous Stream Channel (2015 and Previous)
- ▲ Sediment Sampling Location

Sediment data:
presented in mg/kg (<MDL not shown)
Orange – Number exceeds the ISQG
Red/Shaded – Number exceeds the PEL

Title: SEDIMENT SPATIAL EVALUATION - PAH IN THE DRAINAGE POND

Project: SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
EUREKA HIGH ARCTIC WEATHER STATION
EUREKA, NU

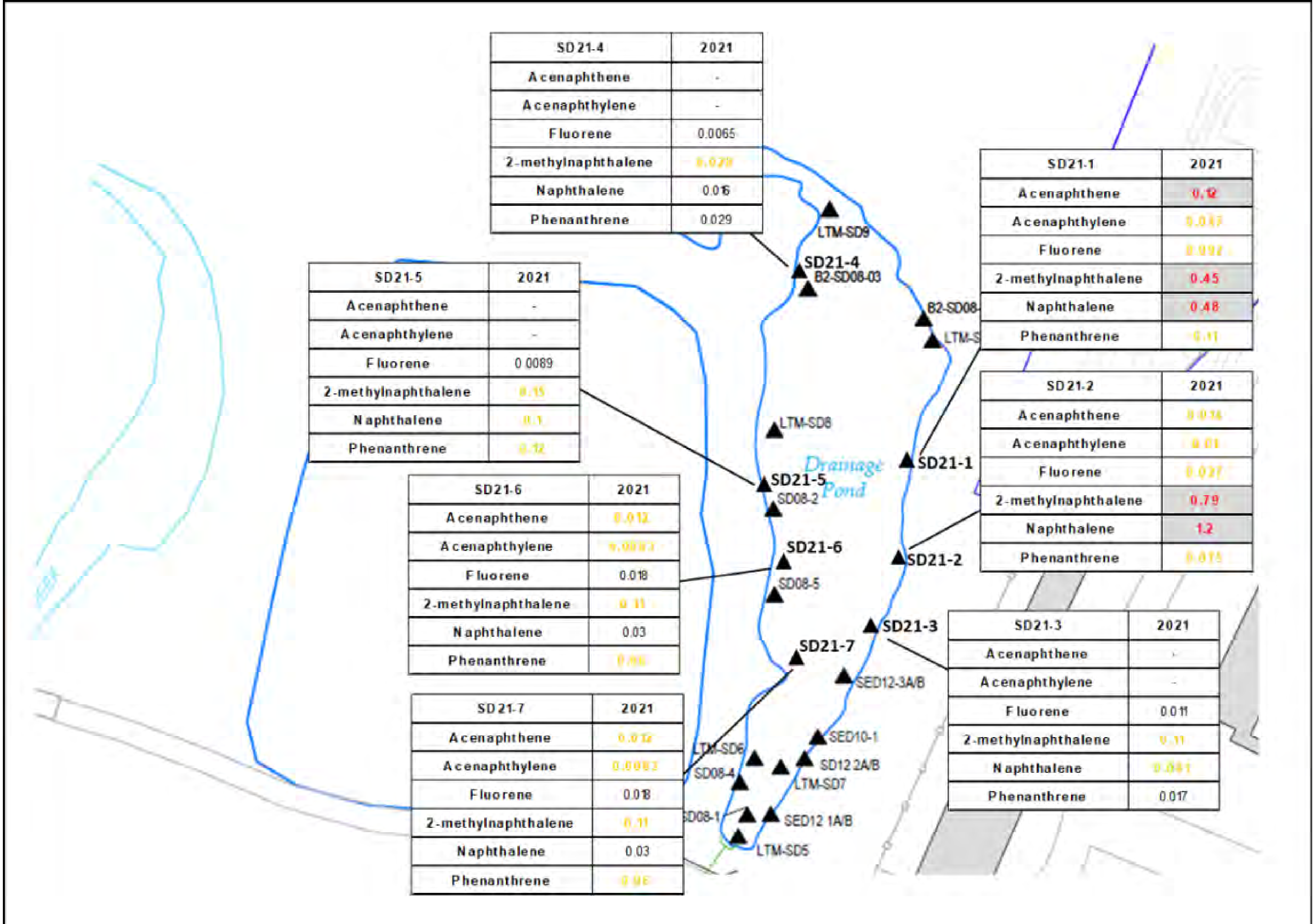
Client: PSPC / ECCC

DILLON CONSULTING
outcome CONSULTANTS

Date: DECEMBER 2020

Project No.: P2020-18

Figure 18a



SD21-4	2021
Acenaphthene	-
Acenaphthylene	-
Fluorene	0.0065
2-methylnaphthalene	0.029
Naphthalene	0.016
Phenanthrene	0.029

SD21-1	2021
Acenaphthene	0.12
Acenaphthylene	0.047
Fluorene	0.092
2-methylnaphthalene	0.45
Naphthalene	0.48
Phenanthrene	0.11

SD21-5	2021
Acenaphthene	-
Acenaphthylene	-
Fluorene	0.0089
2-methylnaphthalene	0.15
Naphthalene	0.1
Phenanthrene	0.12

SD21-2	2021
Acenaphthene	0.014
Acenaphthylene	0.01
Fluorene	0.027
2-methylnaphthalene	0.79
Naphthalene	1.2
Phenanthrene	0.015

SD21-6	2021
Acenaphthene	0.012
Acenaphthylene	0.0083
Fluorene	0.018
2-methylnaphthalene	0.11
Naphthalene	0.03
Phenanthrene	0.06

SD21-3	2021
Acenaphthene	-
Acenaphthylene	-
Fluorene	0.011
2-methylnaphthalene	0.11
Naphthalene	0.061
Phenanthrene	0.017

SD21-7	2021
Acenaphthene	0.012
Acenaphthylene	0.0083
Fluorene	0.018
2-methylnaphthalene	0.11
Naphthalene	0.03
Phenanthrene	0.06

LEGEND

- Building
- Tank
- Powerbox
- Land Farm
- Long Term Monitoring Work Area (LTM)
- Stream Channel 2017
- Previous Stream Channel (2015 and Previous)
- ▲ Sediment Sample Location

Sediment data:
presented in mg/kg (<MDL not shown)
Orange – Number exceeds the ISQG
Red/Shaded – Number exceeds the PEL

Drawing Source: Arcadis, 2016

Drainage Pond Sediment Spatial Evaluation – PAHs, 2021

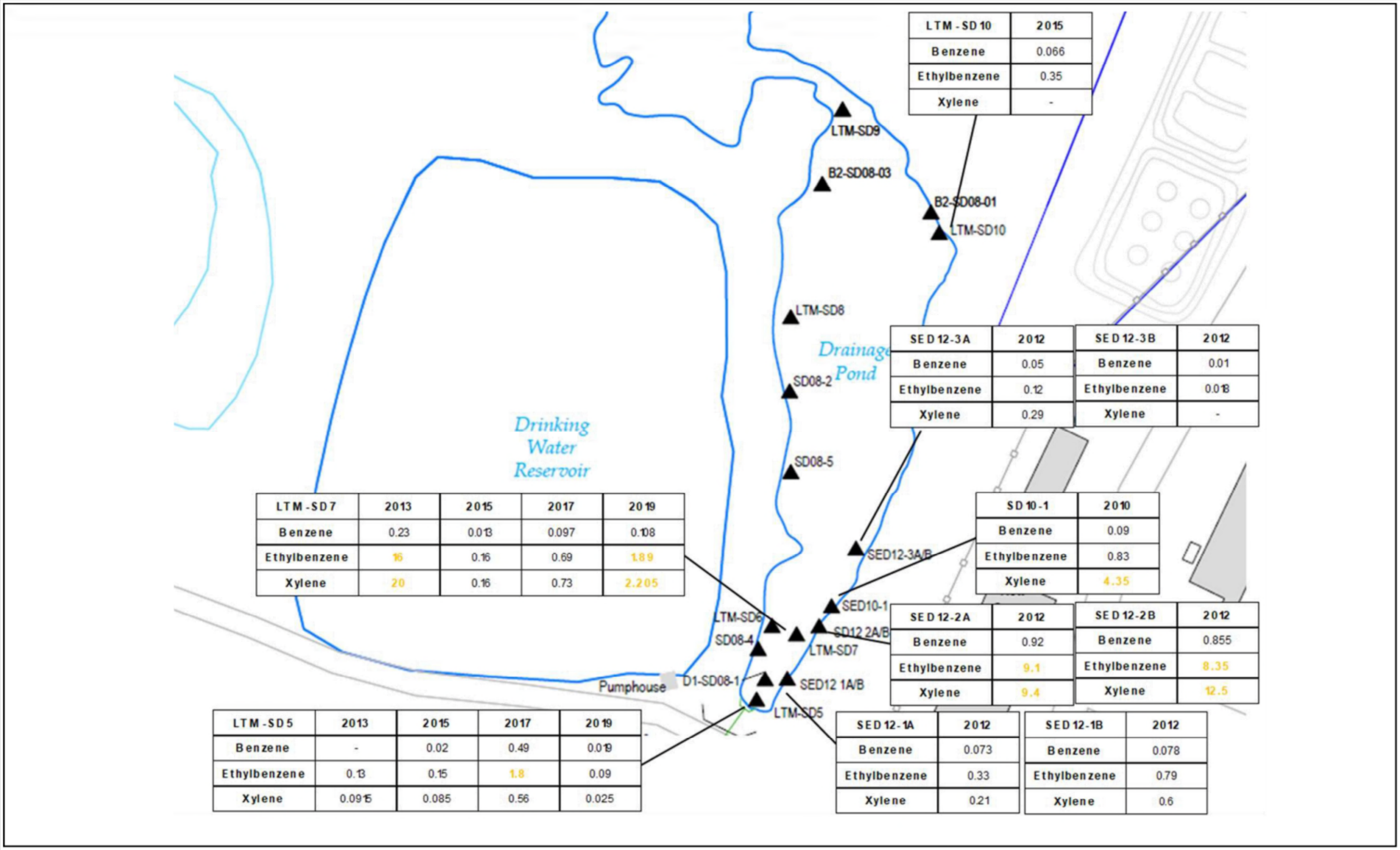
SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
EUREKA HIGH ARCTIC WEATHER STATION
EUREKA, NU

PSPC / ECCC

DILLON CONSULTING | outcome

September, 2021

Figure 18b



LTM-SD10	2015
Benzene	0.066
Ethylbenzene	0.35
Xylene	-

SED12-3A	2012
Benzene	0.05
Ethylbenzene	0.12
Xylene	0.29

SED12-3B	2012
Benzene	0.01
Ethylbenzene	0.018
Xylene	-

LTM-SD7	2013	2015	2017	2019
Benzene	0.23	0.013	0.097	0.108
Ethylbenzene	16	0.16	0.69	1.89
Xylene	20	0.16	0.73	2.205

SD10-1	2010
Benzene	0.09
Ethylbenzene	0.83
Xylene	4.35

SED12-2A	2012
Benzene	0.92
Ethylbenzene	9.1
Xylene	9.4

SED12-2B	2012
Benzene	0.855
Ethylbenzene	8.35
Xylene	12.5

LTM-SD5	2013	2015	2017	2019
Benzene	-	0.02	0.49	0.019
Ethylbenzene	0.13	0.15	1.8	0.09
Xylene	0.0915	0.085	0.56	0.025

SED12-1A	2012
Benzene	0.073
Ethylbenzene	0.33
Xylene	0.21

SED12-1B	2012
Benzene	0.078
Ethylbenzene	0.79
Xylene	0.6

LEGEND

- Building
- Tank
- Powerbox
- Land Farm
- Long Term Monitoring Work Areas (LTM)
- Stream Channel 2017
- Previous Stream Channel (2015 and Previous)
- ▲ Sediment Sampling Location

Sediment data:
presented in mg/kg (<MDL not shown)
Orange – Number exceeds benchmark

Title: SEDIMENT SPATIAL EVALUATION - BTEX IN THE DRAINAGE POND

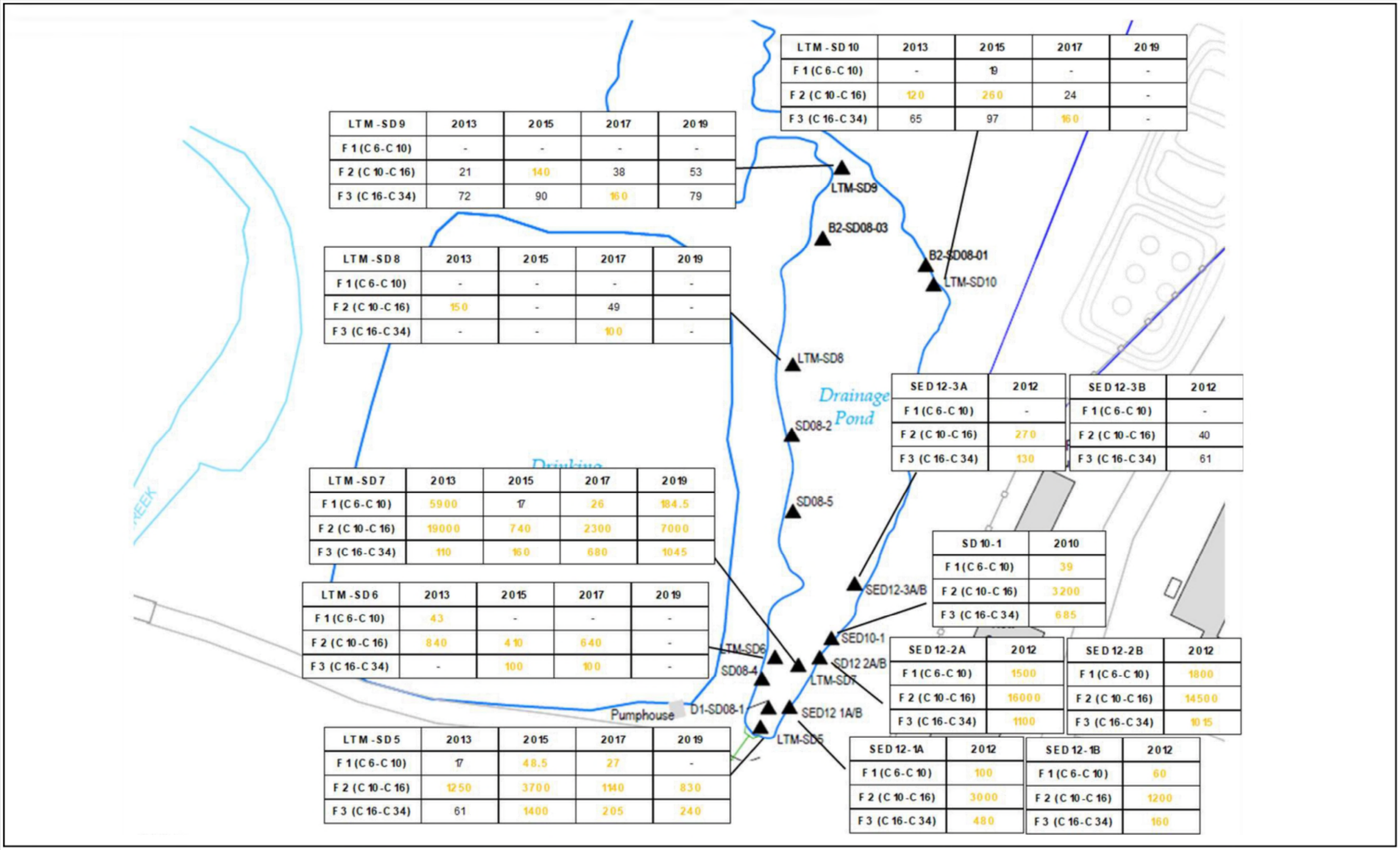
Project: SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
EUREKA HIGH ARCTIC WEATHER STATION
EUREKA, NU

Client: PSPC / ECCC

Date: DECEMBER 2020

Project No.: P2020-18

Figure 19



LTM-SD10	2013	2015	2017	2019
F1 (C6-C10)	-	19	-	-
F2 (C10-C16)	120	260	24	-
F3 (C16-C34)	65	97	160	-

LTM-SD9	2013	2015	2017	2019
F1 (C6-C10)	-	-	-	-
F2 (C10-C16)	21	140	38	53
F3 (C16-C34)	72	90	160	79

LTM-SD8	2013	2015	2017	2019
F1 (C6-C10)	-	-	-	-
F2 (C10-C16)	150	-	49	-
F3 (C16-C34)	-	-	100	-

SED12-3A	2012
F1 (C6-C10)	-
F2 (C10-C16)	270
F3 (C16-C34)	130

SED12-3B	2012
F1 (C6-C10)	-
F2 (C10-C16)	40
F3 (C16-C34)	61

LTM-SD7	2013	2015	2017	2019
F1 (C6-C10)	5900	17	26	184.5
F2 (C10-C16)	19000	740	2300	7000
F3 (C16-C34)	110	160	680	1045

SD10-1	2010
F1 (C6-C10)	39
F2 (C10-C16)	3200
F3 (C16-C34)	685

LTM-SD6	2013	2015	2017	2019
F1 (C6-C10)	43	-	-	-
F2 (C10-C16)	840	410	640	-
F3 (C16-C34)	-	100	100	-

SED12-2A	2012
F1 (C6-C10)	1500
F2 (C10-C16)	16000
F3 (C16-C34)	1100

SED12-2B	2012
F1 (C6-C10)	1800
F2 (C10-C16)	14500
F3 (C16-C34)	1015

LTM-SD5	2013	2015	2017	2019
F1 (C6-C10)	17	48.5	27	-
F2 (C10-C16)	1250	3700	1140	830
F3 (C16-C34)	61	1400	205	240

SED12-1A	2012
F1 (C6-C10)	100
F2 (C10-C16)	3000
F3 (C16-C34)	480

SED12-1B	2012
F1 (C6-C10)	60
F2 (C10-C16)	1200
F3 (C16-C34)	160

LEGEND

- Building
- Tank
- Powerbox
- Land Farm
- Long Term Monitoring Work Areas (LTM)
- Stream Channel 2017
- Previous Stream Channel (2015 and Previous)
- ▲ Sediment Sampling Location

Sediment data:
presented in mg/kg (<MDL not shown)
Orange – Number exceeds derived benchmark

Title: SEDIMENT SPATIAL EVALUATION - PHCs IN THE DRAINAGE POND

Project: SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
EUREKA HIGH ARCTIC WEATHER STATION
EUREKA, NU

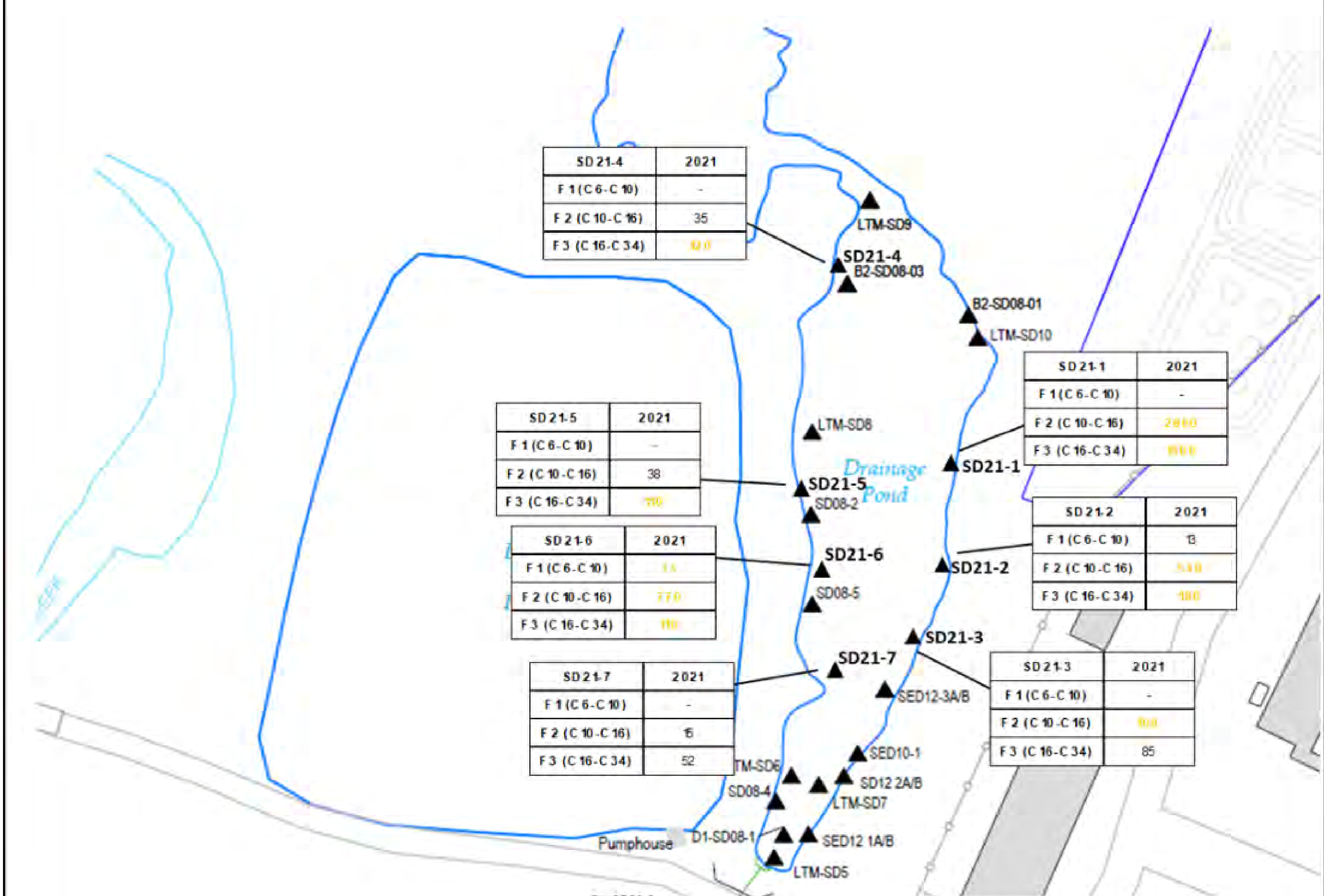
Client: PSPC / ECCC

DILLON CONSULTING | outcome CONSULTANTS

Date: DECEMBER 2020

Project No.: P2020-18

Figure 20a



SD 21-4	2021
F 1 (C 6-C 10)	-
F 2 (C 10-C 16)	35
F 3 (C 16-C 34)	[illegible]

SD 21-1	2021
F 1 (C 6-C 10)	-
F 2 (C 10-C 16)	[illegible]
F 3 (C 16-C 34)	[illegible]

SD 21-5	2021
F 1 (C 6-C 10)	-
F 2 (C 10-C 16)	38
F 3 (C 16-C 34)	[illegible]

SD 21-2	2021
F 1 (C 6-C 10)	13
F 2 (C 10-C 16)	[illegible]
F 3 (C 16-C 34)	100

SD 21-6	2021
F 1 (C 6-C 10)	[illegible]
F 2 (C 10-C 16)	770
F 3 (C 16-C 34)	[illegible]

SD 21-7	2021
F 1 (C 6-C 10)	-
F 2 (C 10-C 16)	15
F 3 (C 16-C 34)	52

SD 21-3	2021
F 1 (C 6-C 10)	-
F 2 (C 10-C 16)	[illegible]
F 3 (C 16-C 34)	85

LEGEND

- Building
- Tank
- Powerbox
- Land Farm
- Long Term Monitoring Work Area (LTM)
- Stream Channel 2017
- Previous Stream Channel (2015 and Previous)
- ▲ Sediment Sample Location

Sediment data:
presented in mg/kg (<MDL not shown)

Orange – Number exceeds derived benchmark

Drawing Source: Arcadis, 2016

Drainage Pond Sediment Spatial Evaluation – PHCs, 2021

SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
EUREKA HIGH ARCTIC WEATHER STATION
EUREKA, NU

PSPC / ECCC

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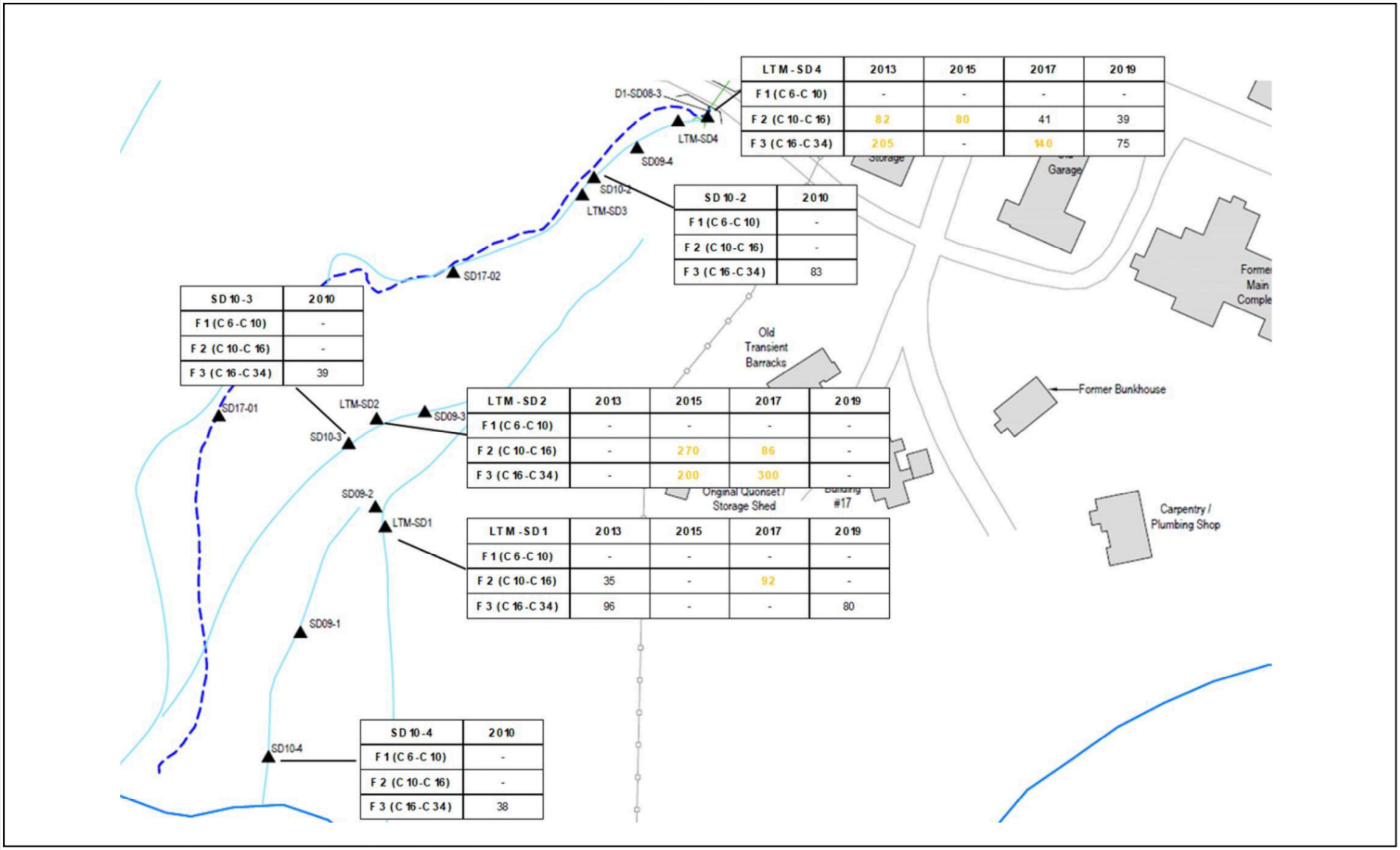
September, 2021

Figure 20b



LTM-SD4	2013	2015	2017	2019
F1 (C6-C10)	-	-	-	-
F2 (C10-C16)	82	80	41	39
F3 (C16-C34)	205	-	140	75

SD10-2	2010
F1 (C6-C10)	-
F2 (C10-C16)	-
F3 (C16-C34)	83

SD10-3	2010
F1 (C6-C10)	-
F2 (C10-C16)	-
F3 (C16-C34)	39

LTM-SD2	2013	2015	2017	2019
F1 (C6-C10)	-	-	-	-
F2 (C10-C16)	-	270	86	-
F3 (C16-C34)	-	200	300	-

LTM-SD1	2013	2015	2017	2019
F1 (C6-C10)	-	-	-	-
F2 (C10-C16)	35	-	92	-
F3 (C16-C34)	96	-	-	80

SD10-4	2010
F1 (C6-C10)	-
F2 (C10-C16)	-
F3 (C16-C34)	38

LEGEND

- Building
- Tank
- Powerbox
- Land Farm
- Long Term Monitoring Work Areas (LTM)
- Stream Channel 2017
- Previous Stream Channel (2015 and Previous)
- ▲ Sediment Sampling Location

Sediment data:
presented in mg/kg (<MDL not shown)

Orange – Number exceeds derived benchmark

Title: SEDIMENT SPATIAL EVALUATION - PHCs IN THE STREAM AREA

Project: SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EUREKA HIGH ARCTIC WEATHER STATION EUREKA, NU

Client: PSPC / ECCC

DILLON CONSULTING

outcome CONSULTANTS

Date: DECEMBER 2020

Project No.: P2020-18

Figure 21

APPENDIX A

J&E Indoor Air Calculations for PHC F1 and PHC F2

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type	mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAL1012	604,080	Aliphatic C>10-C12

MORE

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
5	11.25	41.25	0	11.25	30				2.50E-09

MORE

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.4	0.01	0.002					

MORE

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	500	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.2

Used to calculate risk-based soil concentration.

END

INTERMEDIATE CALCULATIONS SHEET

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	3.52E+04	4.17E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	2.94E+00	1.29E+02	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.00E+03	4.37E+06	0.10	2.50E+01	4.20E-03	7.00E+02	3.56E+41	5.89E-05	2.58E+02	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type	mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAL1216	738,320	Aliphatic C>12-C16

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
				Totals must add up to value of L_t (cell G28)					
5	11.25	41.25	0	11.25	30				2.50E-09

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.4	0.01	0.002					

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	500	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.2

Used to calculate risk-based soil concentration.

END

INTERMEDIATE CALCULATIONS SHEET

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (μg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	1.53E+04	4.17E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	1.27E+01	5.57E+02	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.00E+04	4.24E+05	0.10	2.50E+01	4.20E-03	7.00E+02	3.56E+41	5.89E-05	2.50E+01	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

CN Input

Property Type	mmercial/Industrial

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAR1012	151,020	Aromatic C>10-C12

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
				Totals must add up to value of L_t (cell G28)					
5	11.25	41.25	0	11.25	30				2.50E-09

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.4	0.01	0.002					

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	500	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.2
				Used to calculate risk-based soil concentration.	

END

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (μg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	1.51E+05	4.17E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	3.43E-03	1.50E-01	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.00E+01	2.25E+06	0.10	2.50E+01	4.20E-03	7.00E+02	3.52E+41	5.89E-05	1.32E+02	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type	mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAR1216	184,580	Aromatic C>12-C16

MORE ↓

ENTER Average soil temperature, T_S (^oC)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
5	11.25	41.25	0	11.25	30				2.50E-09

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.4	0.01	0.002					

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	500	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.2

Used to calculate risk-based soil concentration.

END

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	1.16E+05	4.17E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	1.30E-03	5.68E-02	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.00E+01	3.30E+05	0.10	2.50E+01	4.20E-03	7.00E+02	3.46E+41	5.89E-05	1.94E+01	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

DATA ENTRY SHEET

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type	mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAL1012	158,040	Aliphatic C>10-C12

MORE ↓

ENTER Average soil temperature, T_S (^oC)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
5	11.25	41.25	0	11.25	30				2.50E-09

(Thickness columns: Totals must add up to value of L_t (cell G28))

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.4	0.01	0.002					

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.2

Used to calculate risk-based soil concentration.

END

INTERMEDIATE CALCULATIONS SHEET

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	3.52E+04	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	2.94E+00	1.29E+02	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.00E+03	4.37E+06	0.10	2.50E+01	4.20E-03	7.00E+02	3.56E+41	9.82E-05	4.30E+02	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type	mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAL1216	193,160	Aliphatic C>12-C16

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
				Totals must add up to value of L_t (cell G28)					
5	11.25	41.25	0	11.25	30				2.50E-09

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.4	0.01	0.002					

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.2

Used to calculate risk-based soil concentration.

END

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	1.53E+04	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	1.27E+01	5.57E+02	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.00E+04	4.24E+05	0.10	2.50E+01	4.20E-03	7.00E+02	3.56E+41	9.82E-05	4.16E+01	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type	mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAR1012	39,510	Aromatic C>10-C12

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
5	11.25	41.25	0	11.25	30				2.50E-09

Totals must add up to value of L_t (cell G28)

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
Lookup Soil Parameters					Lookup Soil Parameters					Lookup Soil Parameters				
MF	1.4	0.47	0.168	0.002	G	1.6	0.4	0.01	0.002					

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.2

Used to calculate risk-based soil concentration.

END

INTERMEDIATE CALCULATIONS SHEET

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	3.95E+04	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	3.43E-03	1.50E-01	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.00E+01	5.88E+05	0.10	2.50E+01	4.20E-03	7.00E+02	3.52E+41	9.82E-05	5.77E+01	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES:

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES: X

CN Input

Property Type	mmercial/Industrial

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAR1216	48,290	Aromatic C>12-C16

MORE

ENTER Average soil temperature, T_S (^oC)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
5	11.25	41.25	0	11.25	30				2.50E-09

Totals must add up to value of L_t (cell G28)

MORE

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
Lookup Soil Parameters					Lookup Soil Parameters					Lookup Soil Parameters				
MF	1.4	0.47	0.168	0.002	G	1.6	0.4	0.01	0.002					

MORE

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.2

Used to calculate risk-based soil concentration.

END

INTERMEDIATE CALCULATIONS SHEET

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	4.83E+04	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	1.30E-03	5.68E-02	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.00E+01	1.37E+05	0.10	2.50E+01	4.20E-03	7.00E+02	3.46E+41	9.82E-05	1.34E+01	NA	NA	NA	NA

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type	mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAL1012	1,836	Aliphatic C>10-C12

MORE

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
5	11.25	41.25	0	11.25	30				2.50E-09

MORE

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.40	0.01	0.002					

MORE

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.2

Used to calculate risk-based soil concentration.

END

INTERMEDIATE CALCULATIONS SHEET

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	1.84E+03	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	2.94E+00	1.29E+02	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.00E+03	2.28E+05	0.10	2.50E+01	4.20E-03	7.00E+02	3.56E+41	9.82E-05	2.24E+01	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

SL-ADV Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type	mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAL1216	2,244	Aliphatic C>12-C16

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
5	11.25	41.25	0	11.25	30				2.50E-09

Totals must add up to value of L_t (cell G28)

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
Lookup Soil Parameters					Lookup Soil Parameters					Lookup Soil Parameters				
MF	1.4	0.47	0.168	0.002	G	1.6	0.40	0.01	0.002					

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.2

Used to calculate risk-based soil concentration.

END

INTERMEDIATE CALCULATIONS SHEET

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	2.24E+03	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	1.27E+01	5.57E+02	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.00E+04	6.20E+04	0.10	2.50E+01	4.20E-03	7.00E+02	3.56E+41	9.82E-05	6.09E+00	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

DATA ENTRY SHEET

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES:

CN Input

Property Type	mmercial/Industrial

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES: X

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAR1012	459	Aromatic C>10-C12

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
5	11.25	41.25	0	11.25	30				2.50E-09

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.40	0.01	0.002					

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.2

Used to calculate risk-based soil concentration.

END

INTERMEDIATE CALCULATIONS SHEET

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (μg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	4.59E+02	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	3.43E-03	1.50E-01	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.00E+01	6.83E+03	0.10	2.50E+01	4.20E-03	7.00E+02	3.52E+41	9.82E-05	6.70E-01	NA	NA	NA	NA

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type: mmercial/Industrial

YES:

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES: X

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
PHCAR1216	561	Aromatic C>12-C16

MORE

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
5	11.25	41.25	0	11.25	30				2.50E-09

Totals must add up to value of L_t (cell G28)

MORE

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
Lookup Soil Parameters					Lookup Soil Parameters					Lookup Soil Parameters				
MF	1.4	0.47	0.168	0.002	G	1.6	0.40	0.01	0.002					

MORE

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.2

Used to calculate risk-based soil concentration.

END

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	5.61E+02	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	1.30E-03	5.68E-02	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.00E+01	1.59E+03	0.10	2.50E+01	4.20E-03	7.00E+02	3.46E+41	9.82E-05	1.56E-01	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

DATA ENTRY SHEET

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type	mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAL0608	460,515	Aliphatic C6-C8

Site Specific
MOE Defualt

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)		ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
				Totals must add up to value of L_t (cell G28)				OR	
5	11.25	41.25	0	11.25	30				2.50E-09

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.40	0.01	0.002		1.5	0.43		0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.5

Used to calculate risk-based soil concentration.

END

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (μg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	1.57E+05	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	1.22E+00	5.36E+01	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.59E+01	2.89E+08	0.10	2.50E+01	4.20E-03	7.00E+02	3.56E+41	9.82E-05	2.84E+04	NA	NA	NA	NA

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

DATA ENTRY SHEET

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type mmercial/Industrial

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

Site Specific

MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
PHCAL0810	301,428	Aliphatic C>8-C10

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
5	11.25	41.25	0	11.25	30				2.50E-09

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.40	0.01	0.002		1.5	0.43		0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.5

Used to calculate risk-based soil concentration.

END

INTERMEDIATE CALCULATIONS SHEET

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	6.34E+04	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	1.96E+00	8.58E+01	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.26E+02	3.69E+07	0.10	2.50E+01	4.20E-03	7.00E+02	3.56E+41	9.82E-05	3.62E+03	NA	NA	NA	NA

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type	mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAR0810	75,357	Aromatic C>8-C10

Site Specific
MOE Defualt

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)		ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
				Totals must add up to value of L_t (cell G28)				OR	
5	11.25	41.25	0	11.25	30				2.50E-09

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
Lookup Soil Parameters					Lookup Soil Parameters					Lookup Soil Parameters				
MF	1.4	0.47	0.168	0.002	G	1.6	0.40	0.01	0.002		1.5	0.43		0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.5
				Used to calculate risk-based soil concentration.	

END

INTERMEDIATE CALCULATIONS SHEET

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (μg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	7.54E+04	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	1.17E-02	5.15E-01	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
6.34E+00	5.99E+06	0.10	2.50E+01	4.20E-03	7.00E+02	3.55E+41	9.82E-05	5.88E+02	NA	NA	NA	NA

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ (μg/m^3)	Finite source bldg. conc., $C_{building}$ (μg/m^3)	Final finite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

DATA ENTRY SHEET

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type	mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAL1012	2,673,720	Aliphatic C>10-C12

MORE ↓

ENTER Average soil temperature, T_S (^oC)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
5	11.25	41.25	0	11.25	30				2.50E-09

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.40	0.01	0.002		1.5	0.43		0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.5

Used to calculate risk-based soil concentration.

END

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	3.52E+04	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	2.94E+00	1.29E+02	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.00E+03	4.37E+06	0.10	2.50E+01	4.20E-03	7.00E+02	3.56E+41	9.82E-05	4.30E+02	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $\langle\alpha\rangle$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type	mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
PHCAL1216	3,267,880	Aliphatic C>12-C16

Site Specific
MOE Defualt

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
5	11.25	41.25	0	11.25	30				2.50E-09

Totals must add up to value of L_t (cell G28)

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.40	0.01	0.002		1.5	0.43		0.002

Lookup Soil Parameters

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.5

Used to calculate risk-based soil concentration.

END

INTERMEDIATE CALCULATIONS SHEET

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	1.53E+04	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	1.27E+01	5.57E+02	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.00E+04	4.24E+05	0.10	2.50E+01	4.20E-03	7.00E+02	3.56E+41	9.82E-05	4.16E+01	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

DATA ENTRY SHEET

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box) | CN Input | Property Type | mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
PHCAR1012	668,430	Aromatic C>10-C12

MORE ↓

ENTER Average soil temperature, T_S (^oC)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
				Totals must add up to value of L_t (cell G28)					
5	11.25	41.25	0	11.25	30				2.50E-09

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.40	0.01	0.002		1.5	0.43		0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.5
				Used to calculate risk-based soil concentration.	

END

INTERMEDIATE CALCULATIONS SHEET

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	2.52E+05	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	3.43E-03	1.50E-01	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.00E+01	3.75E+06	0.10	2.50E+01	4.20E-03	7.00E+02	3.52E+41	9.82E-05	3.68E+02	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

CN Input

Property Type	mmercial/Industrial

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

Site Specific
MOE Defualt

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
PHCAR1216	816,970	Aromatic C>12-C16

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)		ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
				Totals must add up to value of L_t (cell G28)				OR	
5	11.25	41.25	0	11.25	30				2.50E-09

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
MF	1.4	0.47	0.168	0.002	G	1.6	0.40	0.01	0.002		1.5	0.43		0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
11.25	20	2000	1500	300	0.1	1	1.5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
60	25	25	250	1.0E-06	0.5

Used to calculate risk-based soil concentration.

END

INTERMEDIATE CALCULATIONS SHEET

Results needed for Tables for report

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (μg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	30	0.302	0.390	ERROR	#N/A	#N/A	#N/A	2.50E-09	7,000	1.16E+05	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.00E+06	2.33E-04	11.25	#N/A	1.30E-03	5.68E-02	1.74E-04	4.20E-03	1.36E-02	0.00E+00	1.36E-02	30	11.25

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.00E+01	3.30E+05	0.10	2.50E+01	4.20E-03	7.00E+02	3.46E+41	9.82E-05	3.24E+01	NA	NA	NA	NA

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	#N/A	#N/A

END

APPENDIX B

Human Receptor Calculations

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Caroline Lucas	Site:	3656 Eureka HAWS
Proponent:		File #:	
Date:	December 2020	Comment:	Office Worker

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	No	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	No	No
specify:		

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	Yes	Yes
Inhalation of outdoor contaminant vapours	Yes	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario User-Defined NA

Vapour Transport Modelling

Vapour source for exposure calculations: Soil — Most Conservative

Indoor air concentrations entered over-ride modelling

Receptor Groups (Yes/No)		Default
General public or residents	No	Yes
Employees	Yes	Yes
Canadian native communities	No	No
Other	No	No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	No
Toddler	No	No
Child	No	No
Teen	No	No
Adult	No	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Lead	F1	F2		
Soil (mg/kg)	required	12.2	19.6	143	3402		
Groundwater - source (mg/L)	optional						
Drinking water (mg/L)	optional						
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional	0	0	0	0.17		
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						
				See also PHC Sheet	See also PHC Sheet		

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.5	0.2
Acceptable cancer risk:	1.00E-05	1.00E-05

Precluding Conditions for Fate and Transport Models	
Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	No	No	P-O
Site Characteristics			
Depth to Groundwater (m)	3	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	7.60E-01	P-O
Building Type	Commercial/Industrial	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

	Chemical 1	Chemical 2	Chemical 3
Name			
CAS Number			
Chemical class (organic/inorganic)			
Tolerable daily intake (mg/kg/d) - infant			
Tolerable daily intake (mg/kg/d) - toddler			
Tolerable daily intake (mg/kg/d) - child			
Tolerable daily intake (mg/kg/d) - teen			
Tolerable daily intake (mg/kg/d) - adult			
Tolerable concentration (mg/m^3)			
Oral slope factor (mg/kg/d)$^{-1}$			
Inhalation slope factor (mg/kg/d)$^{-1}$			
Inhalation unit risk (mg/m^3)$^{-1}$			
Relative dermal absorption factor			
Organic carbon partitioning coefficient (mL/g) - Koc			
Log Kow (unitless)			
Henry's Law constant at 25^{o}C (unitless) - H'			
Henry's Law constant at 25^{o}C (atm-m3/mol) - H			
Water Solubility at 25^{o}C (mg/L)			
Molecular Weight (g/mol)			
Vapour Pressure at 25^{o}C (atm)			

Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Adult	Toddler
Body weight (kg)	70.7	70.7
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	16.6	15.8
Water ingestion rate (L/d)	1.5	1.5
Skin surface area (cm^2)		
- hands	890	890
- arms	2500	2500
- legs	5720	5720
- total	17460	17640
Soil loading to exposed skin (g/cm^2/event)		
- hands	0.0001	0.0001
- surfaces other than hands	0.0001	0.00001
Food ingestion (g/d)		
- root vegetables	0	188
- other vegetables	0	137
- fish	0	111
- wild game	0	0
Evaluate Cancer Risks (Yes/No)?	Yes	Yes

User-defined Land-Use / Exposure Scenario

Scenario name	User-Defined	Defaults
Hours per day (indoors)	0	22.5
Hours per day (outdoors)	2	1.5
Days per week	7	7
Weeks per year	24	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	10	60
Years for carcinogen amortization	60	60

HEALTH CANADA PQRA SPREADSHEET Version: March 16, 2009

OUTPUT SHEET - USER-DEFINED RECEPTOR **Adult**

User Name:	Caroline Lucas	**Site:**	3656 Eureka HAWS
Proponent:		**File #:**	
Date:	December 2020	**Comment:**	Office Worker

Exposure Scenario: **User-Defined**
Native population not considered
Cancer Risks Calculated? **Yes**

User-Defined Receptor Characteristics		
Body weight (kg): 70.7	Skin surface area (cm2) - hands: 890	Food ingestion rates (g/d)
Soil ingestion rate (g/d): 0.02	- arms: 2500	Root vegetables: 0
Inhalation rate (m3/d): 16.6	- legs: 5720	Other vegetables: 0
Water ingestion rate (L/d): 1.5	- total: 17460	Fish: 0
	Soil loading (g/cm2-event) - hands: 0.0001	Wild game: 0
	- other: 0.0001	

Chemical Properties	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Tolerable daily intake	mg/kg/d	0.0003	0.0015	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	1.8	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	28	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	6.4	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		slope factor	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.006	0.2	0.2	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Soil	mg/kg	1.22E+01	1.96E+01	1.43E+02	3.40E+03	0.00E+00	0.00E+00
Drinking water	mg/L	NA	NA	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	1.70E-01	0.00E+00	0.00E+00
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	2.03E-02	2.21E-01	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	9.27E-09	1.49E-08	8.33E-08	2.56E-06	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	3.56615E-10	5.72923E-10	0.000782505	0.008508818	0	0
Root vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Other vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Fish	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Wild game	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Lead**	**F1**	**F2**		
Inadvertent ingestion of contaminated soil	2.65E-07	2.56E-06	1.87E-05	4.44E-04	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	8.37E-11	1.35E-10	7.52E-10	2.31E-08	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	1.84E-04	2.00E-03	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	3.63E-07	6.99E-07	1.70E-04	4.05E-03	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	2.65E-07	2.56E-06	1.87E-05	4.44E-04	0.00E+00	0.00E+00
Total dermal exposure	3.63E-07	6.99E-07	1.70E-04	4.05E-03	0.00E+00	0.00E+00
Ingestion + dermal exposure	6.28E-07	3.26E-06	1.89E-04	4.49E-03	0.00E+00	0.00E+00
Total inhalation exposure	8.37E-11	1.35E-10	1.84E-04	2.00E-03	0.00E+00	0.00E+00
Total Exposure (all pathways)	6.28E-07	3.26E-06	3.72E-04	6.49E-03	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Lead**	**F1**	**F2**		
Hazard Quotient - Oral/Dermal		1.26E-02	2.17E-03	1.12E-03	5.84E-02	NA	NA
Hazard Quotient - Inhalation		2.79E-07	8.97E-08	5.27E-04	1.11E-02	NA	NA
Hazard Index - Total		1.26E-02	2.17E-03	1.65E-03	0.07	NA	NA
Target Hazard Index:	0.5						
Cancer Risk - Oral		4.78E-07	NA	NA	NA	NA	NA
Cancer Risk - Dermal		6.53E-07	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		1.13E-06	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		3.91E-10	NA	NA	NA	NA	NA
Cancer Risk - Total		1.13E-06	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Caroline Lucas	Site:	3656 Eureka HAWS
Proponent:		File #:	
Date:	December 2020	Comment:	Construction Worker, Out: Airstrip In: NUNA

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	No	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	No	No
specify:		

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	Yes	Yes
Inhalation of outdoor contaminant vapours	Yes	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario User-Defined — NA

Vapour Transport Modelling

Vapour source for exposure calculations: Soil — Most Conservative

Indoor air concentrations entered over-ride modelling

Receptor Groups (Yes/No)		Default
General public or residents	No	Yes
Employees	Yes	Yes
Canadian native communities	No	No
Other	No	No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	No
Toddler	No	No
Child	No	No
Teen	No	No
Adult	No	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Lead	F1	F2		
Soil (mg/kg)	required	7.6	12.9	0	1360		
Groundwater - source (mg/L)	optional						
Drinking water (mg/L)	optional						
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional	0	0	0	0.54		
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						
				See also PHC Sheet	See also PHC Sheet		

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.5	0.2
Acceptable cancer risk:	1.00E-05	1.00E-05

Precluding Conditions for Fate and Transport Models	
Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	No	No	P-O
Site Characteristics			
Depth to Groundwater (m)	3	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	60	7.60E-01	P-O
Building Type	Commercial/Industrial	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

	Chemical 1	Chemical 2	Chemical 3
Name			
CAS Number			
Chemical class (organic/inorganic)			
Tolerable daily intake (mg/kg/d) - infant			
Tolerable daily intake (mg/kg/d) - toddler			
Tolerable daily intake (mg/kg/d) - child			
Tolerable daily intake (mg/kg/d) - teen			
Tolerable daily intake (mg/kg/d) - adult			
Tolerable concentration (mg/m^3)			
Oral slope factor $(mg/kg/d)^{-1}$			
Inhalation slope factor $(mg/kg/d)^{-1}$			
Inhalation unit risk $(mg/m^3)^{-1}$			
Relative dermal absorption factor			
Organic carbon partitioning coefficient (mL/g) - Koc			
Log Kow (unitless)			
Henry's Law constant at 25°C (unitless) - H'			
Henry's Law constant at 25°C (atm-m3/mol) - H			
Water Solubility at 25°C (mg/L)			
Molecular Weight (g/mol)			
Vapour Pressure at 25°C (atm)			

Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Adult	Toddler
Body weight (kg)	70.7	70.7
Soil ingestion rate (g/d)	0.1	0.02
Inhalation rate (m^3/d)	25.1	15.8
Water ingestion rate (L/d)	1.5	1.5
Skin surface area (cm^2)		
- hands	890	890
- arms	2500	2500
- legs	5720	5720
- total	17460	17640
Soil loading to exposed skin (g/cm^2/event)		
- hands	0.001	0.0001
- surfaces other than hands	0.001	0.00001
Food ingestion (g/d)		
- root vegetables	0	188
- other vegetables	0	137
- fish	0	111
- wild game	0	0
Evaluate Cancer Risks (Yes/No)?	Yes	Yes

User-defined Land-Use / Exposure Scenario

Scenario name	User-Defined	Defaults
Hours per day (indoors)	12	22.5
Hours per day (outdoors)	12	1.5
Days per week	7	7
Weeks per year	16	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	1	60
Years for carcinogen amortization	60	60

HEALTH CANADA PQRA SPREADSHEET Version: March 16, 2009

OUTPUT SHEET - USER-DEFINED RECEPTOR **Adult**

User Name:	Caroline Lucas	**Site:**	3656 Eureka HAWS
Proponent:		**File #:**	
Date:	December 2020	**Comment:**	Construction Worker, Out: Airstrip In: NUNA

		User-Defined Receptor Characteristics	Skin surface area (cm2) - hands: 890	
Exposure Scenario:	**User-Defined**	Body weight (kg): 70.7	- arms: 2500	Food ingestion rates (g/d)
Native population not considered		Soil ingestion rate (g/d): 0.1	- legs: 5720	Root vegetables: 0
Cancer Risks Calculated?	**Yes**	Inhalation rate (m3/d): 25.1	- total: 17460	Other vegetables: 0
		Water ingestion rate (L/d): 1.5	Soil loading (g/cm2-event) - hands: 0.001	Fish: 0
			- other: 0.001	Wild game: 0

Chemical Properties	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Tolerable daily intake	mg/kg/d	0.0003	0.0015	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	1.8	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	28	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	6.4	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		slope factor	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.006	0.2	0.2	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Soil	mg/kg	7.60E+00	1.29E+01	0.00E+00	1.36E+03	0.00E+00	0.00E+00
Drinking water	mg/L	NA	NA	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	5.40E-01	0.00E+00	0.00E+00
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	8.84E-02	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	4.56E-07	7.74E-07	0.00E+00	8.07E-05	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	7.01538E-08	1.19077E-07	0	0.096695287	0	0
Root vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Other vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Fish	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Wild game	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Lead**	**F1**	**F2**		
Inadvertent ingestion of contaminated soil	5.51E-08	5.61E-06	0.00E+00	5.92E-04	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	2.49E-08	4.23E-08	0.00E+00	4.41E-06	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	2.95E-02	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	4.83E-03	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	1.51E-07	3.07E-06	0.00E+00	1.08E-02	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	5.51E-08	5.61E-06	0.00E+00	5.92E-04	0.00E+00	0.00E+00
Total dermal exposure	1.51E-07	3.07E-06	0.00E+00	1.08E-02	0.00E+00	0.00E+00
Ingestion + dermal exposure	2.06E-07	8.68E-06	0.00E+00	1.14E-02	0.00E+00	0.00E+00
Total inhalation exposure	2.49E-08	4.23E-08	0.00E+00	3.43E-02	0.00E+00	0.00E+00
Total Exposure (all pathways)	2.31E-07	8.73E-06	0.00E+00	4.57E-02	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Lead**	**F1**	**F2**		
Hazard Quotient - Oral/Dermal		4.12E-02	5.79E-03	0.00E+00	1.48E-01	NA	NA
Hazard Quotient - Inhalation		8.30E-05	2.82E-05	0.00E+00	1.44E-01	NA	NA
Hazard Index - Total		4.12E-02	5.82E-03	0.00E+00	2.92E-01	NA	NA
Target Hazard Index:	0.5						
Cancer Risk - Oral		9.92E-08	NA	NA	NA	NA	NA
Cancer Risk - Dermal		2.71E-07	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		3.70E-07	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		1.16E-08	NA	NA	NA	NA	NA
Cancer Risk - Total		3.82E-07	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Caroline Lucas	Site:	3656 Eureka HAWS
Proponent:		File #:	
Date:	December 2020	Comment:	Construction Worker, Out: Main station, In: Camp 1

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	No	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	No	No
specify:		

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	Yes	Yes
Inhalation of outdoor contaminant vapours	Yes	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario User-Defined NA

Vapour Transport Modelling

Vapour source for exposure calculations: Soil — Most Conservative

Indoor air concentrations entered over-ride modelling

Receptor Groups (Yes/No)		Default
General public or residents	No	Yes
Employees	Yes	Yes
Canadian native communities	No	No
Other	No	No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	No
Toddler	No	No
Child	No	No
Teen	No	No
Adult	No	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Lead	F1	F2		
Soil (mg/kg)	required	12.2	19.6	143	3402		
Groundwater - source (mg/L)	optional						
Drinking water (mg/L)	optional						
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional	0	0	0	0.029		
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						
				See also PHC Sheet	See also PHC Sheet		

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.5	0.2
Acceptable cancer risk:	1.00E-05	1.00E-05

Precluding Conditions for Fate and Transport Models	
Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	No	No	P-O
Site Characteristics			
Depth to Groundwater (m)	3	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	60	7.60E-01	P-O
Building Type	Commercial/Industrial	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name				
CAS Number				
Chemical class (organic/inorganic)				
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler				
Tolerable daily intake (mg/kg/d) - child				
Tolerable daily intake (mg/kg/d) - teen				
Tolerable daily intake (mg/kg/d) - adult				
Tolerable concentration (mg/m^3)				
Oral slope factor (mg/kg/d)$^{-1}$				
Inhalation slope factor (mg/kg/d)$^{-1}$				
Inhalation unit risk (mg/m^3)$^{-1}$				
Relative dermal absorption factor				
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25^{o}C (unitless) - H'				
Henry's Law constant at 25^{o}C (atm-m3/mol) - H				
Water Solubility at 25^{o}C (mg/L)				
Molecular Weight (g/mol)				
Vapour Pressure at 25^{o}C (atm)				

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Adult	Toddler
Body weight (kg)	70.7	70.7
Soil ingestion rate (g/d)	0.1	0.02
Inhalation rate (m^3/d)	25.1	15.8
Water ingestion rate (L/d)	1.5	1.5
Skin surface area (cm^2)		
- hands	890	890
- arms	2500	2500
- legs	5720	5720
- total	17460	17640
Soil loading to exposed skin (g/cm^2/event)		
- hands	0.001	0.0001
- surfaces other than hands	0.001	0.00001
Food ingestion (g/d)		
- root vegetables	0	188
- other vegetables	0	137
- fish	0	111
- wild game	0	0
Evaluate Cancer Risks (Yes/No)?	Yes	Yes

User-defined Land-Use / Exposure Scenario

Scenario name	User-Defined	Defaults
Hours per day (indoors)	12	22.5
Hours per day (outdoors)	12	1.5
Days per week	7	7
Weeks per year	16	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	1	60
Years for carcinogen amortization	60	60

HEALTH CANADA PQRA SPREADSHEET Version: March 16, 2009

OUTPUT SHEET - USER-DEFINED RECEPTOR **Adult**

User Name:	Caroline Lucas	**Site:**	3656 Eureka HAWS
Proponent:		**File #:**	
Date:	**Dec-20** December 2020	**Comment:**	Construction Worker, Out: Main station, In: Camp 1

Exposure Scenario: **User-Defined**

Native population not considered

Cancer Risks Calculated? **Yes**

User-Defined Receptor Characteristics	Skin surface area (cm2) - hands: 890	
Body weight (kg): 70.7	- arms: 2500	Food ingestion rates (g/d)
Soil ingestion rate (g/d): 0.1	- legs: 5720	Root vegetables: 0
Inhalation rate (m3/d): 25.1	- total: 17460	Other vegetables: 0
Water ingestion rate (L/d): 1.5	Soil loading (g/cm2-event) - hands: 0.001	Fish: 0
	- other: 0.001	Wild game: 0

Chemical Properties	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Tolerable daily intake	mg/kg/d	0.0003	0.0015	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	1.8	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	28	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	6.4	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		slope factor	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.006	0.2	0.2	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Soil	mg/kg	1.22E+01	1.96E+01	1.43E+02	3.40E+03	0.00E+00	0.00E+00
Drinking water	mg/L	NA	NA	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	2.90E-02	0.00E+00	0.00E+00
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	2.03E-02	2.21E-01	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	7.32E-07	1.18E-06	6.58E-06	2.02E-04	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	1.12615E-07	1.80923E-07	0.003131021	0.038527475	0	0
Root vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Other vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Fish	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Wild game	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Lead**	**F1**	**F2**		
Inadvertent ingestion of contaminated soil	8.85E-08	8.53E-06	6.22E-05	1.48E-03	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	4.00E-08	6.42E-08	3.59E-07	1.10E-05	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	1.58E-03	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	1.11E-03	1.21E-02	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	2.42E-07	4.66E-06	1.13E-03	2.70E-02	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	8.85E-08	8.53E-06	6.22E-05	1.48E-03	0.00E+00	0.00E+00
Total dermal exposure	2.42E-07	4.66E-06	1.13E-03	2.70E-02	0.00E+00	0.00E+00
Ingestion + dermal exposure	3.30E-07	1.32E-05	1.20E-03	2.85E-02	0.00E+00	0.00E+00
Total inhalation exposure	4.00E-08	6.42E-08	1.11E-03	1.37E-02	0.00E+00	0.00E+00
Total Exposure (all pathways)	3.70E-07	1.33E-05	2.31E-03	4.21E-02	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Lead**	**F1**	**F2**		
Hazard Quotient - Oral/Dermal		6.61E-02	8.80E-03	7.13E-03	3.70E-01	NA	NA
Hazard Quotient - Inhalation		1.33E-04	4.28E-05	2.11E-03	4.95E-02	NA	NA
Hazard Index - Total		0.07	0.009	0.009	0.419	NA	NA
Target Hazard Index:	0.5						
Cancer Risk - Oral		1.59E-07	NA	NA	NA	NA	NA
Cancer Risk - Dermal		4.35E-07	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		5.95E-07	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		1.87E-08	NA	NA	NA	NA	NA
Cancer Risk - Total		6.13E-07	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Caroline Lucas	Site:	3656 Eureka HAWS
Proponent:		File #:	
Date:	December 2020	Comment:	O&M Worker, Out: Airstrip

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	No	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	No	No
specify:		

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	Yes	Yes
Inhalation of outdoor contaminant vapours	Yes	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario User-Defined NA

Vapour Transport Modelling

Vapour source for exposure calculations: Soil — Most Conservative

Indoor air concentrations entered over-ride modelling

Receptor Groups (Yes/No)		Default
General public or residents	No	Yes
Employees	Yes	Yes
Canadian native communities	No	No
Other	No	No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	No
Toddler	No	No
Child	No	No
Teen	No	No
Adult	No	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Lead	F1	F2		
Soil (mg/kg)	required	7.6	12.9	0	1360		
Groundwater - source (mg/L)	optional						
Drinking water (mg/L)	optional						
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional	0	0	0	0.17		
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						
				See also PHC Sheet	See also PHC Sheet		

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.5	0.2
Acceptable cancer risk:	1.00E-05	1.00E-05

Precluding Conditions for Fate and Transport Models	
Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	No	No	P-O
Site Characteristics			
Depth to Groundwater (m)	3	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	7.60E-01	P-O
Building Type	Commercial/Industrial	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

	Chemical 1	Chemical 2	Chemical 3
Name			
CAS Number			
Chemical class (organic/inorganic)			
Tolerable daily intake (mg/kg/d) - infant			
Tolerable daily intake (mg/kg/d) - toddler			
Tolerable daily intake (mg/kg/d) - child			
Tolerable daily intake (mg/kg/d) - teen			
Tolerable daily intake (mg/kg/d) - adult			
Tolerable concentration (mg/m^3)			
Oral slope factor (mg/kg/d)$^{-1}$			
Inhalation slope factor (mg/kg/d)$^{-1}$			
Inhalation unit risk (mg/m^3)$^{-1}$			
Relative dermal absorption factor			
Organic carbon partitioning coefficient (mL/g) - Koc			
Log Kow (unitless)			
Henry's Law constant at 25^{o}C (unitless) - H'			
Henry's Law constant at 25^{o}C (atm-m3/mol) - H			
Water Solubility at 25^{o}C (mg/L)			
Molecular Weight (g/mol)			
Vapour Pressure at 25^{o}C (atm)			

Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Adult	Toddler
Body weight (kg)	70.7	70.7
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	16.6	15.8
Water ingestion rate (L/d)	1.5	1.5
Skin surface area (cm^2)		
- hands	890	890
- arms	2500	2500
- legs	5720	5720
- total	17460	17640
Soil loading to exposed skin (g/cm^2/event)		
- hands	0.0001	0.0001
- surfaces other than hands	0.0001	0.00001
Food ingestion (g/d)		
- root vegetables	0	188
- other vegetables	0	137
- fish	0	111
- wild game	0	0
Evaluate Cancer Risks (Yes/No)?	Yes	Yes

User-defined Land-Use / Exposure Scenario

Scenario name	User-Defined	Defaults
Hours per day (indoors)	10	22.5
Hours per day (outdoors)	2	1.5
Days per week	7	7
Weeks per year	32	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	10	60
Years for carcinogen amortization	60	60

HEALTH CANADA PQRA SPREADSHEET Version: March 16, 2009
OUTPUT SHEET - USER-DEFINED RECEPTOR **Adult**

User Name:	Caroline Lucas	**Site:**	3656 Eureka HAWS
Proponent:		**File #:**	
Date:	December 2020	**Comment:**	O&M Worker, Out: Airstrip

		User-Defined Receptor Characteristics		
			Skin surface area (cm2) - hands: 890	
Exposure Scenario:	**User-Defined**	Body weight (kg): 70.7	- arms: 2500	Food ingestion rates (g/d)
Native population not considered		Soil ingestion rate (g/d): 0.02	- legs: 5720	Root vegetables: 0
Cancer Risks Calculated?	**Yes**	Inhalation rate (m3/d): 16.6	- total: 17460	Other vegetables: 0
		Water ingestion rate (L/d): 1.5	Soil loading (g/cm2-event) - hands: 0.0001	Fish: 0
			- other: 0.0001	Wild game: 0

Chemical Properties	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Tolerable daily intake	mg/kg/d	0.0003	0.0015	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	1.8	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	28	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	6.4	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		slope factor	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.006	0.2	0.2	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Soil	mg/kg	7.60E+00	1.29E+01	0.00E+00	1.36E+03	0.00E+00	0.00E+00
Drinking water	mg/L	NA	NA	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	1.70E-01	0.00E+00	0.00E+00
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	8.84E-02	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	5.78E-09	9.80E-09	0.00E+00	1.02E-06	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	2.96205E-10	5.02769E-10	0	0.048125112	0	0
Root vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Other vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Fish	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Wild game	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Lead**	**F1**	**F2**		
Inadvertent ingestion of contaminated soil	2.21E-07	2.25E-06	0.00E+00	2.37E-04	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	6.95E-11	1.18E-10	0.00E+00	1.23E-08	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	1.02E-02	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	1.06E-03	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	3.01E-07	6.14E-07	0.00E+00	2.16E-03	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	2.21E-07	2.25E-06	0.00E+00	2.37E-04	0.00E+00	0.00E+00
Total dermal exposure	3.01E-07	6.14E-07	0.00E+00	2.16E-03	0.00E+00	0.00E+00
Ingestion + dermal exposure	5.22E-07	2.86E-06	0.00E+00	2.39E-03	0.00E+00	0.00E+00
Total inhalation exposure	6.95E-11	1.18E-10	0.00E+00	1.13E-02	0.00E+00	0.00E+00
Total Exposure (all pathways)	5.22E-07	2.86E-06	0.00E+00	1.37E-02	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Lead**	**F1**	**F2**		
Hazard Quotient - Oral/Dermal		1.04E-02	1.91E-03	0.00E+00	3.11E-02	NA	NA
Hazard Quotient - Inhalation		2.32E-07	7.87E-08	0.00E+00	5.44E-02	NA	NA
Hazard Index - Total		0.010	0.002	0.000	0.085	NA	NA
Target Hazard Index:	0.5						
Cancer Risk - Oral		3.97E-07	NA	NA	NA	NA	NA
Cancer Risk - Dermal		5.42E-07	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		9.39E-07	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		3.25E-10	NA	NA	NA	NA	NA
Cancer Risk - Total		9.40E-07	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Caroline Lucas	Site:	3656 Eureka HAWS
Proponent:		File #:	
Date:	December 2020	Comment:	O&M Worker, Out: Airstrip

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	No	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	No	No
specify:		

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	Yes	Yes
Inhalation of outdoor contaminant vapours	Yes	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario User-Defined NA

Vapour Transport Modelling

Vapour source for exposure calculations: Soil — Most Conservative

Indoor air concentrations entered over-ride modelling

Receptor Groups (Yes/No)		Default
General public or residents	No	Yes
Employees	Yes	Yes
Canadian native communities	No	No
Other	No	No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	No
Toddler	No	No
Child	No	No
Teen	No	No
Adult	No	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Lead	F1	F2		
Soil (mg/kg)	required	7.6	12.9	0	1360		
Groundwater - source (mg/L)	optional						
Drinking water (mg/L)	optional						
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional	0	0	0	0.43		
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						
				See also PHC Sheet	See also PHC Sheet		

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.5	0.2
Acceptable cancer risk:	1.00E-05	1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	No	No	P-O
Site Characteristics			
Depth to Groundwater (m)	3	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	7.60E-01	P-O
Building Type	Commercial/Industrial	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

	Chemical 1	Chemical 2	Chemical 3
Name			
CAS Number			
Chemical class (organic/inorganic)			
Tolerable daily intake (mg/kg/d) - infant			
Tolerable daily intake (mg/kg/d) - toddler			
Tolerable daily intake (mg/kg/d) - child			
Tolerable daily intake (mg/kg/d) - teen			
Tolerable daily intake (mg/kg/d) - adult			
Tolerable concentration (mg/m^3)			
Oral slope factor (mg/kg/d)$^{-1}$			
Inhalation slope factor (mg/kg/d)$^{-1}$			
Inhalation unit risk (mg/m^3)$^{-1}$			
Relative dermal absorption factor			
Organic carbon partitioning coefficient (mL/g) - Koc			
Log Kow (unitless)			
Henry's Law constant at 25°C (unitless) - H'			
Henry's Law constant at 25°C (atm-m3/mol) - H			
Water Solubility at 25°C (mg/L)			
Molecular Weight (g/mol)			
Vapour Pressure at 25°C (atm)			

Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Adult	Toddler
Body weight (kg)	70.7	70.7
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	16.6	15.8
Water ingestion rate (L/d)	1.5	1.5
Skin surface area (cm^2)		
- hands	890	890
- arms	2500	2500
- legs	5720	5720
- total	17460	17640
Soil loading to exposed skin (g/cm^2/event)		
- hands	0.0001	0.0001
- surfaces other than hands	0.0001	0.00001
Food ingestion (g/d)		
- root vegetables	0	188
- other vegetables	0	137
- fish	0	111
- wild game	0	0
Evaluate Cancer Risks (Yes/No)?	Yes	Yes

User-defined Land-Use / Exposure Scenario

Scenario name	User-Defined	Defaults
Hours per day (indoors)	10	22.5
Hours per day (outdoors)	2	1.5
Days per week	7	7
Weeks per year	32	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	10	60
Years for carcinogen amortization	60	60

HEALTH CANADA PQRA SPREADSHEET Version: March 16, 2009
OUTPUT SHEET - USER-DEFINED RECEPTOR **Adult**

User Name:	Caroline Lucas	**Site:**	3656 Eureka HAWS
Proponent:		**File #:**	
Date:	December 2020	**Comment:**	O&M Worker, Out: Airstrip

		User-Defined Receptor Characteristics	Skin surface area (cm2) - hands: 890	
Exposure Scenario:	**User-Defined**	Body weight (kg): 70.7	- arms: 2500	Food ingestion rates (g/d)
Native population not considered		Soil ingestion rate (g/d): 0.02	- legs: 5720	Root vegetables: 0
Cancer Risks Calculated?	**Yes**	Inhalation rate (m3/d): 16.6	- total: 17460	Other vegetables: 0
		Water ingestion rate (L/d): 1.5	Soil loading (g/cm2-event) - hands: 0.0001	Fish: 0
			- other: 0.0001	Wild game: 0

Chemical Properties	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Tolerable daily intake	mg/kg/d	0.0003	0.0015	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	1.8	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	28	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	6.4	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		slope factor	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.006	0.2	0.2	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Soil	mg/kg	7.60E+00	1.29E+01	0.00E+00	1.36E+03	0.00E+00	0.00E+00
Drinking water	mg/L	NA	NA	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	4.30E-01	0.00E+00	0.00E+00
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	8.84E-02	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	5.78E-09	9.80E-09	0.00E+00	1.02E-06	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	2.96205E-10	5.02769E-10	0	0.114791779	0	0
Root vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Other vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Fish	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Wild game	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Lead**	**F1**	**F2**		
Inadvertent ingestion of contaminated soil	2.21E-07	2.25E-06	0.00E+00	2.37E-04	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	6.95E-11	1.18E-10	0.00E+00	1.23E-08	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	2.59E-02	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	1.06E-03	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	3.01E-07	6.14E-07	0.00E+00	2.16E-03	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	2.21E-07	2.25E-06	0.00E+00	2.37E-04	0.00E+00	0.00E+00
Total dermal exposure	3.01E-07	6.14E-07	0.00E+00	2.16E-03	0.00E+00	0.00E+00
Ingestion + dermal exposure	5.22E-07	2.86E-06	0.00E+00	2.39E-03	0.00E+00	0.00E+00
Total inhalation exposure	6.95E-11	1.18E-10	0.00E+00	2.70E-02	0.00E+00	0.00E+00
Total Exposure (all pathways)	5.22E-07	2.86E-06	0.00E+00	2.93E-02	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Lead**	**F1**	**F2**		
Hazard Quotient - Oral/Dermal		1.04E-02	1.91E-03	0.00E+00	3.11E-02	NA	NA
Hazard Quotient - Inhalation		2.32E-07	7.87E-08	0.00E+00	2.71E-01	NA	NA
Hazard Index - Total		1.04E-02	1.91E-03	0.00E+00	3.02E-01	NA	NA
Target Hazard Index:	0.5						
Cancer Risk - Oral		3.97E-07	NA	NA	NA	NA	NA
Cancer Risk - Dermal		5.42E-07	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		9.39E-07	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		3.25E-10	NA	NA	NA	NA	NA
Cancer Risk - Total		9.40E-07	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Caroline Lucas	Site:	3656 Eureka HAWS
Proponent:		File #:	
Date:	December 2020	Comment:	O&M Worker, Out: Main Station

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	No	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	No	No
specify:		

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	Yes	Yes
Inhalation of outdoor contaminant vapours	Yes	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario User-Defined NA

Vapour Transport Modelling

Vapour source for exposure calculations: Soil — Most Conservative

Indoor air concentrations entered over-ride modelling

Receptor Groups (Yes/No)		Default
General public or residents	No	Yes
Employees	Yes	Yes
Canadian native communities	No	No
Other	No	No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	No
Toddler	No	No
Child	No	No
Teen	No	No
Adult	No	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Lead	F1	F2		
Soil (mg/kg)	required	12.2	19.6	143	3402		
Groundwater - source (mg/L)	optional						
Drinking water (mg/L)	optional						
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional	0	0	0	0.17		
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						
				See also PHC Sheet	See also PHC Sheet		

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.5	0.2
Acceptable cancer risk:	1.00E-05	1.00E-05

Precluding Conditions for Fate and Transport Models	
Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	No	No	P-O
Site Characteristics			
Depth to Groundwater (m)	3	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	7.60E-01	P-O
Building Type	Commercial/Industrial	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

	Chemical 1	Chemical 2	Chemical 3
Name			
CAS Number			
Chemical class (organic/inorganic)			
Tolerable daily intake (mg/kg/d) - infant			
Tolerable daily intake (mg/kg/d) - toddler			
Tolerable daily intake (mg/kg/d) - child			
Tolerable daily intake (mg/kg/d) - teen			
Tolerable daily intake (mg/kg/d) - adult			
Tolerable concentration (mg/m^3)			
Oral slope factor $(mg/kg/d)^{-1}$			
Inhalation slope factor $(mg/kg/d)^{-1}$			
Inhalation unit risk $(mg/m^3)^{-1}$			
Relative dermal absorption factor			
Organic carbon partitioning coefficient (mL/g) - Koc			
Log Kow (unitless)			
Henry's Law constant at 25°C (unitless) - H'			
Henry's Law constant at 25°C (atm-m3/mol) - H			
Water Solubility at 25°C (mg/L)			
Molecular Weight (g/mol)			
Vapour Pressure at 25°C (atm)			

Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Adult	Toddler
Body weight (kg)	70.7	70.7
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	16.6	15.8
Water ingestion rate (L/d)	1.5	1.5
Skin surface area (cm^2)		
- hands	890	890
- arms	2500	2500
- legs	5720	5720
- total	17460	17640
Soil loading to exposed skin (g/cm^2/event)		
- hands	0.0001	0.0001
- surfaces other than hands	0.0001	0.00001
Food ingestion (g/d)		
- root vegetables	0	188
- other vegetables	0	137
- fish	0	111
- wild game	0	0
Evaluate Cancer Risks (Yes/No)?	Yes	Yes

User-defined Land-Use / Exposure Scenario

Scenario name	User-Defined	Defaults
Hours per day (indoors)	10	22.5
Hours per day (outdoors)	2	1.5
Days per week	7	7
Weeks per year	32	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	10	60
Years for carcinogen amortization	60	60

HEALTH CANADA PQRA SPREADSHEET Version: March 16, 2009
OUTPUT SHEET - USER-DEFINED RECEPTOR **Adult**

User Name:	Caroline Lucas	**Site:**	3656 Eureka HAWS
Proponent:		**File #:**	
Date:	December 2020	**Comment:**	O&M Worker, Out: Main Station

Exposure Scenario: **User-Defined**
Native population not considered
Cancer Risks Calculated? **Yes**

User-Defined Receptor Characteristics		
Body weight (kg): 70.7	Skin surface area (cm2) - hands: 890	Food ingestion rates (g/d)
Soil ingestion rate (g/d): 0.02	- arms: 2500	Root vegetables: 0
Inhalation rate (m3/d): 16.6	- legs: 5720	Other vegetables: 0
Water ingestion rate (L/d): 1.5	- total: 17460	Fish: 0
	Soil loading (g/cm2-event) - hands: 0.0001	Wild game: 0
	- other: 0.0001	

Chemical Properties	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Tolerable daily intake	mg/kg/d	0.0003	0.0015	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	1.8	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	28	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	6.4	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		slope factor	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.006	0.2	0.2	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Soil	mg/kg	1.22E+01	1.96E+01	1.43E+02	3.40E+03	0.00E+00	0.00E+00
Drinking water	mg/L	NA	NA	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	1.70E-01	0.00E+00	0.00E+00
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	2.03E-02	2.21E-01	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	9.27E-09	1.49E-08	8.33E-08	2.56E-06	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	4.75487E-10	7.63897E-10	0.001043341	0.054934834	0	0
Root vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Other vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Fish	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Wild game	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Lead**	**F1**	**F2**		
Inadvertent ingestion of contaminated soil	3.54E-07	3.41E-06	2.49E-05	5.92E-04	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	1.12E-10	1.79E-10	1.00E-09	3.08E-08	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	1.02E-02	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	2.45E-04	2.66E-03	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	4.84E-07	9.33E-07	2.27E-04	5.40E-03	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	3.54E-07	3.41E-06	2.49E-05	5.92E-04	0.00E+00	0.00E+00
Total dermal exposure	4.84E-07	9.33E-07	2.27E-04	5.40E-03	0.00E+00	0.00E+00
Ingestion + dermal exposure	8.38E-07	4.34E-06	2.52E-04	5.99E-03	0.00E+00	0.00E+00
Total inhalation exposure	1.12E-10	1.79E-10	2.45E-04	1.29E-02	0.00E+00	0.00E+00
Total Exposure (all pathways)	8.38E-07	4.34E-06	4.97E-04	1.89E-02	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Lead**	**F1**	**F2**		
Hazard Quotient - Oral/Dermal		1.68E-02	2.90E-03	1.50E-03	7.78E-02	NA	NA
Hazard Quotient - Inhalation		3.72E-07	1.20E-07	7.02E-04	6.33E-02	NA	NA
Hazard Index - Total		0.017	0.003	0.002	0.141	NA	NA
Target Hazard Index:	0.5						
Cancer Risk - Oral		6.37E-07	NA	NA	NA	NA	NA
Cancer Risk - Dermal		8.71E-07	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		1.51E-06	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		5.21E-10	NA	NA	NA	NA	NA
Cancer Risk - Total		1.51E-06	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Caroline Lucas	Site:	3656 Eureka HAWS
Proponent:		File #:	
Date:	December 2020	Comment:	O&M Worker, Out: Main Station

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	No	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	No	No
specify:		

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	Yes	Yes
Inhalation of outdoor contaminant vapours	Yes	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario User-Defined NA

Vapour Transport Modelling

Vapour source for exposure calculations: Soil — Most Conservative

Indoor air concentrations entered over-ride modelling

Receptor Groups (Yes/No)		Default
General public or residents	No	Yes
Employees	Yes	Yes
Canadian native communities	No	No
Other	No	No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	No
Toddler	No	No
Child	No	No
Teen	No	No
Adult	No	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Lead	F1	F2		
Soil (mg/kg)	required	12.2	19.6	143	3402		
Groundwater - source (mg/L)	optional						
Drinking water (mg/L)	optional						
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional	0	0	0	0.43		
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						
				See also PHC Sheet	See also PHC Sheet		

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.5	0.2
Acceptable cancer risk:	1.00E-05	1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	No	No	P-O
Site Characteristics			
Depth to Groundwater (m)	3	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	7.60E-01	P-O
Building Type	Commercial/Industrial	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

	Chemical 1	Chemical 2	Chemical 3
Name			
CAS Number			
Chemical class (organic/inorganic)			
Tolerable daily intake (mg/kg/d) - infant			
Tolerable daily intake (mg/kg/d) - toddler			
Tolerable daily intake (mg/kg/d) - child			
Tolerable daily intake (mg/kg/d) - teen			
Tolerable daily intake (mg/kg/d) - adult			
Tolerable concentration (mg/m^3)			
Oral slope factor (mg/kg/d)$^{-1}$			
Inhalation slope factor (mg/kg/d)$^{-1}$			
Inhalation unit risk (mg/m^3)$^{-1}$			
Relative dermal absorption factor			
Organic carbon partitioning coefficient (mL/g) - Koc			
Log Kow (unitless)			
Henry's Law constant at 25^{o}C (unitless) - H'			
Henry's Law constant at 25^{o}C (atm-m3/mol) - H			
Water Solubility at 25^{o}C (mg/L)			
Molecular Weight (g/mol)			
Vapour Pressure at 25^{o}C (atm)			

Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Adult	Toddler
Body weight (kg)	70.7	70.7
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	16.6	15.8
Water ingestion rate (L/d)	1.5	1.5
Skin surface area (cm^2)		
- hands	890	890
- arms	2500	2500
- legs	5720	5720
- total	17460	17640
Soil loading to exposed skin (g/cm^2/event)		
- hands	0.0001	0.0001
- surfaces other than hands	0.0001	0.00001
Food ingestion (g/d)		
- root vegetables	0	188
- other vegetables	0	137
- fish	0	111
- wild game	0	0
Evaluate Cancer Risks (Yes/No)?	Yes	Yes

User-defined Land-Use / Exposure Scenario

Scenario name	User-Defined	Defaults
Hours per day (indoors)	10	22.5
Hours per day (outdoors)	2	1.5
Days per week	7	7
Weeks per year	32	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	10	60
Years for carcinogen amortization	60	60

HEALTH CANADA PQRA SPREADSHEET Version: March 16, 2009

OUTPUT SHEET - USER-DEFINED RECEPTOR **Adult**

User Name:	Caroline Lucas	**Site:**	3656 Eureka HAWS
Proponent:		**File #:**	
Date:	December 2020	**Comment:**	O&M Worker, Out: Main Station

		User-Defined Receptor Characteristics	Skin surface area (cm2) - hands: 890	
Exposure Scenario:	**User-Defined**	Body weight (kg): 70.7	- arms: 2500	Food ingestion rates (g/d)
Native population not considered		Soil ingestion rate (g/d): 0.02	- legs: 5720	Root vegetables: 0
Cancer Risks Calculated?	**Yes**	Inhalation rate (m3/d): 16.6	- total: 17460	Other vegetables: 0
		Water ingestion rate (L/d): 1.5	Soil loading (g/cm2-event) - hands: 0.0001	Fish: 0
			- other: 0.0001	Wild game: 0

Chemical Properties	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Tolerable daily intake	mg/kg/d	0.0003	0.0015	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	1.8	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	28	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	6.4	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		slope factor	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.006	0.2	0.2	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Lead**	**F1**	**F2**		
Soil	mg/kg	1.22E+01	1.96E+01	1.43E+02	3.40E+03	0.00E+00	0.00E+00
Drinking water	mg/L	NA	NA	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	4.30E-01	0.00E+00	0.00E+00
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	2.03E-02	2.21E-01	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	9.27E-09	1.49E-08	8.33E-08	2.56E-06	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	4.75487E-10	7.63897E-10	0.001043341	0.121601501	0	0
Root vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Other vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Fish	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Wild game	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Lead**	**F1**	**F2**		
Inadvertent ingestion of contaminated soil	3.54E-07	3.41E-06	2.49E-05	5.92E-04	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	1.12E-10	1.79E-10	1.00E-09	3.08E-08	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	2.59E-02	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	2.45E-04	2.66E-03	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	4.84E-07	9.33E-07	2.27E-04	5.40E-03	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	3.54E-07	3.41E-06	2.49E-05	5.92E-04	0.00E+00	0.00E+00
Total dermal exposure	4.84E-07	9.33E-07	2.27E-04	5.40E-03	0.00E+00	0.00E+00
Ingestion + dermal exposure	8.38E-07	4.34E-06	2.52E-04	5.99E-03	0.00E+00	0.00E+00
Total inhalation exposure	1.12E-10	1.79E-10	2.45E-04	2.86E-02	0.00E+00	0.00E+00
Total Exposure (all pathways)	8.38E-07	4.34E-06	4.97E-04	3.45E-02	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Lead**	**F1**	**F2**		
Hazard Quotient - Oral/Dermal		1.68E-02	2.90E-03	1.50E-03	7.78E-02	NA	NA
Hazard Quotient - Inhalation		3.72E-07	1.20E-07	7.02E-04	2.79E-01	NA	NA
Hazard Index - Total		0.017	0.003	0.002	0.357	NA	NA
Target Hazard Index:	0.5						
Cancer Risk - Oral		6.37E-07	NA	NA	NA	NA	NA
Cancer Risk - Dermal		8.71E-07	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		1.51E-06	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		5.21E-10	NA	NA	NA	NA	NA
Cancer Risk - Total		1.51E-06	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Caroline Lucas	Site:	3656 Eureka HAWS
Proponent:		File #:	
Date:	September 2021	Comment:	Candac

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	No	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	No	No
specify:		

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	Yes	Yes
Inhalation of outdoor contaminant vapours	Yes	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario User-Defined NA

Vapour Transport Modelling

Vapour source for exposure calculations: Soil — Most Conservative

Indoor air concentrations entered over-ride modelling

Receptor Groups (Yes/No)		Default
General public or residents	No	Yes
Employees	Yes	Yes
Canadian native communities	No	No
Other	No	No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	No
Toddler	No	No
Child	No	No
Teen	No	No
Adult	No	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Blue numbers exceed theoretical saturation/solubility limits; site should be evaluated for potential NAPL

Chemical Name	required	F2	F3	F1			
Soil (mg/kg)	required	7427	376	***837.3***			
Groundwater - source (mg/L)	optional						
Drinking water (mg/L)	optional						
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional	0.872	0	32.6			
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						
		See also PHC Sheet	See also PHC Sheet	See also PHC Sheet			

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.5	0.2
Acceptable cancer risk:	1.00E-05	1.00E-05

Precluding Conditions for Fate and Transport Models	
Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	No	No	P-O
Site Characteristics			
Depth to Groundwater (m)	3	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	7.60E-01	P-O
Building Type	Commercial/Industrial	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.

	Chemical 1	Chemical 2	Chemical 3
Name			
CAS Number			
Chemical class (organic/inorganic)			
Tolerable daily intake (mg/kg/d) - infant			
Tolerable daily intake (mg/kg/d) - toddler			
Tolerable daily intake (mg/kg/d) - child			
Tolerable daily intake (mg/kg/d) - teen			
Tolerable daily intake (mg/kg/d) - adult			
Tolerable concentration (mg/m^3)			
Oral slope factor (mg/kg/d)$^{-1}$			
Inhalation slope factor (mg/kg/d)$^{-1}$			
Inhalation unit risk (mg/m^3)$^{-1}$			
Relative dermal absorption factor			
Organic carbon partitioning coefficient (mL/g) - Koc			
Log Kow (unitless)			
Henry's Law constant at 25°C (unitless) - H'			
Henry's Law constant at 25°C (atm-m3/mol) - H			
Water Solubility at 25°C (mg/L)			
Molecular Weight (g/mol)			
Vapour Pressure at 25°C (atm)			

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Adult	Toddler
Body weight (kg)	70.7	70.7
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	16.6	15.8
Water ingestion rate (L/d)	1.5	1.5
Skin surface area (cm^2)		
- hands	890	890
- arms	2500	2500
- legs	5720	5720
- total	17460	17640
Soil loading to exposed skin (g/cm^2/event)		
- hands	0.0001	0.0001
- surfaces other than hands	0.0001	0.00001
Food ingestion (g/d)		
- root vegetables	0	188
- other vegetables	0	137
- fish	0	111
- wild game	0	0
Evaluate Cancer Risks (Yes/No)?	Yes	Yes

User-defined Land-Use / Exposure Scenario

Scenario name	User-Defined	Defaults
Hours per day (indoors)	6	22.5
Hours per day (outdoors)	6	1.5
Days per week	7	7
Weeks per year	12	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	1	60
Years for carcinogen amortization	60	60

HEALTH CANADA PQRA SPREADSHEET Version: March 16, 2009

OUTPUT SHEET - USER-DEFINED RECEPTOR **Adult**

User Name:	Caroline Lucas	**Site:**	3656 Eureka HAWS
Proponent:		**File #:**	
Date:	September 2021	**Comment:**	Candac

Exposure Scenario: **User-Defined**

Native population not considered

Cancer Risks Calculated? **Yes**

User-Defined Receptor Characteristics	Skin surface area (cm2) - hands: 890	
Body weight (kg): 70.7	- arms: 2500	Food ingestion rates (g/d)
Soil ingestion rate (g/d): 0.02	- legs: 5720	Root vegetables: 0
Inhalation rate (m3/d): 16.6	- total: 17460	Other vegetables: 0
Water ingestion rate (L/d): 1.5	Soil loading (g/cm2-event) - hands: 0.0001	Fish: 0
	- other: 0.0001	Wild game: 0

Chemical Properties	**Units**	**F2**	**F3**	**F1**			
Tolerable daily intake	mg/kg/d	NA	NA	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	NA	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		NA	NA	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.2	0.2	0.2	1	1	1

Chemical Concentrations	**Units**	**F2**	**F3**	**F1**			
Soil	mg/kg	7.43E+03	3.76E+02	8.37E+02	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	NA	NA	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	8.72E-01	0.00E+00	3.26E+01	0.00E+00	0.00E+00	0.00E+00
Outdoor air vapours	mg/m^3	4.83E-01	0.00E+00	3.55E-01	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	5.58E-06	0.00E+00	4.88E-07	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	0.078171444	0	1.901252159	0	0	0
Root vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Other vegetables	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Fish	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated
Wild game	mg/kg wet wt	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated	not evaluated

RESULTS

	Exposure (mg/kg/d)					
	F2	**F3**	**F1**			
Inadvertent ingestion of contaminated soil	4.85E-04	2.45E-05	5.47E-05	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	7.56E-08	0.00E+00	6.61E-09	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	1.18E-02	0.00E+00	4.42E-01	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	6.54E-03	0.00E+00	4.81E-03	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	4.42E-03	2.24E-04	4.98E-04	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	4.85E-04	2.45E-05	5.47E-05	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure	4.42E-03	2.24E-04	4.98E-04	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure	4.90E-03	2.48E-04	5.53E-04	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure	1.84E-02	0.00E+00	4.46E-01	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)	2.33E-02	2.48E-04	4.47E-01	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		F2	**F3**	**F1**			
Hazard Quotient - Oral/Dermal		6.37E-02	1.75E-03	3.29E-03	NA	NA	NA
Hazard Quotient - Inhalation		9.23E-02	2.73E-08	4.30E-01	NA	NA	NA
Hazard Index - Total		0.16	0.002	4.33E-01	NA	NA	NA
Target Hazard Index:	0.5						
Cancer Risk - Oral		NA	NA	NA	NA	NA	NA
Cancer Risk - Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		NA	NA	NA	NA	NA	NA
Cancer Risk - Total		NA	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

APPENDIX C

Ecological Receptor Characteristics

C.1 Ecological Receptor Characteristics

Table C.1 Arctic Hare Receptor Characteristics

Parameter	Units	Value	Reference and Discussion
Characteristics:			
Body weight	kg	1.3	Average value from EC (2012), with range of 0.9 kg to 1.9 kg.
Water ingestion rate	m^3/d	1.3×10^{-4}	Based on U.S. EPA (1993) allometric equation for mammals (consistent with EC 2012 approach).
Food ingestion rate – dry weight basis	g (dw)/d	82	Based on EC (2012) for adults (both sexes) with a mixed diet of browse and commercial rabbit pellets – 0.06 kg dry food/kg BW/day.
Food ingestion rate – wet weight basis	g (ww)/d	270	Applies an assumed moisture content of 70% for food to the dry weight food ingestion rate.
Sediment ingestion rate	g (dw)/d	0	Not considered based on feeding habits.
Soil ingestion rate	g (dw)/d	5.2	Consistent with EC (2012), based on U.S. EPA (1993) value for jackrabbit of 6.3% dry weight food ingestion.
Foraging range	km^2	0.016 to 0.1	Based on EC (2012).
Fraction of time on site	-	1	Assumed based on foraging range
Diet Composition:			
Foliage	–	0.3	Consistent with the dietary properties in EC (2012), with grasses (30%) attributed to foliage, shrubs (60%) attributed to woody vegetation, and berries (10%) attributed to fruits and flowers.
Woody vegetation	–	0.6	
Fruits and flowers	–	0.1	

References:

Environment Canada (EC). 2012. Federal Contaminated Sites Action Plan (FCSAP) ecological risk assessment guidance. Module 3: Standardization of wildlife receptor characteristics. Prepared by Azimuth Consulting Group. March.

United States Environmental Protection Agency (U.S. EPA). 1993. Wildlife exposure factors handbook. Volume I of II. Office of Research and Development. EPA/600/R-93/187. December.

Table C.2 Arctic Fox Receptor Characteristics

Parameter	Units	Value	Reference and Discussion
Characteristics			
Body weight	kg	5.8	Weighs between 2.5 kg to 9 kg (CWF 1994).
Water ingestion rate	m^3/d	4.8×10^{-4}	Based on U.S. EPA (1993) allometric equation for mammals.
Food ingestion rate – dry weight basis	g (dw)/d	291	Based on U.S. EPA (1993) allometric equation for mammals.
Food ingestion rate – wet weight basis	g (ww)/d	874	Assuming a moisture content of 70% for food.
Sediment ingestion rate	g (dw)/d	0	Not considered based on feeding habits
Soil ingestion rate	g (dw)/d	8	Based on EC (2012), using a 2.8% of dry weight food ingestion from Beyer et al. (1994).
Foraging range	km^2	2.5 to 5	Varies depending on season and location (CWF 1994).
Fraction of time on site	-	0.1	Assumed based on foraging range
Diet Composition:			
Berries	–	0.1	The arctic fox is an omnivore, and primarily consumes lemmings, rabbits, and birds, with the addition of berries in the summer (CWF 1994).
Ptarmigan	–	0.2	
Hare	–	0.2	
Lemmings	–	0.5	

References:

Canadian Wildlife Federation (CWF) 1994. Hinterland Who's Who: Arctic Fox. Accessed September 2020 at http://www.hww.ca/en/wildlife/mammals/arctic-fox.html.

Environment Canada (EC). 2012. Federal Contaminated Sites Action Plan (FCSAP) Ecological risk assessment guidance. Module 3: Standardization of wildlife receptor characteristics. Prepared by Azimuth Consulting Group. March.

United States Environmental Protection Agency (U.S. EPA). 1993. Wildlife exposure factors handbook. Volume I of II. Office of Research and Development. EPA/600/R-93/187. December.

Table C.3 Rock Ptarmigan Receptor Characteristics

Parameter	Units	Value	Reference and Discussion
Characteristics:			
Body weight	kg	0.65	Ptarmigan range from 450 g to 650 g (0.45 kg to 0.65 kg) body weight (CWF 1994; Cornell Lab of Ornithology 2015).
Water ingestion rate	m^3/d	4.3×10^{-5}	Based on U.S. EPA (1993) allometric equation for birds.
Food ingestion rate – dry weight basis	g (dw)/d	43	Based on U.S. EPA (1993) allometric equation for all birds.
Food ingestion rate – wet weight basis	g (ww)/d	143	Applies an assumed moisture content of 70% for food to the dry weight food ingestion rate.
Sediment ingestion rate	g (dw)/d	0	Not considered based on feeding habits.
Soil ingestion rate	g (dw)/d	4.0	Based on Beyer et al. (1994) for turkey 9.3% of dry weight food ingestion.
Foraging range	km^2	0.03 to 0.5	According to CWF (1994), Rock Ptarmigans live in high elevations and latitudes with very sparse vegetation.
Fraction of time on site	-	1	Assumed based on foraging range
Diet Composition:			
Fruits and flowers	–	0.35	Ptarmigans are foliage gleaners (Cornell Lab of Ornithology 2015). In summer, they sample leaves, buds, flowers, seeds, and berries and also consume mosses and insects and spiders when these are available; in winter they feed on buds, seeds, and twigs (CWF 1994). Dietary composition and breakdown is based on information for quail from U.S. EPA (1993).
Foliage	–	0.50	
Woody vegetation	–	0.15	

References:

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. The Journal of Wildlife Management, Vol. 58, No.2 (April), pp. 375-382.

Canadian Wildlife Federation (CWF). 1994. Hinterland Who's Who: Ptarmigan. http://www.hww.ca/en/wildlife/birds/ptarmigan.html. Accessed March 21st, 2016.

Cornell Lab of Ornithology. 2015. All about birds: Willow ptarmigan. https://www.allaboutbirds.org/guide/Willow_Ptarmigan /lifehistory. Accessed March 2016.

Morland, S. 2011. "*Lagopus lagopus*" (On-line), Animal Diversity Web. http://animaldiversity.org/accounts/Lagopus_lagopus/. Accessed March 22nd, 2016.

United States Environmental Protection Agency (U.S. EPA). 1993. Wildlife exposure factors handbook. Volume I of II. Office of Research and Development. EPA/600/R-93/187. December.

Table C.4 Snow Bunting Receptor characteristics

Parameter	Units	Value	Reference and Discussion
Characteristics:			
Body weight	kg	0.046	Weight of Snow Bunting ranges from 31 to 46 g (Cornell Lab of Ornithology 2015).
Water ingestion rate	m^3/d	7.5×10^{-6}	Based on U.S. EPA (1993) allometric equation for birds.
Food ingestion rate – dry weight basis	g (dw)/d	7.8	Based on U.S. EPA (1993) allometric equation for all birds.
Food ingestion rate – wet weight basis	g (ww)/d	26	Applies an assumed moisture content of 70% for food to the dry weight food ingestion rate.
Sediment ingestion rate	g (dw)/d	0	Not considered based on feeding habits.
Soil ingestion rate	g (dw)/d	0.73	Based on Beyer et al. (1994) for turkey 9.3% of dry weight food ingestion.
Fraction of time on site	-	1	Assumed
Diet Composition:			
Invertebrates	–	0.50	Snow buntings eat grass and flowering-plant seeds as well as insects and spiders (Cornell Lab of Ornithology 2015).
Vegetation/Seeds	–	0.50	

References:

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. The Journal of Wildlife Management, Vol. 58, No.2 (April), pp. 375-382.

Cornell Lab of Ornithology. 2015. All about birds: Snow Bunting. https://www.allaboutbirds.org/guide/Snow_Bunting /lifehistory. Accessed September 2020.

United States Environmental Protection Agency (U.S. EPA). 1993. Wildlife exposure factors handbook. Volume I of II. Office of Research and Development. EPA/600/R-93/187. December.

Table C.5 Red Knot Receptor Characteristics

Parameter	Units	Nominal Value	Reference and Discussion
Body weight	kg	0.17	Based on Cornell Lab (2019) where body weight ranges from 125 to 205 g.
Water ingestion rate	m^3/d	1.8×10^{-5}	Based on U.S. EPA (1993) allometric equation for birds.
Food ingestion rate – dry weight basis	g (dw)/d	27.6	Based on U.S. EPA (1993) allometric equation for all birds. Increased by 50% to account for increased energy expenditure of arctic shorebirds based on Piersma et al (2003).
Food ingestion rate – wet weight basis	g (ww)/d	138	Applies an assumed moisture content of 80% for food to the dry weight food ingestion rate.
Sediment ingestion rate	g (dw)/d	1.4	Based on Beyer et al. (1994) for average shorebird species of 18% of dry weight food ingestion; distribution defined by range of body weights.
Soil ingestion rate	g (dw)/d	0	Not considered based on feeding habits
Fraction of time on site	-	1	Assumed
Diet composition:			
Benthic invertebrates	-	1.0	The red knot is a sandpiper (shorebird), eating primarily aquatic invertebrates (Cornell Lab 2019).

References:

Beyer, W.N., E.E. Connor, S. Gerould 1994. Estimates of Soil Ingestion by Wildlife. The Journal of Wildlife Management, Vol. 58, No.2 (April), pp. 375-382.

Cornell Lab of Ornithology. 2019. All about birds: Northern Pintail. https://www.allaboutbirds.org/guide/Red_Knot. Accessed October 2020.

Piersma, T., A. Lindstrom, R.H. Drent, I. Tulp, J. Jukema, R.I.G. Morrison, J. Reneerkens, H. Schekkerman, G.H. Visser 2003. High Daily Energy Expenditure of Incubating Shorebirds on High Arctic Tundra: a Circumpolar Study. Functional Ecology, Vol 17. pp 356-362.

United States Environmental Protection Agency (U.S. EPA) 1993. Wildlife Exposure Factors Handbook. Volume I of II. Office of Research and Development. EPA/600/R-93/187. December.

Table C.6 Northern Pintail Receptor Characteristics

Parameter	Units	Value	Reference and Discussion
Characteristics:			
Body weight	kg	1	Average value from Cornell Lab (2019), range of 0.5 kg to 1.5 kg.
Water ingestion rate	m^3/d	5.9×10^{-5}	Based on U.S. EPA (1993) allometric equation for birds.
Food ingestion rate – dry weight basis	g (dw)/d	58	Based on U.S. EPA (1993) allometric equation for all birds.
Food ingestion rate – wet weight basis	g (ww)/d	290	Applies an assumed moisture content of 80% for food to the dry weight food ingestion rate.
Sediment ingestion rate	g (dw)/d	2	Based on Beyer et al. (1994) for mallard 3.3% of dry weight food ingestion; distribution defined by range of body weights (0.5 kg to 1.7 kg) provided in EC (2012). EC (2012) provides an incidental sediment ingestion rate of 2.0-3.3% of dry food ingestion, based on Beyer et al. (1994) and U.S. EPA (1993).
Soil ingestion rate	g (dw)/d	0	Not considered based on feeding habits
Fraction of time on site	-	1	Assumed
Diet Composition:			
Aquatic vegetation	–	0.75	The northern pintail is a dabbling duck, feeding at or just below the surface of the water. According to Nature Work (2020) the diet is made up mostly of seeds of aquatic plants like pondweeds, sedges and grasses as well as benthic invertebrates.
Benthic invertebrates	–	0.25	

References:

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. The Journal of Wildlife Management, Vol. 58, No.2 (April), pp. 375-382.

Cornell Lab of Ornithology. 2019. All about birds: Northern Pintail. https://www.allaboutbirds.org/guide/Northern_Pintail. Accessed October 2020.

Nature Works. 2020. Northern pintail – Anas acuta. Accessed at https://nhpbs.org/natureworks/northernpintail.htm.

United States Environmental Protection Agency (U.S. EPA). 1993. Wildlife exposure factors handbook. Volume I of II. Office of Research and Development. EPA/600/R-93/187. December.

Table C.7 Snowy Owl Receptor Characteristics

Parameter	Units	Value	Reference and Discussion
Characteristics:			
Body weight	kg	2.1	According to CWF (1991) snowy owls body weight range from 1.8 kg for males up to 2.3 kg for females.
Water ingestion rate	m^3/d	9.7×10^{-5}	Based on U.S. EPA (1993) allometric equation for birds.
Food ingestion rate – dry weight basis	g (dw)/d	94	Based on U.S. EPA (1993) allometric equation for all birds.
Food ingestion rate – wet weight basis	g (ww)/d	311	Applies an assumed moisture content of 70% for food to the dry weight food ingestion rate.
Sediment ingestion rate	g (dw)/d	0	Not considered based on feeding habits.
Soil ingestion rate	g (dw)/d	5	Based on Beyer et al. (1994) for average for non-soil/sediment dwelling birds of 6.6% of dry weight food ingestion.
Foraging range	km^2	32 to 54	Based on Chang & Wiebe (2018), the foraging range of snowy owls are extensive.
Fraction of time on site	-	0.1	Assumed based on foraging range
Diet Composition:			
Ptarmigan	–	0.1	According to CWF (1991), the major diet of the Snowy Owl is lemmings with arctic hare, ptarmigan and mice (especially in the winter).
Lemmings	–	0.7	
Hare	–	0.1	
Mouse	–	0.1	

References:

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. The Journal of Wildlife Management, Vol. 58, No.2 (April), pp. 375-382.

Canadian Wildlife Federation (CWF) 1991. Hinterland Who's Who: Snowy Owl. Accessed 2020 at http://www.hww.ca/en/wildlife/birds/snowy-owl.html.

Chang, A. M., & Wiebe, K. L. (2018). Movement patterns and home ranges of male and female Snowy Owls (Bubo scandiacus) wintering on the Canadian prairies. Canadian Journal of Zoology, 96(6), 545–552.

United States Environmental Protection Agency (U.S. EPA). 1993. Wildlife exposure factors handbook. Volume I of II. Office of Research and Development. EPA/600/R-93/187. December.

Table C.8 Glaucous Gull Receptor Characteristics

Parameter	Units	Value	Reference and Discussion
Characteristics:			
Body weight	kg	1.98	Based on Cornell Lab (2019). Glaucous Gulls weight range from 1.3 to 2.7 kg.
Water ingestion rate	m^3/d	9.3×10^{-5}	Based on U.S. EPA (1993) allometric equation for birds.
Food ingestion rate – dry weight basis	g (dw)/d	91	Based on U.S. EPA (1993) allometric equation for all birds.
Food ingestion rate – wet weight basis	g (ww)/d	454	Applies an assumed moisture content of 80% for food to the dry weight food ingestion rate.
Sediment ingestion rate	g (dw)/d	1.2	Based on Beyer et al. (1994) for piscivorous avian species (ring-necked duck an blue-winged teal) of 2% of dry weight food ingestion
Soil ingestion rate	g (dw)/d	0	Not considered based on feeding habits.
Foraging range	km^2	10000	Based on various sources which report very large foraging range.
Fraction of time on site	-	0.1	Assumed based on foraging range
Diet Composition:			
Fish	–	1.0	Based on Cornell Lab (2019). Diet is primarily fish.

References:

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. The Journal of Wildlife Management, Vol. 58, No.2 (April), pp. 375-382.

Cornell Lab of Ornithology. 2019. All about birds: Northern Pintail. https://www.allaboutbirds.org/guide/Glaucous_Gull. Accessed October 2020.

United States Environmental Protection Agency (U.S. EPA). 1993. Wildlife exposure factors handbook. Volume I of II. Office of Research and Development. EPA/600/R-93/187. December.

APPENDIX D

Cadmium SSD

D.1 Cadmium

The complete dataset for cadmium is provided in Attachment 1 and indicates which data points were included in the development of the SSD. Data presented for chronic toxicity in CCME (2014 Appendix A(ii)) were used as the basis of the dataset, with additional data from a literature search. Thus, quality studies were considered within the dataset.

The U.S. EPA released an updated cadmium guideline in 2016 (U.S. EPA 2016) and this document was reviewed and data for new species were considered for the cadmium dataset. Additional studies (Andresen et al. 2016; Cunningham and McGeer 2016) were also considered, but no relevant data were available for the dataset. Data from Mebane (2017) and Nauman et al. (2007) were reviewed and added to the cadmium dataset.

There is a well-established relationship between increasing water hardness and decreasing toxicity of cadmium to organisms. Therefore, the hardness relationship used by CCME (2014) was used to convert the test concentrations to a standardized hardness basis of 50 mg/L, for consistency with the CCME (2014) guideline. The data can be further modified for site-specific conditions. The selected aquatic toxicity data for cadmium were grouped by species (Table D.1). There were 44 species ultimately selected. The SSD curve presented in Figure was developed using the SSD Master V3 tool (CCME 2013) and the logistic distribution was identified as the best fit for the data, especially in the lower end of the curve. Additional parameters describing the curve can be found in Table D.2.

The cadmium dataset is generally comprised of high quality toxicity thresholds, particularly EC_{10}, IC_{25}, and MATC values in the lower part of the curve. The curve fit is reasonable.

Table D.1 Summary of data used to derive SSD for cadmium

Common Name	Test Species	Group	Cadmium Conc. (µg/L)	Study Hardness (as mg/L $CaCO_3$)	Cadmium Conc. (µg/L), adjusted to 50 mg/L $CaCO_3$ hardness	Toxicity Threshold	Endpoint Type	Species Mean Cadmium Conc. (µg/L)	References
1. Mayfly	*Ephemerella infrequens*	Aquatic Invertebrate	0.1	17	1.08	30d EC_{20}	Abundance	1.08	Mebane et al. (2017)
2. Water Flea	*Daphnia magna*	Aquatic Invertebrate	0.13	179	0.20	7 d EC_{10}	Feeding inhibition	1.12	Barata and Baird (2000)
			0.13	179	0.20	7 d EC_{10}	Repro - brood mass		Barata and Baird (2000)
			0.14	179	0.21	7 d EC_{10}	Reproduction - Brood size		Barata and Baird (2000)
			0.21	103	0.51	21 d MATC	Repro - Number of young per survivor		Chapman et al. (1980)
			0.43	209	0.58	21 d MATC	Reproduction - Number of young per adult		Chapman et al. (1980)
			0.15	53	0.63	21 d MATC	Reproduction - Number of young per adult		Chapman et al. (1980)
			0.17	45.3	0.82	21 d EC_{16}	Reproduction		Biesinger and Christensen (1972)
			0.67	209	0.90	21 d MATC	Reproduction - Number of young per survivor		Chapman et al. (1980)
			0.38	103	0.92	21 d MATC	Reproduction - Number of young per adult		Chapman et al. (1980)

Common Name	Test Species	Group	Cadmium Conc. (µg/L)	Study Hardness (as mg/L $CaCO_3$)	Cadmium Conc. (µg/L), adjusted to 50 mg/L $CaCO_3$ hardness	Toxicity Threshold	Endpoint Type	Species Mean Cadmium Conc. (µg/L)	References
			1.09	249.8	1.27	21 d MATC	Reproduction		Kühn et al. (1989)
			0.64	130	1.28	21 d MATC	Reproduction - Number of young per adult		Borgmann et al. (1989)
			1.65	179	2.53	7 d EC_{10}	Weight		Barata and Baird (2000)
			1.2	90	3.26	7 d MATC	Growth		Winner (1988)
			4.3	240	5.17	14 d MATC	Reproduction - Number of young per adult		Elnabarawy et al. (1986)
			1.52	53	6.41	21 d MATC	Repro - Number of young per		Chapman et al. (1980)
			7.07	150	12.6	21 d MATC	Reproduction		Bodar et al. (1988)
3. Amphipod	*Hyalella azteca*	Aquatic Invertebrate	0.51	280	0.54	28 d IC_{25}	Biomass, decrease in	1.15	Ingersoll and Kemble (2001)
			0.74	280	0.78	28 d IC_{25}	Weight		Ingersoll and Kemble (2001)
			1.4	280	1.48	42 d IC_{25}	Reproduction		Ingersoll and Kemble (2001)
			2.6	280	2.75	28 d IC_{25}	Length		Ingersoll and Kemble (2001)
4. Mayfly	*Baetis sp.*	Aquatic Invertebrate	0.23	17	2.49	30d EC_{20}	abundance	2.47	Mebane et al. (2017)

Common Name	Test Species	Group	Cadmium Conc. (µg/L)	Study Hardness (as mg/L $CaCO_3$)	Cadmium Conc. (µg/L), adjusted to 50 mg/L $CaCO_3$ hardness	Toxicity Threshold	Endpoint Type	Species Mean Cadmium Conc. (µg/L)	References
5. Rainbow Trout	*Oncorhynchus mykiss*	Fish	0.15	29.4	1.03	62 d EC_{10}	Weight	2.66	Mebane et al. (2008)
			0.91	250	1.06	65 wks MATC	Reproduction - delay in oogenesis		Brown et al. (1994)
			2.5	29.4	17.2	62 d EC_{10}	Length		Mebane et al. (2008)
6. Amphipod	*Gammarus fasciatus*	Aquatic Invertebrate	1.82	130	3.64	42 d MATC	Mortality	3.64	Borgmann et al. (1989)
7. Bull Trout	*Salvelinus confluentus*	Fish	0.549	30.6	3.65	55 d MATC	Growth	3.65	Hansen et al. (2002)
8. Green Hydra	*Hydra viridissima*	Aquatic Invertebrate	0.4	19.5	3.87	7 d NOEC/L	Population growth inhibition	3.87	Holdway et al. (2001)
9. Mottled Sculpin	*Cottus bairdi*	Fish	1.77	104	4.26	21 d EC_{50}	Biomass, decrease in	5.01	Besser et al. (2007)
			2.4	102	5.88	28 d EC_{50}	Biomass,		Besser et al. (2007)
10. Mountain Whitefish	*Prosopium williamsoni*	Fish	1.2	47.8	5.51	90 d IC_{10}	Biomass, decrease in	5.71	Brinkman and Vieira (2007)
			1.29	47.8	5.92	90 d IC_{20}	Biomass and Weight		Brinkman and Vieira (2007)
11. Gammarid Amphipod	*Echinogammarus meridionalis*	Aquatic Invertebrate	5.16	263.43	5.75	6 d MATC	Feeding inhibition	5.75	Pestana et al. (2007)
12. European Shrimp	*Atyaephyra desmarestii*	Aquatic Invertebrate	5.24	263.43	5.84	6 d MATC	Feeding inhibition	5.84	Pestana et al. (2007)
13. Mayfly	*Diphetor hageni*	Aquatic Invertebrate	0.71	17	7.69	30d EC_{20}	abundance	7.69	Mebane et al. (2017)
14. Mayfly	*Rhithrogena sp.*	Aquatic Invertebrate	0.8	17	8.67	30d EC_{20}	abundance	8.67	Mebane et al. (2017)

Common Name	Test Species	Group	Cadmium Conc. (µg/L)	Study Hardness (as mg/L $CaCO_3$)	Cadmium Conc. (µg/L), adjusted to 50 mg/L $CaCO_3$ hardness	Toxicity Threshold	Endpoint Type	Species Mean Cadmium Conc. (µg/L)	References
15. Midge	*Chironomus tentans*	Aquatic Invertebrate	4	280	4.24	60 d IC_{25}	Hatching success	10.4	Ingersoll and Kemble (2001)
			8.1	280	8.58	60 d IC_{25}	Percent emergence		Ingersoll and Kemble (2001)
			9.9	280	10.5	20 d IC_{25}	Weight		Ingersoll and Kemble (2001)
			10.3	280	10.9	20 d IC_{25}	Biomass, decrease in		Ingersoll and Kemble (2001)
			16.4	280	17.4	20 d IC_{25}	Mortality		Ingersoll and Kemble (2001)
			16.4	280	17.4	60 d IC_{25}	Repro - No. eggs per individual		Ingersoll and Kemble (2001)
16. Brook Trout	*Salvelinus fontinalis*	Fish	1.7	37	9.66	60 d MATC	Weight	11.0	Sauter et al. (1976)
			2	45	9.66	126 d MATC	Biomass, decrease in		Eaton et al. (1978)
			2.4	44	11.8	1100 d MATC	Reproduction		Benoit et al. (1976)
			9.17	188	13.5	60 d MATC	Weight		Sauter et al. (1976)
17. Water Flea	*Ceriodaphnia dubia*	Aquatic Invertebrate	0.43	240	0.52	7 d MATC	Reproduction - Number of young per adult	11.1	Elnabarawy et al. (1986)
			2	17	21.7	7 d MATC	Reproduction		Suedel et al. (1997)
			2	17	21.7	10 d MATC	Reproduction		Suedel et al. (1997)

Common Name	Test Species	Group	Cadmium Conc. (µg/L)	Study Hardness (as mg/L $CaCO_3$)	Cadmium Conc. (µg/L), adjusted to 50 mg/L $CaCO_3$ hardness	Toxicity Threshold	Endpoint Type	Species Mean Cadmium Conc. (µg/L)	References
			2	17	21.7	14 d MATC	Reproductio		Suedel et al. (1997)
			3	17	32.5	Life Cycle EC_{20}	reproduction		Southwest Texas State University (2000)
18. Chinook Salmon	*Oncorhynchus tshawytscha*	Fish	1.2	23	10.1	8 d LC_{10}	Mortality	11.2	Chapman (1978)
			1.3	23	11.0	8 d LC_{10}	Mortality		Chapman (1978)
			1.5	23	12.6	8 d LC_{10}	Mortality		Chapman (1978)
19. Amphipod	*Gammarus pulex*	Aquatic Invertebrate	10.6	269.2	11.6	7 d MATC	Feeding inhibition	11.6	Felten et al. (2008)
			10.6	269.2	11.6	5 d MATC	Respiration		Felten et al. (2008)
20. Diptera Fly	*Rheotanytarsus sp.*	Aquatic Invertebrate	1.1	17	11.9	30d EC_{20}	Abundance	11.9	Mebane et al. (2017)
21. Caddisfly	*Lepidostoma sp.*	Aquatic Invertebrate	1.1	17	11.9	30d EC_{20}	Abundance	11.9	Mebane et al. (2017)
22. Mayfly	*Epeorus longimanus*	Aquatic Invertebrate	1.1	17	11.9	30d EC_{20}	Abundance	11.9	Mebane et al. (2017)
23. Sturgeon	*Acipenser transmontanus*	Fish	1.5	70	5.02	58 d LC_{20}	Mortality	12.1	Vardy et al. (2011)
			8.7	70	29.1	19 d LC_{20}	Mortality		Vardy et al. (2011)
24. Water Flea	*Daphnia pulex*	Aquatic Invertebrate	3.6	125	7.45	42 d MATC	Reproduction - Brood size	13.8	Winner (1986)
			7.35	125	15.2	42 d MATC	Reprod - Brood size		Winner (1986)

Common Name	Test Species	Group	Cadmium Conc. (µg/L)	Study Hardness (as mg/L $CaCO_3$)	Cadmium Conc. (µg/L), adjusted to 50 mg/L $CaCO_3$ hardness	Toxicity Threshold	Endpoint Type	Species Mean Cadmium Conc. (µg/L)	References
			7.78	125	16.1	42 d MATC	Reproduction - Brood size		Winner (1986)
			13.7	240	16.5	14 d MATC	Reproduction - Number of young per adult		Elnabarawy et al. (1986)
			7.07	106	16.8	58 d MATC	Reproduction		Ingersoll and Winner (1982)
25. Fathead Minnow	*Pimephales promelas*	Fish	3.02	47.8	13.9	30 d IC_{20}	Biomass and Weight	13.9	Brinkman and Vieira (2007)
26. Brown Trout	*Salmo trutta*	Fish	0.87	29.2	6.02	30 d IC_{20}	Biomass, decrease in	15.0	Brinkman and Hansen (2007)
			2.18	67.6	7.51	30 d IC_{20}	Biomass, decrease in		Brinkman and Hansen (2007)
			2	45	9.66	61 d MATC	Biomass, decrease in		Eaton et al. (1978)
			6.62	151	11.7	30 d IC_{20}	Biomass, decrease in		Brinkman and Hansen (2007)
			2.22	30.6	14.8	55 d IC_{20}	Biomass, decrease in		Brinkman and Hansen (2007)
			4.71	71.3	15.5	55 d IC_{20}	Biomass, decrease in		Brinkman and Hansen (2007)
			6.4	45	30.9	31 d MATC	Biomass, decrease in		Brinkman and Hansen (2007)

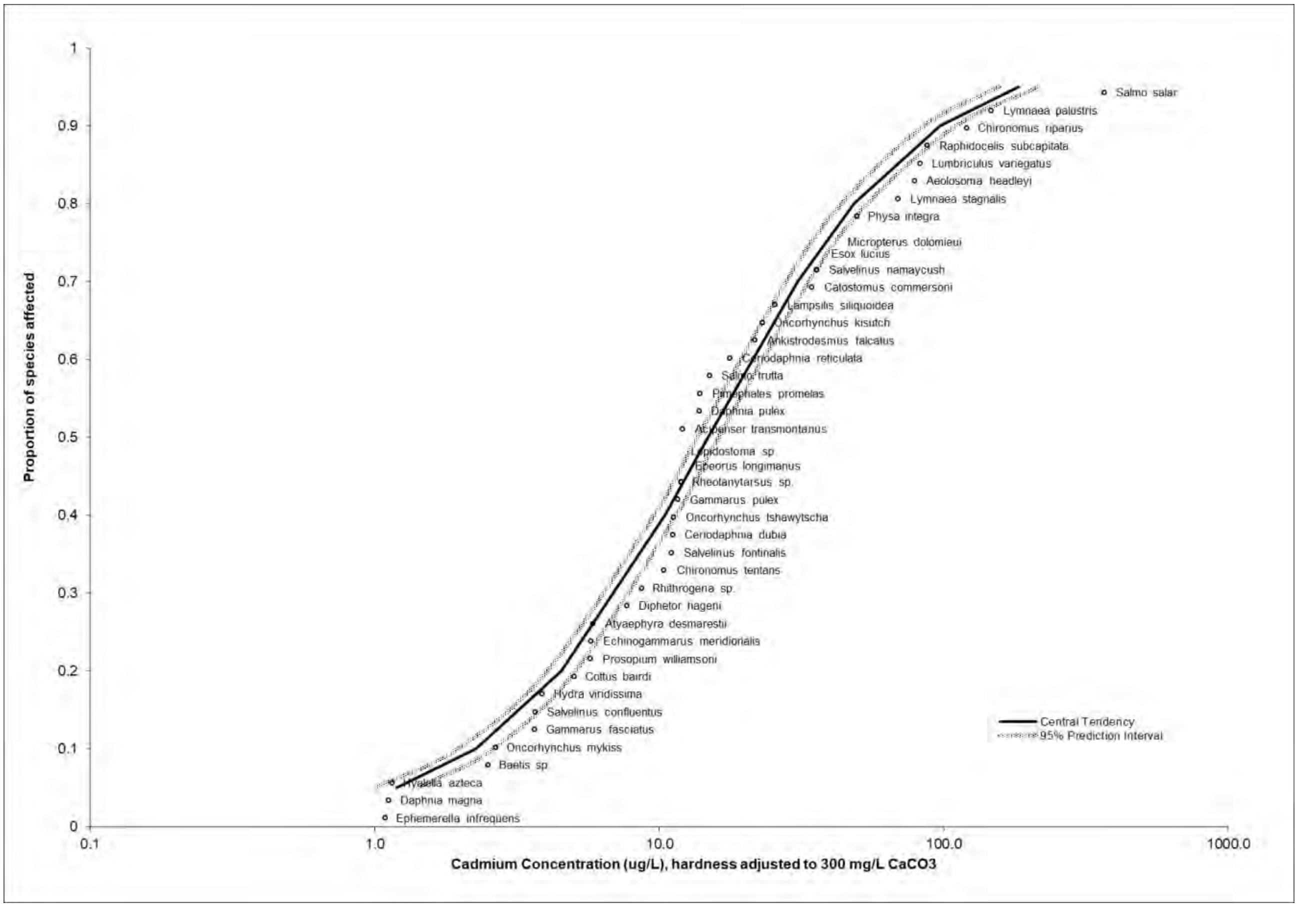
Common Name	Test Species	Group	Cadmium Conc. (µg/L)	Study Hardness (as mg/L $CaCO_3$)	Cadmium Conc. (µg/L), adjusted to 50 mg/L $CaCO_3$ hardness	Toxicity Threshold	Endpoint Type	Species Mean Cadmium Conc. (µg/L)	References
			6.7	45	32.4	83 d MATC	Biomass, decrease in		Brinkman and Hansen (2007)
			6.7	45	32.4	60 d MATC	Biomass, decrease in		Brinkman and Hansen (2007)
27. Cladocerans	*Ceriodaphnia reticulata*	Aquatic Invertebrate	4.9	67	17.0	9 d MATC	Reproduction	17.7	Spehar and Carlson (1984)
			15.3	240	18.4	7 d EC_{50}	Reproduction		Elnabarawy et al. (1986)
28. Green algae	*Ankistrodesmus falcatus*	Algae/Plant	10	118	21.7	96 h NOEC/L	Growth	21.7	Baer et al. (1999)
29. Coho Salmon	*Oncorhynchus kisutch*	Fish	2.1	45	10.1	27 d MATC	Biomass, decrease in	23.1	Eaton et al. (1978)
			7.2	45	34.8	47 d MATC	Biomass, decrease in		Eaton et al. (1978)
			7.2	45	34.8	62 d MATC	Biomass, decrease in		Eaton et al. (1978)
30. Fatmucket	*Lampsilis siliquoidea*	Aquatic Invertebrate	4.6	44	22.6	28 d IC_{10}	Length	25.4	Wang et al. (2010)
			5	44	24.6	28 d IC_{20}	Length		Wang et al. (2010)
			6	44	29.5	28 d ChV	Length		Wang et al. (2010)
31. White Sucker	*Catostomus commersoni*	Fish	7.1	45	34.3	40 d MATC	Biomass, decrease in	34.3	Eaton et al. (1978)
32. Lake Trout	*Salvelinus namaycush*	Fish	7.4	45	35.7	41 d MATC	Biomass, decrease in	35.7	Eaton et al. (1978)
			7.4	45	35.7	64 d MATC	Biomass, decrease in		Eaton et al. (1978)
33. Smallmouth Bass	*Micropterus dolomieui*	Fish	7.4	45	35.7	33 d MATC	Biomass, decrease in	35.7	Eaton et al. (1978)

Common Name	Test Species	Group	Cadmium Conc. (µg/L)	Study Hardness (as mg/L $CaCO_3$)	Cadmium Conc. (µg/L), adjusted to 50 mg/L $CaCO_3$ hardness	Toxicity Threshold	Endpoint Type	Species Mean Cadmium Conc. (µg/L)	References
34. Northern Pike	*Esox lucius*	Fish	7.4	45	35.7	35 d MATC	Biomass, decrease in	35.7	Eaton et al. (1978)
35. Snail	*Physa integra*	Aquatic Invertebrate	10.4	46	49.3	28-d LC_{50}	Mortality	49.3	Spehar et al. (1978)
36. Pond snail	*Lymnaea stagnalis*	Aquatic Invertebrate	35.6	135	69.1	31d EC_{20}	growth	69.1	Paris (2012)
37. Oligochaete	*Aeolosoma headleyi*	Aquatic Invertebrate	40	175	62.6	Life Cycle MATC	grow and rep	79.0	Niederlehner et al. (1984)
			40.1	168	64.9	14 d MATC	Population growth		Niederlehner et al. (1984)
			25.2	62	93.3	10 d MATC	Population growth		Niederlehner et al. (1984)
			70.2	189	103.0	12 d MATC	Population growth		Niederlehner et al. (1984)
38. Oligochaete	*Lumbriculus variegatus*	Aquatic Invertebrate	19.8	140	37.3	28d EC_{20}	Reproduction	82.4	Strauss (2011)
			96.7	140	182.0	28d MATC	Reproduction		Strauss (2011)
39. Green algae	*Raphidocelis subcapitata*	Algae/Plant	6	46.21	28.3	72 h EC_{10}	Growth rate	87.4	Kallqvist (2009)
			8.5	16.21	95.8	72 h EC_{10}	Growth rate		Kallqvist (2009)
			2.8	3.42	114.8	72 h EC_{10}	Growth rate		Kallqvist (2009)
			7.5	6.21	187.4	72 h EC_{10}	Growth rate		Kallqvist (2009)
40. Midge	*Chironomus riparius*	Aquatic Invertebrate	47.4	98	120.0	17 d MATC	Mortality	120.0	Pascoe et al. (1989)
41. Marsh Snail	*Lymnaea palustris*	Aquatic Invertebrate	80	284	83.7	4 weeks NOEC/L	Growth	146.8	Coeurdassier et al. (2003)

Common Name	Test Species	Group	Cadmium Conc. (µg/L)	Study Hardness (as mg/L $CaCO_3$)	Cadmium Conc. (µg/L), adjusted to 50 mg/L $CaCO_3$ hardness	Toxicity Threshold	Endpoint Type	Species Mean Cadmium Conc. (µg/L)	References
			40	50	177.0	4 weeks NOEC/L	Growth		Coeurdassier et al. (2003)
			40	50	177.0	4 weeks NOEC/L	Repro - No. egg masses per individual		Coeurdassier et al. (2003)
			40	50	177.0	4 weeks NOEC/L	Repro - No. eggs per individual		Coeurdassier et al. (2003)
42. Atlantic Salmon	*Salmo salar*	Fish	0.61	28	4.37	496 d MATC	Biomass, decrease in	366.8	Rombough and Garside (1982)
			5.5	19	54.3	402 d MATC	Weight		Rombough and Garside (1982)
			5.5	19	54.3	402 d MATC	Biomass, decrease in		Rombough and Garside (1982)
			88	19	869.2	78 d MATC	Hatching success		Rombough and Garside (1982)
			156	19	1540.9	96 d MATC	Hatching success		Rombough and Garside (1982)
			156	19	1540.9	45 d MATC	Hatching success		Rombough and Garside (1982)
			490	28	3508.0	45 d MATC	Hatching success		Rombough and Garside (1982)
			490	28	3508.0	48 d MATC	Hatching success		Rombough and Garside (1982)

Common Name	Test Species	Group	Cadmium Conc. (µg/L)	Study Hardness (as mg/L $CaCO_3$)	Cadmium Conc. (µg/L), adjusted to 50 mg/L $CaCO_3$ hardness	Toxicity Threshold	Endpoint Type	Species Mean Cadmium Conc. (µg/L)	References
43. Duckweed	*Lemna minor*	Algae/Plant	214	166	349.7	7 d EC_{50}	Growth rate	467.3	Drost et al. (2007)
			214	166	349.7	6 d EC_{50}	Growth rate		Drost et al. (2007)
			315	166	514.8	5 d EC_{50}	Growth rate		Drost et al. (2007)
			337	166	550.7	4 d EC_{50}	Growth rate		Drost et al. (2007)
			393	166	642.3	3 d EC_{50}	Growth rate		Drost et al. (2007)
44. Northwestern salamander	*Ambystoma gracile*	Amphibian	97.2	45	469.4	24 d MATC	Weight	593.5	Nebeker et al. (1995)
			155.4	45	750.4	10 d MATC	Weight		Nebeker et al. (1995)

Figure D.1 Species sensitive distribution for the protection of aquatic life – cadmium



Note: SSD is based on logistic distribution from SSD Master V3 tool (CCME 2013).

Table D.2 SSD curve parameters for cadmium

Parameters	
μ	1.20
s	0.37
A^2	0.39
MSE	0.0013
MSE (lower tail)	0.026
N	44

Table D.3 summarizes the concentrations that are protective of 80%, 90%, and 95% of the species, based on the central tendency and upper and lower prediction intervals of the SSD curve for cadmium, hardness adjusted to 300 mg/L $CaCO_3$. The specific species from the SSD potentially affected at each protection level for the central tendency are also summarized.

Table D.3 Protection levels based on species sensitivity distribution – cadmium Hardness 300 mg/L CaCO3

Protection Level	Concentration (µg/L)			Species Affected at Central Tendency
	Central Tendency	Lower Prediction Interval	Upper Prediction Interval	
95%	1.20	1.01	1.42	*Ephemerella infrequens, Daphnia magna, Hyalella Azteca*
90%	2.26	1.96	2.61	*Ephemerella infrequens, Daphnia magna, Hyalella Azteca*
80%	4.53	4.05	5.07	*Ephemerella infrequens, Daphnia magna, Hyalella Azteca, Baetis Sp., Oncorhynchus mykiss, Gammarus fasciatus, Salvelinus confluentus, Hydra viridissima, Cottus bairdi*

Protection levels for other hardness concentrations can be calculated using the following equation:

$$PL2 = 10^{\left((LOG(HARDNESS2) - LOG(HARDNESS1)) \times 0.83 + LOG(PL1)\right)}$$

Where:

PL1 = protection limit at hardness 1 (see Table D.3)

PL2 = protection limit at hardness 2

HARDNESS1 = hardness concentration of PL1 (see Table D.3)

HARDNESS2 = target hardness concentration for PL2

D.1.1 Toxicity Modifying Factors

As discussed above, sufficient evidence exists to suggest that the toxicity of cadmium reduces with increasing hardness (CCME 2014), and, therefore, hardness has been considered a toxicity-modifying factor for cadmium aquatic toxicity. Calcium deficiency is a mechanism of cadmium toxicity in aquatic organisms and higher water hardness, particularly calcium, reduces cadmium toxicity through competition for uptake sites (Niyogi et al. 2004). There is some evidence that it is calcium specifically, rather than other hardness constituents such as magnesium, sodium, sulphate, that reduces the toxicity of cadmium (Carroll et al. 1979).

Other water quality characteristics (dissolved organic carbon, pH, alkalinity, temperature) have been studied for effects on cadmium toxicity. However no clear relationships could be established for these parameters (CCME 2014; U.S. EPA 2016). The BLM model developed by U.S. EPA (2016) showed cadmium toxicity should generally increase with increasing dissolved organic carbon, pH, and hardness (as both calcium and magnesium); however, hardness is a surrogate for other ions affecting cadmium toxicity and it was concluded that a cadmium BLM model was not necessary since cadmium concentrations are never an issue at the northern Saskatchewan sites. Therefore, only water hardness is considered as a toxicity modifying factor at this time.

D.1.2 Values from Other Jurisdictions

The CCME water quality guideline for the protection of aquatic life is calculated via an equation[1] to account for hardness, and is based on the 95% protection level of 0.09 µg/L hardness adjusted to 50 mg/L CaCO3 (CCME 2014). The SEQG is the same as the CCME guideline. The BCMOE (2013) similarly has a long-term water quality guideline for cadmium based on hardness, although the equation[2] is different from CCME. At a water hardness of 50 mg/L CaCO3, the BCMOE (2013) guideline is 0.13 µg/L dissolved cadmium. Ontario has an interim provincial water quality guideline of 0.1 µg/L at hardness between 0 and 100 mg/L CaCO3 and 0.5 µg/L at hardness greater than 100 mg/L CaCO3 (OMOEE 1994).

The U.S. EPA (2016) also has a chronic criterion for cadmium aquatic toxicity based on an equation[3] for hardness; at a water hardness of 50 mg/L CaCO3, the U.S. EPA guideline is 0.43 µg/L dissolved cadmium. Australia and New Zealand (ANZECC 2000) have a guideline of 0.2 µg/L at hardness of 30 mg/L CaCO3 based on the 95% protection level of the statistical distribution of available data. This value is modified for other hardness concentrations using an equation[4]. The U.K. Environment Agency has developed a guideline of 5 µg//L dissolved cadmium, based on the NOEC or 5th percentile of the SSD with appropriate uncertainty factors (U.K. Environment Agency 2011).

[1] CWQG (µg/L) = $10^{\{0.83(\log[\text{hardness}]) - 2.46\}}$

[2] WQG (µg/L) = $e^{[0.736 \times \ln(\text{hardness}) - 4.943]}$, for dissolved cadmium at hardness between 3.4 and 285 mg/L $CaCO_3$

[3] CCC (µg/L) = $e^{(0.7977 \times \ln(\text{hardness}) - 3.909)}$ x CF, where CF is a conversion factor from total to dissolved = 1.101675 – [(ln hardness) x 0.041838]

[4] HMTV (µg/L) = 0.2 $(\text{hardness}/30)^{0.89}$

D.2 References

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Attachment 1: Cadmium SSD Data

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Ankistrodesmus falcatus	Green algae	Algae/Plant	96 h NOEC/L	Growth	CdCl2	Population	10	21.7	118	7.7 (7.2-8.2)	8.5 (7.4-9.3)	(Baer et al. 1999)	Keep (revisit)		
Raphidocelis subcapitata	Green algae	Algae/Plant	96 h NOEC/L	Growth	CdCl2	Population	5	10.8	118	7.7 (7.2-8.2)	8.5 (7.4-9.3)	(Baer et al. 1999)	Drop: for EC10		
Raphidocelis subcapitata	Green algae	Algae/Plant	72 h EC50	Growth	CdCl2	Population	43.5	50.6	250	8.1	N/A	(Benhra et al. 1997)	Drop: for EC10		
Raphidocelis subcapitata	Green algae	Algae/Plant	72 h EC10	Growth rate	CdCl2	Population	2.8	114.8	3.42	6.71	N/A	(Källqvist 2007)	Keep		
Raphidocelis subcapitata	Green algae	Algae/Plant	72 h EC10	Growth rate	CdCl2	Population	6	28.3	46.21	6.65	N/A	(Källqvist 2007)	Keep		
Raphidocelis subcapitata	Green algae	Algae/Plant	72 h EC10	Growth rate	CdCl2	Population	7.5	187.4	6.21	6.85	N/A	(Källqvist 2007)	Keep		
Raphidocelis subcapitata	Green algae	Algae/Plant	72 h EC10	Growth rate	CdCl2	Population	8.5	95.8	16.21	6.74	N/A	(Källqvist 2007)	Keep		
Ambystoma gracile	Northwestern salamander	Amphibian	10 d LOEC/L	Weight	CdCl2	Larva	227.3	1097.6	45	6.8		(Nebeker et al. 1995)	Drop: calculated MATC		
Ambystoma gracile	Northwestern salamander	Amphibian	24 d LOEC/L	Weight	CdCl2	Larva	193.1	932.5	45	6.8		(Nebeker et al. 1995)	Drop: calculated MATC		
Ambystoma gracile	Northwestern salamander	Amphibian	10 d MATC	Weight	CdCl2	Larva	155.4	750.4	45	6.8		(Nebeker et al. 1995)	Keep		
Ambystoma gracile	Northwestern salamander	Amphibian	24 d MATC	Weight	CdCl2	Larva	97.2	469.4	45	6.8		(Nebeker et al. 1995)	Keep		
Ambystoma gracile	Northwestern salamander	Amphibian	10 d NOEC/L	Weight	CdCl2	Larva	106.3	513.3	45	6.8		(Nebeker et al. 1995)	Drop: calculated MATC		
Ambystoma gracile	Northwestern salamander	Amphibian	24 d NOEC/L	Weight	CdCl2	Larva	48.9	236.1	45	6.8		(Nebeker et al. 1995)	Drop: calculated MATC		
Acipenser transmontanus	Sturgeon	Fish	58 d LC20	Mortality	cadmium chloride hemi-pentahydrate	Fry	1.5	5.0	70	7.9 ± 0.2	8.9 ± 0.9	(Vardy et al. 2011)	Keep		
Acipenser transmontanus	Sturgeon	Fish	19 d LC20	Mortality	cadmium chloride hemi-pentahydrate	Fry	8.7	29.1	70	7.9 ± 0.2	8.9 ± 0.9	(Vardy et al. 2011)	Keep (revisit)		
Acipenser transmontanus	Sturgeon	Fish	58 d LC50	Mortality	cadmium chloride hemi-pentahydrate	Fry	5.6	18.7	70	7.9 ± 0.2	8.9 ± 0.9	(Vardy et al. 2011)	Drop: for LC20		
Acipenser transmontanus	Sturgeon	Fish	19 d LC50	Mortality	cadmium chloride hemi-pentahydrate	Fry	21.4	71.6	70	7.9 ± 0.2	8.9 ± 0.9	(Vardy et al. 2011)	Drop: for LC20		
Catostomus commersoni	White Sucker	Fish	40 d LOEC/L	Biomass, decrease in	CdCl2	Embryo	12	57.9	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Catostomus commersoni	White Sucker	Fish	40 d MATC	Biomass, decrease in	CdCl2	Embryo	7.1	34.3	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Keep		
Catostomus commersoni	White Sucker	Fish	40 d NOEC/L	Biomass, decrease in	CdCl2	Embryo	4.2	20.3	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Cottus bairdi	Mottled Sculpin	Fish	28 d EC50	Biomass,	cadmium	Swim-up	2.4	5.9	102	8.21	8.8	(Besser et al. 2007)	Keep		
Cottus bairdi	Mottled Sculpin	Fish	21 d EC50	Biomass, decrease in	cadmium chloride	Swim-up fry	1.77	4.3	104	8.23	9.5	(Besser et al. 2007)	Keep		
Cottus bairdi	Mottled Sculpin	Fish	28 d LC50	Mortality	cadmium chloride	Swim-up fry	2.9	7.1	102	8.21	8.8	(Besser et al. 2007)	Drop: for EC50		
Cottus bairdi	Mottled Sculpin	Fish	14 d LC50	Mortality	cadmium chloride	Swim-up fry	2.02	4.9	104	8.23	9.5	(Besser et al. 2007)	Drop: for EC50		
Cottus bairdi	Mottled Sculpin	Fish	21 d LC50	Mortality	cadmium chloride	Swim-up fry	1.73	4.2	104	8.23	9.5	(Besser et al. 2007)	Drop: for EC50		
Esox lucius	Northern Pike	Fish	35 d LOEC/L	Biomass, decrease in	CdCl2	Embryo	12.9	62.3	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Esox lucius	Northern Pike	Fish	35 d MATC	Biomass, decrease in	CdCl2	Embryo	7.4	35.7	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Keep		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Esox lucius	Northern Pike	Fish	35 d NOEC/L	Biomass, decrease in	CdCl2	Embryo	4.2	20.3	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Micropterus dolomieui	Smallmouth Bass	Fish	33 d NOEC/L	Biomass, decrease in	CdCl2	Embryo	4.3	20.8	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Micropterus dolomieui	Smallmouth Bass	Fish	33 d LOEC/L	Biomass, decrease in	CdCl2	Embryo	12.7	61.3	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Micropterus dolomieui	Smallmouth Bass	Fish	33 d MATC	Biomass, decrease in	CdCl2	Embryo	7.4	35.7	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Keep		
Oncorhynchus kisutch	Coho Salmon	Fish	27 d LOEC/L	Biomass, decrease in	CdCl2	Embryo	3.4	16.4	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Oncorhynchus kisutch	Coho Salmon	Fish	47 d LOEC/L	Biomass, decrease in	CdCl2	Embryo	12.5	60.4	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Oncorhynchus kisutch	Coho Salmon	Fish	62 d LOEC/L	Biomass, decrease in	CdCl2	Larva	12.5	60.4	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Oncorhynchus kisutch	Coho Salmon	Fish	27 d MATC	Biomass, decrease in	CdCl2	Embryo	2.1	10.1	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Keep		
Oncorhynchus kisutch	Coho Salmon	Fish	47 d MATC	Biomass, decrease in	CdCl2	Embryo	7.2	34.8	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Keep		
Oncorhynchus kisutch	Coho Salmon	Fish	62 d MATC	Biomass, decrease in	CdCl2	Larva	7.2	34.8	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Keep		
Oncorhynchus kisutch	Coho Salmon	Fish	27 d NOEC/L	Biomass, decrease in	CdCl2	Embryo	1.3	6.3	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Oncorhynchus kisutch	Coho Salmon	Fish	47 d NOEC/L	Biomass, decrease in	CdCl2	Embryo	4.1	19.8	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Oncorhynchus kisutch	Coho Salmon	Fish	62 d NOEC/L	Biomass, decrease in	CdCl2	Larva	4.1	19.8	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Oncorhynchus mykiss	Rainbow Trout	Fish	65 wks NOEC/L	Reproduction - delay in oogenesis	3CdSO4 . 8H2O	Adult	0.47	0.5	250	7.4-8.0	>85% air sat	(Brown et al. 1994)	Drop: calculated MATC		
Oncorhynchus mykiss	Rainbow Trout	Fish	65 wks MATC	Reproduction - delay in oogenesis	3CdSO4 . 8H2O	Adult	0.91	1.1	250	7.4-8.0	>85% air sat	(Brown et al. 1994)	Keep		
Oncorhynchus mykiss	Rainbow Trout	Fish	65 wks LOEC/L	Reproduction - delay in oogenesis	3CdSO4 . 8H2O	Adult	1.77	2.1	250	7.4-8.0	>85% air sat	(Brown et al. 1994)	Drop: calculated MATC		
Oncorhynchus mykiss	Rainbow Trout	Fish	62 d EC10	Weight	CdCl2	Early life stage	0.15	1.0	29.4	7.19 (SD = 0.30)	9.2 (SD = 0.9)	(Mebane et al. 2008)	Keep		
Oncorhynchus mykiss	Rainbow Trout	Fish	62 d LOEC/L	Length	CdCl2	Early life stage	0.16	1.1	29.4	7.19 (SD = 0.30)	9.2 (SD = 0.9)	(Mebane et al. 2008)	Drop: calculated MATC		
Oncorhynchus mykiss	Rainbow Trout	Fish	62 d LOEC/L	Weight	CdCl2	Early life stage	0.16	1.1	29.4	7.19 (SD = 0.30)	9.2 (SD = 0.9)	(Mebane et al. 2008)	Drop: calculated MATC		
Oncorhynchus mykiss	Rainbow Trout	Fish	53 d NOEC/L	Mortality	CdCl2	Early life stage	0.6	5.8	19.7	6.75 (5.0-7.7)	10.2 (8.3-11.9)`	(Mebane et al. 2008)	Drop: calculated MATC		
Oncorhynchus mykiss	Rainbow Trout	Fish	62 d NOEC/L	Mortality	CdCl2	Early life stage	1	6.9	29.4	7.19 (SD = 0.30)	9.2 (SD = 0.9)	(Mebane et al. 2008)	Drop: calculated MATC		
Oncorhynchus mykiss	Rainbow Trout	Fish	53 d EC10	Mortality	CdCl2	Early life stage	0.82	7.9	19.7	6.75 (5.0-7.7)	10.2 (8.3-11.9)`	(Mebane et al. 2008)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	53 d MATC	Mortality	CdCl2	Early life stage	0.88	8.4	19.7	6.75 (5.0-7.7)	10.2 (8.3-11.9)`	(Mebane et al. 2008)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	62 d EC10	Mortality	CdCl2	Early life stage	1.6	11.0	29.4	7.19 (SD = 0.30)	9.2 (SD = 0.9)	(Mebane et al. 2008)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	62 d MATC	Mortality	CdCl2	Early life stage	1.6	11.0	29.4	7.19 (SD = 0.30)	9.2 (SD = 0.9)	(Mebane et al. 2008)	Drop: for better endpoints		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Oncorhynchus mykiss	Rainbow Trout	Fish	53 d LOEC/L	Mortality	CdCl2	Early life stage	1.3	12.5	19.7	6.75 (5.0-7.7)	10.2 (8.3-11.9)`	(Mebane et al. 2008)	Drop: calculated MATC		
Oncorhynchus mykiss	Rainbow Trout	Fish	62 d EC10	Length	CdCl2	Early life stage	2.5	17.2	29.4	7.19 (SD = 0.30)	9.2 (SD = 0.9)	(Mebane et al. 2008)	Keep		
Oncorhynchus mykiss	Rainbow Trout	Fish	62 d LOEC/L	Mortality	CdCl2	Early life stage	2.5	17.2	29.4	7.19 (SD = 0.30)	9.2 (SD = 0.9)	(Mebane et al. 2008)	Drop: calculated MATC		
Oncorhynchus mykiss	Rainbow Trout	Fish	62 d NOEC/L	Length	CdCl2	Early life stage	<0.16	#VALUE!	29.4	7.19 (SD = 0.30)	9.2 (SD = 0.9)	(Mebane et al. 2008)	Drop: calculated MATC		
Oncorhynchus mykiss	Rainbow Trout	Fish	62 d NOEC/L	Weight	CdCl2	Early life stage	< 0.16	#VALUE!	29.4	7.19 (SD = 0.30)	9.2 (SD = 0.9)	(Mebane et al. 2008)	Drop: calculated MATC		
Oncorhynchus mykiss	Rainbow Trout	Fish	62 d MATC	Length	CdCl2	Early life stage	< 0.16	#VALUE!	29.4	7.19 (SD = 0.30)	9.2 (SD = 0.9)	(Mebane et al. 2008)	Drop: <		
Oncorhynchus mykiss	Rainbow Trout	Fish	62 d MATC	Weight	CdCl2	Early life stage	< 0.16	#VALUE!	29.4	7.19 (SD = 0.30)	9.2 (SD = 0.9)	(Mebane et al. 2008)	Drop: <		
Oncorhynchus mykiss	Rainbow Trout	Fish	100 d LC1	Mortality	Cd	Unknown	2.39	1.8	414	6.9	7.6	(Davies et al. 1993)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	100 d NOEC/L	Mortality	Cd	Unknown	3.64	2.8	414	6.9	7.6	(Davies et al. 1993)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	100 d LC1	Mortality	Cd	Unknown	2.43	3.2	217	6.93	7.4	(Davies et al. 1993)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	100 d NOEC/L	Mortality	Cd	Unknown	3.58	4.7	217	6.93	7.4	(Davies et al. 1993)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	96 h LC50	Mortality	Cd	Unknown	4.2	5.8	204	6.88	8.6	(Davies et al. 1993)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	100 d ChV	Mortality	Cd	Unknown	1.47	6.9	46.2	6.89	7.4	(Davies et al. 1993)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	100 d LC1	Mortality	Cd	Unknown	1.58	7.5	46.2	6.89	7.4	(Davies et al. 1993)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	8 d LC10	Mortality	CdCl2	parr	0.7	5.9	23	7.1-7.5	10.2 +- 0.2 (SD)	(Chapman 1978)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	8 d LC10	Mortality	CdCl2	smolt	0.8	6.7	23	7.1-7.5	10.2 +-	(Chapman 1978)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	8 d LC10	Mortality	CdCl2	Swim-up fry	1	8.4	23	7.1-7.5	10.2 +- 0.2 (SD)	(Chapman 1978)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	8 d LC10	Mortality	CdCl2	Alevin	6	50.6	23	7.1-7.5	10.2 +- 0.2 (SD)	(Chapman 1978)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	7 d LC50	Mortality	CdCl2* 2.5H2O	Unknown	6.3	113.6	9.2	4.67		(Cusimano et al. 1986)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	7 d LC50	Mortality	CdCl2*2.5H2 O	Unknown	<0.5	#VALUE!	9.2	6.96		(Cusimano et al. 1986)	Drop: for better endpoints		
Oncorhynchus mykiss	Rainbow Trout	Fish	7 d LC50	Mortality	CdCl2*2.5H2 O	Unknown	0.7	12.6	9.2	5.68		(Cusimano et al. 1986)	Drop: for better		
Oncorhynchus tshawytscha	Chinook Salmon	Fish	8 d LC10	Mortality	CdCl2	Alevin	18-26	#VALUE!	23	7.1-7.5	10.2 +- 0.2	(Chapman 1978)	Drop: result		
Oncorhynchus tshawytscha	Chinook Salmon	Fish	8 d LC10	Mortality	CdCl2	Swim-up fry	1.2	10.1	23	7.1-7.5	10.2 +- 0.2	(Chapman 1978)	Keep		
Oncorhynchus tshawytscha	Chinook Salmon	Fish	8 d LC10	Mortality	CdCl2	parr	1.3	11.0	23	7.1-7.5	10.2 +- 0.2	(Chapman 1978)	Keep		
Oncorhynchus tshawytscha	Chinook Salmon	Fish	8 d LC10	Mortality	CdCl2	smolt	1.5	12.6	23	7.1-7.5	10.2 +- 0.2	(Chapman 1978)	Keep		
Pimephales promelas	Fathead Minnow	Fish	7 d NOEC/L	Mortality	CdCl2	4 to 6 days old	8.5	9.1	278	8.37-8.56	7.7-8.6	(Castillo, III and Longley 2001)	Drop; for better endpoints		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Pimephales promelas	Fathead Minnow	Fish	7 d NOEC/L	Mortality	CdCl2	4 to 6 days old	9.6	10.6	267	8.37-8.50	7.3-8.6	(Castillo, III and Longley 2001)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	7 d LOEC/L	Mortality	CdCl2	4 to 6 days old	11.3	12.0	278	8.37-8.56	7.7-8.6	(Castillo, III and Longley 2001)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	7 d NOEC/L	Growth	CdCl2	4 to 6 days	11.3	12.0	278	8.37-	7.7-8.6	(Castillo, III and Longley 2001)	Drop: for IC20		
Pimephales promelas	Fathead Minnow	Fish	7 d LOEC/L	Mortality	CdCl2	4 to 6 days old	12.2	13.4	267	8.37-8.50	7.3-8.6	(Castillo, III and Longley 2001)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	7 d MATC	Mortality	CdCl2	4 to 6 days old	9.8	10.4	278	8.37-8.56	7.3-8.6	(Castillo, III and Longley 2001)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	7 d LOEC/L	Growth	CdCl2	Other	16.5	17.6	278	8.37-8.56	7.7-8.6	(Castillo, III and Longley 2001)	Drop: for IC20		
Pimephales promelas	Fathead Minnow	Fish	10 d MATC	Mortality	CdCl2	Larva	1.4	15.2	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	10 d LC50	Mortality	CdCl2	Larva	1.6	17.3	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	10 d NOEC/L	Growth	CdCl2	Larva	2	21.7	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for IC20		
Pimephales promelas	Fathead Minnow	Fish	14 d LC50	Mortality	CdCl2	Larva	2.3	24.9	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	14 d MATC	Mortality	CdCl2	Larva	2.4	26.0	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	14 d NOEC/L	Growth	CdCl2	Larva	3	32.5	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for IC20		
Pimephales promelas	Fathead Minnow	Fish	7 d LC50	Mortality	CdCl2	Larva	4.4	47.7	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	7 d MATC	Mortality	CdCl2	Larva	4.9	53.1	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	250 d NOEC/L	Mortality	cadmium sulfate	Fry	27	37.2	204	7.6 ± 0.14	6.6 ± 1.2	(Pickering and Gast 1972)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	300 d NOEC/L	Mortality	cadmium sulfate	Adult	37	51.6	201	7.7 ± 0.2	6.5 ± 1.5	(Pickering and Gast 1972)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	250 d MATC	Mortality	cadmium sulfate	Fry	39.2	54.0	204	7.6 ± 0.14	6.6 ± 1.2	(Pickering and Gast 1972)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	250 d LOEC/L	Mortality	cadmium sulfate	Fry	57	78.5	204	7.6 ± 0.14	6.6 ± 1.2	(Pickering and Gast 1972)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	300 d MATC	Mortality	cadmium sulfate	Adult	60.83	84.8	201	7.7 ± 0.2	6.5 ± 1.5	(Pickering and Gast 1972)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	300 d LOEC/L	Mortality	cadmium sulfate	Adult	110	153.4	201	7.7 ± 0.2	6.5 ± 1.5	(Pickering and Gast 1972)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	32 d NOEC/L	Mortality	cadmium chloride	Juvenile	13.4	46.5	67	7.2-7.8		(Spehar and Carlson 1984)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	32 d MATC	Mortality	cadmium chloride	Juvenile	18.9	65.6	67	7.2-7.8		(Spehar and Carlson 1984)	Drop; for better endpoints		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Pimephales promelas	Fathead Minnow	Fish	32 d LOEC/L	Mortality	cadmium chloride	Juvenile	26.7	92.7	67	7.2-7.8		(Spehar and Carlson 1984)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	32 d MATC	Mortality	cadmium nitrate	NR	10	49.3	43.9	6.0-8.1		(Spehar and Fiandt 1986)	Drop; for better endpoints		
Pimephales promelas	Fathead Minnow	Fish	30 d IC20	Biomass and Weight	cadmium sulphate	Embryo	3.02	13.9	47.8	6.81 ± 0.18	9.2 ± 0.6	(Brinkman and Vieira 2008)	Keep		
Prosopium williamsoni	Mountain Whitefish	Fish	90 d IC20	Biomass and Weight	cadmium sulphate	Embryo	1.29	5.9	47.8	6.81 ± 0.18	9.2 ± 0.6	(Brinkman and Vieira 2008)	Keep		
Prosopium williamsoni	Mountain Whitefish	Fish	90 d IC10	Biomass, decrease in	cadmium sulphate	Embryo	1.2	5.5	47.8			(Brinkman and Vieira 2008)	Keep		
Salmo salar	Atlantic Salmon	Fish	496 d LOEC/L	Length	CdCl2	Egg	0.47	3.4	28	7.3 (6.8-7.5)	11.1	(Rombough and Garside 1982)	Drop: calculated MATC		
Salmo salar	Atlantic Salmon	Fish	496 d LOEC/L	Weight	CdCl2	Egg	0.47	3.4	28	7.3 (6.8-7.5)	11.1	(Rombough and Garside 1982)	Drop: calculated MATC		
Salmo salar	Atlantic Salmon	Fish	496 d MATC	Biomass, decrease in	CdCl2	Egg	0.61	4.4	28	7.3 (6.8-7.5)	11.1	(Rombough and Garside 1982)	Keep (revisit)		
Salmo salar	Atlantic Salmon	Fish	470 d LOEC/L	Weight	CdCl2	Egg	2.5	17.9	28	7.3 (6.8-7.5)	11.1	(Rombough and Garside 1982)	Drop: calculated MATC		
Salmo salar	Atlantic Salmon	Fish	470 d LOEC/L	Biomass, decrease in	CdCl2	Egg	2.5	17.9	28	7.3 (6.8-7.5)	11.1	(Rombough and Garside 1982)	Drop: calculated MATC		
Salmo salar	Atlantic Salmon	Fish	92 d MATC	Mortality	CdCl2	Egg	4.5	32.2	28	7.3 (6.8-7.5)	11.1	(Rombough and Garside 1982)	Drop: for better endpoints		
Salmo salar	Atlantic Salmon	Fish	402 d MATC	Weight	CdCl2	Egg	5.5	54.3	19	6.5 (6.3-6.8)	12.5	(Rombough and Garside 1982)	Keep (revisit)		
Salmo salar	Atlantic Salmon	Fish	402 d MATC	Biomass, decrease in	CdCl2	Egg	5.5	54.3	19	6.5 (6.3-6.8)	12.5	(Rombough and Garside 1982)	Keep (revisit)		
Salmo salar	Atlantic Salmon	Fish	78 d MATC	Hatching success	CdCl2	Early gastrulation	88	869.2	19	6.5 (6.3-6.8)	12.5	(Rombough and Garside 1982)	Keep (revisit)		
Salmo salar	Atlantic Salmon	Fish	96 d MATC	Hatching success	CdCl2	Egg	156	1540.9	19	6.5 (6.3-	12.5	(Rombough and Garside 1982)	Keep (revisit)		
Salmo salar	Atlantic Salmon	Fish	158 d MATC	Mortality	CdCl2	Egg	156	1540.9	19	6.5 (6.3-6.8)	12.5	(Rombough and Garside 1982)	Drop: for better endpoints		
Salmo salar	Atlantic Salmon	Fish	45 d MATC	Hatching success	CdCl2	Eyed egg stage	156	1540.9	19	6.5 (6.3-6.8)	12.5	(Rombough and Garside 1982)	Keep (revisit)		
Salmo salar	Atlantic Salmon	Fish	45 d MATC	Hatching success	CdCl2	Egg	490	3508.0	28	7.3 (6.8-7.5)	11.1	(Rombough and Garside 1982)	Keep (revisit)		
Salmo salar	Atlantic Salmon	Fish	48 d MATC	Hatching success	CdCl2	Egg	490	3508.0	28	7.3 (6.8-7.5)	11.1	(Rombough and Garside 1982)	Keep (revisit)		
Salmo salar	Atlantic Salmon	Fish	92 d MATC	Mortality	CdCl2	Egg	490	3508.0	28	7.3 (6.8-7.5)	11.1	(Rombough and Garside 1982)	Drop: for better endpoints		
Salmo trutta	Brown Trout	Fish	30 d NOEC/L	Mortality	CdSO4	Swim-up fry	1.3	4.5	67.6	7.60 (0.10)	8.88 (0.17)	(Brinkman and Hansen 2007)	Drop: for better endpoints		
Salmo trutta	Brown Trout	Fish	30 d NOEC/L	Mortality	CdSO4	Swim-up fry	0.74	5.1	29.2	7.54 (0.13)	8.61 (0.22)	(Brinkman and Hansen 2007)	Drop: for better endpoints		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Salmo trutta	Brown Trout	Fish	30 d IC20	Biomass, decrease in	CdSO4	Swim-up fry	0.87	6.0	29.2	7.54 (0.13)	8.61 (0.22)	(Brinkman and Hansen 2007)	Keep (revisit)		
Salmo trutta	Brown Trout	Fish	30 d IC20	Biomass, decrease in	CdSO4	Swim-up fry	2.18	7.5	67.6	7.60 (0.10)	8.88 (0.17)	(Brinkman and Hansen 2007)	Keep (revisit)		
Salmo trutta	Brown Trout	Fish	30 d NOEC/L	Mortality	CdSO4	Swim-up fry	4.81	8.5	151	7.51 (0.12)	8.58 (0.14)	(Brinkman and Hansen 2007)	Drop: for better endpoints		
Salmo trutta	Brown Trout	Fish	30 d LOEC/L	Mortality	CdSO4	Swim-up fry	2.58	8.9	67.6	7.60 (0.10)	8.88 (0.17)	(Brinkman and Hansen 2007)	Drop: for better endpoints		
Salmo trutta	Brown Trout	Fish	30 d NOEC/L	Weight	CdSO4	Swim-up fry	2.58	8.9	67.6	7.60 (0.10)	8.88 (0.17)	(Brinkman and Hansen 2007)	Drop: for IC20, MATC		
Salmo trutta	Brown Trout	Fish	30 d LOEC/L	Mortality	CdSO4	Swim-up fry	1.4	9.7	29.2	7.54 (0.13)	8.61 (0.22)	(Brinkman and Hansen 2007)	Drop: for better endpoints		
Salmo trutta	Brown Trout	Fish	30 d NOEC/L	Weight	CdSO4	Swim-up	1.4	9.7	29.2	7.54	8.61	(Brinkman and Hansen 2007)	Drop: for IC20, MATC		
Salmo trutta	Brown Trout	Fish	61 d LOEC/L	Biomass, decrease in	CdCl2	Larva	3.7	17.9	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Brinkman and Hansen 2007)	Drop: for IC20, MATC		
Salmo trutta	Brown Trout	Fish	31 d NOEC/L	Biomass, decrease in	CdCl2	Embryo	3.7	17.9	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Brinkman and Hansen 2007)	Drop: for IC20, MATC		
Salmo trutta	Brown Trout	Fish	83 d NOEC/L	Biomass, decrease in	CdCl2	Embryo	3.8	18.3	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Brinkman and Hansen 2007)	Drop: for IC20, MATC		
Salmo trutta	Brown Trout	Fish	60 d NOEC/L	Biomass, decrease in	CdCl2	Larva	3.8	18.3	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Brinkman and Hansen 2007)	Drop: for IC20, MATC		
Salmo trutta	Brown Trout	Fish	31 d MATC	Biomass, decrease in	CdCl2	Embryo	6.4	30.9	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Brinkman and Hansen 2007)	Keep (revisit)		
Salmo trutta	Brown Trout	Fish	83 d MATC	Biomass, decrease in	CdCl2	Embryo	6.7	32.4	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Brinkman and Hansen 2007)	Keep (revisit)		
Salmo trutta	Brown Trout	Fish	60 d MATC	Biomass, decrease in	CdCl2	Larva	6.7	32.4	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Brinkman and Hansen 2007)	Keep (revisit)		
Salmo trutta	Brown Trout	Fish	31 d LOEC/L	Biomass, decrease in	CdCl2	Embryo	11.2	54.1	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Brinkman and Hansen 2007)	Drop: for IC20, MATC		
Salmo trutta	Brown Trout	Fish	83 d LOEC/L	Biomass, decrease in	CdCl2	Embryo	11.7	56.5	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Brinkman and Hansen 2007)	Drop: for IC20, MATC		
Salmo trutta	Brown Trout	Fish	60 d LOEC/L	Biomass, decrease in	CdCl2	Larva	11.7	56.5	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Brinkman and Hansen 2007)	Drop: for IC20, MATC		
Salmo trutta	Brown Trout	Fish	30 d IC20	Biomass, decrease in	CdSO4	Swim-up fry	6.62	11.7	151	7.51 (0.12)	8.58 (0.14)	(Brinkman and Hansen 2007)	Keep (revisit)		
Salmo trutta	Brown Trout	Fish	55 d IC20	Biomass, decrease in	CdSO4	Egg	2.22	14.8	30.6	7.72 (0.12)	8.49 (0.58)	(Brinkman and Hansen 2007)	Keep (revisit)		
Salmo trutta	Brown Trout	Fish	55 d NOEC/L	Mortality	CdSO4	Egg	4.68	15.4	71.3	7.75 (0.14)	8.61 (0.67)	(Brinkman and Hansen 2007)	Drop: for better endpoints		
Salmo trutta	Brown Trout	Fish	30 d LOEC/L	Weight	CdSO4	Swim-up fry	4.49	15.5	67.6	7.60 (0.10)	8.88 (0.17)	(Brinkman and Hansen 2007)	Drop: for IC20, MATC		
Salmo trutta	Brown Trout	Fish	55 d IC20	Biomass, decrease in	CdSO4	Egg	4.71	15.5	71.3	7.75 (0.14)	8.61 (0.67)	(Brinkman and Hansen 2007)	Keep (revisit)		
Salmo trutta	Brown Trout	Fish	30 d LOEC/L	Mortality	CdSO4	Swim-up fry	8.88	15.7	151	7.51 (0.12)	8.58 (0.14)	(Brinkman and Hansen 2007)	Drop: for better endpoints		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Salmo trutta	Brown Trout	Fish	55 d NOEC/L	Mortality	CdSO4	Egg	2.54	16.9	30.6	7.72 (0.12)	8.49 (0.58)	(Brinkman and Hansen 2007)	Drop: for better endpoints		
Salmo trutta	Brown Trout	Fish	55 d NOEC/L	Mortality	CdSO4	Egg	9.62	17.2	149	7.83 (0.14)	8.32 (0.64)	(Brinkman and Hansen 2007)	Drop: for better endpoints		
Salmo trutta	Brown Trout	Fish	30 d LOEC/L	Weight	CdSO4	Swim-up fry	2.72	18.8	29.2	7.54 (0.13)	8.61 (0.22)	(Brinkman and Hansen 2007)	Drop: for IC20, MATC		
Salmo trutta	Brown Trout	Fish	55 d IC20	Mortality	CdSO4	Egg	13.6	24.3	149	7.83 (0.14)	8.32 (0.64)	(Brinkman and Hansen 2007)	Drop: for better endpoints		
Salmo trutta	Brown Trout	Fish	55 d LOEC/L	Mortality	CdSO4	Egg	8.64	28.5	71.3	7.75 (0.14)	8.61 (0.67)	(Brinkman and Hansen 2007)	Drop: for better endpoints		
Salmo trutta	Brown Trout	Fish	55 d LOEC/L	Mortality	CdSO4	Egg	4.87	32.4	30.6	7.72 (0.12)	8.49 (0.58)	(Brinkman and Hansen 2007)	Drop: for better endpoints		
Salmo trutta	Brown Trout	Fish	55 d LOEC/L	Mortality	CdSO4	Egg	19.1	34.1	149	7.83 (0.14)	8.32 (0.64)	(Brinkman and Hansen 2007)	Drop: for better endpoints		
Salmo trutta	Brown Trout	Fish	61 d NOEC/L	Biomass, decrease in	CdCl2	Larva	1.1	5.3	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: for IC20, MATC		
Salmo trutta	Brown Trout	Fish	61 d MATC	Biomass, decrease in	CdCl2	Larva	2	9.7	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Keep (revisit)		
Salvelinus confluentus	Bull Trout	Fish	55 d LOEC/L	Growth	CdCl2	Juvenile	0.786	5.2	30.6	7.55 (SD = 0.12)	8.69 (SD = 0.26)	(Hansen et al. 2002b)	Drop: calculated MATC		
Salvelinus confluentus	Bull Trout	Fish	55 d LOEC/L	Mortality	CdCl2	Juvenile	0.786	5.2	30.6	7.55 (SD = 0.12)	8.69 (SD = 0.26)	(Hansen et al. 2002b)	Drop: calculated MATC		
Salvelinus confluentus	Bull Trout	Fish	55 d MATC	Growth	CdCl2	Juvenile	0.549	3.7	30.6	7.55 (SD = 0.12)	8.69 (SD = 0.26)	(Hansen et al. 2002b)	Keep		
Salvelinus confluentus	Bull Trout	Fish	55 d MATC	Mortality	CdCl2	Juvenile	0.549	3.7	30.6	7.55 (SD = 0.12)	8.69 (SD = 0.26)	(Hansen et al. 2002b)	Drop: for better endpoints		
Salvelinus confluentus	Bull Trout	Fish	55 d NOEC/L	Growth	CdCl2	Juvenile	0.383	2.5	30.6	7.55 (SD = 0.12)	8.69 (SD = 0.26)	(Hansen et al. 2002b)	Drop: calculated MATC		
Salvelinus confluentus	Bull Trout	Fish	55 d NOEC/L	Mortality	CdCl2	Juvenile	0.383	2.5	30.6	7.55 (SD = 0.12)	8.69 (SD = 0.26)	(Hansen et al. 2002b)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	126 d NOEC/L	Biomass, decrease in	CdCl2	Larva	1.1	5.3	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	126 d MATC	Biomass, decrease in	CdCl2	Larva	2	9.7	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Keep (revisit)		
Salvelinus fontinalis	Brook Trout	Fish	126 d LOEC/L	Biomass, decrease in	CdCl2	Larva	3.8	18.3	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	55 d NOEC/L	Biomass, decrease in	CdCl2	Embryo	3.8	18.3	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	55 d LOEC/L	Biomass, decrease in	CdCl2	Embryo	0.48 AND 11.7	#VALUE!	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	65 d NOEC/L	Biomass, decrease in	CdCl2	Larva	1.1	5.3	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	65 d LOEC/L	Biomass, decrease in	CdCl2	Larva	0.48 AND 3.8	#VALUE!	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	1100 d NOEC/L	Reproduction	cadmium chloride	Mixed	1.7	8.4	44	07-Aug	7 (4-12)	(Benoit et al. 1976)	Drop: calculated MATC		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Salvelinus fontinalis	Brook Trout	Fish	1100 d MATC	Reproduction	cadmium chloride	Mixed	2.4	11.8	44	07-Aug	7 (4-12)	(Benoit et al. 1976)	Keep (revisit)		
Salvelinus fontinalis	Brook Trout	Fish	1100 d LOEC/L	Reproduction	cadmium chloride	Mixed	3.4	16.7	44	07-Aug	7 (4-12)	(Benoit et al. 1976)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	60 d LOEC/L	Mortality	cadmium chloride	Fry	7	10.3	188	6.7-7.1	10.6 ± 1.5	(Sauter et al. 1976)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	60 d NOEC/L	Weight	cadmium chloride	Fry	7	10.3	188	6.7-7.1	10.6 ± 1.5	(Sauter et al. 1976)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	60 d MATC	Mortality	cadmium chloride	Fry	9.17	13.5	188	6.7-7.1	10.6 ± 1.5	(Sauter et al. 1976)	Drop: mortality endpoint		
Salvelinus fontinalis	Brook Trout	Fish	60 d MATC	Weight	cadmium chloride	Fry	9.17	13.5	188	6.7-7.1	10.6 ± 1.5	(Sauter et al. 1976)	Keep (revisit)		
Salvelinus fontinalis	Brook Trout	Fish	60 d LOEC/L	Weight	cadmium chloride	Fry	12	17.7	188	6.7-7.1	10.6 ± 1.5	(Sauter et al. 1976)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	60 d NOEC/L	Mortality	cadmium chloride	Fry	12	17.7	188	6.7-7.1	10.6 ± 1.5	(Sauter et al. 1976)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	60 d NOEC/L	Weight	cadmium chloride	Fry	1	5.7	37	6.5-7.2	10 ± 0.8	(Sauter et al. 1976)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	60 d MATC	Weight	cadmium chloride	Fry	1.7	9.7	37	6.5-7.2	10 ± 0.8	(Sauter et al. 1976)	Keep (revisit)		
Salvelinus fontinalis	Brook Trout	Fish	60 d LOEC/L	Weight	cadmium chloride	Fry	3	17.0	37	6.5-7.2	10 ± 0.8	(Sauter et al. 1976)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	60 d NOEC/L	Mortality	cadmium chloride	Fry	3	17.0	37	6.5-7.2	10 ± 0.8	(Sauter et al. 1976)	Drop: calculated MATC		
Salvelinus fontinalis	Brook Trout	Fish	60 d MATC	Mortality	cadmium chloride	Fry	4.24	24.1	37	6.5-7.2	10 ± 0.8	(Sauter et al. 1976)	Drop: mortality endpoint		
Salvelinus fontinalis	Brook Trout	Fish	60 d LOEC/L	Mortality	cadmium chloride	Fry	6	34.1	37	6.5-7.2	10 ± 0.8	(Sauter et al. 1976)	Drop: calculated MATC		
Salvelinus namaycush	Lake Trout	Fish	41 d LOEC/L	Biomass, decrease in	CdCl2	Embryo	12.3	59.4	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Salvelinus namaycush	Lake Trout	Fish	64 d LOEC/L	Biomass, decrease in	CdCl2	Larva	12.3	59.4	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Salvelinus namaycush	Lake Trout	Fish	41 d MATC	Biomass, decrease in	CdCl2	Embryo	7.4	35.7	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Keep		
Salvelinus namaycush	Lake Trout	Fish	64 d MATC	Biomass, decrease in	CdCl2	Larva	7.4	35.7	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Keep		
Salvelinus namaycush	Lake Trout	Fish	41 d NOEC/L	Biomass, decrease in	CdCl2	Embryo	4.4	21.2	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		
Salvelinus namaycush	Lake Trout	Fish	64 d NOEC/L	Biomass, decrease in	CdCl2	Larva	4.4	21.2	45	7.6 (7.2-7.8)	10.3 (8.0-12.2)	(Eaton et al. 1978)	Drop: calculated MATC		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Aeolosoma headleyi	Oligochaete	Aquatic Invertebrate	14 d NOEC/L	Population growth		Young worms	32	51.8	168	NR	NR	(Niederlehner et al. 1984)	Drop: calculated MATC		
Aeolosoma headleyi	Oligochaete	Aquatic Invertebrate	10 d NOEC/L	Population growth		Young worms	17.2	63.7	62	NR	NR	(Niederlehner et al. 1984)	Drop: calculated MATC		
Aeolosoma headleyi	Oligochaete	Aquatic Invertebrate	14 d MATC	Population growth		Young worms	40.1	64.9	168	NR	NR	(Niederlehner et al. 1984)	Keep		
Aeolosoma headleyi	Oligochaete	Aquatic Invertebrate	12 d NOEC/L	Population growth		Young worms	53.6	78.7	189	NR	NR	(Niederlehner et al. 1984)	Drop: calculated MATC		
Aeolosoma headleyi	Oligochaete	Aquatic Invertebrate	14 d LOEC/L	Population growth		Young worms	50.2	81.2	168	NR	NR	(Niederlehner et al. 1984)	Drop: calculated MATC		
Aeolosoma headleyi	Oligochaete	Aquatic Invertebrate	10 d MATC	Population growth		Young worms	25.2	93.3	62	NR	NR	(Niederlehner et al. 1984)	Keep		
Aeolosoma headleyi	Oligochaete	Aquatic Invertebrate	12 d MATC	Population growth		Young worms	70.2	103.0	189	NR	NR	(Niederlehner et al. 1984)	Keep		
Aeolosoma headleyi	Oligochaete	Aquatic Invertebrate	12 d LOEC/L	Population growth		Young worms	92	135.0	189	NR	NR	(Niederlehner et al. 1984)	Drop: calculated MATC		
Aeolosoma headleyi	Oligochaete	Aquatic Invertebrate	10 d LOEC/L	Population growth		Young worms	36.9	136.6	62	NR	NR	(Niederlehner et al. 1984)	Drop: calculated MATC		
Atyaephyra desmarestii	European Shrimp	Aquatic Invertebrate	6 d LOEC/L	Feeding inhibition	cadmium chloride	Adult	6.53	7.3	263.43	7.92 (+-0.02)	>90% sat	(Pestana et al. 2007)	Drop: calculated MATC		
Atyaephyra desmarestii	European Shrimp	Aquatic Invertebrate	6 d NOEC/L	Feeding inhibition	cadmium chloride	Adult	4.2	4.7	263.43	7.92 (+-0.02)	>90% sat	(Pestana et al. 2007)	Drop: calculated MATC		
Atyaephyra desmarestii	European Shrimp	Aquatic Invertebrate	6 d MATC	Feeding inhibition	cadmium chloride	Adult	5.24	5.8	263.43	7.92 (+-0.02)	>90% sat	(Pestana et al. 2007)	Keep		
Baetis rhodani	Mayfly	Aquatic Invertebrate	5 d LC50	Mortality	not specified	Unknown	2300	10176.4	50	7		(Gerhardt 1992)	Drop: duration		
Baetis rhodani	Mayfly	Aquatic Invertebrate	5 d LC50	Mortality	not specified	Unknown	2500	11061.3	50	7		(Gerhardt 1992)	Drop: duration		
Baetis rhodani	Mayfly	Aquatic Invertebrate	5 d LC50	Mortality	not specified	Unknown	3000	13273.5	50	5		(Gerhardt 1992)	Drop: duration		
Capitella capitata sp. Y	Gallery Worm	Aquatic Invertebrate	10 d LC50	Mortality	not reported	Larva	35	#VALUE!	NR			(Mendez and Green-Ruiz 2006)	Drop: no hardness information		
Ceriodaphnia dubia	Water Flea	Aquatic Invertebrate	7 d MATC	Reproduction	CdCl2	Not reported	2	21.7	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Keep		
Ceriodaphnia dubia	Water Flea	Aquatic Invertebrate	10 d MATC	Reproduction	CdCl2	Not reported	2	21.7	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Keep		
Ceriodaphnia dubia	Water Flea	Aquatic Invertebrate	14 d MATC	Reproductio	CdCl2	Not	2	21.7	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Keep		
Ceriodaphnia dubia	Water Flea	Aquatic Invertebrate	14 d LC50	Mortality	CdCl2	Not reported	10.1	109.4	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Ceriodaphnia dubia	Water Flea	Aquatic Invertebrate	10 d LC50	Mortality	CdCl2	Not reported	10.6	114.8	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Ceriodaphnia dubia	Water Flea	Aquatic Invertebrate	7 d MATC	Mortality	CdCl2	Not reported	11.4	123.5	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Ceriodaphnia dubia	Water Flea	Aquatic Invertebrate	10 d MATC	Mortality	CdCl2	Not reported	11.4	123.5	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Ceriodaphnia dubia	Water Flea	Aquatic Invertebrate	14 d MATC	Mortality	CdCl2	Not reported	11.4	123.5	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Ceriodaphnia dubia	Water Flea	Aquatic Invertebrate	7 d LC50	Mortality	CdCl2	Not reported	11.6	125.7	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Ceriodaphnia dubia	Water Flea	Aquatic Invertebrate	7 d MATC	Reproduction - Number of young per adult	CdCl2	Less than 24hrs	0.43	0.5	240	8.0 +- 0.3	>5	(Elnabarawy et al. 1986)	Keep		
Ceriodaphnia reticulata	Cladocerans	Aquatic Invertebrate	7 d EC50	Reproductio	CdCl2	Less than	15.3	18.4	240	8.0 +-	>5	(Elnabarawy et al. 1986)	Keep		
Ceriodaphnia reticulata	Cladocerans	Aquatic Invertebrate	7 d LC50	Mortality	CdCl2	Less than 24hrs	15.3	18.4	240	8.0 +- 0.3	>5	(Elnabarawy et al. 1986)	Drop: for better endpoints		
Ceriodaphnia reticulata	Cladocerans	Aquatic Invertebrate	9 d NOEC/L	Reproduction	cadmium chloride	Less than 24hrs	3.4	11.8	67	7.2-7.8		(Spehar and Carlson 1984)	Drop: calculated MATC		
Ceriodaphnia reticulata	Cladocerans	Aquatic Invertebrate	9 d MATC	Reproduction	cadmium chloride	Less than 24hrs	4.9	17.0	67	7.2-7.8		(Spehar and Carlson 1984)	Keep		
Ceriodaphnia reticulata	Cladocerans	Aquatic Invertebrate	9 d LOEC/L	Reproduction	cadmium chloride	Less than 24hrs	7.2	25.0	67	7.2-7.8		(Spehar and Carlson 1984)	Drop: calculated MATC		
Ceriodaphnia reticulata	Cladocerans	Aquatic Invertebrate	9 d NOEC/L	Mortality	cadmium chloride	Less than 24hrs	7.2	25.0	67	7.2-7.8		(Spehar and Carlson 1984)	Drop: calculated MATC		
Ceriodaphnia reticulata	Cladocerans	Aquatic Invertebrate	9 d MATC	Mortality	cadmium chloride	Less than 24hrs	10.5	36.4	67	7.2-7.8		(Spehar and Carlson 1984)	Drop: for better endpoints		
Ceriodaphnia reticulata	Cladocerans	Aquatic Invertebrate	9 d LOEC/L	Mortality	cadmium chloride	Less than 24hrs	15.2	52.7	67	7.2-7.8		(Spehar and Carlson 1984)	Drop: calculated MATC		
Chironomus riparius	Midge	Aquatic Invertebrate	17 d NOEC/L	Mortality	not reported	1st instar	15	38.0	98	7.6	>90% air sat	(Pascoe et al. 1989)	Drop: calculated MATC		
Chironomus riparius	Midge	Aquatic Invertebrate	17 d MATC	Mortality	not reported	1st instar	47.4	120.0	98	7.6	>90% air sat	(Pascoe et al. 1989)	Keep		
Chironomus riparius	Midge	Aquatic Invertebrate	17 d LOEC/L	Mortality	not reported	1st instar	150	379.7	98	7.6	>90% air sat	(Pascoe et al. 1989)	Drop: calculated MATC		
Chironomus tentans	Midge	Aquatic Invertebrate	60 d IC25	Hatching success	CdCl2	Less than 24hrs	4	4.2	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Keep		
Chironomus tentans	Midge	Aquatic Invertebrate	60 d IC25	Percent emergence	CdCl2	Less than 24hrs	8.1	8.6	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Keep		
Chironomus tentans	Midge	Aquatic Invertebrate	20 d IC25	Weight	CdCl2	Less than 24hrs	9.9	10.5	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Keep		
Chironomus tentans	Midge	Aquatic Invertebrate	20 d IC25	Biomass, decrease in	CdCl2	Less than 24hrs	10.3	10.9	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Keep		
Chironomus tentans	Midge	Aquatic Invertebrate	20 d IC25	Mortality	CdCl2	Less than 24hrs	16.4	17.4	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Keep		
Chironomus tentans	Midge	Aquatic Invertebrate	60 d IC25	Repro - No. eggs per individual	CdCl2	Less than 24hrs	16.4	17.4	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Keep		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Chironomus tentans	Midge	Aquatic Invertebrate	14 d LOEC/L	Growth	CdCl2	2nd instar	100	1083.3	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Chironomus tentans	Midge	Aquatic Invertebrate	7 d LOEC/L	Growth	CdCl2	2nd instar	500	5416.4	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Chironomus tentans	Midge	Aquatic Invertebrate	10 d LOEC/L	Growth	CdCl2	2nd instar	500	5416.4	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Chironomus tentans	Midge	Aquatic Invertebrate	14 d LC50	Mortality	CdCl2	2nd instar	635	6878.8	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Chironomus tentans	Midge	Aquatic Invertebrate	7 d MATC	Mortality	CdCl2	2nd instar	707	7658.7	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Chironomus tentans	Midge	Aquatic Invertebrate	10 d MATC	Mortality	CdCl2	2nd instar	707	7658.7	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Chironomus tentans	Midge	Aquatic Invertebrate	10 d LC50	Mortality	CdCl2	2nd instar	963	10431.9	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Chironomus tentans	Midge	Aquatic Invertebrate	7 d LC50	Mortality	CdCl2	2nd instar	1700	18415.6	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Chironomus tentans	Midge	Aquatic Invertebrate	14 d MATC	Mortality	CdCl2	2nd instar	707	7658.7	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Daphnia magna	Water Flea	Aquatic Invertebrate	7 d EC10	Feeding inhibition	3CdSO4.8H2O	Adult	0.13	0.20	179	8.07 +- 0.07		(Barata and Baird 2000)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	7 d EC10	Repro - brood mass	3CdSO4.8H2O	Adult	0.13	0.20	179	8.07 +- 0.07		(Barata and Baird 2000)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	7 d EC10	Reproduction - Brood size	3CdSO4.8H2O	Adult	0.14	0.21	179	8.07 +- 0.07		(Barata and Baird 2000)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	7 d LC10	Mortality	3CdSO4.8H2O	Adult	1.15	1.8	179	8.07 +- 0.07		(Barata and Baird 2000)	Drop: duration		
Daphnia magna	Water Flea	Aquatic Invertebrate	7 d EC10	Weight	3CdSO4.8H2O	Adult	1.65	2.5	179	8.07 +- 0.07		(Barata and Baird 2000)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	7 d LC50	Mortality	3CdSO4.8H2O	Adult	2.47	3.8	179	8.07 +- 0.07		(Barata and Baird 2000)	Drop: duration		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d NOEC/L	Reproduction - Number of young per adult	Cd standard	Not reported	0.22	0.4	130			(Borgmann et al. 1989)	Drop: calculated MATC		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d MATC	Reproduction - Number of young per adult	Cd standard	Not reported	0.64	1.3	130			(Borgmann et al. 1989)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d LOEC/L	Reproduction - Number of young per adult	Cd standard	Not reported	1.86	3.7	130			(Borgmann et al. 1989)	Drop: calculated MATC		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d MATC	Repro - Number of young per survivor	CdCl2 . 1/2 H2O	Less than 24hrs	0.21	0.5	103	7.9 +- 0.3	6.4 +- 0.8	(Chapman et al. 1980)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d MATC	Reproduction - Number of young per adult	CdCl2 . 1/2 H2O	Less than 24hrs	0.15	0.6	53	7.5 +- 0.2	6.2 +- 1.0	(Chapman et al. 1980)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d MATC	Reproduction - Number of young per adult	CdCl2 . 1/2 H2O	Less than 24hrs	0.38	0.9	103	7.9 +- 0.3	6.4 +- 0.8	(Chapman et al. 1980)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d MATC	Repro - Number of young per	CdCl2 . 1/2 H2O	Less than 24hrs	1.52	6.4	53	7.5 +- 0.2	6.2 +- 1.0	(Chapman et al. 1980)	Keep		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d MATC	Reproduction - Number of young per adult	CdCl2 . 1/2 H2O	Less than 24hrs	0.43	0.6	209	8.2 +- 0.1	6.8 +- 0.7	(Chapman et al. 1980)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d MATC	Repro - Number of young per survivor	CdCl2 . 1/2 H2O	Less than 24hrs	0.67	0.9	209	8.2 +- 0.1	6.8 +- 0.7	(Chapman et al. 1980)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d NOEC/L	Reproduction	CdCl2	24h	0.6	0.7	249.8	8.0 +- 0.2	69-100% sat	(Kühn et al. 1989)	Drop: calculated MATC		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d MATC	Reproduction	CdCl2	24h	1.09	1.3	249.8	8.0 +- 0.2	69-100% sat	(Kühn et al. 1989)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d LOEC/L	Reproduction	CdCl2	24h	1.94	2.3	249.8	8.0 +- 0.2	69-100% sat	(Kühn et al. 1989)	Drop: calculated MATC		
Daphnia magna	Water Flea	Aquatic Invertebrate	7 d MATC	Growth	CdSO4	Neonate	1.2	3.3	90			(Winner 1988)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d EC50	Reproduction	CdCl2.1/2H2O	Less than 24hrs	0.7	3.4	45.3	7.74 (7.4-8.2)	9	(Biesinger and Christensen 1972)	Drop: for better endpoints		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d EC16	Reproduction	CdCl2.1/2	Less than fry	0.17	0.8	45.3	7.74	9	(Biesinger and Christensen 1972)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d LC50	Mortality	CdCl2.1/2H2O	Less than 24hrs	5	24.0	45.3	7.74 (7.4-8.2)	9	(Biesinger and Christensen 1972)	Drop: for better endpoints		
Daphnia magna	Water Flea	Aquatic Invertebrate	14 d EC50	Reproduction - Number of young per adult	CdCl2	Less than 24hrs	3.5	4.2	240	8.0 +- 0.3	>5	(Elnabarawy et al. 1986)	Drop: for better endpoints		
Daphnia magna	Water Flea	Aquatic Invertebrate	14 d MATC	Reproduction - Number of young per adult	CdCl2	Less than 24hrs	4.3	5.2	240	8.0 +- 0.3	>5	(Elnabarawy et al. 1986)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	14 d LC50	Mortality	CdCl2	Less than 24hrs	15.3	18.4	240	8.0 +- 0.3	>5	(Elnabarawy et al. 1986)	Drop: for better endpoints		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d NOEC/L	Reproduction	CdCl2 - H2O	Less than 24hrs	5	8.9	150	8.4 ± 0.2	NR	(Bodar et al. 1988)	Drop: calculated MATC		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d MATC	Reproduction	CdCl2 - H2O	Less than 24hrs	7.07	12.6	150	8.4 ± 0.2	NR	(Bodar et al. 1988)	Keep		
Daphnia magna	Water Flea	Aquatic Invertebrate	21 d LOEC/L	Reproduction	CdCl2 - H2O	Less than 24hrs	10	17.8	150	8.4 ± 0.2	NR	(Bodar et al. 1988)	Drop: calculated MATC		
Daphnia magna	Water Flea	Aquatic Invertebrate	7 d MATC	Mortality	CdCl2	Not reported	7.1	21.7	78	6.9-8.3	7.7-9.0	(Suedel et al. 1997)	Drop: for better endpoints		
Daphnia magna	Water Flea	Aquatic Invertebrate	10 d MATC	Mortality	CdCl2	Not reported	7.1	21.7	78	6.9-8.3	7.7-9.0	(Suedel et al. 1997)	Drop: for better endpoints		
Daphnia magna	Water Flea	Aquatic Invertebrate	14 d MATC	Mortality	CdCl2	Not reported	7.1	21.7	78	6.9-8.3	7.7-9.0	(Suedel et al. 1997)	Drop: for better endpoints		
Daphnia pulex	Water Flea	Aquatic Invertebrate	42 d NOEC/L	Reproduction - Brood size	3CdSO4 8H2O	Less than 24hrs	5.2	10.8	125	8.3-9.0	NR	(Winner 1986)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	42 d MATC	Reprod - Brood size	3CdSO4 8H2O	Less than 24hrs	7.35	15.2	125	8.3-9.0	NR	(Winner 1986)	Keep		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Daphnia pulex	Water Flea	Aquatic Invertebrate	42 d NOEC/L	Reproduction - Brood size	3CdSO4 8H2O	Less than 24hrs	2.7	5.6	125	8.3-9.0	NR	(Winner 1986)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	42 d NOEC/L	Reproduction - Brood size	3CdSO4 8H2O	Less than 24hrs	5.6	11.6	125	8.3-9.0	NR	(Winner 1986)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	42 d LOEC/L	Reproductio	3CdSO4	Less than	10.4	21.5	125	8.3-9.0	NR	(Winner 1986)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	42 d MATC	Reproduction - Brood size	3CdSO4 8H2O	Less than 24hrs	3.6	7.4	125	8.3-9.0	NR	(Winner 1986)	Keep		
Daphnia pulex	Water Flea	Aquatic Invertebrate	42 d MATC	Reproduction - Brood size	3CdSO4 8H2O	Less than 24hrs	7.78	16.1	125	8.3-9.0	NR	(Winner 1986)	Keep		
Daphnia pulex	Water Flea	Aquatic Invertebrate	42 d LOEC/L	Reproduction - Brood size	3CdSO4 8H2O	Less than 24hrs	4.8	9.9	125	8.3-9.0	NR	(Winner 1986)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	42 d LOEC/L	Reproduction - Brood size	3CdSO4 8H2O	Less than 24hrs	10.8	22.3	125	8.3-9.0	NR	(Winner 1986)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	58 d NOEC/L	Reproduction	3CdSO4-8H2O	Less than 24hrs	5	11.9	106	8.49	NR	(Ingersoll and Winner 1982)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	58 d MATC	Reproduction	3CdSO4-8H2O	Less than 24hrs	7.07	16.8	106	8.49	NR	(Ingersoll and Winner 1982)	Keep		
Daphnia pulex	Water Flea	Aquatic Invertebrate	58 d LOEC/L	Reproduction	3CdSO4-8H2O	Less than 24hrs	10	23.7	106	8.49	NR	(Ingersoll and Winner 1982)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	58 d NOEC/L	Reproduction - Brood size	3CdSO4-8H2O	Less than 24hrs	10	23.7	106	8.49	NR	(Ingersoll and Winner 1982)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	58 d NOEC/L	Reproduction - Brood size	3CdSO4-8H2O	Less than 24hrs	15	35.6	106	8.49	NR	(Ingersoll and Winner 1982)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	58 d NOEC/L	Reproductio	3CdSO4-	Less than	5	11.9	106	8.49	NR	(Ingersoll and Winner 1982)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	58 d LOEC/L	Reproduction - Brood size	3CdSO4-8H2O	Less than 24hrs	10	23.7	106	8.49	NR	(Ingersoll and Winner 1982)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	58 d LOEC/L	Reproduction - Brood size	3CdSO4-8H2O	Less than 24hrs	15	35.6	106	8.49	NR	(Ingersoll and Winner 1982)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	58 d LOEC/L	Reproduction - Brood size	3CdSO4-8H2O	Less than 24hrs	20	47.4	106	8.49	NR	(Ingersoll and Winner 1982)	Drop: calculated MATC		
Daphnia pulex	Water Flea	Aquatic Invertebrate	14 d MATC	Reproduction - Number of young per adult	CdCl2	Less than 24hrs	13.7	16.5	240	8.0 +- 0.3	>5	(Elnabarawy et al. 1986)	Keep		
Daphnia pulex	Water Flea	Aquatic Invertebrate	14 d EC50	Reproduction - Number of young per adult	CdCl2	Less than 24hrs	15.3	18.4	240	8.0 +- 0.3	>5	(Elnabarawy et al. 1986)	Drop: for better endpoints		
Daphnia pulex	Water Flea	Aquatic Invertebrate	14 d LC50	Mortality	CdCl2	Less than 24hrs	15.3	18.4	240	8.0 +- 0.3	>5	(Elnabarawy et al. 1986)	Drop: for better endpoints		
Daphnia pulex	Water Flea	Aquatic Invertebrate	21 d LOEC/L	Repro - Number of young per survivor	CdCl2	Less than 24hrs	0.003	0.0	85			(Roux et al. 1993)	Drop: calculated MATC		
Echinogammarus meridionalis	Gammarid Amphipod	Aquatic Invertebrate	6 d LOEC/L	Feeding inhibition	cadmium chloride	Adult	6.35	7.1	263.43	7.92 (+-	>90% sat	(Pestana et al. 2007)	Drop: calculated MATC		
Echinogammarus meridionalis	Gammarid Amphipod	Aquatic Invertebrate	6 d NOEC/L	Feeding inhibition	cadmium chloride	Adult	4.2	4.7	263.43	7.92 (+-0.02)	>90% sat	(Pestana et al. 2007)	Drop: calculated MATC		
Echinogammarus meridionalis	Gammarid Amphipod	Aquatic Invertebrate	6 d MATC	Feeding inhibition	cadmium chloride	Adult	5.16	5.7	263.43	7.92 (+-0.02)	>90% sat	(Pestana et al. 2007)	Keep		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Erythemis simplicicollis	Dragonfly	Aquatic Invertebrate	7 d NOEC/L	Mortality	cadmium chloride hemipentahydrate	Larva	100000	213939.1	120	6.24	NR	(Tollett et al. 2009)	Drop: duration		
Gammarus fasciatus	Amphipod	Aquatic Invertebrate	42 d NOEC/L	Mortality	Cd metal standard	0 - 7 d old	1.49	3.0	130	8.2-8.8		(Borgmann et al. 1989)	Drop: calculated MATC		
Gammarus fasciatus	Amphipod	Aquatic Invertebrate	42 d LOEC/L	Mortality	Cd metal standard	0 - 7 d old	2.23	4.5	130	8.2-8.8		(Borgmann et al. 1989)	Drop: calculated MATC		
Gammarus fasciatus	Amphipod	Aquatic Invertebrate	42 d MATC	Mortality	Cd metal standard	0 - 7 d old	1.82	3.6	130	8.2-8.8		(Borgmann et al. 1989)	Keep		
Gammarus pulex	Amphipod	Aquatic Invertebrate	5 d LOEC/L	Behaviour - Inhibition of swimming ability	CdCl2	Adult	7.5	8.2	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: calculated MATC		
Gammarus pulex	Amphipod	Aquatic Invertebrate	7 d LOEC/L	Behaviour - Inhibition of swimming ability	CdCl2	Adult	7.5	8.2	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: calculated MATC		
Gammarus pulex	Amphipod	Aquatic Invertebrate	7 d NOEC/L	Feeding inhibition	CdCl2	Adult	7.5	8.2	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: calculated MATC		
Gammarus pulex	Amphipod	Aquatic Invertebrate	5 d LOEC/L	Mortality	CdCl2	Adult	7.5	8.2	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: calculated MATC		
Gammarus pulex	Amphipod	Aquatic Invertebrate	7 d NOEC/L	Mortality	CdCl2	Adult	7.5	8.2	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: calculated MATC		
Gammarus pulex	Amphipod	Aquatic Invertebrate	7 d LOEC/L	Respiration	CdCl2	Adult	7.5	8.2	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: calculated MATC		
Gammarus pulex	Amphipod	Aquatic Invertebrate	5 d NOEC/L	Respiration	CdCl2	Adult	7.5	8.2	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: calculated MATC		
Gammarus pulex	Amphipod	Aquatic Invertebrate	7 d MATC	Feeding inhibition	CdCl2	Adult	10.6	11.6	269.2	7.19 +- 0.02		(Felten et al. 2007)	Keep		
Gammarus pulex	Amphipod	Aquatic Invertebrate	7 d MATC	Mortality	CdCl2	Adult	10.6	11.6	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: for better endpoints		
Gammarus pulex	Amphipod	Aquatic Invertebrate	5 d MATC	Respiration	CdCl2	Adult	10.6	11.6	269.2	7.19 +- 0.02		(Felten et al. 2007)	Keep		
Gammarus pulex	Amphipod	Aquatic Invertebrate	7 d LOEC/L	Feeding inhibition	CdCl2	Adult	15	16.4	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: calculated MATC		
Gammarus pulex	Amphipod	Aquatic Invertebrate	7 d LOEC/L	Mortality	CdCl2	Adult	15	16.4	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: for better endpoints		
Gammarus pulex	Amphipod	Aquatic Invertebrate	5 d LOEC/L	Respiration	CdCl2	Adult	15	16.4	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: calculated MATC		
Gammarus pulex	Amphipod	Aquatic Invertebrate	5 d NOEC/L	Mortality	CdCl2	Adult	< 7.5	#VALUE!	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: for better endpoints		
Gammarus pulex	Amphipod	Aquatic Invertebrate	5 d NOEC/L	Behaviour - Inhibition of swimming ability	CdCl2	Adult	< 7.5	#VALUE!	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: calculated MATC		
Gammarus pulex	Amphipod	Aquatic Invertebrate	5 d MATC	Mortality	CdCl2	Adult	< 7.5	#VALUE!	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: for better endpoints		
Gammarus pulex	Amphipod	Aquatic Invertebrate	5 d MATC	Behaviour - Inhibition of swimming	CdCl2	Adult	< 7.5	#VALUE!	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: <		
Gammarus pulex	Amphipod	Aquatic Invertebrate	7 d NOEC/L	Behaviour - Inhibition of swimming ability	CdCl2	Adult	< 7.5	#VALUE!	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: calculated MATC		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as $CaCO_3$)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L $CaCO_3$)
Gammarus pulex	Amphipod	Aquatic Invertebrate	7 d NOEC/L	Respiration	CdCl2	Adult	< 7.5	#VALUE!	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: calculated MATC		
Gammarus pulex	Amphipod	Aquatic Invertebrate	7 d MATC	Behaviour - Inhibition of swimming ability	CdCl2	Adult	< 7.5	#VALUE!	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: <		
Gammarus pulex	Amphipod	Aquatic Invertebrate	7 d MATC	Respiration	CdCl2	Adult	< 7.5	#VALUE!	269.2	7.19 +- 0.02		(Felten et al. 2007)	Drop: <		
Hyalella azteca	Amphipod	Aquatic Invertebrate	7 d LC50	Mortality	AA Standard	Juvenile	0.15	1.5	18	7.39 (6.44-8.52)	NR	(Borgmann et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	7 d LC50	Mortality	Cd atomic absorption standard	Juvenile	0.15	1.5	18	6.44-8.52 * (measured at end)	7-10 (END) - not aerated during test	(Borgmann et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	7 d LC50	Mortality	Cd atomic absorption standard	Juvenile	1.6	3.3	124	7.23-8.83 * (measured at end)	7-10 (END) - not aerated during test	(Borgmann et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d LC50	Mortality	Cd metal standard	0 - 7 d old	0.53	1.1	130	7.9-9		(Borgmann et al. 1991)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	14 d LC50	Mortality	CdCl2	Juvenile	0.65	7.0	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	10 d LC50	Mortality	CdCl2	Juvenile	1.2	13.0	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	7 d LC50	Mortality	CdCl2	Juvenile	1.7	18.4	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	14 d MATC	Mortality	CdCl2	Juvenile	0.16	1.7	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	7 d MATC	Mortality	CdCl2	Juvenile	1.4	15.2	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	10 d MATC	Mortality	CdCl2	Juvenile	1.4	15.2	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	14 d NOEC/L	Growth	CdCl2	Juvenile	2	21.7	17	5.5-7.7	4.2-9.3	(Suedel et al. 1997)	Drop: for IC25		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d IC25	Biomass, decrease in	CdCl2	7-8 d old	0.51	0.5	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Keep (revisit)		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d IC25	Weight	CdCl2	7-8 d old	0.74	0.8	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Keep (revisit)		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d MATC	Mortality	CdCl2	7-8 d old	0.98	1.0	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d IC25	Reproduction	CdCl2	7-8 d old	1.4	1.5	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Keep (revisit)		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d IC25	Mortality	CdCl2	7-8 d old	1.9	2.0	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d LOEC/L	Mortality	CdCl2	7-8 d old	1.9	2.0	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Drop: for better endpoints		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d IC25	Length	CdCl2	7-8 d old	2.6	2.8	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Keep (revisit)		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d NOEC/L	Mortality	CdCl2	7-8 d old	0.51	0.5	280	7.8	>2.5	(Ingersoll and Kemble 2001)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d NOEC/L	Mortality	3CdSO4.8H2O	7-8 d old	2.49	4.1	162.7	7.9 (0.1)	6.1 (1.8)	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d NOEC/L	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	2.49	4.1	162.7	7.9 ± 0.1	6.1 ± 1.8	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d MATC	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	2.63	5.0	139.6	7.1 ± 0.2	5.9 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d MATC	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	2.63	5.0	139.6	7.1 ± 0.2	5.9 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d MATC	Mortality	3CdSO4.8H2O	7-8 d old	3.56	5.9	162.7	7.9 (0.1)	6.1 (1.8)	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d MATC	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	3.56	5.9	162.7	7.9 ± 0.1	6.1 ± 1.8	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d LOEC/L	Mortality	3CdSO4.8H2O	7-8 d old	5.09	8.5	162.7	7.9 (0.1)	6.1 (1.8)	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d LOEC/L	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	5.09	8.5	162.7	7.9 ± 0.1	6.1 ± 1.8	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d LOEC/L	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	4.53	8.5	139.6	7.1 ± 0.2	5.9 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d LOEC/L	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	4.53	8.5	139.6	7.1 ± 0.2	5.9 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d NOEC/L	Mortality	Cadmium sulfate	Unknown	<4.53	#VALUE!	139.6	7.1 ± 0.2	5.9 ± 1.1	(Stanley et al. 2005)	Drop: for better		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d NOEC/L	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	<4.53	#VALUE!	139.6	7.1 ± 0.2	5.9 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d	Mortality	3CdSO4.8	7-8 d old	6.82	12.9	139.6	7	6.7	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d NOEC/L	Mortality	3CdSO4.8H2O	7-8 d old	6.82	12.9	139.6	7.0 (0.3)	6.7 (1.1)	(Stanley et al. 2005)	Drop: for better endpoints		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d MATC	Mortality	3CdSO4.8H2O	7-8 d old	12.52	23.6	139.6	7.0 (0.3)	6.7 (1.1)	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d MATC	Mortality	3CdSO4.8H2O	7-8 d old	12.52	23.6	139.6	7.0 (0.3)	6.7 (1.1)	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d LOEC/L	Mortality	3CdSO4.8H2O	7-8 d old	22.97	43.3	139.6	7.0 (0.3)	6.7 (1.1)	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d LOEC/L	Mortality	3CdSO4.8H2O	7-8 d old	22.97	43.3	139.6	7.0 (0.3)	6.7 (1.1)	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d LC50	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	14.22	26.8	139.6	7.0 ± 0.3	6.7 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d NOEC/L	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	6.82	12.9	139.6	7.0 ± 0.3	6.7 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d LOEC/L	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	22.97	43.3	139.6	7.0 ± 0.3	6.7 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d MATC	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	12.52	23.6	139.6	7.0 ± 0.3	6.7 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d LC50	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	14.1	26.6	139.6	7.0 ± 0.3	6.7 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d NOEC/L	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	6.82	12.9	139.6	7.0 ± 0.3	6.7 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d LOEC/L	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	22.97	43.3	139.6	7.0 ± 0.3	6.7 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d MATC	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	12.52	23.6	139.6	7.0 ± 0.3	6.7 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d LC50	Mortality	3CdSO4.8H2O	7-8 d old	5.09	8.5	162.7	7.9 (0.1)	6.1 (1.8)	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d LC50	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	5.09	8.5	162.7	7.9 ± 0.1	6.1 ± 1.8	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d LC50	Mortality	3CdSO4.8H2O	7-8 d old	14.1	26.6	139.6	7.0 (0.3)	6.7 (1.1)	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d LC50	Mortality	3CdSO4.8H2O	7-8 d old	14.22	26.8	139.6	7.0 (0.3)	6.7 (1.1)	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d LC50	Mortality	3CdSO4.8	7-8 d old	18.77	35.4	139.6	7.1	5.9	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	28 d LC50	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	18.77	35.4	139.6	7.1 ± 0.2	5.9 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d LC50	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	<4.53	#VALUE!	139.6	7.1 ± 0.2	5.9 ± 1.1	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d NOEC/L	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	0.48	0.8	162.7	7.9 ± 0.1	6.1 ± 1.8	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d MATC	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	0.67	1.1	162.7	7.9 ± 0.1	6.1 ± 1.8	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d LOEC/L	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	0.94	1.6	162.7	7.9 ± 0.1	6.1 ± 1.8	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d LC50	Mortality	Cadmium sulfate (3CdSO4-8H20)	Unknown	1.12	1.9	162.7	7.9 ± 0.1	6.1 ± 1.8	(Stanley et al. 2005)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d NOEC/L	Mortality	Cd metal standard	0 - 7 d old	0.57	1.1	130	8.2-8.8		(Borgmann et al. 1989)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d LOEC/L	Mortality	Cd metal standard	0 - 7 d old	0.92	1.8	130	8.2-8.8		(Borgmann et al. 1989)	Drop: for better endpoints		
Hyalella azteca	Amphipod	Aquatic Invertebrate	42 d MATC	Mortality	Cd metal standard	0 - 7 d old	0.72	1.4	130	8.2-8.8		(Borgmann et al. 1989)	Drop: for better endpoints		
Hydra viridissima	Green Hydra	Aquatic Invertebrate	7 d NOEC/L	Population growth inhibition	cadmium chloride		0.4	3.9	19.5	7.25-7.53	7.73-9.44	(Holdway et al. 2001)	Keep		
Hydra vulgaris	Pink Hydra	Aquatic Invertebrate	7 d NOEC/L	Population growth inhibition	cadmium chloride		<12.5	#VALUE!	19.5	7.25-7.53	7.73-9.44	(Holdway et al. 2001)	Drop: <		
Lampsilis siliquoidea	Fatmucket	Aquatic Invertebrate	28 d NOEC/L	Mortality	cadmium nitrate (Cd(NO3)2)	Juvenile	4.4	21.6	44	7.2-7.6	>7.0	(Wang et al. 2010)	Drop: for better endpoints		
Lampsilis siliquoidea	Fatmucket	Aquatic Invertebrate	28 d NOEC/L	Length	cadmium nitrate (Cd(NO3)2)	Juvenile	4.4	21.6	44	7.2-7.6	>7.0	(Wang et al. 2010)	Drop: for IC10/20		
Lampsilis siliquoidea	Fatmucket	Aquatic Invertebrate	28 d IC10	Length	cadmium nitrate (Cd(NO3)2)	Juvenile	4.6	22.6	44	7.2-7.6	>7.0	(Wang et al. 2010)	Keep		
Lampsilis siliquoidea	Fatmucket	Aquatic Invertebrate	28 d IC10	Mortality	cadmium nitrate (Cd(NO3)2)	Juvenile	4.8	23.6	44	7.2-7.6	>7.0	(Wang et al. 2010)	Drop: for better endpoints		
Lampsilis siliquoidea	Fatmucket	Aquatic Invertebrate	28 d IC20	Length	cadmium nitrate (Cd(NO3)2)	Juvenile	5	24.6	44	7.2-7.6	>7.0	(Wang et al. 2010)	Keep		
Lampsilis siliquoidea	Fatmucket	Aquatic Invertebrate	28 d IC20	Mortality	cadmium nitrate (Cd(NO3)2)	Juvenile	5.7	28.0	44	7.2-7.6	>7.0	(Wang et al. 2010)	Drop: for better endpoints		
Lampsilis siliquoidea	Fatmucket	Aquatic Invertebrate	28 d ChV	Mortality	cadmium nitrate (Cd(NO3)2)	Juvenile	6	29.5	44	7.2-7.6	>7.0	(Wang et al. 2010)	Drop: for better endpoints		
Lampsilis siliquoidea	Fatmucket	Aquatic Invertebrate	28 d ChV	Length	cadmium nitrate (Cd(NO3)2)	Juvenile	6	29.5	44	7.2-7.6	>7.0	(Wang et al. 2010)	Keep		
Lampsilis siliquoidea	Fatmucket	Aquatic Invertebrate	28 d EC50	Mortality	cadmium nitrate (Cd(NO3)2)	Juvenile	8.1	39.9	44	7.2-7.6	>7.0	(Wang et al. 2010)	Drop: for better endpoints		
Lampsilis siliquoidea	Fatmucket	Aquatic Invertebrate	28 d LOEC/L	Mortality	cadmium nitrate (Cd(NO3)2)	Juvenile	8.2	40.3	44	7.2-7.6	>7.0	(Wang et al. 2010)	Drop: for better endpoints		
Lampsilis siliquoidea	Fatmucket	Aquatic Invertebrate	28 d LOEC/L	Length	cadmium nitrate (Cd(NO3)2)	Juvenile	8.2	40.3	44	7.2-7.6	>7.0	(Wang et al. 2010)	Drop: for IC10/20		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Lampsilis siliquoidea	Fatmucket	Aquatic Invertebrate	21 d EC50	Mortality	cadmium nitrate (Cd(NO3)2)	Juvenile	12	59.0	44	7.2-7.6	>7.0	(Wang et al. 2010)	Drop: for better endpoints		
Leptophlebia marginata	Mayfly	Aquatic Invertebrate	5 d LC50	Mortality	Not specified	Unknown	5000	22122.6	50	5		(Gerhardt 1992)	Drop: duration		
Leptophlebia marginata	Mayfly	Aquatic Invertebrate	5 d LC50	Mortality	not specified	Unknown	5000	22122.6	50	7		(Gerhardt 1992)	Drop: duration		
Leptophlebia marginata	Mayfly	Aquatic Invertebrate	5 d LC50	Mortality	not specified	Unknown	3600	15928.2	50	5		(Gerhardt 1992)	Drop: duration		
Leptophlebia marginata	Mayfly	Aquatic Invertebrate	5 d LC50	Mortality	not specified	Unknown	5000	22122.6	50	7		(Gerhardt 1992)	Drop: duration		
Lymnaea palustris	Marsh Snail	Aquatic Invertebrate	4 weeks EC50	Growth	cadmium chloride	Adult	58.2	257.5	50	6.65-8.14		(Coeurdassier et al. 2003)	Drop: for NOEC		
Lymnaea palustris	Marsh Snail	Aquatic Invertebrate	4 weeks EC50	Repro - No. egg masses per individual	cadmium chloride	Adult	60.9	269.5	50	6.65-8.14		(Coeurdassier et al. 2003)	Drop: for NOEC		
Lymnaea palustris	Marsh Snail	Aquatic Invertebrate	4 weeks EC50	Repro - No. eggs per individual	cadmium chloride	Adult	64.7	286.3	50	6.65-8.14		(Coeurdassier et al. 2003)	Drop: for NOEC		
Lymnaea palustris	Marsh Snail	Aquatic Invertebrate	4 weeks EC50	Repro - No. eggs per egg mass	cadmium chloride	Adult	124	548.6	50	6.65-8.14		(Coeurdassier et al. 2003)	Drop: for NOEC		
Lymnaea palustris	Marsh Snail	Aquatic Invertebrate	4 weeks LC50	Mortality	cadmium chloride	Adult	320	1415.8	50	6.65-8.14		(Coeurdassier et al. 2003)	Drop: for better endpoints		
Lymnaea palustris	Marsh Snail	Aquatic Invertebrate	4 weeks NOEC/L	Growth	cadmium chloride	Adult	40	177.0	50	6.65-8.14		(Coeurdassier et al. 2003)	Keep		
Lymnaea palustris	Marsh Snail	Aquatic Invertebrate	4 weeks NOEC/L	Repro - No. egg masses per individual	cadmium chloride	Adult	40	177.0	50	6.65-8.14		(Coeurdassier et al. 2003)	Keep		
Lymnaea palustris	Marsh Snail	Aquatic Invertebrate	4 weeks NOEC/L	Repro - No. eggs per individual	cadmium chloride	Adult	40	177.0	50	6.65-8.14		(Coeurdassier et al. 2003)	Keep		
Lymnaea palustris	Marsh Snail	Aquatic Invertebrate	4 weeks NOEC/L	Mortality	cadmium chloride	Adult	320	#VALUE!	NR	6.65-8.14		(Coeurdassier et al. 2003)	Drop: for better endpoints		
Lymnaea palustris	Marsh Snail	Aquatic Invertebrate	4 weeks EC50	Growth	cadmium chloride	Adult	142.2	148.8	284	6.65-8.14		(Coeurdassier et al. 2003)	Drop: for NOEC		
Lymnaea palustris	Marsh Snail	Aquatic Invertebrate	4 weeks NOEC/L	Growth	cadmium chloride	Adult	80	83.7	284	6.65-8.14		(Coeurdassier et al. 2003)	Keep		
Pachydiplax longipennis	Dragonfly	Aquatic Invertebrate	7 d LOEC/L	Mortality	cadmium chloride hemipentahydrate	Larva	250000	534847.8	120	6.24	NR	(Tollett et al. 2009)	Drop: duration		
Pachydiplax longipennis	Dragonfly	Aquatic Invertebrate	7 d MATC	Mortality	cadmium chloride hemipentahydrate	Larva	160000	342302.6	120	6.24	NR	(Tollett et al. 2009)	Drop: duration		
Pachydiplax longipennis	Dragonfly	Aquatic Invertebrate	7 d NOEC/L	Mortality	cadmium chloride hemipentahydrate	Larva	100000	213939.1	120	6.24	NR	(Tollett et al. 2009)	Drop: duration		
Rhithrogena hageni	Mayfly	Aquatic Invertebrate	10 d EC10	Mortality	cadmium sulfate	nymph	2571	11767.5	48	7.66 ± 0.1	9.07 ± 0.15	(Brinkman and Johnston 2008)	Drop: duration		
Rhithrogena hageni	Mayfly	Aquatic Invertebrate	10 d LOEC/L	Mortality	cadmium sulfate	nymph	3520	16111.0	48	7.66 ± 0.1	9.07 ± 0.15	(Brinkman and Johnston 2008)	Drop: duration		
Rhithrogena hageni	Mayfly	Aquatic Invertebrate	10 d NOEC/L	Mortality	cadmium sulfate	nymph	1880	8604.8	48	7.66 ± 0.1	9.07 ± 0.15	(Brinkman and Johnston 2008)	Drop: duration		
Lemna minor	Duckweed	Algae/Plant	7 d EC50	Growth rate	cadmium	Not	214	349.7	166	5.5 +-		(Drost et al. 2007)	Keep (revisit)		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Lemna minor	Duckweed	Algae/Plant	6 d EC50	Growth rate	cadmium sulphate	Not reported	214	349.7	166	5.5 +- 0.2		(Drost et al. 2007)	Keep (revisit)		
Lemna minor	Duckweed	Algae/Plant	5 d EC50	Growth rate	cadmium sulphate	Not reported	315	514.8	166	5.5 +- 0.2		(Drost et al. 2007)	Keep (revisit)		
Lemna minor	Duckweed	Algae/Plant	4 d EC50	Growth rate	cadmium sulphate	NR	337	550.7	166	5.5 +- 0.2		(Drost et al. 2007)	Keep (revisit)		
Lemna minor	Duckweed	Algae/Plant	3 d EC50	Growth rate	cadmium sulphate	NR	393	642.3	166	5.5 +- 0.2		(Drost et al. 2007)	Keep (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	48-hr LC50		2CdCls.5H20	adult	4.58	20.3	50			Martin and Hol	Drop: duration		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50		2CdCls.5H20	Adult	1320	5840.4	50			Martin and Hol	Drop: duration (revisit)		
Crangonyx pseudogracilis	Amphipod	Aquatic Invertebrate	48-hr LC50		2CdCls.5H20	NR	34.6	153.1	50			Martin and Hol	Drop: duration		
Crangonyx pseudogracilis	Amphipod	Aquatic Invertebrate	96-hr LC50		2CdCls.5H20	NR	1.7	7.5	50			Martin and Hol	Drop: duration		
Physa integra	Snail	Aquatic Invertebrate	28-d LC50		CdCl2	NR	10.4	49.3	46			Spehar 1978	Keep		
Physa integra	Snail	Aquatic Invertebrate	7-d LC50		CdCl2	NR	114	540.5	46			Spehar 1978	Drop: duration		
Ephemerella sp.	Mayfly	Aquatic Invertebrate	28-d LC50		CdCl2	NR	<3	#VALUE!	46			Spehar 1978	Drop: <		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			embryo	2000	4780.3	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			embryo	1750	4182.7	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			embryo	300	717.0	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			embryo	240	573.6	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			Juvenile	80	191.2	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			Juvenile	53	126.7	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			Juvenile	170	406.3	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			Juvenile	150	358.5	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			Juvenile	175	418.3	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			Juvenile	170	406.3	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			Juvenile	320	764.8	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			Juvenile	230	549.7	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			Juvenile	540	1290.7	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			Juvenile	450	1075.6	105			Green, William	Drop: duration (revisit)		
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			Juvenile	1000	2390.1	105			Green, William	Drop: duration (revisit)		

Species Latin name	(Common Name)	Type	Endpoint	Observed effect	Formulation	Life stage	Effect concentration (µg/L)	Hardness Corrected Effect (µg/L)	Hardness (as CaCO3)	pH	Dissolve Oxygen (mg/L)	Reference	Notes	300	Hardness adjusted (mg/L CaCO3)
Asellus aquaticus	Isopod	Aquatic Invertebrate	96-hr LC50			Juvenile	600	1434.1	105			Green, William	Drop: duration (revisit)		
Aeolosoma headleyi	Oligochaete	Aquatic Invertebrate	Life Cycle MATC	grow and rep			40	62.6	175			Niederlehner et	Keep		
Aeolosoma headleyi	Oligochaete	Aquatic Invertebrate	Life Cycle EC20	growth			57	89.2	175			Niederlehner et	Drop: for MATC		
Lumbriculus variegatus	Oligochaete	Aquatic Invertebrate	28d MATC	reproduction			96.7	182.0	140			Straus 2011	Keep (revisit)		
Lumbriculus variegatus	Oligochaete	Aquatic Invertebrate	28d EC20	reproduction			19.8	37.3	140			Straus 2011	Keep (revisit)		
Lymnaea stagnalis	Pond snail	Aquatic Invertebrate	31d EC20	growth			35.6	69.1	135			Pais 2012	Keep		
Potamopyrgus antipodarum	Mudsnail	Aquatic Invertebrate	28d MATC	reproduction			1.6	#VALUE!	NR			Sieratowicz et a	Drop: no hardness information		
Potamopyrgus antipodarum	Mudsnail	Aquatic Invertebrate	28d EC20	reproduction			2.6	#VALUE!	NR			Sieratowicz et a	Drop: no hardness information		
Ceriodaphnia dubia	Cladoceran	Aquatic Invertebrate	Life Cycle EC20	reproduction			3	32.5	17			Southwest Tex	Keep		
Baetis sp.	Mayfly	Aquatic Invertebrate	30d EC20	abundance			0.23	2.5	17			Mebane et al. 2	Keep		
Baetis sp.	Mayfly	Aquatic Invertebrate	30d EC50	abundance			0.38	4.1	17			Mebane et al. 2	Drop: for EC20		
Diphetor hageni	Mayfly	Aquatic Invertebrate	30d EC20	abundance			0.71	7.7	17			Mebane et al. 2	Keep		
Diphetor hageni	Mayfly	Aquatic Invertebrate	30d EC50	abundance			1.08	11.7	17			Mebane et al. 2	Drop: for EC20		
Ephemerella infrequens	Mayfly	Aquatic Invertebrate	30d EC20	abundance			0.1	1.1	17			Mebane et al. 2	Keep		
Ephemerella infrequens	Mayfly	Aquatic Invertebrate	30d EC50	abundance			0.37	4.0	17			Mebane et al. 2	Drop: for EC20		
Epeorus longimanus	Mayfly	Aquatic Invertebrate	30d EC20	abundance			1.1	11.9	17			Mebane et al. 2	Keep		
Epeorus longimanus	Mayfly	Aquatic Invertebrate	30d EC50	abundance			1.1	11.9	17			Mebane et al. 2	Drop: for EC20		
Rhithrogena sp.	Mayfly	Aquatic Invertebrate	30d EC20	abundance			0.8	8.7	17			Mebane et al. 2	Keep		
Rhithrogena sp.	Mayfly	Aquatic Invertebrate	30d EC50	abundance			1.2	13.0	17			Mebane et al. 2	Drop: for EC20		
Lepidostoma sp.	Caddisfly	Aquatic Invertebrate	30d EC20	abundance			1.1	11.9	17			Mebane et al. 2	Keep		
Lepidostoma sp.	Caddisfly	Aquatic Invertebrate	30d EC50	abundance			1.1	11.9	17			Mebane et al. 2	Drop: for EC20		
Rheotanytarsus sp.	Diptera Fly	Aquatic Invertebrate	30d EC20	abundance			1.1	11.9	17			Mebane et al. 2	Keep		
Rheotanytarsus sp.	Diptera Fly	Aquatic Invertebrate	30d EC50	abundance			1.1	11.9	17			Mebane et al. 2	Drop: for EC20		
Lemna minor	Duckweed	Algae/Plant	EC10	growth			22	#VALUE!	NR			Naumann et al.	Drop: no hardness information		

Data originally from CCME (2012) Appendix A(ii) with additional literature search

APPENDIX E

Ecological Receptor Calculations

Bunting - Air Strip

Receptor
EurekaBunting
Aquatic Pathways Source
Drainage Pond
Terrestrial Pathways Source
Air Strip
Water Reference Location
Background
Sediment Reference Location
Background
Benthic Reference Location
Background
Fish Reference Location
Background
Aquatic Vegetation Reference Location
Background
Aquatic/Terrestrial Insect Source

Snow Bunting

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	0.046
Water ingestion rate	Water	m^3/d	0.0000075
Food ingestion rate – wet weight basis	Food	g (ww)/d	26
Sediment ingestion rate	Sediment	g (dw)/d	-
Soil ingestion rate	Soil	g (dw)/d	0.73
Fraction of time on site	Frac	-	1
Diet composition:			
Benthic Invertebrates	Benthic	-	-
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	0.5
Foliage	Foliage	-	0.5
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	-
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	DrainagePond	Background
Sediment	-	-
Benthic	-	-
AquaticVeg	-	-
Fish	-	-
Soil	AirStrip	Background
TerrInsects	AirStrip	Background
Foliage	AirStrip	Background
WoodyVeg	-	-
FruitsFlowers	-	-
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	-	-	-	-	-	-
Soil	Soil_AirStrip	mg/kg	7.60E+00	2.03E+01	1.29E+01	6.34E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	TerrInsects_AirStrip	mg/kg ww	2.82E-01	2.46E+00	5.15E+00	6.83E+01
Foliage	Foliage_AirStrip	mg/kg ww	8.55E-02	1.92E+00	3.34E-01	1.44E+01
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	-	-	-	-	-	-
Soil	Soil_Background	mg/kg	1.00E+01	1.80E+01	6.00E+00	4.80E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	TerrInsects_Background	mg/kg ww	3.76E-01	2.42E+00	2.40E+00	5.17E+01
Foliage	Foliage_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	1.39E-04	2.28E-04	4.40E-05	6.68E-04
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	1.21E-01	3.22E-01	2.05E-01	1.01E+00
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	mg/kg-d	7.98E-02	6.95E-01	1.46E+00	1.93E+01
	Foliage	mg/kg-d	2.42E-02	5.41E-01	9.43E-02	4.08E+00
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	2.25E-01	1.56E+00	1.76E+00	2.44E+01
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.04	0.04	0.04	0.14
Concentration		mg/kg ww				

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	3.26E-04	1.30E-03	4.89E-04	5.38E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	1.59E-01	2.86E-01	9.52E-02	7.62E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	mg/kg-d	1.06E-01	6.83E-01	6.77E-01	1.46E+01
	Foliage	mg/kg-d	3.18E-02	5.16E-01	6.14E-02	3.50E+00
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	2.97E-01	1.49E+00	8.34E-01	1.89E+01
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.05	0.04	0.02	0.11
Concentration		mg/kg ww				

Bunting - Main Station

Receptor	
	EurekaBunting
Aquatic Pathways Source	
	Drainage Pond
Terrestrial Pathways Source	
	Main Station
Water Reference Location	
	Background
Sediment Reference Location	
	Background
Benthic Reference Location	
	Background
Fish Reference Location	
	Background
Aquatic Vegetation Reference Location	
	Background
Aquatic/Terrestrial Insect Source	

Snow Bunting

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	0.046
Water ingestion rate	Water	m^3/d	0.0000075
Food ingestion rate – wet weight basis	Food	g (ww)/d	26
Sediment ingestion rate	Sediment	g (dw)/d	-
Soil ingestion rate	Soil	g (dw)/d	0.73
Fraction of time on site	Frac	-	1
Diet composition:			
Benthic Invertebrates	Benthic	-	-
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	0.5
Foliage	Foliage	-	0.5
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	-
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	DrainagePond	Background
Sediment	-	-
Benthic	-	-
AquaticVeg	-	-
Fish	-	-
Soil	MainStation	Background
TerrInsects	MainStation	Background
Foliage	MainStation	Background
WoodyVeg	-	-
FruitsFlowers	-	-
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	-	-	-	-	-	-
Soil	Soil_MainStation	mg/kg	1.22E+01	4.50E+01	1.96E+01	1.01E+02
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	TerrInsects_MainStation	mg/kg ww	4.46E-01	2.75E+00	7.83E+00	1.09E+02
Foliage	Foliage_MainStation	mg/kg ww	1.37E-01	2.62E+00	4.22E-01	1.87E+01
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	-	-	-	-	-	-
Soil	Soil_Background	mg/kg	1.00E+01	1.80E+01	6.00E+00	4.80E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	TerrInsects_Background	mg/kg ww	3.76E-01	2.42E+00	2.40E+00	5.17E+01
Foliage	Foliage_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	1.39E-04	2.28E-04	4.40E-05	6.68E-04
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	1.94E-01	7.14E-01	3.11E-01	1.60E+00
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	mg/kg-d	1.26E-01	7.78E-01	2.21E+00	3.08E+01
	Foliage	mg/kg-d	3.88E-02	7.41E-01	1.19E-01	5.28E+00
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	3.59E-01	2.23E+00	2.64E+00	3.77E+01
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.06	0.06	0.06	0.22
Concentration		mg/kg ww				

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	3.26E-04	1.30E-03	4.89E-04	5.38E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	1.59E-01	2.86E-01	9.52E-02	7.62E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	mg/kg-d	1.06E-01	6.83E-01	6.77E-01	1.46E+01
	Foliage	mg/kg-d	3.18E-02	5.16E-01	6.14E-02	3.50E+00
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	2.97E-01	1.49E+00	8.34E-01	1.89E+01
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.05	0.04	0.02	0.11
Concentration		mg/kg ww				

Fox - Air Strip

Receptor	
	EurekaFox
Aquatic Pathways Source	
	Drainage Pond
Terrestrial Pathways Source	
	Air Strip
Water Reference Location	
	Background
Sediment Reference Location	
	Background
Benthic Reference Location	
	Background
Fish Reference Location	
	Background
Aquatic Vegetation Reference Location	
	Background
Aquatic/Terrestrial Insect Source	

Arctic Fox

Parameter		**Units**	**Value**
Characteristics:			
Body weight	BW	kg	5.8
Water ingestion rate	Water	m^3/d	0.00048
Food ingestion rate – wet weight basis	Food	g (ww)/d	874
Sediment ingestion rate	Sediment	g (dw)/d	-
Soil ingestion rate	Soil	g (dw)/d	8
Fraction of time on site	Frac	-	0.1
Diet composition:			
Benthic Invertebrates	Benthic	-	-
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	-
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	0.1
Lemming	Lemming	-	0.5
Grouse/Ptarmigan	Ptarmigan	-	0.2
Hare	Hare	-	0.2
Mouse	Mouse	-	-
		Total	1.00

Location:	**Exposure**	**Reference**
Water	DrainagePond	Background
Sediment	-	-
Benthic	-	-
AquaticVeg	-	-
Fish	-	-
Soil	AirStrip	Background
TerrInsects	-	-
Foliage	-	-
WoodyVeg	-	-
FruitsFlowers	AirStrip	Background
Lemming	AirStrip	Background
Ptarmigan	AirStrip	Background
Hare	AirStrip	Background
Mouse	-	-

Exposure EPCs	**Code**	**Units**	**Arsenic**	**Copper**	**Lead**	**Zinc**
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	-	-	-	-	-	-
Soil	Soil_AirStrip	mg/kg	7.60E+00	2.03E+01	1.29E+01	6.34E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	FruitsFlowers_AirStrip	mg/kg ww	8.55E-02	1.92E+00	3.34E-01	1.44E+01
Lemming	Lemming_AirStrip	mg/kg ww	1.32E-02	3.81E+00	1.07E+00	3.37E+01
Grouse/Ptarmigan	Ptarmigan_AirStrip	mg/kg ww	3.54E-02	1.78E-01	7.95E-02	2.09E+01
Hare	Hare_AirStrip	mg/kg ww	1.44E-02	5.58E-01	6.26E-03	2.93E+01
Mouse	-	-	-	-	-	-

Background Location EPCs	**Code**	**Units**	**Arsenic**	**Copper**	**Lead**	**Zinc**
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	-	-	-	-	-	-
Soil	Soil_Background	mg/kg	1.00E+01	1.80E+01	6.00E+00	4.80E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	FruitsFlowers_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Lemming	Lemming_Background	mg/kg ww	1.66E-02	3.74E+00	7.63E-01	3.30E+01
Grouse/Ptarmigan	Ptarmigan_Background	mg/kg ww	4.66E-02	1.67E-01	4.42E-02	1.78E+01
Hare	Hare_Background	mg/kg ww	1.89E-02	5.27E-01	3.59E-03	2.51E+01
Mouse	-	-	-	-	-	-

Exposure		**Units**	**Arsenic**	**Copper**	**Lead**	**Zinc**
Intake	Water	mg/kg-d	1.56E-04	6.07E-04	2.26E-04	2.46E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	1.35E-02	2.51E-02	9.23E-03	6.83E-02
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	mg/kg-d	1.66E-03	2.77E-02	3.45E-03	1.90E-01
	Lemming	mg/kg-d	1.22E-03	2.83E-01	5.98E-02	2.49E+00
	Grouse/Ptarmigan	mg/kg-d	1.37E-03	5.06E-03	1.44E-03	5.45E-01
	Hare	mg/kg-d	5.57E-04	1.60E-02	1.16E-04	7.70E-01
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	1.84E-02	3.57E-01	7.42E-02	4.09E+00
TRV		mg/kg-d	3.60E+00	6.10E+01	1.59E+02	2.98E+02
SI Value		-	0.01	0.01	0.00	0.01
Concentration		mg/kg ww				

Background		**Units**	**Arsenic**	**Copper**	**Lead**	**Zinc**
Intake	Water	mg/kg-d	1.66E-04	6.62E-04	2.48E-04	2.73E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	1.38E-02	2.48E-02	8.28E-03	6.62E-02
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	mg/kg-d	1.70E-03	2.75E-02	3.27E-03	1.86E-01
	Lemming	mg/kg-d	1.25E-03	2.82E-01	5.75E-02	2.49E+00
	Grouse/Ptarmigan	mg/kg-d	1.41E-03	5.03E-03	1.33E-03	5.36E-01
	Hare	mg/kg-d	5.70E-04	1.59E-02	1.08E-04	7.58E-01
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	1.89E-02	3.56E-01	7.07E-02	4.06E+00
TRV		mg/kg-d	3.60E+00	6.10E+01	1.59E+02	2.98E+02
SI Value		-	0.01	0.01	0.00	0.01
Concentration		mg/kg ww				

Fox - Main Station

Receptor	
	EurekaFox
Aquatic Pathways Source	
	Drainage Pond
Terrestrial Pathways Source	
	Main Station
Water Reference Location	
	Background
Sediment Reference Location	
	Background
Benthic Reference Location	
	Background
Fish Reference Location	
	Background
Aquatic Vegetation Reference Location	
	Background
Aquatic/Terrestrial Insect Source	

Arctic Fox

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	5.8
Water ingestion rate	Water	m^3/d	0.00048
Food ingestion rate – wet weight basis	Food	g (ww)/d	874
Sediment ingestion rate	Sediment	g (dw)/d	-
Soil ingestion rate	Soil	g (dw)/d	8
Fraction of time on site	Frac	-	0.1
Diet composition:			
Benthic Invertebrates	Benthic	-	-
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	-
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	0.1
Lemming	Lemming	-	0.5
Grouse/Ptarmigan	Ptarmigan	-	0.2
Hare	Hare	-	0.2
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	DrainagePond	Background
Sediment	-	-
Benthic	-	-
AquaticVeg	-	-
Fish	-	-
Soil	MainStation	Background
TerrInsects	-	-
Foliage	-	-
WoodyVeg	-	-
FruitsFlowers	MainStation	Background
Lemming	MainStation	Background
Ptarmigan	MainStation	Background
Hare	MainStation	Background
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	-	-	-	-	-	-
Soil	Soil_MainStation	mg/kg	1.22E+01	4.50E+01	1.96E+01	1.01E+02
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	FruitsFlowers_MainStation	mg/kg ww	1.37E-01	2.62E+00	4.22E-01	1.87E+01
Lemming	Lemming_MainStation	mg/kg ww	1.95E-02	4.27E+00	1.29E+00	3.48E+01
Grouse/Ptarmigan	Ptarmigan_MainStation	mg/kg ww	5.68E-02	2.77E-01	1.11E-01	2.77E+01
Hare	Hare_MainStation	mg/kg ww	2.30E-02	8.44E-01	8.60E-03	3.86E+01
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	-	-	-	-	-	-
Soil	Soil_Background	mg/kg	1.00E+01	1.80E+01	6.00E+00	4.80E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	FruitsFlowers_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Lemming	Lemming_Background	mg/kg ww	1.66E-02	3.74E+00	7.63E-01	3.30E+01
Grouse/Ptarmigan	Ptarmigan_Background	mg/kg ww	4.66E-02	1.67E-01	4.42E-02	1.78E+01
Hare	Hare_Background	mg/kg ww	1.89E-02	5.27E-01	3.59E-03	2.51E+01
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	1.56E-04	6.07E-04	2.26E-04	2.46E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	1.41E-02	2.86E-02	1.02E-02	7.35E-02
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	mg/kg-d	1.73E-03	2.87E-02	3.58E-03	1.96E-01
	Lemming	mg/kg-d	1.27E-03	2.86E-01	6.14E-02	2.50E+00
	Grouse/Ptarmigan	mg/kg-d	1.44E-03	5.36E-03	1.53E-03	5.66E-01
	Hare	mg/kg-d	5.83E-04	1.68E-02	1.23E-04	7.98E-01
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	1.93E-02	3.66E-01	7.70E-02	4.16E+00
TRV		mg/kg-d	3.60E+00	6.10E+01	1.59E+02	2.98E+02
SI Value		-	0.01	0.01	0.000	0.01
Concentration		mg/kg ww				

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	1.66E-04	6.62E-04	2.48E-04	2.73E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	1.38E-02	2.48E-02	8.28E-03	6.62E-02
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	mg/kg-d	1.70E-03	2.75E-02	3.27E-03	1.86E-01
	Lemming	mg/kg-d	1.25E-03	2.82E-01	5.75E-02	2.49E+00
	Grouse/Ptarmigan	mg/kg-d	1.41E-03	5.03E-03	1.33E-03	5.36E-01
	Hare	mg/kg-d	5.70E-04	1.59E-02	1.08E-04	7.58E-01
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	1.89E-02	3.56E-01	7.07E-02	4.06E+00
TRV		mg/kg-d	3.60E+00	6.10E+01	1.59E+02	2.98E+02
SI Value		-	0.01	0.01	0.00	0.01
Concentration		mg/kg ww				

Gull - Drainage Pond

Receptor
EurekaGull
Aquatic Pathways Source
Drainage Pond
Terrestrial Pathways Source

Water Reference Location
Background
Sediment Reference Location
Background
Benthic Reference Location
Background
Fish Reference Location
Background
Aquatic Vegetation Reference Location
Background
Aquatic/Terrestrial Insect Source

Glaucous Gull

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	1.98
Water ingestion rate	Water	m^3/d	0.000093
Food ingestion rate – wet weight basis	Food	g (ww)/d	454
Sediment ingestion rate	Sediment	g (dw)/d	1.2
Soil ingestion rate	Soil	g (dw)/d	-
Fraction of time on site	Frac	-	0.1
Diet composition:			
Benthic Invertebrates	Benthic	-	-
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	1
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	-
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	-
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	DrainagePond	Background
Sediment	DrainagePond	Background
Benthic	-	-
AquaticVeg	-	-
Fish	DrainagePond	Background
Soil	-	-
TerrInsects	-	-
Foliage	-	-
WoodyVeg	-	-
FruitsFlowers	-	-
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	Sediment_DrainagePond	mg/kg dw	1.04E+01	1.82E+01	1.08E+01	7.27E+01
Soil	-	-	-	-	-	-
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	Fish_DrainagePond	mg/kg ww	1.45E+00	2.80E-01	8.10E-02	8.20E+00
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	Sediment_Background	mg/kg dw	1.30E+01	2.70E+01	1.10E+01	5.60E+01
Soil	-	-	-	-	-	-
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	Fish_Background	mg/kg ww	3.40E+00	1.60E+00	9.00E-01	6.60E+02
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	8.85E-05	3.45E-04	1.28E-04	1.40E-02
	Sediment	mg/kg-d	7.72E-03	1.58E-02	6.65E-03	3.50E-02
	Soil	-	-	-	-	-
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	mg/kg-d	7.35E-01	3.37E-01	1.88E-01	1.36E+02
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	7.43E-01	3.53E-01	1.94E-01	1.36E+02
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.13	0.01	0.00	0.79
Concentration		mg/kg ww				

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	9.39E-05	3.76E-04	1.41E-04	1.55E-02
	Sediment	mg/kg-d	7.88E-03	1.64E-02	6.67E-03	3.39E-02
	Soil	-	-	-	-	-
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	mg/kg-d	7.80E-01	3.67E-01	2.06E-01	1.51E+02
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	7.88E-01	3.84E-01	2.13E-01	1.51E+02
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.14	0.01	0.00	0.88
Concentration		mg/kg ww				

Gull - Stream Areas

Receptor
EurekaGull
Aquatic Pathways Source
Stream Areas
Terrestrial Pathways Source

Water Reference Location
Background
Sediment Reference Location
Background
Benthic Reference Location
Background
Fish Reference Location
Background
Aquatic Vegetation Reference Location
Background
Aquatic/Terrestrial Insect Source

Glaucous Gull

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	1.98
Water ingestion rate	Water	m^3/d	0.000093
Food ingestion rate – wet weight basis	Food	g (ww)/d	454
Sediment ingestion rate	Sediment	g (dw)/d	1.2
Soil ingestion rate	Soil	g (dw)/d	-
Fraction of time on site	Frac	-	0.1
Diet composition:			
Benthic Invertebrates	Benthic	-	-
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	1
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	-
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	-
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	StreamAreas	Background
Sediment	StreamAreas	Background
Benthic	-	-
AquaticVeg	-	-
Fish	StreamAreas	Background
Soil	-	-
TerrInsects	-	-
Foliage	-	-
WoodyVeg	-	-
FruitsFlowers	-	-
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_StreamAreas	mg/L	9.90E-04	1.60E-03	2.50E-04	1.30E-02
Sediment	Sediment_StreamAreas	mg/kg dw	1.29E+01	1.96E+01	1.14E+01	1.31E+02
Soil	-	-	-	-	-	-
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	Fish_StreamAreas	mg/kg ww	1.68E+00	3.20E-01	7.50E-02	2.60E+01
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	Sediment_Background	mg/kg dw	1.30E+01	2.70E+01	1.10E+01	5.60E+01
Soil	-	-	-	-	-	-
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	Fish_Background	mg/kg ww	3.40E+00	1.60E+00	9.00E-01	6.60E+02
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	8.92E-05	3.46E-04	1.28E-04	1.40E-02
	Sediment	mg/kg-d	7.87E-03	1.59E-02	6.69E-03	3.85E-02
	Soil	-	-	-	-	-
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	mg/kg-d	7.40E-01	3.38E-01	1.87E-01	1.37E+02
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	7.48E-01	3.54E-01	1.94E-01	1.37E+02
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.13	0.01	0.00	0.80
Concentration		mg/kg ww				

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	9.39E-05	3.76E-04	1.41E-04	1.55E-02
	Sediment	mg/kg-d	7.88E-03	1.64E-02	6.67E-03	3.39E-02
	Soil	-	-	-	-	-
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	mg/kg-d	7.80E-01	3.67E-01	2.06E-01	1.51E+02
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	7.88E-01	3.84E-01	2.13E-01	1.51E+02
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.14	0.01	0.00	0.88
Concentration		mg/kg ww				

Hare - Air Strip

Receptor	
	EurekaHare
Aquatic Pathways Source	
	Drainage Pond
Terrestrial Pathways Source	
	Air Strip
Water Reference Location	
	Background
Sediment Reference Location	
	Background
Benthic Reference Location	
	Background
Fish Reference Location	
	Background
Aquatic Vegetation Reference Location	
	Background
Aquatic/Terrestrial Insect Source	

Arctic Hare

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	1.3
Water ingestion rate	Water	m^3/d	0.00013
Food ingestion rate – wet weight basis	Food	g (ww)/d	270
Sediment ingestion rate	Sediment	g (dw)/d	-
Soil ingestion rate	Soil	g (dw)/d	5.2
Fraction of time on site	Frac	-	1
Diet composition:			
Benthic Invertebrates	Benthic	-	-
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	0.3
Woody Vegetation	WoodyVeg	-	0.6
Fruits and Flowers	FruitsFlowers	-	0.1
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	DrainagePond	Background
Sediment	-	-
Benthic	-	-
AquaticVeg	-	-
Fish	-	-
Soil	AirStrip	Background
TerrInsects	-	-
Foliage	AirStrip	Background
WoodyVeg	AirStrip	Background
FruitsFlowers	AirStrip	Background
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	-	-	-	-	-	-
Soil	Soil_AirStrip	mg/kg	7.60E+00	2.03E+01	1.29E+01	6.34E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	Foliage_AirStrip	mg/kg ww	8.55E-02	1.92E+00	3.34E-01	1.44E+01
Woody Vegetation	WoodyVeg_AirStrip	mg/kg ww	8.55E-02	1.92E+00	3.34E-01	1.44E+01
Fruits and Flowers	FruitsFlowers_AirStrip	mg/kg ww	8.55E-02	1.92E+00	3.34E-01	1.44E+01
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	-	-	-	-	-	-
Soil	Soil_Background	mg/kg	1.00E+01	1.80E+01	6.00E+00	4.80E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	Foliage_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Woody Vegetation	WoodyVeg_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Fruits and Flowers	FruitsFlowers_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	8.50E-05	1.40E-04	2.70E-05	4.10E-04
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	3.04E-02	8.12E-02	5.16E-02	2.54E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	mg/kg-d	5.33E-03	1.19E-01	2.08E-02	9.00E-01
	Woody Vegetation	mg/kg-d	1.07E-02	2.39E-01	4.16E-02	1.80E+00
	Fruits and Flowers	mg/kg-d	1.78E-03	3.98E-02	6.93E-03	3.00E-01
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	4.83E-02	4.79E-01	1.21E-01	3.25E+00
TRV		mg/kg-d	3.60E+00	6.10E+01	1.59E+02	2.98E+02
SI Value		-	0.01	0.01	0.00	0.01
Concentration		mg/kg ww	1.44E-02	5.58E-01	6.26E-03	2.93E+01

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	2.00E-04	8.00E-04	3.00E-04	3.30E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	4.00E-02	7.20E-02	2.40E-02	1.92E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	mg/kg-d	7.01E-03	1.14E-01	1.35E-02	7.71E-01
	Woody Vegetation	mg/kg-d	1.40E-02	2.28E-01	2.71E-02	1.54E+00
	Fruits and Flowers	mg/kg-d	2.34E-03	3.80E-02	4.51E-03	2.57E-01
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	6.36E-02	4.52E-01	6.94E-02	2.80E+00
TRV		mg/kg-d	3.60E+00	6.10E+01	1.59E+02	2.98E+02
SI Value		-	0.02	0.01	0.00	0.01
Concentration		mg/kg ww	1.89E-02	5.27E-01	3.59E-03	2.51E+01

Hare - Main Station

Receptor
EurekaHare
Aquatic Pathways Source
Drainage Pond
Terrestrial Pathways Source
Main Station
Water Reference Location
Background
Sediment Reference Location
Background
Benthic Reference Location
Background
Fish Reference Location
Background
Aquatic Vegetation Reference Location
Background
Aquatic/Terrestrial Insect Source

Arctic Hare

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	1.3
Water ingestion rate	Water	m^3/d	0.00013
Food ingestion rate – wet weight basis	Food	g (ww)/d	270
Sediment ingestion rate	Sediment	g (dw)/d	-
Soil ingestion rate	Soil	g (dw)/d	5.2
Fraction of time on site	Frac	-	1
Diet composition:			
Benthic Invertebrates	Benthic	-	-
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	0.3
Woody Vegetation	WoodyVeg	-	0.6
Fruits and Flowers	FruitsFlowers	-	0.1
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	DrainagePond	Background
Sediment	-	-
Benthic	-	-
AquaticVeg	-	-
Fish	-	-
Soil	MainStation	Background
TerrInsects	-	-
Foliage	MainStation	Background
WoodyVeg	MainStation	Background
FruitsFlowers	MainStation	Background
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	-	-	-	-	-	-
Soil	Soil_MainStation	mg/kg	1.22E+01	4.50E+01	1.96E+01	1.01E+02
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	Foliage_MainStation	mg/kg ww	1.37E-01	2.62E+00	4.22E-01	1.87E+01
Woody Vegetation	WoodyVeg_MainStation	mg/kg ww	1.37E-01	2.62E+00	4.22E-01	1.87E+01
Fruits and Flowers	FruitsFlowers_MainStation	mg/kg ww	1.37E-01	2.62E+00	4.22E-01	1.87E+01
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	-	-	-	-	-	-
Soil	Soil_Background	mg/kg	1.00E+01	1.80E+01	6.00E+00	4.80E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	Foliage_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Woody Vegetation	WoodyVeg_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Fruits and Flowers	FruitsFlowers_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	8.50E-05	1.40E-04	2.70E-05	4.10E-04
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	4.88E-02	1.80E-01	7.84E-02	4.04E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	mg/kg-d	8.56E-03	1.63E-01	2.63E-02	1.16E+00
	Woody Vegetation	mg/kg-d	1.71E-02	3.27E-01	5.26E-02	2.33E+00
	Fruits and Flowers	mg/kg-d	2.85E-03	5.45E-02	8.77E-03	3.88E-01
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	7.74E-02	7.25E-01	1.66E-01	4.29E+00
TRV		mg/kg-d	3.60E+00	6.10E+01	1.59E+02	2.98E+02
SI Value		-	0.02	0.01	0.00	0.01
Concentration		mg/kg ww	2.30E-02	8.44E-01	8.60E-03	3.86E+01

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	2.00E-04	8.00E-04	3.00E-04	3.30E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	4.00E-02	7.20E-02	2.40E-02	1.92E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	mg/kg-d	7.01E-03	1.14E-01	1.35E-02	7.71E-01
	Woody Vegetation	mg/kg-d	1.40E-02	2.28E-01	2.71E-02	1.54E+00
	Fruits and Flowers	mg/kg-d	2.34E-03	3.80E-02	4.51E-03	2.57E-01
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	6.36E-02	4.52E-01	6.94E-02	2.80E+00
TRV		mg/kg-d	3.60E+00	6.10E+01	1.59E+02	2.98E+02
SI Value		-	0.02	0.01	0.00	0.01
Concentration		mg/kg ww	1.89E-02	5.27E-01	3.59E-03	2.51E+01

Knot - Drainage Pond

Receptor
EurekaKnot
Aquatic Pathways Source
Drainage Pond
Terrestrial Pathways Source

Water Reference Location
Background
Sediment Reference Location
Background
Benthic Reference Location
Background
Fish Reference Location
Background
Aquatic Vegetation Reference Location
Background
Aquatic/Terrestrial Insect Source

Red Knot

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	0.17
Water ingestion rate	Water	m^3/d	0.000018
Food ingestion rate – wet weight basis	Food	g (ww)/d	138
Sediment ingestion rate	Sediment	g (dw)/d	1.4
Soil ingestion rate	Soil	g (dw)/d	-
Fraction of time on site	Frac	-	1
Diet composition:			
Benthic Invertebrates	Benthic	-	1
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	-
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	-
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	DrainagePond	Background
Sediment	DrainagePond	Background
Benthic	DrainagePond	Background
AquaticVeg	-	-
Fish	-	-
Soil	-	-
TerrInsects	-	-
Foliage	-	-
WoodyVeg	-	-
FruitsFlowers	-	-
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	Sediment_DrainagePond	mg/kg dw	1.04E+01	1.82E+01	1.08E+01	7.27E+01
Soil	-	-	-	-	-	-
Benthic Invertebrates	Benthic_DrainagePond	mg/kg ww	8.55E-01	1.10E+01	7.45E-01	5.62E+01
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	Sediment_Background	mg/kg dw	1.30E+01	2.70E+01	1.10E+01	5.60E+01
Soil	-	-	-	-	-	-
Benthic Invertebrates	Benthic_Background	mg/kg ww	1.07E+00	1.64E+01	7.59E-01	4.33E+01
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	9.00E-05	1.48E-04	2.86E-05	4.34E-04
	Sediment	mg/kg-d	8.56E-02	1.50E-01	8.89E-02	5.99E-01
	Soil	-	-	-	-	-
	Benthic Invertebrates	mg/kg-d	6.94E-01	8.95E+00	6.05E-01	4.56E+01
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	7.80E-01	9.10E+00	6.94E-01	4.62E+01
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.14	0.26	0.01	0.27
Concentration		mg/kg ww				

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	2.12E-04	8.47E-04	3.18E-04	3.49E-02
	Sediment	mg/kg-d	1.07E-01	2.22E-01	9.06E-02	4.61E-01
	Soil	-	-	-	-	-
	Benthic Invertebrates	mg/kg-d	8.68E-01	1.33E+01	6.16E-01	3.51E+01
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	9.75E-01	1.35E+01	7.07E-01	3.56E+01
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.17	0.39	0.02	0.21
Concentration		mg/kg ww				

Knot - Stream Areas

Receptor	
	EurekaKnot
Aquatic Pathways Source	
	Stream Areas
Terrestrial Pathways Source	
Water Reference Location	
	Background
Sediment Reference Location	
	Background
Benthic Reference Location	
	Background
Fish Reference Location	
	Background
Aquatic Vegetation Reference Location	
	Background
Aquatic/Terrestrial Insect Source	

Red Knot

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	0.17
Water ingestion rate	Water	m^3/d	0.000018
Food ingestion rate – wet weight basis	Food	g (ww)/d	138
Sediment ingestion rate	Sediment	g (dw)/d	1.4
Soil ingestion rate	Soil	g (dw)/d	-
Fraction of time on site	Frac	-	1
Diet composition:			
Benthic Invertebrates	Benthic	-	1
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	-
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	-
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	StreamAreas	Background
Sediment	StreamAreas	Background
Benthic	StreamAreas	Background
AquaticVeg	-	-
Fish	-	-
Soil	-	-
TerrInsects	-	-
Foliage	-	-
WoodyVeg	-	-
FruitsFlowers	-	-
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_StreamAreas	mg/L	9.90E-04	1.60E-03	2.50E-04	1.30E-02
Sediment	Sediment_StreamAreas	mg/kg dw	1.29E+01	1.96E+01	1.14E+01	1.31E+02
Soil	-	-	-	-	-	-
Benthic Invertebrates	Benthic_StreamAreas	mg/kg ww	1.06E+00	1.19E+01	7.87E-01	1.01E+02
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	Sediment_Background	mg/kg dw	1.30E+01	2.70E+01	1.10E+01	5.60E+01
Soil	-	-	-	-	-	-
Benthic Invertebrates	Benthic_Background	mg/kg ww	1.07E+00	1.64E+01	7.59E-01	4.33E+01
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	1.05E-04	1.69E-04	2.65E-05	1.38E-03
	Sediment	mg/kg-d	1.06E-01	1.61E-01	9.39E-02	1.08E+00
	Soil	-	-	-	-	-
	Benthic Invertebrates	mg/kg-d	8.61E-01	9.64E+00	6.39E-01	8.22E+01
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	9.68E-01	9.80E+00	7.32E-01	8.33E+01
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.17	0.28	0.02	0.48
Concentration		mg/kg ww				

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	2.12E-04	8.47E-04	3.18E-04	3.49E-02
	Sediment	mg/kg-d	1.07E-01	2.22E-01	9.06E-02	4.61E-01
	Soil	-	-	-	-	-
	Benthic Invertebrates	mg/kg-d	8.68E-01	1.33E+01	6.16E-01	3.51E+01
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	9.75E-01	1.35E+01	7.07E-01	3.56E+01
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.17	0.39	0.02	0.21
Concentration		mg/kg ww				

Owl - Air Strip

Receptor
EurekaOwl
Aquatic Pathways Source
Drainage Pond
Terrestrial Pathways Source
Air Strip
Water Reference Location
Background
Sediment Reference Location
Background
Benthic Reference Location
Background
Fish Reference Location
Background
Aquatic Vegetation Reference Location
Background
Aquatic/Terrestrial Insect Source

Snowy Owl

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	2.1
Water ingestion rate	Water	m^3/d	0.000097
Food ingestion rate – wet weight basis	Food	g (ww)/d	311
Sediment ingestion rate	Sediment	g (dw)/d	-
Soil ingestion rate	Soil	g (dw)/d	5
Fraction of time on site	Frac	-	0.1
Diet composition:			
Benthic Invertebrates	Benthic	-	-
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	-
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	-
Lemming	Lemming	-	0.7
Grouse/Ptarmigan	Ptarmigan	-	0.1
Hare	Hare	-	0.1
Mouse	Mouse	-	0.1
		Total	1.00

Location:	Exposure	Reference
Water	DrainagePond	Background
Sediment	-	-
Benthic	-	-
AquaticVeg	-	-
Fish	-	-
Soil	AirStrip	Background
TerrInsects	-	-
Foliage	-	-
WoodyVeg	-	-
FruitsFlowers	-	-
Lemming	AirStrip	Background
Ptarmigan	AirStrip	Background
Hare	AirStrip	Background
Mouse	AirStrip	Background

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	-	-	-	-	-	-
Soil	Soil_AirStrip	mg/kg	7.60E+00	2.03E+01	1.29E+01	6.34E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	Lemming_AirStrip	mg/kg ww	1.32E-02	3.81E+00	1.07E+00	3.37E+01
Grouse/Ptarmigan	Ptarmigan_AirStrip	mg/kg ww	3.54E-02	1.78E-01	7.95E-02	2.09E+01
Hare	Hare_AirStrip	mg/kg ww	1.44E-02	5.58E-01	6.26E-03	2.93E+01
Mouse	Mouse_AirStrip	mg/kg ww	1.32E-02	3.81E+00	1.07E+00	3.37E+01

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	-	-	-	-	-	-
Soil	Soil_Background	mg/kg	1.00E+01	1.80E+01	6.00E+00	4.80E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	Lemming_Background	mg/kg ww	1.66E-02	3.74E+00	7.63E-01	3.30E+01
Grouse/Ptarmigan	Ptarmigan_Background	mg/kg ww	4.66E-02	1.67E-01	4.42E-02	1.78E+01
Hare	Hare_Background	mg/kg ww	1.89E-02	5.27E-01	3.59E-03	2.51E+01
Mouse	Mouse_Background	mg/kg ww	1.66E-02	3.74E+00	7.63E-01	3.30E+01

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	8.71E-05	3.39E-04	1.26E-04	1.37E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	2.32E-02	4.34E-02	1.59E-02	1.18E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	mg/kg-d	1.68E-03	3.89E-01	8.22E-02	3.43E+00
	Grouse/Ptarmigan	mg/kg-d	6.74E-04	2.49E-03	7.06E-04	2.68E-01
	Hare	mg/kg-d	2.74E-04	7.85E-03	5.72E-05	3.78E-01
	Mouse	mg/kg-d	2.40E-04	5.55E-02	1.17E-02	4.90E-01
Total Intake		mg/kg-d	2.62E-02	4.98E-01	1.11E-01	4.70E+00
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.00	0.01	0.00	0.03
Concentration		mg/kg ww				

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	9.24E-05	3.70E-04	1.39E-04	1.52E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	2.38E-02	4.29E-02	1.43E-02	1.14E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	mg/kg-d	1.72E-03	3.88E-01	7.91E-02	3.42E+00
	Grouse/Ptarmigan	mg/kg-d	6.91E-04	2.47E-03	6.54E-04	2.63E-01
	Hare	mg/kg-d	2.80E-04	7.80E-03	5.32E-05	3.72E-01
	Mouse	mg/kg-d	2.45E-04	5.54E-02	1.13E-02	4.89E-01
Total Intake		mg/kg-d	2.68E-02	4.97E-01	1.05E-01	4.68E+00
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.00	0.01	0.00	0.03
Concentration		mg/kg ww				

Owl - Main Station

Receptor
EurekaOwl
Aquatic Pathways Source
Drainage Pond
Terrestrial Pathways Source
Main Station
Water Reference Location
Background
Sediment Reference Location
Background
Benthic Reference Location
Background
Fish Reference Location
Background
Aquatic Vegetation Reference Location
Background
Aquatic/Terrestrial Insect Source

Snowy Owl

Parameter		**Units**	**Value**
Characteristics:			
Body weight	BW	kg	2.1
Water ingestion rate	Water	m^3/d	0.000097
Food ingestion rate – wet weight basis	Food	g (ww)/d	311
Sediment ingestion rate	Sediment	g (dw)/d	-
Soil ingestion rate	Soil	g (dw)/d	5
Fraction of time on site	Frac	-	0.1
Diet composition:			
Benthic Invertebrates	Benthic	-	-
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	-
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	-
Lemming	Lemming	-	0.7
Grouse/Ptarmigan	Ptarmigan	-	0.1
Hare	Hare	-	0.1
Mouse	Mouse	-	0.1
		Total	1.00

Location:	**Exposure**	**Reference**
Water	DrainagePond	Background
Sediment	-	-
Benthic	-	-
AquaticVeg	-	-
Fish	-	-
Soil	MainStation	Background
TerrInsects	-	-
Foliage	-	-
WoodyVeg	-	-
FruitsFlowers	-	-
Lemming	MainStation	Background
Ptarmigan	MainStation	Background
Hare	MainStation	Background
Mouse	MainStation	Background

Exposure EPCs	**Code**	**Units**	**Arsenic**	**Copper**	**Lead**	**Zinc**
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	-	-	-	-	-	-
Soil	Soil_MainStation	mg/kg	1.22E+01	4.50E+01	1.96E+01	1.01E+02
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	Lemming_MainStation	mg/kg ww	1.95E-02	4.27E+00	1.29E+00	3.48E+01
Grouse/Ptarmigan	Ptarmigan_MainStation	mg/kg ww	5.68E-02	2.77E-01	1.11E-01	2.77E+01
Hare	Hare_MainStation	mg/kg ww	2.30E-02	8.44E-01	8.60E-03	3.86E+01
Mouse	Mouse_MainStation	mg/kg ww	1.95E-02	4.27E+00	1.29E+00	3.48E+01

Background Location EPCs	**Code**	**Units**	**Arsenic**	**Copper**	**Lead**	**Zinc**
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	-	-	-	-	-	-
Soil	Soil_Background	mg/kg	1.00E+01	1.80E+01	6.00E+00	4.80E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	Lemming_Background	mg/kg ww	1.66E-02	3.74E+00	7.63E-01	3.30E+01
Grouse/Ptarmigan	Ptarmigan_Background	mg/kg ww	4.66E-02	1.67E-01	4.42E-02	1.78E+01
Hare	Hare_Background	mg/kg ww	1.89E-02	5.27E-01	3.59E-03	2.51E+01
Mouse	Mouse_Background	mg/kg ww	1.66E-02	3.74E+00	7.63E-01	3.30E+01

Exposure		**Units**	**Arsenic**	**Copper**	**Lead**	**Zinc**
Intake	Water	mg/kg-d	8.71E-05	3.39E-04	1.26E-04	1.37E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	2.43E-02	4.93E-02	1.75E-02	1.27E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	mg/kg-d	1.75E-03	3.94E-01	8.45E-02	3.44E+00
	Grouse/Ptarmigan	mg/kg-d	7.06E-04	2.63E-03	7.53E-04	2.78E-01
	Hare	mg/kg-d	2.86E-04	8.27E-03	6.06E-05	3.92E-01
	Mouse	mg/kg-d	2.49E-04	5.62E-02	1.21E-02	4.92E-01
Total Intake		mg/kg-d	2.74E-02	5.10E-01	1.15E-01	4.74E+00
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.00	0.01	0.00	0.03
Concentration		mg/kg ww				

Background		**Units**	**Arsenic**	**Copper**	**Lead**	**Zinc**
Intake	Water	mg/kg-d	9.24E-05	3.70E-04	1.39E-04	1.52E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	2.38E-02	4.29E-02	1.43E-02	1.14E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	mg/kg-d	1.72E-03	3.88E-01	7.91E-02	3.42E+00
	Grouse/Ptarmigan	mg/kg-d	6.91E-04	2.47E-03	6.54E-04	2.63E-01
	Hare	mg/kg-d	2.80E-04	7.80E-03	5.32E-05	3.72E-01
	Mouse	mg/kg-d	2.45E-04	5.54E-02	1.13E-02	4.89E-01
Total Intake		mg/kg-d	2.68E-02	4.97E-01	1.05E-01	4.68E+00
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.00	0.01	0.00	0.03
Concentration		mg/kg ww				

Pintail - Drainage Pond

Receptor
EurekaPintail
Aquatic Pathways Source
Drainage Pond
Terrestrial Pathways Source

Water Reference Location
Background
Sediment Reference Location
Background
Benthic Reference Location
Background
Fish Reference Location
Background
Aquatic Vegetation Reference Location
Background
Aquatic/Terrestrial Insect Source

Northern Pintail

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	1
Water ingestion rate	Water	m^3/d	0.000059
Food ingestion rate – wet weight basis	Food	g (ww)/d	290
Sediment ingestion rate	Sediment	g (dw)/d	2
Soil ingestion rate	Soil	g (dw)/d	-
Fraction of time on site	Frac	-	1
Diet composition:			
Benthic Invertebrates	Benthic	-	0.25
Aquatic Vegetation	AquaticVeg	-	0.75
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	-
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	-
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	DrainagePond	Background
Sediment	DrainagePond	Background
Benthic	DrainagePond	Background
AquaticVeg	DrainagePond	Background
Fish	-	-
Soil	-	-
TerrInsects	-	-
Foliage	-	-
WoodyVeg	-	-
FruitsFlowers	-	-
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	Sediment_DrainagePond	mg/kg dw	1.04E+01	1.82E+01	1.08E+01	7.27E+01
Soil	-	-	-	-	-	-
Benthic Invertebrates	Benthic_DrainagePond	mg/kg ww	8.55E-01	1.10E+01	7.45E-01	5.62E+01
Aquatic Vegetation	AquaticVeg_DrainagePond	mg/kg ww	2.55E-01	1.40E+00	1.35E+01	2.39E+00
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	Sediment_Background	mg/kg dw	1.30E+01	2.70E+01	1.10E+01	5.60E+01
Soil	-	-	-	-	-	-
Benthic Invertebrates	Benthic_Background	mg/kg ww	1.07E+00	1.64E+01	7.59E-01	4.33E+01
Aquatic Vegetation	AquaticVeg_Background	mg/kg ww	6.00E-01	8.00E+00	1.50E+02	1.93E+02
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	5.02E-05	8.26E-05	1.59E-05	2.42E-04
	Sediment	mg/kg-d	2.08E-02	3.64E-02	2.16E-02	1.45E-01
	Soil	-	-	-	-	-
	Benthic Invertebrates	mg/kg-d	6.20E-02	8.00E-01	5.40E-02	4.07E+00
	Aquatic Vegetation	mg/kg-d	5.55E-02	3.05E-01	2.94E+00	5.21E-01
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	1.38E-01	1.14E+00	3.01E+00	4.74E+00
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.02	0.03	0.06	0.03
Concentration		mg/kg ww				

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	1.18E-04	4.72E-04	1.77E-04	1.95E-02
	Sediment	mg/kg-d	2.60E-02	5.40E-02	2.20E-02	1.12E-01
	Soil	-	-	-	-	-
	Benthic Invertebrates	mg/kg-d	7.75E-02	1.19E+00	5.50E-02	3.14E+00
	Aquatic Vegetation	mg/kg-d	1.31E-01	1.74E+00	3.26E+01	4.19E+01
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	2.34E-01	2.98E+00	3.27E+01	4.52E+01
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.04	0.09	0.70	0.26
Concentration		mg/kg ww				

Pintail - Stream Areas

Receptor
EurekaPintail
Aquatic Pathways Source
Stream Areas
Terrestrial Pathways Source

Water Reference Location
Background
Sediment Reference Location
Background
Benthic Reference Location
Background
Fish Reference Location
Background
Aquatic Vegetation Reference Location
Background
Aquatic/Terrestrial Insect Source

Northern Pintail

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	1
Water ingestion rate	Water	m^3/d	0.000059
Food ingestion rate – wet weight basis	Food	g (ww)/d	290
Sediment ingestion rate	Sediment	g (dw)/d	2
Soil ingestion rate	Soil	g (dw)/d	-
Fraction of time on site	Frac	-	1
Diet composition:			
Benthic Invertebrates	Benthic	-	0.25
Aquatic Vegetation	AquaticVeg	-	0.75
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	-
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	-
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	StreamAreas	Background
Sediment	StreamAreas	Background
Benthic	StreamAreas	Background
AquaticVeg	StreamAreas	Background
Fish	-	-
Soil	-	-
TerrInsects	-	-
Foliage	-	-
WoodyVeg	-	-
FruitsFlowers	-	-
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_StreamAreas	mg/L	9.90E-04	1.60E-03	2.50E-04	1.30E-02
Sediment	Sediment_StreamAreas	mg/kg dw	1.29E+01	1.96E+01	1.14E+01	1.31E+02
Soil	-	-	-	-	-	-
Benthic Invertebrates	Benthic_StreamAreas	mg/kg ww	1.06E+00	1.19E+01	7.87E-01	1.01E+02
Aquatic Vegetation	AquaticVeg_StreamAreas	mg/kg ww	2.97E-01	1.60E+00	1.25E+01	7.59E+00
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	Sediment_Background	mg/kg dw	1.30E+01	2.70E+01	1.10E+01	5.60E+01
Soil	-	-	-	-	-	-
Benthic Invertebrates	Benthic_Background	mg/kg ww	1.07E+00	1.64E+01	7.59E-01	4.33E+01
Aquatic Vegetation	AquaticVeg_Background	mg/kg ww	6.00E-01	8.00E+00	1.50E+02	1.93E+02
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	5.84E-05	9.44E-05	1.48E-05	7.67E-04
	Sediment	mg/kg-d	2.58E-02	3.92E-02	2.28E-02	2.62E-01
	Soil	-	-	-	-	-
	Benthic Invertebrates	mg/kg-d	7.69E-02	8.61E-01	5.70E-02	7.34E+00
	Aquatic Vegetation	mg/kg-d	6.46E-02	3.48E-01	2.72E+00	1.65E+00
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	1.67E-01	1.25E+00	2.80E+00	9.26E+00
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.03	0.04	0.06	0.05
Concentration		mg/kg ww				

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	1.18E-04	4.72E-04	1.77E-04	1.95E-02
	Sediment	mg/kg-d	2.60E-02	5.40E-02	2.20E-02	1.12E-01
	Soil	-	-	-	-	-
	Benthic Invertebrates	mg/kg-d	7.75E-02	1.19E+00	5.50E-02	3.14E+00
	Aquatic Vegetation	mg/kg-d	1.31E-01	1.74E+00	3.26E+01	4.19E+01
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	2.34E-01	2.98E+00	3.27E+01	4.52E+01
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.04	0.09	0.70	0.26
Concentration		mg/kg ww				

Ptarmigan - Air Strip

Receptor
EurekaPtarmigan
Aquatic Pathways Source
Drainage Pond
Terrestrial Pathways Source
Air Strip
Water Reference Location
Background
Sediment Reference Location
Background
Benthic Reference Location
Background
Fish Reference Location
Background
Aquatic Vegetation Reference Location
Background
Aquatic/Terrestrial Insect Source

Rock Ptarmigan

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	0.65
Water ingestion rate	Water	m^3/d	0.000043
Food ingestion rate – wet weight basis	Food	g (ww)/d	143
Sediment ingestion rate	Sediment	g (dw)/d	-
Soil ingestion rate	Soil	g (dw)/d	4
Fraction of time on site	Frac	-	1
Diet composition:			
Benthic Invertebrates	Benthic	-	-
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	0.5
Woody Vegetation	WoodyVeg	-	0.15
Fruits and Flowers	FruitsFlowers	-	0.35
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	DrainagePond	Background
Sediment	-	-
Benthic	-	-
AquaticVeg	-	-
Fish	-	-
Soil	AirStrip	Background
TerrInsects	-	-
Foliage	AirStrip	Background
WoodyVeg	AirStrip	Background
FruitsFlowers	AirStrip	Background
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	-	-	-	-	-	-
Soil	Soil_AirStrip	mg/kg	7.60E+00	2.03E+01	1.29E+01	6.34E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	Foliage_AirStrip	mg/kg ww	8.55E-02	1.92E+00	3.34E-01	1.44E+01
Woody Vegetation	WoodyVeg_AirStrip	mg/kg ww	8.55E-02	1.92E+00	3.34E-01	1.44E+01
Fruits and Flowers	FruitsFlowers_AirStrip	mg/kg ww	8.55E-02	1.92E+00	3.34E-01	1.44E+01
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	-	-	-	-	-	-
Soil	Soil_Background	mg/kg	1.00E+01	1.80E+01	6.00E+00	4.80E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	Foliage_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Woody Vegetation	WoodyVeg_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Fruits and Flowers	FruitsFlowers_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	5.62E-05	9.26E-05	1.79E-05	2.71E-04
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	4.68E-02	1.25E-01	7.94E-02	3.90E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	mg/kg-d	9.41E-03	2.11E-01	3.67E-02	1.59E+00
	Woody Vegetation	mg/kg-d	2.82E-03	6.32E-02	1.10E-02	4.76E-01
	Fruits and Flowers	mg/kg-d	6.59E-03	1.48E-01	2.57E-02	1.11E+00
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	6.56E-02	5.47E-01	1.53E-01	3.57E+00
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.01	0.02	0.00	0.02
Concentration		mg/kg ww	3.54E-02	1.78E-01	7.95E-02	2.09E+01

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	1.32E-04	5.29E-04	1.98E-04	2.18E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	6.15E-02	1.11E-01	3.69E-02	2.95E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	mg/kg-d	1.24E-02	2.01E-01	2.39E-02	1.36E+00
	Woody Vegetation	mg/kg-d	3.71E-03	6.03E-02	7.17E-03	4.08E-01
	Fruits and Flowers	mg/kg-d	8.67E-03	1.41E-01	1.67E-02	9.53E-01
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	8.64E-02	5.13E-01	8.49E-02	3.04E+00
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.02	0.01	0.00	0.02
Concentration		mg/kg ww	4.66E-02	1.67E-01	4.42E-02	1.78E+01

Ptarmigan - Main Station

Receptor
EurekaPtarmigan
Aquatic Pathways Source
Drainage Pond
Terrestrial Pathways Source
Main Station
Water Reference Location
Background
Sediment Reference Location
Background
Benthic Reference Location
Background
Fish Reference Location
Background
Aquatic Vegetation Reference Location
Background
Aquatic/Terrestrial Insect Source

Rock Ptarmigan

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	0.65
Water ingestion rate	Water	m^3/d	0.000043
Food ingestion rate – wet weight basis	Food	g (ww)/d	143
Sediment ingestion rate	Sediment	g (dw)/d	-
Soil ingestion rate	Soil	g (dw)/d	4
Fraction of time on site	Frac	-	1
Diet composition:			
Benthic Invertebrates	Benthic	-	-
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	0.5
Woody Vegetation	WoodyVeg	-	0.15
Fruits and Flowers	FruitsFlowers	-	0.35
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	DrainagePond	Background
Sediment	-	-
Benthic	-	-
AquaticVeg	-	-
Fish	-	-
Soil	MainStation	Background
TerrInsects	-	-
Foliage	MainStation	Background
WoodyVeg	MainStation	Background
FruitsFlowers	MainStation	Background
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	-	-	-	-	-	-
Soil	Soil_MainStation	mg/kg	1.22E+01	4.50E+01	1.96E+01	1.01E+02
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	Foliage_MainStation	mg/kg ww	1.37E-01	2.62E+00	4.22E-01	1.87E+01
Woody Vegetation	WoodyVeg_MainStation	mg/kg ww	1.37E-01	2.62E+00	4.22E-01	1.87E+01
Fruits and Flowers	FruitsFlowers_MainStation	mg/kg ww	1.37E-01	2.62E+00	4.22E-01	1.87E+01
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	-	-	-	-	-	-
Soil	Soil_Background	mg/kg	1.00E+01	1.80E+01	6.00E+00	4.80E+01
Benthic Invertebrates	-	-	-	-	-	-
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	Foliage_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Woody Vegetation	WoodyVeg_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Fruits and Flowers	FruitsFlowers_Background	mg/kg ww	1.13E-01	1.83E+00	2.17E-01	1.24E+01
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	5.62E-05	9.26E-05	1.79E-05	2.71E-04
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	7.51E-02	2.77E-01	1.21E-01	6.22E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	mg/kg-d	1.51E-02	2.88E-01	4.64E-02	2.06E+00
	Woody Vegetation	mg/kg-d	4.53E-03	8.65E-02	1.39E-02	6.17E-01
	Fruits and Flowers	mg/kg-d	1.06E-02	2.02E-01	3.25E-02	1.44E+00
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	1.05E-01	8.54E-01	2.13E-01	4.73E+00
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.02	0.02	0.00	0.03
Concentration		mg/kg ww	5.68E-02	2.77E-01	1.11E-01	2.77E+01

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	1.32E-04	5.29E-04	1.98E-04	2.18E-02
	Sediment	-	-	-	-	-
	Soil	mg/kg-d	6.15E-02	1.11E-01	3.69E-02	2.95E-01
	Benthic Invertebrates	-	-	-	-	-
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	mg/kg-d	1.24E-02	2.01E-01	2.39E-02	1.36E+00
	Woody Vegetation	mg/kg-d	3.71E-03	6.03E-02	7.17E-03	4.08E-01
	Fruits and Flowers	mg/kg-d	8.67E-03	1.41E-01	1.67E-02	9.53E-01
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	8.64E-02	5.13E-01	8.49E-02	3.04E+00
TRV		mg/kg-d	5.60E+00	3.49E+01	4.70E+01	1.72E+02
SI Value		-	0.02	0.01	0.00	0.02
Concentration		mg/kg ww	4.66E-02	1.67E-01	4.42E-02	1.78E+01

Knot SARA - Stream Areas

Receptor
EurekaKnot
Aquatic Pathways Source
Stream Areas
Terrestrial Pathways Source

Water Reference Location
Background
Sediment Reference Location
Background
Benthic Reference Location
Background
Fish Reference Location
Background
Aquatic Vegetation Reference Location
Background
Aquatic/Terrestrial Insect Source

Red Knot

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	0.17
Water ingestion rate	Water	m^3/d	0.000018
Food ingestion rate – wet weight basis	Food	g (ww)/d	138
Sediment ingestion rate	Sediment	g (dw)/d	1.4
Soil ingestion rate	Soil	g (dw)/d	-
Fraction of time on site	Frac	-	1
Diet composition:			
Benthic Invertebrates	Benthic	-	1
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	-
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	-
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	StreamAreas	Background
Sediment	StreamAreas	Background
Benthic	StreamAreas	Background
AquaticVeg	-	-
Fish	-	-
Soil	-	-
TerrInsects	-	-
Foliage	-	-
WoodyVeg	-	-
FruitsFlowers	-	-
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_StreamAreas	mg/L	9.90E-04	1.60E-03	2.50E-04	1.30E-02
Sediment	Sediment_StreamAreas	mg/kg dw	1.29E+01	1.96E+01	1.14E+01	1.31E+02
Soil	-	-	-	-	-	-
Benthic Invertebrates	Benthic_StreamAreas	mg/kg ww	1.06E+00	1.19E+01	7.87E-01	1.01E+02
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	Sediment_Background	mg/kg dw	1.30E+01	2.70E+01	1.10E+01	5.60E+01
Soil	-	-	-	-	-	-
Benthic Invertebrates	Benthic_Background	mg/kg ww	1.07E+00	1.64E+01	7.59E-01	4.33E+01
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	1.05E-04	1.69E-04	2.65E-05	1.38E-03
	Sediment	mg/kg-d	1.06E-01	1.61E-01	9.39E-02	1.08E+00
	Soil	-	-	-	-	-
	Benthic Invertebrates	mg/kg-d	8.61E-01	9.64E+00	6.39E-01	8.22E+01
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	9.68E-01	9.80E+00	7.32E-01	8.33E+01
TRV - NOAELs		mg/kg-d	4.40E+00	1.96E+01	7.30E+00	8.80E+01
SI Value		-	0.22	0.50	0.10	0.95
Concentration		mg/kg ww				

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	2.12E-04	8.47E-04	3.18E-04	3.49E-02
	Sediment	mg/kg-d	1.07E-01	2.22E-01	9.06E-02	4.61E-01
	Soil	-	-	-	-	-
	Benthic Invertebrates	mg/kg-d	8.68E-01	1.33E+01	6.16E-01	3.51E+01
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	9.75E-01	1.35E+01	7.07E-01	3.56E+01
TRV - NOAELs		mg/kg-d	4.40E+00	1.96E+01	7.30E+00	8.80E+01
SI Value		-	0.22	0.69	0.10	0.40
Concentration		mg/kg ww				

Knot SARA - Drainage Pond

Receptor
EurekaKnot
Aquatic Pathways Source
Drainage Pond
Terrestrial Pathways Source

Water Reference Location
Background
Sediment Reference Location
Background
Benthic Reference Location
Background
Fish Reference Location
Background
Aquatic Vegetation Reference Location
Background
Aquatic/Terrestrial Insect Source

Red Knot

Parameter		Units	Value
Characteristics:			
Body weight	BW	kg	0.17
Water ingestion rate	Water	m^3/d	0.000018
Food ingestion rate – wet weight basis	Food	g (ww)/d	138
Sediment ingestion rate	Sediment	g (dw)/d	1.4
Soil ingestion rate	Soil	g (dw)/d	-
Fraction of time on site	Frac	-	1
Diet composition:			
Benthic Invertebrates	Benthic	-	1
Aquatic Vegetation	AquaticVeg	-	-
Fish	Fish	-	-
Terrestrial Insects	TerrInsects	-	-
Foliage	Foliage	-	-
Woody Vegetation	WoodyVeg	-	-
Fruits and Flowers	FruitsFlowers	-	-
Lemming	Lemming	-	-
Grouse/Ptarmigan	Ptarmigan	-	-
Hare	Hare	-	-
Mouse	Mouse	-	-
		Total	1.00

Location:	Exposure	Reference
Water	DrainagePond	Background
Sediment	DrainagePond	Background
Benthic	DrainagePond	Background
AquaticVeg	-	-
Fish	-	-
Soil	-	-
TerrInsects	-	-
Foliage	-	-
WoodyVeg	-	-
FruitsFlowers	-	-
Lemming	-	-
Ptarmigan	-	-
Hare	-	-
Mouse	-	-

Exposure EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_DrainagePond	mg/L	8.50E-04	1.40E-03	2.70E-04	4.10E-03
Sediment	Sediment_DrainagePond	mg/kg dw	1.04E+01	1.82E+01	1.08E+01	7.27E+01
Soil	-	-	-	-	-	-
Benthic Invertebrates	Benthic_DrainagePond	mg/kg ww	8.55E-01	1.10E+01	7.45E-01	5.62E+01
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Background Location EPCs	Code	Units	Arsenic	Copper	Lead	Zinc
Water	Water_Background	mg/L	2.00E-03	8.00E-03	3.00E-03	3.30E-01
Sediment	Sediment_Background	mg/kg dw	1.30E+01	2.70E+01	1.10E+01	5.60E+01
Soil	-	-	-	-	-	-
Benthic Invertebrates	Benthic_Background	mg/kg ww	1.07E+00	1.64E+01	7.59E-01	4.33E+01
Aquatic Vegetation	-	-	-	-	-	-
Fish	-	-	-	-	-	-
Terrestrial Insects	-	-	-	-	-	-
Foliage	-	-	-	-	-	-
Woody Vegetation	-	-	-	-	-	-
Fruits and Flowers	-	-	-	-	-	-
Lemming	-	-	-	-	-	-
Grouse/Ptarmigan	-	-	-	-	-	-
Hare	-	-	-	-	-	-
Mouse	-	-	-	-	-	-

Exposure		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	9.00E-05	1.48E-04	2.86E-05	4.34E-04
	Sediment	mg/kg-d	8.56E-02	1.50E-01	8.89E-02	5.99E-01
	Soil	-	-	-	-	-
	Benthic Invertebrates	mg/kg-d	6.94E-01	8.95E+00	6.05E-01	4.56E+01
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	7.80E-01	9.10E+00	6.94E-01	4.62E+01
TRV - NOAELs		mg/kg-d	4.40E+00	1.96E+01	7.30E+00	8.80E+01
SI Value		-	0.18	0.46	0.10	0.53
Concentration		mg/kg ww				

Background		Units	Arsenic	Copper	Lead	Zinc
Intake	Water	mg/kg-d	2.12E-04	8.47E-04	3.18E-04	3.49E-02
	Sediment	mg/kg-d	1.07E-01	2.22E-01	9.06E-02	4.61E-01
	Soil	-	-	-	-	-
	Benthic Invertebrates	mg/kg-d	8.68E-01	1.33E+01	6.16E-01	3.51E+01
	Aquatic Vegetation	-	-	-	-	-
	Fish	-	-	-	-	-
	Terrestrial Insects	-	-	-	-	-
	Foliage	-	-	-	-	-
	Woody Vegetation	-	-	-	-	-
	Fruits and Flowers	-	-	-	-	-
	Lemming	-	-	-	-	-
	Grouse/Ptarmigan	-	-	-	-	-
	Hare	-	-	-	-	-
	Mouse	-	-	-	-	-
Total Intake		mg/kg-d	9.75E-01	1.35E+01	7.07E-01	3.56E+01
TRV - NOAELs		mg/kg-d	4.40E+00	1.96E+01	7.30E+00	8.80E+01
SI Value		-	0.22	0.69	0.10	0.40
Concentration		mg/kg ww				

APPENDIX F

Sample Calculations – Ecological Receptors

Main Station
Fox

Receptor Characteristics	Code	Units	Value
Body weight	BW	kg	5.8
Water ingestion rate	Qwat	m3/d	4.80E-04
Soil ingestion rate	Qsoil	g (dw)/d	8
Food ingestion rate – wet weight basis	Qfood	g (ww)/d	8.74E+02
Food Fraction:			
Fruits and Flowers	fff	-	1.00E-01
Lemming	flem	-	5.00E-01
Grouse/Ptarmigan	fpt	-	2.00E-01
Hare	fha	-	2.00E-01
Fraction of time on site	Frac	-	0.1

Concentrations	**Code**	**Units**		Arsenic	Copper	Lead	Zinc	**Comment**
Water	Cwat	mg/L		8.50E-04	1.40E-03	2.70E-04	4.10E-03	
Soil	Csoil	mg/kg		12.2	45	19.6	101	
Fruits and Flowers	Cff	mg/kg dw		0.14	2.62	0.42	18.7	plants TRV from soil
Lemming	Clem	mg/kg ww		0.019	4.27	1.29	34.8	small mammall TRV from soil
Grouse/Ptarmigan	Cpt	mg/kg ww		0.06	0.28	0.11	27.7	feed to flesh
Hare	Cha	mg/kg ww		0.02	0.84	0.01	38.6	feed to flesh

Background Concentrations	**Code**	**Units**		Arsenic	Copper	Lead	Zinc	**Comment**
Water	Cwatbg	mg/L		2.00E-03	8.00E-03	3.00E-03	3.30E-01	
Soil	Csoilbg	mg/kg		10.0	18.0	6.0	48.0	
Fruits and Flowers	Cffbg	mg/kg dw		0.11	1.83	0.22	12.4	
Lemming	Clembg	mg/kg ww		0.02	3.7	0.8	33.0	
Grouse/Ptarmigan	Cptbg	mg/kg ww		0.05	0.17	0.04	17.8	
Hare	Chabg	mg/kg ww		0.02	0.53	3.59E-03	25.1	

Intakes	Code	Units		Arsenic	Copper	Lead	Zinc	**Calculation**
Water	Iwat	mg/kg-d		1.56E-04	6.07E-04	2.26E-04	2.46E-02	= Qwat * (Cwat * Frac + Cwatbg * (1 - Frac)) / BW * (1000 L/m3)
Soil	Isoil	mg/kg-d		1.41E-02	2.86E-02	1.02E-02	7.35E-02	= Qsoil * (Csoil * Frac + Csoilbg * (1 - Frac)) / BW / (1000 g/kg)
Fruits and Flowers	Iff	mg/kg-d		1.73E-03	2.87E-02	3.58E-03	1.96E-01	= Qfood * fff * (Cff * Frac + Cffbg * (1 - Frac)) / BW / (1000 g/kg)
Lemming	Ilem	mg/kg-d		1.27E-03	2.86E-01	6.14E-02	2.50E+00	= Qfood * flem * (Clem * Frac + Clembg * (1 - Frac)) / BW / (1000 g/kg)
Grouse/Ptarmigan	Ipt	mg/kg-d		1.44E-03	5.36E-03	1.53E-03	5.66E-01	= Qfood * fpt * (Cpt * Frac + Cptbg * (1 - Frac))/ BW / (1000 g/kg)
Hare	Iha	mg/kg-d		5.83E-04	1.68E-02	1.23E-04	7.98E-01	= Qfood * fha * (Cha * Frac + Chabg * (1 - Frac)) / BW / (1000 g/kg)
Total Intake	Itot	mg/kg-d		1.93E-02	3.66E-01	7.70E-02	4.16E+00	= Iwat + Isoil + Iff + Ilem + Ipt + Iha
TRV	TRV	mg/kg-d		3.60E+00	6.10E+01	1.59E+02	2.98E+02	
SI value	SI	-		0.01	0.01	0.000	0.01	= Itot / TRV

Drainage Pond
Knot

Receptor Characteristics	Code	Units	Value
Body weight	BW	kg	0.17
Water ingestion rate	Qwat	m3/d	1.80E-05
Sediment ingestion rate	Qsed	g dw/d	1.40E+00
Food ingestion rate – wet weight basis	Qfood	g (ww)/d	1.38E+02
Food Fraction:			
Benthic Invertebrates	fben	-	1.00E+00
Fraction of time on site	Frac	-	1

Concentrations	**Code**	**Units**		Arsenic	Copper	Lead	Zinc	**Comment**
Water	Cwat	mg/L		8.50E-04	1.40E-03	2.70E-04	4.10E-03	
Sediment	Csed	mg/kg dw		10.4	18.2	10.8	72.7	
Benthic Invertebrates	Cben	mg/kg ww		0.86	11.03	0.75	56.20	using TFs from Bechtel Jacobs 1998 and assumed moisture content of 80%

Intakes	Code	Units		Arsenic	Copper	Lead	Zinc	**Calculation**
Water	Iwat	mg/kg-d		9.00E-05	1.48E-04	2.86E-05	4.34E-04	= Qwat * Cwat * Frac / BW * (1000 L/m3)
Sediment	Ised	mg/kg-d		8.56E-02	1.50E-01	8.89E-02	5.99E-01	= Qsed * Csed / BW * Frac / (1000 g/kg)
Benthic Invertebrates	Iben	mg/kg-d		6.94E-01	8.95E+00	6.05E-01	4.56E+01	= Qfood * fben * Cben * Frac / BW / (1000 g/kg)
Total Intake	Itot	mg/kg-d		7.80E-01	9.10E+00	6.94E-01	4.62E+01	= Iwat + Ised + Iben + Iaqveg + Ifish + Ieai
TRV (LOAELs)	TRV	mg/kg-d		5.60E+00	3.49E+01	4.70E+01	1.72E+02	
SI value	SI	-		0.14	0.26	0.01	0.27	= Itot / TRV

APPENDIX G

CANDAC Trailer Worker Evaluation

G.1 CANDAC Trailer Worker Evaluation

In the 2021 sampling event, soil samples were collected from around the CANDAC trailers at the Main Station. These samples had high concentrations of PHC and thus an additional analysis was warranted as there are workers that spend time in and around these CANDAC trailers.

G.1.1 Exposure Assessment

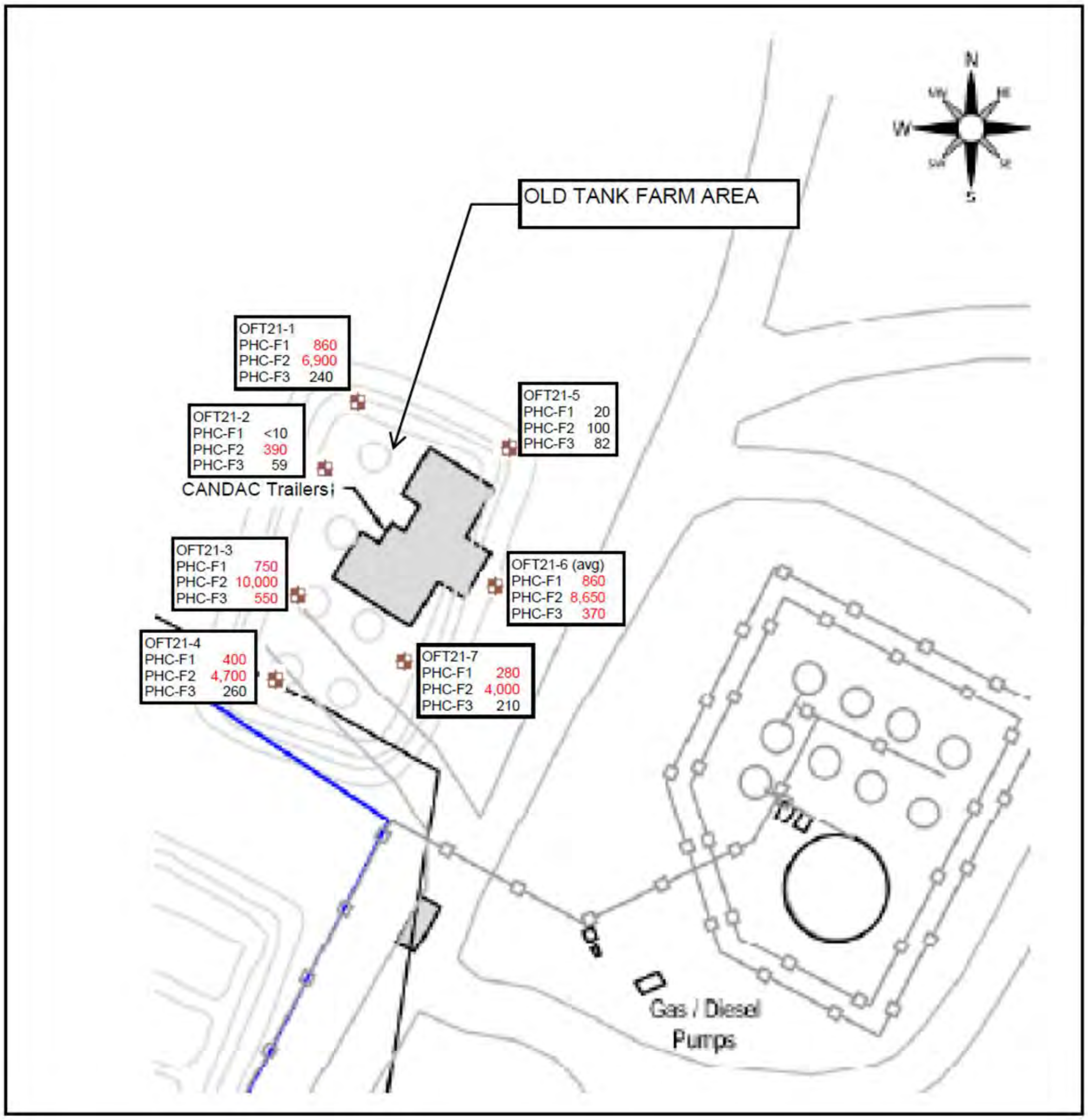
Based on information on other workers at the site, it was assumed that a CANDAC worker will be on site for 3 months of the year and during that time they will spend 6 hours per day inside the trailers and 6 hours per day working outside in the area around the trailers. The exact time that workers would be inside the trailers was not provided. Table G.1 provides the receptor characteristics for the CANDAC worker.

Table G.1 Human Health Receptor Characteristics for the CANDAC Trailer Receptor

Receptor Characteristic	CANDAC Trailer Worker
Age	≥ 20 years
Body Weight (kg)	70.7
Soil Ingestion Rate (g/d)	0.02
Inhalation Rate (m^3/d)	16.6
Water Ingestion Rate (l/d)	1.5
Time Spent Indoors (hr/d)	6
Time spent outdoors (hr/d)	6
Skin Surface area (cm^2)	
Hands	890
Arms	2500
Legs	5720
Total	17460
Soil Loading to exposed skin (kg/cm^2/event)	
Hands	1×10^{-7}
Surfaces other than hands	1×10^{-8}

Notes: Values obtained from Health Canada (2012), unless otherwise stated.

For this receptor, exposure to PHC F1, PHC F2, and PHC F3 was evaluated as levels of these COPC are elevated in the area around the trailers. The levels of metals and PAHs in the area around the CANDAC Trailers are similar to those seen in other areas of the site and thus already captured in the evaluation of the other human receptors in the Main Report. Seven soil samples collected in 2021 from the area around the CANDAC Trailers (see Figure G.1) were considered in the generation of Exposure Point Concentrations (EPCs) of 837 mg/kg for PHC F1, 7,427 mg/kg for PHC F2, and 376 mg/kg for PHC F3. These UCLs are the 95% BCA Bootstrap UCLs calculated using ProUCL.



LEGEND

Building

Tank

Pipeline

Hydro Overhead

CCME ESQG values Tier 1 for Residential/ Parkland coarse-grained soil

PHC-F1 30 mg/kg
PHC-F2 150 mg/kg
PHC-F3 300 mg/kg
Exceedances in red

Title: PETROLEUM HYDROCARBON RESULTS (mg/kg)
OLD TANK FARM / CANDAC TRAILERS

Project: SITE SPECIFIC HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
EUREKA HIGH ARCTIC WEATHER STATION
EUREKA, NU

Client: PSPC / ECCC

DILLON CONSULTING | outcome CONSULTANTS

Date: OCTOBER 2021

Project No.: P2020-18

Figure G-1

As was done for the other evaluated scenarios, the F1 and F2 soil EPCs were used as inputs to the Johnson and Ettinger (J&E) Model, as described in Section 7.2.3, to estimate indoor air concentrations based on vapour intrusion. For these calculations, default values were generally used including those for soil vapour permeability and average vapour flow rate into the building (MOECC 2016). Similar to for the NUNA Camp and Camp 1 buildings, the enclosed space height for the CANDAC Trailers was left at the default 3 m. PHC F3 was not evaluated for indoor air as it is minimally volatile. The predicted indoor-air concentrations are presented in Table G.2 for PHC F1 fractions and Table G.3 for PHC F2 fractions.

Table G.2 Predicted F1 Indoor Air Exposure Point Concentrations for CANDAC Trailers

PHC F1 Fractions	Predicted Indoor Air Concentration (mg/m^3)	Predicted Fraction Breakdown
PHC F1 - Aliphatic C6-C8	28	87.1%
PHC F1 - Aliphatic C>8-C10	3.6	11.1%
PHC F1 - Aromatic C>8-C10	0.59	1.8%
Total PHC F1	32.6	100%

Notes: Indoor air concentrations predicted using the J&E Model (see Section 7.2.3).

Table G.3 Predicted F2 Indoor Air Exposure Point Concentrations for CANDAC Trailers

PHC F2 Fractions	Predicted Indoor Air Concentration (mg/m^3)	Predicted Fraction Breakdown
PHC F2 - Aliphatic C>10-C12	0.43	49.3%
PHC F2 - Aliphatic C>12-C16	0.04	4.8%
PHC F2 - Aromatic C>10-C12	0.37	42.3%
PHC F2 - Aromatic C>12-C16	0.03	3.7%
Total PHC F2	0.87	100%

Notes: Indoor air concentrations predicted using the J&E Model (see Section 7.2.3).

The exposure estimation for the CANDAC worker was performed using the same methods as for the other receptors (detailed within Section 7.2.3 of the report). The exposure results for the CANDAC Trailer Worker receptor are provided in Table G.4.

Table G.4 Calculated F2 intakes for the for CANDAC Trailer Worker

Receptor	Exposure Details	Pathway	Intake (mg/kg-d)		
			PHC F1	PHC F2	PHC F3
CANDAC Trailer Worker	This worker spends 12 hours a day in the CANDAC Trailer area, half of which is indoors and half is outdoors.	Ingestion (soil)	5.5×10^{-5}	4.9×10^{-4}	2.5×10^{-5}
		Inhalation	0.45	1.8×10^{-2}	-
		Dermal (soil)	5.0×10^{-4}	4.4×10^{-3}	2.302×10^{-4}
		Total	**0.45**	**2.3×10^{-2}**	**2.5×10^{-4}**

Notes:
[a] Indoor air concentration calculated using J&E calculations for estimating soil vapour intrusion.

G.1.2 Risk Characterization

The Toxicity Reference Values (TRVs) selected for use in the assessment were applied for this additional receptor as well; details of the TRVs selected for the assessment can be found in Section 7.2 of the report. The resultant Hazard Quotient (HQ) values are presented in Table G.5; as can be seen, all values are below the benchmark of 0.5 for PHCs indicating that there are no risks associated with using the CANDAC Trailer area as evaluated. Exposure to PHCF1 which is the most volatile fraction of PHC results in the highest HQ value.

Table G.5 Calculated HQ Value

Receptor	Exposure Details	HQ Value		
		PHC F1	PHC F2	PHC F3
CANDAC Trailer Worker	This worker spends 12 hours a day in the CANDAC Trailer area, half of which is indoors and half is outdoors.	0.43	0.16	0.002

G.1.3 Soil SSTLs

Associated soil SSTLs were derived in the same way as detailed in Section 9.1.3 of the Main Report. The calculated hazard quotient values were adjusted to a value of 0.5 for PHC to derive the values shown below. The F1 and F2 SSTL values were calculated assuming indoor air concentrations within the trailer remain as calculated.

Table G.6 Risk Based Human Health Soil Values

COPC	Risk-Based Human Health Soil Concentrations (mg/kg)
	CANDAC Trailer Worker
PHC F1	**8045**
PHC F2	**32930**
PHC F3	**107200**

The calculated PHC F1 and PHC F2 soil SSTLs are higher than values calculated for other receptors due, in part, to the fact that the other receptors are more exposed than the CANDAC worker, through a combination of exposure scenarios and receptor characteristics such as inhalation rate, soil ingestion rate, and soil loading to exposed skin. Thus the consideration of the CANDAC worker for a scenario of 6 hours in doors in the trailer and 6 hours outdoors does not result in any changes to the PHC SSTLs that were generated in the Main Report.

G.1.4 Uncertainty

The aspect of this CANDAC worker assessment with the highest uncertainty is the amount of time the worker is assumed to work indoors and outdoors. This assessment provided above assumed the worker is present inside the trailers for 6 hours each day and is working outdoors in the area around the trailers for an additional 6 hours each day. This uncertainty assessment highlights how the amount of time a worker spends indoors can affect the HQ for PHC F1. Table G.7 illustrates that if a worker spends more than 7 hours a day in the trailer then the HQ value would be above 0.5. This does not necessarily mean that there would result in an health effects since the assumptions in the calculations are that the PHC contamination is directly under the CANDAC trailers when in fact it is in the soil surrounding the trailers. However, it suggests that there may be a need to do some vapour sampling within the trailers to ensure that the workers are not at risk. It is also noted that the PHC F1 found in these soil samples is not a result of historical contamination in this area of the Eureka HAWS but is the result of more recent activities. A spill prevention program should be enacted at the HAWS to reduce any future soil contamination.

Table G.7 PHC F1 HQ Sensitivity

Assumed Time Inside Trailers (hr/day)	**Assumed Time Outside Trailers (hr/day)**	CANDAC Trailer Worker PHC F1 HQ Value
6	6	0.43
7	5	0.50
10	2	0.71
12	0	0.85

G.2 References

Health Canada. 2012. Federal contaminated site risk assessment in Canada, Part I: Guidance on human health preliminary quantitative risk assessment (PQRA). Version 2.0.

MOECC. 2016. Modified Generic Risk Assessment “Approved Model.” Standards Development Branch, Ontario Ministry of the Environment and Climate Change. November.