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REPORT

Government of Northwest Territories
Department of Infrastructure

Inuvik Mike Zubko Airport
Infrastructure Upgrades and Airport Operations
Environmental Monitoring Plan

MAY 2023

REVISIONS PAGE

Inuvik Mike Zubko Airport Infrastructure Upgrades and Airport Operations Environmental Monitoring Plan	
Client:	**Engineer:**
Government of Northwest Territories Department of Infrastructure (GNWT–INF)	Associated Engineering (B.C.) Ltd. (Associated)

Revision/ Issue	Date	Description	Prepared by/ Reviewed by	Client Review
1.0	2023-05-24	Submission for Gwich'in Land and Water Board water licence application	Associated	GNWT–INF

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviation	Definition
BTEX	benzene, toluene, ethylbenzene, xylenes
CALA	Canadian Association for Laboratory Accreditation
CCME	Canadian Council of Ministers of the Environment
CEMP	Construction Environmental Management Plan
DFO	Fisheries and Oceans Canada
EM	environmental monitor
ESCP	Erosion and Sediment Control Plan
GLWB	Gwich'in Land and Water Board
GNWT	Government of Northwest Territories
INF	Department of Infrastructure
NTU	nephelometric turbidity units
PHC	petroleum hydrocarbons
QA/QC	quality assurance and quality control
QEP	qualified environmental professional
SCP	Spill Contingency Plan
SQG FAL	Sediment Quality Guidelines for the Protection of Freshwater Aquatic Life
TCLP	toxicity characteristic leaching procedure
TSS	total suspended solids
WQ PAL	Water Quality Guidelines for the Protection of Freshwater Aquatic Life

1 INTRODUCTION

The Government of Northwest Territories (GNWT) – Department of Infrastructure (INF) retained Associated Engineering (B.C.) Ltd. (Associated) to prepare an environmental monitoring plan for construction of the infrastructure upgrades and runway extension (the project) at the Inuvik Mike Zubko Airport (Inuvik Airport) and for regular maintenance of the drainage ditches and operation of the Inuvik Airport, located approximately 12 km east of Inuvik, NT (Figure 1-1). The project includes necessary upgrades to the drainage system that will change the paths and discharge locations of runoff. The drainage upgrades require a Type B water licence application to be submitted to the Gwich'in Land and Water Board (GLWB) under the *Mackenzie Valley Resource Management Act* (SC 1998, c. 25) and the *Northwest Territories Waters Act* (SC 1992, c. 39) and regulations. This morning plan for surface water and sediment (this report) will be included in the water licence application.

GNWT–INF will be responsible for implementing the monitoring plan during the project and after the project is completed, during normal operation of the Inuvik Airport. The proposed construction contractor will be required to follow this monitoring plan and include it in their construction environmental management plan (CEMP), that will be reviewed and approved by a GNWT representative before construction begins. This monitoring plan outlines requirements such as sampling locations, monitoring frequency, parameters to be analyzed, and the response framework.

GNWT–INF will be using aggregate material from the main and north quarries located adjacent to the airport for the project; however, a water licence is not required by the GLWB for work associated with the quarries (A. Macdonald, personal communication, 2023). This plan includes a monitoring location for runoff that currently flows from the southeast of the main quarry because that is the location that runoff from the airport currently enters Chii Zhìt Van (Dolomite Lake). This plan does not include all of the environmental monitoring requirements that will be required at the quarry to ensure compliance with the *Fisheries Act* (RSBC 1985, c. F-14). The contractor will be required to have a qualified environmental professional (QEP) develop a surface water monitoring plan for runoff from the quarry during construction.

1.1 Background

GNWT–INF is completing infrastructure upgrades and constructing a 914 m runway extension at the Inuvik Airport. This project includes necessary upgrades to the drainage system which does not function properly in its current condition (e.g., ponding water, overtopping of roads) and will not support the future upgrades to the airport or the changes in precipitation anticipated due to climate change. The drainage upgrades will change the paths and discharge locations of runoff from the Inuvik Airport and surrounding upland areas. Defined ditches will be constructed to the east, west, and south of the airport to direct runoff to Chii Zhìt Van (Dolomite Lake) and East Lake.

1.2 Site Description

The Inuvik Airport is located approximately 12 km east of the Town of Inuvik, NT, in the Beaufort Delta Region (Figure 1-1). The Inuvik area is characterized by short, cool summers and long, extremely cold winters. The total annual precipitation is approximately 240 mm, with 115 mm from rainfall and the rest from snowfall (Government of Canada 2023). The airport is situated on a plateau north of Chii Zhìt Van and west of East Lake, with a gentle slope from north to south on the east channel of the Mackenzie Delta in the Mackenzie River Basin, Mackenzie Great Bear sub-basin.

Surface water in the Mackenzie Delta is generally frozen for up to 8 months a year and flows seasonally only during spring runoff and periods of high precipitation (Aurora Research Institute 1998). The low-lying wetland areas in the

area are also ice covered for 8 months of the year and hold water seasonally during spring runoff and periods of high precipitation. Chii Zhìt Van is generally ice covered from November to June. The Mackenzie River Basin State of the Aquatic Ecosystem Report indicates that climate change has been identified as a key driver of aquatic ecosystem health in the Mackenzie Great Bear sub-basin, mainly through warmer winters resulting in higher winter and spring stream flows, higher observed levels of turbidity and sedimentation in the Mackenzie River, and permafrost-thaw impacts on streams and lakes in the region (Associated and IEG 2021).

Runoff from the airport surfaces and areas upland of the airport generally drains south, to Chii Zhìt Van, and east from the east of the runway to East Lake, as shown in Figure 1-2. Chii Zhìt Van is approximately 5 km in length, with an approximate depth of 10 m near the shoreline at some locations (Racca et al. 2004). Chii Zhìt Van is used traditionally and recreationally by community members for activities such as hunting, fishing, and boating. East Lake is a shallow lake, approximately 2 km in length, that drains to Chii Zhìt Van. It is not known to be fish bearing or used by local residents.

There are no known background water quality data for surface runoff from the airport and limited water quality data for Chii Zhìt Van.

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Associated Engineering

Government of Northwest Territories

AE PROJECT NO.	2020-2886
SCALE	1:72,000
COORD. SYSTEM	NAD 1983 UTM ZONE 9N
DATE	2023-04-19
REV	02
DRAWN BY	AW
CHECKED BY	CM

FIGURE 1-1
INUVIK AIRPORT LOCATION

GOVERNMENT OF NORTHWEST TERRITORIES
DEPARTMENT OF INFRASTRUCTURE

INUVIK AIRPORT
CIVIL INFRASTRUCTURE IMPROVEMENTS
INUVIK AIRPORT RUNWAY 06-24 EXTENSION

NO.	DATE	ENG	BY	SUBJECT

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Data Sources
1. Orthographic imagery courtesy of ESRI Satellite.
2. Existing, watercourse, waterbodies, and infrastructure shapefiles provided by the Government of Northwest Territories ATLAS.

Associated Engineering

Government of Northwest Territories

Project No.	2020-2886-00
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Drawn:	N. VAN DER MARK
Approved:	M. MACLATCHY
Projection:	UTM ZONE 8N
Date:	2023/05/01

INUVIK AIRPORT - CIVIL INFRASTRUCTURE IMPROVEMENTS & INUVIK MIKE ZUBKO AIRPORT RUNWAY 06-24 EXTENSION

EXISTING DRAINAGE CONDITIONS

DRAWING NUMBER	REV NO.	SHEET
FIGURE 1-2	A	

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Date: 2023-05-01T14:56:23.716

1.3 Project Description

1.3.1 Construction

The project includes activities such as constructing new drainage ditches, extending and widening the runway, and reconstructing the runway, taxiway, and apron pavements.

The proposed new drainage ditches will change the paths of some of the runoff and where it enters the lakes (Figure 1-3). Construction will require vegetation clearing, grubbing, soil excavation, grading, installing erosion control measures in the ditches, and moving material from the quarries using heavy equipment for fill and screened rock. The following erosion control measures will be installed to address potential water quality impacts from total suspended solids:

- Ditches will be armoured with screened rock over non-woven geotextile in sections where water velocity will be greater than 1 m/s;
- Gabion basket check dams, which are rocks typically encased in wire mesh, will be installed at intervals where water velocity will be greater than 2 m/s;
- A screened rock apron will be installed around the culverts;
- Gabion baskets will be installed at the end of the two new outfall locations (OF_02 and OF_4), approximately 5 m above the ordinary high-water mark of Dolomite Lake and 18 m above the ordinary high-water mark of East Lake; and
- Ditches will be hydroseeded with a native grass mix in the ditch sections where screened rock is not required.

The project activities associated with the infrastructure upgrades, runway extension, and other infrastructure upgrades are anticipated to begin on June 12, 2023, and be completed December 30, 2027. The construction of the drainage upgrades for the new proposed ditches (e.g., eastward, westward, and southwestward ditches) are anticipated to begin on August 1, 2023, or after the water licence is issued, and be completed by October 30, 2024.

1.3.2 Inuvik Airport Operations

Operations at the airport primarily involve maintaining and refuelling aircrafts and maintaining runway surfaces. This includes snow clearing, surface sweeping, seasonal deicing activities using an ethylene glycol–containing deicer, and storage and use of petroleum-based products such as fuel, coolants, and lubricants. When deicing activities are completed at the airport, they are completed at the west apron. Runoff from deicing activities flows to the west apron embankment and to the west drainage ditch shown in Figures 1-2 and 1-3. Refuelling of aircrafts is completed on the main apron using mobile fuel trucks.

After construction of the drainage ditches is complete, regular monitoring and maintenance of the drainage ditches is anticipated for them to maintain proper function. Maintenance activities may include removing snow, vegetation, debris, and sediment build-up from culverts and ditches, regrading ditches, and repairing ditches with rock, riprap, or hydroseeding with a native grass mix.

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Notes
1. Precise alignment and location of ditches and culverts can be seen in the "ISSUED FOR TENDER WORK PACKAGE 3 & 4 - EMBANKMENT CONSTRUCTION AND AIRFIELD STORMWATER DRAINAGE" drawings.

Data Sources
1. Orthographic imagery courtesy of ESRI Satellite.
2. Existing, watercourse, waterbodies, and infrastructure shapefiles provided by the Government of Northwest Territories ATLAS.

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INUVIK AIRPORT - CIVIL INFRASTRUCTURE IMPROVEMENTS & INUVIK MIKE ZUBKO AIRPORT RUNWAY 06-24 EXTENSION

PROPOSED DRAINAGE CONDITIONS

DRAWING NUMBER	REV NO.	SHEET
FIGURE 1-3	A	

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1.4 Monitoring Plan Objectives

The objective of the Inuvik Airport monitoring plan is to provide guidance for surface water and sediment[1] monitoring during construction and regular operation of the airport. The monitoring plan is organized by monitoring requirements to be conducted during construction (Section 2) and those conducted after construction, during regular airport operations (Section 3). The plan includes surface water quality monitoring of the following parameters:

- Turbidity and total suspended solids;
- Hydrocarbons;
- Oil and grease;
- Ethylene glycol; and
- Metals.

The plan also includes sediment quality monitoring of metals at the proposed outfall locations to partially address an inquiry from Environment and Climate Change Canada regarding blasting and surface runoff mitigation measures (Burr, W., personal communication, 2022). A QEP will determine whether lakebed sediment quality monitoring should continue after construction based on the water and lakebed sediment quality results collected during construction.

1.5 Regulatory Framework

GNWT–INF is committed to the environment and will be following the required regulatory processes to mitigate potential environmental impacts during the project and operation of the airport. Environmental planning and mitigation will form part of the regulatory applications. Anticipated regulatory permits or authorizations include:

- Type B water licence from the GLWB, regulated under the *Mackenzie Valley Resource Management Act* (SC 1998, c. 25) and *Northwest Territories Waters Act* (SC 1992, c. 39) and regulations
- No Interference with Navigation Notification of Work from Transport Canada, regulated under the Canadian *Navigable Waters Act* (RSC 1985, c. N-22)
- Project review by Fisheries and Oceans Canada (DFO), regulated under the *Fisheries Act* (RSBC 1985, c. F-14)

Samples collected as part of the monitoring plan will be compared to the following guidelines:

- Water chemistry will be compared to the Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guidelines for the Protection of Aquatic Life (WQ PAL) (CCME 1999a, CCME 2023).
- Water chemistry for glycol will be compared to the Environment and Climate Change Canada glycol guidelines for federal airports (ECCC 2017).
- Water chemistry will be compared to the standards in the Type B water licence, if they differ from the guidelines above.
- Sediment chemistry will be compared to the CCME Canadian Sediment Quality Guidelines for the Protection of Freshwater Aquatic Life (SQG FAL) (CCME 1999b).

During construction, the contractor will be required to implement and incorporate the monitoring plan into their CEMP. Given the anticipated duration of construction, GNWT–INF may need to engage QEPs to adapt monitoring activities and provide recommendations for mitigations if exceedances or long-term trends are detected in surface water or sediment.

[1] Sediment monitoring in this plan specifically refers to sediment of the lakebed and not suspended sediment.

In addition to the monitoring plan, the following plans will be submitted as part of the water licence application:

- Erosion and sediment control plan (ESCP) (Associated 2023b)
- Spill contingency plan (SCP) (Associated 2023c)
- Hazardous material response plan (GNWT–INF n.d.)
- Engagement plan (Associated 2023d)

1.6 Assumptions

Development of this monitoring plan was based on the following assumptions:

- No work will occur below the ordinary high-water mark of both lakes.[2]
- Turbidity is the only water quality parameter that will be managed in real time. Other parameters (e.g., hydrocarbons, glycol, and metals) cannot be managed in real time and will require laboratory analysis.
- There is no known background water quality data available for runoff from the airport.
- A QEP will select the actual monitoring locations for the reference samples based on field conditions and access.

The monitoring plan is meant to be an adaptive document and allows for changes based on new information or changing conditions. The plan will be updated to include any requirements outlined in the water licence. It is possible that water quality monitoring may not be required in the long term after construction is finished and the new drainage ditches are functioning as intended. Associated suggests that after three years of data collected during operations, a QEP analyze the water quality data to determine whether the water quality monitoring program should proceed or can be reduced or discontinued, depending on results.

[2] The ordinary high-water mark is defined as the usual or average level to which a body of water rises at its highest point and remains for sufficient time to change the characteristics of the land. In lakes, this refers to the parts of the banks that are frequently flooded by water so as to leave a mark on the land and where the natural vegetation changes from predominantly aquatic vegetation to terrestrial vegetation (DFO 2018).

2 CONSTRUCTION MONITORING

An environmental monitor (EM), who is a QEP or is supervised by a QEP retained by the contractor, will be responsible for the tasks described in the following sections.

2.1 Contractor Requirements

The Contractor will need to comply with the contract environmental specifications, which include developing, implementing, and following a CEMP. The CEMP will include but is not limited to the ESCP, this monitoring plan, SCP, the requirements in the contract specifications issued for tender, and any other requirements outlined in the water licence issued by the GLWB and the Letter of Advice anticipated to be issued by DFO.

2.2 Monitoring Locations

Six monitoring locations (Figure 2-1) are recommended based on the existing and proposed ditch paths and their outfall locations to receiving waters (e.g., Chii Zhìt Van and East Lake). Two of these locations are reference points to be established outside of the influence of airport runoff in Chii Zhìt Van and East Lake which will act as baseline sampling points. Samples will be collected from the surface receiving water directly below the outfalls (the lakes) not from the drainage ditches or outfall structures themselves.

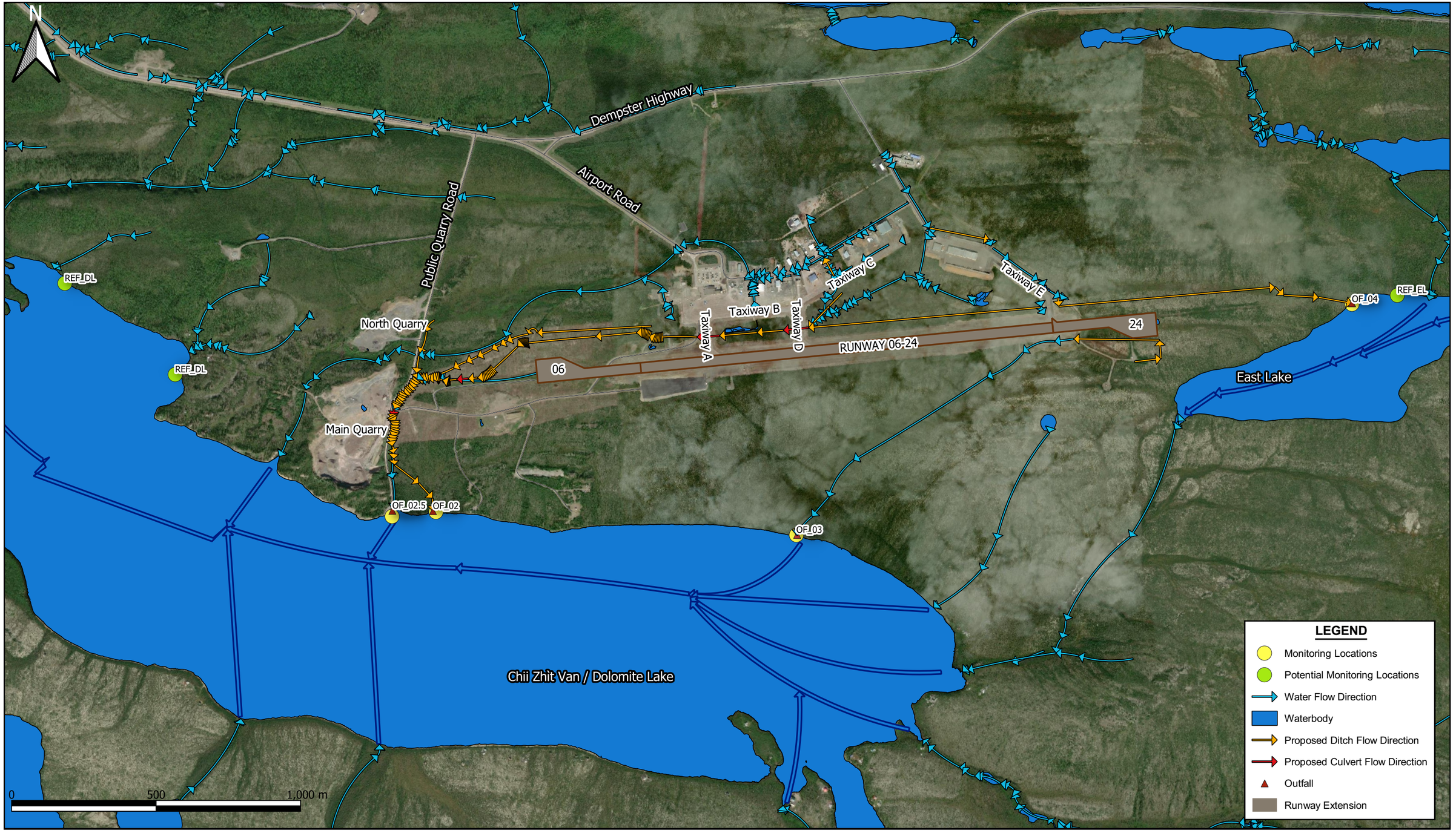
The monitoring locations and rationale for sampling at each location are summarized in Table 2-1.

Table 2-1 Monitoring Locations During Construction Phase

Site	Location and Rationale	Coordinates (decimal degrees)
OF_02.5	• The current runoff point from the airport and the main quarry to Chii Zhìt Van.[1] • Monitoring at this location will occur until runoff from the airport is directed to OF_02. • Arsenic was identified as a potential parameter of concern in sediment from analysis of the quarry rock.[2] The main concerns at this runoff point are arsenic, turbidity, and total suspended solids.[3]	68.297628°, −133.532012°
OF_02	• The proposed outfall location from the airport and upland areas to Chii Zhìt Van. • Water flow starts from the west side of Taxiway E and continues west along the north side of the runway under Taxiways D and A into the new west ditch line that eventually terminates at OF_02 into Chii Zhìt Van. • Sediment samples will be collected from this location because rock from the quarries will be used as granular fill and screened rock in construction. • Total suspended solids, turbidity, and arsenic are potential parameters of concern.	68.297661°, −133.527747°
OF_03	• Runoff currently flows from the southeast of the airport through the natural drainage path into Chii Zhìt Van.	68.296394°, -133.488948°

Site	Location and Rationale	Coordinates (decimal degrees)
	• Water flow from the southeast section of the runway will flow through a newly constructed ditch along the south side of the runway and be reconnected to the existing natural drainage path that flows to Chii Zhìt Van at OF-03. • Sediment samples will not be collected here because of the low flow rates anticipated at this location and the existing natural drainage path (approximately 1,300 m in length) will not be altered (e.g., vegetation will not be removed, and screened rock will not be used in the pathway that flows to the lake). • Total suspended solids and turbidity are potential parameters of concern.	
OF_04	• Runoff from the east end of the airport currently drains into East Lake and is proposed to drain to the same location through OF_04. • Water flow will start from the east side of Taxiway E and flow east along the ditch, eventually terminating at OF_04. • Sediment samples will be collected from this location because rock from the quarries will be used as granular fill and screened rock in construction. • Total suspended solids, turbidity, and arsenic are potential parameters of concern.	68.304840°, −133.428771°
REF_DL	• Located in Chii Zhìt Van; the exact location is to be determined in the field by a QEP, but must be at least 100 m away from the monitored outfalls and avoid the areas downgradient (directly south) of the airport. Potential locations are near the unnamed tributary on the northwest end of the lake, or >100 m west of where the runoff from the quarries enters the lake. See Figure 2-1 for two potential locations. • This location will serve as a baseline to account for naturally occurring changes in the lake throughout the ice-free season.	TBD
REF_EL	• Located in East Lake, the exact location is to be determine in the field but must be upgradient at least 100 m from OF_04. • This location will serve as a baseline to account for naturally occurring changes in the lake throughout the ice-free season.	TBD

[1] OF_02.5 was selected as a monitoring location even though the quarry monitoring plan is being developed separately from this plan because runoff from the airport currently flows to Chii Zhìt Van at this location. Monitoring will occur at OF_02.5 until runoff from the airport is directed to OF_02. [2] As identified by two quarry rock samples obtained in December 2022 (Associated 2023a). [3] The total arsenic concentration in two quarry rock samples exceeded the CCME's interim SQG FAL but not the probable effect guideline. Sediment was not sampled. The total arsenic concentration did not exceed the GNWT environmental guideline for contaminated site remediation for soil (GNWT 2003). The average arsenic concentration in all samples was below all guidelines.
CCME – Canadian Council of Ministers of the Environment; GNWT – Government of Northwest Territories; OF – outfall; QEP – qualified environmental professional; REF_DL – reference point (Dolomite Lake); REF_EL – reference point (East Lake); SQG – Sediment Quality Guideline; TBD – to be determined



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Notes
1. Precise alignment and location of ditches and culverts can be seen in the "ISSUED FOR TENDER WORK PACKAGE 3 & 4 - EMBANKMENT CONSTRUCTION AND AIRFIELD STORMWATER DRAINAGE" drawings.

Data Sources
1. Orthographic imagery courtesy of ESRI Satellite.
2. Existing, watercourse, waterbodies, and infrastructure shapefiles provided by the Government of Northwest Territories ATLAS.

Associated Engineering

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Projection:	UTM ZONE 8N
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INUVIK AIRPORT - CIVIL INFRASTRUCTURE IMPROVEMENTS & INUVIK MIKE ZUBKO AIRPORT RUNWAY 06-24 EXTENSION

MONITORING LOCATIONS

DRAWING NUMBER	REV NO.	SHEET
FIGURE 2-1	A	

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2.3 Monitoring Events

Monitoring events during construction will include the following:

- Background water quality and sediment sampling (Section 2.3.1);
- Construction turbidity monitoring (Section 2.3.2);
- Water quality monitoring three times per year and sediment sampling once per year (Section 2.3.3);
- Visual inspections (Section 2.3.4).

Samples collected during the events outlined in Sections 2.3.1 and 2.3.3 shall be sent to a Canadian Association for Laboratory Accreditation (CALA) accredited laboratory for analysis. The laboratory results will be compared to background concentrations to inform the response framework outlined in Section 2.6.

2.3.1 Background Water Quality and Sediment Sampling

Before construction of the drainage ditches begins, background water quality samples will be collected at OF_02, OF_02.5, OF_03, OF_04, REF_DL, and REF_EL.[3] Background sediment samples will be collected at OF_02, OF_04, REF_DL, and REF_EL. Grab samples will be collected from Chii Zhìt Van and East Lake directly below the outfalls when there is no water flowing from the outfalls and water has not been flowing from the outfalls for at least 24 hours. Samples will be submitted to a CALA accredited laboratory for analysis of the parameters listed in Table 2-2. The results from this sampling event will be used to determine background concentrations at all monitoring locations and to inform the response framework for construction and airport monitoring, outlined in Sections 2.6 and 3.5.

In addition to the initial background samples, sampling from the reference point in Chii Zhìt Van (REF_DL) and in East Lake (REF_EL) (Table 2-1) will happen concurrently with the field turbidity and water quality events outlined in Sections 2.3.2 and 2.3.3. The purpose of sampling these reference sites during baseline and construction monitoring is to distinguish naturally occurring fluctuations in the lake due to inter-annual variation, seasonality and precipitation events from potential changes caused by airport runoff.

Table 2-2 Background Water and Sediment Quality Monitoring Requirements

Medium	Site	Parameters	Frequency	Timing[1]
Surface water	OF_02 OF_2.5 OF_03 OF_04 REF_DL REF_EL	• Field general parameters (pH, conductivity, turbidity) • Lab general parameters (pH, conductivity, TSS) • Metals, to include arsenic (total and dissolved) • PHC F1 and F2, BTEX • Ethylene glycol	Once	Before construction
Sediment	OF_02 OF_04 REF_DL REF_EL	• Metals, to include arsenic	Once	Before construction

[1] To avoid skewed results, background samples should not be collected during freshet or active spring runoff. BTEX – benzene, toluene, ethylbenzene, and xylenes; CCME – Canadian Council of Ministers of the Environment; F – fraction; OF – outfall; PHC – petroleum hydrocarbon; TSS – total suspended solids

[3] To avoid skewed results, background samples should not be collected during freshet or active spring runoff.

2.3.2 Construction Turbidity

During sediment-producing activities (e.g., grubbing and soil excavation) and when water is actively flowing in the ditches and outfall systems, turbidity will be monitored by the EM at least two times per day using a hand-held turbidity meter. If possible, turbidity monitoring should also be completed at the sites in the morning, before construction begins, so that the results collected later in the days can be compared to the background levels at the same locations before construction began. This is also important to capture the changes in turbidity if runoff during construction will occur for greater than 24 hours.

Monitoring for turbidity will occur at OF_2, OF_03, OF_04, and OF_02.5, as these are the main convergence points for water flowing west, south, and east from the airport. Monitoring for turbidity at OF_02.5 will be completed until runoff from the airport is directed to OF_02. Concurrently, turbidity will be monitored at the reference points (REF_DL and REF_EL) to compare results to background levels to account for any naturally occurring fluctuations in the lakes. See Section 2.3.4 for visual observations for turbidity.

The monitoring requirements for construction turbidity are summarized in Table 2-3.

Table 2-3 Turbidity Monitoring Requirements

Site	Parameters	Frequency[1]	Timing
OF_02 OF_03 OF_04	Field turbidity	2 times per day	Duration of construction
OF_02.5	Field turbidity	2 times per day	Duration of construction, until runoff is directed to OF_02
REF_DL REF_EL	Field turbidity	1 time per day	When turbidity is sampled

[1] The frequency of two times per day is a minimum when runoff is actively flowing and may need to be increased at the discretion of the environment monitor. Monitoring is required when water is actively flowing through the drainage ditches to Chii Zhìt Van or East Lake. The frequency of monitoring at the reference sites once time per day is a minimum. This can be increased in order to capture changes in background levels throughout the day.

Turbidity samples will be compared to the CCME WQ PAL. The guidelines and response framework for exceedances are provided in Section 2.6.1.

2.3.3 Water Quality and Sediment Sampling Events

Surface water quality samples will be collected from the monitoring locations at least three times per year, once each at freshet, during a significant rain event, and in the fall, before freeze-up. Surface water samples are to be collected directly below the outfalls from the lakes, or as close as possible. Sediment quality samples will be collected annually in the fall, before freeze-up. The parameters that each sample will be analyzed for are listed in Table 2-4.

Freshet Event

Surface water samples will be collected annually during spring runoff where water is actively flowing through the drainage system and outfall locations. Turbidity and field parameters should also be obtained during this sampling event. These samples are important to capture any potential contaminants flowing into the lakes during spring runoff.

Rain Event

Surface water samples will be collected, at a minimum, during one significant rain event per year during construction. These samples are important to capture any potential contaminants that may be present in the runoff due to construction activities. These results will also help determine whether additional mitigative measures are required if there are any exceedances present.

Fall Event

Surface water samples will be collected just before freeze-up, during a rain event, if possible. In addition to surface water sampling, sediment will also be collected at this same event from the locations listed in Table 2-4. The sediment samples will be representative of any metals, including arsenic, that have settled from the water column into the sediment throughout the ice-free season. These samples will be collected regardless of whether flowing water is present in the outfalls to establish the baseline to compare overwintering conditions to spring freshet conditions and to determine whether any additional mitigative measures are necessary.

Table 2-4 Construction Water and Sediment Quality Sampling Requirements

Medium	Site	Parameters	Frequency	Time of Year
Surface water	OF_02 OF_03 OF_04 REF_DL REF_EL	• Field general parameters (pH, conductivity, turbidity) • Lab general parameters (pH, conductivity, TSS) • Metals, to include arsenic (total and dissolved) • PHC F1 and F2, BTEX • Ethylene glycol	3 times per year during active construction	• Freshet melt runoff • Significant rain event • Fall rain event
Surface water	OF_02.5	• Field general parameters (pH, conductivity, turbidity) • Lab general parameters (pH, conductivity, TSS) • Metals, to include arsenic (total and dissolved) • PHC F1 and F2, BTEX • Ethylene glycol	3 times per year during active construction	• Freshet melt runoff • Significant rain event • Fall rain event Until runoff from the airport is redirected to OF_02
Sediment	OF_02 OF_04 REF_DL REF_EL	• Metals, to include arsenic	Once per year during construction	• Fall event

BTEX – benzene, toluene, ethylbenzene, xylenes; CCME – Canadian Council of Ministers of the Environment; F – fraction; PHC – petroleum hydrocarbons; TSS – total suspended solids

2.3.4 Visual Inspections

Visual inspections of surface water (including drainage ditches to Chii Zhìt Van and East Lake) shall be conducted by an EM daily during construction to identify signs of release of sediment or other waste materials to waterbodies. This should include checking for signs of possible contamination, including floating and suspended materials, oil sheens, discoloration, turbidity, unusual odours, or foam. The visual inspection should be conducted in conjunction with monitoring for turbidity. During dry days, any areas with visible surface water, including the outfall areas and standing water should be observed once per day.

If contaminants are visually identified in the ditches or outfall locations, the procedures outlined in the SCP (Associated 2023c), the ESCP (Associated 2023d), and in the monitoring and response framework in Section 2.6 of this report should be followed.

2.4 Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures will be applied during the monitoring events outlined in Sections 2.3.1, 2.3.2, and 2.3.3. The Protocols Manual for Water Quality Sampling in Canada (CCME 2011) will be followed, where applicable. The QA/QC measures will include:

- Collecting samples in laboratory-supplied bottles;
- Calibrating equipment before sampling;
- Wearing a new pair of nitrile gloves at each sampling location;
- Cleaning equipment between sampling locations;
- Collecting one field duplicate sample per sampling event;
- Following laboratory protocols for storage and shipment of samples, including chain of custody procedures; and
- Submitting samples to a CALA accredited laboratory for analysis.

2.5 Documentation and Reporting

2.5.1 Background Water Quality and Sediment Sampling

The contractor will be required to submit a report summarizing the monitoring and laboratory results collected during background water quality and sediment sampling. The summary report and laboratory results will be provided to GNWT–INF. The background water and sediment quality results will be used to compare the results collected throughout the life of the construction project.

2.5.2 Construction Turbidity and Visual Inspections

The EM is responsible for documenting all field observations (including visual inspections) and turbidity readings in field notes and will add them to a daily field report. The daily field report should include, at a minimum, the following information:

- Name of EM
- Time of observation
- Weather conditions
- Summary of construction activities (e.g., location and type of activity)
- Activities carried out by the EM that day, including the visual inspections
- Field turbidity results (including background levels)

- Photos, if applicable
- Any actions conducted because of exceedances (e.g., turbidity) (halting construction, installing additional silt fencing, etc.)
- Construction and monitoring activities projected to occur the next day

The EM will submit the daily field report to the applicable personnel, as outlined in the Contractor's CEMP. Any turbidity exceedances must be immediately verbally reported to the applicable personnel, as outlined in the contractor's CEMP, which is to include the project engineer.

Turbidity data is to be provided to the project engineer (i.e., Associated) on a weekly basis.

2.5.3 Water Quality and Sediment Sampling Events

All water quality reporting will comply with the GNWT Standards for Reporting Water Quality Information (GNWT 2020).

A QEP will compile a summary report of monitoring and laboratory results once each year which will be provided to GNWT–INF and submitted to the GLWB. All laboratory results will be kept accessible for the life of the construction project and the contractor will submit all results to GNWT–INF.

2.6 Monitoring and Response Framework

The monitoring and response framework was developed to set out how the effectiveness of the monitoring plan will be evaluated. In addition, it establishes an early warning system with appropriate responses to help reduce effects in the receiving environment and apply mitigation efforts, if required.

2.6.1 Construction Turbidity

The monitoring program response framework follows the CCME WQ PAL guidelines for turbidity. The guideline varies based on the following:

- Background levels of turbidity;
- Exposure time (under or over 24 hours); and
- Whether the flow is "clear flow" or "high flow."

Clear flow is defined as water with background levels ≤8 nephelometric turbidity units (NTU) (CCME 1999). High flow is defined as water with background levels >8 NTU. Once the EM obtains the background levels from the reference sites each day, the results will be evaluated according to the CCME WQ PAL, as follows:

Clear-flow conditions (background levels ≤8 NTU)

- ≤8 NTU increase from background levels for short-term exposure (e.g., 24-hour period)
- ≤2 NTU average increase from background levels for long-term exposure (e.g., 24 hours to 30 days)

High-flow conditions (e.g., spring freshet and storm events) or background levels >8 NTU

- ≤8 NTUs increase from background levels at any time when background levels are 8 to 80 NTU
- ≤10% increase from background levels when background levels >80 NTU

If turbidity results exceed the above guidelines (e.g., >8 NTU above background levels during freshet), the following steps should be followed:

1. Stop work if the exceedance is directly attributable to sediment-producing work. Investigate and determine whether the sediment and erosion control measures need to be maintained, repaired, or adjusted; whether additional sediment and erosion control measures can be implemented; or whether any anomalies apply to the result. See the ESCP for details on sediment and erosion control monitoring and response requirements.
2. Allow for turbidity to return to concentrations that meet WQ PAL as determined by the REF sampling point; monitor turbidity at each location at least every hour until this point is reached.
3. Resume construction activities using modified methods as required (e.g., additional silt fencing, barriers, after rain has stopped).
4. Monitor turbidity every hour to confirm that guidelines are not being exceeded with the new mitigations in place.

If a guideline is consistently exceeded and is disrupting work, sediment-producing work may need to be postponed for dry conditions. Mitigation measures should be discussed between the contractor and Associated.

2.6.2 Visual Inspections

If any floating and suspended materials, oil sheens, discoloration, excessive turbidity, unusual odours, or foam are noticed in the ditch and outfall systems, the following steps should be followed:

1. Stop any work that is directly causing the potential issue (e.g., leaking machinery, spills).
2. Follow the procedures in the SCP (Associated 2023c).
3. Investigate the area to determine the cause, and if possible, remove or mediate the source.
4. Inspect the outfalls and runoff locations to ensure contaminants have not entered the waterbodies. If any visual contaminants are noticeable in the lakes, follow the procedures in the SCP.
5. Resume construction activities and regular sampling program once the source has been identified and proper mitigations have been implemented.

2.6.3 Water Quality and Sediment Sample Exceedances

A QEP, retained by the contractor, is to analyze the laboratory results at least one month after results are received to determine whether there are any WQ PAL exceedances. The exceedances should be noted, and GNWT–INF should be notified as soon as possible so that appropriate mitigations can be implemented.

Once each year, results should be analyzed to determine whether there are any long-term trends in parameter concentrations of concern, such as arsenic. A QEP should provide appropriate recommendations. The contractor should provide an annual report to GNWT–INF by March 31 of the year following the sampling events.[4]

[4] The date may change depending on the submission deadlines included in the water licence.

3 AIRPORT OPERATIONS MONITORING

It is important to continue surface water monitoring after the new drainage system and runway extensions are complete. When the airport is in operation, there is still the potential for contaminants such as deicing fluid and hydrocarbons to run off into Chii Zhìt Van and East Lake.

Sediment samples will be collected only if exceedances were observed during sampling events that occurred during the construction period.

Associated is proposing that surface water monitoring should continue for a minimum of three years after construction is completed to determine if there any exceedances or trends in parameter concentrations. A QEP, retained by GNWT, should analyze the results and make a recommendation based on the results about whether monitoring should continue or be adapted.

3.1 Monitoring Locations

The monitoring locations during operations will be the same as those monitored during construction, except for OF_02.5[5] (Figure 2-1), which will be removed because it is not applicable to runoff from the airport after runoff is diverted to OF_02. The reference points in Chii Zhìt Van and East Lake will remain the same to maintain consistency in establishing a baseline. Samples will not be collected from the drainage ditches or outfall structures themselves, but rather from the surface water (i.e., lakes) directly below.

The monitoring locations and the rationale for sampling at the location are summarized in Table 3-1.

[5] After construction is complete, runoff from the airport will flow to OF_02 and not OF_02.5.

Table 3-1 Monitoring Locations During Airport Operations

Site	Location and Rationale	Coordinates
OF_02	• Runoff from the airport and upland areas drains into Chii Zhìt Van. • Water flow starts from the west side of Taxiway E and flows west along the north side of the runway, eventually terminating at OF_02. • Sediment samples will be collected from this location if exceedances are observed during construction, or if recommended by a QEP because rock from the quarries will be used as fill and screened rock in construction. • Total suspended solids, hydrocarbons, and ethylene glycol are potential contaminants of concern	68.297661°, −133.527747°
OF_03	• Runoff from the southeast side of the airport drains into Chii Zhìt Van. • Water flow starts from the southeast side of the runway, flows west along the south side of the runway, and meets up with the existing natural drainage path that flows southwest to Chii Zhìt Van. • Total suspended solids, hydrocarbons, and ethylene glycol are potential contaminants of concern	68.296394°, -133.488948°
OF_04	• Runoff from the east of the airport drains into East Lake. • Water flow starts from the east side of Taxiway E and flows east along a ditch, eventually terminating at OF_04. • Sediment samples will be collected from this location if exceedances were observed during construction, or if recommended by a QEP because rock from the quarries will be used as fill and screened rock in construction. • Total suspended solids, hydrocarbons, and ethylene glycol are potential contaminants of concern	68.304840°, −133.428771°
REF_DL	• Located in Chii Zhìt Van; the exact location is to be determined in the field by a QEP, but must be at least 100 m away from the monitored outfalls and avoid the areas downgradient (directly south) of the airport. Potential locations are near the unnamed tributary on the northwest end of the lake, or >100 m west of where the runoff from the quarries enters the lake. See Figure 2-1 for potential locations. • This location will serve as a baseline to account for naturally occurring changes in the lake throughout the ice-free season.	TBD
REF_EL	• Located in East Lake; the exact location to be determined at the field level but must be upgradient at least 100 m from OF_04. • Will serve as a baseline to account for naturally occurring changes in the lake throughout the ice-free season.	TBD

OF – outfall; QEP – qualified environmental professional; REF_DL – reference point (Dolomite Lake); REF_EL – reference point (East Lake); TBD – to be determined

3.2 Monitoring Events

Monitoring events will include the following:

- Water quality monitoring events to occur three times per year (Section 3.2.1); and
- Visual inspections (Section 3.2.2).

Samples collected during the events outlined in Section 3.2.1 (i.e., freshet, rain, and fall) shall be sent to a CALA accredited laboratory for analysis. The laboratory results will be compared to background concentrations to inform the response framework outlined in Section 3.5.

3.2.1 Water Quality and Sediment Sampling Events

Surface water samples will be collected from the monitoring locations at least three times per year at the following times:

- Freshet;
- During a significant rain event; and
- In the fall season, before freeze-up.

Surface water samples shall be collected directly below the outfalls from the lakes, or as close as possible, and from the shore of the lakes at the reference locations.

Sediment samples shall be collected annually in the fall, before freeze-up, if exceedances were noted in the water or sediment samples collected during construction.

The parameters that each sample will be analyzed for are listed in Table 3-1.

Freshet Event

Surface water sampling shall occur once annually during spring runoff where water is actively flowing through the drainage systems and outfall locations. Surface water samples are to be collected directly below the outfalls from the lake, or as close as possible. General field parameters (e.g., pH) should also be obtained during this sampling event. These samples are important to capture any contaminants being flushed into the lake from spring runoff.

Rain Event

Surface water sampling shall occur during one significant rain event per year. Parameters to be sampled at each location are listed in Table 3-2. Surface water samples are to be collected directly below the outfalls, from the lake, or as close as possible. These samples are important to capture any potential contaminants that may be present in the runoff from airport operations. These results will also help determine whether any additional mitigative measures are required if guideline exceedances are detected.

Fall Event

Surface water sampling shall occur just before freeze-up during a rain event, if possible. Sample parameters per location are listed in Table 3-2. These samples will be collected regardless of whether flowing water is present in the outfalls to establish the baseline to compare overwintering conditions to spring freshet conditions and to determine whether any additional mitigative measures are necessary.

Table 3-2 Operations Water and Sediment Quality Requirements

Medium	Site	Parameters	Frequency	Time of Year
Surface water	OF_02 OF_03 OF_04 REF_DL REF_EL	• Field general parameters (pH, turbidity, conductivity) • Lab general parameters (pH, conductivity, TSS) • Metals, to include arsenic (total and dissolved) • PHC F1 and F2, BTEX • Ethylene glycol	3 times per year during operations	• Freshet • Summer rain event • Fall rain event
Sediment	OF_02 OF_04 REF_DL REF_EL	• Metals, to include arsenic	Once per year, if required	• Fall event

BTEX – benzene, toluene, ethylbenzene, xylenes; F – fraction; PHC – petroleum hydrocarbons; TSS – total suspended solids

3.2.2 Visual Inspections

Visual inspections of surface water (including drainage ditches to Chii Zhìt Van and East Lake) should be conducted at least weekly during freshet, during storm events, at the same time as the sampling events outlined in Table 3-2, and after an environmental incident such as a spill to identify signs of release of suspended sediment or other waste materials to waterbodies. Indications of potential contamination may include the presence of floating and suspended materials, oil sheens, discolouration, turbidity, unusual odours, or foam.

If contaminants are visually identified in the ditches or outfall locations, procedures outlined in the Inuvik Airport Hazardous Material Response Plan (GNWT–INF n.d.) and the monitoring and response framework outlined in Section 3.5 should be followed.

3.3 Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures will be applied during the monitoring events outlined in Section 3.2.1. The Protocols Manual for Water Quality Sampling in Canada (CCME 2011) will be followed. The QA/QC procedures will include:

- Collecting samples in laboratory-supplied bottles;
- Calibrating equipment before sampling;
- Wearing a new pair of nitrile gloves at each sampling location;
- Cleaning equipment between sampling locations;
- Collecting one field duplicate sample per sampling event;
- Following laboratory protocols for storage and shipment of samples, including chain of custody procedures; and
- Submitting samples to a CALA accredited laboratory for analysis.

3.4 Documentation and Reporting

All water quality monitoring results will be reported in compliance with the GNWT Standards for Reporting Water Quality Information (GNWT 2020).

A QEP is to analyze the laboratory results at least one month after results are received to determine whether there are any WQ PAL exceedances. The exceedances should be noted, and GNWT–INF should be notified immediately so that appropriate mitigations can be implemented.

A QEP will analyze the results annually and compile them into a summary report to determine whether additional monitoring or controls are required. This report will be submitted to the GLWB.

3.5 Monitoring and Response Framework

The monitoring and response framework was developed to set out how the effectiveness of the management plan will be evaluated. In addition, it establishes an early warning system and an appropriate general response to help reduce effects in the receiving environment.

3.5.1 Visual Inspections

If any floating and suspended materials, oil sheens, discoloration, turbidity, unusual odours, or foam are noticed in the ditch and outfall systems, the following steps should be followed:

1. Stop any work that is directly causing the potential issue (e.g., spills).
2. Follow the procedures in the Hazardous Material Response – Airport Emergency Plan (GNWT–INF n.d.).
3. Investigate the area to determine the cause, and if possible, remove or mediate the source.
4. Inspect the outfalls and runoff locations to ensure contaminants have not entered the waterbodies. If any visual contaminants are noticeable in the lakes, follow the procedures in the Hazardous Material Response – Airport Emergency Plan.

3.5.2 Water Quality and Sediment Sample Exceedances

Results will be compared to the WQ PAL, except for ethylene glycol. Ethylene glycol results will be compared to the Environment and Climate Change Canada glycol guideline for airports of 100 mg/L (ECCC 2017), which is more stringent than the WQ PAL long term concentration for ethylene glycol of 500 mg/L. There is no WQ PAL short term guideline for ethylene glycol.

A QEP is to analyze the laboratory results at least one month after results are received to determine whether there are any WQ PAL exceedances. The exceedances should be noted, and GNWT–INF should be notified immediately so that appropriate mitigations can be implemented.

Once each year, the QEP shall analyze the results to determine whether there any long-term trends in parameter concentrations of concern and provide appropriate recommendations for mitigations.

CLOSURE

This report was prepared for the Government of Northwest Territories – Department of Infrastructure to guide monitoring for surface water and sediment during construction of the infrastructure upgrades and runway extension at the Inuvik Airport, and for operations of the Inuvik Airport after construction is completed.

The services provided by Associated Engineering (B.C.) Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practising under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,

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