REPORT

Biophysical Report and Peat Development and Operations Plan - 2022 Update

Premier Tech Horticulture Clearwater Peat Harvest Project

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1 PDF Copy - Golder Associated Ltd.

Version History

Version	Report No	Date	Comments
1.0	19132041_PTH_Clearwater_Bio Report_REV0	November 2020	Biophysical Report and Peat Development and Operations Plan issued following receipt of AEP SIR #1
2.0	21496738_PTH_Clearwater_Bio Report_REV0	January 2022	Updated Biophysical Report and Peat Development and Operations Plan issued following receipt of SIR #2. All figures and summaries were updated as a result of a slight modification to the footprint, including the 100 m setback from Mud Creek and water management procedures.

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1.0 INTRODUCTION

Premier Tech Horticulture (Premier Tech) commissioned Golder Associates Ltd. (Golder) to respond to Premier Tech's Supplemental Information Requests (SIRs) received from Alberta Environment and Parks (AEP) on May 28, 2019 and September 15, 2021 (AEP 2021) for the Clearwater Project (Clearwater Project; the Project). This report is intended to provide the required information for the *Biophysical Report* and *Peat Development and Operations Plan* as outlined by the *Guide to Surface Materials Lease Information Requirement for Peat Operations* (Government of Alberta [GOA] 2017). Ultimately, this report will support the *Public Lands Act* and *Water Act* Approval required to construct and operate the Project, associated with AEP file numbers SML090026 and WA00387959.

The Project is located in west-central Alberta, approximately 3.4 km southwest of Chedderville in Sections 1, 2, and 3 of Township 37 Range 7 West of the 5th Meridian (i.e., 1, 2 and 3-37-7-W5M).

The original Development Plan and surface material lease (SML) application (Premier Tech 2010) included six harvest sections between Sections 1, 2, and 3-37-7-W5M. The Project footprint has since been updated to be developed in two phases: Phase 1 Development will include Sections 1 and 2-37-7-W5M, and Phase 2 Development will include Section 3-37-7-W5M. Supplemental biophysical data was collected for Phase 1 and Phase 2 of the Project; however, Phase 2 will be submitted as an amendment or new application following regulatory consultation with AEP. The assessment of environmental impacts is focused on Phase 1 of the Project.

Phase 1 of the Project will include the clearing and drainage of approximately 135.9 hectares (ha) of peatland for horticultural purposes. The total Project footprint of Phase 1, including harvest sections, access roads, harvest roads, sedimentation ponds and drainage ditches is 155.5 ha.

The Biophysical Report is presented in Section 2.0, and the Peat Development and Operations Plan is presented in Section 3.0. This report is intended to respond to SIR #1 (Public Lands Act – SML Application Requirements and Peat Development and Operations Plan Requirements) as received by Premier Tech on May 28, 2019 and SIR #2 as received by Premier Tech on September 15, 2021 (AEP 2021). This report provides a comprehensive summary of documents previously submitted to support of application.

2.0 BIOPHYSICAL REPORT

2.1 Site Location and Project Description

The Project is located in Clearwater County, approximately 3.4 km southwest of Chedderville, Alberta (Figure 2.1-1) in Sections 1 and 2-37-7-W5M. The total Project footprint of Phase 1, including access roads, harvest roads, harvest sections, sedimentation ponds and drainage ditches is 155.5 ha. The Project will include the clearing and drainage of approximately 135.9 ha of peatland for horticultural purposes.

The Project will have an essential role to play to meet commercial demand for peat moss and supply material to the Premier Horticulture processing and packaging facilities.

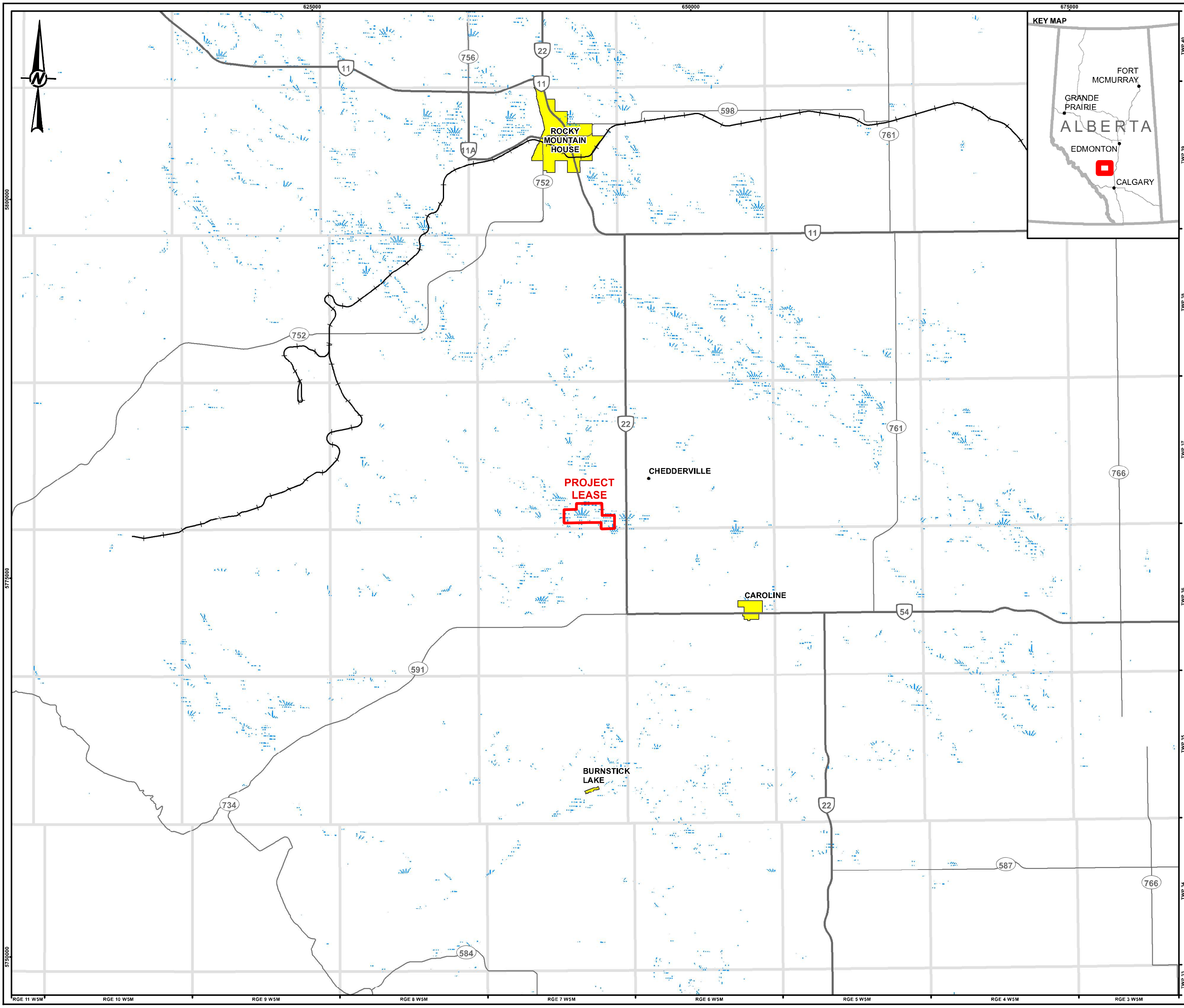
The Project footprint for Phase 1 will consist of five harvest sections, six sedimentation ponds, culverts, one yard site, maintenance roads, and access roads (Figure 2.1-2). The proposed development plan is provided in Figure 2.1-3.

The main access road to the Project site will be from the south of the lease with access from Alberta Provincial Highway 22 and Township Road 365A. Premier Tech will develop a 3.2 km long by 10 m wide permanent access road from Township Road 365A along Range Road 71 to access the Project site.

Prior to harvest, Premier Tech will construct the main access road, harvest roads, drainage ditches and sedimentation ponds. The Project will be developed in five stages over the course of five years, at one stage per year.

Harvest roads will be constructed within harvest sections of the Project footprint. Harvest roads will consist of non-commercial timber laid down to use as corduroy. Each harvest road will be 4.5 m in width. The corduroy layer at the bottom will be 0.5 m thick, and a 0.5 m layer of clay will be placed on top of corduroy. A supplementary 7-10 cm of gravel is added to the top surface of the road to improve usability by vehicles. This type of road allows the water to travel on both sides of the road and facilitates the ripping during the reclamation process.

No clay borrow pits are to be excavated within the SML area. Clay will be provided by a local contractor.



LEGEND

- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- RAILROAD
- WATERCOURSE
- 🟨 POPULATED PLACE
- 🟦 WATERBODY
- WETLAND
- 🟥 PROJECT LEASE BOUNDARY

0 5,000 10,000

1:250,000 METRES

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
PROJECT LOCATION MAP

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	SC
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
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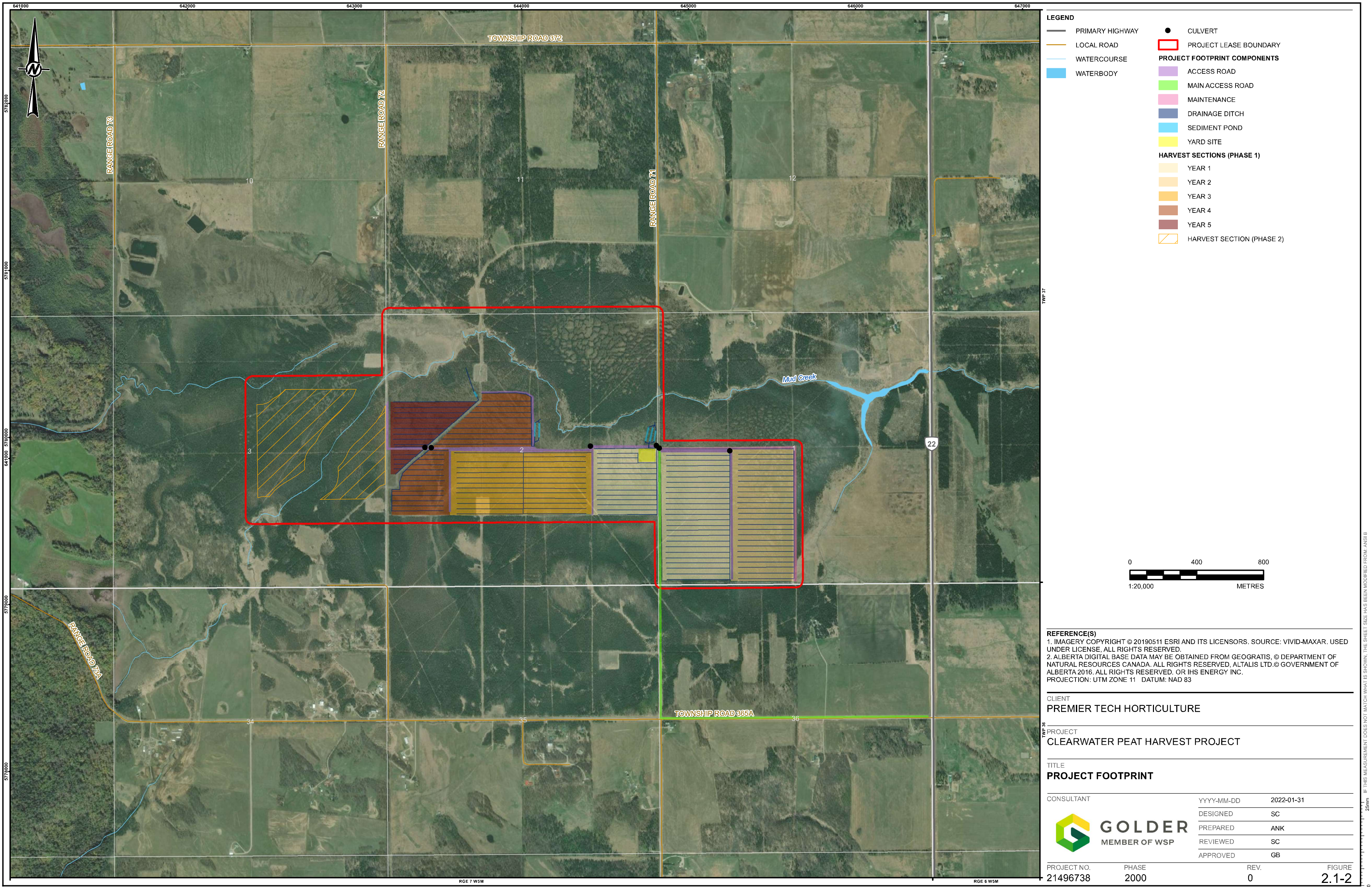

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
PROJECT FOOTPRINT

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	SC
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
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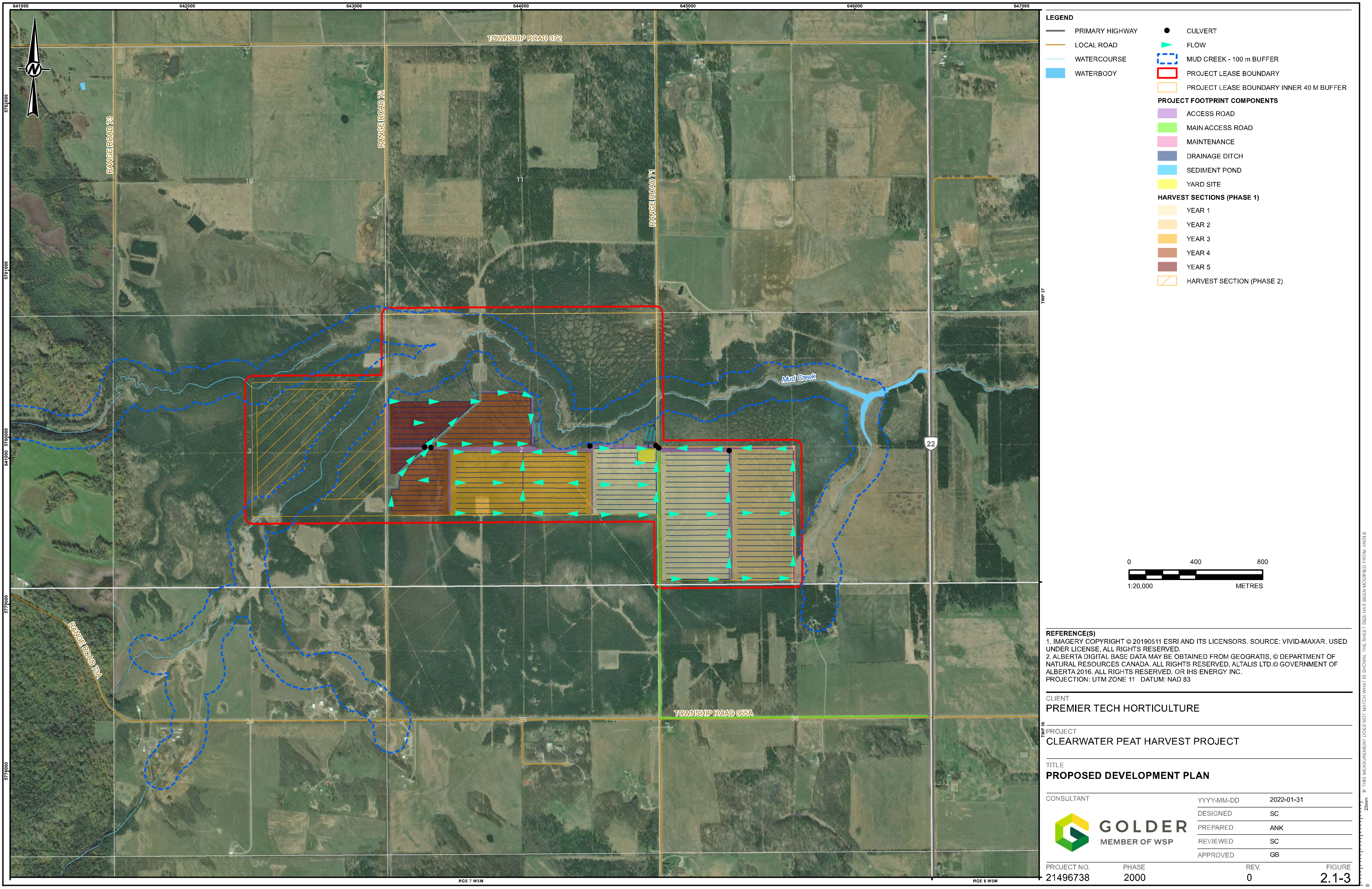

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
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PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
PROPOSED DEVELOPMENT PLAN

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	SC
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
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The Yard site will consist of the main office, garage and diesel tank will be located on a former 80 m by 80 m well pad (Figure 2.1-2). The main office will consist of a 4 m by 10 m mobile building. The 8 m by 15 m maintenance garage will have a concrete floor to contain spills to surrounding soil or groundwater. A 10,000 litre (L) double walled diesel tank is required to supply fuel for equipment on site during operations. The main Yard will be surrounded by concrete blocks for security. Final dimensions for the main office, the maintenance garage and the double wall tank need to be determined once the Project is approved.

The harvest area represents approximately 87% of the Project footprint. The five harvest areas will be divided into domed-shaped fields (30 m width), divided by secondary drainages. The harvest sections will be drained by multiple secondary ditches dividing each peat harvest section. Ditches will have a depth of approximately 1 m and are trapezoidal shaped, with a top width of approximately 1.5 m and a bottom width of 0.3 m. Secondary ditches will connect to perimeter ditches surrounding the harvested sections of the Project. Perimeter ditches will be deeper (i.e., 1.5 to 2 m) allowing water to evacuate from the harvested areas to the sedimentation ponds. Sedimentation ponds will remove solid particles, and water will be will exit through a channel connecting to a pumping station located outside of the 100 m buffer from Mud Creek. The water will be pumped through an agricultural irrigation system that that will disperse the water into the 100 m vegetative buffer zone at a wide angle to prevent any artificial channelling.

Specific requirements for the sedimentation pond design are not provided in the *Guide to Surface Materials Lease Information Requirements for Peat Operations* (GOA 2017) or the *Requirements for Conservation and Reclamation Plans for Peat Operations in Alberta* (GOA 2016). Hence, the sedimentation pond design specifications are based on the Guidelines for Peat Mining Operations in New Brunswick (Thibault 1998) because this is the main document regarding peat harvesting operation guidelines in Canada where Premier Tech has an operation. This relevant information from this document is summarized below:

> *The mining of peat releases variable quantities of loose peat sediment that can be transported along the drainage ditches and deposited outside the operation site into neighbouring water bodies such as streams or marine embayments. Depending on local conditions, two methods are available to minimize the risk of discharging excessive quantities of peat particles in the environment.*
>
> *Overland flow is the preferred method because it effectively captures peat solids and reduces the nutrient load in the water through uptake by the vegetation. When used as receiving areas for drainage waters, wetlands covered by vegetation can remove up to 80% of solids, 15% of dissolved organic matter, 70% of nitrogen compounds and 75% of phosphorus (Selin, 1996). Drainage ditches are terminated in a flat area leaving a buffer zone of undisturbed wetland between the ditches and any receiving bodies of water.*
>
> *Where land constraints (topography, ownership, etc.) does not permit use of the overland flow method, sedimentation basins must be constructed to allow the peat particles to settle. The effectiveness of this method has been demonstrated (Gemtec Ltd, 1993) but it is conditional on regular monitoring of the basins and close adherence to a maintenance schedule".*

Premier Tech will use the above-mentioned guidelines for the design of the sedimentation ponds and include a non-disturbed buffer zone of a minimum of 100 m for all Project components between Project infrastructure and Mud Creek. No disturbance is proposed within the 100 m vegetative buffer between the Project footprint and Mud Creek.

The relevant specifications of the above-mentioned guidelines are listed below:

- Minimum sedimentation pond volume should be calculated on the basis of 25 cubic metres (m^3) per hectare of peatland area drained. This may be achieved by constructing one pond or a combination of two or more.
- The minimum depth of water at the point of outlet should be 1.5 m and the optimum length/width ratio of a sedimentation pond should be in the range of 6.5:1 to 12:1.

During the harvesting phase of the Project, drainage of water storage will be facilitated using lateral or cross drainage ditches draining to perimeter ditches. The flows will then be routed through sedimentation ponds. After treatment, the water will exit through a channel connecting to a pumping station located near the Mud Creek outside of the 100 m buffer. The water will be pumped through an agricultural irrigation system that will disperse the water into the 100m buffer zone at a wide angle to prevent any artificial channeling.

Premier Tech will use two different methods for peat harvesting: vacuuming and Haku. Vacuums are used to harvest fibrous peat and the Haku method is used to harvest peat that is more humified. Using the vacuuming method, the peat moss dries with the sun and wind before being vacuumed by large harvesters. Typically, about 75 mm or a three inch layer of peat is harvested each year when using vacuums. This process will be repeated approximately 60 to 70 times during the summer season. For the Haku method, disc harrows are used to loosen the peat. Peat is then pushed into small ridges with a V shaped blade installed behind a tractor. Peat will be harvested using a peat loader specially designed for this operation. A 0.75 mm average layer will be harvested with the Haku method every year. All harvesting will stop when wind is blowing over 50 km/h as a dust and air quality control measure.

Peat is stored in large piles along access roads until it is hauled to the plant to be processed and bagged.

Stockpiled peat will be hauled off site to the Olds processing plant using 53 foot posom belly and walking floor trailer trucks. The estimated hauling transfer is an estimated 1000 trucks per year. Hauling will occur year round, with the exception of January portion when the facility is shut down for maintenance.

2.1.1 Site Operations

Operational activities for the Project are outlined in the order of occurrence in Table 2.1-1. The total volume of peat of harvestable peat when accounting for 40 cm of shrinkage and 100 cm of residual peat is estimated at 1,797,856 m^3.

To sustain operational activities, the Project will require the support of approximately seven harvesting team members employed from local communities, one full time employee and three full time truck drivers.

Table 2.1-1: Clearwater Project Operational Activities

Activity	Description
Access Road Preparation	The existing rural township road 365A and a portion of Range Road 71 will require minor upgrades prior to construction and operations. The undeveloped portion of Range Road 71 will be developed within the existing road allowance. The road will be 5 m wide with additional space for siding (10 m total). Harvest roads will consist of non-commercial timber laid down to use as corduroy. Each harvest road will be 4.5 m in width. The corduroy layer at the bottom will be 0.5 m thick, and a 0.5 m layer of clay will be placed on top of corduroy. No clay borrow pits are proposed within the SML. A supplementary 7-10 cm of gravel is added to the top surface of the road to improve usability by vehicles. Ditches are constructed along the road to drain water.
Field Preparation	Surface vegetation is cleared. Shallow drainage trenches are dug to slowly lower the water table and allow the peat to dry. Ditches will be constructed using a tractor ditcher or V-ditcher.
Field Harrowing	Harrows loosen the top layer of peat moss. The peat moss dries from sun and wind exposure.
Harvesting	Harvesting will be completed using vacuuming and Haku methods. Vacuums are used to harvest fibrous peat and the Haku method is used to harvest peat that is more humified. In the vacuuming method, the peat dries with the sun and wind before being vacuumed by large harvesters. Typically, about 75 mm or a three inch layer of peat is harvested each year when using vacuums. For the Haku method, disc harrows are used to loosen the peat. Peat is then pushed into small ridges with a V shaped blade installed behind a tractor. The final step is to harvest the peat with a peat loader specially designed for this operation. A 0.75 mm average layer will be harvested with the Haku method every year.
Stockpiling	Peat will be stockpiled along the harvest roads until processing. Stockpiling and loading will be completed using front-end loaders. Stockpiles are monitored to ensure temperature of the stockpiles is stable as a result of decomposition from high humidity organic matter coming into contact with oxygen. Specialized temperature probes are used to monitor the temperature of the piles. If the temperature of the stockpile increases, the stockpile is spread for cooling using a front end loader. Once the temperature has stabilized, the peat is either hauled to the plant.
Transporting	Peat will be transported off site by semi-trailers to the processing facility in Olds, Alberta. Peat is processed and bagged for shipment.
Maintenance	Maintenance of drainage ditches will be completed yearly. Ditches and sedimentation ponds are cleaned using an excavator. When the ditches are cleaned, the sediments are disposed on the harvesting fields where they will be harvested later. If the depth of the perimeter ditches is too deep and that mineral sediments may be mixed with the peat, the sediments are spread on the opposite side of the ditch where no harvesting is occurring. The sediments will be filtered by the vegetation and a small hump will be done to avoid the sediments from returning into the ditches. The same steps are followed for the sedimentation ponds maintenance. The sediments are spread on the sides of the ponds and a mound prevents them from returning into the ponds. The cleaning of the ditches can occur after heavy wind and when necessary during the season. If not required during the harvesting season, it is done during fall when harvesting is over. As for the sedimentation ponds, they are also cleaned when needed. The Guidelines for Peat Mining Operations in New Brunswick says that: “Basins must be cleaned periodically so that the peat accumulation does not exceed 50% and preferably 25% of total basin volume”.
Monitoring	Water quantity and quality monitoring will be conducted throughout the life of the Project.

2.1.2 Schedule

The final Project schedule will be confirmed after regulatory approvals are in place and the final investment decision from Premier Tech has been made. Premier Tech is proposing to start construction as early as 2022. Initial clearing, construction of the drainage ditches and sedimentation ponds will occur during the fall and winter months. Once operational, harvest activities will be ongoing from April to November. The following schedule is proposed for the Project (Table 2.1-2).

Table 2.1-2: Project Schedule

Activity	Harvest Area	Schedule
Entry and Clearing of Production Field Site	Harvest Area 1	Year 1
	Harvest Area 2	Year 2
	Harvest Area 3	Year 3
	Harvest Area 4	Year 4
	Harvest Area 5	Year 5
Drainage Schedule (a)	Harvest Area 1	Year 1
	Harvest Area 2	Year 2
	Harvest Area 3	Year 3
	Harvest Area 4	Year 4
	Harvest Area 5	Year 5
Peat Extraction and Removal	Harvest Area 1	Year 2 to 17
	Harvest Area 2	Year 3 to 18
	Harvest Area 3	Year 4 to 19
	Harvest Area 4	Year 5 to 20
	Harvest Area 5	Year 6 to 21
Remediation and Progressive Reclamation (b)	Harvest Area 1	Year 18 to 20
	Harvest Area 2	Year 19 to 21
	Harvest Area 3	Year 20 to 22
	Harvest Area 4	Year 21 to 23
	Harvest Area 5	Year 22 to 24

(a) Drainage construction will include sedimentation pond and ditch construction in winter months.
(b) Reclamation will be undertaken within three years after the closure of each harvest area.

2.2 Assessment Approach

As part of the requirements of the Peat Development and Operation Plan (Section 3.0), this report will provide an assessment of potential effects of the Project. This section describes the approach and methods used to carry out the assessment of environmental effects for the Project. The purpose of the assessment is to determine whether the Project will have a residual effect on the biophysical and socio-economic elements after the application of mitigation. Key elements of the assessment approach include:

- Identifying Valued Components (VCs).
- Identifying the range of spatial scope for each VC (e.g., study area) and temporal boundaries (e.g., development phases [construction, operation, closure and reclamation]).
- Identifying Project interactions, mitigation, and plan(s) to mitigate potential environmental effects from the Project due to construction, operation, and reclamation.

- Outlining monitoring programs that may be required.

The baseline conditions to describe the existing environment are provided in Section 2.3, and the assessment of the Project is discussed in Section 3.3 as required by the Peat Development and Operations Plan.

2.2.1 Spatial Boundaries

Project study areas are used to capture the potential direct and indirect effects of the Project on each VC and their associated key indicator(s), as well as to understand the context in which the effects can occur. The spatial boundaries or study areas considered in the description of the environmental setting and assessment of potential Project effects on the VCs include one or more of the following: Project footprint (footprint), Local Study Area (LSA), and Regional Study Area (RSA).

The Project footprint represents the physical area required for all Project components, including harvest sections, harvest roads, sedimentation ponds, yard and access road.

The LSAs and RSAs used in the environmental setting and effects assessment vary among different VCs. The LSAs were established to assess the potential direct effects of the Project on the local environment. Each VC and baseline setting component is considered in defining the LSA. The RSAs were established to assess the potential indirect effects of the Project in the broader, regional context. The study areas for each VC are summarized in Table 2.2-1.

Table 2.2-1: Study Areas Used in the Environmental Setting and Effects Assessment

Valued Component	Description of the Local Study Area (LSA)	Description of the Regional Study Area (RSA)
Aquatic Resources	The LSA includes Mud Creek and an unnamed tributary to Mud Creek adjacent to the Project footprint.	The RSA boundary extends upstream to the headwaters of Mud Creek, and downstream to the confluence of Mud Creek and the Clearwater River.
Terrain and Soils	The LSA is defined as the footprint.	A separate RSA was not considered.
Wildlife	The LSA is defined as a contiguous 100 m buffer surrounding the footprint (i.e., Terrestrial LSA).	The RSA boundary extends 5 km from the footprint and effects are largely assessed qualitatively.
Vegetation and Wetlands	The LSA is defined as a contiguous 100 m buffer surrounding the footprint (i.e., Terrestrial LSA).	The RSA boundary was defined based on wildlife habitat considerations and extends 5 km from the footprint and effects are largely assessed qualitatively.
Hydrology	The LSA includes Mud Creek and the unnamed tributary to Mud Creek adjacent to the Project footprint.	The RSA boundary extends upstream to the headwaters of Mud Creek, and downstream to the confluence of Mud Creek and the Clearwater River.
Water Quality	The LSA includes Mud Creek and an unnamed tributary to Mud Creek adjacent to the Project footprint.	The RSA boundary extends upstream to the headwaters of Mud Creek, and downstream to the confluence of Mud Creek and the Clearwater River.
Social, Cultural and Land Use	The Social and Cultural communities are those communities identified along the transportation corridor likely used for the Project. The land use LSA boundary was defined based on the Terrestrial LSA, which is a contiguous 100 m buffer surrounding the footprint.	The RSA boundary was defined based on wildlife considerations and extends 5 km from the footprint.

km = kilometre; m = metre; LSA = Local Study Area; RSA = Regional Study Area.

2.2.2 Temporal Boundaries

The temporal boundaries for the assessment encompass the construction, operation, decommissioning and reclamation phases of the Project. The Project will be constructed in a phased approach with the majority of the construction activity occurring during winter months; however, construction is anticipated to commence as early as 2022, pending receipt of all regulatory approvals. The Project has been designed to operate for 15 to 21 years.

2.2.3 Valued Components

The assessment focuses on the components that were deemed to have the greatest relevance in terms of value and sensitivity, and which are likely to be affected by the Project. Valued components represent physical, biological, cultural, social, and economic properties of the environment that are most often considered to be important by society. The VCs selected for the Project are considered to have legal, scientific, ecological, cultural or social value.

To focus the effects analysis for each VC, one or more key indicators were selected. A key indicator represents a primary issue related to the VC that has the potential to change as a result of the Project and can be described as an aspect or characteristic of the VC that, if changed as a result of the Project, may result in an effect on the VC. The VCs and key indicators selected to address the issues identified in relation to this Project, the rationale for their selection, and associated expressions of change are presented in Table 2.2-2.

Table 2.2-2: Valued Components and Key Indicators

Valued Components	Key Indicator	Expression of Change	Rationale
Aquatic Resources	Fish and fish habitat	▪ Change in habitat quality or quantity ▪ Change in abundance and distribution of fish populations	▪ Regulatory requirements (e.g., *Fisheries Act*) and potential public concern
Terrain and Soils	Soil distribution and quality	▪ Change in soil distribution or quality caused by wind and water erosion ▪ Loss or alteration of area of soil map units ▪ Change in soil distribution and quality caused by disturbance to the soil profile (i.e., soil loss, and compaction)	▪ Peatland soils provide water storage, a filter for surface water as it moves into groundwater, and habitat for vegetation communities and wildlife
	Terrain distribution	▪ Change in terrain distribution	▪ Change in terrain and elevations within harvest footprint reduce available volume of peatland soils to filter groundwater and provide habitat for vegetation communities and wildlife
Wildlife	Ungulates, Mammals, Raptors, Amphibians, Breeding Birds	▪ Change in habitat availability	▪ Regulatory requirements (i.e., Committee on the Status of Endangered Wildlife in Canada [COSEWIC], *Species at Risk Act* [SARA], Alberta *Wildlife Act and Regulation* [143/1997]) *Migratory Bird Act*, Alberta *Wildlife Act*, Master Schedule of Standards and Conditions (MSSC), and potential public concern
		▪ Change in wildlife movement patterns	
		▪ Change in wildlife abundance due to increased mortality risk	

Table 2.2-2: Valued Components and Key Indicators

Valued Components	Key Indicator	Expression of Change	Rationale
Vegetation and Wetlands	Vegetation Communities and Composition	▪ Change in area of vegetation (e.g., treed cover, wetlands) important to wildlife	▪ Vegetation communities provide food and habitat for wildlife
		▪ Loss or alteration of wetland area and functions	▪ Regulatory requirements (i.e., *Alberta Wetland Policy* [GOA 2013a] and related directives), potential public concerns, and to support healthy aquatic ecosystems
		▪ Change in area of habitat with potential to support listed plant species	▪ Regulatory requirements (i.e., *Species at Risk Act* [SARA], Committee on the Status of Endangered Wildlife in Canada [COSEWIC], Alberta *Wildlife Act and Regulation* [143/1997]) and guidelines (Alberta Conservation Information Management System [ACIMS])
		▪ Introduction and spread of regulated weed species	▪ Regulatory requirements to control noxious and prohibited noxious weed species under the *Alberta Weed Control Regulation* (Province of Alberta 2010)
Hydrology	Flow in the receiving Creek	▪ Change in flow regimes in the downstream creek (Mud Creek) ▪ Change in channel morphology	▪ Changes in the quantity of water can affect water quality and aquatic (e.g., fish and macroinvertebrates)
Water Quality	Physical, chemical and microbiological characteristics of the water	▪ Change in water quality in the receiving water (Mud Creek) due to the release of discharges from the sedimentation ponds	▪ Changes in the quality of water can affect aquatic (e.g., fish, macroinvertebrates, plankton) and terrestrial (e.g., livestock and wildlife) biota which can subsequently affect land and resource use ▪ Interaction with human health (e.g., recreational uses or drinking water sources) ▪ Societal values concerning changes in water quality
Social, Cultural and Land and Resource Use	Agriculture	▪ Disruption of agricultural activity and/or loss of land base	▪ Potential disruption of agricultural activity and disturbance of land base due to construction activities
	Other Land Use	▪ Disruption of other land uses and/or loss of land base	▪ Potential disruption of other land uses (e.g., oil and gas, forestry) and disturbance of land base due to construction activities
	Hunting, trapping and Fishing activities	▪ Disruption of hunting, trapping and fishing activities due to increased human activity	▪ Potential disruption of current hunting, trapping and fishing activities due to construction activities
	Visual aesthetics	▪ Alteration of viewscapes and visual aesthetics	▪ Potential alteration of the existing viewscape
	Water use	▪ Reduction in water quantity available for other users	▪ Residual ground disturbance can cause alteration of local surface water flows, drainage patterns (distribution), and surface water quality, which can affect land and resource use.

Table 2.2-2: Valued Components and Key Indicators

Valued Components	Key Indicator	Expression of Change	Rationale
Infrastructure and Services	Transportation and Traffic	▪ Increase in traffic delays and detours as a result of increased traffic volume	▪ Potential for increase in traffic on local highways and roads can cause delays and traffic may be detoured, inconveniencing drivers
	Emergency and Protective Services	▪ Increased use of emergency services and protective services	▪ Potential increase in demand for emergency services (e.g., fire, emergency medical services and protective services)

COSEWIC = Committee on the Status of Endangered Wildlife in Canada; SARA = Species at Risk Act; SKCDC = Saskatchewan Conservation Data Centre

2.3 Environmental Setting

2.3.1 Watershed and Hydrological Description and Map

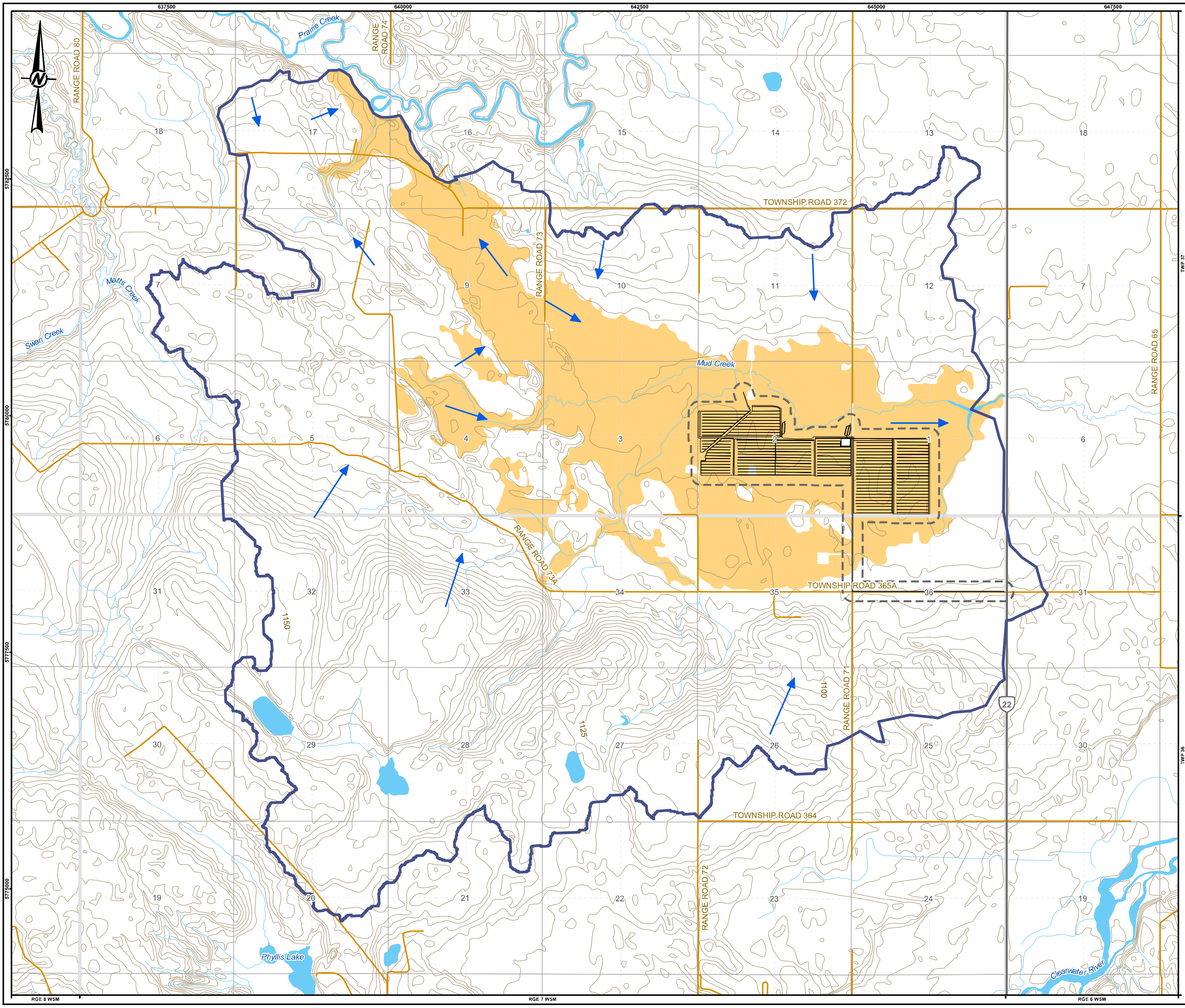
The Project is located south of Mud Creek and east of an unnamed tributary that flows into Mud Creek from the southwest. Mud Creek continues to about another 9 km further downstream where it flows into the Clearwater River.

A watershed and hydrological description map, which includes the wetland boundary, hydrological features within the wetland boundary and 100 m buffer of the Project footprint, as well as all man-made drainage networks and general direction of flow are presented in Figure 2.3-1. A figure of the Project footprint with associated Hydrologic Unit Code (HUC) Code 8 watersheds for the Clearwater River watershed is presented in Figure 2.3-2.

2.3.2 Vegetation Description and Community Map

2.3.2.1 Overview

A vegetation survey was completed to identify and characterize plant communities within the LSA, and regulated weeds as per the *Alberta Weed Control Regulation* (Province of Alberta 2010) were documented if encountered. In addition, a listed plant survey, which is described in detail in Section 2.3.6, was completed in conjunction with the vegetation survey. An overview of the terrestrial LSA with plant community boundaries and survey locations is presented in Figure 2.3-3.



LEGEND

- ELEVATION CONTOUR (5 m)
- → FLOW DIRECTION
- WATERCOURSE
- ▬ WATERBODY
- ☐ PROJECT FOOTPRINT - PHASE 1
- ⬚ TERRESTRIAL LOCAL STUDY AREA - PROJECT FOOTPRINT + 100 M BUFFER
- ☐ WETLAND CATCHMENT
- ▬ FEN BOUNDARY

0 800 1,600

1:40,000 METRES

REFERENCE(S)

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
WATERSHED AND HYDROLOGICAL DESCRIPTION MAP

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	SC
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
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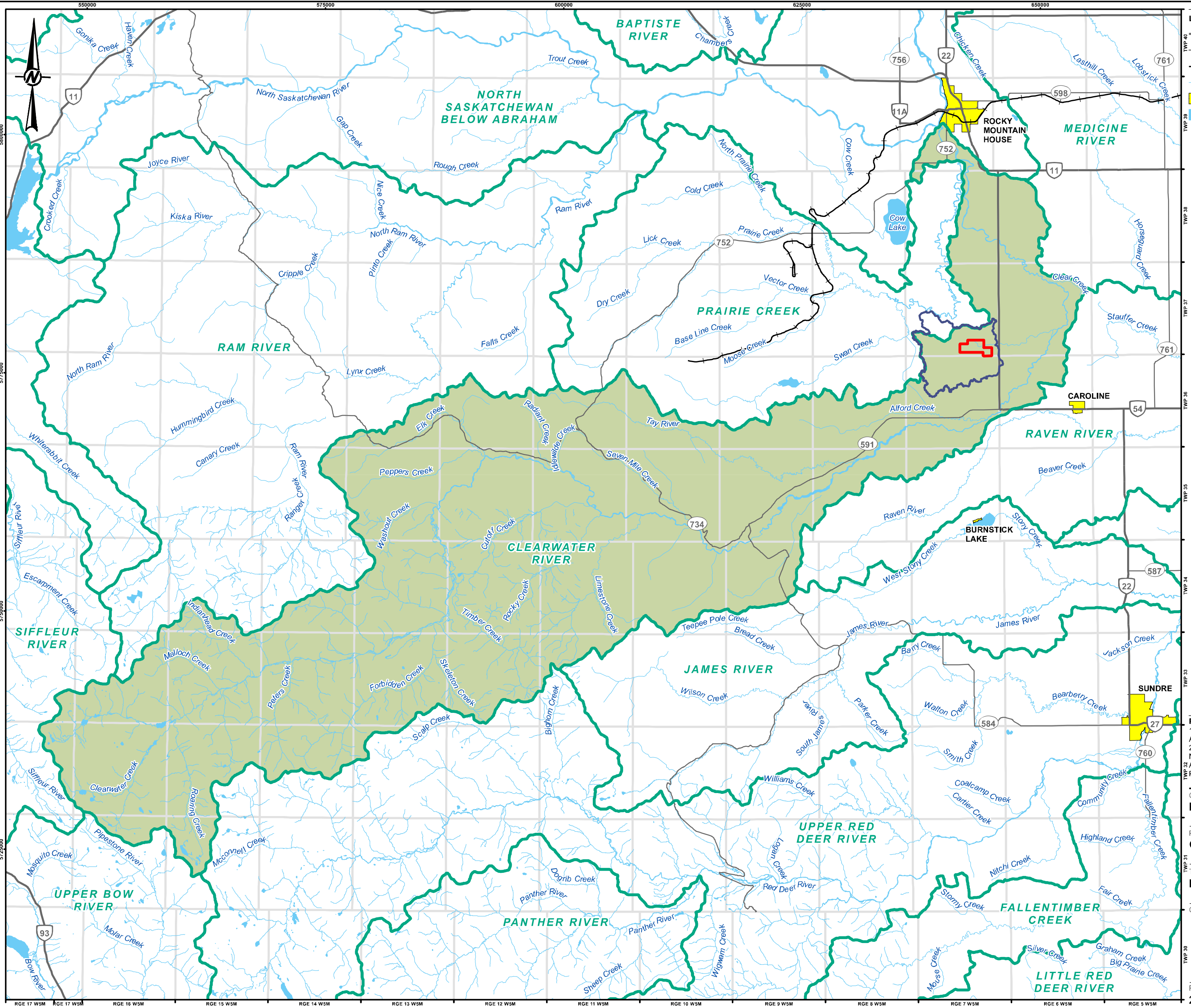

LEGEND

━	PRIMARY HIGHWAY	🟥	PROJECT LEASE BOUNDARY
─	SECONDARY HIGHWAY	🟩	HYDROLOGIC UNIT CODE (HUC) 8 WATERSHED BOUNDARY
┼	RAILROAD	🟩	HUC8 CLEARWATER RIVER WATERSHED BOUNDARY
─	WATERCOURSE	🟦	WETLAND CATCHMENT
🟨	POPULATED PLACE		
🟦	WATERBODY		

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1:400,000 METRES

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
HYDROLOGIC UNIT CODE 8 WATERSHEDS

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	SC
PREPARED	LMS
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
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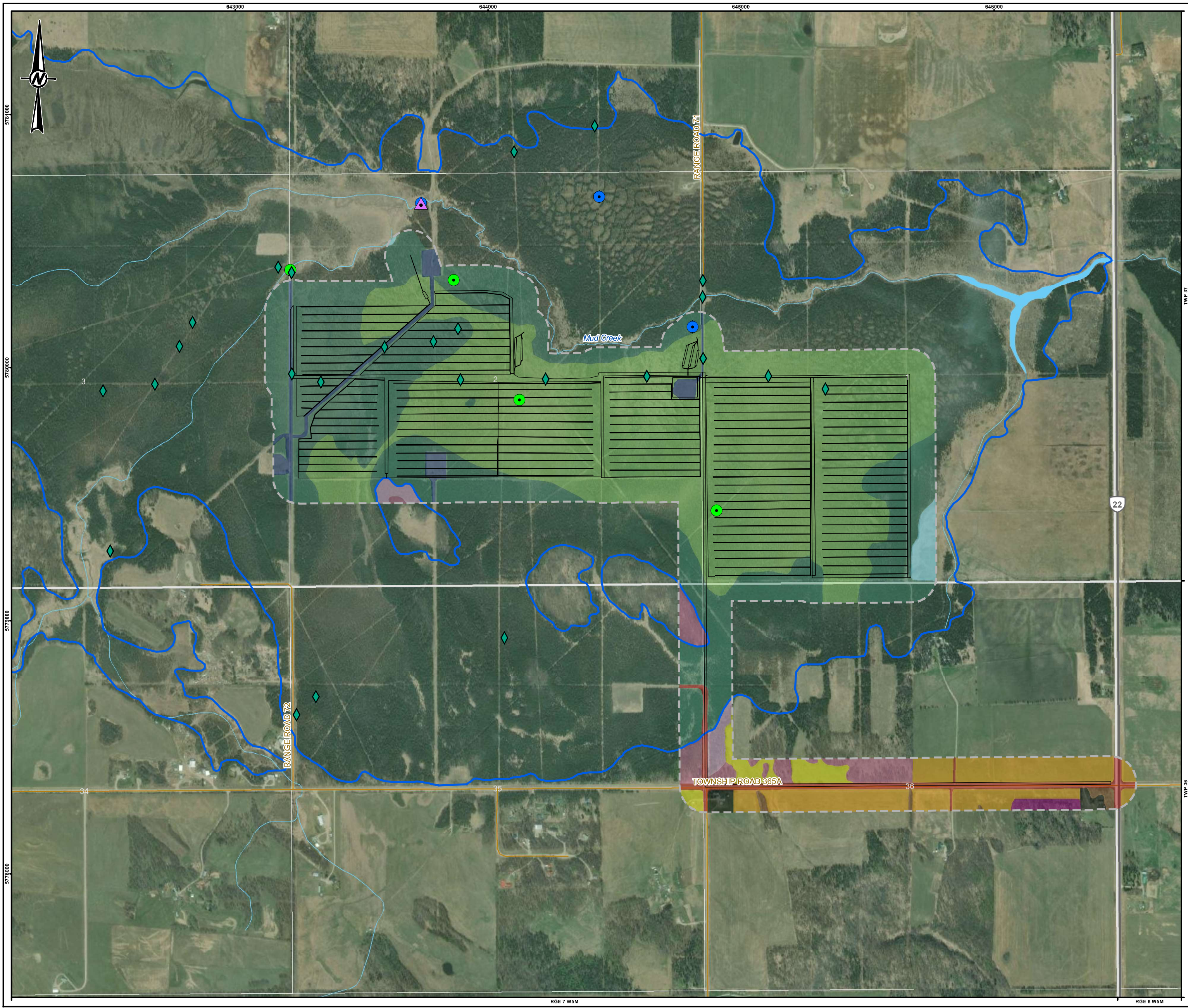

LEGEND

- PRIMARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- PROJECT FOOTPRINT - PHASE 1
- TERRESTRIAL LOCAL STUDY AREA - PROJECT FOOTPRINT + 100 M BUFFER
- ● 2017 DETAILED WETLAND SURVEY POINT
- ◆ 2017 WETLAND CLASSIFICATION POINT
- ● 2020 DETAILED VEGETATION SURVEY POINT
- ▲ WEED LOCATION
- FEN BOUNDARY

UPLAND AGRICULTURAL AND MISCELLANEOUS LAND COVER TYPES

- SHRUBLAND
- FARM YARD
- TAME PASTURE
- ROAD/TRAIL
- HAYLAND

UPLAND ECOSITE PHASES

- LOW-BUSH CRANBERRY LODGEPOLE PINE (e1)
- LOW-BUSH CRANBERRY ASPEN (e2)
- LOW-BUSH CRANBERRY ASPEN-WHITE SPRUCE-LODGEPOLE PINE (e3)

WETLANDS

- GRAMINOID FEN
- SHRUBBY FEN
- WOODED CONIFEROUS FEN
- CLEARED FEN

0 300 600

1:15,000 METRES

REFERENCE(S)

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
LAND COVER TYPES WITHIN THE TERRESTRIAL LOCAL STUDY AREA

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	KS
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
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2.3.2.2 Methods

Prior to the vegetation survey, a preliminary desktop review of plant communities within the LSA was completed using recent aerial imagery and available spatial data (i.e., Alberta Vegetation Inventory [AVI] and Derived Ecosite Phase [DEP] mapping). Wetland plant communities were classified and mapped at the form level (i.e., wooded, shrubby, graminoid) and classifications were assigned following the Alberta Wetland Classification System (AWCS) (GOA 2015). In addition, upland plant communities were classified to ecosite phase following Willoughby et al. (2020), where applicable.

A vegetation survey was completed to verify the desktop vegetation mapping by assessing, classifying, and updating plant community delineations as required. This survey was completed on May 28, 2020 within the LSA in conjunction with a survey for listed plants species, listed plant communities, and regulated weeds. It was not feasible to ground truth the full extent of the wetland because of its large size (i.e., it covers parts of 14 quarter sections; Figure 2.3-1). Plant communities and wetland types were compared in the field to a digitized map showing the desktop-delineated plant community boundaries. Field verification was documented in a field notebook in conjunction with global positioning system (GPS) locations to indicate where plant community boundaries should be altered.

A minimum of one vegetation survey was conducted within each plant community type within the wetland; plots were positioned at locations representative of the dominant vegetation type within the mapped polygon based on vegetation characteristics, slope, aspect, moisture regime, and nutrient regime. At each plot, the following data were collected: unique plot number, survey date, location coordinates, wetland classification, soil moisture and nutrient regimes, dominant plant species, and cover classes. Plants were identified to species, if possible, and distinct vegetation zones were noted by the presence of dominant plant species or communities. Weed, listed plant and wildlife species observations were also recorded if encountered. Vegetation surveys focused on collecting key information for site classification and mapping. Wetland surveys were also completed on June 9 and 10, 2017 using similar methods (Golder 2017).

In the office, following the vegetation survey, mapped plant community boundaries were refined based on a review of imagery, field track files and GPS waypoints, plot field data, and field notes.

2.3.2.3 Results

A description of the wetland plant communities classified using the AWCS (GOA 2015) is provided in Section 2.3.2.3.1. A description of the upland plant communities identified adjacent to the main access road, including upland ecosite phases (classified as per Willoughby et al. [2020]) and agricultural/miscellaneous land cover types, is provided in Section 2.3.2.3.2.

Land cover within the LSA is dominated by wetlands (244 ha; 85%; Table 2.3-1), including wooded coniferous fen (89 ha; 31% of the LSA; Table 2.3-1) and shrubby fen (146 ha; 51%; Table 2.3-1) plant communities. Some wetland areas have previously been cleared (6 ha; 2%), but wetland soils remain relatively undisturbed. In addition, upland ecosite phases cover 11 ha (4%; Table 2.3-1) and agricultural/miscellaneous land cover types cover 32 ha (11%; Table 2.3-1) along the main access road (Figure 2.3-3).

Table 2.3-1: Land Cover Summary Within the Phase 1 Local Study Area[a]

Land Cover Type	Area [ha]	Proportion of Local Study Area [%]
Wetlands		
Graminoid fen	3	1
Shrubby fen	146	51
Wooded coniferous fen	89	31
Cleared fen(b)	*6*	*2*
Wetlands subtotal	*244*	*85*
Upland Ecosite Phases		
Low-bush cranberry lodgepole pine (e1)	3	1
Low-bush cranberry aspen (e2)	7	2
Low-bush cranberry aspen-white spruce-lodgepole pine (e3)	1	<1
Upland Ecosite Phases subtotal	*11*	*4*
Upland Agricultural and Miscellaneous Land Cover Types		
Farmyard	2	1
Hayland	19	7
Road/trail	6	2
Shrubland	1	<1
Tame pasture	4	1
Upland Agricultural and Miscellaneous Land Cover Types subtotal	*32*	*11*
Total	**287**	**100**

(a) The Phase 1 Local Study Area contains the Phase 1 footprint plus a 100 m buffer.

(b) Woody vegetation has been cleared; however, wetland soils are largely undisturbed, and these areas are included as wetland.

2.3.2.3.1 Wetland Plant Communities

The surveyed wetlands were dominated by a fen that includes wooded coniferous, shrubby and graminoid forms. Fens are permanently saturated peatlands that can have variable water chemistry and tend to be dominated by sedges (*Carex* spp.), dense mats of bryophytes, and a variety of vascular plants. The wetland descriptions provided below are based on the AWCS (GOA 2015) and field observations. Overall, species found in the 2020 survey were consistent with those documented in surveys completed by Stantec (2005, 2006), although some of the orchids documented in the late season Stantec survey were not encountered in the early season survey completed in 2020.

Wooded Coniferous Fen

Wooded coniferous fen communities have at least 25% tree cover, primarily dominated by black spruce (*Picea mariana*) and tamarack (*Larix laricina*). Understory shrubs are often present, including shrub birches (*Betula* spp.) and willows (*Salix* spp.). The forb and graminoid layers are often sparse, and brown and sphagnum mosses often dominate the bryophyte layer. The water table in these fens is often less than 20 cm below the ground surface (GOA 2015).

The surveyed wooded coniferous fen community was dominated by black spruce and tamarack, dwarf birch (*Betula pumila*), water birch (*Betula occidentalis*), and a sphagnum moss ground layer. Other species observed in this fen community included common Labrador tea (*Rhododendron groenlandicum*), bog rosemary (*Andromeda polifolia*), bog cranberry (*Vaccinium oxycoccos*), lingonberry (*Vaccinium vitis-idaea*), bearberry (*Arctostaphylos uva-ursi*), twinflower (*Linneae borealis*), Canada mayflower (*Maianthemum canadense*), three-leaved Solomon's seal (*Maianthemum trifolium*), bishop's cap (*Mitella nuda*), marsh cinquefoil (*Comarum palustris*), pink wintergreen (*Pyrola asarifolia*), sedges (*Carex* spp.), and tufted moss (*Aulacomnium palustre*). Vegetation and water quality data suggest this is a moderate-rich fen with freshwater conditions. The organic matter was composed of humic organic material that extended beyond 30 cm, there was poor drainage, and surface water had a pH of 6.5. A representative photo of a wooded coniferous fen in the LSA is presented in Photo 2.3-1.

Photo 2.3-1: Wooded Coniferous Fen Surveyed May 28, 2020

Shrubby Fen

Shrubby fen communities have at least 25% shrub cover, but less than 25% tree cover. These fens are often dominated by bog birch (*Betula glandulosa*), dwarf birch, and willows, which typically only reach one to two metres in height. Other typical species can include Labrador tea and leatherleaf (*Chamaedaphne calyculata*), as well as other forb and graminoid species. Brown and sphagnum mosses often dominate the ground layer. The water table in these fens is often within 10 cm of the ground surface (GOA 2015).

The surveyed shrubby fen community was dominated by black spruce, tamarack, bog willow (*Salix pedicellaris*), dwarf birch, and tufted moss. Other species observed in this fen community included dwarf bilberry (*Vaccinium cespitosum*), cloudberry (*Rubus chamaemorus*), bog laurel (*Kalmia polifolia*), bog rosemary, common Labrador tea, marsh cinquefoil, sweet-scented bedstraw (*Galium trifidum*), three-leaved Soloman's seal, buck-bean (*Menyanthes trifoliata*), swamp horsetail (*Equisetum fluviatile*), seaside arrow-grass (*Triglochin maritima*), and a variety of graminoids including sedges (*Carex diandra* and other *Carex* spp.) and spikerushes (*Eleocharis* spp.). Vegetation and water quality data suggest this is a moderate-rich fen with freshwater conditions. The organic matter was composed of fibric organic material that extended beyond 30 cm, there was poor drainage, and surface water had a pH of 6.5 and electrical conductivity of 69 microsiemens per centimetre (µs/cm). A representative photo of a shrubby fen in the LSA is presented in Photo 2.3-2.

Photo 2.3-2: Shrubby Fen Surveyed May 28, 2020

Graminoid Fen

Graminoid fen communities have less than 25% tree and 25% shrub cover. Brown and sphagnum mosses are often mixed with sedges and forbs. The water table in these fens is often at or near the ground surface (GOA 2015).

The graminoid fen community was dominated by water sedge (*Carex aquatilis*) and bog willow. Other species observed in the graminoid fen community included tamarack, willow, currants (*Ribes* spp.), cloudberry, common yarrow (*Achillea millefolium*), creeping thistle (*Cirsium arvense*), marsh cinquefoil, purple avens (*Geum rivale*), common dandelion (*Taraxacum officinale*), wild mint (*Mentha arvensis*), and bluejoint grass (*Calamagrostis canadensis*). Vegetation and water quality data suggest this is a moderate-rich fen with freshwater conditions. The organic matter was composed of mesic organic material that extended beyond 30 cm, there was poor drainage, and surface water had a pH of 7.5 and electrical conductivity of 106 µs/cm. A representative photo of a graminoid fen in the LSA is presented in Photo 2.3-3.

Photo 2.3-3: Graminoid Fen Surveyed May 28, 2020

2.3.2.3.2 Upland Land Cover Types

Upland Ecosite Phases

Low-bush cranberry lodgepole pine (e1), low-bush cranberry aspen (e2), and low-bush cranberry aspen-white spruce-lodgepole pine (e3) ecosite phases were mapped in the 100 m buffer adjacent to the main access road (Figure 2.3-3), but field verification surveys were neither required nor completed in these uplands (GOA 2017). The low-bush cranberry lodgepole pine (e1) ecosite phase is commonly dominated by lodgepole pine (*Pinus contorta*) in the tree layer, green alder (*Alnus crispa*), twinflower (*Linnaea borealis*) and prickly rose (*Rosa acicularis*) in the shrub layer, bunchberry (*Cornus canadensis*) and common fireweed (*Chamerion angustifolium*) in the forb layer, and Schreber's moss (*Pleurozium schreberi*) and stair-step moss (*Hylocomium splendens*) in the bryophyte layer (Willoughby et al. 2020). Soils are typically well-drained to moderately well-drained, with a mesic soil moisture regime and medium soil nutrient regime (Willoughby et al. 2020). The low-bush cranberry aspen (e2) ecosite phase is dominated by aspen (*Populus tremuloides*) in the tree layer, prickly rose, low-bush cranberry (*Viburnum edule*), green alder and beaked hazelnut (*Corylus cornuta*) in the shrub layer, bunchberry and wild sarsaparilla (*Aralia nudicaulis*) in the forb layer, and bluejoint and hairy wild rye (*Elymus innovatus*) in the graminoid layer (Willoughby et al. 2020). As described for the e1 ecosite phase, e2 soils are typically well-drained to moderately well-drained, with a mesic soil moisture regime and medium soil nutrient regime (Willoughby et al. 2020). The low-bush cranberry aspen-white spruce-lodgepole pine (e3) ecosite phase is dominated by a mixedwood cover of aspen, white spruce (*Picea glauca*) and lodgepole pine in the tree layer, prickly rose, green alder and low-bush cranberry in the shrub layer, bunchberry and wild sarsaparilla in the forb layer, hairy wild rye and blue joint in the graminoid layer, and stair-step moss and Schreber's moss in the bryophyte layer (Willoughby et al. 2020). As described for the e1 and e2 ecosite phases, e3 soils are typically well-drained to moderately well-drained, with a mesic soil moisture regime and medium soil nutrient regime (Willoughby et al. 2020).

Upland Agricultural and Miscellaneous Land Cover Types

Farmyards (i.e., dwellings and associated land and buildings), haylands (i.e., land where hay is grown and harvested), shrublands (i.e., a mix of shrub species) and tame pasture (i.e., land that has been planted with tame forage species for livestock grazing) were mapped in the 100 m buffer adjacent to the main access road (Figure 2.3-3), but field verification surveys were neither required nor completed in these uplands (GOA 2017).

2.3.2.3.3 Incidental Weed Occurrences

No noxious or prohibited noxious weed species were observed during the 2020 vegetation surveys. However, one noxious weed species listed under the *Alberta Weed Control Regulation* (Province of Alberta 2010), creeping thistle (*Cirsium arvense*), was observed during the 2017 survey (Golder 2017) and its location is shown in Figure 2.3-3.

2.3.3 Terrain and Soil Information

2.3.3.1 Background

The Project falls in the Lower Foothills natural region of Alberta (Natural Regions Committee 2006). The lower foothills natural region is mainly underlain by Tertiary sandstones and siltstones in the south and sandstones and shales from the Upper Cretaceous in the north.

Published surficial geology reports described material in the Terrain and Soils LSA as primarily organic deposits with bedded silt, sand, and clay glaciolacustrine sediment to the north and fine to medium grained eolian sand to the west and south (Boydell et al. 2005). The glaciolacustrine sediment is associated with glacial lake Crammond II (Boydell 1978). Two water wells in the north portion of the Project area (GIS Well IDs 454707 and 499578) indicate the mineral surface is comprised of a layer of sand approximately 6 m thick overlying clay (AEP 2015). The Natural Regions Committee describes wetlands in the Lower Foothills Natural Region as dominantly organic deposits (poor to rich fens) with mainly Mesisolic soil developed in them. These Mesisols are described as having equal Terric (mineral soil within 1.6 m of the surface) and Typic (Mineral soil greater than 1.6 m from the surface) subgroups and commonly having Orthic Gleysols in the mineral soil adjacent to these wetlands (Natural Regions Committee 2006).

The LSA falls in Soil Correlation Area 13 (AAFC 2016), the Lower Foothill Area of West-Central Alberta. Provincial soil mapping in the Agricultural Region of Alberta Soil Inventory Database (AGRASID) correlates with the surficial geology mapping showing Niton (a Typic Mesisol) as the dominant soil in the LSA bordered by the Caroline soil series, a Brunisolic Gray Luvisol developed on medium textured wind or water deposited sediment.

2.3.3.2 Methods

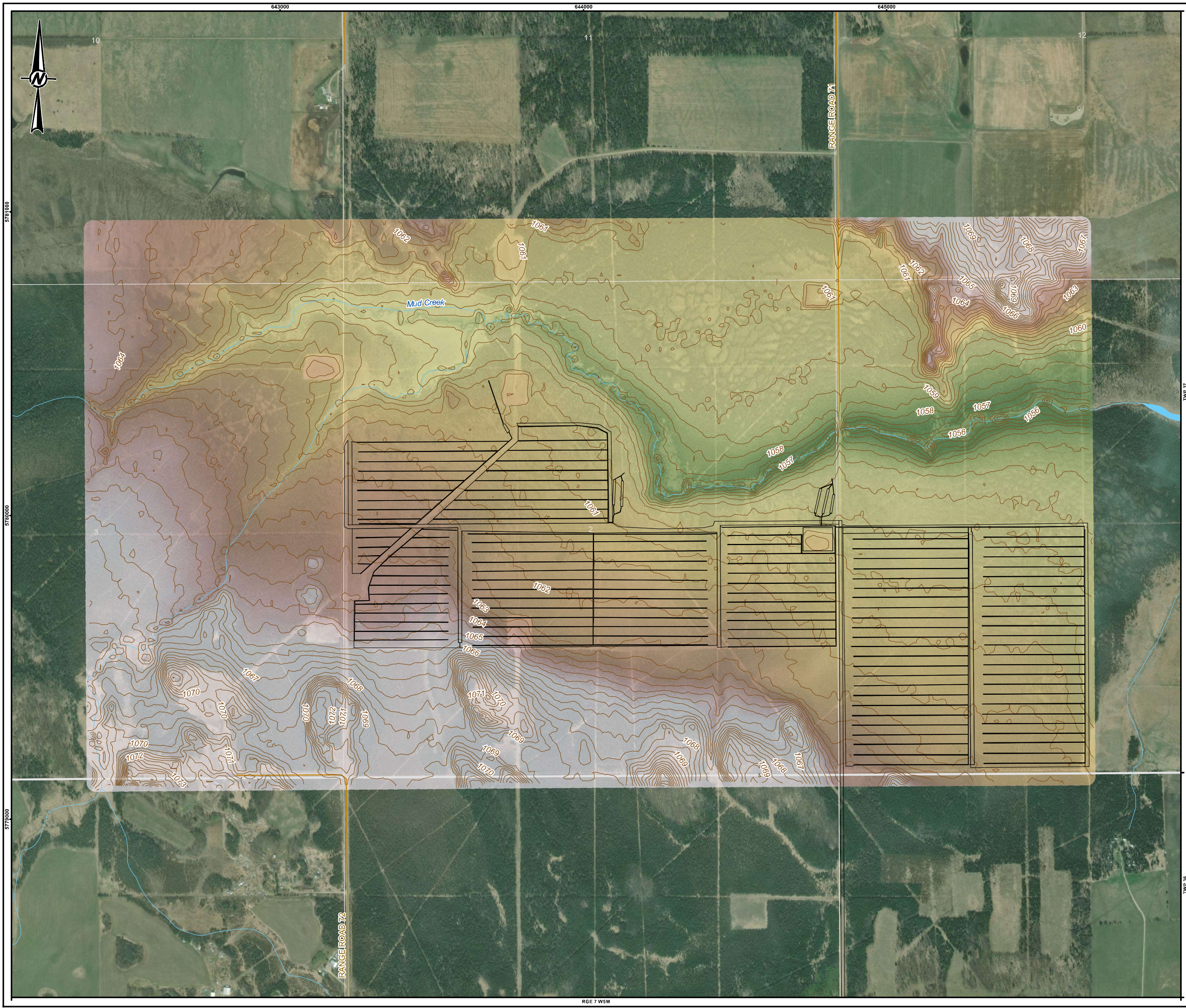
An organic soil (peat) sampling program was completed on June 9 and 10, 2020, and on October 30, 2021, to supplement the data collected in 2008 and 2017 (Premier Tech 2010, Premier Tech 2018). This program was conducted to describe the extent and character of the peat in the Terrain and Soils LSA for Phase 1 and Phase 2 and was designed based on the *Guide to Surface Materials Lease Information Requirements for Peat Operations* (GOA 2017). A minimum of nine inspection sites per quarter section within the LSA were pre-selected and additional inspection points were added to investigate soil adjacent to Mud Creek and the periphery of the LSA where mineral soil was suspected based on an imagery review. Information collected included total or harvestable peat thickness, degree of decomposition of each layer (Von Post scale of humification), mineral material characteristics (if present), and representative average pH of selected profiles. Organic (peat) soil was classified using the Canadian System of Soil Classification (Soil Classification Working Group 1998).

2.3.3.3 Results

The elevation in the Terrain and Soils LSA ranges from 1,056 metres above sea level (masl) in the north near Mud Creek to 1,072 masl in the southwest portion of the Terrain and Soils LSA (Figure 2.3-4).

In total, 96 peat sampling sites have been inspected within the Terrain and Soils LSA; 12 in 2008, 42 in 2017, 30 in 2020, and 12 in 2021 (Figure 2.3-5). Of these sites, 44 are composed dominantly of mesic (H5-H6 [on Von Post Humification scale]) material (Mesisols), 30 are dominantly fibric (H1-H4) material (Fibrisols), nineteen are dominantly humic material (H7-H10) (Humisols), and the remaining are either Terric Organic soils (mineral soil within 160 cm of the surface), or imperfectly and poorly drained mineral soils with less than 40 cm of organic matter at the surface (Figure 2.3-5). Mineral soils (Regosols and Gleysols) are found in association with Mud Creek. Detailed soil field site data are summarized in Appendix A. The spatial extent and location of each peat harvesting component is found on Figure 2.3-5.

Cross sections of peatland profiles found in the LSA were generated from recorded field data and are displayed in Appendix B (Reference Figure 2.3-5 for cross section transects).



LEGEND

LOCAL ROAD

WATERCOURSE

🟦 WATERBODY

☐ PROJECT FOOTPRINT - PHASE 1

CONTOURS (0.5 m INTERVAL)

GROUND ELEVATION (m)

HIGH : 1067

LOW : 1055

0 250 500

1:12,500 METRES

REFERENCE(S)

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT

PREMIER TECH HORTICULTURE

PROJECT

CLEARWATER PEAT HARVEST PROJECT

TITLE

TOPOGRAPHY IN THE PROJECT AREA

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	CB
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
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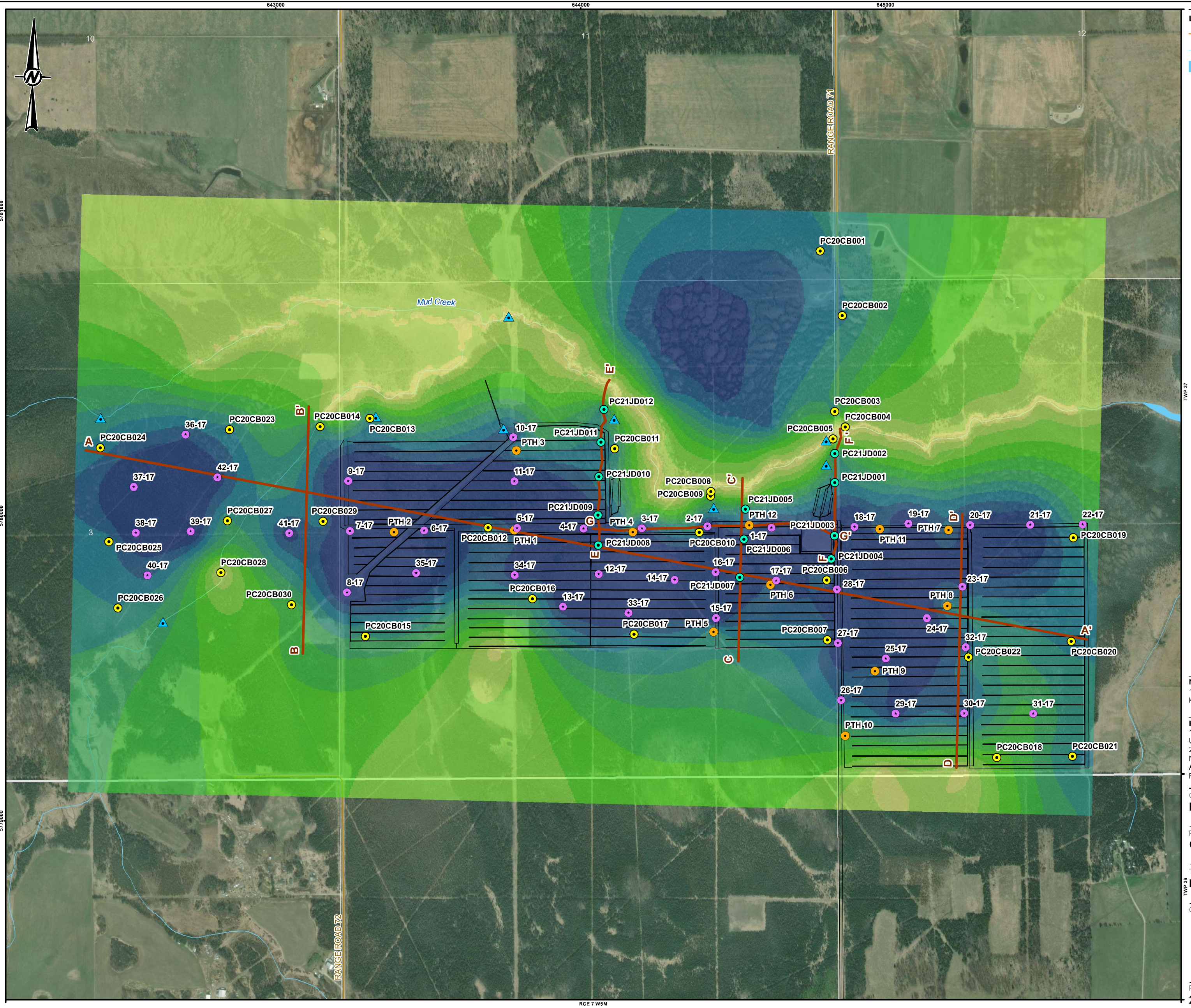

LEGEND

LOCAL ROAD
WATERCOURSE
WATERBODY
PROJECT FOOTPRINT - PHASE 1
2020 PEAT SURVEY SITE
2021 PEAT SURVEY SITE
PREVIOUS PREMIER TECH SOIL SURVEY SITE, 2008
PREVIOUS PREMIER TECH SOIL SURVEY SITE, 2017
SURFACE WATER MONITORING STATION
CROSS SECTION LOCATION

PEAT THICKNESS (cm)[1]

0 - 30
31 - 60
61 - 90
91 - 120
121 - 150
151 - 180
181 - 210
211 - 240
241 - 270
271 - 300+

0 250 500
1:12,500 METRES

NOTE(S)

1. PEAT THICKNESS INTERPOLATED BASED ON PEAT SURVEY SITE DATA AND OTHER SITE KNOWLEDGE AND SHOULD BE CONSIDERED APPROXIMATE.

REFERENCE(S)

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
PEAT THICKNESS

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	CB
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
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2.3.4 Fish and Fish Habitat

Mud Creek and an unnamed tributary to Mud Creek flow eastward along the northern boundary of the Project footprint approximately 10 km upstream from where Mud Creek enters the Clearwater River. This location has been identified as within the range of Bull Trout (*Salvelinus confluentus*), which is a species at risk in Alberta. The objectives of the field surveys were to describe the fish community and current habitat conditions in Mud Creek and the unnamed tributary adjacent to the Project and evaluate the potential for SARA listed species (i.e., Bull Trout) within Mud Creek adjacent to and downstream of the Project site. This section summarizes the results of two field surveys aimed at describing the fish community and habitat conditions in Mud Creek and the unnamed tributary to Mud Creek that occurred in February and May of 2020.

2.3.4.1 Methods

The characterization of existing conditions for fish and fish habitat consisted of:

- A desktop review of existing fish and fish habitat information in the RSA.
- Field studies in the LSA and RSA that involved:
    - An overwintering survey to determine if suitable overwintering habitat is available for fish and evaluate the quality of that habitat.
    - A spring fish and fish habitat survey to determine fish presence and the suitability of habitat for fish during the open water season.

All surveys were conducted at multiple locations along Mud Creek, as well as on an unnamed tributary to Mud Creek that runs adjacent to the Project footprint.

A desktop review of existing information for the watercourses in the vicinity of the Project was completed and included a review of the Alberta Environment and Parks (AEP) Fisheries and Wildlife Management Information System (FWMIS) database (AEP 2020a). All fish species occurrences were cross-referenced with provincial (AEP 2020b) and federal (Government of Canada [GOC] 2020) status lists to determine any listed species that have been observed or recorded near the Project. The Restricted Activity Period (RAP) was determined based on the *Water Act* Code of Practice Rocky Mountain House Management Area Map (AEP 2012b).

Prior to conducting field surveys, all equipment and gear was decontaminated according to Golder’s Aquatic Invasive Species Decontamination Protocol to minimize the risk of spreading Whirling Disease and other aquatic invasive species by removing and/or killing infectious agents. For the spring fish and fish habitat survey, a Fish Research Licence (RL# 20-3212) was obtained from AEP and a Permit under SARA (No. 20-PCAA-00010) was obtained from Fisheries and Oceans Canada (DFO).

Overwintering Survey

An overwintering fish habitat survey was conducted on February 25 to 26, 2020 and included 10 sites within the RSA: seven sites along Mud Creek and three sites on the Unnamed Tributary to Mud Creek. Sites were established approximately every 500 m along each watercourse, with the exception of the furthest downstream sites on Mud Creek, which were spaced approximately 2 to 3 km apart due to accessibility issues.

The characteristics that were measured included snow depth (m), ice thickness (m), under-ice water depth (m), width (m), substrate composition, and water velocity (m/s). In situ water quality parameters were measured using a handheld YSI multiparameter meter, including water temperature (°C), dissolved oxygen (milligrams per litre [mg/L]), oxygen saturation (%), pH, and specific conductivity (µS/cm). Detailed notes and photographs were taken to document site conditions at the time of the survey.

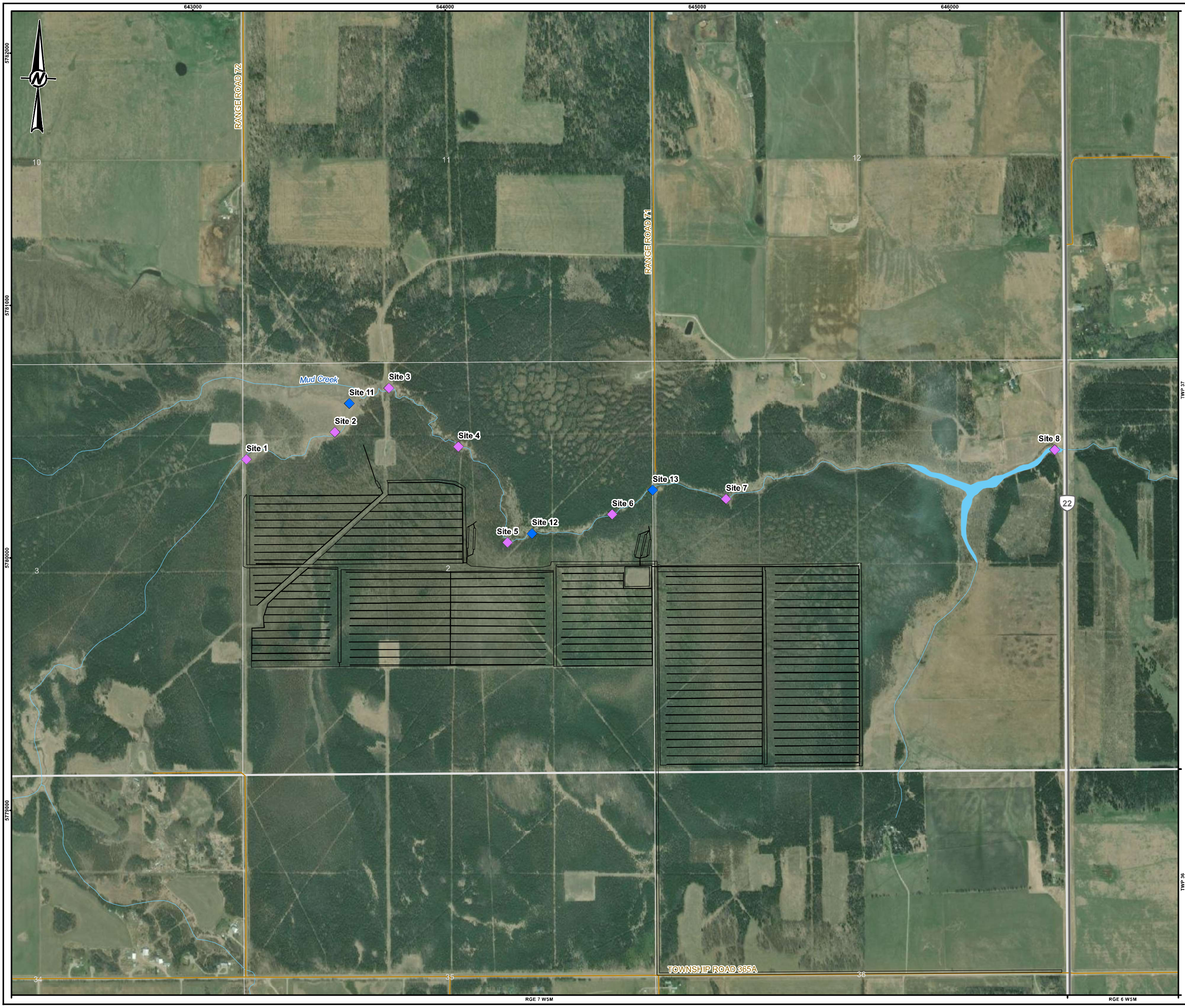
Open-water Survey

The open water habitat survey was conducted on May 14 and 15, 2020 at three sites: two on Mud Creek and one on the Unnamed Tributary to Mud Creek (Figure 2.3-6). A visual assessment of an additional three sites on Mud Creek, located further downstream at existing road crossings, were conducted. These three sites were limited to visual assessments as restricted site access (i.e., private land that access permission was not obtained) prevented a detailed habitat assessment from being completed.

Fish habitat surveys at each site were conducted over an approximately 300 m section of the watercourse, with each section classified into distinct habitat units of similar habitat type (e.g., run, riffle, pool). Within each habitat unit, the habitat characteristics recorded were wetted and bankfull widths and maximum water depth. Substrate composition and availability of instream and overhead cover for fish were visually estimated for each substrate size category and cover type as a percentage of total area within each habitat unit. Discharge was calculated using a Marsh McBirney flow meter and in situ water quality parameters (water temperature [°C], dissolved oxygen [mg/L], oxygen saturation [%], pH, specific conductivity [µS/cm]) were measured with a handheld YSI multiparameter meter. Detailed notes and photographs were taken of the site at the time of the survey.

Fish inventories were completed at the same three sites as the habitat assessment, two on Mud Creek and one on the unnamed tributary to Mud Creek, on May 14 and 15, 2020. Fish sampling methods consisted of baited Gee-type minnow traps and a Smith-Root LR-20B backpack electrofisher, as per the conditions of the AEP Fish Research Licence (Licence Number 20-3212). A total of 10 minnow traps were set at each site in multiple clusters of two to three traps per cluster. A single pass with the electrofisher was completed along the 300 m stretch at each site, using approximately 1000 seconds of effort. Some areas were too deep to safely wade, so backpack electrofishing was limited to primarily encompass the shoreline where depths would allow.

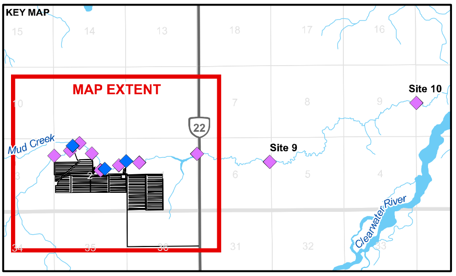
Captured fish were identified to species and measured for fork length (mm) and weight (g), with sex, stage, and maturity recorded if discernable from an external examination. Fish were then released back into the watercourse at the site near where they were captured.



LEGEND

PRIMARY HIGHWAY	PROJECT FOOTPRINT - PHASE 1
LOCAL ROAD	**FISH AND FISH HABITAT SURVEY**
WATERCOURSE	◆ SPRING SURVEY SITE
WATERBODY	◆ WINTER SURVEY SITE

KEY MAP



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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
LOCATIONS OF FISH AND FISH HABITAT SITES FOR SPRING AND WINTER SURVEYS

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	JN
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
21496738	2000	0	2.3-6

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25mm
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2.3.4.2 Results

2.3.4.2.1 Desktop Review

Mud Creek is a Class C watercourse with a Restricted Activity Period (RAP) between October 1 to April 15. A total of eight species of fish have historically been documented in Mud Creek, including four sport fish, two non-sport fish (i.e., suckers), and two forage fish (AEP 2020a; Table 2.3-2). Brown Trout, Brook Trout, and Rainbow Trout have been historically stocked in Mud Creek; however, only Brown Trout and Brook Trout have been subsequently captured in Mud Creek, with no records of Rainbow Trout being captured during previous surveys (AEP 2020a). All of these species are listed as either Secure or Exotic provincially (AEP 2020b) and none are listed under the federal *Species at Risk Act* (GOC 2020). Native stocks of Rainbow Trout are listed as At Risk provincially (AEP 2020b) and the Athabasca River population of Rainbow Trout are listed as Endangered under SARA (GOC 2020); however, Rainbow Trout within Mud Creek are introduced. Furthermore, Mud Creek is within the Clearwater River watershed which is not considered to be within the range of the Athabasca River population of Rainbow Trout.

Bull Trout have been captured in the Clearwater River in close proximity to Mud Creek, but have not been documented in Mud Creek; based on the FWMIS database, they were not captured in a recent 2019 survey conducted in Mud Creek near the confluence with the Clearwater River, and have not been recorded in the watercourse further upstream (AEP 2020a). Bull Trout are considered At Risk in Alberta (AEP 2020b). The Saskatchewan - Nelson Rivers population of Bull Trout are listed as Threatened under the SARA, and the Clearwater River watershed is within their natural range in Alberta (GOC 2020).

Table 2.3-2: Fish Species Documented in Mud Creek and their Provincial and Federal Designated Status

Guild	Common Name	Scientific Name	General Status of Alberta Wild Species[a]	COSEWIC Status[b]	SARA Status[b]
Sport Fish	Brown Trout[c]	*Salmo trutta*	Exotic/Alien	-	-
	Brook Trout[c]	*Salvelinus fontinalis*	Exotic/Alien	-	-
	Mountain Whitefish	*Prosopium williamsoni*	Secure	-	-
	Rainbow Trout[c]	*Onchorhynchus mykiss*	Exotic/Alien	-	-
Non-Sport Fish	Longnose Sucker	*Catostomus catostomus*	Secure	-	-
	White Sucker	*Catostomus commersonii*	Secure	-	-
Forage Fish	Pearl Dace	*Margariscus margarita*	Secure	-	-
	Brook Stickleback	*Culaea inconstans*	Secure	-	-

COSEWIC = Committee on the Status of Endangered Wildlife in Canada; SARA = *Species at Risk Act; - = does not apply.*

(a) AEP 2020b

(b) GOC 2020

(c) These species were historically stocked in Mud Creek.

2.3.4.2.2 Overwintering Survey

During the overwintering survey, all sites had similar characteristics (Table 2.3-3). Snow depth ranged from 0.18 to 0.42 m at the surveyed sites. Some areas of open water were noted. Ice thickness ranged from 0.07 to 0.26 m with the majority all sites being shelf ice. Under-ice water depths were shallow throughout the surveyed areas, with depths ranging from 0.10 to 0.56 m. Water velocity ranged from 0.01 to 0.25 m/s and channel width ranged from 1.0 to 4.2 m. The substrate at the assessed sites consisted primarily of fine sediments (e.g., organics, clay, and silt; 98%), with some course substrate (e.g., gravel, cobble, and boulder; 2%) present near road crossings with culverts (likely anthropomorphic from past culvert construction).

Table 2.3-3: Summary of Overwintering Habitat Characteristics at Sites Along Mud Creek and an Unnamed Tributary to Mud Creek

Site Number	Watercourse	Snow Depth (m)	Ice Thickness (m)	Under-Ice Water Depth (m)	Water Velocity (m/s)	Channel Width (m)	Substrate Presence[(a)]
1	Unnamed Tributary	0.19	0.07	0.21	0.09	2.00	Or/C/S/Gr/Co/Bo
2	Unnamed Tributary	0.18	0.21	0.16	0.01	1.65	Or
3	Unnamed Tributary	0.21	0.25	0.10	0.22	1.10	Or
4	Mud Creek	0.30	0.18	0.24	0.05	1.60	C/S/Sa
5	Mud Creek	0.34	0.15	0.18	0.14	1.70	S/Sa
6	Mud Creek	0.40	0.18	0.18	0.06	1.00	S/Sa/C/Or
7	Mud Creek	0.42	0.25	0.14	0.03	1.75	S/Or/Sa
8	Mud Creek	0.40	0.20	0.46	0.21	2.60	Co/Gr/S/Sa/Bo
9	Mud Creek	0.24	0.26	0.56	0.07	2.10	S/Sa/Or
10	Mud Creek	0.30	0.20	0.16	0.25	4.20	Co/Bo

m = metres; m/s = metres per second.

(a) Or = Organics, C = Clay, S = Silt, Sa = Sand, Gr = Gravel, Co = Cobble, Bo = Boulder.

Water quality remained relatively consistent between the sites surveyed (Table 2.3-4). The water temperature ranged from 0.04°C to 1.20°C, while the dissolved oxygen ranged from 12.0 to 12.8 mg/L, and the oxygen saturation ranged from 82.0% to 89.2%. The pH ranged from 7.5 to 7.9 and the specific conductivity ranged from 489 to 520 µS/cm.

Table 2.3-4: In Situ Water Quality Measurements During the Overwintering Habitat Survey in Mud Creek and the Unnamed Tributary to Mud Creek

Site Number	Watercourse	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	pH	Specific Conductivity (µS/cm)
1	Unnamed Tributary	0.75	12.5	87.2	7.8	512
2	Unnamed Tributary	1.20	12.5	89.2	7.7	520
3	Unnamed Tributary	0.48	12.4	85.9	7.6	520
4	Mud Creek	0.23	12.8	88.5	7.9	517
5	Mud Creek	0.29	12.8	88.6	7.8	517
6	Mud Creek	0.31	12.7	88.2	7.8	515
7	Mud Creek	0.03	12.5	85.8	7.8	476
8	Mud Creek	1.01	12.0	84.4	7.6	489
9	Mud Creek	0.89	12.1	85.2	7.8	492
10	Mud Creek	0.04	12.1	82.0	7.5	504

°C = degrees Celsius; µS/cm = microsiemens per centimetre; mg/L = milligrams per litre.

Flowing water was observed at all sites included in the overwintering survey, with no areas frozen to bottom. The water quality at all sites, particularly the level of dissolved oxygen, is sufficient to support fish during the overwintering period. All measured parameters provide suitable overwintering habitat for forage fish; however, the lack of under-ice water depth throughout much of the area does not provide overwintering habitat for large-bodied fish. Water temperature in the winter at all sites on Mud Creek was generally at or below 1°C, which is below the minimum temperature threshold of 2°C for Bull Trout egg incubation (BC ENV 2020).

2.3.4.2.3 Open-water Fish Habitat Survey

The three sites included as part of the open-water fish habitat survey show similar habitat characteristics, consisting entirely of run habitat with a maximum water depth ranging from 0.9 to 1.5 m (Table 2.3-5). The average wetted width for the sites ranged from 0.75 to 2.0 m, while the average bankfull width ranged from 1.15 to 2.30 m. The substrate composition consisted primarily of fine sediments (e.g., clay, silt, and sand) (98%), with some gravel (1%) and cobble (1%). Discharge ranged from 0.101 to 0.152 m^3/s, increasing as sites moved further downstream. At all sites, instream cover was provided primarily by water depth (30%), with some small woody debris (5%) and submergent vegetation (10%). Overhead cover was provided by the presence of undercut banks throughout the sampling reaches (45%), with overhanging grasses (15%) and woody vegetation (3%). No barriers to fish movement were observed. Representative photos of the Unnamed Tributary and Mud Creek are presented in Photo 2.3-4 to Photo 2.3-6.

Table 2.3-5: Open-water Habitat Characteristics in Mud Creek and an Unnamed Tributary to Mud Creek

Site Number	Watercourse	Habitat Unit Type	Maximum Water Depth (m)	Average Width (m)		Substrate Composition (%) (a)					Discharge (m^3/s)
				Wetted	Bankfull	Or	C/S	Sa	Gr	Co	
11	Unnamed Tributary	Run	0.9	0.75	1.15	0	18	80	1	1	0.101
12	Mud Creek	Run	0.9	1.3	1.50	0	30	70	0	0	0.132
13	Mud Creek	Run	1.5	2.0	2.30	0	30	70	0	0	0.152

m = metres; m^3/s = cubic metres per second.
(a) Or = Organics, C/S = Clay/Silt, Sa = Sand, Gr = Gravel, Co = Cobble.

Photo 2.3-4: Representative Photo of the Unnamed Tributary to Mud Creek at Site 11. May 14, 2020

Photo 2.3-5: Representative Photo of Mud Creek at Site 12. May 14, 2020

Photo 2.3-6: Representative Photo of Mud Creek at Site 13. May 14, 2020

Water temperature ranged from 4.0°C to 5.4°C, and the dissolved oxygen and oxygen saturation ranged from 8.8 to 10.3 mg/L and 67.2% to 81.5%, respectively (Table 2.3-6). The specific conductivity ranged from 326 to 380 µS/cm. The pH probe on the handheld multimeter malfunctioned during the site assessment, so accurate pH measurements were not recorded.

Table 2.3-6: In Situ Water Quality Measurements on Mud Creek and an Unnamed Tributary to Mud Creek

Site Number	Watercourse	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	pH	Specific Conductivity (µS/cm)
11	Unnamed Tributary	4.6	8.9	69.3	-	380
12	Mud Creek	5.4	10.3	81.5	-	328
13	Mud Creek	4.0	8.8	67.2	-	326

"-" = measurement not taken due to pH probe malfunction; °C = degrees Celsius; µS/cm = microsiemens per centimetre; mg/L = milligrams per litre.

At the sites visually assessed at the road crossings on Mud Creek (Sites 8, 9, and 10), habitat was similar to the sites surveyed in detail. There were sections of riffle habitat in addition to run habitat due to the influence of the road crossings and the presence of cobble substrate associated with culvert installations. These areas contained a small amount of coarse substrate (i.e., boulders and cobbles). Channel widths increased further downstream on Mud Creek and abandoned breached beaver dams were observed. As part of the open-water survey, a culvert present at the road crossing at Site 8 was visually inspected and was observed to be in good condition and not perched at the time of the survey. The other road crossings consisted of clear-span bridges.

Overall, rearing habitat for forage fish in Mud Creek and the unnamed tributary is moderate due to sufficient water depth and the presence of undercut banks to provide cover. Rearing habitat is low for sport fish and sucker species due to the narrow width of the channel, absence of fast-moving water, and limited riffle habitat in the surveyed area. Spawning habitat is considered low for forage fish due to the absence of aquatic vegetation, and low for sport fish and sucker species due to the limited amount of coarse substrate and fast flowing water.

2.3.4.2.4 Fish Inventory

A total of 29 fish were captured throughout the surveyed area for the Project comprising four different forage fish species: Finescale Dace (*Phoxinus neogaeus*), Lake Chub (*Couesius plumbeus*), Pearl Dace (*Margariscus margarita*), and Brook Stickleback (*Culaea inconstans*) (Table 2.3-7). Finescale Dace were the most abundantly captured species, at 65.5% of the total catch. Of the three sites that were surveyed, most fish were captured at Site 13, with 21 of the 29 captured fish. Backpack electrofishing was the most successful fishing method, representing 58.6% of the total catch. No sport fish were captured during fish sampling.

Table 2.3-7: Fish Captured during the Fish Inventory on Mud Creek and the Unnamed Tributary to Mud Creek

Site Number	Gear Type	Fish Species Captured				Total Number of Fish Captured
		Finescale Dace	Lake Chub	Pearl Dace	Brook Stickleback	
11	Minnow Trap	1	0	2	2	5
	Electrofishing	2	0	0	0	2
12	Minnow Trap	0	0	1	0	1
	Electrofishing	0	0	0	0	0
13	Minnow Trap	3	2	0	1	6
	Electrofishing	13	2	0	0	15
	Total	**19**	**4**	**3**	**3**	**29**

A total of 210.2 trap-hours and 2,941 seconds (s) of effort was expended for minnow traps and backpack electrofishing, respectively (Table 2.3-8). Catch-per-unit-effort (CPUE) for minnow traps ranged from 0.04 fish/trap-hour to 0.21 fish/trap-hour, while the CPUE for electrofishing ranged from 0 fish/100 s to 1.6 fish/100 s.

Table 2.3-8: Catch-per-unit-effort (CPUE) during the Fish Inventory Survey on Mud Creek and the Unnamed Tributary to Mud Creek

Site Number	Gear Type	Effort	Total Number of Fish Captured	CPUE
11	Minnow Trap	24.3 trap-hours	5	0.21 fish/trap-hour
	Electrofishing	1,026 s	2	0.19 fish/100 s
12	Minnow Trap	22.5 trap-hours	1	0.04 fish/trap-hour
	Electrofishing	972 s	0	0.00 fish/100 s
13	Minnow Trap	163.4 trap-hours	6	0.04 fish/trap-hour
	Electrofishing	943 s	15	1.60 fish/100 s

CPUE = Catch-per-unit-effort; s = seconds.

2.3.4.3 Summary

The fish and fish habitat surveys conducted for the Project along Mud Creek and in the Unnamed Tributary to Mud Creek found suitable overwintering and rearing habitat for forage fish due to the sites not being frozen to bottom during winter months, suitable levels of dissolved oxygen during winter conditions, sufficient water depth, and undercut banks providing instream and overhead cover. However, there is limited overwintering, rearing, and spawning habitat for sport fish and sucker species due to the narrow channel, lack of under-ice water depth over 0.50 m during the winter, as well as limited amounts of coarse substrate and fast flowing water required for spawning.

Four fish species were captured, all of which were forage species, during the fish inventory. Fish were captured at all sites sampled, including in both Mud Creek and the unnamed tributary to Mud Creek. However, the largest number of fish were captured at Site 13, the furthest downstream site on Mud Creek.

2.3.5 Wildlife

The Project is located in the Lower Foothills Natural Subregion of the Foothills Natural Region. Land uses in the Lower Foothills Natural Subregion include timber harvesting, open-pit coal mining, and oil and gas exploration and development (Natural Regions Committee 2006). Till cropping and forage production are primarily restricted to the lower elevation eastern fringe, while grazing occurs throughout the subregion on native grasslands. Wetlands in the subregion are typically characterized by peat accumulation up to 3 m thick and can cover 15% to 40% of valley bottoms (Natural Regions Committee 2006).

The Foothills Region has high habitat diversity because of variable topography and surface and groundwater flow regimes, which leads to variable plant communities (Natural Regions Committee 2006). The location of the Foothills Region between the Rocky Mountain and Boreal Forest Natural Regions contributes to a relatively high species diversity. Significant wildlife species that occur in the Foothills Natural Region include grizzly bear (*Ursus arctos*), woodland caribou (*Rangifer tarandus caribou*), and wolverine (*Gulo gulo*) (Natural Regions Committee 2006). Secondary grizzly bear range intersects the western portion of the RSA (AEP 2020a).

Land cover within the LSA is dominated by wetlands (244 ha; 85%; Table 2.3-1), including wooded coniferous fen (89 ha; 31% of the LSA; Table 2.3-1) and shrubby fen (146 ha; 49%; Table 2.3-1) plant communities. Some wetland areas have previously been cleared (6 ha; 2%), but wetland soils remain relatively undisturbed. In addition, upland ecosite phases cover 11 ha (4%; Table 2.3-1) and agricultural/miscellaneous land cover types cover 32 ha (11%; Table 2.3-1) along the main access road (Figure 2.3-3).

Baseline data for the wildlife assessment were collected using a combination of desktop review of historic information in the RSA combined with field surveys conducted in the LSA for Phase 1 and Phase 2 in February and June 2020. Field surveys followed Alberta's Sensitive Species Inventory Guidelines (ESRD 2013) and Alberta Biodiversity Monitoring Institute protocols (Bayne et al. 2006) and were conducted under AEP permit number 20-061.

The majority of the information for the desktop review was gathered as follows:

- A review of the Fish and Wildlife Internet Mapping Tool (AEP 2020a) to identify species of management concern and wildlife management areas in the RSA. All species occurrences within the RSA were cross-referenced with provincial (AEP 2020b) and federal (GOC 2020) status lists to determine if listed species have been observed or recorded as occurring within the RSA.
- Compiling a list of wildlife that may potentially be found within the RSA using published and unpublished literature sources including reports for past projects. This includes *eBird* (2020).
- Baseline wildlife field surveys were completed in 2020. All listed wildlife species and/or their sign (i.e., scat, tracks) incidentally observed were recorded during the field surveys.

2.3.5.1 Methods

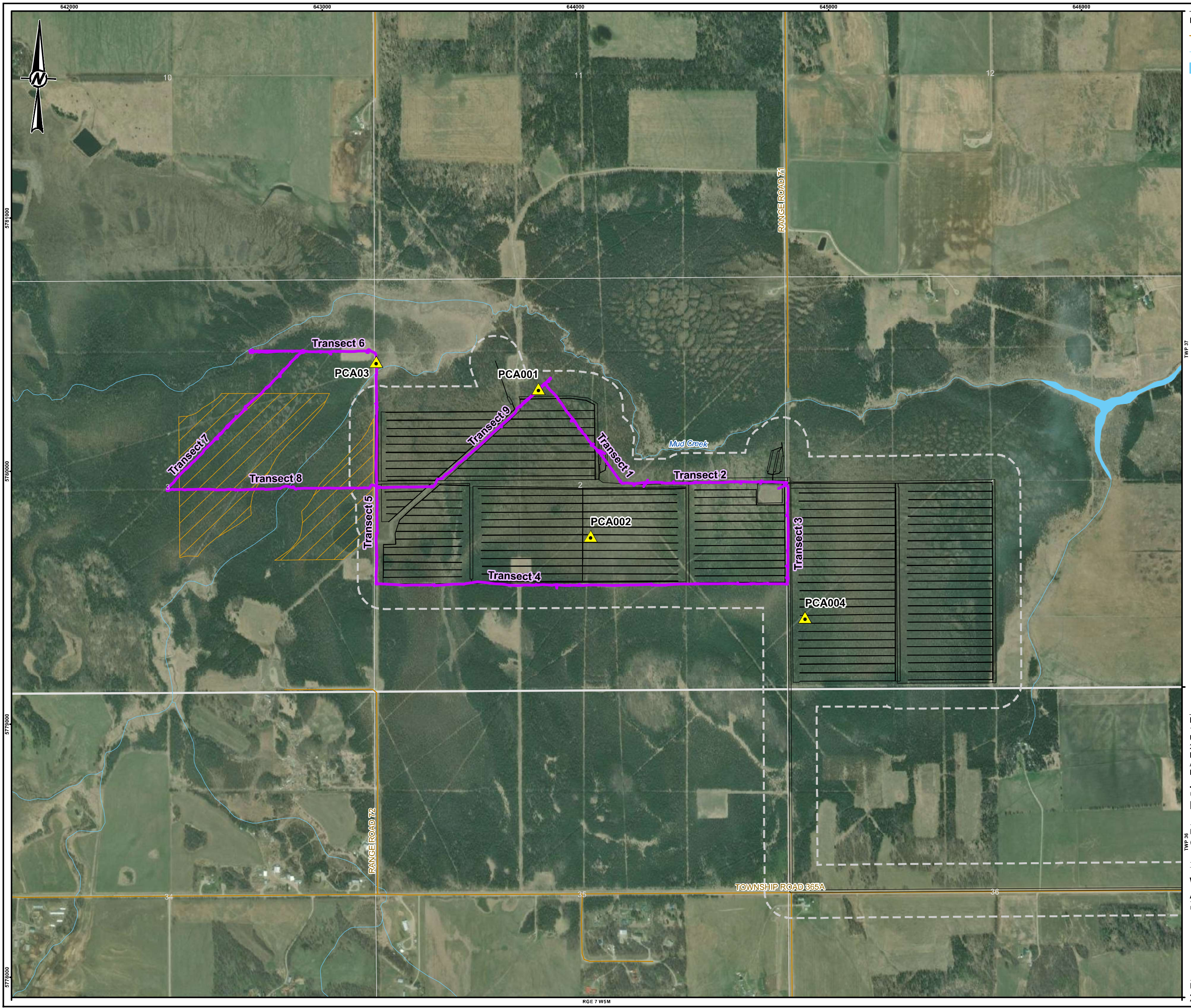
2.3.5.1.1 Winter Track

A one-day winter track program was completed on February 21, 2020. Surveys were completed along existing seismic lines using snowmobiles by two Golder biologists travelling no more than 10 km/h (Bayne et al. 2006). Species presence was noted along each segment of the linear transect surveys. Multiple tracks by the same species in the same segment were not counted. Instead, the basic unit of measurement in the snowmobile protocol was the presence/absence of species per transect segment. Tracks were recorded if they were observed within 1 m on either side of the snowmobile. The start and end points of each segment were recorded using the GPS to determine the distance for each segment (Table 2.3-9, Figure 2.3-7). Transects 1 to 5 and 9 were all within Phase 1; transects 6 and 7 were within Phase 2 (Figure 2.3-7). Most of transect 8 is within Phase 2 but the western portion of this transect intersects Phase 1 (Figure 2.3-7).

Table 2.3-9: Winter Track Transect Segment Length

Project Phase Area	Transect Segment	Length (m)
Phase 1	1	486
Phase 1	2	655
Phase 1	3	395
Phase 1	4	1,620
Phase 1	5	921
Phase 2	6	288
Phase 2	7	739
Phase 1/2	8	1,050
Phase 1	9	611
	TOTAL	**6,765**

m = metres.



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LEGEND

—	LOCAL ROAD	▨	HARVEST SECTION (PHASE 2)
—	WATERCOURSE	☐	PROJECT FOOTPRINT - PHASE 1
🟦	WATERBODY	⬚	TERRESTRIAL LOCAL STUDY AREA - PROJECT FOOTPRINT + 100 M BUFFER
		▲	AUTONOMOUS RECORDING UNIT
		—	WINTER TRACK SURVEY TRANSECT

0 300 600

1:15,000 METRES

REFERENCE(S)

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
WINTER TRACK SURVEY TRANSECTS AND LOCATIONS OF AUTONOMOUS RECORDING UNITS, 2020

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	LD
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
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25mm

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2.3.5.1.2 Autonomous Recording Unit Survey

The use of Autonomous Recording Units (ARUs) in wildlife surveys has increased over the last ten years, especially for elusive and nocturnal species (e.g., marshbirds such as yellow rail) (Brandes 2008; Fristrup and Clark 2009). The benefits of using ARUs include:

- reduced stress to wildlife species from human disturbance
- increased sampling effort in areas that are difficult to access
- survey data can be stored for quality assurance and for further reference

Autonomous recording units were deployed at four locations in the LSA (Table 2.3-10; Figure 2.3-7). The ARUs were programmed and deployed to record migratory breeding birds and amphibians. Song Meter SM4 (Wildlife Acoustics Inc.) ARUs were deployed May 28, 2020 and retrieved June 29, 2020 (i.e., during the amphibian and bird breeding period, as per ESRD 2013]). Amphibian surveys were conducted within 1 hour after sunset, and breeding bird surveys were conducted within 1 hour after sunrise. However, due to the time being set incorrectly on the ARU at site PTCBA04, these time periods were not recorded. Amphibian and breeding bird surveys were conducted at the closest available times given the faulty recording schedule; amphibian surveys were conducted between 0200h and 0300h and breeding bird surveys between 0400h and 0500h at this site as a result. Additionally, one ARU (PTCBA01) failed to record during the nocturnal survey period.

Date, time, observer number, GPS waypoint, and microphone direction and height were recorded at each plot during ARU deployment.

Table 2.3-10: ARU Locations in the Local Study Area in 2020

Project Phase Area	Plot ID	UTM (NAD 83; Zone 12U)		Habitat
		Easting	Northing	
Phase 1	PTCBA01(a)	643910	5780356	Treed fen
Phase 1	PTCBA02	644217	5779894	Shrubby fen
Phase 1	PTCBA04(b)	644964	5779499	Treed fen
Phase 2	PTCBA03	643239	5780445	Graminoid fen

(a) Failed to record nocturnal data

(b) Unit was programmed with the wrong time

ID = Identification; UTM = Universal Transverse Mercator; NAD 83 = North American Datum 1983.

2.3.5.1.2.1 Amphibians

Amphibian surveys were conducted at PTCBA02, PTCBA03, and PTCBA04 from May 28 to June 24, 2020 on nights with good weather (i.e., no/light rain or wind), and between 2200h to 0230h (i.e., during the period when amphibians are most vocally active). Recordings were 5-minutes long and five recordings from each plot were transcribed for a total of 25-minutes of data transcribed per plot.

Amphibian species were assigned a calling index value based on the estimated number of calls because the actual number of calling males is difficult to estimate. Calling index values were defined as follows:

- Calling Index 1 – Individuals counted (e.g., 1 to 3 animals)
- Calling Index 2 – Individual calls can be distinguished but there is some call overlap (e.g., 4 to 7 animals)
- Calling Index 3 – Full chorus, calls are overlapping (e.g., 8 or more animals)

2.3.5.1.2.2 Breeding Bird

Breeding bird surveys were conducted at PTCBA01, PTCBA02, PTCBA03, and PTCBA04 from May 29 to June 20, 2020 (i.e., during the period when songbirds are most vocally active). Recordings were transcribed at sunrise for PTCBA01, PTCBA02, PTCBA03 (0518h to 0557h) and one hour before sunrise for PTCBA04 (0418h to 0427h) due to the time error on the ARU. Four recordings were selected on dates with good weather and 5-minutes were transcribed for a total of 20-minutes of acoustic data transcribed per plot.

2.3.5.2 Results

2.3.5.2.1 Winter Track

A total of eight wildlife species were recorded during the winter track survey, in addition to human use (Table 2.3-11). Coyote (*Canis latrans*) and snowshoe hare (*Lepus americanus*) were observed on all transects, while human use was only noted on one transect (Table 2.3-11). Cougar (*Puma concolor*) and deer (*Odocoileus* spp.) tracks were also commonly observed in the LSA (Table 2.3-11). Most species were observed in both Phase 1 and Phase 2, however mice species and weasel species were only observed in Phase 1 (Table 2.3-11). Human use was noted on transect 8, which intersects both Phase 1 and Phase 2.

Table 2.3-11: Species Recorded during the Winter Track Survey, 2020

Common Name	Scientific Name	Number of Transect Segments with Observations	Transect Segments with Observations	Project Phase Area Observed
Cougar	*Puma concolor*	7	1,2,3,4,5,7,9	Phase 1 and 2
Coyote	*Canis latrans*	9	1,2,3,4,5,6,7,8,9	Phase 1 and 2
Deer species	*Odocoileus* spp.	7	1,3,4,5,6,7,8	Phase 1 and 2
Mice	N/A	3	1,2,4	Phase 1
Moose	*Alces alces*	6	2,4,5,6,7,8	Phase 1 and 2
Red squirrel	*Sciurus vulgaris*	3	4,6,8	Phase 1 and 2
Snowshoe hare	*Lepus americanus*	9	1,2,3,4,5,6,7,8,9	Phase 1 and 2
Weasel species	N/A	3	3,4,5	Phase 1
Human	*Homo sapiens*	1	8	Phase 1/2[(a)]

N/A =not applicable; spp. = species

(a) Transect 8 intersects Phase 1 and Phase 2 and the exact location of tracks along the transect was not noted during field surveys.

2.3.5.2.2 Autonomous Recording Units

2.3.5.2.2.1 Amphibians

Three species of amphibian were detected during surveys: boreal chorus frog (*Pseudacris maculata*), wood frog (*Lithobates sylvaticus*), and western toad (*Anaxyrus boreas*). Boreal chorus frog and western toad were detected at all three plots and wood frog was detected at one plot. The maximum relative abundance for boreal chorus frog was call intensity one at all plots, the maximum relative abundance for wood frog was call intensity one at PTCBA03 (Phase 2), and the maximum relative abundance for western toad was call intensity one at PTCBA03 (Phase 2) and two at plots PTCBA02 and PTCBA04 (Phase 1) (Table 2.3-12).

Table 2.3-12: Amphibian Detections at ARU Plots

Plot ID	Common Name	Scientific Name	Maximum Call Intensity
PTCBA02	boreal chorus frog	*Pseudacris maculata*	1
	western toad	*Anaxyrus boreas*	2
PTCBA03	boreal chorus frog	*Pseudacris maculata*	1
	wood frog	*Lithobates sylvaticus*	1
	western toad	*Anaxyrus boreas*	1
PTCBA04	boreal chorus frog	*Pseudacris maculata*	1
	western toad	*Anaxyrus boreas*	2

Western toad is a species of special concern under the SARA (GOC 2019a). There are two designated populations of western toad: calling and non-calling. Alberta contains most of the global population of calling western toads (ECCC 2016). The calling population remains widespread and may be expanding its range (ECCC 2016). However, declines are suspected and projected based on known species vulnerabilities and threats (ECCC 2016). The main threats to western toads include habitat fragmentation and mortality from transportation corridors, mortality from infection with the amphibian chytrid fungus (*Batrachochytrium dendrobatidis*), habitat loss from forestry, agriculture and oil and gas activities, climate change, and pollution of waterbodies used for breeding (ECCC 2016).

Characteristics that make western toad populations vulnerable to changes from human developments and activities include their high fidelity to breeding sites, reliance on high adult survival, and the requirement to travel between aquatic breeding habitats and terrestrial sites used for foraging and hibernation (ECCC 2016). Preferred breeding habitats are waterbodies that have a sandy or silty bottom and contain some emergent vegetation. However, this species shows high plasticity to breeding habitat selection and can use many wetland types including human-made water bodies such as ditches, road ruts, tailings ponds, and borrow pits (COSEWIC 2012).

Breeding sites can be several kilometres from foraging and hibernation sites and, as such, any change to the ability of toads to move these distances (e.g., habitat fragmentation, road mortality) increases their vulnerability to reduced survival and reproductive success (ECCC 2016). However, the fact that western toads can travel long distances show they have relatively high mobility.

Western toads are also reliant on high adult survival to sustain populations through periods of poor reproductive success. This means that threats that alter adult survival can have pronounced effects on populations. Nevertheless, western toads are relatively adaptive to changes in survival and reproduction as this species lays an average of 12,000 eggs in a single clutch (BC Frogwatch, no date).

2.3.5.2.2.2 Breeding Bird

A total of 122 individuals of 37 avian species were observed during breeding bird ARU transcription, with an additional 2 species observed incidentally during amphibian surveys (barred owl [*Strix varia*] and long-eared owl [*Asio otus*]) (Table 2.3-13).

Lincoln's sparrow (*Melospiza lincolnii*) and hermit thrush (*Catharus guttatus*) were the most commonly occurring species with 9.84% and 8.20% of individuals observed, respectively (Table 2.3-13). Other commonly occurring species included Wilson's snipe (*Gallinago delicata*), dark-eyed junco (*Junco hyemalis*), American robin (*Turdis migratorius*), and chipping sparrow (*Spizella passerina*). Sora (*Porzana carolina*), alder flycatcher (*Empidonax alnorum*), and common yellowthroat (*Geothlypis trichas*) are considered sensitive species in Alberta (AEP 2020b). No federally listed species were detected during the surveys.

Table 2.3-13: Bird Observations at Autonomous Recording Unit Plots

Common Name	Scientific Name	Plots with Detections	% of Plots with Detections	Total Individuals	Percent of Total Observations
alder flycatcher[(a)]	*Empidonax alnorum*	1	0.25	4	3.28
American crow	*Corvus brachyrhynchos*	2	0.5	2	1.64
American goldfinch	*Spinus tristis*	3	0.75	3	2.46
American robin	*Turdus migratorius*	4	1	6	4.92
blue-headed vireo	*Vireo solitarius*	1	0.25	1	0.82
boreal chickadee	*Poecile hudsonicus*	2	0.5	2	1.64
Canada goose	*Branta canadensis*	3	0.75	3	2.46
Canada jay	*Perisoreus canadensis*	3	0.75	3	2.46
cedar waxwing	*Bombycilla cedrorum*	2	0.5	2	1.64
chipping sparrow	*Spizella passerina*	4	1	7	5.74
clay-colored sparrow	*Spizella pallida*	2	0.5	3	2.46
common raven	*Corvus corax*	2	0.5	2	1.64
common yellowthroat[(a)]	*Geothlypis trichas*	1	0.25	3	2.46
Connecticut warbler	*Oporornis agilis*	1	0.25	1	0.82
dark-eyed junco	*Junco hyemalis*	4	1	7	5.74
golden-crowned kinglet	*Regulus satrapa*	1	0.25	1	0.82
greater yellowlegs	*Tringa melanoleuca*	2	0.5	3	2.46
hairy woodpecker	*Picoides villosus*	1	0.25	1	0.82
hermit thrush	*Catharus guttatus*	4	1	10	8.20
lesser yellowlegs	*Tringa flavipes*	1	0.25	1	0.82
Lincoln's sparrow	*Melospiza lincolnii*	4	1	12	9.84
mourning dove	*Zenaida macroura*	3	0.75	5	4.10
mourning warbler	*Oporornis philadelphia*	2	0.5	2	1.64
palm warbler	*Dendroica palmarum*	3	0.75	3	2.46
pine siskin	*Spinus pinus*	4	1	4	3.28
rose-breasted grosbeak	*Pheucticus ludovicianus*	2	0.5	2	1.64
ruby-crowned kinglet	*Regulus calendula*	4	1	5	4.10
solitary sandpiper	*Tringa solitaria*	2	0.5	2	1.64
sora[(a)]	*Porzana carolina*	1	0.25	1	0.82
spruce grouse	*Falcipennis canadensis*	1	0.25	1	0.82
Swainson's thrush	*Catharus ustulatus*	3	0.75	4	3.28
white-throated sparrow	*Zonotrichia albicollis*	1	0.25	1	0.82
white-winged crossbill	*Loxia leucoptera*	1	0.25	1	0.82
Wilson's snipe	*Gallinago delicata*	4	1	8	6.56
yellow-bellied flycatcher	*Empidonax flaviventris*	1	0.25	1	0.82
yellow-bellied sapsucker	*Sphyrapicus varius*	1	0.25	1	0.82
yellow-rumped warbler	*Setophaga coronata*	4	1	4	3.28

(a) Sensitive species in Alberta (AEP 2020b).

Species richness was highest at plot PTCBA02 (25 species; Phase 1) and lowest at PTCBA04 (14 species; Phase 1) (Table 2.3-14). Given that ARUs are most suitable for the detection of regularly vocalizing songbirds (i.e., non-corvid passerines), these species were also assessed separately from the totals. Corvids include jays, crows, and ravens. Of all species detected, 67.6% (25 of 37) were non-corvid passerines, and these species accounted for 77.0% (94 of 122) of all individuals detected. Non-corvid passerine richness was highest at PTCBA02 and PTCBA03 (17 species) and lowest at PTCBA04 (11 species) (Table 2.3-14).

Table 2.3-14: Total Avian Species Richness and Non-Corvid Passerine Richness at Each Autonomous Recording Unit.

Project Phase Area	Plot Name	Habitat Type	All Birds Detected		Non-Corvid Passerines	
			Species Richness	Total Individuals	Species Richness	Total Individuals
Phase 1	PTCBA01	Treed Fen	22	32	15	23
Phase 1	PTCBA02	Shrubby Fen	25	34	17	26
Phase 2	PTCBA03	Graminoid Fen	22	34	17	29
Phase 1	PTCBA04	Treed Fen	14	22	11	16
		Total	**31**	**88**	**20**	**65**

Common Nighthawk and Yellow Rail

Common nighthawk (*Chordeiles minor*) and yellow rail (*Coturnicops noveboracensis*) are species of special concern under the SARA (GOC 2019a). No common nighthawks or yellow rails were detected during the review of nocturnal data.

2.3.6 Rare and Endangered Species

2.3.6.1 Methods

2.3.6.1.1 Wildlife

For the purposes of this report, rare and endangered wildlife species are defined as follows:

- Species recommended by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to be protected under Canada's *Species at Risk Act* ([SARA] GOC 2020).
- Species currently protected under the *SARA* (GOC 2020).
- Species that are considered as may be at risk or at risk by the AEP (2020b).

Incidental observations of protected wildlife species within the RSA were recorded during all terrestrial surveys. Prior to beginning surveys, a list of protected species was generated from reviewing federal and provincial wildlife and conservation legislation documents. The list of potential species is not exhaustive, but highlights species that might occasionally occur within the Project footprint, based on breeding ranges or migratory distribution.

Federal status documents that were reviewed include the assessments and updated status reports on wildlife species created by the COSEWIC and the SARA Public Registry (GOC 2020). The COSEWIC is an independent body of experts that identifies and assesses which wildlife species are considered to be at risk. The COSEWIC reports its results to the Canadian government and the public. The Canadian government takes a COSEWIC designation into consideration when determining those species that should be protected under the SARA. Species protected under the SARA are separated into three different schedules. Schedule 1 is the official list of wildlife species at risk, and classifies species as being extirpated, endangered, threatened, or of special concern. Actions to protect and recover a listed species are implemented once a species is listed on Schedule 1. Schedule 2 and Schedule 3 listed species are those that were designated as species at risk by COSEWIC prior to October 1999. These species must be reassessed using revised criteria before they can be added to Schedule 1 of SARA (GOC 2019b).

Provincially, status determination of wildlife species was based on a review of the Wild Species Status Search (AEP 2020b). The Wild Species Status Search provides standardized information on the ecological status of wildlife species and communities within the province. The AEP identifies a species' risk of extirpation from the province by assigning ranks, which do not necessarily reflect its management policy. For example, some species may be rare within Alberta but are considered common within North America. Ranks are arranged from extirpated/extinct to secure and also include categories for exotic/alien and accidental/vagrant species. At risk and may be at risk species were identified prior to conducting terrestrial wildlife surveys. The potential presence of these species in the RSA was determined by identifying habitat requirements for breeding and foraging activities.

Surveys for federally listed and provincially tracked species were completed in conjunction with other wildlife surveys (e.g., breeding bird, amphibian). Winter track surveys were completed to assess the presence of woodland caribou and wolverine.

2.3.6.1.2 Rare Plants

Provincial and federal agencies maintain lists of vegetation elements of conservation concern. Listed plants in Alberta are represented by species included on Schedule 6 of the Alberta *Wildlife Act* (AWA) and Regulations (143/1997) (GOA 2018a) and by the Alberta Conservation Information Management System (ACIMS) which maintains an online database of listed plant species and ecological communities by Natural Subregion (Allen 2014; ACIMS 2017a). Sensitive vegetation elements can be placed on the ACIMS Tracking list, or the Watched list. Elements on the Tracking list have been determined to be of high conservation priority because they are rare or of concern in some other way. Although species on the Watched list are not of immediate conservation concern, ACIMS endeavours to gather more information about the abundance and distribution of these species throughout the province.

At the federal level, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses and designates species that are in danger of disappearing from Canada (GOC 2020). There are seven COSEWIC status categories: Extinct, Extirpated, Endangered, Threatened, Special Concern, Not at Risk, and Data Deficient. Species can also be designated by COSEWIC as Candidate Wildlife Species, which are species that have not yet been assessed by COSEWIC but are suspected of being at some risk of extinction or extirpation. The federal government periodically reviews the COSEWIC list to determine if a listed species should be protected by law. The Species at Risk Act (SARA) establishes Schedule 1 as the official List of Wildlife Species at Risk (GOC 2020). As such, listed plant and ecological community surveys were completed as a component of the vegetation survey to identify the location of any listed plant species or ecological communities in the LSA.

Prior to the field program, a desktop review was undertaken to identify any listed plant species (vascular and non-vascular) and ecological community occurrences historically observed in the area (ACIMS 2017b).

Listed plant surveys are typically conducted several times over the growing season during periods when potentially listed species are most likely to be visible and when diagnostic features present. As such, an early season survey was carried out within the LSA on May 28, 2020 to search for any listed plant species or ecological communities. In addition, rare plant surveys were completed by Stantec on August 16, 2005 and June 22, 2006 (Stantec 2005, 2006) and wetland surveys were conducted by Golder on June 9 and 10, 2017, which included incidental sightings of listed plant species (Golder 2017).

The early season rare plant survey followed the Alberta Native Plant Council (ANPC) Rare Plant Survey Guidelines (ANPC 2012). At each targeted survey location, a systematic meander was undertaken to explore the diversity of microhabitats present. The beginning of each meander was marked with a GPS location, and then full species inventories were documented along the meander along with general site characteristics, such as wetland type, moisture and nutrient regime. A focus was placed on areas exhibiting high potential for listed plants (e.g., uncommon landscape features, transitional habitats, previous listed plant observations). If rare plants were observed, GPS locations and photos were taken and additional data were collected including microhabitat characteristics, population size and distribution, phenology and health, and any diagnostic identification characteristics. This same information was collected when rare plants were incidentally encountered (e.g., when travelling between sample sites). Collection was limited to specimens that could not be identified in the field, and occurred only when a species was suspected to be tracked and when local populations could withstand sampling as per guidance in applicable rare plant survey guidelines (ANPC 2012).

2.3.6.2 Results

2.3.6.2.1 Wildlife

Western toad is a federally listed species that was noted during the wildlife surveys. No other federally listed or provincially tracked species have been reported within 5 km of the Project footprint (AEP 2020b).

2.3.6.2.2 Rare Plants

An ACIMS database search was completed on May 15, 2020 to help determine the potential for listed plant species or communities within 500 m of the Terrestrial LSA boundary. The ACIMS query returned one non-sensitive element occurrence, pepper spore lichen (*Rinodina metaboliza*), which is listed as S2S4 and was last observed in the area in 1971. Pepper spore lichen mainly occurs on living trees, including black spruce (*Picea mariana*) and larch (*Larix laricina*) (Sheard 2010), both of which occur in fens. The results of the ACIMS search do not preclude the potential for other listed plant species to be present within the LSA.

No listed plant species or listed plant communities were observed during the 2017 wetland surveys (Golder 2017) or the 2020 listed plant surveys. Additionally, no listed plant species were observed during the surveys completed by Stantec in 2005 and 2006 (Stantec 2005, 2006).

2.3.7 Hydrology

2.3.7.1 Previously Completed Hydrology Assessment

Premier Tech previously submitted a *Water Act* application to AEP in 2010. The documents provided with the application include the surface water runoff charts and a hydrological assessment of the effects of Project drainage (Premier Tech 2010). Following reception of additional information request from AEP (April 2011), Premier Tech provided additional baseline hydrology and assessment (Stantec 2013, Appendix C). The 2010 Premier Tech application and Stantec (2013) additional information included the following conclusions:

- Parameters and the method used for surface runoff analysis are both conservative.
- The short-term changes in flow will have negligible effects on downstream users.
- The natural runoff contains some minerals that have leached from the organic soils in the peatland. Once the Project is developed for harvesting, the runoff will have the same characteristics.

Additionally, the assessment indicated that development of ditches throughout the harvesting area would only cause small increases in runoff relative to natural peatland because of the following:

- The Project footprint surface is relatively flat and the grade in the drainage ditches is low.
- The drier surface of the peat created by the drainage system provides a large volume of storage for precipitation, and usually releases rainfall-runoff more slowly than a natural peatland (Daigle and Daigle 2001).
- Runoff peaks tend to be of lower magnitude from developed peatland than natural saturated peatland.

2.3.7.2 Hydrology of the Peatland and Water Balance

Climate

The Lower Foothills Subregion, where the Project is located, is characterized by a cooler and moist growing season when compared to the boreal forest (Natural Regions Committee 2006). Table 2.3-15 provides a summary of the key climate information for the Project site.

Table 2.3-15: Summary of Climate Information for the Project site

Climate Parameter	Values
Mean annual air temperature (°C)	2.3
Warmest month air temperature (°C)	14.7
Coldest month air temperature	-12.8
Mean annual total precipitation (mm)	588
Mean annual snowfall (mm)	158
Mean annual rainfall (mm)	430
Mean annual evapotranspiration (mm)	380
Mean annual evaporation (mm)	700

°C = Degrees Celsius; mm = millimetres.

With mean annual precipitation of about 588 mm and mean annual evaporation of about 700 mm, the runoff expected from the fen areas is relatively small.

Peatland Hydrology

The runoff receiving stream is Mud Creek located at the west and north of the Project footprint as well as an unnamed tributary that flows into Mud Creek from the southwest.

The total Project footprint of Phase 1, including harvest sections, access roads, harvest roads, sedimentation ponds and drainage ditches is 155.5 ha (1.55 km^2). The topography of the site is relatively flat with a gentle slope of the peat surface and water table orienting northward towards Mud Creek. A survey of peat surface and water table elevations completed on 30 October 2021 indicated that the water table is near the peat surface near the centre of the fen and water table depth increases to more than 1.0 m to 2.0 m close to Mud Creek (Figure 2.3-5e,f). However, the water table was near the peat surface all the way to Mud Creek at one centrally-located transect shown in Figure 2.3-5c. The underlying substrate is glaciolacustrine sediment to the north (although two local wells were completed in sand approximately 6 m thick overlying clay) and fine to medium grained eolian sand to the west and south (Section 2.3.3).

The fen does not have natural outflow channels therefore outflows are usually from seepage or shallow groundwater flow (when the water table is below the peat surface) or sometimes due to overland flow (when the water table rises above the surface). Typically, outflow from the peatland would be highest following snowmelt during the spring freshet when the peat is still frozen but seepage outflows could continue year-round.

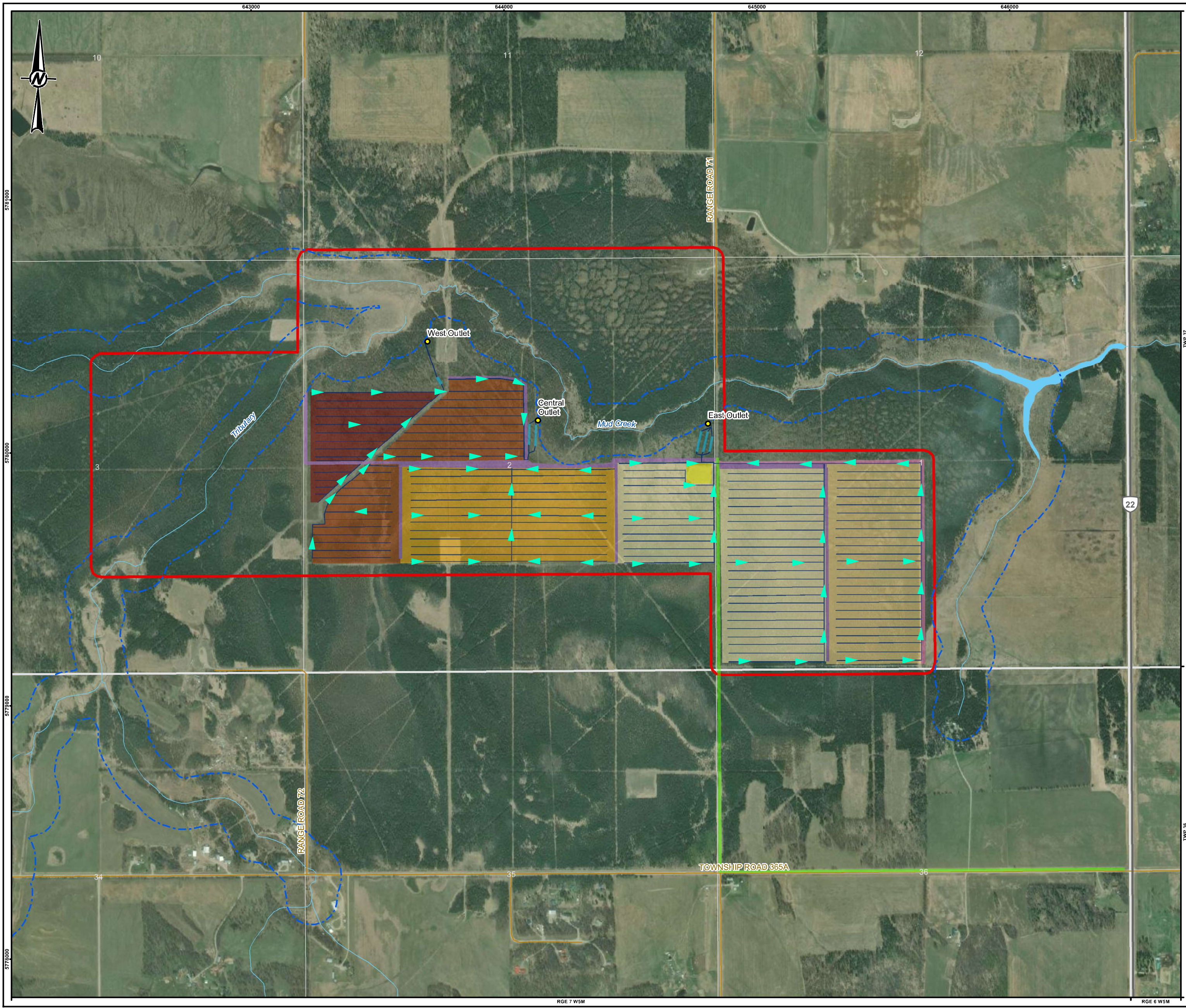
Mud Creek Hydrology

Figure 2.3-8 shows the approximate locations of the three proposed outlet locations below six sedimentation ponds which are the locations used for the hydrology effects assessment and to define baseline conditions.

Table 2.3-16 presents the estimated baseline flow statistics at the effects assessment locations including monthly, seasonal and flood flows. Baseline flow statistics were estimated using the recorded data from the Water Survey of Canada (WSC) gauging station east of the project (i.e., Prairie Creek, WSC Station 05DB005, drainage area of 208 km^2, and the period of record from 1973 to 2020). Mean monthly and seasonal flows were estimated based on the ratio of the drainage areas. Flood flows were estimated using a single station transfer method and a power factor of 0.8 for the ratio of drainage areas and were based on 41 years of instantaneous flood records for Station 05DB005 (1976 to 2020 with missing peaks in 1993, 1996, 2005, and 2017). The 18 June 2005 flood event at Prairie Creek with a daily mean peak of 104 m^3/s and instantaneous of 275 m^3/s is the highest flood on record but was treated as a high-outlier and removed from the analysis. This provides a more conservative estimate for the effects assessment .

Table 2.3-16: Estimated Flow Statistics

Parameters	**Proposed Discharge Location as Shown in Figure 2.3-8**		
	Tributary -West Outlet	**Mud Creek - Central Outlet**	**Mud Creek - East Outlet**
Drainage Area (km^2)	27	34	40.9
Estimated Flow (m^3/s)			
March	0.05	0.06	0.07
April	0.13	0.17	0.20
May	0.36	0.45	0.54
June	0.48	0.60	0.72
July	0.37	0.46	0.55
August	0.22	0.28	0.33
September	0.20	0.25	0.30
October	0.14	0.17	0.21
Mean open-water season	0.24	0.30	0.37
2-year flood flow	3.48	4.19	4.85
5-year flood flow	6.13	7.37	8.54
10-year flood flow	8.13	9.78	11.3
100-year flood flow	16.0	19.3	22.3



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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
LOCATION OF PROPOSED DISCHARGE POINTS FROM SEDIMENTATION PONDS AND LOCATIONS USED IN THE EFFECTS ASSESSMENT

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	JH
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
21496738	2000	0	2.3-8

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2.3.8 Water Quality

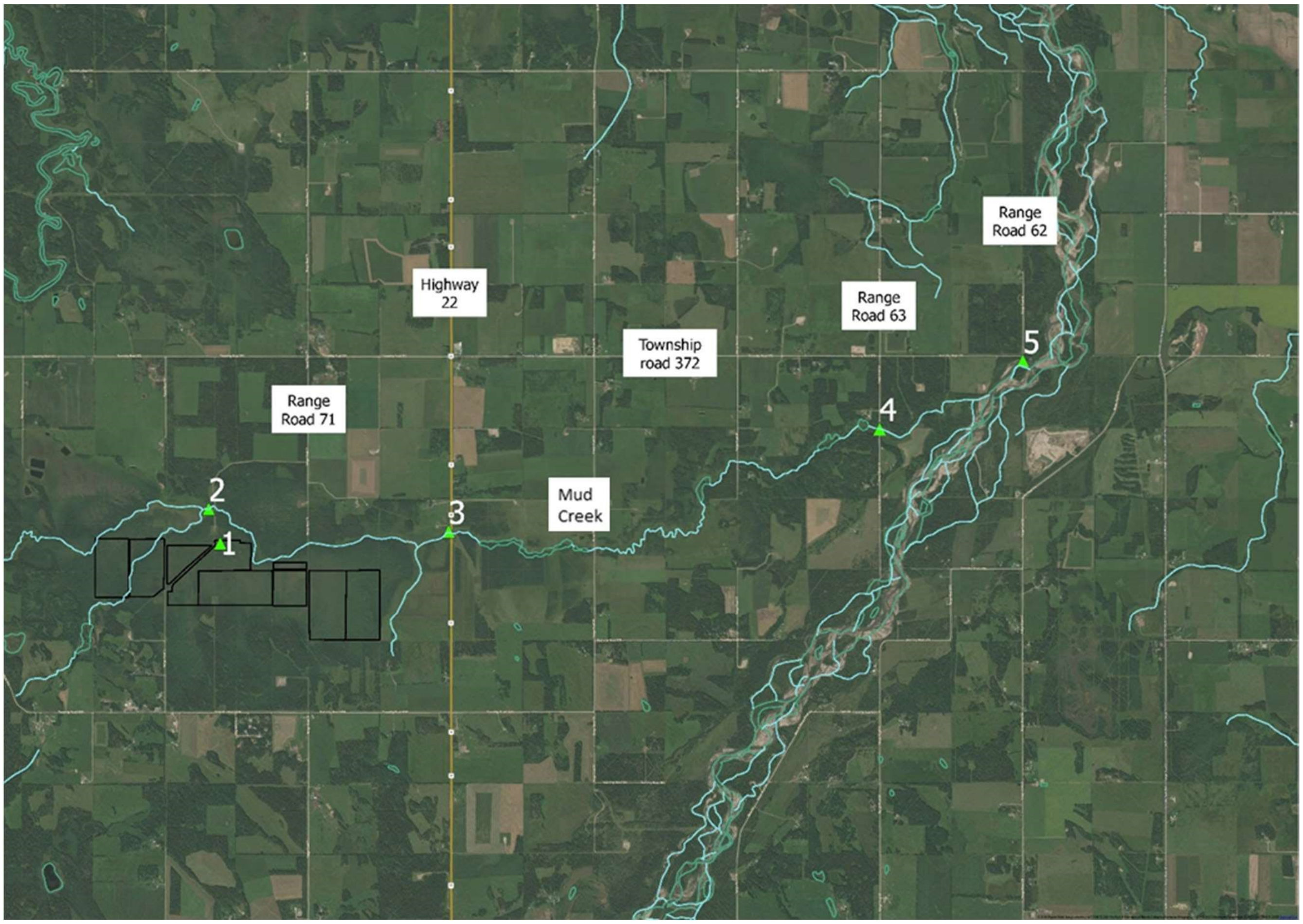
2.3.8.1 Water Quality Baseline Summary

Baseline data from March 2016 to April 2019 representing water that may be released from the Project footprint and the receiving environment have been collected from a shallow well dug within the peat in the Clearwater Project footprint station (one station; Station 1; Figure 2.3-9), and the receiving watercourse, Mud Creek (four stations; Station 2 through 5), during the spring, summer and fall. The available baseline data are reasonably comprehensive and include results from locations that will be influenced by the peat harvesting operations for all recommended parameters over multiple seasons. Some inconsistencies were noted in the monitoring of in situ physio-chemical and laboratory parameters during baseline conditions (e.g., field temperature, field pH, total metals, 5-day biological oxygen demand). A detailed assessment of the baseline water quality data is provided in Appendix D key findings from the baseline water quality data are:

- The water sampled in the Clearwater Project footprint station (Station 1) can be characterized as circumneutral to slightly alkaline (based on laboratory pH analyses), with generally moderate concentrations of TDS and soft to moderately hard water. Water in Mud Creek (Stations 2 to 5) was slightly alkaline with generally moderate concentrations of total dissolved solids (TDS) and moderately hard to very hard water. Total alkalinity concentrations at both the Clearwater Project footprint station and in Mud Creek indicate a low sensitivity to acidification.
- The dominant ions were calcium and bicarbonate at the Clearwater Project footprint station and in Mud Creek. The typical ionic relationship for these waters can generally be expressed as follows: HCO3 > Ca > Mg >> SO4 > Na > K > Cl, except for Station 5 in Mud Creek where concentrations of sulphate were similar to or higher than magnesium.
- Station 1 (Clearwater Project footprint) was relatively nutrient rich, with higher concentrations of phosphorus, nitrogen and dissolved organic carbon, compared to water in the receiving streams. Concentrations of total phosphorus (TP) were indicative of eutrophic conditions in the Clearwater Project footprint and oligo-trophic to meso-eutrophic conditions in Mud Creek.
- Metal concentrations at the Clearwater Project footprint station and in Mud Creek were typically low and below guidelines for aquatic life. Approximately 50% of the metals included in the analyses of samples collected at the five stations were detected in both total and dissolved forms; more metals were detectable at Station 1 than the receiving water stations.
- Water chemistry at Station 1 (Clearwater Project footprint station) was different compared to the chemistry of water collected from Stations 2 to 5 (receiving water of Mud Creek); the chemistry of water from the stations in Mud Creek were generally similar to each other. Station 1 had lower concentrations or values of (circumneutral) pH, TDS, hardness, and alkalinity, and higher concentrations or values of TSS, turbidity, total nitrogen (TN), TP, dissolved organic carbon (DOC) and metals relative to water sampled in Mud Creek.
- Clear and consistent seasonal patterns were generally not observed at the sampling stations. Seasonal patterns observed in the baseline data were limited to lower TDS concentrations, hardness, and alkalinity in the spring at both the Clearwater Project footprint station and in Mud Creek, likely as a consequence of dilution during the spring melt.

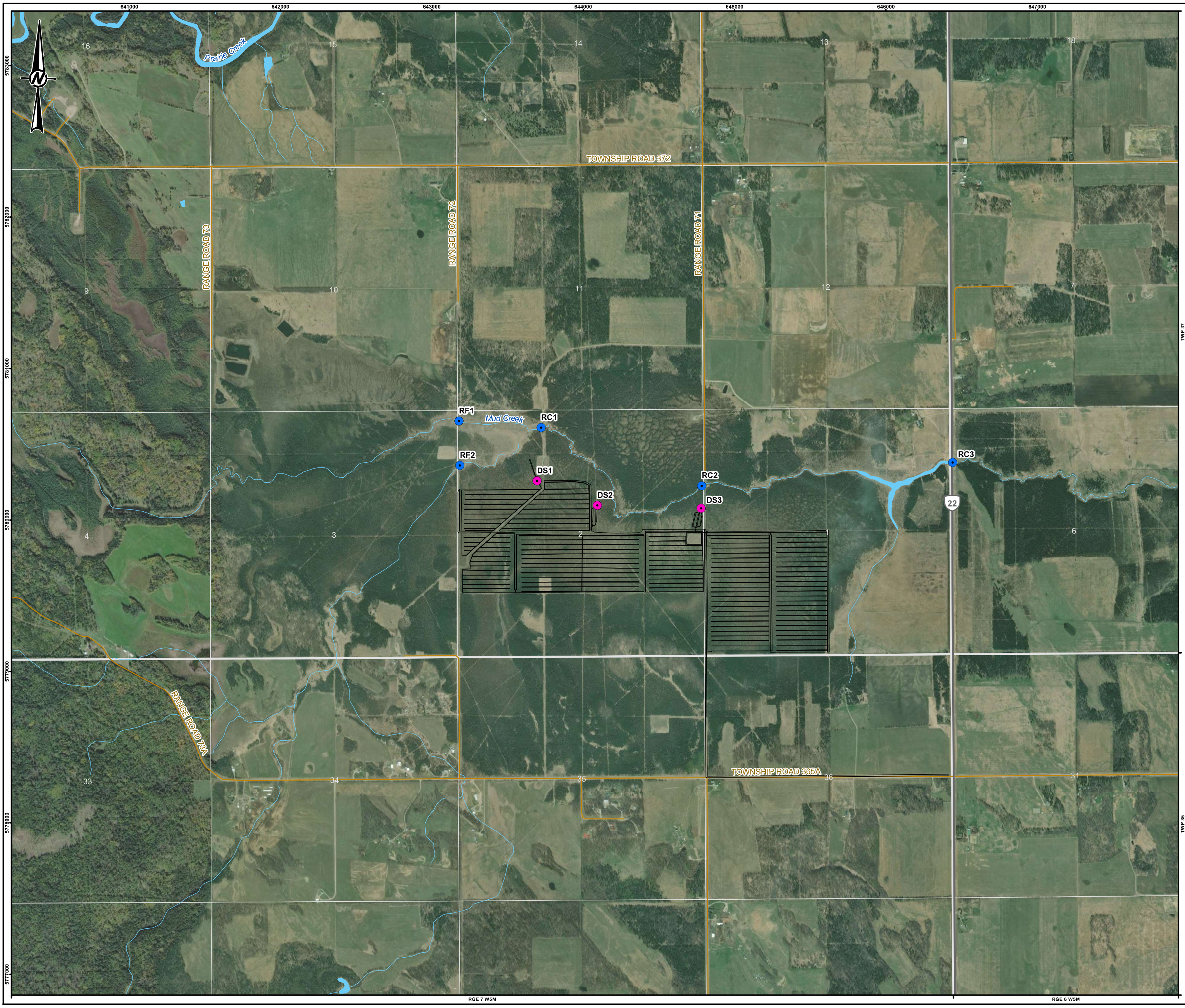
- Water chemistry results at Stations 1 to 5 occasionally exceeded Alberta or Canadian guidelines (GOA 2018b, CCME 1999) for the protection of aquatic life. Not surprisingly, more guideline exceedances and frequency of guideline exceedances at Station 1 were observed than the receiving water stations. The following exceedances in the 2016 to 2019 baseline data set were noted:
    - Station 1 (Clearwater Project footprint station): dissolved oxygen, and total aluminum, copper, iron, mercury, and zinc
    - Stations 2 to 5 (Mud Creek): dissolved oxygen, and total aluminum and iron

Monitoring will continue at two reference sampling locations upstream of the Project, four discharge sampling locations, one in each sedimentation pond, and three receiving water sampling locations downstream of the sedimentation ponds (Figure 2.3-10). The three receiving water sampling locations represent the receiving environment for drainage from the Project given the relatively small area of the Project. Additional details are outlined in the Surface Water Monitoring Plan (Appendix E).



Notes:
Green triangles = sampling locations; black lines = proposed Project footprint (including Phase 1 and Phase 2).

Figure 2.3-9: Baseline Water Sampling Locations for the Clearwater Project



LEGEND

PRIMARY HIGHWAY

LOCAL ROAD

WATERCOURSE

WATERBODY

☐ PROJECT FOOTPRINT - PHASE 1

● MUD CREEK SURFACE WATER MONITORING STATION

● SEDIMENTATION POND SURFACE WATER MONITORING STATION

DS = DISCHARGE

RC = RECEIVING

RF = REFERENCE

0 500 1,000

1:25,000 METRES

NOTE(S)

RC1 = BASELINE "CLEARWATER2"

RC3 = BASELINE "CLEARWATER3"

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT

PREMIER TECH HORTICULTURE

PROJECT

CLEARWATER PEAT HARVEST PROJECT

TITLE

LOCATION OF SURFACE WATER MONITORING STATIONS

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	SC
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
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2.3.8.2 Proposed Water Quality Monitoring

The proposed surface water monitoring plan, which includes water quality monitoring, has been designed to align with the recommendations for locations, sampling frequency, and parameters in the Guide to Surface Materials Lease Information Requirements for Peat Operations and additional guidance provided by AEP (GOA 2017, 2018b). The proposed water quality monitoring includes construction, operations, reclamation, and closure phases; supplemental baseline monitoring in the receiving water (i.e., Mud Creek) could also be collected based on the proposed monitoring framework. During the construction phase of the Project (e.g., construction of sedimentation ponds), additional construction monitoring will be completed to monitor, and mitigate where necessary, activities that could result in elevated turbidity levels (Section 2.3 in GOA 2018c).

Water quality monitoring is proposed to be completed during spring freshet, mid-summer, and fall during seasonal low flow conditions at two reference stations and three receiving water stations in Mud Creek, and three sedimentation pond (i.e., discharge) stations (Figure 2.3-10). Field measurements for pH, conductivity, dissolved oxygen, and specific conductivity and water samples for conventional parameters, major ions, nutrients, and total and dissolved metals will be collected. Water samples collected in the field and quality control samples will be sent to an analytical laboratory accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for analyses. Continuous measurements of temperature during open-water conditions will be collected at the same stations where water quality samples are collected. Monitoring field work, and the assessment and reporting of the data collected during monitoring, will follow standard quality assurance/quality control (QA/QC) procedures as described in Appendix E.

Continuous measurements of temperature and total suspended solids (TSS), or turbidity, which is an indicator/surrogate of TSS, will be collected during open-water conditions at sedimentation pond discharge stations. These results will be compared to expected discharge conditions from the sedimentation ponds and will be used to assess whether the ponds are functioning as designed. Monthly reports will be prepared to compare results of TSS monitoring at the sedimentation pond discharge stations to a threshold of 50 mg/L, which is expected to be both feasible to achieve and protective of Mud Creek. If this threshold is exceeded, follow-up actions, such as inspection of the sedimentation ponds or additional TSS monitoring in Mud Creek, will be taken (see Appendix E for details).

Annual reports will also be prepared that include relevant annual statistical summaries of water quality data, including comparisons to water guidelines (e.g., Alberta water quality guidelines for aquatic life), and data plots. If potential adverse effects to water quality from the Project are identified in the annual reports, determined by guideline exceedances and frequency of exceedances and/or increasing concentrations trends (where applicable), recommendations for appropriate mitigation and additional monitoring will be provided. After five years, a more detailed assessment will be completed to evaluate whether monitoring should be reduced (e.g., if minimal impacts are observed) or expanded (e.g., if adverse impacts require additional monitoring), as described in GOA (2018c). Additional details regarding the proposed water quality monitoring are provided in Appendix E.

2.3.9 Social, Cultural and Land Use

2.3.9.1 Methods

A desktop review was conducted to collect baseline information for the Social and Cultural Study Area and the land use LSA. The following data sources were reviewed:

- Publicly available information from the Government of Alberta
- Satellite imagery from Google Earth

- County of Clearview
- Statistics Canada Census of Population Profiles and Aboriginal Population Profiles (Statistics Canada 2017a-c, 2018)

2.3.9.2 Results

Social and Cultural Setting

The Project is located in Clearwater County, with the closest community, Chedderville, located approximately 3.4 km northeast. Table 2.3-17 presents the population data for the Socio-Economic Study Area (SSA) communities, communities nearest the Project located along the most likely transportation corridor from the Project to the peat processing plant in Olds, Alberta (i.e., the most likely sources of contracted labour). Rocky Mountain House is the nearest hub, located approximately 26 km northeast of the Project. Population for the smaller SSA communities such as Chedderville and Ricinus are included in Clearwater County's population count.

Between 2011 and 2016, the majority of the SSA communities experienced a population decline with the exception of the Village of Caroline and Sunchild Crow Indian Reserve #202. Rocky Mountain House had the largest population decline, with a decrease of 4.3%. The population decline in the majority of SSA communities was in contrast to the growth experienced at the provincial level, where the overall provincial population increased by 11.6% during this period (Statistics Canada 2012a-d, 2017a-d). Population growth in the closest Indian Reserve, Sunchild Cree Indian Reserve #202, was more robust, increasing by 14.5% (Statistics Canada 2013, 2018). Based on satellite imagery, two residences are located within the southern portion of the Land Use LSA by the access route along Township Road 365A (Google Earth 2020).

Table 2.3-17: Population Data for the Socio-Economic Study Area Communities

Community	Approximate Distance to the Project	Population (2011)	Population (2016)	% Change (2011 to 2016)
Chedderville	2 km northeast	n/a	n/a	n/a
Ricinus	5 km southwest	n/a	n/a	n/a
Caroline	12 km southeast	501	512	2.2%
Innisfail	65 km southeast	7,876	7,847	-0.4%
Bowden	75 km southeast	1,241	1,240	-0.1%
Rocky Mountain House	26 km northwest	6,933	6,635	-4.3%
Sunchild Cree Indian Reserve #202	60 km northwest	655	750	14.5%
Clearwater County (Municipal District)	n/a	12,278	11,947	-2.7%
Alberta	n/a	3,645,257	4,067,175	11.6%

km = kilometres; n/a = Data was not available.

Source: Statistic Canada 2012a-e, 2013, 2017a-e, 2018

Land Use

The Project is located entirely within Crown Land and within the White Area of Alberta.

Non-Renewable Resource Use

The Land Use LSA overlaps with one discontinued High Press Pipeline (owned by Cenovus Energy Inc) and a few oil and gas facilities (operated by NAL Resources Management Ltd) (AEP 2020a).

Agriculture

No agricultural dispositions were found within the Land Use LSA (AEP 2020). A review of satellite imagery indicates that the southern portion of the Project (the access road), overlaps with agricultural land (Google Earth 2020).

Parks, Protected Areas, and Recreation Areas

No parks or protected areas are located within the Land Use LSA. The southern edge of the Land Use RSA overlaps with the Clearwater Ricinus Recreation Area (AEP 2020a). Various types of recreational activity are allowed on vacant public land (land that has no formal approvals connected to it for other activities such as agriculture, oil and gas development or mining) (GOA 2020). Information on snowmobiling and ATV use in the Land Use LSA was not available but they may occur given that the Project occurs on Crown land and the presence of cutlines.

Forestry

The Land Use LSA does not overlap with any Forestry Management Areas (AEP 2020a). A review of the satellite imagery indicates that the vast majority of the Project Land Use LSA is a wooded or shrubby fen which is not suitable as merchantable timber. Additional information on the type of forested vegetation is provided in Section 2.3.2.

Hunting, Trapping and Fishing

The Province of Alberta is divided into a series of Wildlife Management Units (WMU). Wildlife within the boundaries of each WMU is managed by the AEP according to the regulations established in Alberta's Wildlife Act. The Land Use LSA is located within WMU 324 (AEP 2020a). Hunting season for all game species in WMU 324 (with the exception of black bear and cougar) occurs between September 1 to November 30 (GOA 2019a). Commonly hunted species include white-tailed deer, mule deer, moose, and elk. The black bear hunting season takes place between September 1 to October 31 and April 1 to June 15. The cougar hunting season takes place between December 1 to the end of February the following year. Alberta hunting regulations require permission before entering or crossing privately owned land, First Nation reserves, Métis settlements, and public land under agricultural or grazing lease. Recreational foot access is generally accepted on public land (Government of Alberta 2019).

Registered Fur Management Areas (RFMAs) identify the locations where trapping occurs. The Land Use LSA overlaps with RFMA 2113, located within Fur Management Zone 4 (AEP 2020, GOA 2019b). Trapping season for this zone occurs between October 1 to May 15 of the following year (Government of Alberta 2019b). Commonly trapped species in Fur Management Zone 4 include badger, beaver, coyote, fisher, fox, lynx, marten, mink, muskrat, otter, squirrel, weasel, wolf, and wolverine.

The Land Use LSA overlaps Mud Creek and an Unnamed Tributary to Mud Creek (AEP 2020a). Recreational sport fishing may occur in these watercourses, however rearing and spawning habitat was assessed as low for sport fish in the surveyed area (refer to Section 2.3.4.2). The Land Use LSA falls within the ES2 Watershed Unit and Zone 2 (Parkland-Prairie Zone). Sport fishing within streams is allowed between April 1 to October 31(GOA 2019c).

Visual Aesthetics

The dominant viewscape in the land use LSA is wooded areas with some clearings, well sites, cutlines and access roads (AEP 2020). Adjacent to the southern access route are open agricultural fields along Township Road 365A. The pipeline within the Land Use LSA is not a visible component of the landscape since they are primarily underground. A review of satellite imagery indicates that there are two residences located in the southern portion of the Land Use LSA, adjacent to the access route along Township Road 365A (Google Earth 2020).

Infrastructure and Services

Traffic Volumes

Access to the Project would use Provincial Highway 22 and Township Road 365A. Premier Tech is expected to transport peat along Township Road 365A, Highways 22, 54, 587, and 2A or 22, 27 and 2A towards the peat processing plant in Olds, Alberta. Table 2.3-18 presents the average annual daily traffic for traffic entering and exiting key points along the expected Project transportation corridor (traffic to and from the Project footprint to the processing centre in Olds, Alberta). Data for Township Road 365A was not available. Traffic volumes along these routes are relatively low and have been generally declining over recent years (Cornerstone Solutions 2020).

Table 2.3-18: Average Annual Daily Traffic for Transportation Corridor Likely Used for the Project

Location Description	2015	2017	2019	% Change
Highway 22, South of 54 East of Caroline	2,190	2,110	1,940	-11.4%
Highway 22, north of 54 East of Caroline	2,490	2,160	2,120	-14.9%
Highway 54, East of 22 and 591 West of Caroline	2,540	2,420	2,380	-6.3%
Highway 54, West of 22 East of Caroline	3,030	2,830	2,680	-11.6%
Highway 54, East of 22 East of Caroline	1,960	1,800	1,740	-11.2%
Highway 587, West of 2A Bowden	1,670	1,580	1,650	-1.2%
Highway 587 East of 2 and 2A East of Bowden	750	750	1,050	40.0%
Highway 2A South of 27 at Olds	7,160	6,930	6,420	-10.3%
Highway 2A North of 27 at Olds	4,740	4,610	5,060	6.8%

Source: Cornerstone Solutions 2020.

Emergency and Protective Services

Emergency services are provided by Clearwater Regional Fire Rescue Services (Clearwater County 2020a). The nearest fire hall, Clearwater Regional Station 30, is located in the Village of Caroline. Protective services are provided by the Royal Canadian Mountain Police, with detachments in Rocky Mountain House, Sundre, Rimbey and Innisfail (Clearwater County 2020b).

Labour Force Characteristics

In 2016, labour force participation rates at the county level and in the larger communities were near the provincial average (71.8%). Based on the 2016 Statistics Canada census, Rocky Mountain House had the highest participation rate (71.0%) of the SSA communities (Statistics Canada 2017a-e). Participation rates for the smaller communities (i.e., Caroline, Innisfail, Bowden) were lower at around 64%. Unemployment rates were also higher than the provincial average (9.0%) for these smaller communities (Table 2.3-19). Unemployment rates for Sunchild Cree Indian Reserve #202 was lower than these large communities at 24.4%, due to their lower participation rate (46.9%) (Statistics Canada 2018a).

Table 2.3-19: Labour Force Activity in 2016 in the Socio-Economic Study Area

Community	Population Aged 15 +	Labour Force	Employed	Unemployed	Participation Rate (%)	Unemployment Rate (%)
Caroline	465	295	260	40	63.4	13.6
Innisfail	6,200	3,980	3,620	365	64.2	9.2
Bowden	1,010	650	545	100	64.4	15.4
Rocky Mountain House	5,060	3,595	3,135	455	71.0	12.7
Sunchild Cree Indian Reserve #202	480	225	165	55	46.9	24.4
Clearwater County(a)	9,575	6,600	5,820	780	68.9	11.8
Alberta	3,206,050	2,302,945	2,096,105	206,835	71.8	9.0

(a) Includes SSA communities of Chedderville and Ricinus.

Source: Statistics Canada 2017a-e, 2018.

Economy

Clearwater County’s top industries are resource based, primarily in mining, quarrying, oil and gas extraction; agriculture, forestry, fishing and hunting; and construction (Statistics Canada 2017a). In 2019, Clearwater County had over 1,000 people employed in construction and transportation related occupations and around 1,800 in occupations in natural resources, agriculture and related production occupations (Clearwater County 2019). Similarly, construction is a major industry in the SSA communities of Innisfail, Bowden, Rock Mountain House, Caroline (Statistics Canada 2017b-e).

2.3.10 Consultation

Consultation for the Project has been ongoing since November 2010. Premier Tech is committed to actively engaging with all stakeholders on the Project including individual landowners, AEP and the rural municipality of Clearwater County. A public notice for the application was initially submitted as required by the *Water Act*. An open house was organized on December 6, 2010 as part of the Development Permit application with Clearwater County. Various SIRs and statement of concerns (SOCs) from stakeholders and AEP were raised during the consultation process including:

- the long-term water quality and quantity of Mud Creek
- the impact to groundwater and the surrounding area
- the impact of surface water source and water quality in Mud Creek
- if Premier Tech would be submitting a water quality monitoring program
- how drainage affect Mud Creek and adjacent landowners
- dust control on local roads
- how operations will impact the environment

Premier Tech reviewed and responded to all concerns and questions from the public notice and open house from 2010.

An updated *Water Act* application was submitted in 2018, and a corresponding public notice was published in June 2018. Premier Tech received nine SOCs and is in the process of working with landowners, stakeholders and AEP to address all concerns.

Premier Tech is currently engaging with Clearwater County to update the Development Permit for the Project. Following approval of the Project by AEP, a second open house will be conducted in conjunction with the renewed development permit application.

Premier Tech is committed to engaging with First Nations and Indigenous consultation is in the early planning stages. Premier Tech will work with the Alberta Aboriginal Consultation Office (ACO) following the submission of this application. The ACO will provide a determination on whether consultation is triggered, with which groups and the level of consultation that is expected. Typically, for proponents seeking a *Water Act* approval for a project that is regulated by AEP, guidance from the ACO (https://www.alberta.ca/proponent-led-indigenous-consultations.aspx) states that the proponent should apply directly to the AEP, who will then work with the ACO to determine the consultation requirements.

3.0 PEAT DEVELOPMENT AND OPERATIONS PLAN

3.1 Site Description and Operational Layout

General Operational Layout

A description of the Project and operational layout is presented in Section 2.1.1.

Summary of Exploration Work

Premier Tech completed initial peat exploration work in 2008 to determine peat type (i.e., Von-post and pH) and depth for the Clearwater Project. A total of 12 of points were collected, ranging in depths from 150 m to 250 m. Based on the preliminary results, the Clearwater site was determined to be viable for peat harvest.

Premier Tech completed supplemental exploratory work in 2017. A total of 42 points were collected to describe peat type and depth. Soil point depths ranged from 100 m to 400 m.

Golder completed additional soil surveys in 2020 and 2021. A total of 42 soil points were sampled up to a maximum of 220 m or mineral soil as required by *Guide to Surface Materials Lease Information Requirements for Peat Operations* (GOA 2017).

A full summary of peat sampling data collected to date is in Appendix A.

Detailed Description of the Peatland Profile

The Clearwater Project fen is approximately 7.5 km in length (east/west) and 2.5 km in width (north/south) extending from 16-37-7-W5M where peat thickness appears to be shallower based on vegetation in published satellite imagery, to 6-37-6-W5M east of Highway 22 where the same vegetation as in the northwest indicates peat may be shallower. The entire extent of the fen is approximately 1,100 ha based on visual boundaries using satellite imagery. The deepest part of the fen has 4 m of peat accumulation and is found in the main harvesting areas west of highway 22. Drainages (Mud Creek and an unnamed tributary of Mud Creek in the southwest part of the fen) generally have mineral soil at the surface but thick peat is found only a short distance from the edge of these drainages. Peat decomposition between the depth of 20 cm and 250 cm is dominantly moderately decomposed (H5).

Details of the soil survey and peat profiles are described in Section 2.3.3 and results are outlined in Appendix A. Cross sections of the peat profile are presented in Appendix B.

Assessment of the Extractable Peat Resource

A breakdown of peat volume by harvest section is presented in Table 3.1-1. The total estimated volume of peat for Phase 1 of the Project is 3,899,560 m^3 (Table 3.1-1). When accounting for 40 cm of shrinkage and 100 cm of residual peat, the total harvestable volume of peat for Phase 1 is estimated at 1,797,856 m^3 (Table 3.1-1).

Table 3.1-1: Peat Volume Estimate

Harvest Section	Parameter	Value
Harvest Section Year 1	Average peat depth (cm)	276
	Peat area (ha)	46
	Volume of peat (Initial) m^3	1,280,730
	Total Volume (Harvestable) m^3	**607,771**
Harvest Section Year 2	Average peat depth (cm)	216
	Peat area (ha)	29
	Volume of peat (Initial) m^3	630,806
	Total Volume (Harvestable) m^3	**183,189**
Harvest Section Year 3	Average peat depth (cm)	269
	Peat area (ha)	32
	Volume of peat (Initial) m^3	855,098
	Total Volume (Harvestable) m^3	**396,535**
Harvest Section Year 4	Average peat depth (cm)	284
	Peat area (ha)	25
	Volume of peat (Initial) m^3	695,848
	Total Volume (Harvestable) m^3	**338,124**
Harvest Section Year 5	Average peat depth (cm)	375
	Peat area (ha)	12
	Volume of peat (Initial) m^3	437,078
	Total Volume (Harvestable) m^3	**272,273**
Total	**Volume of peat (Initial) m^3**	**3,899,560**
	Total Volume (Harvestable) m^3	**1,797,856**

3.2 Active Operations

3.2.1 Description of Proposed Peat Activities

A description of the Project and proposed peat activities is presented in Section 2.1.1. The proposed Project footprint and development plan are provided in Figure 2.1-2 and Figure 2.1-3.

3.2.2 Schedule of Operations

A description of the proposed Schedule is presented in Section 2.1.2.

3.2.3 Water Management Systems and Monitoring Plan

Ditch and Sediment Pond Construction

During the harvesting phase of the Project, drainage of water stored in the peatland will be facilitated using lateral or cross drainage ditches draining into perimeter ditches. The five harvest areas to be drained vary in size from about 11 ha for Harvest Area 5 to 44 ha for Harvest Area 1. The total peat harvest area is 135.9 ha, and total drainage ditch area is 7.3 ha. Construction of sedimentation ponds and the drainage network for the harvest areas is planned for the winter months, and sequencing of construction is provided in Section 2.1.2.

The five harvest areas will be divided into domed-shaped fields divided by secondary drainages. The harvest area is drained by multiple secondary field ditches dividing each peat harvest section. Secondary field ditches are V-shaped, with a top width of approximately 1.5 m, total depth of 1.5 m, and a bottom width of 0.3 m. Secondary ditches connect to larger perimeter ditches surrounding the harvested sections of the Project. Perimeter ditches are deeper (i.e., 1.5 to 2 m) allowing water to evacuate from the harvested areas to sedimentation ponds. Sedimentation ponds will be constructed, built and maintained to meet requirements.

Specific requirements for the sedimentation pond design are not provided in both *Guide to Surface Materials Lease Information Requirements for Peat Operations* (GOA 2017) and *Requirements for Conservation and Reclamation Plans for Peat Operations in Alberta* (GOA 2016). Hence, the sedimentation pond design specifications are based on the Guidelines for Peat Mining Operations in New Brunswick, because this is the main document regarding peat harvesting operation guidelines in Canada where Premier Tech has an operation. This relevant information from this document is summarized below:

> *The mining of peat releases variable quantities of loose peat sediment that can be transported along the drainage ditches and deposited outside the operation site into neighbouring water bodies such as streams or marine embayments. Depending on local conditions, two methods are available to minimize the risk of discharging excessive quantities of peat particles in the environment.*
>
> *Overland flow is the preferred method because it effectively captures peat solids and reduces the nutrient load in the water through uptake by the vegetation. When used as receiving areas for drainage waters, wetlands covered by vegetation can remove up to 80% of solids, 15% of dissolved organic matter, 70% of nitrogen compounds and 75% of phosphorus (Selin, 1996). Drainage ditches are terminated in a flat area leaving a buffer zone of undisturbed wetland between the ditches and any receiving bodies of water.*
>
> *Where land constraints (topography, ownership, etc.) does not permit use of the overland flow method, sedimentation basins must be constructed to allow the peat particles to settle. The effectiveness of this method has been demonstrated (Gemtec Ltd, 1993) but it is conditional on regular monitoring of the basins and close adherence to a maintenance schedule".*

Premier Tech is planning to use the above-mentioned guidelines for the design of the sedimentation ponds. The relevant specifications of the above-mentioned guidelines are listed below:

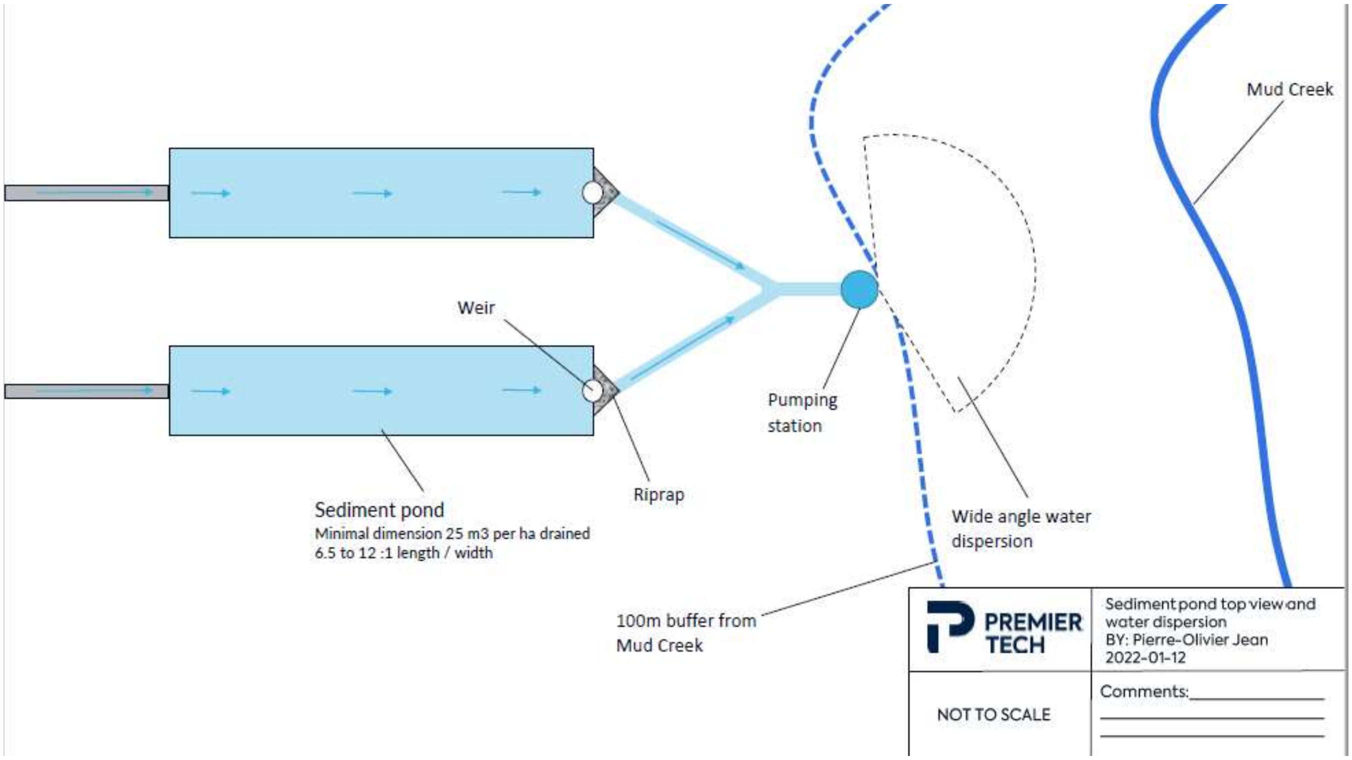
- Minimum sedimentation pond volume was calculated on the basis of 25 m^3 per hectare of peatland area drained. This may be achieved by constructing one or multiple ponds depending on the size of the area to be drained.
- The optimum length/width ratio of a sedimentation pond is in the range of 6.5:1 to 12:1.

Sedimentation ponds are designed to prevent organic matter (i.e., peat dust) from entering the watercourses and allow the timing and rate of discharge to be controlled. The volume of the sedimentation pond is proportional to the area from which water is drained. A summary of the size of sedimentation ponds by harvest section is outlined in Table 3.2-1 below. A figure of a typical sedimentation pond is outlined in Table 3.2-1.

Table 3.2-1: Summary of Sedimentation Ponds for the Clearwater Project

Pond Number and Associated Outlet Ditch	Length (m)	Top Width (m)	Bottom Width (m)	Depth (m)	Harvest areas drained
1 (East Outlet)	83	7	3	2	Areas 1 & 2
2 (East Outlet)	83	7	3	2	Areas 1 & 2
3 (East Outlet)	62	7	3	2	Areas 1 & 2
4 (Central Outlet)	83	7	3	2	Area 3
5 (Central Outlet)	83	7	3	2	Area 4
6 (West Outlet)	45	7	3	2	Area 5

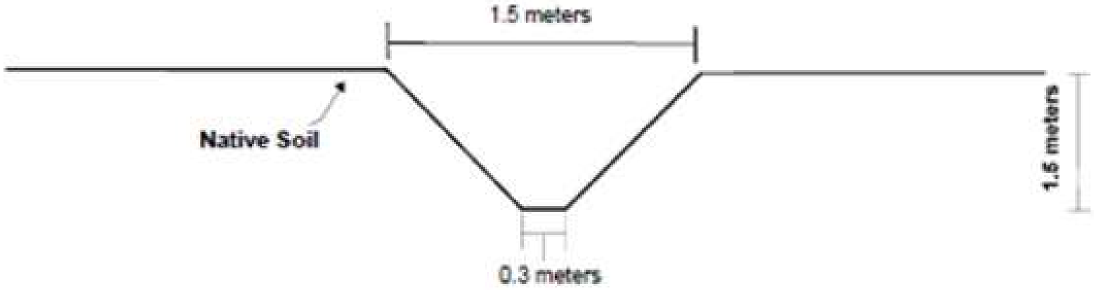
Figure 3.2-1: Typical Sedimentation Pond



Cross Section of Ditches

A typical cross section of ditch is shown in Figure 3.2-2.

Figure 3.2-2: Cross Section of a Typical Ditch



Method of Water Release

The flows from the drainage network will be routed through sedimentation ponds and drain via channels to pumping stations at three outlet locations (Figure 3.2-1). The outlet channels at the pumping locations will be located outside the 100 m setback from the local watercourses as follows:

- The East Outlet drains water from the Harvest Areas 1 and 2 and is located the furthest downstream in the Mud Creek watershed.
- The Central Outlet drains water from Harvest Areas 3 and 4 and is further upstream/west along Mud Creek than the East Outlet.
- The West Outlet drains water from Harvest Area 5 and is located on the east side of the unnamed tributary near its confluence with Mud Creek.

Water collected at the outlet channels will be pumped to the peat surface and dispersed as shown in Figure 3.2-1.

Rates of Discharge

Discharge of water will be required during construction and operations. The proposed drainage ditches and sedimentation ponds will be constructed during the winter months once the peat is sufficiently frozen to support the weight of heavy equipment. Construction of sedimentation ponds will occur first, and dewatering of saturated peat will be required. Water will be pumped during pond construction to the peat surface and the 100 m setback from the watercourses will be maintained. The discharge of water may slightly increase flows in the adjacent watercourses; the calculated rate of discharge assumed to occur over one week per pond varied from 0.0005 m^3/s for Pond 6 (the smallest pond) to 0.0009 m^3/s for the larger ponds; details are provided in Section 3.3.5.

Water that collects in the newly constructed ditches would be routed through the sedimentation ponds and released the following spring using the methods described above. It was assumed the ditch networks would be initially full of water, and estimated discharge rates considered that pumping at each of the outlet locations (once developed) would be ongoing for a period of a week in May until ditch water levels were reduced by 0.75 m. The calculated rate of discharge assumed to occur over one week per outlet location varied from 0.0058 m^3/s for the West Outlet (with the smallest harvest and ditch network area) to 0.0232 m^3/s for the East Outlet (with the largest harvest and ditch network area). Releases from each outlet location shown in Figure 2.3-8 will be staggered by one week which will reduce the flow rate to the receiving environment. Discharge water will be pumped to the peat surface and dispersed over the vegetated buffer.

Peat harvesting activities will require ongoing collection of water in ditches and sedimentation ponds and releases will be ongoing releases during the open water period during operations. During regular operations during the open-water period, the average discharge is estimated to be up to 0.0029 m^3/s which accounts for the water yield from peat harvesting activities; details of calculations and predicted changes in flows for the outlet locations used for effects assessment are provided in Section 3.3.5.

Maintenance and Control of Drainage Works

Deposited sediments in the ditches will be cleaned and disposed on the harvesting fields where they will be harvested later on. If the depth of ditches is too deep so that the sediments may be mixed with the peat, the sediments are spread on the opposite side of the ditch where no harvesting is occurring. The sediments will be filtered by the vegetation and a small berm will be constructed to prevent the sediments from returning into the ditches.

The same approach will be followed for maintaining the sedimentation ponds. The sediments will be spread on the sides of the ponds and a mount will be provided to prevent them from returning into the ponds.

The cleaning of the ditches can occur after heavy wind, after large rainstorm events, and when necessary. If not required during the harvesting season, the cleaning will be done during fall when harvesting is over. The guidelines for Peat Mining Operations in New Brunswick state that sedimentation ponds must be cleaned periodically so that the peat accumulation does not exceed 50% and preferably 25% of total pond volume. The drainage ponds should be cleaned anytime they reach 50% capacity or a minimum of once a year. Sediments will be removed using a manure pump or an excavator. The sediment will be set aside at a sufficient distance from the sedimentation pond bank to prevent the sediments to be channeled back into the pond in case of severe rainfall.

Water Quality Changes

Changes to water quality in Mud Creek and its unnamed tributary due to the Project discharge are expected to be negligible based on the small predicted increases in flows, an undisturbed vegetated buffer of at least 100 m to meet water quality objectives through which discharges from the sedimentation ponds (at outlet locations) will occur, the application of thresholds at the sedimentation pond outlet locations, and the adaptive management proposed in the Surface Water Monitoring Plan for the Project (Appendix E). Concerns related to changes in total suspended solids (TSS) and pH, and thermal impacts to aquatic biota, in Mud Creek were raised during the regulatory review process; additional information has been provided for each of these parameters.

Comparisons of TSS concentrations in discharges from the sedimentation ponds will be compared to a proposed threshold for TSS at the outlet of the sedimentation ponds of 50 mg/L (Section 2.3.8.2 and Appendix E). This proposed threshold is expected to be achievable under typical operating conditions and maintain protection of Mud Creek and its unnamed tributary during discharge. Concentrations of TSS in the sedimentation pond discharges will be 50 mg/L or less based on the expected performance of the sedimentation ponds (BC MOE 2015). The proposed threshold of 50 mg/L at the outlet of the sedimentation ponds is expected to be protective of Mud Creek based on the expected removal of TSS mg/L through a minimum of a 30 m vegetated buffer (which will be 100 m for this Project) with a slope less than 5% between the sedimentation outlet and Mud Creek. The average removal efficiency for TSS for a 10 to 20 m vegetative strip with a slope of less than 5% is expected to be

65% (AEP 1999). A 65% reduction of the maximum expected TSS concentrations of 50 mg/L at the sedimentation pond outlets would result in concentrations of water from the sediment ponds entering Mud Creek at less than 20 mg/L. After this water mixes with Mud Creek (and the unnamed tributary), the resulting concentrations are expected to remain well below Alberta surface water guidelines for TSS[1] (GOA 2018b) based on the expected increases in flows due to the Project (i.e., a predicted maximum flow increase of 2.1% during the construction and operations period).

Water in the sedimentation ponds and outlet locations may be warmer than the watercourses, particularly during the summer months; however, thermal effects to aquatic life the watercourses from the Project are not expected because:

- Increases in temperature in the watercourses from the Project are expected to be negligible due to relatively small additions of Project-related flows. The maximum predicted increase in downstream flows was 2.1% in October and predicted flow increases were up to 1.3% during warmer weather months of July and August (Table 3.3-6).
- The shallow and narrow nature of the channels and lack of suitable spawning habitat identified during the fish habitat survey indicate the watercourses are unlikely to have thermally sensitive receptors (i.e., incubating eggs or larval bull trout).

No direct discharges from the three outlet locations to watercourses will occur, which provides additional confidence that thermal changes in the watercourses will be negligible as a result of the Project. Continuous monitoring of temperatures has been proposed in Mud Creek and its unnamed tributary from May to October upstream of the Project, within reaches where Project discharges from the sedimentation ponds and outlet locations may occur, and downstream of the Project (Section 2.3.8.2 and Appendix E). Temperature data from these locations will be assessed and reported annually describing seasonal and spatial changes in temperature, and identifying any potential changes in temperature in watercourses due to the Project.

If annual reporting of temperature data indicates that the Project may be causing temperature changes in Mud Creek at the proposed monitored stations downstream of the Project, Premier Tech will develop and include the following in an updated surface monitoring program:

- in-stream temperature thresholds to protect aquatic biota in Mud Creek and its unnamed tributary
- potential responses to mitigate thermal effects from the Project if thresholds are exceeded

Waters than drain from peat harvesting areas may have a pH that is lower than neutral; however, changes in pH from the Project that have the potential to effect aquatic life in Mud Creek are not expected because:

- Values of pH in Mud Creek (7.9 to 8.4; Tables 1b to e in Attachment 1 of Appendix D) are within the Government of Alberta guideline range for pH (6.5 to 9; GOA 2018b) and changes in pH in Mud Creek from the Project are expected to be negligible due to relatively small addition of flows to Mud Creek related to the Project. The maximum predicted increase in flows to downstream watercourses was 2.1% in October and the range in predicted increases in flows was less than this during other months when discharge could occur during operations (i.e., May to September; Table 3.3-6).

---

[1] Maximum increase of 25 mg/L from background for any short-term exposure (e.g. 24-h period). Maximum average increase of 5 mg/L from background levels for longer term exposures (greater than 24 h). Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L during high flows.

- Total alkalinity concentrations in Mud Creek (170 to 320 mg/L; Tables 1b to e in Attachment 1 of Appendix D) are higher than the minimum Government of Alberta guideline for protection of aquatic life (20 mg/L; GOA 2018b) and indicate a low sensitivity to acidification (University of Massachusetts Amherst 2020, McNeely et al. 1979). The high alkalinity in Mud Creek is expected to provide sufficient buffering capacity to prevent changes in pH outside the Government of Alberta guideline range due to discharges from the Project that may be more acidic relative to Mud Creek.

Water Monitoring and Reporting Commitments

Water quantity and quality monitoring will be collected as per the proposed Surface Water Monitoring Plan for the Project. Golder prepared a report to describe the proposed surface water monitoring plan to be conducted by Premier Tech during construction, operation and reclamation of the Project (Appendix E). The monitoring plan includes a sampling plan for water quality (temperature and TSS) and flows in Mud Creek.

The water management systems will be operated and maintained to meet the environmental management objectives. For example, if the outflow TSS concentration does not meet the release threshold, the outflow could be temporarily pumped to the natural or reclaimed fen areas for storage and gradual release to the receiving environment or halted until TSS levels return to a concentration below the threshold.

Closure and Drainage Plan

The proposed closure plan is to reclaim the Project site to a state where it will look and function like a natural peatland. The site will be reclaimed using the techniques stated in the Peatland Restoration Guide (2nd Edition by Quinty and Rocherfort 2003). Reclamation post peat fen harvesting has been completed in numerous project sites belonging to Premier Tech such as the site near Giroux, Manitoba (Photo 3.2-2) or the site near Bic St-Fabien, Quebec. The methods stated in the guide have been successfully applied at several other Premier Tech sites in Alberta since 2015. The techniques applied to Premier Tech's existing sites will help to ensure that reclamation techniques will be working properly for the proposed Project.

Reclamation will be undertaken within three years after closure of each harvesting section. The three-year period is required to ensure reclamation is completed under proper weather conditions. Rain is required for reclamation, but too much rain will result in flooding and reclamation will not be successful. In addition, dry temperature will not provide sufficient moisture and no restoration can be properly done under such weather conditions.

All shallow secondary ditches will be filled using a large leveller (Photo 3.2-3). The leveller removes the dome shape from the fields and moves peat into the ditches, resulting in a fresh, flat surface.

Main ditches will be blocked and filled with previously excavated material. Culverts will be removed and recycled. An excavator will be used to put the dredged spoil back into the main ditch. Using a small bulldozer, the topography between the non-impacted buffer and the depleted peat fields will be smoothed to a 1:20 slope. The objective is to re-establish the connectivity between the natural buffer area and the restored peat fields.

Where smooth slope remains, berms will be added for vegetation re-establishment and water retention (Photo 3.2-4). The berms are erected perpendicular to the slope.

Sedimentation ponds will be filled with dredged spoil from regular cleanings. An excavator and small bulldozer will be used to fill the ponds.

A Conservation and Reclamation Plan has been developed for the Project as per the AEP *Requirements for Conservation and Reclamation Plans for Peat Operations* (GOA 2016). A final restoration map and drainage plan is shown in Figure 3.2-3. An example of a revegetated site is presented in Photo 3.2-4. All drainage systems will be removed once operations are complete. The main target plant community after donor material re-introduction is a wooded coniferous fen. Premier Tech is anticipating that black spruce and tamarack will successfully colonize the Project footprint. The proposed collection sites for donor areas are provided in Figure 3.2-4. Collection area have been identified in wooded coniferous fen and shrubby fen wetland types within the Project lease (Figure 3.2-4). To meet the donor area requirement ratio of 1:10, a total of 15.2 ha of donor material is required. Premier Tech has identified 16 ha of collection sites suitable for donor material. More specific details about the collection of donor material is outlined in the Conservation and Reclamation Plan (Golder 2022). Premier Tech anticipates that stem density will be higher along former roads because the surface topography should be slightly higher than the restored peat fields.

Photo provided by Premier Tech

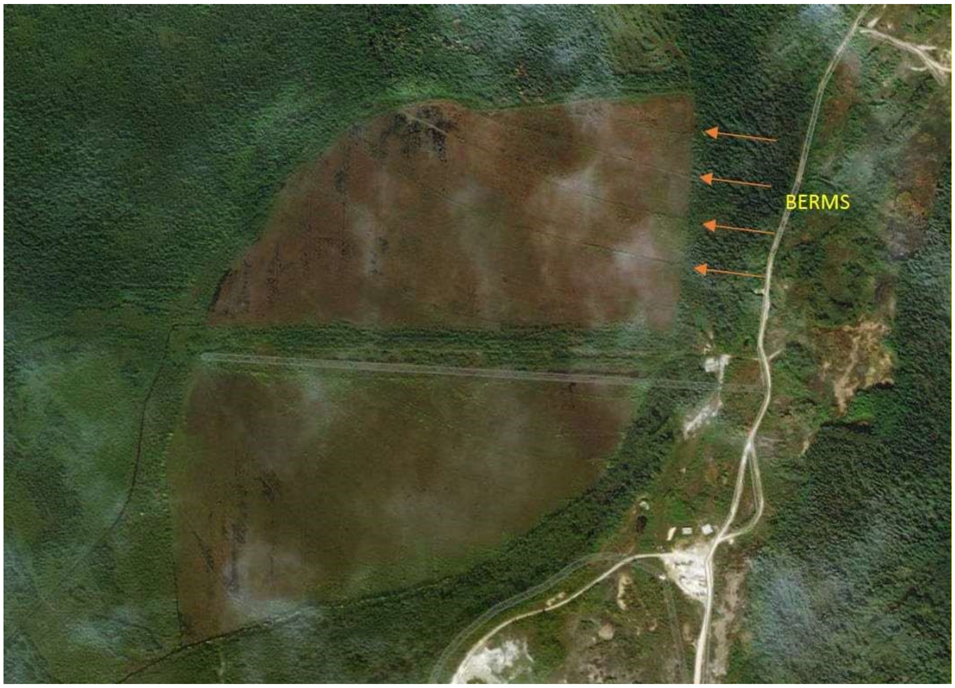
Photo 3.2-1: Ten years post reclamation of a fen near Giroux, MB.

Photo taken October 2019, provided by Premier Tech

Photo 3.2-2: Operator Filling Secondary Ditches using Large Leveller in Saint-Henri, QC.

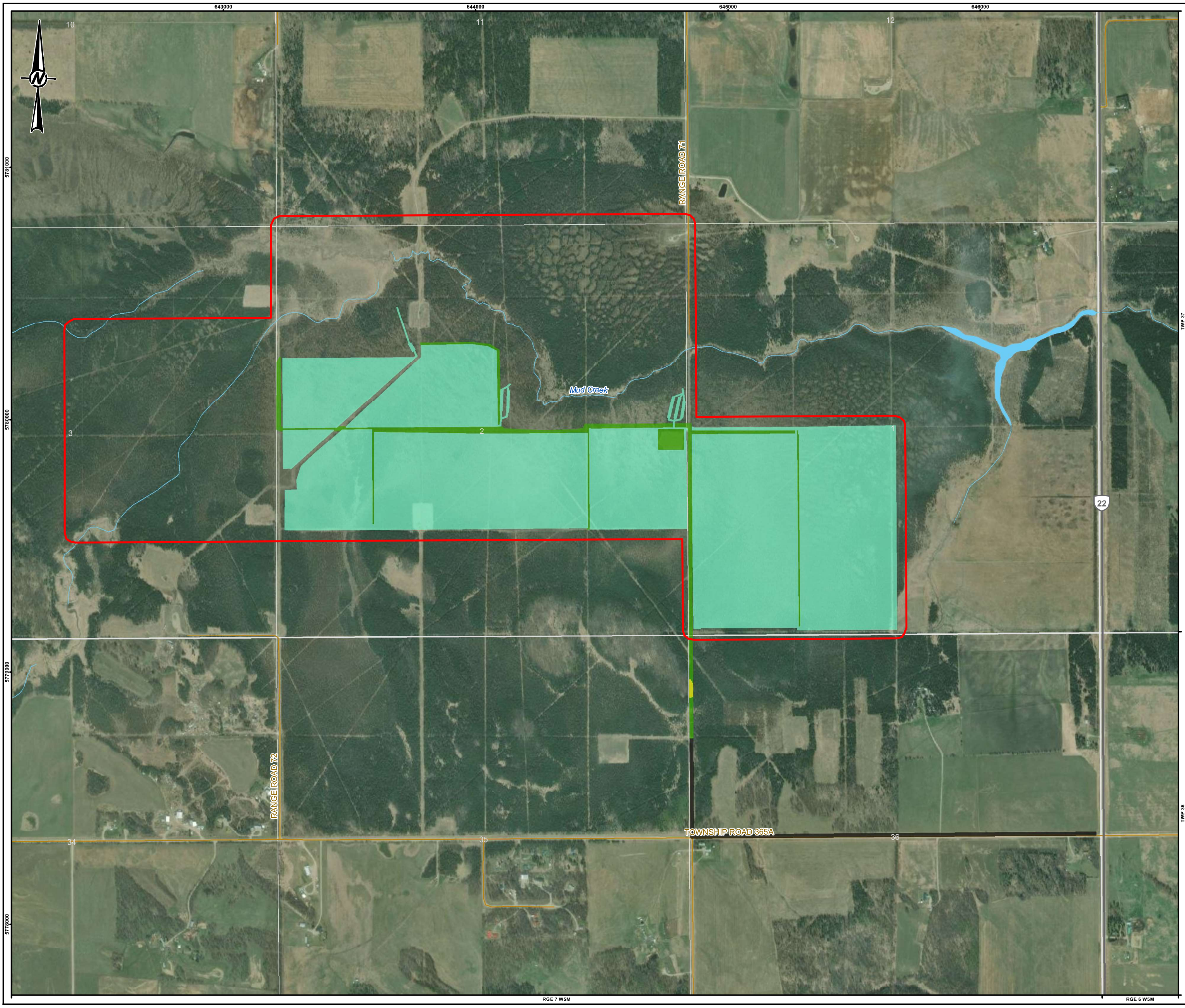
Photo taken 1999, provided by Premier Tech

Photo 3.2-3: Example of Berms being Created at the Pit Bog, SK



Google Earth Satellite, 2015

Photo 3.2-4: Revegetated Site at Pit Bog 15 Years Post Restoration, SK with Berms Visible



LEGEND

▬ PRIMARY HIGHWAY
▬ LOCAL ROAD
— WATERCOURSE
🟦 WATERBODY
▭ PROJECT LEASE BOUNDARY

END LAND USE GOALS

⬛ NO RESTORATION REQUIRED
🟨 UPLAND
🟩 WOODED CONIFEROUS FEN
🟩 WOODED CONIFEROUS FEN (HIGH TREE DENSITY)

0 300 600
1:15,000 METRES

REFERENCE(S)

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
RESTORATION

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	SC
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
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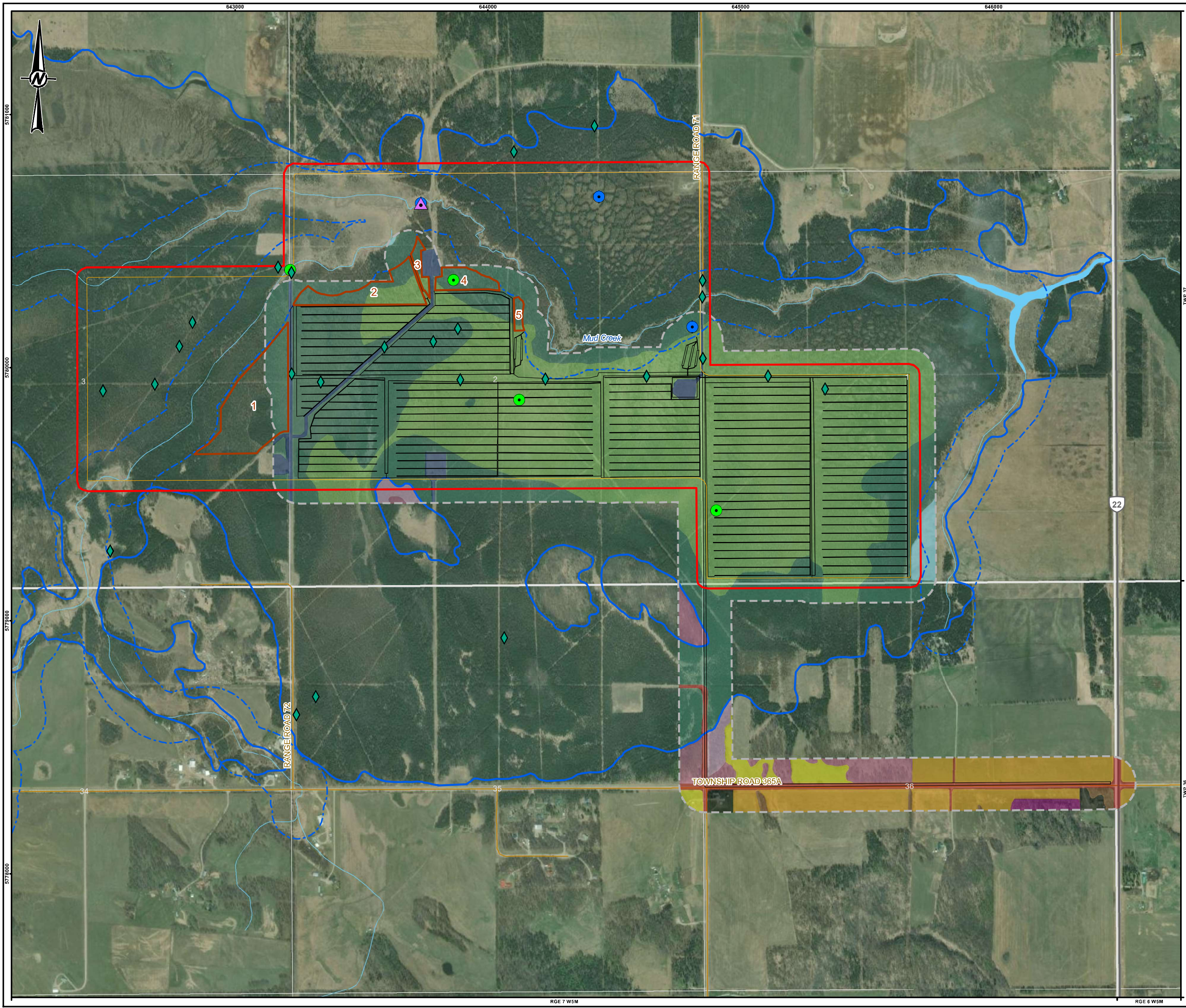

LEGEND

▬	PRIMARY HIGHWAY	▭	PROJECT LEASE BOUNDARY
─	LOCAL ROAD	▭	PROJECT LEASE BOUNDARY INNER 40 M BUFFER
─	WATERCOURSE	▭	PROJECT FOOTPRINT - PHASE 1
■	WATERBODY	⬚	TERRESTRIAL LOCAL STUDY AREA - PROJECT FOOTPRINT + 100 M BUFFER
		⬚	WATERCOURSE - 100 m BUFFER
		⦿	2017 DETAILED WETLAND SURVEY POINT
		◆	2017 WETLAND CLASSIFICATION POINT
		⦿	2020 DETAILED VEGETATION SURVEY POINT
		▲	WEED LOCATION
		▭	FEN BOUNDARY
		▭	PROPOSED COLLECTION AREA

UPLAND AGRICULTURAL AND MISCELLANEOUS LAND COVER TYPES

■	SHRUBLAND
■	FARM YARD
■	TAME PASTURE
■	ROAD/TRAIL
■	HAYLAND

UPLAND ECOSITE PHASES

■	LOW-BUSH CRANBERRY LODGEPOLE PINE (e1)
■	LOW-BUSH CRANBERRY ASPEN (e2)
■	LOW-BUSH CRANBERRY ASPEN-WHITE SPRUCE-LODGEPOLE PINE (e3)

WETLANDS

■	GRAMINOID FEN
■	SHRUBBY FEN
■	WOODED CONIFEROUS FEN
■	CLEARED FEN

0 300 600

1:15,000 METRES

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
PROPOSED COLLECTION AREAS

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	LM
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
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3.2.4 Fire Protection and Suppression during Operations

Peat dust suspended in the air represents a risk of fire at the Project site. Premier Tech has developed a Fire Prevention and Procedure program. This document is provided in Appendix F.

3.2.5 Dust and Air Quality Management

Premier Tech will implement the following procedures to limit the risk of dust affecting both the environment and location communities:

- A treed buffer zone of 40 m around the lease will help provide a natural wind break.
- Harvest fields and ditches will be oriented at a right angle to prevailing winds.
- Stockpiles will be oriented to minimize the area exposed to prevailing winds.
- Plastic sheets will be used to cover stockpiles when left on site for a period of time.
- Premier Tech will install an elbow pipe on the vacuum harvesters that will modify the fan exhaust to flow air horizontally instead of vertically into the air.

3.2.6 Hazardous Waste Management and Spill Treatment Measures

Accidental spills or leaks of hydrocarbons (e.g., gasoline, diesel fuel, oil, and lubricants) could occur during equipment operation, maintenance, fuelling, or fuel storage during construction and operation. Premier Tech has developed an emergency spill response plan for the site and will follow all reporting requirements for releases of substances into the environment that could cause an adverse effect per the Guide to Release Reporting (Alberta Environment 2005). The parking facility, garage and office will be constructed on a concrete pad to reduce the chance of spills. The fuel tank and used oil container will be located on a concrete pad. Pump-outs toilets will be located close to the office in the parking lot. The garbage containers located adjacent to the garage. Garbage will be collected by a local waste management company.

3.2.7 Additional Operational Items

Weed Management

Weed monitoring will be carried out, and weeds within 200 m of the peat fields will be managed manually, mechanically, and with herbicide application if needed.

Wildlife Management

All garbage will be stored in secured, bear resistance containers to prevent nuisance wildlife from entering the site.

During construction and operations of the Project there will be a variety of personnel travelling to, and within, the Project footprint at any given time. All workers (employees and contractors) will be required to undergo Health, Safety and Environment orientation prior to being admitted to site. In conjunction with this orientation, all Premier Tech employees working at the site will be required to receive wildlife awareness training. Speed limits will be established along the main access road to limit wildlife-vehicle collisions.

All wildlife sightings will be reported to Premier Tech. Any nuisance wildlife will be reported to AEP.

Emergency Contact

The emergency contact for the Clearwater Project is:

André Fafard
Operations Director, Alberta
Phone: 403-556-7328 (office) or 403-586-2015 (cell)

3.3 Assessment of Impacts and Proposed Mitigation Measures

This section of the Peat Development and Operations Plan presents an evaluation of the potential environmental effects associated with the Project construction and operation, based on the assessment methods described in Section 2.2 of this report.

Where Project-environmental interactions are anticipated, the potential effects of the Project on the environment are assessed for each VC. This includes the presentation of the potential effects, as well as the accompanying planned mitigation and enhancement measures and the predicted residual effects after considering planned mitigation. The environmental effects assessment for the Project is summarized in Sections 3.3.1 to Section 3.3.6. Potential adverse effects will be reduced by planned mitigation.

3.3.1 Fish and Fish Habitat

Effects to fish and fish habitat were assessed for the duration of construction and operation of the Project. The potential effects resulting from Project activities, recommended mitigation to address these issues, and predicted residual effects and evaluation criteria are summarized in Table 3.3-1.

Overall, residual effects to fish and fish habitat are predicted to be negligible due to the implementation of mitigation measures. Residual effects to surface water hydrology and water quality are also expected to be negligible through the implementation of the mitigation measures. Most effects would occur within the LSA, with limited potential for effects to extend to the RSA.

Only forage fish were captured during fish sampling for the Project. Brown Trout and Brook Trout have been previously captured in Mud Creek (AEP 2020a), but these species are not natural to the area. While Bull Trout have been captured in the Clearwater River in close proximity to Mud Creek, no records of Bull Trout exist within Mud Creek. Furthermore, the Project is more than 9 km upstream from Mud Creek's confluence with the Clearwater River and the availability of preferred spawning substrate for Bull Trout (e.g., gravel and cobble) is limited to road crossings and near the confluence with the Clearwater River. Winter water temperature in Mud Creek was at or below 1°C, which is below the 2°C minimum temperature threshold for optimal egg incubation conditions (BC ENV 2020). As a result, habitat conditions in Mud Creek are not likely to support Bull Trout spawning and incubation. Therefore, taking into account the limited habitat for Bull Trout in Mud Creek and the unnamed tributary, the mitigation measures, and the fish and fish assessment results, no short or long term residual effects on Bull Trout and Bull Trout habitat in the vicinity of the Project are predicted as a result of Project works.

Table 3.3-1: Potential Effects, Mitigation and Predicted Residual Effects for Fish and Fish Habitat

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Project footprint (e.g., access road, site preparation, drainage of harvested area, equipment operations) Construction and Operation	▪ Drainage of harvested areas could have adverse impacts to: ▪ flow regimes in Mud Creek (e.g., flooding) and channel morphology that could affect the stability or use of the creek (e.g., fish habitat) ▪ water quality that affects the health of fish or condition of fish habitat.	▪ The Project footprint will be limited to the extent practical. ▪ Drainage ditches and sedimentation ponds will be constructed to control and manage the water stored in the fen during harvesting. ▪ A 100 m avoidance buffer from the Project footprint will be established around all permanent waterbodies and watercourses within the Project footprint (i.e., Mud Creek and the Unnamed Tributary to Mud Creek). ▪ Discharge from the sedimentations ponds will be released within the vegetated buffer zone and will not discharge directly to Mud Creek ▪ No direct Project footprint or disturbance will occur within the bed and banks of Mud Creek. ▪ Hydraulic gradients of the drainage network will be low to reduce peak flows and erosion potential in the receiving environment. ▪ Erosion control practices will be implemented in disturbed areas to reduce potential for erosion and sediment transport resulting from the Project. ▪ Construction of drainage ditches and sedimentation ponds will be completed during winter to reduce the risks of runoff events that could carry sediment loads to Mud Creek during construction. ▪ Sedimentation ponds will help reduce peak flows and concentrations of suspended solids, dissolved organic matter, and nitrogen and phosphorus compounds in the water prior to discharge to Mud Creek. ▪ Monitoring, maintenance, and cleaning of drainage ditches and sedimentation ponds will be completed so they are functioning as designed. ▪ A Surface Water Monitoring Plan (Appendix E) will be implemented to provide input for adaptive management/mitigation. ▪ The drainage network will be monitored for erosion, and if observed, then erosion control measures will be initiated ▪ Lowering of the water levels in the harvest area will occur gradually once the drainage network is constructed so that outflow discharge will be unlikely to cause erosion in waterbodies and streams. ▪ Reporting requirements for releases of substances into the environment that could cause an adverse effect will be followed per the Guide to Release Reporting (Alberta Environment 2005).	Effects to flow regimes, channel morphology, and water quality are anticipated to be negligible if the proposed mitigation are implemented; as a result, effects on fish and fish habitat are also anticipated to be negligible.
	▪ Introduction of aquatic invasive species	▪ All equipment and gear that has been in contact with water, sediment, and/or aquatic organisms will be decontaminated according to AEP requirements, including clothing, footwear, hand tools, meters, boats, motors, and any equipment or gear that may contact water, sediment, or aquatic organisms (Appendix G).	Effects on fish health and populations are expected to be negligible if proper decontamination procedure is implemented.

Table 3.3-1: Potential Effects, Mitigation and Predicted Residual Effects for Fish and Fish Habitat

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Project footprint (e.g., access road, site preparation, drainage of harvested area, equipment operations) Construction and Operation Continued	▪ Main access road construction, site clearing, harvest roads, and peat harvesting within the harvest area can cause changes to local surface water elevations, flows, and drainage patterns, which may increase erosion and alter surface water quality, which can affect fish and fish habitat.	▪ The Project footprint will be limited to the extent practical. ▪ A 100 m avoidance buffer from harvest areas and sedimentation ponds will be established around all permanent waterbodies and watercourses within the Project footprint apart from linear crossing locations. ▪ Existing trails will be used or upgraded where possible to reduce the amount of new road construction required for the Project. ▪ If required, culverts will be installed along the access roads to maintain downstream flows and watercourse pathways. ▪ Drainage outflow pathways will be monitored for erosion and if observed then erosion control measures will be initiated. ▪ Erosion control practices will be implemented in disturbed areas to reduce potential erosion and sediment transport off-site, resulting from the Project. ▪ Local soils within the harvest area are organic and runoff from the harvested area will be into adjacent peatlands. ▪ A water quality monitoring program will be implemented to provide input for adaptive management/mitigation.	Effects to flow regimes, channel morphology, and water quality are anticipated to be negligible if the proposed mitigation are implemented; as such, effects on fish and fish habitat are also anticipated to be negligible.
Closure and Reclamation	▪ Residual ground disturbance from the Project can cause permanent alteration of local surface water flows, drainage patterns (distribution), and alter surface water quality, which can affect fish and fish habitat.	▪ All site closure activities will consider DFOs Measures to Protect Fish and Fish Habitat (DFO 2019). ▪ The closure landscape and drainage system will be designed such that it has similar characteristics to the natural system in terms of dynamic stability, robustness, longevity, and self-sustaining capability.	Effects to flow regimes, channel morphology, water quality, and fish and fish habitat are anticipated to be negligible if the proposed mitigation are implemented.

Table 3.3-1: Potential Effects, Mitigation and Predicted Residual Effects for Fish and Fish Habitat

Interactions	Potential Effects	Mitigation	Predicted Residual Effects

Accidents and Malfunctions	- Water quality of Mud Creek and the unnamed tributary could be adversely affected by:
	  - accidental releases of sediment loads during construction (e.g., construction of ditches or sediment ponds) or operations (i.e., during harvesting) during a high runoff event
	  - fuel spills from machinery used during construction or operations.
		- A 100 m avoidance buffer from the Project footprint will be established around all permanent waterbodies and watercourses within the Project footprint apart from linear crossing locations.
		- Standard industry practices for construction and material handling procedures will be adopted.
		- Equipment will be inspected for leaks, repaired prior to entry to the Project site, and routinely inspected throughout the duration of the Project.
		- DFOs Measures to Protect Fish and Fish Habitat (DFO 2019) will be considered when planning for pollution control measures, including spill prevention and recommended remediation.
		- Spill response equipment will be readily available. Any spill will be isolated and cleaned up immediately.
		- Spill kits will be located in the immediate vicinity of fueling stations.
		- In the event of a spill, an appropriate soil remediation program will be implemented that addresses site-specific conditions (e.g., soil type, chemical properties of the spill material).
		- An Emergency Response Plan will be prepared prior to the commencement of construction activities and will be followed in the event of an emergency.
		- Secondary containment will be used where appropriate (e.g., generators) capable of containing a spill of fuel, oil, or antifreeze and will be regularly maintained and inspected for leaks.
		- All hazardous substances and dangerous goods waste will be stored in appropriate double-walled containers that will be located on a concrete
			Effects to water quality are anticipated to be negligible if the proposed mitigations are implemented; as such, effects on fish and fish habitat are also anticipated to be negligible.

Table 3.3-1: Potential Effects, Mitigation and Predicted Residual Effects for Fish and Fish Habitat

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Accidents and Malfunctions (continued)	▪ Water quality of Mud Creek and the unnamed tributary could be adversely affected by: ▪ accidental releases of sediment loads during construction (e.g., construction of ditches or sediment ponds) or operations (i.e., during harvesting) during a high runoff event ▪ fuel spills from machinery used during construction or operations.	containment pad with a call, which will provide secondary containment of spills. ▪ Fuel tanks, fuel lines, and generators will be regularly inspected and maintained to remain free of leaks. ▪ No fuels, oils, or other hazardous substances will be stored within 100 m of any waterbody or watercourse. ▪ No equipment maintenance or re-fueling will be conducted within 100 m of any waterbody or watercourse. ▪ Construction of drainage ditches and sedimentation ponds will be completed during winter to reduce the risks of runoff events that could carry sediment loads to Mud Creek during construction. ▪ Monitoring, maintenance and cleaning of drainage ditches and sedimentation ponds will be completed so they are functioning as designed. ▪ Appropriate setbacks from Mud Creek (i.e., 30 m recommended for water quality) have been proposed and exceeded for the Project for harvest areas and sedimentation ponds. ▪ Instructions and the required equipment to clean up potential spills of fuel or other potentially hazardous material used during construction or operations will be available. ▪ Reporting requirements for releases of substances into the environment that could cause an adverse effect will be followed per the Guide to Release Reporting (Alberta Environment 2005).	Effects to water quality are anticipated to be negligible if the proposed mitigations are implemented; as such, effects on fish and fish habitat are also anticipated to be negligible.

3.3.2 Wildlife

Effects to wildlife were assessed for the duration of construction and operation of the Project. The potential effects resulting from Project activities, recommended mitigation to address these issues, and predicted residual effects and evaluation criteria are summarized in Table 3.3-2.

Western toads appear to be common breeders in the LSA based on ARU data collected in 2020. The Project is predicted to remove 155.5 ha of potentially suitable habitat for western toads (i.e., wetland plant communities). This effect of the removal of this habitat is expected to be within the adaptability and resilience limits for the western toad population in the RSA. Suitable habitat for this species will remain adjacent to the Project and other areas in the RSA. It is expected that western toads will be able to access this remaining breeding habitat because they have relatively high mobility. Additionally, the Project may create new suitable breeding habitat for this species (e.g., drainage ditches, outflow ditches, sedimentation ponds).

The Project is located in secondary grizzly bear range. No grizzly bear sign was observed during the site visit in June 2020 and the Project does not appear to be in high quality/effective habitat. To limit effects to grizzly bears, Premier Tech would prefer to gate the access road to discourage entry by vehicles but still allow access to the Crown Land for ATVs and snowmobiles, as per the Master Schedule of Standards and Conditions (AEP and AER 2018).

Table 3.3-2: Potential Effects, Mitigation and Predicted Residual Effects for Wildlife

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Project footprint (e.g., access road, site preparation, drainage of harvested area, equipment operations) Construction and Operation	Direct loss, alteration, and fragmentation of vegetation communities from the Project footprint leading to changes in wildlife habitat quantity, habitat fragmentation, and changes in wildlife movements and survival and reproduction (e.g., carrying capacity of the environment)	Project footprint will be limited to the extent practical. Existing trails and accesses will be used where possible to reduce the amount of new road construction for the Project. Trees around the perimeter of the wetland and in non-harvested areas will be left standing. Culverts will be to be installed to provide movement corridors for amphibians under Project access roads Progressive reclamation will be carried out to minimize the area of disturbance at any given time. The Project does not appear to be located in high quality/effective grizzly bear habitat.	The Project is predicted to remove 155 ha of wetland and <1 ha of upland plant communities; the area to be drained varies from about 44 ha in phase one of harvest to about 11 ha in phase five. Residual effects from the Project are expected to fall within the resilience and adaptability limits of all wildlife VCs because connectivity with the larger wetland complex and adjacent plant communities will be maintained within the RSA.
	Access road construction, site clearing, harvest roads and peat harvesting within the harvest area can cause changes to local surface water levels, flows, drainage patterns (distribution), and surface water quality, which can affect the availability, and distribution of wildlife habitat and changes in wildlife movements and survival and reproduction (e.g., carrying capacity of the environment).	Decreased water levels will be localized and occur close to the ditch network, which minimizes effects to the harvesting area during operations; reclamation activities would reverse effects. Culverts will be installed along the access roads as required to maintain water flows. Erosion control practices will be implemented in disturbed areas to reduce potential erosion and sediment transport off-site.	Changes to local surface water hydrology and water quality are anticipated to be negligible once mitigations are implemented (Section 3.3.5). Application of effective mitigation is expected to keep effects within the resilience and adaptability limits of wildlife VCs.
	Air and dust emissions and subsequent deposition can affect upland and wetland ecosystems and alter wildlife habitat and distribution.	The Project will comply with regulatory requirements regarding air quality. The access road and site service roads will be watered as needed to limit dust generated by haul traffic. Trucks used to haul peat from the Project to the packaging plant will be covered to limit release of dust and debris during transport. Peat stockpiles will be covered to limit dust generation. Peat harvesting or loading activities will not occur on excessively windy days. Equipment will be regularly inspected and maintained. Speed limits will be enforced to limit dust production. Idling of vehicles will be limited to the extent practical.	Air and dust emissions and deposition are expected to increase with construction and operation of the Project Application of effective mitigation is expected to keep effects within the resilience and adaptability limits of wildlife VCs.

Table 3.3-2: Potential Effects, Mitigation and Predicted Residual Effects for Wildlife

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Project footprint (e.g., access road, site preparation, drainage of harvested area, equipment operations) Construction and Operation (continued)	▪ Vegetation clearing leading to destruction of migratory bird nests and western toad mortality	▪ Implement a Wildlife Mitigation and Monitoring Plan, which may include: ○ pre-clearing nest sweeps for migratory birds in accordance with *the Migratory Birds Convention Act* (GOC 1994) when operations occur during the general nesting period for this region (April 17 to August 24; ECCC 2018). ○ pre-clearing amphibian sweeps with possible relocation of individuals when operations occur during the non-winter period.	▪ Application of effective mitigation is expected to keep effects with the resilience and adaptability limits of wildlife VCs
Sensory disturbance Construction and Operations	▪ Sensory disturbance from construction and operation activities leading to changes in wildlife habitat quality and survival and reproduction	▪ Stationary and mobile engines will meet applicable performance standards, such as equipment that has the lowest practical and economically achievable nitrogen oxide emission rates ▪ Internal combustion engines will be outfitted with well-maintained muffler systems.	▪ Sensory disturbance will increase during Project construction and operations ▪ Application of effective mitigation is expected to keep effects with the resilience and adaptability limits of wildlife VCs because of the large amount of human disturbance in the RSA. That is, wildlife in the RSA are expected to have adapted to relatively high levels of sensory disturbance associated with agricultural and oil and gas activities in the RSA.
Traffic Construction and Operations	▪ Collisions with vehicles/equipment used for construction or operations leading to injury or mortality of wildlife	▪ Implement a Wildlife Mitigation and Monitoring Plan, which may include requirements to stop for and report sightings of wildlife in the Project footprint. ▪ Culverts will be to be installed to provide safe passage for amphibians under Project access roads. ▪ Premier Tech's preference would be for the access road to be gated to discourage public vehicle access; however, to maintain access into the Crown Resource Land for ATVs and snowmobiles.	▪ Application of effective mitigation is expected to keep effects with the resilience and adaptability limits of wildlife VCs.
Closure and Reclamation	▪ Residual ground disturbance can cause alteration of local surface water flows, drainage patterns and distribution, and surface water quality, which can affect wetland and upland ecosystems.	▪ Progressive reclamation will be carried out to minimize the area of disturbance at any given time. ▪ Salvaged peat material will be returned to the landscape and contoured, to the extent practical, to blend with the surrounding terrain. ▪ Contouring of disturbed areas will be completed to minimize peat and water erosion, re-establish drainage, and encourage vegetation growth. ▪ All buildings, concrete pads, and other structures will be removed at closure. ▪ All site access and service roads will be removed or returned to pre-Project conditions.	▪ Changes to local surface water hydrology and water quality are anticipated to be negligible once mitigations are implemented (Section 3.3.5). ▪ Application of effective mitigation is expected to keep effects within the resilience and adaptability limits of wildlife VCs.

Table 3.3-2: Potential Effects, Mitigation and Predicted Residual Effects for Wildlife

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Accidents and Malfunctions	▪ Chemical spills (e.g., fuels or petroleum products) on site and during transport of material to the packaging plant may affect wetland and upland ecosystems and alter the abundance and distribution of wildlife habitat.	▪ Standard industry best practices for construction and material handling will be adopted. ▪ Equipment, fuel tanks, fuel lines and generators will be inspected for leaks, repaired prior to entry into the Project site, and routinely inspected and maintained throughout the duration of the Project. ▪ Spill response equipment will be readily available; any spills will be isolated and cleaned up immediately. ▪ An Emergency Response Plan will be prepared by Premier Tech prior to commencement of activities and followed in the event of an emergency. ▪ All hazardous substances and waste dangerous goods will be stored in appropriate double-walled containers that will be located on a concrete containment pad with a wall, which will provide secondary containment of spills. ▪ No fuels, oils, or other hazardous substances will be stored within 100 m of any waterbody, and no equipment maintenance or re-fuelling will be conducted within 100 m of any waterbody unless appropriate primary and secondary containment is in place. ▪ Reporting requirements for releases of substances into the environment that could cause an adverse effect will be followed per the Guide to Release Reporting (Alberta Environment 2005).	▪ While chemical spills may occur, application of preventive measures and effective mitigation is expected to keep effects within the resilience and adaptability limits of wildlife VCs.

Table 3.3-2: Potential Effects, Mitigation and Predicted Residual Effects for Wildlife

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Accidents and Malfunctions (continued)	▪ A wildfire started by Project activities may result in loss of wetland and upland ecosystems, which may alter the abundance and distribution of wildlife habitat.	▪ Premier Tech will follow their Fire Prevention and Procedures Program for the duration of the Project. ▪ Firefighting equipment will be on site, readily accessible, and serviceable during the fire season. ▪ All water packs and pails will be kept full of water during the fire season. ▪ All heavy equipment and fuelling sites will be equipped with approved and fully charged fire extinguishers. ▪ Fire extinguishers and firefighting equipment will be located at strategic points throughout the site and will be maintained in good working order. ▪ Appropriate firefighting training will be provided to ensure that an effective and efficient force of appropriately trained individuals is always on site to perform necessary fire suppression duties. ▪ All equipment on site will be kept clean and in good operating condition so that there is no build-up of combustible materials near manifolds, exhaust systems, and mufflers. ▪ No smoking will be allowed at equipment fuelling stations or outside of designated areas at any time.	▪ The effects of a wildfire could be quite large ▪ Implementation of preventive measures is expected to minimize risk, and implementation of fire suppression measures in the event of a fire is expected to limit the extent and effects of wildfire on wildlife VCs.

3.3.3 Vegetation and Wetlands

Effects to vegetation and wetlands were assessed for the duration of construction and operation of the Project. The potential effects resulting from Project activities, recommended mitigation to address these issues, and predicted residual effects are summarized in Table 3.3-3.

Table 3.3-3: Potential Effects, Mitigation and Predicted Residual Effects for Vegetation and Wetlands

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Project footprint (e.g., access road, site preparation, drainage of harvested area, equipment operations) Construction and Operation	▪ Direct loss, alteration, and fragmentation of wetland and upland plant communities from the Project footprint.	▪ Project footprint will be limited to the extent practical. ▪ Existing trails and accesses will be used where possible to reduce the amount of new road construction for the Project. ▪ Trees around the perimeter of the wetland and in non-harvested areas will be left standing.	▪ Phase 1 would affect 153.4 ha of wetland and <1 ha of upland plant communities, residual effects from the Project are expected to fall within the resilience and adaptability limits of the vegetation and wetlands VC because connectivity with the larger wetland complex and adjacent plant communities will be maintained within the RSA.
	▪ Access road construction, site clearing, harvest roads and peat harvesting within the harvest area can cause changes to local surface water levels, flows, drainage patterns (distribution), and surface water quality, which can affect the availability, distribution and composition of upland and wetland ecosystems.	▪ Decreased water levels will be localized and occur close to the ditch network, which would minimize effects to the harvesting area during operations; reclamation activities would reverse effects. ▪ Culverts will be installed along the access roads as required to maintain water flows. ▪ Erosion control practices will be implemented in disturbed areas to reduce potential erosion and sediment transport off-site.	▪ While changes to local surface water hydrology and water quality may occur, application of effective mitigation is expected to keep effects within the resilience and adaptability limits of the vegetation and wetlands VC.
	▪ Air and dust emissions and subsequent deposition can affect upland and wetland ecosystems. ▪ Dust deposition may cover vegetation and lead to physical and/or physiological damage.	▪ The Project will comply with regulatory requirements regarding air quality. ▪ The access road and site service roads will be watered as needed to limit dust generated by haul traffic. ▪ Trucks used to haul peat from the Project to the packaging plant will be covered to limit release of dust and debris during transport. ▪ Peat stockpiles will be covered to limit dust generation. ▪ Peat harvesting or loading activities will not occur on excessively windy days. ▪ Equipment will be regularly inspected and maintained. ▪ Speed limits will be enforced to limit dust production. ▪ Idling of vehicles will be limited to the extent practical.	▪ While air and dust emissions and deposition are expected to increase with construction and operation of the Project, application of effective mitigation is expected to keep effects within the resilience and adaptability limits of the vegetation and wetlands VC.
	▪ Introduction of weed species can affect the composition of wetland and upland ecosystems.	▪ Equipment will be cleaned prior to arriving on site and inspected regularly. ▪ Weed monitoring will be carried out, and weeds within 200 m of the peat fields will be managed manually, mechanically, and with herbicide if needed.	▪ While introduction and spread of weed species may occur, application of effective weed monitoring and control is expected to keep effects within the resilience and adaptability limits of the vegetation and wetlands VC.

Table 3.3-3: Potential Effects, Mitigation and Predicted Residual Effects for Vegetation and Wetlands

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Project footprint (e.g., access road, site preparation, drainage of harvested area, equipment operations) Construction and Operation Continued	▪ Direct loss of listed plant species or listed plant communities. ▪ Indirect effects to potential listed plant habitat.	▪ A survey for listed plant species and listed plant communities was completed to inform Project footprint placement decisions; no listed plant species or listed plant communities were documented within the LSA. ▪ Mitigation to maintain local surface water hydrology and water quality conditions will be applied to minimize indirect effects to adjacent plant communities. ▪ Mitigation to manage air and dust emissions will be applied to minimize effects to adjacent plant communities.	▪ While changes to local availability and quality of listed plant habitat may occur, application of effective mitigation is expected to keep effects within the resilience and adaptability limits of the vegetation and wetlands VC and most wildlife VCs. ▪ There is uncertainty regarding the population of western toad in the RSA and a more in depth baseline program and monitoring program is recommended to be implemented to limit effects on this species.
Closure and Reclamation	▪ Residual ground disturbance can cause alteration of local surface water flows, drainage patterns and distribution, and surface water quality, which can affect wetland and upland ecosystems.	▪ Progressive reclamation will be carried out to minimize the area of disturbance at any given time. ▪ Salvaged peat material will be returned to the landscape and contoured, to the extent practical, to blend with the surrounding terrain. ▪ Contouring of disturbed areas will be completed to minimize peat and water erosion, re-establish drainage, and encourage vegetation growth. ▪ All buildings, concrete pads, and other structures will be removed at closure. ▪ All site access and service roads will be removed or returned to pre-Project conditions.	▪ While changes to local surface water hydrology and water quality may occur during closure and reclamation, application of effective mitigation is expected to keep effects within the resilience and adaptability limits of the vegetation and wetlands VC.

Table 3.3-3: Potential Effects, Mitigation and Predicted Residual Effects for Vegetation and Wetlands

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Accidents and Malfunctions	▪ Chemical spills (e.g., fuels or petroleum products) on site and during transport of material to the packaging plant may affect wetland and upland ecosystems.	▪ Standard industry best practices for construction and material handling will be adopted. ▪ Equipment, fuel tanks, fuel lines and generators will be inspected for leaks, repaired prior to entry into the Project site, and routinely inspected and maintained throughout the duration of the Project. ▪ Spill response equipment will be readily available; any spills will be isolated and cleaned up immediately. ▪ An Emergency Response Plan will be prepared by Premier Tech prior to commencement of activities and followed in the event of an emergency. ▪ All hazardous substances and waste dangerous goods will be stored in appropriate double-walled containers that will be located on a concrete containment pad with a wall, which will provide secondary containment of spills. ▪ No fuels, oils, or other hazardous substances will be stored within 100 m of any waterbody, and no equipment maintenance or re-fuelling will be conducted within 100 m of any waterbody unless appropriate primary and secondary containment is in place. ▪ Reporting requirements for releases of substances into the environment that could cause an adverse effect will be followed per the Guide to Release Reporting (Alberta Environment 2005).	▪ While chemical spills may occur, application of preventive measures and effective mitigation is expected to keep effects within the resilience and adaptability limits of the vegetation and wetlands VC.

Table 3.3-3: Potential Effects, Mitigation and Predicted Residual Effects for Vegetation and Wetlands

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Accidents and Malfunctions (continued)	▪ A wildfire started by Project activities may result in loss of wetland and upland ecosystems.	▪ Premier Tech will follow their Fire Prevention and Procedures Program for the duration of the Project. ▪ Firefighting equipment will be on site, readily accessible, and serviceable during the fire season. ▪ All water packs and pails will be kept full of water during the fire season. ▪ All heavy equipment and fuelling sites will be equipped with approved and fully charged fire extinguishers. ▪ Fire extinguishers and firefighting equipment will be located at strategic points throughout the site and will be maintained in good working order. ▪ Appropriate firefighting training will be provided to ensure that an effective and efficient force of appropriately trained individuals is always on site to perform necessary fire suppression duties. ▪ All equipment on site will be kept clean and in good operating condition so that there is no build-up of combustible materials near manifolds, exhaust systems, and mufflers. ▪ No smoking will be allowed at equipment fuelling stations or outside of designated areas at any time.	▪ While the effects of a wildfire could be significant, implementation of preventive measures is expected to minimize risk, and implementation of fire suppression measures in the event of a fire is expected to limit the extent and effects of wildfire on the vegetation and wetlands VC.

3.3.4 Terrain and Soil

Potential effects on terrain and soils may occur during Project interactions including construction and operation, closure and reclamation, and accidents or malfunctions. The potential effects resulting from Project activities, recommended mitigation, and predicted residual effects and evaluation criteria are summarized in Table 3.3-4. Effects to terrain and soils are anticipated to be limited to the disturbance footprint.

Table 3.3-4: Potential Effects, Mitigation and Predicted Residual Effects for Soils

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Project footprint (e.g., access road, site preparation, drainage of harvested area, equipment operations) Construction and Operation	▪ Change in terrain and elevations within footprint reduce available volume of peatland soils to filter groundwater and provide habitat for vegetation communities and wildlife.	▪ Limit Project footprint to the minimum extent practicable. ▪ Progressive reclamation will be carried out to minimize the area of disturbance at any given time. ▪ Salvaged peat material will be returned to the landscape and contoured, to the extent practical, to blend with the surrounding terrain. ▪ Contouring of disturbed areas will be completed to minimize peat and water erosion, re-establish drainage, and encourage vegetation growth.	▪ While changes to terrain and elevations will occur after closure and reclamation, the application of effective mitigation is expected to keep the function of terrain and soils in maintaining the resilience and adaptability limits of groundwater, vegetation, and wildlife.
	▪ Direct loss or alteration in soil distribution or quality caused by wind or water erosion in the Project footprint. ▪ Increased water erosion could cause sedimentation in adjacent water bodies.	▪ Limit Project footprint to the minimum extent practicable. ▪ Trees around the perimeter of the wetland and in non-harvested areas will be left standing to maintain wind existing wind break. ▪ Orient harvesting fields perpendicular to the prevailing wind (north-north-west). ▪ Before starting any earthwork associated with construction of the Project access roads and yard site, sediment control (e.g., sediment fencing, berms) will be installed on the upland adjacent to any associated riparian area to prevent topsoil and subsoil migration into the watercourses or waterbodies (if applicable). ▪ The watercourses and waterbodies will be routinely inspected to assess soil stability. Areas of concern will be promptly addressed by implementing appropriate stabilization and/or remedial measures. ▪ Progressive revegetation of disturbed soil; erosion and sediment control measures (e.g., erosion control matting and sediment fencing) to prevent sediment entering watercourses. ▪ Maintenance and control of drainage works, including sedimentation ponds and outlet ditches will be completed when required, and at least once per year. ▪ The access road and site service roads will be watered as needed to limit dust generated by haul traffic. ▪ Trucks used to haul peat from the Project to the packaging plant will be covered to limit release of dust and debris during transport. ▪ Peat stockpiles will be covered to limit dust generation. ▪ Peat harvesting or loading activities will not occur on excessively windy days.	▪ The Project will affect approximately 155.5 ha of soils. While changes to soil distribution and quality may occur through erosion and sedimentation throughout the life of the Project, the application of effective mitigation is expected to keep the function of terrain and soils in maintaining the resilience and adaptability limits of groundwater, vegetation, and wildlife.

Table 3.3-4: Potential Effects, Mitigation and Predicted Residual Effects for Soils

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Project footprint (e.g., access road, site preparation, drainage of harvested area, equipment operations) Construction and Operation	- Loss or alteration of area of soil map units	- Soil disturbance will be limited to only those areas required for Project construction, operation, and reclamation. - Progressive reclamation will be carried out to minimize the area of disturbance at any given time.	- While there will be a loss and change to area of soil map units after Project closure and reclamation, the application of effective mitigation is expected to keep the function of terrain and soils in maintaining the resilience and adaptability limits of groundwater, vegetation, and wildlife.
	- Change in soil distribution and quality caused by disturbance to the soil profile (i.e., soil loss and compaction)	- Sediment ponds, access roads, and other footprint features will be constructed using minimal disturbance techniques where feasible (winter construction, use existing infrastructure) - Maintenance and control of drainage networks, including sedimentation ponds will be completed when required, and at least once per year. - Adjacent trails and roads will be used to access the Project by construction equipment where feasible. - Construction of drainage ditches and sedimentation ponds will be completed during winter if feasible to reduce the risk of compaction. - Where applicable, areas will be cleared of trees, brush, and stump. The woody debris will be either be mulched or left on surface to cushion the soils from vehicle impact or salvaged for spreading over non-active portions of the Project footprint during reclamation to assist in erosion protection and to create safe-sites for regenerating/germinating plants. - In areas with mineral soils, topsoil will be stripped and salvaged where grading is required to reduce admixing with the subsoil. The width of stripping will accommodate variations in localized topography, soil conditions and land use. - Where grading is required (i.e., at the yard site), the topsoil will be stripped from the areas prior to grading the underlying subsoils. - Topsoil and organic material (containing seed bank and propagules) will be salvaged then replaced during reclamation.	- While changes to soil distribution and quality will occur throughout the life of the Project, the application of effective mitigation is expected to keep the function of terrain and soils in maintaining the resilience and adaptability limits of groundwater, vegetation, and wildlife

Table 3.3-4: Potential Effects, Mitigation and Predicted Residual Effects for Soils

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Closure and Reclamation	Residual ground disturbance can cause alteration of local surface water flows, drainage patterns and distribution, and surface water quality, which can affect wetland and upland ecosystems.	Progressive reclamation will be carried out to minimize the area of disturbance at any given time. Salvaged peat material will be returned to the landscape and contoured, to the extent practical, to blend with the surrounding terrain. Contouring of disturbed areas will be completed to minimize peat and water erosion, re-establish drainage, and encourage vegetation growth. All buildings, concrete pads, and other structures will be removed at closure. All site access and service roads will be removed or returned to pre-Project conditions. Disturbed areas will be re-contoured and reclaimed to a stable surface profile to maintain existing land uses.	While changes to terrain and soil will occur after reclamation, the application of effective mitigation is expected to keep the function of terrain and soils in maintaining the resilience and adaptability limits of groundwater, vegetation, and wildlife
Accidents and Malfunctions	Chemical spills (e.g., fuels or petroleum products) from machinery used during construction, operations, or reclamation can contaminate soil	Standard industry best practices for construction and material handling will be adopted. Portable washrooms will be available for use and will be properly maintained (pumped out when full). Equipment, fuel tanks, fuel lines and generators will be inspected for leaks, repaired prior to entry into the Project site, and routinely inspected and maintained throughout the duration of the Project. The parking facility at the Yard site will have a permanent maintenance garage with a concrete floor to collect any oil spills. Any used oil will be stored in a specific area and collected later by a company specialized in recycling. Same specification will be in place for any used batteries. Spill response equipment will be readily available; any spills will be isolated and cleaned up immediately. An Emergency Response Plan will be prepared by Premier Tech prior to commencement of activities and followed in the event of an emergency. All hazardous substances and waste dangerous goods will be stored in appropriate double-walled containers that will be located on a concrete containment pad with a wall, which will provide secondary containment of spills. Reporting requirements for releases of substances into the environment that could cause an adverse effect will be followed per the Guide to Release Reporting (Alberta Environment 2005).	While chemical spills may occur, application of preventive measures and effective mitigation is expected to keep the function of terrain and soils in maintaining the resilience and adaptability limits of groundwater, vegetation, and wildlife

Table 3.3-4: Potential Effects, Mitigation and Predicted Residual Effects for Soils

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Accidents and Malfunctions	▪ Peat or peat dust igniting and creating wildfires can result in soil loss	▪ Premier Tech will follow their Fire Prevention and Procedures Program for the duration of the Project. ▪ Firefighting equipment will be on site, readily accessible, and serviceable during the fire season. ▪ All water packs and pails will be kept full of water during the fire season. ▪ All heavy equipment and fuelling sites will be equipped with approved and fully charged fire extinguishers. ▪ Fire extinguishers and firefighting equipment will be located at strategic points throughout the site and will be maintained in good working order. ▪ Appropriate firefighting training will be provided to ensure that an effective and efficient force of appropriately trained individuals is always on site to perform necessary fire suppression duties. ▪ All equipment on site will be kept clean and in good operating condition so that there is no build-up of combustible materials near manifolds, exhaust systems, and mufflers. ▪ No smoking will be allowed at equipment fuelling stations or outside of designated areas at any time. ▪ When possible, carry out hot work in a workshop	▪ While the effects of a wildfire could be significant, implementation of preventive measures is expected to minimize risk, and implementation of fire suppression measures in the event of a fire is expected to limit the extent and effects of wildfire on the function of terrain and soils to maintain the resilience and adaptability limits of groundwater, vegetation, and wildlife.

3.3.5 Hydrology and Water Quality

Potential Effects

Potential effects on surface water were predicted based on the most recent Project footprint and water management plans as described in Section 3.2.

To harvest the peat, the peatland needs to be drained by regularly spaced secondary ditches and primary ditches that will route the flows to six planned sedimentation ponds and three outlet locations (Figure 2.3-8). Ponds have been sized according to the expected water yield from the peat harvest areas and to enhance settling of organic particles. Water collected at the outlet channels will be pumped to the peat surface and dispersed over the vegetated buffer. The outlet locations are outside the 100 m setbacks from Mud Creek and its unnamed tributary. Pumping activities will occur during the open-water period with the exception of dewatering the sedimentation ponds during their initial construction in winter.

As shown in Table 3.3-5, maximum release rates of up to 0.0029 m^3/s are estimated to occur due to release of water from the peat during harvesting activities when all five harvest areas are active (Year 5 to Year 17). Assumptions in these estimates are based on typical peat properties. It is assumed the peat is made up of about 90% water, 10% solid organic matter, and that 50% of the water content of the harvested peat will be drained by gravity into the ditches each year. Table 3.3-5 summarizes the areas that would be disturbed each year, and the volume of water and average open-water rates that will be drained and retained in the peat moss over the drainage and harvest period of about 21 years. The depth of peat to be removed each year is estimated to be 75 mm (0.075 m).

Table 3.3-5: Planned Harvest Areas and Volume of Water Released during Operations

Year	Areas to be Harvested	Cumulative Area (km^2)	Average Depth of Harvest (m)	Total Volume of Peat Harvest (m^3)	Estimated Volume of Water in the Peat [(a)] (m^3)	Estimated average open-water drainage [(b)] (m^3/s)
2022 (Year 1)	1	0.460	0.075	34,487	31,039	0.0009
2023 (Year 2)	1 and 2	0.753	0.075	56,476	50,828	0.0015
2024 (Year 3)	1, 2 and 3	1.071	0.075	80,300	72,270	0.0021
2025 (Year 4)	1, 2, 3 and 4	1.316	0.075	98,714	88,843	0.0026
2026 (Year 5)	1, 2, 3, 4 and 5	1.432	0.075	107,394	96,655	0.0029
2027 (Year 6)	1, 2, 3, 4 and 5	1.432	0.075	107,394	96,655	0.0029
2028 (Year 7)	1, 2, 3, 4 and 5	1.432	0.075	107,394	96,655	0.0029
2029 (Year 8)	1, 2, 3, 4 and 5	1.432	0.075	107,394	96,655	0.0029
2030 (Year 9)	1, 2, 3, 4 and 5	1.432	0.075	107,394	96,655	0.0029
2031 (Year 10)	1, 2, 3, 4 and 5	1.432	0.075	107,394	96,655	0.0029
2032 (Year 11)	1, 2, 3, 4 and 5	1.432	0.075	107,394	96,655	0.0029
2033 (Year 12)	1, 2, 3, 4 and 5	1.432	0.075	107,394	96,655	0.0029
2034 (Year 13)	1, 2, 3, 4 and 5	1.432	0.075	107,394	96,655	0.0029
2035 (Year 14)	1, 2, 3, 4 and 5	1.432	0.075	107,394	96,655	0.0029
2036 (Year 15)	1, 2, 3, 4 and 5	1.432	0.075	107,394	96,655	0.0029
2037 (Year 16)	1, 2, 3, 4 and 5	1.432	0.075	107,394	96,655	0.0029
2038 (Year 17)	1, 2, 3, 4 and 5	1.432	0.075	107,394	96,655	0.0029
2039 (Year 18)	2, 3, 4, and 5	0.972	0.075	72,907	65,616	0.0019

Table 3.3-5: Planned Harvest Areas and Volume of Water Released during Operations

Year	Areas to be Harvested	Cumulative Area (km^2)	Average Depth of Harvest (m)	Total Volume of Peat Harvest (m^3)	Estimated Volume of Water in the Peat [(a)] (m^3)	Estimated average open-water drainage [(b)] (m^3/s)
2040 (Year 19)	3, 4, and 5	0.679	0.075	50,918	45,826	0.0014
2041 (Year 20)	4 and 5	0.361	0.075	27,094	24,385	0.0007
2042 (Year 21)	5	0.116	0.075	8,680	7,812	0.0002

(a) Assuming that 90% of the peat volume is water.

(b) Assuming that 50% of the water in the peat can be drained using ditches over each year.

Operation of the drainage ditches will have negligible effects on the regional groundwater as the water that will be drained from the fen area is not part of the regional groundwater system. Peat harvesting operations is expected to affect the surficial groundwater above the underlying mineral substrate due to drainage. The effects of this are considered to be minimal and localized to the harvest area. As shown in Table 3.3-5, the effects of dewatering the peat by lowering the water-table using ditches and incremental peat harvesting each year will be very small with a maximum rate of about 0.0029 m^3/s.

The effect of dewatering and peat harvesting will have limited effects on the remaining fen area located between the Project area and Mud Creek and its tributaries. The lateral effects of the drainage and collector ditches are within 8 m of the perimeter ditches, with possible effects up to 25 m (Lefebvre-Ruel et al., 2019).

Once harvesting operations are complete within a peat field, restoration activities will begin, and the natural water-table will be restored to near the restored peat surface. Therefore, the change in water balance of the Project area post closure will be negligible.

Potential Effects to Mud Creek Flows

Figure 2.3-8 shows the approximate locations of the proposed discharge points from the six sedimentation ponds and the locations used for effect assessment. Table 3.3-6 presents the estimated changes in flow statistics at the effect assessment locations including monthly, seasonal and flood flows.

Predicted increases in natural flows during sedimentation pond construction were calculated based on natural flows in March, but would represent an increase of about 1.5% or less at the outlet locations. The calculated discharge rates varied from 0.0005 m^3/s for Pond 6 (the smallest pond) up to 0.0009 m^3/s for the larger ponds.

Predicted increases to natural flows in May due to runoff collected after construction of the drainage ditch network varied from 1.0% for the West Outlet to 1.4% for the East Outlet. The calculated discharge rates ranged from 0.0058 m^3/s for the West Outlet, up to 0.016 m^3/s for the Central Outlet, and up to 0.023 m^3/s for the East Outlet. These discharge rates were assumed to occur over a period of one week for each outlet. To reduce the impact on flows in the adjacent watercourses, the releases from the Outlet locations in spring would be staggered by a week.

The maximum total harvest area that will contribute runoff to Mud Creek is less than 5% of the drainage area of the Mud Creek at the Project site and less than 12% for the Tributary of Mud Creek. The estimated flow increase during open water season varies from zero in most winter months to a maximum monthly increase of 2.1% in October for the unnamed tributary of Mud Creek as shown in Table 3.3-6. The estimated increases in the 2-year return period flood flows are 0.5% or less, and have a relatively smaller impact during larger floods.

Therefore, the proposed harvesting operation is predicted to result in small increases in local flows in Mud Creek and its unnamed tributary. Potential changes to channel erosion, geomorphology and suspended sediment concentrations are predicted to be negligible.

Table 3.3-6: Estimated Changes in Flow Statistics

Parameters	**Proposed Discharge Locations**		
	Tributary - West Outlet	**Mud Creek - Central Outlet**	**Mud Creek - East Outlet**
Drainage Area (km^2)	27	34	40.9
Estimated Maximum Flow Increase (%)			
March (a)	1.1%	1.5%	1.3%
April	0	0	0
May (b,c)	1.0%	1.3%	1.4%
June (b)	0.6%	0.5%	0.4%
July (b)	0.8%	0.6%	0.5%
August (b)	1.3%	1.0%	0.9%
September (b)	1.4%	1.1%	1.0%
October (b)	2.1%	1.7%	1.4%
Mean open-water season	1.2%	0.9%	0.8%
2-year flood flow (c)	0.2%	0.4%	0.5%
5-year flood flow (c)	0.1%	0.2%	0.3%
10-year flood flow (c)	0.1%	0.2%	0.2%
100-year flood flow (c)	<0.1%	0.1%	0.1%

(a) Construction of sedimentation ponds in winter will require dewatering of the saturated peat below the frost layer. It was assumed each pond would be constructed and pumped out over a one week period and releases would maintain the 100 m setback from watercourses. Percentage increases in flows were calculated for the month of March.

(b) To account for discharge during peat harvesting operations from May to October, the operational discharge value of 0.0029 m^3/s shown in Table 3.3-6 was added to the natural flow estimates in these months in order to calculated percent increases in flow.

(c) Following drainage ditch network construction for the five harvesting areas, it was assumed the new ditch network would be nearly full of water, and the release of excess water would be required during spring freshet. Release of excess water was assumed to occur for one week in May from each Outlet location. Maximum discharge values of 0.0058 m^3/s for the West Outlet, 0.016 m^3/s for the Central Outlet, and 0.023 m^3/s for the East Outlet were added to the operational discharge values for the remainder of May to obtain an average increase in flows in May. The same increases at the outlet locations were added to flood magnitudes (assuming they coincided) to obtain the percentage increase in flood magnitudes.

Section 3.2.3 discusses the conceptual closure drainage plan developed for the Project site to demonstrate how the runoff from the reclaimed areas will be properly managed and routed to the receiving creek to minimize negative effects from operations on the peat, its vegetation and runoff. The runoff characteristics of the reclaimed fen areas are expected to be similar to the natural fen areas. Therefore, potential changes to flows in the receiving environment (i.e., Mud Creek and its unnamed tributary) are predicted to be negligible, because the closure drainage system will be properly designed and implemented and the area of reclaimed fen is much less than the drainage area of Mud Creek and its tributary at the Project location.

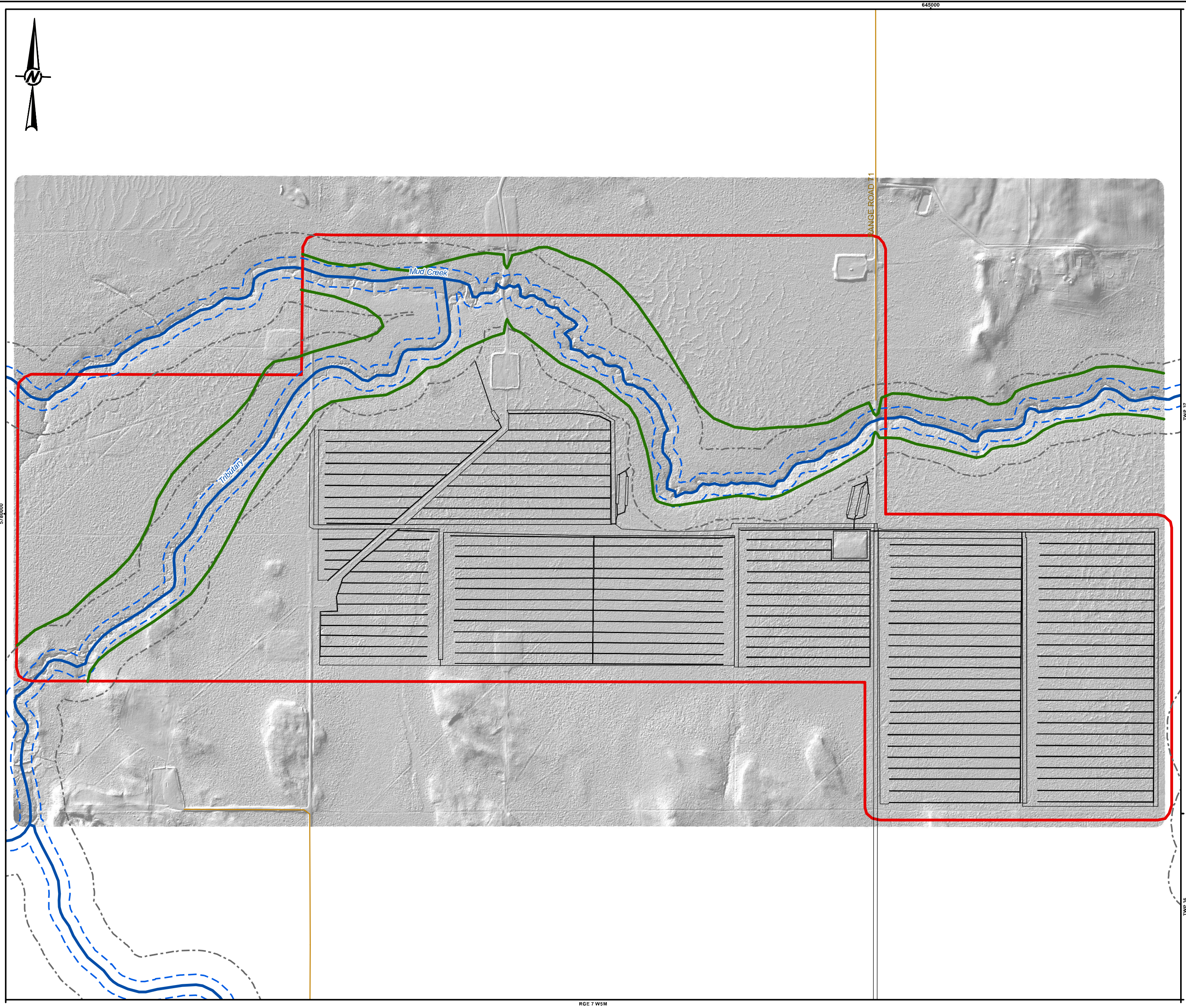
3.3.5.1 Considerations of Setbacks from Mud Creek

The selection of appropriate setbacks from Mud Creek and its tributary of 100 m for the Project is based on AEP direction communicated in 2021 will be sufficient to protect the aquatic ecosystem and considers the potential use of the riparian area by wildlife (AEP 2021). An assessment of the 100-year floodplain extent was previously conducted considering the AEP 2012 guidelines for development near waterbodies in Alberta (AEP 2012a). Both the 100 m set back from Mud Creek and its tributary and the 100-year floodplain extent are shown on Figure 3.3-1. Development of the Project setback from the Mud Creek should include consideration of the following factors per the guidelines:

- Water quality functions of the riparian areas
- Bank and shoreline stability
- Flood water conveyance and storage
- Habitat and biodiversity

Water Quality Functions

The AEP guidelines (AEP 2012a) suggest the effective widths for vegetation filter strips for removing nitrate, and trapping other contaminants including sediment and phosphorus. Therefore, the proper setback from Mud Creek for supporting water quality functions should be more than 20 m. However, since Mud Creek is a fish-bearing stream, the minimum setback for water quality functions should be approximately 30 m per the AEP guidelines.



LEGEND

- 🟩 100 YEAR FLOOD EXTENT
- 🟦 WATERCOURSE (PROVINCIAL BASE DATA)
- 🟥 LEASE BOUNDARY
- ☐ PROJECT FOOTPRINT - PHASE 1
- ⬚ WATERCOURSE - 30 m BUFFER
- ⬚ WATERCOURSE - 100 m BUFFER

0 200 400

1:11,000 METRES

REFERENCE(S)

ALBERTA DIGITAL BASE DATA OBTAINED FROM ALTALIS LTD.© GOVERNMENT OF ALBERTA 2016. ALL RIGHTS RESERVED.
LIDAR DATA PROVIDED BY AIRBORNE IMAGING INC.
PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
100 YEAR FLOOD EXTENT MAP

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	JC
PREPARED	ANK
REVIEWED	SC
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
21496738	2000	0	3.3-1

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Channel Bank Stability

The AEP guidelines suggest that appropriate setback be provided to keep any development from the shoreline areas that may be susceptible to bank movement and erosion. Based on the site assessment conducted by Golder on 12 May 2017, Mud Creek channel banks are stable in most locations but are unstable in some locations. Some reaches of the creek have vertical banks with good grass root zones increasing the bank stability. The creek and bank materials are predominately sand, silt and clay, which may be mixed with falling trees, organic debris and grass/tree roots. Photo 3.3-1 shows the typical creek bed and bank conditions that were observed during the site assessment in 2017.

Photo 3.3-2 shows examples of local bank failures that were observed during the site assessment. The frequency of occurrence of such bank failures along the creek is estimated in the range of one occurrence within 10 to 30 m reach of the creek. At these locations, there is a potential risk of lateral movement of the creek banks.

Based on the detailed LiDAR topographic data, the maximum lateral distance between the two adjacent sinuous creek bends along the Mud Creek is estimated to be approximately 60 m, or 30 m on both sides of the creek valley center line. Therefore, a setback distance of 30 m from the creek bank should be sufficient to address the risk of potential migration of creek banks associated with bank failure events and geomorphic changes over time.

Photo 3.3-1: Photos of Typical Bed and Bank along Mud Creek

Photo 3.3-2: Examples of Local Bank Failures and Potential Lateral Migration of Creek Banks

Floodplain

The AEP (2012) guidelines suggest that any development be set back from the 100-year flood inundation extents to maintain the riparian and flood storage functions of these floodplain areas, and to reduce the flood risk of the Project area.

Premier Tech conducted channel cross section surveys in July 2017 at nine select locations along the creek, which are shown in Figure 3.3-2. The channel survey data are provided in Appendix H. The channel cross section survey data and the LiDAR topographic data were used in combination to derive representative creek channel and floodplain cross sections for various sub-reaches. The LiDAR data was used to estimate the representative energy gradients or slopes for these sub-reaches.

The 100-year flood peak discharges were estimated for the various locations shown in Figure 3.3-2 based on the flood hydrology information provided by Stantec (Stantec 2013). The estimated flood discharges are listed in Table 3.3-7.

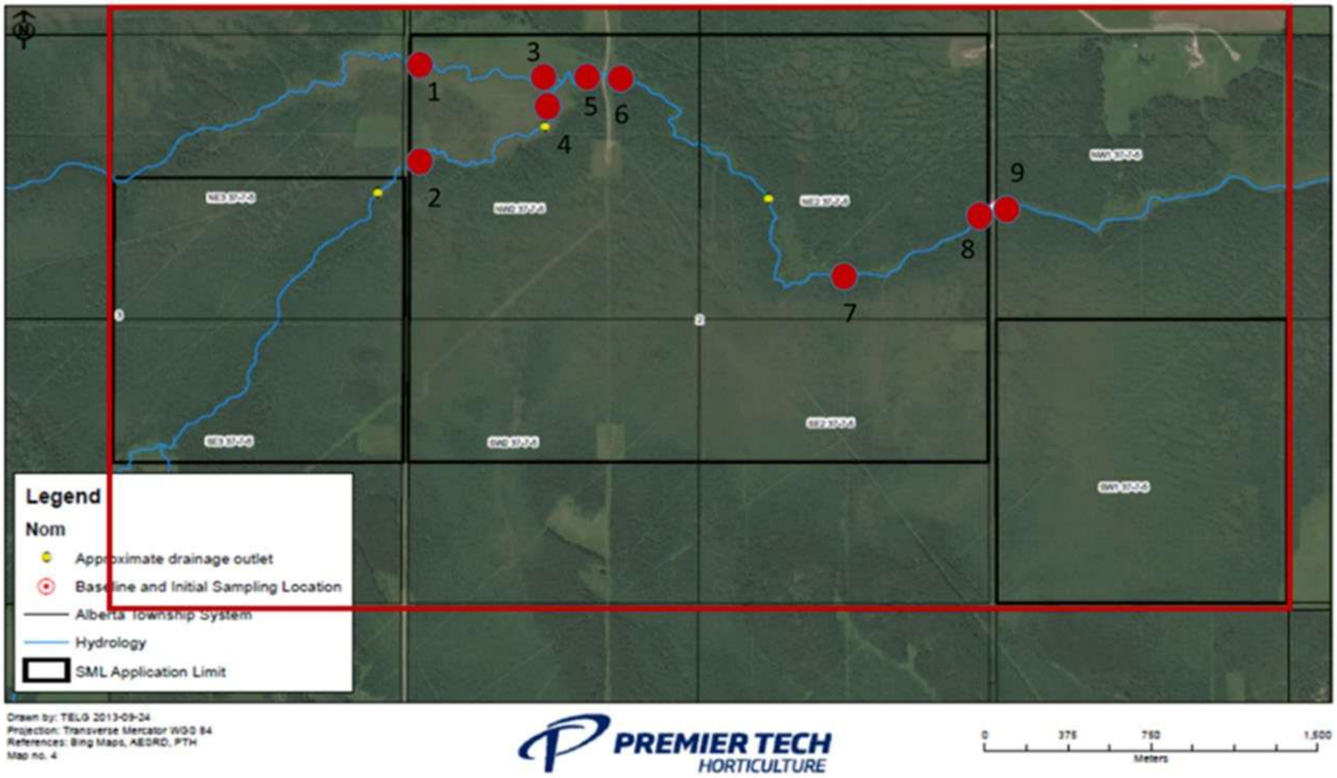

Figure 3.3-2: Channel Cross Section Survey Locations

Table 3.3-7: 100-Year Flood Peak Discharge Estimates

Location Number	Drainage Area (km^2)	100-Year Flood Peak Discharge (m^3/s)
1	4.6	9.6
2	26.5	38.9
3	5.6	11.2
4	27.0	39.4
5	33.5	46.9
6	33.5	46.9
7	35.2	48.8
8	40.9	55.0
9	40.9	55.0

km^2 = square kilometres; m^3/s = cubic metres per second.

The Manning's Equation was used to estimate the 100-year flood levels at the representative cross sections. The Manning's n (or roughness coefficient) values were conservatively estimated at 0.05 and 0.10 for the creek channel and floodplain, respectively. The estimated 100-year flood levels at the select cross sections were used to represent the flood levels at the various sub-reaches and to estimate the 100-year flood inundation extents. The resulting 100-year flood inundation extents are shown in Figure 3.3-1.

Setback Selection

A number of factors were considered for selecting the appropriate Project setback per the AEP guidelines however AEP provided direction that the 100 m setback should govern over other factors such as the 100-year flood extent. Figure 3.3-1 shows that the 100-year flood extents were usually closer to the watercourses than the 100 m setback.

The Project footprint is designed so that harvest areas, sedimentation ponds and outlet locations will be outside of the 100 m setback from Mud Creek and its unnamed tributary (Figure 3.3-1).

Effects to water quantity and quality were assessed for the duration of construction and operation of the Project. The potential effects resulting from Project activities, recommended mitigation to address these issues, and predicted residual effects are summarized in Table 3.3-8.

Mitigation and contingency measures to be included in the operational water management and closure drainage plans include the following:

- Implement the 100 m Project setback from watercourses per AEP direction.
- These 100 m buffer zones mainly consist of well-vegetated areas that will act as a filter for residual solids that may have not settled in the sedimentation ponds.
- Outflows from the drainage ditch networks will be routed through sedimentation ponds to three outlet locations and timing and discharge rates will be controlled through pumping rates and methods used to disperse discharge water at the peat surface
- When higher discharge rates are expected at the outlets (e.g., in spring following ditch development), the releases from the outlets will be staggered by a week to reduce downstream flows

- Sedimentation ponds will function to reduce sediment and organic matter (i.e., peat dust) from entering the watercourses and allow the timing and rate of discharge to be controlled. The volume of the sedimentation pond is proportional to the size of each harvesting area from which water is drained and the length/width ratios were optimized to enhance settling.
- Design and implement self-sustaining closure landscape and drainage system to have similar characteristics as the natural systems in the project area in terms of dynamic stability, robustness, longevity and self-sustaining capability.

Post closure, field ditches will be infilled, and water levels are expected to be close to the surface of the peat after decommissioning of the operational drainage network. The post-reclamation area will continue to drain toward Mud Creek and its tributary. While changes to the water table elevation may occur after closure and reclamation relative to the natural condition, the application of effective mitigation is expected to allow the water table to near the reclaimed peat surface with negligible changes to flows in the receiving environment.

Water quantity and quality monitoring will be collected as per the proposed Surface Water Monitoring Plan for the project (Appendix E).

The water management systems will be operated and maintained to meet the environmental management objectives. The outlet locations shown in Figure 2.3-8 are outside the 100 m setback from the watercourses. Pumping of discharge water to the peat surface and dispersing it over the vegetated buffer (Figure 2.3-8) will result in more gradual water releases to the receiving environment, and provide further mitigation of sediment concentration or water temperatures if these are still above the release criteria trigger thresholds downstream of the sedimentation ponds.

Table 3.3-8: Potential Effects, Mitigation and Predicted Residual Effects for Hydrology and Water Quality

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Project footprint (e.g., access road, site preparation, drainage of harvested area, equipment operations) Construction and Operation	■ Drainage of harvested areas could have adverse impacts to: ■ flow regimes in the downstream creek (Mud Creek and its tributary) (e.g., flooding) ■ channel morphology, that could affect the stability or use of the creek (e.g., fish habitat) ■ water quality that affects the use of the water (e.g., for fish or the food that fish feed on, wildlife, agricultural or recreational purposes in Mud Creek due to the release of discharges from the sedimentation ponds).	■ Drainage ditches and sedimentation ponds will be constructed to control and manage the water stored in the fen during harvesting and the rate of discharge. ■ Construction of drainage ditches and sedimentation ponds will be completed during winter to reduce the risks of runoff events that could carry sediment loads to Mud Creek during construction. ■ Sedimentation ponds will control concentrations of suspended solids, dissolved organic matter, and nitrogen and phosphorus compounds in the water prior to release. ■ Monitoring, maintenance and cleaning of drainage ditches and sedimentation ponds and outlets at the pumping locations will be completed so they are functioning as designed. ■ A 100 m setback from Mud Creek and its tributary will be used for the Project and include sedimentation ponds and outlet locations ■ Water released from the sedimentation ponds to the outlet channels will be pumped to the peat surface allowing for more gradual release to the environment that will further reduce potential water quality impacts. ■ Release of water from the West Outlet, Central Outlet, and East Outlet in spring (assumed to occur in May) will be staggered by one week to reduce downstream flow increases. ■ Water quantity and quality monitoring will be conducted according to the Surface Water Monitoring Plan for the Project (Appendix E)	■ Effects to flow regimes, channel morphology and water quality are anticipated to be negligible if the proposed mitigation are implemented.

Table 3.3-8: Potential Effects, Mitigation and Predicted Residual Effects for Hydrology and Water Quality

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Closure and Reclamation	▪ Disturbed landscape could result in the same potential effects described for construction and operations.	▪ The closure landscape and drainage system will be designed such that it has similar characteristics to the natural system in terms of dynamic stability, robustness, longevity, and self-sustaining capability. ▪ Progressive reclamation will be carried out to minimize the area of disturbance at any given time. ▪ Salvaged peat material will be returned to the landscape and contoured, to the extent practical, to blend with the surrounding terrain. ▪ Contouring of disturbed areas will be completed to minimize peat and water erosion, re-establish drainage, and encourage vegetation growth. ▪ All buildings, concrete pads, and other structures will be removed at closure. ▪ All site access and service roads will be removed or returned to pre-Project conditions. ▪ Disturbed areas will be re-contoured and reclaimed to a stable surface profile to maintain existing land uses. ▪ Field ditches will be infilled and sedimentations ponds will be removed	▪ Effects to flow regimes, channel morphology and water quality in the receiving environment are anticipated to be negligible if the proposed mitigation are implemented.

Table 3.3-8: Potential Effects, Mitigation and Predicted Residual Effects for Hydrology and Water Quality

Interactions	Potential Effects	Mitigation	Predicted Residual Effects

Accidents and Malfunctions	▪ Water quality of Mud Creek could be adversely affected by:
	  ▪ accidental releases of sediment loads during construction (e.g., construction of ditches or sediment ponds) or operations (i.e., during harvesting) during a high runoff event
	  ▪ fuel spills from machinery used during construction or operations.
		▪ Construction of drainage ditches and sedimentation ponds will be completed during winter to reduce the risks of runoff events that could carry sediment loads to Mud Creek during construction.
		▪ Monitoring, maintenance and cleaning of drainage ditches and sedimentation ponds will be completed so they are functioning as designed.
		▪ A 100 m setback from Mud Creek and its tributary will be used for the Project and include sedimentation ponds and outlet locations
		▪ Water released from the sedimentation ponds to the outlet channels will be pumped to the peat surface allowing for more gradual release to the environment that will further reduce potential water quality impacts.
		▪ Instructions and the required equipment to clean up potential spills of fuel or other potentially hazardous material used during construction or operations will be available.
		▪ Reporting requirements for releases of substances into the environment that could cause an adverse effect will be followed per the Guide to Release Reporting (Alberta Environment 2005).
			▪ Effects to water quality are anticipated to be negligible if the proposed mitigations are implemented.

3.3.6 Social, Cultural, and Land Use Issues

Effects to social, cultural, and land use issues were assessment for the duration of construction and operation of the Project. The potential effects resulting from Project activities, recommended mitigation to address these issues, and predicted residual effects and evaluation criteria are summarized in Table 3.3-9.

Table 3.3-9: Potential Effects, Mitigation and Predicted Residual Effects for Social, Cultural, and Land Use Issues

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Construction, Operation and Closure	▪ Increase in local employment and income levels from the Project ▪ Increase in procurement of goods and services from local contractors and businesses due to the Project	▪ No mitigation is required	NA
	▪ Increased demand for emergency services due to the Project beyond the capacity of local resources.	▪ Basic and specific training of workers will be required as part of the Health, Safety and Environmental Management System. ▪ An Emergency Response Plan will be prepared by Premier Tech prior to the commencement of activities and followed in the event of an emergency (i.e., fire, medical emergencies, hydrocarbon spills, and natural incidents). ▪ To limit the occurrence of vehicular accidents, training for equipment operators will be implemented as part of the Occupational Health and Safety Plan included in Premier Tech's Health, Safety and Environmental Management System. ▪ The generator will be placed in appropriate secondary containment capable of containing a spill of fuel, oil, or antifreeze and will be regularly maintained and inspected for leaks as part of Premier Tech's Health, Safety and Environmental Management System. ▪ All hazardous substances and waste dangerous goods will be stored in appropriate double-walled containers that will be located on a concrete containment pad with a wall, which will provide secondary containment of spills. ▪ Premier Tech will work with local emergency service providers so that they are aware of the Project and are able to respond to work-related emergencies if necessary. ▪ Firefighting equipment (i.e., water tank wagon with pump, fire extinguishers, and shovels) will be regularly maintained and readily available on site and personnel will be trained to respond to Project-related fire emergencies if they occur. ▪ The Fire Prevention Plan (Appendix F) will be updated as needed to reflect any changes to site conditions (e.g., new harvest areas or new reclamation areas) or planned site activities.	▪ Negligible once mitigation is implemented
	▪ Increase in traffic volume resulting from the Project that could create traffic delays and congestion.	▪ Project-related traffic will be seasonal. ▪ Operation of transport trucks will occur only during daylight hours and will be dependent on weather and driving conditions.	▪ Negligible once mitigation is implemented

Table 3.3-9: Potential Effects, Mitigation and Predicted Residual Effects for Social, Cultural, and Land Use Issues

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Project footprint (e.g., access road, site preparation, drainage of harvested area, equipment operations) Construction and Operation	▪ Disruption of agricultural activity and/or loss of land base ▪ Disruption of other land uses and/or loss of land base ▪ Disruption of hunting, trapping, and fishing activities due to increased human activity	▪ Premier Tech will respect the rights of disposition holders in the Land Use LSA and will reach agreements with non-renewable resource users in the Land Use LSA, as applicable. ▪ Project construction and operation will comply with all applicable codes, standards and regulations. ▪ Notify registered trappers at least 10 days prior to construction. ▪ Provide potentially affected Indigenous groups with the proposed Project construction schedule and maps ▪ Agreements will be reached with the AEP regarding the cutting and salvaging of merchantable timber in the Project footprint along the main access road. ▪ Existing trails will be used where possible to provide access to the vicinity of the harvesting area to reduce the amount of new road construction required for the Project. ▪ Premier Tech will work with the AEP (who administers the Crown Resource Land), and existing users of the surrounding Crown Resource Land to develop the best approach for managing access to the Project (e.g., Access Management Plan). Premier Tech's preference would be for the access road to be gated to discourage public vehicle access; however, to maintain access into the Crown Resource Land for ATVs and snowmobiles. ▪ During access road construction and initial site preparations it is expected that some activity will occur during frozen ground conditions and some snow clearing may be required. ▪ Signs will be placed at the access road and potential access locations surrounding the Project site to identify industrial activity and warn of the dangers of discharging firearms along the access corridor and on the Project site. ▪ Site closure activities, including demolition, salvage, and/or disposal of site infrastructure and facilities will be completed as soon as possible following the end of operations as per the Closure and Reclamation Plan. ▪ The access road may be returned to pre-Project conditions (e.g., cease maintenance as an all-season access and allow it to return to an ATV/snowmobile trail) or released to another user or stakeholder group (e.g., recreational users), following consultation with regulators and other stakeholders at the time of Project closure.	▪ Negligible once mitigation is implemented

Table 3.3-9: Potential Effects, Mitigation and Predicted Residual Effects for Social, Cultural, and Land Use Issues

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Project footprint (e.g., access road, site preparation, drainage of harvested area, equipment operations) Construction and Operation Continued	▪ Alteration of viewscapes and visual aesthetics	▪ Site closure activities, including demolition, salvage, and/or disposal of site infrastructure and facilities will be completed as soon as possible following the end of operations as per the Closure and Reclamation Plan. ▪ The main access road may be returned to pre-Project conditions (e.g., cease maintenance as an all-season access and allow it to return to an ATV/snowmobile trail) or released to another user or stakeholder group (e.g., recreational users), following consultation with regulators and other stakeholders at the time of Project closure.	▪ Negligible once mitigation is implemented
	▪ Project activities such as drainage network construction and operation, access road construction, clearing, internal roads and peat harvesting may cause changes to local surface water elevations, flows and drainage patters which may alter surface and groundwater quantity, and quality beyond guideline values and increase risk to human health.	▪ Mitigation described in Water Management (Section 3.3.5) will be implemented to address potential effects on water quality. ▪ Implementation of a Surface Water Monitoring Plan, including a water quality monitoring program to provide input for adaptive management/mitigation. ▪ A 100 m avoidance buffer will be established around Mud Creek and the Unnamed Tributary from sedimentation ponds and harvest areas. ▪ Culverts will be installed or replaced along the access roads as required to maintain downstream flows and watercourse pathways. ▪ The Project Development Plan is progressive, main and secondary drainage ditches within new harvest areas will be opened in stages to limit the amount of disturbance at one time. ▪ Implementation of design features that include low slopes in the peat drain network and sedimentation ponds to store water and release it slowly to reduce erosion, and facilitate settling of suspended peat particles. ▪ Implementation of a water quality monitoring program to provide input for adaptive management/mitigation. ▪ Control devices at the outflows of the sedimentation ponds will allow the timing and quantity of water released into the environment to be managed as needed. ▪ Outflow ditches will be surrounded by a buffer of peatland or wetland habitat which is expected to attenuate downstream flooding.	▪ Negligible once mitigation is implemented

Table 3.3-9: Potential Effects, Mitigation and Predicted Residual Effects for Social, Cultural, and Land Use Issues

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Closure and Reclamation	▪ Residual ground disturbance can cause alteration of local surface water flows, drainage patterns (distribution), and surface water quality, which can affect land and resource use.	▪ Site closure activities include the demolition, salvage, and/or disposal of site infrastructure and facilities. ▪ A Development and Operations Plan includes the schedule for opening and closure of harvest areas as well as progressive reclamation of post-harvest areas as they are completed. ▪ A 100 m avoidance buffer will be established around Mud Creek. ▪ All harvest access roads within harvest areas will be removed. ▪ Salvaged soil material will be returned to the landscape and contoured, to the extent practical, to blend with the surrounding terrain. ▪ The main access road may be returned to pre-Project conditions (e.g., cease maintenance as an all-season access and allow it to return to an ATV/snowmobile trail) or released to another user or stakeholder group (e.g., recreational users), following consultation with regulators and other stakeholders at the time of Project closure. ▪ A detailed Conservation and Reclamation Plan will be developed in accordance with reclamation best practices recognized at the time of closure and will be reviewed and updated as necessary to include lessons learned over the course of operations and throughout the reclamation phase.	▪ Negligible once mitigation is implemented

Table 3.3-9: Potential Effects, Mitigation and Predicted Residual Effects for Social, Cultural, and Land Use Issues

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Accidents and Malfunctions	- Chemical spills (i.e., fuels, petroleum products) on site and during transport of material to the packaging plant may affect land and resource use.	- Standard industry practices for construction and material handling procedures will be adopted. - Equipment will be inspected for leaks, repaired prior to entry into the Project site, and routinely inspected throughout the duration of the Project as part of Premier Tech's Health, Safety, and Environmental Management System. - Spill response equipment will be readily available. Any spills will be isolated and cleaned up immediately. - Spill kits will be located in the immediate vicinity of fuelling stations. - In the event of a spill, an appropriate soil remediation program will be implemented that addresses site-specific conditions (e.g., soil type, chemical properties of the spill material). - An Emergency Response Plan will be prepared by Premier Tech prior to the commencement of activities and followed in the event of an emergency. - The generator will be placed in appropriate secondary containment capable of containing a spill of fuel, oil, or antifreeze and will be regularly maintained and inspected for leaks as part of Premier Tech's Health, Safety and Environmental Management System. - All hazardous substances and waste dangerous goods will be stored in appropriate double-walled containers that will be located on a concrete containment pad with a wall, which will provide secondary containment of spills. - Fuel tanks, fuel lines, and generators will be regularly inspected as part of Premier Tech's Health, Safety, and Environmental Management System. - No fuels, oils, or other hazardous substances will be stored within 100 m of any waterbody. - No equipment maintenance or re-fuelling will be conducted within 100 m of any waterbody unless appropriate primary and secondary containment is in place. - Actions identified in the Emergency Response Plan will be implemented immediately in the unlikely event of a spill. - Reporting requirements for releases of substances into the environment that could cause an adverse effect will be followed per the Guide to Release Reporting (Alberta Environment 2005).	- Negligible once mitigation is implemented

Table 3.3-9: Potential Effects, Mitigation and Predicted Residual Effects for Social, Cultural, and Land Use Issues

Interactions	Potential Effects	Mitigation	Predicted Residual Effects
Accidents and Malfunctions Continued	A wildfire started by Project activities may result in loss of land and resource use.	- Premier Tech will follow their Fire Prevention and Procedures Program (Appendix F) for the duration of the Project. - Firefighting equipment will be on site, readily accessible, and serviceable during the fire season. - All water packs and pails will be kept full of water during the fire season. - All heavy equipment and fuelling sites will be equipped with approved and fully charged fire extinguishers. - Fire extinguishers and firefighting equipment will be located at strategic points throughout the site, and will be maintained in good working order. - Appropriate firefighting training will be provided to ensure that an effective and efficient force of appropriately trained individuals is always on site to perform necessary fire suppression duties. - All equipment on site will be kept clean and in good operating condition so that there is no build-up of combustible materials near manifolds, exhaust systems, and mufflers. - No smoking will be allowed at equipment fuelling stations or outside of designated areas at all times. - An Emergency Response Plan will be prepared by Premier Tech prior to the commencement of activities and followed in the event of an emergency.	- Negligible once mitigation is implemented

4.0 CONCLUSION

The potential environmental effects of the Project are considered negligible and can be readily mitigated by standard and specific environmental protection measures. The predicted residual effects associated with the Project are similar to those normally encountered during peat extraction. Based on the knowledge of the Project available as of completion this report, and taking into account the implementation of the mitigation described in the effects assessment, this report concludes that the predicted residual environmental effects associated with the Project are anticipated to be negligible.

5.0 CLOSURE

The material contained in this report reflects Golder's best judgment based on the information available and provided at the time of preparation. Golder has relied upon the representations or opinions of persons contacted during the preparation of this report. The accuracy of these representations and opinions will affect the accuracy of this report.

The reported information is believed to provide a reasonable representation of the general environmental conditions at the Project location. Any use of this report or any reliance on, or decisions based on this report by a third party is the responsibility of such third parties. Golder will not be held responsible or liable for any damages to the physical environment, any property, or to life, which may have occurred from actions of decisions based upon any of the information within this report.

Signature Page

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APPENDIX A

Detailed Peat Sampling Data 2008, 2017, 2020 and 2021

Table A-1: Detailed Peat Sampling Data from 2021, 2020, 2017, and 2008

Site ID	Footprint/Harvest Year	Easting	Northing	Soil Classification	Soil Series	Topsoil Thickness (cm)	Organic Depth (cm)	Mineral Soil Surface (cm)	Soil Drainage	Soil Horizon	Horizon Depth (cm)	Von Post Rating	pH	Texture	Soil Colour	Effervescence
Golder 2021																
PC21JD001	Sediment Pond	644871	5780172	TY.M	NTN	0	220	>220	VP	Of	0 - 40	H3	-	-	-	-
										Om1	40 - 100	H5	-	-	-	-
										Om2	100 - 150	H6	-	-	-	-
										Oh	150 - 220	H7	-	-	-	-
PC21JD002	Creek Exploration	644869	5780269	TY.M	NTN	0	218	>218	VP	Of	0 - 20	H3	-	-	-	-
										Om	20 - 218	H5	-	-	-	-
										Cg	218 - 220	-	-	Silty Clay	-	-
PC21JD003	Yard Site	644873	5779999	TY.M	NTN	0	220	>220	VP	Of	0 - 50	H3	-	-	-	-
										Om	50 - 220	H5	-	-	-	-
PC21JD004	Harvest Section 1	644864	5779922	FI.M	NTNzz	0	220	>220	VP	Of	0 - 70	H3	-	-	-	-
										Om	70 - 220	H5	-	-	-	-
PC21JD005	Creek Exploration	644579	5780079	ME.F	NTNzz	0	220	>220	VP	Of1	0 - 70	H3	-	-	-	-
										Of2	70 - 130	H4	-	-	-	-
										Om	130 - 220	H5	-	-	-	-
PC21JD006	Harvest Section 1	644577	5779980	ME.F	NTNzz	0	220	>220	VP	Of1	0 - 70	H3	-	-	-	-
										Of2	70 - 130	H4	-	-	-	-
										Om	130 - 220	H5	-	-	-	-
PC21JD007	Harvest Section 1	644566	5779854	ME.F	NTNzz	0	220	>220	VP	Of1	0 - 50	H2	-	-	-	-
										Of2	50 - 100	H3	-	-	-	-
										Om1	100 - 200	H5	-	-	-	-
										Om2	200 - 220	H6	-	-	-	-
PC21JD008	Harvest Section 3	644100	5779950	ME.F	NTNzz	0	220	>220	VP	Of1	0 - 60	H3	-	-	-	-
										Of2	60 - 100	H4	-	-	-	-
										Om	100 - 170	H5	-	-	-	-
										Oh	170 - 220	H7	-	-	-	-
PC21JD009	Harvest Section 4	644097	5780047	ME.F	NTNzz	0	220	>220	VP	Of1	0 - 40	H2	-	-	-	-
										Of2	40 - 110	H4	-	-	-	-
										Om1	110 - 150	H5	-	-	-	-
										Om2	150 - 220	H6	-	-	-	-
PC21JD010	Harvest Section 4	644096	5780174	ME.F	NTNzz	0	220	>220	VP	Of1	0 - 50	H2	-	-	-	-
										Of2	50 - 120	H4	-	-	-	-
										Om1	120 - 170	H5	-	-	-	-
										Om2	170 - 220	H6	-	-	-	-
PC21JD011	Harvest Section 4	644100	5780287	ME.F	NTNzz	0	220	>220	VP	Of1	0 - 30	H2	-	-	-	-
										Of2	30 - 130	H4	-	-	-	-
										Om	130 - 220	H6	-	-	-	-
PC21JD012	Creek Exploration	644107	5780395	ME.F	NTNzz	0	220	>220	VP	Of1	0 - 40	H2	-	-	-	-
										Of2	40 - 100	H4	-	-	-	-
										Om1	100 - 160	H5	-	-	-	-
										Om2	160 - 220	H6	-	-	-	-
Golder 2020																
PC20CB001	Alternate Access Road	644805	5780930	TY.M	NTN	N/A	220	>220	VP	Of	0 - 10	H3	-	-	-	-
										Om1	10 - 90	H5	-	-	-	-
										Om2	90 - 130	H6	-	-	-	-
										Om3	130 - 220	H5	-	-	-	-
PC20CB002	Alternate Access Road	644883	5780720	TY.M	NTN	N/A	220	>220	VP	Om	0 - 120	-	-	-	-	-
										Of	120 - 220	-	-	-	-	-
PC20CB003	Alternate Access Road	644866	5780405	TY.M	NTNyc	N/A	200	200	VP	Om1	0 - 120	-	-	-	-	-
										Oh	120 - 135	-	-	-	-	-
										Om2	135 - 165	-	-	-	-	-
										Of	165 - 200	-	-	-	-	-
										Ckg	200 - 220	-	-	Silty Clay Loam	5Y4/1- Dark Gray	moderate
PC20CB004	Creek Exploration	644901	5780355	GLCU.HR	GRZaagl	60	0	40	I	Ah	0 - 35	-	-	Sandy Loam	10YR2/2- Very Dark Brown	none
										Om	35 - 40	-	-	-	-	-
										Ahb	40 - 100	-	-	Loam	10YR2/2- Very Dark Brown	-
PC20CB005	Alternate Access Road	644862	5780315	T.M	NTNxc	N/A	55	55	VP	Om	0 - 55	H5	-	-	-	-
										Cg	55 - 75	-	-	Heavy Clay	5Y4/3- Olive	-
PC20CB006	Harvest Section 1	644853	5779852	ME.F	NTNzz	N/A	220	>220	VP	Of1	0 - 20	H2	-	-	-	-
										Of2	20 - 45	H4	-	-	-	-
										Om	45 - 100	H5	-	-	-	-
										Of3	100 - 220	H4	-	-	-	-
PC20CB007	Harvest Section 1	644859	5779655	TY.F	NTNzz	N/A	220	>220	VP	Of1	0 - 120	H3-H4	-	-	-	-
										Om	120 - 140	H5	-	-	-	-
										Of2	140 - 220	H4	-	-	-	-
PC20CB008	Creek Exploration	644466	5780133	R.G	CYNptzr	42	37	37	P	Om	0 - 10	H4	-	-	-	-
										Oh	10 - 37	H7	-	-	-	-
										Ah	37 - 42	-	-	-	10YR2/1- Black	-
										Cg	37 - 55	-	-	Silty Clay	5Y5/1- Gray	none
PC20CB009	Sediment Pond	644465	5780118	ME.F	NTNzz	N/A	160	160	VP	Of1	0 - 85	H4	-	-	-	-
										Om	85 - 120	H5	-	-	-	-
										Of2	120 - 160	H4	-	-	-	-
										Cg	160 - 180	-	-	Sandy Clay Loam	10Y 5/1- Greenish Gray	-
PC20CB010	Harvest Section 3	644431	5779998	FI.M	NTNzz	N/A	220	>220	VP	Of1	0 - 15	H4	-	-	-	-
										Om1	15 - 70	H5	-	-	-	-
										Of2	70 - 120	H4	-	-	-	-
										Om2	120 - 150	H5	-	-	-	-
										Of3	150 - 200	H4	-	-	-	-
										Of4	200 - 220	H3	-	-	-	-
PC20CB011	Harvest Section 4	644147	5780266	TY.F	NTNzz	N/A	225	>225	VP	Om	0 - 25	H5	-	-	-	-
										Of	25 - 210	H3-H4	-	-	-	-
										Om2	210 - 225	H5	-	-	-	-
PC20CB012	Harvest Section 4	643738	5779997	TY.F	NTNzz	N/A	220	>220	VP	Of1	0 - 15	H1	-	-	-	-
										Om	15 - 35	H5	-	-	-	-
										Of2	35 - 220	H4	-	-	-	-
PC20CB013	Harvest Section 5	643342	5780347	FI.M	NTNzz	N/A	220	>220	VP	Om1	0 - 120	H5	-	-	-	-
										Of	120 - 175	H3-H4	-	-	-	-
										Om2	175 - 220	H5	-	-	-	-
PC20CB014	Phase 2	643179	5780316	FI.M	NTNzz	N/A	220	>220	VP	Om1	0 - 15	H6	-	-	-	-
										Oh	15 - 45	H7	-	-	-	-
										Om2	45 - 70	H5	-	-	-	-
										Of	75 - 120	H3	-	-	-	-
										Om3	120 - 220	H5	-	-	-	-
PC20CB015	Harvest Section 4	643344	5779632	TY.M	NTNyc	N/A	175	175	VP	Of	0 - 10	H2	-	-	-	-
										Om	10 - 170	H4-H5	-	-	-	-
										Oh	170 - 175	H7	-	-	-	-
										Ckg	175 - 180	-	-	Silty Clay Loam	10Y 5/1- Greenish Gray	moderate
PC20CB016	Harvest Section 3	643889	5779768	TY.M	NTN	N/A	185	185	VP	Of1	0 - 10	H2	-	-	-	-
										Om1	10 - 65	H6	-	-	-	-
										Om2	65 - 90	H5	-	-	-	-
										Om3	90 - 130	H6	-	-	-	-
										Om4	130 - 175	H5	-	-	-	-
										Oh	175 - 185	H7	-	-	-	-
										Ckg	185 - 190	-	-	Silt Loam	2.5Y4/3- Olive Brown	weak
PC20CB017	Harvest Section 3	644225	5779659	TY.F	NTNzz	N/A	220	>220	VP	Om1	0 - 60	H5	-	-	-	-
										Of	60 - 170	H4	-	-	-	-
										Om2	170 - 220	H5	-	-	-	-
PC20CB018	Harvest Section 2	645425	5779283	THU.M	NTNzz	N/A	110	110	VP	Om1	0 - 45	H5	-	-	-	-
										Om2	45 - 85	H6	-	-	-	-
										Oh	85 - 110	H7	-	-	-	-
										Cg	110 - 120	-	-	Silty Clay Loam	2.5Y4/1- Dark Gray	-
PC20CB019	Harvest Section 2	645658	5780009	ME.F	NTNzz	N/A	220	>220	VP	Om1	0 - 40	H5	-	-	-	-
										Om2	40 - 90	H6	-	-	-	-
										Of1	90 - 110	H4	-	-	-	-
										Of2	110 - 160	H3	-	-	-	-
										Om3	160 - 220	H5	-	-	-	-
PC20CB020	Harvest Section 2	645660	5779670	TY.F	NTNzz	N/A	220	>220	VP	Om1	0 - 40	H5	-	-	-	-
										Of1	40 - 65	H4	-	-	-	-
										Of2	65 - 105	H3	-	-	-	-
										Of3	105 - 170	H4	-	-	-	-
										Om2	170 - 220	H5	-	-	-	-
PC20CB021	Harvest Section 2	645672	5779293	FI.M	NTNzz	N/A	220	>220	VP	Om	0 - 90	H5	-	-	-	-
										Of1	90 - 105	H4	-	-	-	-
										Ofk	105 - 145	H4	-	-	-	strong (snail shells)
										Omk	145 - 185	H5	-	-	-	-
										Of2	185 - 220	H4	-	-	-	-
PC20CB022	Harvest Section 1	645323	5779610	ME.F	NTNzz	N/A	200	200	VP	Of1	0 - 95	H4	7.53	-	-	-
										Om1	95 - 140	H5	6.86	-	-	-
										Of2	140 - 180	H4	6.9	-	-	-
										Om2	180 - 200	H5	6.9	-	-	-
										Ckg	200 - 220	-	-	Silty Clay	N 4/1- Dark Gray	strong
PC20CB023	Phase 2	642882	5780299	ME.F	NTNzz	N/A	220	>220	VP	Om1	0 - 85	H5	-	-	-	-
										Of	85 - 165	H4	-	-	-	-
										Om2	165 - 220	H5	-	-	-	-
PC20CB024	Phase 2	642460	5780229	ME.F	NTNzz	N/A	220	>220	VP	Om1	0 - 70	H6	-	-	-	-
										Of	70 - 130	H4	-	-	-	-
										Om2	130 - 220	H5	-	-	-	-
PC20CB025	Phase 2	642496	5779922	TY.M	NTN	N/A	220	>220	VP	Om1	0 - 165	H5	-	-	-	-
										Of	165 - 185	H4	-	-	-	-
										Om2	185 - 220	H5	-	-	-	-
PC20CB026	Phase 2	642530	5779705	HU.M	NTNzz	N/A	210	>210	VP	Om	0 - 120	H6	-	-	-	-
										Oh	120 - 150	H7	-	-	-	-
										Om2	150 - 210	H5	-	-	-	-
PC20CB027	Phase 2	642882	5779999	HU.M	NTNzzyc	N/A	175	175	VP	Om1	0 - 65	H5	-	-	-	-
										Om2	65 - 100	H6	-	-	-	-
										Oh1	100 - 125	H7	-	-	-	-
										Om3	125 - 145	H5	-	-	-	-
										Oh2	145 - 175	H7	-	-	-	-
										Cg	175 - 185	-	-	Silty Clay Loam	N 5/1- Gray	-
PC20CB028	Phase 2	642865	5779829	GLCU.R	IOSgl	N/A	0	0	I	Cgj	0 - 25	-	-	Silty Clay Loam	2,5Y4/2- Dark Grayish Brown	-
										C	25 - 60	-	-	Loamy Sand	2,5Y4/2- Dark Grayish Brown	-
PC20CB029	Phase 2	643197	5780005	ME.F	NTNzz	N/A	220	>220	VP	Om1	0 - 95	H5	-	-	-	-
										Of1	95 - 110	H4	-	-	-	-
										Om2	110 - 130	H5	-	-	-	-
										Of2	130 - 150	H4	-	-	-	-
										Om3	150 - 175	H5	-	-	-	-
										Of3	175 - 220	H4	-	-	-	-
PC20CB030	Phase 2	643099	5779729	T.M	NTNxc	N/A	125	125	VP	Om1	0 - 90	H5	-	-	-	-
										Of	90 - 105	H4	-	-	-	-
										Om2	105 - 125	H6	-	-	-	-
										Cg	125 - 140	-	-	Silty Clay Loam	5Y4/1- Dark Gray	-

Table A-1: Detailed Peat Sampling Data from 2021, 2020, 2017, and 2008

Site ID	Footprint/Harvest Year	Easting	Northing	Soil Classification	Soil Series	Topsoil Thickness (cm)	Organic Depth (cm)	Mineral Soil Surface (cm)	Soil Drainage	Soil Horizon	Horizon Depth (cm)	Von Post Rating	pH	Texture	Soil Colour	Effervescence
Premier Tech 2017																
1-17	Harvest Section 1	644666	5780021	FI.M	NTNzz	N/A	330	330	VP	Of	0 - 50	H4	-	-	-	-
										Om	50 - 330	H6	-	-	-	-
										Cg	330+	-	-	Clay	-	-
2-17	Harvest Section 3	644456	5780020	ME.H	NTNzz	N/A	330	330	VP	Om	0-50	H5	-	-	-	-
										Oh	50-330	H7	-	-	-	-
										Cg	330	-	-	Clay	-	-
3-17	Harvest Section 3	644241	5780008	HU.F	DDEaazz	N/A	330	330	VP	Oh1	0-50	H7	-	-	-	-
										Of	50-100	H4	-	-	-	-
										Oh2	100-330	H7	-	-	-	-
										Cg	330	-	-	Clay	-	-
4-17	Harvest Section 3	644050	5780003	HU.F	DDEaazz	N/A	360	360	VP	Om	0-50	H6	-	-	-	-
										Of	50-100	H4	-	-	-	-
										Oh	100-360	H7	-	-	-	-
										Cg	360	-	-	Clay	-	-
5-17	Harvest Section 4	643832	5780000	HU.F	DDEaazz	N/A	350	350	VP	Om	0-50	H6	-	-	-	-
										Of	50-125	H4	-	-	-	-
										Oh	125-350	H7	-	-	-	-
										Cg	350	-	-	Clay	-	-
6-17	Harvest Section 4	643527	5779984	FI.H	BNNaazz	N/A	400	400	VP	Of	0-75	H4	-	-	-	-
										Oh	75-400	H8	-	-	-	-
										Cg	400	-	-	Clay	-	-
7-17	Harvest Section 5	643284	5779977	FI.H	BNNaazz	N/A	350	350	VP	Of	0-75	H4	-	-	-	-
										Oh	75-350	H8	-	-	-	-
										Cg	350	-	-	Clay	-	-
8-17	Harvest Section 4	643279	5779775	ME.H	BNNaazz	N/A	330	330	VP	Om	0-75	H5	-	-	-	-
										Oh	75-330	H8	-	-	-	-
										Cg	330	-	-	Clay	-	-
9-17	Harvest Section 5	643274	5780140	ME.H	BNNaazz	N/A	400	400	VP	Om	0-75	H5	-	-	-	-
										Oh	75-400	H8	-	-	-	-
										Cg	400	-	-	Clay	-	-
10-17	Harvest Section 4	643812	5780297	FI.H	BNNaazz	N/A	300	300	VP	Of	0-50	H4	-	-	-	-
										Oh	50-300	H8	-	-	-	-
										Cg	300	-	-	Clay	-	-
11-17	Harvest Section 4	643820	5780153	HU.M	NTNzz	N/A	400	400	VP	Oh1	0-75	H8	-	-	-	-
										Om	75-200	H5	-	-	-	-
										Oh2	200-400	H8	-	-	-	-
										Cg	400	-	-	Clay	-	-
12-17	Harvest Section 3	644103	5779855	HU.M	NTNzz	N/A	350	350	VP	Oh	0-50	H8	-	-	-	-
										Om	75-350	H5	-	-	-	-
										Cg	350	-	-	Clay	-	-
13-17	Harvest Section 3	643988	5779745	TY.H	BNNaa	N/A	300	300	VP	Oh	0-300	H8	-	-	-	-
										Cg	300	-	-	Clay	-	-
14-17	Harvest Section 3	644352	5779842	HU.M	NTNzz	N/A	330	330	VP	Oh	0-100	H8	-	-	-	-
										Om	100-330	H6	-	-	-	-
										Cg	330	-	-	Clay	-	-
15-17	Harvest Section 1	644491	5779719	HU.M	NTNzz	N/A	330	330	VP	Oh	0-75	H8	-	-	-	-
										Om	75-330	H5	-	-	-	-
										Cg	330	-	-	Clay	-	-
16-17	Harvest Section 1	644487	5779871	ME.H	BNNaazz	N/A	350	350	VP	Om	0-50	H6	-	-	-	-
										Oh	50-350	H8	-	-	-	-
										Cg	350	-	-	Clay	-	-
17-17	Harvest Section 1	644685	5779848	HU.M	NTNzz	N/A	350	350	VP	Oh	0-50	H8	-	-	-	-
										Om	75-350	H5	-	-	-	-
										Cg	350	-	-	Clay	-	-
18-17	Harvest Section 1	644938	5780030	HU.M	NTNzz	N/A	370	370	VP	Oh	0-50	H8	-	-	-	-
										Om1	50-200	H5	-	-	-	-
										Om2	200-370	H6	-	-	-	-
										Cg	370	-	-	Clay	-	-
19-17	Harvest Section 1	645114	5780044	HU.M	NTNzz	N/A	360	360	VP	Oh	0-50	H8	-	-	-	-
										Om	50-200	H6	-	-	-	-
										Of	200-360	H4	-	-	-	-
										Cg	360	-	-	Clay	-	-
20-17	Harvest Section 1	645317	5780044	HU.M	NTNzz	N/A	330	330	VP	Oh	0-50	H8	-	-	-	-
										Om	50-200	H5	-	-	-	-
										Of	200-330	H4	-	-	-	-
										Cg	330	-	-	Clay	-	-
21-17	Harvest Section 2	645515	5780050	HU.M	NTNzz	N/A	330	330	VP	Oh1	0-50	H8	-	-	-	-
										Om	50-200	H5	-	-	-	-
										Oh2	200-330	H8	-	-	-	-
										Cg	330	-	-	Clay	-	-
22-17	Harvest Section 2	645687	5780055	ME.H	BNNaazz	N/A	150	150	VP	Om	0-50	H6	-	-	-	-
										Oh	50-150	H8	-	-	-	-
										Cg	150	-	-	Clay	-	-
23-17	Harvest Section 1	645296	5779841	ME.H	BNNaazz	N/A	275	275	VP	Om	0-50	H6	-	-	-	-
										Oh	50-275	H8	-	-	-	-
										Cg	275	-	-	Clay	-	-
24-17	Harvest Section 1	645183	5779736	HU.F	DDEaazz	N/A	330	330	VP	Oh	0-100	H8	-	-	-	-
										Of	100-330	H4	-	-	-	-
										Cg	330	-	-	Clay	-	-
25-17	Harvest Section 1	645051	5779600	ME.F	DDEaazz	N/A	350	350	VP	Oh	0-50	H8	-	-	-	-
										Om	50-100	H5	-	-	-	-
										Of	100-350	H4	-	-	-	-
										Cg	350	-	-	Clay	-	-
26-17	Access Road	644908	5779460	HU.M	NTNzz	N/A	250	250	VP	Oh	0-75	H8	-	-	-	-
										Om	75-250	H5	-	-	-	-
										Cg	250	-	-	Clay	-	-
27-17	Access Road	644893	5779647	HU.M	NTNzz	N/A	350	350	VP	Oh	0-75	H8	-	-	-	-
										Om	75-350	H5	-	-	-	-
										Cg	350	-	-	Clay	-	-
28-17	Access Road	644886	5779823	TY.M	NTN	N/A	350	350	VP	Oh	0-50	H8	-	-	-	-
										Om	50-350	H5	-	-	-	-
										Cg	350	-	-	Clay	-	-
29-17	Harvest Section 1	645088	5779421	HU.M	NTNzz	N/A	300	300	VP	Oh	0-75	H8	-	-	-	-
										Om	75-300	H5	-	-	-	-
										Cg	300	-	-	Clay	-	-
30-17	Harvest Section 1	645313	5779427	HU.M	NTNzz	N/A	275	275	VP	Oh	0-75	H8	-	-	-	-
										Om	75-275	H5	-	-	-	-
										Cg	275	-	-	Clay	-	-
31-17	Harvest Section 2	645539	5779431	TY.H	BNNaa	N/A	150	150	VP	Om	0-50	H6	-	-	-	-
										Oh	50-150	H8	-	-	-	-
										Cg	150	-	-	Clay	-	-
32-17	Harvest Section 1	645312	5779644	TY.H	BNNaa	N/A	275	275	VP	Om	0-50	H6	-	-	-	-
										Oh	50-275	H8	-	-	-	-
										Cg	275	-	-	Clay	-	-
33-17	Harvest Section 3	644204	5779730	TY.M	NTN	N/A	350	350	VP	Oh	0-50	H8	-	-	-	-
										Om	75-350	H5	-	-	-	-
										Cg	350	-	-	Clay	-	-
34-17	Harvest Section 3	643828	5779845	HU.F	DDEaazz	N/A	300	300	VP	Om	0-50	H6	-	-	-	-
										Of	50-125	H4	-	-	-	-
										Oh	125-300	H7	-	-	-	-
										Cg	300	-	-	Clay	-	-
35-17	Harvest Section 4	643504	5779844	HU.F	DDEaazz	N/A	350	350	VP	Om	0-50	H6	-	-	-	-
										Of	50-125	H4	-	-	-	-
										Oh	125-350	H7	-	-	-	-
										Cg	350	-	-	Clay	-	-
36-17	Phase 2	642737	5780280	TY.H	BNNaa	N/A	270	270	VP	Oh1	0-50	H8	-	-	-	-
										Oh2	50-270	H7	-	-	-	-
										Cg	270	-	-	Clay	-	-
37-17	Phase 2	642572	5780104	TY.H	BNNaa	N/A	360	360	VP	Oh1	0-50	H8	-	-	-	-
										Oh2	50-360	H7	-	-	-	-
										Cg	360	-	-	Clay	-	-
38-17	Phase 2	642582	5779954	TY.H	BNNaa	N/A	330	330	VP	Oh1	0-50	H8	-	-	-	-
										Oh2	50-330	H7	-	-	-	-
										Cg	330	-	-	Clay	-	-
39-17	Phase 2	642761	5779963	TY.H	BNNaa	N/A	350	350	VP	Oh1	0-50	H8	-	-	-	-
										Oh2	50-350	H7	-	-	-	-
										Cg	350	-	-	Clay	-	-
40-17	Phase 2	642623	5779815	TY.H	BNNaa	N/A	250	250	VP	Oh1	0-50	H8	-	-	-	-
										Oh2	50-250	H7	-	-	-	-
										Cg	250	-	-	Clay	-	-
41-17	Phase 2	643085	5779965	TY.H	BNNaa	N/A	300	300	VP	Oh1	0-50	H8	-	-	-	-
										Oh2	50-300	H7	-	-	-	-
										Cg	300	-	-	Clay	-	-
42-17	Phase 2	642845	5780142	TY.H	BNNaa	N/A	300	300	VP	Oh1	0-50	H8	-	-	-	-
										Oh2	50-300	H7	-	-	-	-
										Cg	300	-	-	Clay	-	-
Premier Tech 2008																
PTH 1	Harvest Section 3	643823	5779993	TY.M	NTN	N/A	225		VP	Of	0 - 25	H3	-	-	-	-
										Om1	25 - 125	H5	6.5	-	-	-
										Om2	125 - 200	H6	-	-	-	-
PTH 2	Harvest Section 5	643429	5779977	TY.M	NTN	N/A	175		VP	Om1	0 - 25	H5	-	-	-	-
										Om2	25 - 75	H5	6.92	-	-	-
										Om3	75 - 150	H6	-	-	-	-
PTH 3	Harvest Section 4	643823	5780255	TY.M	NTN	N/A	200		VP	Om1	0 - 25	H4	-	-	-	-
										Om2	25 - 100	H5	6.81	-	-	-
										Om3	100 - 175	H6	-	-	-	-
PTH 4	Harvest Section 3	644212	5779995	TY.M	NTN	N/A	225		VP	Om1	0 - 25	H4	-	-	-	-
										Om2	25 - 125	H5	6.89	-	-	-
										Om3	125 - 200	H6	-	-	-	-
PTH 5	Harvest Section 3	644485	5779675	TY.M	NTN	N/A	175		VP	Om1	0 - 25	H4	-	-	-	-
										Om2	25 - 100	H5	6.91	-	-	-
										Om3	100 - 150	H6	-	-	-	-
PTH 6	Harvest Section 1	644667	5779834	FI.M	NTNzz	N/A	250		VP	Of1	0 - 25	H2-H3	-	-	-	-
										Of2	25 - 50	H3	6.85	-	-	-
										Om1	50 - 75	H4	-	-	-	-
										Om2	75 - 150	H5	-	-	-	-
										Om3	150 - 225	H6	-	-	-	-
PTH 7	Harvest Section 1	645247	5780027	TY.M	NTN	N/A	225		VP	Om1	0 - 25	H4	-	-	-	-
										Om2	25 - 125	H5	6.84	-	-	-
										Om3	125 - 200	H6	-	-	-	-
PTH 8	Harvest Section 1	645249	5779778	TY.M	NTN	N/A	200		VP	Om1	0 - 25	H4	-	-	-	-
										Om2	25 - 125	H5	6.57	-	-	-
										Om3	125 - 175	H6	-	-	-	-
PTH 9	Harvest Section 1	645017	5779559	TY.M	NTN	N/A	225		VP	Of	0 - 25	H3	-	-	-	-
										Om1	25 - 50	H4	6.62	-	-	-
										Om2	50 - 125	H5	6.59	-	-	-
										Om3	125 - 150	H6	-	-	-	-
PTH 10	Harvest Section 1	644924	5779344	TY.M	NTN	N/A	150		VP	Om1	0 - 25	H4	-	-	-	-
										Om2	25 - 50	H5	6.72	-	-	-
										Om3	50 - 125	H6	-	-	-	-
PTH 11	Harvest Section 1	645022	5780024	FI.M	NTNzz	N/A	225		VP	Of	0 - 75	H3	-	-	-	-
										Om1	75 - 125	H4	6.5	-	-	-
										Om2	125 - 150	H5	-	-	-	-
										Om3	150 - 200	H6	-	-	-	-
PTH 12	Harvest Section 1	644593	5780027	FI.M	NTNzz	N/A	250		VP	Of1	0 - 25	H2-H3	-	-	-	-
										Of2	25 - 50	H3	6.85	-	-	-
										Om1	50 - 75	H4	-	-	-	-
										Om2	75 - 125	H5	-	-	-	-
										Om3	125 - 225	H6	-	-	-	-

Soil Classification	
TY.M	Typic Mesisol
FI.H	Fibric Humisol
FI.M	Fibric Mesisol
GLCU.HR	Gleyed Cumulic Humic Regosol
GLCU.R	Gleyed Cumulic Regosol
HU.F	Humic Fibrisol
HU.M	Humic Mesisol
ME.F	Mesic Fibrisol
ME.H	Mesic Humisol
R.G	Rego Gleysol
T.M	Terric Mesisol
THU.M	Terric Humic Mesisol
TY.F	Typic Fibrisol
TY.H	Typic Humisol
TY.M	Typic Mesisol
Source: ASIC 2016	

Soil Series	
BNN	Bonnie
DDE	Drysdale
CYN	Cynthia
GRZ	Gratz
IOS	Iosegun
NTN	Niton
Source: ASIC 2016	

Variant	
aa	Not modal soil correlation area
gl	Gleyed - poor drainage and periodic reduction
pt	Peaty - an organic horizon (> 17% organic carbon) which is > 10 cm thick
xc	Clay at 30-99 cm
yc	Clay at 100-200 cm
zr	Rego/Regosolic
zz	Atypical Subgroup
Source: ASIC 2016	

Soil Drainage	
I	Imperfect
P	Poor
VP	Very Poor
Source: ASIC 2016	

Texture	
SiCL	Silty Clay Loam
SL	Sandy Loam
L	Loam
HC	Heavy Clay
SiC	Silty Clay
SCL	Sandy Clay Loam
SiL	Silt Loam
LS	Loamy Sand
Source: ASIC 2016	

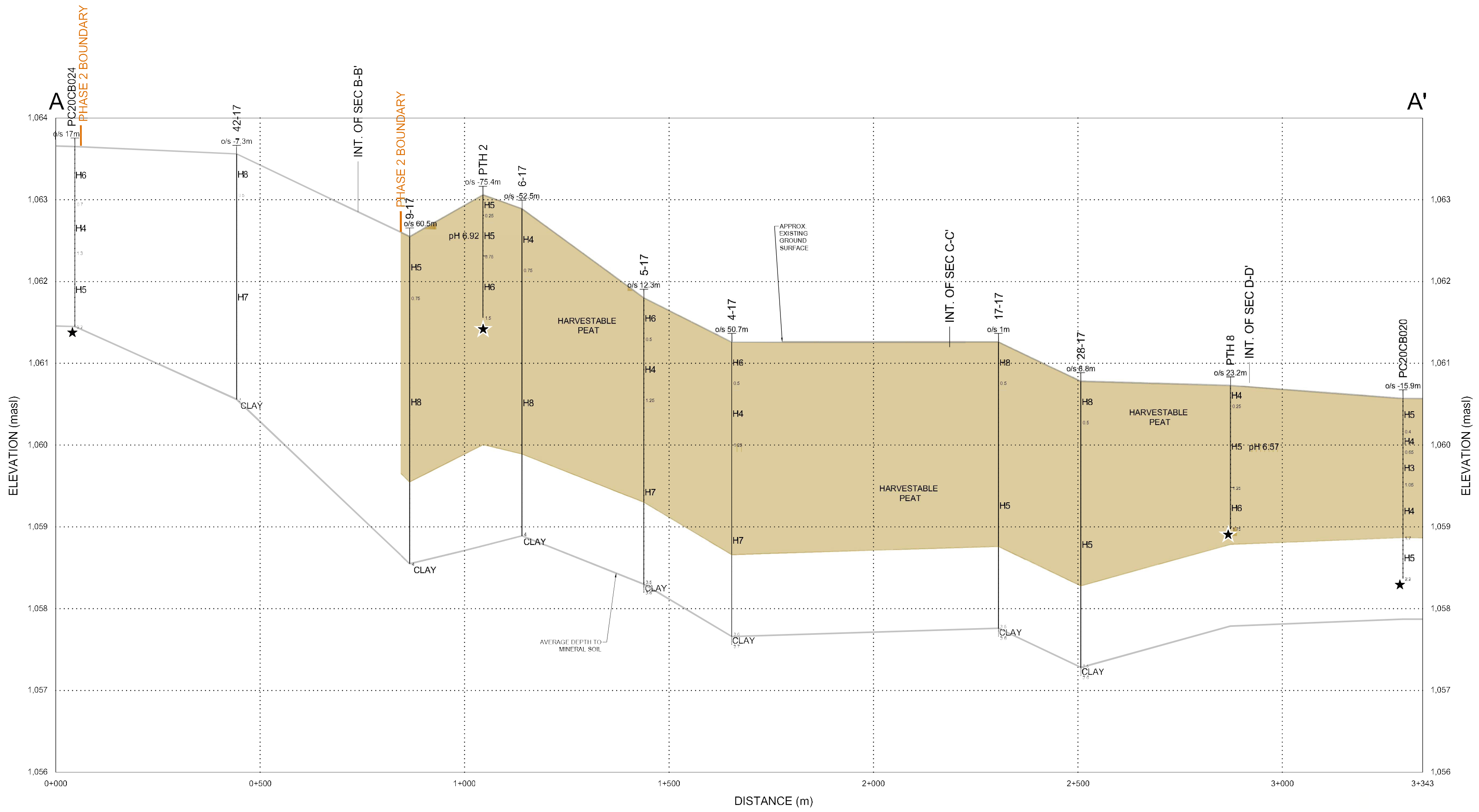
Von Post Scale of Decomposition

SCALE	DECOMPOSITION	PLANT STRUCTURE	LIQUID
H1	Undecomposed	Unaltered	Clear water (light yellow-brown)
H2	Almost undecomposed	Distinct	Clear water (light yellow-brown)
H3	Very weak	Distinct	Turbid (brown), no peat passes between fingers, mushy residue
H4	Weak	Distinct	Strongly turbid, peat substance between the fingers, residue very mushy
H5	Moderate	Clear, becoming indistinct	Turbid water (brown), some peat between fingers, residue vey mushy
H6	Strong	Somewhat indistinct, clearer in squeezed residue	1/3 peat escapes between fingers, residue strongly mushy
H7	Strong	Indistinct but recognizable	½ peat escapes between fingers
H8	Very strong	Very indistinct	2/3 peat escapes between fingers, remaining residue root fibers and wood
H9	Almost complete	Almost unrecognizable	almost all peat escapes between the fingers
H10	Complete	Unrecognizable	all the peat escapes between fingers

Canadian System of Soil Classification (1998)

APPENDIX B

Cross Section of the Peatland Profile



LEGEND

PC20CB022	SAMPLE ID
o/s -33m	DISTANCE OFFSET FROM PROFILE LINE
H4 pH 7.53	H VALUE / pH VALUE
0.95	DEPTH BELOW GROUND SURFACE
H5 pH 6.86	
Silty Clay/Dark Gray	SOIL TEXTURE
1.4	
★	INDICATES DEPTH TO BOTTOM OF SAMPLE

VON POST

SCALE	DECOMPOSITION	PLANT STRUCTURE	LIQUID
H1	Undecomposed	Unaltered	Clear water (light yellow-brown)
H2	Almost undecomposed	Distinct	Clear water (light yellow-brown)
H3	Very weak	Distinct	Turbid (brown), no peat passes between fingers, mushy residue
H4	Weak	Distinct	Strongly turbid, peat substance between the fingers, residue very mushy
H5	Moderate	Clear, becoming indistinct	Turbid water (brown), some peat between fingers, residue vey mushy
H6	Strong	Somewhat indistinct, clearer in squeezed residue	1/3 peat escapes between fingers, residue strongly mushy
H7	Strong	Indistinct but recognizable	½ peat escapes between fingers
H8	Very strong	Very indistinct	2/3 peat escapes between fingers, remaining residue root fibers and wooc
H9	Almost complete	Almost unrecognizable	almost all peat escapes between the fingers
H10	Complete	Unrecognizable	all the peat escapes between fingers

Canadian System of Soil Classification (1998)

NOTE(S)

1. FOR LOCATION OF CROSS-SECTION A-A', REFER TO FIGURE 2.3-5
2. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT SAMPLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN THE BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN. FOR DETAILED STRATIGRAPHY OF EACH BOREHOLE LOCATION REFER TO THE RECORD OF SAMPLE SHEET
3. SAMPLE LOCATIONS ARE OFFSET FROM THE PLAN VIEW PROFILE LINE. ELEVATION OF THE GROUND SURFACE IS INTERPOLATED BETWEEN SAMPLE POINTS.
4. PTH = PREMIER TECH HORTICULTURE
5. SOME PROFILES APPEARS TO BE ABOVE OR BELOW THE GROUND SURFACE ON THE PEAT PROFILE. THIS IS BECAUSE THAT PROFILE DOES NOT FALL DIRECTLY ON THE TRANSECT LINE AND IS OFF SET (OS) BY A NUMBER OF METRES LISTED AT THE TOP OF THE PROFILE. ALL PROFILES INCLUDED ARE REPRESENTATIVE OF THE TRANSECT EVEN IF OFF SET FROM THE CROSS SECTION LOCATION.

REFERENCE(S)

DATA OBTAINED FROM PREMIER TECH 2010, PREMIER TECH 2018, GOLDER 2020, AND GOLDER 2021.

0 250 500
1:10,000 METRES
VERTICAL EXAGGERATION = 200X

CLIENT
PREMIER TECH HORTICULTURE

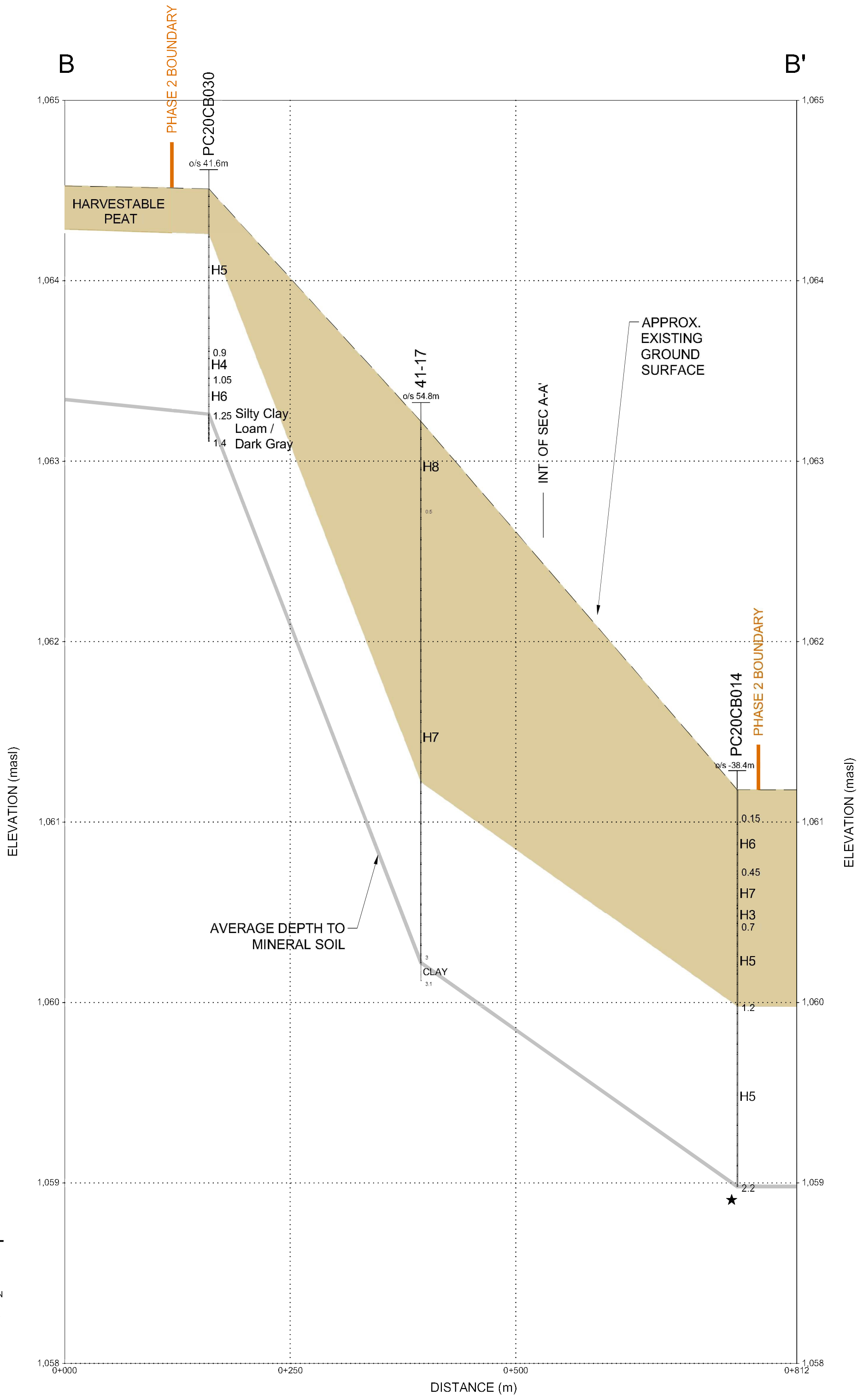
PROJECT
CLEARWATER PEAT HARVEST PROJECT

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
DESIGNED	JH
PREPARED	RFM
REVIEWED	CB
APPROVED	KH

TITLE
CROSS-SECTION A-A'

PROJECT NO.	CONTROL	REV.	FIGURE
21496738	1000-PT-0001	0	2.3-5a



LEGEND

	HYDROLOGY STUDY DEPTH MARKER
	APPROXIMATE WATER TABLE ELEVATION FROM HYDROLOGY STUDY
— — —	TOP OF PEAT FROM HYDROLOGY STUDY
-0.89%	PERCENT WATER TABLE GRADE
PC20CB022	SAMPLE ID
o/s -33m	DISTANCE OFFSET FROM PROFILE LINE
H4 pH 7.53	H VALUE / pH VALUE
0.95	DEPTH BELOW GROUND SURFACE
H5 pH 6.86	
Silty Clay	SOIL TEXTURE
1.4	
★	INDICATES DEPTH TO BOTTOM OF SAMPLE

VON POST			
SCALE	DECOMPOSITION	PLANT STRUCTURE	LIQUID
H1	Undecomposed	Unaltered	Clear water (light yellow-brown)
H2	Almost undecomposed	Distinct	Clear water (light yellow-brown)
H3	Very weak	Distinct	Turbid (brown), no peat passes between fingers, mushy residue
H4	Weak	Distinct	Strongly turbid, peat substance between the fingers, residue very mushy
H5	Moderate	Clear, becoming indistinct	Turbid water (brown), some peat between fingers, residue vey mushy
H6	Strong	Somewhat indistinct, clearer in squeezed residue	1/3 peat escapes between fingers, residue strongly mushy
H7	Strong	Indistinct but recognizable	½ peat escapes between fingers
H8	Very strong	Very indistinct	2/3 peat escapes between fingers, remaining residue root fibers and wood
H9	Almost complete	Almost unrecognizable	almost all peat escapes between the fingers
H10	Complete	Unrecognizable	all the peat escapes between fingers
Canadian System of Soil Classification (1998)			

NOTE(S)

1. FOR LOCATION OF CROSS-SECTION B-B, C-C' AND D-D'', REFER TO FIGURE 2.3-5
2. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT SAMPLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN THE BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN. FOR DETAILED STRATIGRAPHY OF EACH BOREHOLE LOCATION REFER TO THE RECORD OF SAMPLE SHEET
3. SAMPLE LOCATIONS ARE OFFSET FROM THE PLAN VIEW PROFILE LINE. ELEVATION OF THE GROUND SURFACE IS INTERPOLATED BETWEEN SAMPLE POINTS.
4. PTH = PREMIER TECH HORTICULTURE
5. SOME PROFILES APPEARS TO BE ABOVE OR BELOW THE GROUND SURFACE ON THE PEAT PROFILE. THIS IS BECAUSE THAT PROFILE DOES NOT FALL DIRECTLY ON THE TRANSECT LINE AND IS OFF SET (OS) BY A NUMBER OF METRES LISTED AT THE TOP OF THE PROFILE. ALL PROFILES INCLUDED ARE REPRESENTATIVE OF THE TRANSECT EVEN IF OFF SET FROM THE CROSS SECTION LOCATION.

REFERENCE(S)

DATA OBTAINED FROM PREMIER TECH 2010, PREMIER TECH 2018, GOLDER 2020, AND GOLDER 2021.

0 100 200
1:5,000 METRES
VERTICAL EXAGGERATION = 200X

CLIENT
PREMIER TECH HORTICULTURE

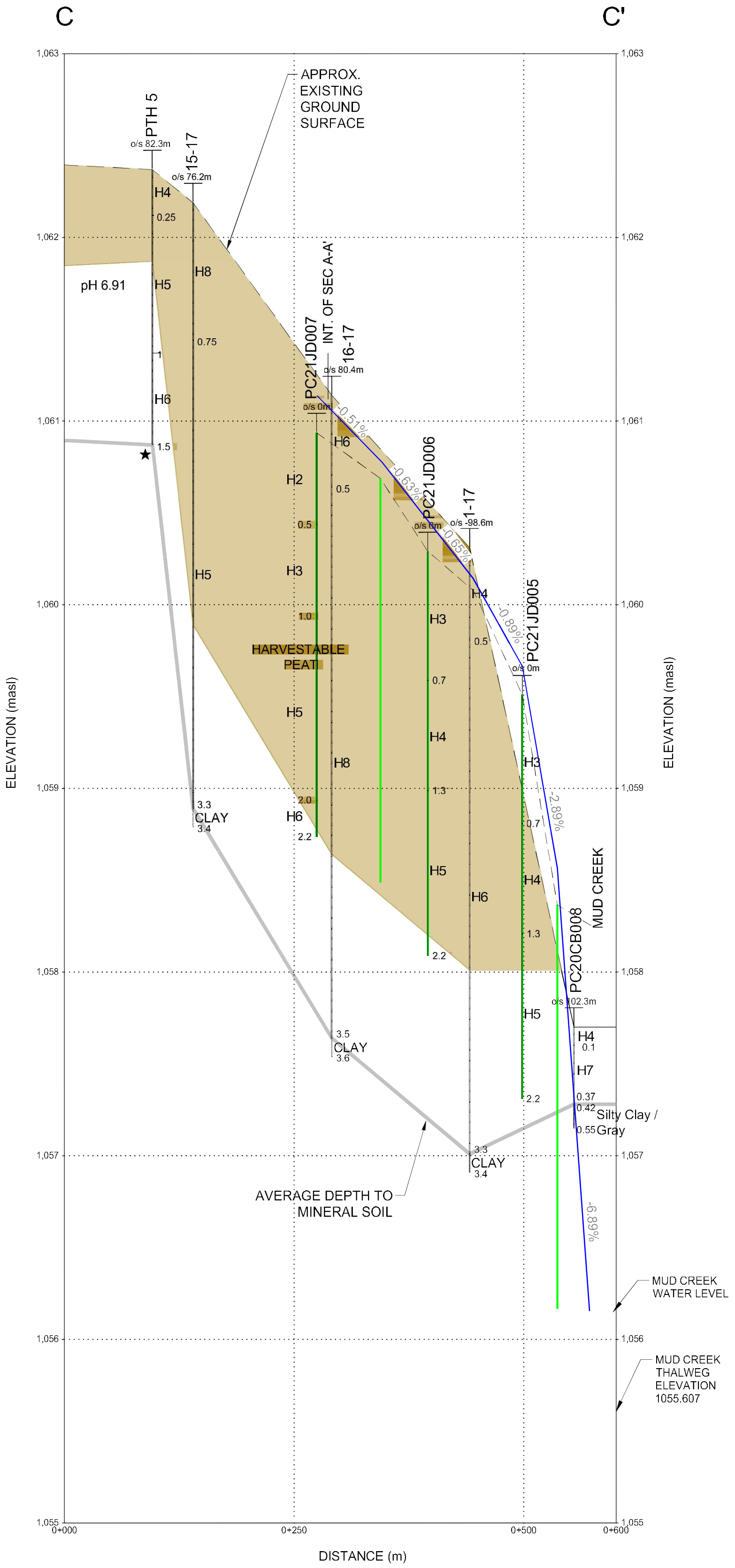
PROJECT
CLEARWATER PEAT HARVEST PROJECT

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
DESIGNED	JH
PREPARED	RFM
REVIEWED	CB
APPROVED	KH

TITLE
CROSS-SECTION B-B'

PROJECT NO.	CONTROL	REV.	FIGURE
21496738	1000-PT-0001	0	2.3-5b



LEGEND

|	HYDROLOGY STUDY DEPTH MARKER
—	APPROXIMATE WATER TABLE ELEVATION FROM HYDROLOGY STUDY
– — –	TOP OF PEAT FROM HYDROLOGY STUDY
-0.89%	PERCENT WATER TABLE GRADE
PC20CB022	SAMPLE ID
o/s -33m	DISTANCE OFFSET FROM PROFILE LINE
H4 pH 7.53	H VALUE / pH VALUE
0.95	DEPTH BELOW GROUND SURFACE
H5 pH 6.86	
Silty Clay	SOIL TEXTURE
★	INDICATES DEPTH TO BOTTOM OF SAMPLE

NOTE(S)

1. FOR LOCATION OF CROSS-SECTION B-B, C-C' AND D-D", REFER TO FIGURE 2.3-5
2. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT SAMPLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN THE BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN. FOR DETAILED STRATIGRAPHY OF EACH BOREHOLE LOCATION REFER TO THE RECORD OF SAMPLE SHEET
3. SAMPLE LOCATIONS ARE OFFSET FROM THE PLAN VIEW PROFILE LINE. ELEVATION OF THE GROUND SURFACE IS INTERPOLATED BETWEEN SAMPLE POINTS.
4. PTH = PREMIER TECH HORTICULTURE
5. SOME PROFILES APPEARS TO BE ABOVE OR BELOW THE GROUND SURFACE ON THE PEAT PROFILE. THIS IS BECAUSE THAT PROFILE DOES NOT FALL DIRECTLY ON THE TRANSECT LINE AND IS OFF SET (OS) BY A NUMBER OF METRES LISTED AT THE TOP OF THE PROFILE. ALL PROFILES INCLUDED ARE REPRESENTATIVE OF THE TRANSECT EVEN IF OFF SET FROM THE CROSS SECTION LOCATION.

REFERENCE(S)

DATA OBTAINED FROM PREMIER TECH 2010, PREMIER TECH 2018, GOLDER 2020, AND GOLDER 2021.

VON POST

SCALE	DECOMPOSITION	PLANT STRUCTURE	LIQUID
H1	Undecomposed	Unaltered	Clear water (light yellow-brown)
H2	Almost undecomposed	Distinct	Clear water (light yellow-brown)
H3	Very weak	Distinct	Turbid (brown), no peat passes between fingers, mushy residue
H4	Weak	Distinct	Strongly turbid, peat substance between the fingers, residue very mushy
H5	Moderate	Clear, becoming indistinct	Turbid water (brown), some peat between fingers, residue vey mushy
H6	Strong	Somewhat indistinct, clearer in squeezed residue	1/3 peat escapes between fingers, residue strongly mushy
H7	Strong	Indistinct but recognizable	½ peat escapes between fingers
H8	Very strong	Very indistinct	2/3 peat escapes between fingers, remaining residue root fibers and wood
H9	Almost complete	Almost unrecognizable	almost all peat escapes between the fingers
H10	Complete	Unrecognizable	all the peat escapes between fingers

Canadian System of Soil Classification (1998)

0 100 200
1:5,000 METRES
VERTICAL EXAGGERATION = 200X

CLIENT
PREMIER TECH HORTICULTURE

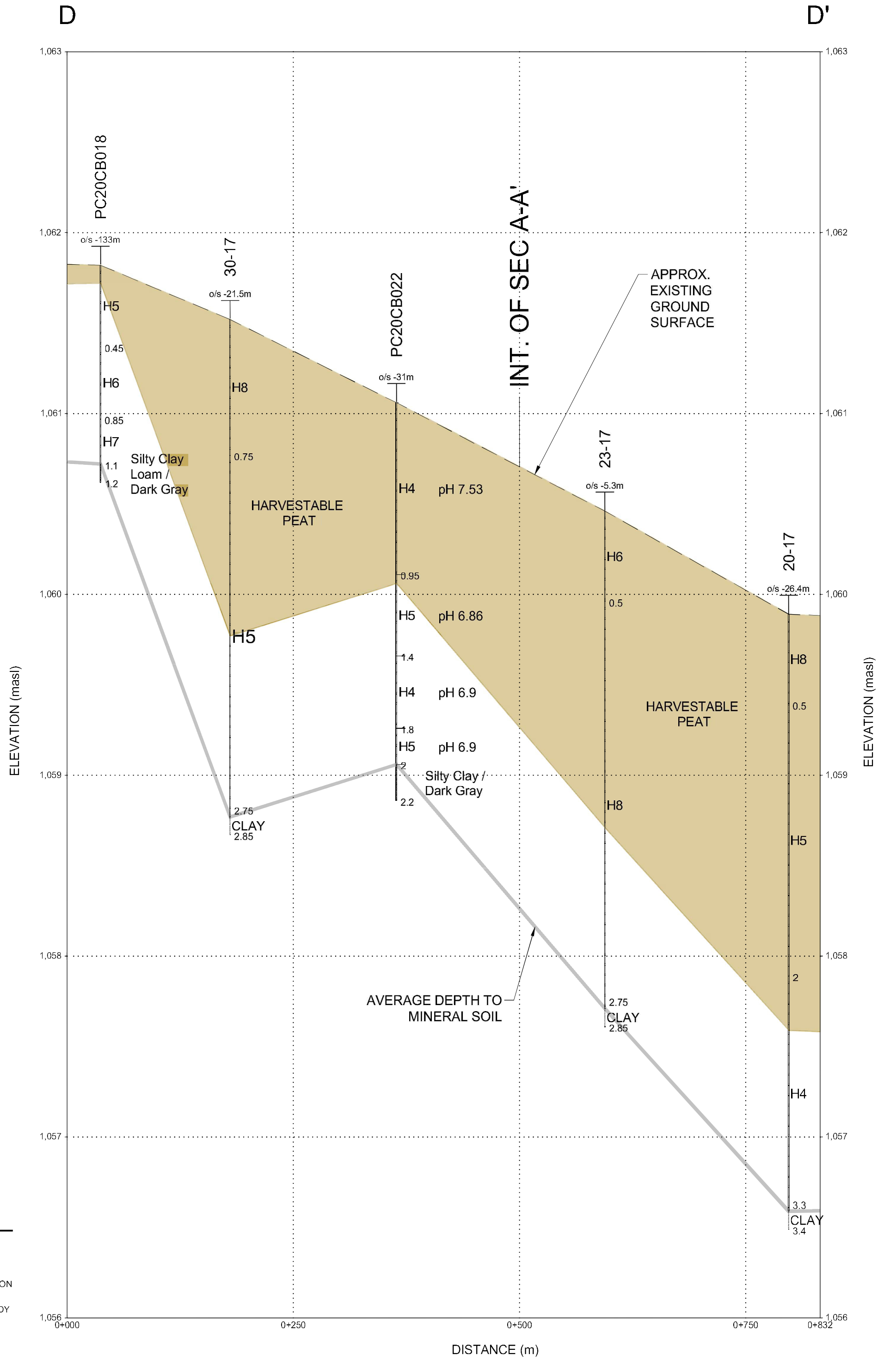
PROJECT
CLEARWATER PEAT HARVEST PROJECT

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
DESIGNED	JH
PREPARED	RFM
REVIEWED	CB
APPROVED	KH

TITLE
CROSS-SECTION C-C'

PROJECT NO.	CONTROL	REV.	FIGURE
21496738	1000-PT-0001	0	2.3-5c



LEGEND

|	HYDROLOGY STUDY DEPTH MARKER
—	APPROXIMATE WATER TABLE ELEVATION FROM HYDROLOGY STUDY
— — —	TOP OF PEAT FROM HYDROLOGY STUDY
-0.89%	PERCENT WATER TABLE GRADE
PC20CB022	SAMPLE ID
o/s -33m	DISTANCE OFFSET FROM PROFILE LINE
H4 pH 7.53	H VALUE / pH VALUE
0.95	DEPTH BELOW GROUND SURFACE
H5 pH 6.86	
Silty Clay	SOIL TEXTURE
1.4	
★	INDICATES DEPTH TO BOTTOM OF SAMPLE

VON POST

SCALE	DECOMPOSITION	PLANT STRUCTURE	LIQUID
H1	Undecomposed	Unaltered	Clear water (light yellow-brown)
H2	Almost undecomposed	Distinct	Clear water (light yellow-brown)
H3	Very weak	Distinct	Turbid (brown), no peat passes between fingers, mushy residue
H4	Weak	Distinct	Strongly turbid, peat substance between the fingers, residue very mushy
H5	Moderate	Clear, becoming indistinct	Turbid water (brown), some peat between fingers, residue vey mushy
H6	Strong	Somewhat indistinct, clearer in squeezed residue	1/3 peat escapes between fingers, residue strongly mushy
H7	Strong	Indistinct but recognizable	½ peat escapes between fingers
H8	Very strong	Very indistinct	2/3 peat escapes between fingers, remaining residue root fibers and wood
H9	Almost complete	Almost unrecognizable	almost all peat escapes between the fingers
H10	Complete	Unrecognizable	all the peat escapes between fingers

Canadian System of Soil Classification (1998)

NOTE(S)

1. FOR LOCATION OF CROSS-SECTION B-B, C-C' AND D-D'', REFER TO FIGURE 2.3-5
2. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT SAMPLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN THE BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN. FOR DETAILED STRATIGRAPHY OF EACH BOREHOLE LOCATION REFER TO THE RECORD OF SAMPLE SHEET
3. SAMPLE LOCATIONS ARE OFFSET FROM THE PLAN VIEW PROFILE LINE. ELEVATION OF THE GROUND SURFACE IS INTERPOLATED BETWEEN SAMPLE POINTS.
4. PTH = PREMIER TECH HORTICULTURE
5. SOME PROFILES APPEARS TO BE ABOVE OR BELOW THE GROUND SURFACE ON THE PEAT PROFILE. THIS IS BECAUSE THAT PROFILE DOES NOT FALL DIRECTLY ON THE TRANSECT LINE AND IS OFF SET (OS) BY A NUMBER OF METRES LISTED AT THE TOP OF THE PROFILE. ALL PROFILES INCLUDED ARE REPRESENTATIVE OF THE TRANSECT EVEN IF OFF SET FROM THE CROSS SECTION LOCATION.

REFERENCE(S)

DATA OBTAINED FROM PREMIER TECH 2010, PREMIER TECH 2018, GOLDER 2020, AND GOLDER 2021.

0 100 200
1:5,000 METRES
VERTICAL EXAGGERATION = 200X

CLIENT
PREMIER TECH HORTICULTURE

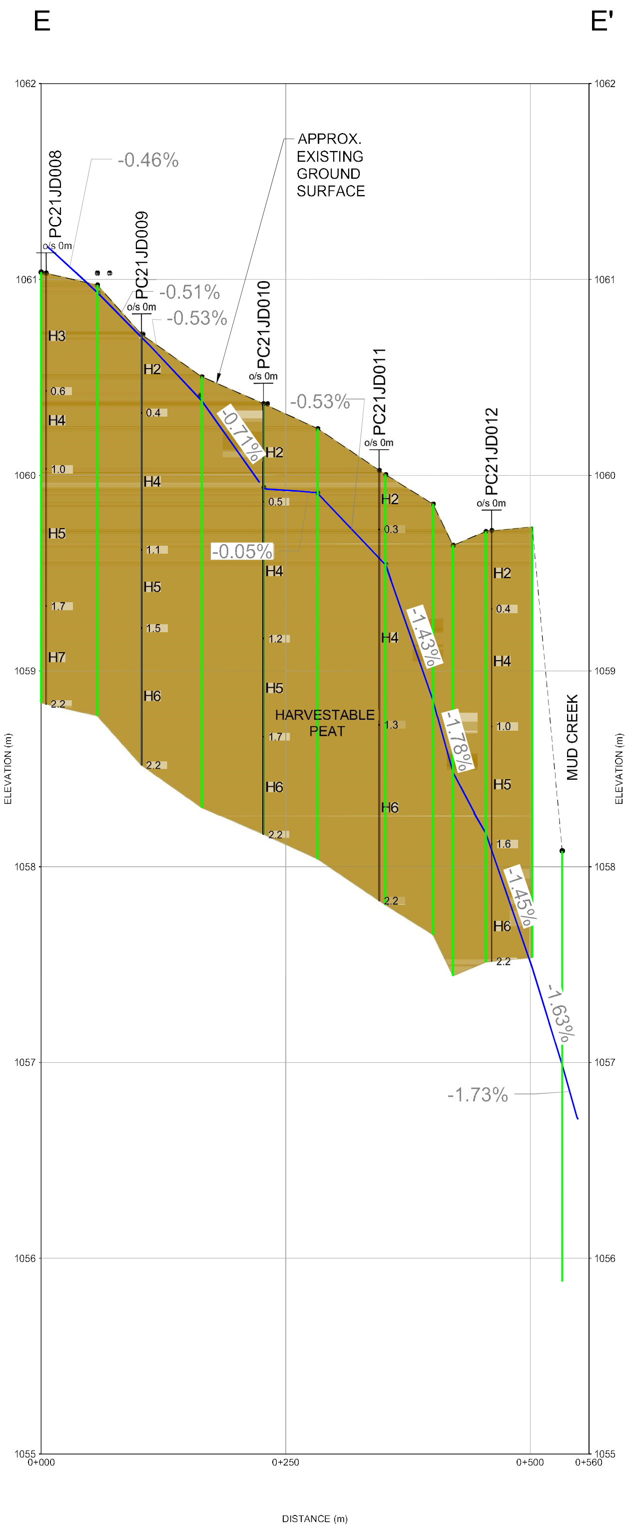
PROJECT
CLEARWATER PEAT HARVEST PROJECT

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
DESIGNED	JH
PREPARED	RFM
REVIEWED	CB
APPROVED	KH

TITLE
CROSS-SECTION D-D'

PROJECT NO.	CONTROL	REV.	FIGURE
21496738	1000-PT-0001	0	2.3-5d



LEGEND

🟩	HYDROLOGY STUDY DEPTH MARKER
―	APPROXIMATE WATER TABLE ELEVATION FROM HYDROLOGY STUDY
– — –	TOP OF PEAT FROM HYDROLOGY STUDY
-0.89%	PERCENT WATER TABLE GRADE
PC20CB022	SAMPLE ID
o/s -33m	DISTANCE OFFSET FROM PROFILE LINE
H4 pH 7.53	H VALUE / pH VALUE
0.95	DEPTH BELOW GROUND SURFACE
H5 pH 6.86	
Silty Clay	SOIL TEXTURE
1.4	
★	INDICATES DEPTH TO BOTTOM OF SAMPLE

VON POST

SCALE	DECOMPOSITION	PLANT STRUCTURE	LIQUID
H1	Undecomposed	Unaltered	Clear water (light yellow-brown)
H2	Almost undecomposed	Distinct	Clear water (light yellow-brown)
H3	Very weak	Distinct	Turbid (brown), no peat passes between fingers, mushy residue
H4	Weak	Distinct	Strongly turbid, peat substance between the fingers, residue very mushy
H5	Moderate	Clear, becoming indistinct	Turbid water (brown), some peat between fingers, residue vey mushy
H6	Strong	Somewhat indistinct, clearer in squeezed residue	1/3 peat escapes between fingers, residue strongly mushy
H7	Strong	Indistinct but recognizable	½ peat escapes between fingers
H8	Very strong	Very indistinct	2/3 peat escapes between fingers, remaining residue root fibers and wood
H9	Almost complete	Almost unrecognizable	almost all peat escapes between the fingers
H10	Complete	Unrecognizable	all the peat escapes between fingers

Canadian System of Soil Classification (1998)

NOTE(S)

1. FOR LOCATION OF CROSS-SECTION B-B, C-C' AND D-D'', REFER TO FIGURE 2.3-5
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3. SAMPLE LOCATIONS ARE OFFSET FROM THE PLAN VIEW PROFILE LINE. ELEVATION OF THE GROUND SURFACE IS INTERPOLATED BETWEEN SAMPLE POINTS.
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REFERENCE(S)

DATA OBTAINED FROM PREMIER TECH 2010, PREMIER TECH 2018, GOLDER 2020, AND GOLDER 2021.

0 100 200
1:5,000 METRES
VERTICAL EXAGGERATION = 200X

CLIENT
PREMIER TECH HORTICULTURE

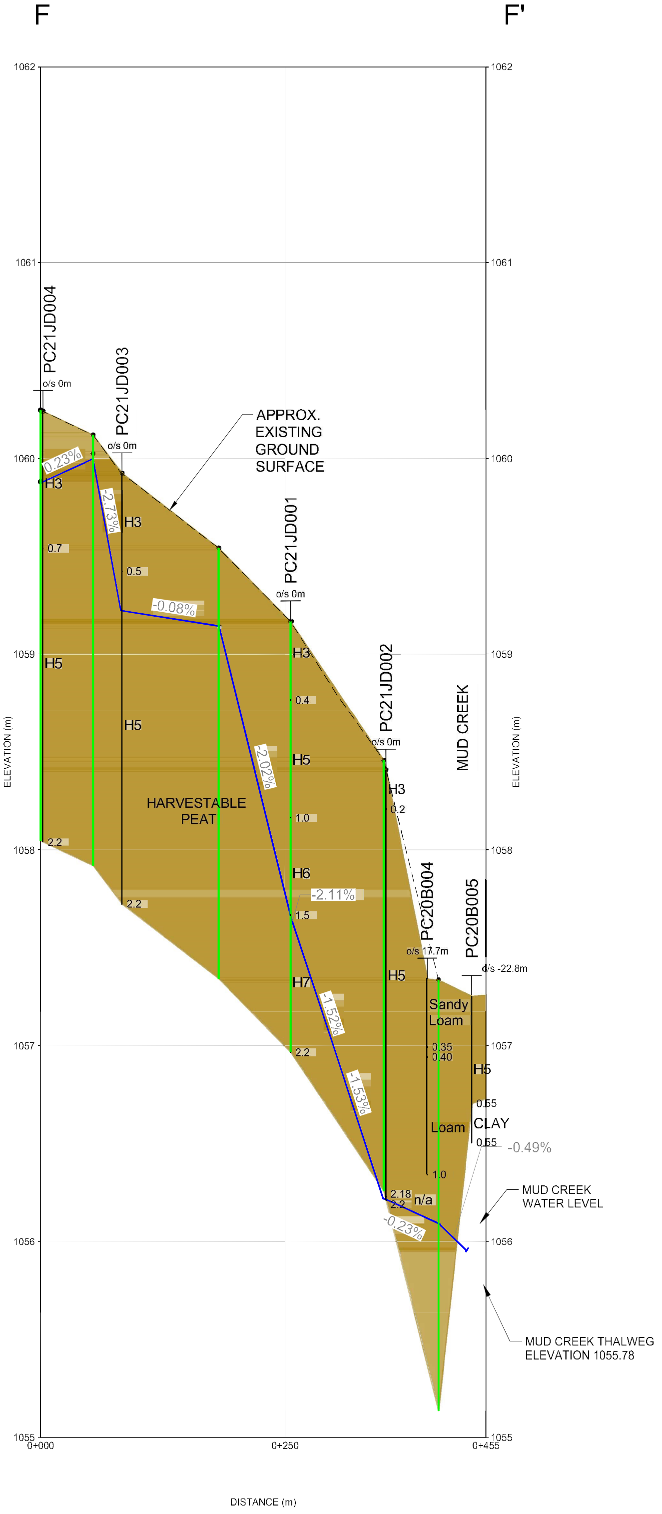
PROJECT
CLEARWATER PEAT HARVEST PROJECT

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
DESIGNED	JH
PREPARED	RFM
REVIEWED	CB
APPROVED	KH

TITLE
CROSS-SECTION E-E'

PROJECT NO.	CONTROL	REV.	FIGURE
21496738	1000-PT-0001	0	2.3-5e



LEGEND

🟩	HYDROLOGY STUDY DEPTH MARKER
🟦	APPROXIMATE WATER TABLE ELEVATION FROM HYDROLOGY STUDY
— — —	TOP OF PEAT FROM HYDROLOGY STUDY
-0.89%	PERCENT WATER TABLE GRADE
PC20CB022 o/s -33m	SAMPLE ID DISTANCE OFFSET FROM PROFILE LINE
H4 pH 7.53	H VALUE / pH VALUE
0.95	DEPTH BELOW GROUND SURFACE
H5 pH 6.86 Silty Clay 1.4	SOIL TEXTURE
★	INDICATES DEPTH TO BOTTOM OF SAMPLE

VON POST

SCALE	DECOMPOSITION	PLANT STRUCTURE	LIQUID
H1	Undecomposed	Unaltered	Clear water (light yellow-brown)
H2	Almost undecomposed	Distinct	Clear water (light yellow-brown)
H3	Very weak	Distinct	Turbid (brown), no peat passes between fingers, mushy residue
H4	Weak	Distinct	Strongly turbid, peat substance between the fingers, residue very mushy
H5	Moderate	Clear, becoming indistinct	Turbid water (brown), some peat between fingers, residue vey mushy
H6	Strong	Somewhat indistinct, clearer in squeezed residue	1/3 peat escapes between fingers, residue strongly mushy
H7	Strong	Indistinct but recognizable	½ peat escapes between fingers
H8	Very strong	Very indistinct	2/3 peat escapes between fingers, remaining residue root fibers and wood
H9	Almost complete	Almost unrecognizable	almost all peat escapes between the fingers
H10	Complete	Unrecognizable	all the peat escapes between fingers

Canadian System of Soil Classification (1998)

NOTE(S)

1. FOR LOCATION OF CROSS-SECTION B-B, C-C' AND D-D'', REFER TO FIGURE 2.3-5
2. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT SAMPLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN THE BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN. FOR DETAILED STRATIGRAPHY OF EACH BOREHOLE LOCATION REFER TO THE RECORD OF SAMPLE SHEET
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REFERENCE(S)

DATA OBTAINED FROM PREMIER TECH 2010, PREMIER TECH 2018, GOLDER 2020, AND GOLDER 2021.

0 100 200
1:5,000 METRES
VERTICAL EXAGGERATION = 200X

CLIENT
PREMIER TECH HORTICULTURE

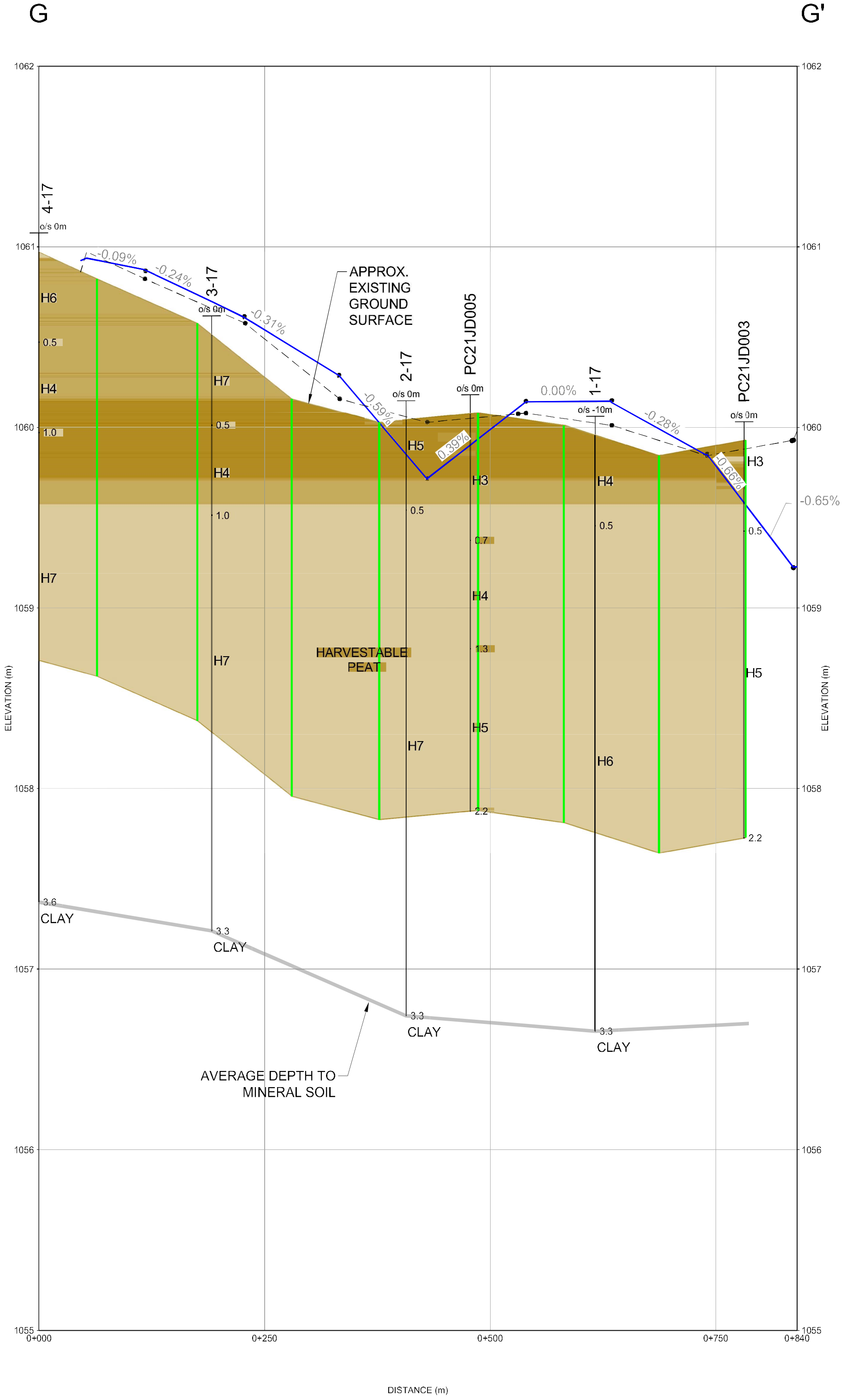
PROJECT
CLEARWATER PEAT HARVEST PROJECT

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
DESIGNED	JH
PREPARED	RFM
REVIEWED	CB
APPROVED	KH

TITLE
CROSS-SECTION F-F'

PROJECT NO.	CONTROL	REV.	FIGURE
21496738	1000-PT-0001	0	2.3-5f



LEGEND

HYDROLOGY STUDY DEPTH MARKER

APPROXIMATE WATER TABLE ELEVATION FROM HYDROLOGY STUDY

TOP OF PEAT FROM HYDROLOGY STUDY

-0.89% PERCENT WATER TABLE GRADE

PC20CB022 SAMPLE ID
o/s -33m DISTANCE OFFSET FROM PROFILE LINE

H4 pH 7.53 H VALUE / pH VALUE

0.95 DEPTH BELOW GROUND SURFACE

H5 pH 6.86
Silty Clay SOIL TEXTURE

1.4

★ INDICATES DEPTH TO BOTTOM OF SAMPLE

VON POST			
SCALE	**DECOMPOSITION**	**PLANT STRUCTURE**	**LIQUID**
H1	Undecomposed	Unaltered	Clear water (light yellow-brown)
H2	Almost undecomposed	Distinct	Clear water (light yellow-brown)
H3	Very weak	Distinct	Turbid (brown), no peat passes between fingers, mushy residue
H4	Weak	Distinct	Strongly turbid, peat substance between the fingers, residue very mushy
H5	Moderate	Clear, becoming indistinct	Turbid water (brown), some peat between fingers, residue vey mushy
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H7	Strong	Indistinct but recognizable	½ peat escapes between fingers
H8	Very strong	Very indistinct	2/3 peat escapes between fingers, remaining residue root fibers and wood
H9	Almost complete	Almost unrecognizable	almost all peat escapes between the fingers
H10	Complete	Unrecognizable	all the peat escapes between fingers

Canadian System of Soil Classification (1998)

NOTE(S)

1. FOR LOCATION OF CROSS-SECTION B-B, C-C' AND D-D'', REFER TO FIGURE 2.3-5
2. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT SAMPLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN THE BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN. FOR DETAILED STRATIGRAPHY OF EACH BOREHOLE LOCATION REFER TO THE RECORD OF SAMPLE SHEET
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REFERENCE(S)

DATA OBTAINED FROM PREMIER TECH 2010, PREMIER TECH 2018, GOLDER 2020, AND GOLDER 2021.

0 100 200
1:5,000 METRES
VERTICAL EXAGGERATION = 200X

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
DESIGNED	JH
PREPARED	RFM
REVIEWED	CB
APPROVED	KH

TITLE
CROSS-SECTION G-G'

PROJECT NO.	CONTROL	REV.	FIGURE
21496738	1000-PT-0001	0	2.3-5g

APPENDIX C

Surface Water Drainage Calculations (Stantec 2013)

PREMIER TECH
HORTICULTURE

September 27th, 2013

Mr. Peter Pui, P. Eng.
Water Administration Engineer
Environmental Management/
Central Region
304 4920 51 Street
Red Deer, Alberta, T4N 6K8

File: 00274125

RE: Application under the Water Act
For the Purpose of Dewatering Bog for Peat Harvesting
At Sections 1, 2 & 3 -037-07-W5M
Additional Information 3

Mr. Pui,

Following reception of your letter dated April 7th 2011 requiring additional information in regards to the Clearwater Bog project, we are sending you this document with answers to the following comments and concerns.

We have not yet addressed the issues raised by the Statement of Concerns from Mr. David Finn. Once this step will be completed, we will provide you with a copy of our report on this matter.

1. **The upstream site for water quality sampling should be established in a permanent upstream location from the beginning of the sampling program (where it is denoted by the red cross on Map No. 2), not moved over time. If the site is moved over time as currently proposed, this introduces additional uncertainty (i.e., are potential differences from year to year due to operation effects or from moving the station).**

The upstream site for water quality sampling will be established in a permanent upstream location from the beginning of the sampling program and will not be moved over time. The sampling location will be where there is a red cross on Map No. 2 from the previous additional information document. This final upstream site location is showed on Map No.4 in Annex A.

2. **Farming operations in the area are minimal due to the naturally wet nature of the landscape. Ranching practices tend to remain consistent over time so it is unlikely that these will be interfering factors. The purpose of the upstream/downstream nature of the program is to capture any potential effects from the peat mining activities.**

We believe that the upstream and downstream water sampling location will provide enough information related to potential effects from the harvesting activities.

3. **Dissolved oxygen needs to be collected in the field, not in a laboratory setting. PH and turbidity can be analyzed in a laboratory setting if necessary.**

Dissolved oxygen will be collected in the field with a portable water quality monitoring instrument. PH and turbidity will be analyzed in an accredited laboratory.

4. **When submitting samples to the lab, the proponent must be mindful of holding times for the samples. An accredited lab will be able to supply this information to the proponent (along with require sampling bottles, preservatives, etc.)**

An accredited laboratory (eg: Maxxam Analytics) will provide the required bottles, preservatives and any other equipment related to water sampling conservation. The samples will be delivered directly to the laboratory or shipped by courier using the fastest service available.

5. **Only one bog water quality data out of the twelve sampling locations was provided in connection to the SML application to Alberta Sustainable Resource Development. Please provide all baseline water quality data for each section of proposed harvest area including Section 3 specifically.**

No water quality data has been submitted to Alberta Environment and Sustainable Resource Development to this date. Water quality samples at the upstream and downstream locations showed on Map No.4 will be taken during three different periods of the year and provided to Alberta Environment and Sustainable Resource Development. The first sampling will be taken this fall. The other two samples will be taken during Spring and Summer 2014.

6. **Was the hydrologic analysis utilized the Rational Method to estimate the 1:25 storm peak flow and runoff volume? Rational Method is better suited for smaller catchment area. Additionally, the IDF for the Town of Rocky Mountain House rather than Edmonton's would be more representative for the project area.**

This question has been answered in a document made by Brian Bennet from Stantec and this document is available in Annex B.

7. **There are roughly 12km² of catchment area upstream of the coulee on the proposed harvest area in Section 3 (map attached). Consideration should have been taken for additional runoff peak flows, volume and potential erosion from this catchment area.**

The fact that a catchment area of roughly 12km^2 is located upstream of the operation area has led us to modify the operation plan. The harvesting areas in sections 5 and 6 have been reduced to make room for a buffer zone on each side of the coulee in this section.

The implementation of a buffer zone on each side of the coulee will allow the water coming from the upstream catchment area to flow toward Mud creek without being affected by the operations. The coulee will not be modified in any way and the water flow will not be reduced nor increased.

The buffer zone on each side of the coulee will be at least 100 feet wide. This means that there won't be any additional runoff peak flows, volume and potential erosion from this catchment area. The coulee will basically stay the same as it was before as no modification will be done. It will be left in its natural state.

Additional information about this point is available in the document prepared by Brian Bennet from Stantec in Annex B.

Should you need additional information, feel free to ask.

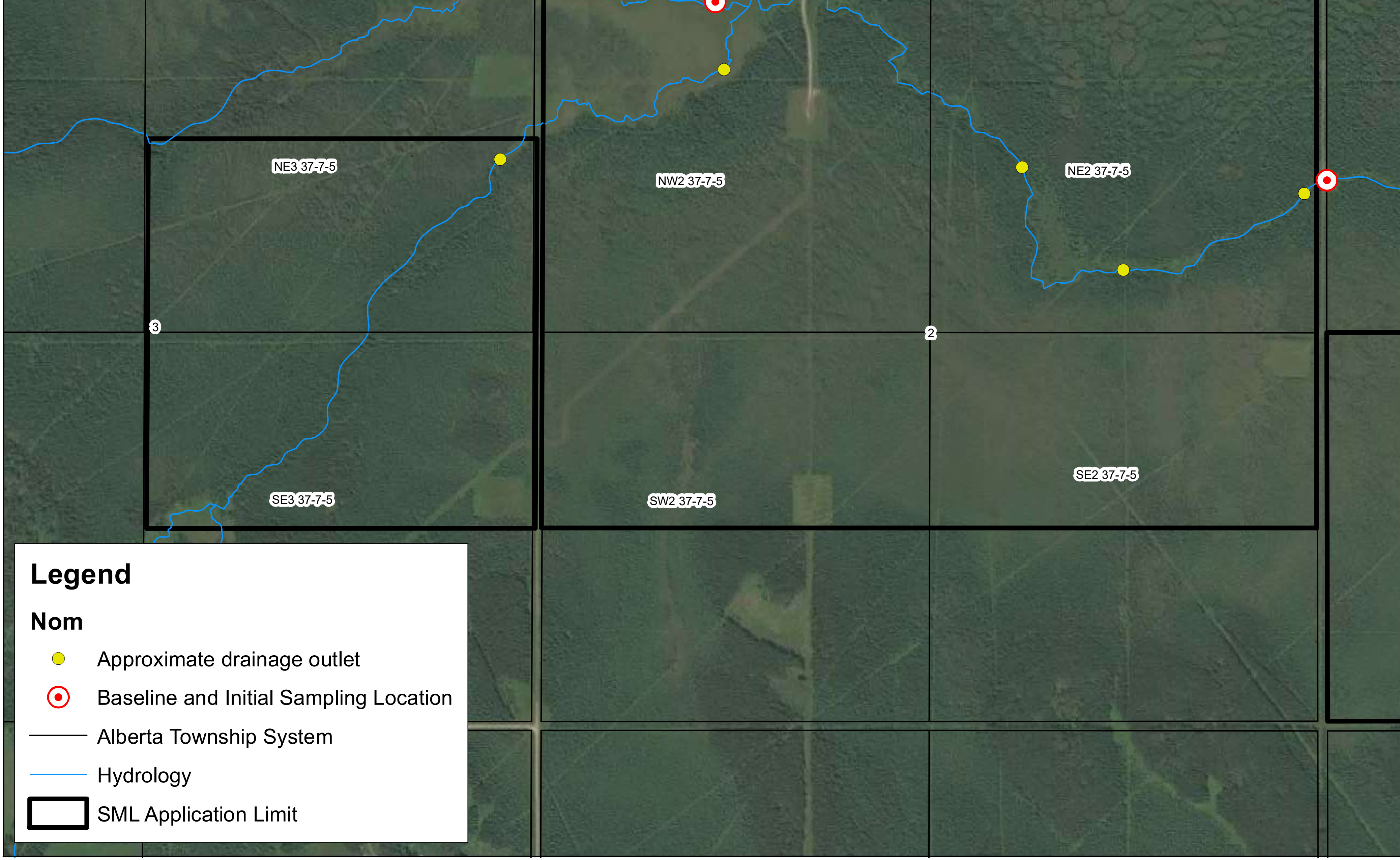
Best Regards,

____

Frédéric Caron
Quality, Resource and Innovation Director
Premier Tech Horticulture

c.c. Mr. Guillaume Tellier, PTH
Mr. Scott Briscoe, PTH

ANNEX A



Drawn by: TELG 2013-09-24
Projection: Transverse Mercator WGS 84
References: Bing Maps, AESRD, PTH
Map no. 4

PREMIER TECH
HORTICULTURE

ANNEX B

Stantec

Memo

To:	Frederic Caron Premier Horticulture Ltd.	From:	Brian Bennett, P.Eng. Stantec Consulting Ltd.
File:	110149908 task 700	Date:	September 13, 2013

Reference: Application under the Water Act (file 00274125)

Further to our previous correspondence we have been asked to respond its 6 and 7 in a letter from Mr. Peter Pui dated 7 April 2011.

Point 6 of his letter requested the use of the IDF for the Town of Rocky Mountain House in the calculations and questioned the use of the Rational Method in the calculations provided.

In estimating the total discharge from the site, we assumed a runoff coefficient of C = 017 due to the flat terrain and porous nature of the soils. Based on a 1 in 25 year storm event, a 30 minute time of concentration rainfall intensity of 58.6 mm/hour was selected based on the rainfall information for the Rocky Mountain House. For the overall site of 388.5 ha, the total runoff would be in the order of 10.74 cubic meters per second (m^3/s). Of this amount about 5.7 m^3/s would come from the area to be harvested. ("i" from formula for Rocky Mountain House = 58.6 for t = 30 minutes)

The use of the IDF for Rocky Mountain House did increase the estimated flows by a few percent. We tried to use computer models for the bog area but found that some of the input parameters have not been established by research for harvested peat bogs. We recognize that the Rational method tends to overestimate stormwater flows for areas over about 60 ha in area. We have been unsuccessful at finding well documented alternative methods of modeling for this specific application. We have used the Rational Method to illustrate a relative flow rate and at worst overestimate any downstream effects.

Point 7 of his letter requested consideration of flows within Mud Creek and erosion potentials.

Figure 2 provided by Alberta Environment shows a drainage basin on Mud Creek of 1,200 ha upstream from blocks 5 and 6 of the Clearwater bog. A flow frequency assessment was carried out for Prairie Creek (WSC # 05DB005), a hydrometric station in the vicinity of the project with similar hydrologic condition to Mud Creek. The Log-Pearson Type III statistical distribution technique was used to fit the data in order to estimate the flows for during the 1:25 and 1:100 year flood events. A relationship between gross drainage area and peak flow rates was established by using a single station transfer including a power of 0.8 to take into consideration scaling of the flow from a larger area. The estimated 1-25 and 1:100-year maximum instantaneous peak discharge are 9.91 m^3/s and 20.63 m^3/s based on a gross drainage area of Mud Creek at the bog of 12 km^2.

(For comparison purposes, using the Rational Method and the same parameters for this area as were used for the bog the flow in Mud Creek at the bog would be 21 m^3/s for a 1:25 year event and 27.6 m^3/s for a 1:100 year event. Using a Chicago storm distribution the peak flow would be 73.1 m^3/s while a Huff storm distribution peaks at 10.54 m^3/s for a 1:100 year event.)

We understand that Premier horticulture plan to maintain a buffer of undisturbed natural vegetation between Mud Creek and the portions of the bog to be harvested except at the specific locations where the drainage ditches connect from the bog. This would mean that that the flow in Mud Creek upstream from the connection would be unchanged from their current condition. The portions of Mud Creek running adjacent to the bog will also be separated from the development by a buffer strip. The flow in this reach of the creek would have some impact as noted in the following paragraph. It is the design intent that appropriate erosion protection would be provided at all locations where the harvesting operations connect to or cross the creek.

Reference: Application under the Water Act (file 00274125)

How does the work in the bog affect the flow in Mud Creek? The portions of the site that remained a bog would contribute to the flow similarly to the pre development state. During the time period when portions of the bog were being drained the flow to Mud Creek would increase, but this activity is typically scheduled for the winter months when it should have minimal effect on the creek bed. Once portions of the bog are being harvested, the areas being harvested would provide additional storage for the drainage basin within the volume in the ditches and sediment ponds and in the storage within the peat itself as it reabsorbs water. This additional storage tends to lessen peak flows. During the time period of restoration, the discharge from the bog would be reduced until the high water table in the bog was reestablished. Once the bog is re-vegetated it would again function as a wetland within the drainage basin.

Please let us know if there are further questions or areas that remain unclear.

Sincerely,

Stantec Consulting Ltd.

<Original signed by>

Brian Bennett, B.Sc., P.Eng.
Senior Engineer, Civil
Phone: (780) 917-7308
Fax: (780) 917-7049
brian.bennett@stantec.com

Attachment: 1) Clearwater bog drainage recalculated using Rocky Mountain House data
2) Prairie Creek to Mud Creek flows
3) frequency Analysis Plot
4) Chicago Distribution 100 year 24 hour Runoff
5) Huff Distribution 100 year 4 hour runoff
6) Figure 2 Clearwater Bog Upstream Catchment Area as per AE
7) Contour Plan

c.

Clearwater Bog	9-Sep-13	BrB
Area	510	acres
surface area	2063897	m2
water content decrease	0.315	
initial depth drained	0.3	m
water volume	195038.2	m3
time for initial winter drain	60	days
	3250.6	m3/day
avg initial winter drainage rate	37.6	L/s
final depth drained	1.2	m
total water volume	780153	m3
Vol drained per year(15 year)	**52010**	m3
drainage rate (15 year term)	1.65	L/s
Total volume of runoff from a 24 hr 1:25 yr storm	**30135**	m3

IDF Parameters (i =a/(t+c)^b)

Rocky Mountain House			1993	
event	A	B	C	theta
100	994.5	0.74	2.79	1.25
50	901	0.74	2.98	1.2
25	779.1	0.74	3.03	1.1
10	633.8	0.73	3.31	1
5	525.2	0.73	3.74	1
2	352.7	0.72	4.94	1

Q + ACi/360

time minutes	C	i mm/hr	Q m3/sec
1440	0.17	3.579	0.349

* The volume drained per year does not include any allowance for normal run-off from the site due to precipitation.

9-Sep-13	1	2	3	4	5	6	Total	BRB
Clearwater Bog								
Area	127	80	80	71	90	62	510	acres
surface area	513950.7	323748.5	323748.5	287326.8	364217	250905.1	2063897	m2
water content decrease	0.315	0.315	0.315	0.315	0.315	0.315	0.315	
initial depth drained	0.3	0.3	0.3	0.3	0.3	0.3	0.3	m
water volume	48568.3	30594.2	30594.2	27152.4	34418.5	23710.5	195038.2	m3
time for initial winter drain	60	60	60	60	60	60	60	days
	809.5	509.9	509.9	452.5	573.6	395.2	3250.6	m3/day
avg initial winter drainage rate	9.4	5.9	5.9	5.2	6.6	4.6	37.6	L/s
final depth drained	1.2	1.2	1.2	1.2	1.2	1.2	1.2	m
total water volume	194273	122377	122377	108610	137674	94842	780153	m3
Vol drained per year(15 year)	**12952**	**8158**	**8158**	**7241**	**9178**	**6323**	**52010**	m3
drainage rate (15 year term)	0.41	0.26	0.26	0.23	0.29	0.20	1.65	L/s
time	1440	1440	1440	1440	1440	1440	1440	minutes
C	0.17	0.17	0.17	0.17	0.17	0.17	0.17	
i	3.579	3.579	3.579	3.579	3.579	3.579	3.579	mm/hr
Q (25 yr event storm formula)	0.087	0.055	0.055	0.049	0.062	0.042	0.349	m3/sec
Q (25 yr event storm table)	0.096	0.061	0.061	0.054	0.068	0.047	0.386	m3/sec
Total volume of runoff from a 24 hr 1:25 yr storm	**7504**	**4727**	**4727**	**4195**	**5318**	**3664**	**30135**	m3
Table value	**7523**	**4739**	**4739**	**4206**	**5331**	**3672**	**30209**	m3

Column1	
Mean	1.239344058
Standard Error	0.065826352
Median	1.253455363
Mode	1.357934847
Standard Deviation	0.383830293
Sample Variance	0.147325694
Kurtosis	1.736497528
Skewness	0.632922961
Range	1.926115094
Minimum	0.5132176
Maximum	2.439332694
Sum	42.13769797
Count	34
Confidence Level(9!	0.133924721

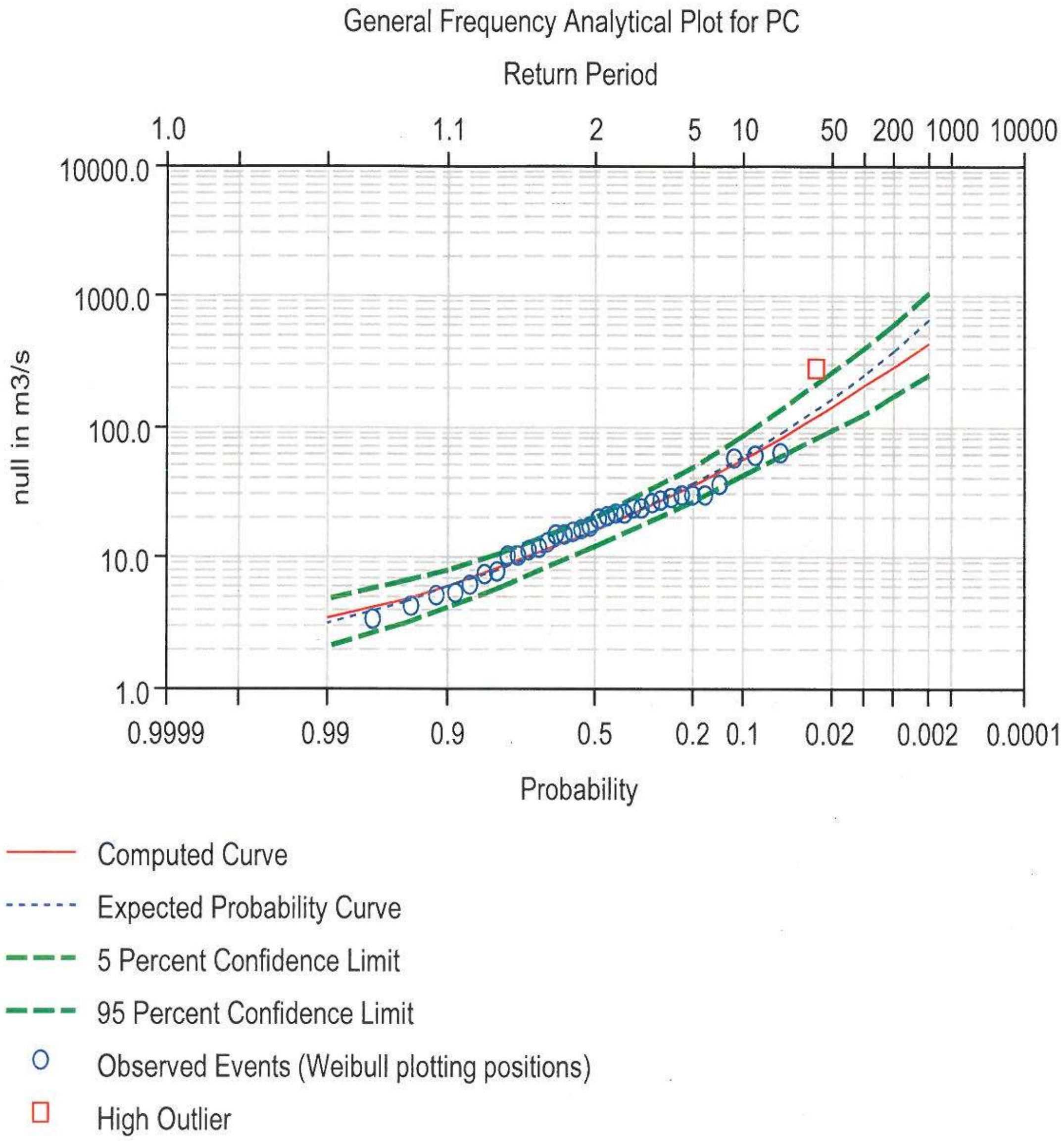
Station:

Run Frequency Analysis

Flow in Mud creek scaled from Prairie Creek Sep-13

Area WSC Station	208
Area (Site)	12

Return Period (years)	**Skew Coeficient (Ks) Log Pearson III**	**Skew Coeficient (Ks) Log Normal**	**Discharge Log Pearson III (m^3/s)**	**Discharge Log Normal (m^3/s)**	**Single Station Transfer (Direct)**
2	-0.104596903	0	15.82	17.35	**1.61**
5	0.796707704	0.842	35.09	36.52	**3.58**
10	1.329646148	1.282	56.20	53.88	**5.74**
25	1.948218429	1.751	97.08	81.55	**9.91**
50	2.374803021	2.054	141.54	106.59	**14.45**
100	2.777716843	2.326	202.08	135.56	**20.63**
200	3.161959895	2.576	283.79	169.08	**28.97**


General Frequency Analytical Plot for PC
Return Period
1.0
1.1
2
5
10
50
200
1000
10000
10000.0
1000.0
100.0
10.0
1.0
null in m3/s
0.9999
0.99
0.9
0.5
0.2
0.1
0.02
0.002
0.0001
Probability
Computed Curve
Expected Probability Curve
5 Percent Confidence Limit
95 Percent Confidence Limit
Observed Events (Weibull plotting positions)
High Outlier

Clearwater Bog

1101 49908 700		Measured		Calc:	BrB
	Coefficient	Area (ha)	CA	Date:	13-Sep-13
Catchment Area	**0.95**	**0.000**	0.000	Checked:	
	0.85	**0.000**	0.000	Date:	
Graveled Area	**0.65**	**0.000**	0.000		
	0.17	**1200.000**	204.000		
Total Area (ha)		1200.000	204.000		
Combined 'C'		0.170			
Discharge per hectare	**0.035**	cms/ha			
Total Discharge Rate	42000.00	l/s		STORAGE	18,660

Table A9.1 - Chicago Distribution

100 Year Storm (4 hr) - Storm Runoff Volumes

Time Step	Intensity mm/hr	Inflow l/s	Inflow Vol. cu.m.	Outflow l/s	Outflow Vol. cu. m.	Storage Volume cu.m.
0	2.99	1694.33	508.300	1694.333	508.300	0.00
5	6.18	3502.00	1050.600	3502.000	1050.600	0.00
10	6.47	3666.33	1099.900	3666.333	1099.900	0.00
15	6.8	3853.33	1156.000	3853.333	1156.000	0.00
20	7.17	4063.00	1218.900	4063.000	1218.900	0.00
25	7.61	4312.33	1293.700	4312.333	1293.700	0.00
30	8.11	4595.67	1378.700	4595.667	1378.700	0.00
35	8.71	4935.67	1480.700	4935.667	1480.700	0.00
40	9.43	5343.67	1603.100	5343.667	1603.100	0.00
45	10.3	5836.67	1751.000	5836.667	1751.000	0.00
50	11.5	6516.67	1955.000	6516.667	1955.000	0.00
55	13	7366.67	2210.000	7366.667	2210.000	0.00
60	15.2	8613.33	2584.000	8613.333	2584.000	0.00
65	18.6	10540.00	3162.000	10540.000	3162.000	0.00
70	25	14166.67	4250.000	14166.667	4250.000	0.00
75	43.9	24876.67	7463.000	24876.667	7463.000	0.00
80	129	73100.00	21930.000	42000.000	12600.000	9330.00
85	129	73100.00	21930.000	42000.000	12600.000	18660.00
90	41.3	23403.33	7021.000	23403.333	7021.000	18660.00
95	30.4	17226.67	5168.000	17226.667	5168.000	18660.00
100	24.6	13940.00	4182.000	13940.000	4182.000	18660.00
105	21	11900.00	3570.000	11900.000	3570.000	18660.00
110	18.5	10483.33	3145.000	10483.333	3145.000	18660.00
115	16.6	9406.67	2822.000	9406.667	2822.000	18660.00
120	15.1	8556.67	2567.000	8556.667	2567.000	18660.00
125	14	7933.33	2380.000	7933.333	2380.000	18660.00
130	13	7366.67	2210.000	7366.667	2210.000	18660.00
135	12.2	6913.33	2074.000	6913.333	2074.000	18660.00
140	11.5	6516.67	1955.000	6516.667	1955.000	18660.00
145	10.8	6120.00	1836.000	6120.000	1836.000	18660.00
150	10.3	5836.67	1751.000	5836.667	1751.000	18660.00
155	9.84	5576.00	1672.800	5576.000	1672.800	18660.00
160	9.42	5338.00	1601.400	5338.000	1601.400	18660.00

Clearwater Bog

1101 49908 700

		Measured		Calc:	BrB
	Coefficient	Area (ha)	CA	Date:	13-Sep-13
Catchment Area	0.17	1200.000	204.000	Checked:	
	0.65	0.000	0.000	Date:	
			0.000		
Total Area (ha)		1200.000	204.000		
Combined 'C'		0.170			

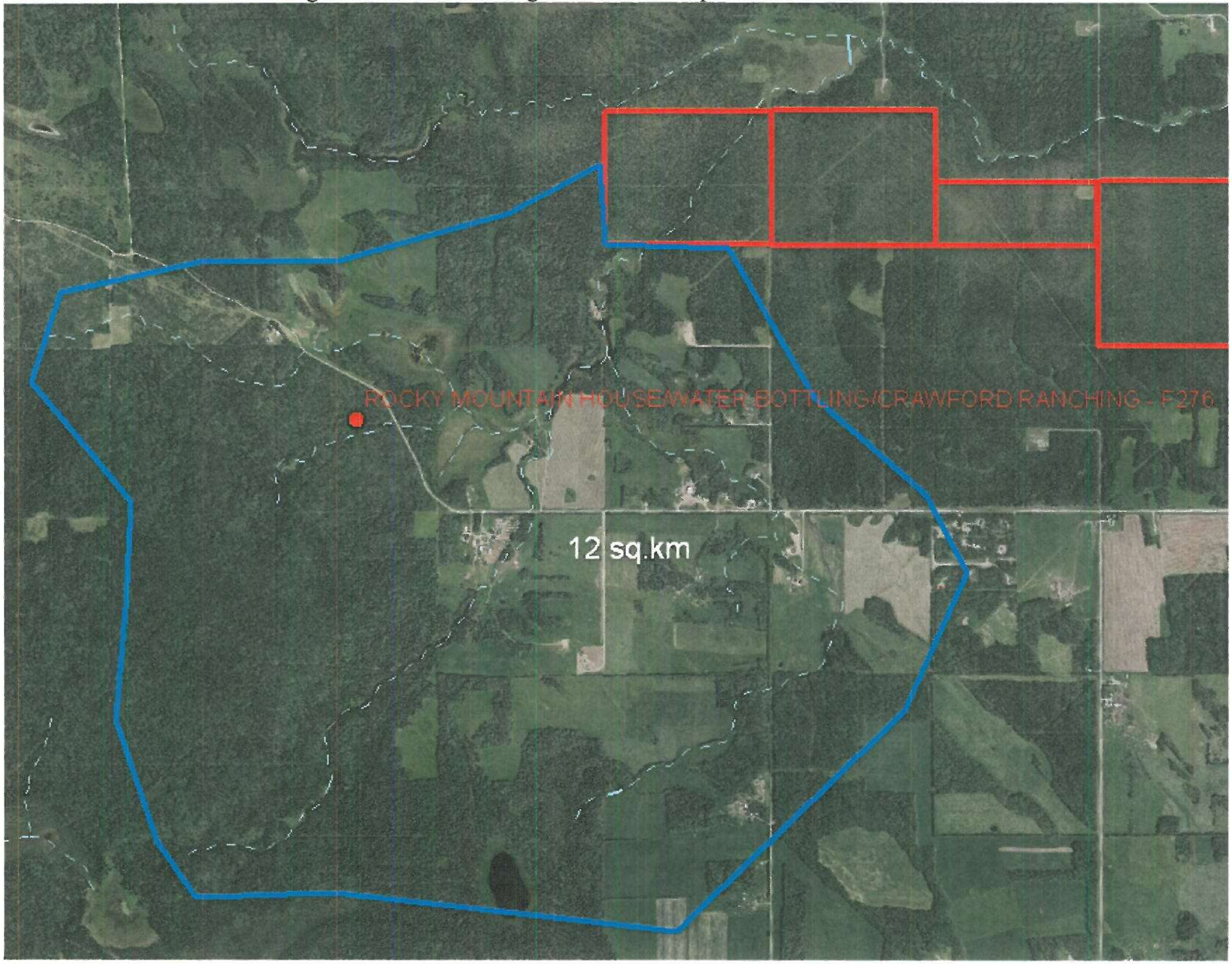
Discharge per hectare	0.035	cms/ha		m3
Total Discharge Rate	42000.00	l/s	STORAGE	-

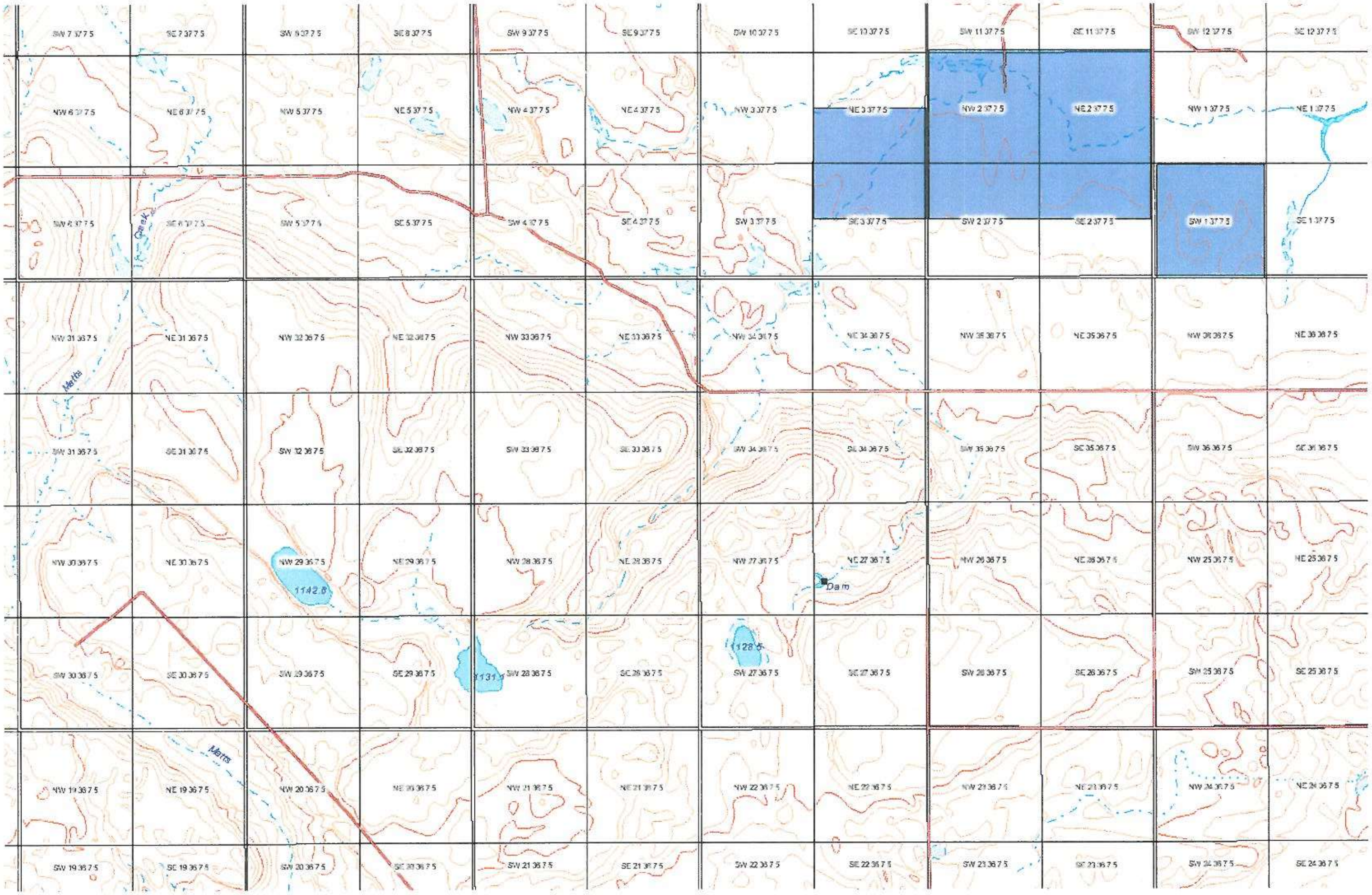
Table A9.2 - Huff Distribution

100 Year Storm (24 hr) - Storm Runoff Volumes

Time Step	Intensity mm/hr	Inflow l/s	Inflow Vol. cu.m.	Outflow l/s	Outflow Vol. cu. m.	Storage Volume cu.m.
00:00	0.00	0.00	0.000	0.000	0.000	0.00
00:15	0.95	535.50	481.950	535.500	481.950	0.00
00:30	1.89	1071.00	963.900	1071.000	963.900	0.00
00:45	2.83	1603.67	1443.300	1603.667	1443.300	0.00
01:00	3.48	1972.00	1774.800	1972.000	1774.800	0.00
01:15	5.04	2856.00	2570.400	2856.000	2570.400	0.00
01:30	7.56	4284.00	3855.600	4284.000	3855.600	0.00
01:45	10.10	5723.33	5151.000	5723.333	5151.000	0.00
02:00	12.60	7140.00	6426.000	7140.000	6426.000	0.00
02:15	15.10	8556.67	7701.000	8556.667	7701.000	0.00
02:30	16.80	9520.00	8568.000	9520.000	8568.000	0.00
02:45	17.30	9803.33	8823.000	9803.333	8823.000	0.00
03:00	17.70	10030.00	9027.000	10030.000	9027.000	0.00
03:15	18.20	10313.33	9282.000	10313.333	9282.000	0.00
03:30	18.60	10540.00	9486.000	10540.000	9486.000	0.00
03:45	18.30	10370.00	9333.000	10370.000	9333.000	0.00
04:00	17.60	9973.33	8976.000	9973.333	8976.000	0.00
04:15	16.80	9520.00	8568.000	9520.000	8568.000	0.00
04:30	16.00	9066.67	8160.000	9066.667	8160.000	0.00
04:45	15.30	8670.00	7803.000	8670.000	7803.000	0.00
05:00	14.50	8216.67	7395.000	8216.667	7395.000	0.00
05:15	13.70	7763.33	6987.000	7763.333	6987.000	0.00
05:30	12.80	7253.33	6528.000	7253.333	6528.000	0.00
05:45	12.00	6800.00	6120.000	6800.000	6120.000	0.00
06:00	11.20	6346.67	5712.000	6346.667	5712.000	0.00
06:15	10.60	6006.67	5406.000	6006.667	5406.000	0.00
06:30	9.88	5598.67	5038.800	5598.667	5038.800	0.00
06:45	9.20	5213.33	4692.000	5213.333	4692.000	0.00
07:00	8.53	4833.67	4350.300	4833.667	4350.300	0.00
07:15	7.89	4471.00	4023.900	4471.000	4023.900	0.00
07:30	7.39	4187.67	3768.900	4187.667	3768.900	0.00
07:45	6.90	3910.00	3519.000	3910.000	3519.000	0.00
08:00	6.41	3632.33	3269.100	3632.333	3269.100	0.00
08:15	5.91	3349.00	3014.100	3349.000	3014.100	0.00
08:30	5.53	3133.67	2820.300	3133.667	2820.300	0.00

Figure 2: Clearwater Bog 3-37-7 W5M Upstream Catchment Area

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SE 7 37 7 5
SW 8 37 7 5
SE 8 37 7 5
SW 9 37 7 5
SE 9 37 7 5
SW 10 37 7 5
SE 10 37 7 5
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SE 11 37 7 5
SW 12 37 7 5
SE 12 37 7 5
NW 6 37 7 5
NE 6 37 7 5
NW 5 37 7 5
NE 5 37 7 5
NW 4 37 7 5
NE 4 37 7 5
NW 3 37 7 5
NE 3 37 7 5
NW 2 37 7 5
NE 2 37 7 5
NW 1 37 7 5
NE 1 37 7 5
SW 6 37 7 5
Creek
SE 6 37 7 5
SW 5 37 7 5
SE 5 37 7 5
SW 4 37 7 5
SE 4 37 7 5
SW 3 37 7 5
SE 3 37 7 5
SW 2 37 7 5
SE 2 37 7 5
SW 1 37 7 5
SE 1 37 7 5
NW 31 36 7 5
Metts
NE 31 36 7 5
NW 32 36 7 5
NE 32 36 7 5
NW 33 36 7 5
NE 33 36 7 5
NW 34 36 7 5
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NW 30 36 7 5
NE 30 36 7 5
NW 29 36 7 5
1142.8
NE 29 36 7 5
NW 28 36 7 5
NE 28 36 7 5
NW 27 36 7 5
NE 27 36 7 5
Dam
NW 26 36 7 5
NE 26 36 7 5
NW 25 36 7 5
NE 25 36 7 5
SW 30 36 7 5
SE 30 36 7 5
SW 29 36 7 5
SE 29 36 7 5
1131.1
SW 28 36 7 5
SE 28 36 7 5
1128.5
SW 27 36 7 5
SE 27 36 7 5
SW 26 36 7 5
SE 26 36 7 5
SW 25 36 7 5
SE 25 36 7 5
Metts
NW 19 36 7 5
NE 19 36 7 5
NW 20 36 7 5
NE 20 36 7 5
NW 21 36 7 5
NE 21 36 7 5
NW 22 36 7 5
NE 22 36 7 5
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NW 24 36 7 5
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SW 19 36 7 5
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SW 22 36 7 5
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SE 23 36 7 5
SW 24 36 7 5
SE 24 36 7 5

APPENDIX D

Baseline Water Quality Summary, 2016 to 2019

REPORT

Premier Tech Clearwater Peat Harvest Project

Baseline Water Quality Summary, 2016 To 2019

Submitted to:

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Document Reference No.
19132041_PTH_Baseline Water Quality_Appendix D_REV0

November 2020

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ATTACHMENT

ATTACHMENT 1
Table 1a to Table 1e: Clearwater Project Baseline Water Quality Summary by Station, 2016-2019.

1.0 INTRODUCTION

Premier Tech Horticulture (Premier Tech) plans to conduct a peat harvesting operation (the Project) for horticultural purposes in Clearwater County. The Clearwater Project is located in west-central Alberta, southwest of the town of Chedderville along Mud Creek, a tributary of the Clearwater River. The eastern most portion of the Project is approximately 500 metres (m) west of Highway 22 and located in portions of Sections 1 and 2 of Township 37, Range 7, west of the 5th Meridian.

This report provides a summary of the baseline water quality data collected by Premier Tech from 2016 to 2019 from the proposed Project area. The available data were reviewed to characterize baseline water quality in waterbodies adjacent to and downstream of the Project and to determine if sufficient data have been collected for the purposes of baseline monitoring. This report supersedes the previous baseline water quality summary in 2017 in support of the Clearwater Project (Golder 2017), which was reviewed by Alberta Environment and Parks (AEP) and resulted in Supplemental Information Requests (SIRs) to Premier Tech on 28 May 2019 (AEP 2019). Specific changes and updates to the baseline water quality summary to address the AEP SIRs include the following:

- Additional sampling was conducted in 2018 (10 May and 20 September 2018) and 2019 (22 April 2019), and the data from these programs have been included for analysis in this report.
- Additional assessment has been provided in this report, including comparison of field pH to guidelines, assessing spatial patterns in water chemistry and seasonal variation in nutrients and metals, and determining general trophic status of waters in the Clearwater Project footprint and in Mud Creek (Section 2.1).
- Comparison of the measured baseline water quality data to recommendations outlined in the *Guide to Surface Materials Lease Information Requirements for Peat Operations* (the Guide; GOA 2017), and the *Guide to Water Act Application Requirements for Surface Water Quality Monitoring for Peat Operations in Alberta* (GOA 2018a), to demonstrate how the available dataset is sufficient to assess the impact of the Project on the water quality of Mud Creek with respect to monitoring locations, frequency, and parameters (Section 2.2).

Runoff from peatlands is a combination of surface water and peat harvest drainage. Peat harvest drainage network construction as part of the development may increase outflows from peatland, decrease wetland water retention capacity and time, and increase soil erosion within the development area and further downstream, which can affect water quality in the downstream receiving environment. Understanding the potential implications to changes to water quality as a result of peat harvesting is necessary to focus the selection of water quality parameters for a reliable baseline water quality characterization.

For peatland developments, key water quality parameters within discharges from peat development areas and their receiving environments include, but are not limited to:

- Total suspended solids (TSS): elevated TSS concentrations are measured in discharges within and from peat harvesting activities.
- pH: low pH has been measured in drainage from harvested areas.
- Total dissolved solids (TDS) and related major ions: increased TDS concentrations have been measured in discharges over time as a result of mineral exclusion from exposed peat.
- Nutrients: increased nutrients (e.g., nitrogen, phosphorus, and organic carbon) have been measured in drainage from harvested areas.

The range of water quality parameters are consistent with recommendation made in Clément et al. (2009), Daigle and Gautreau-Daigle (2001), and Wind-Mulder and Vitt (2000).

Based on the Guide and further guidance from AEP (GOA 2017, 2018a), in situ measurements of temperature, dissolved oxygen and sampling for 5-day biological oxygen demand and metals (i.e., selected 'heavy' and transition metals and elements) should also be completed for the peat harvesting operations. Potential changes to water temperature due to the Project development has also been identified as a concern, due to the potential for Mud Creek to support cold-water fish.

2.0 EXISTING BASELINE STUDIES FOR THE PROJECT

Premier Tech collected field data and water quality samples from 2016 to 2019 to characterize baseline conditions in the proposed Project area and the downstream receiving environment. These samples were collected from a shallow well dug in the Project footprint (i.e., Station 1) and four locations in the receiving waterbody, Mud Creek (i.e., Stations 2 to 5) (Figure 1). Between 2016 to 2019, samples were collected during spring, summer, and fall and laboratory analysis of the collected water samples was completed by Bureau Veritas Laboratories (BV Labs, formerly Maxxam Analytics), Edmonton, Alberta.

The surface water quality baseline data collected at Stations 1 through 5 are presented in Tables 1a through 1e (Attachment 1), which list the field data (i.e., pH, temperature, dissolved oxygen, and specific conductivity) and laboratory data (i.e., general water quality, ionic composition, nutrients, and metals parameter groups). All available data were compared to the Canadian Council of Ministers of the Environment (CCME) (CCME 1999) and Government of Alberta (GOA) (GOA 2018b) water quality guidelines for the protection of aquatic life (Tables 1a to 1e, Attachment 1). Available seasonal water temperatures averages from the dataset and laboratory pH data were used for water quality guideline calculations when required.

Quality assurance/quality control data to provide an indication of data reliability are available for the laboratory analyses. These data were reported by BV Labs, and included matrix spikes, spiked blanks, and method blanks. No issue with laboratory quality assurance/quality control was reported, except for hold-time exceedances. For example:

- Laboratory pH values were reported outside of the method-specific 15-minute hold time for all samples.
- Biochemical oxygen demand samples were reported outside of the method-specified 48-hour hold time for the 6 November 2017 program.
- Total suspended solids samples were reported outside the method-specified 7-day hold time for the 20 September 2018 program.

Quality control data specific to the field program (e.g., field duplicates, trip blanks and field blanks) were not available. It has been assumed that Premier Tech utilized quality assurance procedures for the sampling events, such as use of experienced personnel to collected the field data and water samples, application and use of standard operating procedures for the field work, as well as appropriate sample processing, handling and storage techniques.

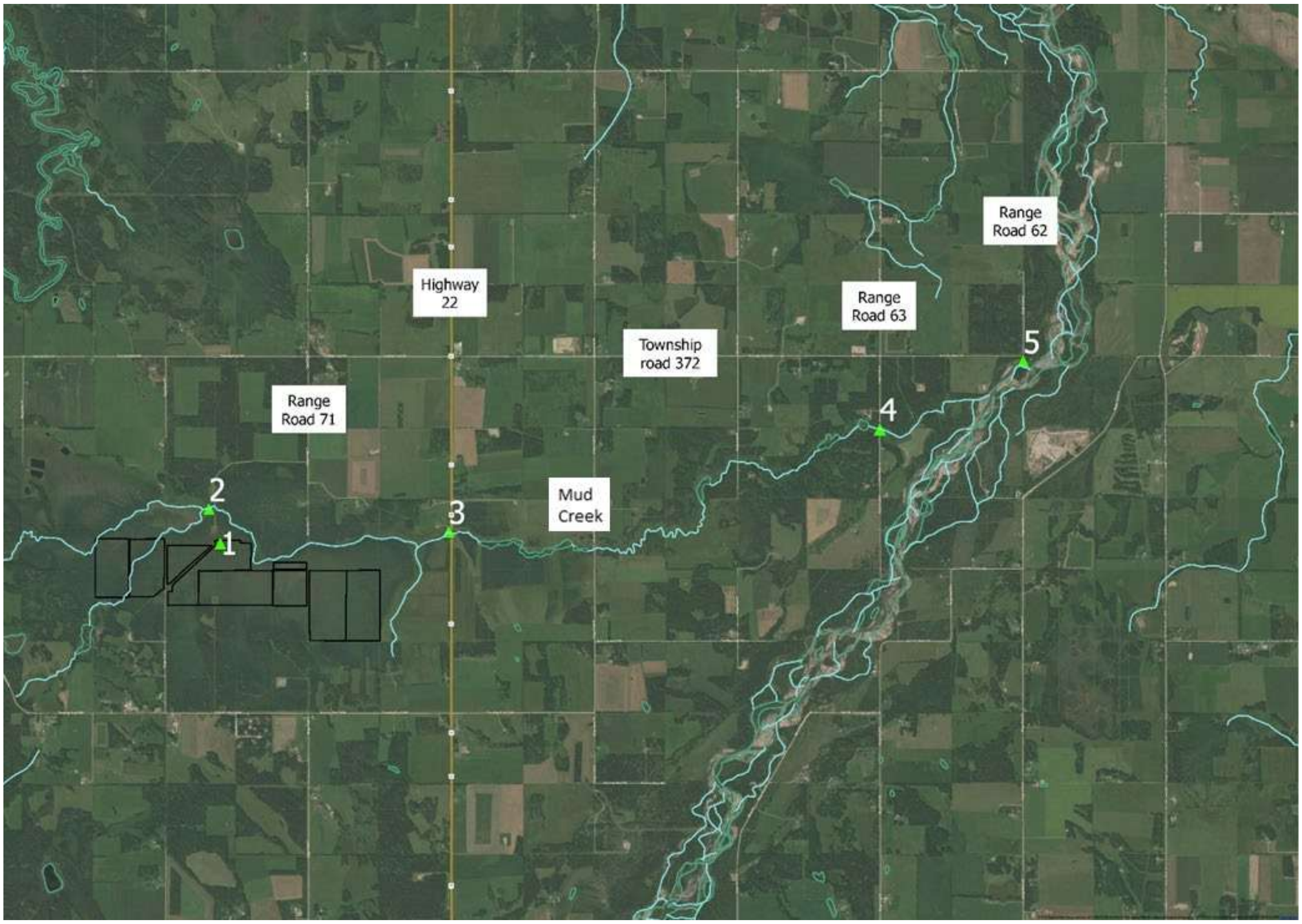

Figure 1: Clearwater Project Baseline Water Quality Sampling Locations, 2016 to 2019
Notes:
Green triangles = sampling locations; black lines = proposed Project footprint (including Phase 1 and Phase 2).

2.1 Baseline Data Characterization

2.1.1 Physico-chemical Data

Field data describing the physico-chemical conditions of the water at each station were available during three programs (Tables 1a to 1e, Attachment 1):

- Temperature and dissolved oxygen in May 2017 (except for Station 1, where field data were not recorded).
- Temperature, dissolved oxygen, field pH, and conductivity in the November 2017 (except for Station 1, where only temperature and dissolved oxygen measurements were recorded).
- Temperature, dissolved oxygen, field pH, and conductivity May 2018.

Monitored temperature ranged from 1.7°C (Station 3; November 2017) to 12.7°C (Station 5; May 2017), and the dissolved oxygen data at the same sites ranged from 9.6% saturation (1 mg/L) at Station 5 in May 2017 to 85.4% saturation (10.3 mg/L) at Station 2 in May 2017. Two dissolved oxygen concentrations were below the GOA minimum guideline for the protection of aquatic life: one collected at Station 1 in November 2017 (4.3 mg/L) and one collected at Station 5 in May 2017 (1.0 mg/L).

2.1.2 Conventional Water Quality Parameters

The waters in the Clearwater Project footprint and Mud Creek over the 2016 to 2019 study period can be characterized as circumneutral to slightly alkaline (based on laboratory pH analyses), with generally moderate concentrations of total dissolved solids (TDS) (i.e., 63 to 330 mg/L). Hardness ranged from soft (i.e., 59 mg/L $CaCO_3$) at Station 1 in May 2017 to very hard (i.e., to 350 mg/L $CaCO_3$) at stations 4 and 5 in November 2017 (GOA 2018b; Tables 1a to e, Attachment 1). Total alkalinity concentrations (i.e., 60 to 320 mg/L; Tables 1a to e, Attachment 1) were all higher than the minimum GOA guideline for protection of aquatic life of 20 mg/L and indicate a low sensitivity to acidification (University of Massachusetts Amherst 2020, McNeely et al. 1979).

Spatial variability in water quality between the Clearwater Project footprint station and receiving water stations in Mud Creek were evident for some parameters, including TSS, turbidity, pH, TDS, hardness, and alkalinity. Higher concentrations of TSS and turbidity values were observed at Station 1 (Clearwater Project footprint) compared to the receiving streams, particularly during March 2016 when TSS concentrations and turbidity values at Station 1 were 160 mg/L and 44 Nephelometric Turbidity Units (NTU), respectively. Concentrations of TSS and turbidity values at Station 1 ranged from 4.7 mg/L to 160 mg/L and 1.1 NTU to 44 NTU, respectively, and 1.3 mg/L to 13 mg/L and 0.20 NTU to 3.6 NTU, respectively, at Stations 2 to 5. Station 1 had circumneutral pH; lower TDS, hardness, and alkalinity; and higher TSS and turbidity compared to the receiving water stations. Water from Stations 2 to 5 was slightly alkaline and had higher TDS concentrations compared to Station1; TDS concentrations were similar among the receiving stream stations (Tables 1a to 1e, Attachment 1).

Seasonal trends in water quality among all stations in TDS concentrations, hardness, and alkalinity were apparent; lower TDS concentrations, hardness, and alkalinity in spring relative to late winter and summer/fall periods were observed, likely as a consequence of dilution during the spring melt.

2.1.3 Ionic Composition

The ionic composition of the water collected in 2016 to 2019 at each station was similar. The dominant ions were calcium and bicarbonate (Tables 1a to 1e, Attachment 1). The ionic relationship for these waters can generally be expressed as follows:

$$HCO_3 > Ca > Mg >> SO_4 > Na > K > Cl$$

The pattern differed slightly at Station 5 where concentrations of sulphate were similar to or higher than magnesium. The concentrations of all major ions in Clearwater Project footprint and Mud Creek were below the GOA and CCME guidelines for the protection of aquatic life.

2.1.4 Nutrients

Nutrient concentrations at the sampling stations showed some variability. Station 1 (Clearwater Project footprint) was relatively nutrient-rich (total nitrogen [TN]: 1.8 to 4.9 mg N/L; total phosphorus [TP]: 0.046 to 0.12 mg P/L; dissolved organic carbon [DOC]: 13 to 30 mg/L) compared to water in the receiving streams. Slightly reduced nutrient concentrations were observed in the receiving streams, with the following concentration ranges (TN: 0.14 to 2.0 mg N/L; TP: 0.004 to 0.027 mg P/L [excluding the March 2016 samples]; and DOC: 1 to 19 mg/L). Higher concentrations of TP in the downstream stations were observed in March 2016 compared to other months and compared to Station 1.

In general, dissolved inorganic nitrogen (e.g., nitrate+nitrite and ammonia) represented a low proportion of the total nitrogen concentration (typically less than 50%), highlighting the predominant organic nutrient nitrogen fractions in the water. In the receiving waters, the proportion of the organic and inorganic nitrogen fractions to the corresponding total nitrogen concentration varied seasonally; total Kjeldahl nitrogen was the highest proportion of total nitrogen during most sampling programs, but nitrate+nitrite dominated in the late fall (November) of 2017.

The concentrations of all nitrogen parameters were below the GOA and CCME guidelines for the protection of aquatic life. Concentrations of TP were indicative of eutrophic conditions in the Clearwater Project footprint and oligo-trophic to meso-eutrophic conditions in Mud Creek based on CCME's Canadian Guidance Framework for Phosphorus (CCME 2004).

2.1.5 Metals

Metal concentrations at the sampling stations were typically higher at Station 1 than the receiving water stations. Approximately 50% of the metals included in the analyses of samples collected at the five stations were detected in both total and dissolved forms; more metals were detectable at Station 1 than the receiving water stations (see Tables 1a to 1e, Attachment 1).

Clear and consistent seasonal patterns were not observed in metals at all stations; however, total and dissolved metal concentrations at Station 1 were highest when early spring conditions (March) were sampled in 2016. At most receiving water stations, peak total metal concentrations were observed during the June 2016 sampling event, which is consistent with the Guide's statement that concentrations of many parameters peak during the summer (GOA 2017; GOA 2018a).

Five metals were measured in concentrations above CCME and GOA water quality guidelines for the protection of aquatic life: total aluminum, copper, iron, mercury, and zinc. The concentration of one metal (i.e., dissolved iron at Station 1; 0.33 mg/L) was slightly above the dissolved water quality guideline (0.30 mg/L). Most guideline exceedances were observed at Station 1 (Clearwater Project footprint), where concentrations of all five metals exceeded guidelines. In the receiving water, guideline exceedances were limited to aluminum and iron concentrations.

2.2 Comparison to Baseline Water Quality Data Recommendations

The available water quality data are sufficient to provide a baseline characterization of the water quality conditions within the Clearwater Project and the stream reaches immediately adjacent to and downstream of the proposed Project area. Data gaps have been identified in Sections 2.2.1 to 2.2.3; however, the gaps do not prevent an overall characterization of baseline water quality conditions (e.g., for ionic composition, nutrients, and metals). The baseline data will be augmented in the fall of 2020 and reference (i.e., upstream of the Project) data will continue to be collected as part of operational and reclamation/closure monitoring. Future water quality monitoring will be completed under the surface water monitoring plan (Appendix E), which has been designed to align with the recommendations for locations, frequency, and parameters outlined in the Guide and in additional guidance from AEP (GOA 2017, 2018a) for peat harvesting.

2.2.1 Station Locations

The Guide (GOA 2017) and additional guidance from AEP (GOA 2018a) include recommendations for water quality sampling locations. Baseline water quality should be assessed for the proposed site and all potentially affected waters, including contributing and receiving waters, and all tributaries that flow into a fish-bearing receiving water body (GOA 2017). Specifically, initial baseline water sampling should occur:

- Upstream of any water flowing into the peatland, and its exit point.
- Any water body within the peatland that will be drained as a result of peat operations.
- Any water body in close proximity to the peatland (500 m) that may be impacted by drainage of the peatland.
- Any watercourse or water body that will receive drainage water from the peatland as a result of operations.

- Any tributary to a fish bearing stream above its entry point as well as upstream and downstream of the tributary entry point to the fish bearing receiving water (river or lake).
- Immediately downstream of any anthropogenic point source for pollutants entering a watercourse (e.g., road crossings, bridges, etc.).

Premier Tech included one sampling location from within the Clearwater Project footprint and four sampling locations in the receiving streams downstream of the Project as shown in Figure 1; these latter four stations represent the receiving environment for drainage from the Project given the relatively small area of the Project. Additional locations upstream of the Project (i.e., for reference) have been identified for additional monitoring during operations and reclamation/closure phases in the monitoring plan (See Appendix E).

2.2.2 Sampling Frequency

The Guide (GOA 2017) includes recommendations for water quality sampling frequency for peat harvesting, as recommended by Halsey et al. (1998) in their report to the Alberta Peat Task Force. According to this report, sampling is recommended to be conducted three times per year in spring freshet, mid-summer, and autumn base flow conditions.

The baseline data collected by Premier Tech were collected over the course of four sampling events in 2016 (twice in spring, early summer, and early fall), two sampling events each in 2017 (late spring and late fall) and 2018 (late spring and early fall), and one sampling event in 2019 (spring). Baseline data have been collected across different seasons to characterize seasonal variability in baseline conditions; Premier Tech plans to augment the baseline data with additional sampling in the fall of 2020, which will be included in future assessments of baseline conditions for the Project.

2.2.3 Parameter Suite

The parameter suite recommended for monitoring peat harvesting operations is summarized in Table 1 and was based on the Guide and additional water quality-specific guidance from AEP, as outlined in the "Guide to *Water Act* Application Requirements for Surface Water Quality Monitoring for Peat Operations in Alberta" reference document (GOA 2018a).

Table 1: Required Parameters for the Clearwater Project

Water Parameter Grouping	Constituents of Potential Concern
Physico-chemical Field Measurements	in situ pH, temperature, dissolved oxygen, and specific conductivity
Conventional Parameters	hardness, total alkalinity, total suspended solids, total dissolved solids, turbidity, 5-day biological oxygen demand, dissolved organic carbon, and specific conductivity
Major Ions	calcium, sulphate, magnesium, sodium, potassium, chloride
Nutrients	total ammonia, total Kjeldahl nitrogen, nitrate, nitrite, nitrate and nitrite, total phosphorus, dissolved phosphorus(a)
Total and Dissolved Metals	aluminum, arsenic, cadmium, chromium, iron, lead, manganese, mercury, molybdenum, vanadium

Note: Parameters listed are consistent with Table 1 in GOA (2017) and Table 1 in GOA (2018a).

(a) In the GOA 2017 guide, phosphate was also listed as a recommended parameter; dissolved phosphorus (as recommended in GOA 2018a) was used to assess the dissolved fraction of phosphorus instead of phosphate.

All in situ and laboratory parameters in Table 1 have been monitored at multiple locations and in multiple seasons during baseline conditions (Tables 1a to 1e); data gaps are summarized for field (i.e., in situ) and laboratory parameters:

- In situ physico-chemical parameters, such as pH, dissolved oxygen, specific conductivity, and temperature, were not consistently collected over the baseline monitoring period. These in-situ parameters are good front-line indicators of water quality that can be used to identify potential effects in the receiving environment. The inclusion of pH, temperature, and dissolved oxygen is important because these parameters may affect relative toxicity of certain parameters to aquatic life (e.g., pH and temperature influence ammonia toxicity potential), as well as have a direct influence on fish habitat (e.g., food quality and quantity, vegetative cover, and available dissolved oxygen) and behaviour (e.g., reproductive timing and success). Two parameters, specific conductivity and pH, were measured in laboratory samples so where field data are not available, these laboratory data can be used to provide estimates for these parameters. However, due to the short hold times for laboratory pH (i.e., 15 minutes; APHA 2012), field pH results are typically more reliably and should be collected as part of routine field measurements.
- Data inconsistencies in laboratory water sample chemistry data were also identified. Not all parameters were analysed during each of the field programs (e.g., 5-day biological oxygen demand and total suspended solids). Stations were not sampled for total metals in April 2016 and in 2017, 2018, and 2019 sampling events; however, dissolved metals were collected at all stations during those sampling events, with the exception of Station 1 in November 2017 and all stations in May 2018. In March 2016, mercury was analyzed at a detection limit (DL) greater than it's guideline for the protection of aquatic life (CCME 1999; GOA 2018b) for samples collected at stations 2, 3, 4, and 5.

Additional fall monitoring for the full suite of in situ physico-chemical and laboratory parameters are planned for 2020; the additional sampling will allow supplementation of information for the field and laboratory parameters with an incomplete data record.

Another potential gap is the absence of baseline data for hydrocarbon compounds. Peatland areas can be sources of hydrocarbon compounds, including polycyclic aromatic hydrocarbons (PAHs), which suggest that these compounds (particularly gross indicator forms, such as total recoverable hydrocarbons, benzene, toluene, ethylbenzene, xylenes, and total phenols) should be included (Klavina et al. 2011). Hydrocarbon compound analysis is not required by the Guide, but could be useful to determine if hydrocarbons are present in the natural environment before the Project operations begin.

3.0 CONCLUSIONS

Baseline data from March 2016 to April 2019 have been collected from a shallow well dug within the peat in the Clearwater Project footprint (one station), and the receiving watercourse, Mud Creek (four stations), during the spring, summer and fall. The available baseline data are reasonably comprehensive and include results from locations that will be influenced by the peat harvesting operations for all recommended parameters over multiple seasons. Some inconsistencies were noted in the monitoring of in situ physico-chemical and laboratory parameters during baseline conditions (e.g., missing results for field temperature, field pH, total metals, 5-day biological oxygen demand). Key findings from the Project baseline water quality data are:

- The water sampled in the Clearwater Project footprint (Station 1) can be characterized as circumneutral to slightly alkaline (based on laboratory pH analyses), with generally moderate concentrations of TDS and soft to moderately hard water. Water in Mud Creek (Stations 2 to 5) was slightly alkaline with generally moderate concentrations of TDS and moderately hard to very hard water. Total alkalinity concentrations at both the Clearwater Project footprint station and in Mud Creek indicate a low sensitivity to acidification.

- The dominant ions were calcium and bicarbonate at the Clearwater Project footprint station and in Mud Creek. The typical ionic relationship for these waters can generally be expressed as follows: HCO_3 > Ca > Mg >> SO_4 > Na > K > Cl, with the exception of Station 5 in Mud Creek where concentrations of sulphate were similar to or higher than magnesium.
- Station 1 (Clearwater Project footprint) was relatively nutrient rich, with higher concentrations of phosphorus, nitrogen, and dissolved organic carbon, compared to water in the receiving streams. Concentrations of TP were indicative of eutrophic conditions in the Clearwater Project footprint and oligo-trophic to meso-eutrophic conditions in Mud Creek.
- Metal concentrations at the Clearwater Project footprint station and in Mud Creek were typically low and below guidelines for aquatic life. Approximately 50% of the metals included in the analyses of samples collected at the five stations were detected in both total and dissolved forms; more metals were detectable at the Clearwater Project footprint station than the receiving water stations.
- Water chemistry at Station 1 (Clearwater Project footprint) was different compared to the chemistry of water collected from Stations 2 to 5 (receiving water of Mud Creek); the chemistry of water from the stations in Mud Creek were generally similar to each other. Station 1 had lower concentrations or values of (circumneutral) pH, TDS, hardness, and alkalinity, and higher concentrations or values of TSS, turbidity, TN, TP, DOC, and metals relative to water sampled in Mud Creek.
- Clear and consistent seasonal patterns were generally not observed at the sampling stations. Seasonal patterns observed in the baseline data were limited to lower TDS concentrations, hardness, and alkalinity in the spring at both the Clearwater Project footprint and in Mud Creek, likely as a consequence of dilution during the spring melt.
- Water chemistry results at Stations 1 to 5 occasionally exceeded Alberta or Canadian guidelines (GOA 2018a, CCME 1999) for the protection of aquatic life. Not surprisingly, more guideline exceedances and frequency of guideline exceedances at Station 1 were observed than the receiving water stations. The following exceedances in the 2016 to 2019 baseline data set were noted:
    - Station 1 (Clearwater Project footprint): dissolved oxygen, and total aluminum, copper, iron, mercury, and zinc.
    - Stations 2 to 5 (Mud Creek): dissolved oxygen, and total aluminum and iron.

Additional sampling events are planned for fall 2020 to augment the baseline water quality dataset; monitoring will continue at two additional upstream reference locations and locations adjacent to and downstream of the peat harvesting under the surface water monitoring plan (Appendix E), which has been designed to align with the recommendations for locations, sampling frequency and parameters in the Guide and additional guidance provided by AEP (GOA 2017, 2018a).

4.0 REFERENCES

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ATTACHMENT 1

Table 1a to Table 1e: Clearwater Project Baseline Water Quality Summary by Station, 2016-2019.

Attachment 1

Clearwater Project Baseline Water Quality Summary by Station, 2016-2019

Table 1a: Water Quality Summary for Station 1, 2016 to 2018

Parameter	Unit	Guidelines for the Protection of Aquatic Life:				Station 1 Sampling Data							Summary of Station 1 Sampling Data from 2016 to 2018								
		Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)	15-Mar-16	16-Apr-16	22-Jun-16	16-Sep-16	19-May-17	6-Nov-17	10-May-18	Median	Minimum	Maximum	Non-Dectable	Count	% Above Guideline			
																		Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)
Field Measured																					
pH	-	-	6.5 - 9.0	-	6.5 - 9.0	-	-	-	-	-	-	8.2	8.2	-	-	0	1	-	-	-	-
Temperature	°C	-	-	-	-	-	-	-	-	-	4.3	12	8	4.3	12	0	2	-	-	-	-
Dissolved oxygen	mg/L	5.0	6.5	-	6.5	-	-	-	-	-	**4.3**(A, C)	8.7	6.5	**4.3**(A, C)	8.7	0	2	50	50	-	50
Dissolved oxygen	%	-	-	-	-	-	-	-	-	-	33	80	56.6	33	80	0	2	-	-	-	-
Conductivity	µS/cm	-	-	-	-	-	-	-	-	-	-	200	200	200	200	0	1	-	-	-	-
Conventional Parameters																					
pH	-	-	6.5 - 9.0	-	6.5 - 9.0	6.7	7.0	7.3	7.0	7.3	-	-	7.0	6.7	7.3	0	5	-	-	-	-
Hardness, as $CaCO_3$	mg/L	-	-	-	-	140	100	110	120	59	-	-	110	59	140	0	5	-	-	-	-
Total alkalinity, as $CaCO_3$	mg/L	-	20(a)	-	-	130	100	98	110	60	-	-	100	60	130	0	5	-	-	-	-
Total dissolved solids	mg/L	-	-	-	-	140	110	100	120	63	-	-	110	63	140	0	5	-	-	-	-
Total suspended solids	mg/L	-	-	-	-	160	8	5	29	-	-	-	19	5	160	0	4	-	-	-	-
Dissolved organic carbon	mg/L	-	-	-	-	19	15	24	30	13	-	-	19	13	30	0	5	-	-	-	-
Turbidity	NTU	-	-	-	-	44	3.3	1.7	1.1	-	-	-	2.5	1.1	44	0	4	-	-	-	-
Conductivity	µS/cm	-	-	-	-	260	210	190	220	120	-	-	210	120	260	0	5	-	-	-	-
5-day biological oxygen demand	mg/L	-	-	-	-	27	4.2	6.4	-	-	-	-	6.4	4.2	27	0	3	-	-	-	-
Major Ions																					
Calcium	mg/L	-	-	-	-	39	28	28	32	16	-	-	28	16	39	0	5	-	-	-	-
Chloride	mg/L	640	120	640	120	2.1	2.3	1.9	3.3	2.5	-	-	2.3	1.9	3.3	0	5	-	-	-	-
Magnesium	mg/L	-	-	-	-	11	8.1	8.6	9.6	4.4	-	-	8.6	4.4	11	0	5	-	-	-	-
Potassium	mg/L	-	-	-	-	<0.3	0.60	1.3	1.8	1.0	-	-	1.0	<0.3	1.8	1	5	-	-	-	-
Sodium	mg/L	-	-	-	-	3.4	3.2	3.3	4.9	2.8	-	-	3.3	2.8	4.9	0	5	-	-	-	-
Sulphate	mg/L	-	218 - 309(b)	-	-	1.6	<1.0	<1.0	<0.5	<1.0	-	-	<1.0	<0.5	1.6	4	5	-	-	-	-
Nutrients																					
Nitrate	mg-N/L	124	2.9	124	2.9	<0.01	<0.01	<0.01	0.014	<0.01	-	-	<0.01	<0.01	0.014	4	5	-	-	-	-
Nitrite	mg-N/L	0.060 - 0.12(c)	0.020 - 0.040(c)	-	0.060	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	<0.01	<0.01	<0.01	5	5	-	-	-	-
Nitrate + nitrite	mg-N/L	-	-	-	-	<0.02	<0.02	<0.002	<0.02	<0.01	-	-	<0.02	<0.002	<0.02	5	5	-	-	-	-
Total Ammonia	mg-N/L	-	2.0(d)	-	2.0(d)	0.23	0.24	0.13	0.29	0.16	-	-	0.23	0.13	0.29	0	5	-	-	-	-
Total Kjeldahl Nitrogen	mg-N/L	-	-	-	-	4.9	1.8	3.8	3.5	-	-	-	3.7	1.8	4.9	0	4	-	-	-	-
Total nitrogen (calculated)	mg-N/L	-	-	-	-	4.9	1.8	3.8	3.5	-	-	-	3.7	1.8	4.9	0	4	-	-	-	-
Total phosphorus	mg-P/L	-	-	-	-	0.074	0.046	0.064	0.081	0.12	-	-	0.074	0.046	0.12	0	5	-	-	-	-
Dissolved phosphorus	mg-P/L	-	-	-	-	0.010	0.014	0.0070	0.0040	0.0033	-	-	0.0070	0.0033	0.014	0	5	-	-	-	-
Total Metals																					
Aluminum	mg/L	-	-	-	0.10(e)	**0.19**(C)	-	0.055	0.077	-	-	-	0.077	0.055	**0.19**(C)	0	3	-	-	-	33
Antimony	mg/L	-	-	-	-	0.00076	-	0.00063	<0.0006	-	-	-	0.00063	<0.0006	0.00076	1	3	-	-	-	-
Arsenic	mg/L	-	0.0050	-	0.0050	0.00043	-	0.00056	0.00065	-	-	-	0.00056	0.00043	0.00065	0	3	-	-	-	-
Barium	mg/L	-	-	-	-	0.15	-	0.098	0.086	-	-	-	0.098	0.086	0.15	0	3	-	-	-	-
Beryllium	mg/L	-	-	-	-	<0.001	-	<0.001	<0.001	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Boron	mg/L	29	1.5	29	1.5	<0.02	-	<0.02	<0.02	-	-	-	<0.02	<0.02	<0.02	3	3	-	-	-	-
Cadmium	mg/L	0.0012 - 0.0030(b)	0.00010 - 0.00021(b)	0.0012 - 0.0030(b)	0.00010 - 0.00021(b)	<0.00002	-	<0.00002	0.000060	-	-	-	<0.00002	<0.00002	0.000060	2	3	-	-	-	-
Calcium	mg/L	-	-	-	-	37	-	33	28	-	-	-	33	28	37	0	3	-	-	-	-
Chromium	mg/L	-	0.0010(f)	-	0.0010	<0.001	-	<0.001	<0.001	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Cobalt	mg/L	-	0.00082 - 0.0012(b)	-	-	0.00038	-	<0.0003	<0.0003	-	-	-	<0.0003	<0.0003	0.00038	2	3	-	-	-	-
Copper	mg/L	0.0095 - 0.022(b)	0.0070(b)	-	0.0020 - 0.0032(b)	**0.0043**(C)	-	0.00095	**0.0032**(C)	-	-	-	**0.0032**(C)	0.00095	**0.0043**(C)	0	3	-	-	-	67
Iron	mg/L	-	-	-	0.30	**1.1**(C)	-	**1.0**(C)	**0.50**(C)	-	-	-	**1.0**(C)	**0.50**(C)	**1.1**(C)	0	3	-	-	-	100
Lead	mg/L	-	0.0010 - 0.0049(b)	-	0.0010 - 0.0049(b)	0.00047	-	<0.0002	0.00022	-	-	-	0.00022	<0.0002	0.00047	1	3	-	-	-	-
Lithium	mg/L	-	-	-	-	<0.02	-	<0.02	<0.02	-	-	-	<0.02	<0.02	<0.02	3	3	-	-	-	-
Magnesium	mg/L	-	-	-	-	11	-	9.7	8.5	-	-	-	9.7	8.5	11	0	3	-	-	-	-
Manganese	mg/L	-	-	-	-	0.038	-	0.064	0.066	-	-	-	0.064	0.038	0.066	0	3	-	-	-	-
Mercury	mg/L	0.000013	0.0000050	-	0.000026	**0.0038**(A, C)	<0.000002	**0.000021**(A, C)	<0.000002	<0.000002	-	-	<0.000002	<0.000002	**0.0038**(A, C)	3	5	40	40	-	20
Molybdenum	mg/L	-	0.073	-	0.073	0.00027	-	<0.0002	<0.0002	-	-	-	<0.0002	<0.0002	0.00027	2	3	-	-	-	-
Nickel	mg/L	0.30 - 0.62(b)	0.033 - 0.069(b)	-	0.025 - 0.12(b)	0.00094	-	<0.0005	0.0011	-	-	-	0.00094	<0.0005	0.0011	1	3	-	-	-	-
Potassium	mg/L	-	-	-	-	<0.3	-	1.1	1.5	-	-	-	1.1	<0.3	1.5	1	3	-	-	-	-
Selenium	mg/L	-	0.0020	-	0.0010	<0.0002	-	<0.0002	<0.0002	-	-	-	<0.0002	<0.0002	<0.0002	3	3	-	-	-	-
Silicon	mg/L	-	-	-	-	6.0	-	5.2	4.4	-	-	-	5.2	4.4	6.0	0	3	-	-	-	-
Silver	mg/L	-	0.00025	-	0.00025	<0.0001	-	<0.0001	<0.0001	-	-	-	<0.0001	<0.0001	<0.0001	3	3	-	-	-	-
Sodium	mg/L	-	-	-	-	3.2	-	3.6	4.2	-	-	-	3.6	3.2	4.2	0	3	-	-	-	-
Strontium	mg/L	-	-	-	-	0.17	-	0.16	0.13	-	-	-	0.16	0.13	0.17	0	3	-	-	-	-
Sulphur	mg/L	-	-	-	-	0.32	-	0.29	2.6	-	-	-	0.32	0.29	2.6	0	3	-	-	-	-
Thallium	mg/L	-	0.00080	-	0.00080	<0.0002	-	<0.0002	<0.0002	-	-	-	<0.0002	<0.0002	<0.0002	3	3	-	-	-	-
Tin	mg/L	-	-	-	-	<0.001	-	<0.001	<0.001	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Titanium	mg/L	-	-	-	-	0.0046	-	0.0018	0.0017	-	-	-	0.0018	0.0017	0.0046	0	3	-	-	-	-
Uranium	mg/L	0.033	0.015	0.033	0.015	<0.0001	-	<0.0001	<0.0001	-	-	-	<0.0001	<0.0001	<0.0001	3	3	-	-	-	-

Table 1a: Water Quality Summary for Station 1, 2016 to 2018

Parameter	Unit	Guidelines for the Protection of Aquatic Life:				Station 1 Sampling Data							Summary of Station 1 Sampling Data from 2016 to 2018								
		Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)	15-Mar-16	16-Apr-16	22-Jun-16	16-Sep-16	19-May-17	6-Nov-17	10-May-18	Median	Minimum	Maximum	Non-Dectable	Count	% Above Guideline			
																		Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)
Vanadium	mg/L	-	-	-	-	<0.001	-	<0.001	<0.001	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Zinc	mg/L	-	0.030	-	-	**$0.061^{(C)}$**	-	0.0033	0.024	-	-	-	0.024	0.0033	**$0.061^{(C)}$**	0	3	-	33	-	-
Dissolved Metals																					
Aluminum	mg/L	$0.10^{(g)}$	$0.050^{(g)}$	-	-	0.036	0.022	0.024	0.029	0.0087	-	-	0.024	0.0087	0.036	0	5	-	-	-	-
Antimony	mg/L	-	-	-	-	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	-	-	<0.0006	<0.0006	<0.0006	5	5	-	-	-	-
Arsenic	mg/L	-	-	-	-	0.00030	0.00021	0.00043	0.00061	<0.0002	-	-	0.00030	<0.0002	0.00061	1	5	-	-	-	-
Barium	mg/L	-	-	-	-	0.19	0.078	0.073	0.092	0.041	-	-	0.078	0.041	0.19	0	5	-	-	-	-
Beryllium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	<0.001	<0.001	<0.001	5	5	-	-	-	-
Boron	mg/L	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	<0.02	<0.02	<0.02	5	5	-	-	-	-
Cadmium	mg/L	-	-	-	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	-	<0.00002	<0.00002	<0.00002	5	5	-	-	-	-
Chromium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	<0.001	<0.001	<0.001	5	5	-	-	-	-
Cobalt	mg/L	-	-	-	-	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	-	-	<0.0003	<0.0003	<0.0003	5	5	-	-	-	-
Copper	mg/L	-	-	-	-	0.00047	0.0016	0.00087	0.0026	0.00090	-	-	0.00090	0.00047	0.0026	0	5	-	-	-	-
Iron	mg/L	-	0.30	-	-	**$0.33^{(C)}$**	0.29	0.17	0.14	<0.06	-	-	0.17	<0.06	**$0.33^{(C)}$**	1	5	-	20	-	-
Lead	mg/L	-	-	-	-	0.00029	<0.0002	<0.0002	<0.0002	<0.0002	-	-	<0.0002	<0.0002	0.00029	4	5	-	-	-	-
Lithium	mg/L	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	<0.02	<0.02	<0.02	5	5	-	-	-	-
Manganese	mg/L	-	-	$4.2 - 8.9^{(h)}$	$0.43 - 0.73^{(h)}$	0.048	0.022	0.058	<0.004	0.0041	-	-	0.022	<0.004	0.058	1	5	-	-	-	-
Molybdenum	mg/L	-	-	-	-	0.00033	<0.0002	<0.0002	<0.0002	<0.0002	-	-	<0.0002	<0.0002	0.00033	4	5	-	-	-	-
Nickel	mg/L	-	-	-	-	0.00065	0.0011	<0.0005	0.00080	<0.0005	-	-	0.00065	<0.0005	0.0011	2	5	-	-	-	-
Selenium	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	-	<0.0002	<0.0002	<0.0002	5	5	-	-	-	-
Silicon	mg/L	-	-	-	-	5.9	4.5	4.3	4.6	2.1	-	-	4.5	2.1	5.9	0	5	-	-	-	-
Silver	mg/L	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	<0.0001	<0.0001	<0.0001	5	5	-	-	-	-
Strontium	mg/L	-	-	-	-	0.17	0.13	0.13	0.15	0.069	-	-	0.13	0.069	0.17	0	5	-	-	-	-
Sulphur	mg/L	-	-	-	-	1.9	0.22	0.32	0.31	<0.2	-	-	0.31	<0.2	1.9	1	5	-	-	-	-
Thallium	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	-	<0.0002	<0.0002	<0.0002	5	5	-	-	-	-
Tin	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	<0.001	<0.001	<0.001	5	5	-	-	-	-
Titanium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	<0.001	<0.001	<0.001	5	5	-	-	-	-
Uranium	mg/L	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	<0.0001	<0.0001	<0.0001	5	5	-	-	-	-
Vanadium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	<0.001	<0.001	<0.001	5	5	-	-	-	-
Zinc	mg/L	-	-	$0.094 - 0.21^{(i)}$	$0.035 - 0.15^{(i)}$	0.085	0.0081	0.0032	0.0097	0.018	-	-	0.0097	0.0032	0.085	0	5	-	-	-	-

Notes:

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision *after* comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

Not all samples have associated field measured parameters and so laboratory pH was used to calculate individual guidelines when field pH was not present. The water temperature measured at Station 1 on 10 May 2018 (12°C) was used to calculate guidelines for all spring samples missing field data (i.e., those collected in March, April and May). The water temperature measured at Station 1 on 6 November 2017 (4.3°C) was used to calculate guidelines for all fall samples missing field data (i.e., those collected in September). A water temperature of 20°C was used to calculate guidelines for the summer (June) sample missing field data. If field measured data were present for a sample, the sample-specific values were used during guideline calculation for that sample.

(a) Guideline is a minimum value, unless the background concentration or value is lower.

(b) Guideline is hardness dependent and calculated based on the individual hardness value for each sample. The guideline range shown is based on the hardness range observed in the dataset (59 to 140 mg/L).

(c) Guideline is chloride dependent and is calculated based on the individual chloride concentration in each sample. The guideline range shown is based on the chloride concentration range observed in the dataset (1.9 to 3.3 mg/L).

(d) The ammonia guideline is pH and temperature dependent. The data were compared to the minimum guideline (2.0 mg-N/L), which was based on the combination of laboratory pH (7.3) and water temperature (20°C).

(e) Guideline is pH dependent: 0.005 mg/L at pH < 6.5 and 0.1 mg/L at pH ≥ 6.5.

(f) Guideline is for chromium VI.

(g) Guideline is pH dependent and calculated based on the individual pH for each sample. The guideline range shown is based on the pH range observed in the dataset (6.7 to 7.3).

(h) The dissolved manganese guidelines are dependent on pH and hardness, and are calculated based on the individual pH and hardness measurements for each sample. The minimum acute manganese guideline (4.2 mg/L) is based on the combination of laboratory pH (7.3) and hardness (59 mg/L). The minimum chronic manganese guideline (0.43 mg/L) is based on the combination of laboratory pH (7.3) and hardness (59 mg/L).

(i) The dissolved zinc guidelines are dependent on pH (chronic only), hardness, and DOC and are calculated based on the individual pH, hardness, and DOC measurements for each sample. The minimum acute zinc guideline (0.094 mg/L) is based on the combination of hardness (59 mg/L) and DOC (13 mg/L). The minimum chronic zinc guideline (0.035 mg/L) is based on the combination of laboratory pH (7.3), hardness (59 mg/L) and DOC (13 mg/L). Guidelines calculated with pH, hardness, and DOC values falling outside the defined ranges (i.e., pH of 6.5 to 8.13 for the chronic guideline, hardness of 14 to 251 mg/L for the acute guideline and 23 to 399 mg/L for the chronic guideline, and DOC of 0.3 to 17 mg/L for the acute guideline and 0.3 to 23 mg/L for the chronic guideline) should be used with caution, as the guidelines do not necessarily accurately reflect toxic effects at the low and high pH, hardness, and DOC extremes.

(A) Concentration is higher than the acute aquatic life GOA guideline or below the minimum dissolved oxygen guideline.

(C) Concentration is higher than the chronic aquatic life GOA and/or CCME guideline or below the minimum dissolved oxygen guideline.

µS/cm = microsiemens; NTU = nephelometric turbidity units; mg-N/L = milligrams as nitrogen per litre; mg-P/L = milligrams as phosphorus per litre; < = less than; ≥ = greater than or equal to; DOC = dissolved organic carbon; GOA = Government of Alberta; CCME = Canadian Council of Ministers of the Environment; - = no guideline or no data.

Table 1b: Water Quality Summary of Station 2, 2016 to 2019

Parameter	Unit	Guidelines for the Protection of Aquatic Life:				Station 2 Sampling Data									Summary of Station 2 Sampling Data from 2016 to 2019								
		Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)	15-Mar-16	16-Apr-16	22-Jun-16	16-Sep-16	19-May-17	6-Nov-17	10-May-18	20-Sep-18	22-Apr-19	Median	Minimum	Maximum	Non-Dectable	Count	% Above Guideline			
																				Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)
Field Measured																							
pH	-	-	6.5 - 9.0	-	6.5 - 9.0	-	-	-	-	-	8.2	8.1	-	-	8.2	8.1	8.2	0	2	-	-	-	-
Temperature	°C	-	-	-	-	-	-	-	-	7.4	1.8	11	-	-	7.4	1.8	11	0	3	-	-	-	-
Dissolved oxygen	mg/L	5.0	6.5	-	6.5	-	-	-	-	10	11	9.1	-	-	10.3	9.1	11	0	3	-	-	-	-
Dissolved oxygen	%	-	-	-	-	-	-	-	-	85	81	82	-	-	82.2	81.0	85	0	3	-	-	-	-
Conductivity	µS/cm	-	-	-	-	-	-	-	-	-	500	300	-	-	400	300	500	0	2	-	-	-	-
Conventional Parameters																							
pH	-	-	6.5 - 9.0	-	6.5 - 9.0	8.1	8.1	8.4	8.0	8.2	8.3	-	8.3	8.3	8.3	8.0	8.4	0	8	-	-	-	-
Hardness, as $CaCO_3$	mg/L	-	-	-	-	210	210	300	240	190	340	-	270	250	245	190	340	0	8	-	-	-	-
Total alkalinity, as $CaCO_3$	mg/L	-	20(a)	-	-	210	210	280	230	190	300	-	280	250	240	190	300	0	8	-	-	-	-
Total dissolved solids	mg/L	-	-	-	-	220	210	280	230	190	310	-	280	250	240	190	310	0	8	-	-	-	-
Total suspended solids	mg/L	-	-	-	-	5.3	13	2.7	2.7	-	<1.0	-	1.3	8.0	4.0	<1.0	13	1	7	-	-	-	-
Dissolved organic carbon	mg/L	-	-	-	-	8.9	9.6	2.4	7.4	14	2.0	-	2.1	3.1	5.3	2.0	14	0	8	-	-	-	-
Turbidity	NTU	-	-	-	-	1.1	3.1	0.43	0.81	-	0.24	-	-	1.6	0.96	0.24	3.1	0	6	-	-	-	-
Conductivity	µS/cm	-	-	-	-	400	400	490	430	360	540	-	500	460	445	360	540	0	8	-	-	-	-
5-day biological oxygen demand	mg/L	-	-	-	-	3.3	<2.0	2.1	-	-	2.5	-	<2.0	<2.0	2.1	<2.0	3.3	3	6	-	-	-	-
Major Ions																							
Calcium	mg/L	-	-	-	-	57	58	81	65	53	94	-	72	66	66	53	94	0	8	-	-	-	-
Chloride	mg/L	640	120	640	120	3.5	1.5	<1.0	<1.0	<1.0	<1.0	-	<1.0	1.7	<1.0	<1.0	3.5	5	8	-	-	-	-
Magnesium	mg/L	-	-	-	-	17	17	25	19	13	26	-	22	20	20	13	26	0	8	-	-	-	-
Potassium	mg/L	-	-	-	-	7.4	2.0	1.1	1.1	1.3	1.2	-	0.96	1.6	1.3	0.96	7.4	0	8	-	-	-	-
Sodium	mg/L	-	-	-	-	3.6	3.7	5.3	3.7	3.6	5.7	-	4.5	4.9	4.1	3.6	5.7	0	8	-	-	-	-
Sulphate	mg/L	-	429(b, c)	-	-	1.5	3.4	5.6	<1.0	<1.0	5.8	-	6.8	5.8	4.5	<1.0	6.8	2	8	-	-	-	-
Nutrients																							
Nitrate	mg-N/L	124	2.9	124	2.9	0.16	0.15	0.13	0.034	0.053	0.17	-	0.15	0.16	0.15	0.034	0.17	0	8	-	-	-	-
Nitrite	mg-N/L	0.060 - 0.12(d)	0.020 - 0.040(d)	-	0.060	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	8	8	-	-	-	-
Nitrate + nitrite	mg-N/L	-	-	-	-	0.16	0.15	0.13	0.034	0.053	0.17	-	0.15	0.16	0.15	0.034	0.17	0	8	-	-	-	-
Total Ammonia	mg-N/L	-	0.17(e)	-	0.17(e)	0.17	<0.05	<0.05	0.056	<0.015	<0.015	-	0.018	<0.015	0.018	<0.015	0.17	5	8	-	-	-	-
Total Kjeldahl Nitrogen	mg-N/L	-	-	-	-	1.0	0.61	0.12	0.42	0.51	0.10	-	0.092	0.27	0.35	0.092	1.0	0	8	-	-	-	-
Total nitrogen (calculated)	mg-N/L	-	-	-	-	1.2	0.76	0.25	0.45	0.56	0.27	-	0.24	0.43	0.44	0.24	1.2	0	8	-	-	-	-
Total phosphorus	mg-P/L	-	-	-	-	0.21	0.027	0.012	0.010	0.014	0.0041	-	0.0054	0.018	0.013	0.0041	0.21	0	8	-	-	-	-
Dissolved phosphorus	mg-P/L	-	-	-	-	0.19	0.011	0.0030	0.0050	0.0087	0.0032	-	0.0036	0.0053	0.0052	0.0030	0.19	0	8	-	-	-	-
Total Metals																							
Aluminum	mg/L	-	-	-	0.10(f)	0.038	-	0.0078	0.063	-	-	-	-	-	0.038	0.0078	0.063	0	3	-	-	-	-
Antimony	mg/L	-	-	-	-	<0.0006	-	<0.0006	<0.0006	-	-	-	-	-	<0.0006	<0.0006	<0.0006	3	3	-	-	-	-
Arsenic	mg/L	-	0.0050	-	0.0050	0.00045	-	0.00031	0.00053	-	-	-	-	-	0.00045	0.00031	0.00053	0	3	-	-	-	-
Barium	mg/L	-	-	-	-	0.15	-	0.22	0.15	-	-	-	-	-	0.15	0.15	0.22	0	3	-	-	-	-
Beryllium	mg/L	-	-	-	-	<0.001	-	<0.001	<0.001	-	-	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Boron	mg/L	29	1.5	29	1.5	<0.02	-	<0.02	<0.02	-	-	-	-	-	<0.02	<0.02	<0.02	3	3	-	-	-	-
Cadmium	mg/L	0.0040 - 0.0073(b)	0.00027 - 0.00037(b)	0.0040 - 0.0073(b)	0.00027 - 0.00037(b)	<0.00002	-	<0.00002	0.000035	-	-	-	-	-	<0.00002	<0.00002	0.000035	2	3	-	-	-	-
Calcium	mg/L	-	-	-	-	54	-	75	58	-	-	-	-	-	58	54	75	0	3	-	-	-	-
Chromium	mg/L	-	0.0010(g)	-	0.0010	<0.001	-	<0.001	<0.001	-	-	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Cobalt	mg/L	-	0.0013 - 0.0017(b)	-	-	<0.0003	-	<0.0003	<0.0003	-	-	-	-	-	<0.0003	<0.0003	<0.0003	3	3	-	-	-	-
Copper	mg/L	0.030 - 0.053(b)	0.0070(b)	-	0.0040(b)	<0.0002	-	0.00021	0.00022	-	-	-	-	-	0.00021	<0.0002	0.00022	1	3	-	-	-	-
Iron	mg/L	-	-	-	0.30	0.15	-	0.063	0.16	-	-	-	-	-	0.15	0.063	0.16	0	3	-	-	-	-
Lead	mg/L	-	0.0070(b)	-	0.0070(b)	<0.0002	-	<0.0002	<0.0002	-	-	-	-	-	<0.0002	<0.0002	<0.0002	3	3	-	-	-	-
Lithium	mg/L	-	-	-	-	<0.02	-	<0.02	<0.02	-	-	-	-	-	<0.02	<0.02	<0.02	3	3	-	-	-	-
Magnesium	mg/L	-	-	-	-	16	-	23	16	-	-	-	-	-	16	16	23	0	3	-	-	-	-
Manganese	mg/L	-	-	-	-	0.012	-	0.016	0.016	-	-	-	-	-	0.016	0.012	0.016	0	3	-	-	-	-
Mercury	mg/L	0.000013	0.0000050	-	0.000026	<0.0002(DL>A, DL>C)	<0.000002	<0.000002	<0.000002	<0.000002	<0.000002	-	<0.000002	<0.000002	<0.000002	<0.000002	<0.0002(DL>A, DL>C)	8	8	-	-	-	-
Molybdenum	mg/L	-	0.073	-	0.073	0.0011	-	0.00085	0.00060	-	-	-	-	-	0.00085	0.00060	0.0011	0	3	-	-	-	-
Nickel	mg/L	0.81 - 1.3(b)	0.090 - 0.15(b)	-	0.15(b)	<0.0005	-	<0.0005	<0.0005	-	-	-	-	-	<0.0005	<0.0005	<0.0005	3	3	-	-	-	-
Potassium	mg/L	-	-	-	-	7.7	-	1.0	1.0	-	-	-	-	-	1.0	1.0	7.7	0	3	-	-	-	-
Selenium	mg/L	-	0.0020	-	0.0010	<0.0002	-	0.00021	<0.0002	-	-	-	-	-	<0.0002	<0.0002	0.00021	2	3	-	-	-	-
Silicon	mg/L	-	-	-	-	4.9	-	4.8	4.7	-	-	-	-	-	4.8	4.7	4.9	0	3	-	-	-	-
Silver	mg/L	-	0.00025	-	0.00025	<0.0001	-	<0.0001	<0.0001	-	-	-	-	-	<0.0001	<0.0001	<0.0001	3	3	-	-	-	-
Sodium	mg/L	-	-	-	-	3.7	-	5.1	3.4	-	-	-	-	-	3.7	3.4	5.1	0	3	-	-	-	-
Strontium	mg/L	-	-	-	-	0.18	-	0.29	0.16	-	-	-	-	-	0.18	0.16	0.29	0	3	-	-	-	-
Sulphur	mg/L	-	-	-	-	1.8	-	2.0	1.1	-	-	-	-	-	1.8	1.1	2.0	0	3	-	-	-	-
Thallium	mg/L	-	0.00080	-	0.00080	<0.0002	-	<0.0002	<0.0002	-	-	-	-	-	<0.0002	<0.0002	<0.0002	3	3	-	-	-	-
Tin	mg/L	-	-	-	-	<0.001	-	<0.001	<0.001	-	-	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Titanium	mg/L	-	-	-	-	<0.001	-	<0.001	0.0015	-	-	-	-	-	<0.001	<0.001	0.0015	2	3	-	-	-	-
Uranium	mg/L	0.033	0.015	0.033	0.015	0.00065	-	0.00090	0.00049	-	-	-	-	-	0.00065	0.00049	0.00090	0	3	-	-	-	-
Vanadium	mg/L	-	-	-	-	<0.001	-	<0.001	<0.001	-	-	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Zinc	mg/L	-	0.030	-	-	<0.003	-	<0.003	<0.003	-	-	-	-	-	<0.003	<0.003	<0.003	3	3	-	-	-	-
Dissolved Metals																							
Aluminum	mg/L	0.10(h)	0.050(h)	-	-	0.0049	0.0042	0.0044	0.0055	0.0049	<0.003	-	0.0059	0.0041	0.0047	<0.003	0.0059	1	8	-	-	-	-
Antimony	mg/L	-	-	-	-	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	-	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	8	8	-	-	-	-
Arsenic	mg/L	-	-	-	-	0.00043	0.00038	0.00027	0.00036	0.00038	0.00020	-	<0.0002	0.00033	0.00035	<0.0002	0.00043	1	8	-	-	-	-

Table 1b: Water Quality Summary of Station 2, 2016 to 2019

Parameter	Unit	Guidelines for the Protection of Aquatic Life:				Station 2 Sampling Data									Summary of Station 2 Sampling Data from 2016 to 2019								
																				% Above Guideline			
		Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)	15-Mar-16	16-Apr-16	22-Jun-16	16-Sep-16	19-May-17	6-Nov-17	10-May-18	20-Sep-18	22-Apr-19	Median	Minimum	Maximum	Non-Dectable	Count	Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)
Barium	mg/L	-	-	-	-	0.16	0.16	0.23	0.17	0.13	0.26	-	0.22	0.19	0.18	0.13	0.26	0	8	-	-	-	-
Beryllium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Boron	mg/L	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	8	8	-	-	-	-
Cadmium	mg/L	-	-	-	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	8	8	-	-	-	-
Chromium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Cobalt	mg/L	-	-	-	-	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	-	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	8	8	-	-	-	-
Copper	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002	0.00022	<0.0002	<0.0002	0.00022	7	8	-	-	-	-
Iron	mg/L	-	0.30	-	-	0.080	0.086	<0.06	<0.06	0.069	<0.06	-	<0.06	<0.06	<0.06	<0.06	0.086	5	8	-	-	-	-
Lead	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	8	8	-	-	-	-
Lithium	mg/L	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	8	8	-	-	-	-
Manganese	mg/L	-	-	12 - 15(i)	0.27 - 0.43(i)	0.0073	0.015	0.016	0.0048	0.010	0.0059	-	<0.004	0.0092	0.0083	<0.004	0.016	1	8	-	-	-	-
Molybdenum	mg/L	-	-	-	-	0.0011	0.00062	0.00086	0.00053	0.00052	0.00088	-	0.00087	0.0011	0.00087	0.00052	0.0011	0	8	-	-	-	-
Nickel	mg/L	-	-	-	-	<0.0005	0.00051	<0.0005	<0.0005	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	0.00051	7	8	-	-	-	-
Selenium	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	8	8	-	-	-	-
Silicon	mg/L	-	-	-	-	5.1	4.9	4.9	5.0	3.7	6.0	-	4.9	4.8	4.9	3.7	6.0	0	8	-	-	-	-
Silver	mg/L	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	8	8	-	-	-	-
Strontium	mg/L	-	-	-	-	0.19	0.19	0.31	0.18	0.15	0.31	-	0.28	0.24	0.22	0.15	0.31	0	8	-	-	-	-
Sulphur	mg/L	-	-	-	-	1.8	1.9	1.8	1.2	1.1	2.2	-	2.2	2.2	1.9	1.1	2.2	0	8	-	-	-	-
Thallium	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	8	8	-	-	-	-
Tin	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Titanium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Uranium	mg/L	-	-	-	-	0.00062	0.00055	0.00083	0.00043	0.00038	0.00090	-	0.00090	0.00077	0.00070	0.00038	0.00090	0	8	-	-	-	-
Vanadium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Zinc	mg/L	-	-	0.20 - 0.26(j)	0.036 - 0.060(j)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-	<0.003	<0.003	<0.003	<0.003	<0.003	8	8	-	-	-	-

Notes:

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision *after* comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

Not all samples have associated field measured parameters and so laboratory pH was used to calculate individual guidelines when field pH was not present. The average water temperature measured at stations 2 to 5 during spring (9.6°C) was used to calculate guidelines for all spring samples missing field data (i.e., those collected in March, April and May). The average water temperature measured at stations 2 to 5 during fall (3.2°C) was used to calculate guidelines for all fall samples missing field data (i.e., those collected in September). The water temperature of 20°C was used to calculate guidelines for the summer (June) sample missing field data. If field measured data were present for a sample, the sample-specific values were used during guideline calculation for that sample.

(a) Guideline is a minimum value, unless the background concentration or value is lower.

(b) Guideline is hardness dependent and calculated based on the individual hardness value for each sample. The guideline range shown is based on the hardness range observed in the dataset (190 to 340 mg/L).

(c) For some samples, water hardness was greater than 250 mg/L. At this hardness, no BC ENV water quality guideline (recommended by GOA 2018b) has been established for sulphate; however, the observed data were screened against the guideline for very hard water (i.e., 429 mg/L) for comparative purposes.

(d) Guideline is chloride dependent and is calculated based on the individual chloride concentration in each sample. The guideline range shown is based on the chloride concentration range observed in the dataset (0.5 to 3.5 mg/L).

(e) The ammonia guideline is pH and temperature dependent. The data were compared to the minimum guideline (0.17 mg-N/L), which was based on the combination of laboratory pH (8.4) and water temperature (20°C).

(f) Guideline is pH dependent: 0.005 mg/L at pH < 6.5 and 0.1 mg/L at pH ≥ 6.5.

(g) Guideline is for chromium VI.

(h) Guideline is pH dependent and calculated based on the individual pH for each sample. The guideline range shown is based on the pH range observed in the dataset (8.0 to 8.4).

(i) The dissolved manganese guidelines are dependent on pH and hardness, and are calculated based on the individual pH and hardness measurements for each sample. The minimum acute manganese guideline (12 mg/L) is based on the combination of laboratory pH (8.2) and hardness (190 mg/L). The minimum chronic manganese guideline (0.27 mg/L) is based on the combination of laboratory pH (8.2) and hardness (190 mg/L). Guidelines calculated with pH and hardness values falling outside the defined ranges (i.e., pH of 5.8 to 8.4 for the acute and chronic guidelines, hardness of 25 to 250 mg/L for the acute guideline, and hardness of 25 to 670 mg/L for the chronic guideline) should be used with caution, as the guidelines do not necessarily accurately reflect toxic effects at the low and high pH and hardness extremes.

(j) The dissolved zinc guidelines are dependent on pH (chronic only), hardness, and DOC and are calculated based on the individual pH, hardness, and DOC measurements for each sample. The minimum acute zinc guideline (0.20 mg/L) is based on the combination of hardness (340 mg/L) and DOC (2.0 mg/L). The minimum chronic zinc guideline (0.036 mg/L) is based on the combination of laboratory pH (8.3), hardness (270 mg/L) and DOC (2.1 mg/L). Guidelines calculated with pH, hardness, and DOC values falling outside the defined ranges (i.e., pH of 6.5 to 8.13 for the chronic guideline, hardness of 14 to 251 mg/L for the acute guideline and 23 to 399 mg/L for the chronic guideline, and DOC of 0.3 to 17 mg/L for the acute guideline and 0.3 to 23 mg/L for the chronic guideline) should be used with caution, as the guidelines do not necessarily accurately reflect toxic effects at the low and high pH, hardness, and DOC extremes.

(DL>A) Analytical detection limit is higher than the acute aquatic life GOA total mercury guideline.

(DL>C) Analytical detection limit is higher than the chronic aquatic life GOA and CCME total mercury guideline.

µS/cm = microsiemens; NTU = nephelometric turbidity units; mg-N/L = milligrams as nitrogen per litre; mg-P/L = milligrams as phosphorus per litre; < = less than; ≥ = greater than or equal to; DOC = dissolved organic carbon; GOA = Government of Alberta; CCME = Canadian Council of Ministers of the Environment; BC ENV = British Columbia Ministry of Environement and Climate Change Strategy; - = no guideline or no data.

Attachment 1

Clearwater Project Baseline Water Quality Summary by Station, 2016-2019

Table 1c: Water Quality Summary of Station 3, 2016 to 2019

Parameter	Unit	Guidelines for the Protection of Aquatic Life:				Station 3 Sampling Data									Summary of Station 3 Sampling Data from 2016 to 2019								
		Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)	15-Mar-16	16-Apr-16	22-Jun-16	16-Sep-16	19-May-17	6-Nov-17	10-May-18	20-Sep-18	22-Apr-19	Median	Minimum	Maximum	Non-Dectable	Count	% Above Guideline			
																				Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)
Field Measured																							
pH	-	-	6.5 - 9.0	-	6.5 - 9.0	-	-	-	-	-	8.2	7.9	-	-	8.1	7.9	8.2	0	2	-	-	-	-
Temperature	°C	-	-	-	-	-	-	-	-	9.2	1.7	8.0	-	-	8.0	1.7	9.2	0	3	-	-	-	-
Dissolved oxygen	mg/L	5.0	6.5	-	6.5	-	-	-	-	8.8	11	9.7	-	-	9.7	8.8	10.7	0	3	-	-	-	-
Dissolved oxygen	%	-	-	-	-	-	-	-	-	77	77	82	-	-	76.9	76.8	82	0	3	-	-	-	-
Conductivity	µS/cm	-	-	-	-	-	-	-	-	-	500	500	-	-	500	500	500	0	2	-	-	-	-
Conventional Parameters																							
pH	-	-	6.5 - 9.0	-	6.5 - 9.0	8.1	8.1	8.4	8.2	8.2	8.4	-	8.3	8.3	8.3	8.1	8.4	0	8	-	-	-	-
Hardness, as $CaCO_3$	mg/L	-	-	-	-	190	220	310	240	180	330	-	280	260	250	180	330	0	8	-	-	-	-
Total alkalinity, as $CaCO_3$	mg/L	-	20$^{(a)}$	-	-	210	220	280	240	180	290	-	300	260	250	180	300	0	8	-	-	-	-
Total dissolved solids	mg/L	-	-	-	-	210	220	290	240	180	310	-	290	260	250	180	310	0	8	-	-	-	-
Total suspended solids	mg/L	-	-	-	-	8.0	4.7	3.3	1.3	-	4.7	-	13	6.7	4.7	1.3	13	0	7	-	-	-	-
Dissolved organic carbon	mg/L	-	-	-	-	10	9.0	2.2	9.5	16	1.7	-	2.1	3.5	6.3	1.7	16	0	8	-	-	-	-
Turbidity	NTU	-	-	-	-	2.4	3.4	1.2	0.85	-	0.52	-	-	3.0	1.8	0.52	3.4	0	6	-	-	-	-
Conductivity	µS/cm	-	-	-	-	390	410	510	440	340	550	-	520	480	460	340	550	0	8	-	-	-	-
5-day biological oxygen demand	mg/L	-	-	-	-	2.3	2.2	<2.0	-	-	<2.0	-	2.5	<2.0	2.2	<2.0	2.5	3	6	-	-	-	-
Major Ions																							
Calcium	mg/L	-	-	-	-	49	59	81	63	51	85	-	73	67	65	49	85	0	8	-	-	-	-
Chloride	mg/L	640	120	640	120	4.6	2.2	1.8	1.1	1.9	1.9	-	1.9	2.5	1.9	1.1	4.6	0	8	-	-	-	-
Magnesium	mg/L	-	-	-	-	16	18	27	21	13	29	-	24	22	22	13	29	0	8	-	-	-	-
Potassium	mg/L	-	-	-	-	6.2	2.0	1.3	0.96	1.2	1.3	-	1.1	1.5	1.3	0.96	6.2	0	8	-	-	-	-
Sodium	mg/L	-	-	-	-	3.2	3.9	5.0	4.1	4.0	5.4	-	4.3	4.7	4.2	3.2	5.4	0	8	-	-	-	-
Sulphate	mg/L	-	309 - 429$^{(b, c)}$	-	-	2.0	3.8	6.5	<1.0	<2.0	6.9	-	7.1	7.0	5.2	<1.0	7.1	2	8	-	-	-	-
Nutrients																							
Nitrate	mg-N/L	124	2.9	124	2.9	0.28	0.29	0.30	0.099	0.098	0.40	-	0.35	0.28	0.29	0.098	0.40	0	8	-	-	-	-
Nitrite	mg-N/L	0.060 - 0.18$^{(d)}$	0.020 - 0.060$^{(d)}$	-	0.060	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	8	8	-	-	-	-
Nitrate + nitrite	mg-N/L	-	-	-	-	0.28	0.29	0.30	0.099	0.098	0.40	-	0.35	0.28	0.29	0.098	0.40	0	8	-	-	-	-
Total Ammonia	mg-N/L	-	0.17$^{(e)}$	-	0.17$^{(e)}$	0.15	<0.05	<0.05	0.064	<0.015	0.021	-	0.021	<0.015	0.021	<0.015	0.15	4	8	-	-	-	-
Total Kjeldahl Nitrogen	mg-N/L	-	-	-	-	1.1	0.57	0.22	0.48	0.99	0.19	-	0.19	0.25	0.37	0.19	1.1	0	8	-	-	-	-
Total nitrogen (calculated)	mg-N/L	-	-	-	-	1.4	0.86	0.52	0.58	1.1	0.59	-	0.54	0.53	0.58	0.52	1.4	0	8	-	-	-	-
Total phosphorus	mg-P/L	-	-	-	-	0.17	0.022	0.0060	0.0060	0.016	0.0095	-	0.012	0.010	0.011	0.0060	0.17	0	8	-	-	-	-
Dissolved phosphorus	mg-P/L	-	-	-	-	0.15	0.010	0.0030	0.0040	0.0070	<0.003	-	0.0037	0.0041	0.0041	<0.003	0.15	1	8	-	-	-	-
Total Metals																							
Aluminum	mg/L	-	-	-	0.10$^{(f)}$	0.080	-	**0.27$^{(C)}$**	0.029	-	-	-	-	-	0.080	0.029	**0.27$^{(C)}$**	0	3	-	-	-	33
Antimony	mg/L	-	-	-	-	<0.0006	-	<0.0006	<0.0006	-	-	-	-	-	<0.0006	<0.0006	<0.0006	3	3	-	-	-	-
Arsenic	mg/L	-	0.0050	-	0.0050	0.00060	-	0.00051	0.00050	-	-	-	-	-	0.00051	0.00050	0.00060	0	3	-	-	-	-
Barium	mg/L	-	-	-	-	0.15	-	0.25	0.16	-	-	-	-	-	0.16	0.15	0.25	0	3	-	-	-	-
Beryllium	mg/L	-	-	-	-	<0.001	-	<0.001	<0.001	-	-	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Boron	mg/L	29	1.5	29	1.5	<0.02	-	<0.02	<0.02	-	-	-	-	-	<0.02	<0.02	<0.02	3	3	-	-	-	-
Cadmium	mg/L	0.0038 - 0.0071$^{(b)}$	0.00026 - 0.00037$^{(b)}$	0.0038 - 0.0071$^{(b)}$	0.00026 - 0.00037$^{(b)}$	<0.00002	-	<0.00002	0.000030	-	-	-	-	-	<0.00002	<0.00002	0.000030	2	3	-	-	-	-
Calcium	mg/L	-	-	-	-	51	-	77	57	-	-	-	-	-	57	51	77	0	3	-	-	-	-
Chromium	mg/L	-	0.0010$^{(g)}$	-	0.0010	<0.001	-	<0.001	<0.001	-	-	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Cobalt	mg/L	-	0.0013 - 0.0017$^{(b)}$	-	-	<0.0003	-	<0.0003	<0.0003	-	-	-	-	-	<0.0003	<0.0003	<0.0003	3	3	-	-	-	-
Copper	mg/L	0.028 - 0.051$^{(b)}$	0.0070$^{(b)}$	-	0.0039 - 0.0040$^{(b)}$	0.00040	-	0.00069	0.00030	-	-	-	-	-	0.00040	0.00030	0.00069	0	3	-	-	-	-
Iron	mg/L	-	-	-	0.30	0.18	-	**0.44$^{(C)}$**	0.11	-	-	-	-	-	0.18	0.11	**0.44$^{(C)}$**	0	3	-	-	-	33
Lead	mg/L	-	0.0067 - 0.0070$^{(b)}$	-	0.0067 - 0.0070$^{(b)}$	<0.0002	-	0.00021	<0.0002	-	-	-	-	-	<0.0002	<0.0002	0.00021	2	3	-	-	-	-
Lithium	mg/L	-	-	-	-	<0.02	-	<0.02	<0.02	-	-	-	-	-	<0.02	<0.02	<0.02	3	3	-	-	-	-
Magnesium	mg/L	-	-	-	-	17	-	25	18	-	-	-	-	-	18	17	25	0	3	-	-	-	-
Manganese	mg/L	-	-	-	-	0.011	-	0.022	0.012	-	-	-	-	-	0.012	0.011	0.022	0	3	-	-	-	-
Mercury	mg/L	0.000013	0.0000050	-	0.000026	<0.0002$^{(DL>A, DL>C)}$	<0.000002	<0.000002	<0.000002	<0.000002	<0.000002	-	<0.000002	<0.000002	<0.000002	<0.000002	.0002$^{(DL>A, D}$	8	8	-	-	-	-
Molybdenum	mg/L	-	0.073	-	0.073	0.0013	-	0.00095	0.00065	-	-	-	-	-	0.00095	0.00065	0.0013	0	3	-	-	-	-
Nickel	mg/L	0.77 - 1.3$^{(b)}$	0.086 - 0.14$^{(b)}$	-	0.15 - 0.15$^{(b)}$	0.00061	-	0.00079	0.00052	-	-	-	-	-	0.00061	0.00052	0.00079	0	3	-	-	-	-
Potassium	mg/L	-	-	-	-	7.5	-	1.3	0.95	-	-	-	-	-	1.3	0.95	7.5	0	3	-	-	-	-
Selenium	mg/L	-	0.0020	-	0.0010	<0.0002	-	0.00024	<0.0002	-	-	-	-	-	<0.0002	<0.0002	0.00024	2	3	-	-	-	-
Silicon	mg/L	-	-	-	-	5.1	-	5.4	4.7	-	-	-	-	-	5.1	4.7	5.4	0	3	-	-	-	-
Silver	mg/L	-	0.00025	-	0.00025	<0.0001	-	<0.0001	<0.0001	-	-	-	-	-	<0.0001	<0.0001	<0.0001	3	3	-	-	-	-
Sodium	mg/L	-	-	-	-	3.7	-	4.8	3.6	-	-	-	-	-	3.7	3.6	4.8	0	3	-	-	-	-
Strontium	mg/L	-	-	-	-	0.20	-	0.33	0.20	-	-	-	-	-	0.20	0.20	0.33	0	3	-	-	-	-
Sulphur	mg/L	-	-	-	-	1.9	-	2.2	1.4	-	-	-	-	-	1.9	1.4	2.2	0	3	-	-	-	-
Thallium	mg/L	-	0.00080	-	0.00080	<0.0002	-	<0.0002	<0.0002	-	-	-	-	-	<0.0002	<0.0002	<0.0002	3	3	-	-	-	-
Tin	mg/L	-	-	-	-	<0.001	-	<0.001	<0.001	-	-	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Titanium	mg/L	-	-	-	-	0.0022	-	0.0059	<0.001	-	-	-	-	-	0.0022	<0.001	0.0059	1	3	-	-	-	-
Uranium	mg/L	0.033	0.015	0.033	0.015	0.00083	-	0.0011	0.00063	-	-	-	-	-	0.00083	0.00063	0.0011	0	3	-	-	-	-
Vanadium	mg/L	-	-	-	-	0.0010	-	0.0018	<0.001	-	-	-	-	-	0.0010	<0.001	0.0018	1	3	-	-	-	-
Zinc	mg/L	-	0.030	-	-	0.0045	-	<0.003	<0.003	-	-	-	-	-	<0.003	<0.003	0.0045	2	3	-	-	-	-
Dissolved Metals																							
Aluminum	mg/L	0.10$^{(h)}$	0.050$^{(h)}$	-	-	0.0053	0.0040	0.0049	0.0077	0.0072	0.0030	-	0.0069	0.0039	0.0051	0.0030	0.0077	0	8	-	-	-	-
Antimony	mg/L	-	-	-	-	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	-	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	8	8	-	-	-	-
Arsenic	mg/L	-	-	-	-	0.00036	0.00033	0.00027	0.00045	0.00040	0.00024	-	<0.0002	0.00025	0.00030	<0.0002	0.00045	1	8	-	-	-	-

Table 1c: Water Quality Summary of Station 3, 2016 to 2019

Parameter	Unit	Guidelines for the Protection of Aquatic Life:				Station 3 Sampling Data									Summary of Station 3 Sampling Data from 2016 to 2019								
		Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)	15-Mar-16	16-Apr-16	22-Jun-16	16-Sep-16	19-May-17	6-Nov-17	10-May-18	20-Sep-18	22-Apr-19	Median	Minimum	Maximum	Non-Dectable	Count	% Above Guideline			
																				Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)
Barium	mg/L	-	-	-	-	0.14	0.16	0.24	0.19	0.12	0.26	-	0.24	0.21	0.20	0.12	0.26	0	8	-	-	-	-
Beryllium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Boron	mg/L	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	8	8	-	-	-	-
Cadmium	mg/L	-	-	-	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	8	8	-	-	-	-
Chromium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Cobalt	mg/L	-	-	-	-	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	-	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	8	8	-	-	-	-
Copper	mg/L	-	-	-	-	<0.0002	0.00022	<0.0002	<0.0002	<0.0002	<0.0002	-	0.00028	0.00021	<0.0002	<0.0002	0.00028	5	8	-	-	-	-
Iron	mg/L	-	0.30	-	-	0.083	0.072	<0.06	0.076	0.11	<0.06	-	<0.06	<0.06	0.072	<0.06	0.11	4	8	-	-	-	-
Lead	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	8	8	-	-	-	-
Lithium	mg/L	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	8	8	-	-	-	-
Manganese	mg/L	-	-	11 - 15$^{(i)}$	0.27 - 0.29$^{(i)}$	0.0071	0.0094	0.010	0.0099	0.013	0.0055	-	<0.004	0.0078	0.0086	<0.004	0.013	1	8	-	-	-	-
Molybdenum	mg/L	-	-	-	-	0.0010	0.00064	0.00088	0.00060	0.00050	0.00093	-	0.00085	0.00087	0.00086	0.00050	0.0010	0	8	-	-	-	-
Nickel	mg/L	-	-	-	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	8	8	-	-	-	-
Selenium	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00020	-	<0.0002	0.00020	<0.0002	<0.0002	0.00020	6	8	-	-	-	-
Silicon	mg/L	-	-	-	-	5.0	4.9	4.8	5.0	3.8	6.1	-	4.9	4.8	4.9	3.8	6.1	0	8	-	-	-	-
Silver	mg/L	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	8	8	-	-	-	-
Strontium	mg/L	-	-	-	-	0.18	0.22	0.34	0.24	0.17	0.35	-	0.32	0.29	0.27	0.17	0.35	0	8	-	-	-	-
Sulphur	mg/L	-	-	-	-	2.1	2.0	2.1	1.4	1.2	2.6	-	2.4	2.3	2.1	1.2	2.6	0	8	-	-	-	-
Thallium	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	8	8	-	-	-	-
Tin	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Titanium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Uranium	mg/L	-	-	-	-	0.00063	0.00060	0.00098	0.00057	0.00045	0.00095	-	0.00098	0.00089	0.00076	0.00045	0.00098	0	8	-	-	-	-
Vanadium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Zinc	mg/L	-	-	0.19 - 0.28$^{(j)}$	0.038 - 0.067$^{(j)}$	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-	<0.003	<0.003	<0.003	<0.003	<0.003	8	8	-	-	-	-

Notes:

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision *after* comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

Not all samples have associated field measured parameters and so laboratory pH was used to calculate individual guidelines when field pH was not present. The average water temperature measured at stations 2 to 5 during spring (9.6°C) was used to calculate guidelines for all spring samples missing field data (i.e., those collected in March, April and May). The average water temperature measured at stations 2 to 5 during fall (3.2°C) was used to calculate guidelines for all fall samples missing field data (i.e., those collected in September). The water temperature of 20°C was used to calculate guidelines for the summer (June) sample missing field data. If field measured data were present for a sample, the sample-specific values were used during guideline calculation for that sample.

(a) Guideline is a minimum value, unless the background concentration or value is lower.

(b) Guideline is hardness dependent and calculated based on the individual hardness value for each sample. The guideline range shown is based on the hardness range observed in the dataset (180 to 330 mg/L).

(c) For some samples, water hardness was greater than 250 mg/L. At this hardness, no BC ENV water quality guideline (recommended by GOA 2018b) has been established for sulphate; however, the observed data were screened against the guideline for very hard water (i.e., 429 mg/L) for comparative purposes.

(d) Guideline is chloride dependent and is calculated based on the individual chloride concentration in each sample. The guideline range shown is based on the chloride concentration range observed in the dataset (1.1 to 4.6 mg/L).

(e) The ammonia guideline is pH and temperature dependent. The data were compared to the minimum guideline (0.17 mg-N/L), which was based on the combination of laboratory pH (8.4) and water temperature (20°C).

(f) Guideline is pH dependent: 0.005 mg/L at pH < 6.5 and 0.1 mg/L at pH ≥ 6.5.

(g) Guideline is for chromium VI.

(h) Guideline is pH dependent and calculated based on the individual pH for each sample. The guideline range shown is based on the pH range observed in the dataset (7.9 to 8.4).

(i) The dissolved manganese guidelines are dependent on pH and hardness, and are calculated based on the individual pH and hardness measurements for each sample. The minimum acute manganese guideline (11 mg/L) is based on the combination of laboratory pH (8.2) and hardness (180 mg/L). The minimum chronic manganese guideline (0.27 mg/L) is based on the combination of laboratory pH (8.2) and hardness (180 mg/L). Guidelines calculated with pH and hardness values falling outside the defined ranges (i.e., pH of 5.8 to 8.4 for the acute and chronic guidelines, hardness of 25 to 250 mg/L for the acute guideline, and hardness of 25 to 670 mg/L for the chronic guideline) should be used with caution, as the guidelines do not necessarily accurately reflect toxic effects at the low and high pH and hardness extremes.

(j) The dissolved zinc guidelines are dependent on pH (chronic only), hardness, and DOC and are calculated based on the individual pH, hardness, and DOC measurements for each sample. The minimum acute zinc guideline (0.19 mg/L) is based on the combination of hardness (330 mg/L) and DOC (1.7 mg/L). The minimum chronic zinc guideline (0.038 mg/L) is based on the combination of laboratory pH (8.3), hardness (280 mg/L) and DOC (2.1 mg/L). Guidelines calculated with pH, hardness, and DOC values falling outside the defined ranges (i.e., pH of 6.5 to 8.13 for the chronic guideline, hardness of 14 to 251 mg/L for the acute guideline and 23 to 399 mg/L for the chronic guideline, and DOC of 0.3 to 17 mg/L for the acute guideline and 0.3 to 23 mg/L for the chronic guideline) should be used with caution, as the guidelines do not necessarily accurately reflect toxic effects at the low and high pH, hardness, and DOC extremes.

(C) Concentration is higher than the chronic aquatic life CCME guideline.

(DL>A) Analytical detection limit is higher than the acute aquatic life GOA total mercury guideline.

(DL>C) Analytical detection limit is higher than the chronic aquatic life GOA and CCME total mercury guideline.

μS/cm = microsiemens; NTU = nephelometric turbidity units; mg-N/L = milligrams as nitrogen per litre; mg-P/L = milligrams as phosphorus per litre; < = less than; ≥ = greater than or equal to; DOC = dissolved organic carbon; GOA = Government of Alberta; CCME = Canadian Council of Ministers of the Environment; BC ENV = British Columbia Ministry of Environement and Climate Change Strategy; - = no guideline or no data.

Attachment 1
Clearwater Project Baseline Water Quality Summary by Station, 2016-2019

Table 1d: Water Quality Summary of Station 4, 2016 to 2019

Parameter	Unit	Guidelines for the Protection of Aquatic Life:				Station 4 Sampling Data									Summary of Station 4 Sampling Data from 2016 to 2019								
		Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)	15-Mar-16	16-Apr-16	22-Jun-16	16-Sep-16	19-May-17	6-Nov-17	10-May-18	20-Sep-18	22-Apr-19	Median	Minimum	Maximum	Non-Dectable	Count	% Above Guideline			
																				Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)
Field Measured																							
pH	-	-	6.5 - 9.0	-	6.5 - 9.0	-	-	-	-	-	8.2	8.2	-	-	8.2	8.2	8.2	0	2	-	-	-	-
Temperature	°C	-	-	-	-	-	-	-	-	12	2.3	8.0	-	-	8.0	2.3	12	0	3	-	-	-	-
Dissolved oxygen	mg/L	5.0	6.5	-	6.5	-	-	-	-	8.8	10	9.7	-	-	9.7	8.8	10	0	3	-	-	-	-
Dissolved oxygen	%	-	-	-	-	-	-	-	-	81	74	82	-	-	81	74	82	0	3	-	-	-	-
Conductivity	µS/cm	-	-	-	-	-	-	-	-	-	500	500	-	-	500	500	500	0	2	-	-	-	-
Conventional Parameters																							
pH	-	-	6.5 - 9.0	-	6.5 - 9.0	8.0	8.1	8.3	8.2	8.3	8.3	-	8.3	8.4	8.3	8.0	8.4	0	8	-	-	-	-
Hardness, as CaCO$_3$	mg/L	-	-	-	-	170	220	300	250	210	350	-	300	250	250	170	350	0	8	-	-	-	-
Total alkalinity, as CaCO$_3$	mg/L	-	20$^{(a)}$	-	-	170	210	260	230	200	320	-	280	250	240	170	320	0	8	-	-	-	-
Total dissolved solids	mg/L	-	-	-	-	190	220	270	240	210	330	-	290	260	250	190	330	0	8	-	-	-	-
Total suspended solids	mg/L	-	-	-	-	11	3.3	2.0	2.0	-	1.3	-	2.0	2.7	2.0	1.3	11	0	7	-	-	-	-
Dissolved organic carbon	mg/L	-	-	-	-	15	6.9	4.3	14	19	2.2	-	2.7	5.0	6.0	2.2	19	0	8	-	-	-	-
Turbidity	NTU	-	-	-	-	3.6	3.2	2.1	2.2	-	1.2	-	-	3.2	2.7	1.2	3.6	0	6	-	-	-	-
Conductivity	µS/cm	-	-	-	-	350	410	470	440	370	570	-	510	470	455	350	570	0	8	-	-	-	-
5-day biological oxygen demand	mg/L	-	-	-	-	3.3	<2.0	2.1	-	-	<2.0	-	<2.0	2.5	2.1	<2.0	3.3	3	6	-	-	-	-
Major Ions																							
Calcium	mg/L	-	-	-	-	45	58	75	68	59	91	-	77	66	67	45	91	0	8	-	-	-	-
Chloride	mg/L	640	120	640	120	6.4	3.5	2.1	1.9	3.5	2.6	-	2.8	3.8	3.2	1.9	6.4	0	8	-	-	-	-
Magnesium	mg/L	-	-	-	-	14	18	27	20	15	30	-	25	21	21	14	30	0	8	-	-	-	-
Potassium	mg/L	-	-	-	-	9.7	2.3	1.2	1.2	1.6	1.6	-	1.4	1.9	1.6	1.2	9.7	0	8	-	-	-	-
Sodium	mg/L	-	-	-	-	3.4	4.1	5.3	4.1	4.9	6.0	-	4.9	4.8	4.9	3.4	6.0	0	8	-	-	-	-
Sulphate	mg/L	-	309 - 429$^{(b, c)}$	-	-	4.5	4.4	4.7	<1.0	3.4	7.2	-	6.7	7.4	4.6	<1.0	7.4	1	8	-	-	-	-
Nutrients																							
Nitrate	mg-N/L	124	2.9	124	2.9	0.25	0.23	<0.01	<0.01	<0.01	1.1	-	0.050	0.050	0.050	<0.01	1.1	3	8	-	-	-	-
Nitrite	mg-N/L	0.060 - 0.24$^{(d)}$	0.020 - 0.080$^{(d)}$	-	0.060	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	8	8	-	-	-	-
Nitrate + nitrite	mg-N/L	-	-	-	-	0.25	0.23	<0.02	<0.02	<0.01	1.1	-	0.050	0.050	0.050	<0.01	1.1	3	8	-	-	-	-
Total Ammonia	mg-N/L	-	0.21$^{(e)}$	-	0.21$^{(e)}$	0.22	<0.05	<0.05	<0.05	0.021	0.019	-	<0.015	<0.015	0.021	<0.015	0.22	5	8	-	-	-	-
Total Kjeldahl Nitrogen	mg-N/L	-	-	-	-	1.7	0.47	0.23	0.57	1.4	0.21	-	0.17	0.30	0.39	0.17	1.7	0	8	-	-	-	-
Total nitrogen (calculated)	mg-N/L	-	-	-	-	2.0	0.70	0.23	0.57	1.4	1.3	-	0.22	0.35	0.64	0.22	2.0	0	8	-	-	-	-
Total phosphorus	mg-P/L	-	-	-	-	0.26	0.023	0.012	0.012	0.015	0.0048	-	0.012	0.011	0.012	0.0048	0.26	0	8	-	-	-	-
Dissolved phosphorus	mg-P/L	-	-	-	-	0.22	0.013	0.0060	0.0050	0.0075	<0.003	-	0.0038	0.0050	0.0055	<0.003	0.22	1	8	-	-	-	-
Total Metals																							
Aluminum	mg/L	-	-	-	0.10$^{(f)}$	**0.18$^{(C)}$**	-	0.046	0.070	-	-	-	-	-	0.070	0.046	**0.18$^{(C)}$**	0	3	-	-	-	33
Antimony	mg/L	-	-	-	-	<0.0006	-	<0.0006	<0.0006	-	-	-	-	-	<0.0006	<0.0006	<0.0006	3	3	-	-	-	-
Arsenic	mg/L	-	0.0050	-	0.0050	0.00095	-	0.0010	0.00067	-	-	-	-	-	0.00095	0.00067	0.0010	0	3	-	-	-	-
Barium	mg/L	-	-	-	-	0.15	-	0.22	0.16	-	-	-	-	-	0.16	0.15	0.22	0	3	-	-	-	-
Beryllium	mg/L	-	-	-	-	<0.001	-	<0.001	<0.001	-	-	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Boron	mg/L	29	1.5	29	1.5	<0.02	-	<0.02	<0.02	-	-	-	-	-	<0.02	<0.02	<0.02	3	3	-	-	-	-
Cadmium	mg/L	0.0036 - 0.0075$^{(b)}$	0.00025 - 0.00037$^{(b)}$	0.0036 - 0.0075$^{(b)}$	0.00025 - 0.00037$^{(b)}$	0.000020	-	<0.00002	0.000024	-	-	-	-	-	0.000020	<0.00002	0.000024	1	3	-	-	-	-
Calcium	mg/L	-	-	-	-	45	-	68	59	-	-	-	-	-	59	45	68	0	3	-	-	-	-
Chromium	mg/L	-	0.0010$^{(g)}$	-	0.0010	<0.001	-	<0.001	<0.001	-	-	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Cobalt	mg/L	-	0.0013 - 0.0017$^{(b)}$	-	-	<0.0003	-	<0.0003	<0.0003	-	-	-	-	-	<0.0003	<0.0003	<0.0003	3	3	-	-	-	-
Copper	mg/L	0.027 - 0.055$^{(b)}$	0.0070$^{(b)}$	-	0.0037 - 0.0040$^{(b)}$	0.00098	-	0.00042	0.00053	-	-	-	-	-	0.00053	0.00042	0.00098	0	3	-	-	-	-
Iron	mg/L	-	-	-	0.30	**0.51$^{(C)}$**	-	**0.42$^{(C)}$**	0.30	-	-	-	-	-	**0.42$^{(C)}$**	0.30	**0.51$^{(C)}$**	0	3	-	-	-	67
Lead	mg/L	-	0.0063 - 0.0070$^{(b)}$	-	0.0063 - 0.0070$^{(b)}$	0.00022	-	<0.0002	<0.0002	-	-	-	-	-	<0.0002	<0.0002	0.00022	2	3	-	-	-	-
Lithium	mg/L	-	-	-	-	<0.02	-	<0.02	<0.02	-	-	-	-	-	<0.02	<0.02	<0.02	3	3	-	-	-	-
Magnesium	mg/L	-	-	-	-	14	-	25	17	-	-	-	-	-	17	14	25	0	3	-	-	-	-
Manganese	mg/L	-	-	-	-	0.035	-	0.040	0.020	-	-	-	-	-	0.035	0.020	0.040	0	3	-	-	-	-
Mercury	mg/L	0.000013	0.0000050	-	0.000026	<0.0002$^{(DL>A, DL>C)}$	<0.000002	<0.000002	<0.000002	<0.000002	<0.000002	-	<0.000002	<0.000002	<0.000002	<0.000002	<0.0002$^{(DL>A, DL>C)}$	8	8	-	-	-	-
Molybdenum	mg/L	-	0.073	-	0.073	0.0016	-	0.00094	0.00065	-	-	-	-	-	0.00094	0.00065	0.0016	0	3	-	-	-	-
Nickel	mg/L	0.74 - 1.4$^{(b)}$	0.082 - 0.15$^{(b)}$	-	0.14 - 0.15$^{(b)}$	0.0011	-	<0.0005	0.00064	-	-	-	-	-	0.00064	<0.0005	0.0011	1	3	-	-	-	-
Potassium	mg/L	-	-	-	-	11	-	1.1	1.1	-	-	-	-	-	1.1	1.1	11	0	3	-	-	-	-
Selenium	mg/L	-	0.0020	-	0.0010	<0.0002	-	<0.0002	<0.0002	-	-	-	-	-	<0.0002	<0.0002	<0.0002	3	3	-	-	-	-
Silicon	mg/L	-	-	-	-	5.4	-	3.3	4.3	-	-	-	-	-	4.3	3.3	5.4	0	3	-	-	-	-
Silver	mg/L	-	0.00025	-	0.00025	<0.0001	-	<0.0001	<0.0001	-	-	-	-	-	<0.0001	<0.0001	<0.0001	3	3	-	-	-	-
Sodium	mg/L	-	-	-	-	3.6	-	4.9	3.7	-	-	-	-	-	3.7	3.6	4.9	0	3	-	-	-	-
Strontium	mg/L	-	-	-	-	0.16	-	0.30	0.21	-	-	-	-	-	0.21	0.16	0.30	0	3	-	-	-	-
Sulphur	mg/L	-	-	-	-	1.8	-	1.8	1.4	-	-	-	-	-	1.8	1.4	1.8	0	3	-	-	-	-
Thallium	mg/L	-	0.00080	-	0.00080	<0.0002	-	<0.0002	<0.0002	-	-	-	-	-	<0.0002	<0.0002	<0.0002	3	3	-	-	-	-
Tin	mg/L	-	-	-	-	<0.001	-	<0.001	<0.001	-	-	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Titanium	mg/L	-	-	-	-	0.0040	-	0.0023	0.0028	-	-	-	-	-	0.0028	0.0023	0.0040	0	3	-	-	-	-
Uranium	mg/L	0.033	0.015	0.033	0.015	0.00068	-	0.00094	0.00057	-	-	-	-	-	0.00068	0.00057	0.00094	0	3	-	-	-	-
Vanadium	mg/L	-	-	-	-	0.0013	-	0.0014	0.0012	-	-	-	-	-	0.0013	0.0012	0.0014	0	3	-	-	-	-
Zinc	mg/L	-	0.030	-	-	0.0043	-	<0.003	<0.003	-	-	-	-	-	<0.003	<0.003	0.0043	2	3	-	-	-	-
Dissolved Metals																							
Aluminum	mg/L	0.10$^{(h)}$	0.050$^{(h)}$	-	-	0.0081	0.0031	0.0048	0.0073	0.0054	0.0034	-	0.0052	0.0031	0.0050	0.0031	0.0081	0	8	-	-	-	-
Antimony	mg/L	-	-	-	-	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	-	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	8	8	-	-	-	-
Arsenic	mg/L	-	-	-	-	0.00060	0.00034	0.00082	0.00067	0.00062	0.00034	-	0.00034	0.00045	0.00053	0.00034	0.00082	0	8	-	-	-	-

Attachment 1

Clearwater Project Baseline Water Quality Summary by Station, 2016-2019

Table 1d: Water Quality Summary of Station 4, 2016 to 2019

Parameter	Unit	Guidelines for the Protection of Aquatic Life:				Station 4 Sampling Data									Summary of Station 4 Sampling Data from 2016 to 2019								
		Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)	15-Mar-16	16-Apr-16	22-Jun-16	16-Sep-16	19-May-17	6-Nov-17	10-May-18	20-Sep-18	22-Apr-19	Median	Minimum	Maximum	Non-Dectable	Count	% Above Guideline			
																				Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)
Barium	mg/L	-	-	-	-	0.14	0.16	0.23	0.18	0.14	0.27	-	0.25	0.21	0.20	0.14	0.27	0	8	-	-	-	-
Beryllium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Boron	mg/L	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	8	8	-	-	-	-
Cadmium	mg/L	-	-	-	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	8	8	-	-	-	-
Chromium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Cobalt	mg/L	-	-	-	-	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	-	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	8	8	-	-	-	-
Copper	mg/L	-	-	-	-	0.00047	0.00032	0.00025	0.00025	0.00031	<0.0002	-	0.00028	0.00039	0.00030	<0.0002	0.00047	1	8	-	-	-	-
Iron	mg/L	-	0.30	-	-	0.22	0.12	0.23	0.18	0.17	<0.06	-	<0.06	<0.06	0.15	<0.06	0.23	3	8	-	-	-	-
Lead	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	8	8	-	-	-	-
Lithium	mg/L	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	8	8	-	-	-	-
Manganese	mg/L	-	-	11 - 15(i)	0.27 - 0.40(i)	0.018	0.023	0.026	0.0089	0.020	0.012	-	0.0054	0.018	0.018	0.0054	0.026	0	8	-	-	-	-
Molybdenum	mg/L	-	-	-	-	0.0011	0.00071	0.00080	0.00063	0.00052	0.00090	-	0.00088	0.00094	0.00084	0.00052	0.0011	0	8	-	-	-	-
Nickel	mg/L	-	-	-	-	0.00094	0.00063	<0.0005	<0.0005	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	0.00094	6	8	-	-	-	-
Selenium	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	8	8	-	-	-	-
Silicon	mg/L	-	-	-	-	5.1	4.7	3.0	4.4	3.5	5.6	-	3.2	3.9	4.2	3.0	5.6	0	8	-	-	-	-
Silver	mg/L	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	8	8	-	-	-	-
Strontium	mg/L	-	-	-	-	0.16	0.21	0.33	0.24	0.20	0.36	-	0.33	0.28	0.26	0.16	0.36	0	8	-	-	-	-
Sulphur	mg/L	-	-	-	-	1.7	2.0	1.5	1.4	1.1	2.7	-	2.2	2.4	1.9	1.1	2.7	0	8	-	-	-	-
Thallium	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	8	8	-	-	-	-
Tin	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Titanium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Uranium	mg/L	-	-	-	-	0.00057	0.00063	0.00081	0.00059	0.00056	0.00096	-	0.0010	0.00090	0.00072	0.00056	0.0010	0	8	-	-	-	-
Vanadium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Zinc	mg/L	-	-	0.20 - 0.32(j)	0.045 - 0.072(k)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-	<0.003	<0.003	<0.003	<0.003	<0.003	8	8	-	-	-	-

Notes:

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision *after* comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

Not all samples have associated field measured parameters and so laboratory pH was used to calculate individual guidelines when field pH was not present. The average water temperature measured at stations 2 to 5 during spring (9.6°C) was used to calculate guidelines for all spring samples missing field data (i.e., those collected in March, April and May). The average water temperature measured at stations 2 to 5 during fall (3.2°C) was used to calculate guidelines for all fall samples missing field data (i.e., those collected in September). The water temperature of 20°C was used to calculate guidelines for the summer (June) sample missing field data. If field measured data were present for a sample, the sample-specific values were used during guideline calculation for that sample.

(a) Guideline is a minimum value, unless the background concentration or value is lower.

(b) Guideline is hardness dependent and calculated based on the individual hardness value for each sample. The guideline range shown is based on the hardness range observed in the dataset (170 to 350 mg/L).

(c) For some samples, water hardness was greater than 250 mg/L. At this hardness, no BC ENV water quality guideline (recommended by GOA 2018b) has been established for sulphate; however, the observed data were screened against the guideline for very hard water (i.e., 429 mg/L) for comparative purposes.

(d) Guideline is chloride dependent and is calculated based on the individual chloride concentration in each sample. The guideline range shown is based on the chloride concentration range observed in the dataset (1.9 to 6.4 mg/L).

(e) The ammonia guideline is pH and temperature dependent. The data were compared to the minimum guideline (0.21 mg-N/L), which was based on the combination of laboratory pH (8.3) and water temperature (20°C).

(f) Guideline is pH dependent: 0.005 mg/L at pH < 6.5 and 0.1 mg/L at pH ≥ 6.5.

(g) Guideline is for chromium VI.

(h) Guideline is pH dependent and calculated based on the individual pH for each sample. The guideline range shown is based on the pH range observed in the dataset (8.0 to 8.4).

(i) The dissolved manganese guidelines are dependent on pH and hardness, and are calculated based on the individual pH and hardness measurements for each sample. The minimum acute manganese guideline (11 mg/L) is based on the combination of laboratory pH (8.0) and hardness (170 mg/L). The minimum chronic manganese guideline (0.27 mg/L) is based on the combination of laboratory pH (8.1) and hardness (220 mg/L). Guidelines calculated with pH and hardness values falling outside the defined ranges (i.e., pH of 5.8 to 8.4 for the acute and chronic guidelines, hardness of 25 to 250 mg/L for the acute guideline, and hardness of 25 to 670 mg/L for the chronic guideline) should be used with caution, as the guidelines do not necessarily accurately reflect toxic effects at the low and high pH and hardness extremes.

(j) The dissolved zinc guidelines are dependent on pH (chronic only), hardness, and DOC and are calculated based on the individual pH, hardness, and DOC measurements for each sample. The minimum acute zinc guideline (0.20 mg/L) is based on the combination of hardness (350 mg/L) and DOC (2.2 mg/L). The minimum chronic zinc guideline (0.045 mg/L) is based on the combination of laboratory pH (8.3), hardness (300 mg/L) and DOC (2.7 mg/L). Guidelines calculated with pH, hardness, and DOC values falling outside the defined ranges (i.e., pH of 6.5 to 8.13 for the chronic guideline, hardness of 14 to 251 mg/L for the acute guideline and 23 to 399 mg/L for the chronic guideline, and DOC of 0.3 to 17 mg/L for the acute guideline and 0.3 to 23 mg/L for the chronic guideline) should be used with caution, as the guidelines do not necessarily accurately reflect toxic effects at the low and high pH, hardness, and DOC extremes.

(C) Concentration is higher than the chronic aquatic life CCME guideline.

(DL>A) Analytical detection limit is higher than the acute aquatic life GOA total mercury guideline.

(DL>C) Analytical detection limit is higher than the chronic aquatic life GOA and CCME total mercury guideline.

µS/cm = microsiemens; NTU = nephelometric turbidity units; mg-N/L = milligrams as nitrogen per litre; mg-P/L = milligrams as phosphorus per litre; < = less than; ≥ = greater than or equal to; DOC = dissolved organic carbon; GOA = Government of Alberta; CCME = Canadian Council of Ministers of the Environment; BC ENV = British Columbia Ministry of Environement and Climate Change Strategy; - = no guideline or no data.

Table 1e: Water Quality Summary of Station 5, 2016 to 2019

Parameter	Unit	Guidelines for the Protection of Aquatic Life:				Station 5 Sampling Data									Summary of Station 5 Sampling Data from 2016 to 2019								
		Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)	15-Mar-16	16-Apr-16	22-Jun-16	16-Sep-16	19-May-17	6-Nov-17	10-May-18	20-Sep-18	22-Apr-19	Median	Minimum	Maximum	Non-Dectable	Count	% Above Guideline			
																				Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)
Field Measured																							
pH	-	-	6.5 - 9.0	-	6.5 - 9.0	-	-	-	-	-	7.9	7.9	-	-	7.9	7.9	7.9	0	2	-	-	-	-
Temperature	°C	-	-	-	-	-	-	-	-	13	7.0	8.3	-	-	8.3	7.0	13	0	3	-	-	-	-
Dissolved oxygen	mg/L	5.0	6.5	-	6.5	-	-	-	-	**1.0**$^{(A, C)}$	7.9	9.8	-	-	7.9	**1.0**$^{(A, C)}$	9.8	0	3	33	33	-	33
Dissolved oxygen	%	-	-	-	-	-	-	-	-	9.6	65	83	-	-	65	9.6	83	0	3	-	-	-	-
Conductivity	µS/cm	-	-	-	-	-	-	-	-	-	500	500	-	-	500	500	0.50	0	2	-	-	-	-
Conventional Parameters																							
pH	-	-	6.5 - 9.0	-	6.5 - 9.0	8.2	8.1	8.3	8.2	8.3	8.2	-	8.2	8.3	8.2	8.1	8.3	0	8	-	-	-	-
Hardness, as $CaCO_3$	mg/L	-	-	-	-	280	230	300	270	210	350	-	290	260	275	210	350	0	8	-	-	-	-
Total alkalinity, as $CaCO_3$	mg/L	-	20$^{(a)}$	-	-	170	220	250	240	200	290	-	260	250	245	170	290	0	8	-	-	-	-
Total dissolved solids	mg/L	-	-	-	-	310	240	290	260	220	330	-	300	280	285	220	330	0	8	-	-	-	-
Total suspended solids	mg/L	-	-	-	-	4.7	5.3	4.0	1.3	-	2.7	-	1.3	2.0	2.7	1.3	5.3	0	7	-	-	-	-
Dissolved organic carbon	mg/L	-	-	-	-	0.96	7.8	2.6	9.2	16	1.8	-	2.3	3.5	3.1	0.96	16	0	8	-	-	-	-
Turbidity	NTU	-	-	-	-	2.2	2.9	2.9	1.5	-	1.6	-	-	3.0	2.6	1.5	3.0	0	6	-	-	-	-
Conductivity	µS/cm	-	-	-	-	510	430	490	460	390	570	-	520	490	490	390	570	0	8	-	-	-	-
5-day biological oxygen demand	mg/L	-	-	-	-	<2.0	<2.0	2.5	-	-	<2.0	-	3.2	<2.0	<2.0	<2.0	3.2	4	6	-	-	-	-
Major Ions																							
Calcium	mg/L	-	-	-	-	75	62	77	71	59	92	-	77	69	73	59	92	0	8	-	-	-	-
Chloride	mg/L	640	120	640	120	<1.0	3.4	1.8	1.8	3.5	2.2	-	2.6	3.5	2.4	<1.0	3.5	1	8	-	-	-	-
Magnesium	mg/L	-	-	-	-	23	19	26	21	15	30	-	24	22	23	15	30	0	8	-	-	-	-
Potassium	mg/L	-	-	-	-	0.87	2.1	1.2	1.3	1.5	1.5	-	1.3	1.5	1.4	0.87	2.1	0	8	-	-	-	-
Sodium	mg/L	-	-	-	-	2.6	4.3	5.1	4.4	4.6	5.5	-	4.8	4.7	4.7	2.6	5.5	0	8	-	-	-	-
Sulphate	mg/L	-	429$^{(b, c)}$	-	-	110	13	29	15	9.3	26	-	30	29	28	9.3	110	0	8	-	-	-	-
Nutrients																							
Nitrate	mg-N/L	124	2.9	124	2.9	0.10	0.18	<0.01	<0.01	<0.01	0.20	-	<0.01	0.044	0.044	<0.01	0.20	4	8	-	-	-	-
Nitrite	mg-N/L	0.060 - 0.12$^{(d)}$	0.020 - 0.040$^{(d)}$	-	0.060	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	8	8	-	-	-	-
Nitrate + nitrite	mg-N/L	-	-	-	-	0.10	0.18	<0.02	<0.02	<0.01	0.20	-	<0.014	0.044	0.044	<0.01	0.20	4	8	-	-	-	-
Total Ammonia	mg-N/L	-	0.21$^{(e)}$	-	0.21$^{(e)}$	<0.05	<0.05	<0.05	<0.05	0.030	<0.015	-	<0.015	<0.015	0.030	<0.015	<0.05	7	8	-	-	-	-
Total Kjeldahl Nitrogen	mg-N/L	-	-	-	-	0.14	0.45	0.16	0.44	0.74	0.15	-	0.14	0.19	0.18	0.14	0.74	0	8	-	-	-	-
Total nitrogen (calculated)	mg-N/L	-	-	-	-	0.24	0.63	0.16	0.44	0.74	0.35	-	0.14	0.23	0.30	0.14	0.74	0	8	-	-	-	-
Total phosphorus	mg-P/L	-	-	-	-	0.015	0.016	0.0070	0.0070	0.013	0.0052	-	0.0065	0.0068	0.0070	0.0052	0.016	0	8	-	-	-	-
Dissolved phosphorus	mg-P/L	-	-	-	-	0.0060	0.0080	0.0040	0.0040	0.0064	<0.003	-	0.0037	<0.003	0.0040	<0.003	0.0080	2	8	-	-	-	-
Total Metals																							
Aluminum	mg/L	-	-	-	0.10$^{(f)}$	0.040	-	0.016	0.040	-	-	-	-	-	0.040	0.016	0.040	0	3	-	-	-	-
Antimony	mg/L	-	-	-	-	<0.0006	-	<0.0006	<0.0006	-	-	-	-	-	<0.0006	<0.0006	<0.0006	3	3	-	-	-	-
Arsenic	mg/L	-	0.0050	-	0.0050	<0.0002	-	0.00085	0.00070	-	-	-	-	-	0.00070	<0.0002	0.00085	1	3	-	-	-	-
Barium	mg/L	-	-	-	-	0.083	-	0.22	0.17	-	-	-	-	-	0.17	0.083	0.22	0	3	-	-	-	-
Beryllium	mg/L	-	-	-	-	<0.001	-	<0.001	<0.001	-	-	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Boron	mg/L	29	1.5	29	1.5	<0.02	-	<0.02	<0.02	-	-	-	-	-	<0.02	<0.02	<0.02	3	3	-	-	-	-
Cadmium	mg/L	0.0045 - 0.0075$^{(b)}$	0.00029 - 0.00037$^{(b)}$	0.0045 - 0.0075$^{(b)}$	0.00029 - 0.00037$^{(b)}$	<0.00002	-	<0.00002	0.000026	-	-	-	-	-	<0.00002	<0.00002	0.000026	2	3	-	-	-	-
Calcium	mg/L	-	-	-	-	71	-	72	60	-	-	-	-	-	71	60	72	0	3	-	-	-	-
Chromium	mg/L	-	0.0010$^{(g)}$	-	0.0010	<0.001	-	<0.001	<0.001	-	-	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Cobalt	mg/L	-	0.0014 - 0.0017$^{(b)}$	-	-	<0.0003	-	<0.0003	<0.0003	-	-	-	-	-	<0.0003	<0.0003	<0.0003	3	3	-	-	-	-
Copper	mg/L	0.033 - 0.055$^{(b)}$	0.0070$^{(b)}$	-	0.0040$^{(b)}$	<0.0002	-	0.00024	0.00059	-	-	-	-	-	0.00024	<0.0002	0.00059	1	3	-	-	-	-
Iron	mg/L	-	-	-	0.30	0.082	-	**0.41**$^{(C)}$	0.30	-	-	-	-	-	0.30	0.082	**0.41**$^{(C)}$	0	3	-	-	-	33
Lead	mg/L	-	0.0070$^{(b)}$	-	0.0070$^{(b)}$	<0.0002	-	<0.0002	<0.0002	-	-	-	-	-	<0.0002	<0.0002	<0.0002	3	3	-	-	-	-
Lithium	mg/L	-	-	-	-	<0.02	-	<0.02	<0.02	-	-	-	-	-	<0.02	<0.02	<0.02	3	3	-	-	-	-
Magnesium	mg/L	-	-	-	-	22	-	24	18	-	-	-	-	-	22	18	24	0	3	-	-	-	-
Manganese	mg/L	-	-	-	-	<0.004	-	0.016	0.021	-	-	-	-	-	0.016	<0.004	0.021	1	3	-	-	-	-
Mercury	mg/L	0.000013	0.0000050	-	0.000026	<0.0002$^{(DL>A, DL>C)}$	<0.000002	<0.000002	<0.000002	<0.000002	<0.000002	-	<0.000002	<0.000002	<0.000002	<0.000002	<0.0002$^{(DL>A, DL>C)}$	8	8	-	-	-	-
Molybdenum	mg/L	-	0.073	-	0.073	0.00079	-	0.00083	0.00065	-	-	-	-	-	0.00079	0.00065	0.00083	0	3	-	-	-	-
Nickel	mg/L	0.88 - 1.4$^{(b)}$	0.098 - 0.15$^{(b)}$	-	0.15$^{(b)}$	<0.0005	-	<0.0005	0.00057	-	-	-	-	-	<0.0005	<0.0005	0.00057	2	3	-	-	-	-
Potassium	mg/L	-	-	-	-	1.0	-	1.1	1.0	-	-	-	-	-	1.0	1.0	1.1	0	3	-	-	-	-
Selenium	mg/L	-	0.0020	-	0.0010	0.00044	-	<0.0002	<0.0002	-	-	-	-	-	<0.0002	<0.0002	0.00044	2	3	-	-	-	-
Silicon	mg/L	-	-	-	-	2.6	-	3.3	3.9	-	-	-	-	-	3.3	2.6	3.9	0	3	-	-	-	-
Silver	mg/L	-	0.00025	-	0.00025	<0.0001	-	<0.0001	<0.0001	-	-	-	-	-	<0.0001	<0.0001	<0.0001	3	3	-	-	-	-
Sodium	mg/L	-	-	-	-	2.8	-	4.7	3.7	-	-	-	-	-	3.7	2.8	4.7	0	3	-	-	-	-
Strontium	mg/L	-	-	-	-	0.83	-	0.44	0.30	-	-	-	-	-	0.44	0.30	0.83	0	3	-	-	-	-
Sulphur	mg/L	-	-	-	-	36	-	9.1	4.4	-	-	-	-	-	9.1	4.4	36	0	3	-	-	-	-
Thallium	mg/L	-	0.00080	-	0.00080	<0.0002	-	<0.0002	<0.0002	-	-	-	-	-	<0.0002	<0.0002	<0.0002	3	3	-	-	-	-
Tin	mg/L	-	-	-	-	<0.001	-	<0.001	<0.001	-	-	-	-	-	<0.001	<0.001	<0.001	3	3	-	-	-	-
Titanium	mg/L	-	-	-	-	<0.001	-	<0.001	0.0012	-	-	-	-	-	<0.001	<0.001	0.0012	2	3	-	-	-	-
Uranium	mg/L	0.033	0.015	0.033	0.015	0.00060	-	0.00083	0.00061	-	-	-	-	-	0.00061	0.00060	0.00083	0	3	-	-	-	-
Vanadium	mg/L	-	-	-	-	<0.001	-	0.0011	0.0012	-	-	-	-	-	0.0011	<0.001	0.0012	1	3	-	-	-	-
Zinc	mg/L	-	0.030	-	-	<0.003	-	<0.003	<0.003	-	-	-	-	-	<0.003	<0.003	<0.003	3	3	-	-	-	-
Dissolved Metals																							
Aluminum	mg/L	0.10$^{(h)}$	0.050$^{(h)}$	-	-	0.0038	0.0085	0.0042	0.0051	0.0067	0.0033	-	0.0055	<0.003	0.0047	<0.003	0.0085	1	8	-	-	-	-
Antimony	mg/L	-	-	-	-	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	-	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	8	8	-	-	-	-
Arsenic	mg/L	-	-	-	-	<0.0002	0.00044	0.00066	0.00056	0.00056	0.00042	-	0.00036	0.00041	0.00043	<0.0002	0.00066	1	8	-	-	-	-

Attachment 1

Clearwater Project Baseline Water Quality Summary by Station, 2016-2019

Table 1e: Water Quality Summary of Station 5, 2016 to 2019

Parameter	Unit	Guidelines for the Protection of Aquatic Life:				Station 5 Sampling Data									Summary of Station 5 Sampling Data from 2016 to 2019								
		Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)	15-Mar-16	16-Apr-16	22-Jun-16	16-Sep-16	19-May-17	6-Nov-17	10-May-18	20-Sep-18	22-Apr-19	Median	Minimum	Maximum	Non-Dectable	Count	% Above Guideline			
																				Acute (GOA)	Chronic (GOA)	Acute (CCME)	Chronic (CCME)
Barium	mg/L	-	-	-	-	0.083	0.18	0.23	0.20	0.15	0.27	-	0.24	0.20	0.20	0.083	0.27	0	8	-	-	-	-
Beryllium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Boron	mg/L	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	8	8	-	-	-	-
Cadmium	mg/L	-	-	-	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	8	8	-	-	-	-
Chromium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Cobalt	mg/L	-	-	-	-	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	-	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	8	8	-	-	-	-
Copper	mg/L	-	-	-	-	<0.0002	0.00034	<0.0002	0.00025	0.00023	<0.0002	-	<0.0002	0.00025	0.00023	<0.0002	0.00034	4	8	-	-	-	-
Iron	mg/L	-	0.30	-	-	<0.06	0.15	0.20	0.19	0.17	0.065	-	<0.06	<0.06	0.11	<0.06	0.20	3	8	-	-	-	-
Lead	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	8	8	-	-	-	-
Lithium	mg/L	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	8	8	-	-	-	-
Manganese	mg/L	-	-	13 - 15$^{(i)}$	0.27 - 0.46$^{(i)}$	<0.004	0.035	0.0093	0.013	0.021	0.026	-	0.041	0.029	0.024	<0.004	0.041	1	8	-	-	-	-
Molybdenum	mg/L	-	-	-	-	0.00075	0.00066	0.00076	0.00063	0.00058	0.00099	-	0.00072	0.00083	0.00074	0.00058	0.00099	0	8	-	-	-	-
Nickel	mg/L	-	-	-	-	<0.0005	0.00063	<0.0005	<0.0005	0.00061	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	0.00063	6	8	-	-	-	-
Selenium	mg/L	-	-	-	-	0.00041	<0.0002	<0.0002	<0.0002	<0.0002	0.00022	-	<0.0002	<0.0002	<0.0002	<0.0002	0.00041	6	8	-	-	-	-
Silicon	mg/L	-	-	-	-	2.6	4.2	3.2	4.1	3.3	5.0	-	3.2	3.4	3.4	2.6	5.0	0	8	-	-	-	-
Silver	mg/L	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	8	8	-	-	-	-
Strontium	mg/L	-	-	-	-	0.84	0.28	0.47	0.35	0.24	0.51	-	0.49	0.41	0.44	0.24	0.84	0	8	-	-	-	-
Sulphur	mg/L	-	-	-	-	38	4.3	8.5	4.5	2.8	9.2	-	8.8	9.2	8.7	2.8	38	0	8	-	-	-	-
Thallium	mg/L	-	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	8	8	-	-	-	-
Tin	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Titanium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Uranium	mg/L	-	-	-	-	0.00051	0.00074	0.00075	0.00056	0.00060	0.00083	-	0.00081	0.00080	0.00075	0.00051	0.00083	0	8	-	-	-	-
Vanadium	mg/L	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	8	8	-	-	-	-
Zinc	mg/L	-	-	0.17 - 0.29$^{(j)}$	0.028 - 0.078$^{(k)}$	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-	<0.003	<0.003	<0.003	<0.003	<0.003	8	8	-	-	-	-

Notes:

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision *after* comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

Not all samples have associated field measured parameters and so laboratory pH was used to calculate individual guidelines when field pH was not present. The average water temperature measured at stations 2 to 5 during spring (9.6°C) was used to calculate guidelines for all spring samples missing field data (i.e., those collected in March, April and May). The average water temperature measured at stations 2 to 5 during fall (3.2°C) was used to calculate guidelines for all fall samples missing field data (i.e., those collected in September). The water temperature of 20°C was used to calculate guidelines for the summer (June) sample missing field data. If field measured data were present for a sample, the sample-specific values were used during guideline calculation for that sample.

(a) Guideline is a minimum value, unless the background concentration or value is lower.

(b) Guideline is hardness dependent and calculated based on the individual hardness value for each sample. The guideline range shown is based on the hardness range observed in the dataset (210 to 350 mg/L).

(c) For some samples, water hardness was greater than 250 mg/L. At this hardness, no BC ENV water quality guideline (recommended by GOA 2018b) has been established for sulphate; however, the observed data were screened against the guideline for very hard water (i.e., 429 mg/L) for comparative purposes.

(d) Guideline is chloride dependent and is calculated based on the individual chloride concentration in each sample. The guideline range shown is based on the chloride concentration range observed in the dataset (0.5 to 3.5 mg/L).

(e) The ammonia guideline is pH and temperature dependent. The data were compared to the minimum guideline (0.21 mg-N/L), which was based on the combination of laboratory pH (8.3) and water temperature (20°C).

(f) Guideline is pH dependent: 0.005 mg/L at pH < 6.5 and 0.1 mg/L at pH ≥ 6.5.

(g) Guideline is for chromium VI.

(h) Guideline is pH dependent and calculated based on the individual pH for each sample. The guideline range shown is based on the pH range observed in the dataset (7.9 to 8.3).

(i) The dissolved manganese guidelines are dependent on pH and hardness, and are calculated based on the individual pH and hardness measurements for each sample. The minimum acute manganese guideline (13 mg/L) is based on the combination of laboratory pH (8.3) and hardness (210 mg/L). The minimum chronic manganese guideline (0.27 mg/L) is based on the combination of laboratory pH (8.3) and hardness (210 mg/L). Guidelines calculated with pH and hardness values falling outside the defined ranges (i.e., pH of 5.8 to 8.4 for the acute and chronic guidelines, hardness of 25 to 250 mg/L for the acute guideline, and hardness of 25 to 670 mg/L for the chronic guideline) should be used with caution, as the guidelines do not necessarily accurately reflect toxic effects at the low and high pH and hardness extremes.

(j) The dissolved zinc guidelines are dependent on pH (chronic only), hardness, and DOC and are calculated based on the individual pH, hardness, and DOC measurements for each sample. The minimum acute zinc guideline (0.17 mg/L) is based on the combination of hardness (280 mg/L) and DOC (1.0 mg/L). The minimum chronic zinc guideline (0.028 mg/L) is based on the combination of laboratory pH (8.2), hardness (280 mg/L) and DOC (1.0 mg/L). Guidelines calculated with pH, hardness, and DOC values falling outside the defined ranges (i.e., pH of 6.5 to 8.13 for the chronic guideline, hardness of 14 to 251 mg/L for the acute guideline and 23 to 399 mg/L for the chronic guideline, and DOC of 0.3 to 17 mg/L for the acute guideline and 0.3 to 23 mg/L for the chronic guideline) should be used with caution, as the guidelines do not necessarily accurately reflect toxic effects at the low and high pH, hardness, and DOC extremes.

(A) Concentration is below the GOA minimum dissolved oxygen guideline.

(C) Concentration is higher than the chronic aquatic life GOA and/or CCME guideline or below the minimum dissolved oxygen guideline.

(DL>A) Analytical detection limit is higher than the acute aquatic life GOA total mercury guideline.

(DL>C) Analytical detection limit is higher than the chronic aquatic life GOA and CCME total mercury guideline.

µS/cm = microsiemens; NTU = nephelometric turbidity units; mg-N/L = milligrams as nitrogen per litre; mg-P/L = milligrams as phosphorus per litre; < = less than; ≥ = greater than or equal to; DOC = dissolved organic carbon; GOA = Government of Alberta; CCME = Canadian Council of Ministers of the Environment; BC ENV = British Columbia Ministry of Environement and Climate Change Strategy; - = no guideline or no data.

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APPENDIX E

Proposed Surface Water Monitoring Plan

Report

Premier Tech Clearwater Peat Harvest Project

Proposed Surface Water Monitoring Plan – 2022 Update

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1.0 INTRODUCTION

Premier Tech Horticulture (Premier Tech) plans to conduct peat harvesting operations for horticultural purposes in Clearwater County. The Clearwater Peat Harvest Project (the Project) is located in west-central Alberta, southwest of the town of Chedderville along Mud Creek, a tributary of the Clearwater River. The eastern most portion of the Project is approximately 500 metres (m) west of Highway 22 and located in portions of Sections 1 and 2 of Township 37, Range 7, west of the 5th Meridian. This report describes the proposed plan of surface water monitoring to be conducted by Premier Tech during the construction, operation, and reclamation/closure phases of the Project.

Golder Associates Ltd. (Golder) prepared a Surface Water Monitoring Plan in 2017 in support of the Clearwater Project (Golder 2017). Alberta Environment and Park (AEP) provided Premier Tech with Supplemental Information Requests (SIRs) on 28 May 2019 (AEP 2019). An updated report in 2020 was provided to AEP that superseded the existing Golder 2017 report (Golder 2020). Specific changes and updates to the surface water monitoring plan to address the AEP SIRs and Project footprint changes included the following:

- The proposed sampling locations (i.e., upstream of the development, at discharge points and downstream of the development), frequency of monitoring (varies by parameter), and water quality parameter suite in the surface monitoring plan have been updated so that they align with recommendations in the *Guide to Surface Water Materials Lease Information Requirements for Peat Operations* (GOA 2017) and *Guide to Water Act Application Requirements for Surface Water Quality Monitoring for Peat Operations in Alberta* (GOA 2018a).
- The proposed sampling locations have been updated to reflect Phase 1 of the Project footprint.

Additional SIRs were provided by AEP on 15 September 2021 (AEP 2021). This current version of the Surface Water Monitoring Plan has been updated to address the second round of SIRs, specifically:

- The overview of monitoring includes a reference to the most recent baseline data collected in the fall of 2020 and spring of 2021.
- Comparisons to guidelines are limited to Alberta surface water quality guidelines.
- Reference stations have been moved further upstream of the Project area.
- Relevant figures, text, and tables have been updated to be consistent with the updated Project footprint and number of sedimentation ponds.
- Adaptive management thresholds and responses, and more frequent reporting, for total suspended solids (TSS) concentrations in the discharges from sedimentation ponds have been added.
- Additional continuous monitoring and adaptive management responses for instream temperatures have been added.

The monitoring plan applies to Project construction, operation, and closure phases, and includes annual reporting and a framework for reducing or expanding monitoring in the future, depending on the potential for effects observed during primary monitoring (e.g., see Section 2.5.1). These updates are consistent with the water quality monitoring recommendations in the *Guide to Water Act Application Requirements for Surface Water Quality Monitoring for Peat Operations in Alberta* (GOA 2018a).

2.0 SURFACE WATER MONITORING

2.1 General

A surface water monitoring plan has been prepared to meet the monitoring needs of the Project during the construction, operation, and reclamation/closure phases of the Project. Premier Tech plans to implement surface water quantity and quality monitoring as part of the Project environmental management program and to meet regulatory requirements.

2.2 Monitoring Objectives and Requirements

The objective of the surface water monitoring plan is to collect water quantity and quality data at select locations throughout the life of the Project to support the implementation of an environmental management program and to meet the following regulatory monitoring requirements:

- Environmental Protection and Enhancement Act (EPEA) monitoring requirements for all locations where water is discharged from the Project site.
- The Department of Fisheries and Oceans (DFO), Sub-Section 35-2 of the Federal *Fisheries Act*, monitoring requirement for all water bodies to which changes will be caused by the Project activities.
- Guide to Surface Water Materials Lease Information Requirements for Peat Operations (GOA 2017) and Guide to Water Act Application Requirements for Surface Water Quality Monitoring for Peat Operations in Alberta (GOA 2018a), which relate to making an application for a Surface Materials Lease to authorize a peat operation.
- Guidelines for Quality Assurance and Quality Control (QA/QC) in Surface Water Quality Programs in Alberta (Mitchell 2006), which provide guidance on appropriate QA/QC for surface water monitoring programs.

2.3 Proposed Surface Water Monitoring System

The proposed surface water monitoring system is divided into various station types based on their characteristics and requirements. The different types of stations required at the various monitoring sites are identified and described in Table 1.

Table 1: Monitoring Station Types

Item	Station Type	Monitoring Parameters[(a)]	Description of Monitoring Activities
1	Sedimentation Pond Discharge at Outlet Locations	Q and WQ	■ Monitoring of pumping volumes (discharge) at the West Outlet, Central Outlet, and East Outlet. ■ In situ field measurement of physico-chemical WQ parameters and grab sample collection for laboratory analysis[(b)]. ■ Continuous (at least hourly) measurements of temperature and TSS (or turbidity)

Table 1: Monitoring Station Types

Item	Station Type	Monitoring Parameters(a)	Description of Monitoring Activities
2	Mud Creek and its unnamed tributary Monitoring Stations	WL, Q, and WQ	🟩 Water level and discharge monitoring at two location(s) upstream of the Project outlet locations (on Mud Creek and the unnamed tributary) and also downstream of the East Outlet location. The water quantity and quality monitoring will be conducted during the open-water period. Water quantity will be monitored using water level loggers and stage-discharge rating curves will be developed. 🟩 In situ field measurement of physico-chemical WQ and grab sample collection at two locations upstream of the Project outlet locations (on Mud Creek and the unnamed tributary) and three locations downstream of one or more Project outlet locations (on Mud Creek). 🟩 Continuous (at least hourly) measurements of temperature at the same locations as grab samples are collected.
3	Reclamation / Closure Runoff Discharge Stations	WL, Q, and WQ	🟩 Water level and outflow monitoring at all locations of water discharges from the closure and reclaimed areas to Mud Creek using water level logger and discharge rating curves. 🟩 In situ field measurement of physico-chemical WQ and grab sample collection for laboratory analysis.

(a) WL = Water Level; Q = Discharge; WQ = Water Quality

(b) See Table 2 for a complete list of field and laboratory parameters to be monitored.

Figure 1 shows the locations of the proposed surface water monitoring stations along Mud Creek and its unnamed tributary. Selection of the locations of these stations is consistent with the requirements of the Guide to Surface Materials Lease Information Requirements for Peat Operations (GOA 2017) and Guide to Water Act Application Requirements for Surface Water Quality Monitoring for Peat Operations in Alberta (GOA 2018a).

The surface water monitoring of the selected locations will be conducted continually during the construction, operation, and reclamation/closure phases of the Project. During the construction phase of the Project (e.g., construction of sedimentation ponds), additional construction monitoring will be completed to monitor, and mitigate where necessary, activities that could result in elevated turbidity levels (Section 2.3 in GOA 2018a). Surface water monitoring will be extended post reclamation and closure of the Project for a period of 5 to 10 years. Water quality requirements are not necessarily static for a project and may be amended based on the results of the data collected during the first five years of monitoring (i.e., primary monitoring) for more flexible management of the operation (Section 2.5.1).

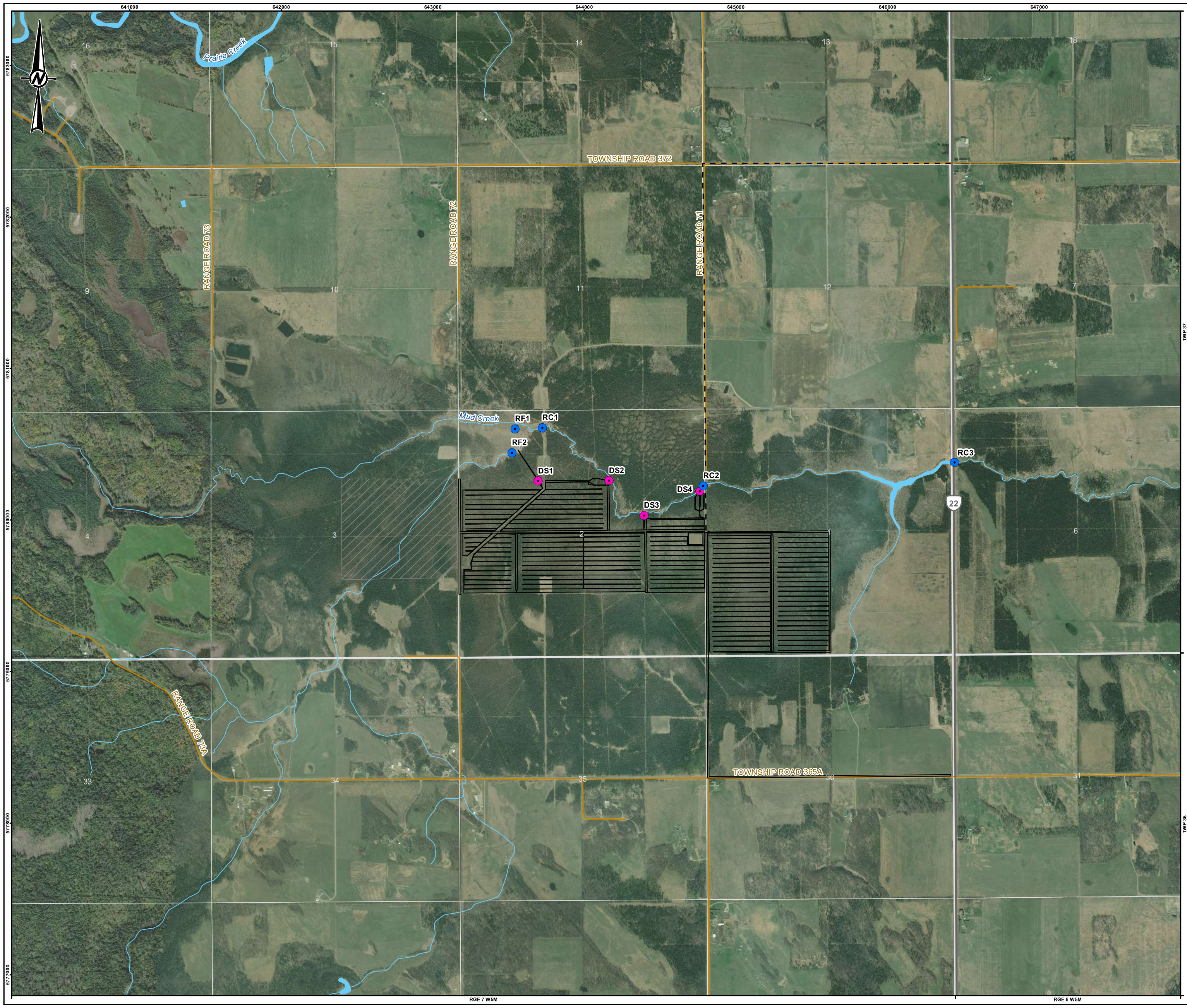
Monthly reports will be prepared to compare TSS (either measured directly or calculated from turbidity[1]) data that are collected continuously at the sedimentation basins outlets to a threshold of 50 mg/L and, if relevant, provide a description of actions taken or to be taken as a result of exceeding this threshold. A TSS threshold of 50 mg/L at the outlet of the sedimentation basins is expected to be achievable under typical operating conditions and be protective of Mud Creek (Golder 2022; Section 3.2.3 of main report). If TSS concentrations at the outlet of a sedimentation basin exceeds 50 mg/L for more than one hour in a given month, an inspection of the sedimentation basin will be completed to identify and mitigate the source of the elevated TSS concentrations at the outlet. If TSS concentrations at the outlet of a sedimentation basin regularly exceeds 50 mg/L with a potential to result in elevated TSS concentrations in Mud Creek (i.e., exceedances occur during multiple days in one month or in consecutive months), TSS monitoring in Mud Creek will be completed upstream and downstream of the

---

[1] TSS may be calculated based on a normally occurring linear relationship between TSS and turbidity in the sedimentation basin as per the “Conversion Relationship between Nephelometric Turbidity Units (NTU) into mg/L for Alberta Transportations’ Turbidity Specification” referenced in GOA (2021).

Project area, with an emphasis of periods when discharges from the sedimentation basins could occur (i.e., during rain events or spring freshet). If monitoring of TSS concentrations in Mud Creek indicates that the Alberta Environment Surface Water Quality Guidelines for TSS (GOA 2018b) have been exceeded due to the Project, Premier Tech will develop a response plan to reduce TSS concentrations in Project-related discharges to Mud Creek to below concentrations that have the potential to cause exceedances of guidelines in Mud Creek. The response plan may also propose discharge criteria (e.g., discharge limits such as maximum grab or maximum average concentrations, or both) that would apply at the outlets of the sedimentation basins and be protective of Mud Creek.

Annual reports will be prepared to summarize the monitoring activities and results for individual years. In general, the reports will include summary statistics of the water quality, water temperature, water level, and discharge data as well as graphs for presentation to regulators and shareholders. Water quality data will be compared to relevant Alberta guidelines for the protection of aquatic life from the most recently published Environmental Quality Guidelines for Alberta Surface Waters (e.g., currently GOA 2018b). If monitoring results indicate an adverse effect on water (quality or quantity) due to the Project, appropriate mitigation and additional monitoring (e.g., increase monitoring frequencies or locations) will be recommended. If continuous temperature data indicate that the Project may be causing temperature changes in Mud Creek, Premier Tech will develop, for inclusion in an updated Surface Monitoring Program, in-stream temperature thresholds to protect aquatic biota in Mud Creek and potential responses to mitigate thermal effects from the Project if thresholds are exceeded. After five years, an assessment of water quality data collected over the last five years will be completed to determine whether changes to the water quality component of the surface water monitoring plan are appropriate (Section 2.5).



LEGEND

▬	PRIMARY HIGHWAY	- -	ALTERNATE ACCESS ROAD
▬	LOCAL ROAD	☐	PROJECT FOOTPRINT - PHASE 1
▬	WATERCOURSE	▨	PROJECT FOOTPRINT - PHASE 2
🟦	WATERBODY	●	MUD CREEK SURFACE WATER MONITORING STATION
		●	SEDIMENTATION POND SURFACE WATER MONITORING STATION

DS = DISCHARGE
RC = RECEIVING
RF = REFERENCE

0 500 1,000
1:25,000 METRES

NOTE(S)
RC1 = BASELINE "CLEARWATER2"
RC3 = BASELINE "CLEARWATER3"

REFERENCE(S)
1. IMAGERY COPYRIGHT © 20190511 ESRI AND ITS LICENSORS. SOURCE: VIVID-MAXAR. USED UNDER LICENSE, ALL RIGHTS RESERVED.
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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PROJECT

TITLE
LOCATION OF SURFACE WATER MONITORING STATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2020-10-08
DESIGNED	SC
PREPARED	LMS
REVIEWED	AH
APPROVED	GB

PROJECT NO.	PHASE	REV.	FIGURE
19132041	3000	0	1

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2.4 Surface Water Quantity Monitoring Methods

2.4.1 Monitoring Overview

The purpose of surface water quantity monitoring is to measure discharge volumes from the Project as well as streamflow both upstream and downstream of the Project. As shown on Figure 1, Mud Creek main stem flows east past the Project location until it reaches the Clearwater River about 10 km downstream. An unnamed tributary of Mud Creek flows northeast to its confluence with Mud Creek near the west end of the Project. As Project releases to the environment will occur during the open-water period, surface water quantity monitoring will also focus on the open water period during operations.

2.4.2 Measurement of Pumping at the Outlet Locations

The flows from the drainage network will be routed through six planned sedimentation ponds and drain via channels to pumping stations at three outlet locations. Pumping volumes will be monitored at the three outlet locations whenever discharge occurs by monitoring the pumping rate and duration, or another appropriate method. Water collected at the outlet channels will be pumped to the peat surface and dispersed. The outlet channels at the pumping locations will be located outside the 100 m setback from the downstream watercourses as follows:

- The East Outlet drains water from the Harvest Areas 1 and 2 and will be located the furthest downstream in the Mud Creek watershed. On Figure 1, the East Outlet pumping station is located at or near DS3.
- The Central Outlet drains water from Harvest Areas 3 and 4 and will be further upstream/west along Mud Creek than the East Outlet. On Figure 1, the Central Outlet pumping station is located at or near DS2.
- The West Outlet drains water from Harvest Area 5 and will be located on the east side of the unnamed tributary near its confluence with Mud Creek. On Figure 1, the West Outlet pumping station is located at or near DS1.

Surface water quantity monitoring is not required at DS1 or DS2 until the drainage ditch network and sedimentation pond is constructed for these peat harvest areas. Pumping volumes should be documented on an ongoing basis and including in Project monitoring reports (a minimum of once annually).

2.4.3 Hydrometric Monitoring Upstream and Downstream of the Project

Streamflow monitoring is proposed for three locations upstream and downstream of the Project during construction and operations, and proposed monitoring locations are shown in Figure 1 as follows:

- RF1 will be located upstream of the Project on Mud Creek near an existing road.
- RF2 will be located upstream of the Project on an unnamed tributary of Mud Creek near an existing road.
- RC2 will be located downstream of the Project on Mud Creek below the East Outlet. The water quantity monitoring station should capture discharge released from the East Outlet therefore it may need to be set up somewhat east of and clearly downgradient of releases at DS3.

It is noted that hydrometric monitoring at RC1 and RC3 will not be required as no additional useful information would be gained.

Surface water quantity monitoring will start when construction and operations begins and continue through operations and reclamation periods. Hydrometric stations will be installed the first year at suitable channel locations, ideally at channel locations that have stable bed and banks, in a relatively straight reach with a single channel that captures a wide range of flows, avoiding large woody debris, beaver dams.

Standard hydrometric monitoring methods will be used to install the stations and collect stream gauging data. A range of water level and flow conditions is required to build an open-water stage-discharge rating curve (OWRC) for each hydrometric station. More frequent monthly field visits are recommended in the first year to confirm that the locations are suitable and adequately capture a wide range of conditions from peak flows to lower flows. The frequency may be reduced to three times a year (spring, summer, fall) in the subsequent years until the Project is fully operational, and thereafter the frequency can be reduced to twice per year (spring and fall). The OWRC will continued to be developed as more data become available.

The following data collection activities will be required:

- Installation of a pressure transducer (vented or else non-vented with a barometric sensor) with an integral or separate data logger. Hourly measurements will be sufficient.
- Installation of three local benchmarks on stable ground close to each station.
- Manual measurement of discharge using a current meter at a suitable channel cross-section.
- Survey of water surface elevation at the station relative to its benchmarks.
- Downloading data from pressure transducers during each field visit.
- Documenting each station location with photos during each field visit.

Pressure transducers may need to be removed in winter or else winterized in fall to avoid damage. They should be reinstalled at their stations prior to any Project discharge activities occurring in spring.

Data processing will be performed at the end of each open water season using Aquarius hydrometric software and database package or equivalent and reporting should occur on an annual basis. Stage (water level at the gauge) data corrections may include offset and drift corrections. Stage-shifts will be applied to the discharge rating curves at the measurement points when the measurement value shows an error greater than plus or minus five percent in relation to the rating curve.

2.5 Surface Water Quality Monitoring Methods

2.5.1 Monitoring Overview

- Surface water quality monitoring for peat operations has two major phases: baseline monitoring, which is completed prior to submitting an application and characterizes local hydrology and water quality (See Appendix D), and monitoring as part of approval requirements for construction, operations, closure, and reclamation.
- The baseline data collected by Premier Tech (See Appendix D) were collected over the course of four sampling events in 2016 (twice in spring, early summer, and early fall), two sampling events each in 2017 (late spring and late fall) and 2018 (late spring and early fall), and one sampling event in 2019 (spring). Premier Tech augmented the baseline data with additional sampling in the fall of 2020 and spring of 2021, which will be included in future assessments of baseline conditions for the Project.
- The proposed monitoring for the Project described in Sections 2.5.1 to 2.5.4 is considered primary monitoring (Figure 2). Primary monitoring is used to determine the concentration of water quality parameters released from sedimentation ponds and evaluate changes to the receiving environment. After five years of primary monitoring, water quality data will be reviewed by evaluating potential temporal trends in the

sediment pond discharges and receiving water, and identifying notable differences between water quality parameter concentrations in discharges and upstream of the Project, compared to the downstream receiving waters. The results of this data review will be used to determine whether sampling can be reduced to core monitoring (i.e., no adverse impact from peat operations is evident), continue as-is (e.g., if additional information is required to assess impacts), or be elevated to enhanced monitoring (i.e., potential adverse effects from peat operations are discernible; Figure 2). Core or enhanced monitoring would involve reductions or increases, respectively, in monitoring frequencies, locations, or parameters.

- Regardless of whether the Project moves to core or enhanced monitoring or continues with primary monitoring, annual reports will be prepared that include relevant annual statistical summaries of water quality data, comparisons to water guidelines (e.g., Alberta water quality guidelines for aquatic life) and temporal and spatial data plots. If adverse effects to water quality from the Project are identified in the annual reports, recommendations for appropriate mitigation and additional monitoring will be provided.

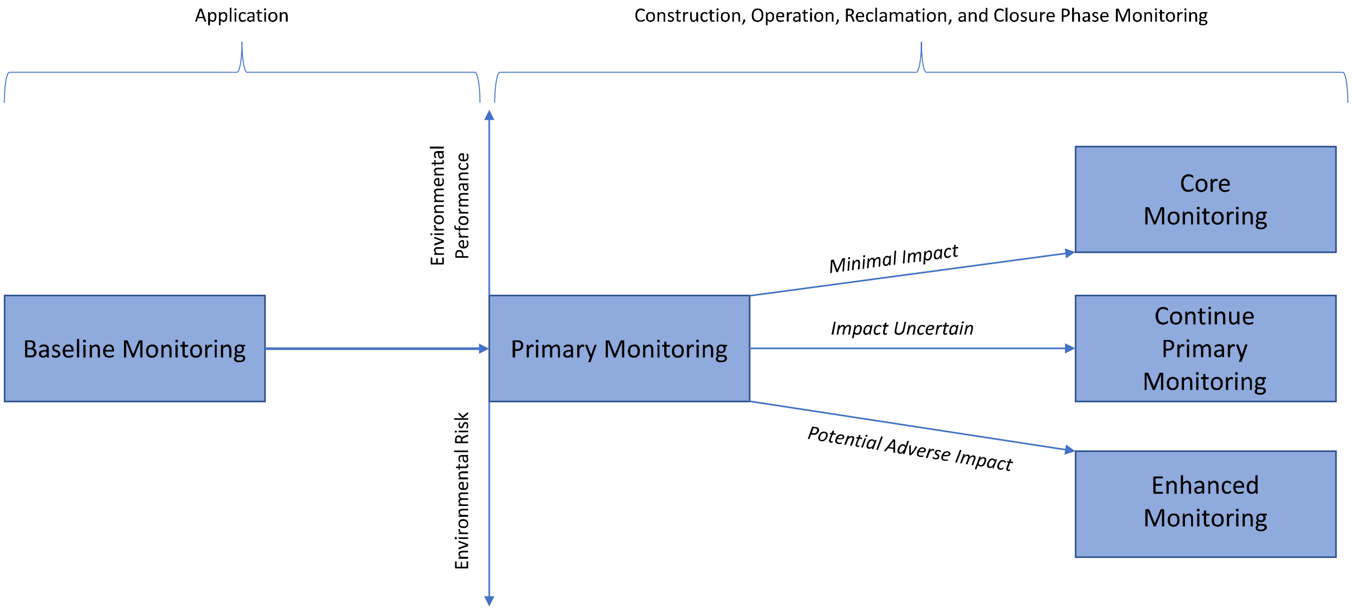

Figure 2: Phases and tiers for surface water quality monitoring programs for peat operations in Alberta

2.5.2 Station Locations

Water quality should be assessed for the proposed site and all potentially affected waters, including contributing and receiving waters, and all tributaries that flow into a fish bearing receiving water body (GOA 2017). Guidance from AEP (GOA 2018a) includes recommendations for water quality sampling locations for peat harvesting. Sampling locations should, at a minimum, include:

- One upstream location (i.e., reference location not impacted by operations) for each receiving waterbody.
- One downstream location for each receiving waterbody.
- Any waterbody within or adjacent to the peat operation area that is not protected by at least a 50 m buffer.

As shown in Figure 1, Premier Tech has included two reference sampling locations upstream of the Project, three discharge sampling locations, one in each sedimentation pond, and three receiving water sampling locations downstream of the sedimentation ponds. The three receiving water sampling locations represent the receiving environment for drainage from the Project given the relatively small area of the Project.

2.5.3 Sampling Frequency

Following the guidance from AEP (GOA 2017; GOA 2018a), monitoring at each sampling location will be conducted at least three times per year, during the following seasons:

- Spring freshet
- Mid-summer
- Fall during seasonal low flow conditions

The time period during or immediately after storm events will be avoided when possible for mid-summer sampling events.

In addition to seasonal sampling in Mud Creek, continuous measurements of water temperature will be collected in Mud Creek and its unnamed tributary during open-water conditions at the same locations where water quality sampling is proposed. Continuous measurements of water temperature and total suspended solids (TSS) or turbidity, which is an indicator of TSS, will also be collected at the sedimentation pond outlet stations during open-water conditions.

2.5.4 Parameter Suite and Sampling Methods

The parameter suite for samples recommended by AEP (GOA 2017; GOA 2018a) for monitoring peat harvesting operations is summarized in Table 2.

Table 2: Required Parameters for the Clearwater Project

Water Parameter Grouping	Constituents of Potential Concern (a)
Physico-chemical field measurements	in situ pH, temperature, dissolved oxygen, and specific conductivity
Conventional parameters	hardness, total alkalinity, total suspended solids, total dissolved solids, turbidity, 5-day biological oxygen demand, dissolved organic carbon and specific conductivity
Major ions	calcium, sulphate, magnesium, sodium, potassium, chloride
Nutrients	total ammonia, total Kjeldahl nitrogen, nitrate, nitrite, nitrate and nitrite, total phosphorus, dissolved phosphorus(a)
Total and dissolved metals	aluminum, arsenic, cadmium, chromium, iron, lead, manganese, mercury, molybdenum, vanadium

Note: Parameters listed are consistent with Table 1 in GOA (2017) and Table 1 in GOA (2018a).

(a) In GOA (2017), phosphate was also listed as a recommended parameter; dissolved phosphorus (as recommended in GOA 2018a) is recommended to represent the total concentrations of dissolved phosphorus.

Physico-chemical field parameters (i.e., pH, temperature, dissolved oxygen, and specific conductivity) will be measured in the field using a calibrated water quality multi-parameter meter (e.g., YSI meter, or equivalent field meter). Spot field measurements will be collected at mid-channel when possible, close to the water surface (i.e., at 0.3 m below the water surface, or halfway through the water column if the total depth is less than 0.6 m). Care will be taken to not submerge the sensors of the water quality meter in the sediment, and the meter will be allowed to stabilize for a minimum of five minutes before the water quality values are recorded. Spot field measurements will be collected at each station (Figure 1) in conjunction with water quality samples for laboratory analysis.

Laboratory water chemistry samples will be collected at the same depth and location as the spot field measurements. These samples will be collected from the water after the physico-chemical water quality measurements have been recorded. The sampling depth, date, and time of field data and water chemistry sample collection will be recorded on field data sheets. Field personnel will avoid disturbing the bottom sediment when collecting the sample, and will collect the sample upstream of any disturbance caused by wading or stepping near the bank. Sample bottles will be ordered and supplied by the laboratory prior to field work, along with a chain of custody form.

To collect a sample, the sample bottle will be lowered, bottle opening first, into the water to the required sampling depth upstream of where the field personnel is standing. The bottle will be slowly inverted at this depth and allowed to fill. If the bottle is pre-charged with preservative, a routine bottle will be used to collect water and fill the pre-charged bottle, without overfilling. Prior to, or immediately after, sampling, the bottles will be labeled with the date and time of collection, station name or sample identification number, and initials of personnel collecting the sample. The bottles will be stored on ice to keep cool (approximately 4°C). At the end of the program, all samples will be transported to an analytical laboratory, accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA), as soon as practical so that analyses can be conducted within the laboratory recommended hold time for all parameters (Table 2). The laboratory will process the samples in accordance with standard methods (e.g., APHA 2012).

Continuous measurements of water temperature will be collected in Mud Creek and its unnamed tributary using probes with loggers (e.g., HOBO temperature loggers) that can store continuous data; these instruments will be installed in such a way to minimize the risk of losing them due to flows or vandalism. Continuous measurements of water temperature and TSS, or turbidity, will be collected either in the sedimentation pond or in the discharge from the sedimentation pond using similar types of probes with loggers. Data from loggers will be downloaded and checked regularly. Instrumentation will be installed such that changing water levels in the ponds are accounted for and probes are submerged for the maximum period of time during open-water conditions. Data from loggers will be downloaded and checked regularly. Instrumentation will be installed such that changing water levels in the ponds are accounted for and probes are submerged for the maximum period of time during open-water conditions.

3.0 QUALITY ASSURANCE AND QUALITY CONTROL

Premier Tech will implement Quality assurance (QA) and quality control (QC) practices to maintain data integrity. These practices are relevant to all aspects of the monitoring program, from data or sample collection to data analysis and reporting. QA encompasses management and technical practices designed to ensure that the data generated are of consistent high quality. QC is an aspect of QA and includes the procedures used to measure and evaluate data quality, and the corrective actions to be taken when data quality objectives are not met.

3.1 Surface Water Quantity Monitoring

QA and QC procedures will be implemented for the monitoring data collection and analysis. The field data QA/QC procedures for water quantity monitoring include the following:

- Specific work instructions to cover all field tasks and activities.
- Instrument testing of current meters and survey equipment to verify their proper calibration and function before field trips.
- Installation of monitoring stations according to the protocols and instructions provided by the manufacturer.
- Verification of continuous datalogging after installation.
- Regular recovery (download) of logged data to reduce the risk of complete data loss due to instrument malfunction, damage to the monitoring stations, or data over-write.

- Routine checks for gross errors or missing data in the recorded data series after data download.
- Identification and verification of unusual deviations from, or abrupt changes in, average and expected data values or other statistical values.
- Routine collection of detailed field notes documenting any outstanding differences in observations or possible reasoning for discrepancies in recorded data.

The field data will be analyzed, described, and summarized using statistical techniques. Each data series will be checked to make sure that they meet the standard criteria for such analyses. The QA/QC procedures include the following:

- Data entry checks and review for errors.
- Comparison of results against available local and regional data.
- Verification of any analysis results by personnel not involved in the original analyses.

3.2 Surface Water Quality Monitoring

The surface water quality monitoring QA/QC program will be conducted according to the recommendations in the Guidelines for Quality Assurance and Quality Control in Surface Water Quality Programs in Alberta (Mitchell 2006) reference document.

In the field, QA and QC procedures include the following:

- Calibration of the water quality meter or loggers at the beginning of the program to check the precision and reliability (repeatability) of field measurements.
- During field programs, completion of daily end-of-day checks of the water quality meter by measuring pH and specific conductivity in calibration standards to determine if calibration drift occurred throughout the day.
- Checking of probes on continuous loggers for fouling and maintain and replace probes as appropriate to provide accurate readings.
- Regular recovery of recorded data to reduce the risk of complete data loss due to instrument malfunction or damage to the monitoring stations.
- Collection of field blanks, trip blanks, and duplicate samples as described below:
  - One trip blank and either a field blank or duplicate sample will be collected in each sampling program.
    - Field blanks are samples prepared in the field using de-ionized water provided by the analytical laboratory. The de-ionized water samples are exposed to the sampling environment at the sample site and handled in the same manner as the other samples collected. Field blanks are used to detect potential sample contamination during sample collection, handling, shipping, and analysis.
    - A trip blank is a complete set of sealed bottles containing de-ionized water, which is provided by the lab. The trip blank is never opened but accompanies sample bottles to and from the field site. Travel/trip blanks are used to detect potential sample contamination during storage and transport.

    - A duplicate sample is the collection of replicate samples from one sample site (i.e. two sample containers filled in rapid succession at the same sampling depth). Duplicate samples are used to check within-site variation, and the precision of field sampling methods and laboratory analysis.
  - The location where the field blank or duplicate sample is collected will be randomly chosen and recorded in the field notes.
  - The QC samples will be submitted blind to the laboratory for analysis with the other samples.

Office-based QA and QC procedures include the following:

- For field data:
  - Calculation of the percent error between the known calibration standard values and the end-of-day checks, as outlined in the equation below; percent errors greater than 5% represent a notable drift in pH or specific conductivity.
    - $Percent\ error = \left|\frac{end-of-day\ check\ measurement\ - calibration\ solution\ value}{calibration\ solution\ value}\right| \times 100\%$
  - If percent differences are notable, further evaluation of the field data will be conducted to determine if any data should be invalidated (i.e., compare field data against historical and laboratory data).
  - Completion of a 10% review of all field data entries to check for accuracy, completeness, and correct units.
- For laboratory data:
  - Field and travel blank data review for detectable results; detectable results are considered notable if they are more than five times greater than the detection limit.
  - Calculation of the relative percent difference (RPD) between duplicate samples, as outlined below; RPD are considered notable if they are greater than 20%.
    - $RPD = \frac{(Maximum\ Concentration)-(Minimum\ Concentration)}{(Average\ of\ the\ Maximum\ and\ Minimum\ Concentrations)} \times 100\%$
  - Laboratory data check for completeness (i.e., all parameters are analyzed with the correct methods and correct units).
  - Confirmation that parameter hold times were met and the correct detection limits were used.
- For reporting:
  - Completion of a 10% check of all data entered or imported and if errors are identified, complete a check of all data entered and imported.
  - Review of plots of logged data to check for anomalous data and drift in calibration.
  - Confirmation that assumptions for statistical analyses are met.
  - Verification of analytical results (e.g., calculations and plots) by personnel not involved in the original analyses.

4.0 HEALTH AND SAFETY

A health and safety plan will be prepared prior to any site visit. Upon arriving at each monitoring location, the field crew will first assess the site conditions from a health and safety perspective. A hazard assessment will be completed prior to starting any field work. All field crew members involved in the sampling program will have the proper personal protection equipment (PPE) and training appropriate for the sampling tasks.

Throughout the monitoring program, a line of communication will be established and maintained between the field and office/management personnel. In the event of any safety concern, work will be stopped, the hazards assessed, and the crew and management engaged. The safety of the crew is paramount and will not be compromised during the data collection.

While working on or near open water, the field crew will be continually aware of changing weather conditions and the time of day. If foul weather or darkness threatens visibility or may impact the field crew’s ability to make their way to a point of safety, work will be terminated immediately.

Signature Page

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APPENDIX F

Fire Prevention Plan

FIRE
PREVENTION
AND
PROCEDURES
PROGRAM

Premier
Horticulture

FIRE PREVENTION AND PROCEDURES PROGRAM

PREMIER HORTICULTURE POLICIES

Fires are a real threat to our lives and our possessions, and can also compromise the continuation of operations.

During the course of its activities, Premier Horticulture's main goal is to reduce such losses. To achieve that, the plant manager has the responsibility of ensuring the protection of the company's goods of which he is in charge, through an adequate and timely maintenance of the equipment. Team members are expected to use safe working methods, in accordance with the company's rules and also contribute to the implementation of a disaster free environment.

GOODS PRESERVATION PROGRAM

Every establishment has to implement a fire prevention program that shall meet the minimal policies and standards for fire prevention.

The program will include the following:

I. Emergency response team page 3
II. Techniques to fight minor fires page 5
III. Fire prevention and protection measures page 9
IV. Instructions in case of fire protection systems interruption page 16
V. Fire prevention appraisal page 19
VI. Appendixes page 20

RESPONSIBILITY

The supervisor of each establishment is in charge of the "Fire Prevention and Procedures Program" implementation so that:

- All personnel receive adequate information and training once a year.
- Quarterly informal tool box/tail gate meetings take place and include this program as one of the main subjects up for discussion.
- Suitable check-up and maintenance programs are instated.
  - Strict monthly inspection;
  - Preventive maintenance program;
  - Cleaning of equipment;
  - Check-up and control of fire fighting equipment (water tanks, barrels, extinguishers, etc.).
- An investigation is done rapidly and appropriate corrective measures are taken in case of losses due to fire, explosion, natural disaster or electrical failure:
  - An investigation must be do;
  - An incident report must be filled out (appendix 3);
  - Recommendations must be written;
  - Corrective measures must be taken;
  - A follow-up report must be subsequently issued.
- In each plant, an appropriate person is designated as responsible for the coordination of the fire prevention initiatives put forward by the location.

I. EMERGENCY RESPONSE TEAM

THE TEAM

In each establishment, there must be team members ready to intervene in emergency situation, properly trained to use fire fighting equipment so to be able to control the situation until the public fire service arrive and take over.

The safety of team members is essential: it is very important to keep in mind that this team is not one of professional firefighters.

THE TEAM MEMBERS

The emergency response team will be made of the establishment's personnel trained for specific tasks as follows:

⇒ **A leader:** an individual who leads the emergency measures and supervise the evacuation.

This person must have the following qualifications:

- Knowledge of the building, its accesses and emergency exits, as well as of the emergency escape route that team members and visitors must follow.
- Knowledge of the responsibilities and tasks of the other emergency response teams.
- Knowledge of the functioning and maintenance procedures of the fire extinguishers and emergency equipment.
- Have in his possession all the master keys that give access to all the establishment's premises.
- Knowledge of the peat procedures and related risks.

⇒ **An emergency caller:** an individual who's duty is to call the fire department, police and all other qualified authorities ⇨ **911**.

This person must have the following qualifications:

- The capacity to contact the fire department and make a brief but exact summary of the fire's nature, origin and location.

- ⇒ **A sprinkler system operator (if applicable):** an individual who's duties are to make sure that the sprinkler system's gate stays open through the fire and that it is closed at the leader or the fire department chief's request only.

- ⇒ **A fire engine operator (if applicable):** an individual who's duties include to check-up the automatic fire engine or to turn on the manual fire engine and make sure it works properly until the leader or the fire department chief's request to turn it off.

II. TECHNIQUES TO FIGHT MINOR FIRES

Note: **Always keep in mind that smoke coming out of fire may be toxic, so be very careful about fumes.**

When a fire is noticed:

- Remain calm.
- Evaluate the situation, in order to determine:
    - The scope of the fire;
    - The kind of fire (electrical, flammable liquid, peat, gas, etc.);
    - The possibility of fighting the fire with a fire extinguisher;
    - Explosion hazards;
    - Toxic fumes;
    - Available help and resources.
- Evacuate the hazardous area by applying the "Emergency Action Plan".

If firefighters are necessary:

- Designate someone to go to the entrance of the site, in order to lead the rescue team.
- Introduce yourself to the fire brigade's chief on his arrival and give him as much details as possible on the situation. The important details are:
    - The origin of the fire (electricity, overheating, welding sparks, etc.);
    - Missing people, and their possible location;
    - Explosion hazards (ex: gas lines);
    - If electrical power has been cut or not;
    - Time the fire started;
    - Water supply;
    - Available resources (man and material).
- Follow his instructions.
- Once the fire is completely extinguished, designate someone to maintain a continuous fire watch for a minimum of 12 hours, including break and lunch time, and that will be maintained until there is no risk remaining.
- Fill in an incident report as soon as possible, and forward it to the Plant Director and the Health and Safety Team.

BUILDING FIRE

- Evacuate the building.
- Call the fire department ⇨ **911**.
- If the situation seems to be safe, cut the electrical power of the equipment and/or building.
- If the situation seems to be safe, designate someone to bring potentially explosive containers outside, such as propane, oxygen, acetylene bottles, etc.
- If the situation seems to be safe, try to fight the fire with the available extinguishers and fire equipment.
- If the situation seems to be too dangerous or out of control, wait for the rescue team.
- Do not let anybody get back into the building without the responsible approval.

VEHICLE FIRE

- Call the fire department ⇨ **911**.
- If the situation seems to be safe, try to move the vehicle away from installations and flammable materials (do not get in a burning vehicle).
- If the situation seems to be safe, try to fight the fire with an extinguisher.
- Use water to soak the vehicle's surroundings, to avoid fire spreading, especially in peat bogs. Keep a distance of at least 5 meters (15 ft).

PEAT BOG FIRE

- If the fired area is superior to 1 m^2 (9 ft^2), immediately call the fire department ⇨ **911**.
- Ask for immediate assistance in order to get sufficient staff to fight the fire.
- Use all the people available, with pails, shovels, extinguishers, etc.

- Immediately ask to get equipment on site, such as water wagons, tooth harrows, loaders, shovels, pails, etc.
- Always have your back to the wind to fight the fire.
- Get water onto the fire as soon as possible.
- Dig deeply using the tooth harrow, bring wet peat to the surface around the fire. If the ground is dry and wet peat is deep, use profiler to bring wet peat to the surface.
- Make sure the hose is used properly so to not disperse the flying embers. Adjust the spray so to obtain a fine mist instead of a more powerful spray.
- Use water to soak the surface around the fire to avoid fire spreading.
- Bring in the loader to carefully deposit wet peat on the fire.

PEAT PILE FIRE

- If the fired area is superior to 1 m^2 (9 ft^2) or if the flames are visible, immediately call the fire department ⇨ **911**.
- Make sure that no one opens the burning pile.
- Ask for immediate assistance in order to get sufficient staff to fight the fire.
- Use all the people available, with pails, shovels, extinguishers, rakes, etc.
- Immediately ask to get equipment, such as water wagons, tooth harrows, loaders, shovels, pails, etc. on site.
- Get water onto the fire as soon as possible.
- Dig deeply using the tooth harrow, bring wet peat to the surface around the fire. If the ground is dry and wet peat is deep, use profiler to bring wet peat to the surface.
- Make sure the water hose is used properly so as not to disperse the flying embers. Adjust the spray so to obtain a fine mist instead of a more powerful spray.
- Use water to soak the surface around the fire, in order to avoid fire spreading.
- Slowly rake the peat in order to completely soak the pile.
- On a calm and rainy day, use the loader to spread the pile while other team members mist water on it.

- On any other day, bring in the loader downwind to carefully deposit wet peat on the pile while other team members mist water on it.
- Use the loader carefully, in order not to allow air entries into the pile.

III. FIRE PREVENTION AND PROTECTION MEASURES

It is possible to reduce to the bare minimum the frequency and the severity of fires causing material losses by combining prevention and risk control activities.

Here are the main potentially hazardous activities that have been observed:

- Smoking page 9
- Harvesting Conditions page 10
- Intervention Equipment in Peat Bogs page 10
- Building Maintenance page 11
- Hot Work page 12
- Fire Equipment Inspection page 12
- Flammable Liquids page 13
- Electricity page 13
- Nearby Hazard Protection page 14
- Preventive Maintenance page 14
- Detection/Alarm Systems page 14
- Automatic Protection page 15
- Construction page 15

SMOKING

Smoking is a major cause of fire. However, it is possible to reduce the amount of fires attributed to this particular cause by implementing several hazard prevention techniques:

- Smoking prohibited, or the determining of special areas for team members, clients and visitors must be defined. These areas must be isolated from high-risk areas and be safe.

- Adequate containers (including ashtrays and metallic pails) must be placed in every smoking area.

- The «No Smoking» and «Smoking Permitted» areas must be clearly identified.

- All personnel and visitors must be informed of the company's smoking policy.

HARVESTING CONDITIONS

In order to minimize the fire hazards during harvesting, you have to respect the following safety measures:

- Mobile equipment must be parked facing wind, with a distance of approximately 75 feet between each.
- Make sure that tractors are not side by side during the harvesting, and keep a distance of 30 meters (100 feet) between them.
- Empty the vacuums (2 heads-4 heads) pulled by a tractor so the latter face the wind.
- Empty the self-propelled vacuums (SAM) so that the motor face the wind.

Furthermore, it is imperative to conform to the following harvesting conditions norm (Maximum wind speed for peat harvesting, PN PHL001, appendix 4)

- In case of accident or fire, call **911**.
- Every bog lead hand or foreman must be equipped with an anemometer to measure the speed of the wind.
- During peat harvesting, the bog lead hand or foreman **must measure** the wind velocity every two hours.
- When the wind blows at **25 km/h and over**, the bog lead hand or foreman must check if there is no gusts of more than 45 km/h. **Readings must be taken every 30 minutes**.
- If there are **wind gusts of more than 45 km/h**, peat harvesting operations (vacuum and harrowing) are **suspended** until the speed of the wind reduces below 35 km/h.
- If the **wind blows at 50 km/h** and over, all the operations in peat bogs (vacuum, harrowing, loader, transportation), are **suspended** until the speed of the wind reduces below 35 km/h.

INTERVENTION EQUIPMENT IN PEAT BOGS

The norm concerning intervention equipment in peat bogs must be respected in order to ensure a fast and efficient action at the time of a fire (Intervention equipment to fight fire in a peat bog, PN PHL002, appendix 5)

- 45-gallon barrels and pails must be installed before the beginning of harvesting and maintained full of water during the season. There must be at least 1 barrel per 4 fields.
- On every peat bog, there must be a water pump and a 1000-gallon fire tank per 400-acre parcel of peat bog, located near peat processing.
- Every vacuum and loader must be equipped with a manual pump type water extinguisher.
- Every vacuum must be equipped with a shovel and a pail (cubic foot).
- A 2 by 2 meters (6 X 6 ft) fire proof cloth must be available in every bog foreman's truck.
- At all time, the tank refill pump must be installed close to the water pond or on the tank.
- A water pond, of at least 20 meters (66 ft) long by 2 meters (6 ft) wide at the base and of which wall slope is at least 1 for 1, must be present for every parcel of 500 acres or less of peat bog.
- The water pond must be identified.
- Mobile equipment must be parked facing wind, with a distance of approximately 75 feet between each.

BUILDING MAINTENANCE

Building maintenance is an essential part of any efficient fire prevention program and requires the commitment of all team members. To this end, the following key elements must be adopted:

- Regular and systematic removal of waste.
- During production activity, sweeping and cleaning of floors done constantly.
- Removal of all dust accumulation on equipment, conveyors and footbridges at least once a week, and if needs to be, according to the accumulation.
- Proper flammable materials handling and storage methods.
- Regular equipment maintenance, in accordance with the manufacturer's recommendations.
- Cleaning of conveyors at the end of the working shift when plant is stopped for more than 4 hours, and no peat must be found then.

- At closing time, a 3 hours surveillance by a designated person, in order to detect problems such as presence of fire, smoke, odors, garbage, combustible waste, pouring or waste of flammable products, etc. of all source liable to ignite.

HOT WORK

Every work involving open flames or generating heat or sparks introduces a potential source of fire in the area. All this hot work must be given close care and attention in order to reduce fire hazards to the minimum, be previously authorized by management by using either Premier Horticulture's form or the Canadian Sphagnum Peat Moss Association's form (appendixes 2 and 3), and follow the very strict rules described hereinafter.

Peat is a product considered as having low flammability because it generally contains a fairly high percentage of moisture. However, experience has shown that, in peat processing plants, there is formation and deposit of peat dust, which, with time, will become very dry and, if disturbed, can mix with air to form a very flammable mixture comparable to solvent vapours or grain dust.

It is therefore important to ensure that such dry dense dust does not come in contact with intense heat sources such as propane or acetylene blowtorch flame, open flame, arc or sparks from electric welding, grinding, cutting, etc. In such situation, a really fast combustion may occur, ignite a fire and cause serious burns.

Consequently, it is **strictly forbidden to smoke** in a peat plant. Furthermore, welding, open flame, etc. will be used in plants only when absolutely necessary. Whenever possible, the part to be repaired should be disassembled, removed from the plant and repaired in the garage.

Whenever it is necessary to use open flame or intense heat in a peat processing building, it will be done only through the area supervisor who will give a written authorization in order to carry out the appropriate procedure, and insure its strict adherence as outlined in the "MARSH Hot Work Permit" (revised January 2002).

FIRE EQUIPMENT INSPECTION

- Monthly inspection (extinguishers, water pumps, etc.). At all time, the equipment must be ready to be used, located in the appropriate place and easily accessible.

- Regular start up (water pump, engine), at least once a month.

FLAMMABLE LIQUIDS

Flammable liquids are a major fire hazard. Once ignited, they can provoke intense fires that spread rapidly and often get out of control. Safe handling and storage of flammable liquids can significantly reduce the frequency and severity of fires.

- Passive protection equipment (safety containers, ground belts, safety pressure valves, etc.) must be in good condition.
- Small quantities of flammable liquids must be stored in a safety cabinet. Otherwise, storage of flammable liquids must be done in a warehouse outside buildings.
- The containers located outside must be equipped with a retention tank that can contain 110% of the container's maximum volume in order to retain any possible pouring (ULC - S653).
- Warehouse must be fire resistant and have a leak containment dyke in order to retain possible pouring. The containment must be able to retain 10% of the authorized container volume or the volume of the biggest of these containers (NFPA – 30).
- The confined areas where flammable liquids are stored must be equipped with adequate natural or mechanical ventilation in order to eliminate concentration of flammable vapors.

ELECTRICITY

Proper use of electricity is vital for any company. Ignoring this reality is the most frequent and costly cause of fire.

- The basic protection devices, such as fuses, circuit breakers, overload relays, ground protection relays and differential relays must be provided when needed.
- A steady and documented preventive maintenance program must be made for the electrical equipment. The manufacturer's recommendations must be followed.
- The infrared scanning of equipment will be done by qualified technicians. The frequency of infrared scanning will be based on results obtained during previous tests.
- A reliable and qualified electrician must be available to answer troubleshooting calls.
- A biennial inspection must be done by a certified master electrician to make sure that installations are in conformity with the "Electrical Installations Inspection Guide for Peat Moss Processing Plants" (Premier Horticulture, January 2001).

In order to prevent building fires that could be initiated by electrical causes, the following rules must be observed:

- Only an electrician or an authorized team member, trained for the changing fuse and the reset procedures, may repair or alter electrical circuits. Replacing light bulbs of up to 100 watts, fluorescents and fuses of 30 amperes or less at 110 volts may, however, be carried out by any team member.
- All damaged electrical circuits showing wires stripped of their insulation will be promptly de-energized and promptly repaired to avoid sparks and fire.
- If a portable light is used on an extension cord in a plant, the fixtures must be a dust proof type.
- Any extension cord used in a plant should be used only temporarily and over a short period, and should be removed from the plant immediately after use.

NEARBY HAZARD PROTECTION

Even though it is not always possible to prevent fires, the following measures must be taken in order to limit hazards:

- Wooden pallets must be stored outside, at least 15 meters (50 ft) away from any building or structure.
- The grass must be cut regularly and no waste should pile up inside and outside buildings.

PREVENTIVE MAINTENANCE

A preventive maintenance program will be developed in order to provide the appropriate functioning of equipment.

DETECTION/ALARM SYSTEMS

The installation of automatic detection systems equipped with an appropriate alarm increases the chances of reducing the consequences of an incident and minimizes its severity.

- Heat and/or smoke detectors must be installed (ex: electrical rooms, plants, etc.).

AUTOMATIC PROTECTION

The installation of automatic sprinklers ensures a better fire protection.

NOTE: *Generally, buildings inside which peat moss operations take place are located in isolated areas, far from cities. Because of this, water supply for automatic sprinkler systems is not often available.*

Protection through automatic sprinklers shall be particularly considered for establishments where high-value goods (added value products) are produced or stored.

CONSTRUCTION

Building architecture and construction materials can have an influence on the severity of a fire.

- New building should be built up with incombustible or fire proof material.
- Multiple-story buildings must be equipped with vertical divisions. The staircases, conveyors and openings must be closed with fireproof materials.
- Openings in main walls and fire proof partition walls must be equipped with fire proof doors to prevent fire spreading.

IV. INSTRUCTIONS IN CASE OF FIRE PROTECTION SYSTEMS INTERRUPTION

SCOPE

The following procedures must be applied to all automatic fire protection system interruptions (sprinklers, heat detectors, etc.).

DEFINITION

An «interruption» is a situation when the fire protection systems (sprinklers, alarms, etc.) have been shut down or put out of order, entirely or partially, whatever the reason or duration.

Types of interruption:

- **URGENT** – happens when an incident interrupts partially or totally the efficiency of a protection system. For example, the interruption of a sprinkler system to repair a melted down part.
- **PLANNED** – happens when the interruption of the protection system is planned. For example, the interruption of a sprinkler system to add new sprinklers.
- **HIDDEN** – happens when the system is interrupted or put out of order without the personnel in charge knowing it. For example, when a system is put out of order and no indication to that effect is detected.

It is important to draw up a telephone list of the contractors who have the necessary equipment to deal with emergency repairs and who are willing to do so 24 hours a day.

PROCEDURES TO FOLLOW DURING AN INTERRUPTION

- Immediately inform the establishment's management so that they can take imperative temporary protection measures.

- Start the repair work as soon as possible and do not interrupt the repair work until all done.
- Inform the public fire department of the protection system interruption so that:
    - They will be ready to intervene in case of a fire;
    - They will be able to use fire trucks, water tanks and/or fire hoses to temporarily supply water to sprinklers.
- Divide the tasks and take all the necessary actions in advance so that all personnel, materials and tools are ready when protection is interrupted, so that the work can be done without delays. Otherwise, like in the case of important repairs to a building, put the system back on at the end of every working day.
- In order to maintain the most sprinklers in function and to use all the water supply available, use as much as possible isolation valves instead of main valves.
- Do a briefing with the managers of buildings and/or areas where fire protection has been interrupted. They will make a brief inspection of the area in order to detect and correct any unsatisfying maintenance, storage or risky conditions.
- Interrupt all hazardous production or maintenance activities until the protection system is back on. Metal cutting, welding or any other kind of hot work must be forbidden in all the areas where protection is interrupted. The use of flammable liquids, spray painting or brush painting, etc. must be restricted in all these areas.
- As much as possible, remove all flammable materials from the unprotected area and move it away, in a protected area.
- Reinforce the « No Smoking » policy in all unprotected area.
- When the sprinkler and/or alarm system is out of order, a surveillance must be done 24 hours a day.

RESTORING THE SYSTEM

When the repairs to the protection system are done, the following measures must be taken and checked by a management's representative or a contractor:

- Sprinklers:
    - Turn back on and lock all valves that have been turned off or restore the protection system;
    - Do emptying tests on the sprinkler systems that were out of order;
    - If the system has suffered important damages due to broken parts, frost or leaking pipes, a hydrostatic test must be done in order to ensure that the system will do fine when pressurized;
    - Immediately inform the public fire department and any other person who was informed of the system's interruption that the protection has been restored;
    - Refill to its full capacity all the water wagons and/or containers that were out of order and check if the heating system is in working condition;
    - Put back on « automatic » the fire pumps that were out of order.

- Alarm systems:
    - Carry out alarm tests;
    - Inform the head office and the organization in charge of the alarm service (ex..: Microtec). If need be, ask for the immediate restoring of the system and ensure that it is done.

V. FIRE PREVENTION SELF-APPRAISAL

INTRODUCTION

The person in charge of the Health and Safety Department will be responsible for the inspection and will have to:

- Know the establishment and be familiar with maintenance methods and test procedures.
- Know the "Fire Prevention and Procedures Program".
- Know the dangers and protection systems existing in the area.
- Know the fire equipment as well as inspection and verification techniques needed to do an efficient inspection of this equipment.
- Know the equipment and security system as well as their verification methods.

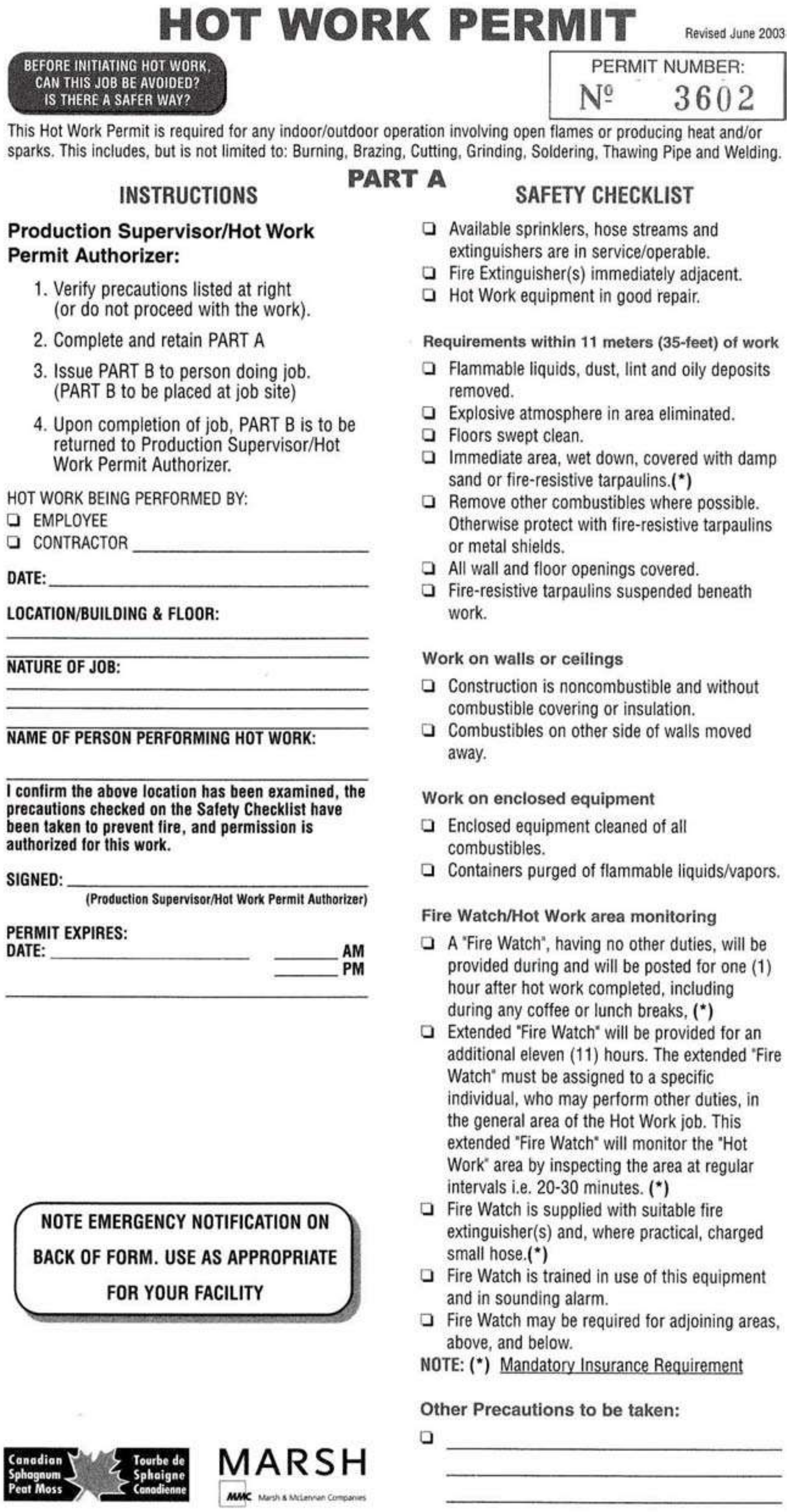
APPENDIXES

Hot work permit MARSH

Accident analysis report

Maximum wind speed for peat harvesting

Intervention equipment to fight fire in peat bogs



HOT WORK PERMIT

Revised June 2003

BEFORE INITIATING HOT WORK, CAN THIS JOB BE AVOIDED? IS THERE A SAFER WAY?

PERMIT NUMBER:
Nº 3602

This Hot Work Permit is required for any indoor/outdoor operation involving open flames or producing heat and/or sparks. This includes, but is not limited to: Burning, Brazing, Cutting, Grinding, Soldering, Thawing Pipe and Welding.

PART A

INSTRUCTIONS

Production Supervisor/Hot Work Permit Authorizer:

1. Verify precautions listed at right (or do not proceed with the work).
2. Complete and retain PART A
3. Issue PART B to person doing job. (PART B to be placed at job site)
4. Upon completion of job, PART B is to be returned to Production Supervisor/Hot Work Permit Authorizer.

HOT WORK BEING PERFORMED BY:

☐ EMPLOYEE

☐ CONTRACTOR ______________________

DATE: ______________________

LOCATION/BUILDING & FLOOR:

____

____

NATURE OF JOB:

____

____

NAME OF PERSON PERFORMING HOT WORK:

____

I confirm the above location has been examined, the precautions checked on the Safety Checklist have been taken to prevent fire, and permission is authorized for this work.

SIGNED: ______________________

(Production Supervisor/Hot Work Permit Authorizer)

PERMIT EXPIRES:

DATE: ________________ ______ **AM**

______ **PM**

____

NOTE EMERGENCY NOTIFICATION ON BACK OF FORM. USE AS APPROPRIATE FOR YOUR FACILITY

SAFETY CHECKLIST

☐ Available sprinklers, hose streams and extinguishers are in service/operable.

☐ Fire Extinguisher(s) immediately adjacent.

☐ Hot Work equipment in good repair.

Requirements within 11 meters (35-feet) of work

☐ Flammable liquids, dust, lint and oily deposits removed.

☐ Explosive atmosphere in area eliminated.

☐ Floors swept clean.

☐ Immediate area, wet down, covered with damp sand or fire-resistive tarpaulins.**(*)**

☐ Remove other combustibles where possible. Otherwise protect with fire-resistive tarpaulins or metal shields.

☐ All wall and floor openings covered.

☐ Fire-resistive tarpaulins suspended beneath work.

Work on walls or ceilings

☐ Construction is noncombustible and without combustible covering or insulation.

☐ Combustibles on other side of walls moved away.

Work on enclosed equipment

☐ Enclosed equipment cleaned of all combustibles.

☐ Containers purged of flammable liquids/vapors.

Fire Watch/Hot Work area monitoring

☐ A "Fire Watch", having no other duties, will be provided during and will be posted for one (1) hour after hot work completed, including during any coffee or lunch breaks, **(*)**

☐ Extended "Fire Watch" will be provided for an additional eleven (11) hours. The extended "Fire Watch" must be assigned to a specific individual, who may perform other duties, in the general area of the Hot Work job. This extended "Fire Watch" will monitor the "Hot Work" area by inspecting the area at regular intervals i.e. 20-30 minutes. **(*)**

☐ Fire Watch is supplied with suitable fire extinguisher(s) and, where practical, charged small hose.**(*)**

☐ Fire Watch is trained in use of this equipment and in sounding alarm.

☐ Fire Watch may be required for adjoining areas, above, and below.

NOTE: (*) Mandatory Insurance Requirement

Other Precautions to be taken:

☐ ______________________

____

____

Canadian Sphagnum Peat Moss · Tourbe de Sphaigne Canadienne

MARSH
MMC Marsh & McLennan Companies

Premier Tech

ACCIDENT ANALYSIS REPORT

Injury ☐ **Prevention** ☐ **Material Damage** ☐

Name : ______________________

Date of Birth : YYYY / MM / DD

Address : ______________________

Phone: ______________________

Team member number : ______________________

S.I.N. : ______________________

Place of accident : ______________________

Occupation : ______________________

Status : ____________ **(Code see over)**

Shift : ☐ day ☐ evening ☐ night

Date of accident : YYYY / MM / DD

With company since : ______________________

Time of accident : H H / M M ☐ **am** ☐ **pm**

Incurrent position since : ______________________

Date of work stoppage : YYYY / MM / DD

Time of work stoppage : H H / M M ☐ **am** ☐ **pm**

Body part (s) affected : ______________________

Type of Injury : ______________________

Description and comments about the accident by the injured person

____

____

____

____

____

____

Injured Worker's Signature **Witness's Signature (if applicable)**

Cause of the Accident	**Explanations**
☐ **Individual Protection Equipment**	
☐ **Unsafe Behaviour**	
☐ **Needs of Training**	
☐ **Failure to follow Safety Act and Rules**	
☐ **Work Environment (lighting, noise)**	
☐ **Others**	

Signatures

Manager **Safety Representative**

First-Aid Worker (if applicable)

Date : ______________________

CAUSES OF THE ACCIDENT

1. **What first caused the accident?**

2. **Why? (as regard to your response to the question 1)**

3. **Why? (as regard to your response to the question 2)**

4. **Why? (as regard to your response to the question 3)**

5. **Why? (as regard to your response to the question 4)**

The source(s) of the accident:

Corrective measures:

Person Responsible for Follow-Up: ______________________________

Deadline: ____________________

ACCIDENT PROCEDURES

All injuries, even minor ones, must be reported to a supervisor and recorded in an injuries/treatment register.

In case of serious injuries :

- Stay calm.
- Inform the first aid worker and the supervisor.
- Call an ambulance at this number 911 or send someone to call for one (use the nearest phone) and make sure there is someone at the entrance of the site to guide the ambulance.
- Do not move the injured person to avoid aggravating the injury, except if the injured person is in danger.
- Calm and reassure the injured person.
- Unbutton the shirt, open the collar and unfasten the belt, and cover the injured person with a blanket.
- Avoid the gathering to close around the injured person.

TEAM MEMBER STATUS

CODE	STATUS
1	**Regular Full Time (37.5 or 40 h)**
2	**Regular Part Time (less than 37.5h)**
3	**Under Contract**
4	**Seasonal**
5	**Probation**
6	**Student (Internship or summer job)**
7	**Others**

PRODUCTION NORM

Title:	I. MAXIMUM WIND SPEED FOR PEAT HARVESTING		**Page:** 1/1
Norm Number:	PHL-PR-NO-001e1	**Division:**	Premier Horticulture
Writing Date:	02-06-04	**Written by:**	Claude Samson
Revision Date :		**Signed:**	

1. In case of accident or fire, call **911**.
2. Every bog lead hand or foreman must be equipped with an anemometer to measure the speed of the wind.
3. During peat harvesting, the bog lead hand or foreman **must measure** the wind velocity every two hours.
4. When the wind blows at **25 km/h and over**, the bog lead hand or foreman must check if there is no gusts of more than 45 km/h. **Readings must be taken every 30 minutes**.
5. If there are **wind gusts of more than 45 km/h**, peat harvesting operations (vacuum and harrowing) are **suspended** until the speed of the wind reduces below 35 km/h.
6. If the **wind blows at 50 km/h** and over, all the operations in peat bogs (vacuum, harrowing, loader, transportation), are **suspended** until the speed of the wind reduces below 35 km/h.

PRODUCTION NORM

Title:	**I. INTERVENTION EQUIPMENT TO FIGHT FIRE IN PEAT BOGS**		**Page:** 1/1
Norm number:	PHL-HS-NO-001e1	**Division :**	Premier Horticulture
Writing date:	02-06-04	**Written by:**	Claude Samson
Revision date:		**Signed:**	

1. 45-gallon barrels and pails must be installed before the beginning of harvesting and maintained full of water during the season. There must be at least 1 barrel per 4 fields.
2. On every peat bog, there must be a water pump and a 1000-gallon fire tank per 400-acre parcel of peat bog, located near peat processing.
3. Every vacuum and loader must be equipped with a manual pump type water extinguisher.
4. Every vacuum must be equipped with a shovel and a pail (cubic feet)
5. A 2 by 2 meters (6 X 6 ft) fire proof cloth must be available in every bog foreman’s truck.
6. At all time, the tank refill pump must be installed close to the water pond or on the tank.
7. A water pond, of at least 20 meters (66 ft) long by 2 meters (6 ft) wide at the base and of which wall slope is at least 1 for 1, must be present for every parcel of 500 acres or less of peat bog.
8. The water pond must be identified.
9. Mobile equipment must be parked facing wind, with a distance of approximately 75 feet between each.

APPENDIX G

Aquatic Invasive Species Decontamination Plan

Aquatic Invasive Species Decontamination (Whirling Disease)

Decontamination requirements for Aquatic Invasive Species (AIS) are based on Risk Zones outlined by Alberta Environment and Parks (AEP) and have different levels of decontamination based on the area where work is occurring (AEP 2020c). The approach is designed to minimize the risk of spreading Whirling Disease and other Aquatic Invasive Species by removing and/or killing infectious agents on all equipment and gear.

Risk Zones in Alberta are identified on the Decontamination Risk Map prepared by Alberta Environment and Parks available at https://open.alberta.ca/publications/whirling-disease-decontamination-risk-zone-map. The risk zones in the province are as follows:

- Red Zone: confirmed presence of whirling disease, aquatic invasive species (AIS), and/or other fish disease.
- Yellow Zone: high risk for introduction or spread of AIS and fish disease due to one or more of the following criteria: whirling disease susceptible species, high recreational use and access to water, and high population base.
- White Zone: does not have any species susceptible to whirling disease, has no confirmed high profile AIS or whirling disease and represents lower risk due to lower population base and less activity or use.

All work locations outside of Alberta are considered to be White Zones for the purposes of decontamination requirements.

The decontamination protocols listed in Table G-1 are categorized based on the risk zone in which the work is taking place and are described below. The Project falls within the highest risk zone in the province (i.e., Red Zone), with confirmed instances of Whirling Disease in the Clearwater River watershed; as such, decontamination procedures will follow Levels 1 through 3.

Table G-1: Risk Zone Decontamination Requirements

White Zone	Yellow Zone	Red Zone
Level 1 (stream-side) Clean, Drain, Dry	Level 1 (stream-side) Clean, Drain, Dry	Level 1 (stream-side) Clean, Drain, Dry
	Level 2 (stream-side or off site) Clean, QUAT, Rinse, Dry	Level 2 (stream-side) Clean, QUAT, Rinse, Dry
		Level 3 (off site) Hot Water Treatment Secondary QUAT Treatment Dry

For Level 1 decontamination, the following mitigation procedures will be implemented by all Premier Tech/Contractor(s) who will be in contact with the water, sediment, or biota below the high water mark in water bodies, watercourses, or wetlands on the Project site:

- All equipment and gear that has been in contact with water, sediment, and/or aquatic organisms will be decontaminated including clothing, footwear, tools, boats, heavy equipment, vehicles, pumps, hoses, and all other equipment or gear that may have been in contact with water, sediment, or aquatic organisms.

- The use of equipment or materials that may be difficult to decontaminate (e.g., wood, leather, felt, Styrofoam) will be avoided and equipment which may be sensitive to the decontamination processes (e.g., rubber items being exposed to hot water) will be recognized.
- All equipment will be inspected prior to and after each use and remove any plant, mud, and other organic debris. Special attention will be taken to inspect hidden or difficult to reach areas on equipment where organic material accumulates.
- After use, gear will be cleaned and rinsed on site using native water. For small items, a small nylon bristle-scrub brush (no wood), can be used to aid in the removal of organic debris or biological material. Large equipment must be cleaned with a long-handled nylon scrub brush.
- All spaces or items that can hold water on site will be drained. Factory guidelines will be followed for eliminating water from engines. The motor should be lowered prior to leaving the body of water to properly ensure all water is drained after each use. The drain plug should be removed from boats and put the boat on an incline so that the water can drain out.
- Everything will be allowed to completely dry before launching into another body of water for a minimum period of 24 hours.

Once Level 1 decontamination has been completed, the following Level 2 decontamination procedures must be implemented by all Premier Tech/Contractor(s) who will be in contact with the water, sediment, or biota below the high water mark in water bodies, watercourses, or wetlands on the Project site:

- Level 1 decontamination will be completed prior to starting Level 2 decontamination (equipment does not need to be dry between Level 1 and starting Level 2). Equipment taken off-site without Level 2 decontamination must be segregated (contained with garbage bags, coolers, totes, etc.) to prevent cross contamination until the decontamination is completed.
- If Level 2 decontamination is being completed on site, the Quaternary Ammonium Compounds Treatment (QUAT) solution will be stored and used at least 30 m away from the water body or watercourse.
- Submersible items will be immersed in a 1,500 ppm QUAT solution such that all surfaces which may have been in contact with potentially contaminated water, mud, fish, or biological material are submerged for 10 minutes. Care must be taken to ensure that any porous materials that may have absorbed potentially contaminated water are thoroughly soaked and physically agitated while submerged.
- Non-submersible items where surfaces have been in contact with potentially contaminated water can be surface disinfected by thoroughly wiping wetted surfaces with heavy-duty paper towel which has been soaked in a 3,000 ppm QUAT solution, or by using a hand-pump sprayer. Surfaces must be kept damp for 10 minutes. Any disposable items used for this purpose must be double bagged until disposal in a safe location away from water.
- A 1500 ppm solution of QUAT disinfectant will be applied to equipment that can be sprayed down but not submerged (i.e., heavy equipment, vehicles, pumps, etc.), with special attention to areas that will not be exposed to direct sunlight. The QUAT solution can be applied using pump-up sprayers which are labelled specifically for use with chlorine or other disinfectants. The solution should be liberally sprayed on all surfaces on all sides, keeping surfaces moist for 10 minutes.
- Following QUAT treatment, small items will be rinsed in a container containing clean water; native water may not be used. Gear that was wiped or sprayed with QUAT will be wiped down with clean water to remove any QUAT residue. Large equipment which is primarily metal do not need to be rinsed. Equipment can also be sprayed down with clean water from a municipal water line.

- Once treatment and rinse completed, items will be allowed to dry as long as possible (24 hours minimum recommended).
- QUAT solution will not be released (including rinse water) to the water body or watercourse; the containers containing the solution must be transported back to an appropriate location for disposal (e.g., warehouse). QUAT solution must only be poured down drains that lead to a municipal waste water treatment facility; do not allow QUAT solution to enter storm sewer drains.

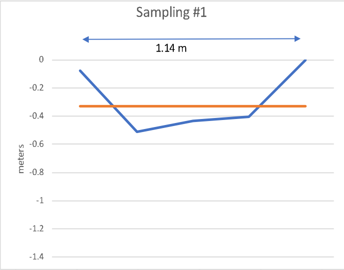
All equipment leaving a Red Zone (AEP 2020c) requires Level 3 decontamination off-site, unless it is staying in the same Red Zone. If equipment was used in a Red Zone, the following Level 3 decontamination procedures must be implemented by all Premier Tech/Contractor(s) who will be in contact with the water, sediment, or biota below the high water mark in water bodies, watercourses, or wetlands on the Project site:

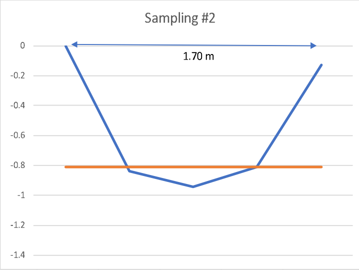
- Level 2 decontamination will be completed prior to starting Level 3 decontamination (equipment does not need to be dry between Level 2 and starting Level 3). Equipment taken off-site without Level 2 decontamination must be segregated (contained with garbage bags, coolers, totes, etc.) to prevent cross contamination until the decontamination is completed.
- First treatment will consist of a hot water wash using water that is at least 90°C for at least 10 minutes. Smaller, submersible equipment should be placed in a hot water bath to decontaminate, whereas larger equipment should be decontaminated using a high-pressure unit that can maintain a continuous application of 90°C. Applied water must be in continuous contact with all surfaces, both external and internal for at least 10 minutes. Equipment to be decontaminated should be evaluated for tolerance to hot water by contacting the distributor or manufacturer prior to treatment. If equipment is sensitive to hot water, this step can be skipped.
- Second treatment will consist of exposure to a QUAT solution for 10 minutes, with the same concentrations and methods described in the Level 2 decontamination. A 1,500 ppm QUAT solution should be used for equipment that can be submerged in the QUAT solution, and a 3,000 ppm QUAT solution should be used for equipment where the solution is applied using a sprayer or wiped on with solution-saturated heavy duty paper towel. Non-submersible equipment should remain damp for at least 10 minutes, with additional focus on parts of the equipment where it is difficult to maintain 90°C water temperatures during the hot water wash. Equipment not subjected to the hot water bath will require 20 minutes of QUAT solution contact to ensure Level 3 decontamination.
- Following QUAT treatment, small items will be rinsed in a container containing clean water. Gear that was wiped or sprayed with QUAT will be wiped down or rinsed with clean water to remove any QUAT residue. Large equipment which is primarily metal do not need to be rinsed. Equipment can also be sprayed down with clean water from a municipal water line.
- Once treatment and rinse are completed, items will be allowed to dry as long as possible (24 hours minimum recommended).
- QUAT solution (including rinse water) will not be allowed to flow into a water body or watercourse. QUAT solution must only be poured down drains that lead to a municipal waste water treatment facility; do not allow QUAT solution to enter storm sewer drains.
- Where feasible, it is recommended keeping equipment typically used in Red Zones (AEP 2020c) separate from equipment used in White or Yellow Zones and avoid using Red Zone equipment outside of Red Zones.

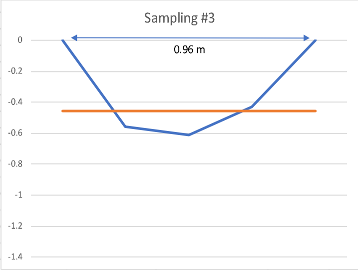
APPENDIX H

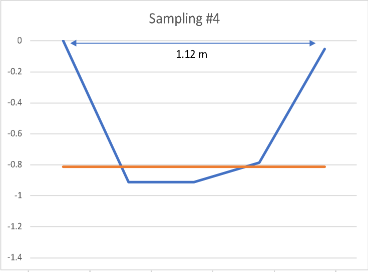
Golder Sampling Locations for the Mud Creek Setback

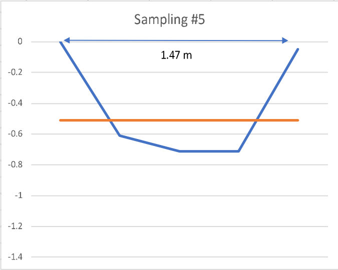
											m/s							
Station #	X	Y	Break points levels relative to 0 (South West to North East along the cross section)					Diameter	Water Depth	Velocity SW	Velocity Center	Velocity NE	Water Level relative to 0 (for graphs)				
1	-114.905555	52.158234	-0.0762	-0.508	-0.4318	-0.4064	0	1.143	0.1778	0.1	0.2	0.1	-0.3302	-0.3302	-0.3302	-0.3302	-0.3302
2	-114.905531	52.155728	0	-0.8382	-0.9398	-0.8128	-0.127	1.7018	0.127	0.3	0.4	0.2	-0.8128	-0.8128	-0.8128	-0.8128	-0.8128
3	-114.900551	52.157877	0	-0.5588	-0.6096	-0.4318	0	0.9652	0.1524	0	0.1	0	-0.4572	-0.4572	-0.4572	-0.4572	-0.4572
4	-114.900202	52.157339	0	-0.9144	-0.9144	-0.7874	-0.0508	1.1176	0.1016	0.2	0.4	0.2	-0.8128	-0.8128	-0.8128	-0.8128	-0.8128
5	-114.898637	52.157957	0	-0.6096	-0.7112	-0.7112	-0.0508	1.4732	0.2032	0	0.1	0.2	-0.508	-0.508	-0.508	-0.508	-0.508
6	-114.89753	52.158121	0	-1.0414	-0.9144	-0.9398	-0.381	2.4384	0.2794	0.5	0.5	0.5	-0.762	-0.762	-0.762	-0.762	-0.762
7	-114.888259	52.152997	-0.1016	-0.9652	-1.0668	-0.9652	0	1.8288	0.2794	0.2	0.4	0.1	-0.7874	-0.7874	-0.7874	-0.7874	-0.7874
8	-114.88268	52.154431	-0.0254	-1.0922	-1.2446	-1.27	0	1.524	1.016	0	0.2	0.1	-0.254	-0.254	-0.254	-0.254	-0.254
9	-114.881687	52.154644	0	-1.143	-1.1684	-1.2192	-0.0508	2.4384	1.016	0.1	0.2	0.1	-0.2032	-0.2032	-0.2032	-0.2032	-0.2032

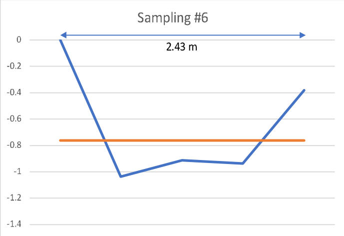


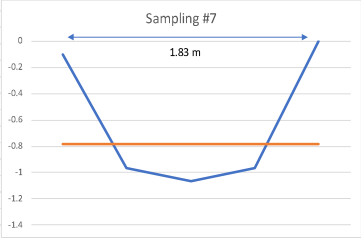


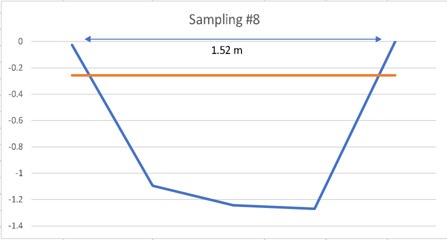


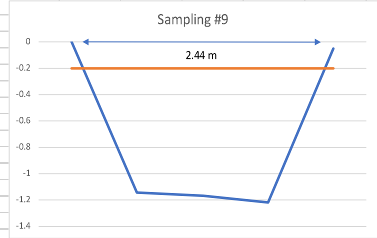












Orange line = water level

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