



Wetland Assessment Report
Montague Gold Mines, Nova Scotia
Final Report

Project #: TV183013

May 2021

Prepared for:

Intrinsik Corporation on Behalf of Nova Scotia Lands

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Prepared by:

Wood Environment & Infrastructure Solutions,
a Division of Wood Canada Limited
50 Troop Avenue, Unit 300
Dartmouth, Nova Scotia B3B 1Z1
Canada
T: (902) 468-2848

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GLOSSARY OF TERMS

DFO	Fisheries and Oceans Canada
ESA	Environmental Site Assessment
GPS	Global Positioning System
ha	hectares
m	metres
masl	metres above sea level
NS	Nova Scotia
PSPC	Public Services and Procurement Canada
WAM	Wet Areas Mapping
WESP-AC	Wetland Ecosystem Services Protocol for Atlantic Canada
Wood	Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited

TABLE OF CONTENTS

1.0 INTRODUCTION	1
1.1 PURPOSE	1
2.0 METHODS.....	2
2.1 APPROACH.....	2
2.2 BACKGROUND REVIEW	2
2.3 WETLAND FIELD SURVEY	3
2.3.1 Wetland Delineation	4
2.3.2 Wetland Functional Assessment	4
3.0 RESULTS	6
3.1 AREA 1.....	7
3.1.1 Site specific Observations	8
3.2 AREA 3.....	11
3.2.1 Site Specific Observations.....	12
3.3 AREA 4 (INCLUDING BARRY’S RUN)	14
3.3.1 Site Specific Observations.....	15
3.4 DRAINAGE	17
3.5 SIGNIFICANT WETLAND FEATURES	19
3.6 WATER QUALITY RESULTS	20
3.7 WETLAND FUNCTIONS.....	21
3.7.1 Location Specific Benefits	23
3.8 DISCUSSION OF WETLAND HEALTH AND SENSITIVITY	23
3.8.1 Health and Health-Risk.....	23
3.8.2 Sensitivity	25
4.0 CONCLUSIONS	27
4.1 NEXT STEPS	28
5.0 REFERENCES	30

LIST OF TABLES

Table 2-1:	Wetland Function Parameters.....	5
Table 3-1:	Wetland Conditions in Area 1	9
Table 3-2:	Wetland Conditions in Area 3	13
Table 3-3:	Wetland Conditions in Area 4 (Barry's Run).....	16
Table 3-4:	Summary of Wetland Functional Assessment.....	22
Table 4-1:	Wetland Assessment Summary.....	27

LIST OF APPENDICES

Appendix A	Figures
Appendix B	Functional Assessment Summary Tables
Appendix C	Site Photos

1.0 INTRODUCTION

Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited (Wood) was retained by Intrinsik Corporation (Intrinsik), on behalf of Nova Scotia Lands Inc. (a Crown Corporation), to complete wetland assessments, including boundary delineation and functional assessments for wetlands potentially impacted by historic mining activity in Montague Gold Mines, Nova Scotia (Figures 1 to 4 in Appendix A). This work was supported by a desktop study and reconnaissance survey conducted in Fall 2019 (Wood, 2020a). Summer surveys in 2020 provided the additional information needed to assess wetland functions and confirm wetland boundaries in the field.

Historic gold mining activities have left a legacy of contaminated mine tailings and associated water quality impacts in and adjacent to wetlands and watercourses. As part of ongoing planning (lead by Intrinsik) for the remediation of identified contaminated areas, an assessment of potential impacts on wetlands was conducted. Wood has reviewed results of numerous supplementary surveys (water quality, risk assessment, etc.) conducted by Study Team partners (composed of Intrinsik, Wood, EcoMetrix, and Klohn Crippen Berger) in 2019 and 2020 and conducted summer field surveys of selected wetland areas on Crown and Municipal Land (and land owned by Halifax Water). This report provides an assessment of identified wetlands in the context of potential remediation of contaminated historic mine tailings.

1.1 Purpose

The purpose of the wetland assessment is to respond to two basic information needs required to support decision making by NS Lands in regard to the need for remediation and selection of the most appropriate site management options, including:

- What is the condition and sensitivity of wetlands which will be directly impacted by the current conceptual remediation plans (either through removal of tailings and consolidation in a containment cell; or, through use of a geomembrane/capping approach, which would cover the wetland); and
- What is the condition and sensitivity of wetlands nearby and down gradient within the historic zone of mining related impacts and will they be affected by remediation activities; particularly, are they currently "significantly impacted", "in recovery", or "healthy".

This information will be used by the Study Team to develop reasonable objectives for final site condition in each wetland and to refine the remediation plan and footprint. For example, where a wetland is found to contain contaminated material, a risk assessment would evaluate exposure of the biological environment. If the risks are considered relatively low in the context of identified sensitivities, then a monitor and recovery approach may be acceptable when compared with the potential effects of physical remediation.

The assessment results can also be used in the preparation of environmental permits that may be required related to physical activities, associated with remediation planning and implementation, in the wetlands.

2.0 METHODS

2.1 Approach

The Study Area and the wetlands selected for assessment were developed in discussion with the Study Team and based on the currently proposed conceptual remediation plan footprint. The Study Area is divided into four parts, Areas 1, 2, 3, and 4 (Figure 1, Appendix A). Wood reviewed available data and a reconnaissance field program was developed for selected wetlands, followed by a detailed assessment (Figures 1 to 4 in Appendix A).

The desktop analysis was presented in a reconnaissance survey report (Wood, 2020a) in late fall of 2019 in order to collect essential site-specific observations and meet the winter/spring project planning schedule. This approach was intended to provide a basic understanding of the wetland areas potentially affected by remediation and to facilitate detailed planning of the 2020 field surveys. The detailed surveys were completed in Areas 1, 3 and 4 in Summer 2020 and included comprehensive vegetation & wildlife surveys and delineation and functional assessment of potentially impacted wetlands.

Area 2 was excluded from the field surveys and functional assessment as it was determined to be a low priority due to the minor (some coarse waste rock) reported impacts. The Area 2 wetland is mainly standing water (aquatic bed/deep marsh) with healthy vegetation. Based on available information, and water/sediment sampling showed relatively low metals concentrations in the main Mitchell's Brook channel; there was no rationale to consider mitigation specifically for the Mitchell's Brook part of the wetland.

2.2 Background Review

Prior to the field survey, aerial photos of the survey area were overlaid with wetlands and streams as shown in provincial mapping, Crown Land areas, and tailings areas as reported in Nova Scotia Lands Inc. (2019). For the reporting, the boundaries of the "Lake Major Protected Water Area" were added. Depth to water table mapping was used to identify areas with an elevated likelihood for presence of wetlands not previously identified in provincial mapping or the desktop review of aerial photos.

In addition to basic mapping, and results of the wetland reconnaissance study (Wood, 2020a), Wood reviewed other ongoing supplementary studies during the assessment. The review included reference to the following documents and map resources:

- NSDLF Significant Species and Habitats Database (Provincial Landscape Viewer);
- Aerial Imagery (Google Earth, and historical photos going back to 1931);
- Topographical Elevation Data (provincial mapping, 1 m interval, imported as .KMZ to Google Earth);
- NSDLF Wet Areas Mapping (WAM)(i.e., depth-to-water-table);
- Selected map resources associated with the Wetland Ecosystem Services Protocol – Atlantic Canada (WESP-AC) evaluation system and supporting files (NBDELG, 2018);
- Species At Risk Data Report (ACCD, 2019); and
- Site condition data reported in recent "Conceptual Closure Plan" final report (Nova Scotia Lands Inc., 2019).
- Human Health Risk Assessment (HHRA) for Barry's Run (Intrinsik, 2020).

- Wetland Reconnaissance Study Report, Montague Gold Mines & Goldenville, Nova Scotia - Draft Report (Wood, 2020a).
- Sediment Quality Data Summary (by Ecometrix), unpublished memo dated May 29, 2020.
- Water Quality Data Summary (by Ecometrix), unpublished memo dated May 29, 2020.
- Site visit summaries from Ecometrix field program (July 23-29, 2020)(Unpublished).
- Phase I Environmental Site Assessment (DRAFT)(Wood, 2020b).

The listed resources were used in combination with field observations to complete the functional assessments and identify risks and sensitivities in each wetland.

2.3 Wetland Field Survey

The wetland field survey was conducted (during the vegetation growing season) to *confirm* wetland conditions on-site including:

- Wetland type and approximate boundary/area, as compared to provincial mapping;
- Apparent surface hydrology (presence of standing water and flow direction);
- Apparent impacts on the wetland, both historic and recent;
- Apparent altered hydrology, such as ditching, barriers, excavations, etc;
- Signs of diminished wetland health or function, caused by legacy mining impacts, may include:
 - o Unvegetated or sparsely vegetated areas;
 - o Dead or dying vegetation;
 - o Reduced species diversity or dominance by one or a few species (such as cattails);
 - o Waste-rock or tailings deposits in the wetland;
 - o Excessive sedimentation, particularly ongoing sediment loading;
 - o Iron stained ground or iron floc/algae in the water;
 - o Dead fish or other wildlife, not obviously from natural causes;
- Signs of wetland uses by people for recreation, subsistence food gathering, or other uses; and
- Incidental wildlife observations, such as tracks, scat, nests, dens, browsed vegetation, migratory birds or mammals present.

The Site was traversed on foot, focussing on the areas adjacent to the core tailings deposits (primarily Areas 1A-1C and 3A-3C) and downgradient for several hundred metres. Access was limited to Crown Land and some municipal land (and land managed by Halifax Water); however, to the extent possible, subject areas on non-Crown land were observed from adjacent Crown Land or public rights-of-way. Wetland functions were assessed using the Wetland Ecosystem Services Protocol for Atlantic Canada (WESP-AC), detailed in Section 2.3.2, below. Field observations were collected as required to complete the field forms. In addition, dominant habitat types and vegetation located within the Study Area were identified and documented. Representative site photos are presented in Appendix C. Notable ecological features such as watercourses, cavity trees, and potential bat hibernacula were recorded, as well as any incidental observations and evidence of fauna.

2.3.1 Wetland Delineation

The wetlands were surveyed by two trained Wetland Delineators: Mr. Garrett Bell (20+ years' experience) and Ms. Elizabeth Robinson (5+ years' experience). The wetland boundary determination was conducted according to the US Army Corps of Engineers wetland delineation method, following the USACE Northcentral and Northeast Regional Supplement guidelines. The wetland determination is based on a three-part test that requires the presence of wetland vegetation (i.e., majority of dominant species must be wetland associated), hydric soil, and signs of wetland hydrology resulting in periods of flooding, ponding, or saturation. Indicators of wetland hydrology considered include water marks, drift lines, sediment deposition, drainage patterns, stained leaves, and visual observation of inundation. Wetland boundaries were delineated during the vegetation growing season. Boundaries were delineated in detail in areas that will likely be subject to ground disturbing activities during remediation planning or implementation. Wetland areas where physical disturbance by remediation efforts are not currently anticipated have been field verified by spot-checking provincially mapped boundaries and aerial photo interpretation was used to refine the mapping where justified by field observations. The field verified wetland locations were recorded using a GPS and Project wetland mapping has been revised accordingly. The survey was restricted to Crown Land, so much of the wetland could not be observed directly. The wetland area outside Crown Land property was determined using available provincial wetland mapping and aerial imagery interpretation.

2.3.2 Wetland Functional Assessment

The functions, benefits, and sensitivity of each wetland was assessed using the Wetland Ecosystem Services Protocol - Atlantic Canada (WESP-AC) wetland evaluation technique. The process involves the completion of three forms; a desktop review of aerial imagery that examines the landscape level conditions within which the wetland is situated, and two field forms. The WESP-AC values system provides a framework for identifying potential high value functions based on available information. WESP-AC defines 17 specific functions that wetlands may provide (Table 2-1), categorized into five grouped wetland functions and evaluated for "Function" and "Benefit". Wetland function relates to inherent properties of a wetland based on physical, chemical, and/or biological processes (e.g., water storage). Functions have potential value to users when opportunity is present, i.e., when the function provides a valuable service to a user that is capable of receiving the value. Wetland benefits reflect the *relative* value of the functions based on site-specific circumstances, which determine how important the function is to the users that are present, and whether that is of ecological, social, or economic importance. For example, the ability to trap sediment is of no value to fish in a wetland without surface water. The highest valued (i.e., most sensitive) wetlands are those that have both high 'Function' and 'Benefit' values for a given function. A functional assessment was completed for each wetland and score sheets are presented in Appendix B.

Table 2-1: Wetland Function Parameters

Grouped Wetland Function	Specific Wetland Functions
Hydrologic Function	Surface Water Storage
Water Quality	Sediment Retention & Stabilization
	Phosphorus Retention
	Nitrate Removal & Retention
	Carbon Sequestration
Aquatic Support	Aquatic Invertebrate Habitat
	Stream Flow Support
	Organic Nutrient Export
	Water Cooling
Aquatic Habitat	Anadromous Fish Habitat
	Resident Fish Habitat
	Waterbird Feeding Habitat
	Waterbird Nesting Habitat
	Amphibian and Turtle Habitat
Transitional Habitat	Songbird, Raptor, & Mammal Habitat
	Pollinator Habitat
	Native Plant Habitat

3.0 RESULTS

Wetland surveys were carried out in Area 1 (A-G) on July 9th & 10th and in Area 3 (A-D) and Barry's Run (Area 4A-D) from September 2nd to 4th, 2020. Observed wetland types and significant features are shown on Figures 1 through 4, in Appendix A. Wetland functional assessment scores are presented in Appendix B. Representative site photos are provided in Appendix C.

The descriptions of wetland areas have been organized according to the Tailings Areas identified by the Study Team in the Conceptual Closure Plan in order to reflect the observed local wetland conditions/impacts relative to the currently proposed remediation methods. In the following sections, the term "Project wetlands" is used to refer to wetlands that will be subject to remediation activities. The term is used conceptually since the precise location and extent of the remediation footprint has not yet been determined.

Field surveys and wetland delineations in the summer of 2020 have confirmed the provincial wetland mapping (presence/absence and area) is considered relatively accurate. The vegetation communities within each wetland are generally much more varied and complex than mapping would indicate. There is also a dimension of evolving recovery within post-disturbance wetland areas such that the current vegetation community may change significantly as natural restoration continues to develop.

The tailings deposits in the impacted wetland areas were observed to be light grey, fine grained, dense or compacted (stamp mill tailings) which were frequently saturated to the surface. The grey colour could interfere with normal wetland delineations and was considered a "problem soil" in the terminology of the US Army Corps delineation methodology (USACE, 2012). Wetlands that have developed on this substrate were delineated based on hydrophytic vegetation and hydrology (acknowledging the "problem soil") as defined in the delineation guidelines. However, it is a highly disturbed form of wetland and not considered "normal". Where the wetland soil is composed largely of fine tailings, the vegetation is low growing (30-60 cm) and herbaceous species are more abundant. In more naturally developed wetland areas, the vegetation is much taller (60 cm – 2.5 m) and woody species are co-dominant with taller herbaceous species.

Stunted vegetation was observed in more severely impacted wetland areas, mainly apparent as low growing woody and herbaceous vegetation (below 1 m height). Around wetland edges there are a few dead and dying trees which is typical in wetlands with variable water levels. Conifer trees with yellowing needles were observed at a few locations but were not wide-spread or concentrated in zones, so these do not appear to be indicative of a site-specific condition. Stunted growth often occurs naturally, particularly in wetlands. For example, high flood levels / prolonged wetness, low nutrient levels in bogs or some mineral soil, compacted soil, thin soil layers, and locations exposed to strong wind often result in stunted vegetation, particularly woody vegetation. These apparent impacts could reflect suboptimal conditions including too much water (trees), compacted soil, lack of nutrients, as well as the possible presence of elevated metals concentrations (mainly arsenic) in the tailings. Recurring disturbances by off-road vehicles also impedes vegetation recovery in some areas.

In more impacted areas associated with dense sand substrate (Area 1A and 3C), the vegetation is predominantly cattails, Canada rush (*Juncus canadensis*), water horsetail (*Equisetum fluviatile*), marsh fern (*Thelypteris palustris*), and scattered stunted alder (*Alnus incana*). During the latter part of the season (September) two herbaceous species became abundant on fine tailings deposits, purple gerardia (*Gerardia*

purpurea) and nodding lady's-tresses (*Spiranthes cernua*), with colourful flowers conspicuous in the low-growing vegetation. It is unknown if there is a chemical component of species dominance on the fine tailings or if it is purely physical characteristics (i.e., openness, compaction, hydrology, etc), but there seems to be a somewhat predictable vegetation pattern on local fine tailings deposits.

The identified riparian wetlands are integral to the health and function of Mitchell's Brook and Flat Barren Brook, contributing water flow moderation (storage, stream flow support, flood attenuation) and water quality benefits (sediment retention, chemical purification, nutrient export, and cooling). Aquatic vegetation supports benthic and fish communities, water bird feeding and nesting, and amphibians and reptiles. Many terrestrial wildlife and avian species (bats, migratory birds, raptors) will use wetland habitats such as these for foraging or breeding (nesting). Many invertebrates, including pollinators, depend on wetlands and aquatic habitats for some part of their lifecycle. There are possible Species at Risk (SAR) present in the Montague Gold Mines wetlands, described further in the following sections. However, no SAR were observed during the field surveys.

Signs of wildlife usage were observed in several wetlands, including a beaver lodge, dam and trails, beaver cut-marks, an old song-bird nest, deer tracks and rabbit pellets. No moose tracks were observed.

Despite warning signs indicating the potentially dangerous nature of the soil/sediments, there were signs of use of certain tailings areas by humans. In particular, the tire tracks and presence of remnants of a campfire in Area 1A and 1C indicate activities that could negatively impact human health. Also, an angling float found in the fen along Barry's Run indicates that angling is taking place either in Barry's Run where sediments have been reported to contain elevated concentrations of arsenic, or further upstream in contributor streams with potentially elevated levels of arsenic from the upstream tailings areas east of the Highway 107. Presence of ATV tracks in and near the wetland at Barry's Run appear to indicate regular use of this area. There are several well-worn trails and improvised foot-bridges near the edges of Barry's Run (Area 4A and 4B).

3.1 Area 1

At Area 1, a mixture of coarse waste rock and fine grain stamp mill tailings has been deposited directly into the riparian wetland associated with Mitchell's Brook, a tributary of the Shubenacadie River, between Loon Lake and Lake Charles. The core deposit remains unvegetated and appears to be an ongoing source of contaminated water and sediment loading that impacts adjacent wetlands and aquatic habitats downstream. The site is surrounded by residential suburbs of Dartmouth and local roadways. There are regular human activities in the wetland areas including recreation trails (vehicles and hiking). Local drainage has been slightly modified by historic mining activity and the main channel flows through the edge of the core tailings deposit (Areas 1A-1D).

Area 1 comprises a single large wetland, approximately 16.5 hectares. Although there are several sub-units (1A through 1G) identified for reference in remediation planning, the overall wetland type is consistent throughout (Figure 1, Appendix A). The overall wetland type is shrub swamp. Predominant species in the less impacted parts of the wetland are speckled alder (*Alnus incana*), meadow sweet (*Spirea alba*), wild rose (*Rosa virginiana*), red maple (*Acer rubra*) and grey birch (*Betula populifolia*) saplings. Herbaceous cover included cattails (*Typha* sp.), royal fern (*Osmunda regalis*), cinnamon fern (*Osmunda cinnamomea*), water horsetail (*Equisetum fluviatile*), multiple common *Juncas* and *Carex* sedges, and blue-joint grass (*Calamagrostis canadensis*) and spreading bent grass (*Agrostis stolonifera*). Overall diversity in the wetland

is relatively low with variation mainly in local abundance of dominant species and size and condition of individuals.

The surrounding upland is uniformly mixed forest with white spruce (*Picea glauca*), red spruce (*Picea rubens*), white pine (*Pinus strobus*), tamarack (*Larix laricina*), white birch (*Betula papyrifera*), yellow birch (*Betula allegheniensis*), red maple, grey birch and heart-leaved birch (*Betula cordifolia*), and a few white ash (*Fraxinus americana*). Upland shrubs include beaked hazelnut (*Corylus cornuta*), low-bush blueberry (*Vaccinium angustifolium*), and service-berry (*Amelanchier* sp.). Herbaceous species include wild sarsaparilla (*Arallia nudicaulis*), bunch-berry (*Cornus canadensis*), bracken fern (*Pteridium aquilinum*), star-flower (*Trientalis borealis*), and false-lilly-of-the-valley (*Maianthemum canadense*). Past timber harvesting and severe blow-down (root-throws) have created areas of open canopy forest with dense understory. Where the forest is more mature, the canopy is closed and the understory and ground cover is sparsely vegetated.

There is a major distinction to be made between the wetland north of the watercourse versus the area south of the watercourse. The majority of the mapped wetland area north of Mitchell's Brook is essentially growing on tailings (sometimes including coarse waste rock). Technically it is wetland based on hydrophytic vegetation, hydrology, and what is considered a "problem soil" as defined in the delineation guidelines. However, it is a highly disturbed form of wetland and not considered "normal". Near to the watercourse and south of the watercourse, the wetland appears to be more natural in its development (i.e., fewer disturbances and "normal" organic soil and more typical vegetation growth pattern).

Where the wetland soil is composed largely of mine tailings, the vegetation is low growing (30-60 cm) and herbaceous species are more abundant. In more naturally developed wetland areas, the vegetation is much taller (60 cm – 2.5 m) and woody species are co-dominant with taller herbaceous species. Most of the non-vegetated tailings areas have been excluded from the wetland delineation. Only where they appeared to be permanently wet but frequently disturbed (suppressing vegetation growth) were they considered part of the wetland.

Table 3-1 summarizes wetland survey observations for Area 1(A to G). The following section provides site specific observations for each sub-unit.

3.1.1 Site specific Observations

Area 1A

The vegetated part of Area 1A that surrounds the core tailings deposit is apparently growing on dense coarse grey sand, with relatively little organic content. Soil pits revealed little soil horizon development and poor root growth, indicating a short term recovery condition. This could be due to recent human activities suppressing recovery (prior to the site being closed for human health concerns), or that some sediment transport is ongoing. The soil condition is likely suboptimal but despite this, vegetation present is apparently composed of native species consistent with local wetland habitats. The low-growing nature may indicate poor soil conditions, which could be improved over time by natural soil development processes. However, the current condition has reduced the relative functional value for habitat due to lower species diversity, and uniform low vegetation structure. The proximity to the adjacent watercourse and other more natural wetland areas within Area 1 impart benefits to the impacted area thus minimizing the overall negative effects. Of particular note, if erosion is still occurring in the core tailings deposit, the vegetated area in 1A will help to reduce sedimentation in the watercourse. In other words, the wetland is impacted here but the negative effects are somewhat mitigated by the nearby presence of higher functioning wetland elements and the impacted wetland itself may be providing significant value to downstream habitats.

Table 3-1: Wetland Conditions in Area 1

Study Area	Land Ownership	Provincial Wetland Map		Observed Wetland		Observed Impacts				Observed Hydrology	Dominant Vegetation Species	Species At Risk Present	Special Features
		Wetland Type	Vegetation	Wetland Type	Vegetation	Waste Rock	Sediment	Supressed Vegetation	Non-vegetated				
1A	Crown	NA	NA	Marsh	Graminoid	x	x	x	x	Large watercourse (WC) flow-through, ephemeral tributaries	Marsh fern, sedges, rushes, horsetails, <i>Agrostis stolonifera</i>	None observed	Possible habitat for bird SAR, Collins Park/BoMont protected water supply
1B	Crown	Swamp	Tall shrub	Swamp	Tall shrub, trees	x	x			Large WC flow-through in tailings	Alder, mixed saplings, cattails	None observed	Possible habitat for bird SAR, Collins Park/BoMont protected water supply
1C	Crown	Swamp	Low shrub	Marsh	Graminoid, tall shrub	x	x			Large WC flow-through, shallow flooding	Rushes, sensitive fern, cattails	None observed	Possible habitat for bird SAR, Collins Park/BoMont protected water supply
1D	Crown/Non-Crown	Swamp	Low shrub, exposed	Marsh	Graminoid	x	x			Shallow seasonal flooding, drainage southward	Marsh fern, rushes, horsetails cattails, alder	None observed	Possible habitat for bird SAR, Collins Park/BoMont protected water supply
1E	Crown/Non-Crown	Swamp	Low shrub	Marsh	Graminoid, tall shrub		x			Large WC flow-through, shallow flooding	Rushes, sensitive fern, cattails	None observed	Possible habitat for bird SAR, Collins Park/BoMont protected water supply
1F	Crown	NA	NA	NOT WETLAND – This area was found to be too small (> 0.01 ha) based on summer survey observations. May be considered a “vernal pool”.									
1G	Crown	Swamp	Tall shrub	Marsh/Swamp	Graminoid, tall shrub	x	x			Shallow seasonal flooding, drainage southward	Cattails, alders, rose	None observed	Possible habitat for bird SAR, Collins Park/BoMont protected water supply

A small wetland remnant to the north of the main hardpan tailings area was identified. It is suspected that this is a remnant of the former historic wetland and is part of Area 1A, although it is separated now by tailings deposits. There is still an intermittent drainage path from this area toward Area 1D which has been disturbed by off-road vehicles. There is coarse waste rock and fine sediment in this wetland area.

Area 1B

The southern boundary of the wetland extends considerably further than currently depicted on provincial mapping, including an area which is periodically impounded by beaver dams. A major man-made drainage trench has been created historically (Figure 2). The purpose of the trench is unclear, but it is effectively draining at this time. The trench may connect Area 1B with a southern extremity of Area 2.

Area 1B has signs of past disturbance within it but appears to be in full recovery with dense natural wetland vegetation growth and organic rich soils. Most of this area had shallow standing water (<10 cm) at the time of the survey in early July.

Area 1C

This area has small amount of coarse waste rock and fine tailings in the soil. The vegetation appears more natural in terms of species diversity and structure. Vegetation height is generally above 60 cm, mainly graminoid with low and tall shrubs. The surface is spongy with significant organic soil development. There are signs of seasonal flooding in this meadow but there was little surface water in July except in the watercourse. The watercourse substrate is mostly unvegetated sand.

Area 1D

There is a large amount of coarse waste rock and fine tailings in this area. However, the entire surface is saturated (flooded seasonally) and there is a low-growing vegetation cover (mainly graminoids with a few shrubs and saplings). As with most parts of the wetland, dominant species included speckled alder, cattails, water horsetail (*Equisetum fluviatile*), marsh fern, sensitive fern, royal fern (stunted), and Canada Rush. The soil is relatively dense grey sand with some organic (mucky) content near the surface. Most of this area was not accessible due to private property, but visibility was good, due to low growing vegetation. The impacted condition appears to be widespread and consistent throughout. The adjacent upland, although forested, is also covered by coarse waste rock.

Area 1E

Much of this area was not accessible due to private property, however, the parts visible from Area 1C indicate a wetter, marshier vegetation community with higher densities of cattail in the middle. Near the highway, Area 1E is dominated by a mixture of red maple, spruce, cinnamon fern, and many cattails. In the outlet of Mitchell's Brook, at Culvert 2 (Figure 2), the stream bottom consists of minor sediment, quite bare; with plants growing only at the edge.

Area 1F

Area 1F (Figure 1) was thought to be potential wetland and was investigated to confirm this possibility. There is a very small wetland area (a shallow former mining excavation, practically a ditch) next to the trail which is used to access the main site. It appears to only temporarily hold water impounded by the trail embankment. It was completely dry at the time of the survey although a small patch of wetland vegetation (cattails and sensitive fern) exists. It is considered too small to be mapped but may be identified as an ephemeral pool as there was standing (frozen) water during the late-season reconnaissance survey. It is also at a considerably higher elevation than the main Area 1B and there is no apparent drainage channel,

although the trail does show where stormwater has crossed on the road surface. This area east of Area 1B is predominantly old mining excavations and abandoned mine openings. The majority of the open clearing visible in aerial imagery is a historic mine access road and associated waste rock deposits. Area 1F is not a wetland.

Area 1G

This area is very similar to Area 1B but contains a number of historic excavations that have become vegetated, shallow, open water habitat. This part of the wetland may be receiving sedimentation from disturbed areas (bare soil) next to the old mine road that runs along the eastern edge of Area 1G. There are also small deposits of waste rock, and perhaps fine tailings, along the road edge. A portion of the old mine road was constructed within the wetland, having been infilled with coarse waste rock. This road appears to still be used occasionally. There is a small plastic culvert under the road at Mitchell's Brook, where it enters Area 1G.

3.2 Area 3

Area 3 (3A-3D), east of Montague Gold Mines, is associated with Flat Barren Brook, a tributary of Lake Major. It is somewhat more remote from the developed areas, surrounded by forest with a powerline corridor crossing through the middle. It is located in the upper reaches of the Shubenacadie River watershed within the Lake Major protected watershed. Historically, a mixture of coarse waste rock and fine grain stamp mill tailings has been deposited directly into the riparian wetland. The tailings deposits are mostly revegetated, except for some coarse waste rock areas. There is evidence of hunting and perhaps hiking on local trails, but there is little access by off-road vehicles (only along the powerline corridor).

Area 3 comprises four separate wetlands connected hydrologically. They range in size from 0.28 to 13 ha in area. Field surveys have extended the previously mapped area of Wetland 3C to the south to include a series of beaver dam wetlands that cross the powerline. Historic tailings were observed in Areas 3A-3C, but there was no obvious sign of tailings in Area 3D. There are historic mine disturbances around Area 3D, but if tailings were deposited in the wetland, they have fully recovered.

The predominant wetland type is Fen and tall shrub swamp (3A, 3B, 3C), but Area 3D stands out as the only bog (predominantly sphagnum ground cover) in the Study Area. Dominant wetland vegetation includes speckled alder, meadow sweet, wild rose, red maple and grey birch saplings. Herbaceous cover included cattails, royal fern, cinnamon fern, water horsetail, multiple common *Juncas* and *Carex* sedges, and blue-joint grass. Species diversity in Areas 3A and 3B is relatively low, partly due to small size. Diversity is higher in Areas 3C and 3D due to a variety of hydrologic regimes and vegetation structure. Where the wetland soil is composed largely of mine tailings, the vegetation is low growing (30-60 cm) and herbaceous species are more abundant. In more naturally developed wetland areas, the vegetation is much taller (60 cm – 2.5 m) and woody species are co-dominant with taller herbaceous species.

During the latter part of the season (September) two herbaceous species became familiar on fine tailings deposits, purple gerardia (*gerardia purpurea*) and nodding lady's-tresses (*Spiranthes cernua*), with colourful flowers conspicuous in the low-growing vegetation. Other species apparently associated with dense sand substrate were cattails, Canada rush, water horsetail, marsh fern, and scattered stunted alder. These contrast quite strongly with more natural wetland vegetation, which in Areas 3C and 3D included sphagnum moss and tussock sedge (*Carex stricta*), leather-leaf (*Chamaedaphne caliculata*), tamarack saplings, and *Myrica* species (both sweetgale and bayberry). It is unknown if there is a chemical component of species

dominance on the fine tailings or if it is purely physical characteristics (i.e., openness, compaction, hydrology, etc), but there seems to be a somewhat predictable vegetation pattern on local fine tailings deposits.

The surrounding upland is uniformly mixed forest with white spruce, red spruce, white pine, tamarack, white birch, yellow birch, red maple, grey birch and heart-leaved birch, and white ash. Upland shrubs include beaked hazelnut, low-bush blueberry, and service-berry. Herbaceous species include wild sarsaparilla, bunch-berry, bracken fern, star-flower, and false-lily-of-the-valley. Past timber harvesting and severe blow-down (root-throws) have created areas of open canopy forest with dense understory. Where the forest is more mature, the canopy is closed and the understory and ground cover is sparsely vegetated.

Table 3-2 summarizes wetland conditions for Area 3. The following section provides site specific observations for each wetland in Area 3.

3.2.1 Site Specific Observations

Area 3A

Area 3A is approximately 0.6 ha and is divided almost in half by a beaver dam. The southern half is impounded marsh dominated by cattails and vegetated open water and the north half is sedge meadow (on fine tailings). The dam drains regularly across the meadow but there is no continuous channel. At the north end of the meadow, concentrated run-off drains into a man-made trench (historic mine works) which conveys drainage northeast to Area 3C. It appears that the entire wetland area has been subject to historic mine impacts. There is visible ground disturbance and fenced-off abandoned mine openings and coarse waste rock around the south and east side of the wetland. It is likely that part of the pond is man-made excavation. Following overnight precipitation, the water in the pond and draining across the meadow was brown with sediment. The drainage in the trench downgradient did not appear "dirty". There was evidence of waterfowl hunting (a blind) adjacent to the pond. There is a seasonal drainage from the road upgradient that drains into the wetland which was not flowing at the time of the site visit, despite recent rain.

Area 3B

Area 3B is approximately 0.28 ha and is dominated by cattails and alders with a thin margin of dead trees around the edge. The vegetation is robust and appeared healthy (not "low-growing"). The dead trees possibly indicate past beaver impoundment, but none was evident at this time. There is a conspicuous deposit of coarse waste rock/fill in the eastern edge of the wetland which is covered by lichens and mosses. The wetland substrate appears to be fine tailings (coarse grey sand). There is no channel in the wetland, just shallow standing water 0-5 cm, but a small stream (not previously mapped) was observed draining out of the wetland toward Area 3C. There is a seasonal drainage from the road upgradient which was not flowing at the time of the site visit, despite recent rain.

Area 3C

Area 3C is approximately 13 ha in an area comprised of a complex of beaver impounded marsh, tailings impacted meadow, shrub swamp and poor fen. The beaver impounded area is south of the powerline crossing and includes some major deposits of coarse waste rock in and adjacent to the wetland. A large beaver lodge is located amongst the coarse rock deposits. North of the powerline crossing, there is a large open meadow that appears to have formed on fine tailings (dense coarse grey sand) (Figure 2). The meadow vegetation is low-growing and similar to impacted vegetation communities observed in Area 1A, and the meadow surface is relatively hard and flat.

Table 3-2: Wetland Conditions in Area 3

Study Area	Land Ownership	Provincial Wetland Map		Observed Wetland		Observed Impacts				Observed Hydrology	Dominant Vegetation Species	Species At Risk Present	Special Features
		Wetland Type	Vegetation	Wetland Type	Vegetation	Waste Rock	Sediment	Supressed Vegetation	Non-vegetated				
3A	Crown	NA	NA	Marsh	Open water, graminoid	x	x	x	x	Impounded open water, man-made drainage out	Equisetum sp., grasses, cattails	None Observed	Possible habitat for bird SAR, Lake Major protected water supply
3B	Crown	NA	NA	Swamp	Tall shrub, graminoid	x	x			Small WC flow-through	Alder, larch Cattails, meadowsweet	None Observed	Possible habitat for bird SAR, Lake Major protected water supply
3C	Crown/Non-Crown	Swamp	Low shrub, aquatic	Fen/marsh/Swamp	Graminoid, low shrub, tall shrub	x	x	x		Small WC flow-through, beaver pond, flooded forest	Grasses, rushes, meadowsweet, sphagnum moss	None Observed	Possible habitat for bird SAR, Lake Major protected water supply
3D	Crown/Non-Crown	Swamp	Treed	Bog/Swamp	Trees					Intermittent flow-through	Black spruce, fir, larch, sphagnum	None Observed	Possible habitat for bird SAR, Lake Major protected water supply

This impacted vegetation community extends northward to the confluence with a major tributary from the west. The incoming tributary may have “deflected” the progress of the advancing sediment plug during deposition, as the wetland area north of the tributary appears mostly natural in vegetation and surface character. From the confluence, heading downstream, there is a transition zone of about 100 m in which the vegetation and ground surface gradually changes from impacted to more natural, leading up to the long open water channel where the wetland habitat appears normal with soft organic soil and uneven surface forms with typical fen vegetation species dominating.

A small tributary and marshy extremity of the wetland extends across the powerline corridor to the west of the main drainage path which did not appear to have been impacted by historic mining activities.

Unlike Area 1, it is unclear where the core fine tailings source was located, or if there is more than one source.

Area 3D

Area 3D is approximately 1.6 ha and has two habitat types including alder shrub swamp in the southern lobe and bog (poor fen) in the north. These are connected by a narrow drainage path through high relief. The drainage is northward but there is no continuous channel in the wetland. The wetland vegetation appeared natural and no obvious sign of historic mining impacts was evident. There is a large area of abandoned mine openings and coarse waste rock deposits (and an old mine road) along the southeast edge. The old road is apparently used regularly as a foot trail, perhaps for hunting or hiking.

3.3 Area 4 (including Barry’s Run)

Area 4 (Areas 4A-4D) lies downgradient from Area 1, southwest of the highway, along the Mitchell’s Brook flow path to Lake Charles. Like Area 1, it is in the upper Shubenacadie River watershed. The site is surrounded by residential suburbs of Dartmouth and local roadways. There are regular human activities in two wetland areas (4A & 4B) including recreation trails (vehicles and hiking). A swimming and fishing advisory was established warning not to eat fish or disturb sediments in the stream and fen areas but there is some indication that fishing may still occur. The HHRA (Intrinsik, 2020) found risks are low, based on certain assumptions, but recommended signage remains in place and that people stay out of the area to avoid disturbing the sediments, in particular, and to reduce exposure potential. Also, the HHRA assumptions should be confirmed through engagement, as it is uncertain to what degree people are using the land (i.e., higher uncertainty related to time on site that was assumed). The “low risk” results need to be confirmed and some risk management may be warranted. The smaller Areas (4C & 4D) do not appear to receive human visitors.

Area 4 comprises four separate wetlands connected hydrologically. They range in size from 0.23 to 10.6 ha in area, including the large fen meadow known locally as Barry’s Run (Area 4A). Field surveys have slightly altered the previously mapped boundary of Areas 4C and 4D, particularly recognizing these as separate wetlands at slightly different elevations, connected by a short rocky watercourse. These wetlands all receive drainage from Area 1 (described further in Section 3.4, below) and were considered to be potentially impacted by historic mining activities in the form of transported fine tailings in sediment and arsenic contaminated surface water. Arsenic rich sediment has been recorded previously in the substrate of Barry’s Run (Area 4A), although there are no obvious indications from surface observations. Fine tailings (grey sand and silt) were observed in Area 4B as a dominant component of watercourse substrate but soils in Areas 4C and 4D appear natural, including mixed grainsize with organic content and typical soil horizon development. All wetlands may receive impacted water (higher arsenic concentrations) at some time during the year, but

it appears that Areas 4C and 4D are generally bypassed by the main Mitchell's Brook channel and receive only seasonal runoff. Area 4 is somewhat distinct as having much higher topographic relief with very steep slopes around much of the wetland boundaries. It is likely that seasonal high flow can generate significant erosion.

Barry's Run (Area 4A) is predominantly fen included sphagnum moss and tussock sedge (*Carex stricta*), leather-leaf (*Chamaedaphne caliculata*), tamarack saplings, and *Myrica* species (both sweetgale and bayberry). There is a large area of vegetated open water in Barry's Run, including woody debris and sheltered shoreline with a few small, vegetated islands. The open water habitat appears ideal for waterfowl, mammals, reptiles and amphibians. The aquatic habitat also appears to be high quality in terms of structure and nutrient input.

Areas 4B, 4C and 4D are composed of two wetland types, including shallow marsh and tall shrub swamp. The marsh habitat is predominantly covered by cattails, royal fern, cinnamon fern, water horsetail, multiple common *Juncas* and *Carex* sedges, blue-joint grass and tall rushes like black-girdled wool grass (*Scirpus atrocinctus*). The tall shrub habitat is mainly speckled alder, meadow sweet, wild rose, red maple and grey birch saplings. The vegetation in Area 4 wetlands does not obviously show impacts from historic mine related contamination or sedimentation.

The surrounding upland is uniformly mixed forest with white spruce, red spruce, white pine, tamarack, white birch, yellow birch, red maple, grey birch and heart-leaved birch, and white ash. Upland shrubs include beaked hazelnut, low-bush blueberry, and service-berry. Herbaceous species include wild sarsaparilla, bunch-berry, bracken fern, star-flower, and false-lilly-of-the-valley. Severe blow-down (root-throws) have created areas of open canopy forest with dense understory. Where the forest is more mature, the canopy is closed and the understory and ground cover is sparsely vegetated. There are frequent bedrock outcrops and large boulders laying on the surface in Area 4 uplands.

Table 3-3 summarizes wetland conditions for Area 4. The following section provides site specific observations for each wetland in Area 4.

3.3.1 Site Specific Observations

Area 4A

Barry's Run (Area 4A) is approximately 10.6 ha. It is predominantly (poor) fen wetland type with typical low-shrub habitat, and a mixture of sphagnum & sedge dominant ground cover. There are no obvious indications of impacts on vegetation from historic mine tailings or contaminated surface water. There is a well-used trail system around the edge of the wetland with numerous access points and an improvised bridge across the inlet watercourse. A small amount of off-road vehicle use was noted, but impacts are not severe and disturbed areas were mostly revegetated. The watercourse features indicate very suitable habitat for waterfowl and other wildlife, including plentiful basking sites for reptiles and small mammals, with a fairly dense amount of rooted aquatic vegetation such as small yellow pond-lily (*Nuphar* sp.), water-lily (*Nymphaea* sp.), pondweed (*Potamogeton* sp.), and robust emergents, including bayonet rush (*Juncus militaris*), burr-reed (*Sparganium americanum*), and water arum (*Calla palustris*). Deer tracks were observed. There is a beaver house built on the shore. A small amount of wind- or waterborne trash was observed, as would be expected in such close proximity to residential neighbourhoods. There were no visible indications of historic mine tailings deposits in the wetland.

Table 3-3: Wetland Conditions in Area 4 (Barry’s Run)

Study Area	Land Ownership	Provincial Wetland Map		Observed Wetland		Observed Impacts				Observed Hydrology	Dominant Vegetation Species	Species At Risk Present	Special Features
		Wetland Type	Vegetation	Wetland Type	Vegetation	Waste Rock	Sediment	Supressed Vegetation	Non-vegetated				
4A (Barry’s Run)	Non-Crown	Fen	Low shrub, aquatic	Fen	Graminoid, low shrub		X	X		Large WC flow-through	Sedges, blue-joint, meadowsweet	None observed	Possible habitat for bird SAR, Collins Park/BoMont protected water supply
4B	Non-Crown	Fen	Low shrub, aquatic	Fen	Graminoid, tall shrub		X		X	Large WC flow-through, beaver dam	Cattails, rushes, blue-joint, alder	None observed	Possible habitat for bird SAR, Collins Park/BoMont protected water supply
4C	Non-Crown	Swamp	Low shrub	Swamp	Tall shrub, graminoid					Small WC flow-through, beaver dam	Alder, cattails, rushes, blue-joint	None observed	Possible habitat for bird SAR, Collins Park/BoMont protected water supply
4D	Non-Crown	Swamp	Low shrub	Swamp	Tall shrub, graminoid					Intermittent flow-through		None observed	Possible habitat for bird SAR, Collins Park/BoMont protected water supply

Area 4B

Area 4B is approximately 1.43 ha consisting of two wetland types, beaver impounded cattail marsh and alder shrub swamp. The beaver dam appears to be storing a significant depth of fine sediment which may be associated with erosion from the Area 1 tailings. There is very little aquatic vegetation in the open water. In addition to seasonal run-off from Area 1E (via Culvert 3)(Figure 4), there is possibly some salt/sand input from winter highway maintenance. There is a regularly used trail and improvised foot-bridges across the stream near the edge of the wetland. There is also a relatively large area of soil disturbance caused by off-road vehicles. The disturbance appears to be the result of a single event and is in the early stages of recovery. An ATV path through the wetland does not seem to have been used in 2020. There are no visible indications of historic mine tailings deposits in the wetland, apart from the potential for sedimentation in the watercourse. The wetland vegetation appears normal and robust.

Area 4C

Area 4C is approximately 0.23 ha consisting of two wetland types, beaver impounded cattail marsh and alder shrub swamp. There is a beaver dam at the outlet and a small shallow pond with green and red algae in it. The vegetation appears healthy and robust. The soil in this wetland appears normal (i.e., not coarse grey sand), consisting of variable grain-sizes and with significant organic content. The soil horizon development is consistent with natural wetland processes.

Area 4D

Area 4D is approximately 1.29 ha consisting of tall shrub swamp habitat. There was no obvious indication of historic mine related impacts in the wetland. There was little standing water except at the outlet. Historic air photos show this wetland as being partly flooded and containing a large beaver house in 1954, but currently there is no beaver dam. Area 4D receives water from an intermittent drainage at Culvert 1. As well as seasonal run-off from Area 1C, there is possibly some salt input from winter highway maintenance.

3.4 Drainage

Area 1

All drainage flows generally to the west and southwest. One significant observation was that there is no open channel drainage from upstream at the east end of the wetland complex (coming from Loon Lake) into Area 1 (on the Crown land portion). The flow, which is considerable, appears to percolate swiftly through coarse rock rubble (suspected waste rock) and/or an historic (now derelict) water control structure. Some parts of the drainage channel are lined with stone block walls but generally there is now just an incoherent jumble of rocks remaining.

At Culvert 1, downgradient from Area 1C, there is a single small round culvert (~1m diameter). In December, the stream flow was fast and continuously flowing through the culvert, but in July the culvert was dry and subsurface flow was percolating through the highway embankment emanating from beneath the culvert into the stream channel several metres downgradient.

At Culvert 2, downgradient from Area 1E, Mitchell's Brook is fast-flowing. There are two large round culverts (>1.5 m diameter) in a high-flow / low-flow configuration. On the east side of the highway, there was no obvious ponding which may have indicated flow obstructions, and no obvious sedimentation. The low-flow culvert was flowing in July with about 10 cm depth. It is possible that seasonal high volume flows carry away any accumulated fine sediment.

At Culvert 3, downgradient from Area 1E (and potentially Area 1D), there are two large culverts identical to Culvert 2, which convey an apparently intermittent flow across the highway. The culvert was dry in July but a continuous small flow emanated from the road embankment beneath the culvert.

All three drainages from Area 1 have signs of wide ranging flow volumes from very high to very low. Also, during extreme flow periods it is likely that upstream fish passage is severely limited by “hanging culverts” and steep gradients.

Area 3

All drainage in Area 3 flows eastward toward Lake Major. Field surveys showed that drainage from both Area 3A and 3B flow at least seasonally into Area 3C. Based on mapping, it seems likely that drainage from Area 3D may also flow into the lower reaches of Area 3C.

There is a historic man-made trench that drains Area 3A into the southwest corner of the beaver impounded area of Area 3C. A natural looking watercourse drains from Area 3B which likely flows seasonally to the southeast corner of the beaver pond in Area 3C.

No continuous surface water channel was observed through the large open meadow in the centre of Area 3C. The open water channels entering from the south appear to spread out laterally and infiltrate into the soil. At the north end of the large meadow, where a major tributary flows into the wetland from the west, it appears that flow from the meadow concentrates again into an open channel that joins with the major tributary onto the wide downstream flat-water through the northeast part of the wetland. There are signs in the meadow and on aerial imagery that suggest seasonal flooding or sheet-flow around the eastern and western edges of the meadow (dark bands) and a raised hump (light area) in the middle. It is possible that this condition has resulted from the deposit of deep sand tailings in the stream valley. Perhaps one day the open channel will re-establish itself across the meadow by headward erosion.

Area 4

Barry’s Run (Area 4A) is fed mainly by one permanently flowing watercourse, Mitchell’s Brook, which flows fast down a steep rocky watercourse from Area 4B through a section of narrow rocky rapids and then a long flat-water run. The smaller upstream “run” is at a slightly higher elevation than the Barry’s Run Meadow and is separated by a short section of wide rocky rapids.

Drainage to Area 4B was found in the field to be somewhat different than previously shown on provincial mapping. The main channel is the permanently flowing Mitchell’s Brook which flows from Culvert 2 (Figure 4) down a high gradient rocky channel. At one point, this flows as a sheet over a smooth bedrock surface. At the inlet to Area 4B, there is a large “plunge-pool” indicating high volume seasonal inflow and there is a thick deposit of trapped sediment in the beaver pond at the outlet.

Area 4B also receives drainage from a smaller watercourse that drains Areas 4C and 4D which receives intermittent (seasonal) runoff via Culvert 1 from Area 1E. It is possible that runoff intercepted along the highway is also being directed into Area 4D. Another intermittent drainage flows to Area 4B from Culvert 3.

In September, at both Culvert 1 and Culvert 3, there was no flow in the culvert but there was some flow emanating from beneath the culverts through the roadway embankments. At both sites, there is a steep, rocky channel

connecting the culvert to the downgradient wetland, but there were sections of dry channel where surface water had infiltrated into the substrate. Signs of severe channel erosion were evident between Culvert 3 and Area 4D.

3.5 Significant Wetland Features

As part of the desktop review, an Atlantic Canada Conservation Data Centre report was requested for the site, the provincial significant habitats interactive website was reviewed, and the regional biologist was contacted to provide additional context. During the site visit within the Crown Land portion of the wetlands, species at risk were actively searched for. No species at risk were observed.

The ACCDC Data Report (ACCDC, 2019) indicates a number of SAR are recorded in the area which may use wetland habitat of the types present within the impacted areas. In particular, Canada Warbler (*Cardellina canadensis*) and Snapping Turtle (*Chelydra serpentina*) are likely wetland residents, while Common Nighthawk (*Chordeiles minor*) and Monarch Butterfly (*Daneus plaxippus*) could inhabit disturbed portions of the site, taking advantage of open canopy regenerating tall shrub and forest areas, adjacent to the riparian zone.

Of particular note, the ACCDC report identified the presence of Black Ash (*Fraxinus nigra*) and bat hibernacula as "location sensitive" species (meaning that the precise location was not given in the report to protect the species). A follow-up discussion with the Nova Scotia Lands & Forestry (NSL&F) regional biologist confirmed the approximate locations of the recorded Black Ash and bat hibernacula to be at least 2 to 3 km from proposed remediation sites (Donald Sam, Pers. Comm., February 24, 2020). There remains a general potential for unrecorded occurrences to be present in Project wetlands.

The region of the upper Shubenacadie River is a well-known bird migration flyway with relatively high nesting densities for Black Duck (*Anas rubripes*) and other waterfowl species. A recent study in north-west Nova Scotia found that almost half of the migratory birds in the province are using tall shrub and forested wetlands for breeding, although not exclusively (Brazner et al, 2019).

Birds and bats may be foraging within the Project wetlands and would be exposed to metal contamination accumulating through the food web. Many of the flying insects which are a large part of aerial feeder's diets begin their lifecycle as aquatic predators.

Snapping Turtles have a diverse diet and could be ingesting contaminated material from a number of sources within the wetlands, such as elevated metals in vegetation or fish. They may also be nesting in the fine tailings deposits which would superficially resemble ideal streamside sand bars that are the preferred natural nesting areas. If this were to happen, this would expose the eggs, young, and adults to buried contaminants. Hibernation may also involve Snapping Turtles burrowing into substrates. Thus, if Snapping Turtles are present then the potential for exposure to historic mining contaminants would be high, especially where tailings remain unvegetated.

A review of the provincial Significant Species and Habitats Database using the online Provincial Landscape Viewer (<https://nsgl.novascotia.ca/plv/>) did not reveal any Significant Habitat Areas, apart from wetlands, in close proximity to the site.

In the western part of the Site, within Area 1 (Areas 1A, 1B, 1C), the Project wetlands are within the Collin's Park and BoMont protected watershed areas. These water sources provide drinking water to local communities on the

outskirts of Dartmouth. It should be noted that Halifax Water carefully monitors drinking water quality, and source water quality in all areas.

The potential species identified for Area 1 are identical for Area 3; however, the likelihood of SAR in Area 3 may be somewhat higher due to a higher diversity of wetland types and aquatic habitat. Also, Area 3 is more remote from roads and developed areas with fewer disturbances within the wetlands. Field surveys conducted in early September 2020, did not reveal the presence of any SAR, but the potential still exists.

Area 3 wetlands (A-D) and Flat Barren Brook are within the Lake Major protected watershed area. This is a major source of drinking water for the Dartmouth area. It should be noted that Halifax Water carefully monitors drinking water quality, and source water quality in all areas.

The potential species identified for Area 1 are identical for Area 4; however, the likelihood of SAR in Area 4 may be somewhat higher due to a higher diversity of wetland types and aquatic habitat. However, similar to Area 1, Area 4 wetlands are relatively near developed areas and are somewhat isolated by built infrastructure (surrounded by roadways). Field surveys conducted in early September 2020, did not reveal the presence of any SAR, but the potential still exists.

Area 4 wetlands are within the Collin's Park and BoMont protected watershed areas. This water sources provides drinking water to local communities on the outskirts of Dartmouth. It should be noted that Halifax Water carefully monitors drinking water quality, and source water quality in all areas.

3.6 Water Quality Results

The impacts on local water and sediment quality from historic mining at Montague Gold Mines has been investigated in the "Conceptual Closure Plan" final report (Nova Scotia Lands Inc., 2019) and follow-up sampling conducted in late 2019 (by EcoMetrix) which indicate elevated mercury concentrations in proximity to the core tailings deposit in Area 1A and high arsenic in sediment and water within Areas 1 (A-E), 2, 3C, and 4A.

Both arsenic and mercury attached to solids are being trapped and stabilized in local wetlands. To a lesser extent water chemistry in the wetlands may be transforming and ultimately purifying water quality for downstream environments. There is also a potential for wetlands to transform elemental mercury to a more bioavailable form, methylmercury, which can then bioaccumulate through the food web. The ongoing investigations by the Study Team will assess levels of methylmercury in aquatic biota.

Currently, acid rock drainage does not appear to have a significant impact, with very low pH values detected at just a few locations within the core tailings areas. However, there is a potential for further oxidation of the tailings to generate significant acid runoff that could have negative effects on adjacent wetlands and aquatic environments downstream. This potential is considered high enough to justify active remediation (Nova Scotia Lands Inc., 2019). No evidence of acid rock drainage was observed in the field at Montague Gold Mines in winter 2019 or summer 2020 and there was no indication of acid drainage impacts on terrestrial or wetland vegetation communities near the tailing's areas.

3.7 Wetland Functions

Table 3-4 summarizes the results of the wetland functional assessments. Summary sheets for each wetland are presented in Appendix B (full-length forms are available upon request). The WESP-AC methodology assesses a wide range of aspects which have been aggregated into groups of complimentary functions for discussion. Two additional categories are Wetland Condition and Wetland Risk which evaluates the effects on the wetland of past or ongoing impacts and adjacent land use, and the current quality of habitat compared to unimpacted wetlands of the same type. It is important to note all values are assessed relative to the range of wetlands in Nova Scotia.

For this assessment, all sub-units of Area 1 (A-G, excluding F) were addressed as a single wetland. This approach was used because all parts are directly associated with the main branch of Mitchell's Brook and are broadly similar in vegetation species and hydrological regime, varying mainly as a result of historic mining disturbances. In other words, the differences are far less than the similarities and the overall wetland area functions as one.

The Study Area Wetlands provide generally low hydrologic and water quality support function, but in the local context, the benefits are considered relatively high. Areas 3B and 3D stand out as having lower values, due to their small size, little to no inflow, and minor influence on downstream waters. All other wetlands provide low magnitude but locally significant functions in support of flow maintenance and water quality.

Aquatic support and aquatic habitat functions are generally high in all wetlands with surface water (most of them), providing nutrient input, cooling (shade), and shelter for anadromous and resident fish, invertebrates, amphibians & turtles, and waterfowl feeding and breeding habitat, particularly in the context of known high density waterfowl migration in the area.

Transition habitat (value of wetlands to terrestrial wildlife, pollinators, and plant species diversity) scores moderate to high in function and uniformly high in benefits for all wetlands. The Study Wetlands provide unique structural diversity in the regional landscape, especially in consideration of high rates of local land development and fragmentation by infrastructure.

Wetland Condition scores moderate to high for all wetlands, indicating that where historic impacts have occurred, the current state of recovery is advanced. Essentially, the Study Wetlands are in fully functional, despite the past and potentially ongoing mine tailings related impacts.

Wetland Risk evaluates the level of stress on wetlands due to human related factors that degrade its ecological condition and/or reduce its ability to provide functions. Most of the Study Wetlands have moderate stress levels, due to both historic and current human activities, including past mining (tailings deposits, excavation, infilling, drainage manipulation), recreational off-road vehicle disturbance, and inputs from local road run-off and adjacent unvegetated land. Barry's Run has a low stress level, along with Area 3D (which is remote and did not appear to have mining impacts within it).

Table 3-4: Summary of Wetland Functional Assessment

Study Area	HYDROLOGIC Group		WATER QUALITY SUPPORT Group		AQUATIC SUPPORT Group		AQUATIC HABITAT Group		TRANSITION HABITAT Group		WETLAND CONDITION		WETLAND RISK		Average Function	Average Benefits
	Function	Benefits	Function	Benefits	Function	Benefits	Function	Benefits	Function	Benefits	Function	Benefits	Function	Benefits		
1 (A-G)	1	3	1	3	2	3	3	3	3	3		3		2	2	3
3A	1	1	1	3	3	3	3	3	2	3		3		2	2	3
3B	1	1	1	3	1	2	2	3	2	3		2		2	1	2
3C	1	2	1	3	3	3	3	3	3	3		3		2	2	3
3D	1	1	1	3	2	2	2	3	3	3		3		1	2	2
4A	1	3	1	3	3	3	3	3	3	3		2		1	2	3
4B	1	3	1	3	3	3	3	3	2	3		2		2	2	3
4C	1	3	1	3	3	3	3	3	3	3		3		2	2	3
4D	1	3	1	3	3	3	3	3	2	3		3		2	2	3
Average (all wetlands)	1	2	1	3	3	3	3	3	3	3		3		2		

1 = Low
2 = Moderate
3 = High

3.7.1 Location Specific Benefits

One significant conclusion from the functional assessment results is that all of the Study Area Wetlands have elevated benefits scores due to location specific cumulative factors including:

- Landscape within 5 km is at least 40% developed, causing remaining habitat to be more critical for local wildlife populations.
- Proximity to coastal areas provides unique access for shore birds and other migratory species and coastal associated plants.
- Known high density waterfowl migration route associated with upper Shubenacadie River watershed; and
- Proximity to other complimentary open water and diverse wetland types within 5 km and 1 km radius.

These have a relatively large influence on overall benefits values which would not be true if these wetlands were located further inland in undeveloped landscapes and lower diversity of nearby wetlands and waterbodies.

The implication of this is that the Study Area Wetlands may provide higher level benefits which are relatively insensitive to the historic mining related impacts and would also be relatively insensitive to potential contaminated site remediation activities (in close proximity to core tailings deposits). In other words, limited remediation of historic mining impacts in wetlands that are considered "In Recovery" will likely not significantly affect the overall wetland functions and benefits in a positive or negative fashion. This assumes that remediation is conducted following appropriate best management practices to ensure that hydrological changes and physical disturbances do not destabilize sediments or release contaminants downgradient.

3.8 Discussion of Wetland Health and Sensitivity

3.8.1 Health and Health-Risk

Follow-up field surveys in summer of 2020 and the functional assessments have confirmed that all Study Area Wetlands may be considered fully functional. Where historic mining related metals concentrations are below guidelines, wetlands should be considered "healthy" (i.e., unimpacted or fully recovered). Where wetlands are fully vegetated, but metals concentrations are above guidelines, they may be considered "in recovery" and have been shown to provide high value functions and benefits. Wetland areas that are sparsely vegetated or non-vegetated, so long after the cessation of mining activities, are "currently impacted" by historic tailings deposits and are not yet "in recovery". In other words, where wetland vegetation is unhealthy or absent, it is likely that historic mining related impacts are currently ongoing and are actively preventing natural recovery.

At the Montague Gold Mines location, no wetland area was observed in which recovery is being prevented by legacy historic mining impacts. No large areas of dead or dying vegetation were observed. It is not clear if there is a causation related to metals contamination but likely the physical properties of the coarse sand substrate are a major factor.

It is recognized that some wetland areas may themselves be potential sources of further impacts to downstream wetlands and aquatic systems, wildlife populations, and humans. Any wetland area that is identified as an ongoing source of impacts to human or SAR populations (including downstream wetlands that support SAR) should be

considered a high priority for further study to determine the need for risk management or remediation treatment. Remediation measures to protect SAR will also reduce risk of significant impacts on common wildlife populations.

Preliminary results of the human health risk assessment and a draft Phase I environmental site assessment indicate a relatively low risk to human populations, subject to further specific study components (Intrinsik 2020, Wood 2020b). Obviously, any risk to human health would justify remediation activities in wetlands, regardless of other ecological considerations.

No SAR have been previously recorded in Study Area Wetlands and none were observed during the 2020 summer field surveys. The functional values and benefits provided by Study Area Wetlands are in the higher part of the spectrum of Nova Scotia wetlands. Therefore, remediation of historic mining impacts to protect SAR and/or facilitate recovery in downgradient aquatic and wetland habitats is apparently not needed. However, should wetland areas be selected for remediation, the functions they provide are now better understood which will help to mitigate or offset potential negative impacts caused by the remediation work. There is a need for continuing risk management to address the presence of metals contamination above guidelines and background levels. A program of monitored recovery would be ideal for the Montague Gold Mines wetland areas, since recovery seems to be progressing naturally and the potential benefits of intervention are relatively low.

Some wetland areas that are "in recovery" may also be a source of low-level metals contamination. However, in such wetlands, the value of functions provided may outweigh the risks of further impacts. Subject to confirmatory monitoring, it is reasonable to assume that recovery will continue, and contaminated material will become stabilized and pose a smaller risk over time. It is a natural function of wetlands to stabilize sediment and purify water quality, so long as the sources of continuing impacts are identified and mitigated. The potential of Project Wetlands to be continuing sources of significant export of contaminated material will be the topic of further study as the remediation design concept is developed.

The Study Team is currently investigating the possibility that some Project Wetlands which are receiving mercury species produced by tailings areas, may transform it into more bioavailable methylmercury in a way that could amplify the negative effects of mining contamination. An increased risk to human health due to methylmercury concentrations would potentially elevate the wetland area to the "currently impacted" category and further study would be warranted to assess the risk factors and the need for mitigation measures such as monitoring and/or in-situ remediation.

The functional values and benefits provided by Project Wetlands that are "in recovery" are in the higher part of the spectrum of Nova Scotia wetlands. Therefore, remediation of historic mining impacts to protect SAR and/or facilitate recovery in downgradient aquatic and wetland habitats may not be needed, pending the outcomes of the risk assessment studies. However, should "in recovery" wetland areas be selected for remediation, the functions they provide are now better understood which will help to mitigate or offset potential negative impacts caused by the remediation work. There is a need for continuing risk management to address the presence of metals contamination above guidelines and background levels. A program of monitored recovery would be ideal for the Montague Gold Mines wetland areas since recovery appears to be progressing naturally in most Project Wetlands and the potential benefits of intervention are relatively low.

3.8.2 Sensitivity

Sensitive wetlands are wetlands which exhibit certain high value functions during wetland functional assessments. In addition, wetland classes that are easily damaged and hard to restore, such as bogs and fens, or wetland classes that are regionally rare, are considered sensitive by wetland practitioners. In Nova Scotia, wetlands that are classified under the Nova Scotia Wetlands Policy as “Wetlands of Special Significance” (NSE, 2019) have to be considered “sensitive”.

The location of the Montague Gold Mines wetlands within identified public watershed protection areas would lead to a designation as Wetlands of Special Significance (WSS) under the Nova Scotia Wetland Conservation Policy. According to the Policy:

“Government will not support or approve alterations proposed for a WSS or any alterations that pose a substantial risk to a WSS, except:

- alterations that are required to maintain, restore, or enhance a WSS;*
- alterations deemed to provide necessary public function, based on an Environmental Assessment (if required) with public review or other approvals (e.g., Wetland Alteration Approval) as appropriate.”*

Since the historic mining related impacts at the Montague Gold Mines main tailings site pose a current risk to humans, SAR, and threatens further ongoing impacts on SAR habitat and adjacent and downstream WSS, the proposed remediation of the core tailings area meets both exceptional conditions for which alterations of WSS would be permitted.

The known or likely presence of SAR counter-intuitively may be considered a strong rationale to apply mitigation. While the value of SAR habitat would ordinarily be seen as a high concern, which would cause the wetland to be considered “sensitive”, the presence of significant metal contamination and other man-made risk factors change the wetland into a “population sink”. Such areas will lure SAR to them having the appearance of ideal habitat but will ultimately cause more harm than good by reducing health and fecundity or direct mortality. The Project wetlands at Montague Gold Mines are not known to provide critical habitat for any SAR. Additional field surveys during the growing season in 2020 did not reveal the presence of additional SAR populations. They do contain potential habitat for some SAR, particularly certain migratory birds (e.g., Canada Warbler, Olive-sided Flycatcher) which is generically true of all forested and shrubby wetlands. This would elevate the potential risk to local SAR within “currently impacted” wetlands from exposure to elevated metals concentrations, if present, and would warrant further study to determine the need for mitigation or monitoring. The incidental loss of some habitat area due to physical remediation methods may be considered justifiable for the protection of the local SAR populations.

Experience from earlier studies has shown the behaviour of wetland located tailings (anoxic tailings), once disturbed, creates a situation wherein arsenic is highly mobilized into the environment and should be avoided to the extent possible. Thus “sensitivity” to physical disturbance must be considered when developing options for monitoring, mitigation and/or remediation of historic mining impacts. Remediation and site control measures designed to isolate the core tailings deposits and prevent or reduce soil disturbance severity and frequency will help to lower the risk level. Lower risk will lead to generally better vegetation recovery, improved water quality, and minimize potential impacts on SAR populations.

In Area 1, a loss of significant temporary water storage may represent a significant impact since the site lies in the upper reaches of the watershed with many downstream stakeholders. Providing an engineered solution could be expensive and difficult to maintain. However, the WESP-AC analysis indicates a relatively low function for wetland storage and delay (low function, moderate benefits). In Area 3, there are few downstream stakeholders, so this is would not be significant.

4.0 CONCLUSIONS

Table 4-1 summarizes results of the wetland surveys, boundary delineations and functional assessments for Study Wetlands including current condition, and distribution within the study area and identified key issues of concern related to impacts caused by historic mine tailings.

Table 4-1: Wetland Assessment Summary

Study Area	Confirmed Wetland	Size (ha)	Recovery Status	Species At Risk Presence	Average Function	Average Benefits	Key Issues
WL1 (A-E, G)	Yes	16.5	In Recovery	None Observed	Moderate	High	1, 2
1F	No	NA	NA	NA	NA	NA	NA
3A	Yes	0.60	In Recovery	None Observed	Moderate	High	1
3B	Yes	0.29	In Recovery	None Observed	Low	Moderate	1
3C	Yes	13.03	In Recovery	None Observed	Moderate	High	1, 2, 3
3D	Yes	1.61	In Recovery	None Observed	Moderate	Moderate	
4A	Yes	10.63	In Recovery	None Observed	Moderate	High	2, 3
4B	Yes	1.43	In Recovery	None Observed	Moderate	High	2, 3
4C	Yes	0.23	In Recovery	None Observed	Moderate	High	3
4D	Yes	1.29	In Recovery	None Observed	Moderate	High	3
Key Issues: 1. Potential source of continuing metals and sediment releases to adjacent and downstream wetlands (including WSS) and aquatic habitat. 2. Sensitivity to remobilization of potentially contaminated stream sediments by changes in hydrology. 3. Exposure to contaminated surface water or sediments transported from upstream sources							

Major conclusions of the assessment, relative to risk management and planning of remediation design and implementation are:

- At the Montague Gold Mines location all wetland areas subject to historic mining impacts are considered “In Recovery” and no wetland area was observed in which recovery is being prevented by legacy historic mining impacts.
- Remediation of historic mining impacts (near the core tailings deposits) will likely not significantly affect the overall wetland functions and benefits in a positive or negative fashion (assuming appropriate mitigation measures are employed).
- Potential for impacts on Species At Risk in Study Areas due to historic mining impacts or potential remediation activities are relatively low (no clear interaction identified); however, reducing risk related to historic mine tailings could benefit both potential SAR and common wildlife.
- Hydrodynamic regime and risk of erosion-sedimentation needs to be better understood in all Project Wetlands to ensure mitigation planning addresses potential downstream impacts from project related activities.
- A program of monitored recovery would be ideal for the Montague Gold Mines wetland areas, since recovery seems to be progressing naturally and the potential benefits of intervention are relatively low.

In addition, the potential implications of various mitigation and remediation options must be carefully weighed. For each possible remediation area being considered, it will be necessary to clearly understand the potential health risk represented by contaminated wetlands to human and SAR populations and whether the risk is acceptable both from existing exposure levels or from impacts that might be caused by remediation itself. Intrusive remedial techniques may mobilize contaminants which are reasonably stable in undisturbed wetland sediments, based on earlier studies. Similarly, the implications of intrusive remediation or development of an engineered channel on water storage and downstream peak flow attenuation (i.e., flooding, scouring) will need to be evaluated to inform program design and mitigation planning. The following principles should be considered when developing remediation plans in the Study Area Wetlands:

- Minimize the area of physical disturbance to the extent possible;
- Consider potential downstream effects of changes in hydrology as a result of lost storage capacity or alteration of the stream channel; and
- Consider potential for tailings runoff characteristics (mainly acid rock drainage) to change over time or to be altered by unintended consequences of remediation.

4.1 Next Steps

The following suggestions are offered for consideration in the overall mine tailings risk management program development. The planning and design requirements for advancing the study program should include:

- Assess the potential for Project wetlands to amplify mercury related impacts by the production of more bio-available methylmercury (currently ongoing by Study Team);
- Evaluate sensitivity of wetland areas and associated aquatic environments to changes in stream hydrology, including changes in peak flows downgradient (i.e., potential flooding and/or scouring), that may result from invasive remediation techniques such as displacement/infilling of wetland areas or engineered channel modifications;
- Establish a “monitored recovery” program (in consultation with regulators) for wetlands potentially impacted by remediation activities, and relative to final mine site closure criteria. Consideration of innovative techniques to reducing toxicity of wetland sediments could be explored in conjunction with monitored recovery; and
- Impacts on wetlands by remediation activities should be fully mitigated by compensation for area loss, consistent with Provincial policy.

Closing

Please do not hesitate to contact the undersigned if you have any questions or require additional information regarding this study.

Regards,

**Wood Environment & Infrastructure Solutions,
a Division of Wood Canada Limited**

Prepared by:



Garrett Bell, CET
Senior Environmental Technologist

Prepared by:



Elizabeth Robinson, B.Sc., EPT
Environmental Technologist

Reviewed by:



Kimberlea Green, P.Geo., M.Sc.
Senior Project Professional

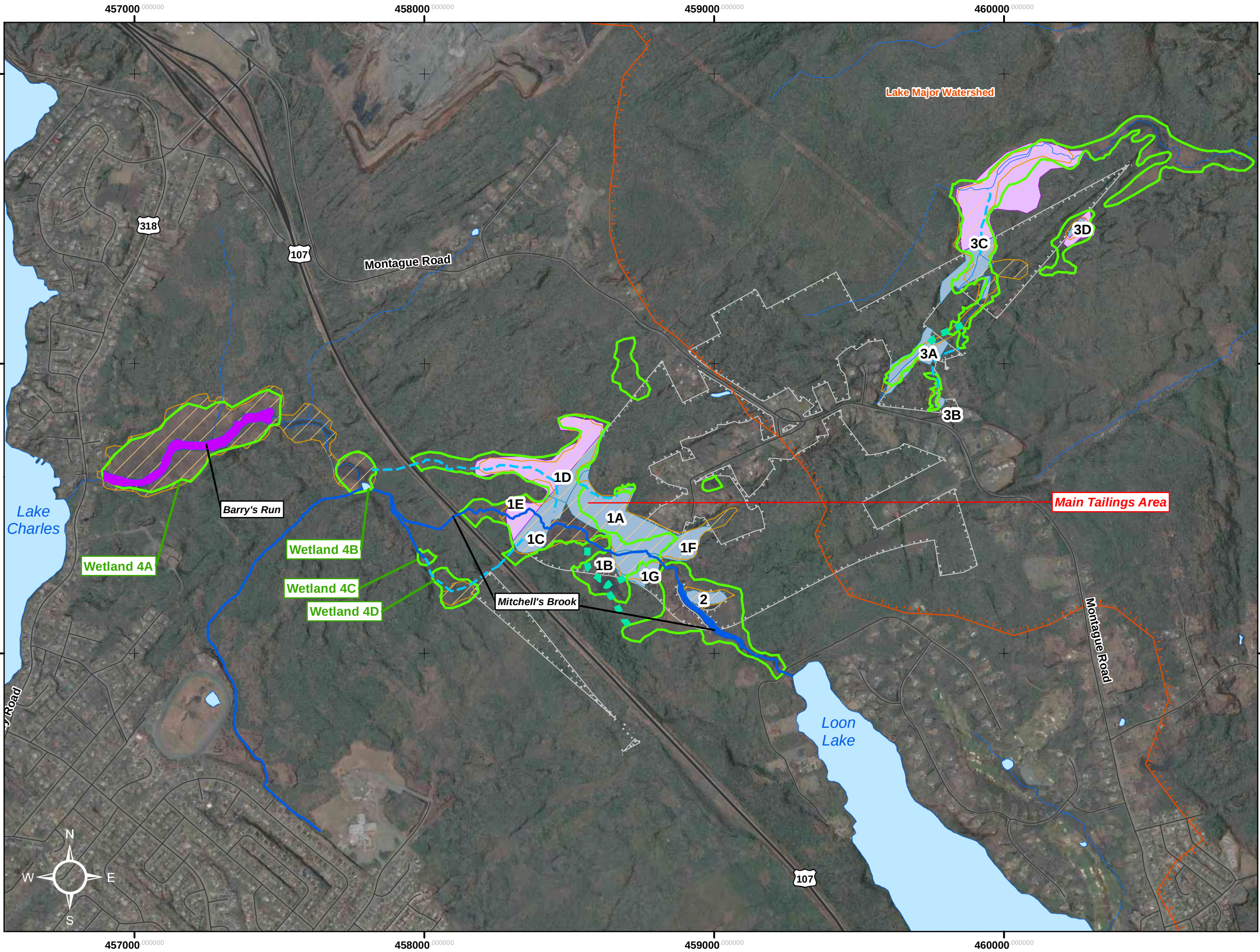
5.0 REFERENCES

- Atlantic Canada Conservation Data Centre (ACCDC), 2019. Data Report 6526: Montague Gold Mines, NS. Dated 17 December 2019.
- Brazner, John & Laura Achenbach, 2019. Do Breeding Bird Communities or Conservation Value Differ Among Forested Wetland Types or Ecoregions in Nova Scotia? Published November 18, 2019 online in: Wetlands (<https://doi.org/10.1007/s13157-019-01222-2>).
- ESRI, 2019: Aerial Base Mapping; accessed November 2019.
- Intrinsik Corp. (Intrinsik), 2020. Human Health Risk Assessment of Sediment, Surface Water and Fish from Barry's Run - Final Report. Dated February 14, 2020.
- Nova Scotia Environment, 2019: Wetland Conservation Policy Facts. 2 pp; accessed December 4th, 2019.
- Nova Scotia Department of Lands and Forestry (NSL&F), 2019: Crownland boundaries, Lake Major water protection Area Boundary, Depth to Water Table mapping, streams; available at: <https://novascotia.ca/natr/forestry/gis/downloads.asp>; accessed 2019 and 2020.
- Nova Scotia Department of Lands and Forestry (NSL&F), 2019 and 2020: Wildlife Department: Wetland Mapping; available at: <https://novascotia.ca/natr/forestry/gis/downloads.asp>; accessed 2019 and 2020.
- Nova Scotia Department of Lands and Forestry (NSL&F), 2019. Significant Species and Habitats Database. Accessed on December 4th, 2019 at: <https://novascotia.ca/natr/wildlife/habitats/hab-data/>
- Nova Scotia Department of Lands and Forestry (NSL&F), 2014. Wet Areas Mapping. Accessed on December 4th, 2019 at: <https://novascotia.ca/natr/forestry/gis/wamdownload.asp>
- Nova Scotia Lands Inc., 2019. Conceptual Closure Plan for the Historic Montague Mines Tailings Areas, Halifax, Nova Scotia (Final Report). Prepared by Intrinsik Corp, EcoMetrix, Klohn Crippen Berger and Wood. Dated July 24, 2019.
- Nova Scotia Department of Natural Resources (NSDNR), 2012. Vulnerable Wood Turtle (*Gleptemys insculpta*) Special Management Practices. Dated July 2012. Available at: (https://novascotia.ca/natr/wildlife/habitats/terrestrial/pdf/SMP_Wood_Turtles.pdf)
- U.S. Army Corps of Engineers (USACE), 2012. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0).
- Wood Environment & Infrastructure Solutions (Wood), 2020a. Wetland Reconnaissance Study Report, Montague Gold Mines & Goldenville, Nova Scotia - Draft Report. Dated April 2020.
- Wood Environment & Infrastructure Solutions (Wood), 2020b. Phase I Environmental Site Assessment, Former Montague Gold Mines - Draft Report. Dated October 2020.

APPENDIX A

Figures

- Figure 1: Site Overview
- Figure 2: Tailings Area 1
- Figure 3: Tailings Area 3
- Figure 4: Barry's Run



LEGEND:

- Barry's Run
- Mitchell's Brook
- Intermittent Drainage
- Manmade Trench
- Streams/Creeks
- Lakes
- Crown Parcel
- Lake Major Watershed
- Wetlands - Field Verified

Tailings

- Crown
- Non-Crown
- Possible Tailings Traces

CLIENT:

NOVA SCOTIA LANDS INC.

wood.

TITLE:

FIELD WETLANDS MAPPING OVERVIEW

PROJECT:

MONTAGUE GOLD MINES WETLAND ASSESSMENT

PROJECT NO: TV183013	DATE: OCT 2020
REV NO: 0	DWN/CHK'D BY: CM/GB
DATUM: NAD83 CSRS 2010	PROJECTION: UTM ZONE 20 N

FIGURE:

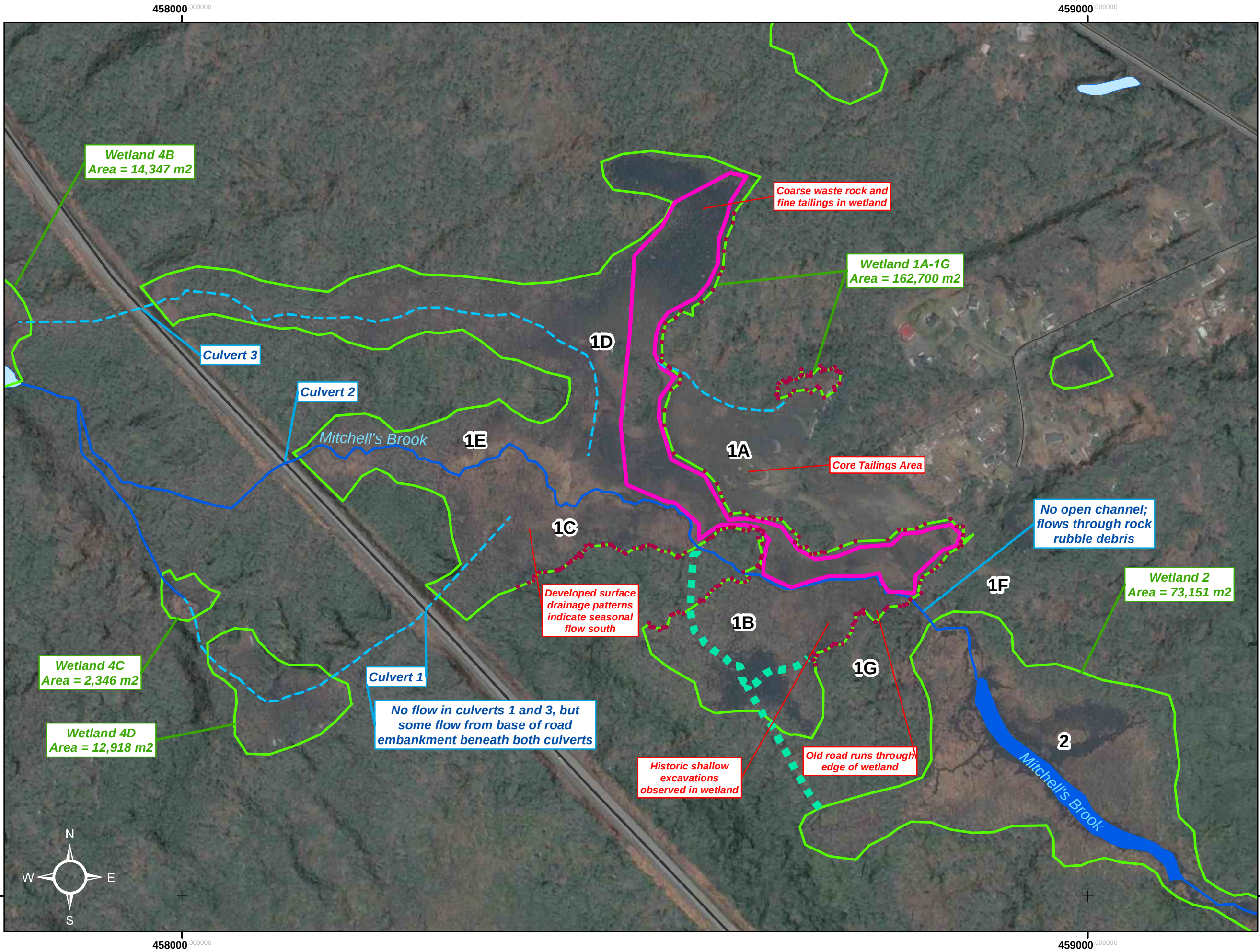
FIGURE 1

SCALE:

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062.5125250375500

Metres



- LEGEND:
- July 2020 Wetland Delineation Points
 - Mitchell's Brook
 - Intermittent Drainage
 - Manmade Trench
 - Streams/Creeks
 - Lakes
 - Wetlands
 - Approximate Limits of Dense Sandy Soil (no organics)

CLIENT:

NOVA SCOTIA LANDS INC.



TITLE:

FIELD WETLANDS MAPPING
AREA 1

PROJECT:

MONTAGUE GOLD MINES
WETLAND ASSESSMENT

PROJECT NO: TV183013	DATE: OCT 2020
REV NO: 0	DWN/CHK'D BY: CM/GB
DATUM: NAD83 CSRS 2010	PROJECTION: UTM ZONE 20 N

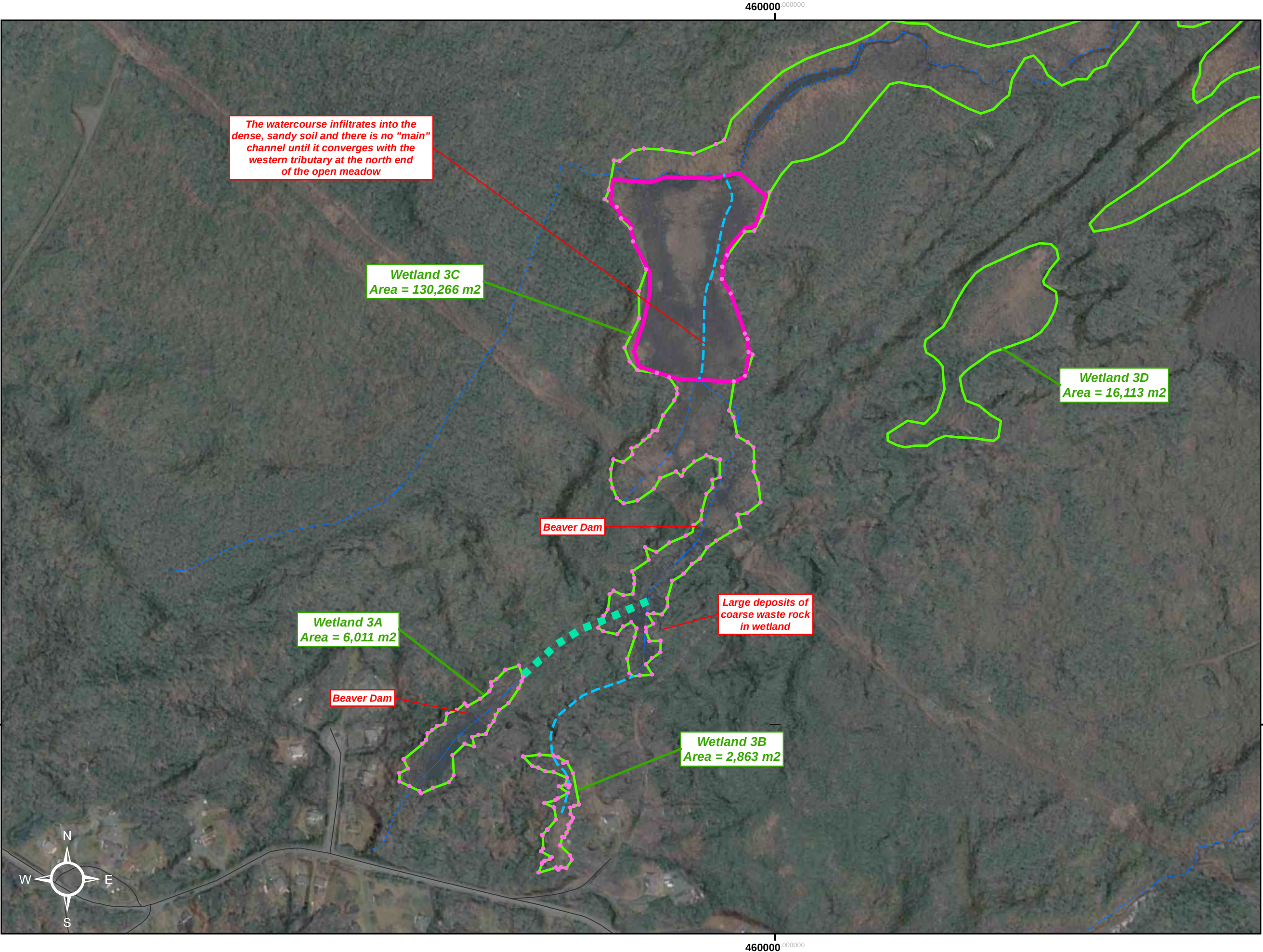
FIGURE:

FIGURE 2

SCALE:

1:4,000

0 25 50 100 150 200
Metres



- LEGEND:
- September 2020 Wetland Delineation Points
 - Intermittent Drainage
 - Manmade Trench
 - Streams/Creeks
 - Wetlands
 - Approximate Limits of Dense Sandy Soil (no organics)

CLIENT:

NOVA SCOTIA LANDS INC.



TITLE:

FIELD WETLANDS MAPPING
AREA 3

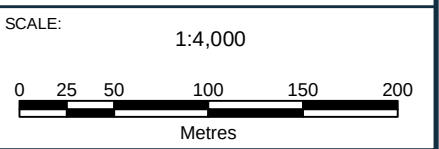
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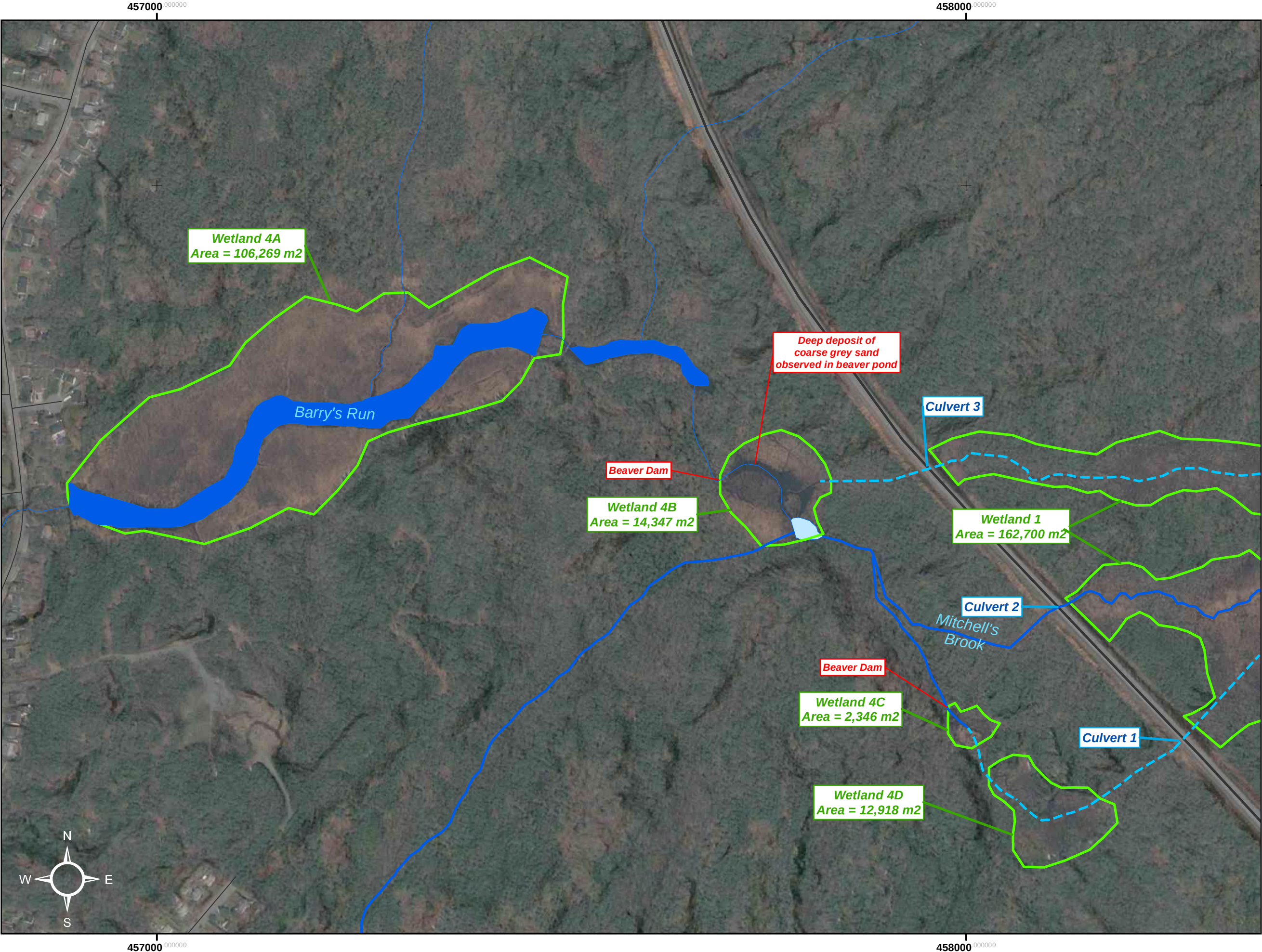
MONTAGUE GOLD MINES
WETLAND ASSESSMENT

PROJECT NO: TV183013	DATE: OCT 2020
REV NO: 0	DWN/CHK'D BY: CM/GB
DATUM: NAD83 CSRS 2010	PROJECTION: UTM ZONE 20 N

FIGURE:

FIGURE 3





- LEGEND:
- Mitchell's Brook
 - Intermittent Drainage
 - Streams/Creeks
 - Lakes
 - Wetlands

CLIENT:

NOVA SCOTIA LANDS INC.



TITLE:

FIELD WETLANDS MAPPING
AREA 4 (BARRY'S RUN)

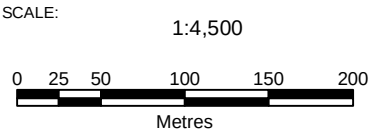
PROJECT:

MONTAGUE GOLD MINES
WETLAND ASSESSMENT

PROJECT NO: TV183013	DATE: OCT 2020
REV NO: 0	DWN/CHK'D BY: CM/GB
DATUM: NAD83 CSRS 2010	PROJECTION: UTM ZONE 20 N

FIGURE:

FIGURE 4





APPENDIX B
Wetland Functional Assessment Summary Tables

Wetland ID: Area 1 (A-G, excluding F)

Date: July 08, 2020

Latitude & Longitude (decimal degrees): 44.715379, -63.523691

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	1.60	Lower	7.11	Higher	3.14	3.15
Stream Flow Support (SFS)	2.62	Moderate	5.71	Moderate	2.11	3.73
Water Cooling (WC)	5.45	Higher	7.46	Higher	3.63	3.98
Sediment Retention & Stabilisation (SR)	3.54	Lower	10.00	Higher	4.96	10.00
Phosphorus Retention (PR)	0.30	Lower	10.00	Higher	3.93	10.00
Nitrate Removal & Retention (NR)	3.07	Moderate	10.00	Higher	5.06	10.00
Carbon Sequestration (CS)	1.89	Lower			6.09	
Organic Nutrient Export (OE)	7.73	Higher			5.70	
Anadromous Fish Habitat (FA)	6.08	Higher	6.24	Higher	3.99	3.97
Resident Fish Habitat (FR)	8.79	Higher	5.87	Higher	4.66	3.67
Aquatic Invertebrate Habitat (INV)	5.82	Higher	8.45	Higher	5.91	5.61
Amphibian & Turtle Habitat (AM)	7.42	Higher	6.82	Higher	6.97	7.55
Waterbird Feeding Habitat (WBF)	6.54	Moderate	10.00	Higher	5.02	10.00
Waterbird Nesting Habitat (WBN)	7.47	Higher	10.00	Higher	5.41	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	8.85	Higher	10.00	Higher	7.62	10.00
Pollinator Habitat (POL)	10.00	Higher	10.00	Higher	8.35	10.00
Native Plant Habitat (PH)	5.51	Moderate	8.66	Higher	6.10	8.66
Public Use & Recognition (PU)			0.96	Lower		0.96
Wetland Sensitivity (Sens)			0.77	Lower		2.98
Wetland Ecological Condition (EC)			7.10	Higher		8.61
Wetland Stressors (STR) (higher score means more stress)			9.94	Higher		4.95
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	1.60	Lower	7.11	Higher	3.14	3.15
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	2.87	Lower	10.00	Higher	5.55	10.00
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	6.57	Moderate	7.83	Higher	5.13	5.03
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	8.02	Higher	8.89	Higher	6.09	8.52
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	9.06	Higher	9.78	Higher	7.85	9.78
WETLAND CONDITION (EC)			7.10	Higher		8.61
WETLAND RISK (average of Sensitivity & Stressors)			5.35	Moderate		3.96

Wetland ID: Area 3A

Date: September 04, 2020

Latitude & Longitude (decimal degrees): 44.720288, -63.509351

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	1.47	Lower	2.43	Lower	3.04	1.08
Stream Flow Support (SFS)	3.31	Moderate	6.18	Moderate	2.67	4.03
Water Cooling (WC)	3.17	Moderate	1.54	Lower	2.11	0.82
Sediment Retention & Stabilisation (SR)	3.08	Lower	10.00	Higher	4.60	10.00
Phosphorus Retention (PR)	0.15	Lower	10.00	Higher	3.84	10.00
Nitrate Removal & Retention (NR)	4.05	Moderate	10.00	Higher	5.76	10.00
Carbon Sequestration (CS)	1.74	Lower			6.02	
Organic Nutrient Export (OE)	4.82	Moderate			4.63	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	7.92	Higher	6.51	Higher	4.20	4.07
Aquatic Invertebrate Habitat (INV)	8.78	Higher	7.29	Higher	7.11	5.02
Amphibian & Turtle Habitat (AM)	9.57	Higher	6.20	Higher	8.10	7.07
Waterbird Feeding Habitat (WBF)	8.28	Higher	10.00	Higher	6.36	10.00
Waterbird Nesting Habitat (WBN)	9.10	Higher	10.00	Higher	6.60	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	5.63	Moderate	10.00	Higher	4.85	10.00
Pollinator Habitat (POL)	7.61	Moderate	10.00	Higher	6.31	10.00
Native Plant Habitat (PH)	2.84	Lower	7.05	Moderate	5.04	7.05
Public Use & Recognition (PU)			0.87	Lower		0.89
Wetland Sensitivity (Sens)			2.07	Lower		3.37
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			8.43	Higher		4.23
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	1.47	Lower	2.43	Lower	3.04	1.08
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	3.15	Lower	10.00	Higher	5.54	10.00
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	6.90	Higher	6.14	Higher	5.62	4.15
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	8.27	Higher	8.27	Higher	6.57	8.11
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	6.48	Moderate	9.51	Higher	5.85	9.51
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			5.25	Moderate		3.80

Wetland ID: Area 3B

Date: September 04, 2020

Latitude & Longitude (decimal degrees): 44.719169, -63.540424

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	1.85	Lower	2.54	Lower	3.32	1.13
Stream Flow Support (SFS)	2.00	Moderate	5.15	Moderate	1.61	3.36
Water Cooling (WC)	3.63	Moderate	0.64	Lower	2.42	0.34
Sediment Retention & Stabilisation (SR)	1.60	Lower	10.00	Higher	3.45	10.00
Phosphorus Retention (PR)	0.00	Lower	10.00	Higher	3.31	10.00
Nitrate Removal & Retention (NR)	2.82	Moderate	10.00	Higher	4.88	10.00
Carbon Sequestration (CS)	1.16	Lower			5.74	
Organic Nutrient Export (OE)	3.19	Lower			4.03	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	4.30	Moderate	7.11	Higher	2.28	4.45
Aquatic Invertebrate Habitat (INV)	2.08	Lower	4.50	Moderate	4.40	3.59
Amphibian & Turtle Habitat (AM)	6.86	Higher	5.74	Higher	6.67	6.71
Waterbird Feeding Habitat (WBF)	5.54	Moderate	10.00	Higher	4.26	10.00
Waterbird Nesting Habitat (WBN)	3.35	Moderate	10.00	Higher	2.43	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	6.83	Moderate	10.00	Higher	5.88	10.00
Pollinator Habitat (POL)	6.51	Moderate	10.00	Higher	5.40	10.00
Native Plant Habitat (PH)	1.31	Lower	7.09	Moderate	4.43	7.09
Public Use & Recognition (PU)			1.04	Lower		1.01
Wetland Sensitivity (Sens)			0.37	Lower		2.86
Wetland Ecological Condition (EC)			4.78	Moderate		7.50
Wetland Stressors (STR) (higher score means more stress)			7.42	Higher		3.75
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	1.85	Lower	2.54	Lower	3.32	1.13
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	2.11	Lower	10.00	Higher	5.05	10.00
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	3.17	Lower	4.29	Moderate	3.76	3.01
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	5.44	Moderate	8.29	Higher	4.90	8.12
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	5.86	Moderate	9.52	Higher	5.56	9.52
WETLAND CONDITION (EC)			4.78	Moderate		7.50
WETLAND RISK (average of Sensitivity & Stressors)			3.90	Moderate		3.30

Wetland ID: Area 3C

Date: September 04, 2020

Latitude & Longitude (decimal degrees): 44.725319, -63.506293

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	2.00	Lower	5.02	Moderate	3.44	2.23
Stream Flow Support (SFS)	6.76	Higher	6.81	Higher	5.44	4.45
Water Cooling (WC)	5.33	Higher	6.93	Higher	3.56	3.70
Sediment Retention & Stabilisation (SR)	4.15	Moderate	10.00	Higher	5.44	10.00
Phosphorus Retention (PR)	1.30	Lower	10.00	Higher	4.56	10.00
Nitrate Removal & Retention (NR)	3.69	Moderate	10.00	Higher	5.50	10.00
Carbon Sequestration (CS)	4.75	Moderate			7.44	
Organic Nutrient Export (OE)	5.83	Moderate			5.00	
Anadromous Fish Habitat (FA)	6.35	Higher	5.99	Higher	4.16	3.81
Resident Fish Habitat (FR)	8.16	Higher	6.09	Higher	4.32	3.81
Aquatic Invertebrate Habitat (INV)	7.27	Higher	9.00	Higher	6.50	5.90
Amphibian & Turtle Habitat (AM)	6.61	Higher	7.21	Higher	6.54	7.85
Waterbird Feeding Habitat (WBF)	9.18	Higher	10.00	Higher	7.05	10.00
Waterbird Nesting Habitat (WBN)	9.38	Higher	10.00	Higher	6.80	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	7.54	Moderate	10.00	Higher	6.49	10.00
Pollinator Habitat (POL)	8.61	Higher	10.00	Higher	7.14	10.00
Native Plant Habitat (PH)	5.09	Moderate	7.88	Higher	5.94	7.88
Public Use & Recognition (PU)			0.78	Lower		0.83
Wetland Sensitivity (Sens)			1.51	Lower		3.20
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			8.50	Higher		4.26
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	2.00	Lower	5.02	Moderate	3.44	2.23
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	4.11	Lower	10.00	Higher	6.59	10.00
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	6.78	Higher	8.29	Higher	5.81	5.29
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	8.66	Higher	8.93	Higher	6.41	8.55
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.85	Higher	9.65	Higher	6.83	9.65
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			5.00	Moderate		3.73

Wetland ID: Area 3D

Date: September 04, 2020

Latitude & Longitude (decimal degrees): 44.724503, -63.501857

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	0.86	Lower	2.26	Lower	2.59	1.00
Stream Flow Support (SFS)	4.55	Moderate	4.34	Moderate	3.67	2.83
Water Cooling (WC)	4.63	Moderate	1.47	Lower	3.08	0.79
Sediment Retention & Stabilisation (SR)	1.66	Lower	0.76	Lower	3.49	0.37
Phosphorus Retention (PR)	1.09	Lower	0.86	Lower	4.43	0.67
Nitrate Removal & Retention (NR)	1.99	Lower	10.00	Higher	4.29	10.00
Carbon Sequestration (CS)	2.69	Lower			6.47	
Organic Nutrient Export (OE)	6.79	Moderate			5.35	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	3.58	Moderate	4.25	Moderate	5.00	3.46
Amphibian & Turtle Habitat (AM)	6.00	Moderate	6.37	Higher	6.22	7.20
Waterbird Feeding Habitat (WBF)	5.39	Moderate	10.00	Higher	4.14	10.00
Waterbird Nesting Habitat (WBN)	4.05	Moderate	10.00	Higher	2.93	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	8.65	Higher	10.00	Higher	7.45	10.00
Pollinator Habitat (POL)	8.14	Higher	10.00	Higher	6.75	10.00
Native Plant Habitat (PH)	4.99	Moderate	8.07	Higher	5.89	8.07
Public Use & Recognition (PU)			0.69	Lower		0.77
Wetland Sensitivity (Sens)			0.98	Lower		3.04
Wetland Ecological Condition (EC)			6.52	Higher		8.33
Wetland Stressors (STR) (higher score means more stress)			4.60	Moderate		2.40
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	0.86	Lower	2.26	Lower	2.59	1.00
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	2.27	Lower	6.94	Higher	5.57	6.84
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	5.84	Moderate	3.85	Moderate	4.82	2.91
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	4.55	Moderate	7.64	Higher	4.44	7.72
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.95	Higher	9.68	Higher	7.07	9.68
WETLAND CONDITION (EC)			6.52	Higher		8.33
WETLAND RISK (average of Sensitivity & Stressors)			2.79	Lower		2.72

Wetland ID: Area 4A (Barry's Run)

Date: September 04, 2020

Latitude & Longitude (decimal degrees): 44.717734, -63.540424

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	1.87	Lower	6.49	Higher	3.34	2.88
Stream Flow Support (SFS)	2.97	Moderate	5.11	Moderate	2.39	3.34
Water Cooling (WC)	4.08	Moderate	7.54	Higher	2.72	4.02
Sediment Retention & Stabilisation (SR)	4.65	Moderate	10.00	Higher	5.83	10.00
Phosphorus Retention (PR)	1.20	Lower	10.00	Higher	4.50	10.00
Nitrate Removal & Retention (NR)	4.00	Moderate	10.00	Higher	5.72	10.00
Carbon Sequestration (CS)	3.89	Moderate			7.04	
Organic Nutrient Export (OE)	4.38	Moderate			4.47	
Anadromous Fish Habitat (FA)	6.55	Higher	6.32	Higher	4.30	4.02
Resident Fish Habitat (FR)	8.10	Higher	6.26	Higher	4.30	3.92
Aquatic Invertebrate Habitat (INV)	8.33	Higher	9.31	Higher	6.93	6.05
Amphibian & Turtle Habitat (AM)	9.33	Higher	6.88	Higher	7.97	7.59
Waterbird Feeding Habitat (WBF)	8.16	Higher	10.00	Higher	6.27	10.00
Waterbird Nesting Habitat (WBN)	9.63	Higher	10.00	Higher	6.98	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	7.54	Moderate	10.00	Higher	6.49	10.00
Pollinator Habitat (POL)	7.52	Moderate	10.00	Higher	6.23	10.00
Native Plant Habitat (PH)	5.78	Higher	7.58	Moderate	6.21	7.58
Public Use & Recognition (PU)			1.70	Moderate		1.47
Wetland Sensitivity (Sens)			0.16	Lower		2.79
Wetland Ecological Condition (EC)			4.78	Moderate		7.50
Wetland Stressors (STR) (higher score means more stress)			6.38	Higher		3.25
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	1.87	Lower	6.49	Higher	3.34	2.88
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	4.04	Lower	10.00	Higher	6.40	10.00
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	6.64	Higher	8.31	Higher	5.53	5.26
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	8.99	Higher	8.95	Higher	6.97	8.55
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.24	Higher	9.60	Higher	6.40	9.60
WETLAND CONDITION (EC)			4.78	Moderate		7.50
WETLAND RISK (average of Sensitivity & Stressors)			3.27	Lower		3.02

Wetland ID: Area 4B

Date: September 04, 2020

Latitude & Longitude (decimal degrees): 44.716760, -63.533325

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	2.19	Lower	6.77	Higher	3.58	3.00
Stream Flow Support (SFS)	4.00	Moderate	5.55	Moderate	3.22	3.62
Water Cooling (WC)	4.21	Moderate	7.84	Higher	2.81	4.19
Sediment Retention & Stabilisation (SR)	4.34	Moderate	10.00	Higher	5.59	10.00
Phosphorus Retention (PR)	0.59	Lower	10.00	Higher	4.11	10.00
Nitrate Removal & Retention (NR)	4.07	Moderate	10.00	Higher	5.78	10.00
Carbon Sequestration (CS)	2.68	Lower			6.46	
Organic Nutrient Export (OE)	7.26	Higher			5.53	
Anadromous Fish Habitat (FA)	6.89	Higher	4.29	Moderate	4.52	2.73
Resident Fish Habitat (FR)	7.76	Higher	4.20	Moderate	4.11	2.63
Aquatic Invertebrate Habitat (INV)	8.78	Higher	8.21	Higher	7.11	5.49
Amphibian & Turtle Habitat (AM)	7.58	Higher	6.63	Higher	7.05	7.40
Waterbird Feeding Habitat (WBF)	7.54	Higher	10.00	Higher	5.80	10.00
Waterbird Nesting Habitat (WBN)	6.98	Higher	10.00	Higher	5.06	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	7.42	Moderate	10.00	Higher	6.39	10.00
Pollinator Habitat (POL)	7.09	Moderate	10.00	Higher	5.88	10.00
Native Plant Habitat (PH)	4.10	Moderate	7.42	Moderate	5.54	7.42
Public Use & Recognition (PU)			0.36	Lower		0.55
Wetland Sensitivity (Sens)			1.43	Lower		3.18
Wetland Ecological Condition (EC)			4.78	Moderate		7.50
Wetland Stressors (STR) (higher score means more stress)			7.38	Higher		3.73
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	2.19	Lower	6.77	Higher	3.58	3.00
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	3.63	Lower	10.00	Higher	5.98	10.00
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	7.42	Higher	7.70	Higher	5.89	4.96
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	7.56	Higher	8.51	Higher	6.18	8.27
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	6.81	Moderate	9.57	Higher	6.16	9.57
WETLAND CONDITION (EC)			4.78	Moderate		7.50
WETLAND RISK (average of Sensitivity & Stressors)			4.41	Moderate		3.45

Wetland ID: Area 4C

Date: September 04, 2020

Latitude & Longitude (decimal degrees): 44.714418, -63.530244

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	1.43	Lower	6.94	Higher	3.02	3.08
Stream Flow Support (SFS)	3.31	Moderate	5.49	Moderate	2.67	3.59
Water Cooling (WC)	5.10	Higher	7.82	Higher	3.40	4.17
Sediment Retention & Stabilisation (SR)	2.61	Lower	10.00	Higher	4.23	10.00
Phosphorus Retention (PR)	0.00	Lower	10.00	Higher	3.18	10.00
Nitrate Removal & Retention (NR)	3.47	Moderate	10.00	Higher	5.35	10.00
Carbon Sequestration (CS)	0.16	Lower			5.27	
Organic Nutrient Export (OE)	9.02	Higher			6.18	
Anadromous Fish Habitat (FA)	6.76	Higher	2.78	Moderate	4.43	1.76
Resident Fish Habitat (FR)	6.36	Higher	2.66	Moderate	3.37	1.66
Aquatic Invertebrate Habitat (INV)	8.06	Higher	6.64	Higher	6.82	4.69
Amphibian & Turtle Habitat (AM)	6.34	Moderate	6.01	Higher	6.40	6.92
Waterbird Feeding Habitat (WBF)	5.63	Moderate	10.00	Higher	4.32	10.00
Waterbird Nesting Habitat (WBN)	4.37	Moderate	10.00	Higher	3.17	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	7.46	Moderate	10.00	Higher	6.43	10.00
Pollinator Habitat (POL)	7.76	Moderate	10.00	Higher	6.43	10.00
Native Plant Habitat (PH)	4.70	Moderate	7.62	Moderate	5.78	7.62
Public Use & Recognition (PU)			0.23	Lower		0.45
Wetland Sensitivity (Sens)			2.78	Lower		3.59
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			6.23	Higher		3.18
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	1.43	Lower	6.94	Higher	3.02	3.08
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	2.51	Lower	10.00	Higher	4.93	10.00
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	7.70	Higher	7.24	Higher	5.79	4.42
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	6.33	Higher	8.14	Higher	5.37	8.03
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.20	Higher	9.60	Higher	6.32	9.60
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			4.51	Moderate		3.38

Wetland ID: Area 4D

Date: September 04, 2020

Latitude & Longitude (decimal degrees): 44.713185, -63.529040

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	1.50	Lower	7.11	Higher	3.06	3.15
Stream Flow Support (SFS)	3.31	Moderate	5.67	Moderate	2.67	3.70
Water Cooling (WC)	5.10	Higher	7.68	Higher	3.40	4.10
Sediment Retention & Stabilisation (SR)	2.19	Lower	10.00	Higher	3.91	10.00
Phosphorus Retention (PR)	0.00	Lower	10.00	Higher	3.35	10.00
Nitrate Removal & Retention (NR)	3.30	Moderate	10.00	Higher	5.23	10.00
Carbon Sequestration (CS)	0.16	Lower			5.27	
Organic Nutrient Export (OE)	8.63	Higher			6.03	
Anadromous Fish Habitat (FA)	6.45	Higher	2.78	Moderate	4.23	1.76
Resident Fish Habitat (FR)	6.36	Higher	2.66	Moderate	3.37	1.66
Aquatic Invertebrate Habitat (INV)	8.06	Higher	6.44	Higher	6.82	4.58
Amphibian & Turtle Habitat (AM)	6.34	Moderate	5.96	Higher	6.40	6.88
Waterbird Feeding Habitat (WBF)	5.63	Moderate	10.00	Higher	4.32	10.00
Waterbird Nesting Habitat (WBN)	3.94	Moderate	10.00	Higher	2.85	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	7.35	Moderate	10.00	Higher	6.33	10.00
Pollinator Habitat (POL)	7.76	Moderate	10.00	Higher	6.43	10.00
Native Plant Habitat (PH)	4.05	Moderate	7.59	Moderate	5.52	7.59
Public Use & Recognition (PU)			0.23	Lower		0.45
Wetland Sensitivity (Sens)			1.71	Lower		3.26
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			6.23	Higher		3.18
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	1.50	Lower	7.11	Higher	3.06	3.15
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	2.35	Lower	10.00	Higher	4.85	10.00
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	7.45	Higher	7.14	Higher	5.77	4.36
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	6.09	Higher	8.14	Higher	5.32	8.03
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.07	Moderate	9.60	Higher	6.26	9.60
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			3.97	Moderate		3.22



APPENDIX C
Site Photos

Areas 1A to 1G



Photo 1. Area 1A – Looking west across the main tailings deposit; edge of wetland at right.



Photo 2. Area 1A – Looking south from the location above, toward Area 1C. There is significant rutting by off-road vehicles. In the distance, Mitchell Brook flows from left to right from the treeline into the shrubby meadow.



Photo 3. Area 1A – Looking southwest from the location above toward Area 1E.



Photo 4. Area 1A – At the east end of Area 1A, recreational vehicles access the site through the wetland.



Photo 5. Area 1C – Typical “low” vegetation structure in the impacted wetland. Warning signs about the contamination are visible on the tree.



Photo 6. Area 1C – Common ground cover includes marsh fern (*Thelypteris palustris*), Canada rush (*Juncus canadensis*), water horsetail (*Equisetum fluviatile*), and red-top (*Agrostis stolonifera*).



Photo 7. Area 1C – Looking southeast along Mitchell Brook in Area 1C. Vegetation is similar to 1A but somewhat higher and more diverse.



Photo 8. Area 1C – Mitchell Brook is approximately 1 m wide at this point and 50 – 100 cm deep. Cattails are scattered throughout Area 1C.



Photo 9. Area 1C – Looking south in Area 1C. The wetland includes more diverse structure including tall shrubs, tree saplings. The topsoil has a much higher organic content than Area 1A



Photo 10. Area 1C – Intermittent drainage channels have formed in Area 1C that appear to flow toward the highway (Culvert 1A). Possibly this indicates that Mitchell Brook does not effectively drain the wetland during high flow events



Photo 11. Area 1E – Wetland area appears to increase in wetness going west along Mitchell Brook. Area 1E showed visible small pools and more dense cattails.



Photo 12. Area 1E – Looking southwest across Area 1E toward Culvert 2.



Photo 13. Area 1A (extremity) – There is a small extremity of Wetland 1A that is adjacent to the north edge of the core tailings deposit. It is connected to the rest of the wetland along a narrow drainage path (below).



Photo 14. Area 1A (extremity) – Off-road vehicles have been driven in the drainage corridor of the wetland extremity, causing more rapid drainage to develop. Signs of seasonal severe erosion/sedimentation were observed along this path.



Photo 15. Area 1D – Looking west toward Area 1D. Coarse waste rock and fine tailings were observed in the wetland; however, the general vegetation community is very similar to both 1A and 1C.



Photo 16. Area 1D – Looking north from the location above; wetland to the left and adjacent mixed forest to the right. The wetland boundary is fairly sharp at the toe of relatively steep slope.



Photo 17. Area 1D – Wetland soil is fully saturated grey sand with variable thin organic layers at the surface.



Photo 18. Area 1D – The adjacent upland soil is also grey sand at depth but with no saturation and signs of weak podzolic soil development. It is possible that the natural soil colour is grey; which adds some complexity to wetland delineation.



Photo 19. Area 1A to 1G – Typical mixed forest upland habitat around the wetland.



Photo 20. Area 1A to 1G – The ground cover is variable, sometimes sparse, with a thick layer of accumulated conifer needles.



Photo 21. Area 1B – Looking east toward the inlet of Mitchell Brook into Wetland. Water appears to flow through a jumble of coarse rock rubble with no discernable natural channel. Some of the rubble is a rock wall (lower left), possibly remains of a former control structure.



Photo 22. Area 1B – The water at the inlet was clear and supported aquatic vegetation. The degree of interruption to fish passage is unknown.



Photo 23. Area 1B – Looking south from the location above, along a constructed forest road. The road crosses through the edge of the wetland.



Photo 24. Area 1B – The above road width has been filled with coarse waste rock.



Photo 25. Area 1B – Looking west from the forest road toward Area 1B. The vegetation is quite similar to the other wetland areas but with 1-2 m height and variable species dominance.



Photo 26. Area 1B – A portion of the wetland in Area 1B has been significantly disturbed by historic earthworks (right side of photo). This area has generally revegetated naturally and has developed open water habitat in the excavations.



Photo 27. Area 1G – Looking south in Area 1G across a large beaver pond.



Photo 28. Area 1G – The beaver pond area has been much larger than at present and a significant fringe of dead forest surrounds the pond.



Photo 29. Area 1G – Looking west from Area 1G along a deep man-made trench that drains this part of the wetland. The trench connects directly to Mitchell Brook where it enters Area 1C from the forest edge.



Photo 30. Area 1G – A small beaver dam currently blocks effective drainage in the trench but there is still a significant flow downstream.



Photo 31. Area 1B – Looking east along Mitchell Brook as it passes through the forest between Area 1B and 1C. There is much woody debris and shade (i.e., potentially good fish habitat)



Photo 32. Area 1C – Looking east toward the confluence of Mitchell Brook with the man-made trench. The contributing flow from the trench is significant.



Photo 33. Area 1E – Looking west from Area 1C to 1E. Large cattail beds are visible in the distance (light green fringe before forest edge).



Photo 34. Area 1E – Much of Area 1C is covered by algae coated thatch indicating a seasonal flooding condition.



Photo 35. Tailings Area 1F – Looking west across Area 1F, which was considered too small to be a regulated wetland. The reason for its existence is the site access road (seen in the distant gap in trees, which has no culvert).



Photo 36. Tailings Area 1F – the majority of the ground in Area 1F is coarse waste rock and an old road (lower right) which leads to an abandoned mine shaft nearby.



Photo 35. Mitchell Brook downgradient of Area 1E –Two large culverts (Culvert 2 in Figure 2) at Mitchell Brook where it crossed the highway.



Photo 36. Mitchell Brook downgradient of Area 1E – Water stains indicate significant high seasonal flows.



Photo 35. Mitchell Brook downgradient of Area 1E – Looking downstream from Culvert 2; the gradient is very steep and fast flowing.



Photo 36. Mitchell Brook downgradient of Area 1E – At one point, the water flows in a thin sheet over a bedrock chute.

Area 3A



Photo 1. Area 3A – Looking north from wetland centre across a beaver pond. It is not clear if the pond is entirely due to beaver or if there was an original excavation.



Photo 2. Area 3A – Looking south from the location above toward tailings impacted wetland. There is coarse and fine tailings around the eastern edge of the wetland and several fenced in abandoned mine works.



Photo 3. Area 3A – Looking east along the beaver dam. Water in the pond and drainage from it was visibly dirty, following significant rain the previous night.



Photo 4. Area 3A – Looking west from the location above. The western shore is a very steep slope.



Photo 5. Area 3A – Fenced in mine works are visible at centre and historic mining earth disturbance remains partially bare.



Photo 6. Area 3A – There is a fairly large amount of shallow vegetated open water in the wetland providing attractive waterfowl habitat. A hunting blind was observed adjacent to the pond.

Area 3B



Photo 1. Area 3B – Wetland occupies a small basin in the landscape with only occasional (roadside) surface flow from upgradient. Coniferous trees, dead and living, ring the wetland margin.



Photo 2. Area 3B – An area of historic fill (presumably mine tailings) was observed on the east edge where low growing vegetation persists.



Photo 3. Area 3B – Adjacent to the wetland (left side), the fill (gravel and fines) is almost unvegetated in places, having only lichen and moss cover.



Photo 4. Area 3B – Unvegetated fill deposit adjacent to wetland.



Photo 5. Area 3B – The dominant wetland vegetation is cattails and speckled alders.



Photo 6. Area 3B – The wetland soil is fully saturated grey coarse sand with relatively low organic content.



Photo 7. Area 3B – The adjacent upland is immature coniferous forest with a dense crown cover and sparsely vegetated needle covered ground surface.



Photo 8. Area 3B – The upland soil is also grey coarse sand, showing signs of leaching and iron accumulation in the upper part.



Photo 9. Area 3B – A small stream flows out of Area 3B, showing signs of seasonal high flow volumes. This watercourse flows intermittently into the beaver pond at the south end of Area 3C.



Photo 10. Area 3B – The bed is filed with sand over coarse rock fragments.

Area 3C



Photo 1. Area 3C – A man-made trench drains Area 3A.



Photo 2. Area 3C – The trench empties into the southwest corner of Area 3C in the edge of a beaver impoundment. At the time of the survey, the water level was very low, possibly indicating the dam was not being maintained.



Photo 3. Area 3C – Looking south in the main beaver pond, toward the direction that receives drainage from Area 3B. There are signs of severe seasonal erosion.



Photo 4. Area 3C – The beaver pond is located in an area of significant historic mine tailings deposits.



Photo 5. Area 3C – A beaver lodge is present, although normally it would be surrounded by water.



Photo 6. Area 3C – Currently there is a large, vegetated area in the drained beaver pond with a network of shallow water channels.



Photo 7. Area 3C – There is a better maintained beaver dam further downstream at the powerline corridor.



Photo 8. Area 3C – Looking west at the powerline, across the main drainage channel in Area 3C (flows from left to right). The wetlands in Area 3 are “topographically constrained”, having relatively steep sided ridges along the edges.



Photo 9. Area 3C – Looking northeast in an extremity of Area 3C where a smaller tributary joins it north of the powerline.



Photo 10. Area 3C – Looking east along the powerline in the southwest "lobe" of Area 3C. There was no indication this part of the wetland has been impacted by historic mining activity.



Photo 11. Area 3C – Looking northeast in the large flat meadow of Area 3C. The vegetation is somewhat similar to other tailings impacted areas. There is no channel in this meadow and the water flow must be mainly sheet flow.



Photo 12. Area 3C – The wetland soil is grey coarse sand, identical to other tailings impacted sites. The sand substrate is dense and firm to walk on.



Photo 13. Area 3C – Looking west, where a major tributary enters the wetland. The more impacted wetland area is visible at left. It appears the wetland areas north of the watercourse (right side) are less heavily impacted.



Photo 14. Area 3C – Looking southwest across the main meadow toward the location in Photo 11, above. More natural wetland vegetation and landforms begin to develop as indicated by increased microtopography, higher organic content in soils, and higher species diversity.



Photo 15. Area 3C – Looking southeast, across the wetland where impacted areas (at right) appear to transition into natural conditions (at left).



Photo 16. Area 3C – Looking northeast, downstream from the location above. From this point on, the condition of the wetland appeared relatively natural.



Photo 17. Area 3C – Some uplands in Area 3C show signs of past timber harvesting with relatively young regen and open structure.



Photo 18. Area 3C – Mature forest is dominated by softwoods and there is a high percentage of blow-downs, perhaps indicative of coastal hurricane influence.

Area 3D



Photo 1. Area 3D – The south end of Area 3D is predominantly shrub swamp.



Photo 2. Area 3D – There is standing water and deep muck in the south part.



Photo 3. Area 3D – The south part and the north part are connected by a narrow drainage path.



Photo 4. Area 3D – The north part of the wetland is more open, consisting of peatland (poor fen) with a shrub swamp margin.



Photo 5. Area 3D – Thick sphagnum moss covers most of the ground and there is little standing water. There is no obvious indication of historic mining impacts in this wetland, although abandoned mine works are directly adjacent.



Photo 6. Area 3D – The surrounding upland is mature mixed forest with an open canopy. The terrain is rippled with bedrock ridges.



Photo 7. Area 3D – Old mine road adjacent to wetland in Area 3D.



Photo 8. Area 3D – Abandoned mine work adjacent to wetland in Area 3D.

Area 4A (Barry's Run)



Photo 1. Area 4A – Looking east along Barry's Run.



Photo 2. Area 4A – The majority of the wetland is shrubby fen peatland.



Photo 3. Area 4A – There are smaller areas dominated by sedges.



Photo 4. Area 4A – There are signs of infrequent off-road vehicle impacts (semi-annual).



Photo 5. Area 4A – The aquatic habitat appears highly productive with much floating leaved vegetation. Woody debris like this fallen tree provide ideal basking platforms for turtles and shelter for fish.



Photo 6. Area 4A – The inlet to the main Barry's Run meadow is a broad rocky riffle.



Photo 7. Area 4A – Shortly upstream of the meadow, at a slightly higher elevation, is a long wide slow-moving section of stream.



Photo 8. Area 4A – The watercourse flowing down from Area 4B is a steep rocky riffle with turbulent pools.

Area 4B



Photo 1. Area 4B – A beaver dam controls flow at the outlet.



Photo 2. Area 4B – The beaver pond appears to contain deep deposits of dense grey sand which may be historic mine tailings.



Photo 3. Area 4B – Looking upstream from the beaver dam. The wetland is mostly emergent vegetation north of the stream (at left) and alder shrub swamp on the south (at right).



Photo 4. Area 4B – The emergent vegetation community is predominantly cattails and rushes.



Photo 5. Area 4B – There is a large disturbance caused by off-road vehicle's which remains unvegetated. The soil is grey sand and may be historic mine tailings.



Photo 6. Area 4B – A smaller channel enters from the northeast that receives drainage from Area 1D via Culvert 3.



Photo 7. Area 4B – Looking downstream from Culvert 3, the drainage to Area 4B is intermittent in summer, frequently disappearing below ground but flowing permanently in sections.



Photo 8. Area 4B – Culvert 3 has signs of seasonal high-volume flows but in July there was no flow in the culverts, although a strong current emanated from the base of the embankment.



Photo 9. Area 4B – The main inlet to the wetland is a broad rocky channel that receives combined flow from Mitchell Brook (Culvert 2) and Areas 4C & 4D to the southeast.



Photo 10. Area 4B – Looking upstream from the location above. This wetland seems to have attracted interest from recreational users, having a primitive footbridge and well used trails around it.

Area 4C



Photo 1. Area 4C – A beaver dam controls water at the outlet of Area 4C.



Photo 2. Area 4C – Looking upstream from the location above. There are signs of variable high-water levels, perhaps seasonally.



Photo 3. Area 4C – The beaver pond has areas with both orange and green algae.



Photo 4. Area 4C – Cattails and rushed dominate the open middle with a fringe of alder shrubs and small coniferous trees (mainly tamarack). There are no indications of historic mining activity.

Area 4D



Photo 1. Area 4D – This wetland is at a slightly higher elevation than Area 4C and has no standing water (except perhaps seasonally). The vegetation is a mix of open meadow and tall shrub swamp.



Photo 2. Area 4D – The margin of the wetland is swampy including some trees. There is no indication of historic mining impacts. The soil appears naturally developed with high organics.



Photo 3. Area 4D – An inlet channel was dry at the time of the visit.



Photo 4. Area 4D – A steep intermittent stream flows from Area 1E via Culvert 1. There are signs of seasonal high-volume flow. The flow infiltrated into the ground before reaching the wetland.



Photo 5. Area 4D – There was no flow in Culvert 1, despite recent rain.



Photo 6. Area 4D – Looking downstream from the culvert above. A small current emanates from the embankment fill several metres downgradient.