JUNIPER ORGANICS LIMITED

MCKIEL BOGS DEVELOPMENT PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT

JUNIPER, NEW BRUNSWICK

JUNE 2024 CONFIDENTIAL

WSP REFERENCE: CA0010514.9469 FINAL

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REFERENCE TO BE CITED

WSP. 2024. McKiel Bogs Development Project, Environmental Impact Assessment, Juniper, New Brunswick. Report produced for Juniper Organics Limited. WSP Reference: CA0010514.9469. 79 pages and appendices.

EXECUTIVE SUMMARY

Juniper Organics Limited (JOL) is an affiliate of J.D. Irving, Limited and has operated since 2012 in Juniper, New Brunswick. Juniper Organics manufactures peat moss, grower mixes and retail products for the Eastern North American market. The plant produces loose-filled and compressed bags in various formats. JOL has developed and is currently harvesting peatland 846 in Juniper to provide raw material for the plant. It intends to develop the McKiel bogs to increase the peat supply to the Juniper processing facility to optimize its operation and ensure long-term activity at this plant.

As required by subsection 5(1) of the *Environmental Impact Assessment Regulation* (Regulation 87-83) for projects that affect two hectares (ha) or more of bog, marsh, swamp or other wetland, JOL must submit a registration document to receive approval from the Department of Environment and Local Government (DELG) for its McKiel Bogs Project. The company appointed WSP Canada Inc. (WSP) to prepare the registration document in accordance with the *Guide to Environmental Impact Assessment in New Brunswick* and the *Sector-specific Guidelines for Peat Development Projects* of the DELG.

The McKiel bogs are located on private land 17 km northeast of the village of Juniper. The site, which straddles York and Carleton counties, can be accessed from Highway 107 in Deersdale through a forest road. According to the New Brunswick Peatland Inventory database, it comprises peatlands No. 850, 851 and 852. They cover 67, 100, and 120 ha, respectively, for a total of 287 ha, including 186 ha with peat depth greater than 1 meter (m).

McKiel bogs' project will consist of standard peat operations using the pneumatic method with vacuum harvesters. A total of 117.45 ha will be developed for harvesting out of the 287 ha or 41 %. It will necessitate the construction of a drainage network of secondary drainage ditches, main ditches, and sedimentation ponds. Infrastructure will include access roads (1.4 km), bog roads (7 km) and three 0.1-ha service areas, one for each bog. The project includes the conservation of 43.6 ha, which is comprised mostly of areas with several pools or shallow peat and donor sites covering 20.5 ha, which will be used for the restoration.

The project will be completed in three phases: construction, operation, and reclamation. The construction phase will extend over a four-year period. All infrastructure will be constructed in the first year, and the harvested area will be developed during the following three years, one bog being developed each year in the following order: 850, 852, and 851.

The proposed drainage network will capture all the water flowing from the harvested fields and infrastructure and the water will be directed into the sedimentation ponds and/or over low vegetated land areas (overland flow) to filter water before it reaches receiving watercourses in accordance with current requirements. The overland flow will be used at four drainage outlets located more than 100 m away from the receiving watercourse. Sedimentation ponds combined with the overland flow will be used to ensure more efficient trapping of suspended peat sediment for 8 outlets located less than 100 m from the receiving watercourse.

The operation phase involves harrowing, harvesting, stockpiling, and transporting peat. It also includes maintenance of fields and infrastructure that will be carried out annually or as needed. During this phase, the drainage network will remove water from the fields to create the necessary conditions for drying and harvesting peat without affecting the flow rate or water quality in the receiving watercourses.

The McKiel bogs, at full open capacity (117.45 ha), are expected to provide up to 82,218 meters cube (m^3) annually to the Juniper facility. Production will slowly decrease by 2030. The bog's life expectancy is estimated at about 40 years and the total production is at 1,757,872 m^3.

The project does not include the construction of a peat-processing plant, since the peat will be transported to JOL's Juniper facility to be processed. Adding the McKiel peat bogs would allow an additional eight seasonal positions on the new bog.

Peat harvest will cease when the remaining peat layer reaches approximately 50 centimetres (cm). This layer of peat will serve as a basis for restoring the site to a wetland ecosystem. The reclamation phase involves returning the site to wetlands, mostly through Sphagnum Revegetation. Areas unsuitable for Sphagnum Revegetation will be reclaimed as Forested Wetland Habitat. Bog ponds will also be created among the Sphagnum Revegetation and Forested Wetland Habitat areas. The site reclamation phase will proceed progressively as fields will be closed to harvest.

Peatlands No. 850, 851 and 852 are located in the Central Uplands ecoregion of New Brunswick. This ecoregion sits at a higher elevation than the surrounding Lowlands ecoregion. Therefore, the climate is cooler, with relatively abundant precipitation. The topography of the ecoregion limits the quantity of wetlands. Alder swamps and marshes surrounding lakes are the most common wetlands of the ecoregion. No Special Status Area is present in a radius of five kilometers (km).

The project site is located in the Beadle Ecodistrict, a region covered at 92% by forests. Peatlands 850, 851 and 852 are all part of McKiel bogs, a wetland complex located in a small basin surrounded by low hills. Each bog has one peat dome with ±2 m of poorly decomposed surface peat layer on top of 2 m of well-humified peat and a maximum peat depth of 5.2 m. McKiel bogs are covered by typical peatland plant communities that are Sphagnum Lawn Peatland, Sphagnum Peatland with Pools and Sphagnum Shrub Peatland characterized by black spruce in the tree layer, a well developed ericaceous shrub layer and a moss carpet dominated by Sphagnum species. No special status plant species were found during a plant survey, and a survey for the Southern Twayblade will be conducted in June 2024.

Terrestrial mammals present in the surrounding forest may use peatlands on a transient basis. Breeding birds and Common Nighthawk surveys will be conducted in June 2024.

McKiel bogs straddle the watersheds of Carson Brook, Unnamed Brook, Kenny Brook, McKiel Lake, and McKiel Brook. McKiel Lake receives the water from Carson Brook, Kenny Brook, and Unnamed Brook. It is one of the area's large lakes and covers 151.5 ha. McKiel Lake discharges to the west into McKiel Brook, which flows toward the Southwest Miramichi River. Thus, the project site is located within the Miramichi River watershed. A fish survey conducted in September 2023 in the four watercourses revealed the presence of Atlantic Salmon in Kenny Brook and the Unnamed Brook and Brook Trout in Kenny Brook. Fish surveys conducted by Fisheries and Oceans Canada (DFO) in 2022 and 2023 revealed the presence of 11 fish species including the American Eel and the absence of the Atlantic Salmon.

The project site is located on lands believed to be Mi'gmaq traditional territory that may also be of interest to the Wolastoqey. The closest Indigenous community is the Wolastoqey community of Tobique First Nation (Neqotkuk). The closest Mi'gmaq communities are Natoaganeg (Eel Ground) and Metepenagiag (Red Bank).

Overall, the area surrounding peatlands No. 850, 851 and 852 is sparsely populated and there is no inhabited settlement within a 10 km radius of the project site.

Due to the proposed mitigation measures, the McKiel Bogs Project is expected to have little impact on the environmental components. Diffuse overland flow and its combination with sedimentation ponds at drainage network outlets will efficiently capture suspended peat particles and prevent impact on downstream fish and fish habitat. The preservation of 43.6 ha out of the 287 ha covered by the peatlands and the site's location in a region covered at 92% by forest will provide habitat to plant and wildlife throughout the duration of the project. The project will temporarily stop carbon sequestration by the peatland until it is restored. The implementation of the reclamation plan will ensure re-establishment of Sphagnum dominated plant communities and the return of the ecosystem’s functions such as carbon sequestration, hydrologic regime, and species and habitat diversity. Specific mitigation measures also address other components such as air and soil quality, workers' health and safety, and fire. As the area is relatively undeveloped, except for the Juniper peatland 15 km to the southwest, no cumulative impacts are expected.

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ABBREVIATIONS AND ACRONYMS

AHB: Archaeological and Heritage Branch

CSPMA: Canadian Sphagnum Peat Moss Association

DELG: New Brunswick Department of Environment and Local Government

DNRED: New Brunswick Department of Natural Resources and Energy Development

EIA: Environmental Impact Assessment

EPP: Environmental Protection Plan

JDI: J.D. Irving, Limited

JOL: Juniper Organics Limited

MTI: Mi'gmawe'l Tplu'taqnn Inc.

NBAPC: New Brunswick Aboriginal People's Council

NBPMA: New Brunswick Peat Moss Association

OMRI: Organic Materials Review Institute

WNNB: Wolastoqey Nation in New Brunswick

WSP: WSP Canada Inc.

1 Introduction

Juniper Organics Ltd. (JOL) is an affiliate of J.D. Irving, Limited (JDI) and has operated since 2012 in Juniper, New Brunswick. JOL manufactures peat moss, grower mixes and retail products for the Eastern North American market. The processing, mixing and bagging plant produces loose-filled and compressed bags in various formats. Juniper Organics Ltd. developed and has a current harvesting operation on peatland 846 in Juniper that consists of 160 hectares (ha) of operational peatland. This project aims to increase the peat supply to the Juniper processing facility to optimize its operation and ensure long-term activity at this plant.

The McKiel bogs are located 17 kilometers northeast of the village of Juniper in Carleton County. The site can be accessed from Highway 107 in Deersdale through a forest road. According to the New Brunswick Peatland Inventory database, it consists of peatlands No. 850, 851 and 852 (Keys and Henderson, 1988). They cover 67, 100, and 120 ha, respectively, for a total of 287 ha, including 186 ha with peat depth greater than 1 meter (m). The McKiel bogs at full open capacity (117.45 ha) are expected to provide up to 82,2180 m^3 annually to the Juniper facility. Juniper will comply with all applicable regulations.

The company retained the services of WSP Canada Inc. (WSP) to assist with the obtention of the necessary permits and approvals. McKiel Bogs Project must be registered under the EIA Regulation (87-83) under the Clean Environment Act as it will affect two hectares or more of bog, marsh, swamp, or other wetland. This document represents the Environmental Impact Assessment (EIA) that is part of the proponent's project registration. It was prepared in accordance with *A Guide to Environmental Impact Assessment in New Brunswick* (Department of Environment and Local Government, 2023a) and the *Additional Information requirements for Peat Development Projects* (Department of Environment and Local Government, 2023b) of the New Brunswick Department of Environment and Local Government (DELG). This EIA document includes:

- Presentation of the proponent and rationale for the project;
- Description of the project construction, operations, and decommissioning phases;
- Description of the physical, biological, and human environment;
- Summary of the project's impacts and associated proposed mitigation measures and a monitoring program.

2 The Proponent

2.1 Juniper Organics Limited

Juniper Organics Limited (JOL) is an affiliate of J.D. Irving, Limited (JDI) and has operated since 2012 in Juniper, New Brunswick. It is a well-known peat moss producer and has developed expertise in peatland management and peat processing over the years. Juniper Organics manufactures peat moss, grower mixes and retail products for the horticulture market. The plant produces loose-filled and compressed bags in various formats. The plant is a 100,000-square-foot facility capable of processing 390,000 m^3 annually when operating two shifts. The plant has three separate modern bagging lines – one loose fill (form, fill & seal), one 4-stage baler, and one large format tower baler.

Juniper Organics Limited has a current harvesting operation on peatland 846 in Juniper that consists of 160 ha of operational peatland. It supplies only a portion of the current plant's manufacturing capacity. JOL's goal is to optimize the use of this facility and ensure the sustainability of peat resources in anticipation of the closure of certain areas in Peatland 846 as they move into the restoration.

Currently, JOL employs four year-round and 19 seasonal employees. Developing and operating the McKiel peat bogs would allow more year-round positions at the plant and an additional eight seasonal positions on the new bog.

The company is a member of the CSPMA (Canadian Sphagnum Peat Moss Association), NBPMA (New Brunswick Peat Moss Association), and OMRI (Organic Materials Review Institute), and it is Veriflora certified.

2.2 Contact Information

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3 The Undertaking

3.1 Project Overview

The present registration document proposes the development of McKiel bogs located near Deersdale, NB and 17 km northeast of the village of Juniper (Map 1). McKiel bogs comprise three peatlands identified in the New Brunswick Peatland Inventory database (Keys and Henderson, 1988) as peatlands No. 850, No. 851 and No. 852.

The site will be developed over a four-year period. All infrastructure is intended to be constructed in the first year, and the harvested area will be developed during the following three years, one bog being developed each year in the following order: 850, 852, and 851.

McKiel bogs project will consist of standard peat operations using the pneumatic method with vacuum harvesters. It is expected that a volume close to 1.8 million m^3 of peat will be harvested over the life of the bogs, estimated to be 40 years. Peat harvest will cease when the remaining peat layer reaches approximately 50 centimeters (cm). This layer of peat will serve as a basis for the restoration of the site back to a wetland ecosystem.

3.2 Purpose and Rationale for the Project

This project aims to increase the peat supply to the Juniper processing facility to optimize its operation and ensure long-term activity at this plant. The McKiel bogs at full open capacity (117.45 ha) are expected to provide up to 82,218 m^3 annually to the Juniper facility, which will be processed with existing capacity by adding operating hours.

Another goal is to ensure the sustainability of peat resources in anticipation of the closure of certain areas in Peatland 846 as they move into the restoration and provide enough peat to operate one full-time shift at its processing plant. The development of McKiel bogs will also contribute to securing jobs. Currently, JOL employs four full-time and 19 seasonal employees in Juniper. Adding the McKiel peat bogs would allow more year-round positions at the plant and an additional eight seasonal positions on the new bog.

3.3 Project Location

The proposed McKiel bogs project consists of a wetland complex that comprises peatlands No. 850, 851 and 852, as indicated by the New Brunswick Peatland Inventory database (Keys and Henderson, 1988). The McKiel bogs are located 17 km northeast of Juniper, a village located in Carleton County, New Brunswick (Map 1). The bogs straddle York and Carleton counties. Peatlands No. 850, 851 and 852 can be accessed from Highway 107 in Deersdale through a forest road.

The peatlands for the proposed project are located on the northwest side of McKiel Lake. Two small peatlands, No. 1327 and 1329, identified on GeoNB (2024), are located southwest of McKiel Lake.

McKiel bogs are located on PID 75145623 and PID 10002400, which belong to the New Brunswick Railway Company, also an affiliate of J.D. Irving, Limited. JOL may acquire a +/- 430 ha area (proposed Lot -23-01) that extends on both PIDs (Map 2). If the transaction is completed, a new parcel will be created with its own PID. As an alternative, JOL and the New Brunswick Railway Company may enter an alternative commercial agreement where the land remains under the current ownership structure.

3.4 Physical Components and Dimensions of the Project

The McKiel bogs development project will use the conventional peat harvesting pneumatic method (vacuum harvesting). The undertaking will include the following components (Maps 3 and 4; Table 1):

- 3 access roads to reach the three peatlands (No. 850, 851 and 852) from existing forest roads for a total of 1.41 km;
- 16 harvest sectors covering a total of 117.45 ha;
- A drainage network that includes:
  - 6.27 km of main drainage ditches;
  - 8 water outlets with sedimentation pond;
  - 4 water outlets that will discharge drainage water by passive overland flow.
- 3 service areas 0.1 ha each;
- 14 donor sites covering a total of 20.5 ha;
- 4 conservation areas covering a total of 43.6 ha;
- Undeveloped area covering 138.9 ha (<1m of peat) based on GeoNB (2024) peatland delineation.

Table 1 McKiel Bogs Characteristics and Dimensions

Component	Peatland No. 850	Peatland No. 851	Peatland No. 852
Total Peatland Area (ha)[1]	67	100	120
Commercial Peatland Area (ha)[1, 2]	45	70	71
Harvest Sectors	5	4	7
Harvest Area (ha)	34.36	28.74	54.35
Average Depth in Commercial Peatland (m)[1]	3.56	3.49	2.79
Maximum Peat Depth (m)[1]	5.2	5.2	4.1
Volume of surface peat (H1 – H4) within the commercial peatland (Million m^3) [1, 3]	0.75	1.45	1.15
Volume of humic peat (H5 – H10) within the commercial peatland (Million m^3) [1, 4]	0.85	0.99	0.83
Access road length (m)	438	663	301

Component	Peatland No. 850	Peatland No. 851	Peatland No. 852
Bog road length (m)	2,477	2,133	2,388
Main ditch length (m)	1,569	1,545	3,155
Donor site (ha)	1.9	3.8	14.8
Conservation area (ha)	9.4	27.8	6.4

[1] According to Keys and Henderson (1988)

[2] Commercial peatland = Peatland area with a peat thickness greater than one meter

[3] Surface peat corresponds to H1 to H4 peat on the von Post scale

[4] Surface peat corresponds to H5 to H10 peat on the von Post scale

The peat will be processed at the Juniper processing plant.

Buffer zones will be left untouched around parcel boundaries, forested areas, undrained ponds and plant borrow zones for restoration.

The proposed drainage network will capture all the water flowing from the harvested fields and bog roads. The water will be directed into sedimentation ponds and/or diffused overland flow over low vegetated land areas to filter water before it reaches the receiving watercourses.

3.5 Development Plan

3.5.1 Construction Phase

The construction phase includes the construction of infrastructures and the preparation of peat fields. All infrastructures will be located outside the buffer zone around watercourses (80 m) and confluence (100 m) to avoid areas with high archaeological potential.

Access Roads

Access roads will be built between existing forest roads and each peatland (Peatlands No. 850, 851 and 852). These roads will be located entirely on private land. The proposed access roads will cross no mapped watercourses and no culvert installation will be needed.

The access roads will be 5.25 m wide and bordered by 3 m wide ditches when required. All road infrastructure, including ditches, will be built within a right of way of 20 m. The ditches, where required, will have a slope of 45 degrees, and offtake ditches will direct runoff water toward vegetated areas on both sides of the road to avoid direct flow to watercourses. Trees and vegetation will be cleared. The merchantable timber will be marketed to JDI, which has forestry operations in the area, and non-merchantable trees will be used for bog road construction.

Drainage Network

The drainage network of Peatlands No. 850, 851 and 852 will include main and secondary ditches, sedimentation ponds, and diffuse overland flow at discharge outlets. The sequence of work will start with constructing sedimentation ponds and overland flow at discharge outlets. Main ditches and secondary ditches will follow this. The overland flow will be used at four drainage outlets located more than 100 m away from the receiving watercourse. Sedimentation ponds combined with the overland flow will be used to ensure more efficient trapping of suspended peat sediment for 8 outlets located less than 100 m from the receiving watercourse. An outline of the proposed drainage subnetwork is displayed on Map 4.

Sedimentation ponds will follow the technical specifications outlined in relevant guidelines (Thibault, 1998; Landry and Daigle, 2009). They will have an approximate 4.5 m width and 2 m depth. Figure 1 shows a schematic cross-section of a sedimentation pond. The respective length and width are determined in accordance with the drainage subnetwork area in order to ensure a retention volume of 25 m^3 per hectare drained without exceeding 90 m in length. The required pond volume will also be increased by 20% because actual pond width decreases with depth since the sides will slope at an angle of approximately 55° (Landry and Daigle, 2009). The length of ponds #3, #5 and #8 will be increased to respect the length/width ratio. The minimum width was determined to be 3.5 m. As such, a pond of 4.5 m x 2 m x 34 m will allow treatment of 10 ha of peatland area. The size of drainage subnetworks does not require that more than one pond be constructed at outlets. Table 2 presents the size of each sedimentation pond that will be constructed for McKiel bogs. Overland flow outlets will drain area of 2.82 ha, 21.14 ha, 6.3 ha, and 5.53 ha for harvest sectors 1d, 2b+2c, 2d, and 3b respectively (Map 4).

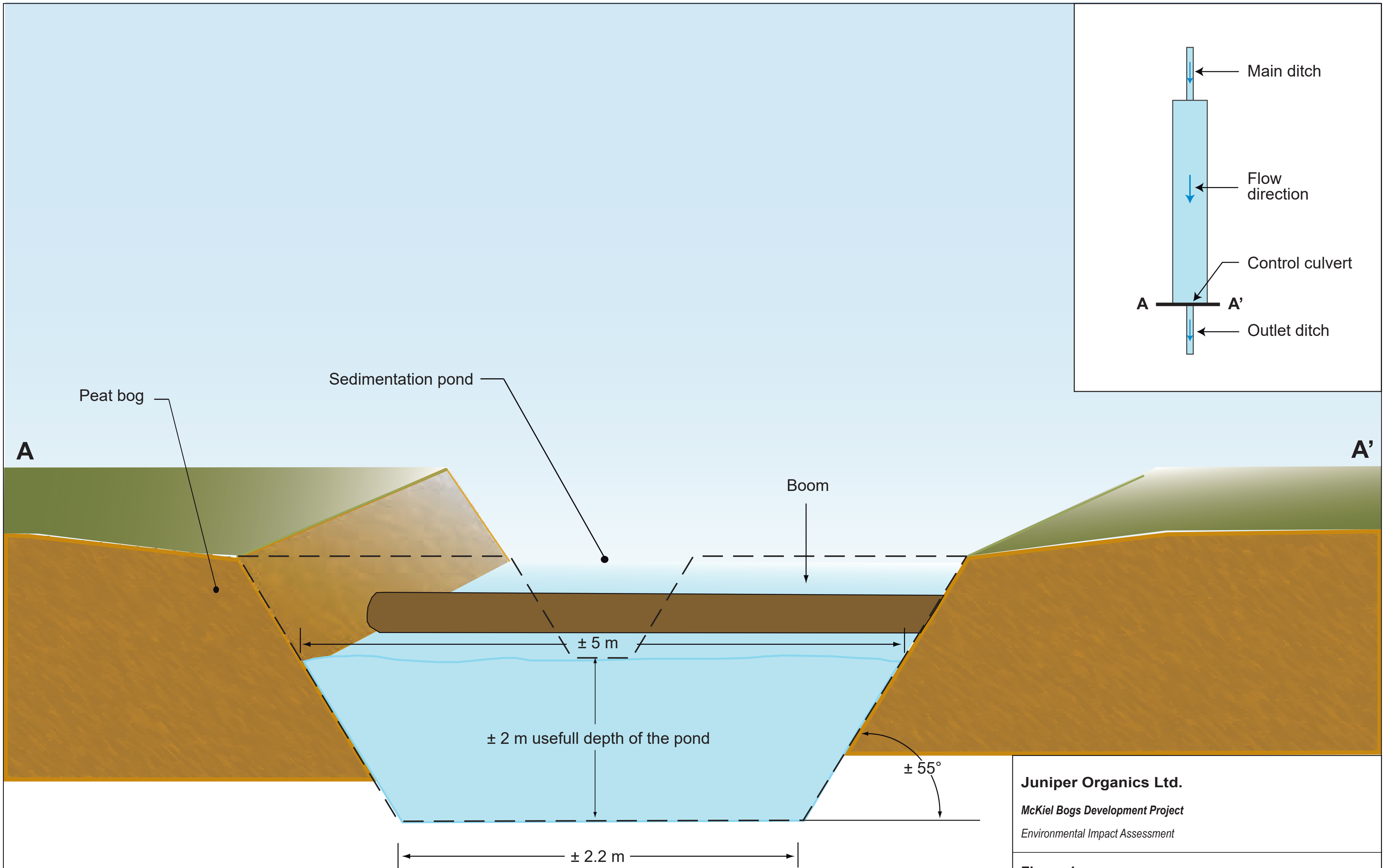
Table 2 Sedimentation Ponds Specification for Each Drainage Subnetwork

Pond No.[1]	Bog	Harvest Sector(s)[1]	Drained Area (ha)	Pond					
				Required Volume (m^3)	Adjusted Volume (+20%)	Width (m)	Depth (m)	Length (m)	Ratio Length/Width
1	850	1e	10.10	252.5	303	4.5	2	34	7.5
2	850	1a + 1b + 1 c	21.44	536	643.2	6	2	54	8.9
3	851	3a	6.66	166.5	199.8	4.5	2	28	6.2
4	851	3d	9.87	246.75	296.1	4.5	2	33	7.3
5	851	3c	6.68	167	200.4	4.5	2	28	6.2
6	852	2e + 2f	15.46	386.5	463.8	5	2	46	9.3
7	852	2g	8.37	209.25	251.1	4.5	2	28	6.2
8	852	2a	3.07	76.75	92.1	3.5	2	22	6.3

[1] Numbering refers to Map 4

Main ditches will run along the downstream edge of harvest areas to collect water from the secondary ditches and channel it towards the sedimentation pond or outlet of the corresponding subnetwork. They will be dug with an excavator to unload the excavated peat over nearby harvest fields or the surface bordering the ditch along segments that do not run next to any harvest field. No mineral material from the bottom of the main ditches will be put on harvest fields. The main ditches will be 2-3 m wide and 2-3 m deep. The total length of the main ditches will be 6.27 km (Table 1).

Secondary ditches will be constructed parallel to each other and ±20 – 30 m apart and run along each harvest field. The secondary ditches will be dug with a V-ditcher pulled by a tractor to a depth of approximately 1.5 m. Width will reach 1.35 m at the ditch's crest, and walls will be sloped at an angle of about 65°. Using a V-ditcher allows excavated peat to spread directly over adjacent harvest fields. Two to three V-ditcher passes within the same ditch are required to obtain the desired depth and width.



Juniper Organics Ltd.

McKiel Bogs Development Project

Environmental Impact Assessment

Figure 1
Schematic Cross-section of a Sedimentation Pond

March 2024

Designed by: F. Quinty
Drawn by: J.-M. Tremblay
Checked by: F. Quinty

File: CA0010514_9469_EIS_f1_sedpond_240325.ai

Service Areas

The McKiel bogs development project requires a service area for each of the three peatlands (No. 850, 851 and 852). There will be no garage for maintenance, no permanent fuel tank (one portable fuel tank at each service area), and no peat stockpiling, so service areas will be minimal. They will have a rectangular shape (20 m x 50 m) and cover 1,000 m^2. Service areas are shown on Map 3, but their precise location will be determined based on local conditions during construction. Each service area will include an employee parking area near the access road for a maximum of 4-5 vehicles (50 feet x 20 feet) and an equipment parking area (120 feet x 50 feet) in this same area. A small building (12 feet by 12 feet) to hold basic maintenance tools and materials and a shelter/break area for employees will be constructed in each service area.

The service areas will not have a water well and bottled water will be provided for employees. A generator will be used for power. There will be no septic, and one portable washroom per bog will be used. A specialized contractor will service it.

For fuel, 2000 liter highway tanks on trailers that meet Transportation of Dangerous Goods Licensing and Inspection requirements will be used. One trailer will be positioned in the service area of each peatland. The trailers will be stationary and licensed. When needed, re-fueling will be conducted in a designated service area. Under no circumstance will equipment be left unattended, or pump nozzles secured during the refueling process. There will be no refueling or maintenance of vehicles or equipment within 30 m of a watercourse. The operator will record all fuel pumped from the tanks when they receive the product. All lubes and petroleum products will be stored in their original containers in a designated area. No petroleum or hazardous material will be stored within 30 m of a wetland or watercourse.

Depending on the maintenance issue, machinery will be maintained at an existing garage in Deersdale or on-site at a designated area.

Peat Field Preparation

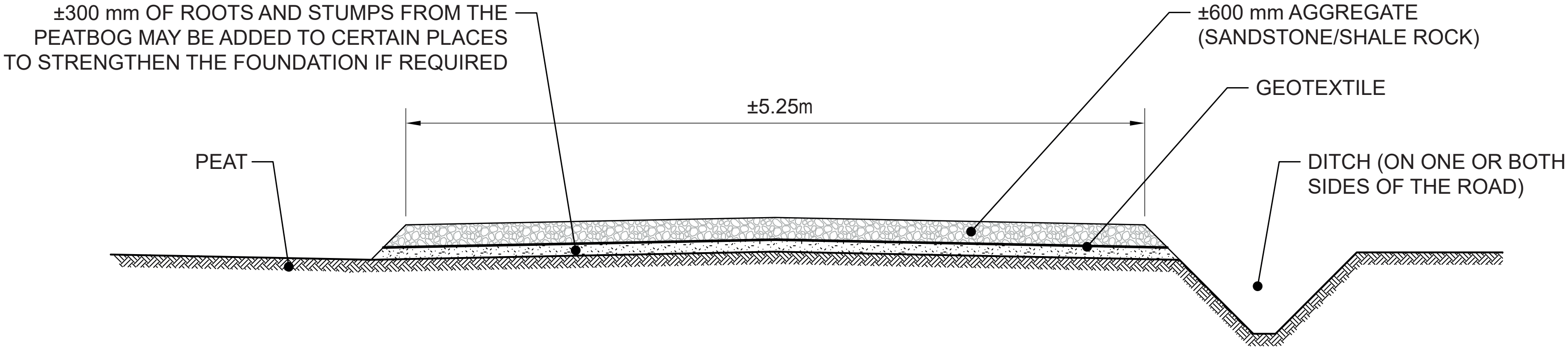
Peat field preparation consists of removing trees and the dome-shaped contouring of peat fields to facilitate drainage. All non-merchantable timber and shrubs are mulched, and the debris is used for bog road construction and to fill depressions in the peatland. Following the removal of trees, the surface vegetation will be shredded with a rototiller or a chopper and mixed with the underneath peat. It is also possible that the surface vegetation collected can be used as plant material for restoration.

A profiler profiles (dome-shape) peat fields by scraping and moving peat from the edges toward the center of fields. This dome-shaped profile allows adequate drainage and favors peat drying.

Bog Roads and Stockpiling Areas

Bog roads will be constructed using mineral material to access peat fields to road trucks. An effort was made to locate bog roads at the periphery of peatlands to minimize the loss of peat under bog roads. The proposed bog roads will cross no mapped watercourses and no culvert installation will be needed.

The mineral material used for the road will be separated from the peat underneath by a geotextile membrane, as shown in Figure 2. An approximately 30 cm layer of branches and roots will be put on top of the peat where required to strengthen the road base. JOL will use aggregate from local sources as mineral material.



Juniper Organics Ltd.

McKiel Bogs Development Project

Environmental Impact Assessment

Figure 2
Bog Road Cross-Section

March 2024

Designed by: F. Quinty
Drawn by: J.-M. Tremblay
Checked by: F. Quinty

File: CA0010514_9469_EIS_f2_bogroad_240325.ai

Bog roads will be ± 5.25 m wide and bordered by a ditch on one or two sides. It is planned that bog roads will stretch over 7 km in total (Table 1).

Internal bog roads include the roads that link the service area to peat harvest areas and will be used by equipment required to complete project activities, including road trucks to haul peat to the processing plant (Map 3). Bog roads may be built on mineral material that could be present between the service area and the peat harvest areas. Within the peatland, construction of bog roads on organic soil will be completed using a base layer of non-commercial timber or woody debris collected during site preparation. Sometimes, bog roads may require a layer of mineral material or gravel. In these cases, geotextile will be installed under the mineral material or gravel to prevent mixing with peat.

In the peat harvest area, the bog roads will be widened to allow temporary stockpiling of the harvested peat along bog roads before loading it into road trucks to be transported to the JOL plant. The stockpiling areas will be made of woody material removed during field preparation. No mineral material will be used in stockpiling areas.

3.5.2 Operation Phase

The operation phase involves harrowing, harvesting, stockpiling, peat transportation, and maintenance.

Harrowing

Peat fields are first harrowed to a depth of approximately 15 cm using tooth rakes attached to tractors. This operation decompresses the undisturbed compacted peat and breaks it into small chunks. Before harvesting can start, fields are again harrowed with other types of rakes to loosen up 2 to 4 cm of peat for drying.

Harvesting

Harvesting may occur between April and November but is generally more frequent between June and September. Weather conditions represent the major constraint since peat must be harvested when dry. Harvesting operations will take place seven days a week under appropriate weather peat conditions. During dry spells, harvesting operations can occur every day for 12-16 hours daily. Harvesting operations stop during significant rainfall and can start again typically two to three days after harrowing and when surface peat reaches the desired moisture content of 45-55%. The expected annual depth rate of harvesting is around 7 cm of peat, representing 700 m^3/ha. Once dry, the peat is collected using a method referred to as pneumatic harvesting with vacuum harvesters. JOL will use standard two-headed vacuum harvesters equipped with dust collection systems. Harvesters typically go up and down a field and dump the harvested peat into stockpiles along the bog road.

Harvesting and harrowing operations alternate all through the harvesting season.

Stockpiling

As mentioned, vacuum harvesters typically travel up and down a field and dump the harvested peat into stockpiles along the bog road. A front-end loader is used to stockpile this harvested peat into larger piles. It is also used to load peat from these field stockpiles into road trucks, carrying it to the processing plant in Juniper. There will be no stockpiling in the service area.

To maintain the quantity and quality of the harvested peat, the stockpiles left in the fall at the end of the harvesting season are covered with large plastic tarps. This procedure prevents loss of peat by wind action or soaking by heavy rain. Covering the stockpiles also reduces the risk of transporting peat particles in the drainage network and/or outside the developed area.

Transportation

There will be no on-site peat processing. Peat will be transported in bulk to the Juniper processing plant using a highway tractor and tarp-covered trailer. Trucks will head south to Deersdale on a forest road for about 13 km and use Highway 107 westward for 17 km before reaching the processing plant in Juniper (Map 1).

Peat will generally be transported daily. The number of shipments will vary depending on the requirements of the Juniper processing plant. An average of 7 daily shipments are expected to travel from McKiel bogs to the processing plant at full production (117.45 ha) based on a volume equivalent to 110 m^3 per truckload over a six-month period of 5 days per week. A larger number of shipments may be necessary during high-demand periods. According to the development plan, the volume of harvested peat will diminish as parts of the peatland are depleted. Consequently, the number of shipments per year will decrease with time (see Section 3.5.5 and Table 5).

Maintenance

To maintain a consistent depth and ensure efficient drainage by the drainage network, the removal of accumulated debris in both secondary and main ditches will be conducted as required. Maintenance activities will be performed, including reshaping the dome-shaped peat fields using a leveler and collecting branches, roots, and wood debris with a specialized rake. Sedimentation ponds will also be cleaned annually or as needed following intense rain or wind events to maintain efficiency. These routine operations are scheduled annually, ideally in the fall following the harvesting season and preceding winter closure. Nevertheless, flexibility allows for executing these tasks whenever the need arises.

Site Access Control

Access to the forest road from Deersdale will be controlled by a gate with cameras at the entrance of the access road. Key cards will be provided to contractors and employees. All in and out swipes will be recorded.

3.5.3 Water Management during Construction and Operation

Peat Deposit Drainage

Water collected by the ditch network during construction will mostly originate from natural storage within peat porosity. Water will drain from the various fields progressively as the bottom of ditches is brought deeper and, consequently, as the local water table is gradually lowered. The occasional surface runoff will also reach the ditches following rainfall once secondary ditches are constructed.

A minor component of water inflow to the ditches will also occur as direct rainfall over their surface. Stagnant water will also be drained in areas where a ditch will intersect a pond (see next section, Ponds Drainage). Drainage water and surface runoff collected from secondary ditches will flow gravitationally toward the main ditches and end up at the downstream end of the subnetwork.

Water will enter and slowly flow through the sedimentation ponds. Water discharge will occur at the pond outlet as overland flows toward the infiltration areas.

The ditch network will be subdivided into a series of subnetworks. The outlet of each subnetwork will not drain more than 22 ha of harvest fields (Map 4, Table 2).

It is important to emphasize that ditch construction within the peatland will be carried out progressively. A maximum of 60 ha of peatland will be open to harvest within the McKiel Brook watershed (part of the Southwest Miramichi River watershed) for a single year. Field opening will be executed in several successive phases during a working season, as each secondary ditch requires two to three V-ditcher passes to be completed. Each of these passes is executed a few weeks apart. Peat field drainage will thus incrementally occur as ditches bordering any given field will deepen. The various fields subdivided through ditching will gradually drain during the following months until the water table reaches a new state of equilibrium. Most of the peat field's drainage process will occur within a year. As such, the residual flow of drainage water will be marginal upon initiating a subsequent ditching season in a different area. Consequently, the annual contribution of drainage water to the global runoff in the various watersheds will be very low, in addition to being spread over several years of field opening.

Ponds Drainage

Ponds found in the McKiel bogs are located where the peat cover is the thickest and on top of peat domes where surface topography is the flattest. As such, ponds are predominantly found in the central portion of the three bogs.

The portion of peatland located in the central part of peatland No. 851 displays a significant density and coverage of ponds over its extent. Pond coverage represents less than 15% of the total area of the three bogs. They essentially occur as large ponds, with more or less concentric patterns in their spatial distribution. Their shape varies greatly and is usually irregular.

The proposed peat development areas have been designed to avoid pond sectors and minimize drainage. It would not be possible to develop the structured network of fields and ditches required for peat harvesting in these sectors without draining the ponds present. As a result, the number and surface area of ponds that will be drained gradually during the opening of peat harvest areas on the three bogs are minimal. Thus, the global impact of pond drainage in these harvest areas will be negligible.

Estimation of Temporal Evolution of Drainage Discharge

Peat fields will be drained by ditching and induce water table lowering progressively. It is estimated that a maximum of 60 ha of peatland will be drained annually in the McKiel Brook watershed until development reaches its full extension.

Each secondary ditch will be ditched in two to three cutting phases until the targeted depth is reached. The time span between each cutting phase may reach several weeks to allow sufficient drainage of any given field and enable the execution of other surface preparation operations.

The anticipated drainage discharge during a ditching season has been evaluated using a conservative approach, assuming that the complete excavation of each ditch will be executed in two phases two weeks apart. Additionally, the estimate was based on the year of greatest expected expansion (Peatland No. 852 in 2026), where 60 ha of fields will likely be ditched in a single watershed[1].

A typical ditch length of 320 m is used, which represents the average ditch length for the largest section to be opened in a single year. This is based on high productivity ditching rates in optimal conditions. It is supposed that the first phase will remove the slice of peat within a depth interval of 0-0.91 m (layer 1), while the second removes the 0.91-1.53 m deep slice (layer 2). A given excavation phase is completed continuously, at a rate of fourteen ditches per day, until the 60 ha surface has been covered at a spacing of 25 m between secondary ditches.

This approach can maximize the peak drainage discharge that may be recorded during ditch network construction. However, one must note that the actual duration of the operations could deviate from this estimate, possibly spread over a longer period.

Drainage discharge was estimated by separating the vertical profile of each peat field into two layers to represent the two stages of secondary ditch excavation. Drainage of each layer was considered independently from the other, and a two-week delay was defined between drainage initiation in two contiguous layers. The delay represents a conservative assessment of the period required for dewatering and surface profiling between the two stages.

Drainage discharge in the first stages of each ditch excavation phase was calculated using the exact solution method of Polubarinova-Kochina (1962), which evaluates the outflow to a fully penetrating channel during the drawdown. Drainage discharge for the later stages was calculated using the Boussinesq (1904) exact solution method. The transition point between the early and late stages of drainage was established using the hydrograph separation approach proposed by Brutsaert and Nieber (1977). The hydraulic properties of the peat were based on the stratigraphic and humification characteristics described by Keys and Henderson (1988) as well as data computed by Carrier (2003) in various peatlands of New Brunswick, Price (1996) and Price *et al*. (2003). The details of the hydraulic properties defined for each peat layer are given in Table 3.

Table 3 Hydraulic Properties Defined for Each Layer of Peat

	LAYER 1 0-0.91 m	**LAYER 2 0.91-1.53 m**
Hydraulic conductivity (m/s)	6.3E-06	2.5E-06
Peat-specific yield (-)	0.250	0.150

The drainage discharge calculations used the geometric and spatial characteristics of the secondary ditches presented in Section 3.5.1.

The peak drainage discharge during the construction of the peatland ditch network was estimated to be 3,032 m³/day for a given watershed. This value is equivalent to a rainfall event with an intensity of 0.21 mm/h over a 60 ha area for a 24-hour period with no infiltration, interception, or storage loss (complete contribution of rainfall to surface runoff). The drainage peak discharge occurs on the fifth day of the first cutting phase since a thicker slice of peat with a higher specific yield is ditched during the first phase. A second drainage peak appears two weeks later on the fifth day of the second phase. Drainage discharge during the second cutting phase remains between 1,480 and

[1] The harvest area to be opened in peat bog 852 is 54.37 ha, but the hydrological estimates uses 60 ha to be conservative.

2,153 m³/day. A sustained decrease in drainage discharge is observed following the end of the second phase, which corresponds to the completion of ditching in the area under consideration. A residual drainage discharge of about 75 m³/day is observed after 365 days, a little more than 2% of the peak discharge value estimated. Figure 3 presents the evolution of drainage discharge during and after ditch network construction in an area of peatland covering 60 ha.

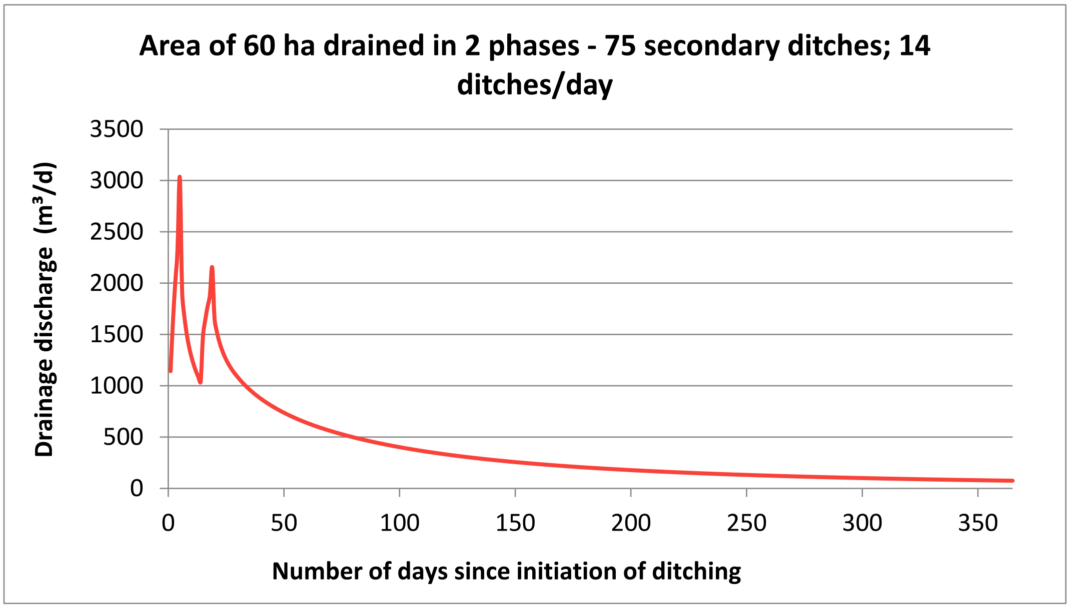


Figure 3 Expected Peatland Drainage Discharge during a Ditching Season

Drainage Water Quality

It is expected that water associated with peat and pond drainage will display a chemical quality typical of that observed in water of undeveloped peatlands. It will thus be acidic, with a relatively low metal content. In contrast, the chemical signature of water originating from surface runoff and discharged at the subnetwork outlets will be similar to that of rainwater and snowmelt, given its short residence time in the peatland. The discharge associated with the resurgence of infiltrated rainfall/snowmelt water in the ditch network will likely exhibit intermediate chemical characteristics and be influenced by both rainfall/snowmelt water quality and the chemical characteristics of peat. Ion content and conductivity of discharge generated by resurgent water will be low, and acidity will be moderate.

In addition, when runoff occurs on a snow-free surface, suspended solids in the form of peat particles will generally be mobilized and transported by the runoff. However, it is expected that suspended solids content in discharge associated with the resurgence of infiltrated rainfall/snowmelt water will be low, as peat particle mobility will be restricted to water flow within the ditches.

Runoff water discharged at the sedimentation ponds or diffuse overland flow outlets will have variable suspended solids content, depending on the intensity of runoff, antecedent climatic conditions, moisture condition of the peat field surface at the start of the runoff event, and field activities being conducted (*e.g.*, maintenance, ditching).

While none of the watercourses located downstream from the bog have been classified under the *Water Classification Regulation*, the fact that no discharge of peatland water will take place in any of these streams prevents significant stream water quality alteration as a result of the development of McKiel bogs.

Water Flow and Discharge during Construction and Operation

Rainfall and snowmelt events will generate surface runoff when the infiltration capacity of the surface has been exceeded. Surface runoff from each field will flow toward the secondary ditches, where the drainage network will collect it.

Surface runoff collection by the drainage network may occur during ditching in response to episodes of runoff-generating rainfall. In such cases, water discharge at the network outlets will originate from drainage and runoff.

Water discharge at the outlets will come from runoff generation induced by precipitation during harvesting. A secondary component of water discharge at the outlet will originate from the resurgence of rainfall/snowmelt from the peat fields and into the ditch network after infiltration and porous-medium flow through peat.

Due to the time required for runoff from distant parts of the watershed to reach a given outlet ("concentration time"), the peak discharge will occur in phase with or slightly lagging, episodes of rainfall or snowmelt. The discharge timing will also depend upon the duration and intensity of the precipitation events, as well as the antecedent climatic conditions and moisture conditions of the peat field surface at the start of the runoff event. The discharge rate will be low to moderate, although it may be elevated during episodes of intense surface runoff. Phases of elevated discharge rates will generally have a short duration. The water discharge volume associated with surface runoff will be proportional to the precipitation recorded and inversely proportional to the magnitude of infiltration and evaporation.

The timing of water discharge associated with the resurgence of infiltrated rainfall/snowmelt in the ditch network will be delayed concerning the infiltration episode(s). This delay might span from a few hours to numerous weeks, depending upon the peat's antecedent moisture conditions and the distance between the location of infiltration and the ditch where resurgence occurs. Water stemming from infiltration and resurgence will thus discharge at the outlets following a proportional time delay. Due to the moderate permeability of drained peat, flow through peat and subsequent discharge to the ditches will occur at a relatively low rate. For this reason, the discharge rate at the network outlets will be low. Volumes of water discharge associated with infiltrated rainfall/snowmelt resurgence will be proportional to the magnitude of infiltration and inversely proportional to the magnitude of evaporation, as well as the volumes of rainfall and snowmelt.

3.5.4 Waste Management

During the construction and operation phases of the project, JOL will apply waste disposal procedures to mitigate all potential impacts of this project.

Table 4 presents the disposal procedure and the waste handling method during the lifespan of operations at McKiel bogs.

Table 4 Waste Disposal Procedure

Waste Type	Handling/Storage Method	Disposal Procedure
Solid landfill wastes are generated because of daily operations	All daily waste will be placed in trash cans and emptied into the dumpster as needed.	When necessary, the waste management company will be contacted to replace the dumpster and dispose of waste.
Waste petroleum products and petroleum-contaminated waste	These products are to be sorted and stored in the appropriate containers in the waste storage area.	A selected and qualified disposal company will remove the containers and dispose of the product in an acceptable manner as needed.
Oil Containers	Empty containers completely	A selected and qualified disposal company will remove the containers and dispose of the product in an acceptable manner as needed.
Tires	Non-serviceable tires should be taken to the Deersdale garage	When required, a qualified disposal agent will be contacted to remove the waste tires
Automotive/Industrial Batteries	Store at the designated area	A qualified disposal agent or recycling company will dispose of batteries as required.
Scrap Metal	Scrap metal items are to be stored in the designated area	As required, scrap metals will be sold to a scrap dealer for recycling

3.5.5 Development Schedule

The development schedule for McKiel bogs was designed based on the following assumptions:

- Harvestable peatland area with a peat depth of 1 m and over = 117.45 ha.
- Harvesting rate = 7 cm/yr.
- Annual yield of 700 m^3 per hectare.
- Loss of 50 cm of surface peat due to subsidence of the surface peat following drainage.
- A 50 cm layer of peat left in place following harvesting.

It was also based on peat depth projections that used data from the New Brunswick Peatland Inventory database (Keys and Henderson, 1988) and peat depth data collected by WSP in spring 2024 shown on Map 5.

The development of McKiel bogs will take over 4 years. The project is expected to begin in 2024 with the construction of infrastructure for the three sites (access roads, service areas, sedimentation ponds, main ditches, etc.). Field preparation will start in 2025 with clearing and field drainage construction of the 34.36 ha harvest area of bog No. 850. Peat harvesting is set to begin in 2026. Bogs No. 852 and No. 851 will be entirely developed in 2026 and 2027, respectively, the same way as bog No. 850. Production will start at 54.35 ha on bog No. 852 in 2027 and 28.74 ha on bog No. 851 in 2028.

That should allow vacuum peat harvesting of about 24,057 m^3 on the initial 34.36 ha as early as summer 2026. The other sectors will be developed in the following years until all the harvest areas are open (117.45 ha). The annual production will increase until it reaches 82,218 m^3 once the harvest area is fully developed and it will decrease progressively as the shallow peat area will be closed. Table 5 presents cumulative production areas, peat production volume, and closed areas over the project lifetime at 5-year intervals.

The 117.45 ha are estimated to supply a total volume of 1,757,872 m^3, equivalent to about 5,871,293 bales (340 L) of horticultural grade peat that will allow this harvesting operation a lifespan of around 40 years.

Table 5 McKiel Bog Development Schedule

Year	Production Area (ha)				Closed Area (ha)	Cumulative Closed Area (ha)	Peat Production (m^3/yr)	Cumulative Peat Production (m^3)
	No. 850	No. 851	852	Total				
Before 2030	34.37	28.74	54.34	117.45	8.50	8.50	61,717	246,869
2030	29.18	28.69	47.44	105.30	7.37	15.87	73,713	320,582
2035	25.65	27.94	41.91	95.50	9.83	25.70	66,848	682,283
2040	21.50	25.80	34.87	82.17	13.09	38.80	57,516	1,007,189
2045	16.93	20.51	27.57	65.01	16.83	55.63	45,509	1,282,762
2050	11.60	12.71	19.48	43.78	21.04	76.66	30,649	1,495,449
2055	6.06	7.03	14.06	27.15	16.38	93.04	19,008	1,637,054
2060	2.85	3.84	6.10	12.80	12.10	105.14	8,957	1,722,045
2065	0.00	0.00	0.00	0.00	12.31	117.45	0	1,757,872

3.6 Reclamation Plan

Juniper Organics Limited is aware of its environmental obligations and is dedicated to complying with all regulatory requirements, including implementing responsible management procedures to mitigate potential impacts and restore or reclaim peatlands at the cessation of harvesting activities. JOL will restore or reclaim former harvested sites based on options offered by the most recent science results and approved by the DNRED and DELG, including:

1 Sphagnum Revegetation;

2 Forested Wetland Habitat;

3 Open Water.

Other options, such as small berry cultivation, are possible, but they do not achieve the re-establishment of functional wetland ecosystems and may not be economically viable (PERG, 2009). Reclamation will then involve the three main options, although JOL favors Sphagnum Revegetation where conditions are suitable. The best available methods at the time of reclamation work will be applied. At this point, this comprises methods developed by the Peatland Ecology Research Group (PERG) for rewetting (Landry and Rochefort, 2012), re-establishing peatland vegetation (Quinty and Rochefort, 2003), and planting tree species (Hugron *et al.*, 2013). The reclamation plan should favor the option with the best chance of success according to anticipated conditions at the cessation of peat harvesting. A detailed reclamation plan that will address peat field restoration and reclamation, as well as infrastructure decommissioning (including access roads and service areas), will be submitted as a separate document.

3.6.1 Sphagnum Revegetation

Sphagnum Revegetation aims to return peat-harvested areas to functional peat-accumulating peatland ecosystems. In the short term, the specific objectives are raising the water table and establishing peatland plant communities dominated by Sphagnum mosses. Meeting these two objectives should initiate a process leading to the return of a functioning peatland.

A method referred to as the Moss Layer Transfer Technique (MLTT) was developed with the help of the Canadian peat industry (Quinty and Rochefort, 2003; Quinty *et al.*, 2020a). Sphagnum Revegetation is best suited when a layer of peat of at least 50 cm deep is left, and ombrotrophic conditions are present, that is, a pH <5.5 and corrected electric conductivity <250 µs/cm (Andersen *et al.*, 2011). Such conditions can be created in abandoned fields where drainage can be blocked without affecting peat roads or nearby fields still being harvested. Management, adequate rewetting, and donor sites with targeted plant communities are among Sphagnum Regeneration’s main drivers of success (Gonzalez and Rochefort, 2014).

This approach consists of shredding the top living vegetation layer in undisturbed peatland areas called donor sites (Quinty *et al*., 2019). This plant material is spread over abandoned peat fields and covered by straw mulch that helps create appropriate growing conditions for peatland species, namely a more humid and temperate microclimate (Quinty *et al.*, 2020b). Light phosphorus-rich fertilizer is added to speed up plant establishment. Secondary and main ditches are blocked or filled to raise the water table and restore the hydrological regime (Quinty *et al.*, 2020c). Site-specific field preparation, such as berm construction, is also required to favor uniform wet soil conditions. Plant material is commonly collected from donor sites such as new peat fields being developed or shallow peat areas unsuitable for peat harvesting. It is important to note that vegetation can recover rapidly in donor areas after collecting plants (Guêné-Nanchen *et al.*, 2019). Some donor sites were used up to three times at intervals of about five years.

The MLTT leads, in most cases, to the progressive return of peatland functions. For instance, recent research showed that a complete plant community including more than 80% of a reference site species could be established within ten years (Poulin *et al.*, 2013; Hugron *et al*., 2020) and that the acrotelm may rebuild in 17 years, thus reducing water level fluctuations (McCarter and Price, 2013; Lucchese *et al.*, 2010). Carbon storage, an important function of peatlands, returns after 14 years and earlier at some sites (Waddington *et al.*, 2010; Strack and Zuback, 2013; Nugent *et al*., 2018).

Juniper Organics Limited proposes to apply Sphagnum Revegetation, where conditions will be appropriate to favor successful reclamation, that should include most of the harvest sectors. However, according to the cross-sections of the Peatland Inventory, sedge peat is found in sectors 2e and 2f (bog 852) under a layer of 1 m of peat dominated by sphagnum. Between 1 and 2 m from the surface, sedge peat is mixed with sphagnum, and pure sedge peat composes the bottom layer of the peat deposit (>2 m).

The presence of sedge is a factor that will be considered for the elaboration of the reclamation plan, but it may not be a determining factor. Although sedge peat is associated with fen and a more nutrient rich status compared to bog, the chemical conditions (mostly pH and electric conductivity (EC)) that will prevail at time of restoration will likely play a more important role than just the presence of sedge in determining what plant community could be restored.

The moss layer transfer technique (MLTT) is the preferred method to restored harvested peatland and it has been successfully applied in transitional peatlands and poor fen (also called sphagnum peatland) where sphagnum mosses and sedge grow together. It is possible that the MLTT be used in presence of a sedge – sphagnum peat mix. If the peat substrate and groundwater show a pH > 5.5 to 5.8 and EC>140 mS/cm (>250 mS/cm according to Andersen *et al.*, 2011), an alternative wetland restoration method will be considered.

3.6.2 Forested Wetland Habitat

Forested Wetland Habitat reclamation aims to turn harvested peat fields into forested wetland habitats comparable to what already exists in the region, especially in poorly drained areas often found at peatland margins. In the short term, the objectives are to maintain a high water table, plant tree seedlings, and promote spontaneous colonization by other plant species to start a process leading to a forest habitat. The goal of Forested Wetland Habitat differs from that of a commercial tree plantation, although specific objectives may be similar. Tree density is lower, and growth and yield may not reach the commercial standard in a peatland environment due to adverse conditions such as a high water table and nutrient-poor conditions.

Tree plantation that leads to Forested Wetland Habitat is a valuable reclamation option in various situations (Hugron *et al.*, 2013). Planted forests around harvested areas located at the peatland margin, which are transitional zones between peatlands and uplands, may contribute to the formation of laggs. Forested Wetland Habitat may also be the favored option for progressive reclamation of fields that can hardly be rewetted because they are surrounded by areas being harvested. Moreover, trees could be planted along access roads where the soil may remain drier and serve as windbreaks.

In practice, Forested Wetland Habitat reclamation consists of planting tree seedlings and favoring spontaneous colonization by vegetation to start a process that will lead to forested wetlands. The two species most commonly planted on abandoned peatlands are Black Spruce (*Picea mariana*) and Tamarack (*Larix laricina*), but other typical wetland tree and shrub species can also be planted. It is strongly suggested to plant more than one species to obtain a higher biodiversity and to prevent plantation die out due to disease or other problems that can affect one species. However, Black Spruce will be favored in drier areas and Tamarack in wetter and more minerotrophic nutrient-rich conditions. According to the current tree planting method in harvested bogs, seedlings are planted at a density of 1,200/ha, corresponding to a spacing of 3 meters between plants and fertilized. Seedlings are planted in patterns that mimic natural forests instead of being planted in line like a tree plantation. Other plant species, such as birch and ericaceous shrubs, should establish themselves spontaneously and increase biodiversity (Poulin *et al.*, 2005). Planted trees should speed up that process by providing sheltered sites. Ditches can be partly blocked to raise the water table without flooding if that does not affect peat fields that are still harvested. Ditches are expected to get clogged with time, and the water level will rise slowly, leading to forested wetland conditions.

Forested Wetland Habitat will be favored in areas where conditions are not optimal for Sphagnum Revegetation, such as where there is less than 50 cm of peat left, in dry conditions or zones influenced by minerotrophic conditions (Hugron *et al.*, 2013). It is expected that such situations will be present toward the peatland margin closer to nutrient-rich habitats, where peat is shallow and along access roads bordered by operational main drainage ditches.

3.6.3 Open Water

McKiel bogs are characterized by a large number of open water bodies. Bog pools of various sizes occupy extensive surfaces in the center of all three peatlands, and substantial portions of these areas will be preserved. Nonetheless, the reclamation plan will include the creation of open water bodies. The *Peatland Restoration Guide* offers guidance for pond creation (Quinty and Rochefort, 2003). Pools may be created by excavating shallow depressions. The excavated peat is spread around the pool and mounds may be created to favor species that prefer drier conditions. Pools usually have small dimensions (<100 m^2) and a curved, irregular shoreline. Usually, created pools occupy a restricted area within reclaimed peatlands as it is technically difficult and costly to excavate large pools. The major problem is to dispose of the excavated peat. One strategy is to create pools in existing depressions where water accumulates naturally among Sphagnum Revegetation and Forested Wetland Habitat areas, thus reducing the need to excavate. Some ditches may also be left as open and enlarged to create water bodies.

Open water bodies improve the ecological value of restored wetlands because bog pools are considered hotspots of natural peatland biodiversity (Fontaine *et al.*, 2007). They provide habitat for ecologically valuable plant species, invertebrates, insects, and birds and wildlife can use them.

Amphibians and certain insects rapidly colonize and create bog pools, while vegetation requires more time to establish (Mazerolle *et al.*, 2006).

3.6.4 Depth of Peat Left on Site

A peat layer of approximately 50 cm will be left on site as much as possible to maintain bog conditions and favor the restoration process. Nevertheless, given the uneven mineral deposit under the peat and the pneumatic harvest method that requires long, flat peat fields, leaving a regular peat layer is impossible, and 50 cm represents an average. It is also possible that a shallow layer of the peat be left in some sectors to benefit from the presence of high-quality peat almost to the bottom of the deposit.

3.6.5 Size and Location of Protected Peatland and Donor Sites

Juniper Organics Limited has designated five zones covering 43.6 ha in the three peatlands that will be protected for conservation purposes (Map 3). These areas comprise the largest pools, including some considered lakes with a 30 m buffer zone around them.

Based on existing vegetation data, 14 potential donor sites have been identified. They are located either at the periphery of the peatlands or around the conservation areas. They cover 20.5 ha, sufficient to restore the 117.45 ha harvest area since donor sites must cover 10% of the area to be restored. The potential donor sites represent 17.4% of the harvest area. The donor sites were validated in the field in the spring 2024.

Extended areas with less than 1 m of peat depth, mostly located in the west part of peatland No. 852, will also be left undeveloped. Provided the species are adequate, they could be used as a source of plants.

3.6.6 Rehabilitation Plan for Drainage Ditches and Infrastructure

Secondary ditches will be filled with peat or left open to create open water. Main ditches will be blocked or filled to ensure rewetting and proper conditions for Sphagnum Revegetation, Forestry Wetland Habitat, open water bodies, or any other wetland reclamation options. Some sections of main ditches may not be filled and may, therefore, become shallow open water bodies. In any case, the sides of the main ditches will be graded to ensure they do not represent a safety hazard for humans and wildlife. Some main ditches located at the periphery of bogs will be filled and their surface reshaped to re-establish connectivity between the restored peatland and the adjacent environment (Quinty *et al.*, 2000c).

Sedimentation ponds will be restored as shallow water bodies in a similar way as the main drainage ditches. Channels at the outlet of sedimentation ponds leading to overland flow will be filled, blocked, and topped with vegetation taken around or seeded with an appropriate seed mix. In any case, blockage of the drainage network will stop water flow towards outlets.

Access roads will be left in place to provide access for post-decommissioning monitoring and fire protection purposes.

3.6.7 Decommissioning Schedule

When possible, JOL will implement appropriate reclamation options within ±3 years after peat harvesting stops on peat fields or sections of fields, provided that it does not interfere with its operations. At this point, it is impossible to develop a decommissioning schedule more precisely than the development schedule (Table 5). Such a schedule will be prepared and updated periodically.

4 Description of Existing Environment

4.1 Physical Environment

The territory of New Brunswick is divided into seven ecoregions based on climate (precipitation and temperature) and other ecological parameters such as elevation, marine influence, and vegetation. Peatlands No. 850, 851 and 852 are located in the Central Uplands Ecoregion. As its name suggests, this ecoregion sits at a higher elevation than the surrounding Lowlands ecoregion. Therefore, the climate is cooler, with relatively abundant precipitation. The climate is warmer globally than the adjacent Northern Uplands Ecoregion, especially considering the central uplands are mainly south- and west-facing. As opposed to the northern uplands, the forest cover is not dominated by northern coniferous species, as trees with affinities to warmer temperatures are spread throughout the ecoregion. The topography of the ecoregion limits the quantity of wetlands. Alder swamps and marshes surrounding lakes are the most common wetlands of the Central Uplands Ecoregion (New Brunswick Department of Natural Resources, 2007).

Ecoregions are divided into ecodistricts based on geomorphologic and lithologic differences. The project site is located within the Beadle Ecodistrict.

4.1.1 Geological and Geomorphological Setting

The New Brunswick Bedrock Geology data from the GeoNB (2024) catalogue was used to describe the project site's geological and geomorphological setting. On a large scale, the project site is located within the Beadle Ecodistrict, which is characterised by an abundance of lakes with rolling hills and broad valleys in between. Most of the ecodistrict is dominated by intrusive igneous material, mainly Devonian gabbroic rocks and Ordovician granites.

The project site is located in two smaller geological areas: the McKiel Lake area and the Knights Brook formation. Most of the McKiel Lake area, a geological area including most of Peatlands No. 850, 851 and 852, is comprised of felsic intrusive rocks. The bedrock can be described as grey to pink, medium- to coarse-grained, equigranular to megacrystic, strongly foliated, feldspar-phyric biotite granite. The Knights Brook Formation surrounds the McKiel Lake area, a geological formation composed of medium-grained clastic sedimentary rocks characterized by light greenish grey to dark grey, fine- to medium-grained, thin- to medium-bedded sandstone, quartz wacke and minor feldspathic wacke interstratified with dark grey to black shale and siltstone. Two small sections of the project site in the northwest part of Peatlands No. 850 and 851 are located in the Knights Brook Formation.

Peatlands No. 850, 851 and 852 are characterized by the presence of an organic layer (peat) deposited on shallow basins with poor drainage. The thickness of the organic deposits varies between 1 and 5 m (Natural Resources Canada, 2021).

4.1.2 Climate

The Beadle Ecodistrict is known to have a cool and wet climate with high average precipitation during the summer.

The closest meteorological station is located at the “Juniper” airport, approximately 13 km from the project site. Mean yearly temperature is 3.7 °C while mean, minimum, and maximum temperatures for July are 17.8 °C, 11.5 °C, and 24.1 °C, respectively (Environment Canada, 2021). Mean, minimum and maximum temperatures for January are -12.4 °C, -17.9 °C and -6.8 °C, respectively. Mean yearly precipitation is 1159.7 mm, with 862.6 mm falling as rain and 297.2 mm as snow. The period from July to January has the most rain and snowfall, with an average monthly precipitation varying between 102.6 and 109.0 mm. September is drier, with an average of 94.8 mm, but winter, spring, and early summer (February to June) are the driest periods of the year, with an average monthly precipitation varying between 71.0 and 95.2 mm.

Mean wind speed at the project site and its direct surrounding areas vary between 5.5 and 7.5 m/s (Gasset *et al.*, 2007). This is further supported by the data recorded at the Juniper airport, where the average wind speed between 2020 and 2023 fluctuated between 5.27 and 8.27 m/s (Metar-Taf, 2024). Wind speed is at its lowest during summer. During June, the dominant wind direction is northeast. For the rest of the year, the dominant wind direction fluctuates between 201° and 349° (southwest or northwest).

Average monthly temperatures and precipitation between 1981 and 2010, as observed at the Juniper station, are presented in Table 6 (Environment and Natural Resources, 2023).

Table 6 Average Monthly Temperatures and Precipitation at Juniper Station

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Temperature												
Daily mean (°C)	-12.4	-10.7	-4.6	2.6	10.0	15.1	17.8	16.9	12.2	5.8	-0.5	-8.0
Precipitation												
Rainfall (mm)	30.1	16.4	34.2	66.6	94.0	90.2	107.4	105.3	102.5	91.7	79.4	44.8
Snowfall (cm)	78.9	54.7	53.4	18.7	1.2	0.0	0.0	0.0	0.1	3.1	29.0	58.1
Total (mm water equivalent)	109.0	71.0	87.7	85.3	95.2	90.2	107.4	105.3	102.6	94.8	108.4	102.9

The Climate Atlas of Canada (Prairie Climate Centre, 2024) was consulted to explain how climatic conditions may affect peat harvesting in the Woodstock region under anticipated global warming scenarios. According to that source, the number of days with warm temperatures should increase in the future. For the 2021-2050 period, the number of days with temperatures above 30 °C should increase from 6.1 days (1976-2005 period) to 15.5 days, an increase of 9.4 days.

The Atlas displays projections for two possible climate paths (RCP 4.5 and 8.5). Each assumes a different level of future greenhouse gas emissions, which leads to more or less global warming.

Considering a Low-Carbon climate future (RCP 4.5), data shows a 1.9 °C and 2.9 °C increase in the mean annual temperature for the 2021-2050 and 2051-2080 periods, respectively, compared to the 1976-2005 period.

For a High Carbon climate future (RCP 8.5), mean annual temperature would increase by 2.1 °C and 4.3 °C for the 2021-2050 and 2051-2080 periods, respectively.

According to these scenarios, there should be a significant increase in the number of days with very hot temperatures (> 30 °C). This will affect peat harvesting activities since hot temperatures favour drying and airborne peat particle emissions. This may also increase the risk of fire in the bog. On the other hand, the harvesting season may begin earlier in the spring and extend later in the fall.

4.1.3 Hydrology

McKiel bogs straddle the watersheds of four watercourses and lakes: Carson Brook, Unnamed Brook, Kenny Brook, McKiel Lake, and McKiel Brook, respectively. McKiel Lake receives the water from Carson Brook, Kenny Brook, and Unnamed Brook. It is one of the area's large lakes and covers 151.5 ha. McKiel Lake discharges to the west into McKiel Brook, which flows toward the Southwest Miramichi River. Thus, the project site is located within the Miramichi River watershed. Total peatland areas located in each sub-watershed are 72.6 ha, 55.5 ha, 70.4 ha, 59.0 ha, and 94.0 ha, respectively (Map 4).

The three bogs have a significant part of their surface occupied by ponds. For instance, the central part of peatland No. 851 displays a significant density and coverage of ponds over its extent. Pond coverage nevertheless represents less than 15% of the total area of the three bogs. They essentially occur as large ponds with variable shapes, usually irregular.

Natural water flow within the undrained bog predominantly occurs as subsurface acrotelm flow, and surface runoff only occurs during episodes of significant precipitation or snowmelt.

4.1.4 Hydrogeology

Groundwater is present throughout the entire local stratigraphic sequence. It mostly flows in bedrock and, to a lesser extent, surficial deposits. The various geological formations, however, exhibit different hydrogeological behavior. In the peat deposits, the acrotelm’s permeability is several orders of magnitude higher than the catotelm's. Hence, water flow mainly occurs within the acrotelm in saturated to nearly saturated conditions. Conversely, the catotelm remains saturated, but its low permeability precludes significant water flow.

The major component of flow in the acrotelm is horizontal, while vertical exchanges with the underlying catotelm occur at a lower rate. Water fluxes between the acrotelm and catotelm may be oriented upward or downward, depending on point-specific hydraulic conditions. Horizontal water flow in the acrotelm and catotelm essentially occurs in a direction parallel to the local topographical gradient, hence, oriented from the center of the bog’s domes toward the periphery.

Being a low-permeability unit, the catotelm acts as an aquitard, which precludes significant water flow along the vertical axis between the organic deposits and the underlying mineral deposits. Local topography and hydraulic conditions are also unfavorable to significant water exchange between organic and mineral deposits. The relatively flat profile of the peatland surface results in low hydraulic gradients.

Bedrock constitutes the main aquifer at both the regional and local scales. Sedimentary and plutonic rocks forming bedrock are generally fractured.

Most groundwater movement in the bedrock aquifer occurs along the fractures that pervade the rock mass, although some flow may also occur within the porous matrix (Stapinsky *et al.*, 2002).

Horizontal groundwater flow in the bedrock aquifer is generally oriented in accordance with the topographical gradient. As such, groundwater flow divides between watersheds generally coincide with surface water divides.

Recharge of the aquifer essentially occurs through rainwater infiltration in areas where bedrock is overlain by a thin and more permeable mineral overburden cover.

McKiel bogs are situated at the downgradient end of the local groundwater flow system within the bedrock. Areas located west of and upgradient with respect to the three peatlands act as recharge areas for the bedrock aquifer. Groundwater then flows mainly south toward McKiel Lake.

No known domestic or municipal wells are within a 10 km radius of McKiel bogs (DELG, 2024).

4.1.5 Water Quality

Water quality monitoring is an important component regarding the impacts of the McKiel bogs development project on the environment. For the purpose of the EIA, water quality is evaluated in two ways:

1- as part of the standard fish habitat description and

2- based on the analysis of water samples done for the watercourse water quality baseline.

Fish Habitat

As part of the fish habitat characterization, the following parameters were measured with a YSI probe:

- Temperature (°C);
- Dissolved Oxygen (% and mg/L);
- Total Dissolved Solids;
- Salinity (ppt);
- pH;
- Conductivity (uS/cm).

Measures were taken directly in the three watercourses that flow between the bogs and into McKiel Lake, which are Kenny Brook, Unnamed Brook, and Carson Brook, and in McKiel Brook, which is the discharge of McKiel Lake (Map 2). Complete on-site measurement results are presented in the fish and fish habitat report (Appendix A). They show that water quality in the watercourses is suitable for salmonids.

Water Samples Analysis

Watercourses receiving drainage water are sampled once per season for the water quality baseline. They are the same four watercourses that were sampled for fish habitat. Summer, fall, and winter sampling were completed when preparing the EIA. They were sampled on:

- Summer: September 11, 2023;
- Fall: November 21, 2023;
- Winter: January 24, 2024;

- Spring: April 16, 2024.

Water samples were collected in compliance with the applicable protocols. RPC Lab analysed them for the parameters listed in the Environmental Impact Assessment, Peat Development Projects sector guidelines (Department of Environment and Local Government, 2023b).

The location of the sampling stations was determined based on access and safety. As the site is located in a remote, undeveloped area, sections of the watercourses are difficult to access, especially during winter and spring. For the first sampling (summer 2023), 6 stations were sampled, including two on McKiel Brook between September 11th and 14th, 2023 (Map 2). The goal was to assess the correlation between the two stations. For the fall, winter, and spring samplings, only one of them, station MB1, was sampled. That station is easily accessible from the main road. Two stations were also sampled on Kenny Brook, and it was decided to use only station KB2, the one closer to the bog, for further sampling.

It is possible that the location of stations upstream from the bogs could return higher pH and electrical conductivity compared to locations downstream from the peatlands due to the effect of acidic bog water. This will have to be considered once the site is in operation and water quality monitoring is conducted from sampling stations downstream from the drainage network outlet.

Analytical results from the collected water samples are provided in Tables Table 7a, Table 7b, Table 7c, and Table 7d. Certificates of analysis are provided in Appendix B.

The results of the analysis of surface water are indicative of the biochemical characteristics of the environment through which the water flows. The results are compared to the New Brunswick Department of Environment and Local Government (DELG) water quality guidelines for the protection of aquatic life. These guidelines are presented in Appendix C and are mostly inspired by the Canadian Council of Ministers of the Environment (CCME) guidelines. Overall, the DELG criteria used to indicate a healthy aquatic habitat are respected. The only thresholds that have been exceeded are cadmium and iron concentrations during summer 2023 for all stations as shown in Table 7a. Iron concentrations recorded in all sampling stations range from 840 to 1900 µg/L and exceed CCME's threshold (300 µg/L) to protect freshwater aquatic life (long-term exposure). These concentrations decreased to acceptable levels during fall 2023 and winter 2024. Furthermore, the measured cadmium concentration in all watercourses is equal or superior to the long-term exposure threshold (0.04 µg/L) established by the CCME for the protection of aquatic life. It is also noted that total nitrogen exceeds the recommended threshold for a few sampling stations through the year.

Every parameter exceeding the recommended threshold established by the CCME and the DELG is identified in red in the tables below.

Stream waters exhibit a decreasing trend in measured metal concentrations between summer 2023 and winter 2024 for most parameters.

Regarding pH, values fluctuate between 6.0 and 7.0. The CCME evaluates that pH in freshwater should be maintained, in the long term, between 6.5 and 9 to provide adequate conditions for aquatic life. Considering that the pH measured at the sampling stations can reach values under 6.5, the streams seem slightly more acidic than optimal conditions for aquatic wildlife. It is expected that the drainage water when the site is in operation may affect the pH of the receiving watercourse for a short period following the construction of the drainage network (see Section 3.5.3).

Table 7a Surface Water Analysis (Summer 2023)

Parameter	Units	MB1	MB2	KB1	KB2	B1	CB2	DELG Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)
Metals								
Aluminum	mg/L	0.275	0.256	0.305	0.219	0.437	0.200	5 if pH <6.5 or 100 if pH >6.5
Antimony	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	No data
Arsenic	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005
Barium	mg/L	0.003	0.003	0.003	0.002	0.004	0.002	No data
Beryllium	mg/L	<0.0001	<0.0001	0.0001	0.0001	0.0001	0.0003	No data
Bismuth	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	No data
Boron	mg/L	0.002	0.002	0.002	0.002	0.002	0.002	1.5
Cadmium	mg/L	0.000004	0.000004	0.000004	0.000005	0.000004	0.000006	Guideline dependent on hardness – See Appendix C
Calcium	mg/L	4.15	3.10	4.49	4.37	2.86	2.83	No data
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	No data
Cobalt	mg/L	0.0001	0.0002	0.0001	0.0001	<0.0001	0.0015	No data
Copper	mg/L	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	Guideline dependent on hardness – See Appendix C
Iron	mg/L	0.55	0.59	0.40	0.40	1.73	0,29	0.3
Lead	mg/L	0.0005	0.0005	0.0004	0.0003	0.0008	0.0002	Guideline dependent on hardness – See Appendix C
Lithium	mg/L	0.0014	0.0012	0.0022	0.0022	0.0006	0.0008	No data
Magnesium	mg/L	0.56	0.50	0.47	0.47	0.64	0.41	No data
Manganese	mg/L	0.052	0.032	0.016	0.014	0.359	0.018	Guideline is dependent on hardness and pH – See Appendix C
Mercury	mg/L	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	0.000026
Molybdenum	mg/L	0.0002	0.0002	0.0005	0.0005	<0.0001	<0.0001	0.073
Nickel	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	Guideline dependent on hardness – See Appendix C
Potassium	mg/L	0.02	0.380	0.280	0.400	0.380	0.410	No data

Parameter	Units	MB1	MB2	KB1	KB2	B1	CB2	DELG Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)
Rubidium	mg/L	0.0018	0.0015	0.0023	0.0021	0.0023	0.0021	No data
Selenium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1
Silver	mg/L	<0.0001	<0.1	<0.1	<0.1	<0.1	<0.0001	0.0025
Sodium	mg/L	1.65	1.47	1.96	1.95	1.51	1.71	No data
Strontium	mg/L	0.014	0.012	0.013	0.013	0.011	0.011	No data
Tellurium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	No data
Thallium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.008
Tin	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	No data
Uranium	mg/L	0.0005	0.0005	0.0009	0.001	<0.0001	<0.0006	0.015
Vanadium	mg/L	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001 <0.001 <0.001
Zinc	mg/L	0.004	0.004	0.005	0.004	0.004	0.004	Guideline dependent on hardness – See Appendix C
pH	units	7.0	6.5	7.0	6.9	6.0	6.8	> 6.5 and < 9.0
Ammonia (as N)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	Guideline dependent on temperature and pH – See Appendix C
Nitrate + Nitrite (as N)	mg/L	0.15	0.12	0.53	0.40	< 0.05	0.13	No data
Nitrate (as N)	mg/L	0.15	0.12	0.53	0.40	< 0.05	0.13	3
Nitrite (as N)	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0,06
Nitrogen – Total	mg/L	0.5	0.4	0.8	0.6	0.8	0.4	0,7
Phosphorus – Total	mg/L	0.034	0.037	0.037	0.037	0.049	0.019	See notes[1]
Solids - Total Suspended	mg/L	27	<5	11	<5	<5	22	No data
Conductivity	µS/cm	28	23	30	32	24	25	No data
Hardness (as $CaCO_3$)	mg/L	12.7	9.8	13.1	12.8	9.8	8.8	No data

[1] Maximum increase of 25 mg/L from background levels for any short-term exposure (e.g., 24-h period). Maximum average increase of 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30 d)

Table 7b Surface Water Analysis (Fall 2023)

Parameter	Units	MB1	KB2	CB1	VB1	DELG Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)
Aluminum	mg/L	0.204	0.115	0.083	0.222	5 if pH <6.5 or 100 if pH >6.5
Antimony	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	No data
Arsenic	mg/L	<0.001	<0.001	<0.001	<0.001	0.005
Barium	mg/L	0.002	0.002	0.001	0.002	No data
Beryllium	mg/L	<0.0001	<0.0001	0.0001	<0.0001	No data
Bismuth	mg/L	<0.001	<0.001	<0.001	<0.001	No data
Boron	mg/L	0.002	0.001	0.001	0.001	1500
Cadmium	mg/L	0.00004	0.00004	0.00003	0.00002	Guideline dependent on hardness – See Appendix C
Calcium	mg/L	2.42	3.09	1.79	1.47	No data
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	No data
Cobalt	mg/L	<0.0001	<0.0001	<0.0001	0.0003	No data
Copper	mg/L	<0.001	<0.001	<0.001	<0.001	Guideline dependent on hardness – See Appendix C
Iron	mg/L	0.37	0.14	0.09	0.69	0.3
Lead	mg/L	0.0004	0.0001	<0.0001	0.0004	Guideline dependent on hardness – See Appendix C
Lithium	mg/L	0.0010	0.0016	0.0007	0.0005	No data
Magnesium	mg/L	0.47	0.37	0.36	0.45	No data
Manganese	mg/L	0.011	0.006	0.007	0.072	Guideline is dependent on hardness and pH – See Appendix C
Mercury	mg/L	<0.000025	<0.000025	<0.000025	<0.000025	0.000026
Molybdenum	mg/L	0.0001	0.0002	<0.0001	<0.0001	0.073
Nickel	mg/L	<0.001	<0.001	<0.001	<0.001	Guideline dependent on hardness – See Appendix C
Potassium	mg/L	0.23	0.23	0.28	0.29	No data
Rubidium	mg/L	0.0011	0.0012	0.0016	0.0015	No data
Selenium	mg/L	<0.001	<0.001	<0.001	<0.001	1
Silver	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.0025
Sodium	mg/L	1.42	1.79	1.65	1.43	No data
Strontium	mg/L	0.010	0.010	0.008	0.007	No data
Tellurium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	No data
Thallium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.008
Tin	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	No data
Uranium	mg/L	0.0003	0.0006	0.0003	<0.0001	0.015
Vanadium	mg/L	<0.001	<0.001	<0.001	<0.001	No data
Zinc	mg/L	0.003	0.002	0.002	0.003	Guideline dependent on hardness – See Appendix C
Other parameters						
Ammonia (as N)	mg/L	<0.05	<0.05	<0.05	<0.05	Guideline dependent on temperature and pH – See Appendix C

Parameter	Units	MB1	KB2	CB1	VB1	DELG Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)
pH	units	6.8	6.9	6.7	6.1	> 6.5 and < 9.0
Nitrate + Nitrite (as N)	mg/L	0.25	0.34	0.22	0.11	No data
Nitrate (as N)	mg/L	0.25	0.34	0.22	0.11	3
Nitrite (as N)	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	0.06
Nitrogen – Total	mg/L	0.8	0.6	0.4	0.7	0.7
Phosphorus – Total	mg/L	0.023	0.021	0.012	0.048	0.03
Solids - Total Suspended	mg/L	<5	7	<5	17	See notes[1]
Conductivity	µS/cm	24	33	25	20	No data
Hardness (as $CaCO_3$)	mg/L	8.0	9.2	6.0	5.5	No data

[1] Maximum increase of 25 mg/L from background levels for any short-term exposure (e.g., 24-h period). Maximum average increase of 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30 d)

Table 7c Surface Water Analysis (Winter 2024)

Parameter	Units	MB1	KB2	UB1	CB2	DELG Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)
Aluminum	mg/L	0.110	0.047	0.231	0.062	5 if pH <6.5 or 100 if pH >6.5
Antimony	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	No data
Arsenic	mg/L	<0.001	<0.001	<0.001	<0.001	0.005
Barium	mg/L	0.002	0.001	0.003	<0.001	No data
Beryllium	mg/L	<0.0001	<0.0001	<0.0001	0.0001	No data
Bismuth	mg/L	<0.001	<0.001	<0.001	<0.001	No data
Boron	mg/L	0.001	0.001	0.001	0.001	1.5
Cadmium	mg/L	0.00002	0.00002	0.00003	0.00003	Guideline dependent on hardness – See Appendix C
Calcium	mg/L	2.90	4.08	1.41	2.05	No data
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	No data
Cobalt	mg/L	<0.0001	<0.0001	0.0007	<0.0001	No data
Copper	mg/L	<0.001	<0.001	<0.001	<0.001	Guideline dependent on hardness – See Appendix C
Iron	mg/L	0.15	0.06	0.68	0.06	0.3
Lead	mg/L	0.0002	<0.0001	0.0018	<0.0001	Guideline dependent on hardness – See Appendix C
Lithium	mg/L	0.0012	0.0022	0.0005	0.0007	No data
Magnesium	mg/L	0.45	0.43	0.37	0.35	No data
Manganese	mg/L	0.008	0.004	0.134	0.010	Guideline is dependent on hardness and pH – See Appendix C
Mercury	mg/L	<0.000025	<0.000025	<0.000025	<0.000025	0.000026
Molybdenum	mg/L	0.0002	0.0004	<0.0001	<0.0001	0.073
Nickel	mg/L	<0.001	<0.001	<0.001	<0.001	Guideline dependent on hardness – See Appendix C
Potassium	mg/L	0.30	0.32	0.29	0.30	No data
Rubidium	mg/L	0.0013	0.0015	0.0015	0.0015	No data
Selenium	mg/L	<0.001	<0.001	<0.001	<0.001	1
Silver	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.0025
Sodium	mg/L	1.65	2.13	1.45	1.66	No data
Strontium	mg/L	0.010	0.012	0.005	0.008	No data
Tellurium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	No data

Parameter	Units	MB1	KB2	UB1	CB2	DELG Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)
Thallium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.008
Tin	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	No data
Uranium	mg/L	0.0003	0.0005	<0.0001	0.0003	0.015
Vanadium	mg/L	<0.001	<0.001	0.001	<0.001	No data
Zinc	mg/L	0.002	0.002	0.004	0.002	Guideline dependent on hardness – See Appendix C
Other parameters						
Ammonia (as N)	mg/L	<0.05	<0.05	<0.05	<0.05	Guideline dependent on temperature and pH – See Appendix C
pH	units	6.8	7.0	6.1	6.7	> 6.5 and < 9.0
Nitrate + Nitrite (as N)	mg/L	0.59	0.76	0.24	0.27	No data
Nitrate (as N)	mg/L	0.59	0.76	0.24	0.27	3
Nitrite (as N)	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	0.06
Nitrogen – Total	mg/L	0.8	0.8	0.6	0.5	0,7
Phosphorus – Total	mg/L	0.017	0.019	0.040	0.013	0,03
Solids - Total Suspended	mg/L	<5	<5	15	<5	See notes[1]
Conductivity	µS/cm	27	36	18	24	No data
Hardness (as $CaCO_3$)	mg/L	9.1	12.0	5.0	6.6	No data

[1] Maximum increase of 25 mg/L from background levels for any short-term exposure (e.g., 24-h period). Maximum average increase of 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30 d).S

Table 7d Surface Water Analysis (Spring 2024)

Parameter	Units	MB1	KB2	UB1	CB2	DELG Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)
Aluminum	mg/L	0.156	0.143	0.129	0.092	5 if pH <6.5 or 100 if pH >6.5
Antimony	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	No data
Arsenic	mg/L	<0.001	<0.001	<0.001	<0.001	5
Barium	mg/L	0.002	0.001	0.001	<0.001	No data
Beryllium	mg/L	<0.0001	<0.0001	<0.0001	0.0001	No data
Bismuth	mg/L	<0.001	<0.001	<0.001	<0.001	No data
Boron	mg/L	0.001	0.001	0.001	0.001	1.5
Cadmium	mg/L	0.00017	0.00021	0.00007	0.00003	Guideline dependent on hardness – See Appendix C
Calcium	mg/L	1.57	2.20	0.84	1.40	No data
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	No data
Cobalt	mg/L	<0.0001	<0.0001	0.0001	<0.0001	No data
Copper	mg/L	<0.001	<0.001	<0.001	<0.001	Guideline dependent on hardness – See Appendix C
Iron	mg/L	0.18	0.10	0.22	0.04	0.3
Lead	mg/L	0.0003	0.0002	0.0002	<0.0001	Guideline dependent on hardness – See Appendix C
Lithium	mg/L	0.0006	0.0012	0.0003	0.0005	No data
Magnesium	mg/L	0.29	0.26	0.21	0.27	No data
Manganese	mg/L	0.015	0.006	0.024	0.005	Guideline is dependent on hardness and pH – See Appendix C
Mercury	mg/L	<0.000025	<0.000025	<0.000025	<0.000025	0.000026
Molybdenum	mg/L	<0.0001	0.0002	<0.0001	<0.0001	0.073
Nickel	mg/L	<0.001	<0.001	<0.001	<0.001	Guideline dependent on hardness – See Appendix C
Potassium	mg/L	0.29	0.29	0.36	0.30	No data
Rubidium	mg/L	0.0013	0.0014	0.0015	0.0016	No data
Selenium	mg/L	<0.001	<0.001	<0.001	<0.001	1
Silver	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.0025
Sodium	mg/L	0.95	1.27	1.01	1.31	No data
Strontium	mg/L	0.006	0.007	0.003	0.006	No data
Tellurium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	No data
Thallium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.008

Parameter	Units	MB1	KB2	UB1	CB2	DELG Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)
Tin	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	No data
Uranium	mg/L	0.0002	0.0005	<0.0001	0.0003	0.015
Vanadium	mg/L	<0.001	<0.001	<0.001	<0.001	No data
Zinc	mg/L	0.003	0.003	0.002	0.002	Guideline dependent on hardness – See Appendix C
Other parameters						
Ammonia (as N)	mg/L	<0.05	<0.05	<0.05	<0.05	Guideline dependent on temperature and pH – See Appendix C
pH	units	6.8	7.0	6.1	6.7	> 6.5 and < 9.0
Nitrate + Nitrite (as N)	mg/L	0.59	0.76	0.24	0.27	No data
Nitrate (as N)	mg/L	0.59	0.76	0.24	0.27	3
Nitrite (as N)	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	0.06
Nitrogen – Total	mg/L	0.8	0.8	0.6	0.5	0,7
Phosphorus – Total	mg/L	0.017	0.019	0.040	0.013	0,03
Solids - Total Suspended	mg/L	<5	<5	15	<5	See notes[1]
Conductivity	µS/cm	27	36	18	24	No data
Hardness (as $CaCO_3$)	mg/L	9.1	12.0	5.0	6.6	No data

[1] Maximum increase of 25 mg/L from background levels for any short-term exposure (e.g., 24-h period). Maximum average increase of 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30 d).

4.1.6 Peat Characteristics

Peatlands No. 850, 851 and 852 that form McKiel bogs have similar peat characteristics (Table 8). According to Keys and Henderson (1988), they have a ±2 m poorly decomposed surface peat layer on top of 2 m of well-humified peat. Surface peat corresponds to the H1-H4 peat, and humic peat corresponds to the H5-H10 peat on the von Post scale that evaluates the degree of decomposition. Sphagnum is the dominant botanical component of the peat except for the basal layer where Sphagnum is mixed with sedge.

Peatland No. 850 has a surface peat layer containing several lenses of more decomposed peat and shrubs and Trichophorum. The surface peat sits on a deep layer of well-humified peat dominated by Sphagnum, except for the basal peat.

Table 8 Peat Characteristics of Peatlands No. 850, 851 and 852

Peatland No.	Area (ha)	Maximum Peat Depth (m)	Average Depth (m)	Volume Surface Peat[1] (Mm^3)	Volume Humic Peat[1] (Mm^3)
850	67	5.2	3.56	0.75	0.85
851	100	5.2	2.99	1.45	0.99
852	120	4.1	2.52	1.15	0.83

[1] For the peatland area with over 1m peat depth
Mm^3 = Million Cubic Meters

Peatland No. 851 has the highest surface and humic peat volume of the three bogs. Cross-sections of the peat deposit reveal several lenses of more humified peat and shrubs within the surface peat.

Although it is the largest of the three bogs, peatland No. 852 has a lower peat volume than peatland No. 851 because it has a shallower peat depth, which is 1 m less than the two other bogs on average. Sphagnum largely dominates the peat and contains a small quantity of shrubs and wood.

Peat samples were collected at one station per bog at 10, 30 and 70 cm below the surface and analysed for the presence of mercury (Map 2). RPC performed analyses, and the results are reported in Table 9. Certificates of analyses are provided in Appendix B. Peatland No. 850 shows the highest concentration of mercury with 0.12, 0.08, and 0.05 mg/kg at 10, 30, and 70 cm below the surface, respectively. Mercury concentrations are below 0.08 mg/kg at all depths at peatlands No. 851 and 852. All concentrations are far below the provisional standard of 0.8 mg/kg dry matter for agricultural soils determined by the CCME for human health (CCME, 2007). The mercury likely comes from airborne deposition since there is no source of mercury locally. In fact, peat cores have been used to evaluate the variation of mercury deposition in recent times (Madsen, 1981).

Table 9 Mercury Concentration in Peat at Different Depths below the Surface

Peatland	Mercury Concentration (mg/kg) [1]		
	10 cm	30 cm	70 cm
850	0.12	0.08	0.05
851	0.04	0.05	0.04
852	0.07	0.05	0.05

[1] Reporting limit 0.01

4.2 Biological Environment

4.2.1 Wetlands and Vegetation

The Central Uplands Ecoregion is divided into five ecodistricts. The project site itself is located in Beadle Ecodistrict, a region filled with lakes and hills separated by valleys with a dominant forest cover. In 2017, 92% of the area of the Beadle Ecodistrict was covered by forests. Elevations in the Beadle Eecodistrict vary approximately from 300 m in the south to 600 m in the north. The vegetation in flatland areas with moist conditions and impeded drainage is usually dominated by spruces (*Picea* sp.) and balsam fir (*Abies balsamea*). Mixed forests are more abundant in areas where drainage improves, such as mid-slopes (New Brunswick Department of Natural Resources, 2007).

Peatlands No. 850, 851 and 852 are all part of McKiel bogs, a wetland complex located in a small basin surrounded by low hills. Other wetland types surround the peatlands, separated by watercourses flowing between them. The three bogs developed on glacial till.

Peatland No. 850 is a patterned bog with a single dome elongated southward. A series of small pools, some mapped as waterbodies on GeoNB (2024), are dispersed concentrically atop the dome. The base of the peat is flat along the north-south axis of the bog, but the bottom is strongly sloping eastward from the west margin. It has a narrow margin except on the east side, where wetlands along Kenny Brook border it.

Peatland No. 851 is also a patterned bog with various-sized pools arranged in a concentric pattern on the dome. The larger ones (up to 1.75 ha) are mapped as waterbodies. The only dome is elongated along the northwest – southeast axis. The base of the peatland generally slopes toward the south, and the floor has a flat to irregular topography. Bog No. 851 is surrounded by wetlands, including those that border Kenny Brook to the west and an Unnamed Brook to the east.

Peatland No. 852 has one dome that stretches along the northwest – southeast axis with a shallow peat area that extends over 200 to 400 m to the west. It has numerous pools that do not show any pattern. The base of the peat is irregular. Bog No. 852 is bordered by wetlands, including those along Carson Brook, which flows along the northeast side.

WSP completed a vegetation survey of the peatlands in August 2023 (Appendix D). Three plant communities were identified: Sphagnum lawn peatland, Sphagnum peatland with pools and Sphagnum shrub peatland. Table 10 outlines these plant communities' main features based on the field survey results.

Table 10 Characteristics of Plant Communities of Peatlands No. 850, 851 and 852

Vegetation Strata	Sphagnum Lawn Peatland	Sphagnum Peatland with Pools	Sphagnum Shrub Peatland
Tree strata	Black Spruce (*Picea mariana*)	Absent	Black Spruce
Shrub Strata	Dominated by Leatherleaf (*Chamaedaphne calyculata*) and Black Spruce accompanied by Sheep Laurel (*Kalmia angustifolia*), Common Labrador tea (*Rhododendron groenlandicum*) or Glaucous-leaved Bog Rosemary (*Andromeda polifolia*).	Dominated by Leatherleaf and Black Spruce accompanied by Sheep Laurel, Common Labrador Tea or Glaucous-leaved Bog Rosemary.	Dominated by Leatherleaf, Mountain Holly (*Ilex mucronata*) and Black Spruce accompanied by Early Lowbush Blueberry (*Vaccinium angustifolium*), Pale Bog Laurel (*Kalmia polifolia*) and Common Labrador Tea.
Herbaceous Strata	Dominated by Tufted Clubrush (*Trichophorum cespitosum*) and Beakrush (*Rhynchospora* sp.) accompanied by Dense Cottongrass (*Eriophorum vaginatum* subsp. *spissum*), Tawny Cottongrass (*Eriophorum virginicum*) and Northern Pitcher Plant (*Sarracenia purpurea*).	Dominated by White Beakrush (*Rhynchospora alba*) and Tufted Clubrush accompanied by Dense Cottongrass, Tawny Cottongrass and Northern Pitcher Plant.	Dominated by Tufted Clubrush and Narrow-leaved Cottongrass (*Eriophorum angustifolium*) accompanied by Dense Cottongrass.
Moss Strata	Sphagnum mosses and lichens.	Sphagnum mosses and lichens.	Sphagnum mosses.

SPECIAL STATUS SPECIES

A request was submitted to the Atlantic Canada Conservation Data Center (ACCDC) to identify plant species potentially present in the area. The ACCDC report is provided in Appendix E. According to this report, there are no occurrences of any special status species within the limits of the project site. On the other hand, eight occurrences of special status species were reported within a 5 km radius of the project site. The Southern Twayblade (*Neottia bifolia)*, endangered at the provincial level, is the only one that can potentially be present in the project footprint as its habitat includes fens and hummocks, moist woods, bogs, and marshes. This small plant was not observed during the plant survey since it is visible only for a short period at the end of June. A survey targeting the Southern Twayblade will be conducted in June 2024. No other rare plant species or special status species were observed on the project site during the survey.

4.2.2 Terrestrial Wildlife

Peatlands are a habitat for various terrestrial wildlife and can contribute to regional biodiversity, particularly at the limit between temperate and boreal regions (Calmé *et al*., 2002; Spitzer and Danks, 2006). An individual peatland can be the home for more than 1,000 arthropod species (Blades & Marshall, 1994). Several invertebrate species can be found exclusively in peatlands (Spitzer & Danks, 2006). Many vertebrate species also use peatland, but none is restricted to these ecosystems regarding habitat (Rochefort *et al.*, 2012). Wet ground conditions, low pH and nutrient status typically found in peatlands make these ecosystems inhospitable. These conditions do not translate into high biological productivity. Peatlands are mostly used by species looking for open areas.

MAMMALS

New Brunswick hosts several mammals, most well suited for the forested landscape dominant in the province. The following terrestrial mammal species can be found in New Brunswick:

- Black bear (*Ursus americanus*);
- Canada lynx (*Lynx canadensis*);
- Bobcat (*Lynx rufus*);
- Moose (*Alces alces*);
- White-tail deer (*Odocoileus virginianus*);
- Raccoon (*Procyon lotor*);
- Red fox (*Vulpes vulpes*);
- Otter (*Lontra canadensis*);
- Coyote (*Canis latrans*);
- Fisher (*Pekania pennanti*);
- Muskrat (*Ondatra zibethicus*);
- Mink (*Neovison vison*);
- Beaver (*Castor canadensis*);
- Snowshoe hare (*Lepus americanus*);
- Porcupine (*Erethizon dorsatum*);

- Chipmunk (*Tamias striatus*);
- Squirrels; and,
- Several small rodent species.

While there is limited research on the interaction of large mammals with peatlands in New Brunswick, existing evidence, as reported by Gautreau-Daigle (1990), indicates that moose utilize these habitats. Specifically, moose prefer forested peatlands over open ones, and they often remain at the peripheries of open bogs. This preference is particularly notable in winter, as Nikla et al. (2004) highlighted.

Annually, the New Brunswick Natural Resources and Energy Development (NBNRED) releases harvest reports for big game and fur-bearing mammals in New Brunswick. These reports offer details on the legal harvest count of animals within 27 wildlife management zones (WMZs) during a specific year. The project site lies within WMZ 12.

According to the last "Big Game Harvest Reports" (NBNRED, 2022), a total of 3,611 Moose were killed in 2022. Among those, 231 Moose were harvested within the WMZ 12 for a ratio of 0.067/km^2. For Deer, a total of 8,816 individuals were hunted, 127 within the limits of the WMZ 12. Overall, the Moose and Deer populations in New Brunswick appear stable. However, the NBNRED recognizes the difficulty in accurately assessing the true health of the population due to possible unregulated harvest.

The NBNRED also conducts annual track transect surveys to gather abundance indices of furbearers and their prey across diverse habitat types in New Brunswick. A total of 6 track transects are present within a 25 km radius of the project site: routes 23, 24, 116, 117, 120, and 121. Surveys were conducted for each transect for several years since 2003. According to the data provided by these track transects, the following mammals have been noted by surveyors: Marten (*Martes americana*), Fisher, Bobcat, Lynx, Grouse, Weasel (*Mustela* sp.), Coyote, Fox, Otter, Deer, Moose, Mink and Mouse species (Figure 4).

Results from the harvest reports and track transects provide data about species present in the region, but that does not mean they are present in or use McKiel bogs.

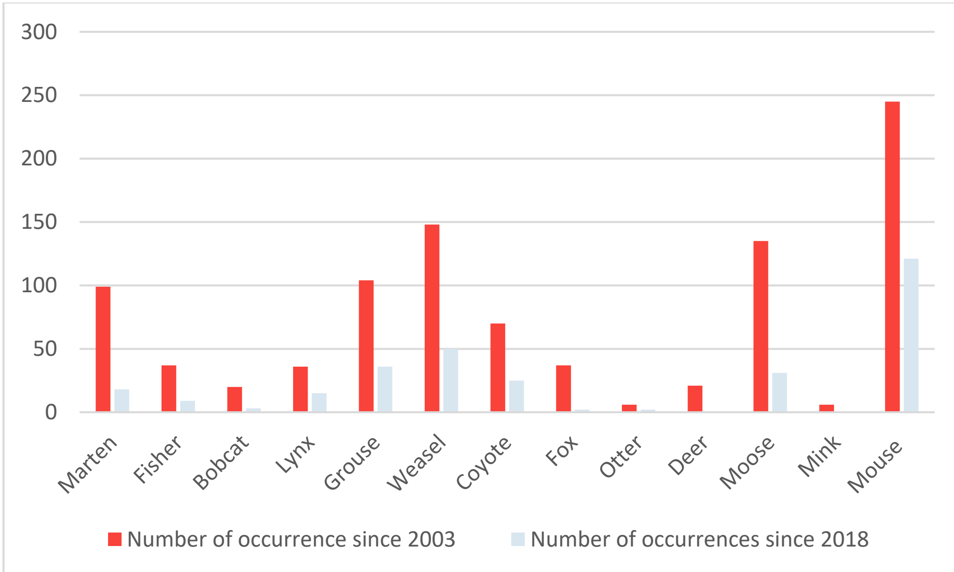


Figure 4 **NBNRED Track Transects Occurrences Summary (NBNRED, 2022)**

BIRDS

In peatlands, avian fauna stands out as the most well-represented vertebrate category, constituting approximately 80% of the total vertebrate species in these ecosystems, as Payette and Rochefort (2001) reported. Despite the diversity of bird species using peatlands exceeding 100 species, according to Desrochers and van Duinen (2006), none are exclusive to these ecosystems. A comprehensive bird survey conducted in 120 eastern Canadian bogs spanning from 1993 to 2002, as documented by Desrochers and van Duinen (2006), recorded a substantial 10,575 bird observations. Notably, most of these observations can be attributed to four key species listed in decreasing order of prevalence: Common Yellowthroat (*Geothlypis trichas*), White-throated Sparrow (*Zonotrichia albicollis*), Lincoln's Sparrow (*Melospiza lincolnii*), and Savannah Sparrow (*Passerculus sandwichensis*).

According to the data collected in the *Second Atlas of Breeding Birds of the Maritime Provinces* (Bird Studies Canada, 2023), 160 bird species were observed in the Carleton-Victoria region, where the study site is located. The Carleton-Victoria region was divided into 57 squares for the Atlas' purpose. The project site is located in McKiel Lake Square (19FM56). Although point count bird surveys have not been completed for the atlas in the McKiel Lake Square, the presence of 40 species was confirmed for the Carleton-Victoria region. All these species have been noted to be potentially breeding in the region. These observations were completed over four years (2006 to 2010). Breeding was confirmed for six species in the McKiel Lake Square: the Scarlet Tanager (*Piranga olivacea*), the American Redstart (*Setophaga ruticilla*), the Hermit Thrush (*Catharus guttatus*), the Blue Jay (*Cyanocitta cristata*), the Yellow-bellied Sapsucker (*Sphyrapicus varius*), the Bald Eagle (*Haliaeetus leucocephalus*) and the Common Loon (*Gavia immer*). Observations in the McKiel Lake square and the Carleton-Victoria region are compiled and presented in Appendix F.

WSP will conduct bird surveys during spring and summer 2024 and complete a report to present the survey results. The report will be submitted as an addendum to the EIA.

HERPETOFAUNA

While peatlands represent a challenging environment for amphibians due to the adverse effects of acidic conditions on their permeable skin, certain species, including the Wood Frog, Green Frog, Leopard Frog, American Toad, Four-toed Salamander, and Eastern Redback Salamander, can use these habitats (Desrochers and van Duinen, 2006; Mazerolle, 2003). Additionally, among reptiles, the Redbelly Snake (*Storeria occipitomaculata*) and the Smooth Green Snake (*Opheodrys vernalis*) are known to use peatlands.

SPECIAL STATUS WILDLIFE SPECIES

Special status species include Species at Risk (SAR) listed as Endangered, Threatened or of Special Concern under the federal SARA (Species at Risk Act, S.C. 2002, c. 29) and any species listed as Endangered, Threatened or Special Concern under the provincial New Brunswick Species at Risk Act (NB SARA; Species at Risk Act, S.N.B 2012, c.6). According to ACCDC, three terrestrial wildlife species listed as status species under the SARA have been reported within the project site or a radius of 10 km of the project site. The species listed include the Bald Eagle, the Olive-sided Flycatcher (*Contopus cooperi*) and the Canada Warbler (*Cardellina canadensis*). Considering the concerns about its exploitation, the Bald Eagle is listed as a location-sensitive species by the ACCDC. Its presence within the limits of the project site was confirmed. The ACCDC report confirms the presence of seven other location-sensitive species and 54 other special status species within a 100 km radius of the project site.

The completed data report of the ACCDC is presented in Appendix E. Table 11 presents the three species listed under SARA found within a 10 km radius of the project and the location-sensitive species that recorded within a radius of 100 km of the project area.

Table 11 Special Status Wildlife Species Potentially Present in the Project Area

Common Name	Latin Name	Federal/Provincial Status	Habitat	Presence Potential
Bald Eagle	*Haliaeetus leucocephalus*	Not at risk/Endangered	Nest near open water (lakes, rivers, bays and seacoast)	There are several water bodies. The presence of McKiel Lake and the fish it may contain can be favourable for the presence of Bald Eagles. The peatlands this project targets are not a good habitat for bald eagles. Thus, its presence potential is considered **low**. Bald eagles or their nests were not observed during the vegetation surveys. On the other hand, the presence of this species was confirmed by the ACCDC.

Common Name	Latin Name	Federal/Provincial Status	Habitat	Presence Potential
Canada Warbler	*Cardellina canadensis*	Threatened/Special concern	Boreal forest, mixed forest. Often found in forest patches with mossy understory with ferns, shrubs and rhododendrons.	Considering the project site is mainly located in peatlands, the presence potential for this species is **low**.
Cobblestone Tiger Beetle	*Cicindela marginipennis*	Endangered/Endangered	It is only encountered in Canada on forested islands of Saint-John River, where cobble beaches are often flooded.	Considering its favoured habitat, the presence potential of this species is considered **low.**
Eastern Painted Turtle	*Chrysemys picta picta*	Special concern/No status	Tranquil, shallow waterbodies such as pools, rivers, lake shores, wet meadows, and bogs, characterized by a soft, muddy bottom abundant in vegetation.	Considering the presence of nearby brooks, McKiel Lake and bog ponds, the presence potential of this species is **moderate**.
Olive-sided Flycatcher	*Contopus cooperi*	Special concern/Threatened	Coniferous or mixed forest, burned forest, areas with tall trees and snags, laggs or alongside open areas.	Considering the transition between the peatlands and the surrounding forested areas is favourable for the Olive-sided Flycatcher, the presence potential for this species is **moderate**.
Peregrine Falcon	*Falco peregrinus*	No status/Endangered	Open habitats with tall natural or human structures. Cliffs, skyscrapers, quarries, and other infrastructure.	Peatlands are not a favourable habitat for falcons. The presence potential of Peregrine Falcon on the project site is considered **low**.
Snapping Turtle	*Chelydra serpentina*	Special concern/Special concern	Live in a large variety of aquatic habitats but only in freshwater. Water bodies with low currents, muddy bottoms, and abundant vegetation.	Considering the presence of nearby brooks, McKiel Lake and bog ponds, the presence potential of this species is **moderate**.
Wood Turtle	*Glyptemys insculpta*	Threatened/Threatened	Lives mainly in wooded streams. Prefers moderately flowing currents and sandy or gravelly bottoms.	Considering there is no wooded streams in the peatlands this project targets, the presence potential for this species is considered **low**.

4.2.3 Aquatic Wildlife

Bogs are usually isolated from surrounding watercourses, thus limiting the presence of fish in the pools. The limited variety of fish in peatlands can also be attributed to the prevalent acidity, low oxygen levels, and nutrient-poor water. Consequently, the shallow ponds commonly located in bogs often lack suitable conditions for fish. Nevertheless, occasional sightings of small fish can occur in the open-water bodies of peatlands. It is worth noting that alterations made by beavers in peatlands have been recognized to enhance the conditions for fish habitats, as reported by Ray *et al.* in 2004.

Several watercourses are present in the study site area. Peatlands No. 850, 851 and 852 are adjacent to McKiel Lake and three small watercourses: Kenny Brook, Carson Brook and an Unnamed small watercourse. The peatlands also contain many small and large pools but have no connectivity with the watercourses, and the probability of finding fish in bog pools is low.

Nevertheless, McKiel Lake is a tributary of the Southwest Miramichi River that supports approximately 29 fish species, according to data provided by the New Brunswick Department of Natural Resources, that include Atlantic Salmon (*Salmo salar*), Banded Killifish (*Fundulus diaphanus*), Yellow Perch (*Perca flavescens*), White Sucker (*Catostomus commersonii*), Blacknose Dace (*Rhinichthys atratulus*), Brook Trout (*Salvelinus fontinalis*), Brown Bullhead (*Ameiurus nebulosus*), Striped Bass (*Morone saxatilis*), Rainbow Smelt (*Osmerus mordax*), Mummichog (*Fundulus heteroclitus*), Lake Chub (*Couesius plumbeus*), Golden Shinner (*Notemigonus crysoleucas*), American Eel (*Anguilla rostrata*), and American Shad (*Alosa sapidissima*) (Miramichi River Environmental Assessment Committee, 2011).

A fish and fish habitat survey was completed by WSP in the fall of 2023 in the four watercourses that will receive drainage water from the harvest areas: Kenny Brook, Carson Brook, an Unnamed Brook, and McKiel Brook.

The survey included electrofishing, the installation of minnow traps and water sampling for water quality analysis. During the survey, three fish species were observed: Atlantic Salmon, Brook Trout (*Salvelinus fontinalis*) and Slimy Sculpin (*Cottus cognatus*). Atlantic Salmon is considered an endangered species. The complete report of the aquatic surveys is presented in Appendix A.

MCKIEL LAKE

The Department of Fisheries and Oceans Canada (DFO) conducted fish sampling in McKiel Lake, which receives drainage waters from Carson Brook, Kenny Brook, and Unnamed Brook (DFO, 2024). Fish surveys were conducted in 2022 and 2023 and summaries and data from these surveys are presented in Appendix G. These surveys used various methods to identify and quantify the fish species present in the lake that provide a comprehensive understanding of the lake's fish population.

Fisheries and Oceans Canada used fyke nets and gill nets in 2022 and 2023, and z-traps in 2022 to capture fish. Fyke nets were deployed for no more than 24 hours at the mouth of tributaries where fish enter and leave the lake. Gill nets were placed in narrow channels frequented by fish with a deployment time of up to 48 hours. Z-traps relied on bait and the natural instincts of fish to follow in-stream structures into a small entrance from which they could not escape. Upon retrieval, fish from all methods were counted, measured, and weighed before being released back into the lake.

Results revealed significant insights into the fish population of the lake. A total of 547 fish were caught for the two years of the survey, 334 in 2022 and 213 in 2023 (Table 12). They belong to 11 species while 9 and 10 species were captured in 2022 and 2023 respectively. The most common species are the Yellow Perch, the White Sucker, the Fall Fish, and the White Perch (*Morone americana)*. The Golden Shiner are the Brown Bullhead were also well represented for the two years of the survey. The American Bullfrog (*Lithobates catesbeianus*) and the Lake Chub were not captured in 2022 and the American Eel was not caught in 2023.

Table 12 Number of fish captured by species in McKiel Lake in 2022 and 2023 (DFO, 2024)

Common Name	*Latin Name*	2022	2023
Alewife	*Alosa pseudoharengus*	2	11
American Bullfrog	*Lithobates catesbeianus*	0	2
American Eel	*Anguilla rostrata*	2	0
Brown Bullhead	*Ameiurus nebulosus*	17	5
Common Shiner	*Luxilus cornutus*	9	2
Fall Fish	*Semotilus corporalis*	70	21
Golden Shiner	*Notemigonus crysoleucas*	7	21
Lake Chub	*Couesius plumbeus*	0	4
White Perch	*Morone americana*	51	26
White Sucker	*Catostomus commersonii*	74	36
Yellow Perch	*Perca flavescens*	102	85
Total		**334**	**213**

ATLANTIC SALMON

The government of Canada regards Atlantic Salmon as an important species that has created a rich cultural heritage (DFO, 2022). The species has been used for food, social, and ceremonial purposes by many First Nations and other communities in eastern Canada. However, the Atlantic salmon population in eastern Canada has been decreasing since 1971. Today, the Canadian government lists the Atlantic Salmon as an endangered species under the Canada's Species at Risk Act. Fisheries and Ocean Canada estimates that the Atlantic Salmon the population in the Inner Bay of Fundy, is at risk of completely disappearing in the next ten years if there is no human intervention.

In freshwater, the main threats for Atlantic Salmon are the changes in environmental conditions, contaminants, barriers to fish passage and the depressed population phenomena (Fisheries and Ocean Canada, 2010). The observed decrease in smolt production can also be associated with habitat degradation, low pH and temperature increase. Globally, these effects and threats can be linked to agriculture, urbanization, forestry, mining and other human activities.

The Atlantic Salmon requires a habitat defined by its fast-moving water and a fine substrate that may include small gravel and sand. During the aquatic survey, Atlantic Salmon were caught or observed in two watercourses, Kenny Brook and the Unnamed Brook (Appendix A). The habitat provided by these brooks is deemed mostly adequate for the species and the presence of Atlantic Salmon must be considered. However, the watercourses are not directly connected to the peatlands targeted by the project. Salmonid species in New Brunswick are known to migrate from May to early August and from September to mid-November (New Brunswick Department of Environment, 2012). Their spawning period is usually from mid-April to late May.

4.2.4 Special Status Areas

According to the ACCDC report (Appendix E), no special area is present within a 5 km radius of the study area.

4.3 Human Environment

4.3.1 Local Communities

The McKiel bogs straddle York and Carleton counties and are part of the Western Valley Rural District & Capital Region Rural District. The closest populated areas are the hamlets of Deersdale and Juniper, 12 km south and 17 km southwest of the project site, respectively.

4.3.2 First Nations

There are sixteen Indigenous communities in New Brunswick. There are nine Mi'gmaq communities, six Wolastoqey communities and the Peskotomuhkati. The project site is located on lands believed to be Mi’gmaq traditional territory that may also be of interest to the Wolastoqey. The closest Indigenous community is the Wolastoqey community of Tobique First Nation (Neqotkuk). The closest Mi’gmaq communities are Natoaganeg (Eel Ground) and Metepenagiag (Red Bank).

Juniper Organics Limited follows a policy of voluntary early engagement with all sixteen Indigenous communities and their representative organizations, including Mi’gmawel Tplu’tqann Inc. (MTI), Wolastoqey Nation in New Brunswick (WNNB), Kopit Lodge, and the New Brunswick Aboriginal People’s Council (NBAPC). Early engagement is intended to determine Indigenous community and organization interest in engaging on any proposed projects that might trigger the Crown’s Duty to Consult. This process could include overview presentations, site tours, sharing of studies, reports and assessments, including the opportunity to review the draft EIA document for comment and feedback. If Indigenous communities choose to participate in this process with JOL, an understanding of potential impacts to Aboriginal and treaty rights can be learned very early in the project design, so that accommodations (if necessary) can be proposed to avoid, minimize, or mitigate identified impacts prior to the Crown’s Duty being triggered.

4.3.3 Regional Population

The project is located at the limit of Carleton County and York County. These two counties are home to a population of 26,360 and 105,261 inhabitants, respectively (Statistics Canada, 2023; Table 13). Overall, the area surrounding peatlands No. 850, 851 and 852 is sparsely populated. According to the Canadian census completed in the last two decades, the population increased for both counties between 2016 and 2021. The population of Carleton County is concentrated along the Saint John River, and Woodstock, located 66 km southwest of the project, is the largest town with 5,254 inhabitants. York County is home to the city of Fredericton, the capital of New Brunswick, with a population of 58,220 and is located 72 km south-southeast of McKiel bogs.

Table 13 Canadian Census Statistics for the Carleton and York Counties

	Carleton County	York County
Population in 2021	26,360	105,261
Population in 2016	26,178	99,453
Population density	8/km^2	13/km^2
Median age	46.4	42.0
Total private dwellings	11,865	48,294

Source: Statistics Canada, 2023

There is no inhabited settlement within a 10 km radius of the project site and no private domestic water well is located within a 10 km radius of the peat operation perimeter.

4.3.4 Services

Currently, the McKiel bogs can be accessed by forest roads close to each peatland and connected to Highway 107 in Deersdale. These unpaved roads will be extended to allow access to the service area of the three peatlands.

The closest police service is in Woodstock (822 Main Street, phone: 506-325-4601), while the closest fire department is the Juniper Fire Department (9 Teague Road).

Upper River Valley Hospital in Waterville, 11 km north of Woodstock, is the closest place where health services can be provided in case of an emergency (> 70 km).

McKiel bogs are relatively isolated from urban areas. Most services (groceries, restaurants, car repair services, etc.) can be found in Woodstock, approximately 66 km southwest of the McKiel bogs, or in Fredericton, approximately 72 km southeast of the project site.

4.3.5 Land Use

The region's economy relies mostly on forestry operations. In 2017, approximately 92% of the Beadle Ecodistrict was covered by forest (Government of New Brunswick, 2017). Less than 1% of the area covered by the Beadle Ecodistrict is used for agriculture, and 21% of the non-forested area of the region is covered by roads.

4.3.6 Economy

The project site is located directly on the limit between the Central and Northwest economic regions, two of the five economic regions officially recognized by the government of New Brunswick. The two main urban areas of the Central Economic Region are Fredericton and Oromocto. The main urban areas of the Northwest economic region are Edmundston, Grand-Sault, Florenceville-Bristol and Woodstock. Table 14 presents some statistics relative to the labour force for each economic region (Government of New Brunswick, 2023).

Table 14 Labour Force Characteristics in the Central and Northwest Economic Regions (2022)

	Central Economic Region	Northwest Economic Region	New Brunswick
Population aged 15+	121,900	65,200	664,100
Not in Labour Force	43,800	27,000	261,600
Labour Force	78,100	38,200	402,500
Employment	73,300	36,100	373,500
Unemployment	4,700	2,100	29,000
Participation rate	64.1%	58.7%	60.6%
Employment Rate	60.1%	55.4%	56.2%
Unemployment Rate	6.0%	5.5%	7.2%

Over the last years, both regions have recorded an increase in their labour force. The arrival of international and interprovincial migrants can explain this growth. For both economic regions, unemployment rates have decreased in the last two years due to a growing number of retirements, which increase job opportunities.

This project should positively impact the local population by providing jobs that do not require special skills.

4.3.7 Areas of Interest

As previously mentioned, the Juniper and Deersdale hamlets are the closest populated areas. The biggest urban area of the region is Fredericton. In 1956, a private airport was built east of Juniper. The airport is still active today.

4.3.8 Historic Land Use

The project site is located in the Beadle Ecodistrict, a region that is located on Mi'gmag traditional territory and is of potential interest to Wolastoqey communities. The area was likely used as hunting grounds or for traveling overland by portage trails between Saint John and Miramichi rivers. In more recent times, the region was used for logging, especially around all accessible rivers, as soon as the late 1700s. Juniper was created in the early 1900s as a lumbering center.

4.3.9 Archaeological Considerations

The Archaeological Services Branch of the Department of Tourism, Heritage and Culture was contacted for the presence of archaeological and/or heritage sites in the project area. According to the information received, there are no sites of interest within a distance of 5 km of the area targeted by the peat harvesting projects (Appendix H).

Based on current knowledge, the project site is not known to be currently used by the First Nations communities present in the region. However, considering the project site is located on the traditional territories of the Mi'gmaq and the Wolastoqey communities, the following measures will be taken to address archeological concerns if artifacts are accidentally discovered during the construction phase:

- Employees and contractors will be trained on the WNNB Accidental Discovery of Archaeological Artifacts Protocol, which has been co-developed by WNNB and AHB.

- Any worker who discovers a potential archaeological object, paleontological object, burial object, or human remains will immediately stop and notify the Site Manager immediately, who shall execute the Protocol.
- All work in progress within a perimeter of 15 m around the discovery location will stop immediately until further instructions from the Minister. The Site Manager may extend the protection perimeter depending on the importance of the discovery.
- During early engagement with MTI, there was a discussion of having a Mi'gmaq monitor onsite during initial site preparation activities. This concept is to be seriously considered and discussed further with MTI.

5 Summary of Environmental Impacts and Mitigation Measures

5.1 Hydrology

5.1.1 Surface Water Regime

Drainage for McKiel bogs is planned to maintain and comply as much as possible with natural flow direction and contribution to the local watercourses. In general, during the drainage of the peat, the increase or not of the runoff flow to the surrounding environments, in particular the receiving environments, depends on the drainage technique used, the type of peat and its hydraulic properties and its location within the watershed (Landry & Rochefort, 2012). The main factors that affect the runoff rate are the level of the water table in the bog and the rate of water infiltration at the bog surface (Gemtec Limited, 1991).

As a result, two approaches were used to quantify the impact of the drainage of McKiel bogs on surface water, namely watershed and hydrological changes, including runoff.

McKiel bogs are located in the watershed of McKiel Brook. Still, they spread over the drainage divides of six existing sub-watersheds (SW) that include the following harvest areas at their natural state and after the construction of the drainage network (Map 4):

- Kenny Brook (SW-north 850): includes harvest areas 1a, 1b, 1c, 3a, and 3d;
- McKiel Brook Downstream (SW-south 850): includes harvest areas 1a, 1c, 1d, and 1e;
- Unnamed Brook (SW-north 851): includes harvest areas 3a, 3b and 3c;
- Upstream McKiel Brook (SW-south 851): includes harvest areas 3c and 3d;
- Carson Brook (SW-north 852): includes harvest areas 2b, 2c, 2d, 2e, and 2f;
- McKiel Lake (SW-south 852): includes harvest areas 2a, 2b, 2c, 2d, 2e, 2f and 2g.

The McKiel Lake sub-watershed corresponds to the portion of Peatland No. 852 that drains directly into McKiel Lake.

The total area of each sub-watersheds varies between 23 and 1,438.2 ha. The area of each sub-watersheds that will be drained/harvested varies between 14.5 and 1444,4 ha depending on the watershed (Map 4).

The natural flow of water through the peat is primarily in the form of subsurface flow in the acrotelm, and surface runoff occurs only during significant precipitation or melt events. The pattern of drainage networks has been planned to minimize the transfer of water from one watershed to another compared to the natural state to prevent the impact on the hydrological environment. This is also because passive drainage, by gravity, requires conforming drainage flow directions with natural hydrology.

Due to the development of the drainage network, the variation in the area attached to each watershed is lower for most sub-watersheds, in the order of -9.8% to +1.2%, depending on the watershed. The only exception is the upstream McKiel Brook basin, which shows a high percentage of exchange (-36.6%). This results from the presence of two sedimentation ponds (No. 4 and 5 on Map 4) planned downstream of peatland No. 851 at the limit of the water divide. According to local topography, the outlet of these basins may drain into upstream McKiel Brook SW or the adjacent sub-watersheds.

Due to the development and construction of drainage networks, the variation in peatland area within each watershed is anticipated to be small. Therefore, the difference in the water supply to each stream from the McKiel bogs will be insignificant.

summarizes the current and future total areas of each sub-watershed and the expected variation of this area due to drainage.

Table 15 Current and Expected Areas by Sub-Watershed

	Sub-Watersheds					
	Kenny Brook (north 850)	**Downstream McKiel Brook (south 850)**	**Unnamed Brook (north 851)**	**Upstream McKiel Brook (south 851)**	**Carson Brook (north 852)**	**McKiel Lake (south 852)**
Complete Sub-Watershed						
Current total area (ha)	1,410.9	121.0	452.3	23.0	1,438.2	105.9
Variation from current Area (ha)	17.0	-11.8	3.2	-8.4	6.2	-6.2
Future area with drainage network (ha)	1,427.9	109.2	455.5	14.5	1,444.4	99.7
Variation from current area (%)	1.2%	-9.8%	0.7%	-36.6%	0.4%	-5.9%

It is important to mention that these values represent approximations based on a watershed breakdown from topographic data from Natural Resources and Energy Development, Government of New Brunswick (Oct. 2023). The degree of precision inherent in this data means that the actual position of natural water divides may vary from those determined in the study. Consequently, the flow directions in the ditches, as well as the position of the sedimentation basins and discharge points are subject to change in order to adapt to the reality of the site.

5.1.2 McKiel Bogs Water Budget Estimate

The hydrological water budget of McKiel bogs was carried out to quantify potential changes to naturally occurring water fluxes. Monthly runoff was estimated using the Thornthwaite (1948) method, which allows for calculating potential and actual evapotranspiration based on climatic data and latitudinal location. The difference between precipitation and actual evapotranspiration is a surplus distributed between surface runoff and peat water table recharge. Hydrological data for 2003 from the JUNIPER hydrometric station were used for this calculation because it provides the most complete data. Although located 15 km from the study site, this station is the closest with complete data (Environment Canada, 2023).

Quantifying potential evapotranspiration (PET) in undisturbed conditions yielded a value of 534 mm/y. This figure was validated using reference evapotranspiration (ET) data computed by Xing *et al*. (2008) for conditions prevailing in Fredericton and adjusted for a time-varying crop coefficient reproducing the seasonal stages in Sphagnum growth. The latter method yielded a PET of 582 mm/year over an undisturbed New Brunswick peatland. Close conformity between the two results validated the use of the Thornthwaite method.

Average yearly precipitation ranges at about 1,245 mm. It appears that actual ET in undisturbed conditions would be close or equal to PET since water availability is generally not a limiting factor for a maritime bog. As such, the local watersheds have a net natural water output of approximately 710 mm/year. Water output would essentially take the form of subsurface acrotelm flow from the peatland toward its periphery. Some surface runoff oriented in the same directions could also occur on a time-specific and point-specific basis.

The water budget for disturbed conditions considered a maximum readily available soil water supply of 225 mm for the peat deposits, in accordance with the peat's storage capacity present in the area.

As the method of Thornthwaite (1948) does not take into account the influence of frozen conditions and storage of water in the form of snow on infiltration capacity and delayed runoff response related to spring snowmelt, minor modifications were applied to the computed runoff in order to represent monthly runoff fluctuations and timing in a more realistic manner. As such, integral (100%) non-delayed surface runoff was considered for rainfall recorded between December and March, in accordance with observations presented in Gemtec Limited (1994).

Field measurements carried out by Gemtec Limited (1991) in Peatland No. 569 showed that equivalent surface runoff coefficients concerning incident rainfall were systematically lower than 0.2 (between 0.02 and 0.16) compared to incidental rain and can reach a maximum value of 0.5 for a completely saturated peat and during a period of intense rain. Nevertheless, a runoff coefficient of 0.3 was used to evaluate the surface runoff discharge from the bogs during harvesting phases to yield more conservative estimates of the total surface runoff outflow to the surrounding terrain. Since the McKiel bogs have not been harvested and drained in the past, a runoff coefficient of 0.16 was used to assess surface runoff generation in the bog before the new harvest phases.

The estimated monthly runoff pattern from McKiel bogs in its natural state and upon reaching its full development is presented in Figure 5. Runoff quantities are also presented as specific runoff per unit hectare of mined peatland (drained state).

Water budget assessment for both natural state and drained state conditions shows that the total yearly output of water from the bog would remain more or less the same. This is because peatland drainage should have little effect on the actual evapotranspiration losses. Indeed, water available for evapotranspiration is the water that remains stored within the peat once infiltrated water has drained away freely.

Vegetation cover removal upon field preparation will result in increased surface runoff and, thus, direct water losses under important precipitation events and precipitation events in previously wet conditions. However, this should have only a limited effect on water availability for evapotranspiration, as the water storage capacity of peat will be significantly enhanced by field drainage. As such, infiltration under low-to-average rainfall will replenish water stocks available for evapotranspiration and offset the effects of water losses via surface runoff. Vegetation cover removal will also reduce potential transpiration to about zero. On the other hand, potential evaporation is expected to increase because of the ground’s reduced albedo and increased exposure to winds. Antagonistic hydrological consequences of surface modifications about development activities should thus have a limited impact on actual global evapotranspiration at the field scale.

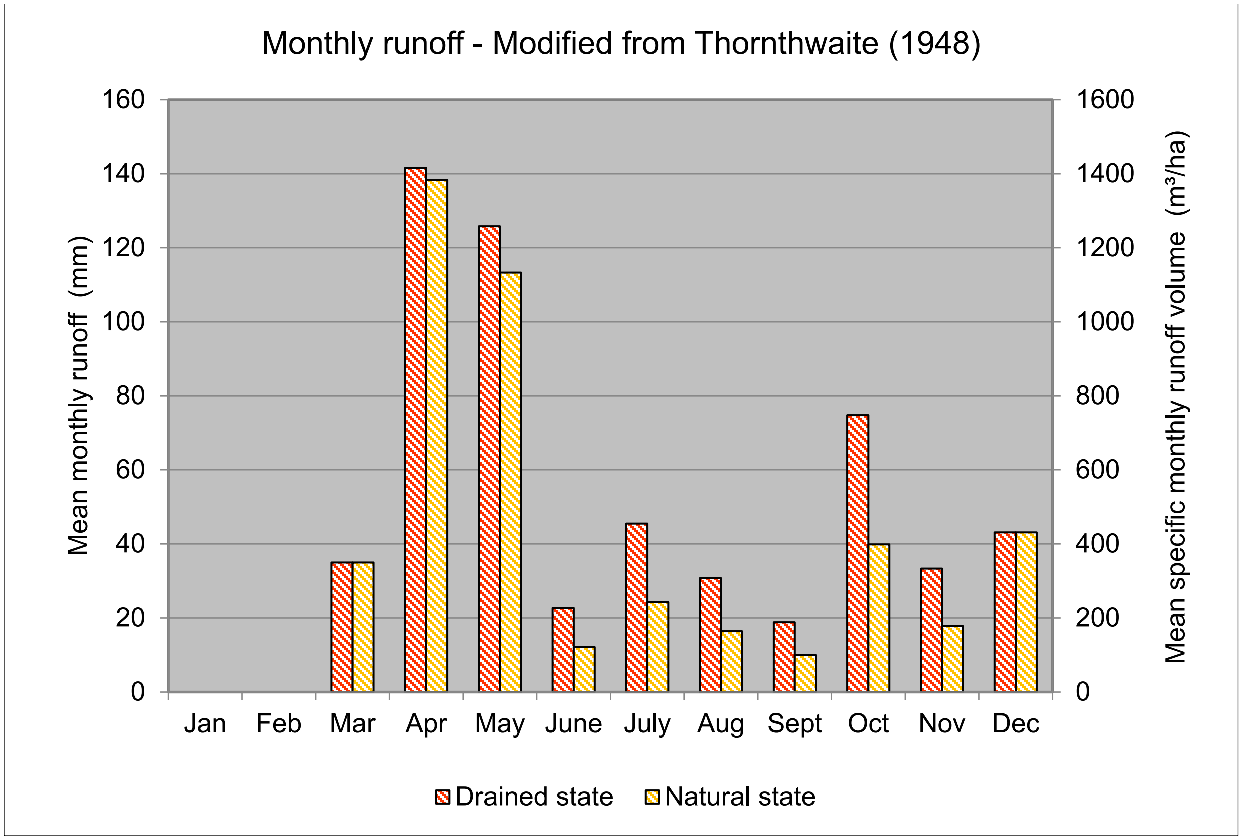


Figure 5 **Estimated Monthly Runoff in Harvest Areas for McKiel Bogs**

Ditching will affect the rate and timing at which water drains away from the bog. Water discharge at the drainage network outlets will initiate infiltration, subsurface hypodermic flow, and overland flow, the latter decreasing as water moves away from the release points until it becomes non-existent. Hence, drained water will essentially be reintegrated into the natural subsurface flow system. Drainage network outlets within 100 m from a receiving watercourse will have sedimentation ponds in addition to overland flow. These sedimentation ponds will buffer peak flows.

No drainage water or surface runoff from McKiel bogs harvest fields will discharge directly to Kenny Brook, Carson Brook, and Unnamed Brook, without going through a sedimentation pond and/or overland flow. The natural hydrological regime of the streams will thus be maintained, and no significant modification is expected on the intensity or timing of the spring freshet or peak flows in response to rainfall events. Consequently, peat harvesting within the three sub-watersheds of the above streams will not significantly impact naturally occurring erosion and sedimentation processes within these streams or their tributaries.

No drainage water or surface runoff from McKiel bogs will discharge directly into McKiel Lake. Indeed, all network outlets will be located at least 100 m from the nearest tributary without flowing through a sedimentation pond. No significant impact is expected regarding the intensity or timing of the spring freshet or peak flows in response to rainfall events. Consequently, peat harvesting within the McKiel Brook watershed will not significantly impact naturally occurring erosion and sedimentation processes within McKiel Lake or its tributaries.

5.1.3 Surface Water Quality

Drainage water and surface runoff originating from peatland development can have elevated suspended particles (solids) content. In addition, they will likely exhibit a relative acidity, especially for drainage water.

Most harvest fields of McKiel bogs will drain to the ditch network, discharging into sedimentation ponds, where the bulk of the transported suspended solids (essentially peat particles) can settle. Subsequent discharge from sedimentation ponds will take the form of overland flow to adjacent undisturbed low-lying vegetated lands, allowing the settling of residual peat particles. Drainage water at outlets located more than 100 m from the receiving watercourse will discharge as overland flow. This technique has proven efficient at limiting the impact on water quality (Thibault, 1998). It has been implemented and tested at many harvested peatlands in New Brunswick.

Combining the two suspended solids management measures will ensure efficient peat particle interception. Considering the relatively flat topography down-gradient from the final release points and the space between such points and the nearest tributary, Kenny Brook, Unnamed Brook, Carson Brook or McKiel Lake (≥50 m in most cases), no significant discharge of suspended solids to the local streams or their tributaries is expected.

Peat drainage water released to the land surrounding McKiel bogs harvest fields will have high acidity. Peat drainage water's arsenic, aluminum, and iron concentrations may also be above CCME criteria for freshwater aquatic life protection. High acidity will mostly occur during the initial drainage phase. The pH of water discharging from the peatland will subsequently increase as the relative contribution of water initially stored in the peat deposits to the overall discharge decreases and as a result of enhanced surface runoff and more rapid peat drainage in response to rainfall. Exposure of underlying mineral soil or more alkaline peat will also contribute to progressively increasing the pH of water discharging from the peatland. As the discharging water becomes less acidic, aluminum and iron concentrations will decrease (Shotyk, 1986).

A similar tendency is expected for arsenic, whose presence in peat originates from airborne deposition (Shotyk *et al.*, 1996). On the other hand, phosphorus concentrations in discharging water will tend to increase due to the acceleration of organic matter decomposition due to peat field drainage (Thibault, 1998).

5.1.4 Mitigation Measures for Surface Water

All drainage water from the developed area will be directed to sedimentation ponds for treatment before being discharged to the environment or directed to low-lying undisturbed land to be diffused as overland flow. Both measures (sedimentation pond and diffuse overland flow) will be used in most cases. No water discharge will occur within 50 m of a tributary of the streams mentioned above or McKiel Lake, ensuring adequate filtration of drainage water.

As a result of the particle settlement that will take place inside sedimentation ponds, these structures will actively contribute to reducing suspended peat content in discharge water. In addition, their outlets will be designed and built to induce diffuse water flow through the existing vegetation upon water discharge. Temporary water retention inside ponds will also positively affect water flow at the drainage subnetworks outlets, as it dampers peak flows and allows a more uniform water discharge over time, regarding magnitude.

Studies carried out in New Brunswick showed that sedimentation ponds and diffuse overland discharge contribute to both controlling flows at the sedimentation pond outlets downstream of the drainage network and improving the quality of discharge water (Gemtec Limited, 1993). According to the guidelines for peat mining operations (Thibault, 1998), diffuse overland flow is more efficient than sedimentation ponds for reducing sediment load in drainage water. JOL proposes combining the two methods where drainage water outlets are within 100 m of a receiving watercourse.

Juniper Organics Limited will regularly inspect ponds and outlets to ensure they are in good order and functioning properly. If flow channels form at the outlets, mitigation measures will be implemented to prevent or correct any apparent erosion process. All ditches and all sedimentation ponds will be cleaned of peat at the end of each harvesting season or whenever required.

Water quality at discharge points will be monitored regularly, starting upon the beginning of construction and field opening and continuing until the restoration phase. Environmental monitoring will include water quality analysis and visual inspection at active sedimentation pond outlets (see Section 5.11 Monitoring Program).

Progressive opening of the harvest fields also represents another mitigation measure, as it distributes peak flow following drainage network construction over a three-year period.

Mitigation measures primarily related to surface water flow include progressive harvest field restoration once harvesting is completed in a given area. This will allow the restoration of the natural hydrological regime of the peat fields and thus eliminate most of the impacts on peatland surface water flow in the short term. Revegetation of the former harvest fields will contribute to restoring the natural hydrological regime since a large percentage of water is lost through evapotranspiration in peatlands. It is estimated that the acrotelm may rebuild in 17 years following Sphagnum Revegetation, thus returning to natural bog water level fluctuations (McCarter and Price, 2013; Lucchese *et al.*, 2010). The creation of open water bodies and dikes to retain water on site and raise the water table regulates surface runoff, restores the water storage capacity of the peat, and improves water quality. Reestablishing peatland vegetation will also stabilize bare peat surfaces and prevent the release of peat particles in the drainage network and toward receiving watercourses.

A series of mitigation measures to reduce access road construction impacts will be implemented based on the *Guidelines for Road and Watercourse Crossings* (Natural Resources, 2004). Such measures target erosion prevention and sediment control. For instance, existing vegetation will be protected, silt fences and straw bales will be used to trap sediment, and geotextile will be used to prevent stream bank erosion.

5.2 Hydrogeology

5.2.1 Groundwater Regime

The two types of groundwater are considered:

- Groundwater of the local aquifer contained within the Paleozoic bedrock (Ordovician age).
- Perched groundwater contained in the peat deposits.

The hydrogeological interactions between the peat deposits and the underlying formations, including the Paleozoic bedrock, are low. Therefore, no significant impact is expected on the local aquifer due to the proposed peat development expansion. No significant impact is expected on groundwater availability for local down-gradient users. No impact is expected on groundwater availability for local users who have installed up-gradient from the peatland.

Ditching and drainage activities will result in the lowering of the water table in the harvested area. The water table will be lowered during the construction phase and kept at a locally low level throughout the operation phase. The water table drop will not extend more than about 25 to 50 m beyond the harvested area (Landry and Rochefort, 2012) as most of the peat deposit (catotelm) has a low hydraulic conductivity. A slight local rise in the level of the surficial water table is expected at the sedimentation ponds release points due to greater infiltration resulting from increased water availability.

The 50 cm layer of peat left after peat harvesting has ended will remain saturated and help maintain a high water table in the harvested sites. The progressive decommissioning will lead to a recovery of the perched groundwater as ditches are blocked and open water bodies are created. The residual impact on peat deposits in groundwater is expected to be low.

5.2.2 Groundwater Quality

Peat harvesting does not involve using chemicals or other hazardous materials except petroleum products for equipment. Water quality in the perched (peat) aquifer could be potentially affected by accidental petroleum spills during the construction and operation phases. The spatial extent of the impact would, however, be point-specific. Implementation of emergency response actions will allow efficient containment before appropriate clean-up, and restoration procedures will further mitigate the associated negative impacts. Moreover, peat has the property of absorbing oil and other petroleum products, and it is used to clean up oil spills. Hence, no chemicals or other hazardous materials may be released into the surrounding environment.

No impact on water quality in the bedrock aquifer is expected. Hence, no alteration to the quality of groundwater that may be utilized as a potable water supply in nearby domestic wells is expected.

5.2.3 Mitigation Measures for Groundwater

Drainage and harvesting will only affect the upper portion of the peat deposits. After operations end, the residual peat layer will remain saturated, and a superficial water table will be maintained in the harvest areas. Progressive restoration will induce a rise in this water table as the ditches are blocked and areas of open water are created. It is expected that the residual impact will be low.

Petroleum product transfer and handling operations will be executed away from any watercourse and with dedicated equipment to adequately prevent and manage any spill. If an accidental spill occurs outside of these areas, the execution of emergency response procedures will ensure that it is confined adequately and swiftly. Appropriate cleaning and remediation measures will then further mitigate the associated negative impacts. Consequently, no chemical or hazardous product will be released to the surrounding environment.

5.3 Wetlands and Vegetation

5.3.1 Impacts

Peat field preparation involves the removal of trees and peatland vegetation from harvest areas and bog roads, which will have an important impact at the site level.

Plant communities of the peatlands targeted by this project are dominated by open ombrotrophic vegetation. Considering there are not many peatlands in the region compared to other New Brunswick areas, the project will result in a contraction of this habitat regionally. Nonetheless, bog habitats and plant communities will not be threatened by the project locally or regionally since they are present at the margin of peatlands, in conservation areas, as well as in other peatlands in the area, the closest being bogs No. 1327 and 1329 located across McKiel Lake.

The vegetation survey completed in August 2023 did not find any rare species, as shown in the report (Appendix D).

5.3.2 Mitigation Measures

The main mitigation measures that address the impacts on flora, plant communities, and wetland habitats are outlined in the reclamation plan presented in Section 3.6. This plan aims at restoring the impacted peatland ecosystems after peat extraction activities are completed. Hence, this impact will be temporary, considering the peatlands targeted by this project will be progressively restored as harvesting stops. The reclamation plan encompasses three options for harvested areas—Sphagnum Revegetation, Forested Wetland Habitat, and Open Water—each tailored to address anticipated conditions following the cessation of peat harvesting. In the short term, the specific objectives of these options are to reintroduce appropriate peatland plant species and block drainage ditches. Achieving these objectives is expected to effectively mitigate most impacts of peat harvesting on flora and vegetation.

The implementation of the reclamation plan will result in the restoration of wetland plant communities and the preservation of existing local habitat diversity as each proposed option targets different habitat:

- Sphagnum Revegetation corresponds to typical peatland plant communities such as open areas.
- Forested Wetland Habitat as found at the bog margin.
- Open Water should lead to the creation of numerous bog pools in the three peatlands. Floating mats and specific plant communities characterize bog pools, and they are considered as biodiversity hot spots.

The techniques employed in Sphagnum Revegetation have a proven track record in New Brunswick, demonstrating consistently high success rates over the years. Recent studies highlight the Moss Layer Transfer Technique (MLTT) as particularly effective, ensuring the restoration of bog plant communities and over 80% of peatland species within a decade (Poulin *et al.*, 2013; Hugron *et al.*, 2020). For areas unsuitable for Sphagnum Revegetation, tree plantations will establish forest stands that may evolve into transitional habitats called laggs and Forested Wetland Habitats, contributing to conserving peatland integrity.

In the case of Open Water creation, ongoing research is developing approaches with the expectation that successful restoration methods for bog ponds will be available during reclamation. These efforts aim to enhance the ecological value of created pools, and the application of the best available techniques will be ensured during the reclamation process.

Juniper Organics Limited will rehabilitate peat fields approximately within three years following the cessation of peat harvesting where possible. Such progressive reclamation will accelerate the return of peatland plant communities and habitats.

Preserving conservation areas covering 43.6 ha within the portion of the bogs with more than 1 meter (m) of peat (commercial peatland) and 98 ha in the non-commercial peatland (area with less than 1 m of peat) will ensure that a large area remains in its natural state. The conservation areas include mainly open bogs and pools. Donor sites, encompassing a total of 20.5 ha, were also selected directly within Peatlands No. 850, 851 and 852 limits. Most donor sites can self-restore when plant collection is done correctly. Following the collection, the sphagnum layer can be restored within 10 years (Guêné-Nanchen *et al.*, 2019). Plant communities regenerating in donor sites might differ from those present before the harvest, considering that different conditions are induced on these sites. The location of conservation and donor sites is shown on the development plan (Map 3).

The following measures will also be applied to avoid introduction of invasive species within the development area:

- Seed mix that will be used to restore non-bog habitat, if any, will contain seeds of native plant species as much as possible and be devoid of invasive species;
- All machinery that will be used will be cleaned with a pressure water hose prior to entering the site;
- Equipment used for construction will be inspected prior to, during and immediately following construction to ensure that plant matter is not transported from one construction area to the other especially in wetland areas and in areas found to support Purple Loosestrife.

Considering the anticipated initial impact and the suggested mitigation measures, the project's expected residual impact on vegetation and rare plant species is estimated to be minimal.

5.4 Terrestrial Wildlife

5.4.1 Impacts

Site preparation and peat harvesting will disturb wildlife mainly through habitat loss and disruption for mammals, birds, and herpetofauna at the site level. However, the fact that no wildlife species is restricted to these ecosystems in terms of habitat limits the impact. Undeveloped and conservation areas will act as refuges for wildlife, especially because they will remain in direct contact with surrounding natural areas. They will facilitate the return of species after reclamation (Mazerolle *et al.*, 2001). Preserving areas with pools is crucial for maintaining habitat for aquatic bird and insect species that use intermittently open water areas for staging. The timing of migratory bird species passage in spring and fall coincides with periods of low harvesting intensity. Consequently, the potential impact on these species and their habitats is expected to be minimal.

The impact of the project on terrestrial wildlife is considered temporary, considering it will be limited to the lifespan of the peat harvesting operation, approximately 40 years, and the time required to restore peatland habitat (10-15 years). After peat harvesting operations are completed, each peatland will be reclaimed. Typically, progressive reclamation will begin with fields situated at the periphery of a peatland, where the peat is shallower, as is evident in peatland No. 850, 851, and 852. These reclaimed fields will gradually become available peatland habitats, providing opportunities for wildlife from nearby natural areas and buffer zones to colonize the rejuvenated areas.

5.4.2 Special Status Species

Three wildlife species with legal protection status were identified by the ACCDC within a radius of 10 km from the project site, with seven additional location-sensitive species within a 100 km radius. Among these species, three were considered to have a moderate presence potential: the Eastern Painted Turtle, the Snapping Turtle, and the Olive-sided Flycatcher (Table 11).

The Eastern Painted Turtle and the Snapping Turtle favor similar habitats: calm and shallow aquatic environments, including pools, rivers, lake shores, wet meadows, and bogs. Both species are like water bodies with a soft, muddy substrate with lush vegetation where they can hide. As such, bog pools are the only favourable habitat where they can be found within the limits of the project site. However, their potential presence is higher near McKiel Lake and the surrounding brooks, considering these places offer better habitat conditions for turtles. Furthermore, the proposed conservation areas include the zones with the highest bog pool concentration. Thus, the favoured habitat for both turtle species will be protected and remain accessible from surrounding natural habitats except for Peatland No. 850.

The Olive-sided Flycatcher prefers transitional and semi-open habitats for nesting. This habitat type can be found in the lagg and transition area surrounding Peatlands No. 850, 851 and 852. Consequently, the project has little probability of impacting this species by destroying potential nesting grounds within the limits of the peatlands. Mitigation measures will be applied to limit the project's impact on this species.

The impact on birds will be reassessed upon completing bird surveys conducted during summer 2024.

5.4.3 Mitigation Measures

The primary mitigation measure for wildlife is implementing the reclamation plan (Section 3.6). The restoration of typical bog plant communities and pools included in this plan aims to re-establish habitats occasionally utilized by mammals, birds, and herpetofauna. Conserving approximately 43.6 hectares of bog habitat within Peatlands No. 850, 851, and 852, including pools suitable for various bird species, is another important measure in sustaining wildlife populations during the project's duration. Situated in a largely undeveloped region, the peatlands targeted by the project also benefit from the presence of surrounding natural areas, which adequately support the local wildlife population. As a result, wildlife is expected to recolonize the peatlands during the reclamation process.

Standard measures regarding wildlife protection will also be implemented. For instance, under no circumstances will workers or any person on the project site approach harm or harass wildlife, and any observation of special status wildlife species will be reported to the DELG. Efforts will be deployed to ensure that garbage and food scraps are disposed of properly to avoid attracting wildlife. Further provisions for wildlife response and mitigation measures largely based on the "Guidelines for Effective Wildlife Response Plans" (ECCC, 2021) will be indicated in the Environmental Protection Plan (EPP).

Juniper Organics Limited will also comply with the regulations of the Migratory Birds Convention Act (MBCA), the Migratory Birds Regulations (MBR) and the Fish and Wildlife Act. JOL commits to respect the regulations, including, but not limited to, the following:

- Under Part 1 of the MBR, no person shall:
  - capture, kill, take, injure or harass a migratory bird or attempt to do so;
  - destroy, take or disturb an egg;
  - damage, destroy, remove or disturb a nest, nest shelter, eider duck shelter or duck box.
- Under Section 5.1 of the MBCA, no substance harmful to migratory birds will be deposited in waters or an area frequented by migratory birds.
- If nests containing eggs or young of migratory birds are located or discovered during operations, all disruptive activities in the nesting area should be halted until nesting is completed. Any nest found should be protected with a buffer zone determined by a setback distance appropriate to the species, the intensity of disturbance and the surrounding habitat until the young have naturally and permanently left the vicinity of the nest.
- Development operations will be minimized during the critical nesting season (mid-April to the end of August) to minimize impacts on bird species. In cases where vegetation clearing activities must occur during this period, considered the most crucial breeding time, specific measures will be outlined in the Environmental Protection Plan.
- During the nesting season, peat stockpiles will be actively used that will prevent birds to nest or deter them from peat piles.

It is important to note that mitigation measures regarding birds may be modified based on the results of the 2024 surveys.

According to the data from the ACCDC, there are three turtle species present within a 100 km radius of the project site: the eastern painted turtle (*Chrysemys picta picta*), the snapping turtle (*Chelydra serpentina*) and the wood turtle (*Glyptemys insculpta*). Considering the potential presence of these species, specific mitigation measures for these species will be applied during the project.

The snapping turtle and the eastern painted turtle are known to nest along road shoulders and in stockpiles. As such, physical barriers (geotextile barrier or other equivalent measure) around stockpiles are a mitigation measure that is commonly used, but it is not applicable in the case of harvested peatland as peat stockpiles are consistently accessed by machinery either to download peat or charge it into trucks.

Education and awareness are also key factors to prevent any negative impacts for turtles. The workers will be made aware of the potential presence of turtles in the area. Workers will be encouraged to report any turtle sightings. If nesting areas are seen by workers, the nest will be identified with flags that can be seen from a distance. If possible, the flags will be placed only after the nest is deemed empty of any female adult turtles (that might lay their eggs) to avoid any stress on them. Once properly identified, nesting areas will be avoided for their protection. Access roads will also undergo regular inspections for the presence of turtles.

Mitigation measures for the snapping turtle and the painted turtle will be included in the EPP. Interactions with these species will likely be limited as access to most stockpiles will be difficult for turtles who will either have to cross peat fields (extended area of bare and dry peat) or main ditches bordered by vertical walls.

Based on the anticipated initial impact and the proposed mitigation measures, the project's impact on wildlife and rare wildlife species is estimated to be low.

5.5 Aquatic Wildlife

5.5.1 Impacts

Peat harvesting requires constructing a drainage system, lowering the water table to allow peat drying, and using machinery. These activities can alter water quality in receiving watercourses.

Peatland drainage ditches, despite the use of sedimentation basins and other methods to trap peat particles, can deliver suspended sediments downstream (St-Hilaire *et al.*, 2006; Clément *et al.*, 2009; Pschenyckyj *et al.*, 2023). Peat harvesting activities can also affect water quality by increasing concentrations of total organic carbon and phosphorus, as well as increasing acidification. Additionally, suspended solids may be carriers for contaminants and heavy metals deposited in the environment, potentially altering physical and chemical characteristics (Ouellet *et al.*, 2006). The bioaccumulation of certain metals, like mercury, has been associated with dissolved organic carbon discharged from bogs into watersheds (French *et al.*, 1999). However, studies in the Richibucto River area suggest that although peat particles exhibit elevated mercury levels, bioaccumulation in aquatic biota may not necessarily occur (Surette *et al.*, 2002).

While there is limited research that supports that claim, it is known that peat harvesting can result in a temporary decline in fish abundance in downstream watercourses during and after harvesting operations (St-Hilaire *et al.*, 2006; Clément *et al.*, 2009). The primary effect on aquatic wildlife stems from releasing peat particles into the atmosphere or water, potentially influencing water quality downstream of Peatlands No. 850, 851 and 852.

Despite the potential impacts of increased suspended solids, sediments, and other elements on aquatic biota, studies on the specific effects of peat harvesting on aquatic organisms are scarce (Kreutzweiser *et al.*, 2013).

Atlantic Salmon

The Atlantic Salmon is the sole aquatic species listed under the SARA observed close to the project site. The main way the project may affect Atlantic Salmon is its potential to modify water flow and quality. The hydrological study shows that the project will result in increased water flow toward the receiving watercourse during the construction of the drainage network. According to the worst-case scenario, the opening of Peatland No. 852 (60 ha), the anticipated peak flow will occur on the fifth day of the first cutting phase, adding 35 L/s to the receiving watercourse. In that case, that volume of water will be divided between 6 outlets toward the Carson Brook and the McKiel Lake watersheds. This temporary variation that will last a few days will not likely affect the flow of the receiving watercourse after going through sedimentation ponds and overland flow.

Water quality, especially total suspended solids (TSS), is an important factor that affects salmon. When the TSS level reaches 25 mg/L, behavioral change in young salmonids commences if they are exposed for more than 1 hour (Sorenson *et al.*, 1977). Although these levels are not immediately lethal, they prompt an avoidance response.

Suspended solids concentration above 90 mg/L can cause damage to gills, which can be fatal for young Atlantic salmons. As TSS levels rise further, they affect dissolved oxygen (DO) levels, exacerbating stress in salmonids.

5.5.2 Mitigation Measures

As indicated, peat extraction activities may lead to short periods with increased TSS concentration. However, this increase is often linked to poor maintenance of the sedimentation ponds (Clément *et al.*, 2009). To limit the impacts of a project occurring near a watercourse on the aquatic ecosystem, Fisheries and Oceans Canada proposes to work during a time when there is the least risk of harming fish and fish habitat. Although the timing window might vary depending on the province, the fish species target or the watercourse, the low-risk period for fish is usually during the driest period of the year. In New Brunswick, the summer low flow period identified by Fisheries and Oceans Canada extends from June 1 to September 30. This low-risk period aligns with the peat extraction, which will occur mainly during summer.

Sedimentation ponds and overland flow are the two main mitigation measures to limit the project's impact on the water quality and the aquatic habitat downstream (Thibault, 1998). This author states that overland flow is the most effective method for trapping suspended peat particles. They can be used separately or combined to increase efficiency. The drainage network of the three bogs will comprise 17 drainage outlets, including 10 with sedimentation ponds (Map 4; Table 2). The overland flow will be used as a single mitigation measure at outlets located more than 100 m from a watercourse. They will be combined with sedimentation ponds at outlets 100 m or less from a receiving watercourse. This will allow the suspended sediments, other peat particles, and elements resulting from peat harvesting to settle down or dilute.

To further limit impacts on the environment, peat harvesting will be restricted during periods of strong winds, and stockpiles will be covered with tarps from October to the beginning of the following harvesting season to minimize the release of peat particles into the air. These preventive measures limit the transportation of peat particles towards watercourses, thus mitigating potential effects on fish habitats downstream and other aquatic wildlife.

Considering these mitigation measures, it is anticipated that the peat harvesting project will not impact the water quality of surface water or that of the receiving watercourses. The impact on fish, including salmon, and fish habitat downstream is considered to be negligible.

5.6 Air Quality

5.6.1 Impacts

Peat extraction activities can affect air quality due to the release of airborne particles. After vegetation clearing and drying out the peatlands, the peat surface layer is more exposed and prone to wind erosion, which can result in peat particles emission into the air. Activities such as harrowing, vacuum harvesting, and handling during transportation also have the potential to emit peat particles into the air. Wind can carry these particles to the surrounding areas, where they will deposit and become a nuisance, impacting human health and activities. Additionally, peat particle deposition may adversely affect vegetation, wildlife, and watercourses.

The process of extracting peat requires using tractors and other vehicles, which can contribute to the emission of pollutants, potentially impacting air quality in the surrounding areas. The local population should not be impacted because the project site is isolated and there is no settlement within a 10 km radius.

5.6.2 Mitigation Measures

The Canadian peat industry is aware of the potential impact of peat particle emissions and has developed measures that limit these emissions. JOL intends to apply the following measures to reduce the impact of peat particles on air quality:

- Use vacuum harvesters with equipment to reduce dust emissions during peat extraction.
- Limit vehicle speed, especially on access roads.
- Transportation of peat into tarp-covered trailers.
- Limit peat harvesting and handling in windy conditions.
- Proper equipment maintenance.
- Where existing, leaving in place a treed buffer zone at least 50 m wide as a wind break to trap airborne peat particles.
- Not leaving in the field after October 31, peat stockpiles that are not covered or do not have a crust.
- Re-establishing the vegetation cover as proposed in the reclamation plan (Section 3.6).

Juniper Organics Limited will implement management practices to restrict the release of airborne peat particles and prevent the risk of fires. If wind speed exceeds 50 km/h during harvesting, the harvest supervisor must seek permission from the manager before proceeding with harvest operations. If permission is not granted, all harvesting activities will be immediately suspended. This threshold may be adjusted based on site conditions, such as the humidity of the peat substrate. For example, consistent winds of 40 km/h increase the risk of fires and peat particle emissions after a dry period, while 70 km/h winds are considered safe following a series of rainy days.

The presence of forested areas between the proposed peat fields and the adjacent water bodies (McKiel Lake and its tributaries) will act as a buffer zone and limit the impact of airborne peat particles on the aquatic habitat.

5.7 Carbon Sequestration Function

5.7.1 Impacts

It is widely accepted that an important ecological function of peatlands is their role as a sink by both sequestering and storing carbon in the form of plant debris that constitutes the peat (Chapman, 2002). Peat is estimated to accumulate at a rate of less than 1 mm/y, thus storing 0.68 tonnes/ha/y of carbon (Rydin *et al.*, 2013). Carbon sequestration in a single bog is negligible at this rate, but it becomes significant considering that peatlands cover 108 million hectares in Canada (Bona *et al.*, 2024).

The McKiel bogs development project will result in a loss of the carbon (C) sink capacity over a period of time. In fact, the upper peat layers will become a source of atmospheric C as the drained peat will oxidize and start to decompose with exposition to air.

The estimation of the C sink impact is based on the document *Guidance on Quantification of Net GHG Emissions, Impact on Carbon Sinks, Mitigation Measures, Net-Zero Plan and Upstream GHG Assessment* (ECCC, 2021) that complements the Strategic Assessment of Climate Change (SACC), provided by Environment and Climate Change Canada (ECCC). The SACC was published in 2020 to facilitate the consideration of climate change throughout the federal impact assessment process. This technical guide provides a detailed methodology to quantify the impact on carbon sinks resulting from a project. The estimated C sink Approach 1 (annual total C flux approach) with the default values for the Atlantic Maritime ecozone was selected.

The estimation of the impact on C stock was calculated using the expected harvested peat volume for Peatlands No. 850, 851, and 852 and the average C density for open bogs compiled from published data (Loisel *et al.*, 2014; Magnan *et al.*, 2023).

The values and associated references used are presented in . The calculations are based on the following assumptions established for a "worst-case" or conservative scenario:

- Peatlands No. 850, 851 and 852 will be open and harvested equally across all the projected areas during the operation phase;
- No restoration while the harvesting operations are ongoing on the project site.

The C sink impact is estimated to be 1,357 t C that will not be sequestered over 55 years, 40 years of operation, and the first 15 years after restoration, which corresponds to emissions from 1,383 passenger vehicles over a year. According to Nugent *et al.* (2018), the peatland returns to a net C sink (78 g C m-2 yr-1) 15 years after an active restoration. The impact in C stock is estimated at 84,026 t C.

These estimates represent the worst-case scenario, as the peatlands targeted by this project will be developed over 3 years and not all at once. Moreover, the site will be progressively restored with the latest advancements in peatland restoration science as harvesting ceases in different sections. As early as 2029, areas will be closed and ready for the restoration process to begin. According to the development scenario (Section 3.5.5), carbon will start accumulating on 22 ha on the first restored area around 2044. By 2080, which is 15 years after complete closing and restoration, the annual sequestration potential will be 91.3 t C. By that time, the previously restored area will already have accumulated 1,614 t C. The calculation does not consider that peat is used for horticultural purposes and a portion of it can be absorbed by plants.

Research in natural and disturbed peatlands has also shown great variability in C exchange dynamics. Climate and disturbances are some of the causes of such variability. Variability is also represented in our estimation of impacts on C sink and stocks, with the difference between long-term data (21 g C m^{-2} yr^{-1} or 0.21 t C ha^{-1} yr^{-1}) and 15-year post-restoration data (78 g C m^{-2} yr^{-1} or 0.78 t C ha^{-1} yr^{-1}).

Table 16 Values and Associated References Used to Calculate Carbon Emissions

Parameter	Value	Units	Reference
Peatland type	Bog	NA	Section 4.2.1
Ecozone	Atlantic Maritime	NA	ESWG (1995)
Harvested area	117.45	ha	Section 3.5.5
Harvested volume	1,757,872	m^3	Section 3.5.5
Harvesting time	40	years	Section 3.5.5
Average C density, open bog of Eastern Canada	0.0478	g cm^{-3}	Magnan *et al.* (2023)
Mean annual long-term carbon accumulation rate (LORCA)	0.21	t C ha yr	ECCC (2021) Table 31.
Average Net Ecosystem Exchange (NEE) after 15 years of restoration (average of 14 to 16 years)	78	g C m^2 yr	Nugent *et al.* (2018)

5.7.2 Mitigation Measures

Peat fields will be restored once harvesting is completed and the mitigation measures, including the restoration method, are described in the reclamation plan (Section 3.6). This plan aims to meet the requirements of the Peat Mining Policy of the New Brunswick government, which is “to ensure that peatlands that have been used for peat extraction are, upon cessation of activities, reclaimed to a natural wetland habitat to the greatest extent possible”.

The restoration process will be done gradually. Once restoration has begun, 15 years might be necessary for the peatland to return to a net C sink. Thus, the project's impact on carbon sequestration can be considered temporary, but the mitigation measures will be applied in the long term.

5.8 Other Impacts

5.8.1 Soil Quality

Peat extraction significantly affects soils by removing most of the organic layer contained within a peatland. The organic layer within the ground differs from the mineral layer underneath because it primarily consists of more or less decomposed plant remnants. Peatlands’ organic soils can regenerate over time. Despite this, the impact of peat harvesting on soil quality is limited as a ±50 cm layer of peat is typically left in place after peat extraction. The remaining peat usually possesses bog chemical and physical properties that can promote the restoration of hydrologic conditions and the re-establishment of peatland plant communities (Gonzalez and Rochefort, 2014). The return of peatland vegetation will ensure the return of soil properties, including carbon sequestration, as indicated by recent research (Waddington *et al.*, 2010; Strack and Zuback, 2013; Nugent *et al.*, 2018).

Other potential impacts on soil quality arise almost exclusively from leakage or petroleum product spills related to mechanized equipment for peat harvesting. If a spill occurs, it will affect a limited area, especially because dry peat soils can absorb hydrocarbons rapidly, preventing contaminants from spreading and potentially reaching watercourses. Furthermore, the only place that will be used for fuel storage is the service area. An accidental oil spill can also impact downstream water bodies and aquatic wildlife if not controlled properly. Fueling and servicing will only occur at a distance of at least 30 meters from environmentally sensitive areas (waterbodies and wetlands).

Juniper Organics Limited developed an emergency response procedure and a safe fueling practice in case of a spill, which will be described in the Environmental Protection Plan (EPP). In addition, JOL will ensure adequate maintenance of machinery.

Peat harvesting does not involve the use of other chemical products. Considering that all machinery will be well maintained and that JOL has taken all mitigation measures, the impact of oil spills should be limited.

5.8.2 Workers' Health and Safety

Juniper Organics Limited has a robust safety management system to ensure compliance with all applicable occupational health and safety laws. As part of this safety management system, JOL uses a risk-based approach to consistently identify risks to worker's health and safety and make continuous improvements. Examples of risks specific to peat bog development and operation include mobile equipment interaction with pedestrians, maintenance of equipment, dust exposure, and fires. JOL will record all incidents and implement relevant prevention measures. Hygiene and safety policies will be consistently enforced, including during emergencies.

5.8.3 Climate

Peatlands contribute to the global climate by storing substantial amounts of carbon in the form of undecomposed plant debris, forming peat and thereby aiding in the mitigation of the greenhouse effect (Chapman, 2002; Rydin *et al.*, 2013; Harris *et al.*, 2022). These ecosystems, covering 3 to 4% of the planet's land surface, are rare worldwide. However, they contain approximately one-third of the world's soil carbon. According to the United Nations Environment Programme and their Global Peatlands Assessment (UNEP, 2022), about 12% of the world's peatlands have been drained or disturbed, mainly by human activities. The United Nations recognizes the importance of keeping carbon locked away in peatlands as primordial in the global climate crisis.

Peat accumulation is estimated to be less than 1 mm per year, storing approximately 68 g of carbon per square meter annually (Rydin *et al.*, 2013). While the carbon sequestration in a single bog at this rate may seem negligible, its significance becomes apparent when considering the vast expanse of peatlands. This ecosystem covers 113 million hectares in Canada (Bona *et al.*, 2024).

Peatlands also influence microclimate conditions in two ways. Peatland vegetation influences the albedo and is responsible for evapotranspiration, two processes resulting in localized cooling effects (Rydin *et al.*, 2013). Second, the typical hummock-hollow microtopography induces a non-uniform snow distribution. The snow patches that remain longer in the spring also contribute to cooler temperatures locally. In turn, the microclimate influences the functions of the whole ecosystem, which relies on the plant-hydrology equilibrium. The disappearance of trees and vegetation creates bare peat surfaces where diurnal temperature fluctuations increase. Wind speed may also become higher. Such change is site-specific and does not have repercussions outside the developed area. Reestablishing peatland vegetation, tree cover, and overall bog conditions following progressive reclamation will return harvested sites to pre-development conditions regarding microclimate, and the residual impact is considered negligible.

Canada is a big producer of peat used for horticultural uses. In 2017, the Canadian peat industry had extracted 31,675 hectares of peatland, representing 0.03% of Canada's peatland. However, JOL is committed to applying restoration measures once harvesting operations are completed to restore the disturbed peatlands. In the last 20 years, Canada's peat industry has contributed significantly to peatland restoration research. Furthermore, the CSPMA, an association that counts JOL as one of its members, has pledged to restore 100% of harvested peatlands. Thus, Peatlands NO. 850, 851 and 852 will be restored in this project once harvesting operations are completed. More details are presented on the restoration method and modalities in the reclamation plan (Section 3.6). The end goal is to restore the carbon storage function of the peatlands.

Research indicates that carbon sequestration in peatlands usually begins 12 to 14 years after sphagnum restoration efforts, effectively restoring the carbon sink function (Nugent *et al.*, 2018). Additionally, the harvested peat can be utilized for tree production, with more than 150,000,000 tree seedlings grown annually in peat substrate to contribute to Canada's reforestation initiatives. Consequently, no substantial impact on the global climate is anticipated from the project.

5.8.4 Fire

The desiccation resulting from field drainage and surface preparation enhances the flammability of surface peat. Fires can be initiated when dry peat comes into contact with the hot components, such as engine exhaust, of machinery used for peat harvesting and other operations. The likelihood of such fires can vary significantly depending on prevailing wind speed and direction. Therefore, the fire risk threatens the peat resource, and JOL will implement measures to mitigate the fire risk and manage peat fires in the site area. These measures will be outlined in the EPP. The measures include the following:

- Mobile water tanks are present in the fields.
- Harvesting equipment is equipped with an extinguisher and portable water tank.
- Workers trained for fire response.
- Close monitoring of harvesting operations in dry and windy conditions.
- Modifying or ceasing operations under extreme fire weather conditions.

Extreme conditions are characterized by a convergence of three parameters that create favourable fire circumstances. For instance, an extended period of warm and dry weather, coupled with consistent 40 km/h winds, increases the risk of fire occurrence and its subsequent spread. To guide management decisions around fire risk, JOL will monitor the Fire Weather Index as indicated by the New Brunswick Department of Natural Resources and Energy.

5.8.5 Noise

Utilizing machinery and completing the various operations needed during this project produces noise that could impact wildlife in the immediate area. Noise levels would be similar in scale and scope to operations in active agricultural fields using similar equipment. The surrounding area is not inhabited. Therefore, there will be no direct noise impacts on local residents. Deersdale and Juniper are the closest hamlets near the project site, and they are located at 12 and 17 km from the project site, respectively. However, the noise may affect wildlife locally. Considering the conservation of treed buffer zones at the limit of the developed peatlands, the noise should be limited. Thus, the noise impact is considered insignificant.

5.8.6 Road Traffic

The development of peatlands No. 850, 851, and 852 will increase traffic on the roads used to transport harvested peat to the Juniper facility for processing, mainly Highway 107 and Juniper Road (Map 1).

All loads will be properly secured during transit in accordance with the Motor Vehicle Act (M-17).

The number of transports of peat harvested at Peatlands No. 850, 851 and 852 is estimated at 800 per year at full production, representing 6 transports/day, five days/week over a 6-month period (26 weeks). Overall, road traffic would increase slightly due to workers moving on and off-site. The additional traffic should not have a significant impact on current road traffic.

5.9 Cumulative Impact

Cumulative effect assessments identify residual project impacts that have the potential to interact cumulatively with effects from other projects. A cumulative effect assessment can help see the impacts of a project at a regional scale instead of just considering the local effects of a project. Human activities around the project site are restricted to forest management (logging) and peat harvesting.

5.9.1 Peatland Footprint

The McKiel bogs development project will develop Peatlands No. 850, 851 and 852 for peat harvesting. One other bog, Peatland No. 856, is currently used for peat extraction by JOL within a 20 km radius. Thus, the local impact on peatlands can be considered cumulative.

As previously stated, only 8% of the Beadle Ecodistrict is not forested, and 45% of the non-forested areas are covered by wetlands, including but not limited to peatlands. Since large peatlands are naturally scarce in the region, it is important to maintain many peatlands in their natural states to safeguard bog habitats. Conservation areas within the peatlands will help maintain these ecosystems and the diversity of bog habitats in the long term. Locally, Peatlands No. 1327, 1328, and 1329, located south and northeast of the project site, will remain in their natural state. Several other small peatlands exist in the Beadle Ecodistrict. These peatlands in the region guarantee the preservation of these habitats in the Ecodistrict.

On a provincial scale, the development of peatlands No. 850, 851, and 852 is one among several peat harvesting projects in New Brunswick. In the province, peat harvesting is the predominant activity affecting peatlands. Considering the cumulative impact of these projects, peat harvesting has led to a provincial decline in peatland habitat. New Brunswick's peatlands cover around 140,000 hectares, with 7% (10,000 hectares) already used for horticultural peat and 1,200 hectares having undergone restoration or reclamation (E. Prystupa, personal communication). The development of peatlands No. 850, 851, and 852 will contribute to the regional footprint on peatland, albeit temporarily, as the site will be reclaimed once peat harvesting is concluded.

5.9.2 Hydrogeological Processes

Expansion of the drainage network and opening of new peat fields in the Southwest Miramichi River watershed will induce modifications to local surface and subsurface flow systems. The project site is located at the upstream edge of the watershed. For the most part, the anticipated hydrological impact of the proposed development will be temporary and primarily observed during the initial field drainage phase. Since harvest field openings will be carried out progressively, this impact will be moderate and mainly confined to areas situated at the periphery of the peatlands. As mentioned in Sections 5.1 and 5.2, no substantial impact is expected on the quality of surface or groundwater resulting from the proposed project. Implementing mitigation measures outlined in this section (5) will effectively prevent any degradation in the quality of receiving waters. Consequently, the peat harvesting operations in Peatlands No. 850, 851 and 852 should not significantly affect local water quality.

Other anthropogenic activities in the Southwest Miramichi watershed include peat harvesting at JOL Peatland No. 846. The development of that bog is completed, and its contribution to the hydrological processes has returned to its natural state. Future peatland restoration at both sites (Juniper and McKiel bogs) will lower water outflow from the peatlands as drainage is blocked and restored areas fill up with water. That process will extend over a few years and will not have no significant effect considering the percentage of any watershed that will be restored at once. Forestry is an important activity in the watershed, but these operations have little impact on the hydrological processes when managed properly.

The modifications anticipated with the proposed development project will have no cumulative effect.

5.9.3 Flora and Fauna

Forestry is the main activity in the region, and this industry avoids peat bogs including those targeted for horticultural peat harvesting as they do not offer merchantable timber and because access to machinery is difficult. JOL peatland No. 846 is the only other activity affecting the area's peatlands. Peatland No. 846 is one of the peatlands, along with Peatlands No. 850, 851, and 852, with pools considered biodiversity hotspots. Such pools are almost absent from small peatlands. Nonetheless, no cumulative impact is expected on the flora and fauna that use these habitats because most of them are preserved as conservation areas in McKiel bogs and peatland No. 846. No cumulative impact on vegetation is anticipated since few projects affect peatlands, and mitigation measures will be applied.

Cumulative impacts on wildlife are expected to be insignificant, considering peatland habitats that will remain untouched locally, including bog ponds. Wildlife species use peatlands on a transient basis. No wildlife species is restricted to this ecosystem. Additionally, among all animals, birds, constituting approximately 80% of the total vertebrate species in these ecosystems, are regarded as adaptable to spatial alterations in their habitat. Considering the proposed conservation areas include many ponds, birds should still be able to use these areas as staging areas.

5.9.4 Others

The main impacts of peat harvesting on air quality result from dust generation during the operation phase, which may affect human activities, vegetation, and water quality. Implementing mitigation measures should maintain the cumulative effect to a low intensity. The impact on air quality should not cumulate to that of the other harvested peatland located in the area, given the distance of over 13 km between the project site and Juniper peatland.

Increased traffic potentially impacts public safety and quality of life for residents, possibly generating cumulative impacts. The project is estimated to increase transport by 6/day, 5 days/week for 6 months, and add itself to the local circulation. The project and the hamlet of Juniper are in a remote area, and the main road, Highway 107, will be used for peat transport to support only local traffic. The cumulative impact on traffic will be negligible.

The cumulative impact on other components such as microclimate, fire, noise, soils and human health are expected to be negligible, mainly due to the seasonal nature of these impacts.

5.10 Reversibility of Impacts

The McKiel bogs development project should not result in significant irreversible environmental impacts after the mitigation measures are implemented. The reclamation plan described in Section 3.6 represents the main mitigation measures to be implemented and is the principal factor limiting the impact of peat harvesting to a low value.

The reclamation plan aims to reinstate harvested sites into fully functional wetland ecosystems. Existing research indicates that a peatland vegetation cover can naturally regenerate across the entire harvested area, and the carbon storage function can be restored within 12 to 14 years, specifically through the application of the Moss Layer Transfer Technique for sphagnum regeneration (Poulin *et al.*, 2013; Waddington *et al.*, 2010; Strack and Zuback, 2013; Nugent *et al.*, 2018). Hydrological conditions are restored within approximately 17 years (McCarter and Price, 2013; Lucchese *et al.*, 2010). Therefore, the development project at the McKiel bogs is not expected to cause irreversible impacts, provided that mitigation measures are implemented.

5.11 Monitoring Program

Juniper Organics Limited proposes to develop a monitoring program that will meet DELG requirements. The monitoring program will be based on the program currently in use for Peatland No. 846 under the approval to operate and will include collecting and analyzing water samples from the outlets of active sedimentation ponds regularly or after a significant wind or rain event.

The total suspended solids concentration from the sedimentation ponds will be monitored:

A. Once every two weeks under normal weather conditions;

B. The day following a heavy rain;

C. The day of, and the next after, any wind storm expected to result in a significant loss of peat from the bogs.

Sampling will be conducted during the harvesting period and bi-weekly samples (A) will not be required for those periods that samples have been taken under (B) or (C).

The monitoring program includes four monitoring stations, one located in McKiel Brook that was sampled for the baseline study, and three stations on Carson Brook, Unnamed Brook and Kenny Brook downstream from the harvesting operations (Map 2). These stations should be accessible once the site is developed. These stations will be sampled three times a year, during Spring, Summer and Fall. The chemical analysis will include the following parameters: Aluminum, Ammonium, Cadmium, Chromium, Cobalt, Conductivity, Dissolved Oxygen, Hardness, Iron, Lead, Mercury, Nickel, Nitrate, pH, Phosphorus, Tin, Sulphur, Total Nitrogen, Total Suspended Solids, Vanadium, and Zinc.

Samples will be analyzed for total suspended solids (TSS) by a certified laboratory that operates in accordance with the recognized standards for quality management systems.

The monitoring program also includes the visual inspection of the ditches and sedimentation ponds. The monitoring and maintenance of these sediment control structures are described in the EPP.

6 Public Involvement

6.1 Public Consultation

Public interactions with the project are limited due to the remote location. There are no neighbours within 10 km of the project. Public and stakeholder engagement will begin upon registration of the project's Environmental Impact Assessment. The public consultation plan includes publishing two ads in a local newspaper, providing a flyer to local residents, meeting with local district council and the MLA, and engaging with special interest groups. The public consultation summary report will be submitted to the TRC as an addendum.

6.2 Engagement with First Nation

Indigenous early engagement was initiated for the project on September 22, 2023, consistent with the JDI commitment to early engagement with all sixteen Indigenous communities in New Brunswick and their representative organizations. Upon request, a consultation report will be provided to the New Brunswick Department of Indigenous Affairs.

7 Conclusion

The McKiel bogs development project consists of harvesting peat over an area of 117.45 ha distributed on Peatlands No. 850, 851 and 852. It will involve the construction of infrastructures that includes a service area, access and bog roads, and a drainage network comprised of sedimentation ponds and main and secondary ditches. The project's life expectancy is approximately 40 years, with an estimated production of 1,757,872 m^3 of peat that will be processed at the JOL Juniper facility for horticultural uses.

The project will have negligible to insignificant impacts on the environment after the implementation of a series of mitigation measures. The main measure is the restoration of harvest fields back to a functioning peatland ecosystem, which will prevent any cumulative and irreversible impact.

8 Project Related Documents

This EIA represents the Registration Document for JOL McKiel Bogs Development Project as requested under *Environmental Impact Assessment Regulation* (Regulation 87-83). Project Related Documents also include the following appendices. Any Project Related Document which is currently under development will be submitted via Addendum to the TRC.

Project related documents are:

- Appendix A Fish Survey Report
- Appendix B Water and Peat Chemical Analyses Certificates
- Appendix C Water Quality Guidelines and Calculations
- Appendix D Vegetation Survey Report
- Appendix E Atlantic Canada Conservation Data Center (ACCDC) Report
- Appendix F Bird Data
- Appendix G McKiel Lake Fish Survey Data
- Appendix H Email from Archeology

To be submitted as an addendum:

- Appendix I Archaeological Assessment Report
- Appendix J Southern Twayblade Survey Report
- Appendix K Nesting Birds and Common Nighthawk Survey Report
- Public Consultation Summary Report
- First Nation Engagement Report
- Environmental Protection Plan
- Reclamation Plan

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