SCOTTS CANADA LTD

PEATLAND 524 EXPANSION PROJECT

MAY 2017

PEATLAND 524 EXPANSION PROJECT

Scotts Canada Ltd

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Reference:

WSP. 2017. *Peatland 524 Expansion Project.* Report produced for Scotts Canada Ltd. 84 pages and appendices.

EXECUTIVE SUMMARY

Scotts Canada Ltd. (“Scotts”) is a subsidiary of The Scotts Miracle-Gro Company, who is the largest peat user in North America. The company has historically been filling its needs by purchasing sphagnum peat moss from many peat producers in Canada and Europe. In an effort of vertical integration Scotts Canada acquired peat producing companies and it now has seven harvesting operations in New Brunswick including Peatland 524 located in the Tabusintac area. The goal of the proposed *Peatland 524 Expansion Project* is to increase Scotts’ own peat harvesting capacity*,* to meet the growing demand for its professional products based on high quality peat moss. In addition, Scotts wishes to ensure the sustainability of its peat resources in anticipation of the closure of certain other areas of the peatlands, which it currently operates.

Peatland 524 has been in operation since the early 1960’s. It was first prepared for peat harvesting using a mechanized block cut method. Most block cut fields have been converted to vacuum harvesting and few fields are still used for block cutting to meet demand from specific clients. So far, 374 ha have been used for peat production including 42 ha that are restored or closed. As of 2017, Scotts is conducting peat harvesting operations over 332 ha on Peatland 524 comprising 296 ha on crown land and 36 ha on private land. The proposed expansion will add 304 ha to the currently harvested area including 58 ha on private land and 246 ha on crown land.

As required by subsection 5(1) of the *Environmental Impact Assessment Regulation* (Regulation 87-83) for peat harvesting projects, Scotts must submit a registration document to receive approval from the Department of Environment and Local Government (DELG) for its Peatland 524 Expansion 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 proposed *Peatland 524 Expansion Project* is located in the Local Service District of Tabusintac in the county of Northumberland, New Brunswick. The closest communities are Covedell, Tabusintac and Neguac. The nearest city is Miramichi located 40 km to the southwest. Peatland 524 is bordered by the Gulf of St. Lawrence to the east and to the south, and by upland to the west. To the north, it is separated from French Cove and the Tabusintac River estuary by a narrow strip of land and Peatland 523.

The project does not include the construction of a peat processing plant since the additional peat will be processed at the Covedell plant located besides Peatland 524, which is producing compressed horticultural peat and mix. The project comprises the development of peat fields using standard methods and the construction of drainage network of secondary drainage ditches, main ditches and sedimentation ponds. Infrastructures will also include access roads (12 km) and peat stockpile areas.

The project is to be completed in three phases: construction, operation and reclamation.The construction phase includes, digging the sedimentation basins and the main drainage ditches, building access roads, and preparing fields for harvest in conjunction with digging the secondary drainage ditches.

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 or over low vegetated land areas in order to filter water before it reaches receiving watercourses in accordance with current requirements. The construction will proceed progressively over a period of at least five (5) years.

The operation phase involves harrowing, harvesting, stockpiling, and transportation of 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 quality of water in the receiving watercourses. The Peatland 524 Expansion Project will allow peat production for the entire peatland to increase from 609 500, in 2016, to a peak of 1 590 900 equivalent 6 cubic feet bales (compressed) in 2021. The production will slowly decrease afterward. The life expectancy of the bog is estimated at 55 years.

The reclamation phase involves returning the site to wetlands, either through Sphagnum Revegetation using the Moss layer transfer technic or Forest Habitat by tree seedling plantation. Bog ponds will also be created among the Sphagnum Revegetation and Forest Habitat areas. The site reclamation phase will proceed progressively as fields will be closed to harvest.

Peatland 524 is a large peatland complex that covers 1,236 ha and that is typical of the bogs locate along the northeast and east coast of New Brunswick. It is drained by Malpec Brook and Lufburys Brook.

Peatland 524 has three domes where the deepest peat reaches 9 m. The east side of the bog sits directly into the Bay of Tabusintac and there is a significant level of natural erosion coming from the waves of the Gulf of St. Lawrence hitting the peat cliff. Plant communities that cover the bog are representative of ombrotrophic conditions that prevail on 85-95 % of the site and are dominated low shrubs, lichens and mosses while deer grass lawns occur around ponds. Minerotrophic conditions are restricted to the bog margins. The southern twayblade is the only legally protected endangered plant species (provincial level) that was found in the bog. However, the southern twayblade colony lies outside the area to be developed.

Many terrestrial wildlife species are present at the level of Tabusintac River watershed, but the Canada lynx is the only legally protected mammal species (provincial level) that was recorded in a radius of 4 km around Peatland 524 and the proposed expansion area. The area is known to be used by a high number of birds. There are six Environmentally Significant Areas (ESA), two Important Bird Areas (IBA), two Nature Conservancy of Canada properties, a Natural Protected Area and a Ramsar site aiming at protecting the Tabusintac river estuary ecosystem. They target primarily aquatic birds that nest or use lagoons, marshes, beaches and barrier islands located in the Tabusintac river estuary and offshore. Of the bird species possibly present in the area, two are more closely associated with peatlands, the palm warbler and the Lincoln’s sparrow. Seven legally protected bird species are reported for the area, but none have peatland as preferred habitat.

According to surveys conducted in Malpec and Luftbury’s brook in 2016, the two watercourses that drain the bog, the only portion that represents a potential habitat for salmonid species is the section close to the mouth of Malpec Brook downstream the bog. However, the lagoon and eelgrass marshes found between the coast and the barrier islands support a variety of aquatic mammals, fish and mollusks.

Fishing and aquaculture represent two important economic activities in the areas. Among others, oysters are cultivated off shore in the lagoon north and south of the peatland. The area of Peatland 524 is part of the Mi'kmaq traditional territory that comprises nine communities in the province. The Mi'kmaq First Nation Reserve of Esgenopetitj (Burnt Church) is the closest to the site and it has three reserves that are Burnt Church 14, Pokemouche 13 and Tabusintac 9.

Due to proposed mitigation measures, the Peatland 524 Expansion Project is expected to have little impact on the environmental components. Diffuse overland flow and its combination with sedimentation ponds at most drainage network outlets will capture suspended peat particles in an efficient manner and prevent impact on downstream water quality. The preservation at its natural state of a 565 ha area will provide plant and wildlife habitat throughout the duration of the project. The implementation of the reclamation plan will insure 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. Forest habitat may also be created where conditions will not be suitable for Sphagnum revegetation. Specific mitigation measures also address specific components such as air and soil quality, workers health and safety and fire.

The cumulative impact should be minimal considering that Peatland 524 is already used for peat harvesting and that existing peat processing facilities will be used. Environmental impacts will be reversible since the reclamation plan will return the site to a peatland ecosystem.

The project will have positive impact on the human environment with the creation of 8 full time jobs and 15 seasonal jobs in addition to economic benefits for local communities and the province. The ongoing public consultation process have raised few comments and concerns among the local residents and organisations that use surrounding land. Scotts has also engaged with the Mi’kmaq First Nation to inform them about its project and to take into consideration their concerns. Scotts will pay attention to any comment and will cooperate in solving any problem related to its operations all along the duration of the project.

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1 INTRODUCTION

Scotts Canada Ltd. (“Scotts”) is a subsidiary of The Scotts Miracle-Gro Company, the world's leading marketer of branded consumer lawn and garden products, who is the largest peat user in North America due to its very strong retail market share. The company has historically been filling its needs by purchasing sphagnum peat moss from many peat producers in Canada and Europe. In an effort of vertical integration Scotts Canada acquired peat producing companies, and it now has seven harvesting operations in New Brunswick including Peatland 524 located in the Tabusintac area, which has been used for peat production since 1962. The goal of this project is to increase Scotts’ own peat harvesting capacity with a 304 ha expansion of the current Peatland 524, to meet the growing demand for its professional products based on high quality blonde peat moss. In addition, Scotts wishes to ensure the sustainability of its peat resources in anticipation of the closure of certain other areas of the peatlands, which it currently operates.

Peatland 524 is located close to Highway 11 and Highway 8 that provide easy access for shipping. However, the proposed expansion project (Peatland 524 Expansion Project) take into account the other surrounding land uses such as special status areas aiming at protecting aquatic birds in the Tabusintac River estuary, aquatic farming between that land and the barrier islands north and south of the peatland, and traditional use of the land by First Nations.

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, 2017a) and the *Additional Information requirements for Peat Development Projects* of the New Brunswick Department of Environment (Department of Environment and Local Government, 2017b). This EIA document includes:

→ Introduction of the proponent

→ Description of the project construction, operations and decommissioning phases

→ Description of the physical, biological and human environment

→ Summary of the impacts of the project and associated proposed mitigation measures and monitoring program

→ Summary of the public consultation

2 THE PROPONENT

Scotts Canada Ltd. (Scotts) is a subsidiary of The Scotts Miracle-Gro Company, a United States publicly traded corporation (NYSE: SMG). For a long time one of the largest buyers of peat moss, Scotts decided to integrate its operations better and bought the Québec based Fafard & Frères Ltd. (Fafard) company in 2014, a manufacturer of peat moss, grower mixes and retail products for the Canadian market. In 2011 Fafard had already acquired Heveco, the predecessor company that had conducted peat harvesting activities on the Peatland 524 since 1962. More recently (2016), Scotts bought Acadian Peat Moss (APM) another New Brunswick based company. Although they are part of Scotts, Fafard, Heveco and APM keep their respective identities and markets. Now, these three companies represent the heart and expertise of Scotts' peat operations in Canada who wants to build on this knowledge to develop its part of the professional peat market based on value-added products. In addition to providing peat to other subsidiaries of Scotts Miracle Grow, they continue to service their prior markets.

2.1 MARKET LEADER

The Scotts Miracle-Gro Company is the world's largest marketer of branded consumer products for lawn and garden care. Scotts employs more than 5,500 people globally.

Scotts Miracle-Gro brands are sold through the world's leading home improvement retail companies and mass merchandisers. Other key channels include large hardware chain stores, independent hardware stores, garden centers, nurseries, greenhouses and food and drug stores.

Scotts progressed from a small seed grower in 1868 to a leading lawn care business with the merger of Miracle-Gro in 1995. It remains a family run business with James Hagedorn as its CEO. Over the years, thousands of dedicated associates built Scotts to an international marketer of industry-leading brands. Scotts believes every associate and every job is important to their success.

The company's mission is to help consumers around the world by providing them with innovative solutions to create beautiful and healthy lawns and gardens.

2.2 RESPONSIBLE STEWARDS OF OUR PLANET

Scotts is committed to conducting its business according to high legal and ethical standards. They particularly value the viewpoints of those who care about the environment. From innovating products to planning community involvement programs, they team up with experts and organizations that can help them be more effective in protecting the environment, educating others on being good stewards of the earth and improving the communities in which we live and work. For additional information, visit https://scottsmiraclegro.com/responsibility/.

2.3 PEAT PRODUCTION

Scotts benefits from the expertise in peat bog operation management that was developed over the years by Fafard founded in 1940, Heveco founded in 1962 and APM founded in 1965. In 2017, Scotts' operations include the harvesting of peat on more than 15 sites in Canada spread over New Brunswick (7), Québec (6) and Ontario (2). Peat processing plants also operate in New Brunswick, Québec, Ontario and Alberta.

The company is a proud member of the CSPMA (Canadian Sphagnum Peat Moss Association), NBPMA (New Brunswick Peat Moss Association) and APTHQ (Association des Producteurs de Tourbe Horticole du Québec). Fafard was the first peat moss company to obtain the *Veriflora* certification in responsible peatland management, and now almost all Canadian Scotts' peat bogs are *Veriflora* certified. Scotts supports environmental research projects in collaboration with the various institutions such as the *Industrial Research Chair in Peatland Management* directed by Dr. Line Rochefort of Université Laval and the Institut national de la recherche scientifique (INRS).

2.4 CONTACT INFORMATION

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3 THE UNDERTAKING

3.1 NAME OF THE UNDERTAKING

The undertaking is referred to as the "*Peatland 524 Expansion Project*".

3.2 PROJECT OVERVIEW

The present registration document proposes an expansion of existing horticultural peat moss harvesting on lands designated as Peatland 524 located near Tabusintac in the Northumberland County, New Brunswick (Map 1).

Peatland 524 has been in operation since the early 1960's. It was first prepared for peat harvesting using a mechanized block cut method. Most block cut fields have been converted to vacuum harvesting and a few fields covering less than 4 ha are still used for block cutting to meet demand from specific clients. New fields are now being opened to be harvested with the pneumatic method that uses vacuum harvesters.

As of 2017, Scotts is conducting peat harvesting operations over 332 ha on Peatland 524 (Table 1). This surface comprises 36 ha on private land and 296 ha on crown land in accordance with Peat Lease #9 that has been issued from October 1, 2012, to September 30, 2022, by the Province of New Brunswick (Appendix A). That lease includes four parcels of land covering 1 077 hectares (Table 2). Restored fields account for 4 ha and closed fields for 38 ha.

Table 1 Current and proposed area of land use for Peatland 524

	CURRENT (ha)	EXPANSION (ha)	TOTAL (ha)
Crown land (Lease 9)			
Production	296	246	542
Closed	33	-	33
Restored	4	-	4
Private land			
Production	36	58	94
Closed	5		5
Total	**374**	**304**	**678**

The proposed expansion will add 304 ha to the surface currently harvested area including 58 ha on private land and 246 ha of crown land. The area will be developed using standard methods. Sedimentation ponds and main drainage are generally constructed at first followed by peat roads and secondary ditches that will delimit peat fields. In the presence of very soft ground, access roads are constructed at first in winter to allow access for sedimentation pond construction. Peat will be harvested with the pneumatic method that uses vacuum harvesters.

The additional peat will be processed at the Covedell plant located at the entrance to Peatland 524, which is producing compressed horticultural peat and mix compressed bags in a different format. There are four different baggers in the plant: two small format 4 stage balers, one 55 cubic foot compressed baler, and one 110 cubic foot compressed baler.

Table 2 Parcels and areas included in the project

PID#	OWNER	AREA (ha)[1]
40084717	Scotts Canada Ltd.	49
40157117	Scotts Canada Ltd.	1
40232456	Scotts Canada Ltd.	6
40232464	Scotts Canada Ltd.	5
40232472	Lease# 9	851
40234296	Lease# 9	14
40234304	Lease# 9	33
40234494	Scotts Canada Ltd.	89
40234502	Scotts Canada Ltd.	83
40235418	Scotts Canada Ltd.	7
40323438	Lease# 9	179
Total		**1,317**

1 Rounded numbers

Additional equipment will have to be acquired and installed within three to four years to process the increased volume of peat following the expansion.

Assuming full planned capacity by 2021, a total of 1,600,000 6 ft^3, representing about 3,750 truckloads of finished goods will be shipped to customers annually, averaging 16 truckloads per day.

Scotts' Covedell team is composed of approximately 27 full-time jobs at the plant and 25 seasonal jobs from May to October pending weather conditions. When the full development will be achieved, about 35 employees will be required at the plant, and the number of seasonal employees should reach 40, creating an additional eight full-time jobs and 15 seasonal jobs for a total of 75 employees.

3.3 PURPOSE AND RATIONALE FOR THE UNDERTAKING

The Scotts Miracle-Gro Company has historically been filling its needs by purchasing sphagnum peat moss from many peat producers in Canada and Europe. To vertically integrate, the company's goal is to increase its peat supply internally, therefore, increasing the production requirements from the Covedell plant. Fafard, Heveco and Acadian Peat Moss' customer base for peat and mixes have been retained by Scotts Canada and this business continues to increase every year. Scotts also wants to develop its share of the professional market with value-added peat moss products. The company is always looking for additional procurement coming from smaller local peat harvesters in the region to face the demand but that cannot guarantee a secure supply of peat.

Peatland 524 is strategically located close to Highway 11 and Highway 8 that provides easy access for shipping, and it offers a substantial potential for a production increase. So far, 374 ha have been used for peat production. At first, the peat was harvested in large part using the block cut method for years. Since this method is no longer in use these sectors were converted to the pneumatic method that uses vacuum harvesters. The site is a large peatland that still has extended natural areas where new peat fields covering 304 ha can be developed. After the expansion, natural areas will still cover 565 ha within Peatland 524 that represents 45 % of site.

Scotts will develop Peatland 524 in accordance with the standards and practices of peatland development of the industry and the Government of New Brunswick. Scotts is also committed to meet all the requirements and obligations under the New Brunswick regulations in conducting its peat harvesting and processing activities.

3.4 PROJECT LOCATION

The *Peatland 524 Expansion Project* is located in the Local Service District of Tabusintac in the county of Northumberland, New Brunswick. The closest communities are Covedell 1 km to the west, Tabusintac less than 3 km to the northwest and Neguac 5 km to the southwest. The nearest city is Miramichi located 40 km to the southwest. The site is accessible through Covedell Road from Highway 11 in Covedell.

Peatland 524 is bordered by the Gulf of St. Lawrence to the east and south, and by upland to the west. To the north, it is separated from French Cove and the Tabusintac River estuary by a narrow strip of land and Peatland 523.

3.5 PHYSICAL COMPONENTS AND DIMENSIONS OF THE PROJECT

The *Peatland 524 Expansion Project* will consist of standard peat operations using the pneumatic method (vacuum harvesting) to harvest the peat. The project will require the following components:

→ Access roads between peat fields and the processing plant

→ A drainage network that will consist of secondary ditches, main ditches, and sedimentation ponds

→ Peat fields

The peat will be processed at the existing Covedell processing plant.

According to Keys and Henderson (1987), Peatland 524 covers 1,236 ha. The project will be restricted to the area with over 1 m of peat depth, and that covers 1,128 ha. The volume of peat in that area was estimated at 48 million cubic meters including 38 million cubic meters of surface fibric peat.

Scotts holds the lease #9 that includes 4 parcels for a total of 1,077 hectares, and it owns 7 parcels comprising 240 ha for a total of 1,317 ha (Table 2). Peat harvesting started with Heveco in 1962 on Peatland 524, and 374 ha including 160 ha for block cut have been developed so far. This area forms a reverse “U” shape around the center of the bog and it is bordered by the shoreline to the east and Malpec Brook to the west (Map 2).

The *Peatland 524 Expansion Project* targets new fields which will be opened in the center, to the south and to the west of the bog, and on either side of Malpec Brook (Map 2). 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 infrastructure (access roads and drainage network). The water will be directed into sedimentation ponds or over low vegetated land areas in order to filter water before it reaches receiving watercourses.

3.6 DEVELOPMENT PLAN

The development plan consists of a construction phase, an operation phase, a development schedule and a decommissioning plan. The construction phase describes the methods used to prepare peat fields and infrastructure. The operation phase presents the peat harvesting method and associated operations. The development schedule outlines the way the new sections will be developed in terms of time and space. The decommissioning phase consists of the reclamation plan that will be implemented when peat harvesting terminates on peat fields, and upon total shutdown of peat harvesting activities.

3.6.1 CONSTRUCTION PHASE

The construction phase includes:

1. Construction of access roads
2. Establishment of a drainage network
3. Field preparation

3.6.1.1 ACCESS ROADS

New roads will be built to access peat field sections that will be developed within the proposed expansion project. They will connect to existing roads that link currently harvesting fields and the processing plant. Most new roads will be constructed by adding a 60 cm layer of aggregate over the *in situ* peat (Figure 1). The mineral soils used for the road will be separated from the peat underneath by a geotextile membrane as illustrated on Figure 1. An approximate layer of 30 cm layer of branches and roots will be put on top of the peat to strengthen the road base where the ground is too soft. Scotts will use aggregate from local sources that are made of sandstone. Access roads will be ±5.25 m wide and they will be bordered on one or both sides by a main ditch. New access roads are anticipated to stretch over 12 km long and cover an area of 6 ha (Map 2).

Existing service areas will be used and no one will be added in the expansion area. Harvested peat will be temporarily stockpiled along access roads at the end of each peat field, so that vacuum harvesters do not have to travel far to offload the peat once their reservoir is full.

3.6.1.2 DRAINAGE NETWORK

The drainage network of the proposed expansion will comprise a main (collector) and secondary ditches, sedimentation ponds, and diffuse overland flow discharge outlets. The sequence of work will start with the construction of sedimentation ponds and overland flow discharge outlets. This will be followed by main ditches, and subsequently, secondary ditches. Drainage from certain portions of the proposed expansion will discharge into existing ditches of the current operation. In those instances, existing sedimentation ponds will be increased in size and in number to account for the larger drainage area. In cases where no sedimentation ponds exist at current discharge outlets, sedimentation ponds of adequate size will be constructed to detain water from both the existing and expanded portions of the enlarged subnetwork (Thibault, 1998). Outline of the proposed expanded drainage network is displayed on Map 3.

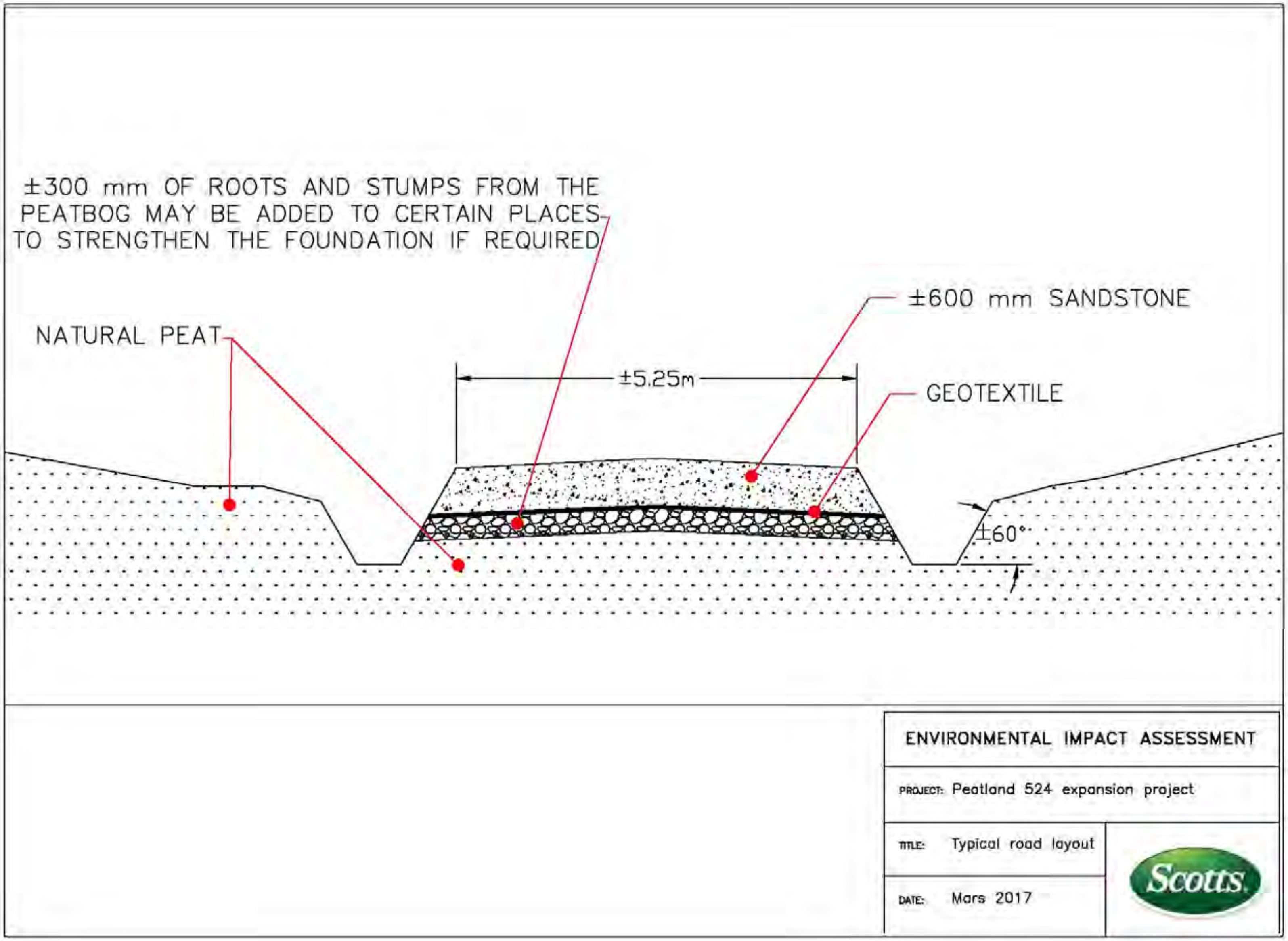

Figure 1 **Schematic cross-section of an access road.**

With the exception of southern sectors 1b and some portions of 1a (Map 2), all new or expanded drainage subnetworks will be equipped with sedimentation ponds at their downstream end (Map 3). Their role is to retain suspended peat particles that could otherwise be released into the environment.

Constructing the sedimentation ponds in the initial stage of construction will ensure that high turbidity waters generated during ditch excavation and field opening are managed adequately. Each subnetwork will discharge to a specific pond or group of ponds. Sedimentation ponds will be located at the downstream periphery of peat fields. Technical characteristics of all ponds will comply with applicable guidelines (Thibault, 1998; Landry & Daigle, 2009). They will have an approximate 7.5 m width and 2 m depth. Figure 2 shows a schematic cross-section of a sedimentation pond. The respective length is determined in accordance with the drainage subnetwork area, in order to ensure a retention volume of 25 m³ per hectare drained, without exceeding 90 m. Required pond volume will also be increased by 20 % to take into account the fact that actual pond width decreases with depth since the sides will slope at an angle of approximately 55°. As such, a pond of 7.5 m x 2 m x 90 m will allow treatment of 45 ha of peatland area. If the drained area exceeds 45 ha, additional sedimentation pond(s) will be built in parallel or in a series fashion, depending on the terrain configuration, to guarantee an adequate volume for treatment. Table 3 presents the size of each sedimentation pond that will be constructed.

Sedimentation ponds will be equipped with a web membrane destined to filter out coarser floating particles. The design of the sedimentation ponds will also include a closure mechanism to prevent water exit from each pond, during maintenance. Where possible, discharge of water from the sedimentation ponds will take place in the form of a diffuse overland flow through the vegetation of the surrounding peatland surfaces, thus creating an additional filtration process to the sedimentation system.

Diffuse overland flow is a very efficient method for filtering drainage waters before they reach a receiving stream (Thibault, 1998). Water discharged at the outlets will mostly flow in a semi-radial, diverging fashion through the acrotelm[1] in a direction opposite to the harvesting areas. During snowmelt or intense rainfall events, discharge outflow will increase, thus inducing runoff over terrain surface. The progressive lateral spread of runoff will ensure that flow remains diffuse and transforms into the subsurface flow through acrotelm some distance from the release point (outlet). The lateral spread will also result in a significant reduction of the velocity of flow. Once discharged, water will be available for evapotranspiration and further infiltration towards deeper portions of the peat deposits. Consequently, no significant surface runoff originating from the peatland should reach neighboring streams, which are all located more than 30 meters away, and generally more than 50 m away, from a discharge point. No significant modification of the hydrology and hydrological regime of the local streams is expected as a consequence of drainage water discharge.

Main (collector) ditches will run along the downstream edges of harvest zones to collect water from the secondary ditches and channel it towards sedimentation pond(s) of the corresponding subnetwork. They will be dug with an excavator that will unload the excavated peat over nearby harvest fields or over the surface bordering the ditch along segments that do not run next to any harvest field.

1 The acrotelm is the upper layer of a peatbog where the water table fluctuates. The catotelm is the underlying layer which is permanently below the water table.

Table 3 Sedimentation ponds specification for each drainage subnetwork

DRAINAGE SUBNETWORK	DRAINED AREA	EFFECTIVE REQUIRED RETENTION VOLUME	ACTUAL POND VOLUME - ADJUSTED 20%	THEORETICAL LENGHT IF 1 POND	ADJUSTED POND LENGHT ACCORDING TO THE NUMBER OF POND	NUMBER OF POND REQUIRED	POND WIDTH	POND LENGHT	LENGHT/WIDTH RATIO
Sedimentation Pond #	(ha)	(m^3)	(m^3)	(m)	(m)	(-)	(m)	(m)	(-)
1	90	2256	2708	181	60	3	7.5	60.0	8.0
2	79	1980	2375	158	79	2	7.5	79.0	10.5
3	10	241	289	19	19	1	4.3	33.5	8.0
4	56	1409	1690	113	56	2	7.5	56.5	7.5
5	90	2257	2709	181	60	3	7.5	60.0	8.0
6	64	1598	1917	128	64	2	7.5	64.0	8.5
7	3	83	100	7	7	1	2.5	20.0	8.0
8	22	538	646	43	43	1	6.5	49.5	7.5
9	41	1015	1217	81	81	1	7.5	81.0	11.0
10	8	210	252	17	17	1	4	31.5	8.0
11	6	155	185	12	12	1	3.5	26.5	7.5

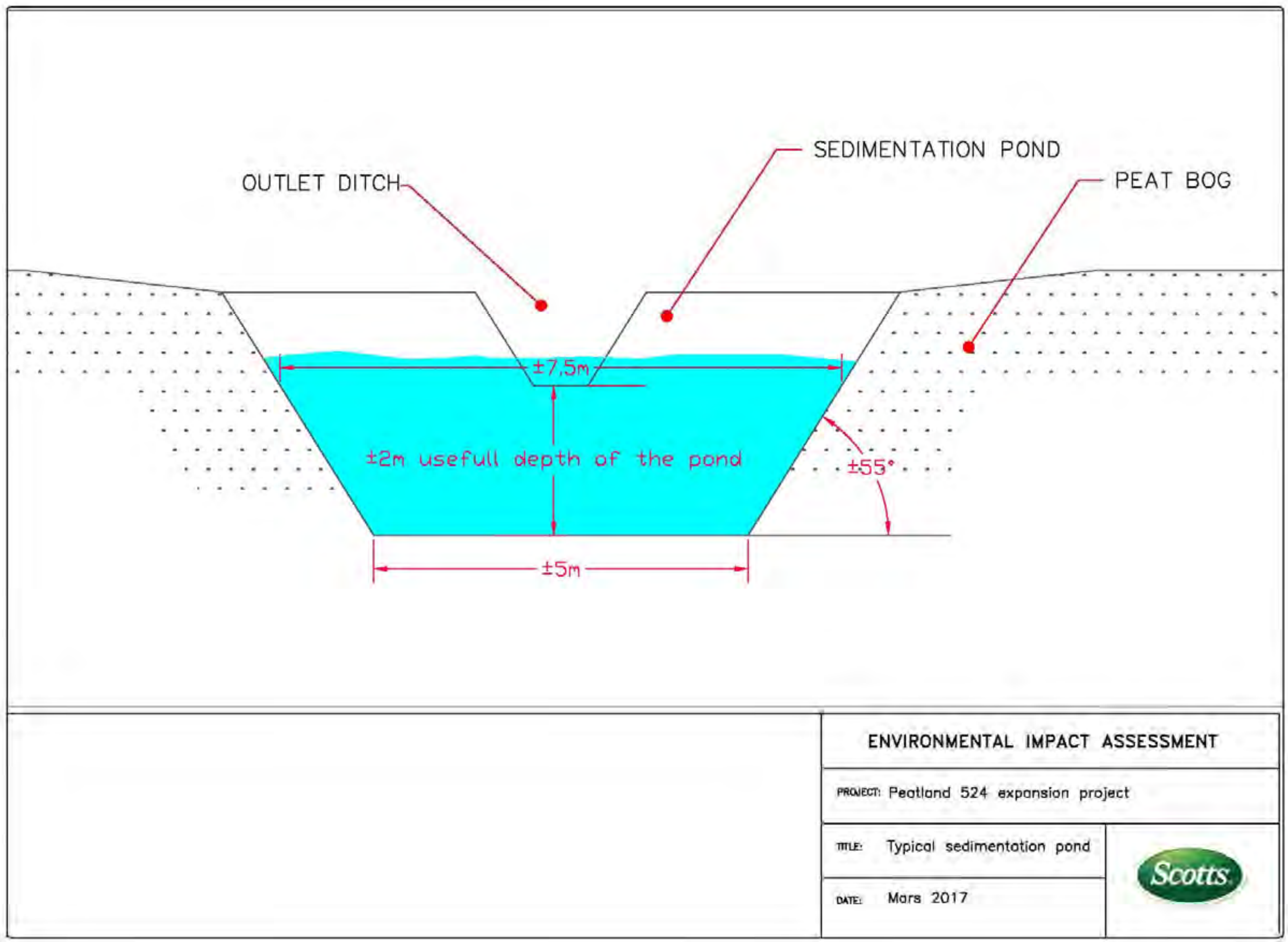

Figure 2 **Schematic cross-section of a sedimentation pond.**

Excavated peat will be spread over the fields, where it may then be harvested or used for access road construction, depending on its quality. Excavated mineral material will be used to stabilize sedimentation pond banks, construct access roads or piled up for future use at the decommissioning phase. No fill will, however, be directly deposited over peat, to prevent mixing of the two and alteration of the peat fields. Main ditches will have a V shape and a depth of 1.8 m and a width ranging from 2 m at the top to 0.6 m at the bottom.

Secondary ditches will be constructed parallel to each other and ±25 m apart, and run along each harvest field. The secondary ditches will also be dug with a V-ditcher pulled with a tractor, to a depth of approximately 1.5 m on current land surface. Width will reach 1.35 m at the ditch's crest, and walls will be sloped at an angle of about 65°. The use of a V-ditcher allows excavated peat to be directly spread over adjacent harvest fields. Two to three V-ditcher pass within the same ditch are required to obtain desired depth and width.

Ponds located in areas targeted for expansion will be connected to the drainage network via temporary ditches, to drain them. Depressions created by pond drainage will be filled with peat. Once filled, ponds will become an integral part of the harvest fields. Ponds that are too deep to be drained will be circumvented by the drainage network.

The development of Sector 2 will require the displacement of a 1,219 m section of Lufburys Brook, which drains a bog pond (Map 3). The Lufburys Brook will be diverted toward the main ditch along the road leading to currently harvested fields. If necessary, the ditch will be enlarged and deepened to make sure it can evacuate water flow from Lufburys Brook. The previous brook channel will be filled with peat and incorporated into peat fields.

3.6.1.3 PEAT FIELDS PREPARATION

Peat field preparation consists of the removal of trees and the dome-shaped contouring of peat fields to facilitate drainage. Although the project area comprises mostly open bog, all merchantable timber will be offered to the licensee contractor for the area. All non-merchantable timber and shrubs will be used for access 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 it will either be mixed with the peat or collected and used for restoration of closed fields.

A profiler will be used to profile (dome-shape) peat fields by scraping and moving peat from the edges toward the center of fields. This dome-shaped profile allows adequate drainage.

3.6.2 OPERATION PHASE

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

3.6.2.1 HARROWING

The surface is milled and harrowed with various type of equipment to loosen the peat and accelerate the drying process which depends largely on the sun and favorable wind conditions. At the onset of dry weather following rain, fields are harrowed with another type of rake that turns over the surface of the peat to allow it to dry.

3.6.2.2 HARVESTING

Harvesting may occur between April and November, but it concentrates from May to September. Weather conditions represent the major constraint since peat must be harvested when it is dry. Once dry, peat is collected using a method referred to as pneumatic harvesting. The proponent will generally use standard two-headed vacuum harvesters equipped with a device that direct peat dust toward the ground instead of up to the air to limit airborne peat particles. Commonly, harvesters go up and down a field and offload the collected peat into stockpiles along access roads.

The expected annual rate of harvesting is estimated at 7 cm of *in situ* compacted peat. A 50 cm layer of peat will be left in place when harvesting stops, to ensure adequate conditions for the restoration process.

Harvesting and harrowing operations alternate all along the harvesting season. During dry spells, peat harvesting operations can be conducted every day for 10 and 12 hours daily. It stops during rainfall and can start again after a period of two to three days after harrowing and when surface peat reaches the desired moisture content of 45-55%.

3.6.2.3 STOCKPILING AND TRANSPORTATION

Typically, vacuum harvesters go up and down a field and offload the harvested peat into small stockpiles along the access road. From there, peat is loaded into large trailers with a front end loader or a hydraulic excavator and moved to a stockpiling area outside the bog in proximity to the processing plant. The stockpiled peat is hauled to the plant for processing and bagging as quickly as possible to prevent rewetting, but some stockpiles may stay in the fields for a longer period, especially during dry spells when harvesting goes on for several days. Peat piles that are expected to be kept for a longer period in the field will be covered to prevent rewetting and peat being blown away by the wind. No peat stockpile will be left in the field after October 31st without protection against the wind as stated in the Approval to Operate issued for the currently harvested sections of the bog (Appendix A).

Peat stockpiles located at the end of peat fields will be oriented as much as possible in the axis of dominant winds that are SW-NE for most of the peat harvesting season to minimize peat being blown away.

3.6.2.4 MAINTENANCE

Secondary ditches will be reworked yearly to maintain a constant depth, and accumulated debris will be removed. The main ditches will be cleaned when deemed necessary.

Peat field maintenance will include reshaping (for dome-shaped fields) using a leveller and collection of branches, roots and other wood debris on field surfaces with a special rake. These operations will be conducted yearly, preferably in the fall after the harvesting season and before winter. However, any of these operations can be carried out when necessary.

Stockpiles located in the stockpiling area will be continuously monitored for signs of heating. In such cases, heated peat will be removed with a front end loader or an excavator to prevent self-heating and peat quality deterioration. Heated peat can be mixed with non-heated peat or used for access roads depending on the degree of damage from heating.

3.6.3 WATER MANAGEMENT DURING CONSTRUCTION AND OPERATION

3.6.3.1 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 in a progressive way, as the ditches bottoms are 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. In areas where a ditch will intersect a pond, stagnant water will also be drained (see next section). Drainage water and surface runoff collected from secondary ditches will flow gravitationally towards the main ditches and end up at the downstream end of the subnetwork.

Water will enter and slowly flow through the sedimentation ponds, where present. Discharge of water will occur at the outlets of the ponds or, in their absence, directly at the outlet of the downstream main ditch 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 100 ha of harvest fields (Map 3, Table 3).

It is important to emphasize that ditch construction within the peatland will be carried out progressively. A maximum of 58 ha of peatland will be open to harvest within a given natural watershed, during a single year. Field opening will be executed in a number of successive phases, during a working season, as each secondary ditch requires between two and three V-ditcher passes in order to be completed. Each of these passes are executed a few weeks apart. Peat field drainage will thus take place in an incremental fashion as ditches bordering any given field will be deepened. 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 drainage process of a peat field will take place within a year. As such, the residual flow of drainage water will be marginal upon initiation of a subsequent ditching season in a different area. Consequently, an 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 fields opening (Map 4).

3.6.3.2 PONDS DRAINAGE

Ponds found in Peatland 524 are located where the peat cover is the thickest and surface topography is the flattest. As such, ponds are predominantly found in the central portion of the peatland, primarily within Lufburys Brook natural watershed, as well as in areas that border the watershed along its southern limit.

Very few ponds exist in expansion sectors located west (sectors 9a & 9b, 10, 13, Map 3) and Southeast (sectors 1a & 1b, Map 3) of the current operation, which represent approximately 60% of the proposed expansion total area. When present, these standing waterbodies occur as small ponds, distributed scarcely and randomly. As such, the impact of their drainage will be minimal.

The density of ponds found in the central portion of the peatland represents between 5 and 10 % of the total area. They essentially occur as larger ponds, with no apparent pattern in their spatial distribution. Their shapes greatly vary and are usually irregular.

In spite of this, special care has been given to the delineation of expansion sectors located in the central portion of the peatland (namely sectors 2, 14, 15, 17, 18 & 19, Map 3) to minimize pond drainage. Actual extension of the various sectors and the positioning of their respective limits have been determined and adjusted to circumvent most of the ponds found in the area and avoid the need to drain them. The outlined harvest areas and drainage network optimize peat field creation while minimizing encroachment on ponds. As a result, the number and surface area of ponds that will be drained during the opening of sectors 14, 15, 17 and 18 are minimal, and comparable to those of sectors located west and southeast of the proposed development (see previous paragraph).

In Sector 2, there are approximately 40 ponds with individual surface area greater than 20 m², but no greater than 1500 m². These ponds will be drained during field openings. They represents less than 1% of the total area of Sector 2. Global impact of pond drainage in this sector will thus be minimal, similar to that for sectors 14, 15, 17, 18 & 19.

Of all the sectors targeted by the proposed expansion, only Sector 19 displays a significant density and coverage of ponds over its extent. Pond coverage nevertheless represents less than 10% of the sector’s total area. It would not be possible to develop the structured network of fields and ditches required for peat harvest in this sector without draining the ponds present. Attempts to by-pass the ponds would result in a very complex drainage network in Sector 19, which would, in turn, translate into less-than-optimal production conditions. Another alternative to pond drainage would be to subtract the pond areas from extraction. This would result in the loss of significant volume of extractable peat, given the number of ponds present in the area, as well as their irregular shape.

3.6.3.3 ESTIMATION AND TEMPORAL EVOLUTION OF DRAINAGE DISCHARGE

Peat fields will be drained by ditching and induced water table lowering in a progressive fashion. It is estimated that a maximum of 58 ha of peatland will be drained annually in a given natural watershed until expansion reaches its full extension.

Excavation of each secondary ditch will proceed in two to three cutting phases until target depth is reached. The time span between each cutting phase may reach several weeks, to allow sufficient drainage of any given field, as well as to 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 complete excavation of each ditch will be executed in two phases. Additionally, the estimation was based on the year of greatest expected expansion (2019), where 58 ha of fields will likely be ditched in a single watershed (all in Sector 1a, Map 2).

It is hypothesized that execution of each cutting phase will proceed at a rate of 5,305-metres of secondary ditches per day. This is based on actual, high productivity ditching rates in optimal conditions. It is supposed that ditching is carried out five days a week, with two-days interruption on weekends. Each cutting phase is assumed to take place over three consecutive weeks, which is the time theoretically required for covering 58 ha in ideal conditions. The second phase will be initiated the following (fourth) week and executed according to the same schedule as phase 1. Under those assumptions, the complete ditching of the 58 ha of peat fields would be executed in six weeks.

This approach has the benefit of maximizing the peak drainage discharge that may be recorded during ditches network construction. One must note, however, that actual duration of the operations could deviate from this estimate, and possibly spread over a longer period.

The assumption is made that the first V-ditcher pass will remove the slice of peat within depth interval 0-0.91 m, while the second will remove the 0.91-1.53 m deep slice.

Drainage discharge was estimated by separating the vertical profile of each peat field in two layers to represent the two stages of secondary ditch excavation. Drainage of each layer was considered independently from the other, and a three-week delay was defined between drainage initiation in two contiguous layers. The delay represents a conservative assessment of the timespan 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 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 (1987) as well as data computed by Carrier (2003) in various peatlands of New Brunswick, Price (1996) and Price *et al*. (2003). The detail for hydraulic properties defined for each peat layer is given in Table 4.

Table 4 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

Geometric and spatial characteristics of the secondary ditches presented in section 3.6.1.2 were used in the drainage discharge calculations.

The peak drainage discharge during the construction of the peatland ditch network was estimated to be 1,527 m³/day for a given watershed. This value is equivalent to a rainfall event with an intensity of 0.1 mm/h over a 58 ha area during a 24 h period with no infiltration, interception or storage loss (complete contribution of rainfall to surface runoff). The drainage peak discharge occurs on the last day of the first cutting phase since a thicker slice of peat with a higher specific yield is ditched during the first phase. Drainage discharge during the second cutting phase remains between 1,000 and 1,250 m³/day. A sustained decrease in drainage discharge is observed following the end second phase, which corresponds to completion of ditching in the area under consideration. A residual drainage discharge of about 75 m³/day is observed after 365 days, a little less than 5% 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 58 ha.

3.6.3.4 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 metals 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. Discharge associated with the resurgence of infiltrated rainfall/snowmelt water in the ditch network will likely exhibit hybrid 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.

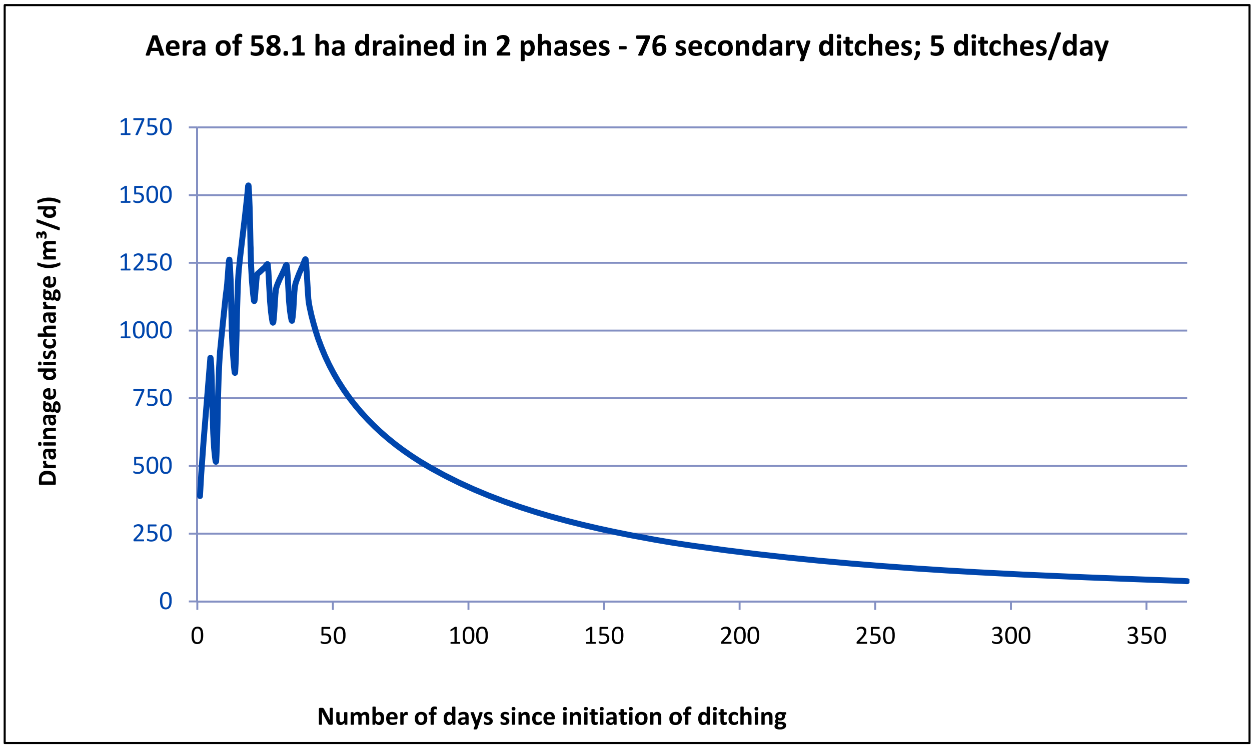

Figure 3 Expected peatland drainage discharge during a ditching season

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

While none of the streams located down-gradient from the bog has been classified under the *Water Classification Regulation*, the fact that no discharge of peatland water will take place in any of these streams rules out the possibility of significant stream water quality alteration as a result of the *Peatland 524 Expansion Project*.

3.6.3.5 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 towards the secondary ditches, where it will be collected by the drainage network. Surface runoff collection by the drainage network may take place during ditching, in response to episodes of runoff-generating rainfall. In such cases, water discharge at the network outlets will originate from both drainage and runoff.

During harvesting, water discharge at the outlets will essentially come from runoff generation induced by precipitation. 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 timing of the discharge will also depend upon the duration and intensity of the precipitation events, as well as the antecedent climatic conditions and moisture condition 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 rate will generally have a short duration. The volume of water discharge 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 with respect to the infiltration episode(s). This delay might span from a few hours to numerous weeks, depending upon antecedent moisture conditions of peat and upon 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, 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.

3.6.4 DEVELOPMENT SCHEDULE

Scotts has developed a schedule for the *Peatland 524 Expansion Project* that includes new field development and closure. The development of new fields should begin in 2017 and may extend beyond 2021 to complete the proposed expansion. Peat harvesting would stop in 2075 and reclamation shortly after.

Table 5 presents the opening schedule for the expansion project. It also shows the closure and reclamation areas and schedule as well as the expected peat production volume for the whole peatland until total decommissioning of the site. Map 2 shows the location and year of opening for each sector.

Table 5 **Opening, closure and reclamation schedule, and expected peat production volume for the current operation and proposed expansion of Peatland 524.**

YEAR	YEARLY PROJECTED OPENING FOR EXPANSION PROJECT (ha)	PERIOD PROJECTED CLOSURE (ha)	PERIOD PROJECTED RECLAMATION (ha)	TOTAL OPENED AREA (ha)	CLOSED AND NOT RECLAIMED AREA (ha)	TOTAL RECLAIMED AREA (ha)	ANNUAL EQUIVALENT 6 ft^3 COMPRESSED
2016	-	-	-	332	38	4	609 500
2017	83	-	-	415	38	4	1 038 500
2018	37	-	17	452	21	21	1 130 750
2019	58	-	20	510	0	41	1 275 900
2020	57	-	-	567	0	41	1 417 225
2021	69	-	-	636	0	41	1 590 900
2022-2030	-	84	50	553	34	91	1 382 075
2031-2040	-	100	100	453	34	191	1 132 250
2041-2050	-	143	130	310	47	321	775 175
2051-2060	-	83	100	227	30	421	566 925
2061-2075	-	139	125	87	44	546	218 675
2075-2100	-	87	132	0	0	678	0
Sub-total	304	636	674	-	-	-	

The development schedule was based on several hypotheses and data:

→ Harvestable volume of surface peat of 38,000,000 for the whole Peatland 524 (Keys and Henderson, 1987)

→ Harvest rate of 7 cm/yr that correspond to 2,550 6 cubic feet bales/ha based on a decompaction factor of 120 % (1 m^3 in situ = 1.2 m^3 harvested)

→ Surface subsidence of 70 cm at opening caused by dewatering

→ Peat layer of 50 cm left in place to facilitate reclamation

- → Average initial peat depth estimated for each sector based on the peat isopach map (Keys and Henderson, 1987) and data collected in 2004 by Heveco on block cut fields and 2016 by Scotts for some sectors
- → For previously block cut, a 1.2 m layer was subtracted from the Heveco 2004 peat depth data

According to Keys and Henderson (1987), the whole peat bog contains 38,000,000 m^3 of harvestable peat (surface peat) which converts into approximately 111,000,000 equivalents 6 ft^3 compressed which is the generally accepted unit of measure used in the industry. Considering the areas that will not be opened and those that have already been opened, a reasonable estimation of 60,000,000 equivalents 6 ft^3 compressed can be expected to be harvested during the remaining peatland useful life which is about 55 years of harvesting. At maximum production in 2021, the targeted annual harvested volume should be 1,500,000 to 1,600,000 equivalent 6 ft^3 compressed. This value will slowly decrease over time with the progressive closure of depleted peat fields.

The proposed development schedule should be considered as the best scenario for Scotts. Several factors such as an increased demand for peat and meteorological conditions may influence the development schedule of the *Peatland 524 Expansion Project*.

3.6.5 DECOMMISSIONING PLAN

The decommissioning plan comprises a reclamation plan that addresses peat fields and measures for infrastructure. At this point, a conceptual decommissioning plan was prepared based on anticipated conditions at the cessation of peat harvesting activities on the expansion. A more detailed plan that will integrate the expansion area to the existing decommissioning plan will be prepared and submitted to Department of Energy and Resource Development (DERD).

The reclamation plan defines goals to be achieved in the long term and proposes reclamation options that are implemented to meet these goals. In theory, the goal of reclamation is to establish appropriate conditions that will lead to the return of a peat accumulating ecosystem where possible. It comprises peatland restoration that is the re-creation over time of a functioning peat accumulating ecosystem, and reclamation that aims at initiating an earlier successional stage of the peatland whose functions can differ from that of the peatland that existed before extraction (Hugron et al., 2013). In the present case, the definition of goals must take into account several factors.

In practice, few options exist for the reclamation of harvested peatlands in regards to the targeted goals. For instance, the New Brunswick *Peat Mining Policy* (Department of Energy and Resource Development, 2017a) proposes three options:

- → Sphagnum Revegetation
- → Forest Habitat
- → Open Water

The cultivation of sphagnum moss often referred to as paludiculture, is another option that is currently being tested in New Brunswick. Scotts is involved in this research program with the Peatland Ecology Research Group (PERG), but at this point, this option cannot be considered because it is still at the experimental stage.

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 (Peatland Ecology Research Group, 2009). Reclamation will then involve the three main options although Scotts 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 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 that has the best chance of success according to anticipated conditions at the cessation of peat harvesting.

3.6.5.1 SPHAGNUM REVEGETATION

The goal of Sphagnum Revegetation is to return peat harvested areas back to functional peat-accumulating peatland ecosystems. In the short term, the specific objectives comprise 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). 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 that are still being harvested. Management, adequate rewetting and donor sites with targeted plant communities are among the main drivers of success for this option (Gonzalez and Rochefort, 2014).

This approach consists of shredding the top living vegetation layer in undisturbed peatland areas (borrow areas). This plant material is spread over abandoned peat fields and covered by straw mulch that help to create appropriate growing conditions for peatland species. 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. Site-specific field preparation, such as berm construction, is also required to favour uniform wet soil conditions. Plant material is commonly collected from borrow areas such as new peat fields being developed, or from shallow peat areas adjacent to peat fields. Such borrow areas have already been identified based on an inventory of plant communities (Map 2). It is important to note that vegetation can recover rapidly on borrow areas after plants are collected (Rochefort *et al.*, 2003). Some borrow areas were used up to three times at an interval of about five years.

The MLTT leads in a majority of cases to the progressive return of peatland functions. For instance, recent research showed that a complete plant community can establish within ten years (Poulin *et al.*, 2012) 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, returned after 6 to 10 years at some sites (Waddington *et al.*, 2010; Strack and Zuback, 2013).

Scotts proposes to apply Sphagnum Revegetation where conditions will be appropriate to favor successful reclamation.

3.6.5.2 FOREST HABITAT

The goal of Forested Habitat reclamation is 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 objective is to plant tree seedlings and promote spontaneous colonization by other plant species to start a process leading to a forest habitat. The goal of Forest 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.

Tree plantation is a valuable reclamation option in various situations (Hugron *et al.*, 2013). Tree plantation around harvested areas located at the peatland margin may contribute to the formation of laggs that are transitional zones between peatlands and uplands. Forest habitat may also be the favoured 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, Forest 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 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 conditions. According to the current tree planting method in harvested bogs, seedlings are planted at a density of 1,200/ha, which corresponds to a spacing of 3 meters between plants, and they are fertilized. Seedlings are planted in such patterns that will mimic natural forest, 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. With time, ditches will get clogged, and the water level will rise slowly, leading to forested wetland conditions.

Forest habitat will be favoured 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 towards the peatland margin closer to nutrient rich habitats and where peat is shallow and along access roads bordered by operational drainage ditches.

3.6.5.3 OPEN WATER

Creation of open waterbodies improves the ecological value of restored wetlands because bog ponds are considered hotspots of natural peatland biodiversity (Fontaine *et al.*, 2007). They provide habitat for specific species of ecologically-valuable plants, invertebrates, and insects and they can be used by birds and wildlife. Moreover, ponds represent a natural feature of Peatland 524. However, few studies examined the creation of ponds as part of peatland reclamation, and efficient revegetation techniques for pond have yet to be developed (Laberge *et al.*, 2013). Current research should soon provide guidelines on pond specification to favour colonization by insects (Drapeau-Picard, 2016). Despite the lack of methods, the proposed reclamation plan includes the creation of ponds.

Created ponds will occupy a restricted area within the rehabilitated site as they usually do in peatlands. Ponds may be created within the Sphagnum Revegetation and Forest Habitat sectors where they will add to habitat diversity and contribute to the ecological value of these ecosystems. The exact location and surface occupied by Open Water will be determined at the time of the reclamation work based on local hydrology and topography. Depressions and low-lying zones where water accumulates naturally and may prevent sphagnum restoration or tree survival and growth are best suited for Open Water.

The *Peatland Restoration Guide* offers guidance for pond creation (Quinty and Rochefort, 2003). Ponds are created by excavating shallow depressions. The excavated peat is spread around the pond and mounds may be created to favour species that prefer drier conditions. Ponds usually have small dimensions (<100m^2) and a curved-irregular shoreline.

It was shown that created bog ponds are rapidly colonized by amphibians and certain insects, and that vegetation requires more time to become established (Mazzerolle *et al.*, 2006).

3.6.5.4 INFRASTRUCTURE DECOMMISSIONING

Infrastructure decommissioning involves the rehabilitation of access roads and ditches.

Access roads will be left in place and will be compensated for. They will provide access for post-decommissioning monitoring purposes and for use by other eventual land users, especially for bird and wildlife watchers and hunters.

Secondary ditches will be filled with peat or left open to create open water. Main ditches will also be blocked to retain water within the site and their sides will be graded to make sure they do not represent a safety hazard for human and wildlife.

3.6.5.5 DECOMMISSIONING SCHEDULE

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

4 DESCRIPTION OF THE EXISTING ENVIRONMENT

4.1 BIOPHYSICAL FEATURES

Peatland 524 is located in the Caraquet ecodistrict of the Eastern Lowlands ecoregion, in the Atlantic Maritime ecozone. The Eastern Lowlands ecoregion contains the highest percentage of wetlands of all New Brunswick ecoregions.

4.1.1 GEOLOGICAL AND GEOMORPHOLOGICAL SETTING

In terms of geology, Peatland 524 is located in the Maritimes Carboniferous Basin, which covers most of northeastern New Brunswick. This formation is composed of thick and complex sequences of sedimentary rocks from Carboniferous some 300 million years ago. The predominant lithologies found in the area are sandstones, conglomerates, siltstones, and mudstones.

Quaternary deposits of marine origin are found above bedrock in areas west and north of the peatland, where they outcrop. These deposits consist of beach sediments composed mainly of gravel and sand (Gauthier, 1982). At the local scale, the thickness of these sediments is generally lower than 1.5 m according to data obtained from New Brunswick online Well Log System. Some nearshore sediments, composed of silt and fine sand, may also be locally present underneath the beach sediments.

Organic deposits overlie the beach sediments in and around Peatland 524. The thickness of the organic deposits varies between 1 and 10 m. They are essentially composed of sphagnum peat, although two areas of saltwater marsh have also been identified at the periphery of Peatland 524 (Gauthier, 1982).

4.1.2 CLIMATE

The Tabusintac area is located in the maritime climatic zone, which is characterized by cool temperatures and frequent precipitations year-round. The closest meteorological station is Miramichi A, operated by Environment Canada. Mean yearly temperature is 4.9°C while mean, minimum, and maximum temperatures for July are 19.1°C, 13.0°C, and 25.2°C, respectively (Environment Canada, 2016). Mean, minimum and maximum temperatures for January are -10.8°C, -16.6°C and -5.0°C, respectively. Mean yearly precipitation is 1,072 mm with 794 mm falling as rain and 291 mm as snow. November, July, and May are the wettest months with around 100 mm of precipitation. The dominant wind direction for the peat harvesting season (May to September) is south, and there is less than one day per month with gusts exceeding 52 km/h.

Average monthly temperatures and precipitation are presented in Table 6.

Table 6 Average monthly temperatures and precipitation at Miramichi A station

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
						Temperature						
Daily mean (°C)	-10.8	-8.9	-3.4	3.2	10.0	15.7	19.1	18.5	13.5	6.9	0.7	-6.2
						Precipitation						
Rainfall (mm)	21.5	18.1	34.1	58.7	97.5	86.3	99.9	93.1	83.8	87.0	75.2	38.6
Snowfall (cm)	70.4	54.6	59.6	25.8	1.7	0.0	0.0	0.0	0.0	2.6	26.8	49.9
Total (mm water equivalent)	87.0	70.9	90.8	84.9	99.5	86.3	99.9	93.1	84.5	89.7	100.6	85.3

4.1.3 HYDROGEOLOGY

Groundwater is present throughout the entire local stratigraphic sequence. The various geological formations, however, exhibit different hydrogeological behavior. In the peat deposits, the acrotelm has a permeability several orders of magnitude higher than that of the catotelm. Hence, in saturated to nearly-saturated conditions, water flow mainly occurs within the acrotelm. 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 do occur, however at a lower rate. Water fluxes between the acrotelm and catotelm may be oriented upward or downward, depending on the 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 towards their respective periphery.

Being a low permeability unit, the catotelm acts as an aquitard, which precludes the occurrence of a 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. Waters of the Gulf form a continuous groundwater discharge zone over about half of the peatland's periphery. They contribute to maintaining high hydraulic heads in the mineral deposits underneath the peat cover, especially considering the high permeability of gravel and sand. Thus, vertical hydraulic gradients between organic and mineral deposits are likely low.

Additionally, where the lower contact of the peat deposits lies below the Gulf's mean water level, the vertical hydraulic gradient with underlying mineral material is null, meaning that no water flow can take place vertically between the two formations. Hence, from a global perspective, hydrogeological interactions between the peat deposit and the underlying formations are low.

Bedrock constitutes the main aquifer at both the regional and local scale. Sedimentary 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 as well take place within the porous matrix (Stapinsky *et al.* 2002). Locally available data indicate that piezometric surface of the bedrock aquifer would lie below bedrock surface. This would translate in the existence of unconfined conditions within the aquifer.

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.

Peatland 524 is situated at the downgradient end of the local groundwater flow system within bedrock, as the Gulf of St. Lawrence forms its discharge limit. Areas located west of, and upgradient with respect to the peatland, act as recharge areas for the bedrock aquifer. Groundwater then flows predominantly eastward, towards the Gulf.

Groundwater from the bedrock aquifer is used as the main water supply source in the area. Domestic wells are in place in dwellings located along Road 11 and Covedell Road. All wells located along Highway 11 sit in an uphill, and upgradient, position on the peatland. For their part, the majority of domestic wells located along Covedell Road lie within a different watershed (the Gulf itself) than those within which are situated the neighboring portions of Peatland 524 (Malpec Brook, Lufbury Brook – see Map 4). The domestic well closest to the proposed expansion would be at a distance of about 375 m from it, and situated along Covedell Road.

4.1.4 SURFACE WATER REGIME

Peatland 524 straddles the watersheds of two main streams, respectively Malpec Brook and Lufburys Brook. Additional portions of the peatland are located within areas where no defined or apparent stream flows. These areas are mainly found along the peatland's southeastern periphery and, to a lesser extent, northern edge. They drain directly to the Gulf of St. Lawrence or, in the case of the peatland's northern edge, to French Cove. Total peatland areas located in Malpec Brook and Lufburys Brook natural watersheds are respectively 512 and 411 ha, while 649 ha of peatland directly drains to the Gulf or Cove. Natural water flow within the undrained bog predominantly occurs in the form of subsurface acrotelm flow, and surface runoff only occurs during episodes of significant precipitation or snowmelt.

4.1.5 PEATLAND AND STREAM WATER QUALITY

Peatland water was sampled in the existing sedimentation pond that is located at the northeastern corner of the current operation. This sedimentation pond receives drainage water from the harvest fields of the northern portion of the developed peatland. Sampling of pond water has been carried out three times so far, in July of 2016, beginning of March and end of April 2017, in order to document summer, winter and spring conditions respectively.

In addition, stream water of Malpec Brook was sampled twice, in March and end of April 2017, to document local water quality. Sampling took place along the brook's main branch, approximately 2 km upstream from its discharge point into the Gulf. This sampling station is located downstream from the current operation's west harvest fields.

Surface waters were sampled in accordance with the *Guidelines for Peat Mining Operations in New Brunswick* (Thibault, 1998). Analytical results from the collected water samples are provided in Table 7 and certificates of analysis are enclosed in Appendix B. The results are compared to CCME's recommended quality criteria for *Freshwater aquatic life protection* (CCME, 2007). Metals concentrations provided refer to the total extractable concentrations, *i.e.* dissolved and particulate forms.

Table 7 Analytical results of surface water sampling

Parametres	CCME [1]		QL [2]	Units	Sample ID / Sampling date / Analytical results				
	Short term	Long term			Tabusintac Pond 1			Malpec Brook	
					TA-P1	Bassin #1	Sortie Bassin #1	Melpec brook	Ruisseau Malpec
					2016-07-12	2017-03-06	2017-04-25	2017-03-06	2017-04-25
Metals and major cations									
Aluminum [3]	-	5	1	µg/L	**151**	**166**	**193**	**46**	**34**
Antimony	-	-	0.1	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	-	5	1	µg/L	**26**	**11**	**6**	<1	<1
Baryum	-	-	1	µg/L	266	134	62	17	12
Beryllium	-	-	0.1	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	-	-	1	µg/L	<1	<1	<1	<1	<1
Boron	29 000	1 500	1	µg/L	70	9	4	4	3
Cadmium [4]	0.18 - 2.4	0.04-0.18	0.01	µg/L	0.01	0.02	0.02	<0.01	<0.01
Calcium	-	-	50	µg/L	15 200	5 830	2 690	5 360	3 830
Chromium	-	9.9	1	µg/L	1	<1	<1	<1	<1
Cobalt	-	-	0.1	µg/L	1.5	0.9	0.6	<0.1	<0.1
Copper [4]	-	2 - 2.63	1	µg/L	<1	1	**3**	1	<1
Iron	-	300	20	µg/L	**8 960**	**6 050**	**2 730**	**390**	**320**
Lead [4]	-	1 - 3.72	0.1	µg/L	0.7	0.9	0.9	0.4	0.3
Lithium	-	-	0.1	µg/L	4	1.1	0.7	0.5	0.3
Magnesium	-	-	10	µg/L	18 300	1 640	540	780	580
Manganese	-	-	1	µg/L	1 010	611	285	56	35
Mercury	-	0.026	0.025	µg/L	<0.025	<0.025	<0.025	<0.025	<0.025
Molybdenium	-	73	0.1	µg/L	0.6	0.3	0.1	0.1	<0.1
Nickel [4]	-	25 - 104.9	1	µg/L	<1	<1	<1	<1	<1
Phosphorus [5]	-	>100	2	µg/L	**169**	74	45	19	18
Potassium	-	-	20	µg/L	5 660	660	290	310	230
Rubidium	-	-	0.1	µg/L	2.9	1.1	0.7	0.3	0.2
Selenium	-	1	1	µg/L	<1	<1	<1	<1	<1
Silver	-	0.25	0.1	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Sodium	-	-	50	µg/L	142 000	12 100	3 310	4 890	4 390
Strontium	-	-	1	µg/L	141	23	10	18	10
Tellurium	-	-	0.1	µg/L	<0.1	1 080	<0.1	<0.1	<0.1
Thallium	-	0.8	0.1	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	-	-	0.1	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	33	15	0.1	µg/L	<0.1	<0.1	<0.1	0.3	<0.1
Vanadium	-	-	1	µg/L	3	2	1	<1	<0.1
Zinc	-	30	1	µg/L	6	8	9	16	3
Inorganic compounds									
Ammonia Nitrogen [3][6]	-	> 57.3	0.05	mg/L	<0.05	0.3	0.34	<0.25	0.26
Nitrate (N)	550	13	0.25	mg/L	<0.25	<0.25	<0.25	<0.25	<0.25
Nitrite (N)	-	0.06	0.25	mg/L	<0.25	<0.25	<0.05	<0.25	<0.05
Sulphates	-	-	5	mg/L	35	<5	<5	<5	<5
Sulfur	-	-	50	mg/L	-	1 080	-	720	-
Total Nitrogen - Kjehdhal	-	-	1	mg/L	1.1	<1	<1	<1	<1
Physico-chemical parameters									
Conductivity	-	-	1.9	µS/cm	1 030	119.3	42.6	58.4	49,0
Dissolved oxygen	-	> 5.5	1	mg/L	-	11.6	-	8.68	-
Hardness (CaCO3)	-	-	0.2	mg/L	113	21.3	8.9	16.6	12,0
pH	-	≥ 6.5 & ≤ 9	-	-	**5.9**	**4.9**	**5,00**	**5.1**	**4.9**
Total suspended solids [7]	25	5	2	mg/L	**12**	4	**6**	<2	<2
Tannins and lignins	-	-	0.5	mg/L	5.2	-	-	-	-

100 : Concentration ≤ Long-terme
100 : Long-terme < Concentration ≤ Court-terme
100 : Concentration > Court-terme

NOTES:

[1]: Canadian guidelines for water quality: protection of freshwater aquatic life for short and long term exposure
Canadian environmental quality guidelines, Canadian council of Ministers of the Environment (CCME, 1999 and updates)

[2]: Quantification limit reported by the analysis laboratory.

[3]: Criterion value adjusted as a function of pH.

[4]: Criterion value adjusted as a function of hardness.

[5]: For hypereutrophic conditions

[6]: Criterion value adjusted for an estimated water temperature of 15°C.

[7]: Allowable increase with respect to baseline concentration of the receiving waterbody

Pond waters exhibit a decreasing trend in measured concentrations between July 2016 and April 2017, for all major cations as well as most metals. Concentrations between the three sampling phases show a decrease of a factor ranging between 2 and 43. The decrease occurred in conjunction with a decrease in both conductivity and suspended solids content. Thus pond waters became less mineralized in winter conditions, and even more so following the spring freshet. Only aluminum, copper, lead and zinc concentrations increased, between July 2016 and April 2017, and magnitude of the increase is very low. This increase is likely linked to a decrease of the waters' pH, that could be caused by a greater input of peat water. All but three parameters that were detected in the July sample were also detected in March and April 2017.

High concentrations have been recorded for aluminum (151 to 193 µg/L), arsenic (6 to 26 µg/L) and iron (2 730 to 8 960 µg/L), from July 2016 to April 2017. The three metals exceed CCME's corresponding guidelines for protection of freshwater aquatic life (long-term exposure). High phosphorus concentration was also recorded in the July sample (169 µg/L). This value ranks above the lower threshold value for hypertrophic conditions as determined by CCME's guideline (100 µg/L), to which a peatland can be assimilated. Since there is no defined upper limit, the concentration recorded in the July sample is not an actual guideline exceedance.

Total suspended solids (TSS) measured in the July and April samples are respectively equal to 12 and 6 mg/L. These figures would exceed CCME's guideline for long-term exposure on freshwater aquatic life, on the hypothesis that TSS concentration of the receiving waterbody would be lower than 7 and 1 mg/L, respectively in July 2016 and in April 2017. Indeed, the guideline prescribes a maximum increase of 5 mg/L with respect to local baseline concentration. As the samples were collected inside the sedimentation pond, it is likely not representative of TSS concentrations discharged at the pond outlet, as further sedimentation before discharge would decrease the concentration. In the case of the March 2017 sample, TSS concentration was measured at 4 mg/L.

Values of pH measured in samples from the sedimentation pond ranged between 4.9 and 5.9, indicating that detained water is acidic, and below the lower boundary of CCME's corresponding guideline range.

The high concentrations in major ions and inorganic compounds measured in the July and March samples from the sedimentation pond, suggest that detained water is influenced by the mineral deposits underlying peat, as well as the resurgence of mineralized groundwater from these deposits. This is mainly because the pond was excavated in the mineral deposits over more than 70 % of its average total depth, which results in direct contact with detained water. Some segments of the upstream ditches may also intersect mineral deposits. Results obtained for the samples would therefore not be representative of the actual chemistry of peat water, but rather indicative of the actual chemistry of drainage water discharging at the local network outlet.

High aluminum, arsenic, and iron concentrations are commonly found in acidic peat water. Nevertheless, elevated metal concentrations measured in the pond samples could also be influenced by groundwater resurgence in the pond, even though water from the mineral deposits are less acidic, depending on the local hydrogeochemistry.

Waters sampled in March and April 2017 in Malpec Brook displayed a low content in metals, major cations, and inorganic compounds. All but one detected parameter showed a reduction of its concentration between March and April, by a factor ranging between 1.05 and 5.3. The only exception is ammonia nitrogen, for which a concentration marginally higher than the detection threshold (0.26 vs 0.25 mg/L) was measured in April, while the compound had not been detected in March. The decrease in concentrations between March and April would be indicative of a dilution resulting from the input of low-mineral water from snowmelt.

Only two parameters were measured in concentrations higher than CCME's corresponding guideline: aluminum (46 and 34 µg/L) and iron (390 and 320 µg/L). No arsenic was detected, and measured phosphorus concentration was low (19 µg/L). No suspended solid was detected, meaning that TSS concentration was lower than 2 mg/L. Regarding pH, values of 5.1 and 4.9 were recorded in March and April 2017, respectively. These values are indicative of acidic conditions.

From a global perspective, water quality results obtained for Malpec Brook reflect the biochemical nature of the environment through which it flows. Indeed, all channelized flow takes place within peat. While a certain portion of the stream's watershed is overlain by mineral deposits, all subsurface flow discharging to the stream circulates through peat before reaching the stream. Thus, sampled water exhibits a chemical signature that is typical of peatland-fed streams of the area.

4.1.6 PEAT CHARACTERISTICS

The study site is representative of the peatlands of Region 1 as defined by Keys and Henderson (1987) and that forms a 5-15 km wide band along the northeast and east coast of New Brunswick. These authors cite Tabusintac Peatland 524 as an example of large peatland complexes that result from the coalescence of nearby peatlands. In the present case, the peatland comprises three peat domes. The main one, by far the largest and the deepest with up to 9 m of peat, is parallel to the sea shore. The east side ridge of the dome sits directly into the Bay of Tabusintac and there is a significant level of natural erosion coming from the waves of the Gulf of St. Lawrence hitting the peat cliff, which creates up to 4 m high peat walls in certain locations.

The two other domes form the west limit of the peatland. They consist of much smaller concentric domes that are separated by a branch of Malpec Brook. Peat depth exceeds 7 m at these domes. The center of the bog is rather flat with peat depth between 3 m and 4 m and it has numerous bog ponds. The top 2 to 4 m layer of the deposit is composed of poorly decomposed sphagnum peat. This high quality peat overlays a variable layer of moderately decomposed woody sphagnum peat. The base of the deposit consists of a 1 to 2 m layer of more decomposed sedge peat. According to Keys and Henderson (1987), the base of the peat within the southeast portion of the peatland is up to 2 m below sea level. Due to the proximity to the sea, the development will have to consider the potential effect of salt water on peat quality.

The peat deposit lies on sand probably of postglacial marine origin.

Peat samples were taken to determine the concentration of metallic (inorganic) mercury present in the soil in accordance with the guidelines for peat projects (Department of Environment and Local Government, 2017b). Samples were collected at one station located in an untouched part within the northeast of the proposed peatland expansion and at 10, 30 and 60 cm from the surface (Map 4). The peat samples were analyzed by the Coastal Zone Research Institute Inc., and certificate of analysis are provided in Appendix B.

The results reveal that the concentration of mercury is below the detection limit of 0.01 mg/kg in the samples taken at 30 and 60 cm from the surface. The 0-10 cm peat layer shows a concentration of 0.02 mg/kg that is just over the detection limit. This level is far below the provisional standard of 0.8 mg/kg dry matter for agricultural soils determined by the CCME for human health (CCME, 1999). It is likely that the mercury 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 time (Madsen, 1981).

4.1.7 WETLANDS AND VEGETATION

Peatlands of Region 1 have very pronounced domes and an open vegetation cover, and ombrotrophic conditions prevail on 85-95% of the surface (Keys and Henderson, 1987). In general, these relatively dry and uniform surfaces are dominated by low shrubs, lichens, and mosses while deer grass (*Trichophorum cespitosum*) lawns occur around ponds. Minerotrophic conditions are restricted to bog margins.

Peatland 524 is representative of Region 1 regarding vegetation based on past descriptions (Airphoto Analysis Associates Consultants Limited, 1975). Plant communities of the area targeted by the project were described by Daigle and Gautreau-Daigle (2016), and their report is presented in Appendix C. The results of this survey are summarized below according to three zones that can be distinguished in the study area.

4.1.7.1 SOUTH ZONE

The south zone is composed of sector 1a and 1b (Map 5). It is characterized by open hummocky areas with more or less dry conditions at the surface. The areas are almost devoid of trees, but a dense cover of low shrubs that includes black huckleberry (*Gaylussacia baccata*), sheep laurel (*Kalmia angustifolia*), leather leaf (*Chamaedaphne calyculata*), Labrador tea (*Rhododendron groenlandicum*) and rhodora (*Rhododendron canadense*) is present. The herbaceous strata is restricted to few species such as cotton-grass (*Eriophorum angustifolium* and *E. vaginatum*) and cloudberry (*Rubus chamaemorus*). A full moss and lichen carpet covers the ground. Sphagnum moss species are present in most areas while lichens occupy the top of hummocks. There are few ponds in the south zone.

4.1.7.2 NORTH ZONE

The north zone comprises six sectors (2, 14, 15, 17, 18, and 19, Map 5) that surround the center of the bog that will remain undeveloped. It is an open area, as the south zone, but with wetter conditions and numerous ponds. Dry conditions prevail in the west and south parts with a dense low ericaceous layer, sparse herbs, and an important lichen cover.

Wetter conditions associated with ponds occur in the north (sector 19) and the part of Sector 2 toward the bog center (Map 5). Pond margins are characterized by low shrubs vegetation dominated by leatherleaf, dwarf huckleberry (*Gaylussacia dumosa*) and bog-rosemary (*Andromeda glaucophylla*) and a more developed herb layer with white-beak rush (*Rhynchospora alba*), tawny cotton-grass (*E. virginicum*) and sparse deer grass. A sphagnum carpet completes this plant community.

4.1.7.3 WEST ZONE

Sectors 9a, 9b, 10, and 13 form the west zone of the area to be developed. The vegetation of this zone is generally representative of dry conditions found elsewhere in the bog. It is dominated by open areas with stunted black spruce, low to medium ericaceous shrubs, sparse herb species and a full ground cover composed of sphagnum moss and lichens.

However, the presence of the Malpec Brook and its tributaries influence the vegetation locally especially at the margin of Sector 9b that is bordered by tall dense rhodora and sweet gale (*Myrica gale*) thickets.

4.1.7.4 SPECIAL STATUS PLANT SPECIES

Surveys for the rare and endangered vascular plants have been conducted during the summer of 2016, and full results are presented in Appendix C. A first survey targeting the southern twayblade (*Neottia bifolia*) was performed on June 23, 24 and 27th, and a second visit was done on August 2nd, 3rd and 9th for the other species. Surveys followed the method recommended in *A Guide to Environmental Impact Assessment in New Brunswick* (Department of Environment and local government, 2017a).

At the time of the survey, sectors 17 and 19 were not included in the expansion project and they were not surveyed, but the vegetation of this sector was characterized to evaluate its potential to be used as borrow site for Sphagnum Revegetation.

Six rare and protected species were observed in the bog (Table 8, Map 5). The southern twayblade was found at the northern margin of the peatland that is its preferred habitat. This species is considered endangered in New Brunswick and has a legal protection (Government of New Brunswick, 2013).

Table 8 Special status plant species observed in Peatland 524

COMMON NAME	LATIN NAME	PROV LEGAL PROT	PROV. RARITY RANK	PROV. GS RANK	LOCATION
Southern Twayblade	*Neottia bifolia*	Endangered	S2	1 (at risk)	Northern margin outside the area to be developed
Bog birch	*Betula pumila*		S3	4 (secure)	Sector 1b and 2
Russet cotton-grass	*Eriophorum russeolum*		S3	4 (secure)	Sector 9b
White fringed orchid	*Platanthera blephariglottis*		S3	4 (secure)	Sector 1a and outside the area to be developed
Cloudberry	*Rubus chamaemorus*		S3	4 (secure)	All sectors
Northern yellow-eyed-grass	*Xyris montana*		S3	4 (secure)	Sector 14

The five other species are listed as “Uncommon” in the province (S3) but “Secure” on the provincial GS rank and have no legal protection in New Brunswick (Atlantic Canada Conservation Data Center [ACCDC], 2016). The exact location of these plant was not available and symbols on Map 5 correspond to their presence within the sector. A total of three individuals of bog birch (*Betula pumila*) were found in sectors 1b and 2 within the area to be developed, a small colony of russet cotton-grass (*Eriophorum russeolum*) was identified in sector 9b, white-fringed orchids (*Plathantera blephlariglottis*) were found in sector 1a and northwest of this sector outside the area to be developed (not shown on Map 5), cloudberry was found in every sector and several colonies of northern yellow-eyed-grass (*Xyris montana*) were found in sector 14.

It is likely that rare species that are common at the site level may be present in sectors 17 and 19 since they have similar plant communities as the rest of the north zone. However, the habitat of the southern twayblade is absent of these sectors and this protected species should not be present.

ACCDC (Appendix D) reports no other plant species classified under COSEWIC or SARA, or having a provincial legal protection. Two species considered as sensitive at the provincial level are present within a 5 km radius from the bog center, and they are the saltmarsh sedge (*Carex salina*), and the red bulrush (*Blysmus Rufus*) two plants that grow in saline habitats and that cannot be present in the peatland.

4.1.8 TERRESTRIAL WILDLIFE

According to Rochefort *et al.* (2012), many vertebrate species use peatland somehow, but no one is restricted to these ecosystems in terms of habitat. Peatlands are not considered as an appealing habitat for wildlife because of wet ground conditions and low pH and nutrient status that do not allow high biological productivity. They are used by some species mainly those searching for open areas.

4.1.8.1 MAMMALS

Friolet *et al.* (2008) report 18 mammal species present in the Tabusintac River watershed (Table 9). Among these species, black bear, moose, and bobcat may use Peatland 524, but most likely the two watercourses that run within and around the site.

Table 9 Mammal present in the Tabusintac River watershed

ENGLISH NAME	LATIN NAME
Black bear	*Ursus americanus*
Moose	*Alces alces*
White-tailed deer	*Odocoileus virginianus*
Coyote	*Canis latran*
Red fox	*Vulpes vulpes*
Bobcat	*Felis rufus*
Racoon	*Procyon lotor*
Beaver	*Castor canadensis*
Snowshoe hare	*Lepus americanus*
Muskrat	*Ondatra zibethicus*
River otter	*Lontra canadensis*
Mink	*Mustela vison*
Ermine	*Mustela ermine*
Striped skunk	*Mephitis mephitis*
Pecan	*Martes pennanti*
Woodchuck	*Marmotta monax*
Porcupine	*Erethizon dorsatum*
Long-tailed weasel	*Mustela frenata*

Among small mammals meadow vole (*Microtus pennsylvanicus*), star-nose mole (*Condylura cristata*), American red squirrel (*Tamiasciurus hudsonicus*), Eastern chipmunk (*Tamias striatus*), Northern flying squirrel (*Glaucomys sabrinus*), redback vole (*Clethrionomys gapperi*), rat, mouse and shrew species are reported in the region (Friolet *et al.*, 2008).

The southern bog lemming (*Synaptomis cooperi*), the masked shrew (*Sorex cinereus*), the meadow jumping mouse (*Zapus hudsonius*), the meadow vole and the pigmy shrew (*Microsorex hoyi*) are known to use peatlands (Rochefort *et al.*, 2012).

The arctic shrew (*Sorex arcticus*) and the maritime shrew (*Sorex maritimensis*) are two other species that use peatland, but the site is more likely to be outside their range (Rochefort *et al.*, 2012; Mazerolle *et al.*, 2001).

4.1.8.2 BIRDS

Peatland 524 lies in an area that is known to be used by a high number of birds. Actually, birds represent an important feature of the Tabusintac region and many special status areas aiming at protecting birds are present in the bog vicinity (see Section 4.1.10). These areas aim at protecting primarily aquatic birds that nest or use lagoons, marshes, beaches and barrier islands located in the Tabusintac river estuary and offshore.

These species comprise (Ramsar, 2017; IBA Canada, 2017; K. MacKenzie, personal communication):

- Canada goose (*Branta canadensis*)
- common eider (Somateria mollissima)
- American black duck (*Anas rubripes*)
- common tern (*Sterna hirundo*)
- great black-backed gull (*larus marinus*)
- herring gull (*larus argentatus*)
- ring-billed gull (*Larus delawarensis*)
- piping plover (*Charadrus melodius*)
- spotted sandpiper (*Actitis macularia*)
- double-crested cormorant (*Phalacrocorax auritus*)
- rudy turnstone (Arenaria interpres)
- lesser and greater yellowlegs (*Trenga flavipes*, *Trenga melanoleuca*)
- semipalmated plover (*Charadrius semipalmatus*)
- sanderling (*Calidris alba*)
- great blue heron (*Ardea Herodias*)

Some of these species may occasionally use Peatland 524, especially the numerous bog ponds that are concentrated in the center of the peatland.

Data from the Second Atlas of Breeding Birds of the Maritime Provinces (Birds Canada, 2017) were consulted to compile a list of bird species that could potentially be present in Peatland 524 (see Appendix E).

The site splits between the Miramichi and the Acadian Peninsula regions and point count data from square 20LT43, 20LT53, 20LT44, and 20LT54 were used to identify bird species recorded locally. The covered area includes 103 point counts along roadside some of which located close or at the margin of peatlands. Compiled data for these squares are presented in Appendix E.

These records return 60 confirmed, 31 possible, and 32 probable bird species in point counts in the four squares for a total of 123 species. The same source reports 167 and 155 species for the Acadian Peninsula and the Miramichi region, respectively. According to these data, 48 species known to be present in the Miramichi and/or Acadian Peninsula region were not reported in the area surrounding Peatland 524. This number includes 11 bird species that had a confirmed, possible or probable status for the area in the first edition of the bird atlas.

Most birds that may use peatlands are generalist species except for the palm warbler (*Setophaga palmarum*) and the Lincoln's sparrow (*Melospiza lincolnii*) that are more closely associated with peatlands (Rochefort *et al.*, 2012). According to the second bird atlas Birds Canada (2017) the presence of these two species is possible in the area around Peatland 524. The presence of the palm warbler was confirmed in the first atlas while the Lincoln's sparrow was not reported.

4.1.8.3 HERPETOFAUNA

Friolet *et al.* (2008) report many reptile and amphibian species for the Acadian peninsula (Table 10). Although peatlands represent a hostile habitat for amphibians because acidic conditions can affect them given the permeability of their skin, some species such as the wood frog, green frog, and leopard frog as well as the American toad, the four-toed salamander and the Eastern redback salamander can use peatlands (Desrochers and van Duinen, 2006; Mazerolle, 2003). Among reptiles, the redbelly snake and the smooth green snake are found in peatlands.

Table 10 Reptile and amphibian present in the Tabusintac River watershed

ENGLISH NAME	LATIN NAME
Redbelly snake	*Storeria occipitomaculata*
Common garter snake	*Thamnophis sirtalis*
Smooth green snake	*Opheodrys vernalis*
Yellow-spotted salamander	*Ambystoma maculatum*
Eastern redback salamander	*Plethodon cinereus*
American toad	*Bufo americanus*
Spring peeper	*Pseudocaris crucifer), g*
Green frog	*Rana clamitans*
Pickerel frog	*Rana palustris*
Leopard frog	*Rana pipiens*
Wood frog	*Rana sylvatica*

4.1.8.4 SPECIAL STATUS WILDLIFE SPECIES

According to ACCDC (2016), 35 rare terrestrial wildlife species have been reported within a radius of 5 km around Peatland 524 that includes two mammal and 33 bird species. The two mammals are the woodland caribou (*Rangifer tarandus)* that is endangered at the Canadian level, but that is considered as extirpated from New Brunswick, and the Canada lynx (*Lynx canadensis*) that has an endangered status provincially. ACCDC (2016) reports one record of Canada lynx in a radius of 4 km around Peatland 524.

Among the 33 bird species, 26 are aquatic and seven terrestrial birds. Aquatic species are not likely to use peatlands although it is possible that some birds stop on bog ponds. Terrestrial species include the barn swallow (*Hirundo rustica*) and the bank swallow (*Riparia riparia*) that are not known to nest in peatlands, the bobolink (*Dolichonyx oryzivorous)*, the Canada warbler (*Wilsonia canadensis*), the olive-sided flycatcher (*Contopus cooperi*), the horned lark (*Eremophila alpestris*) and the vesper sparrow (*Pooecetes gramineus*). These species do not nest in peatlands, but they may use open habitat such as peatlands.

Out of the 35 rare wildlife species, only nine are listed under the COSEWIC or SARA or have a provincial legal status (Table 11). None of these species have peatlands among their preferred habitat, but three species, the bobolink, the olive-sided flycatcher and the Canada warbler could potentially use these ecosystems. According to data collected in the area around peatland 524 (Birds Canada, 2017), the presence of bobolink was confirmed north of the site while the presence of the olive-sided flycatcher is probable and that of the Canada warbler is possible.

The presence of bald eagle (*Haliaeetus leucocephalus*), a provincially threatened and location sensitive species has also been confirmed within a 5 km radius from the peatland.

4.1.9 AQUATIC WILDLIFE

4.1.9.1 FRESHWATER WILDLIFE

A fish and fish habitat study has been conducted during summer 2016, and detailed results are presented in a report in Appendix F. The Malpec and Lufburys Brooks that drain the bog were surveyed (Map 5).

Lufburys Brook is considered to be only bog drainage although it is affected by tidal intrusion on much of its course. It originates from a bog pond and is about 1.5 m wide and 0.5-1.0 m deep. The physical characteristics of this stream represent very poor fish habitat when compared to standard salmonid (salmon and trout) habitat metrics. The water is warm, unshaded, acidic and organic fines (peat particles) represent 100 percent of the streambed.

No fish were captured or observed through electrofishing and direct observation. If fish are present, they occur in very low numbers and would likely represent common coarse fish species such as stickleback, shiner, killifish, etc. This stream does not represent salmonid habitat and it can be stated with certainty that salmon and trout do not inhabit this watercourse. Presence of piled sticks and debris revealed the presence and activity of beavers.

The observation of fish throughout the length of Malpec Brook confirms that this watercourse represents fish habitat. Although the species of fish could not be confirmed through observation, as well as the small size and early development of the individuals, one would expect they could be stickleback, golden shiner, creek chub or banded killifish since these species occur in similar habitats in this area.

The watercourse is about 2 m wide and 0.5-1 m deep and it presents a variety of conditions. In the vicinity of the bog it reflects many characteristics of bog drainage and would represent very poor salmonid habitat. As a result, salmon and trout would not be expected to occur at this location. However, closer to the mouth of the brook, downstream beaver dams, water is free-flowing over gravel, the pH is less acidic in comparison to the other stream and this section has some of the basic characteristics of salmonid habitat. As a result, low numbers of brook trout (*Salvelinus fontinalis*) might be found at this location when water temperatures are cool.

Table 11 Wildlife species listed under the COSEWIC, SARA and New Brunswick Species at Risk Act observed or potentially present in a radius of 5 km from Peatland 524

COMMON NAME	LATIN NAME	COSEWIC	SARA	PROV LEGAL PROT	HABITAT
Piping plover	*Charadrius melodus*	Endangered	Endangered	Endangered	Sandy beaches
Woodland caribou (Atlantic Gaspésie population)	*Rangifer tarandus*	Endangered	Endangered	Extirpated	Summits Gaspésie peninsula
Bank swallow	*Riparia riparia*	Threatened	Threatened		Vertical banks
Barn swallow	*Hirundo rustica*	Threatened		Threatened	Caves, holes, crevices and ledges in cliff faces, buildings
Bobolink	*Dolichonyx oryzivorous*	Threatened		Threatened	Tall grass prairies, grassland, forage crops
Olive-sided flycatcher	*Contopus cooperi*	Threatened	Threatened	Threatened	Open areas, forest clearings
Canada warbler	*Wilsonia canadensis*	Threatened	Threatened	Threatened	Wet mix deciduous-coniferous forest with a well-developed shrub layer
Barrow’s goldeneye (eastern population)	*Bucephala islandica*	Special concern	Special concern	Special concern	Freshwater lakes
Canadian lynx	*Lynx canadensis*	Not at risk		Endangered	Boreal forest

The estuary and the bay of Tabusintac represent a spawning zone, a staging zone for migratory species and feeding zone for many fish and wildlife species given the highly productive and diversified habitat with shallow water (4 m) and extended reef areas, including 3,500 ha of eelgrass colonies, pools, sand dunes and beaches.

4.1.9.2 MARINE WILDLIFE

ESTUARIAN AND LAGOON ECOSYSTEM

Coastal salt marshes expanding along the coastline and on the bay side of the sand bars network located at the Tabusintac River’s mouth are dominated by cordgrass (*Spartina sp.),* where smooth cordgrass (*Spartina alterniflora)* often stands out accompanied by saltmeadow (*Spartina patens*).

Salt marshes support a wide variety of wildlife such as aquatic birds, mammals, and fishes that use them, especially for feeding, either at the low or high tide. At high water levels, they constitute preferential spawning and breeding sites for different fish species (Friolet *et al.*, 2008).

Mud flats, delineating salted marshes, sand dune system as well as the coastline of the Tabusintac' Bay and Estuary are submerged areas where sediment movements occur. They are, therefore, favored habitat for benthic animals such as mollusks, worms (Oligochaetes, Polychaetes, etc.) and amphipods, which in turn are food sources for shore birds and fishes.

AQUATIC VEGETATION

Eelgrass (*Zostera marina)* is widely distributed over the littoral of the Tabusintac Bay and Estuary and is the dominant species of the shallow water seagrass beds. Eelgrass meadows are an important component of the intertidal and subtidal zones because of its habitat function for fish (juvenile and adult) and invertebrates. It has been reported that approximately 80% of the Tabusintac Bay's total area is covered by eelgrass beds, thus explaining the high biological productivity of the sector (Friolet *et al.*, 2008). In eastern Canada, *Zostera marina* is considered an Ecologically Significant Species because of its key role in the nearshore marine ecosystem (Fisheries and Oceans Canada, 2012).

Plant species identified along the barrier dunes are principally represented by the following: beach wormwood (*Artemisia stellariana*), beach pea (*Lathyrus maritimus*), sea lymegrass (*Lymus mollis*), American beachgrass (*Ammophila breviligulata*), Scotch lovage (*Ligusticum scoticum*), seaside spurge (*Euphorbia polygonifolia*), star-flowered false Solomon's seal (*Maianthemum stellatum*) and sharp-fruit knotweed (*Polygonum oxyspermum*).

Among plants at risk figures the Gulf of St. Lawrence aster (*Symphyotrichum laurentianum*) (threatened SARA status) (Friolet *et al.*, 2008; Government of Canada, 2017).

Data concerning macrophytes and algal communities in the Tabunsintac region are rather scarce. The presence of any species commonly found on the East Atlantic Coast could be expected, especially companion species of eelgrass such as algae *Gracilaria folifera* and *Fucus vesiculosus* (Friolet *et al.*, 2008).

INVERTEBRATES

Tabusintac Bay is a transitional zone home to biological activities that supports a diverse and ecological richness of fauna and flora. The mix of marine and fresh water represents a dynamic and productive area. The Estuary supports the natural spawning and growth of the softshell clam (*Mya arenaria*), hard clam (quahog) (*Mercenaria mercenaria*), blue mussel (*Mytilus edulis*), American oyster (*Crassostrea virginica*) and Atlantic surf clam (*Spisula solidissima*). Besides, oyster aquaculture activities are ongoing on the north and south coast, while expansion projects and harvest of natural populations are foreseen (Friolet *et al.*, 2008; Donald Gay and Doreen Grattan-Gay, Neguac, NB, personal communication) (section 4.1.11.6). Crustaceans are principally represented by the rock crab (*Cancer irroratus*) and American lobster (*Homarus americanus*), that are commercially fished in surrounding waters, along with the grass shrimp (*Palaemonetes sp.*) and the sand shrimp (*Crangon septemspinosa*) (Friolet *et al.*, 2008).

MARINE MAMMALS

Grey seal (*Halichoerus grypus*) is known to frequent Tabusintac's dune and beaches areas. Other marine mammals observed in New Brunswick might also be present in the sector, such as harbor porpoise (*Phocoena phocoena*) (threatened SARA status), Atlantic white-sided dolphin (*Leucopleurus acutus*) and common mink whale North Atlantic subspecies (*Balaenoptera acutorostrata*) (Friolet *et al.*, 2008).

FISH

The most common fish species occurring in the Tabusintac watershed are the Atlantic salmon (*Salmo salar*), brook trout (*Salvelinus fontinalis*), striped bass (*Morone saxatilis*), Atlantic tomcod (*Microgadus tomcod*), caplin (*Mallotus villosus*), blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), rainbow smelt (*Osmerus mordax*), and American eel (*Anguilla rostrata*) (Friolet *et al.*, 2008).

Based on a four year study (2002-2005) using box traps at two sites in the Tabusintac River Estuary, Herrell and Methven (2009) showed that diadromous fishes dominated the total catch, that is: blueback herring and alewife being the most represented (41.7%), followed by striped bass (21.5%), American eel (5.3%), Atlantic salmon (4%), tomcod (3%) and brook trout (1%). White sucker, a freshwater species, contributed to nearby 12% of the catches while winter flounder *(Pseudopleuronectes americanus*), a marine species, and smooth flounder (*Liopsetta putnami*), an estuarine species, together account for 11.2% of the total catch. Finally, American Smelt, Northern pipefish (*Syngnathus fuscus*), white perch (*Morone Americana*), Cunner (*Tautogolabrus adspersus*) and Sea lamprey *(Petromyzon marinus)*, together contribute to less than 0.5% of the total catch.

Sampling of fish communities by beach seining as part of the Tabusintac Watershed Association Community Aquatic Monitoring Program (2006-2007) monitored the following taxa : Blackspotted stickleback (*Gasterosteus wheatlandi*), threespine stickleback (*Gasterosteus aculateus*), fourspine stickleback (*Apeltes quadracus*), ninespine stickleback (*Pungitius pungitius*), mummichog (Fundulus heteroclitus), silversides (*Atherinidae sp.*) and shorthorn sculpin (*Myoxocephalus Scorpius*) as well as smooth flounder, winter flounder, tomcod, Northern pipefish, rainbow smelt, striped bar, alewife, cunner and American eel, as mentioned above. Most of the specimens caught were juveniles (Friolet *et al.*, 2008).

REPTILES

Leatherback turtle (*Dermochelys coriacea*) can be found off the coasts of New Brunswick, Nova Scotia, Newfoundland and Labrador, and Prince Edward Island. The highest densities of leatherbacks are occurring on the Scotian Shelf and Slope, southern Gulf of St. Lawrence, and south coast of Newfoundland (Fisheries and Oceans Canada, 2017).

4.1.10 SPECIAL STATUS AREAS

There are many special status areas in the vicinity of Peatland 524 (Map 5). The Tabusintac river estuary constitutes a very productive ecosystem as it mixes fresh and salt water and it is protected from the Gulf of St. Lawrence by a series of barrier islands. This protection allows the development of salt marshes where colonies of eel grass established.

These rich ecosystems support large bird populations including nesting bird species and migrating aquatic birds that use it as a stopover. It provides habitat to piping plover (an endangered species protected under SARA), great blue heron, osprey and common tern.

The Peatland 524 area comprises six Environmentally Significant Areas (ESA), two Important Bird Areas (IBA), two Nature Conservancy of Canada properties, a Natural Protected Area and a Ramsar site that all aim at protecting the Tabusintac River estuary ecosystem and parts of it, and two conservation areas set apart by Scotts. Some of these sites overlap or may combine two statuses.

ESAs are managed by the Nature Trust of New Brunswick whose mission is to manage and conserve areas that have ecological, cultural, geological or recreational value. The information on ESAs was provided by the Department of Environment and Local Government (K. MacKenzie, personal communication):

→ Tabusintac River and Estuary - ESA 233: The Tabusintac River and Estuary ESA represents a coastal lagoon protected from the Gulf of St. Lawrence by dunes and barrier islands. The lagoon has several marshes dominated by eel grass that makes it a highly productive ecosystem. It is used by a wide variety of wildlife including birds and fish species such as osprey, great blue heron, Canada geese, sea-run trout, and salmon.

→ Tabusintac Blacklands/Covedell – ESA 283: This ESA corresponds to Peatland 523, a small bog located north of Peatland 524 that is eroded on its east side. It is the habitat of large nesting populations of osprey and great blue heron and used by a wide variety of waterfowl for staging and migratory stopovers. It corresponds to the Tabusintac River Class II Protected Natural Area.

→ Blacklands Sandspit @ Swinging Point - ESA 277: ESA 277 comprises beaches located on offshore barrier islands that are the habitat of the piping plover, terns, and gulls.

→ Wishart Point Marsh - ESA 281: ESA 281 comprises two marshes that were the site of rare sightings of the green-backed heron (*Butorides striatus*), european widgeon (*Anas Penelope*) and field sparrow (*Spizella pusilla*). It is a staging area for migrating waterfowl, and it has a colony of salt marsh copper (Maritime Copper) butterfly (*Lycaena dospassosi*).

→ Tabusintac Gully and Sand Spits – ESA 284: These offshore sand spits and eel grass beds are a nesting habitat for the common tern, greater black-backed gull colonies, piping plover and arctic tern (*Sterna paradisaea*). The short-tailed swallowtail (*Papilio brevicauda*) butterfly may also use the area.

→ Neguac Beach Sandspits - ESA 340: The Neguac Beach Sandspits ESA comprises barrier islands, beaches and dunes as well as a salt marsh with extensive eel grass beds. It is the habitat of great blue heron, piping plover and common tern.

Two IBAs are located close to Peatland 524. They are managed by Bird Studies Canada and Nature Canada, two conservation non-governmental organizations (IBA Canada, 2017). IBAs are sites that are identified based on criteria internationally used and recognized. They may encompass public and private land and overlap with another protection status.

→ The Tabusintac River Lagoon and Estuary IBA encompasses the class II provincial Tabusintac River Protected Area and the Ramsar site. It includes a variety of habitats such as estuarine flats, salt marshes, sand dunes and beaches, saline ponds, inshore islands and shoreline forests.

The presence of eel grass beds increases its productivity and attracts aquatic birds. It is the habitat of the piping plover, common tern, great blue heron, and osprey. The site is also used by waterfowl species including American black duck, Canada geese, teal, scaup and red-breasted mergansers (*Mergus serrator*).

→ The Neguac Sandspit IBA is composed of barrier islands and dunes that provide nesting habitat for the piping plover. It also harbors a colony of common terns and ospreys.

Nature Conservancy of Canada (NCC): NCC owns 452 ha of land in the Tabusintac Estuary area to protect sensitive ecosystems and habitat for bird species including the piping plover. It also owns a 90 ha sector within Peatland 524 that forms a small dome surrounded by trees and a small creek in the tidal zone.

The Tabusintac River Class II Protected Natural Area is an Ecological Reserve managed by the DERD. This protected area is accessible, but activities are strongly regulated within their limits (Government of New Brunswick, 2003). It corresponds to the Tabusintac Blacklands/Covedell (ESA 283).

The Tabusintac Lagoon and River Estuary Ramsar site no. 612 aims at protecting the coastal lagoon system that is sheltered from the Gulf of St. Lawrence by a barrier of beach and dune system since it was designated in 1993 (Ramsar, 2017). The Ramsar designation is granted to wetlands of international significance. This site represents a highly productive system with extensive eel grass colonies. The system is also the largest tern nesting colony and is a major shore and aquatic bird concentration area especially in the fall and spring when a high diversity of species use it during migration. The site covers 4,997 ha including parts of Peatland 524. Peat harvesting is an activity that is recognized and accepted within the site and Scotts is committed to conservation activities including a 75 m buffer zone along the coast, leaving freshwater ponds for migratory birds and restoring the site after peat harvesting.

Scotts engaged to conserve two areas covering 14 and 2 ha within Peatland 524 in answer to local concerns (Jacques Thibault, personal communication). The goal was to preserve bog pools as biodiversity islands that could eventually help site restoration.

4.2 HUMAN ENVIRONMENT

4.2.1 COMMUNITIES

Peatland 524 is situated in eastern New Brunswick near the small town of Tabusintac in the Northumberland County. The town has the status of Local Service District (LSD). Three other communities are located within 3 km of the peatland: Covedell to the west, Comeau Settlement to the southwest and Wishart Point to the north. The closest cities are Miramichi located 40 km to the southwest with a population of 17,800 and Tracadie-Sheila 20 km to the northeast with a population of 5,000.

4.2.2 FIRST NATIONS

The area of Peatland 524 is part of the Mi’kmaq traditional territory that comprises nine communities located to the east, north, and south of the province (Government of New Brunswick, 2017). The Mi’kmaq First Nation Reserve of Esgenopetitj (Burnt Church) is the closest to the site (Map 1). It has three reserves that are Burnt Church 14, Pokemouche 13 and Tabusintac 9. Burnt Church 14 located 12 km to the southwest where it occupies an area of 9.54 km^2 is the largest community with a population of 1,046 persons (Statistics Canada, 2012a).

The Mi'kmaq Nation Eel Ground 2 is located approximately 60 km southwest of Peatland 524. It occupies an area of 28.23 km^2 and has a population of 448 (Statistic Canada, 2012b). The community comprises three reserves that are Eel Ground 2, Big Hole Tract 8 (south half), and Renous 12.

The Pabineau First Nation lies 55 km to the west of Peatland 524, in the Bathurst area. It has a population of 200 including non-status Indians and non-Indians.

4.2.3 POPULATION

Specific demographic data is not available for the Tabusintac LSD; therefore population data for the Alnwick census subdivision from the 2011 census was used (Table 12). That census division englobes the area between Miramichi and Tracadie-Sheila except for the Mi'kmaq communities of Neguac and Tabusintac. According to these data, the population has decreased by 3.7 % between 2006 and 2011. The median age is 47 and 87.5% of the population is over 15 years old. The vast majority of the population (4,815) is francophone.

Table 12 Population and dwelling statistics for Alnwick Parish

POPULATION AND DWELLING INFORMATION	ALNWICK PARISH (CENSUS SUBDIVISION)
Population in 2011	5,922
Population in 2006	6,152
2011 to 2006 Population Change (%)	-3.7
Total Private Dwellings	2,404
Population Density per km^2	8.1
Land Area (km^2)	734.66

Source: Statistics Canada, 2012c

4.2.4 SERVICES

Covedell Road, which connects to Highway 11 in the community of Covedell, provides the only access to Peatland 524. A distance of 1.7 km separates the northernmost limit of Peatland 524 to Highway 11.

The closest police and fire department are located at a short distance (< 10 km) in Neguac. Health services can be provided by the Tracadie-Sheila hospital or the Centre de Santé of Neguac.

Tabusintac has a Centennial Memorial Library and a Museum that are situated directly on Highway 11.

Among other services, Tabusintac holds a farmer market on Saturdays from June to October at the community center.

4.2.5 LAND USE

Seventy percent (70%) of the land in the Caraquet ecodistict is covered by forests, and the remaining areas are occupied by wetlands (47%), agriculture lands (25%) and developed lands including roads (20%) (Government of New Brunswick, 2017). Forests of this ecoregion are dominated by boreal coniferous communities. Peatlands cover substantial areas, and they are commercially used for peat harvesting for horticultural purposes.

As of 2015, six peatlands, including Peatland 524, were used for peat harvesting between Tracadie-Sheila and Miramichi (Department of Energy and Resource Development, 2017b). Farming occurs patchily along the coast and is dominated by pasture, forage and grain production, with significant areas of blueberry cultivation.

The following activities and land use are found within the 5-km radius of study area:

- → Peatland 522, located 5 km north of Peatland 524 and east of Brantville, is another peatland currently used for peat harvesting by Scotts
- → The closest residential dwellings are located approximately 1 km west of Peatland 524, along Highway 11
- → The Tabusintac River is famous for hunting and sport fishing

4.2.6 ECONOMY

Peatland 524 is located in the northeast economic region that includes the county of Northumberland. The northeast economic region has a high unemployment rate (16.8 %) that is higher than the provincial rate (10.2%), and active population is decreasing (Ministry of Post-Secondary Education, Training and Labour, 2013). The northeast region is mostly rural and poorly diversified economically. Its main activities are agriculture, forestry, fishing, and mining. Primary and secondary sectors account for only 11.6% of jobs as of 2012. The rest is dominated by the service sector.

According to 2011 census data for Hardwicke, a comparable census subdivision[2], and the province of New Brunswick (Statistics Canada, 2013a and 2013 b) the median income in 2010 for the population aged 15 years and over was $23,497 for the Hardwicke subdivision compared to $26,582 for New Brunswick. The median family income was $54,533 for Hardwicke and $65,384 for the province.

Locally, commercial fishing represents an important activity since the McEachern wharf located in Tabusintac harbored 69 fishing boats in 2004 and the value of catch reached $2.5 million (Friolet *et al.*, 2008). There were 30 aquaculture leases in the Tabusintac Bay for oyster culture in 2004.

4.2.7 AREAS OF INTEREST

The area around Peatland 524 is widely used by birders, fishermen, hunters and natural scientists. The Tabusintac River estuary and the associated sand bars and barrier islands that protect it from the Gulf of St. Lawrence have been recognized for their high ecological value. The site was designated as a wetland of international importance under the Ramsar convention in 1993 because it supports major water bird concentrations during fall and spring migration. This recognition, as well as the numerous conservation zones in the area, attracts many visitors who come to observe wildlife.

The Tabusintac Watershed Association is a local organization that was founded in 1998 to maintain the ecosystem in a healthy state through the realization of diverse projects in collaboration with local stakeholders and governmental organizations.

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2 Statistic Canada has no data on income for the Alnwick subdivision.

4.2.8 HISTORIC LAND USE

The proposed site lies within the traditional Mi'kmaq District of Gespegeog that comprises Chaleur Bay and the coastal region of New Brunswick, which is one of the seven districts of the Mi'kmaq territory (Government of New Brunswick, 2017).

For 4,000 years, the Mi'kmaq or their ancestors had settlements at the mouths of the Tabusintac, Tracadie, and Pokemouche rivers where they fished, gathered shellfish and hunted seabirds and sea mammals. A French explorer established a short-lived fishing and fur trading post on Miscou Island in 1645. About 80 years later, French immigrants formed a permanent settlement at Caraquet.

They were subsequently joined by Acadians returning from exile in the 1760s and, later, by people from the province of Québec. The various communities that evolved along the coast relied on fishing and farming for their livelihood. Logging was facilitated by the river (Government of New Brunswick, 2017).

A request to Archeological Services Branch of the Department of Tourism, Heritage and Culture returned no archeological record within the area targeted by the expansion project, but a historical cemetery is present in the vicinity between Peatland 524 and Highway 11 (Appendix G; Map 5).

The absence of records does not mean the absence of archeological sites and watercourses and confluence present a high potential for such sites.

5 SUMMARY OF ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

5.1 HYDROLOGY

5.1.1 SURFACE WATER REGIME

Ditch construction associated with the development of Peatland 524 created a structured drainage network over approximately 374 ha of peatland. The ditch network pattern had been planned in a way that minimized modifications in the respective water contribution of the areas under development to the various watersheds. As such, following ditch network completion of the current operation, 537 and 430 ha of peatland now drain towards Malpec and Lufburys Brooks watersheds, respectively compared to 512 and 411 ha before drainage. A remaining 605 ha of peatland directly drain to the Gulf of St. Lawrence or French Cove that is 44 ha less than at the original state (649 ha). The variation in the aerial extent of peatland located within one watershed or the other as a result of peat drainage was, therefore, equal to 4.9% and 4.6%, respectively for Malpec and Lufburys Brooks. When considering the entire watersheds extent, peat drainage resulted in a variation of only 3.3% and 4.3% of their respective area, and thus of their respective water input to the corresponding stream.

The proposed expansion will extend the ditch network over an additional 304 ha of peatland. Drainage for the expansion is again planned in a way that will maintain and comply as much as possible with natural flow directions and contributions to the local streams. Upon completion of the expanded ditch network, approximately 543 and 403 ha of peatland will drain towards Malpec and Lufburys Brooks watersheds, respectively. A remaining 626 ha of peatland will directly drain to the Gulf or Cove. The variation in the aerial extent of peatland located within one watershed or the other as a result of peat drainage will, therefore, be equal to 6.0% and -1.9%, respectively for Malpec and Lufburys Brooks, with respect to natural conditions. When considering the entire watersheds extent, peat drainage for the proposed expansion will result in a variation of 4.1% and -1.7% of their respective natural area. The difference in water input from Peatland 524 to the two streams will thus be insignificant. The difference in water input to the Gulf or Cove is negligible, considering the size of these waterbodies.

Hydrological water budget of Peatland 547 was carried out to quantify potential changes to naturally-occurring water fluxes. Monthly runoff was estimated using the method of Thornthwaite (1948), which allows calculation of potential and actual evapotranspiration based on climatic data and latitudinal location. The difference between precipitation and actual evapotranspiration are distributed between surface runoff and peat water table recharge.

Quantification of potential evapotranspiration (PET) in undisturbed conditions yielded a value of 545 mm/y. Validation of this figure was performed 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/y over an undisturbed New Brunswick peatland. Close conformity between the two results validated the use of the Thornthwaite method.

Average yearly precipitation range at about 1,072 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, there is a net natural water output of approximately 527 mm/y to the local watersheds. Water output would essentially take the form of subsurface acrotelm flow from the peatland and towards its periphery. Some surface runoff oriented in the same directions could as well take place on a time-specific and point-specific basis.

Water budget for disturbed conditions considered a maximum readily available soil water supply of 225 mm for the peat deposits, in accordance with the storage capacity of peat 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). In addition, snow storage depletion and subsequent contribution to runoff were modeled to reproduce the spring freshet timing and evolution of nearby Southwest Miramichi River, based on hydrological data recorded at hydrometric station 01BO001 at Blackville (Environment Canada, 2017).

Field measurements carried out by Gemtec Limited (1991) in Peatland 509 showed that equivalent surface runoff coefficients with respect to incident rainfall were systematically lower than 0.2. 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.

The estimated monthly runoff pattern from Peatland 524 upon reaching its full development is presented in Figure 4. Runoff quantities are also presented in the form of specific runoff per unit hectare of mined peatland.

Water budget assessment for both natural (undisturbed) and developed (disturbed) conditions shows that 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 taking place in previously wet conditions. However, this should have only limited effect on water availability for evapotranspiration, as 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 in relation with development activities should thus have limited impact on actual global evapotranspiration at the field scale.

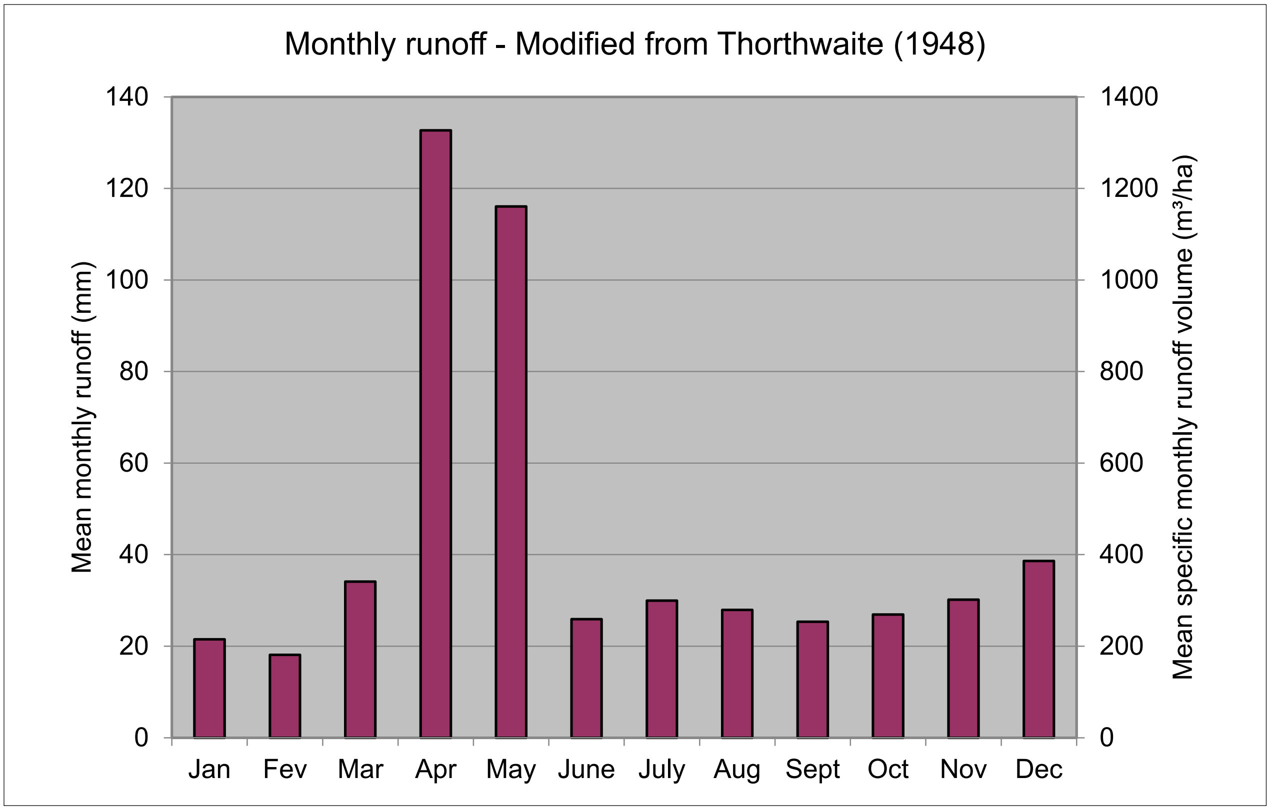

Figure 4 Estimated monthly runoff in harvest areas for Peatland 524

Ditching will affect the rate and timing at which water drains away from the bog. Water discharge at the network outlets will initiate infiltration, subsurface hypodermic flow, and overland flow, the latter decreasing as water will move away from the release points until becoming non-existent. Hence drained water will essentially be reintegrated in the natural subsurface flow system. Drainage network outlets will be installed at a minimum distance of 30 m from the nearest watercourse to prevent runoff from reaching the natural surface drainage network.

No drainage water or surface runoff from Peatland 524 harvest fields will discharge to Malpec Brook. Natural hydrological regime of the stream will thus be maintained, and no significant modification is expected on the intensity or timing of spring freshet or peak flows in response to rainfall events. Consequently, peat harvesting within Malpec Brook watershed will have no significant impact on naturally-occurring erosion and sedimentation processes within Malpec Brook or its tributaries.

No drainage water or surface runoff from the proposed expansion will discharge in the Gulf of St. Lawrence nor French Cove. Indeed, all network outlets will be located at least 100 m away from the nearest shoreline, including all diffuse overland flow discharge points. No significant impact are expected regarding water input, shoreline erosion or sediment deposition in these waterbodies, as a result of peatland water discharge in areas draining directly to the Gulf/Cove.

Construction of the ditch network in the eastern part of the proposed expansion will require the diversion and realignment of the upper reach of Lufburys Brook. Stream water will be re-routed via the main ditch that runs along the southeastern and eastern edge of harvest zone #2 (see Map 3). Collected water will then discharge to the sedimentation ponds at the downstream end of harvest zone #2. As for other sedimentation ponds, water outflow will take the form of diffuse overland flow at the pond's downstream end. Water will then reintegrate the natural flow system via infiltration and subsurface runoff, and may subsequently discharge to the lower reach of Lufburys brook. As a result, there will be no net water loss for Lufburys Brook watershed as a whole.

The unaltered portion of the brook located upstream from the sedimentation pond outlets of harvest Sector 2 (Map 3) will experience a reduction of its mean discharge rate, as well as its peak and low flows. This reduction will be in exceedance of a factor of 2. This will be favourable to an increase in the natural sedimentation taking place in this portion of the brook. The impact of stream diversion and realignment on the upstream unaltered portion of Lufburys Brook will thus have a high intensity on the hydrological regime of the upstream portion of the watercourse, and will be permanent in duration.

Downstream from sedimentation pond outlets of harvest zone # 2, the mean discharge rate in Lufburys Brook will not display significant change with respect to its unaltered regime. The magnitude of peak flows as well as flows in the higher range will decrease, as a result of the partial diversion. As well, the timing of peak flows will be delayed compare to natural conditions due to temporary retention within the sedimentation pond and discharge in the form of diffuse flow. Natural erosion processes within the brook's lower reach should decrease in magnitude as a result of lower high flows, while sedimentation processes may increase. Considering the flat local topography and generally low flows prevailing in the stream, the hydrological impacts in the downstream reach of Lufburys Brook are expected to be non-significant.

Watercourse crossings along the peatland access roads will be designed to accommodate the local peak flow of Malpec and Lufburys Brooks at the position of the crossings. The required waterway opening will be determined in compliance with applicable New Brunswick guidelines. Crossing construction will follow the *Watercourse Alteration Technical Guidelines* of the Department of the Environment. No temporary/permanent flow interruption or water diversion to another stream will take place during or after crossing construction.

5.1.2 SURFACE WATER QUALITY

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

Close to 80% of the proposed expansion's harvest fields will drain to the ditch network discharging into sedimentation ponds, where the bulk of the transported suspended solids (essentially peat particles) will be able to settle. That proportion includes all harvest fields located within Malpec or Lufburys Brooks watersheds, where drainage water may eventually reach one brook or the other. Subsequent discharge from sedimentation ponds will take the form of overland flow to adjacent undisturbed vegetated lands, which will allow the settling of residual peat particles. This technique has proven to be efficient at limiting the impact on water quality (Thibault, 1998). It has been implemented and tested at many harvested peatlands in New Brunswick.

The combination of the two suspended solids management approaches will ensure efficient peat particles interception. Considering the relatively flat topography down-gradient from the final release points and the space between such points and the nearest watercourse (≥ 30 m for ponds 3 and 4, ≥ 50 m in most cases), no significant discharge of suspended solids to the local streams is expected.

The portion of the proposed expansion that will directly drain to and discharge at outlets of diffuse overland flow (no sedimentation pond) is located in a sector with no distinct stream flow. Settling of peat particles will take place away from the outlet as flow velocity decreases. Vegetation and micro-topography will also contribute in trapping peat particles in the close vicinity of the outlet. Local surface gradient, the thickness of the organic terrain and receiving area available for particles deposition down-gradient from the outlets will comply with applicable guidelines for overland flow drainage discharge (Thibault, 1998). Also, the minimum buffer zone width between these outlets and the nearest receiving water body (Gulf of St. Lawrence) will be extended to 75 m to provide additional settling area as a mitigation measure. On the basis of these considerations, no significant discharge of suspended solids to a down-gradient waterbody (Gulf of St. Lawrence) is expected as a result of diffuse overland outflow.

Peat drainage water released to lands surrounding the proposed expansion’s harvest fields will display a high acidity. Arsenic, aluminum and iron concentrations of peat drainage water may also be above CCME criterion 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 in progressively increasing the pH of water discharging from the peatland. As the discharging water becomes less acidic, aluminum and iron concentrations will tend to decrease (Shotyk, 1998).

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 as a result of peat field drainage (Thibault, 1986).

Both Malpec and Lufburys Brooks flow over areas covered by peat deposits in their natural state. It is likely that waters of Lufburys Brook display the same chemical signature as that documented for Malpec Brook.

The fact that pH measured in Malpec Brook is in the same order as that measured in the waters of the sampled sedimentation pond suggest that peatland drainage discharge will not have any long-term impact on the acidity of down-gradient streams once the initial drainage of more acidic water has been completed. There may be an impact on the metals and ions content of stream waters in response to peat drainage discharge. However, water discharged at the network outlets will reintegrate the local subsurface flow system, where it will mix with peat water from unaltered areas. Aside from the strict mixing, concentrations in these waters will then further evolve from the contact and flow through the unaltered peat in response to the prevailing biochemical conditions. The resurgence of these waters will take place some distance (≥ 50 m) from the stream. As no direct discharge to the streams will take place, the impact on the chemical content of receiving stream waters is expected to be non-significant.

The same conclusion can be extended where resurgence takes place directly in the Gulf of St. Lawrence in areas down-gradient from diffuse overland flow outlets.

Reduction in the magnitude of Lufburys Brook higher flows may favour seawater inflow in the lower reaches of the stream, in periods of high-magnitude tides. However, it is under conditions of lower stream flow that seawater penetration will reach the greatest distances inland and have the greatest impact on the saline content of stream water. No significant change is expected in the stream's low flows as a result of peatland drainage expansion. Therefore, the global impact of seawater inflow/penetration on the stream water's saline content should not be significantly modified by the proposed expansion.

5.1.3 MITIGATION MEASURES FOR SURFACE WATERS

In accordance with the Approval to Operate I-8981 that was delivered to Scotts for Peatland no. 524 – Tabusintac (Appendix A), a series of measures will be implemented in order to limit impact on surface water quality.

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. In most cases, both measures (sedimentation pond + diffuse overland flow) will be used. No water discharge will occur within 30 m of a watercourse ensuring adequate filtration of drainage water.

As a result of particle settlement that will take place inside sedimentations ponds, these structures will actively contribute to the reduction of suspended peat content in discharge water. In addition, their outlets will be designed and built in a way that induces diffuse water flow through the existing vegetation, upon water discharge. Temporary retention of water inside ponds will also have a positive effect on 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.

Scotts proposes combining the two methods in all areas where drainage water may eventually reach a downstream brook. This, therefore, includes harvest fields of the proposed expansion located within the Malpec or Lufburys Brooks watersheds. In addition, a combination of the two methods will also be implemented in all other areas where access for the maintenance machinery is not an issue. All in all, close to 80% of the proposed expansion's area will drain towards outlets where both mitigation methods are implemented. In drainage subnetworks where diffuse overland flow will be the sole method for managing water and peat particles at the outlets, the receiving areas left intact for peat deposition will have an increased buffer width of at least 75 m, with respect to the nearest down-gradient receiving waterbody.

Scotts will regularly inspect ponds and outlets to insure that they are in good order and functioning properly. In the event that 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 the proposed expansion's discharge points will be the subject of regular monitoring, starting upon the beginning of construction and fields opening, and taking place until the restoration phase. Environmental monitoring will include analysis of water quality at selected drainage network outlets, including sedimentation ponds outlets (see 5.10 Monitoring Program).

Progressive opening of the harvest fields also represent another mitigation measure, as it limits the area under harvesting to a minimum, as well as the ensuing effects.

Mitigation measures primarily related to surface water flow include progressive restoration of the harvest fields, once harvesting will be completed in a given area. This will allow 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). Creation of open waterbodies 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.

A series of mitigation measures aimed at reducing impacts of access road construction will be implemented based on the *Guidelines for Road and Watercourse Crossings* (Department of Natural Resources, 2004). Such measures target preventing erosion 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 banks erosion.

5.2 HYDROGEOLOGY

5.2.1 GROUNDWATER REGIME

The two types of groundwater are considered:

→ Groundwater of the local aquifer, which is contained within the Paleozoic bedrock

→ Perched groundwater contained in the peat deposits

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 as a result of the proposed peat development expansion. No significant impact on the availability of groundwater for local down-gradient users is expected. No impact is expected on groundwater availability for local users installed up-gradient from the peatland.

Ditching and drainage activities will result in the lowering of the water table in the harvested deposits. The lowering of the water table will take place during the construction phase and will be 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 as the majority 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 that will be left after peat harvesting has ended will remain saturated and will 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 waterbodies are created. It is expected that residual impact on peat deposits groundwater will be low.

5.2.2 GROUNDWATER QUALITY

Peat harvesting does not involve the use of chemicals or other hazardous material except for 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 would allow efficient containment before appropriate clean-up, and restoration procedures would further mitigate the associated negative impacts. Moreover, peat has the property of absorbing oil and other petroleum products, and it is used to clean oil spills. Hence, no chemicals or other hazardous materials may be released into the surrounding environment.

No impact is expected on water quality in the bedrock aquifer. Hence, no alteration to the quality of groundwater that may be utilized as 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. The residual peat layer that will remain in place after the end of operations will remain saturated, and a superficial water table will be maintained in the harvest areas. Progressive restoration will induce a rise of 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.

Operations of petroleum products transfer and handling will be executed away from any watercourse and with dedicated equipment aimed at adequately preventing and managing any spill. If an accidental spill occurs outside of these areas, the execution of emergency response procedures would 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 FLORA

5.3.1 IMPACT

Peat field preparation involves the clearing of trees and peatland vegetation from peat fields and access roads that result in an important impact at the site level. Peatland 524 is a typical bog of the coastal region of New Brunswick (Region 1 *sensu* Keys and Henderson, 1987) in regards to plant communities. These habitats and plant communities are not threatened by the project locally or regionally since they exist in the buffer zone, the 565 ha will remain at their natural state and in other nearby bogs including Peatland 523 and 525. Consequently, no loss of exceptional habitat is expected. Part of these plants will be used as donor material for the restoration of closed fields.

The southern twayblade is the only species that has a legal protection status observed in Peatland 524. It was found at the northern margin of the peatland in a zone that will not be developed. Moreover, peat fields adjacent to that area are closed and will be restored in the mid-term providing additional protection to the southern twayblade population through the return of peatland conditions, including the hydrological regime and a peat bog plant cover.

The other rare species that were reported by the vegetation survey are all listed as secure in New Brunswick (Table 8). The bog birch, the northern-yellow-eyed grass, the russet cotton-grass and the cloudberry were recently found in another peatland. Cloudberry was found in all surveyed sectors of the peatland suggesting that it is also present in sections of the peatland that will remain untouched. These observations support the fact that these species may be more common than expected and would not be threatened by the project. The presence of the white-fringe orchid inside and outside the area to be developed suggests that populations of this species will be maintained locally during the operation phase and will facilitate the recolonization the site after it is reclaimed.

5.3.2 MITIGATION MEASURES

The reclamation plan described in Section 3.6.5 represents the main mitigation measure in regards to flora and habitat. The long-term goal of the reclamation plan is to restore wetland ecosystems currently present in the area. In the short term, specific objectives of the three reclamation options are to re-establish a plant cover and to restore the hydrological regime. Meeting these two objectives should eliminate most impacts of peat harvesting on flora and vegetation.

The plan includes three options that are Sphagnum Revegetation, Forest Habitat, and Open Water, which address specific conditions anticipated at the cessation of peat harvesting. In all cases, the reclamation plan will lead to the re-establishment of peatland plant communities as well as the habitat diversity that already exists locally:

- → Sphagnum revegetation corresponds to typical peatland plant communities such as open areas
- → Forest habitats are found at the bog margin
- → Open water should lead to the creation of bog ponds that are numerous in the peatland. Bog ponds are characterized by floating mats and specific plant communities, and are considered as biodiversity hot spots

Methods used for Sphagnum Revegetation and Forest Habitat have been applied for years in New Brunswick, and they return a high success rate. Recent research demonstrated that the Moss Layer Transfer Technique ensures the re-establishment of bog plant communities within ten years (Poulin *et al.*, 2012). Tree plantation in areas unsuitable for Sphagnum Revegetation will create forest stands that may evolve toward laggs that are transitional habitats between peatland and upland and that contribute to conserve peatland integrity. In the case of pond creation, approaches are being developed and it is expected that successful restoration methods for bog ponds will be available at time of reclamation of the expansion area and will improve the ecological value of created ponds. The best available techniques will be applied at time of reclamation works.

Scotts will rehabilitate peat fields within three years following cessation of peat harvesting when possible. Such progressive reclamation will minimize the surface devoid of vegetation at any time and maximize the presence of vegetated areas.

Conservation areas and buffer zones will also be preserved within the peatland. A total of 565 ha will remain at their natural state that includes zones protected by Scotts (16 ha) and Nature Conservancy of Canada (90 ha), borrow areas (75 ha), and areas that will not be developed in the center as well as at the margin of the bog (383 ha).

These natural areas comprise the three main habitats that are open bog, forested wetland and ponds. Habitats found at bog margin are often the site of rare species as it is the case for Peatland 524 with a southern twayblade population located north of the peatland in a zone between closed fields and the peatland limit. These areas that will remain untouched will ensure the presence of the different habitats all along the project and will serve as sources of seeds and propagules that will help the revegetation process.

Based on the anticipated initial impact and the proposed mitigation measures, it is estimated that the residual impact of the project on vegetation and rare plant species will be low.

5.4 TERRESTRIAL WILDLIFE

5.4.1 IMPACT

Peat field preparation will disturb wildlife and result in a loss of habitat and disturbance of mammals, birds, and herpetofauna at the site level. Since the habitat types that will be affected are well represented in other peatlands locally and in the 565 ha will remain at their natural state within Peatland 524, there will be no loss of exceptional habitat and the impact can be considered as a temporary contraction of habitat between field development and reclamation. Peatland 523 that is adjacent to Peatland 524 to the north is protected as part of an Ecological Reserve and an Environmentally Significant Area. To the south, Peatland 525 represents another site that provides wildlife habitat. It covers 321 ha and most of it should remain in its natural state since it offers little potential for commercial harvesting because of shallow peat and multiple owners. The presence of these two peatlands in direct contact with Peatland 524 along with conservation and undeveloped areas within the bog will serve as refugee for wildlife and favour the return of wildlife species following reclamation as do natural bog remnants at the periphery of harvested areas (Mazerolle *et al.*, 2001).

The impact will be temporary because the site will be reclaimed following peat harvesting. Reclamation usually begins by fields located at the margin of a peatland where peat is shallower as it is the case for Peatland 524. These reclaimed fields will progressively provide habitat and be colonized by wildlife living in adjacent natural areas and buffer zones.

The area around Peatland 524 comprises habitats for various bird species including aquatic bird colonies. These habitats comprise lagoons, marshes, beaches and barrier islands located in the Tabusintac River estuary and offshore at some distance from the proposed development and most of them are already protected. Aquatic species are not known to utilize peatlands except for bog ponds that may be used for staging on an occasional basis. The development plan was designed to minimize encroachment on ponds that will leave open waterbodies available for birds. The passage of migratory birds species in spring and fall correspond to periods of low intensity of harvesting operation. There has been no record of impact by the current operations. Consequently, the potential impact on these species and habitats should be low.

5.4.1.1 SPECIAL STATUS SPECIES

According to Rochefort *et al.* (2012), no vertebrate species is restricted to peatlands. However, these ecosystems are used by a variety of species including rare species. Among the nine special status species that were reported to be present within a 5 km radius around Peatland 524, only four can potentially use peatlands, the Canada lynx, the bobolink, the olive-sided flycatcher and the Canada warbler (Table 11). The Canada lynx was observed locally, but its preferred habitat is a forest. Given the low abundance of small mammals and the absence of snowshoe hare, its favorite prey, in peatlands, the Canada lynx is not likely to use Peatland 524 and be affected by the project.

According to data collected in the area around Peatland 524 (Birds Canada, 2017), the presence of bobolink was confirmed north of the site while the presence of the olive-sided flycatcher is probable. These two bird species are associated with open areas such as open bog, but their preferred habitats are crop fields, grassland, and prairies in the case of bobolink and forest clearings for the olive-sided flycatcher. These habitats are abundant locally since the landscape around Tabusintac is a mosaic of agricultural fields and forested areas. As these sites are more likely to attract the two species compare to peatlands, it is considered that the impact of the project on bobolink and olive-sided flycatcher is low. The situation is similar for the Canada warbler that prefers forested habitat with openings or disturbed forest with a dense layer of shrubs or regeneration.

5.4.2 MITIGATION MEASURES

The implementation of the reclamation plan represents the main mitigation measure in regards to wildlife. The return of typical bog plant communities and ponds will restore wildlife habitats that are used by mammals, birds, and herpetofauna on an occasional basis. It is considered that the conservation of 565 ha within the bog limit including numerous ponds and the presence of undeveloped peatland in the surrounding area are sufficient to maintain wildlife population locally, which will subsequently re-colonize the peatlands during the reclamation process.

Based on the anticipated initial impact and the proposed mitigation measures, it is estimated that the impact of the project on wildlife and rare wildlife species will be low.

Any observation of special status wildlife species will be reported to the New Brunswick Department of Environment.

5.5 MARINE WILDLIFE

5.5.1 IMPACT

The main source of impact to marine wildlife comes from peat particles that are released into the environment either to the atmosphere or water. These emissions may have an influence on water quality, bottom sediment composition and aquaculture in the marine environment. However, these impacts need to be evaluated in a context where other abiotic factors influence overall environmental conditions.

Peat harvesting activities influence marine water quality in a way that can hardly be compared to the impact of other land use (Jarvet and Pärn, 1995). Peat harvesting operation influences marine water quality by inducing higher concentration of total organic carbon and phosphorus, and by favoring acidification.

Moreover, suspended solids can be a vehicle for many contaminants as well as heavy metals deposited in the environment, and they can potentially alter physical and chemical characteristics (Ouellet *et al*., 2006). Bioaccumulation of some metals, such as mercury, has been associated with dissolved organic carbon which could be related to the discharge of dissolved organic matter from bogs into the watershed (French *et al*. 1999). However, studies conducted in the Richibucto River area concluded that although an elevated level of mercury is present in peat particles, bioaccumulation of mercury in the marine biota does not necessarily occur (Surette *et al*., 2002).

The release of a significant amount of suspended solids in rivers, estuaries and coastal areas could modify the composition of the bottom sediments. Hence, the deposition and mixing of peat particles with the original bottom substrata can change the characteristic of the benthic habitat. Benthic organisms live in close relationship with the bottom sediment, and modification of the physical characteristics of the substrata will affect the benthic community composition. Consequently, changes in substrata type could trigger modifications in population dynamics of invertebrates groups, which constitute the base of the food chain (Ouellet *et al*., 2003). Suspended solids released by peat harvesting mix with those coming from rivers, estuaries and from coastal erosion that is an important process along the coast of New Brunswick. Coastal erosion is a natural process that has been active for centuries, and the marine environment is already adapted to the presence of peat particles.

Resuspension processes have a major influence on food availability and quality for filter feeder organisms. A large quantity of suspended solids in watercourse can cause a decline in filter feeders, such as oysters because sediments obstruct their feeding mechanisms. An experiment showed that the higher the concentration of the organic particles, the more the absorption capacity of oysters (*Crassostrea virginica*) was reduced due to the dilution of particles easily assimilated by the species (Strychar, 1997). However, oyster is well known to tolerate a naturally high turbidity level and has adapted a filtering mechanism to separate inorganic particulates from food in suspension. Oyster prefers a suspended sediment concentration range between 6 and 700 mg/L and selectively retains particles with highest nutritional value. This means that suspended particles may have an impact on culture only at a specific concentration. Also, Daigle and collaborators showed in experimental conditions (limited context), that concentrations of peat particles higher than 20 mg/L had no effect on the oyster's physiology, reproductive development, and survival (Daigle *et al.*, 1995).

5.5.2 MITIGATION MEASURES

The main source of the impact of peat harvesting on marine wildlife results from the emission of peat particles either in surface water as suspended solid or to the atmosphere. Hence all mitigation measures that aim at reducing peat particle emission contribute to reducing the effect on the marine environment.

Sedimentation ponds and diffuse overland flow represent two efficient ways to trap peat particles that are transported by surface water. In 11 of the 20 discharge point of the proposed expansion, both methods will be combined for a more effective trapping of peat particles. At the remaining nine discharge point, drainage water will be diffused overland through the vegetation. This represents the preferred and most efficient method. Scotts will respect the design criteria as described in Thibault (1998).

Overland flow also reduces the rate of dissolved organic matter by 15 %, nitrogen by 70 % and phosphorus by 75 % (Selin, 1996). Scotts has modified its development plan to leave a larger buffer zone to maximize the filtration of drainage water before it reaches watercourses.

A series of mitigation measures will also be implemented to reduce the emission of peat dust in the atmosphere. These measures, which are described in the following section, comprise the conservation of treed and buffer zones. As for overland flow, the development will incorporate larger buffer zones that will allow deposition of a greater quantity of peat dust within the project limit. The mitigation measures also include:

- → The use of two-headed vacuum harvesters equipped with a device that directs peat dust toward the ground to reduce dust emission and transportation
- → Limiting peat harvesting and handling operations in the presence of strong winds, and
- → The used of tarpaulin covered trailers for peat transportation

The implementation of mitigation measures will reduce the emission of peat particles by peat harvesting operations and should not result in significant impact on aquaculture. These measures will also limit the potential impact on marine environment and wildlife to a low level.

5.6 AIR QUALITY

5.6.1 IMPACT

There are few local sources of air contaminant in the Tabusintac area. According to Friolet *et al.* (2008), air quality in the Tabusintac area is representative of that of the province, but it may be influenced by emissions from industry and a power plant in Miramichi.

Peat harvesting can be a source of airborne particles and may raise some concerns. Harrowing, vacuum harvesting, handling and transportation operations can all potentially result in the emission of peat particles into the air. The wind can transport these particles in the surrounding area where they will deposit and represent a nuisance and affect human health and activities. Vegetation, wildlife, and watercourses can also be affected by peat particle deposition. Concerns were raised during the public consultation about such impact.

The use of tractors and other vehicles is also a source of pollutants that can affect global air quality and represent a nuisance, locally, for nearby residents.

5.6.2 MITIGATION MEASURES

Scotts intends to apply to the proposed development the measures aiming at mitigating the impact on air quality that is implemented in the currently harvested portion of Peatland 524 in accordance with the Approval to Operate I-8981 (Appendix A). They include:

- → Use of vacuum harvesters with equipment to reduce dust emission during the peat extraction (see 3.6.2.2)
- → Limited vehicle speed especially on access roads

- → Transportation of peat into tarpaulin-covered trailers
- → Orientation of peat stockpiles in such a way to reduce their exposition to wind
- → Cover peat stockpiles with tarp
- → Limited 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 and 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 part of reclamation either by establishing a sphagnum carpet (Sphagnum Revegetation) or by planting trees (Forest Habitat) to stabilize bare peat surfaces and prevent further generation of peat dust by the wind

It is considered that the impact to off-site receptors should be minimal and localized following the implementation of these mitigation measures.

5.7 OTHER IMPACTS

5.7.1 SOIL QUALITY

Peat harvesting developments have an impact on soils since the main activity consists in collecting the soil. Peatland soils are not comparable to mineral soils since they are made of more or less decomposed plant remnants, and they can regenerate over time. Nonetheless, peat harvesting has a limited impact on soil quality because a 50 cm layer of peat will be left in place at the cessation of activities. The remaining peat usually has bog chemical and physical properties that will help recreate bog conditions and allow the re-establishment of peatland plant communities (Gonzalez and Rochefort, 2014). The return of peatland plant species will ensure the return of soil properties including carbon sequestration (Waddington *et al.*, 2010; Strack and Zuback, 2013).

Other potential impacts on soil quality arise almost exclusively from leakage or spills of petroleum products related to the use of mechanized equipment for peat harvesting. Peat harvesting does not involve the use of other chemical products. If a spill occurs, it will affect a limited area, especially because dry peat soils have the potential to absorb hydrocarbon rapidly, which prevents the contaminant’s spread and potential of reaching watercourses. The measures aiming at mitigating the impact on soil quality that are implemented in the currently harvested portion of Peatland 524 in accordance with the Approval to Operate I-8981 that was delivered to Scotts will be applied to the proposed expansion. Petroleum products will be stored in a storage system, contaminated soil and waste oil will be disposed of in a manner acceptable by the DELG.

5.7.2 WORKER HEALTH AND SAFETY

Exposure to peat dust and the risk of work-related accidents are the main source of potential impacts about workers health and safety. Scotts intends to implement existing mitigation measures that are in place for the current peat harvesting operations to reduce the likelihood of potential impacts, which includes dust control measures and use of tractors with air-conditioned cabs to reduce workers' exposure to peat dust. Appropriate safety equipment and training are also provided for workers.

The site manager keeps records of all incidents and implements appropriate prevention measures. Hygiene and safety policy is applied at all time and in the case of emergency.

5.7.3 CLIMATE

Peatlands play a role in global climate by sequestering large amounts of carbon in the form of plant debris that constitute the peat and that contribute to reducing the greenhouse effect (Chapman, 2002). It is estimated that peat accumulates at a rate less than 1 mm/yr thus storing 68 g/m^2/yr of carbon (Rydin and Jeglum, 2006). At this rate, carbon sequestration in a single bog is negligible, but it becomes significant considering that peatlands cover 113 million hectares in Canada (Daigle and Gautreau-Daigle, 2001).

As of 2015, 29,750 ha corresponding to 0.03 % of the total peatland area had been used by the Canadian peat industry, and a significant proportion of this area had been restored by the moss layer transfer technique (Canadian Sphagnum Peat Moss Association, unpublished data). At a local scale, the impact of the proposed project will be mitigated by the reclamation plan, which will resume carbon storage as peat (sphagnum restoration), and wood (tree plantation). Research has shown that peatlands start sequestering carbon six to ten years after sphagnum restoration work thus re-establishing the carbon sink function. Moreover, the harvested peat may be used for tree production, since every year over 150,000,000 tree seedlings that contribute to Canada's reforestation efforts are grown in peat substrate. Hence, no significant impact is expected on global climate.

Peatlands influence microclimate conditions in two ways. Peatland vegetation determines the albedo and is responsible for evapotranspiration, two processes resulting in localized cooling effect (Rydin and Jeglum, 2006). Second, the typical hummock-hollow microtopography induces a non-uniform snow distribution. The resulting 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 that rely 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. Re-establishment of peatland vegetation, tree cover and overall bog conditions following progressive reclamation will return harvested sites to pre-development conditions regarding micro-climate.

5.7.4 FIRE

Drying caused by the drainage and surface preparation of the fields increases surface peat flammability. The contact between dry peat and hot parts (engine exhaust) of machinery that is used for peat harvesting and other operations may initiate fires whose proportion may vary widely according to prevailing wind speed and direction.

Hence, fire represents a risk for the peat resource and Scotts will apply to the expansion area a series of measures aimed at reducing the risk of fire and controlling peat fires, which are already implemented on the current operations and that include:

- → Presence of mobile water tanks in the fields
- → Most harvesting equipment equipped with extinguisher and portable water tank
- → Workers trained for firefighting
- → Close monitoring of harvesting operations in dry and windy conditions
- → Stopping of harvesting operations in extreme conditions

5.7.5 NOISE

The noise generated by machinery and the diverse operations may potentially affect nearby residents as revealed by some concerns that were raised during the public consultation. The conservation of treed buffer zones between the developed peatlands and nearby settlements should limit the impact of noise. Moreover, truck drivers are asked not to use Jacob brakes and harvesting operations will be restricted to the 7 am to 9 pm period. Scotts will collaborate with residents in identifying the source of such problem and developing solutions.

5.7.6 ROAD TRAFFIC

The *Peatland 524 Expansion Project* will increase traffic on public roads, especially on Covedell Road and on Highway 11. The number of transports of peat harvested at Peatland 524[3] is currently estimated at 1,400 per year that represents six transports/day, five days/week over the entire year (50 weeks). This number will increase to 3,750 per year or 15 transport/day. Trucks will leave the Covedell plant and travel south on Highway 11 in order to reach Highway 8 in Miramichi. The addition of 9 transport/day should not have a significant impact on current road traffic.

5.8 CUMULATIVE IMPACT

Impacts from other human activities may combine and result in higher impact values than would otherwise be expected from an individual project. As such, cumulative impacts may arise from the proposed expansion of Peatland 524 in combination with the presence of current operations at the site and the two other harvested peatlands (Peatlands 514 and 522) located within a radius of 10 km.

Expansion of the drainage network and opening of new peat fields in Malpec and Lufburys Brooks watersheds, as well as in areas draining directly to the Gulf of St. Lawrence or French Cove, will induce further modifications to local surface and subsurface flow systems, with respect to pre-development conditions. As was the case for the initial development of Peatland 524, modifications anticipated with the proposed expansion will mostly take place in zones located up-gradient, or upstream, from the receiving streams or waterbodies.

3 Covedell plant processes peat from Brantville Peatland 522 that accounts for 523 transports for 2016.

The presence of an intact buffer zone between altered areas and their receiving stream/waterbody, as well as the implementation of complementary mitigation measures, will essentially preserve the natural hydrological and hydrogeological processes taking place near or in these watercourses, following initial peat fields drainage.

The notable exception is the partial diversion of Lufburys Brook's upper reach, directly through the extended drainage network. Associated impacts, detailed in Section 5.1, will not be cumulative in nature, as the stream had not been modified by the initial development.

Sedimentation ponds will be added at the outlets of a number of drained areas that are already part of the current harvesting zones, but presently only rely on diffuse overland flow for managing water discharge. Sedimentation ponds will be constructed at every pre-existing drainage outlet located less than 100 m from a stream. The addition of sedimentation ponds to pre-existing subnetworks represents a positive impact on local flow regime and water quality that will result from the proposed expansion, especially for areas where no new harvest fields will be developed. This action will thus lessen cumulative impacts associated with the proposed expansion.

For the most part, anticipated hydrological impact of the proposed development will be limited in time and prevalent during initial field drainage. Since harvest field openings will be carried out in a progressive fashion, this impact will be moderate, and will mostly affect areas located at the peatland periphery.

As mentioned previously, no significant impact is expected on the quality of surface or groundwater, as a consequence of the proposed expansion. Implementation of the mitigation measures presented in sections 5.1 and 5.2, such as sedimentation ponds and diffuse overland flow, will prevent quality degradation of the receiving waters. Consequently, the expansion of peat harvesting operations in Peatland 524 will not have a significant incremental effect on eventual modification(s) to local water quality that could have occurred as a result of the initial development.

No cumulative impacts on vegetation is anticipated since the plant communities that will be lost will still be present in the 565 ha will remain at their natural state within Peatland 524 and other peatlands locally. Peatlands 523 and 525 that are adjacent to Peatland 524 and Peatlands 514a, 522a, and 525a, located within a radius of 10 km, will maintain a pool of diverse habitats for plants and wildlife. No cumulative impact is expected on rare plant species since the only legally protected species found on Peatland 524 is located outside the proposed expansion. Other rare species were recently found in other bogs and they may well be present in the conservation areas and in other peatlands that will remain untouched.

Cumulative impacts on wildlife are expected to be insignificant considering that a pool of peatland habitats present locally, including bog ponds, will remain untouched and that wildlife species use peatlands on a punctual basis. No wildlife species is restricted to this ecosystem.

The main impacts of peat harvesting on air quality result from dust generation during the operation phase that may affect human activities, vegetation, and water quality. Airborne peat particles emitted from the proposed expansion will add to that of the current operation on Peatland 524. The total harvested area will increase from 374 ha in 2016 to a maximum of 636 ha in 2021 before starting to decrease by 2022 (Table 5). The implementation of mitigation measures should maintain the potential cumulative effect to a low intensity. It is considered that the impact on air quality should not cumulate to that of the two other harvested peatlands located in the area given the distance of > 5 km between each site.

Increased traffic represents a potential impact for public safety and quality of life for residents that has the possibility of generating cumulative impacts. It is estimated that the expansion project will result in an increase of 9 transport/day.

5.9 REVERSIBILITY OF IMPACTS

The proposed expansion project for Peatland 524 should not result in significant irreversible impacts on the environment after the implement of mitigation measures. The reclamation plan described in Section 3.6.5 represents the main mitigation measures to be implemented and is the principal factor that limits the impact of peat harvesting to a low value.

The goal of the reclamation plan is to restore harvested sites back to functional wetland ecosystems. Research has shown that a peatland vegetation cover can re-establish itself over the entire surface of a harvested peatland and the carbon storage function be restored within 10 years of the application of the Moss Layer Transfer Technique for sphagnum regeneration (Poulin *et al.*, 2012; Waddington *et al.*, 2010; Strack and Zuback, 2013). Hydrological conditions also recover within about 17 years (McCarter and Price, 2013; Lucchese, *et al.*, 2010). Consequently, the expansion project on Peatland 524 should not result in irreversible impacts provided that appropriate mitigation measures are applied.

5.10 MONITORING PROGRAM

Scotts proposes to extend to the expansion area the monitoring program that is already in use for the rest of the peatland. The current monitoring program includes the collection and analysis of water samples from the outlet of subset of sedimentation ponds every two weeks or after a significant windy or rainy event according to the current Approval to Operate I-8981. Included in this subset are ponds # 1, 2, 3, 8 and 9. Samples are analysed for TSS by a laboratory accredited by the Canadian Association for Laboratory Accreditation Inc (CALA), and that operates in accordance with the ISO/IEC 17025 standard for quality management systems.

6 PUBLIC INVOLVEMENT

Scotts developed and applied a consultation program to ensure that those potentially affected by the project are made aware of the project registration and can express their comments as requested by the *Environmental Impact Assessment Regulation (87-83)*.

A bilingual letter explaining the *Peatland 524 Expansion Project* along with a map depicting the location of the project was prepared and sent out to all parcel owners within a radius of 1 km from the peatland. Owners of parcels located in the sea south and north of Peatland 524 were also included in the mailing list. The same letter was also sent to:

- M. Pat Finnigan, Member of Parliament
- Ms. Lisa Harris, Member of the Legislative Assembly of New Brunswick
- Tabusintac Local Service District
- Tabusintac Watershed Association
- New Brunswick Wildlife Federation
- Piper Project
- Club de naturalistes de la Péninsule Acadienne
- Comité sauvons nos rivières
- Miramichi River Environment Assessment Committee
- The Nature Conservancy of Canada
- Club VTT Alnwick

The letter provided basic project information and invited recipients to express their comments by phone, mail or email. All letters were sent on February 9 and recipients had until March 10 to answer back. The letter for the Club VTT Alnwick was sent on March 22, and they had until April 22 to send their comments.

As of March 10, 2017, six persons and organization had expressed comments about Scotts *Peatland 524 Expansion Project*. They are summarized in Table 13.

The letter, mailing list, and response letters are provided in Appendix H.

Scotts will provide a report documenting the public involvement process in accordance with the proposed schedule, within 60 days after the project registration.

Table 13 Summary of comments made during the public consultation

COMMENT
One oyster farm operator is concerned about the potential impact of suspended peat in water and airborne peat dust on cultivated oysters and wild oysters and quahogs.
The PID owner is concerned about the destruction of wild bird habitat, potential impact of airborne peat dust and loss of geese and duck hunting grounds following drainage.
The PID owner expressed concerns about importation of fill in the bog, truck traffic, dust emission, effect of drainage on water courses, wildlife, noise, non-benefit seasonal jobs, site restoration, and relation with neighbours.
The PID owner is concerned about dust emissions, truck traffic, pollution by plastic, and water quality in regards to oyster culture.
The Local Service District welcomes the project but is concerned about truck peat and dirt spillage that already raises complaints and the potential impact on waterfowl and associated recreational activities such as hunting.
Nature Conservancy of Canada underlined the ecological significance of the area surrounding Peatland 524 and the important investment and commitments of various organizations to protect that area. NCC expressed concerns about water and air quality, coastal erosion in harvested areas, and the effect of drainage on adjacent protected land. It recommended that rare species surveys be conducted and offered to collaborate to better identify the impact of development on adjacent land.

Scotts also took steps to introduce its project to First Nations in collaboration with the Department of Energy and Resource Development (DERD) and the Secretariat of Aboriginal Affairs (SAA). Based on recommendations from DERD, engagement has been undertaken with the Mi’kmaq First Nation that comprises nine communities located in the coastal zone. A letter was sent to the chief of each community and to Mi'gmawe’l Tplu'taqnn Incorporated (MTI), an organization representing Mi’kmaq communities, to inform them of the project. The Maliseet Nation communities are located inland and were not included in Scott's engagement with First Nations. The information letter sent to First Nations is provided in Appendix I.

7 APPROVAL OF UNDERTAKING

→ Authorizations may be needed from the Department of Transportation and Infrastructures (DTI).

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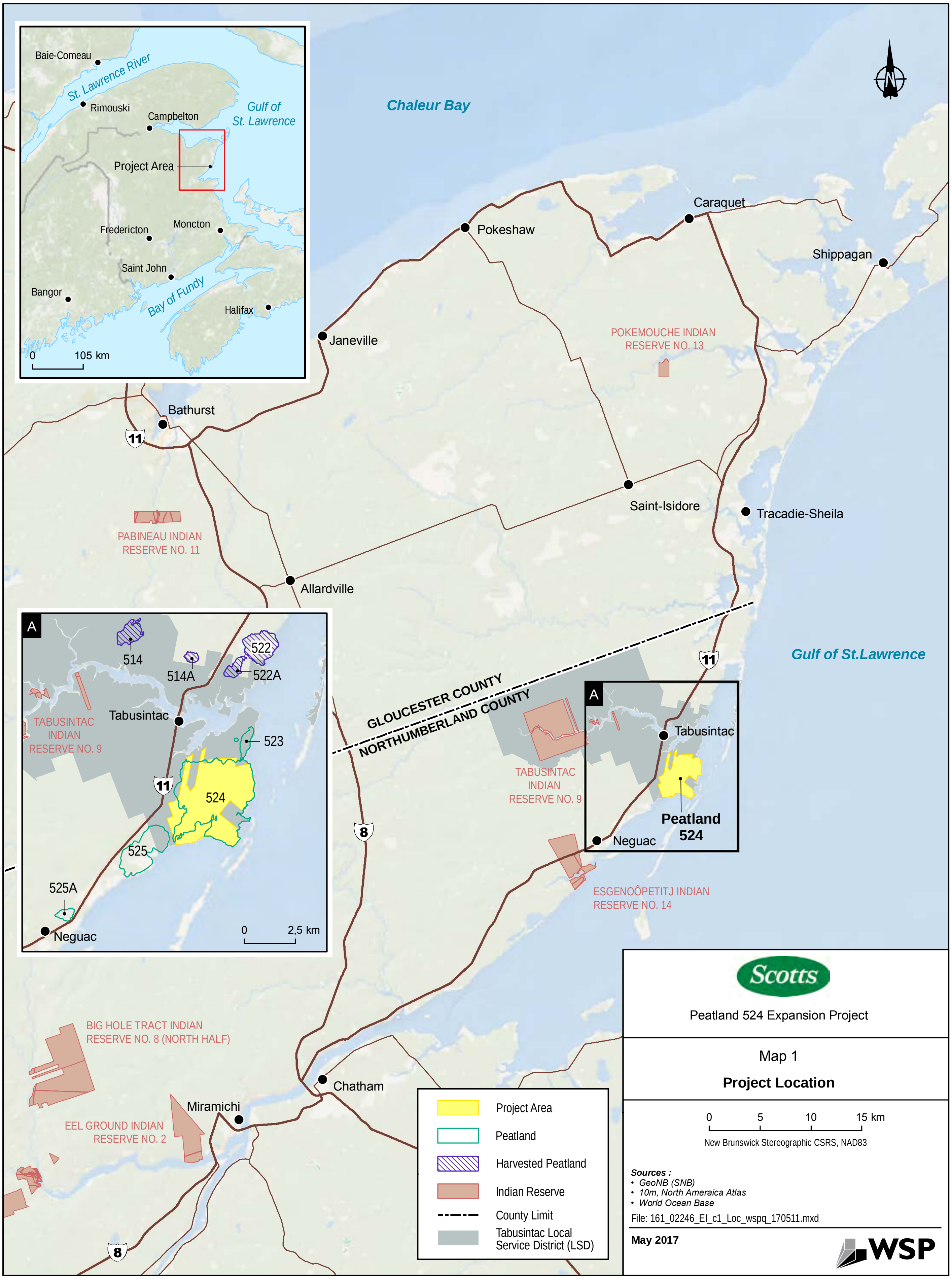
MAPS



Scotts

Peatland 524 Expansion Project

Map 1

Project Location

0 5 10 15 km

New Brunswick Stereographic CSRS, NAD83

Sources :
- *GeoNB (SNB)*
- *10m, North Ameraica Atlas*
- *World Ocean Base*

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May 2017

WSP

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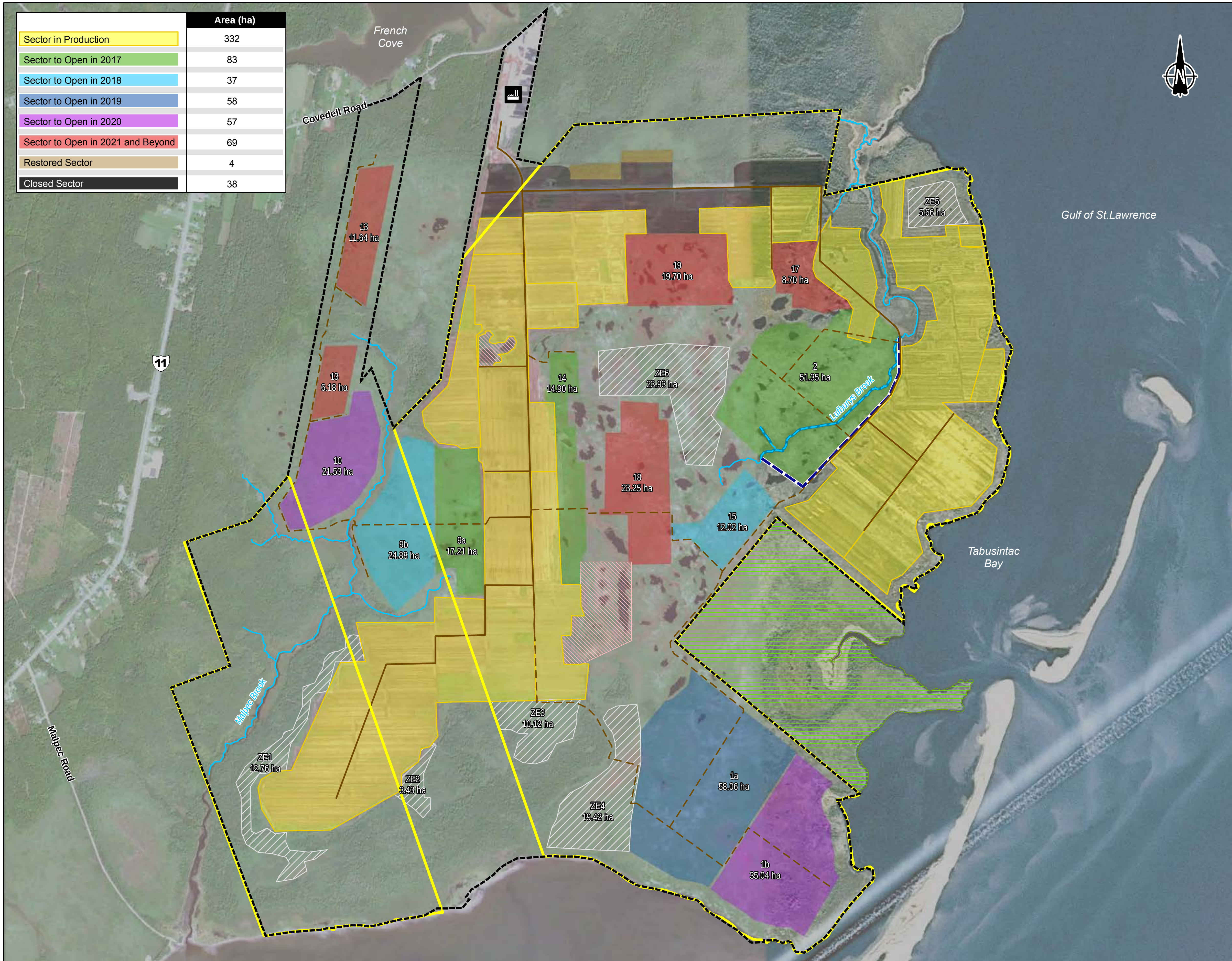

	Area (ha)
Sector in Production	332
Sector to Open in 2017	83
Sector to Open in 2018	37
Sector to Open in 2019	58
Sector to Open in 2020	57
Sector to Open in 2021 and Beyond	69
Restored Sector	4
Closed Sector	38

Project
- Sector in Production
- Sector to Open in 2017
- Sector to Open in 2018
- Sector to Open in 2019
- Sector to Open in 2020
- Sector to Open in 2021 and Beyond
- Restored Sector
- Closed Sector
- Project Area
- Borrow Area

Conservation
- Scotts Conservation Area
- Nature Conservancy Canada

Infrastructure and Limits
- Covedell Peat Processing Plant
- Existing Access Road
- Proposed Access Road
- Lease 9 Limit

Hydrography
- Watercourse
- Stream Bed to Be Relocated
- Proposed Stream Bed Location

Scotts

Peatland 524 Expansion Project

Map 2
Development Plan

0 200 400 600 m
New Brunswick Stereographic CSRS, NAD83

Sources:
- *Project Data, Scotts Canada*
- *New Brunswick Hydrographic Network (NBHN), GeoNB (SNB)*
- *Image: Google Earth, 2011*

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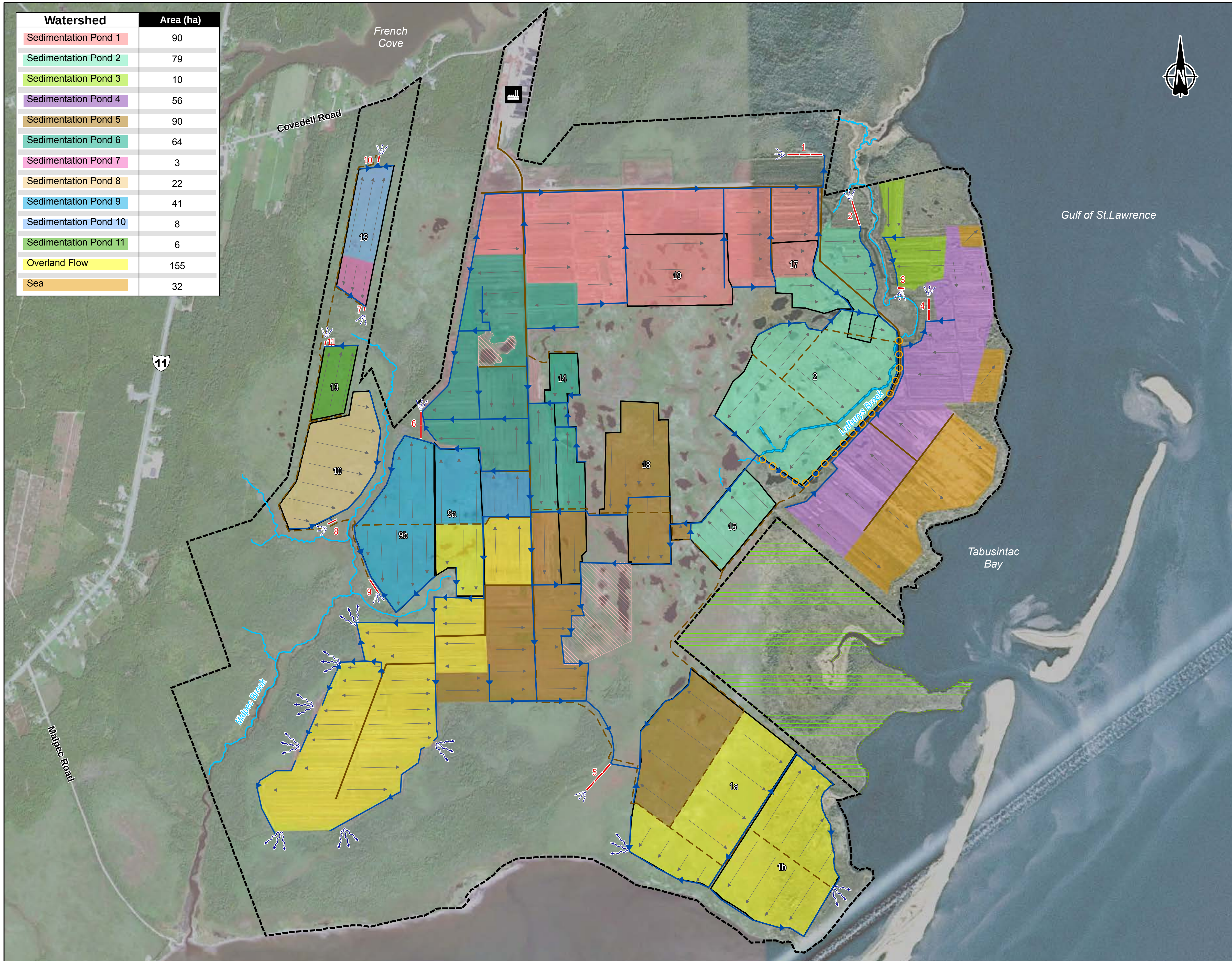
Watershed	Area (ha)
Sedimentation Pond 1	90
Sedimentation Pond 2	79
Sedimentation Pond 3	10
Sedimentation Pond 4	56
Sedimentation Pond 5	90
Sedimentation Pond 6	64
Sedimentation Pond 7	3
Sedimentation Pond 8	22
Sedimentation Pond 9	41
Sedimentation Pond 10	8
Sedimentation Pond 11	6
Overland Flow	155
Sea	32



Project

- Project Area
- Proposed Expansion (Section #)

Conservation

- Scotts Conservation Area
- Nature Conservancy Canada

Infrastructure

- Covedell Peat Processing Plant
- Existing Access Road
- Proposed Access Road
- Sedimentation Pond

Hydrography

- Watercourse
- Stream Bed to Be Relocated
- Proposed Stream Bed Location
- Water Flow
- Drainage Network
- Diffuse Overland Flow

Scotts

Peatland 524 Expansion Project

Map 3
Drainage Network

0 200 400 600 m

New Brunswick Stereographic CSRS, NAD83

Sources:
- *Project Data, Scotts Canada*
- *New Brunswick Hydrographic Network (NBHN), GeoNB (SNB)*
- *Image: Google Earth, 2011*

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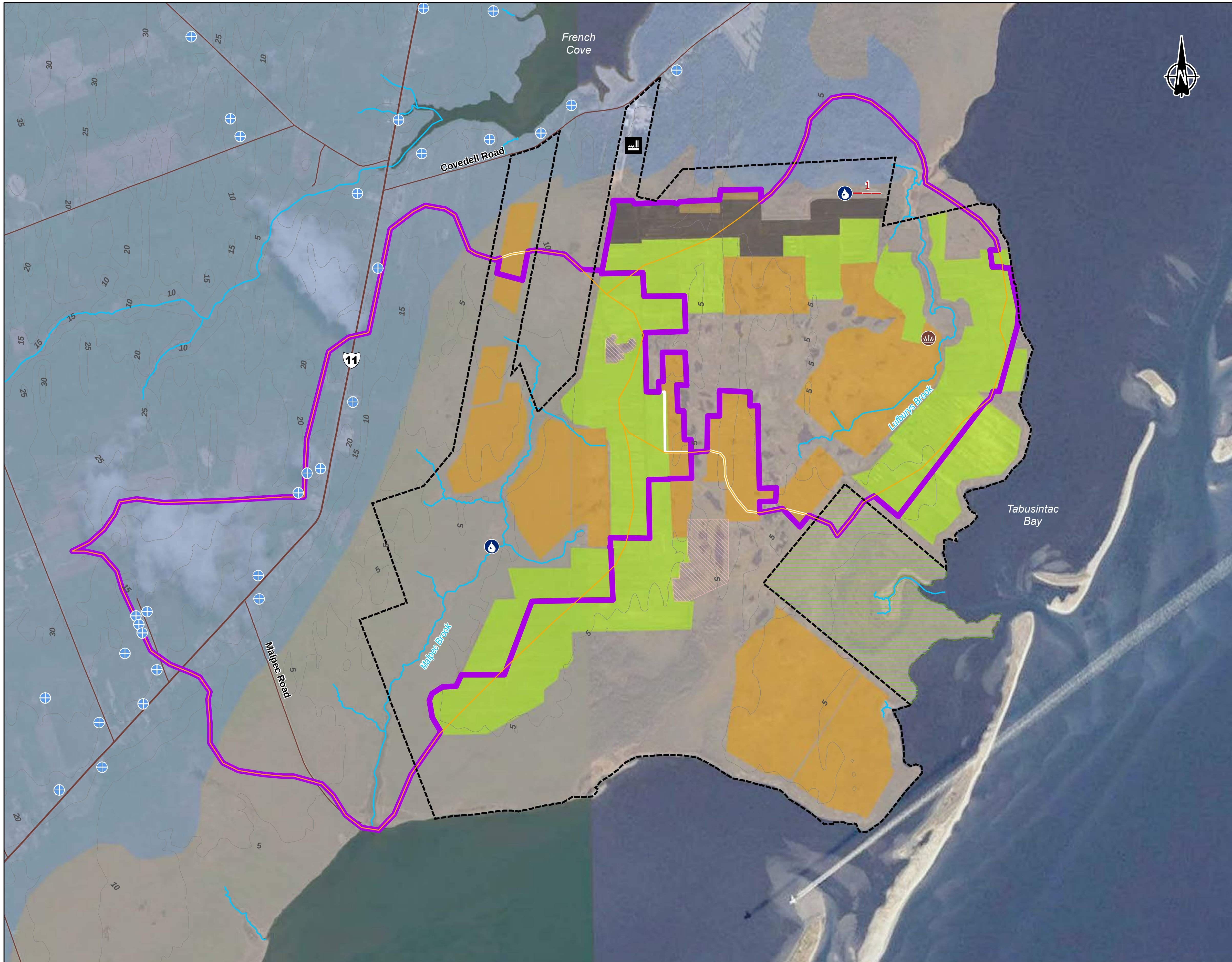

Project

- Project Area
- Proposed Expansion
- Current Operation
- Restored Sector
- Closed Sector

Conservation

- Scotts Conservation Area
- Nature Conservancy Canada

Infrastructure

- Water Supply Well
- Covedell Peat Processing Plant
- Primary Road
- Secondary Road

Surficial Deposits

- Organic Deposits
- Beach Sediments: Gravel and Sand
- Peat Sampling Location

Hydrography

- Watercourse
- Natural Watershed Divide for Main Peatland Streams
- Current Watershed Divide Resulting From Peat Drainage
- Future Watershed Divide Resulting From Expansion of Drainage Network
- Water Sampling Location
- Existing Sedimentation Pond

Topography

- Topographic Contour Lines Interval : 5m

Scotts

Peatland 524 Expansion Project

Map 4
Physical Environment

0 250 500 750 m

New Brunswick Stereographic CSRS, NAD83

Sources:
• Project Data, Scotts Canada
• New Brunswick Hydrographic Network (NBHN), GeoNB (SNB)
• Online Well Log System, Dept. of Environement, NB, 2017
• Image: World Imagery, 2010, resolution 50cm

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Project

- Project Area
- Proposed Expansion (Section #)
- Current Operation
- Restored Sector
- Closed Sector

Infrastructure and Limits

- Covedell Peat Processing Plant
- Primary Road
- Secondary Road
- Parcel
- Local Service District (LSD)

Archeology

- Old Cemetery

Special Status Area

- Ecological Significant Area (ESA)
- Important Bird Area (IBA)
- Scotts Conservation Area
- Natural Protected Area (Class 2) (NPA)
- Nature Conservancy Canada (NCC)
- Ramsar

Rare Plant Species

- Southern Twayblade (Legally Protected)
- Bog Birch
- Cloudberry
- Russet Cotton-Grass
- Northern Yellow-Eyed-Grass
- White-Fringed Orchid
- Exact Location
- Approximate Location

Hydrography

- Watercourse

Fauna

- Fish Habitat Survey

Scotts

Peatland 524 Expansion Project

Map 5
Biological and Human Environment

0 950 1 900 2 850 m
New Brunswick Stereographic CSRS, NAD83

Sources:
• Project Data, Scotts Canada
• New Brunswick Hydrographic Network (NBHN), GeoNB (SNB)
• Image: World Imagery, 2010, resolution 50cm
• ACCDC

File: 161_02246_EI_c5_Biological_wspq_170515.mxd

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