

**PFM DEVELOPMENTS**

# GROVE HAMLET

SEWAGE LAGOON RECLAMATION

ENVIRONMENTAL IMPACT ASSESSMENT  
REGISTRATION

CONFIDENTIAL



**GROVE HAMLET -  
EIA REGISTRATION  
SEWAGE LAGOON RECLAMATION  
ENVIRONMENTAL IMPACT  
ASSESSMENT REGISTRATION**

**WSP Project no 151-09013-009**

Prepared for:  
**PFM Developments Inc.**

Date: March 2017

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Our Ref: 151-09013

March 3, 2017

CONFIDENTIAL

Mrs. Lee Swanson  
New Brunswick Department of Environment and Local Government, Environmental  
Assessment (Section)  
PO Box 6000  
Fredericton, NB E3B 5H1

Dear Mrs. Swanson,

**Subject:** SEWAGE LAGOON RECLAMATION  
ENVIRONMENTAL IMPACT ASSESSMENT REGISTRATION

PFM Developments Inc. plans to decommission a former sewage lagoon located on a property identified as PID 70601752, which is located northwest of the end of Glengrove Road, northeast of École Champlain in Moncton, NB. Decommissioning of the lagoon will include removal of water and any impacted sediments and soils, then infilling and reshaping the land to maintain positive drainage. Final grading will be consistent with the proposed future land use for that property and that of adjacent properties. The subject property is zoned as green space, which allows for development of community parkland and parking areas, which is what is proposed for the subject land. The parallel and adjacent lands are zoned for multi-family residential development, which will be undertaken by our client (PFM Developments). Landscaping and drainage of the green space and parking areas will consider adjacent land development as an integrated land block for the purposes of stormwater management.

The land in the surrounding area where the lagoon is located is zoned by the City of Moncton as residential, which includes residential, multi-family residential, small commercial, green space, etc., as per City development rules. The City of Moncton has reviewed the development plans for the general area and approved the area development plan at the Feb 6<sup>th</sup> City Council meeting. The lagoon is a redundant feature in the local landscape and has not been used for several decades. Considering the current and planned local land use, it also presents health and safety hazards to the local community. Consequently, it was determined that the former sewage lagoon should be decommissioned and the land reclaimed for an appropriate purpose.

Decommissioning a sewage lagoon is subject to an Environmental Impact Assessment as defined by Schedule A under the Department of Environment and Local Government (2012), under the following item:

(n) sewage disposal or sewage treatment facilities, other than domestic, on-site facilities.

The Lagoon Decommissioning Plan generally includes removal of water, sediments and impacted soils within the lagoon footprint. The cleaned up, remediated reservoir would then be backfilled using clean fill and reshaped to maintain positive drainage. Final grading would be consistent with the proposed future land use and development of multi-family residential development on adjacent and parallel lands. Backfill will be taken from a naturalized stormwater pond planned for a piece of land local to the lagoon, as part of the overall development approval.

WSP's review showed that there will be minimal impacts to the natural environment, based on current and future land use and the VECs reviewed herein. Therefore, WSP is of the opinion that, with the use of the proposed mitigation measures and Lagoon Reclamation Plan discussed in this report, there will be no significant impact to the environment. Therefore, while further technical work to reclaim the lagoon site and to develop the land to meet its current zoning criteria, no further environmental assessment work is recommended.

Yours sincerely,

W.R. (Bill) MacMillan, P.Eng., M.Sc.  
Manager | Environment (NB)

cc:  
*Encl.*

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# SIGNATURES

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## EXECUTIVE SUMMARY

A former sewage lagoon is located on PID 70601752 in the Grove Hamlet subdivision. The area surrounding the lagoon has been zoned as residential area and is slated for future development. Consequently, since the lagoon has not been utilized in decades, it has been determined that for health and safety considerations the former sewage lagoon should be decommissioned. Decommissioning a sewage lagoon is subject to an Environmental Impact Assessment as defined by Schedule A under the Department of Environment and Local Government (2012), under the following item:

(n) sewage disposal or sewage treatment facilities, other than domestic, on-site facilities.

The decommissioning of the lagoon would include removal of water, infilling and reshaping the land to fit with the natural contours present in and around the site. Final grading would be consistent with the proposed future land use and development of multi-family dwellings parallel and adjacent to the reclaimed lagoon site.

A review of Project activities, applicable legislation, and previous assessment experience identified the following VECs:

- Topography and Drainage
- Air Quality
- Surface Water and Groundwater Resources
- Wildlife, Migratory Birds and Species at Risk
- Population and Road Transportation Network
- Accidental Spills and Malfunctions

The review showed that there will be minimal impacts to the natural environment, based on the VECs reviewed herein. Therefore, WSP is of the opinion that, with the use of the mitigation measures and Lagoon Reclamation Plan discussed in this report, there will be no significant impact to the environment. Therefore, while further technical work to reclaim the lagoon site and to develop the land to meet its current zoning criteria, no further environmental assessment work is recommended.



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# 1 GENERAL INFORMATION AND CONTACT

<b>i. Name of Proponent</b>	PFM Developments Inc.
<b>ii. Address of Proponent</b>	28 Yves Court Dieppe, NB E1A 0Z7
<b>iii. Chief Executive Officer</b>	Name: Charles Michaud Official Title: President - PFM Developments Inc. Telephone No: Office: 506-833-0093 / Cell: 506-863-3593
<b>iv. Principal Contact Person for Purposes of Project Description</b>	WSP Canada Inc. W.R. (Bill) MacMillan, P.Eng., M.Sc. Manager   Environment (NB) 55 Driscoll Crescent  Moncton, NB E1E 4C8 [T]: (506) 857-1675 [F]: (506) 857-1679
<b>v. Property Ownership</b>	PFM Developments Inc.

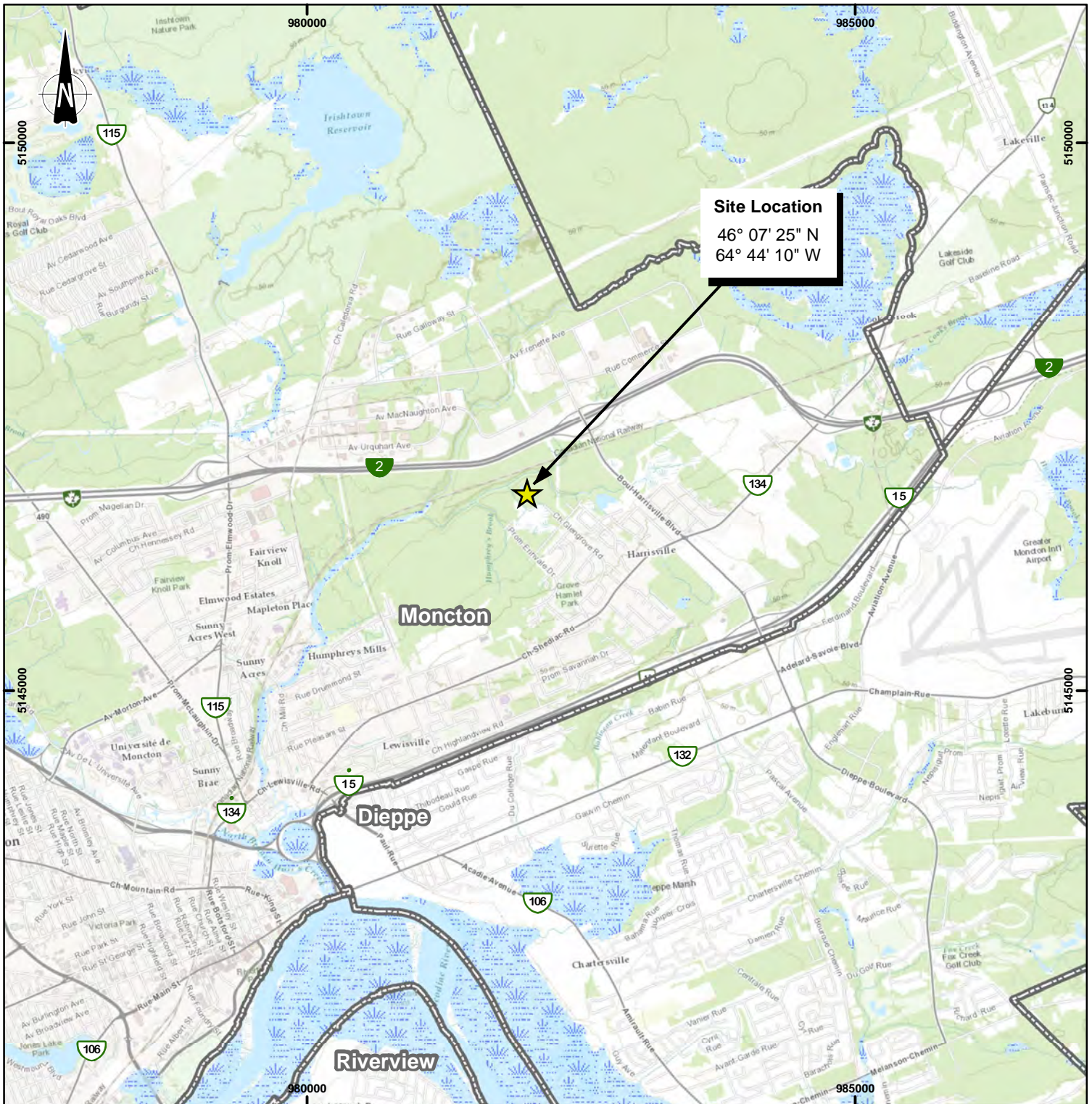
## 2 PROJECT INFORMATION

<b>vi. Name of Project</b>	Grove Hamlet Subdivision – Former Sewage Lagoon Decommissioning
<b>vii. Project Overview</b>	<p>PFM Developments Inc. is planning to decommission a former sewage lagoon that is situated on a property identified as PID 70601752. The Project is located northwest of the end of Glengrove Road and northeast of École Champlain, as shown in Figure 1. The decommissioning of the lagoon will include removal of water, infilling and reshaping the land to fit with the natural contours present in and around the site. Final grading will be consistent with the proposed future land use and development of multi-family dwellings parallel and adjacent to the reclaimed lagoon site. Figure 2 illustrates the proponent's development plans in and around the site. This includes the development of a commercial space and construction of two multi-family apartment buildings. In addition, as part of the larger community development the developer is creating a naturalized stormwater retention pond on a separate piece of property to the west of the lagoon site. The intent is to use the material excavated from the stormwater pond to backfill the former lagoon.</p>
<b>viii. Purpose/Rationale/Need for the Project Description</b>	<p>The area surrounding the lagoon has been zoned as residential area and is slated for future development. Consequently, since the lagoon has not been utilized in decades, it was determined that for health and safety considerations the former sewage lagoon should be decommissioned.</p> <p>Decommissioning a sewage lagoon is subject to an Environmental Impact Assessment as defined by Schedule A under the Department of Environment and Local Government (2012). An EIA is prompted by the modification of a</p> <p>(n) sewage disposal or sewage treatment facilities, other than domestic, on-site facilities.</p>
<b>ix. Project Location:</b>	<p>The project is located north of the Grove Hamlet Subdivision in Moncton, NB, County of Westmorland (PID 70601752). The Project is located northwest of the end of Glengrove Road and northeast of École Champlain, as shown in Figure 1. The lagoon is situated at latitude: 46.123671° and longitude: -64.736043°.</p>



<p><b>x. Physical Components and Dimensions of the Project</b></p>	<p>The lagoon is approximately 8,000 m<sup>2</sup> in area and is approximately 1.0 m in depth (max). The former lagoon is located on PID 70601752, which is approximately 4.2 ha of land. Currently, there is approximately 8000 m<sup>3</sup> of water in the lagoon.</p>
<p><b>xi. Project Details</b></p>	<p>Decommissioning is expected to commence in April 2017 and will take approximately four to six (4 – 6) weeks to complete. A typical 5 day work week of 7 am to 7 pm schedule is anticipated. Site access is available through Erinvale Drive, although it is anticipated the majority of truck traffic will access the site via Glengrove Road.</p> <p>The decommissioning details of the project include draining the lagoon and proper disposal of any contaminated water and/or sediments (if any), in-filling with clean fill and the reshaping of the land to facilitate drainage relative to the surrounding area and future development plans.</p> <p>The lagoon is currently fitted with an outlet pipe that leads to Humphry's Brook, as part of its former wastewater lagoon infrastructure. If the water is of suitable quality, it will be slowly released into Humphry's Brook at an agreed upon release rate, depending on the time of year, etc. If the water is not acceptable for direct release to the environment the lagoon will be drained using a pump truck and the effluent will be disposed of at a suitable facility. Clean fill will then be placed and the land will be reshaped using dump trucks/trailers, bulldozers, excavator, loader and roller compacter. Subgrade material will likely be native fill, locally supplied clean glacial till. Crushed rock, where required for construction of pavement subbase and base layers will be supplied by a local approved quarry and will be placed using the appropriate equipment to achieve quality results.</p>





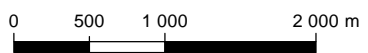
**Site Location**  
 46° 07' 25" N  
 64° 44' 10" W

-  Municipal Limit
-  Site Location



**PFM DEVELOPMENTS**  
**GROVE HAMLET SEWAGE LAGOON REMOVAL EIA REGISTRATION**  
 Moncton, NB

**Figure 1**  
**Site Location**



1 : 50 000  
 Projection : NAD83, UTM zone 20N

**Sources :**  
 Topographic map : WMS Toporama  
 Municipal Limits : SNB.ca  
 Provincial Limits : SNB.ca

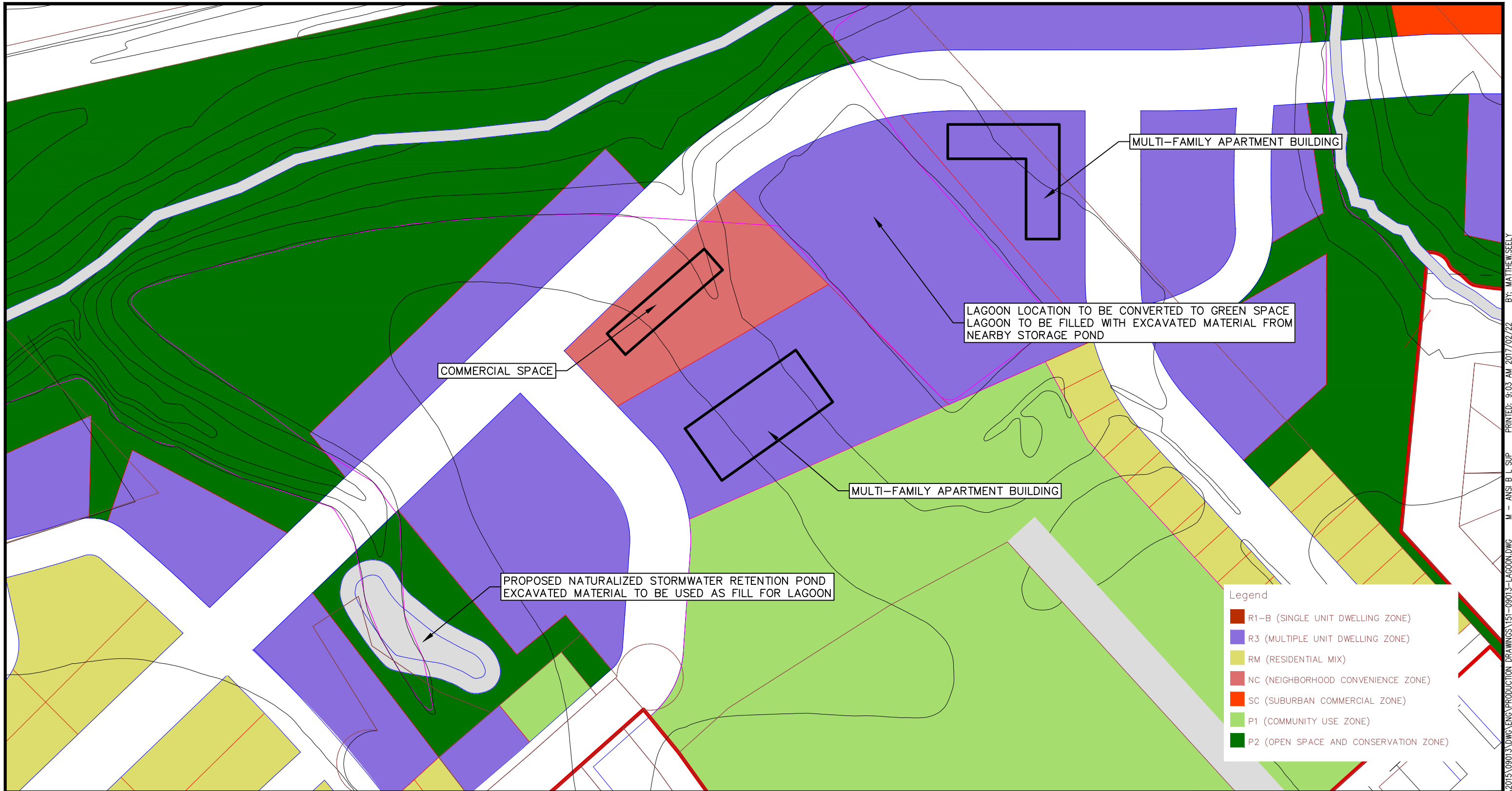
Preparation : C. Landry  
 Drawing : C. Landry  
 Verification : C. LaFlamme

January 19<sup>th</sup>, 2017 151-09013-00



File: 151\_09013\_00\_F1\_ProjectLocation\_170119.mxd





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PROJECT:

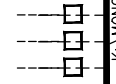
GROVE HAMLET SUBDIVISION  
 UNIT 15

PROJECT NO:

151-09013

SUPPLEMENTAL:

ADDENDUM:  
 DIRECTIVE:  
 CHANGE ORDER:



TITLE:

SITE DEVELOPMENT PLAN  
 Figure 2

SCALE:

1:2000

DRAWN BY:

M. SEELY

CHECKED BY:

B. MacMILLAN

REVISION:

0

DATE: (YYYY/MM/DD)

2017/02/22

SUPPLEMENTAL NO:

-----

WSP REF. NO.: -----



## 3 DESCRIPTION OF THE EXISTING ENVIRONMENT

### 3.1 PHYSIOGRAPHY AND DRAINAGE

#### 3.1.1 TOPOGRAPHY AND DRAINAGE

The Project is located in the Kouchibouguac Ecodistrict of the Petitcodiac Ecoregion, which is described as “a low-lying, gently rolling area with ridges and valleys” (Zelanzny, 2007). Based on a review of topographical information (New Brunswick Department of Natural Resources, 2015) portions of project area has a southeast to southwest aspect (project footprint and east area) and northwest to northeast aspect (western area). The slope of the area is >5 to 20%.

The forest soil unit located within the study area is the Salisbury Unit. Salisbury soils are developed on well to imperfectly drained lodgement tills derived mainly from red mudstone and has a fine-textured parent material (loam to sandy-clay loam). This area is described as dominantly imperfectly drained with significant moderately well or poorly drained areas (New Brunswick Department of Natural Resources, 2015).

#### 3.1.2 GEOLOGY

##### **Surficial Geology**

Available geological mapping for the project area indicates the surficial geology in the area consists of Late Wisconsinan aged blankets of morrainal sediments consisting of lodgement and ablation till. The sands and gravels associated with this feature were deposited directly by late-Wisconsinan ice or with minor reworking by water. In particular, surficial geology at the Subject Property is composed of blanketed loamy lodgment till, minor ablation till, silt, sand, gravel, rubble, silt, and some gravel, which are generally 0.5 m to 3 m thick (Rampton, 1984).

##### **Bedrock Geology**

Bedrock geology mapping indicates bedrock beneath and surrounding the project area is Late Carboniferous aged bedrock of the Pictou Group. The bedrock geology is composed of The Pictou Group which comprises the Salisbury, Richibucto, and Tormentine formations in the Moncton Sub basin of southeastern New Brunswick; and the Minto, Hurley Creek, and Sunbury Creek formations on the New Brunswick Platform. Lithologically equivalent rocks in the Cumberland Sub basin of Nova Scotia include the Malagash, Balfron, Tatamagouche, and Cape John formations. The Pictou Group comprises coarse- to fine-grained, dark red, reddish brown and grey, commonly micaceous sandstones, red siltstones and mudstones, and minor grey argillaceous shales. Limestone pebble conglomerate and grey and minor red mud-chip conglomerates are distinctive constituents, as are rare lacustrine limestone beds. Coal beds tend to be thin. Silica-cemented paleosols are common near the base of the group on the New Brunswick Platform and parts of the Moncton Subbasin. The strata represent primarily fluvial deposition (New Brunswick Department of Natural Resources, 2008)

## 3.2 ATMOSPHERIC ENVIRONMENT

### 3.2.1 CLIMATE

Most of the climate in New Brunswick is considered to be continental as a result of westerly air flows passing over the interior of the continent and not over a temperature-moderating ocean. The Project is situated in the southwestern portion of the Province in the Petitcodiac Ecoregion. This region lies at the between the warm, dry Eastern Lowlands Ecoregions and the cool, wet Fundy Coast Ecoregion, which exhibits a predominant maritime climate. Consequently, the area where this project is located is within a transitional climatic zone that can see both types of climate (Zelanzny, 2007)

In New Brunswick, there are forty-seven (47) stations that record data for climate normal calculations from 1981 to 2010. The closest station to the Project is at Moncton (A) Canadian Climate Station, which meets the United Nations' World Meteorological Organization (WMO). Moncton (A) is located at an elevation of 70.70 m at latitude 46°06'N and longitude 64°40'W (Government of Canada, 2016)

The range of temperatures in the region is large, ranging from an extreme maximum of 37.2°C (recorded in August, 1944) to a minimum of -32.2°C (recorded in January, 1957). The mean average annual temperature is 5.4°C, with July the warmest month at a mean daily temperature of 18.8°C, and January the coldest at a mean daily temperature of -8.9°C (Government of Canada, 2016).

With respect to precipitation, the area in and around Moncton can expect on average 876 mm annually. October is typically the rainiest month with an average precipitation of 112.1 mm, with January being the snowiest month with an average recorded monthly snowfall of 78 cm. Extreme precipitation events occur, and in April 1962 a total of 131.8 mm of rain was recorded. With respect to snow, in February 1992 a total amount of 83.0 cm of snow fell in one (Government of Canada, 2016).

Winds generally blow in from the southwest with an average wind speed of 16.8 km/hr. On average, there are 23.6 days per year with wind speeds greater than 52 km/h. In March 1963 a wind gust of 161 km/h was recorded. The windiest months on average are in March and January (Government of Canada, 2016).

### 3.2.2 AIR QUALITY

The ambient air quality is monitored by the New Brunswick Environment throughout the province. The closest air quality monitoring station to the Project Area is located in Moncton, approximately 25 km northwest of the Project Area. The air quality monitoring station in Moncton monitors the ambient air; Ozone, Carbon Monoxide, Hydrogen Sulphide, Nitrogen Dioxide, Sulphur Dioxide, and Particulate Matter (New Brunswick Department of Environment and Local Government, Undated).

The air quality in New Brunswick is classified using the Air Quality Health Index (AQHI). The AQHI is a simple scale that measures the health risk associated with local air quality conditions. The AQHI is calculated based on a combination of common air pollutants which are known to harm human health and they include: Ozone (O<sub>3</sub>) at ground level, Particulate Matter (PM<sub>2.5</sub>/PM<sub>10</sub>) and Nitrogen Dioxide (NO<sub>2</sub>) (Office of the Chief Medical Officer of Health (Public Health), 2016).

The AQHI is separated into four categories of Low Risk (1-3); Moderate Risk (4-6); High Risk (7-10); and Very High Risk (above 10) (Office of the Chief Medical Officer of Health (Public Health), 2016) . The AQHI levels are summarized in Table 1.



TABLE 1 AIR QUALITY HEALTH INDEX CATEGORIES

Health Risk	Air Quality Health Index	General Population
Low	1-3	Ideal air quality for outdoor activities
Moderate	4-6	No need to modify usual outdoor activities unless you experience symptoms such as throat irritation and coughing
High	7-10	Consider reducing or rescheduling strenuous activities outdoors if you experience symptoms of throat irritation or coughing
Very High	Above 10	Reduce or reschedule strenuous activities, especially if you experience symptoms of throat irritation or coughing

The ambient air quality is monitored throughout New Brunswick at a number of different locations. There is an ambient air quality monitor in Moncton that monitors Ozone, Carbon Monoxide, Hydrogen Sulphide, Nitrogen Dioxide, Sulphur Dioxide and Particulate Matter. The results of the AQHI from December 2015-December 2016 has been summarized in Table 2.

TABLE 2 AQHI YEARLY SUMMARIZATION

Month	Maximum	Mean	Minimum
Dec-15	2.7	1.6	1
Jan-16	4	2	1.1
Feb-16	3.7	2	1.1
Mar-16	3.6	2	1.1
Apr-16	2.6	2	1.3
May-16	2.9	1.6	1
Jun-16	3.1	1.4	1
Jul-16	3.1	1.4	1
Aug-16	4.4	1.3	1
Sep-16	2.5	1.2	1
Oct-16	2.4	1.3	1
Nov-16	2.9	1.5	1
Dec-16	2.8	1.8	1.4
<b>Yearly Average</b>	<b>3.4</b>	<b>1.8</b>	<b>1.2</b>

The overall average for the year of December 2015 – December 2016 is 1.8. This value corresponds to the AQHI of 'Low Risk', meaning ideal air quality for outdoor activities.

The New Brunswick Department of Environment and Local Government (DELG) conducted an air quality study in 2009 at MacAleese Lane in Moncton, NB. MacAleese Lane is located approximately 2.5 km west of the

Project Area. DELG issued a final report on the MacAleese Lane study on April 29, 2010 and identified no exceedances of air quality objectives for any of the pollutants identified. There are instances of three events that resulted in high total suspended particulate levels. The air quality data recorded for MacAleese Lane study is comparable to DELG's permanent air quality monitoring station in Moncton on Thanet Street, approximately 5 km southwest of the Project Area (New Brunswick Department of Environment and Local Government, 2015).

### 3.3 GROUNDWATER RESOURCES

Under the Potable Water Regulation of the Clean Water Act, the Province of New Brunswick maintains a database of groundwater quality collected from domestic water wells drilled since 1994 (New Brunswick Department of Environment and Local Government: Sciences and Reporting Branch - Sciences and Planning Division, 2008). The well depths found within the area of the Project range from less than 50 m to depths greater than 100 m. The average well depth for New Brunswick is 40.8 m. Table 3 is a summary of the groundwater quality for the general area of the project.

TABLE 3 GROUNDWATER QUALITY SUMMARY

Parameter	Concentration(s)
Alkalinity	< 200 mg/L
Aluminum	< 0.1 mg/L; 0.1 – 1.0 mg/L
Antimony	≤ 0.006 mg/L
Arsenic	< 0.010 mg/L
Barium	< 1.0 mg/L
Boron	< 0.2 mg/L
Bromide	< 0.2 mg/L; 0.2 – 20 mg/L
Cadmium	≤ 0.005 mg/L
Calcium	< 50 mg/L; 50-200 mg/L
Chloride	< 250 mg/L; 250 – 1000 mg/L
Chromium	≤ 0.05 mg/L
Conductivity	< 1000 $\square$ SIE/cm; 1000– 10000 $\square$
Copper	< 0.1 mg/L; 0.1 – 1.0 mg/L
Fluoride	< 1.5 mg/L; 1.5 – 10 mg/L; >10 mg/L
Hardness	< 200 mg/L; 200 – 500 mg/L
Iron	< 0.3 mg/L; 0.3 – 3.0 mg/L; > 3.0 mg/L
Lead	< 0.010 mg/L
Magnesium	< 15 mg/L
Manganese	< 0.05 mg/L; 0.05 – 5.0 mg/L
Nitrate	< 1.0 mg/L; 1.0 – 10 mg/L
pH	< 6.5; 6.5 – 8.5 mg/L; > 8.5 mg/L
Potassium	< 2 mg/L; 2 – 20 mg/L
Selenium	< 0.01 mg/L; 0.01 – 0.1 mg/L

Parameter	Concentration(s)
Sodium	< 200 mg/L; 200 – 500 mg/L; > 500 mg/L
Sulphate	< 100 mg/L
Thallium	< 0.001 mg/L; ≥ 0.001 mg/L
Uranium	< 0.02 mg/L
Zinc	< 0.05 mg/L; 0.05 – 5.0 mg/L

### 3.4 FRESHWATER ENVIRONMENT

According to the GeoNB Government website, the closest mapped watercourse in the proximity of the Project Area is Humphrey's Brook. Humphrey's Brook, which is located approximately 70 m north of the Project location, flows into the Petitcodiac River approximately 5.3 km southwest of the Project Area.

#### 3.4.1.1 THE PETITCODIAC RIVER

The Petitcodiac River is located approximately 5.3 km from the Project Area. The Petitcodiac River is the main stem of the Petitcodiac Watershed and has a drainage area over 2,000 km<sup>2</sup>. The river flows through numerous communities and empties into the Shepody Bay. The river is situated along numerous land use activities that include agricultural and forestry activities, urban, commercial and industrial developments, various sewage lagoons/treatment facilities, a causeway and TransAqua – Greater Moncton's Wastewater treatment facility (Petitcodiac Watershed, 2016). The latest water quality data from the 2015-2016 monitoring period of the Petitcodiac River can be seen in Table 4 below (Petitcodiac Watershed, 2016).

TABLE 4 PETITCODIAC RIVER WATER QUALITY

Parameter	15-Jun-15	15-Jul-15	15-Aug-15	15-Sep-15	15-Oct-15	15-May-16	16-Jun-16
E.coli (MPN/100ml)	> 200.5	> 200.5	> 200.5	> 200.5	> 200.5	44.3	547.5
Total Coliforms (MPN/100ml)	> 200.5	> 200.5	> 200.5	> 200.5	> 200.5	> 2419.6	>2419.6
Dissolved Oxygen (mg/L)	8.8	8.18	6.57	8.6	13.18	11.13	9.74
Temperature (°C)	16.4	20.8	26.3	16.8	4.7	10.1	11.1
pH	7.61	7.66	7.96	7.7	7.6	7.09	7.88
Specific Conductivity (µs/cm)	141.1	187.7	331	251	186.2	125.1	109.6
Nitrates (mg/L)	0.125	0.171	0.127	0.063	0.136	0.136	0.231
Phosphates (mg/L)	0.05	0.11	0.08	0.02	0.38	0.07	0.06
Salinity (ppt)	0.07	0.09	0.16	0.08	0.09	0.06	0.05
Total Dissolved Solids (mg/L)	91.65	122.2	215.15	128.3	120.9	81.25	71.5

### 3.4.1.2 HUMPHREY'S BROOK

Humphrey's Brook has a sub-watershed area of 38 km<sup>2</sup> and is a tributary to the Petitcodiac River. The headwaters of Humphrey's Brook flow through a golf course, Moncton Airport complex, urban development and the Caledonia Industrial Park. Humphrey's Brook is also the receiving end of many storm and sanitary sewer pipe as water is diverted away from the developed landscape (Petitcodiac Watershed, 2016).

The lower tidal section of Humphrey's Brook is subject to poor water quality from wetland destruction and snow dumping. The water quality from 2015-2016 monitoring period can be seen below in Table 3 (Petitcodiac Watershed, 2016).

TABLE 5 HUMPHREY'S BROOK WATER QUALITY

Parameter	15-Jun-15	15-Jul-15	15-Aug-15	15-Sep-15	15-Oct-15	15-May-16	16-Jun-16
E.coli (MPN/100ml)	> 200.5	> 200.5	> 200.5	> 200.5	101.3	325.5	> 2419.6
Total Coliforms (MPN/100ml)	> 200.5	> 200.5	> 200.5	> 200.5	> 200.5	920.8	>2419.6
Dissolved Oxygen (mg/L)	9.52	6.64	7.57	10.24	12.33	11.46	9.55
Temperature (°C)	13.7	19.9	21.5	15.3	5	8.5	13
pH	7.26	7.31	7.7	1.81	7.65	7.07	7.96
Specific Conductivity (µs/cm)	386.8	459.8	424.8	419	318.4	300.2	326
Nitrates (mg/L)	0.188	0.352	0.115	0.107	0.416	0.3	0
Phosphates (mg/L)	0	0.11	0.23	0.02	0.08	0.57	0.24
Salinity (ppt)	0.19	0.22	0.2	0.2	0.15	0.14	0.16
Total Dissolved Solids (mg/L)	251.55	299	276.25	272.35	206.7	195	211.9

### 3.4.1.3 FORMER SEWER LAGOON SURFACE WATER

The water in the existing lagoon is approximately 1 metre deep. A surface water sample was taken on June 17th, 2016 by the owner of the property Charles Michaud and his son. The testing protocol was given by the NB Department of Health. Samples taken were subsequently sent to RPC for analysis. Table 6 lists the parameters analyzed and results.

Comparing the analytical parameters for Humphrey's Brook in Table 5 with that from the Former Sewer Lagoon in Table 6 shows that the water quality of the former sewer lagoon surface water are equal to or better than that indicated for Humphrey's Brook. Furthermore, the water in the existing lagoon does not appear to be nutrient enriched, as might be anticipated for such a facility. Phosphorus levels are within typical mesotrophic conditions of 0.1 to 0.2 mg/L (Canadian Council of Ministers of the Environment, 2007) and nitrate and nitrite levels are below the CCME Water Quality Guidelines for the Protection of Aquatic Life of 13 mg/L (peak) and 0.6 mg/L for long term concentrations.

TABLE 6 FORMER SEWER LAGOON SURFACE WATER QUALITY\*

Parameter	Units	RL	Result
Ammonia (as N)	mg/L	0.05	<0.05
Kjeldahl Nitrogen	mg/L	0.25	1.8
Nitrate + Nitrite (as N)	mg/L	0.05	<0.05
Nitrate (as N)	mg/L	0.05	<0.05
Nitrite (as N)	mg/L	0.05	<0.05
Phosphorus – Total	mg/L	0.002	0.14
BOD <sub>5</sub>	mg/L	6	<6
Solids - Total Suspended	mg/L	5	12
E. Coli (Method ID MB05)	cfu/100 ml	N/A	10

RL = Reporting Limit

\*Results taken June 17<sup>th</sup>, 2016

### 3.5 TERRESTRIAL ENVIRONMENT

#### 3.5.1 WILDLIFE HABITAT

The Project is located in the Kouchibouguac Ecodistrict of the Petitcodiac Ecoregion, which is described as “a low-lying, gently rolling area with ridges and valleys”. Red spruce is known to dominate along with white and black spruce, balsam fir, red maple, white birch and trembling aspen (Zelanzny, 2007) . Based on a desktop review using online NBDNR data dated 2011, the vegetation surrounding the former lagoon is predominantly forested (Figure 2). To the east is a mature coniferous stand of black spruce and balsam fir. The remainder of the area surrounding the former lagoon, and to the east is dominated by a young intolerant hardwood stand composed of white birch, poplar species and red maple. There is an active walking trail to the east and west of the former lagoon.

There are two regulated wetlands located within 2 km of the Project Area. A wetland is located approximately 0.75 km northwest of the Project Area and follows along Humphrey’s Brook where it connects to a larger system of Provincially Significant mapped wetlands that drain into the Petitcodiac River. A smaller additional wetland is located approximately 1.5 km southeast of the Project Area, as shown in Figure 2.

#### 3.5.2 WILDLIFE

There are 57 native species of mammals (Dilworth, 1984), approximately 350 resident and migratory bird species (Squires, 1976), and 25 species of amphibians and reptiles, including various species of salamanders, frogs, turtles, and snakes(Gorham, 1970)known to inhabit New Brunswick. Vegetative communities are the main determinant of habitat for most area wildlife species.

Wildlife species in the area would be typical of those found in an urban setting. Mammal species would include skunks, rabbits, racoons, foxes and white-tail deer. Frogs and snakes are also likely to be found in and around the Project footprint. With respect to birds, the forested habitat surrounding the Project footprint would provide suitable nesting and foraging habitat for migratory species adapted to urban environments.

No species at risk survey has been conducted. However due to the limited scope of activities, small footprint area, and application of appropriate mitigation measures relating to wildlife and bird species in general; a requirement for an extensive review of the presence/absence of species at risk is not anticipated.

## 3.6 SOCIO-ECONOMIC ENVIRONMENT

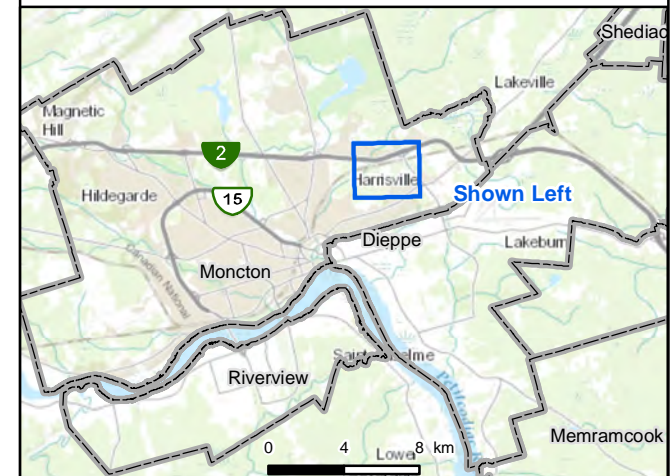
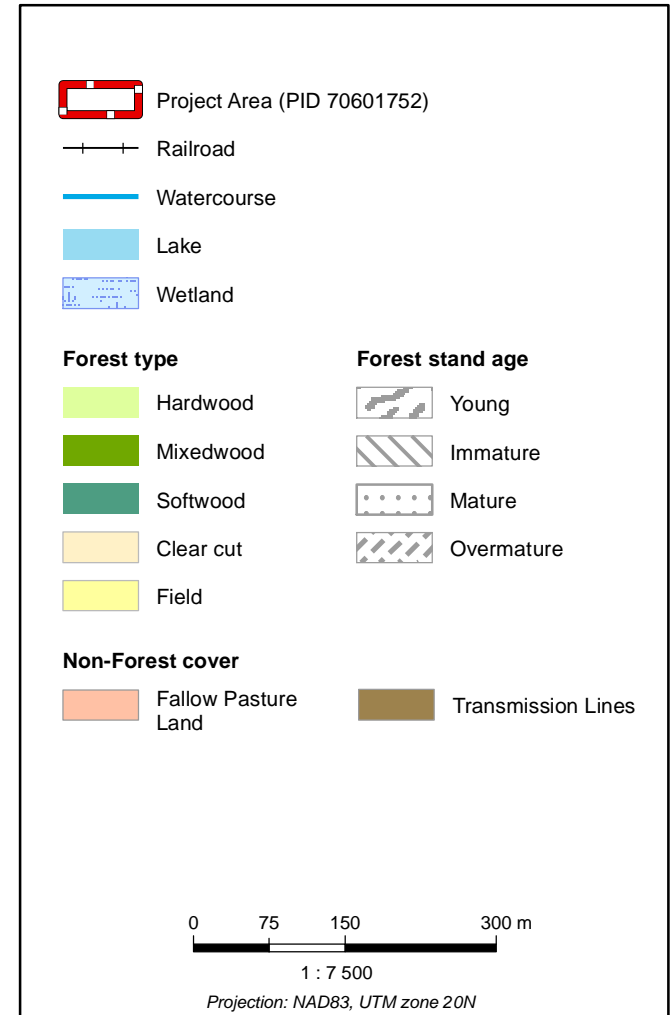
The City of Moncton is one of Canada's fastest growing economies and has a population of 145,000 people according to the 2014 Census (3+ Corporation, 2014). Moncton is known as the hub of the Maritimes with more than 1.3 million people living within a 2.5 hour drive of the city. Moncton has seen a 9.7% population growth between 2006 and 2011, making Moncton the fastest growing Canadian urban centre east of Saskatoon. Moncton has also added 25,000 jobs to the work force since 1990. Moncton has a large retail sector, with sales reaching \$2.1 billion in 2011 which is 17% higher than the Canadian City's average (City of Moncton, 2016).

### 3.6.1 LAND USE

The Project is located in the Greater Moncton Region, in the Parish of Moncton, Westmorland County (Government of New Brunswick, 2016).

The property (PID 70601752) is wholly owned by PFM Developments Inc. and is approximately 4.2 ha in size located just south of the TransCanada - Hwy 2. Based on the zoning map from the City of Moncton, the Project is located in Rural Residential Zone (City of Moncton, 2013).

The area adjacent and surrounding the Project is approximately 90% developed into residential lands. A new elementary school was recently developed immediately southwest of the Project, and the land located south/southeast of the Project Area is residential development. The area immediately surrounding the Project Area is currently forested but is zoned for and is scheduled to be developed into a residential subdivision in the near future.



**GROVE HAMLET SEWAGE LAGOON REMOVAL EIA REGISTRATION**  
**PFM DEVELOPMENTS**  
 Moncton, NB

**Figure 3**  
**Project Habitat Mapping and Site Development Plan**

**Sources :**  
 Maps - ESRI World Imagery  
 - ESRI World topographic Map  
 Municipal Limits: SNB.ca  
 Wetland : SNB.ca  
 Forest : SNB.ca  
 Non-Forest : SNB.ca

Preparation: C. Landry  
 Drawing: C. Landry  
 Verification: C. LaFlamme

**WSP**

January 19<sup>th</sup>, 2017      151-09013-00

File: 151\_09013\_00\_F3\_SiteLayoutInl\_170223.mxd





### 3.6.2 ROAD TRANSPORTATION

The Project is located south of the TransCanada Highway, west of Harrisville Boulevard and immediately north of Glengrove Road. Moncton has a series of roads throughout the city that connect to major highways leading to and from the city of Moncton. There are no intersections connected to the Project Site, however the existing access road will be solidified during the construction phase of the Project.

### 3.6.3 HERITAGE RESOURCES

An exhaustive evaluation of cultural features was not completed for this project. Considering that the project footprint is contained solely within an existing disturbed landscape, and little to no excavation will be required during decommissioning of previously undisturbed soils, the requirement for an historical evaluation prior to construction is not anticipated.

### 3.6.4 ABORIGINAL LAND AND RESOURCE USE

The Project Area lies within the traditional territory of the Mi'kmaq First nations, however, the Project Area is located on private land. The closest First Nations communities to the Project Area include Fort Folly, approximately 32 km away and Bouctouche First Nation approximately 42 km away. The project is not expected to interfere with First Nations lands or historical resources.

## 4 SUMMARY OF ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION

Based on a review of Project activities, applicable legislation, and previous assessment experience, the following valued ecological components were selected:

- Topography and Drainage
- Air Quality
- Surface Water and Groundwater Resources
- Wildlife, Migratory Birds and Species at Risk
- Population and Road Transportation Network
- Accidental Spills and Malfunctions

A matrix presented in Table 6 below identifies and describes potential project impacts, pathways, and the mitigation measures for each VEC identified for the decommissioning phase of the proposed project.

TABLE 7 ENVIRONMENTAL IMPACTS AND MITIGATION SUMMARY

Valued Environmental Component	Possible Pathway	Potential Impact	Mitigation
Topography and Drainage	<ul style="list-style-type: none"> <li>• Infilling of lagoon</li> <li>• Reshaping of land</li> </ul>	<ul style="list-style-type: none"> <li>• Water pooling</li> <li>• Sediment-laden runoff</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure land is reshaped to conform to the contours of the land and proposed future land use criteria.</li> </ul>
Air Quality	<ul style="list-style-type: none"> <li>• Drain/reclaim lagoon</li> <li>• Infilling of lagoon</li> <li>• Reshaping of land</li> </ul>	<ul style="list-style-type: none"> <li>• Fugitive dust</li> <li>• Equipment/ vehicle emissions</li> <li>• Noise</li> </ul>	<ul style="list-style-type: none"> <li>• Control dust with the use of water.</li> <li>• Cover piles of soil to prevent particulate release.</li> <li>• Maintain equipment to limit particulate exhaust releases.</li> <li>• Control speed of vehicles.</li> <li>• Plan to conduct work activities that are likely to result in an increase in noise emissions during daytime hours (7am-7pm) wherever possible.</li> <li>• Minimize heavy truck traffic and associated noise where possible.</li> </ul>
Surface Water and Groundwater Resources	<ul style="list-style-type: none"> <li>• Drain/reclaim lagoon</li> <li>• Infilling of lagoon</li> <li>• Reshaping of land</li> </ul>	<ul style="list-style-type: none"> <li>• Effects on surface water quality</li> <li>• Effects on groundwater quality</li> </ul>	<ul style="list-style-type: none"> <li>• Should water from the former sewer lagoon be discharged into Humphrey's Brook, a Watercourse and Wetland Alteration Permit is required and must be strictly adhered to.</li> <li>• Suspend on-site activities during extreme weather events.</li> <li>• Preserve existing vegetation to the extent possible.</li> <li>• Ensure that appropriate sediment and soil erosion control measures are put into place where applicable.</li> <li>• Sample and analyze lagoon sediments for possible contaminants.</li> <li>• Dispose of contaminated water and/or soils (if any) at a NBDELG approved facility.</li> </ul>
Wildlife, Migratory Birds and Species at Risk	<ul style="list-style-type: none"> <li>• Drain/reclaim lagoon</li> <li>• Infilling of lagoon</li> <li>• Reshaping of land</li> </ul>	<ul style="list-style-type: none"> <li>• Alteration/ displacement of habitat</li> <li>• Noise/ physical disturbance of wildlife</li> <li>• Behavioural changes</li> <li>• Mortality</li> </ul>	<ul style="list-style-type: none"> <li>• Schedule decommissioning activities to occur during periods of lowest sensitivity to wildlife.</li> <li>• Abide by all relevant timing constraints for wildlife as identified by regulatory agencies</li> <li>• No on-site employees will harass wildlife</li> <li>• Adhere to <i>Migratory Bird Convention Act</i> stipulations</li> <li>• Report the discovery of any ground nests</li> </ul>
Population and Road Transportation Network	<ul style="list-style-type: none"> <li>• Drain/reclaim lagoon</li> <li>• Infilling of lagoon</li> <li>• Reshaping of land</li> </ul>	<ul style="list-style-type: none"> <li>• Noise/ disturbance</li> <li>• Traffic</li> <li>• Fugitive dust</li> </ul>	<ul style="list-style-type: none"> <li>• Control speed of vehicles</li> <li>• Plan to conduct work activities that are likely to result in an increase in noise emissions during daytime hours (7am-7pm) wherever possible.</li> <li>• Minimize heavy truck traffic and associated noise where possible.</li> </ul>
Accidental Spills and Malfunctions	<ul style="list-style-type: none"> <li>• Drain/reclaim lagoon</li> <li>• Infilling of lagoon</li> <li>• Reshaping of land</li> </ul>	<ul style="list-style-type: none"> <li>• Contamination of local environment</li> </ul>	<ul style="list-style-type: none"> <li>• Adherence to maintenance schedules and daily pre-work inspection for vehicles and equipment on-site.</li> <li>• Adequate training must be provided for personnel responsible for transportation, storage, handling or use of hazardous material.</li> <li>• Appropriately sized spill kits must be available on-site for clean-up efforts.</li> </ul>



## 5 LAGOON RECLAMATION PLAN

This following Lagoon Reclamation Plan has been developed in order to ensure the former sewage lagoon is decommissioned in an environmentally responsible manner. The Lagoon Reclamation Plan will consist of three phases:

- Dewatering
- Removal of sediment and any impacted native soil
- Backfill/ Landscape

### 5.1 DEWATERING

A surface water sample was taken in June 2016, following guidelines given by the New Brunswick Department of Health and analyzed at RPC, to determine the water quality in the lagoon. The results showed no evidence of elevated nutrients or bacteria beyond what is typical for mesotrophic aquatic systems, and not greater than the levels currently observed in Humphrey's Brook. As a result, it is suggested that during the lagoon dewatering phase the water in the lagoon be released into Humphrey's Brook through the existing drainage pipe.

In order to ensure that no contaminants that would negatively impact Humphrey's Brook are released into the watercourse, it is recommended that prior to the dewatering phase, another round of surface water sampling be conducted.

The surface water sampling plan will consist of collecting a total of three (3) surface water samples taken at either end of the lagoon and one in the centre of the lagoon. The surface water will be analyzed for general chemistry parameters, microbiology (E. coli and fecal coliforms), trace metals, and petroleum hydrocarbons (BTEX/Modified TPH per TIER I RBCA).

Should the surface water sample results fall within acceptable limits of release, the lagoon water would be discharged into Humphrey's Brook. A Watercourse and Wetland Alteration permit would be sought and the lagoon water would be discharged based on the stipulations stated in the permit. Should the surface water samples results not fall within acceptable limits of release, the lagoon water would be pumped and delivered to an appropriate certified treatment facility.

### 5.2 REMOVAL OF SEDIMENTS AND IMPACTED NATIVE SOILS

The sediments located at the bottom of the lagoon and the underlying soils are to be sampled and analyzed for contaminants.

The sediment/soil sampling plan will consist of collecting a total of three (3) sediment samples taken from either end of the lagoon and one in the centre of the lagoon. Sampling depth requirements are anticipated to be approximately 0.5 m for sediments and underlying soils, consisting of approximately 0 to 0.25 m of sediment and 0.25 m to 0.5 m. However, the sampling depth will be modified based on observation of sediment depth and staining in the underlying soils, as assessed in the field. The sediment/soil samples will be analyzed for general chemistry parameters, trace metals, and petroleum hydrocarbons (BTEX/Modified TPH per TIER I RBCA).

Should the sediment/soil samples fall within acceptable limits (below Tier I criteria), it is recommended that the material be stockpiled and used as appropriate. Should the sediment/soil samples not fall within acceptable limits (below Tier I criteria), it is recommended that the material be removed and delivered to an appropriate certified treatment facility.

### 5.3 BACKFILL/ LANDSCAPE

After dewatering and removal of sediment, the subgrade is to be assessed for stability relative to the proposed future land use. Should the subgrade fall within acceptable limits for planned land use, it will remain in place. Should the subgrade not fall within acceptable limits for planned land use, it will be removed and stockpiled to be used as appropriate. Alternatively, soil stabilization techniques, such as the use of geotextiles, wick drains, Portland cement amendment, etc., would be employed to obtain suitable soil structural characteristics. The area will then be backfilled with clean fill and compacted appropriately for intended land use. The current plan is to source the fill from the excavation of the proposed stormwater retention pond as indicated in Figure 2 and Figure 3. Following backfilling to the appropriate grade, the area will be landscaped to accommodate intended/proposed land use.

## 6 PUBLIC INVOLVEMENT

The Proponent proposes to conduct a modest public involvement program. Upon registration, a copy of the EIA Registration document will be made available at the regional office of the New Brunswick Department of Environment and Local Government for public viewing. The proponent will also provide a written notification to elected officials about the Project, and publish an advertisement in the local newspaper indicating that the project is being considered. The Public Notice of Registration will be published in the local Times & Transcripts. This notice will include:

- a brief description of the proposed Project;
- information on how to view the Registration Document;
- a description of the Project's location;
- the status of the Provincial approvals process for the Project;
- a statement indicating that people can ask questions or raise concerns with the proponent regarding the environmental impacts;
- proponent contact information (name, address, phone number, email); and
- the date by which comments must be received.

A 25-day public comment period will be initiated upon registration. Valid comments or questions from the public on the EIA registration will be responded to, and a summary of public involvement activities conducted, issues raised, and responses provided will be prepared and submitted to NBDELG within 60 days of registration, or earlier.

## 7 CLOSURE

This report has been completed for the sole benefit of PFM Developments. Any use that a third party makes of this report, or any reliance on or decisions made based on it, is the sole responsibility of the third party. WSP accepts no responsibility for damages, if any, suffered by any third party as a result of the decisions made or actions conducted based on this report.

The conclusions presented in this report represent the best judgment of the assessor based on the current environmental standards and land use. The assessor is unable to certify against undiscovered environmental liabilities due to the nature of the investigation and the limited data available. In evaluating the property, WSP has relied in good faith upon representation and information supplied by individuals noted in the report with respect to existing property conditions. Accordingly, WSP accepts no responsibility for any deficiency or inaccuracy in this report as a result of omissions, misstatements or misinterpretations of the persons involved. In addition, WSP will not accept liability for loss, injury, claim or damage arising from any use or reliance on this report as a result of misrepresentation or fraudulent information.

This report was prepared from information collected during site visits and review of available environmental online information. This report has been prepared by Christina LaFlamme, M.Sc., EP, and reviewed by W. R. (Bill) MacMillan, P.Eng., M. Sc.

Yours truly,  
**WSP Canada Inc.**



Christina LaFlamme, M.Sc., EP  
Project Manager / Environmental Scientist



W.R. (Bill) MacMillan, P.Eng., M. Sc.  
Senior Geoenvironmental Engineer  
Manager | Environment (NB)



## 8 REFERENCES

- 3+ Corporation. (2014). *Greater Moncton Regional Community Profile*. Retrieved 12 08, 2016, from <http://colston.ca/wp-content/themes/colston/images/greater-moncton-community-profile.pdf>
- Canadian Council of Ministers of the Environment. (2007). *Canadian Water Quality Guidelines for the Protection of Aquatic Life: Nutrients, Canadian Guidance Framework for the Management of Nearshore Marine Systems*. In C. C. Environment, *Canadian Environmental Quality Guidelines, 1999*. Winnipeg: Canadian Council of Ministers of the Environment.
- City of Moncton. (2013, 12 03). Zoning Map. Moncton, NB, Canada. Retrieved 12 09, 2016, from <https://www.moncton.ca/Assets/Residents+English/Zoning+Map+updated+November+22+2016.pdf>
- City of Moncton. (2016). *Moncton Statistics*. Retrieved 12 08, 2016, from City of Moncton: [https://www.moncton.ca/Business/Moncton\\_Statistics.htm](https://www.moncton.ca/Business/Moncton_Statistics.htm)
- Department of Environment and Local Government. (2015). *Ecole Champlain Air Quality Study*. Fredericton: Government of New Brunswick.
- Dilworth, T. (1984). *Land Mammals of New Brunswick*. Fredericton: Unipress Ltd.
- Gorham, S. (1970). *The Amphibians and Reptiles of New Brunswick. Monograph Series No.6*. Saint John: NB Museum.
- Government of Canada. (2015, 11 23). *Air Quality Health Index Categories and Health Messages*. Retrieved 12 08, 2015, from Environment and Climate Change Canada: <http://www.ec.gc.ca/cas-aqhi/default.asp?lang=En&n=79A8041B-1>
- Government of Canada. (2016, 06 07). *Air Quality Health Index*. Retrieved 11 24, 2016, from Environment and Climate Change Canada: <http://www.ec.gc.ca/cas-aqhi/default.asp?lang=En&n=CB0ADB16-1>
- Government of Canada. (2016, April 19). *Canadian Climate Normals 1981-2010: Moncton New Brunswick*. Retrieved from Climate Normals & Averages: [http://climate.weather.gc.ca/climate\\_normals/results\\_1981\\_2010\\_e.html?searchType=stnName&txtStationName=Moncton&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=6207&dispBack=0](http://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=Moncton&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=6207&dispBack=0)
- Government of New Brunswick. (2008). *New Brunswick Groundwater Chemistry Atlas: 1994-2007*. Sciences and Reporting Branch - Sciences and Planning Division - Department of Environment.
- Government of New Brunswick. (2016). *Air Quality Health Index (AQHI)*. Retrieved 12 06, 2016, from Office of the Chief Medical Officer of Health (Public Health): [http://www2.gnb.ca/content/gnb/en/departments/ocmoh/healthy\\_environments/content/air\\_quality.html](http://www2.gnb.ca/content/gnb/en/departments/ocmoh/healthy_environments/content/air_quality.html)
- Government of New Brunswick. (2016). *New Brunswick Counties*. Retrieved 12 09, 2016, from Provincial Archives of New Brunswick: <http://archives.gnb.ca/exhibits/forthavoc/html/Counties.aspx?culture=en-CA>
- New Brunswick Department of Environment and Local Government. (2015). *Ecole Champlain Air Quality Study*. Fredericton: Government of New Brunswick.
- New Brunswick Department of Environment and Local Government. (Undated). *Air Quality Monitoring in New Brunswick*. Fredericton: New Brunswick Department of Environment and Local Government.
- New Brunswick Department of Environment and Local Government: Sciences and Reporting Branch - Sciences and Planning Division. (2008). *New Brunswick Groundwater Chemistry Atlas: 1994-2007*. Fredericton: Government of New Brunswick.
- New Brunswick Department of Natural Resources. (2008). *Bedrock Geology of New Brunswick, Map NR-1 (2008 Edition), Scale 1:500,000*. Fredericton: NBDNR - Minerals, Policy and Planning Division.
- New Brunswick Department of Natural Resources. (2015, August 18). *NB Data Catalogue - Forest Soils*. Retrieved from GeoNB: <http://www.snb.ca/geonb1/e/DC/catalogue-E.asp>
- New Brunswick Environment and Local Government. (n.d.). *An Introduction to Air Quality in New Brunswick*. Retrieved 11 24, 2016, from <http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Air-Lair/IntroductionAirQuality.pdf>
- Office of the Chief Medical Officer of Health (Public Health). (2016). *Air Quality Health Index (AQHI)*. Retrieved from Healthy Environments: [http://www2.gnb.ca/content/gnb/en/departments/ocmoh/healthy\\_environments/content/air\\_quality.html](http://www2.gnb.ca/content/gnb/en/departments/ocmoh/healthy_environments/content/air_quality.html)

- Petitcodiac Watershed. (2016). *Humphrey's Brook*. Retrieved 12 08, 2016, from Petitcodiac Watershed Alliance: <http://petitcodiacwatershed.org/education/watershed/humphreys-brook/>
- Petitcodiac Watershed. (2016). *The Petitcodiac River*. Retrieved 12 08, 2016, from Petitcodiac Watershed Alliance: <http://petitcodiacwatershed.org/education/watershed/petitcodiac-river/>
- Rampton, V. (1984). *Generalized Surficial Geology Map of New Brunswick, NR-8, 1:500,000 scale*. Fredericton: New Brunswick Department of Natural Resources and Energy - Minerals Policy and Planning Division.
- Squires, W. (1976). *The Birds of New Brunswick, 2nd Edition, Monograph Series N.7*. Saint John: NB Museum.
- Zelanzny, V. (2007). *Our Landscape Heritage - The Story of Ecological Land Classification in New Brunswick, 2nd edition*. Fredericton: NBDNR - Ecosystem Classification Working Group.



