

9.3 Atmospheric Resources

9.3.1 Climate

NS has a "temperate continental" climate (Rudloff, 1981) marked by relatively large daily and day-to-day ranges of temperature, especially during the spring and fall, and moderate rainfall. NS lies in the "prevailing westerlies" characteristic of mid-latitudes in the northern hemisphere. Within this general circulation are embedded air masses originating at higher or lower latitudes that interact to produce storm systems. NS experiences a relatively large number of storm systems that contribute to a roughly twice-weekly shift between fair and cloudy and stormy weather.

The continental climate is modified by NS's surrounding waters (EC, 2007a). The Atlantic and Bay of Fundy waters are relatively cold (8°C to 12°C) which helps to keep the air temperature over southwestern NS on the cool side in spring and summer. In January, when water temperatures are between 0°C and 4°C, winter temperatures are moderated. Farther offshore to the east, southeast, and south are the comparatively warm 16°C waters of the Gulf Stream that are credited with prolonging warm weather well into October.

Ice conditions in the Gulf of St. Lawrence retard the arrival of spring. Cool summer seas also help stabilize overriding air masses, thus suppressing local storm development. In addition, the merging of contrasting ocean currents (i.e., warm Gulf Stream and the cold Labrador Current) produces a great deal of sea fog that often moves far inland. The climatic normals of the assessment area are described in detail below.

9.3.1.1 Climate Normals for the Region

The climate of the Project area is best characterized by long-term meteorological data collected by EC at Stillwater-Sherbrooke (Table 9.3-1) and at Halifax-Shearwater station (Table 9.3-2). Stillwater-Sherbrooke is at an elevation of 14 m with latitude 45° 09' N and longitude 61° 59' W and is located approximately 25 km northeast of the Project area. The Halifax-Shearwater station is at an elevation of 51 m with latitude 44° 38' N and longitude 63° 30' W and is located approximately 160 km southwest of the Project area and is included for its wind speed and direction data since these parameters are not available from the Stillwater-Sherbrooke station.

These distances from the site support their spatial representativeness since they place them in the same general synoptic flow regime as well as most mesoscale systems. The Stillwater-Sherbrooke and Halifax-Shearwater stations are also located in a similar geographic setting as the Project area. These stations are the closest to the Project area and provide the commonly observed meteorological parameters.

Table 9.3-1 Stillwater-Sherbrooke Climate Normals (1971-2000) and Extremes (1967-2001)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Daily Average (°C)	-6	-5.7	-1.2	4	9.2	14.4	18.3	18.4	14.3	8.8	3.8	-2.2
Daily Maximum (°C)	-0.9	-0.5	3.6	8.4	14.6	20.3	24	23.9	19.8	13.9	7.8	2.2
Daily Minimum (°C)	-11	-10.8	-6	-0.5	3.8	8.5	12.7	12.9	8.7	3.7	-0.3	-6.5
Extreme Maximum (°C)	17.5	14.5	25.5	23.3	32	35	34	32.5	32.2	26.7	18.5	15.5
Date (yyyy/dd)	1995/16	1981/23	1998/31	1973/18	1992/22	1976/24	1999/18	1991/14	1969/01	1968/02	1983/05	1998/01
Extreme Minimum (°C)	-31	-39	-29	-12.5	-6.1	-2.2	3.5	1.7	-3	-7	-15.5	-32.5
Date (yyyy/dd)	1993/16	1985/07	1985/07	1986/05	1972/14	1969/01	1993/18	1968/20	2000/30	1993/11	1989/25	1998/01
Precipitation												
Rainfall (mm)	94.5	72.9	97.9	102.1	126.1	112.5	97.1	109.9	122.9	141.5	149	118.9
Snowfall (cm)	42.6	41.8	29.2	14.2	0.5	0	0	0	0	0	9.1	34.7
Precipitation (mm)	137	114.7	127.1	116.2	126.6	112.5	97.1	109.9	122.9	141.5	158.1	153.6
Extreme Daily Rainfall (mm)	96	71.2	80	85	105.9	78.7	75	134.8	142.6	81.3	89.6	114.3
Date (yyyy/dd)	1990/26	1988/16	1972/23	1982/28	1972/16	1970/27	1983/22	1990/01	1996/14	1996/10	1983/16	1975/10
Days With												
Maximum Temperature >0°C	14	14.3	24.5	29.5	31	30	31	31	30	31	28.8	20.9
Measureable Rainfall	6.2	5.4	7.2	9.4	11	9.9	8.5	8	9	10.9	11.4	8.4
Measureable Snowfall	7.3	6.7	4.3	2.3	0.15	0	0	0	0	0.08	2.2	5.7
Measureable Precipitation	11.6	10.5	10.2	10.9	11	9.9	8.5	8	9	10.9	12.4	12.4

Source: EC, 2007a

Table 9.3-2 Halifax Shearwater Climate Normals (1971-2000) and Extremes (1944-2001)

Wind Speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Speed (km/h)	18.1	17.7	17.8	16.9	14	12.8	11.3	11.1	12.8	14.8	16.5	17.7	15.1
Most Frequent Direction	W	NW	NW	N	S	S	S	SW	SW	W	NW	W	W
Maximum Hourly Speed	83	97	78	85	72	77	87	60	97	80	89	89	
Date (yyyy/dd)	1990/30	1963/20	1986/07	1962/13	1961/20	1964/12	1975/28	1956/08	1954/11+	1962/07	1958/29	1956/30+	
Extreme Minimum (°C)	127	146	148	122	106	111	114	93	126	132	121	150	
Date (yyyy/dd)	1960/03	1976/02	1976/17	1962/13	1961/03	1964/12	1975/28	1986/09	1958/29	1963/29	1963/08	1956/30	
Direction of Maximum Gust	S	S	SW	NE	W	NW	S	SW	N	S	NE	SW	SW

Source: EC, 2007a

Notes:

W = west
 NW = northwest
 N = north
 SW = southwest
 NE = northeast
 km/h = kilometres per hour

9.3.1.2 Precipitation

NS is wettest over the highlands of Cape Breton Island, where over 1600 mm of precipitation fall in an average year. The southern coast experiences almost as much, with totals of 1500 mm. By contrast, the north shore along the Northumberland Strait has less than 1000 mm a year.

Precipitation is slightly greater in the late fall and early winter because of the more frequent and intense storm activity. In most years there is a good supply of rain during the spring and summer. However, drought is not unknown in NS.

On average, only about 15% of NS's total annual precipitation originates as snow. Snowfall is relatively light near the warm Atlantic shore and near the entrance to the Bay of Fundy, where less than 150 cm may fall in one winter. Here, copious rain and freezing rain make up for the scanty snowfalls. Inland, the yearly snowfall increases to 250 cm. As a rule, elevated areas receive the greatest snowfall and have the longest snow cover season.

The snow-cover season, that is, the period when there is at least 2.5 cm of snow on the ground, varies considerably. Usually its duration extends from about 110 days a year along the southern coast to 140 days inland and in areas adjacent to the frozen seas. In coastal areas the snow-cover may come and go. The average annual precipitation reported at the Stillwater-Sherbrooke station is 1517.2 mm, of which approximately 11% per cent is in the form of snow. The extreme daily precipitation recorded between 1971 and 2001 was 142.6 mm, which occurred in September (Table 9.3-1). Total monthly precipitation ranges from 97.1 mm to 158.1 mm.

9.3.1.3 Fog and Sunshine

Each year there is an average of 115 days with fog at Canso and 101 days with fog at Shearwater. Canso is located approximately 55 km from the proposed Project site. The period from mid-spring to early summer is the foggiest time. Bands of thick, cool fog lie off the coast, produced where the chilled air above the Labrador Current mixes with warm, moisture-laden air moving onshore from the Gulf Stream. With onshore winds these banks of fog move far inland. Sea fog often affects the headlands by day, moving inland and up the bays and inlets at night. At other times of the year fog is much more transient and local in nature.

Because of the extensive fogs, as well as mists, and low cloud, sunshine amounts throughout the province are usually less than half the total possible. Sunshine totals range from 1700 to 1969 hours a year. August is the sunniest month along the coast. Sunless days (days with less than five minutes of bright sunshine) amount to between 75 and 90 a year, with a marked seasonal high from November to February. Sunny days, on which less than 70% of the sky is covered with cloud in the early afternoon, amount to between 130 to 160, with a peak from July through October.

9.3.1.4 Severe Weather

Storms frequently pass close to the Atlantic coast of NS and cross the southern part of Newfoundland, producing highly changeable and generally stormy weather. This region has more storms over the year than any other region of Canada. With a variety of weather conditions from hurricane-force winds to heavy precipitation, storm systems can pass rapidly through or stall and batter the region for several days. Other conditions associated with these storms include freezing spray, reduced visibility in snow, rain, or fog, and numbing wind chills, especially in the storm's wake.

In late summer and fall the remnants of a hurricane or tropical storm are felt at least once a year in NS. For example in September, 2003, Hurricane Juan struck Atlantic Canada with peak winds of 165 km/h. Juan resulted in eight fatalities and over 200 million dollars in damage and was described as the worst storm to hit Halifax since 1893 (EC pers. comm., 2003).

Thunderstorms are infrequent in NS and occur on about 10 days of the year. The most winter lightning in Canada occurs in an area south of Sable Island, in the Atlantic Ocean. Cold air moving down from the Arctic collides with warmer air rising from the Gulf Stream. This collision creates ideal conditions for thunderstorms and lightning (EC, 2007b).

Tornadoes have been recorded but are rare. Reports of waterspouts over near-shore waters are received yearly. Other severe weather phenomena include ice storms and blizzards. Each year one or two 25 cm snowfalls occur in NS. When combined with strong winds, impacts can include property damage and loss of life.

9.3.1.5 Thermal Inversions

Under certain conditions, an atmospheric thermal inversion layer occurs. Thermal inversions result when a layer of cooler air is trapped near ground level by a layer of warmer air above. Under these conditions, the vertical motion of air flow is strongly suppressed. If the base of the inversion lies above the level of the plume, then the volume of air available for dilution is limited. The elevated inversion acts as a lid, restricting vertical mixing, reducing dilution and increasing ground-level concentrations in areas with high emissions.

Temperature Inversions are expected to be experienced for short durations in the assessment area due to the influence of the sea-land interphase. The temperature inversions are particularly important due to the ability to hinder dispersion or to promote a phenomenon known as fumigation (trapping of stack emissions near the ground).

9.3.1.6 Temperatures

The range of temperatures at the site is rather large from winter to summer. Summers are relatively cool; for example, the warmest average daily maximum temperature recorded at the Stillwater-Sherbrooke station from June to July was 24 °C. The record high temperature at Stillwater-Sherbrooke is 35 °C in the month of June. Winters are cold with an average daily minimum temperature in January at Stillwater-Sherbrooke of -11.0 °C. The lowest recorded temperature at Stillwater-Sherbrooke is -39 °C. The most significant aspect of winter is the marked day-to-day variation caused by the alternation of Arctic and maritime air.

9.3.1.7 Winds

The wind at any given location is often quite different from the wind conditions which prevail even a short distance away. Wind direction and speed varies as a result of natural and man-made obstructions, topography, and surface cover. Along the coast, an onshore sea breeze circulation often sets up, particularly during a warm, sunny afternoon in the spring or early summer.

Unfortunately, wind data is not available from the Stillwater-Sherbrooke Station. Wind information is available from the Halifax-Shearwater station and at a station located on Beaver Island which is located 75 km southwest of the Project area. Winds at Halifax-Shearwater are fairly light with the highest speeds occurring in the winter with an average of 17.8 km/h for those months. A peak gust of 150 km/h was recorded in December 1956. The lightest winds occur in summer with a monthly average wind speed of 11.1 km/h in August. The mean wind speed for the year is 15.1 km/h. The prevailing wind direction at Halifax-Shearwater is from the south or southwest from May through September and from the west or northwest from October through April.

Wind statistics taken between 1988 and 1999 from Beaver Island showed average monthly near shore wind speeds between 19 and 31 km/h. Extreme average hourly wind speeds ranged between 65 and 98 km/h. Westerly winds predominated, with stronger winds from the northwest (November to January) than the southeast (Meteorological Service of Canada, 2000).

9.3.1.8 Climate Update and Predicted Future Trends

Climate normals for 1971-2000 used during the previous studies (AMEC, 2006) remain the standard reference for current studies; therefore, the existing climate information described above is still valid. However, considerable advances have been made in prediction of future trends, particularly with respect to global warming and sea-level rise. This new information is best summarized for NS in *Scenarios and Guidance for Adaptation to Climate Change and Sea-Level Rise – NS and [Prince Edward Island] PEI Municipalities* (Richards and Daigle, 2011). This document includes climate change modeling results for various municipalities and has been used to generate regional predictions for Guysborough County. Key climate parameters are presented in Table 9.3-3 for the current Normals period (1971-2000), and future scenarios that represent the following two 30 year averaging periods. It can be seen that there is a predicted minor increase in average temperature and rainfall over the life of the Project; which will cause relatively small changes in regional hydrology. The number of very hot and very cold days, annually, is predicted to remain about the same for Guysborough County over the life of the Project (Richards and Daigle, 2011).

Table 9.3-3 Guysborough, NS, Climate Change Scenario Data

Parameter	Historical 1980s	Projected 2020s	Projected 2050s
Average Temperature (°C)			
Annual	5.8	6.7	7.8
Winter	-3.2	-2.2	-1.0
Spring	2.4	3.4	4
Summer	14.1	15.1	16.2
Autumn	9.6	10.6	11.7
Average Precipitation (mm)			
Annual	1425.8	1452.8	1461.3
Winter	352.6	363.9	371.7
Spring	359.7	369.5	375.9
Summer	307.5	312.6	308.1
Autumn	405.9	405.9	403.3
Days with rain	137.1	143.9	147.4
Days with snow	24.5	42.6	34.2
Freeze free season days	82.5	78.6	69.7
Freeze-thaw cycles - annual	224.3	244.5	264.2
Water surplus (mm)	1148.3	971.0	964.0
Water deficit (mm)	13.8	15.9	20.0
Change in intensity of short term rainfall (%)	0	5	9

The total sea levels presented in Table 9.3-4 are intended to represent the worst case flooding scenario resulting from the simultaneous occurrence of a significant storm surge event for the return-period and the highest astronomical tide possible (i.e., Higher High Water at Large Tide) (Richards and Daigle, 2011). The return-periods are derived statistically and can be thought of as the number of years over which a flood level of that size will occur once. The sea level rise indicated for Canso Harbour (Table 9.3-4) would be similar for Country Harbour. It can be seen that there is a predicted sea level rise of approximately 45 cm and resulting increase in potential storm surge flood elevation over the Project lifetime.

Table 9.3-4 Extreme Total Sea Level, Canso Harbour, NS

Return Period	Level 2000	Level 2025	Level 2055
Sea Level Rise from Climate Change		0.16 +/- 0.03	0.45 +/- 0.15
10 yr return period	2.56 +/- 0.20	2.72 +/- 0.23	3.01 +/- 0.35
25 yr return period	2.66 +/- 0.20	2.82 +/- 0.23	3.11 +/- 0.35
50 yr return period	2.73 +/- 0.20	2.89 +/- 0.23	3.18 +/- 0.35
100 yr return period	2.80 +/- 0.20	2.96 +/- 0.23	3.25 +/- 0.35

One other important issue related to climate change is the generally accepted prediction that the number and perhaps severity of extreme weather events will increase (Richards and Daigle, 2011). This is as yet poorly defined using current knowledge and techniques, such that the absolute number or severity of seasonal storms cannot be predicted beyond recent trends.

However, the best available professional judgment is that these will increase in NS over the lifetime of the Project.

Predictions of future extreme wind and waves in the marine environment are described in Section 9.6.1, below.

For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.18.

9.3.2 Regional Air Quality Baseline

Baseline ambient air quality data were obtained from continuous ambient air quality monitoring stations in the Project area and federal emission inventory reports. Emission inventory information is presented based on the 2012 National Inventory Report, *1990 – 2010, Greenhouse Gas Sources and Sinks in Canada* (EC, 2012a).

The specific air contaminants that are of most interest relative to the impact of the Pieridae facility operations consist of the following:

- SO₂, formed when fuel containing sulphur, such as coal and oil, is burned, and when gasoline is extracted from oil, or metals are extracted from ore;
- NO_x, generated when fuel is burned at high temperatures as in a combustion process;
- CO, formed from the incomplete combustion of carbon-containing fuel;
- total suspended particulates (TSP), PM with aerodynamic diameter less than a nominal 10 micrometers (PM₁₀) and less than 2.5 micrometers (PM_{2.5}), terms for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets; and
- VOCs.

According to a 2012 emissions inventory reported by EC, the only other significant source of air emissions within 25 km of the Project area is the SOEI gas plant and metering station that is adjacent to the Pieridae site. As a result of the lack of industry in the Project area, the only available background air quality data consist of short-term monitoring data collected by ExxonMobil at their SOEI gas plant. This facility is the primary contributor to ambient concentrations of most air contaminants in the area. Background ozone concentrations are primarily the result of long range transport of ozone and its precursors (i.e., NO_x and VOC) from upwind regions, primarily from the south and west.

Continuous monitoring for NO₂ and SO₂ near the Goldboro plant was conducted in Seal Harbour from June 10, 2004, through August 10, 2004. There are no other longer term background air quality data available that are representative of this area.

The highest monitored 24-hour NO₂ concentration during this two month period was approximately 3.8 micrograms per cubic metre (µg/m³) and the highest SO₂ value was 10.5 µg/m³. The NAAQO provides an ambient air objective for NO₂ of 200 µg/m³ and an objective for SO₂ of 300 µg/m³ for a 24 hour averaging period.

Monitoring for TSP and PM_{2.5} at Seal Harbour was conducted for three 24-hour periods in each of July, August, and September of 2004. The highest monitored 24-hour TSP concentration during this three month period was 19.8 µg/m³ and the highest PM_{2.5} value was 4.0 µg/m³. NS has an ambient air objective of 120 µg/m³ for a 24 hour averaging period. The CCME (2000) provides a Canadian-Wide Standard for PM_{2.5} of 30 µg/m³, based on a 24-hour average over three consecutive years.

NS has an *Environment Act*, which includes the Air Quality Regulation. The Air Quality Regulation contains maximum permissible ground level concentrations for air quality in NS. The *Environment Act* states that “no person shall knowingly commence or continue any activity designated by the regulation as requiring an approval unless that person holds the appropriate approval.” The Activities Designation Regulation indicates which sectors require an Approval to Construct and/or an Approval to Operate (CCME, 2012).

The Approvals to Operate are valid up to 10 years. The Province has also developed guidelines and standards with respect to industrial air emissions, though these are not binding unless they are included in the Approval. Quantification methodologies are prescribed in the Approvals, as are reporting requirements. The Air Quality regulations also indicate reporting requirements for specific scenarios and emission thresholds.

The quantification and reporting information collected is used to determine compliance with Approvals.

NSE has established maximum permissible ground level concentrations for ambient air quality in NS. All approvals issued by the Minister of Environment contain provisions to ensure that the maximum permissible ground level concentrations are not exceeded.

Table 9.3-5 shows the applicable provincial criteria relating to ambient air quality.

Table 9.3-5 NS Provincial Ambient Air Quality Maximum Permissible Ground Level Concentrations

Pollutant	Averaging Time Period	Maximum Permissible
NO ₂ (µg/m ³)	1 hour	400
	24 hour	-
	Annual	100
SO ₂ (µg/m ³)	1 hour	900
	24 hour	300
	Annual	60
H ₂ S (µg/m ³)	1 hour	42
	24 hour	8
TSP (µg/m ³)	24 hour	120
	Annual	70
PM ₁₀ (µg/m ³)	24 hour	-
PM _{2.5} (µg/m ³)	24 hour	-
CO (mg/m ³)	1 hour	34, 600
	8 hour	12, 700

The CCME (2000) have developed a Canada-Wide Standard for $PM_{2.5}$ of $30 \mu g/m^3$, based on a 24-hour average over three consecutive years.

It should be noted that in October 2012 jurisdictions, with the exception of Quebec, agreed to begin implementing a new air quality management system. Air Quality Management System is a comprehensive approach for improving air quality in Canada and is the product of collaboration by the federal, provincial and territorial governments and stakeholders. It includes:

- New Canadian Ambient Air Quality Standards to set the bar for outdoor air quality management across the country.
- Industrial emissions requirements that set a base of performance for major industries in Canada.
- A framework for air zone air management within the provinces and territories that enables action tailored to specific sources of air emissions in a given area.
- Regional airsheds that facilitate coordinated action where air pollution crosses a border.
- Improved intergovernmental collaboration to reduce emissions from the transportation sector.

The Canadian Ambient Air Quality Standards will be established as objectives under the CEPA, and will replace the existing Canada-Wide Standards under CCME (2000). Standards for fine PM and ground-level ozone have been developed and work has begun on standards for NO_2 and SO_2 . Table 9.3-6 provides a list of the Canadian Ambient Air Quality Standards fine PM and ozone standards.

Table 9.3-6 Canadian Ambient Air Quality Standards for Fine Particulate Matter ($PM_{2.5}$) and Ozone

Pollutant	Averaging Time	Standards (numerical values)		Metric
		2015	2020	
$PM_{2.5}$	24-hour (calendar day)	$28 \mu g/m^3$	$27 \mu g/m^3$	The 3-year average of the annual 98 th percentile of the daily 24 hour average concentrations.
$PM_{2.5}$	Annual (calendar year)	$10 \mu g/m^3$	$8.8 \mu g/m^3$	The 3-year average of the annual average concentrations.
Ozone	8-hour	63 parts per billion (ppb)	62 ppb	The 3-year average of the annual 4 th highest daily maximum 8 hour average concentrations.

Source: CCME, 2010

The new Air Quality Management System is designed to address the challenges of air quality management, including cross-jurisdictional issues, and deliver a Canada-wide approach that

provides flexibility to deal with regional differences in air quality issues while, at the same time, ensuring a level of consistency so that Canadians can be assured of good air quality outcomes.

For industry, the Air Quality Management System proposes establishing base-level industrial emissions requirements in major industrial sectors, initially for SO₂, NO_x, VOCs and TPM. Eventually other pollutants may be addressed. The Base-level Industrial Emissions Requirement are intended to ensure that all significant industrial sources in Canada, regardless of where facilities are located, meet an acceptable benchmark of environmental performance. Wherever possible, the Base-level Industrial Emissions Requirement would build on existing pollution controls, agreements and protocols that assure the appropriate standard of emissions performance.

Base-level Industrial Emissions Requirement would be set under a federally lead, time-limited federal/provincial/territorial consensus process, with stakeholder involvement, and will be reviewed regularly to ensure they reflect technological improvements.

9.3.2.1 Criteria Air Contaminants (CAC) and Greenhouse Gases (GHG)

It is useful to examine the existing releases of air contaminants from local sources in the assessment area. This serves as a benchmark for comparing the emissions related to the proposed Project and to assist in the assessment of cumulative environmental effects. These existing releases of air contaminants are generally classified into two categories: Criteria Air Contaminants (CACs), which include PM, SO₂, NO₂, CO and GHGs.

Criteria Air Contaminant (CAC) Emissions

This section provides a summary of CAC emissions for all sources in NS (Table 9.3-7) and for major regulatory permitted industrial sources (Table 9.3-8, below) in the area that submit emissions information to the National Pollutant Release Inventory (NPRI). The NPRI is a legislated, nation-wide, publicly accessible inventory of pollutants released, disposed of, and recycled by facilities in Canada. Facilities which meet reporting requirements are required to report to the NPRI under the CEPA.

Table 9.3-7 NPRI 2011 CAC Emissions of NS (t/year)

Category	Total PM	PM ₁₀	PM _{2.5}	SO _x	NO _x	VOC	CO	NH ₃ ¹
Industrial Sources	11907	3578	1747	6118	3469	4967	2039	53
Non Industrial Fuel Combustion	7339	6345	5903	68789	20761	8468	37939	107
Total Mobile Sources	3142	3051	2741	17357	40376	12242	173197	663
Incineration	-	-	-	7	8	6	18	1
Open Sources	353222	87862	16389	446	165	2007	497	4296
Miscellaneous	240	240	240	-	-	11581	91	48
Total	375982	101188	27111	92736	65332	269784	214861	5170

Source: EC, 2012b

Note:

1. NH₃ = Ammonia

A review of Table 9.3-7 indicates that the majority of PM and NH₃ emissions in the province originate from open sources. Open sources include agriculture, construction activities, paved and unpaved roads, forest fires, landfill sites, mine tailings, and prescribed burning. Non industrial fuel combustion sources such as commercial and residential fuel combustion, electric power generation, and residential fuel wood combustion generated the most SO₂. The total mobile source category accounted for the most NO_x, VOC and CO emissions. Mobile sources include air and marine transportation, diesel and gas vehicles and rail transportation.

Table 9.3-8 provides a summary of CAC emissions from regulatory permitted point sources in the area.

Table 9.3-8 Emissions from Permitted Point Sources in the Assessment Area - 2011

Source (Permit No.)	CAC Emissions (t/year)						
	CO	NO _x	SO ₂	VOCs	TSP	PM ₁₀	PM _{2.5}
SOEI gas plant, ExxonMobil Canada (5012)	43	391	--	22	--	3.8	3.8

Source: EC, 2012b

A review of Table 9.3-8 indicates that the only reported permitted point source in the assessment area in 2011 was the SOEI gas plant.

Greenhouse Gases (GHG)

GHGs including CO₂, CH₄, and nitrous oxide (N₂O) can be emitted from a number of natural and anthropogenic sources. Emissions from biogenic or other sources generally exhibit little variation from one year to the next, and are considered to be nominal when compared to those resulting from the combustion of fossil fuels.

Total GHG emissions are normally reported as CO₂-equivalents (CO₂e). This is accomplished by multiplying the emission rate of each compound by the global warming potential relative to CO₂. CO₂e considers the Global Warming Potential of the three main GHGs: CO₂, CH₄ and N₂O. The Global Warming Potential of these gases are as follows: CO₂ = 1.0, CH₄ = 21 and N₂O = 310. Therefore, the CO₂e is equal to ((CO₂ mass x 1.0) + (CH₄ mass x 21) + (N₂O mass x 310)).

The Canada total GHG emissions for the years 1990 and 2010 are presented in Table 9.3-9 (EC, 2012a).

Table 9.3-9 GHG Emissions: Canada

Sector	1990 Emissions (Mt ¹ CO ₂ e)	2010 Emissions (Mt CO ₂ e)
Energy	467	562
Industrial Processes	56	51.8
Solvent and Other Product Use	0.18	0.24
Agriculture	47	56
Land Use, Land-Use Change and Forestry	-67	72
Waste	19	22
Total	589	692

Source: EC, 2012a

Note:

1. Million tonnes (Mt)

In 2010, energy use for stationary combustion sources accounted for almost 81% of the CO₂e emitted in Canada. There is an increasing trend in GHG emissions. Between 1990 and 2010, Canada saw GHG emissions rise by 103 Mt CO₂e (approximately 17%).

The NS total GHG emissions for the years 1990 and 2010 are presented in Table 9.3-10.

Table 9.3-10 GHG Emissions: NS

Sector	1990 Emissions (Mt CO ₂ e)	2010 Emissions (Mt CO ₂ e)
Total	19.1	20.4

Source: EC, 2012a

Between 1990 and 2010, NS saw GHG emissions rise by 1.3 Mt CO₂e (approximately 7%).

The total GHG emissions for the SOEI gas plant for the Year 2010 are presented in Table 9.3-11.

Table 9.3-11 GHG Emissions from Permitted Point Sources in the Immediate Assessment Area – 2010

Point Sources	CO ₂	CH ₄	N ₂ O	Total
SOEI gas plant (5012) Sum (t)	84673.92	341.76	7.75	
Sum (t CO ₂ e)	84674	7177	2403	94254

Source: EC, 2012a

The 2010 total SOEI gas plant GHG emissions expressed as CO₂e is 0.09 Mt (EC, 2012a).

For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.4.

9.3.3 Acoustic Environment (Noise)

9.3.3.1 Regulatory Context

The Federal, Provincial, Municipal governments and WHO provide guidelines on noise assessment in the following documents:

- NSE Guideline for Environmental Noise Measurement and Assessment;
- WHO and the International Finance Corporation Guidelines for Community Noise;
- MODG Noise By-Law #29. Prevention of Excessive Noise; and
- Health Canada document Useful Information for Environmental Assessments.

The Provincial Guideline was developed to facilitate the evaluation of noise pollution in the environment and establish acceptable sound levels. Noise levels are frequently presented in A-weighted decibels (dB(A)); which measures relative loudness of sounds in air as perceived by the human ear. The guidelines for acceptable equivalent continuous sound levels (Leq) are:

- Leq of 65 dB(A) between 0700 to 1900 hours;
- Leq of 60 dB(A) between 1900 to 2300 hours; and
- Leq of 55 dB(A) between 2300 to 0700 hours.

Typical noise guidelines are usually related to time of day, since noise impacts are generally perceived as being of the nuisance variety in terms of human activity, which also varies by time of day. To ensure that a representative sample is collected during any one of the periods, a minimum of two continuous representative hours of data in one period is required, unless the sound being generated is reasonably steady and the Leq is not expected to change drastically.

The 'Guideline Values' are the criteria established by the Nova Scotia Department of the Environment in 1991, and are intended to reflect the effect that noise has on man. The Guideline states that "Noise legislation should be designed primarily to protect public health and within reasonable economic restraints provide a quiet and restful environment in which to live, work and play."

The WHO provides a night-time guideline for noise of 45 dB (L_{eq}) and 60 decibels (maximum sound level) (dB (L_{Amax})), which is acceptable level at the outside facades of living spaces.

Goldboro and surrounding area is governed by the MODG. The Municipality's Noise By-Law, By-Law #29, Prevention of Excessive Noise provides sections that refer to the governance of noise during the operation of combustion engines, such as gas turbines. The following provides pertinent excerpts from the By-Law:

- The discharge into open air of the exhaust of any steam engine, stationary internal combustion engine, or motor boat, except through a muffler or other device which will effectively prevent loud or explosive noises.
- The operation of any noise-creating blower, power fan or any internal combustion engine, the operation of which causes noise due to the explosion of gases or fluids,

unless the noise from such blower or fan is muffled and such engine is equipped with a muffler device sufficient to deaden such noise.

- The sounding of any signalling device for a period longer than would be reasonable under the circumstances.

In addition the By-Law states the following that applies to the operation of machinery during the construction phase:

- No person shall, in the Municipality, make any noise which disturbs or tends to disturb the peace and tranquillity of the Municipality or any portion thereof, and in particular, between the hours of 11:00 pm and 6:00 am.

Guidance for noise assessment is provided by Health Canada in their document Useful Information for Environmental Assessments, section 6 – Noise (Health Canada, 2012). Health Canada does not have noise guidelines or enforceable noise thresholds or standards. Responsible authorities (and/or provincial/ territorial authorities) are encouraged to consult with provincial and municipal authorities to determine which standards or regulations exist for the location of the proposed Project, as differences may exist in their respective approaches to limiting noise impacts.

Health Canada assesses the environmental impact of noise on sensitive receptors such as residences, based on the calculated Day-Night level (Ldn). The Ldn is determined by imposing a 10 decibels (dB) penalty to the night-time noise levels and calculating the subsequent 24 hour cumulative sound level. Night-time period is taken from 22:00-07:00 and daytime as 07:00-22:00. For quiet areas that are expected to continue to be quiet, Health Canada applies an Ldn of 45 dB(A).

The context for noise assessment may be assisted by an understanding of typical noise levels for a variety of scenarios/activities. These are described in Table 9.3-12.

Table 9.3-12 Typical Noise Values

Sound Level (dB(A))	Descriptor
0-25	Threshold for Normal Hearing
10	Normal Breathing
40 (generally lower limit of ambient sound)	Quiet Office, Quiet Residential Street
50	Rainfall
50-60	Typical Office
60-95	Typical Household Appliances
80-120	Typical Construction Equipment
110	Jet Takeoff

9.3.3.2 *Baseline Noise*

The general locale of the proposed facility is semi-rural in nature. However, its actual location is in an industrial park which is currently the site of the SOEI gas plant.

Ambient noise monitoring was performed near the proposed site on two occasions (Figure 9.3-1):

- in 2004 at the nearby SOEI gas plant site; and
- in 2007 at the proposed site as part of the environmental assessment for the proposed MapleLNG Terminal.

In September 2004, noise monitoring was conducted in the vicinity the SOEI gas plant at four locations (northeast, southeast, southwest, and northwest corners) within the property bounds (Figure 9.3-1).

The monitoring was conducted over a period of 24 hours (September 15-16, 2004), with measurements being taken once per minute in dB(A). Given the limited noise sources in the area, this sample can be considered representative of typical noise levels in the area of the Project. The results are reported as Leq. Leq is the level of a constant sound which, in a given situation and time period, has the same sound energy as does a time-varying sound. Technically, equivalent sound level is the level of the time-weighted, mean square, A-weighted sound pressure. Typical noise guidelines are usually related to time of day, since noise impacts are generally perceived as being of the nuisance variety in terms of human activity, which also varies by time of day. The results of this monitoring are summarized in Table 9.3-13 below.

Table 9.3-13 *Hourly Leq Range (dB(A)) SOEI Gas Plant, September 15-16, 2004*

Time Period	Leq Range	Guideline Value
14:00-18:00	45.5-63.7	65
18:00-23:00	38.6-54.8	60
23:00-07:00	38.5-52.7	55
07:00-14:00	39.1-61.4	65

In 2007, an ambient noise assessment was carried out by Jacques Whitford Limited for the Keltic Project EA (Jacques Whitford, 2007a). Ambient noise was monitored at the proposed Keltic plant (approximate location of the proposed Pieridae site) and at three residential receptors over a two day period October 17 to 19, 2007 (Figure 9.3-1). The on-site Keltic monitoring was located approximately 180 m north from the nearest point on the property boundary of MapleLNG and the only other significant man made noise source was the operating SOEI gas plant. The residential receptors were located 1.7 to 2.5 km from the proposed MapleLNG site. The results of this monitoring are summarized in Table 9.3-14 below.

Table 9.3-14 Ambient Noise Levels, October 17-19, 2007

Monitoring Location	Approximate Distance from MapleLNG Boundary	October 17, 2007 07:00-19:00 Leq (dB(A))	October 18, 2007 07:00-19:00 Leq (dB(A))	October 19, 2007 07:00-19:00 Leq (dB(A))
Keltic Project	250	47	45	45
Residence Isaac's Harbour	2480	37	27	26
Residence Goldboro Public Wharf	2070	51	46	46
Residence Drum Head	1710	39	37	32
Guideline Value	-	65	60	55

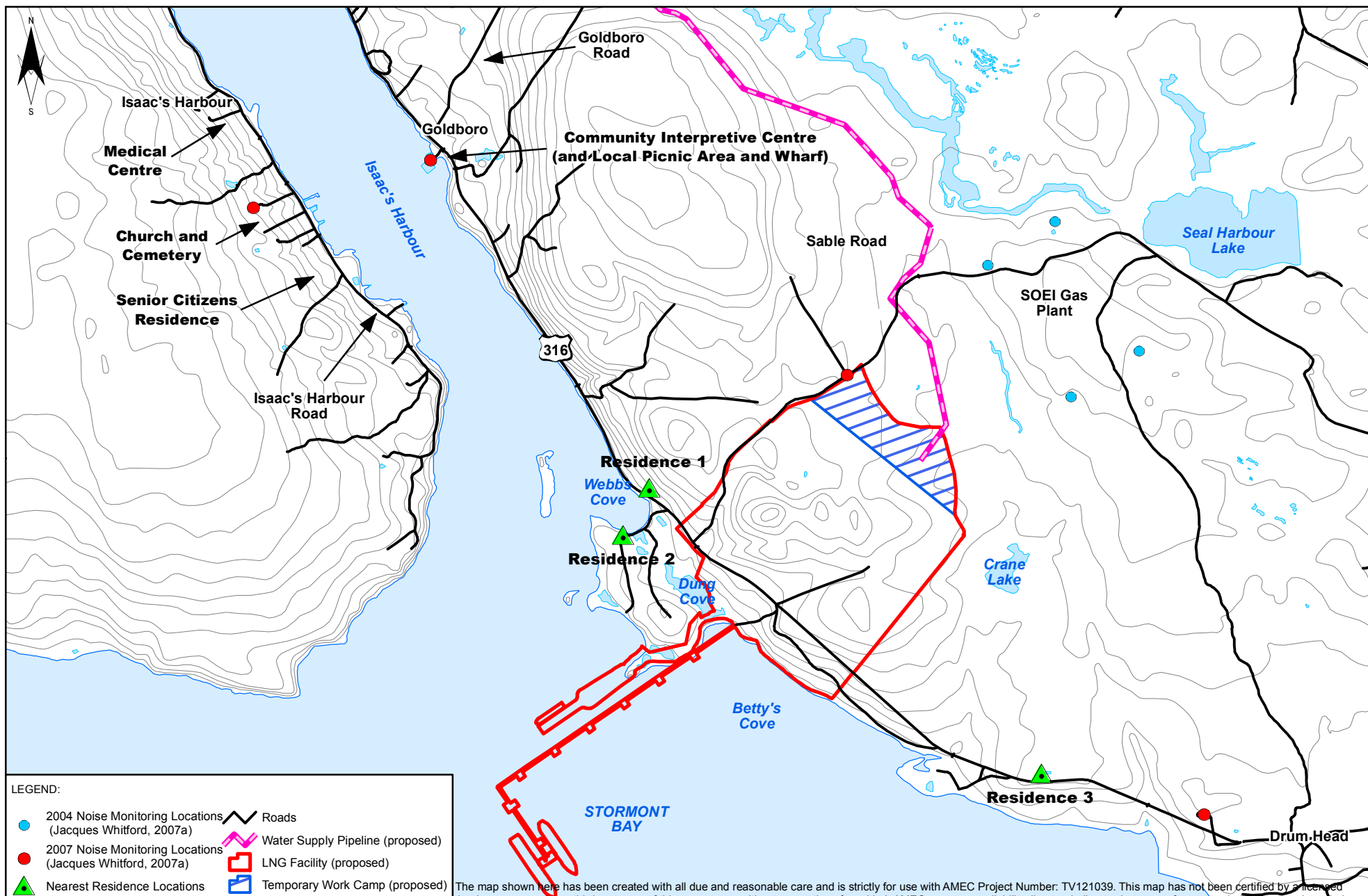
For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.5.

9.3.4 Ambient Lighting

Existing ambient light levels were not monitored in the Project area; however, they would be typical of a semi-rural environment with low levels of ambient luminance. There will be some slight impacts from the SOEI gas plant and associated flare stack. The three turbines installed in the Goldboro Industrial Park (Figure 1.7-2) are on 35 m towers with an overall height of approximately 43 m and are not required by NavCanada to have aeronautical lighting (Whitman, C., pers. comm., 2013). The artificial lighting in the surrounding community is consistent with that in sparsely populated rural communities.

Existing ambient light levels were not monitored in Meadow Lake. Meadow Lake is located in a dark rural area with no ambient electric light.



For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.6.



LEGEND:

- 2004 Noise Monitoring Locations (Jacques Whitford, 2007a)
- 2007 Noise Monitoring Locations (Jacques Whitford, 2007a)
- ▲ Nearest Residence Locations
- Roads
- Water Supply Pipeline (proposed)
- LNG Facility (proposed)
- Temporary Work Camp (proposed)

The map shown here has been created with all due and reasonable care and is strictly for use with AMEC Project Number: TV121039. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. AMEC assumes no liability, direct or indirect, whatsoever for any such third party unintended use.

CLIENT: Pieridae Energy (Canada) Limited	0 500 1,000 Metres DATUM: UTM Zone 20	PROJECT: ENVIRONMENTAL ASSESSMENT 	DWN BY: JT	DATE: Aug 2013
AMEC Environment and Infrastructure A Division of AMEC Americas Ltd. 50 Troop Avenue, Unit 300 Dartmouth, N.S., B3B 1Z1 (P) 902-468-2848 (F) 602-468-1314 	PROJECTION: NAD83 PROJECT NO: TV121039	TITLE: NEAREST SENSITIVE RECEPTORS AND BASELINE NOISE MONITORING LOCATIONS	CHK'D BY: TM/CL SCALE: 1:25,000	REV. NO: N/A FIGURE NO: 9.3-1

9.4 Terrestrial Environment

The description of the terrestrial biological environment includes habitat, vegetation and wildlife found in the proposed Project site and nearby areas, but is extended to include birds observed in the marine areas adjacent to the Project site, as well as birds observed near Harbour Island, Goose Island and Country Island.

A site survey by AMEC staff in September 2012 showed that the proposed LNG facilities site experienced little, if any, change since the Keltic Project follow-up studies in 2007 and 2008. Therefore, the description of the existing terrestrial environment presented in the Keltic Project EA (AMEC, 2006) remains largely valid. However, data have been reviewed, validated, updated and supplemented as necessary (particularly for SAR, odonates, and butterflies). Environmental components which have likely experienced change, or where data gaps have appeared related to updated legislation and policies (e.g., NSESA, SARA, MBCA, etc.) have been addressed in targeted field surveys carried out in 2012 and 2013.

The review of available existing information, included SOCC databases, federal and provincial government departments and agencies, non-profit groups, internet websites, existing reports and knowledgeable individuals. Sources include:

- Atlantic Canada Conservation Data Centre (ACCDC);
- *Keltic Petrochemicals and Liquefied Natural Gas Facility Environmental Assessment* (AMEC, 2006);
- NSDNR;
- NSE;
- NSMNH;
- Canadian Wildlife Service (CWS)/ EC; and
- other sources as indicated where applicable.

Figure 9.4-1 depicts the terrestrial habitat located within the proposed LNG facility with Figure 9.4-2 showing the locations of the identified wetlands. Figure 9.4-3 shows both the terrestrial and wetland habitats located at Meadow Lake and Figure 9.4-4 illustrates both the terrestrial and wetland habitats located along the proposed water supply pipeline.

9.4.1 Terrestrial Habitat and Vegetation

9.4.1.1 LNG Facility

The following description of existing terrestrial habitat at the LNG facility is based on observations during a reconnaissance survey conducted September 24 to 28, 2012. The purpose of the site visit was to compare the current conditions on the site with the description presented in the Keltic Project EA (AMEC, 2006) and available mapping, and to identify the extent of change and/or requirements for new information. Rare plant surveys were not carried out at that time due to the unsuitable phenology window, but were conducted in June 2013. Survey methods and photos are provided in Appendix D (Appendix D-1 and D-3).

Desk top reviews and the late September field survey were carried out in order to:

- describe existing habitats and develop a habitat map;
- confirm, identify, and describe significant habitats including wetlands;
- delineate and functionally assess wetlands in the LNG facility;
- identify high potential habitats for rare vascular plant species;
- conduct a rare lichen survey and evaluated existing habitats for their potential to support rare lichen species;
- identify and describe indications of previous disturbance; and
- record (opportunistic) wildlife sightings.

Forest inventory mapping available from NSDNR is based on aerial photography and satellite data. For Guysborough East, which includes the Goldboro LNG site, the data used the aerial photography from 1990 to 1998, satellite data last obtained 1999-2002, and treatment data from 2003 (NSDNR, 2011). The current Forest Inventory Maps for several counties, including Guysborough County, are in the process of being updated (NSDNR, pers. comm., 2013a). The current Forest Inventory Map (NSDNR 2007/2012) was reviewed (NSDNR, 2013b). The field survey confirmed that the Forest Inventory Map is not accurate in depicting current site conditions (see below); for example, an area coded as “old field” has now largely progressed to coniferous forest dominated by White Spruce (*Picea glauca*), with the remainder dominated by ericaceous shrubs.

Ecological Land Classification (ELC) links the abiotic and biotic components of each ecosystem. Climate, landform, and soil influence the distribution of vegetation (NSDNR, 2003). ELC therefore provides information on the factors that influence habitats present at the Project site. The site is located in the Acadian Forest Ecozone, the Atlantic Coastal Ecoregion (Ecoregion 8) and the Eastern Shore Ecodistrict (Ecodistrict # 820) (NSDNR, 2006). Ecodistrict 820 has an annual precipitation of 1426 mm, a growing season of 195 days, a mean annual temperature of 5.8°C, a mean summer temperature of 14.8°C and a mean winter temp of -3.7°C (NSDNR, 2003). The presence of the Atlantic Ocean has more influence on the forests in this ecodistrict than the soils, geology or landform. The ocean provides a consistent coastal climate, resulting in the absence of Red Spruce (*Picea rubens*), Sugar Maple (*Acer saccharum*), White Pine (*Pinus strobus*) and American Beech (*Fagus grandifolia*) in coastal forests. Coastal forest is typically dominated by Balsam Fir (*Abies balsamea*), Black Spruce (*Picea mariana*) and scattered White Spruce. The coastal forests are short lived and usually exist less than 100 years, but the moist climate is conducive to natural regeneration. Typically, most stands of Balsam Fir and Black Spruce have already developed a layer of regeneration while the overstorey breaks up. The influence of the ocean extends inland until it reaches the 60 m contour. Therefore, the Project site is influenced by the ocean (NSDNR, 2003).

The LNG facility footprint, including temporary work camp, encompasses two Ecosections (NSDNR, 2006). Ecosection WMRD applies to most of the footprint. The remainder is classified as Ecosection WCHO and is concurrent with the Red Head Peninsula. Descriptions of the climatic, geographic and ecological conditions such as disturbance patterns associated

with this classification can be found in NSDNR (2003). Ecoregions describe the more permanent physical features of topographic patterns, soil texture and soil drainage (NSDNR, 2003). Ecoregion WMRD indicates well drained, medium textured soil on ridged topography. Ecoregion WCHO indicates well drained, coarse textured soil on hummocky terrain (NSDNR, 2006). Well drained soils (W) consist of “soils over 60% well drained”. Medium textured soils (M) include sandy loam, fine sandy loam, very fine sandy loam, while coarse textured soil include gravel, coarse sand, sand, loamy sand and coarse sandy loam (NSDNR, 2003). The ELC symbols HO and RD indicate topographic patterns. HO (hummocky) is defined as a series of small rounded hills with a gentle slope usually never exceeding 15/%. RD (ridges) is defined as a pattern of linear or curvilinear ridges (NSDNR, 2003).

Habitat Survey Results

The survey of the LNG facility footprint in September 2012 confirmed that terrestrial habitat conditions remain largely unaltered since previous studies, except for an increased height/mass of woody plants due to growth and regeneration after forest harvesting. A limited area may have been harvested since 2005, the last year when vegetation surveys were carried out for the Keltic Project (AMEC, 2006). There have been no industrial developments since 2006, despite the site’s location in an industrial park. The site survey also confirmed that the ELC descriptions are accurate. However, a more detailed description of the plant communities is required in order to model the suitability of the habitats for rare vascular plants and rare lichens.

Most of the Project area is covered by a mosaic of coniferous forest of various ages resulting from repeated cutting, and is dissected by logging roads (Figure 9.4-1). The coastal Red Head Peninsula reflects past farming activity indicated by the presence of old-field, much of which is now colonized by White Spruce forest and ericaceous shrubs. The habitat on the promontory can be described as barren vegetation. There are two small ponds near the shoreline which are brackish to saline (AMEC, 2006). In September 2012, they were identified as part of a marine wetland (see Section 9.4.2). The ponds are separated from each other by the undulating relief, and from the ocean by barrier beaches in the south and in the north. A fairly large freshwater pond, Dung Cove Pond (“Pond 6” in AMEC (2006)) (Photo 21) is located at the base of the peninsula, and is separated from the marine waters of Betty’s Cove by a barrier beach (cobble dike and cobble beach) (Figure 9.4-1). In September 2012, it exhibited elevated water levels after heavy rain falls on previous days, indicated by submerged non- aquatic plants. The two saline ponds did not appear to exhibit elevated water levels. There are no dunes or sandy beaches in the LNG facility footprint.

The following description of habitat is based on the most frequent plant species observed in 2012, and tree size where applicable. Ten habitat types and plant communities were identified, including two categories of wetlands, containing several wetland classes. The habitat types are summarized in Table 9.4-1. Photos depicting habitat types are provided in Appendix D-1. Photos of wetlands are provided in the separate wetland survey report (Appendix E). Habitat types in the LNG facility footprint including the temporary work camp are shown on Figure 9.4-1 as well as Figure 9.4-2, and are described in more detail below.

Table 9.4-1 Habitat Types in the LNG Facility Footprint; Definitions and Summaries

Picture # ¹	Type	Definition and Summaries
1,2,3,4	Natural Stand: Coniferous Forest	Forest stands composed of more than 75% coniferous (softwood) trees. In the Project footprint, the trees in these polygons are more mature ² than the trees in “young coniferous forest”. Dominated by Balsam Fir, mature or nearing maturity, with tree diameters for Balsam Fir from about 15 cm diameter at breast height (dbh ³) to 20 cm and occasionally 30 cm dbh; Red Maple and Heartleaf Birch (<i>Betula cordifolia</i>) are few and up to 20-30 cm dbh.
5,6,7,8,9,10	Young Coniferous Forest ⁴	Areas of re-growth, most often following forestry activity, and other disturbance. Dominated by young trees (saplings) with occasional patches of shrubs (often Mountain Holly (<i>Nemopanthus mucronatus</i>), Witherod (<i>Viburnum nudum</i>) or alders (<i>Alnus incana</i>)). Older regenerating forest ⁵ is dominated by young Balsam Fir with an estimated height of 6-10 m.
11,12	Tall Shrubs ⁴	At the Goldboro Project site, tall shrubs with an estimated height of around 2 m, dominated by Mountain Holly and Witherod. NSDNR categorized this polygon as “brush”, which is defined as any area containing less than 25% merchantable tree cover and contains non-merchantable woody plants consisting of at least 25% cover.
	Alder	Alders 75% or greater cover- any forested area containing alders that compose 75% or more crown closure (NSDNR, code 39 in forest inventory map). Near the Goldboro Project site: a dense thicket of tall alders.
13, 14	Disturbed - Re-generating ⁴	At the Project site, this category is represented by areas either dominated by raspberry with dead wood, or with patches of shrubs of about 1 m height, or by clear cuts ⁶ with indications of early stages of regeneration ⁵ , such as seedlings and small saplings of trees and shrubs. Dominated by small woody plants and herbaceous vegetation.
15, 16	Riparian ⁴	Habitat along watercourses. In the Project footprint, there is little such habitat. Long stretches of streams have no real floodplain, possibly due to the steep gradient of the terrain.
17, 19	Barren and Ericaceous Shrub Dominated Barren	Any area of less than 25% live tree cover containing “ericaceous” vegetation with less than 50% rock out crops and/ or boulder cover and less than 50% other woody plant cover. Area dry and firm in summer. Indicator plants: Bearberry (<i>Arctostaphylos uva-ursi</i>), Rhodora (<i>Rhododendron canadense</i>), Blueberry (<i>Vaccinium</i> sp.), Huckleberry (<i>Gaylussacia</i> sp.) and Lambkill (<i>Kalmia angustifolia</i>). Ericaceous shrub dominated barren ⁶ : Ericaceous shrubs of up roughly 1 m height, dominated by Bayberry (<i>Myrica pensylvanica</i>). At the Project site, this habitat replaces former “old field” ⁷ . Rock outcrops or boulders not apparent, and ericaceous shrubs provide more than 50% of the plant cover.
18	White Spruce Forest ³	Coniferous forest dominated by White Spruce. In the Project footprint: occupying former “old field”.
	Freshwater Wetlands ⁸	“Any wet area not identified as a lake, river or stream”. Encompasses the wetland classes: fen, marsh, swamp, and open water; definition extended to include wetland class bog.
18, 19, 20	Marine wetlands ⁴	Including estuarine flat, coastal saline pond, salt marsh, dune, etc.

Source: NSDNR, 2013b

Notes:

- Picture # refer to pictures included in September 2012 terrestrial survey report (Appendix D-1).
- “Mature” is used here in a biological- ecological sense, not in a forestry sense, and includes observation of factors such as standing dead trees and fallen coarse woody debris which may provide indications concerning the timing of disturbance.
- dbh was estimated.
- Habitat type not used in the Forest Inventory.
- NSDNR Forest Stand Maturity Classes defines “regenerating forest” as “trees less than 1m high and less than 20 years of age”, and “young trees” as “trees less than 40 years and 6 m or less in height”.
- Clear cuts are defined by NSDNR as “Any stand that has been completely cut and any residuals make up less than 25% crown closure and with little or no indication of regeneration”.
- Old Field = “Any field that has an indication of merchantable tree species growing in with less than 25% crown closure and less than 1.0 m of height”. In the Project footprint, this habitat type has been replaced due to re-colonization.
- Definition extended beyond Forest Inventory Map Definition.

Coniferous Forest

Coniferous forest is a forest dominated by coniferous trees (greater than 75%). The dominant tree species is Balsam Fir, accompanied by spruce (usually Black Spruce). A few Mountain Ash (*Sorbus* sp.), Heart-leaf Birch and Red Maple are scattered throughout. The coniferous forest can be more or less open, resulting in various light conditions (Photos 1, 2, 3, 4 in Appendix D-1). The ground cover is dominated by feather mosses with up to 95% cover (e.g., *Hylocomium splendens*, *Pleurozium shreberi*); other mosses including *Dicranum* sp., *Ptilidium crispacastrensis*, and occasionally peatmoss (*Sphagnum* sp.) occur. Sparse patches of terricolous lichens (such as reindeer lichen and related species (*Cladonia rangiferina* (*Cladonia* sp. / *Cladina* sp., *C. maxima*)) are found infrequently. Herbaceous plants such as Bunchberry (*Cornus canadensis*), Sarsaparilla (*Aralia nudicaulis*), Starflower (*Trientalis borealis*), Twin Flower (*Linnaea borealis*), Canada Mayflower (*Maianthemum canadensis*) Goldthread (*Coptis trifolia*), Common Wood Sorrel (*Oxalis montana*) and ferns (e.g., *Dryopteris* sp., *D. felix femina*, or Bracken (*Pteridium aquilinum*), and in damp areas occasionally Cinnamon Fern (*Osmunda cinnamomea*)) are sparse (Photo 1 and 2).

Sheep Laurel (*Kalmia angustifolia*), blueberries (*Vaccinium* sp.), and seedlings or saplings of trees and Witherod contribute to a sparse low shrub stratum. Standing and fallen woody debris occur (Photo 1). However, open coniferous forest can also have a well developed layer of low shrubs, mostly Lambkill, as well as herbaceous plants and mosses (Photo 3). The terrain is generally hummocky, and boulders are moss-covered (e.g., in the western and northern quadrants (Photo 1 and 2; (Figure 9.4-1).

In the LNG facility footprint, some of the coniferous forest is apparently older than others, as indicated by the stem diameter. Many Balsam Fir trees have a dbh of 10 to 15 cm (e.g., LMK 5, 18, 19, 21, 22 in Appendix D-1). However, open coniferous forest with trees that are mature or near maturity can be found in the northern and western sections of the property. For example, Balsam Fir with about 20 cm dbh dominate near wetlands and old the minesites (excavations, mineshafts and tailings piles) in the western section of the property (Photo 1, 2, 4). Balsam Fir with 22 to 30 cm dbh, Red Maple and White Birch with a dbh of 20 to 30 cm, and Mountain Ash with a dbh of 8 to 10 cm diameter (usually multiple trunks), along with smaller trees, occur (e.g., near LMK 1, 11, 13, 14 and 26 in Appendix D-1). Presence of standing and fallen woody debris and rotten tree stumps can be interpreted to indicate that these forest sections have likely not been harvested for some time.

Young (Regenerating) Coniferous Forest

This habitat type encompasses both younger and older regenerating forests. Regenerating forests are areas of re-growth, usually following apparent clear-cut harvesting or other disturbances. These young forests consist of dense stands or young trees dominated by young trees (seedlings, saplings) and shrubs (often Mountain Holly, Witherod, or Alders) (Photo 5 to 10 in Appendix D-1). Balsam Fir is the dominant tree species, accompanied by spruce (Black Spruce with some White Spruce), and scattered Heart-leaf Birch, Red Maple, and Mountain Ash. Herbaceous ground vegetation is often sparse due to the density of the woody vegetation. Ground cover consists of patches of conifer needles (Photo 7) or patches of feather mosses with bunchberry where there is more (Photo 6). The dense, young forest southwest and down-

slope of Highway 316 has a somewhat different species composition, where White Spruce are more dominant. Near the shoreline, remnants of White Spruce forest with open areas covered by Cinnamon Fern and Blue-Joint (*Calamagrostis canadensis*), as well as patches of Alder (Photo 10) (Figure 9.4.-1).

Dense young coniferous forest is dominated by Balsam Fir with a dbh less than about 5 to 8 cm (Photo 7). Older regenerating coniferous forest is dominated by young coniferous trees with an estimated height of 6 to 8 or 10 m (Photo 6). Most of these young forest stands are very dense, resulting in low light conditions (Photo 7). Patches of older regenerating forest with more deciduous tree saplings (mostly birch), while still dense, are lighter and have a herbaceous ground cover of Bunchberries with some Wood Aster (*Aster acuminatus*) (Photo 8). It should be noted that the NSDNR Forest Stand Maturity Classification defines “regenerating forest” and “young trees” in a more restrictive way (see Table 9.4-1).

Tall Shrub Habitat

Tall shrub habitat is dominated by tall Mountain Holly and Witherod, scattered alders and occasionally Rhodora, with scattered tree saplings (Balsam Fir, Red Maple, Mountain Ash, Heart-leaf Birch) (Photo 11 and 12 in Appendix D-1). The shrubs are an estimated 2 m or more high, and the tree saplings reach an estimated 4 to 6 m height. Ground cover consists of mosses (e.g., peatmoss (*Sphagnum* sp.) and others such as *Dicranum* sp.), ferns (*Dryopteris* sp., bracken, occasionally Ladyfern (*Dryopteris filix-femina*)), Bunchberry and scattered Sarsaparilla. Bunchberry can achieve 95% cover (Photo 11). Low shrubs in the understorey are sparse: Lambkill and Velvet-leaved Blueberry (*Vaccinium myrtilloides*) occur, and occasionally Labrador Tea (*Rhododendron groenlandicum*) and Huckleberry; LMK15); erratic boulders are moss covered. A few scattered larger trees can be found, e.g., Balsam Fir or Heart-leaf Birch with dbh of an estimated 15 to 20 cm. An extensive area of tall shrub habitat is located along the northern boundary of the LNG facility and temporary work campsite (Figure 9.4-1).

Alder

A dense thicket of tall Speckled Alder is located in the north of the LNG facility in the area of the temporary work camp surrounding the Sable Island helipad (Figure 9.4-1). Please note that this helipad is no longer in use. The alder shrubs are largely over 1.5 m in height, and ground is often devoid of herbaceous vegetation. The polygon was identified as “urban” in the NSDNR Forestry Map (2013b), a definition which encompasses areas of human habitation; residential, industrial and recreational use.

Disturbed- Regenerating

The habitat in the central part of the property consists of a mosaic of plant communities which appear to be re-colonizing the area after disturbance (Photo 13 and 14 in Appendix D-1) (Figure 9.4-1). This includes regenerating tall shrub habitat, regenerating coniferous forest (LMK 28 in Appendix D-1), regenerating clear-cuts and a raspberry (*Rubus* sp.) dominated community (Photo 14). Regenerating coniferous forest is also present in a relatively small area near the western property boundary (Photo 13).

Regenerating tall shrub habitat is characterized by thickets of comparatively low shrubs (estimated height about 1.0 to 1.2 m). The species composition is similar to the tall shrub habitat (Photo 12). Regenerating clear-cuts at the Project area are dominated by small woody plants and herbaceous vegetation. While NSDNR defines clear-cuts as "...areas with little or no indication of re-generation", in this report early stages of regeneration as seen within a few years after are included. Clear-cuts at the start of regeneration are characterized by tree stumps, a few seed trees and herbaceous ground vegetation. Seedlings small saplings of trees and shrubs are usually present after a few years. However, woody vegetation is small and not dense enough to inhibit herbaceous ground vegetation. Species composition depends on the type of the harvested and surrounding forest.

Red Raspberry (*Rubus idaeus*) dominated community is scattered with numerous standing dead tree trunks or dead tall shrubs (Photo 14 in Appendix D-1); plants include Cinnamon Fern, brambles (*Rubus* sp.), Lambkill, Goldenrod (*Solidago rugosa*) and seedlings or saplings of cherry (*Prunus* sp.), Balsam Fir and small Heart-leafed Birch. Balsam Fir saplings of an estimated height of 3 m can be found.

Riparian

Riparian habitats are found along watercourses (Photo 15 and 16, Appendix D-1). In the Project area, it is generally located in forests and wetlands. There is little such habitat. Long stretches of streams have no real floodplain, possibly due to the steep gradient of the terrain and the small size of the streams. Consequently, species composition is often similar to the surrounding habitats. A few submergent aquatic vascular plants such as Burreed (*Sparganium* sp.) were found, e.g., in Wetland 4. A stretch of well- developed riparian habitat was found along the un-named stream originating in Wetland 1, and running along the western boundary (Photo 15), and in the forest below Wetland 5 (Photo 16).

Barren and Ericaceous Shrub Barren

Barren habitat (definition see Table 9.4-1) is located on the promontory called Red Head (Figure 9.4-1). Vegetation includes young White Spruce, ericaceous shrubs and herbaceous vegetation with grasses (Photo 19 in Appendix D-1).

Barren habitat dominated by ericaceous shrubs of about roughly 1 m height has replaced former "old field" habitat adjacent to the white spruce forest (Figure 9.4-1). The ericaceous shrubs are dominated by Bayberry, accompanied by blueberries, Black Chokecherry (*Photinia melanocarpa*), seedlings of White Spruce and Red Maple, and scattered alders (Photo 17). Rock outcrops or boulders are not apparent, and ericaceous shrubs provide more than 50% of the plant cover.

A polygon mapped as "rock barren" (NSDNR, 2013b) surrounding the ponds in a marine wetland near Red Head rather is barren habitat. Rock barren is defined as "area covered by at least 50% exposed rock outcrops and/or boulders (which are rock fragments over 60 cm in diameter) (NSDNR, 2013b) however, this area is rather a layer of beach cobble interspersed with grass, Beach Pea (*Lathyrus japonicas*), Sea Lavender (*Limonium carolinianum*), Seaside Plantain (*Plantago maritima*), Silverweed (*Argentina anserina*) and a few White Spruce trees,

and therefore does not fit the NSDNR definition of rock barren. It does however, have less than 25% live tree cover.

White Spruce Forest

White Spruce is the dominant tree species in this coastal habitat (Photo 18 in Appendix D-1). This forest is often dense and the groundcover is sparse, and trees are several metres tall. At the Project site, this habitat occupies former old field habitat, which reflects past farming activity, on the Red Head peninsula (Figure 9.4-1).

Freshwater and Marine Wetlands

Thirteen freshwater wetlands and one saline wetland were detected during the surveys in September 2012 and June 2013. Another two wetlands which were identified next to the LNG facility boundaries are hydrologically connected to the Project footprint (Figure 9.4-2). One of these has also been delineated. Details on the wetlands are provided in separate reports in Section 9.4.2. Survey methods are provided in Appendix D-1 and D-3; wetland delineation reports and photos are provided in Appendix E.

Depth-to-water-table mapping available from NSDNR (2012a) and aerial photography aided in the detection of several wetlands, while others were found in areas of low probability for the presence of wetlands. Most of the detected wetlands are freshwater wetland complexes consisting of several wetland classes and types: shallow open water, fen, bog, shallow marsh, shrub swamp, and wooded swamp, i.e., both mineral wetlands and peatlands are present. Most wetlands are associated with streams or surface drainage features. Two wetlands, both sloped fens, are located adjacent to Highway 316.

The NS Wetlands Vegetation and Classification Inventory show no wetlands in the Project footprint (NSDNR, 2012b). However, a marsh of 3.05 ha size extending northwest from the northwestern end of Dung Cove Pond (Photo 21) may be hydrologically connected to the Project footprint. The NS Wetlands and Coastal Habitats Inventory (NSDNR, 2000), now superseded, classifies the marsh as deep marsh. Dung Cove Pond is described in the Keltic Project EA (AMEC, 2006) as a freshwater pond, but is also labeled as “Wetland 1” in this report.

One marine wetland was identified during the field surveys in September 2012 (see Section 9.4.2). It contains two small ponds which are brackish to saline (see above). The ponds are separated from each other by the undulating relief, and from the ocean by barrier beaches in the south and in the north. Vegetation on the sheltered (pond side) of the barrier includes Beach Pea, Scotch Lovage (*Ligusticum scoticum*), Sea Lavender and Seaside Plantain (Photo 19 in Appendix D-1). The eastern-most of the ponds (Pond 5 in AMEC, 2006) supports aquatic vegetation, e.g., pondweed (*Potamogeton* sp.) and *Enteromorpha* sp., a green algae also found in the intertidal zone in marine habitat. There are a few small water-filled depressions and hydrophytic vegetation such as rushes (*Juncus* sp.) (Photo 19). Glasswort (*Salicornia europaea*) grows in patches between the two ponds. These ponds did not exhibit visibly elevated water levels despite heavy rain falls on previous days.

Freshwater and marine wetlands are further discussed in Section 9.4.2.

LNG Facility Vegetation

In addition to the vegetation as described above, the following plant communities were noted during the fall 2012 surveys. The ocean shoreline vegetation is typical of marine shores and includes Beach Pea, Sea Rocket (*Cakile edentula*), Oysterleaf (*Mertensia maritima*), Seaside Plantain, Scotch Lovage, and Sea Lavender. Seaweeds (*Fucus* sp., *Ascophyllum* sp.) are attached to the rocks in the intertidal and subtidal zone (Photo 18 to 20 in Appendix D-1).

Dung Cove Pond supports hydrophytic vegetation such as Blueflag Iris (*Iris versicolor*), wool grass (*Scirpus* sp.), and rushes (including *Juncus effusus*), as well as aquatic vegetation such as pondweed (*Potamogeton* sp.).

The September 2012 and June 2013 site surveys showed that the plant inventory assembled for the Keltic Project EA (AMEC, 2006) appears to reflect the vegetation at the Goldboro LNG Facility footprint accurately. For the Keltic Project, field surveys including plant surveys were carried in June, August and early September 2004 and June, July, August and early September 2005 (AMEC, 2006). The surveys therefore cover the appropriate phenology window. Over 300 vascular plant species (including 46 introduced species) were found in the Keltic Project footprint (AMEC, 2006), which includes the Goldboro LNG Facility and Meadow Lake area. The inventory for the Goldboro LNG Facility is expected to be smaller than that due to the smaller footprint. The Keltic Project EA plant inventory is provided in Appendix D-2. The inventories for New Harbour River, Goldbrook Lake and Ocean Lake are not applicable to the Project footprint and were removed from the data set. A total of 282 vascular plant species and subspecies are listed in Appendix D-2. Due to the late season, an extensive plant inventory was not assembled in September 2012 (Appendix D-1). Survey methods and photos for the September 2012 terrestrial vegetation survey are provided in Appendix D-1 and in Appendix D-3 for the June 2013 terrestrial vegetation survey.

Plant and Lichen Species of Conservation Concern (SOCC)

A complete list of vascular plant species (less the above mentioned areas) found during the surveys for the Keltic Project (AMEC, 2006) is provided in Appendix D-2. Since there have been numerous changes in the conservation status ranks of plant (and lichen) species since 2004/ 2005, the Keltic Plant inventory has been updated by comparing the plant list with current rankings and listings for SAR or SOCC (SARA, NSESA, NSDNR General Status Ranks (NSDNR, 2009), ACCDC, and the 2010 National Status Ranks (National General Status Working Group (NGSWG), 2013)).

According to AMEC (2006), the only plant species- at- risk detected in 2004 and 2005 were Variegated Scouring Rush (*Equisetum variegatum*) and a sedge (*Carex* cf. *atlantica*). While Variegated Scouring Rush no longer is a SOCC in 2013 (NSDNR Green), it still is of limited conservation concern to ACCDC (S3). *Carex* cf. *atlantica* was detected in the New Harbour River Basin which is not part of the Goldboro Project footprint. In September 2012, a large number of Variegated Scouring Rush was found in Wetland 3 (Figure 9.4.-2).

According to Jacques Whitford (2007b), Northern Comandra (*Geocaulon lividum*) and Water Celery or Tape Grass (*Vallisneria americana*) were observed for the Keltic Project. Northern

Comandra is considered to be of concern to ACCDC (S3) with a NS General Status of Yellow according to NSDNR. Tape Grass is an aquatic plant listed as S2 by ACCDC and is Red listed by NSDNR. Northern Comandra was observed outside the proposed Project area and Tape Grass was observed in Dung Cove Pond (Pond 6).

In September 2012, rare lichen surveys were carried out at the LNG facility site. Survey methods and photos are provided in Appendix D-1. No rare lichens were found in September 2012 or previously (AMEC, 2006). However, two species of lungworts which are of interest due to their habitat requirements were found (*Lobaria pulmonaria*, *Lobaria scrobiculata*) (Photo 23 and 24 in Appendix D-1).

A survey conducted in June 2013 did not identify any additional plant or lichen SOCC. Plant and lichen SOCC are further discussed in Section 9.7.

Indications of Previous Disturbance

The entire LNG facility is dissected by logging roads of various ages. Clear-cuts and re-growing forest in the central, western and southern parts indicate fairly recent forest harvesting within the last few decades. Multi-trunked Red Maple and Mountain Ash trees which are found all over the Project site may indicate potential harvesting further in the past (possibly as far back as 60-100 years). A cleared grassy area near the western property boundary at Highway 316 used to be occupied by seasonal residence (AMEC, 2006) (Figure 9.4-1). It has since been removed, but an old apple tree is left. The western third of the LNG facility contains numerous small abandoned mine openings (AMOs) within the older forest. There are several mine tailings heaps.

9.4.1.2 Meadow Lake

Meadow Lake is located about 8 km north northeast of the Goldboro LNG Facility. Like the LNG facility, Meadow Lake is in the Acadian Forest Ecozone, the Atlantic Coastal Ecoregion (Ecoregion 8) and the Eastern Shore Ecodistrict (Ecodistrict # 820) (NSDNR, 2006). The climatic and vegetation characteristics of these units are described in Section 9.4.1.1. The northern half is encased by Ecosection WLTD; there is no description for these symbols (NSDNR 2003; NSDNR, 2006). For the southern half of Meadow Lake is surrounded by Ecosection WMKK in the west and Ecosection IMSM in the south and the east (NSDNR, 2006). Ecosection WMKK indicates well-drained, medium textured soil on hilly terrain; IMSM indicates imperfectly drained, medium textured soils on smooth or flat terrain (NSDNR, 2006). Imperfectly drained soils (I) are not well or poorly drained (NSDNR, 2003). ELC codes KK and SM indicated topographic patterns. KK (hills) is defined as “a series of knobs and knolls with moderate to steep slopes between 5- 30% relief”; Relief amplitude ranges from 15-60m. SM (Smooth or flat (Level)) includes floodplain, lake plain, deltas, intervalles, and open bogs and wetlands. SM is defined as “land with no particular pattern, flat or very gently sloping, unidirectional surface with a generally constant slope not broken by elevations and depressions; slopes are generally less than 1%” (NSDNR, 2003). The remaining ELC symbols are described in Section 9.4.1.1.

Meadow Lake Vegetation

The following description of habitats and vegetation at Meadow Lake is based on information from the Keltic Project EA (AMEC, 2006), the Meadow Lake Intake Structure EA (AMEC, 2008a) and ELC (NSDNR, 2003 and NSDNR, 2006). Confirmatory field surveys were carried out in June 2013 (Appendix D-3).

Major vegetation types in the Meadow Lake Basin were determined from using 2002 NSDNR Forest Inventory Mapping, vertical aerial photography, and field observations (AMEC, 2006). Major vegetation types are depicted in Figure 9.4-3.

Vegetation types, areas, and proportions in the lake basin are shown in Table 9.4-2.

Table 9.4-2 Meadow Lake Vegetation Types

Vegetation Type	Area (ha)	%
Coniferous stands	60	35
Wetlands	93	54
Brush/Barrens	14	8
Raised Bog	3	2
Intolerant hardwood/Conifer Mix	2	1
Total	173	100

Mixed stands of coniferous tree species, mainly Balsam Fir and Black Spruce, as well as intolerant hardwoods such as Red Maple and White Birch, are located variously in the southern part of the basin. Midway to the north, the coniferous stands are dominated by black spruce, and further to the north Eastern Larch (*Larix laricina*) becomes increasingly prominent. Wetland habitat is further discussed in Section 9.4.2.3.

Intolerant hardwoods such as Red Maple and White Birch are often found with regenerating coniferous species in areas where there has been some disturbance such as cutting, fire, and blowdown. Brush areas are usually dominated by heath shrubs or by Speckled Alder, the latter often following clear cutting. Barrens are areas of low heath vegetation with shallow soil on a rock base. Vegetation often comprises Reindeer Moss (*Cladonia rangiferina*) and Black Crowberry (*Empetrum nigrum*) (NSMNH, 1996). In the general region, barrens may contain shrub specimens of Rhodora, Sheep Laurel, Teaberry (*Gaultheria procumbens*), and Red Maple (AMEC, 2006 and AMEC, 2008a and b).

A total of 108 native and three introduced vascular plant species were noted at the Meadow Lake site (AMEC, 2006). A complete list of vascular plants noted for the Meadow Lake Basin is presented in Appendix D-2. The Inventory established for the Keltic Project EA has been amended with the current conservation ranks. The overall number of vascular plants at this site, compared to other areas, was lower due a number of factors including fewer disturbances and exposure to human activity, and less marine influences. These factors lead to increased introductions of non-native species, often inadvertently, and human activity such as farming activity and road building creates further disturbances allowing introduced species to gain a competitive advantage (AMEC, 2008a). Tape Grass is the only plant SOCC found at the

Meadow Lake during the 2004/2005 surveys. A survey conducted in June 2013 did not identify any additional plant or lichen SAR or SOCC.

9.4.1.3 Water Supply Pipeline Corridor

The following description of habitats and vegetation at the ROW of the buried water supply pipeline is based on information from the Meadow Lake Intake Structure EA (AMEC, 2008a) and ELC (NSDNR, 2003 and NSDNR, 2006), Supplemented by onfirmatory field surveys carried out in June 2013.

Like the LNG facility and Meadow Lake, the water pipeline is in the Acadian Forest Ecozone, the Atlantic Coastal Ecoregion (Ecoregion 8) and the Eastern Shore Ecodistrict (Ecodistrict # 820) (NSDNR, 2006). The climatic and vegetation characteristics of these units are described in Section 9.4.1.1. The water supply line runs through several Ecosections. Near Meadow Lake, it is located in Ecosection IMSM, then it crosses through Ecosection WMKK and IMHO, before entering Ecosection WMRD near the LNG facility (NSDNR, 2006). The symbols and the associated physical characteristics for Ecosection WMRD are explained in Section 9.4.1.1 above, and for Ecosection WMKK and IMSM in Section 9.4.1.2 above. Ecosection IMHO indicates imperfectly drained, medium textured spoils on hummocky terrain (NSDNR, 2006). Imperfectly drained soil is defined as land systems that are not well or poorly drained. Medium textured soils (M) include sandy loam, fine sandy loam, very fine sandy loam and loam (NSDNR, 2003). HO indicates hummocky terrain, which is defined as a “series of small rounded hills with a gentle slope usually never exceeding 15%” (NSDNR, 2003).

The vegetation on the proposed location for the buried water supply pipeline (Figure 1.7-3 and Figure 9.4.4) for the most part has been cut, re-cut, or actively cut with the result that it is an area of changing mosaics of coniferous stands, clear cuts, and shrubland. The presently forested areas are mostly Balsam Fir. In 2003, forested stands were primarily Balsam Fir (88%), with Black Spruce, White Birch, Red Maple, and Mountain Ash accounting for the remainder. For the most part, these stands are of young age, with 75% of stems less than 20 cm dbh. Overall, Black Spruce is estimated at less than 20% and mostly in the lower, wetter sites, and White Spruce (less than 10%). Areas previously clear-cut, for the most part, are now dominated by Speckled Alder, and in some cases by young White Birch. Other areas are dominated by heath shrubs (AMEC, 2006).

A survey was conducted in June 2013 and ten habitat types and plant communities were identified within this area, including one general wetland category which encompasses all wetland types encountered. Interestingly, mixed forest and early deciduous forest habitats were not found in the footprint of the LNG facility. Habitat types are shown on Figure 9.4-4 and are described in more detail in Table 9.4-3 below. Survey methods and photos for the June 2013 terrestrial vegetation survey are provided in Appendix D-3.

Table 9.4-3 Habitat Types in the Proposed Water Supply Pipeline; Definitions and Summaries

Picture # ¹	Type	Definition and Summaries
1, 2, 3	Natural Stand: Coniferous Forest	Forest stands composed of more than 75% coniferous (softwood) trees. The trees in these polygons are more mature ² than the trees in “young coniferous forest”. Dominated by balsam fir, mature or nearing maturity, with tree diameters for Balsam Fir from about 15 cm dbh ³ to 20 cm and occasionally 30 cm dbh; Red Maple and Heartleaf Birch are few and up to 20-30 cm dbh.
4, 5, 6, 15	Natural Stand: Mixed Forest	Forest stands composed mostly of Balsam Fir, White Birch, Red Maple, and Black Spruce. . Picture 15 shows mixed forest with White Spruce.
7	Young Coniferous Forest ⁴	Areas of re-growth, most often following forestry activity, and other disturbance. Dominated by young trees (saplings) with occasional patches of shrubs (often Mountain Holly, Witherod or alders). Older regenerating forest is dominated by young Balsam Fir with an estimated height of 6-10 m.
8, 9, 10	Tall Shrubs ⁴	At the Goldboro Project site, tall shrubs with an estimated height of around 2 m, dominated by Mountain Holly and Witherod. NSDNR categorized this polygon as “brush”, which is defined as any area containing less than 25% merchantable tree cover and contains non-merchantable woody plants consisting of at least 25% cover.
5	Alder	Alders 75% or greater cover- any forested area containing alders that compose 75% or more crown closure (NSDNR, code 39 in forest inventory map). Near the Goldboro Project site: a dense thicket of tall alders.
11	Disturbed - Re-generating ⁴	At the Project site, this category is represented by areas either dominated by raspberry with dead wood, or with patches of shrubs of about 1 m height, or by clear cuts ⁵ with indications of early stages of regeneration ⁶ , such as seedlings and small saplings of trees and shrubs. Dominated by small woody plants and herbaceous vegetation.
12	Early Deciduous Forest	Dominated with Red Maple in the canopy layer and Mountain Ash, Witherod and alder in the ground layer. Habitat found along the Water Supply Pipeline near Meadow Lake.
13, 14	Riparian ⁴	Habitat along watercourses. In the Project footprint, there is little such habitat. Long stretches of streams have no real floodplain, possibly due to the steep gradient of the terrain.
16	Wind Throw	Fir and spruce species standing within an open habitat. Majority of trees pushed over leaving high amounts of coarse woody debris.
17-21	Freshwater Wetlands ⁷	“Any wet area not identified as a lake, river or stream”. Encompasses the wetland classes: fen, marsh, swamp, and open water; definition extended to include wetland class bog.

Source: NSDNR, 2013b

Notes:

1. Picture # refers to pictures included in June 2013 terrestrial survey report (Appendix D-3).
2. “Mature” is used here in a biological- ecological sense, not in a forestry sense, and includes observation of factors such as standing dead trees and fallen coarse woody debris which may provide indications concerning the timing of disturbance.
3. dbh was estimated.
4. Habitat type not used in the Forest Inventory
5. Clear cuts are defined by NSDNR as “Any stand that has been completely cut and any residuals make up less than 25% crown closure and with little or no indication of regeneration”.
6. NSDNR Forest Stand Maturity Classes defines “regenerating forest” as “trees less than 1m high and less than 20 years of age”, and “young trees” as “trees less than 40 years and 6 m or less in height”.
7. Definition extended beyond Forest Inventory Map Definition.

A complete list of vascular plants noted for the proposed water supply pipeline is presented in Appendix D-2. A survey conducted in June 2013 did not identify any additional plant or lichen SAR or SOCC.

For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.7.

9.4.2 Wetlands

A total of thirteen wetlands were identified within the LNG facility area and/or determined to be hydrologically connected downstream. The majority of wetland habitat identified consists of small riparian fens none of which were found to be larger than 1 ha in size and most covered less than 0.5 ha. Other wetland types identified include swamp, bog and coastal saline pond as well as complexes including a combination of a number of these wetland types. The total area of wetland habitat identified within the LNG facility area is approximately 3.3 ha. Several other wetlands were identified in the footprint of the pipeline ROW and Meadow Lake (see Section 9.4.2.3 below).

9.4.2.1 Study Methods

Several definitions of “wetland” exist in literature:

- Lands that are seasonally or permanently covered by shallow water, including lands where the water table is at or close to the surface. The presence of abundant water causes the formation of hydric soils and favours the dominance of either hydrophytic or water-tolerant plants. The five major types of wetlands are: marshes, swamps, bogs, fens and shallow open waters (EC, 2013b).
- A wetland is land “where the water table is at, near, or above the surface or which is saturated for a long enough period to promote such features as wet-altered soils and water tolerant vegetation” (EC, 1996).
- A wetland is land that is “saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic (i.e., water-loving) vegetation and various kinds of biological activity which are adapted to a wet environment” (Government of Canada, 1991).
- Wetlands are areas of “marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres” (United Nations Educational, Scientific and Cultural Organization (UNESCO) 1987).

Although each definition is slightly different, the relevant common aspects adopted for the purpose of this report that define a wetland are:

- land that is saturated or covered by water for some time during the growing season;
- poorly drained soils; and
- predominantly, hydrophytic vegetation.

Following this definition, wetland determinations were based on the following three criteria:

- majority of dominant vegetation species are wetland associated species;
- hydrologic conditions exist that result in periods of flooding, ponding, or saturation during the growing season; and
- hydric soils are present.

A combination of desktop review and field work was utilized to identify and assess wetland habitat occurring within and/or adjacent to the Project area. Wetland delineations were conducted according to standard methodologies approved by NSE (2013d). The determination of wetland habitat in the field was based largely on the Corps of Engineers Wetland Delineation Manual (the Manual) (Environmental Laboratory, 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual (US Army Corps of Engineers (USACE), 2012). Functional assessments were conducted using the NovaWET method which has been developed by NSE for the purpose of assessing wetland functions in NS. A field report is presented in Appendix E which provides further details related to the methodologies used to delineate and assess all wetlands identified as well as detailed results of the wetland study.

9.4.2.2 Wetland Habitat in Project Area

This study identified a significant increase in wetland habitat within the Project area from what previous surveys of the area identified for the Keltic Project EA (AMEC, 2006). Two of the wetlands identified during the Keltic Project EA were re-surveyed during this recent field program. The wetland numbers assigned to wetlands during the 2012 and 2013 surveys are compared to the previous wetland numbering system for the Keltic Project EA in Table 9.4-4 below.

Table 9.4-4 Wetland Locations and Classification

Wetland # for Current Survey (AMEC, 2013b)	Wetland # for Keltic Project EA
WL1 – WL8; WL11-13	Not identified during previous survey.
WL9	WL12
WL10 – Does not occur within the Project boundary but is hydrologically connected downstream.	Part of WL13 or 4.
Determined to be a pond (not wetland) (Dung Cove Pond).	WL1
These wetlands do not occur within the current Project area.	WL2 – WL11 and WL14

Note:

WL = wetland

Eleven of the thirteen wetlands surveyed were found to occur within the LNG facility area (Figure 9.4-2), and complete delineations were conducted in addition to habitat and functional assessments (WL1 to WL6, WL8, WL9 and WL11 to WL13 in Table 9.4-5). Two wetlands were located outside of the Project area but were found to be hydrologically connected downstream from the site (WL7 and WL10). It should be noted that WL7 is located immediately adjacent to the eastern boundary of the Project area and as such may be impacted by Project activities

depending on the actual infrastructure footprint at the time of construction. WL10 occurs along the unnamed stream that flows along the western side of the Project area. As a result of planned Project activities, this stream will likely be impacted which may in turn impact WL10. Table 9.4-5 provides a summary of all wetlands assessed along with their general characteristics and corresponding coordinates (UTM Zone 20, NAD 83).

Table 9.4-5 Wetland Locations and Characterization

Wetland #	Coordinates		Type	Size (ha)	Landscape Position	Water Flow Path	Landform
	Easting	Northing					
WL1	607441	5002595	Bog/Fen/Swamp/Marsh	0.17	Lotic Stream	Throughflow	Basin
WL2	607504	5002543	Herb Fen	0.20	Terrene	Outflow	Basin
WL3	607627	5002408	Fen/Bog/Marsh	0.19	Terrene Pond	Outflow	Basin
WL4	607114	5002089	Fen	0.15	Lotic Stream	Throughflow	Slope
WL5	607422	5001908	Fen	0.32	Lotic Stream	Throughflow	Slope
WL6	608135	5002011	Shrub/Treed Fen	0.10	Terrene	Isolated	Basin
WL7	608389	5002048	Shrub Bog	0.1	Lotic Stream	Throughflow	Basin
WL8	607318	5001668	Shrub Swamp/Fen	0.62	Lotic Stream	Throughflow	Slope
WL9	606913	5001574	Coastal Saline Pond	0.61	Terrene	Isolated	Basin
WL10	607037	5001949	Shrub Swamp	0.05	Lotic Pond	Throughflow	Slope
WL11	608129	5001772	Treed Bog	0.44	Terrene	Isolated	Basin
WL12	608268	5002104	Treed Swamp / Fen	0.17	Lotic Stream	Throughflow	Basin
WL13	607390	5002423	Treed Bog	0.19	Lotic Stream	Throughflow	Basin

Wetland 1 (WL1)

WL1 is a fen/bog/swamp/marsh wetland complex approximately 0.17 ha in total area located adjacent to Sable Road. The area surrounding this wetland is currently in a natural forested state with the exception of Sable Road along the western boundary. A variety of microhabitats are found in this wetland which may provide habitat for a variety of mammals, amphibians and reptiles. The unnamed stream that flows through this wetland was found to contain American Eel (*Anguilla rostrata*) (COSEWIC – Threatened) and as such this wetland may provide nursery habitat for this species.

Wetland 2 (WL2)

WL2 is an herb fen wetland approximately 0.20 ha in total area located in the northwest end of the Project area. Mine tailings were noted within this wetland though wetland hydrology does not seem to be impacted. Vegetation in this wetland is primarily dominated with graminoid vegetation including sedges (*Carex sp.*) and rushes (*Juncus sp.*). This wetland may form a component of the headwaters of the unnamed stream that constitutes the outlet of this wetland and flows along the western boundary of the Project area since no obvious surface water inlet was noted at the time of the field survey. Given the interaction of this wetland with the unnamed stream, this wetland may also provide nursery habitat for American Eel.

Wetland 3 (WL3)

WL3 is a fen/bog wetland complex approximately 0.19 ha in total area located in the northwest end of the Project area. Mine tailings were also noted within this wetland although wetland hydrology does not seem to be impacted. Vegetation in this wetland is primarily dominated with

graminoid vegetation including sedges (*Carex sp.*) and rushes (*Juncus sp.*) and a large patch of Variegated Horsetail (ACDC ranked S3) was also found. A small pond is associated with this wetland which may provide habitat for amphibians and reptiles as well as a variety of insect fauna. This wetland may also form a component of the headwaters of the unnamed stream that constitutes the outlet of this wetland and flows along the western boundary of the Project area since no obvious surface water inlet was noted at the time of the field survey. Given the interaction of this wetland with the unnamed stream, this wetland may also provide nursery habitat for American Eel.

Wetland 4 (WL4)

WL4 is a fen wetland approximately 0.15 ha in total area located in the southwest end of the Project area. This wetland is located along the north side of Highway 316 which may have influenced wetland development in this area. The unnamed stream flows through this wetland before flowing under the highway and eventually into Dung Cove Pond. The braided channels within this wetland may provide nursery habitat for American Eel as well other fish species that may occur within the watercourse. The immediate area surrounding this wetland is influenced by recent forestry activity that has resulted in the creation of an early successional forest community. Despite these stressors, the wetland consists of native plant species with little influence from non-native/invasive species.

Wetland 5 (WL5)

WL5 is a fen/bog wetland complex approximately 0.32 ha in total area located in the southern end of the Project area, north of Highway 316. Similarly to WL4, the development of wetland habitat in this area may have been a result of Highway 316 slowing drainage of the small streams that flows through this wetland. Forestry activities have been noted within and surrounding this wetland. No fish species were noted within the channels flowing through the wetland however this wetland does provide habitat for birds, mammals, reptiles and amphibians.

Wetland 6 (WL6)

WL6 is a fen/bog wetland complex approximately 0.10 ha in total area located in the northeast end of the Project area. This wetland appears to be isolated with no inlet or outlet and has developed in a dip in the landscape where shallow bedrock has impeded drainage. Forestry activity was noted in the buffer area of this wetland which has resulted in an early successional forest surrounding the wetland on three sides while a mature forest still remains on the southwest side.

Wetland 7 (WL7)

WL7 is a bog wetland approximately 0.10 ha in total area located outside of the Project area along the northeast boundary. Forestry activity has occurred within the buffer surrounding the wetland however despite this, the plant community in this wetland was determined to be relatively intact with moderate species diversity and little to no influence of invasive/non-native species. The wetland may also provide moderate habitat to amphibians, reptiles, birds and mammals.

Wetland 8 (WL8)

WL8 is a shrub swamp/sloped fen wetland complex approximately 0.62 ha in total area located in the southern end of the Project area. This wetland is located south of highway 316 at the landward end of the peninsula. Forestry activities surrounding the wetland have resulted in the development of an early successional forest community in the upland area while a barrier beach borders a portion of the south side of the wetland. The wetland supports habitat for birds, mammals, amphibians and reptiles.

Wetland 9 (WL9)

WL9 consists of two coastal saline ponds connected by a temporarily flooded channel. This wetland is located at the southeast end of the peninsula and is bordered by a barrier beach on three sides. Vegetation cover within the wetland is relatively low, with the majority of wetland consisting of open water. This wetland does provide habitat for waterfowl and waterbirds. Ninespine Stickleback (*Pungitius pungitius*), Threespine Stickleback (*Casterosteus aculeatus*) and Fourspine Stickleback (*Apeltes quadracus*) were also noted to occur within this wetland in previous reports (AMEC, 2006).

Wetland 10 (WL10)

WL10 is a riparian shrub swamp located along an unnamed stream at the point where it flows into the northwest corner of Dung Cove Pond. The wetland is bordered on three sides by a mixed forest while Dung Cove Pond borders the southern boundary. This wetland formed along the unnamed stream that flows along the western side of the Project area. Fish surveys conducted in this stream found Brook Trout (*Salvelinus fontinalis*) (in the lower reaches) and American Eel where as Ninespine stickleback, Mummichog (*Fundulus heteroclitus*) and Banded Killifish (*Fundulus diaphanus*) were also found in Dung Cove Pond and as such this wetland may provide nursery habitat for these species. The wetland is dominated by tall shrub species such as alder and may provide habitat for birds, mammals, amphibians, and reptiles as well.

Wetland 11 (WL11)

Wetland 11 is an isolated shrub/ treed bog located at the eastern boundary of the LNG facility property. Forestry activity within and adjacent to the wetland has altered the vegetation composition and structure of both the wetland and surrounding buffer however despite this, the plant community in this wetland was determined to be relatively intact with moderate species diversity and little to no influence of invasive/non-native species. Based on the water flowpath (no outflow) and wetland type (bog) this wetland may also provide a source of groundwater discharge.

Wetland 12 (WL12)

Wetland 12 is a throughflow treed swamp / fen located in the northeast end of the LNG facility footprint. This wetland is located in an early successional forest community created by past forestry activities. The trees in a portion of this wetland have been cleared leaving open areas dominated by cinnamon fern and meadow rue. The area immediately adjacent to the watercourse that runs through this wetland has remained treed with black spruce, balsam fir and red maple as the dominants.

Wetland 13 (WL13)

WL13 is characterized as a throughflow bog. The integrity of this wetland and surrounding buffer is considered to be high where impacts to this wetland are minimal and the adjacent buffer area is considered to be in a natural state and fully vegetated. This wetland may significantly contribute to the maintenance of water flow to the unnamed stream that constitutes the inlet and outlet of this wetland and flows along the western boundary of the Project area. Given the interaction of this wetland with the unnamed stream, this wetland may also provide nursery habitat for American Eel.

9.4.2.3 Meadow Lake and Pipeline ROW Wetland Habitat

Wetland habitat located around Meadow Lake was identified in a previous report (AMEC, 2008a). These wetlands are not thought to be impacted by the Project and therefore were not part of the field surveys conducted in 2013 and as such functional assessment and complete delineations were not conducted. Over 100 ha of wetland habitat was identified to be directly associated with Meadow Lake.

The major types of wetlands encountered in the Meadow Lake area, include:

- bogs (>5 ha); and
- fens / marsh complexes (>95 ha).

Approximately half of the Meadow Lake basin is wetland (see Figure 9.4-3). A raised bog is located along the west side of the lake. Peat moss (*Sphagnum* sp.) forms much of the substrate with dominant plants including Bakeapple (*Rubus chamaemorus*), Northern Pitcher Plant (*Sarracenia purpurea*), Bog Laurel (*Kalmia polifolia*), Labrador Tea (*Ledum groenlandicum*), blueberry (*Vaccinium* sp.), Common Juniper (*Juniper communis*), Bog Rosemary (*Andromeda glaucophylla*), small and large cranberries (*Vaccinium oxycoccus* and *Vaccinium macrocarpon*), Leather-leaf (*Chamaedaphne calyculata*), Bog Huckleberry (*Gaylussacia dumosa*), Rhodora, Black Crowberry, Black Chokeberry, Round-leaved Sundew (*Drosera rotundifolia*), Sheep Laurel, Horned Bladderwort (*Utricularia cornuta*), Dragon's-mouth (*Arethusa bulbosa*) and Grass-pink (*Calopogon tuberosus*). Toward the shore the species composition changes to fen with sedges (i.e., *Carex exilis* and *Carex oligosperma*) becoming more frequent.

The wetlands at the northern end of the lake consist primarily of fen/marsh complexes dominated by Reed Grass (*Calamagrostis pickeringii*), Blue-joint Grass (*Calamagrostis canadensis*), and Tussock Sedge (*Carex stricta*).

Water Supply Pipeline

The water supply pipeline is proposed to run immediately adjacent to the existing M&NP natural gas mainline. Field surveys conducted in June 2013 confirmed the presence of a number of wetlands located within the proposed pipeline alignment (Appendix E). Figure 9.4-4 shows that the current water supply pipeline alignment will intersect a number of wetlands of various sizes and types. The majority of wetland types encountered within the proposed alignment include bog, swamp, fen and marsh.

Information related to the distribution of wetland habitat will be used to finalize the water supply pipeline alignment. Once finalized, additional field surveys will be conducted in all wetlands known to be within the footprint or zone of influence of the water supply pipeline. These surveys will include complete delineations and functional assessments following standardized methods used for assessing wetland habitat impacted by other Project components.

9.4.2.4 Additional Wetland Habitat Outside of Project Area

In addition to the two wetlands located outside of the Project area included in the 2012 assessment, a number of other individual wetlands and wetland complexes were noted to occur in the general area of the Project site. A high concentration of wetland habitat is identified in the vicinity of Betty's Cove Brook located east and northeast of the Project area. A swamp is also located to the west of the Project site on the west side of Sable Road. Mitigation measures will be in place to ensure impacts to these wetlands resulting from Project activities do not occur (this is further discussed in the effects assessment (Section 10.8)).

There is also a wetland identified along the western shore of Dung Cove on the peninsula located south of Highway 316. According to the NS Wetland Database this wetlands is connected to the shrub swamp surveyed during this current field program (WL10). At the time of the survey these wetlands were determined to be separated by upland habitat and considered to be separate wetlands. Mitigation measures will be established to protect Dung Cove Pond and as such the wetland located along the western boundary should also remain unimpacted.

No salt marsh areas were noted within the Project footprint. Eelgrass (*Zostera marina*) beds were observed and are further discussed in Section 9.6.2.

For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.8.

9.4.3 Terrestrial Wildlife

9.4.3.1 Significant Habitats

Significant habitats include sites where SAR or SOCC occur, habitats that are rare in NS, and sites where unusually large concentrations of wildlife occur (NSEL, 2009). Potentially also considered in this database are habitats that are critical for species that are not rare but valued by humans, as well as habitat for species that are not rare but sensitive to human developments.

The NSDNR Significant Species and Habitats (SigHab) database (NSDNR, 2012c) was reviewed and Appendix F provides a complete list of significant habitats identified within 100 km of the Project footprint. It should be noted however, that this database may not be comprehensive nor up to date for the Project area. A large number of significant habitat polygons are located within 100 km of the proposed Project site (Figure 9.4-5). Due to the fact

that several database records (identified by “WLD” numbers) are listed multiple times, the total number of significant habitat areas within 100 km of the proposed terminal is 635 and includes:

- 89 deer wintering areas (DWA);
- 102 migratory bird areas;
- 108 areas with species of concern;
- 59 areas for SAR; and
- 277 areas considered “other habitats” (NSDNR, 2012).

There are 20 significant habitats located in or within 20 km to the Project site (Table 9.4-6). The majority of the significant habitats (6) are deer wintering areas, followed by migratory bird areas (4), species of concern (3) and SAR (2). There are also five “other habitats” which represent important habitat for migratory birds and nesting areas for osprey as well as common eider. Only one significant habitat was located within the Project footprint (WLD# GU 921 - deer wintering habitat) (NSDNR, 2012c).

Table 9.4-6 Significant Habitats within Approximately 20 km of the Proposed Project Site Location

WLD#	Approximate Location in relation to the Proposed Project Site¹	Type
GU742	Nearest point is 9.5 km to the southwest across Fishermans Harbour.	Other habitat (Common Eider)
GU803	Nearest point is 17.5 km to the southwest near Wine Harbour.	Migratory bird (Cormorant)
GU871	Nearest point is 20 km to the east near Tor Bay.	Migratory bird (Waterfowl)
GU887	Nearest point is 3 km to the southeast across the bay.	Other habitat (Migratory Birds)
GU888	Nearest point is 5.5 km to the southeast across the bay.	Other habitat (Migratory Birds)
GU890	Nearest point is 18.5 km to the southwest in Wine Harbour.	Other habitat (Migratory Birds)
GU897	Nearest point is 1 km to the west across Isaac's Harbour.	Deer wintering (White-tailed Deer)
GU900	Nearest point is 20 km to the north near West Roach vale.	Deer wintering (White-tailed Deer)
GU907	Nearest point is 17 km to the northwest near Forest Hill.	Other habitat (Osprey)
GU917	Nearest point is 3 km to the south across the bay.	Migratory bird (Common Eider)
GU918	Nearest point is 3 km to the south across the bay.	Deer wintering (White-tailed Deer)
GU919	Nearest point is 3.5 km to the west across Isaac's Harbour.	SOCC (Common Merganser)
GU921	Project footprint located within significant habitat.	Deer wintering (White-tailed Deer)
GU923	Nearest point is 9.5 km to the southeast across the bay.	SAR (Roseate Tern, Leach's Storm-Petrel, Herring Gull, Great Black-backed Gull, Common Eider, and Unclassified Tern)
GU925	Nearest point is 4 km to the southwest across Fishermans Harbour.	Deer wintering (White-tailed Deer)

WLD#	Approximate Location in relation to the Proposed Project Site ¹	Type
GU926	Nearest point is 12 km to the southwest across Bickerton West.	Migratory bird (American Black Duck)
GU928	Nearest point is 17.5 km to the southwest in Port Hilford.	SOCC (Common Loon)
GU929	Nearest point is 12.5 km to the southwest near Harpellville.	Deer wintering (White-tailed Deer)
GU939	Nearest point is 4 km to the southwest across bay in Fishermans Harbour.	SAR (Roseate Tern and Unclassified Tern)
GU948	Nearest point is 4 km to the southwest across bay.	SOCC (Northern Bluet and Sphagnum Sprite)

Note:

1. To maintain consistency, all approximate distances provided in this table were estimated based on the location of the proposed Project site.

DWAs are considered to be important habitat for White-Tailed Deer (*Odocoileus virginianus*), a species that is not rare but valued by hunters. While deer are usually solitary, congregating in herds in suitable wintering areas greatly increases winter survival. In snow-rich winters (more than 30 to 45 cm of accumulated snow), deer move into coastal areas in order to supplement the food supply, e.g., with seaweeds found on the shores, resulting in increased numbers of deer in the area. DWAs usually are dense softwood stands close to water and regenerating hardwoods, which generally are found in riparian habitats, seashores or on south facing slopes at elevations under 150 m.

9.4.3.2 Invertebrates (Odonates and Butterflies)

LNG Facility site and ROW

Odonate surveys conducted to date for the Project by Mr. Paul Brunelle in September 2012 and July and August 2013 have documented 40 species occurring in the vicinity of wetlands, waterbodies, and uplands within the Project footprint (Appendix G). This represents 32% of the species known to occur in NS. Nine of the species are new records for Guysborough County. One species, the Sweetflag Spreadwing (*Lestes forcipatus*) is listed as Undetermined by NSDNR, indicating insufficient data exists to assign a species rank.

Odonates require wet areas for breeding, and the ponds, wetlands and watercourses in the Project area provide suitable habitat for these species, particularly the large barrachois pond on Red Head (Pond 6, also known as Dung Cove Pond), which may support as many as 59 species (Appendix G).

Butterflies are expected to be present at the Project site, particularly in the central part, the wetlands and the coast, where suitable herbaceous vegetation exists. Only one butterfly was reported during field surveys in the Project area; a Monarch (*Danaus plexippus*) (SARA, COSEWIC - Special Concern) was observed in September 2012 along Sable Road, likely during its southward migration. An effort was made during the April 2013 surveys to detect early-flying butterfly species, including Mourning Cloak (*Nymphalis antiopa*) and Jutta Arctic (*Oeneis jutta*); however, none were observed. Butterfly observations were conducted by an experienced Maritimes Butterfly Atlas (MBA) participant also part of the July 2013 survey effort;

just two species, the Canadian Tiger Swallowtail (*Papilio canadensis*) and Northern Crescent (*Phyciodes cocyta*) were observed in the Project footprint.

According to the MBA, there have been no observations to date in the 10 km by 10 km atlas square (20PR00) in which the Project area is situated (MBA, 2012). However, there have been a total of 20 records of 12 species in the squares adjacent to 20PR00, none of which are considered rare for the region. These species include:

- Least Skipper (*Ancyloxypha numitor*);
- Cabbage White (*Pieris rapae*);
- Clouded Sulphur (*Colias philodice*);
- Pink-edged Sulphur (*Colias interior*);
- Northern Spring Azure (*Celastrina lucia*);
- Northern Blue (*Plebejus idas*);
- Great Spangled Fritillary (*Speyeria cybele*);
- Atlantis Fritillary (*Speyeria atlantis*);
- Northern Crescent (*Phyciodes cocyta*);
- Red Admiral (*Vanessa atalanta*);
- American Lady (*Vanessa virginiensis*); and
- Common Wood-nymph (*Cercyonis pegala*).

Meadow Lake

Odonate and butterfly observations at Meadow Lake were collected as part of the July and August survey efforts. No lepidopterans were observed at Meadow Lake during the July or August 2013 surveys. However, most of the lake is situated within the same atlas square as the Project site, so information on potential butterfly species presence obtained from the MBA (2012) applies to Meadow Lake. Odonate species composition at the lake is expected to be generally similar, although species that require salt marsh and lentic (running water) habitats (Table 1.A in Appendix G) are unlikely to occur at Meadow Lake. Species requiring large waterbodies are more likely to occur at Meadow Lake. One Yellow-listed species Little Bluet (*Enallagma minisculum*), was detected at Meadow Lake in 2013. The larval stages of this species utilize shallow lake margins, and so could be affected by draw-down effects.

Two other species, the Mantled Baskettail (*Epithea semiaquea*), and the Sweetflag Spreadwing are listed by NSDNR as Undetermined, meaning that current knowledge of this species in NS is not sufficient to assign a status rank.

9.4.3.3 Vertebrates Other Than Birds

Wildlife in the region is described as abundant and diverse; representatives of all four terrestrial vertebrate groups have been observed by sight or sign at the Keltic Project site (AMEC, 2006). While the Keltic Project footprint was about double the size of the Project footprint and included several lakes, the species listed in the report are generally widespread and present in a variety of habitats, and can be expected to occur in the Project footprint. Species listed in discussions

of the Keltic Project surveys are species that were observed at the “Keltic Project Site Proper,” which overlaps with the Project footprint, as well as those that were observed at Meadow Lake.

Mammals

At least 20 terrestrial mammals were observed by sight or sign in the general Project area during surveys for the Keltic Project (AMEC, 2006) and during field surveys conducted in 2013; a list of these species is presented in Appendix H. Of these, Coyote (*Canis latrans*), Red Fox (*Vulpes vulpes*), American Black Bear (*Ursus americanus*), White-tailed Deer, Moose (*Alces americanus*), Striped Skunk (*Mephitis mephitis*), Raccoon (*Procyon lotor*), Short-tailed Weasel (*Mustela erminea*), River Otter (*Lontra canadensis*), Bobcat (*Lynx rufus*), Woodchuck (*Marmota monax*), Red Squirrel (*Tamiasciurus hudsonicus*), Beaver (*Castor canadensis*), Muskrat (*Ondatra zibethicus*), Meadow Vole (*Microtus pennsylvanicus*), Porcupine (*Erethizon dorsatum*), Snowshoe Hare (*Lepus americanus*) and Harbour Seal (*Phoca vitulina*) were observed in or near the Project footprint. Red-backed Vole (*Myodes gapperi*), Eastern Chipmunk (*Tamias striatus*) and American Mink (*Neovison vison*) were seen elsewhere in the Keltic Project site Project area, and seals (harbour or grey (*Halichoerus grypus*); possibly both species) were observed on rocks northeast of Red Head (AMEC, 2006).

Suitable habitat exists on the Project site for several small mammal species that occur in the province but were not observed during the field surveys, including:

- Masked Shrew (*Sorex cinereus*);
- Smokey Shrew (*Sorex fumeus*);
- Arctic Shrew (*Sorex arcticus*);
- Maritime Shrew (*Sorex maritimensis*) (often considered conspecific with Arctic Shrew, e.g., Stewart *et al.*, 2002; however, Woodman *et al.*, 2008 considers it a separate species);
- Water Shrew (*Sorex palustris*);
- Pygmy Shrew (*Sorex hoyi*);
- Short-tailed Shrew (*Blarina brevicauda*);
- Northern Long-eared Bat (*Myotis septentrionalis*);
- Little Brown Bat (*Myotis lucifugus*);
- Northern Flying Squirrel (*Glaucomys sabrinus*);
- Deer Mouse (*Peromyscus maniculatus*);
- Southern Bog Lemming (*Synaptomys cooperi*);
- Meadow Jumping Mouse (*Zapus hudsonius*); and
- Woodland Jumping Mouse (*Napaeozapus insignis*).

Furbearer harvest numbers from 2011-2012 (NSDNR, 2013c) are shown in Table 9.4-7. Each of these species was observed at some time during the course of the 2005 field studies; the four aquatic species were observed in association with Dung Cove Pond (AMEC, 2006).

Table 9.4-7 Furbearer Harvest in Guysborough County in 2011-2012

Species	Number Harvested
Aquatic Furbearers	
Muskrat	244
Beaver	154
Otter	65
Mink	25
Terrestrial Furbearers	
Short-tailed Weasel	91
Bobcat	53
Red Fox	8
Raccoon	25
Striped Skunk	3
Red Squirrel	29
Coyote	94
Snowshoe Hare	2,028

Snowshoe hare populations fluctuate dramatically, usually over an approximately ten year period. Very high Snowshoe Hare numbers were reported in 2005, providing an abundance of prey for Coyotes, Bobcats, and raptors. Coyote populations appeared to be high throughout the Keltic Project site Project area in 2005, perhaps in response to the abundance of Snowshoe Hares (AMEC, 2006).

The range of Canada Lynx (*Lynx canadensis*) (NSESA - Endangered) is restricted to Cape Breton Island (NSDNR, pers. comm., cited in AMEC, 2006). Eastern Cougar (*Felis concolor*) (COSEWIC - Data Deficient) has been reported in NS, but with little substantial evidence corroborating its presence.

The area at the base of the Red Head Peninsula on either side of Dung Cove Pond (Figure 9.4-5) has been identified as a deer wintering area (AMEC, 2006). White-tailed Deer and their sign were abundant during the April 2013 field surveys and during the 2004 and 2005 surveys for the Keltic Project. A deer herd estimated by local sources to be about 50 in number occurs between the LNG Terminal area and Drum Head; during the February 2005 winter survey, at least 35 deer were counted in this area.

Ten mammal species were observed near Meadow Lake during surveys for the Keltic Project (AMEC, 2006): Coyote, Beaver, Red-backed Vole, Meadow Vole, Porcupine, Snowshoe Hare, Bobcat, White-tailed Deer, Muskrat and Red Squirrel. Based on available habitat, it is likely that any of the species known or having potential to occur at the LNG plant site may also occur near Meadow Lake, with the exception of seals.

Amphibians and Reptiles

During the April 2013 field surveys for the Project, Wood Frog (*Lithobates sylvaticus*), and Spring Peeper (*Pseudacris crucifer*) were heard in many of the wet habitats on the site. Green Frog (*Lithobates clamitans*), Wood Frog and American Toad (*Anaxyrus americanus*) were observed on the site in July 2013. In 2005, several species of anurans (frogs and toads) were

observed in all permanently wet habitats in the general Keltic Project area, including American Toad, Green Frog, Mink Frog (*Lithobates septentrionalis*), Wood Frog, and Pickerel Frog (*Lithobates palustris*) (AMEC, 2006). Other frog species, including Bullfrog (*Lithobates catesbeianus*) and Leopard Frog (*Lithobates pipiens*), have the potential to be present based on their range. Special effort was made during surveys for the Keltic Project to locate salamanders, especially the Four-toed Salamander (*Hemidactylium scutatum*); however, none were observed. In addition to the Four-toed Salamander, Eastern Newt (*Notophthalmus viridescens*), Spotted Salamander (*Ambystoma maculatum*), Red-backed Salamander (*Plethodon cinereus*) and Blue Spotted Salamander (*Ambystoma laterale*) have potential to occur in parts of the larger Project area.

Three species of snakes were found in the general Project area in 2005: Eastern Smooth Green Snake (*Opheodrys vernalis*), Red-bellied Snake (*Storeria occipitomaculata*) and Garter Snake (*Thamnophis sirtalis*). The latter two species were observed in the industrial park (AMEC, 2006). No turtles were observed during the field surveys. Other reptile species that could be present based on habitat and range include the Ring-necked Snake (*Diadophis punctatus*), Snapping Turtle (*Chelydra serpentina*), Painted Turtle (*Chrysemys picta*) and Wood Turtle (*Glyptemys insculpta*) (AMEC, 2006). Wood Turtles are listed under SARA and COSEWIC as Threatened, NSESA as Threatened, and NSDNR as Yellow. Snapping turtles are listed under SARA and COSEWIC as Special Concern, and NSESA as Vulnerable. Snapping turtles are considered possible in all lakes and permanent streams, and may be in Dung Cove Pond in the LNG terminal area. Similarly, Painted Turtle would be expected in bodies of permanent water where they often bask on old logs, rocks, and open shores. Wood Turtle, the most terrestrial of the three species, is considered to be possibly present.

A list of amphibians and reptiles that have been observed in the Project area is presented in Appendix H.

Three frog species and one snake were observed near Meadow Lake during surveys for the Keltic Project (AMEC, 2006): Green Frog, Mink Frog, Wood Frog and Eastern Smooth Green Snake. Green Frogs were noted to be especially abundant in all permanently wet habitats.

Based on available habitat, it is likely that most of the species known or having potential to occur at the LNG plant site may also occur near Meadow Lake. American Toad, Pickerel Frog, Spring Peeper, Leopard Frog and Bullfrog were not observed, but have ranges that may encompass this area. Despite particular survey effort, no salamanders were observed. The Four-toed Salamander, Red-spotted Newt, Spotted Salamander, Red-backed Salamander and Blue Spotted Salamander have ranges that may encompass this area. Eastern Garter Snake, Red-bellied Snake and Ring-necked Snake were not observed, but are considered likely to inhabit the area (AMEC, 2006). No turtles were observed, but the Snapping Turtle and Painted Turtle are considered possible in the lake. The available habitat in Meadow Lake is not believed to be suitable for Wood Turtles (pers. comm., M. Crowell, 2007, cited in AMEC, 2008a).

9.4.3.4 Birds

Breeding bird surveys, including targeted surveys for avian SAR, were conducted on July 2nd and 3rd, 2013 by two experienced avian biologists. A total of 11 point counts were conducted in the footprint of the LNG facility (including temporary work camp), spaced 300 m or more apart and representing each of the main habitat types. In addition, the shoreline along the Red Head peninsula was walked, and the coastline was scanned for coastal bird species. The proposed pipeline route to Meadow Lake was walked, and 14 point counts were conducted at approximately 500 m intervals along its length (Appendix D-4).

Additional information on bird species in the Project area was obtained from prior surveys conducted in and near the Keltic Project footprint, the Maritimes Breeding Bird Atlas (MBBA), the Christmas Bird Count database and through information requests from EC-CWS (National Audubon Society, 2013).

Most birds are protected either under the MBCA, or regulated under the NSWA (including raptors, non-migratory game birds, and kingfishers). Species diversity in the Project area appears high and populations robust. In total, 123 species of birds have been observed during field surveys conducted in 2004 and, 2005 (AMEC, 2006), 2008 (Bird Studies Canada, 2009) and 2013 (recent field surveys by AMEC) in and near the Project LNG footprint and the Goldboro LNG. Of these, 44 species were confirmed or probably breeding, 28 species were considered possible breeders, and 54 species were considered migrants and/or non-breeders in the Project area (Appendix H). A table showing species observed in each of the different habitat types on the Keltic Project area is provided in Appendix H.

Species Protected under Nova Scotia Wildlife Act (NSWA)

Eight diurnal raptors and three owl species were observed in or near the Project area (Appendix H). Short-eared Owl (*Asio flammeus*) (SARA, COSEWIC Special concern) has been confirmed breeding in a large wetland area east of the Project footprint (AMEC, 2006), and there is an active Osprey (*Pandion haliaetus*) nest on a platform near the Sable site road (observed during AMEC site visit in, June, 2013). As well there is an active Northern Harrier (*Circus cyaneus*) nest located south of the water supply pipeline ROW in WL2 (observed during AMEC site visit in June, 2013). In addition to raptors, Belted Kingfisher (*Megasceryle alcyon*) and three game bird species were observed. Ruffed Grouse (*Bonasa umbellus*) was considered possibly breeding in the area, while Spruce Grouse (*Falcipennis canadensis*) was a probable or confirmed breeder.

Migratory Birds

Most species of migratory birds, including songbirds, waterfowl, shorebirds and seabirds, are protected under the MBCA. These groups are discussed in turn below.

Landbirds

A total of 71 species of migratory land birds were observed in the Project area, including finches, thrushes, kinglets, vireos, and numerous warbler species (Appendix H). Of these species, 27 were probably or confirmed to be breeding, and a further 20 of these species were considered to be possibly breeding in the Project area.

Shorebirds

A total of 15 species of shorebirds were found, including two species (Willet (*Tringa semipalmata*) and Greater Yellowlegs (*Tringa melanoleuca*)) probably or confirmed breeding, and two (Killdeer (*Charadrius vociferus*) and Spotted Sandpiper (*Actitis macularius*)) possibly breeding, while the remaining species were migrants (Appendix H). The cobble dike and beach at Betty's Cove are noted as relatively important habitat for shorebirds, with most of the observed shorebirds found here (AMEC, 2006). However, overall, the eastern shore of NS does not support large numbers of migrating shorebirds.

Seabirds and Waterfowl

Eight species of seabirds were observed in coastal environments at or near the proposed Project site, including three tern species, two gull species, Common Loon (*Gavia immer*), Double-crested Cormorant (*Phalacrocorax auritus*) and Black Guillemot (*Cephus grylle*) (Appendix H). A total of 14 species of waterfowl have been observed in the Project area, with six species probably or confirmed breeding.

A total of 12 seabird colonies have been identified in the vicinity of the Project area (Wilhelm S., pers. comm., 2013); these are listed in Table 9.4-8. The largest, Country Island, supports approximately 1500 nesting pairs of terns, including Common (*Sterna hirundo*), Arctic (*Sterna paradisaea*) and Roseate Tern (*Sterna dougallii*), and a large colony of Leach's Storm Petrels (*Oceanodroma leucorhoa*) (approximately 20,000 pairs). Black Guillemot and Common Eider (*Somateria mollissima*) also nest on County Island, although numbers of breeding pairs are not provided (Rock and Shervill, 2012). The other colonies support large gulls (Herring (*Larus argentatus*) and Great Black-backed (*Larus marinus*)), Common and/or Arctic Tern, and cormorants (Double-crested and/or Great (*Phalacrocorax carbo*)).

Results of winter surveys for waterfowl conducted between 2000 and 2011 were obtained from CWS (Hicks, A., pers. comm., 2013). In the survey block that encompasses Country Harbour, American Black Duck (*Anas rubripes*), Common Eider and Common Loon, Long-tailed Duck (*Clangula hyemalis*) are regularly seen. Unidentified cormorants and scaups (i.e., not identified to species level) are observed most years; the cormorants are likely to be Great Cormorant, which is more abundant in the area during the winter months. Black Scoter (*Melanitta americana*), Canada Goose (*Branta canadensis*), Common Goldeneye (*Bucephala clangula*) and Surf Scoter (*Melanitta perspicillata*) have occasionally been recorded during the winter surveys. Bufflehead (*Bucephala albeola*), Common Merganser (*Mergus merganser*), Hooded Merganser (*Lophodytes cucullatus*), Mallard (*Anas platyrhynchos*) and White-winged Scoter (*Melanitta fusca*) have also been observed. "Unidentified Goldeneye" were reported in some survey years; these are likely to be mostly Common Goldeneye (*Bucephala clangula*) but may include Barrow's Goldeneye (*Bucephala islandica*) as well.

Table 9.4-8 Seabird Colonies in Proximity to Proposed Project Area

Colony	Latitude	Longitude	Species	Pairs
Bickerton Island	45.083	-61.717	Great Black-backed Gull	24
			Herring Gull	1
Country Island	45.1	-61.54	Leach's Storm-petrel	~20,000
			Roseate Tern, Common and/or Arctic Tern	1,500
Goose Island	45.117	-61.583	Great Black-backed Gull	4
Gull Ledge	44.911	-62.035	Great Black-backed Gull	3
			Cormorant sp.	125
Gull Rock	44.91	-62.028	Common and/or Arctic Tern	24
Harbour Island	45.13	-61.602	Great Black-backed Gull	131
			Herring Gull	92
Small island west of Hapes Point, near shore	44.948	-62.109	Common and/or Arctic Tern	56
Spit, east side Liscomb Island	45.003	-61.973	Common and/or Arctic Tern	11
Thrumcap Island	44.957	-62.04	Great Black-backed Gull	8
Thrumcap Island	45.155	-61.517	Great Black-backed Gull	14
			Herring Gull	7
			Cormorant sp.	105
Tobacco Island	45.023	-61.912	Great Black-backed Gull	22
			Cormorant sp.	119
Walter Island	45.067	-61.817	Great Black-backed Gull	21
			Herring Gull	104
Wedge Island	45.007	-61.871	Great Black-backed Gull	7
			Herring Gull	33

Source: Wilhelm S., pers. comm., 2013

Maritimes Breeding Bird Atlas and Christmas Bird Count Results

Results were obtained for the Second Maritimes Breeding Bird Atlas for the 10 km by 10 km Atlas square which includes the Project area (MBBA, 2013). Breeding evidence was recorded for a total of 81 species, including 21 confirmed breeding and 16 considered probably breeding based on observed evidence (Appendix H).

Data were obtained for the Audubon Christmas Bird Count in Sheet Harbour, which is the count location nearest the Project area (National Audubon Society, 2013). A total of 74 species have been reported as wintering in the three years of Christmas Bird Counts for which data were available (Appendix H).

Based on available habitat, the avifauna of Meadow Lake may be expected to be similar to that of inland portions of the LNG site. During surveys for the Keltic Project (AMEC, 2006), a total of 60 species were observed in the Meadow Lake area, including five shorebird species, two game birds, 42 landbirds, five raptors and six waterbirds (including waterfowl and seabirds). Breeding evidence was reported for 45 species in the Meadow Lake area (Appendix H).

For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.9.



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LEGEND:

- Watercourse
- LNG Facility (proposed)
- Inferred Wetland
- Field Delineated Wetland

Habitat Type

- | | |
|------------------------|--|
| Disturbed Regenerating | Ericaceous Shrub Barren |
| Alder | Tall Shrubs |
| Barren | White Spruce Forest |
| Coniferous Forest | Young (Regenerating) Coniferous Forest |

CLIENT:

Pieridae Energy (Canada) Limited

AMEC Environment & Infrastructure
A Division of AMEC Americas Ltd.

50 Troop Avenue, Unit 300
Dartmouth, N.S., B3B 1Z1
(P) 902-468-2848 (F) 602-468-1314



PROJECT No:

TV121039

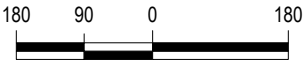
DATUM:

NAD 83

PROJECTION:

UTM 20 North

SCALE:



1:10,000

PROJECT:



**GOLDBORO
LNG**
ENVIRONMENTAL ASSESSMENT

TITLE:

**TERRESTRIAL HABITAT
AT LNG FACILITY**

DWN BY:

TM

CHK'D BY:

SB

DATE:

June 2013














REV NO:

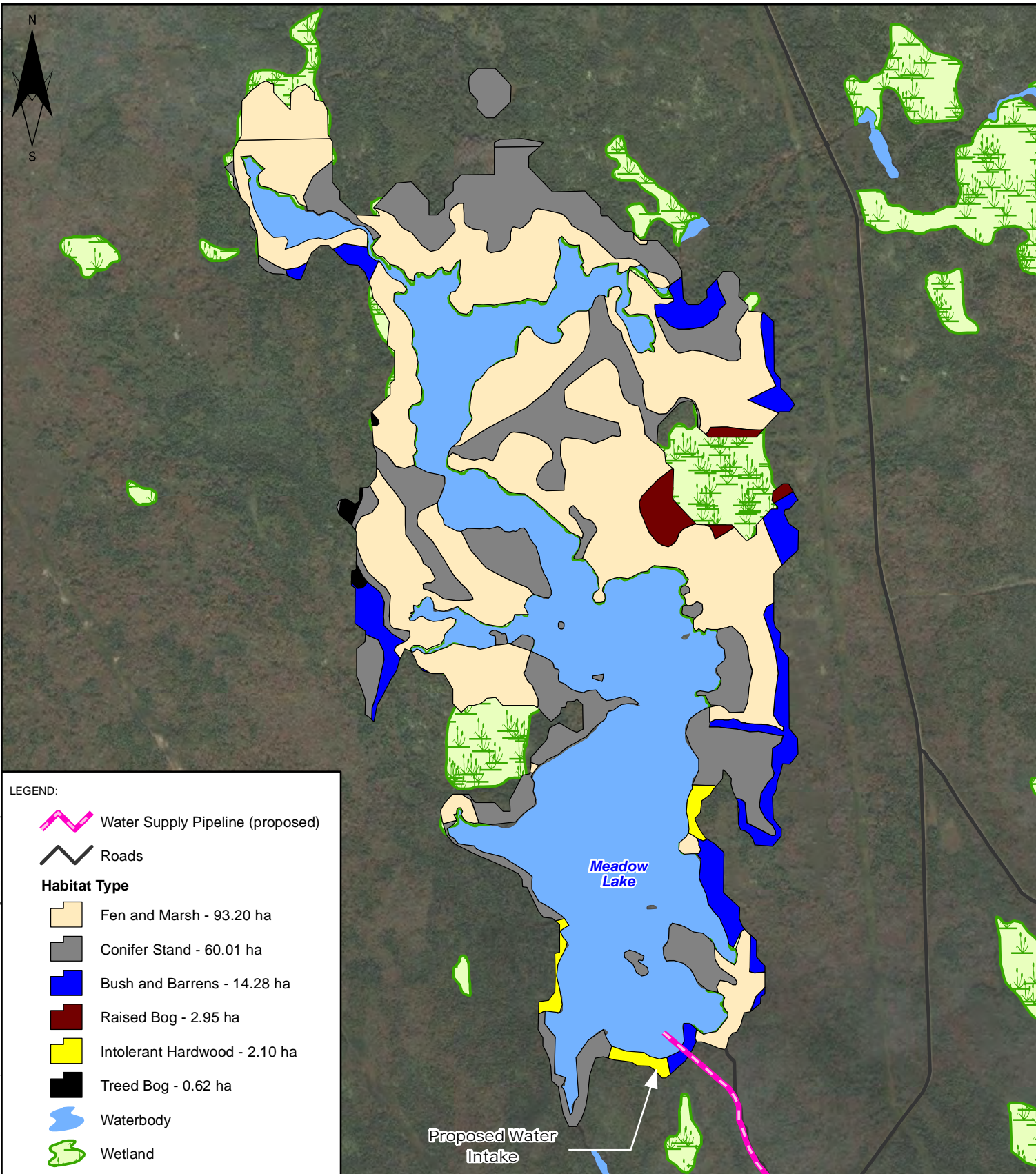
FIGURE:

9.4-1

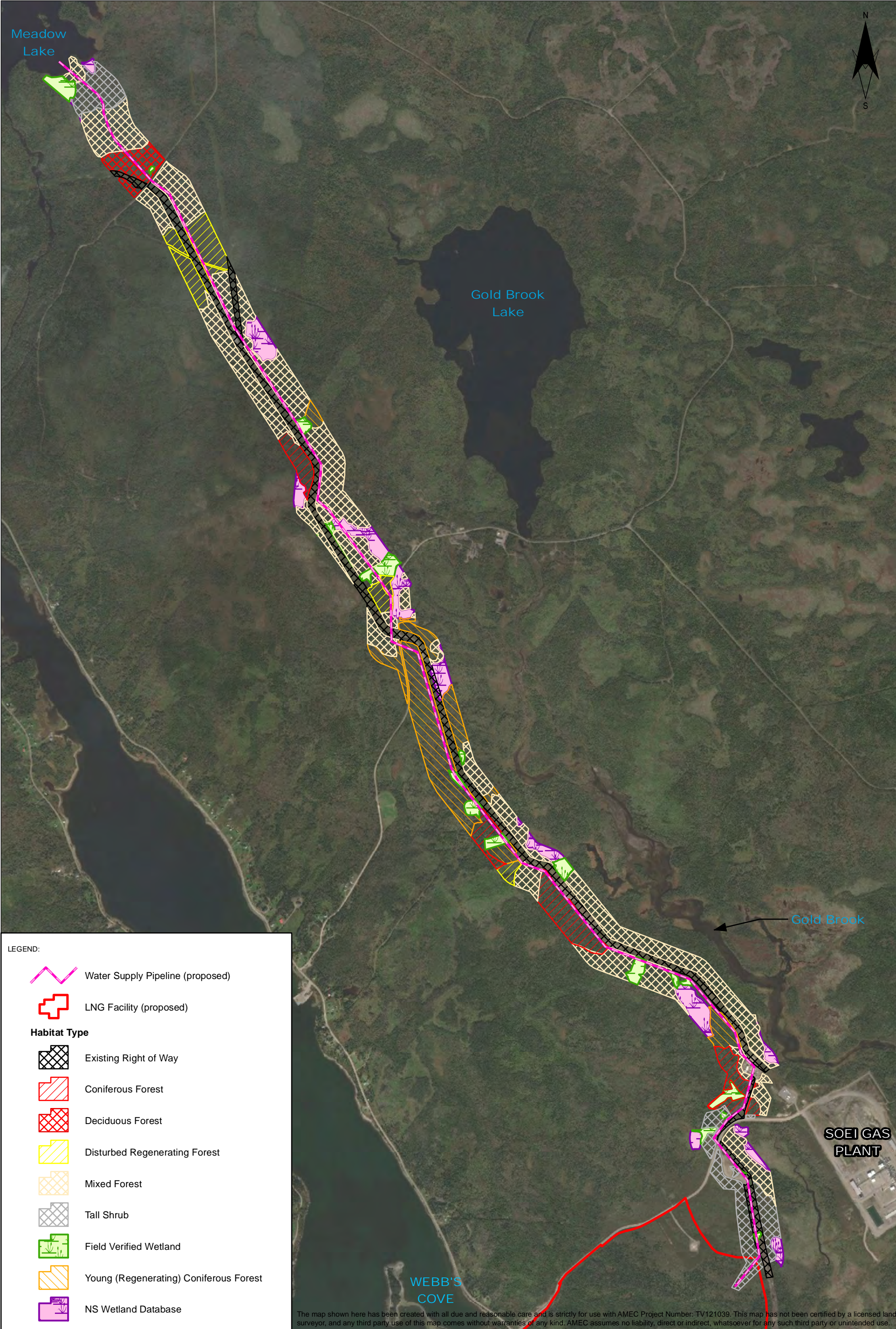


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LEGEND:		Wetland Type		CLIENT:		PROJECT No: TV121039		PROJECT:		DWN BY: TM	
	LNG Facility (proposed)		Bog		Marsh	Pieridae Energy (Canada) Limited		DATUM: NAD 83	ENVIRONMENTAL ASSESSMENT		CHK'D BY: SB
	Inferred Wetland		Bog or Fen		Salt Marsh	AMEC Environment & Infrastructure A Division of AMEC Americas Ltd. 50 Troop Avenue, Unit 300 Dartmouth, N.S., B3B 1Z1 (P) 902-468-2848 (F) 902-468-1314	PROJECTION: UTM 20 North	DATE: June 2013			
	Field Delineated Wetland		Fen		Swamp			SCALE: 200 100 0 200  Metres 1:11,000	WETLANDS AT LNG FACILITY	REV NO:	
	Temporary Work Camp (proposed)	(As per Nova Scotia Wetland Database)						FIGURE: 9.4-2			



CLIENT: Pieridae Energy (Canada) Limited	SCALE: 1:16,000	PROJECT: ENVIRONMENTAL ASSESSMENT	DWN BY: JT
AMEC Environment and Infrastructure A Division of AMEC Americas Ltd. 50 Troop Avenue, Unit 300 Dartmouth, N.S., B3B 1Z1 (P) 902-468-2848 (F) 902-468-1314	DATUM: UTM Zone 20 PROJECTION: NAD83 PROJECT NO: TV121039	TITLE: TERRESTRIAL AND WETLAND HABITAT AT MEADOW LAKE	CHK'D BY: TM/GB DATE: Aug 2013 REV. NO: N/A FIGURE NO: 9.4-3



LEGEND:

Water Supply Pipeline (proposed)

LNG Facility (proposed)

Habitat Type

Existing Right of Way

Coniferous Forest

Deciduous Forest

Disturbed Regenerating Forest

Mixed Forest

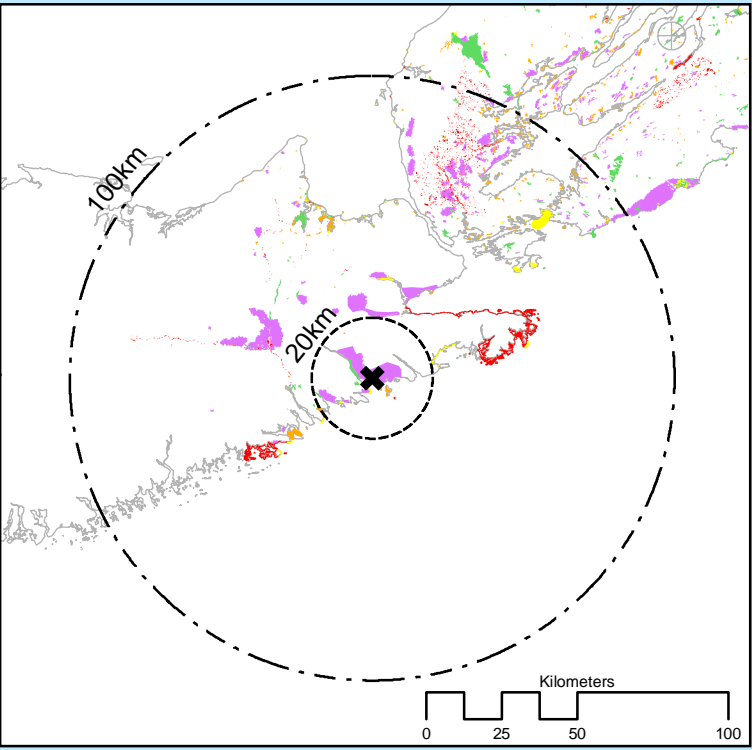
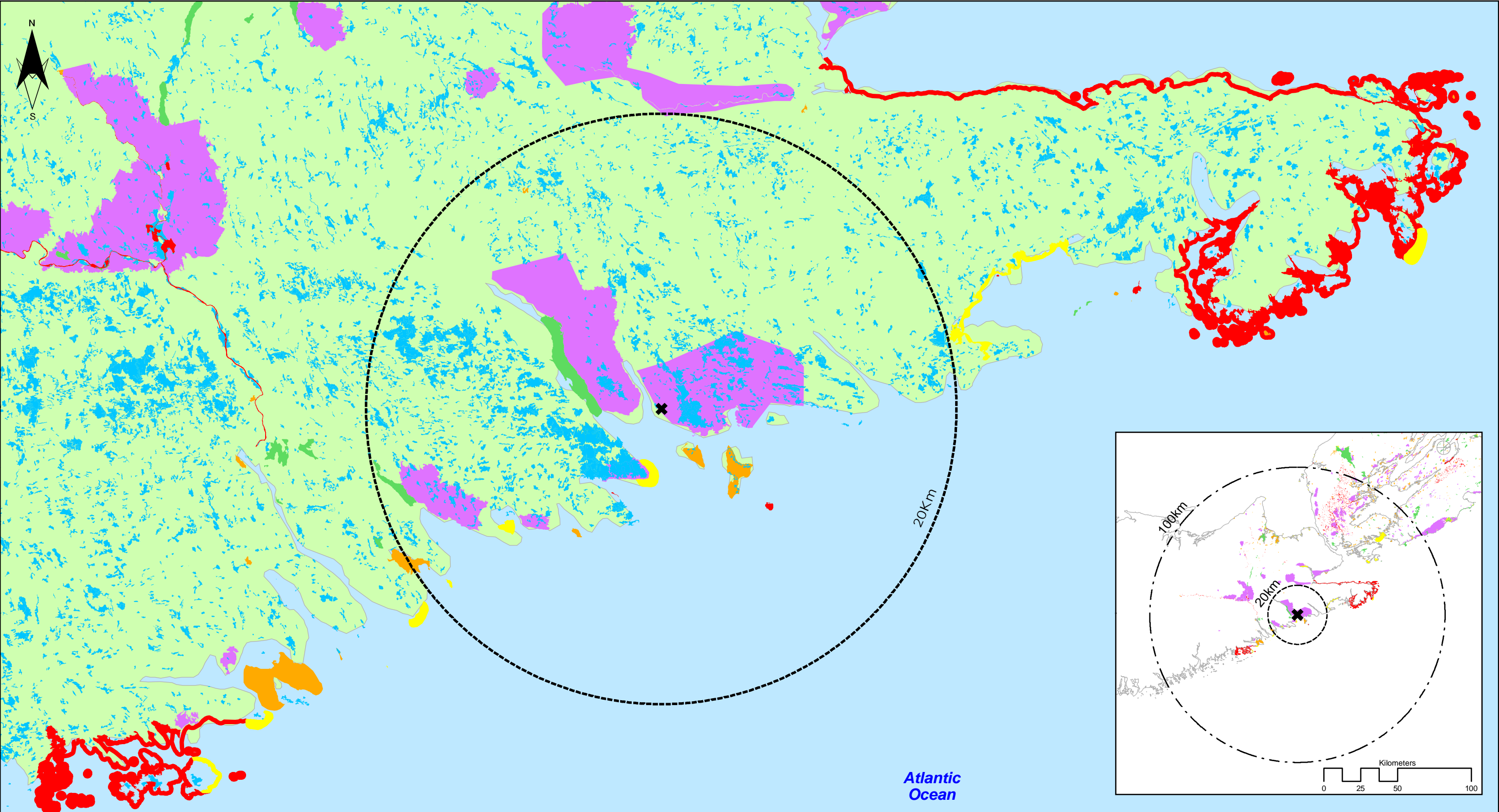
Tall Shrub

Field Verified Wetland

Young (Regenerating) Coniferous Forest

NS Wetland Database

CLIENT: Pieridae Energy (Canada) Limited	0300600 Meters	PROJECT: ENVIRONMENTAL ASSESSMENT	DWN BY:	DATE:
	DATUM: NAD 83		JT	Aug 2013
AMEC Environment and Infrastructure A Division of AMEC Americas Ltd. Suite 1 - 495 Prospect Street Fredericton, NB E3B 9M4 Tel. 506-458-1000 Fax 506-450-0829 Web www.amec.com	PROJECTION: UTM 20 North	TITLE: TERRESTRIAL AND WETLAND HABITAT ALONG WATER SUPPLY PIPELINE	CHK'D BY:	REV. NO:
	PROJECT NO: TV121039		SB	
			SCALE: 1:18,000	FIGURE NO: 9.4-4



LEGEND: ✕ LNG Property ○ LNG Site 20km Radius Freshwater or Wetland Province of Nova Scotia Ocean Significant Habitats Deer Wintering Migratory Bird Moose Wintering Areas of Concern Other Habitat Species at Risk		CLIENT: Pieridae Energy (Canada) Limited		PROJECT No: TV121039	 ENVIRONMENTAL ASSESSMENT	DRAWN BY: TM
		AMEC Environment & Infrastructure A Division of AMEC Americas Ltd. 50 Troop Avenue, Unit 300 Dartmouth, N.S., B3B 1Z1 (P) 902-468-2848 (F) 902-468-1314 		DATUM: NAD 83		CHK'D BY: MS/SB
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						REV NO:
						FIGURE: 9.4-5