Hardwood forests – Hardwood dominated forests occur in the Tanner Hill area and isolated other areas. Stands are generally dominated by red maple, white birch and grey birch with minor amounts of red/black spruce and balsam fir. Ground cover is generally similar to the mixed woods dominated by shrub species.

Aquatic habitats and riparian floodplains - Occur within and adjacent to the watercourses along the proposed pipeline route. The watercourses along the proposed pipeline route are typically small with the exception of the Middle River. An extensive floodplain habitat occurs along the Middle River.

Wetlands – Wetlands occur both within and adjacent to the proposed pipeline easement. Those within the proposed pipeline easement include bogs, treed swamps and shrub swamps. Often wetlands are located along watercourses and may be part of the riparian floodplain area.

Disturbed habitats – Disturbed habitats are prevalent along the proposed alignment including previously cutover and regenerating areas, abandoned and active agricultural lands throughout, as well as residential and commercial development located primarily along roads crossings and industrial areas.

Significant Habitats

Significant habitats were identified in the general area by the DNR Significant Habitat database (http://novascotia.ca/natr/wildlife/habitats/hab-data/). The Middle River of Pictou is a known habitat for wood turtles (*Glyptemys insculpta*) which are protected as a species at risk.

The East River of Pictou is identified as a migratory bird habitat, specifically as habitat for the Greater Scaup (*Aythya marila*) which is not listed as at risk. Several habitats in proximity of the proposed pipeline were identified by NSDNR as nest locations for Bald Eagle (*Haliaeetus leucocephalus*); NSDNR has identified these polygons as "other habitat". The Bald Eagle is not listed as a species at risk.

No forest stands greater than 60 years old or defined old growth forest were identified within the proposed pipeline easement.

Further discussion on priority species habitat within the project study area is presented in subsequent sections.

4.1.1 Geophysical

Topography

The 20.5 km long proposed pipeline route, which will originate from the existing M&NP valve station on the West River Side Road (in Limerock, Nova Scotia) and terminate at Northern Pulp, covers a large geographical area and the southern portion of the proposed route for the most part parallels a power line corridor. For the southern portion of the route, ground surface elevations generally range from 50 m asl in Limerock to 150 m asl west of Alma. Of note, east of Alma, where the proposed pipeline will cross under the Middle River of Pictou, the elevation is 0 m asl. For the northern portion of the route, ground surface elevations generally range from 10 m asl at Abercrombie Point to 60 m asl north of Mount William. Topography has been described in the archaeological study (CRM Group, March 2013) as undulating to hilly terrain underlain.

Soils

Soils along the proposed pipeline route are identified on **Figure 4-2a** and described below (Agriculture Canada 1988). It is noted that on the figure "…/A" through "…/H" refers to slope with "A" denoting a level surface, "E" denoting a moderate slope and "H" denoting an extreme slope.

- **Hansford** (Hd2 and Hd3) – sandy loam to gravelly sandy loam over compact, reddish brown, gravelly sandy loam to gravelly loam till; well drained to imperfectly drained (Hd3) soils.
- **Queens** (Qu3 and Qu5) – silt loam to clay loam over very firm silt loam to clay loam over compact, dark reddish brown, loam to clay loam till; imperfectly drained to poorly drained (Qu5) soils.
- **Cumberland** (Cm4 and Cm5) – sandy loam to loam over loose, stratified sand and gravel alluvium; imperfectly to poorly drained (Cm5) soils.
- **Westbrook** (Wb1 and Wb2) – gravelly loam to gravelly sandy loam over compact, red to reddish brown, gravelly sandy loam to very gravelly sandy loam, shallow till; well drained soils.
- **Pugwash** (Pw2, Pw4 and Pw5) – sandy loam to loam over compact, reddish brown, sandy loam to loam till; moderately well drained to poorly drained (Pw5) soils.

Most of the soils are described as being derived from Carboniferous sandstone, shale or conglomerate, with the exception of the Cumberland alluvium.

Surficial Geology

The majority of the proposed pipeline route is comprised of ground moraine deposited during the last glaciation (Wisconsinan age) as shown on **Figure 4-2b** (Conley and Brown 1992). In particular, the Silty Till Plain is described as silty and compact, with material derived from both local and distant sources. The Silty Till Plain, which is 3 to 30 m thick, is sufficient enough to mask bedrock undulations. West of Alma, there is a localized area of residuum that is described as fragmented rock consisting of angular blocks and finer interstitial debris, overlain by a thin, discontinuous veneer of till. Of note, in the area of the proposed pipeline to Michelin, a portion of the route is underlain by Hummocky Ground Moraine. This till is described as a mixture of gravel, sand and mud of direct glacial origin, with thicknesses ranging from 2 to 25 m. It is often sandy and stony and is loose with inclusions of water-lain sediment.

Bedrock Geology

The bedrock geology varies along the proposed pipeline route as shown on **Figure 4-2c** based on NSDNR Geology Maps and Databases – online – database. The geology is generally described below, starting in Limerock and ending in Abercrombie.

In the area of the M&NP valve station, the underlying bedrock is composed of Late Carboniferous, Cumberland Group, Middle River Formation described as mudstone, sandstone and minor conglomerate.

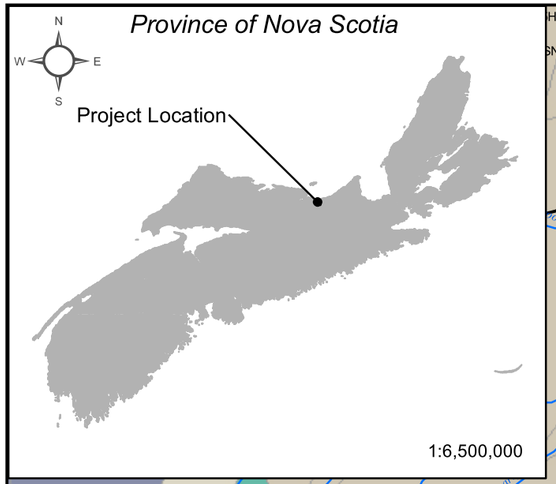


Figure 4-2a

Soil Types

Pictou County Natural Gas Pipeline

Legend

- Collector
- Expressway / Highway
- Preferred Route and Michelin Connector
- Maritimes and Northeast Pipeline
- Utility
- Watercourses
- Waterbody
- NSDNR Wetlands

Soil Types that Intersect Preferred Route

- Pugwash
- Queens
- Westbrook
- Hansford
- Cumberland

Heritage Gas

DILLON CONSULTING

0 0,5 1 2 km

SCALE 1:50,000 STATUS: DRAFT DATE: 06/27/13

Data Sources: NSDNR, GeoNova; Heritage Gas, NRC, 2012-2013 field surveys

Projection: NAD_1983_CSRS_UTM_Zone_20N

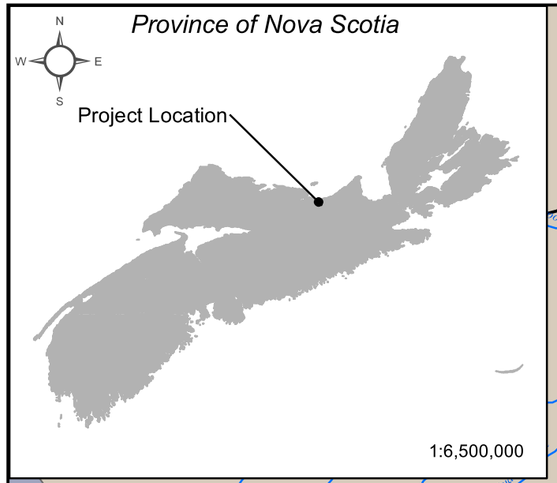


Figure 4-2b

Surficial Geology

Pictou County Natural Gas Pipeline

Legend

- Collector
- Expressway / Highway
- Preferred Route and Michelin Connector
- Maritimes and Northeast Pipeline
- Utility
- Watercourses
- Waterbody
- NSDNR Wetlands
- Alluvial Deposits
- Bedrock
- Colluvial Deposits
- Glaciofluvial Deposits (Kames and Eskers)
- Glaciofluvial Deposits (Outwash Fans)
- Hummocky Ground Morraine
- Organic Deposits
- Residuum
- Silty Till Plain (Ground Moraine)

Heritage Gas

DILLON CONSULTING

0 0,5 1 2 km

SCALE 1:50,000 STATUS: DRAFT DATE: 06/27/13

Data Sources: NSDNR, GeoNova, Heritage Gas, NRC, 2012-2013 field surveys

Projection: NAD_1983_CSRS_UTM_Zone_20N

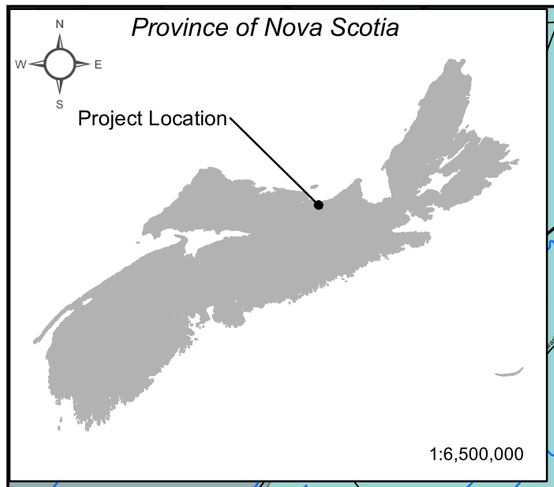


Figure 4-2c

Bedrock Geology

Pictou County Natural Gas Pipeline

Legend

- Road
- Collector
- Expressway / Highway
- Preferred Route and Michelin Connector
- Maritime and Northeast Pipeline
- Utility
- Watercourses
- Waterbody
- NSDNR Wetlands

Bedrock Formations

- Boss Point Formation
- Carboniferous Canso Group: sandstone and mudstone
- Carboniferous New Glasgow conglomerate
- Churchville Formation
- Lismore Formation
- Middle River Formation
- Millsville Conglomerate
- Nuttby Formation
- Pictou Group mudstone and sandstone
- Stellarton Formation

Heritage Gas

DILLON CONSULTING

0 0.5 1 2 km

SCALE 1:50,000 STATUS: DRAFT DATE: 06/27/13

Data Sources: NSDNR, GeoNova, Heritage Gas, NRC, 2012-2013 field surveys

Projection: NAD_1983_CSRS_UTM_Zone_20N

East of Tanner Hill, bedrock is composed of Late Carboniferous, Cumberland Group, New Glasgow Conglomerate described as alluvial conglomerate with minor sandstone and siltstone. East of Alma and the Middle River of Pictou, bedrock is composed of Carboniferous Canso Group (undivided) generally described as sandstone and mudstone.

In a small area where the proposed pipeline diverts northwards, bedrock may be composed of Early Carboniferous Windsor Group, Churchville Formation. This formation is described as sandstone, shale, limestone and minor gypsum. However, north of Mount William, the bedrock geology is Late Carboniferous, Cumberland Group, New Glasgow Conglomerate (described above).

For the remainder of the proposed pipeline route (northwards to Northern Pulp, including the proposed pipeline to Michelin), bedrock is composed of Late Carboniferous Pictou Group (undivided) generally described as mudstone, and sandstone.

Of note, south of the proposed pipeline route, bedrock includes Carboniferous-Devonian Horton Group, Nuttby Formation (siltstone, sandstone and conglomerate) in the area of Tanner Hill Road and Late Carboniferous Pictou Group, Stellarton Formation (shale, sandstone, coal and oil shale) in the area of Westville.

For the majority of the proposed pipeline route, the bedrock is of sedimentary origin and no areas of pyritic slates have been identified. Pyritic slates are commonly associated with the Meguma Group Halifax Formation, which is not located in the study area, for which exposure to weathering can lead to acid rock drainage. In a small area, limestone or gypsum may be present. A potential issue associated with these rock types is the development of a karst topography following the dissolution of minerals by groundwater. Karst conditions are not known to exist in the New Glasgow region (Sempra, May 2000); however, bedrock of the Windsor Group potentially underlies a portion of the proposed pipeline route west of the Mount William Road and the Trenton Connector interchange.

A geotechnical investigation, undertaken by Conquest Engineering in Spring 2013, identified that the compressive strength of the rock in the area denoted as Windsor Group strata was 84.4 Megapascals (MPa) at 7.6 m depth and 42.6 MPa at 12.2 m depth. The borehole record indicates the lithology as sandstone and sandstone with trace fossils. Limestone or gypsum bedrock was not encountered in this portion of the study area or in any of the boreholes along the proposed pipeline route.

Sulphide mineralization can be associated with coal seams (e.g., Stellarton Formation bedrock); however, the thick overburden in the area creates a low risk of encountering mineralized rock (Sempra 2000). Historical reports indicate that bedrock exposures at Sweet Brook and near Alma were sampled and bedrock encountered from the geotechnical drilling program was tested. No occurrence of sulphide exceeding the Provincial Environmental Standard at the time (i.e., 0.4%) was encountered (Sempra 2000).

2013 Geotechnical Investigations

Geotechnical investigations, undertaken by Conquest Engineering in the Spring of 2013, identified depth to bedrock ranging from 1.5 to 10.8 m along the proposed pipeline route (as determined through borehole drilling and test pitting). For the abandoned railway (north of Mount William), test pits and boreholes indicated the presence of 1.2 to 1.6 m of fill over up to 1.9 m of till. Depth to bedrock was 3.5 to 4.3 m.

The compressive strength of the rock ranged from 3.0 to 137.4 MPa, with an average of 46.8 MPa and was composed of weak mudstone (easily cored), conglomerate or medium strong sandstone.

Grain size analysis determined that the till is generally comprised of finer grained material (i.e., silty clay or clayey sand), with one borehole (near Mount William Road) comprised of silty clayey gravel, with sand.

Maximum depth to refusal based on wetland probes ranged from 0.3 to 0.7 m along the proposed pipeline route. Begg Brook has a silty bottom; however, no silt was found on the bottom of the Middle River of Pictou (i.e., rocky substrate). It is noted that horizontal directional drilling technology will be used to install the proposed pipeline under the Middle River of Pictou.

Soil quality analysis conducted along the abandoned railway (i.e., 7 samples) indicated non-detectable to low concentrations of petroleum hydrocarbons below Atlantic Risk Based Corrective Action (RBCA) Tier 1 Guidelines; metals concentrations below Canadian Council of Ministers of Environment (CCME) Soil Quality Guidelines, with the exception of slightly elevated arsenic in one sample at 4.0 m depth; and non-detectable to low concentrations of polycyclic aromatic hydrocarbons (PAHs) below CCME Soil Quality Guidelines.

Groundwater Supplies

Potable groundwater in the rural portions of the study area is supplied by private water wells. The towns of New Glasgow and Westville are supplied water from the Forbes Lake Watershed located near Churchville (south of Stellarton), for which the proposed pipeline route avoids the watershed. The Town of Stellarton withdraws their water from the East River outside of the Project area.

Groundwater supplies should not be affected by the installation of the proposed pipeline as no blasting requirements have been identified and horizontal directional drilling technologies will be utilized to install the proposed pipeline under watercourses and wetlands. A geotechnical investigation (Conquest Engineering, 2013) confirmed depth to bedrock along the route. In areas of potentially shallow bedrock (e.g., Alma, Sweet Brook), the depth to bedrock was determined to be 3.7 m or greater near Alma and the depth to refusal for the wetland probe near Sweet Brook (Limerock) was 0.5 m.

4.1.2 Atmospheric

Nova Scotia, and much of the Atlantic Region, lies within the zone of prevailing westerly winds. This zone is characterized by the passage of a series of high and low pressure systems. Paths taken by these systems are further influenced by ocean currents and continental topography. Cyclonic passages (low pressure systems moving through an area) may track across the continent or up the eastern seaboard. Typical cyclonic passages are marked by the onset of wind from an easterly direction, thickening cloud, and a gradual fall in pressure. Strong north-easterly winds and heavy precipitation are familiar accompaniments to these storms. Should the storm centre pass to the south, the wind direction will change in a counter-clockwise manner and precipitation may persist for several days. If the low pressure centre tracks to the north of the observing station, the wind direction usually veers (changes in a clockwise manner). The cyclonic passages typically last from a few days to a week.

During the summer, persistent high pressure systems off Bermuda result in prolonged periods of stagnant weather with warm temperatures and light winds from the south. These events promote the movement of air pollutants from the eastern seaboard to the Atlantic coast. When these meteorological conditions persist, the potential for deterioration air quality is increased. This meteorological condition generally accompanies the days with visible pollutant haze and hot, stagnant summer days. Hurricanes that develop in the tropics can move up the eastern seaboard. These storms are significantly downgraded as they encounter the colder waters of the northeast US and Canada. Typically, by the time a hurricane reaches Atlantic Canada, it will have weakened into a tropical storm or an intense low pressure system with strong winds and heavy rains. The peak time for these storms is between September and October.

Winters have been cold with frequent snowfall. The average annual snowfall amount over the period from 1971 to 2000 is 182 cm. Climate normals are developed from meteorological data covering a 30-year period and are used to characterize climatic elements and eliminate any year-to-year variations. The majority of the precipitation is in the form of rainfall, which may occur in any month of the year. The monthly rainfall totals are highest during the fall months.

Climate normals are developed from meteorological data covering a 30-year period and are used to characterize climatic elements and eliminate any year-to-year variations. Environment Canada's weather station at Lyons Brook, Nova Scotia was chosen as a representative site for climate normal data. The annual temperature normal for the monitoring station at Lyons Brook for the period from 1971 to 2000 is 65^{o}C. The daily maximum is 11.4^{o}C and the daily minimum is 1.7^{o}C.

Temperature Normals for the area are shown in Table 4-1. The annual temperature range is normally between 19.3^{o}C and -6.1^{o}C. However, extreme temperatures of +36^{o}C in summer and 32.5^{o}C in winter have been recorded.

Table 4-1 - Environment Canada Temperature Data for Pictou Region

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average (°C)	-6.1	-6	-1.6	4.2	10.2	15.4	19.3	18.9	14.5	9	3.5	-2.9	6.5
Standard Deviation	2	1.9	1.9	1.3	1.6	1.2	1.4	1	1.4	1.3	1.2	2.5	1.5
Daily Maximum (°C)	-1.2	-1.1	3.1	8.7	15.7	20.9	24.7	24.2	19.5	13.3	7.2	1.2	11.4
Daily Minimum (°C)	-11.1	-10.8	-6.2	-0.2	4.7	9.8	13.7	13.6	9.5	4.6	-0.1	-6.9	1.7
Extreme Maximum (°C)	17	17.5	19	23.5	33	33	34	**36**	34	26	20.5	16	
Date (yyyy/dd)	1995/16	1994/20	1986/30	1994/16	1992/23	1988/16	1991/20	**2001/10**	2001/09	2001/04	1997/03	1999/06	
Extreme Minimum (°C)	-29	**-32.5**	-25	-13	-5	-1	3.5	3	-2	-6	-14	-25	
Date (yyyy/dd)	1994/27	**1993/07**	1985/07	1995/06	1992/01	1986/13	1997/16	1989/28	1995/25	1993/21	1989/25	1989/30	

Precipitation normals and extremes are presented in Table 4-2. Although rain may occur in any month of the year, the rainfall in the area is highest during fall and early winter. Total average rainfall is 1233 mm. Snow and freezing precipitation can occur between October and May, with the largest amounts falling between December and March. The average annual snowfall amount over the period from 1971 to 2000 is 276.2 cm.

Table 4-2 – Environment Canada Precipitation Data for Pictou Region

Precipitation:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall (mm)	48.4	31.7	48.2	72.7	84.8	90.7	81.1	83.6	117.3	121	112.5	64.7	956.7
Snowfall (cm)	62.1	63.8	52.8	17.9	1.6	0	0	0	0	0.5	18.8	58.8	276.2
Precipitation (mm)	110.5	95.4	101	90.6	86.4	90.7	81.1	83.6	117.3	121.5	131.3	123.5	1233
Extreme Daily Rainfall (mm)	30	35	43	59	43	46	70	80	**83**	73	51	65	
Date (yyyy/dd)	994/18	993/17	992/08	001/27	994/05	985/06	986/28	999/15	**96/14**	990/29	987/12	990/08	
Extreme Daily Snowfall (cm)	39	**45**	33	25	10	0	0	0	0	8	30	34	
Date (yyyy/dd)	985/15	**86/22**	993/11	999/04	992/05	984/01	984/01	984/01	984/01	985/28	989/23	988/17	
Extreme Daily Precipitation (mm)	45	51	43	59	43	46	70	80	**83**	73	53	65	
Date (yyyy/dd)	985/15	988/16	992/08	001/27	994/05	985/06	986/28	999/15	**96/14**	990/29	987/12	990/08	
Extreme Snow Depth (cm)	76	**95**	90	61	2	0	0	0	0	8	32	50	
Date (yyyy/dd)	001/22	**86/26**	987/16	001/04	995/07	988/01	988/01	988/01	988/01	985/29	992/20	987/31	

Table 4-3 provides a summary of Nova Scotia's Ambient Air Quality Standards (NSE – Air Quality Regulations under Section 112, Environment Act 2010) for regulated air contaminants. These contaminants can contribute to a variety of health and environmental effects depending on the nature of the pollutant, its concentration, the exposure period, the presence of other pollutants and receptor sensitivity.

Table 4-3 Maximum Permissible Ground Level Concentrations

Contaminant	Averaging Period	Maximum Permissible Ground Level Concentrations	
		ug/m^3	Pphm
Carbon Monoxide (CO)	1 hour	34 600	3 000
	8 hours	12 700	1 110
Hydrogen Sulphide (H_2S)	1 hour	42	3
	24 hours	8	0.6
Nitrogen Dioxide (NO_2)	1 hour	400	21
	Annual	100	5
Ozone (O_3)	1 hour	160	8.2
Sulphur Dioxide (SO_2)	1 hour	900	34
	24 hours	300	11
	Annual	60	2
Total Suspended Particulate (TSP)	24 hours	120	-
	Annual	70*	-

* geometric mean
ug/m^3 micrograms per cubic metre
Pphm parts per hundred million

The air quality on mainland Nova Scotia is generally very good. It is likely that air quality in the majority of the study area falls within the desirable objectives of the federal classification and well within the provincial limits. There are however a few major industries within the northern portion of the study area which may influence local air quality in a less desirable manner. Industries include the last remaining pulp mill in the province of Nova Scotia as well as a major tire manufacturer. Both these industrials will benefit greatly by the presence of natural gas, replacing their dependence on Bunker C which will reduce greenhouse gas and other emissions.

There is a number of ambient air monitoring stations throughout Nova Scotia, including one in Pictou. The Pictou station (National Air Pollution Surveillance Program (NAPS: 030901)) monitors ozone, particulate matter, total reduced sulphur, nitric oxide, nitrogen dioxide, and volatile organic compounds. The annual percent data available for 2011 is summarized in Table 4-4.

Table 4-4 Environment Canada Ambient Air Monitoring Data – Pictou Station 030901 (Year 2011)

NapsID	STA_City	O3	NO2	NO	NOx	SO2	CO	BAM35 PM25
030901	Pictou	92	97	74	96	0	0	98

Air emissions must comply with the provincial Air Quality Regulation made under Section 112 of the Environment Act, 1995. The Government of Canada is also a signatory to the Kyoto Accord committing it to reduce greenhouse gas emissions. Fugitive emissions of natural gas, as well as point source emissions such as those from equipment and vehicles, are sources of greenhouse gases, but this contribution is minor on regional and global scales. Heritage Gas is committed to and supportive of the Voluntary Challenge and Registry (VCR) program and will implement measures to minimize fugitive emissions from its facilities such as:

- conducting regular equipment/vehicle maintenance to improve operating performance and fuel efficiency (and thereby reducing greenhouse gas emissions);

- managing wood waste from construction activities, such that chipping is the preferred waste management method;
- reducing natural gas emissions during line commissioning by monitoring gas concentrations at the exit point in the line and/or by flaring purged gas; and,
- specifying, constructing and implementing high quality system components that reduce fugitive emissions from the system.

Guidelines are provided for noise levels and dust levels by the Nova Scotia Department of the Environment ("NSE"). These levels are related to the disturbance and nuisance created by excess noise at different times of day and the nuisance effect of fugitive dust.

4.1.3 Watercourses

Watercourses are defined under the Environment Act as:

"*the bed and shore of every river, stream, lake, creek, pond, spring, lagoon or other natural body of water, and the water therein, … whether it contains water or not, and all groundwater*"

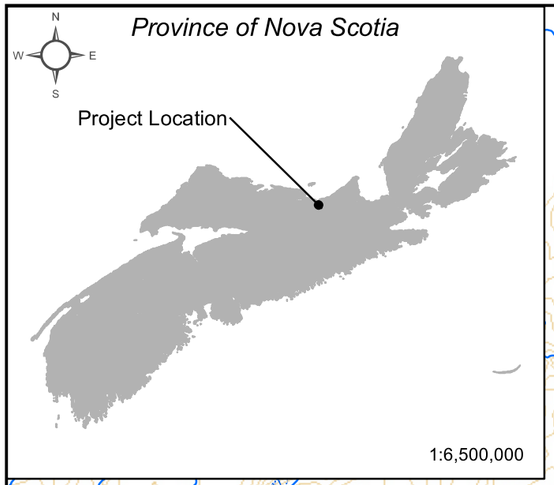
(http://nslegislature.ca/legc/statutes/envromnt.htm). Alteration of watercourses requires an approval by the NSE.

The proposed pipeline route is within the East/Middle/West Pictou (WDP) primary watershed of Nova Scotia and passes through three tertiary watersheds. Watercourses within this area flow to the Northumberland Strait of the Atlantic Ocean.

Watercourses along the proposed route are located on **Figure 4-3** based on 1:10000 mapping and field reconnaissance. The western quarter of the route is within the West River subwatershed, while the majority of the route is within the Middle River watershed. A small portion at Abercrombie Point, drains toward the estuary area of the East River. The proposed route crosses freshwater watercourses. However the Middle River area, downstream of the proposed pipeline route has some estuarine influence, and the Middle and East River areas in the Abercrombie area again downstream of the proposed route, are estuarine.

Surface water quality data was collected for the majority of watercourses along the alignment on November 9, 2012 and October 24, 2012 by Dillon Consulting Limited as whole water grabs. Supplementary samples were taken in June 2013 and results will be available on request. Water chemistry analysis was conducted by Maxxam Analytical. **Appendix D** provides the water chemistry data. **Table 4-5** provides a summary of the watercourses along the alignment and includes identification of water chemistry exceedances to CCME Freshwater Aquatic Life Guidelines (FWAL; http://ceqg-rcqe.ccme.ca/).

Further assessment of fish habitat is provided in **Section 4.1.5**



WT 7
WC 11 - Begg Brook
WC 10 - Begg Brook
WC M5 - Begg Brook
Abercrombie
WT M8
WC M4
WT 6
WC 9
Begg Brook
WT M7
WC M3 - Begg Brook
WT M6
WT M5
Granton
WT M4A
WC M2 - Trib to Begg Brook
106
WT M4
WT M3
WT M2
WT M1A
Mount William
WC M1 - Trib to Bear Brook
WC 7 - Middle River
WT 4b
WT5
WC 6b
WT 3
WC 6
Alma
Middle River
WT M1
WT 5d
WC 8b
WT 5c
WT 5b
WC8a - Trib to Bear Brook
WT 5a
WC 4 - Trib to West River
WC 3 - Trib to Miller Brook
WC 2 - Trib to Miller Brook
WT 1
WC 1 - Sweets Brook
WT 0-B
WT 0-A
Field determined - not a wetland
Tanner Hill
Limerock
104
Miller Brook
Brown Brook
Hugh Brook
Skinner Brook
Fox Brook
Westville
Stellar
Ply
Trenton
New Glasgow
Linacy
Lowden Brook
Smelt Brook
Rear Brook
East River
West River
Four Mile Brook
Middle Pictou Watershed
East Pictou Watershed
Sutherlands River
Text

Figure 4-3

Watercourses and Wetlands

Pictou County Natural Gas Pipeline

Legend

- Contour Interval (5m)
- Railroad
- Collector
- Expressway / Highway
- Preferred Route and Michelin Connector
- Maritimes and Northeast Pipeline
- Utility
- Watercourses
- Sub-Watershed Boundary
- Field Verified Wetland
- NSDNR Wetlands
- Waterbody

WC = Watercourse
WT = Wetland

Heritage Gas

DILLON CONSULTING

0 0.5 1 2 Kilometers

SCALE 1:50,000 STATUS: DRAFT DATE: 06/27/13

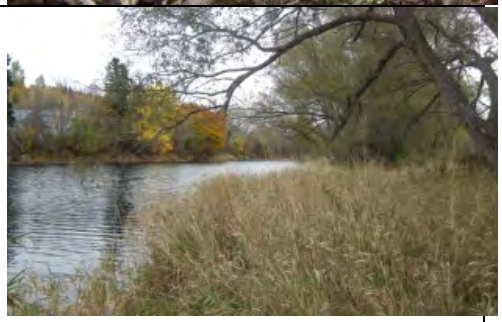
Data Sources: NSDNR, NRC, 2012-2013 field surveys

Projection: NAD_1983_CSRS_UTM_Zone_20N

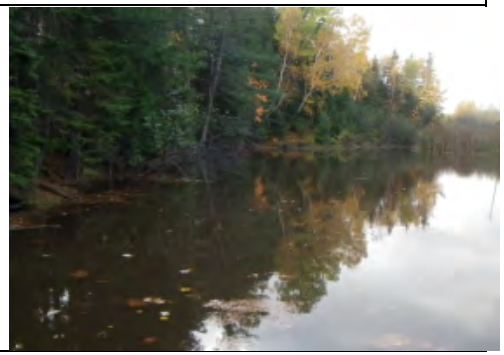
Table 4-5 Watercourses Crossed by the Proposed Alignment

No.	Name/Label	Sub-Watershed	Approximate Size at Crossing Location	Surface Water Chemistry Summary* Fall 2012 (Reference No. for Analytical Data)	Photo
WC-1	Sweet Brook	West River	Width: stream channel 3-5 m but multiple braids in 80 m floodplain Depth (max.): 0.4 m Flow status: permanent watercourse Fish habitat: good to excellent Other comments: east side steep slopes more gently than sloping west side. Back channel on east side of floodplain likely floods during freshet. Alder wetland on east side of floodplain	(Red 2013_1) pH 7.94 units Conductivity 580 uS/cm Total Suspended Solids - Not Detected FWAL Exceedances: chloride (140 mg/L)	
WC-2	Trib. to Miller Brook	West River	Width: stream channel 2.5 m Depth (max.): 0.2 m Flow status: permanent watercourse Fish habitat: good Other comments: evidence of ATV crossing (plywood structure)	(Red 2013_2) pH 7.34 units Conductivity 100 uS/cm Total Suspended Solids 3.2 mg/L FWAL Exceedances: aluminum (347 ug/L), iron (361 ug/L)	
WC-3	Trib. to Miller Brook	West River	Width: stream channel 2 m Depth (max.): 0.1 m Flow status: permanent watercourse Fish habitat: moderate Other comments: 0.5 m bank west side with shallow approach slope from abandoned field. West side likely floods into the marginal wetland and perhaps abandoned field. 1.5 - 2 m bank east side with steep forested slope beyond west side. Iron staining	(Red 2013_3) pH 7.88 units Conductivity 350 uS/cm Total Suspended Solids 1 mg/L FWAL Exceedances: none	

No.	Name/Label	Sub-Watershed	Approximate Size at Crossing Location	Surface Water Chemistry Summary* Fall 2012 (Reference No. for Analytical Data)	Photo
			indicates possible groundwater seep		
WC-4	Trib. to West River	West River	Width: stream channel <2 m Depth (max.): 0.1-0.3 m Flow status: seasonal watercourse / ditch Fish habitat: unlikely Other comments: receives flow from ponded area upstream; drainage ditch in agricultural field downstream	(Red 2013_4) pH 7.27 units Conductivity 64 uS/cm Total Suspended Solids 2 mg/L FWAL Exceedances: aluminum (265 ug/L), cadmium (0.019 ug/L)	
WC-5	Trib. to Miller Brook	West River	Width: <1m Depth (max.): 0.1m Flow status: intermittent ditch Fish habitat: no Other comments: headwater to watercourse downstream of agricultural fields. Along agricultural fields and edge of road, drainage has been ditched	(Red 2013_5) pH 7.91 units Conductivity 690 uS/cm Total Suspended Solids 5.4 mg/L FWAL Exceedances: chloride (160 mg/L)	
WC-6	Trib. to Middle River	Middle River	Width: stream channel < 1 m Depth (max.): 0.05 m Flow status: seasonal watercourse; intermittent, expect dry in summer Fish habitat: no Other comments: within a 2 m steep bank down to watercourse on both sides	Sample Collected June 2013 Data Pending	

No.	Name/Label	Sub-Watershed	Approximate Size at Crossing Location	Surface Water Chemistry Summary* Fall 2012 (Reference No. for Analytical Data)	Photo
WC-6b	Trib. to Middle River	Middle River	Width: < 1 m Depth (max.): 0.1 m Flow status: seasonal watercourse (defined channel); may be dry occasionally Fish habitat: no Other comments: alder channel extends 4 m total; flows toward southward	Sample not available	
WC-7	Middle River	Middle River	Width: Stream Channel is 10 – 15 m Depth (max.): 3-5 m Flow status: permanent watercourse Fish habitat: good Other comments: approx. 50 m wide channel with marginal wetlands. On east side small wetland; west side braid at 100 m from river; then upland prior to 50 m floodplain wetland. Steep slope on west bank, gradual slope on east bank.	(Red 2013_6) pH 7.86 units Conductivity 220 uS/cm Total Suspended Solids 1 mg/L FWAL Exceedances: aluminum (131 ug/L)	
WC-8	Trib. to Bear Brook	Middle River	Width: 2 m Depth (max.): 0.2 m Flow status: permanent, may be seasonally dry Fish habitat: poor, seasonal potential Other comments: parallel route for distance after crosses and wetland downstream good fish habitat	Sample Collected June 2013 Data Pending	

No.	Name/Label	Sub-Watershed	Approximate Size at Crossing Location	Surface Water Chemistry Summary* Fall 2012 (Reference No. for Analytical Data)	Photo
WC-8b	Trib. to Bear Brook	Middle River	Width: < 1 m Depth (max.): 0.1 m Flow status: intermittent Fish habitat: no Other comments: crosses route	Sample Collected June 2013 Data Pending	
WC-M1	Trib. to Bear Brook	Middle River	Width: 2 m Depth (max.): 30 cm Flow status: permanent Fish habitat: moderate Other comments: shallow approach slopes, < .5 m bank west side, shallow east side	(Magenta 2013_1) pH 7.16 units Conductivity 130 uS/cm Total Suspended Solids 31 mg/L FWAL Exceedances: aluminum (286 ug/L), cadmium (0.040 ug/L), iron (744 ug/L)	
WC - M2	Trib. to Begg Brook	Middle River	Width: Stream Channel 15 m Depth (max.): >1 m pond, shallow downstream Flow status: permanent watercourse (obstruction caused pond) Fish habitat: no, due to obstructions Other comments: obstruction caused pond	(Magenta 2013_2) pH 6.20 units Conductivity 45 uS/cm Total Suspended Solids 3.2 mg/L FWAL Exceedances: pH (6.20 units), aluminum (273 ug/L), cadmium (0.032 ug/L), iron (454 ug/L)	

No.	Name/Label	Sub-Watershed	Approximate Size at Crossing Location	Surface Water Chemistry Summary* Fall 2012 (Reference No. for Analytical Data)	Photo
WC-M3	Begg Brook	Middle River	Width: Stream channel 2+ m Depth (max.): 0.5 – 1 m Flow status: permanent watercourse Fish habitat: good Other comments: Steep channel banks (0.5 m drop), wide flood plain	(Magenta 2013_3) pH 7.90 units Conductivity 310 uS/cm Total Suspended Solids 1 mg/L FWAL Exceedances: iron (364 ug/L)	
WC-M5	Begg Brook	Middle River	Width: Stream Channel 15 – 20 m Depth (max.): 1-2.5 m depth. Flow status: permanent watercourse Fish habitat: fair quality Other comments: suspended sediment	(Magenta 2013_6) pH 7.46 units Conductivity 140 uS/cm Total Suspended Solids 14 mg/L FWAL Exceedances: aluminum (1220 ug/L), cadmium (0.052 ug/L), chromium (1.6 ug/L), copper (2.2 ug/L), iron (1290 ug/L), lead (1.71 ug/L)	
WC-10	Begg Brook	Middle River	Width: 30 m Depth (max.): > 1 m Flow status: permanent Fish habitat: poor quality Other comments: ponded area with large culvert damaged downstream	(Red 2013_9) pH 7.71 units Conductivity 240 uS/cm Total Suspended Solids 7.6 mg/L FWAL Exceedances: aluminum (362 ug/L), iron (949 ug/L)	

No.	Name/Label	Sub-Watershed	Approximate Size at Crossing Location	Surface Water Chemistry Summary* Fall 2012 (Reference No. for Analytical Data)	Photo
WC-11	Trib. to Begg Brook	Middle River	Width: < 2 Depth (max.): 0.1 Flow status: permanent Fish habitat: unlikely Other comments: steep approach slopes, submergent wetland downstream, woody debris, evidence of beaver activity, silt/fines dominated substrate, low velocity flow, backflooded culvert upstream	Red 2013_10 Sampled June 2013 Data pending	
WC-M4	Trib. to Begg Brook		Width: Stream channel 5-7 m Depth (max.): 1-2 m Flow status: Permanent watercourse Fish habitat: good to excellent Other comments: steep approach slope especially west side	(Magenta 2013_4) pH 7.90 units Conductivity 320 uS/cm Total Suspended Solids 4 mg/L FWAL Exceedances: aluminum (189 ug/L), iron (2170 ug/L)	
WC-9	Trib. to Middle River		Width: Stream channel 2-5.5 m Depth (max.): 0.5-1.5 m Flow status: Seasonal watercourse; likely dry in summer Fish habitat: no Other comments: -	(Magenta 2013_5) pH 7.84 units Conductivity 260 uS/cm Total Suspended Solids 1 mg/L FWAL Exceedances: iron (429 ug/L)	

*FWAL Guidelines – Canadian Water Quality Guidelines for the Protection of Aquatic Life (Freshwater Aquatic Life), Summary Table as found on CCME website http://ceqg-rcqe.ccme.ca/:

No.	Name/Label	Sub-Watershed	Approximate Size at Crossing Location	Surface Water Chemistry Summary* Fall 2012 (Reference No. for Analytical Data)	Photo
Chloride – 120 mg/L pH – recommended range is 6.5 to 9.0 units Aluminum – 5 ug/L where pH is <6.5 units and 100 ug/L where pH is ≥6.5 units Cadmium – dependent on hardness; Cd guideline (ug/L) = e1.273[ln(hardness in mg/L CaCO3)-4.705 Copper –dependent on hardness; Cu guideline (ug/L) = e0.8545[ln(hardness in mg/L CaCO3)]-1.465 * 0.2. The minimum guideline is 0.002 mg/L regardless of hardness. Chromium – the guidelines for trivalent and hexavalent chromium are 0.0089 and 0.0010 mg/L, respectively (FWAL 1997). Total chromium is reported by the lab and compared to the more stringent guideline (0.0010 mg/L). Iron – 300 ug/L Lead –dependent on hardness; Pb guideline (ug/L) = e1.273[ln(hardness in mg/L CaCO3)]-4.705. The guideline varies from 0.001 mg/L for hardness 0 to 60 mg/L CaCO3 to 0.007 mg/L for hardness >180 mg/L CaCO3					