DILLON CONSULTING

NOVA SCOTIA TRANSPORTATION AND INFRASTRUCTURE RENEWAL

Environmental Assessment Final – Highway 107 Burnside to Bedford

Final Report

June 2017 – 13-8348

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1.0 INTRODUCTION

Nova Scotia Transportation and Infrastructure Renewal (NSTIR) propose to construct, operate and maintain a four-lane highway connecting Burnside Business Park to Bedford within the Halifax Regional Municipality (HRM). This Environmental Assessment (EA) addresses the approximately 9 kilometers (km) of proposed extension (and associated interchanges) of Akerley Boulevard and Burnside Drive, new alignment westerly to Duke Street (and associated Magazine Hill/Anderson Lake interchange), and the approximately 1.5 km widening of Duke Street to the Bicentennial Highway, comprising "Highway 107 Burnside to Bedford" (to be referred to as the Project). **Figure 1-1** outlines the proposed alignment, Project components and location. A center point for the Project area in latitude and longitude is: 44.723263°, -63.627978° in decimal degrees; 44°43'23.75"N, 63°37'40.68"W in degrees, minutes, seconds. Properties along the alignment include Property Identifiers (PIDs): 40823015, 40917411, 40832834, 40918278, 41258732, 41404658, 41404666, 41215583, 40872020, 40917460, 40760845, 40918286, 00360982, 00415745, 00415661, 41215674, 41215666, 41457235, 41457250, 40114084, 41457219, 00339648, 40740334, 41376872, 41354465, 41381419, 41354440, 40939845, and 40172785.

Nova Scotia Environment (NSE) has confirmed that a provincial EA (Class 1) is required as the Project involves the construction of four or more lanes of traffic and is longer than 2 km of newly paved highway.

This EA has been prepared by Dillon Consulting Limited (Dillon) on behalf of NSTIR and builds on previous assessments (P. Lane and Associates Limited (P. Lane), 1991 and Stantec, 2011). The following document meets the requirements of the *Nova Scotia Environment Act*, Environmental Assessment Regulations.

1.1 Project Contacts and Proponent

Parties Involved	Contact: Department, Name, Title, Division, Email	Telephone	Fax
Nova Scotia Department of the Environment	Environmental Assessment Branch Bridget Tutty ea@gov.ns.ca	902.452-7891	902.424.0503
Proponent:	NSTIR, Environmental Services Group Sylvie Colomb, Environmental Analyst Sylvie.Colomb@novascotia.ca	902.424.8143 902.240-7411	902.424.7544
Consultant:	Dillon Consulting Limited Karen March, Project Manager KMarch@Dillon.ca	902.450.4000	902.450.2008

Identification of the proponent

Name of Undertaking:	**Highway 107 Burnside to Bedford**
Name of Proponent:	Nova Scotia Department of Transportation and Infrastructure Renewal
Postal Address:	P. O. Box 186 Halifax NS B3J 2N2
Street Address:	Johnston Building 1672 Granville Street Halifax, NS
Tel:	(902) 424 2297
Fax:	(902) 424-0532
Email:	tpwaff@novascotia.ca

Environmental Assessment Contact

Name:	Ms. Sylvie Colomb
Official Title:	Environmental Analyst
Address:	Same as Above
Tel:	(902) 424-8143
Fax:	(902) 424-7544
Email:	Sylvie.colomb@novascotia.ca

Proponent Executive

Name:	Ms. Bonnie Miles-Dunn
Official Title:	Acting Director, Highway Engineering Services and Capital Programs

B Miles-Dunn — 06/29/17

Signature — Date

Nova Scotia Transportation
and Infrastructure Renewal

HIGHWAY 107 BURNSIDE TO BEDFORD
ENVIRONMENTAL ASSESSMENT

FIGURE 1-1
PROJECT COMPONENTS

NOVA SCOTIA

DILLON CONSULTING

PROPOSED HIGHWAY 107 ALIGNMENT
PROPOSED ROUNDABOUTS
HIGHWAY
OTHER ROAD
WATERCOURSE
TRAIL/TRACK
POWERLINE
RAIL LINE
WETLAND (TOPOGRAPHIC DATABASE)
OPEN WATER
PROPOSED OVERPASS STRUCTURES (HFX #: CROSSING R #: ROUNDABOUT)
BUFFERED CENTRELINE STUDY AREA (75 M)
APPROXIMATE RIGHT OF WAY STUDY AREA (AS PER NSTIR MAY 2017)

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSTIR, NSDNR

MAP CREATED BY: SCM
MAP CHECKED BY: KLM
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 125 250 500 750 Metres

N
W E
S

FINAL

PROJECT: 13-8348

DATE: June 2017

1.2 Project History

A proposed connection from Burnside to Sackville, as an alternative to Trunk 7/Windmill Road, has been considered for over 25 years. When the section of Highway 107 from Main Street (Trunk 7, in Dartmouth/Cole Harbour) to Akerley Boulevard in Burnside was constructed, plans were developed for the eventual connection of Highway 107 through Burnside to meet the Burnside Drive extension near the railroad overpass. Also, the design for the Glendale Avenue/Duke Street interchange on Highway 102 was planned to include appropriate ramps for the future Highway 107 connection.

A provincial EA (P. Lane, 1991) of an alternate route was completed and received Ministerial Approval in October 1991. Conditions associated with this approval related to mitigating noise and access issues with a nearby high school (historic location of Charles P. Allen High School). The extension was not constructed at this time. An additional *Canadian Environmental Assessment Act* (CEAA) EA was commissioned before the 2012 changes to the *Act*. The CEAA EA was completed in draft in 2011 (Stantec, 2011). These previous EAs examined a proposed route to the north of Anderson Lake (which includes portions of the current route). The current proposed alignment follows the 2011 alignment in Burnside and along Duke Street, and is modified from the 1991 and 2011 routes within the new Right-of-Way (RoW) area, to an alignment south of Anderson Lake.

1.3 EA Registration Concordance

Table 1-1 below provides a summary of concordance of this document with the minimum information requirements required under the Environmental Assessment Regulations to register an undertaking in Nova Scotia.

Table 1-1
Concordance with Nova Scotia Environmental Assessment Registration Requirements

No. **Description**	**Concordance**
i) the name of the proposed undertaking,	Section 1.0 Introduction
ii) the location of the proposed undertaking,	Section 1.0 Introduction; **Figure 1-1**
iii) the name, address and identification of the proponent,	Section 1.1
iv) a list of contact persons for the proposed undertaking and their contact information,	Section 1.1 Project Contact and Proponent
v) the name and signature of the Chief Executive Officer or a person with signing authority, if the proponent is a corporation,	Section 1.1
vi) details of the nature and sensitivity of the area surrounding the proposed undertaking,	Section 4.0 Description of Existing Environment, and Appendices with Project specific studies
vii) the purpose and need for the proposed undertaking,	Section 2.0 Purpose and Need for the Project
viii) the proposed construction and operation schedules for the undertaking,	Section 3.0 Project Description
ix) a description of the proposed undertaking,	Section 3.0 Project Description
x) environmental baseline information,	Section 4.0 Description of Existing Environment
xi) a list of the licences, certificates, permits, approvals and other forms of authorization that will be required for the proposed undertaking,	Section 3.8 Regulatory Framework

No. **Description**	**Concordance**
xii) all sources of any public funding for the proposed undertaking,	Section 2.0 Purpose and Need for the Project
xiii) all steps taken by the proponent to identify the concerns of the public and aboriginal people about the adverse effects or the environmental effects of the proposed undertaking,	Section 5.0 Consultation and associated Appendix
xiv) a list of all concerns expressed by the public and aboriginal people about the adverse effects or the environmental effects of the proposed undertaking,	Section 5.0 Consultation and associated Appendix
xv) all steps taken or proposed to be taken by the proponent to address concerns of the public and aboriginal people identified under subclause (xiv).	Section 5.0 Consultation, and Section 6.0 Environmental Effects Assessment

2.0 PURPOSE AND NEED FOR THE PROJECT

The 100 Series Highway network in Nova Scotia is intended to provide for the safe and efficient movement of large volumes of people and goods over long distances while minimising negative economic, social and environmental impacts. The proposed Highway 107 Burnside to Bedford Project will facilitate a direct connection between Highway 102 and the Burnside Business Park, and indirectly connection with Highway 101. This route will improve the transportation network in HRM and mitigate current traffic congestion issues, as well as provide associated benefits: improved transportation efficiency, reduced risk of traffic accidents, and reduced potential for vehicle emissions (including greenhouse gases (GHG)) resulting from peak "stop and go" traffic.

This Project addresses an issue with current traffic volumes in the area, providing an alternative route from Bedford/Sackville to Dartmouth and the Burnside Business Park. The existing route of the Bedford Bypass connecting to the Magazine Hill section of Trunk 7 (Windmill Road) is subject to traffic congestion particularly during peak commute hours and is in need of additional capacity. A 2010 traffic study (Genivar, 2011) found two-way weekday volumes on Magazine Hill (Trunk 7) between Bedford and Dartmouth averaging about 46,000 vehicles per day (vpd), with morning and afternoon peak hourly volumes of 4400 to 4800 vehicles per hour (vph). Population growth predictions for the area support the increasing need for the Project.

The following assessment of the potential for the Highway 107 Project to alleviate traffic issues was provided within a previous assessment (Stantec, 2011). Although the assessment related to an alternate route for the Project, the conclusions pertain to the current route as well.

> "Historical traffic volume data obtained by NSTIR on Highway 102, Bedford Bypass and Magazine Hill were used to determine a traffic volume growth rate for the study sections of road of approximately 1.5% per year. The 2010 and projected future peak hour volumes with and without completion of the Burnside to Bedford Highway 107 are included below.

Projected Trunk 7 (Magazine Hill) and Highway 107 Peak Hour Volumes 2010 to 2026

Peak Hour	Projected Peak Hour Two-Way Volumes					
	Magazine Hill				Highway 107 (Phase 1)	
	2010	2016 Without Highway 107	2016 With Highway 107	2026 With Highway 107	2016	2026
AM Peak Hour	4,400	4,800	3,500	4,000	1,800	2,000
PM Peak Hour	4,800	5,200	3,700	4,200	1,600	1,800
Source: *Traffic Study for Highway 107 Phase 1 - Burnside to Sackville*, GENIVAR Inc., February 2011						

The following details summarize trip diversion to Highway 107:

- Traffic diverted to Highway 107 is expected to reduce Magazine Hill volumes by 27% during the 2016 AM peak hour and 29% during the PM peak hour.
- Projected 2016 two-way peak hour volumes on Highway 107 Phase 1 are projected to include approximately 1800 vph during the AM peak hour and 1600 vph during the PM peak hour.

While savings have not been quantified, vehicles that will use Highway 107 will experience time and distance savings compared to existing routes. Since many of these trips are between the Sackville area

> and Burnside, and many others are now using Highway 102 and Highway 118 to access Burnside, a high percentage of the Highway 107 users can be expected to realize significant time and distance savings. Also, the removal of 27% to 29% of the traffic from Magazine Hill and Windmill Road will allow for reduced congestion and improved travel performance for the residual traffic on those roads."

The Highway 107 Burnside to Bedford Project will include a direct connection from the Burnside Business Park to Duke Street; will improve traffic flow at the Highway 102 interchange with Duke Street; and, will provide an alternate access to the Burnside Business Park, especially for trips from the Sackville area, and improved access to Highway 118. This direct connection would reduce commuter and truck traffic congestion on existing routes (*e.g.*, "Magazine Hill" (Bedford Bypass/Trunk 7); Highway 118; and Rocky Lake Drive – locations as noted on **Figure 1-1**).

HRM acts as a hub for the shipment of goods to and from other locations in North America, and the transportation sector represents a significant driver in the municipal economy (HRM, 2007). The federal, provincial and municipal governments recognise the need to focus on transportation and infrastructure improvements in the area, such as the proposed Project, to achieve economic objectives.

Public Funding

The Project will be 100% publicly funded. Costs are expected to be shared between the Provincial and the Federal Government.

3.0 PROJECT DESCRIPTION

3.1 Highway Location and Project Components

The Project is located between the Burnside Business Park (north of Dartmouth) and Highway 102 in the Bedford/Sackville area of HRM, Nova Scotia. It includes approximately 9 km of new four-lane controlled access (100 Series) RoW, and upgrade/widening of an additional approximately 1500 meters (m) of the existing Duke Street within the Bedford Commons/Bedford Industrial Park to connect with Highway 102 (Bicentennial Highway). The new RoW portion is located to the north-east of the existing commercial/industrial and residential areas along Trunk 7/Windmill Road and includes lands to be purchased from the Department of National Defence (DND) and other private landowners.

The highway design speed will be 110 km/hour with a reduced speed for the approach to Duke Street and along Duke Street. The RoW width will vary where design dictates between 100 and 150 m. The median separating the directions of travel will consist of a variety of configurations:

- From the Burnside Business Park to the Burnside interchange will be a 5.6 m wide curbed and grassed median (13 m between centerlines of the directions of travel);
- From the Highway 118 interchange at the top of Akerley Drive to the Rocky Lake railway, the median will be a Freeway Cable Barrier;
- From the Rocky Lake railway to Duke Street, the median will be a raised 2 m wide concrete barrier; and
- No median barrier is proposed for the Duke Street widening portion.

Constraints considered in design include:
- Topography;
- Wetlands;
- Watercourse crossings;
- Anderson Lake;
- Potential for unexploded ordnance (UXO) hazards; and
- Existing powerline (and planned upgrades by Nova Scotia Power).

These features, in conjunction with safety considerations such as appropriate curve radius and sightlines, limited options for the alignment route. Where possible, the route follows ridgelines to minimize interactions with wetlands. Prior landowner agreements were obtained for the route chosen.

It is anticipated that the highway will be maintained and remain in operation indefinitely.

The Project includes the following components:

- New four lane highway (new RoW located south of and around Anderson Lake) between Burnside Business Park and Rocky Lake Drive, and associated watercourse crossing structures including incorporation of structures allowing federal access to Anderson Lake, and of fish passage where required;
- Two grade separated overpasses to cross active railways (north of Burnside Business Park and south of Rocky Lake Drive);
- Widening of Duke Street between Highway 102 and Rocky Lake Drive (expected to extend the existing roadway up to 30 m along the south side) and watercourse crossing structures upgrade;

- Active HRM multipurpose trail/utility corridor parallel to the highway within the RoW;
- Two roundabouts to upgrade the interchange of Duke Street/Highway 102;
- Three new intersections with roundabouts at Burnside Drive/Akerley Boulevard, Duke Street/Rocky Lake Road and Duke Street/Damascus Road;
- Three new interchanges with multiple roundabout structures; one facilitating access to Highway 118, one connecting Burnside Drive and for access to lands north of Highway 107 (Akerley Boulevard), and an additional potential access in the Magazine Hill area;
- Drainage structures, as required, to maintain current surface water flow paths and projected climate-related changes to flow volumes; and
- Off-site wetland and fish habitat compensation as required by provincial and federal regulators.

Temporary ancillary elements that may be required for the Project would typically occur within the RoW and may include:

- Materials and equipment storage areas;
- Petroleum storage areas;
- Temporary detours and access roads (along existing roads, trails or other access);
- Temporary mobile offices;
- Mobile crushing operations;
- Mobile asphalt plants (expected to be located in interchange footprint areas); and
- Disposal sites and bullpen areas.

Borrow, as required, will generally be sourced off-site. The location of the temporary ancillary elements will be identified as part of contractors' bid during the construction phase and will be subject to approval by NSTIR and any applicable regulators. Temporary facility siting and operation will be in accordance with NSTIR standards (including NSTIR's Generic Environmental Protection Plan – EPP) and applicable legislation. Potential effects and mitigation for temporary ancillary elements frequently parallel those discussed under the construction and operation activities for the Project. Decommissioning and abandonment of any off-site temporary facilities will include site restoration and stabilization.

Figure 3-1 provides a standard cross section of the new RoW portion of the Project. Note that the multi-purpose trail is not shown but will be within the Project footprint on the north side of the highway.

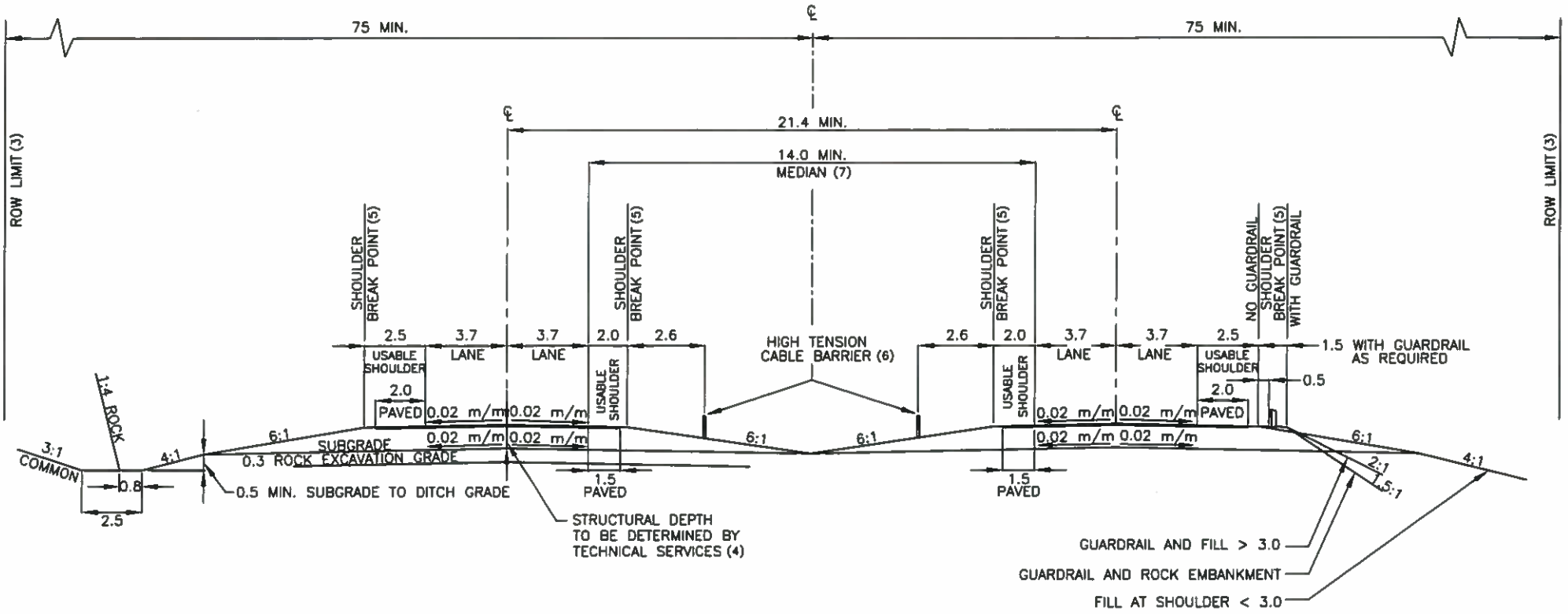
3.1.1 Interchanges and Grade Separation Structures

Figure 1-1 identifies proposed structure locations. Modern multilane roundabouts (R1 to R11) will follow NSTIR design standards. **Photo 1** shows a typical roundabout similar to those proposed for this Project.

The connection of the Highway 107 with the access to Highway 118 will be completed through Akerley Boulevard with a combination of partial cloverleaf interchange, roundabouts and grade separated Akerley Boulevard underpass (HFX552) which also allows access to lands to the north of the highway.

Photo 1 Typical Roundabout (Photo provided by NSTIR)

Figure 3-1 Typical Highway Cross Section (new RoW section)



NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. DIMENSIONS ARE MEASURED PERPENDICULAR TO CENTERLINE.
3. TO BE ADJUSTED TO ALLOW FOR MINIMUM OF 5.0m BEYOND DAYLIGHT LOCATION OR EXCEPTIONALLY 3.0m MAY BE ACCEPTABLE.
4. THE SUBGRADE WIDTH IS DEPENDENT UPON THE DEPTH OF STRUCTURAL MATERIAL.
5. 0.8m ROUNDING CENTERED ON SHOULDER BREAK POINT IF GUARDRAIL NOT INSTALLED.
6. PLACEMENT OF BARRIER TO BE DETERMINED BASED ON HORIZONTAL GEOMETRY.
7. INSTALL ROUNDED DEPRESSION OR SWALE WITH DRAINAGE TREATMENT AS REQUIRED IN MEDIAN.
8. CABLE BARRIER TO BE BRIFEN SYSTEM MEETING TL-4 OR APPROVED EQUIVALENT.

NOVA SCOTIA
Transportation and Infrastructure Renewal

No.	REVISION

Scale :	N.T.S.
Drawn by :	G.WRIGHT
Checked by :	K.BODDY
Date of Plan :	SEPT2014
File No. :	S-2014-029

Manager Highway Planning and Design

Director Highway Engineering Services

Executive Director Highway Engineering and Construction

STANDARD CROSS SECTION
FREEWAY CABLE BARRIER MEDIAN (A)

A diamond interchange with roundabouts and grade-separated underpass (HFX555) will be located in the Magazine Hill area and will provide future access to lands east of the highway and potentially to the Bedford/Truck 7 area.

The Rocky Lake Railway overpass (HFX465) will likely consist of a single span steel or concrete girder bridge with a concrete deck and integral or semi-integral abutments.

The Anderson Lake access road and Wrights Brook tributary (HFX554) will also require a grade separated structure (potentially a bridge). Design details are pending from NSTIR.

The Burnside Railway overpass (HFX464) will likely consist of a single span steel or concrete girder bridge with a concrete deck and integral or semi-integral abutments.

The grade separated over/underpass structures will likely have an active transportation (AT) trail on the structures. Designs for grade separated structures and discussions with Canadian Transportation Agency are currently underway.

3.1.2 Watercourse Crossings

The proposed Project alignment crosses several watercourses requiring structures. Adequate hydraulic design considering both present day and future conditions will be carried out for new structures. The majority of the watercourse crossings will consist of culverts, which will be installed to control drainage and allow fish passage, where applicable. Culvert extensions matching existing culvert sizing will occur along the Duke Street widening section. Fish passage is not required in this area as drainage present is generally unsuitable for fish.

A clear span structure is proposed for the Tributary to Wrights Brook crossing (downstream of Anderson Lake). The watercourse crossing span, likely a steel or concrete bridge/arch, is expected to be approximately 20 to 30 m long. This structure will have an opening for the watercourse and for the DND access road to Anderson Lake. Some realignment of the current Anderson Lake gravel access road may be required.

The crossing of Wrights/Wiggins Brook (water crossing - WC-04) between Enchanted Lake and Flat Lake in Burnside will be constructed as a concrete culvert (approximately 1800 mm diameter) with fish passage features (baffles) designed through discussion with the Department of Fisheries and Oceans Canada (DFO). This crossing location will be re-aligned to allow construction “off-line” and will include a plunge pool and baffle installation.

The crossing of Parkers Brook (WC-18a; an inlet to Lily Lake - east of Rocky Lake Drive) will be a concrete pipe culvert (approximately 1050 mm diameter). On discussion with DFO (pers. comm. S. Nurse and C. Jacobi), it was determined that based on the low slope in the area, embedding this culvert will provide sufficient fish passage.

Other new drainage structures will consist of concrete pipe culverts appropriately sized based on 1 in 100 year storm events.

A small pond and associated wetland, located south of Anderson Lake, will be completely infilled. Infilling will also occur in a small pond/wetland south of Duke Street during the widening portion of the Project. Final infill design will be based on further geotechnical investigations. It is not anticipated that removal of peat material will be required at the pond south of Anderson Lake. Some peat removal may be required at the Duke Street pond. If peat extraction is required, NSTIR will attempt to salvage this

valuable material for use elsewhere along the RoW or make it available to other groups to use for their off-site wetland restoration projects. Watercourse crossings and infill of wetlands will be conducted following NSE requirements and NSTIR's Generic EPP.

The alignment RoW includes coves of Anderson Lake and Little Lake. However, no infill of the lakes will occur. Anderson Lake contains a rescued population of Atlantic whitefish (*Coregonus huntsmani*), a species listed as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and under the federal *Species at Risk Act* (SARA) and the *Nova Scotia Endangered Species Act* (NSESA). Additional information on watercourses and wetlands in the study area is provided in **Section 4**.

3.1.3 Access Roads

No new access roads are anticipated for this phase of the proposed Project.

3.1.4 Active Transportation Trail

A 4 m-wide paved multi-use AT trail is planned for installation parallel to the highway alignment on the north side within the RoW. Construction of the trail will be included as part of the highway subgrade. The trail will be separated from the highway travel lane (offset 10 m), by a high tension cable guardrail system installed in the gravel shoulder of the highway. The inclusion of the trail will enable users to travel directly from the Burnside Business Park to the Rocky Lake/Bedford Commons area.

The AT trail has been designed in consultation with HRM (contact: H. Koblents). HRM will be responsible for operation and maintenance. HRM is also investigating further connectivity with the intent that the residential areas of Sackville/Bedford and the business parks are ultimately linked.

3.1.5 Future Phases and Other Development in the Area

Subsequent phases are expected for approximately 2026 or later, as traffic conditions require. Planning for subsequent work is ongoing.

Other construction activities that may occur within the construction time frame of the proposed Project include:

- Additional Phase 13 development proposed in Burnside Business Park to the north of the proposed Project alignment;
- On-going Rocky Lake Quarry operation (to the north of the alignment near Rocky Lake Drive);
- Limited development within the Bedford Industrial Park; and
- Infill of development in the Bedford Commons.

DND plans with respect to development of the Canadian Forces Ammunition Depot (CFAD) Bedford property to the east of Trunk 7/Windmill Road are unknown, but development is not expected within the timeframe of this Project's construction. Additional information on land use in the area is presented in **Section 4**.

3.2 Alternatives to the Project

Various alternatives to the Project were investigated including:

- Null Alternative
  - The alternative of not addressing traffic concerns and transportation efficiency in this area is not consistent with provincial initiatives to facilitate economic development or with NSTIR's mandate to promote safe and efficient movement of people and goods. The null alternative has potential to increase risk and traffic safety concerns as the population and commuter traffic levels increase. The social and economic impacts associated with the null scenario are considered unacceptable.
- Alternative Transportation Modes
  - No viable alternatives to the Project (alternative forms of transportation) exist. Therefore, no further consideration is given to alternatives to the Project.
- Upgrades of Existing Networks
  - Upgrading the 'Magazine Hill'-Trunk 7/Bedford By-Pass through the study area to handle increased traffic would not achieve the goals of this Project. It lacks the 100 Series Highway features; is constrained by abutting development including DND properties; it does not provide a separate, independent route that can provide traffic congestion relief in the event of an incident on Magazine Hill; and it does not provide connection to Highway 102.
- Alternative Alignments - Two other similar alignments were considered for the highway extension; both crossing north of Anderson Lake. The first option, for which NSTIR received provincial EA approval in 1991, did not proceed at that time and the approval expired. A refinement of the 1991 alignment was developed when the Project progressed in 2010/2011. This alignment was not considered feasible due to impact to an aggregate resource valuable to the construction industry. It is noted that the current alignment interacts with less wetland area than an option to the north of Anderson Lake and there is less potential for habitat fragmentation due to existing infrastructure (DND and power line) in the area. The proposed alignment is considered to be the best alternative considering a transportation planning perspective, adjacent resources, and environmental constraints.
- Alternative Design - Different interchange design options (e.g., at grade, cloverleaf, diamond interchange) and median widths were considered during design. The current design uses roundabouts at intersections with existing roads to minimize the Project footprint and to maximize traffic efficiency. Roundabouts are the preferred design for intersections as they provide opportunities to improve safety and operational efficiency and environmental benefits such as reduced noise and contribution to reduction in Green House Gases (GHGs) by reducing idling (http://safety.fhwa.dot.gov/ intersection/roundabouts/fhwasa10006/#s2). The median design was chosen to match existing infrastructure where joining existing roads, and in the new RoW areas, to address potential safety concerns. The Freeway Cable Barriers for the new RoW section provides additional safety through reducing the potential for vehicles to cross the median into oncoming traffic.

3.3 Project Activities

Key Project activities and incorporated mitigation are described below. The Project activity descriptions are broken out into three basic groups: preconstruction, construction and, operations and maintenance. Decommissioning, although not currently anticipated, if required in the future, will be undertaken in compliance with relevant laws, regulations, and guidelines applicable at that time.

The alignment design will reflect NSTIR's Highway Design Guidelines and Standard drawings and the Transportation Association of Canada (TAC) guidelines for highway design. Construction will be completed following NSTIR's Generic EPP, as revised for this Project.

3.3.1 Preconstruction Activities

Preconstruction includes activities such as:

- NSTIR screening of potential issues;
- Preliminary planning;
- Consultation and design;
- Completion of the EA and associated permitting;
- Wetland and fish habitat compensation planning;
- Surveying;
- UXO clearance (and related tree clearing); and
- Geotechnical/acid rock investigations.

With the exception of limited ground disturbance for geotechnical/acid rock investigations and UXO clearance, these preconstruction activities are typically non-intrusive. Tree clearing and UXO clearance will occur before geotechnical work. Geotechnical/acid rock investigations will be conducted using tracked drill rigs or excavators with access along existing trails (such as the power line alignment, existing All-terrain Vehicle (ATV) trails and DND access), where feasible. Activities will follow NSTIR Generic EPP procedures including avoidance of sensitive features such as wetlands and watercourses, and use of erosion and sediment control (ESC), as applicable. The Generic EPP also identifies contingency actions if acid rock is encountered. Contingency actions include guidance provided by Environment and Climate Change Canada (ECCC) and NSE to avoid acid rock, where possible, and if avoidance is not possible, to cap exposed rock with clay and/or bury/encapsulate ripped material.

One feature unique to this alignment is the potential for UXO within a portion of the Project limits. As a result of this issue, UXO clearance activities will be required in areas with potential hazards. Before the removal of UXO and before clearing for the entire Project begins, tree clearing of the UXO areas is required. UXO Clearance is expected to be contracted to Defence Construction Canada (DCC) through DND before land transfer and will include complete (100%) coverage of the RoW within the hazard area identified by DND on DND property. Following initial UXO clearance, requirements beyond the current DND property will be assessed based on findings and evaluation of risk. Clearance activities typically consist of rendering materials safe on-site (controlled detonation). Based on safety concerns, larger hazards may be removed from the property to an appropriate approved handling location.

3.3.2 Construction Activities

In general, highway construction will require cut and fill operations to achieve a blend of horizontal (H) and vertical (V) alignment characteristics. Where possible within the potential UXO hazard areas, the highway design maximizes fill and minimizes cuts. Based on the geology and topography of the area, it is anticipated that fills for subgrade in the new RoW area will be sourced where possible from the bedrock cuts required and will be balanced on-site to the extent possible. Most of the RoW will be fill, but a large cut will occur in the area half-way between Anderson Lake and Lily Lake.

Initial construction activities are associated with preparing the roadbed to base elevation (including access roads and structures) such as clearing and grubbing, blasting, excavation, placement of fill material, and drainage structure placement.

Work within the new RoW area will generally progress from either end using the RoW as access or access from existing roads (e.g., DND Anderson Lake access). A staging area may be established approximately half-way between Anderson Lake and Lily Lake. This larger area of cut may facilitate an on-site portable crushing operation within the RoW. Equipment required for crushing, in addition to the crusher, would include loaders and trucks. Equipment access to the area would be along the cleared RoW or the powerline trail and existing access roads. This area would also provide a staging area for stockpiles and work progression in either direction.

Subbase and base construction are followed by roadbed preparation. On completion of the roadbed, paving is conducted, followed by final activities such as shouldering, vegetation establishment and stabilization, and construction of fencing. Fencing is expected to extend along both sides of the new RoW, to the north of the multi-purpose trail on the north side, and on the south side of the highway, to the north of the existing power line easement (except west of Anderson Lake where the powerline easement crosses the highway). Fencing design may include wildlife fencing (with a design similar to that used by the New Brunswick Department of Transportation and Infrastructure) or equivalent alternative as determined through the detailed design process. Fencing is expected to be located within the RoW and within 5 m of the toe of slope or within the highway shoulder, where needed to avoid wetlands and watercourses.

The extent of construction truck traffic will depend on the location of sources of fill and of asphalt plants in relation to the alignment. Construction vehicles typically operate in continuous 12-hour shifts, however, this is not expected near residential areas. Truck traffic during subgrade construction will be primarily confined to on-site operations and transportation of material for cut and fill operations. Some truck traffic will occur off-site to travel to adequate borrow and/or disposal sites. Specific information on vehicle operation is unknown at this time since specific borrow and disposal have not yet been identified. If the asphalt plant is located on-site and a suitable source of aggregate for the asphalt and road base construction can be found on-site, truck traffic during this phase of construction would be limited to the delivery of prime, tack coat, asphalt cement and diesel fuel. If the asphalt plant is located off-site or aggregate must be obtained from another source, the amount of truck traffic on roads approaching the alignment would increase accordingly for the construction period.

Table 3-1 outlines the highway construction activities.

Table 3-1 Construction Activities

Activity	Construction Description	Key Features of EPP* or Standard Practice
Site Preparation		
Erosion Prevention	• Installation of Erosion and Sediment Control (ESC) measures.	EPP Section 3 • Installed prior to intrusive activity. • As detailed in NSTIR guidance documents (Section 3.4.4).
Clearing and grubbing	• Removal of trees and shrubs to within 0.3 m of ground for the footprint of the Project. • Equipment - conventional forest harvest equipment and techniques. • Additional clearance widths (*e.g.*, 5 m from the toe of slope or top of cut) may be required to access areas of deep cuts and fills. • Merchantable timber (minimum	EPP Section 3.3 and 3.6 • Limits of clearing clearly indicated on contract drawings and in the field (*i.e.*, surveyed and marked with flagging tape). • Timing of activity outside the primary breeding season for birds (*i.e.*, no clearing between May 1 and August 31) or if alternate timing is required, on agreement with ECCC on appropriate mitigation. • Where possible, clearing operations shall be conducted during the winter months on frozen ground to reduce damage to soils and the vegetative mat and avoid most interactions with birds.

Activity	Construction Description	Key Features of EPP* or Standard Practice
	butt diameter of 100 mm and a length of 2.5 m) de-limbed and removed from the site. • Non-salvageable material chipped within the RoW and left in place (except within buffer zones for watercourses and wetlands).	• Hand clearing conducted where ground conditions are not suitable for heavy equipment access (*e.g.*, within watercourse and wetland buffer zones). Note: Initial tree and ground clearing required for UXO clearance activities is considered under Pre-construction but will incorporate the mitigation noted here. If areas of identified UXO risk remain, specifications will identify the risk, and an Explosives Ordinance Disposal (EOD) technician will be required to be present during all applicable excavations.
Roadbed Preparation		
Excavation for cuts	• Excavation of material for construction of subgrade. • Common/overburden removal with an excavator. • Rock removal, if "soft" (e.g., shales, sandstones), by ripper blades on heavy equipment. • Swamp excavation if the soil is unsuitable as subgrade - Soil shall be either excavated or replaced with a competent fill, or "floated over" using geogrids or berm construction. May occur when peat encountered or when exposed soil saturated with water.	EPP Sections 2.6, 3.15, 5.4 • Excavated soils unsuitable for use as fill or dressing slopes disposed of at a site approved by the Project Engineer and with appropriate permits and stabilized with appropriate erosion control. • No disposal to wetlands, sensitive areas or disposal in a manner that adversely affects drainage patterns or adjacent properties. • Measures for stability of slopes of both cuts and embankments implemented. Conservation slopes for cuts and embankments not to exceed 3 H: 1 V in sands and gravel as well as in cohesive soils (silts and clays). Flatter slopes used if necessary, depending on the erodibility of the soils. • Disposal of potential acid generating bedrock, if encountered, conducted in compliance with the Sulphide Bearing Material Disposal Regulations.
Blasting (excavation)	• Blasting may be necessary if ripping of bedrock is not possible.	• Blasting to follow provincial regulations and federal guidelines; including limitation of ground vibration and air concussion. • Pre-blast well surveys to be conducted before blasting within 300 m of highway centreline at a minimum. • Blasting to be monitored for ground vibration and air concussion, both close to the blast site and at the closest structures. • Blasting, if required, to be conducted by a qualified and certified blasting contractor who will deliver the explosives to the site on an as needed basis.
Placement of fill and subgrade construction	• Spreading acceptable fill, either from cut or approved borrowed sources, in a layer of specified thickness (depending on the engineering properties of the material but not usually exceeding 200 mm) and using moisture control procedures, compacting it to a specified density.	EPP Section 3.7 • Where feasible, as determined by the suitability of the material and hauling costs, material excavated from the RoW to be used for fill. • If the excavated material insufficient, materials to be obtained from nearby borrow sources.
Subbase and base construction	• Subbase course (gravel superior in quality to that used for subgrade) placed immediately above the subgrade with heavy	EPP Section 3.7 • Equipment access to the construction area within new RoW is typically along the RoW or existing access.

Activity	Construction Description	Key Features of EPP* or Standard Practice
	equipment (excavators, bulldozers, rollers, trucks, and graders). • Base course placed immediately above the subbase; consists of a series of layers graded to provide structural integrity and good drainage beneath the asphalt concrete surface.	
Rail and road crossing structures	• Excavation and construction of concrete footings and placement of structures produced off-site. • Construction of earth and rock abutments.	• Procedures detailed in NSTIR's Standard Specifications (http://novascotia.ca/tran/publications/standard.pdf).
Watercourse Crossings		
Bridges and open span concrete structures	• Design meeting DFO requirements. • Foundations dewatered and excavated. • Bridge abutment and pier construction generally includes the erection of forms and reinforcing steel and placement of concrete produced from off-site sources. • Bridge abutments built in conjunction with earth and rock embankments, or on bedrock foundations prepared as part of the roadway subgrade and drainage system development activities.	EPP Section 3.5 • In locations where the excavation is located adjacent to, or in a watercourse, cofferdams to be constructed to separate the work area from the watercourse. • All work to be completed following the requirements of the EPP and government approvals, permits and authorizations.
Culverts and drainage system	• Development of a drainage system and installation of culverts generally conducted during the earthwork operation for new RoW. • For road widening portions, existing culverts to be extended. • Roadside ditches and cross culverts to direct surface water away from the highway and into natural drainage systems.	EPP Section 3.4 • New culverts to be designed to meet the NSE's requirements for passage of the 100 year storm event, and where applicable, DFO's requirements for fish passage. • Culvert extensions to be sized consistent with existing culverts. • Culvert construction to follow the requirements for culvert construction detailed in NSTIR's EPP and government approvals, permits, and authorizations. • Site-specific plans to be developed for each crossing - identifying ESC measures and construction sequencing specific to the water crossing. • Culverts requiring fish passage to be constructed per DFO's fish passage requirements in place when the highway is designed. • DFO requirements with respect to fish habitat compensation to be met as part of approvals /authorizations required.
Surfacing and Finishing		
Paving	• Hot or warm mix asphalt (petroleum based liquid asphalt with sand and crushed stone mixed at offsite plant, or in an approved mobile facility)	• Procedures detailed in NSTIR's Standard Specifications. • Location for any on-site mobile asphalt plants to be approved by NSTIR/NSE and anticipated to be within the proposed footprint area of the interchanges.

Activity	Construction Description	Key Features of EPP* or Standard Practice
	transported, spread and rolled at the site. • Equipment to include pneumatic tire and steel drum rollers, graders, trucks, and asphalt concrete pavers.	
Shouldering	• Placement of gravels, typically using a shouldering machine, next to the pavement edge. • Material then graded and rolled.	• Procedures detailed in NSTIR's Standard Specifications.
Topsoil	• Topsoil may be applied to dress medians and side slopes.	EPP Section 3.6.1 • Topsoil saved during the grubbing process where possible or feasible re-used.
Hydroseeding	• Re-vegetation of the Project footprint cleared areas outside of the paved and graveled areas to include hydroseeding as appropriate.	• Hydroseeding application rates and procedures detailed in NSTIR's Standard Specifications. • Hydroseeding conducted as soon as possible after completion of surface preparation.
Finishing Activities	• Line painting with line painting machinery. • Installation of lighting, signs and guide rails involving small excavation of footings. • Installation of fencing and wildlife fencing as appropriate. • Removal of temporary ancillary structures and facilities.	• Procedures detailed in NSTIR's EPP and Standard Specifications.

*EPP Section numbers from http://novascotia.ca/tran/works/enviroservices/100seriesEPP.asp

3.3.3 Operation/Maintenance Activities

Operation activities include highway use and maintenance activities. General highway infrastructure maintenance activities retain roadways at a reasonable level of service, comfort, and safety and typically take place during the summer months. Maintenance may occur on a regularly scheduled basis, or asneeded. Disruption to the public from these repairs would be temporary and infrequent in nature.
Winter operational activities are related to snow removal and ice control to reduce safety hazards and traffic disruptions and occur as needed based on weather conditions.

NSTIR has adopted the practice of roadside vegetation management with the goal to provide healthy ground cover without large trees or shrubs. Vegetation management activities include vegetation clearance to maintain sight lines and control of unwanted species, as well as enhancement of desirable vegetation species.

Maintenance activity procedures are identified in NSTIR's Standard Specifications and the Generic EPP. NSTIR commits to compliance with accepted environmental standards and protocols and with pertinent legislation and guidelines. **Table 3-2** outlines highway maintenance and operations activities.

Table 3-2 Maintenance and Operations Activities

Activity	Maintenance/Operations Description
Highway use	• Vehicle use.
Infrastructure maintenance	
Paving repair	• Maintenance of the asphalt pavement including a range of activities from limited crack filling and pothole repair to re-surfacing every 10 to 15 years, and re-paving every 20 to 25 years. • Repair of paved surface may involve excavation or removal of the existing pavement and subgrade, patching and levelling, grading and gravelling, surface treatment and pavement overlays.
Re-painting	• Line painting and highway markings with same methods as employed during construction.
Shoulder and infrastructure maintenance	• Maintenance of the shoulder gravel using grader. • Maintenance of fencing, signage, lighting and guide rails using same methods as employed during construction.
Ditch maintenance	• Upkeep of ditches/drainage through re-ditching with ditching equipment from the RoW.
Culvert maintenance	• Periodic repairs of culverts may be required ranging from trash removal to culvert replacement. • Replacement would follow similar procedures to original construction with work timed for appropriate environmental construction windows.
Bridge maintenance	• Superstructure maintenance occurs to repair or replace damaged or deteriorated components. • Deck maintenance for deck drains, weep-holes, catch basins or other features to prevent water damage. • Chip sealing of the pavement surface. • Substructure maintenance if damages extend below the paved surface. • Protective coatings removals and applications for corrosion control for steel structures following Environmental Protection Guidelines for the Application and Removal of Structural Steel Protective Coatings (NSE, 1997). • Slope protection for stabilization (*e.g.*, with armour stone or hydroseeding). • Grouting of voids under approach slabs or inside piers and abutments. Replacement would follow similar procedures to original construction with work timed for construction windows.
Winter activities	
Snow removal	• Plowing with graders, trucks, and four-wheel drive vehicles. • Services provided by, or contracted out and supervised by, local NSTIR maintenance employees.
Sanding	• Sand applied by snow removal equipment particularly in areas where salt is not preferred due to nearby surface water supply or other sensitive feature.
Salting	• Proactive approaches as per http://novascotia.ca/tran/winter/info_sheet.pdf • Salt (sodium chloride) applied by snow removal equipment. • Rate of salt application varies with the number of storms during the winter, the frequency and duration of frost conditions, and the personal judgment of the drivers of salt trucks. NSTIR is currently undertaking initiatives for managing the use of road salts through implementing best management practices while fulfilling its obligation to providing safe, efficient, and cost-effective roadway systems including: • Construction of several additional salt/sand storage structures to increase covered storage capacity;

Activity	Maintenance/Operations Description
	• Operation of 40 road weather information system (RWIS) sites around the province; • New winter maintenance standards to provide a consistent and measurable level of service for ice and snow removal to all areas of Nova Scotia; and, • Upgrading of the salt spread truck fleet through the installation of computerized salt controls, infrared pavement temperature sensors, and retrofitting of some trucks with pre-wetting capability.
Vegetation management	
Mechanical removal	• Vegetation removal to maintain sightlines and clear zones or control noxious weeds through manual and mechanized cutting (typically mowing along shoulders and brush cutting on back slopes).
Herbicide use	• Herbicide use, if required, for noxious weed control or sight line maintenance. • In all situations, NSTIR attempts to minimize its use of pesticides. • If herbicide use is required, the application to be carried out by trained personnel who will apply the herbicide in accordance with an approval issued by NSE pursuant to the Pesticide Regulations under the Nova Scotia *Environment Act*. • No herbicide will be applied under the following conditions: within 30 m of any watercourse, as prescribed on product label, and within 60 m of a protected water supply.
Plantings and vegetation enhancement	• Plantings and encouragement of desirable vegetation species requiring minimal management.

3.3.4 Standards and Best Management Practices (BMPs)

The key guidance documents for the Project are the EPP (based on the Generic EPP, NSTIR, 2007), other NSTIR environmental guidance documents, and the Standard Specification Highway Construction and Maintenance (NSTIR, 1997 and revisions). In addition to direction on the specific Project activities noted above, the EPP also provides direction for controlling dust and noise, on petroleum, oil, lubricant (POL) and chemical handling and storage, and on waste management. Regulatory requirements are noted in **Section 3.6**.

Additional guidance documents that will be followed where applicable include:

- Canadian Council of Ministers of the Environment (CCME) guidance on water quality;
- Nova Scotia Wetland Conservation Policy (NSE, 2011);
- Federal Contaminated Sites Assessment Program guidance;
- Design Criteria for Fish Passage in New or Retrofit Culverts in the Maritime Provinces (Savoie and Hache, 2002);
- Guidelines for the design of fish passage for culverts in Nova Scotia (DFO, 2015);
- Guidelines for Use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky, 1998);
- Integrated Roadside Vegetation Management Plan (NSTIR, 2003);
- Pit and Quarry Guidelines (NSE, 1999);
- The Code of Good Practice for General Construction (ECCC, 1979);
- The Code of Good Practice for Highways and Railways (Storgaard and Associates, 1979);
- Beaverdam Removal Code of Practice (Nova Scotia Department of Environment (NSE) and Nova Scotia Department of Natural Resources (NSDNR));
- Highway Drainage Guidelines, TAC;
- Environmental Stewardship Practices, Procedures and Policies for Highway Construction and Maintenance AASHTO (2007);
- NSTIR Erosion and Sediment Control for Highway Construction and Building Sites course;

- TAC's National Guide to Erosion and Sediment Control on Roadway Projects; and
- TAC's Synthesis of Environmental Management Practices for Road Construction, Operation and Maintenance.

3.4 Possible Malfunctions or Accidents

Possible malfunctions or accidents that could potentially arise during highway projects include chemical and fuel spills, contaminated sites, and failure of erosion and sediment control measures. NSTIR's Generic EPP provides contingency plan direction for these items as well as for acid generating bedrock and heritage resources. NSTIR will review its existing Contingency Plan with respect to sensitive features along the alignment and tailor the Project plans accordingly.

Additional potential malfunctions that are considered as part of this assessment include vehicular accidents, fires, and hazards associated with UXO.

3.5 Project Schedule

The Highway 107 Burnside to Bedford Project will be constructed following regulatory approvals, detailed field topographic survey and geometric design, and acquisition of the right of way. Preconstruction geotechnical/acid rock drainage assessments are anticipated to occur in the late summer of 2017. Construction is anticipated to take approximately five years to complete. Clearing is proposed to begin in September of 2017 (UXO clearance required prior to general RoW clearing), with structures, subgrade and paving to be completed from 2018 to 2022.

Scheduling of Project activities such as clearing and grubbing and installation of watercourse crossings will take into account sensitive time periods for migratory and breeding birds as well as aquatic species, to minimize potential interactions with the Project.

The proposed alignment is expected to be maintained and to remain in operation indefinitely.

3.6 Regulatory Environment

NSTIR is committed to adherence to applicable municipal, provincial and federal laws. The Project is not expected to require federal authorizations; however, key provincial requirements will apply. All approvals/permits required will be obtained before construction. Federal and provincial environmental legislation that will guide Project implementation are outlined in **Table 3-3**. Relevant policy framing legislation, such as the Nova Scotia Wetland Conservation Policy, will also be followed. NSTIR will work with HRM to meet applicable municipal permit requirements.

Table 3-3 Preliminary List of Key Relevant Environmental Legislative Requirements

Legislation	Requirement	Approval/ Permit Anticipated
FEDERAL		
Navigation Protection Act (NPA)	No body of water on the NPA schedule – Notice of Works Form.	Notice
Fisheries Act and Regulations	Preliminary determination from DFO that no serious harm anticipated. Fish passage requirements to be met.	Review
Species at Risk Act (SARA)	Protection of listed species.	**Yes**

Legislation	Requirement	Approval/ Permit Anticipated
Transportation of Dangerous Goods Act and Regulations	Documented handling requirements for transportation of dangerous goods if occur.	No
Migratory Birds Convention Act (MCBA) and regulations	Protection of migratory birds, nests, eggs and young. Clearing to occur outside of nesting season.	No
Canadian Environmental Protection Act (CEPA)	Pollution prevention requirements. Direction on priority substances and deleterious substances.	No
PROVINCIAL		
Environment Act and Regulations		
Environmental Assessment Regulation	Project requires Ministerial Approval.	**Yes**
Activities Designation Regulations	Culvert and bridge installation – including compliance with Specifications.	**Yes**
	Wetland Alteration	**Yes**
Sulphide Bearing Material Disposal Regulations	If potential acid draining rock to be disturbed	No
Contaminated Sites Regulations	Meet requirements if contaminated sites on provincial land	No
Petroleum Management Regulations	Meet petroleum storage requirements as applicable	No
Environmental Emergency Regulations	Meet requirements if environmental emergency	No
Nova Scotia Endangered Species Act (NSESA)	Protection of listed species	**Yes**
Special Places Protection Act	Heritage Research Permit (completed as part of this EA)	No
Crown Lands Act and Regulations	Crown land easements, leases, and licences.	Location specific
Forests Act – Forest Protection Regulation	Requirements for fire suppression equipment for operations in forests to be met.	No
Dangerous Goods Transportation Act and Regulations	Requirements for safe transport of dangerous goods to be met.	No
Labour Standards Codes	Labour requirements to be met.	No
Occupational Health and Safety Act and Regulations	Workplace health and safety requirements to be met including General Blasting Regulations	Activity specific

4.0 Description of Existing Environment

The proposed Highway 107 Burnside to Bedford Project components addressed by this assessment will form part of a major highway link between the Halifax metropolitan areas of Dartmouth/Burnside, Bedford, and Sackville. **Figure 4-1** shows the regional context. The new RoW area is predominately within undeveloped resource lands, and DND lands, while the Duke Street widening section is predominately within commercial/industrial land use areas. Limited residential areas occur adjacent to the RoW, primarily in the Rocky Lake Drive area.

This section provides a description of the biophysical environment and social-economic features relevant to the EA scope. The purpose is to provide a general understanding of the existing environment. The information was gathered using a variety of methods building on previous assessment of the area and including field study work where gaps were identified; literature reviews; desktop modelling; advice from experts and regulatory provincial and federal agencies; consultation with stakeholders; and, review of aerial/satellite imagery and geographic maps.

4.1 Study Boundaries

Study boundaries focus the EA by identifying the periods and locations of interest for environmental components and Project interactions. In respect to describing the existing environment, a regional study area applies to descriptions of the transportation system and extends to communities connected by the Project and to the regional atmospheric area. Environmental components of the Project are described focusing on the alignment RoW and Project components but extend beyond, where appropriate, to describe larger features or features that may be contiguous with the RoW (e.g., watercourses and wetlands). The Project "Footprint" represents the alignment "daylight" or "disturbed" area; this is typically the toe of slope or top of slope in a cut in the constructed area. The Project footprint is currently under design for the majority of the alignment. For the purposes of the EA, the NSE EA Branch (pers. comm. B. Tutty), confirmed that assuming the proposed new alignment RoW represents the footprint is acceptable as a conservative assumption. For the Duke Street widening portion, the footprint is assumed to extend 30 m to the south of the existing road.

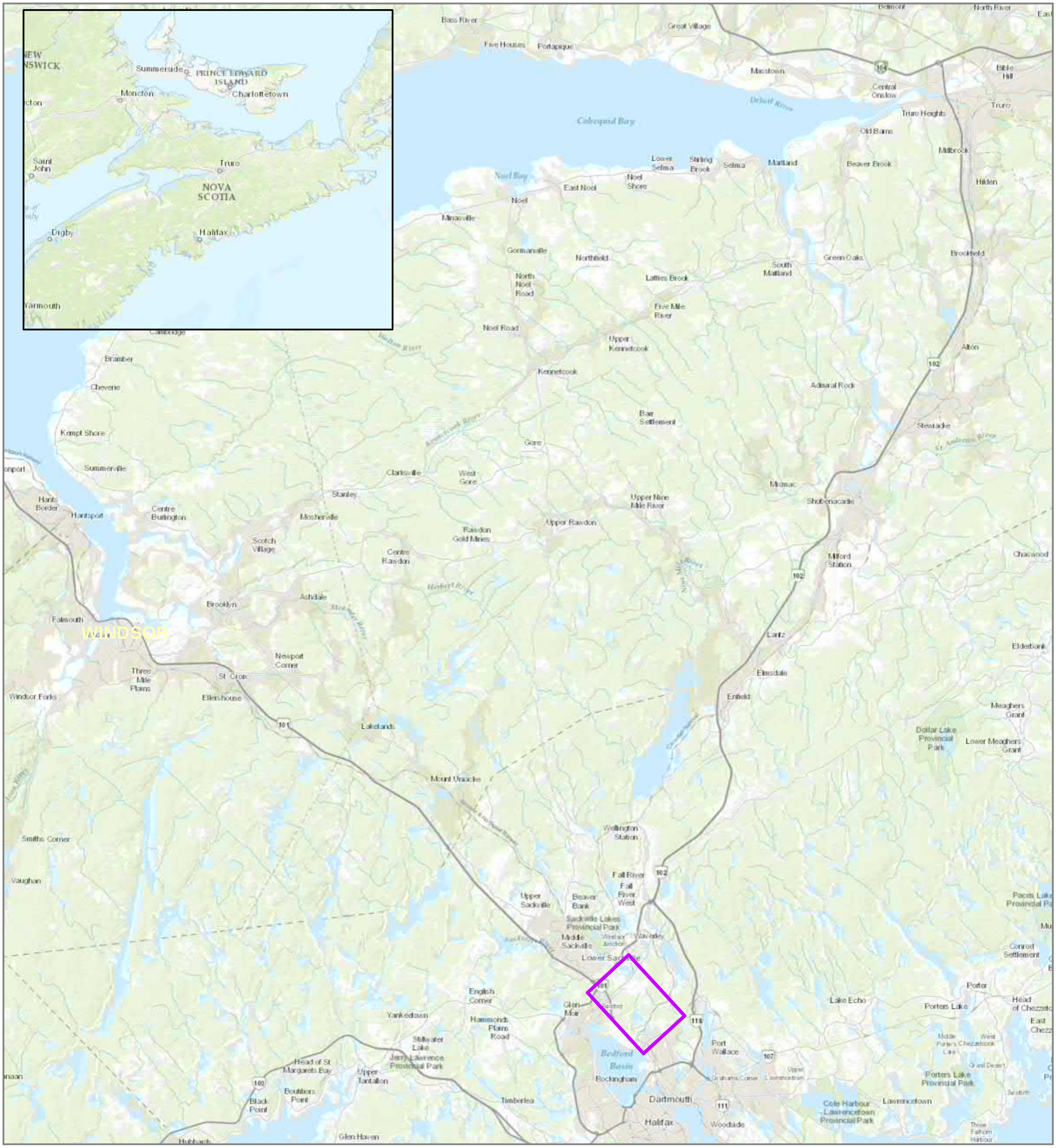
The time frame of interest reflects the proposed 2017 construction period and operations indefinitely.

4.2 Biophysical Environment

4.2.1 Climate and Weather

As identified in the 2011 (Stantec) assessment:

> "Climate in the Halifax area is moderated by the near-by ocean influence. The area is located in the Atlantic Interior Theme Region (Davis and Browne 1997). This large region exhibits considerable climatic variation but is characterized by an inland-lowland climate which is sheltered from direct marine influences and has cold winters and warm summers. Being in close proximity to the coast, mean total annual precipitation within the Assessment Area would approach 1600 mm whereas the frost-free period is between 100-140 days. The mean annual temperature of the Atlantic Interior Theme Region varies from 1°C to over 5°C. Average January temperatures are below -5°C within most of the Region, but areas closer to the coast are generally warmer. By the end of March, mean temperatures are typically above freezing and by July most of the Region has warmed to greater than 17.5°C (Davis and Browne 1997). The main influences on vegetation within the Atlantic Interior Theme Region are its inland climate with



PROJECT LOCATION

Nova Scotia Transportation and Infrastructure Renewal
Highway 107 Burnside to Bedford
Environmental Assessment

FIGURE 4-1
REGIONAL CONTEXT

MAP DRAWING INFORMATION:
DATA PROVIDED BY:
NSTIR, Esri, DigitalGlobe, GeoEye, i-cubed,
Earthstar Geographics, CNES/Airbus DS,
USDA, USGS, AEX, Getmapping, Aerogrid,
IGN, IGP, swisstopo, and the GIS User Community,
Esri, HERE, DeLorme, TomTom,

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FINAL

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Date: June 2017

warm summers, its sandy and acidic soils, varied drainage, and extensive disturbance by fire and logging (Davis and Browne 1997)."

Representative climate normals from the nearest principal weather station (Halifax Citadel supplemented by Stanfield International Airport) are provided in **Table 4-1** below.

Table 4-1
Representative Climate Normals for Halifax Citadel or Halifax Stanfield International Airport

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature Normals, Halifax Citadel NS (1971 - 2000)													
Daily Average (°C)	-4.4	-4.1	-0.3	4.6	9.8	15	18.6	18.9	15.2	9.6	4.5	-1.3	7.2
Daily Maximum (°C)	-0.2	-0.1	3.5	8.4	14.1	19.4	22.9	23	19	13.1	7.9	2.6	11.2
Daily Minimum (°C)	-8.6	-8.1	-4.2	0.8	5.5	10.5	14.2	14.8	11.4	5.9	1.2	-5.1	3.2
Precipitation Normals, Halifax Citadel NS (1971 - 2000)													
Rainfall (mm)	112.3	76.2	106	111.3	118.1	108	105.9	98.3	107.1	134.4	146.8	131.7	1356.1
Snowfall (cm)	38.4	37.7	28.4	9.8	1.2	0	0	0	0	1	6.9	28.5	151.8
Precipitation (mm)	150.7	113.8	134.4	121.1	119.4	108	105.9	98.3	107.1	135.4	153.7	160.2	1508
Wind Normals for Halifax Stanfield International Airport, NS (1971-2000)													
Ave. Speed (km/h)	18.6	18.4	19	18.6	16.7	15.6	14.5	13.5	14.6	16.1	17.6	18.4	16.8
Most Frequent Direction	W	W	W	S	S	S	S	S	S	S	NW	W	S

Source: Canadian Climate Normals 1971-2000 http://climate.weather.gc.ca/climate_normals

4.2.2 Air Quality

Background air quality for key air contaminants (fine particulate matter - PM2.5 (diameters that are 2.5 micrometers and smaller), carbon monoxide – CO, sulphur dioxide – SO_2, nitrogen dioxide – NO_2 and ozone – O_3) was summarized in the 2011 (Stantec) assessment and remains applicable for the area:

"Nova Scotia including the study area has in general, has good air quality due to the combination of relatively small population and limited industrial bases (NSDOE, 1998). ….there are small industrial sources of air contaminants at the northwestern end of the alignment…. Climatic conditions in Nova Scotia provide good dispersion of air contaminants. The ambient air quality also benefits from the infusion of relatively clean polar and arctic air masses. Occasionally, however, long-range transport of air masses from central Canada or the eastern seaboard may transport contaminants into the area, causing poorer air quality.

Nova Scotia Environment and Environment Canada operate a network of ambient air monitoring stations within the province to measure ambient concentrations of various air contaminants. The results from the Halifax monitoring stations, which are the closest to the Project location, are discussed briefly below to provide context with regard to regional ambient air quality. From the selected air contaminants, PM2.5, CO, SO_2, NO_2, and O_3 are monitored in Halifax.

Based on Halifax monitoring results, as published in the National Air Pollution Surveillance (NAPS) Network ambient air quality monitoring report for 2005 and 2006 (Environment Canada, 2008), which represents the latest available information, the following general observations can be made:

- The monitored concentrations of PM2.5 at the Halifax monitoring station have generally been low, with the highest monthly average of 10 $\mu g/m^3$ reported in July;

- None of the monitored concentrations of CO exceeded the 1-hour or 8-hour objectives (34,600 µg/m^3 (30.2 ppm) and 12, 700 µg/m^3 (11 ppm) respectively);
- None of the monitored concentrations of NO_2 exceeded the 1-hour or Annual objectives (400 µg/m^3 (213 ppb) and 100 µg/m^3 (53.2 ppb) respectively);
- None of the monitored concentrations of SO_2 exceeded the 1-hour or 24-hour objectives (900 µg/m^3 (343.5 ppb) and 300 µg/m^3 (114.5 ppb) respectively); and
- The ground-level ozone monitoring results in 2005 and 2006 indicate that the 1-hour national ambient air quality objective of 82 ppb (161 µg/m^3) was always achieved at the monitoring site.

The Halifax monitoring stations are located in the downtown area and would, therefore, be representative of regionally heavy vehicle traffic and other commercial/industrial sources. Inferences made from the data presented above regarding the air quality in the Assessment Area would likely be an overestimate. Therefore, as the measured data in downtown Halifax has met all applicable regulatory standards, the existing ambient air quality in the Assessment Area is generally expected to be good."

This data is corroborated by more recent monitoring. NSE has continued to monitor the ambient air quality in Halifax since the last national network report, and the following general comments can be made on the 2016 observations (NSE, 2017):

- The monitored concentration of PM2.5 at the Halifax monitoring station ranged from 0.4 to a high of 17.7 µg/m^3 reported November 15;
- The monitored concentration of O_3 ranged from 0 to 46.6 ppb, with the maximum occurring in May;
- The monitored concentration of SO_2 ranged from 0 to 12.7 ppb, with the highest concentration being observed in February;
- The monitored concentration of CO ranged from 0 to 1.75 ppm with an average of 0.17 ppm;
- The monitored concentration of NO_2 ranged from 0 to the highest observed concentration of 58 ppb in January;
- The monitored concentration of NO ranged from 0 to 220 ppb with the highest concentration occurring in October; and
- The monitored concentration of NO_X ranged from 0 to 249 ppb with an average of 14 ppb.

4.2.2.1 Emissions

The existing air contaminant emissions from Nova Scotia sources assist in establishing a benchmark for comparison with Project-related emissions and assist in the assessment of cumulative environmental effects. Existing air contaminant emissions are classified into two categories:

- Criteria air contaminants (CACs), including particulate matter and combustion gases such as sulphur dioxide (SO_2), nitrogen oxides (NO_x), and carbon monoxide (CO); and
- Greenhouse gases (GHGs), including primarily carbon dioxide (CO_2) but also including, to a lesser extent or magnitude, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCS), perfluorocarbons (PFCS) and sulphur hexafluoride (SF_6).

A summary of estimated emissions of CACs in Nova Scotia for 2014, as presented in the ECCC 2014 CAC Emissions Summaries for Nova Scotia (ECCC, 2015) and the ECCC GHG Emissions Inventory for 2014 (ECCC, 2016), is presented in **Table 4-2**. The emissions of CACs and GHGs include those from industrial, residential, transportation and miscellaneous other sources in Nova Scotia. These emission summaries represent the latest information available.

Table 4-2
Emissions of Criteria Air Contaminants and Greenhouse Gas Emission Estimates for Nova Scotia

Contaminant	Estimated Emissions for NS (Year 2014) (tonnes)
Total Suspended Particulate Matter (TPM)	370, 029
Particulate Matter less than 10 microns (PM10)	101, 500
Particulate Matter less than 2.5 microns (PM2.5)	30, 373
Sulphur Oxides (SOx as SO_2)	75, 486
Nitrogen Oxides (NOx as NO_2)	72, 432
Carbon Monoxide (CO)	172, 631
Volatile Organic Compounds (VOCs)	42, 296
Greenhouse Gases (GHGs) (CO_2-equivalent)	16,600,000

In 2014, Nova Scotia contributed 16.6 Megatonnes (Mt) or 2.3% of Canada's total GHG emissions. While the majority of the alignment crosses through undeveloped lands, there are industries located at either end of the alignment which would be considered as point sources of CAC and GHG emissions. In particular, there are industrial business located on Rocky Lake Drive, Duke Street and Mann Street, including but not limited to cement and concrete manufacturing businesses, as well as the Rocky Lake Quarry and associated infrastructure. In addition to these point sources, CAC and GHG emissions are also emitted from vehicles, and building heating; these emissions also occur due to long range transport from the United States northeast.

Existing and future zoned land use in the vicinity of the proposed Project is primarily industrial/institutional, mixed commercial or undeveloped. Sensitive receptors in relation to potential dust emissions include:

- Residences along Rocky Lake Drive (adjacent to the RoW),
- Rocky Lake Junior High School (located approximately 150 m west of the Duke Street widening/Rotary and approximately 300 m northwest of the new alignment portion), and
- Residences east of the Bedford Bypass (nearest location, over 300 m west of the proposed interchange near Magazine Hill).

4.2.3 Noise/Vibration

The proposed Project extends from the northern end of Burnside Drive and Akerley Boulevard, through undeveloped land and connects with Duke Street via a roundabout at Rocky Lake Drive where widening will occur to the connection with Highway 102. The major difference in alignment from the 2011 Stantec study is that the newly proposed alignment is south of Anderson Lake, generally paralleling the Bedford Bypass. As with the previous 2011 alignment, commercial, industrial and institutional receptors located in the Burnside Business Park are present in the vicinity of the southern portion of the alignment. At the northern portion of the alignment, in the vicinity of Rocky Lake Drive and Duke Street, there are several commercial, residential, and industrial land uses. Several residential receptors are located to the west of the proposed alignment and across the Bedford Bypass. Addressing noise impacts on a high school historically located in the area (C.P. Allen High) was a condition of release by the Department of Environment (now NSE) in 1991. NSTIR subsequently adjusted the alignment to connect with Rocky Lake Drive at Duke Street via a roundabout to reduce noise related impacts.

During their 2011 assessment, Stantec identified several potential sensitive receptors (e.g., schools, daycares) located along the proposed alignment. These receptors have been updated for the current Project and are presented in **Table 4-3**.

Table 4-3
Potential Noise Sensitive Receptors in the Vicinity of the Proposed Highway 107 Alignment

Sensitive Receptor	Approximate Distance from Proposed Alignment
Central Nova Scotia Correctional Facility, Forensic Hospital and Rehabilitation Centre	50 m to centerline
Rocky Lake Junior High School (near old C.P. Allen site)	150 m to Duke Street
Bedford and Forsyth Education Centre (closed Bedford Junior High)	550 m to centerline
St. Joseph's Children's Centre	100 m to Duke Street
Stoneridge Fellowship (Church)	250 m to end Highway 102 interchange
Sydelle's Restaurant (Rocky Lake Drive)	60 m to centerline
Nearest residence (outside of RoW)	80 m to centerline

The locations of each of the potential noise sensitive receptors within the current Project area are presented in **Figure 4-2**. There are approximately 19 residential properties within 300 m of the alignment along Rocky Lake Drive. Five of these are within the current proposed RoW and will likely be acquired by NSTIR at some stage during the Project. There are approximately 100 residences within 1,000 m of the proposed alignment along the Bedford By-Pass.

To characterize the existing sound quality, Stantec completed baseline noise measurements at six receptor locations (**Figure 4-2**) in June/July 2011 as part of a previous route assessment (Stantec, 2011). Stantec's baseline noise measurements used Type 1 integrating sound level meters to measure one-minute sound pressure levels that were then used to calculate hourly Leq (Equivalent Sound Level) values. For complete methodology and results of Stantec's baseline noise measurements, refer to their 2011 report provided in **Appendix A**.

To assess the sound quality along the revised alignment, Dillon completed supplemental baseline noise survey in October and November of 2013. The supplemental baseline noise survey consisted of approximately 48 hours of continuous sound monitoring at three locations identified in **Figure 4-2**. The three locations were selected as they were the closest receptors to the revised alignment that were not previously assessed.

The supplemental noise monitoring was completed using three calibrated RION Type II sound level meters, each equipped with a wind-screen and data logger. The monitoring was completed between October 26, 2013, and November 6, 2013. The baseline measurement commenced either on a Thursday evening and concluded on a Sunday morning or commenced on a Sunday morning and concluded on a Tuesday morning to encompass periods of time when background sounds are relatively lower (i.e., weekends).

The NSE has established the following noise guidelines for Nova Scotia (NSDOE, 1989):

(i) 65 dBA from 7 am-7 pm (Days);
(ii) 60 dBA from 7 pm to 11 pm (Evenings); and
(iii) 55dBA from 11 pm to 7 am (Nights).

The A-weighted maximum, minimum and mean hourly sound level equivalents (LeqA) for daytime (7am – 7pm), evening (7pm – 11 pm) and nighttime (11pm – 7am) for the three supplemental noise monitoring locations (DCL-01 to DCL-03), and the six locations completed by Stantec in 2008 (SCL-01 to SCL-06) are presented in **Table 4-4**. Also included in this table are the 90^{th} percentile sound levels (i.e., Lp90) for the three supplemental noise monitoring locations.

STONERIDGE FELLOWSHIP CHURCH
SCL - 01
Rocky Lake
Lake William
Spider Lake
SCL - 02
ST. JOSEPH'S DAYCARE
ROCKY LAKE JR. HIGH SCHOOL
SCL - 04
SCL - 05
SYDELLE'S RESTAURANT
Lily
SCL - 03
BEDFORD JUNIOR HIGH SCHOOL
DCL - 02
DCL - 03
DCL - 01
Anderson Lake
Lake Charles
CENTRAL NOVA SCOTIA CORRECTIONAL FACILITY
SCL - 06
Little Lake
Flat Lake
Enchanted Lake
Juniper Lake
Bedford Basin

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FIGURE 4-2
BASELINE NOISE MONITORING

DILLON BACKGROUND NOISE MONITORING SITE (DCL #)
STANTEC BACKGROUND NOISE MONITORING SITE (SCL #)
PROPOSED HIGHWAY 107 ALIGNMENT
HIGHWAY
OTHER ROAD
WATERCOURSE
TRAIL/TRACK
WETLAND
OPEN WATER
BUILDING
PROPERTY PARCELS
APPROXIMATE RIGHT OF WAY STUDY AREA (AS PER NSTIR MAY 2017)
BUFFERED CENTRELINE STUDY AREA (75 M)

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSTIR, NSDNR

MAP CREATED BY: SCM
MAP CHECKED BY: KLM
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 125 250 500 750 Metres

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Hourly results of the baseline sound measurements are provided in **Appendix A** for the three supplemental receptors. Hourly weather data is also provided in this Appendix.

Table 4-4
Noise Monitoring Results

Receptor ID	Receptor Description	Receptor Address	Maximum Hourly Leq (dBA)	Minimum Hourly Leq (dBA)	Geometric Mean LAeq (dBA)	Ave.Lp90 (dBA)
Daytime (7am - 7pm)						
DCL-01	Single Story Residential	134 Dartmouth Rd.	70.8	66.0	67.8	62.4
DCL-02	Two Story Residential	397 Rocky Lake Dr.	68.2	52.3	58.9	52.4
DCL-03	Two Story Residential	31 Lowe Court	65.9	55.8	59.1	52.4
SCL-01	Two Story Church	85 Temple Terrace	49.6	42.4	46.9	
SCL-02	Two Story Commercial (daycare)	30 Damascus Rd.	61.1	45.8	51.1	
SCL-03	Two Story Residential	115 Rockmanor Dr.	64.2	60.7	62.3	
SCL-04	Two Storey Commercial (old Charles P. Allen High School)	196 Rocky Lake Dr.	52.8	43.1	47.7	
SCL-05	Single Storey Commercial (Sydelle's Restaurant)	733 Rocky Lake Dr.	69.5	54.9	59.4	
SCL-06	Two Story Institutional (NS Correctional Facility)	90 Gloria McCluskey Ave.	47.6	38.2	43.1	
Evening (7pm - 11pm)						
DCL-01	Single Story Residential	134 Dartmouth Rd.	66.5	62.0	64.4	58.0
DCL-02	Two Story Residential	397 Rocky Lake Dr.	69.2	51.1	58.0	48.8
DCL-03	Two Story Residential	31 Lowe Court	59.0	54.1	57.1	50.0
SCL-01	Two Story Church	85 Temple Terrace	47.0	44.4	45.7	
SCL-02	Two Story Commercial (daycare)	30 Damascus Rd.	50.6	48.7	49.7	
SCL-03	Two Story Residential	115 Rockmanor Dr.	59.4	55.1	55.1	
SCL-04	Two Storey Commercial (old Charles P. Allen High School)	196 Rocky Lake Dr.	46.3	40.4	40.4	
SCL-05	Single Storey Commercial (Sydelle's Restaurant)	733 Rocky Lake Dr.	70.0	46.5	46.5	
SCL-06	Two Story Institutional (NS Correctional Facility)	90 Gloria McCluskey Ave.	60.9	38.1	38.1	
Nighttime (11pm - 7am)						
DCL-01	Single Story Residential	134 Dartmouth Rd.	67.7	53.4	59.1	42.7
DCL-02	Two Story Residential	397 Rocky Lake Dr.	65.1	42.5	49.1	41.2

Receptor ID	Receptor Description	Receptor Address	Maximum Hourly Leq (dBA)	Minimum Hourly Leq (dBA)	Geometric Mean LAeq (dBA)	Ave.Lp90 (dBA)
DCL-03	Two Story Residential	31 Lowe Court	56.7	46.4	51.8	37.2
SCL-01	Two Story Church	85 Temple Terrace	45.4	36.6	41.3	
SCL-02	Two Story Commercial (daycare)	30 Damascus Rd.	46.3	40.1	42.7	
SCL-03	Two Story Residential	115 Rockmanor Dr.	63.3	45.8	51.6	
SCL-04	Two Storey Commercial (old Charles P. Allen High School)	196 Rocky Lake Dr.	45.5	32.1	38.0	
SCL-05	Single Storey Commercial (Sydelle's Restaurant)	733 Rocky Lake Dr.	57.4	39.0	47.9	
SCL-06	Two Story Institutional (NS Correctional Facility)	90 Gloria McCluskey Ave.	43.7	38.0	40.5	

Receptors DCL-01, DCL-03, and SCL-03 are located adjacent to the Bedford Bypass, which contributes to the relatively high background sound levels at these receptors. The traffic on Rocky Lake Road and rail traffic on the rail line adjacent to receptors DCL-02 and SCL-05 is the source of elevated sound levels at these two receptors. Sound levels at Receptor SCL-06, located at the Central Nova Scotia Correctional Facility, were dominated by traffic sound from the existing Highway 107 / Akerley Boulevard (Stantec, 2011). Receptors located at monitoring sites SCL-01, SCL-02 and SCL-04 were quieter sites with some background traffic sounds (Stantec, 2011).

Baseline sound monitoring results indicate that the NSE noise guidelines were exceeded at residential receptors DCL-01, DCL-02, DCL-03 during all periods of the day (Day, Evening and Nighttime). Sound monitoring results exceeded the NSE noise guidelines during the day at SCL-05 and during the evening at SCL-06. The long-term sound monitoring results are indicative of typical urban area (USEPA, 1971).

4.2.4 Topography

The proposed alignment area is partially located within a slightly elevated plateau basin and ridgetop is rising from Bedford Basin to the west of the Project RoW. The general topography ranges up to 80 m above sea level (asl) north of Anderson Lake, with lows represented by the Anderson Lake Basin in the central portion of the proposed alignment area, Wrights Brook (both ~ 40 m asl) in the southern portion, and Parkers Brook in the northern portion (~50 m asl).

4.2.5 Bedrock Geology

The length of the proposed alignment area is underlain by Cambro-Ordovician Meguma Group Goldenville Formation bedrock. The Goldenville Formation is comprised of a bedded sequence of green to greenish-grey meta-sandstone (less than 0.5 m to several meters thick beds), interlain with green to grey, cleaved meta-siltstone and rare black slate (<0.5 m thick beds). The geological contact with the Meguma Group Halifax Formation (pyritic slate) is located to the northwest (~ 3 km) and to the south (over 3 km) from the proposed alignment area.

According to the 2011 Stantec CEAA Screening Report, horizontal compression created folds in these units, evident today as the Waverley Anticline and the Bedford Syncline, which follow the regional strike of bedrock in a north-easterly direction and occur approximately perpendicular to the proposed Project. Goldenville Formation meta-sandstone in the region is not considered to be acid generating (C. White,

NSDNR, per. comm. 2011), although it is possible within discrete mineralized zones which can occur along the axis of the anticline structures. The proposed Project is intersected by a syncline and is not immediately adjacent to either the Halifax Formation contact or an Acadian Pluton (MacDonald and Horne, 1987). Therefore, mineralized zones and associated risk of acid generating bedrock are not anticipated within the proposed Project. Samples of both argillite and greywacke rock types were collected at the nearest contact with the Halifax Formation (near the Highway 102 interchange) in support of the 1991 EA. This area has been identified by others as having some characteristics of Goldenville-Halifax Transition and, therefore, would be at a higher risk for the presence of acid generating bedrock. The rock geochemistry analytical results indicated that the formation near the Goldenville-Halifax contact in this area was a low risk for generating acid when exposed to oxygenated waters (P. Lane, 1991). Despite this, it will be necessary to test for acid-generating bedrock in any areas where bedrock cutting or excavation will be required.

4.2.6 Surficial Geology

An extensive area of exposed bedrock or very thin overburden cover is identified north of Burnside, through the Anderson Lake Basin area and approaching Rocky Lake Drive. The proposed alignment skirts the southern edge of the Rocky Lake Quarry in the northern portion of the proposed Project. Surficial geology is outlined in **Figure 4-3**.

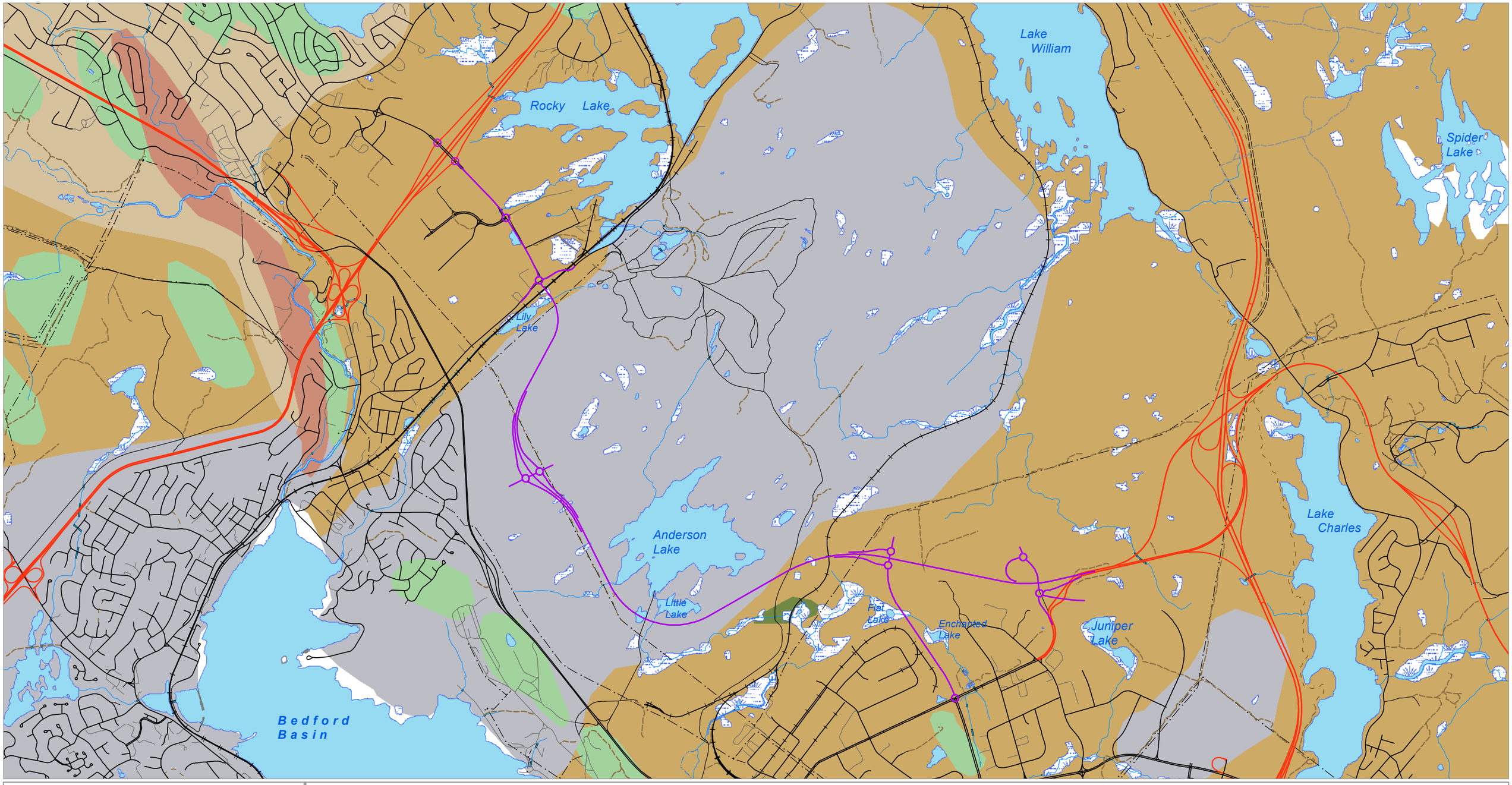
For a major portion of the proposed alignment area (i.e., Anderson Lake Basin and north), the ground surface is dominated by exposed bedrock. To the south and north of this bedrock zone, surficial geology is mapped as Stony Till Plain (**Figure 4-3**), with till described as being of quartzite origin, light blue grey with loose angular clasts, largely cobble sized with a siltier matrix in metamorphosed terrain. The till sheet can be as thick as 10 m (with an average of 3 m), but also occurs as a thin mantle or veneer on drumlins and, at times, overlies other tills, such as Lawrencetown and Hartlen.

It is important to note that the surficial geology has been affected by human activities in the southern portion of the proposed alignment area (i.e., Burnside Business Park) and along Duke Street. In particular, the on-going development of Burnside involves large-scale landscaping and redistribution of till and bedrock.

According to the 2011 Stantec CEAA Screening Report, natural tills present in the proposed alignment area are of both glacial (Pleistocene) and post-glacial (Holocene) origin (Utting, 2011). Pleistocene tills were deposited by glaciers as they moved across the land surface. In the proposed Project area, these tills are primarily characterized as poorly sorted deposits of locally derived gravel and bedrock clasts in a loose sandy matrix, deposited either as hummocky, irregular mounds up to 10 m thick or as a thin veneer (ranging from 0 to 5 m thick). Pleistocene tills are typically present as widespread blankets on the land surface, encompassing discrete deposits of younger Holocene tills. Holocene tills were deposited as the glaciers melted and melt-water receded to modern sea levels. In the proposed alignment area, the Holocene tills are alluvial or lacustrine in origin, and are present in discrete deposits within and overlying the older Pleistocene tills. Alluvial deposits are characterized as gravel, sand and some fine-grained sediment deposited by active streams and rivers, up to 10 m deep. Lacustrine deposits are comprised of much finer materials (sand, silt, clay, and organics) deposited in freshwater lakes, ponds and wetlands, up to 5 m deep.

4.2.7 Soils

Information regarding soil has been derived from the Soil Survey of Halifax County West, Nova Scotia (Agriculture Canada, 1980). The soil type present in the study area is almost entirely (outside of rocklands and peatlands) Halifax Soils. These are coarse textured sandy loam soils derived from quartzite till with



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HIGHWAY 107 BURNSIDE TO BEDFORD
ENVIRONMENTAL ASSESSMENT

FIGURE 4-3
SURFICIAL GEOGRAPHY

NOVA SCOTIA

PROPOSED HIGHWAY 107 ALIGNMENT
HIGHWAY
OTHER ROAD
TRAIL/TRACK
WATERCOURSE
WETLAND
OPEN WATER

SURFICIAL GEOLOGY

SILTY TILL PLAIN
DRUMLINS
BEDROCK
STONY TILL PLAIN
ALLUVIAL
ORGANIC

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSTIR, NSDNR

MAP CREATED BY: SCM
MAP CHECKED BY: KLM
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 125 250 500 750 Metres

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good to excessive drainage. Limited concern for sediment generation is associated with this soil type. Soils have been modified in areas that are currently developed (Burnside Business Park, Bedford Commons and Industrial Park).

Two general areas of potential contaminants were identified during the EA in the vicinity of the RoW study area. Two small debris piles were observed within DND property, east of the unnamed pond at CFAD; one of which was within the Project RoW. Potential contaminants at these locations included metals and UXO. Metals concentrations above Canadian Council of Ministers of the Environment (CCME) Interim Sediment Quality Guidelines (ISQG) and hydrocarbons (potentially related to natural organics) were also noted within the unnamed pond sediment.

In addition, DND has also been monitoring a historic contaminated site located approximately 100 m to the north of the RoW within a historic infill groin at Anderson Lake - Former Pump House (Site 7401). An ecological risk assessment, follow-up monitoring, and a Risk Management Plan development have been undertaken for this site by DND (Stantec, 2014). Risk management measures identified include restrictions on building at Site 7401 and a requirement for assessment of ecological receptors if disturbance of the soil at the Site occurs.

4.2.8 Groundwater Resources

The proposed alignment area is located within the Metamorphic Groundwater Region of Nova Scotia, which includes aquifers in the Meguma Supergroup and the Georgeville Group. Of the five groundwater regions of Nova Scotia, the Metamorphic Region is associated with the lowest estimated well yields (median 20 litres per minute; Lpm), low specific capacity (median 2.15 cubic meters, per day, per metre; $m^3/d/m$), and low transmissivity (median 1.3 square metres per day; m^2/d) (Kennedy and Drage, 2009). Fracture permeability limits groundwater availability in metamorphic and plutonic formations, and groundwater supply capacity is normally limited in this region to individual residential or small commercial applications. Also, due to the limited overburden thickness along a major portion of the proposed alignment area, surficial groundwater resources are unlikely.

In the developed portions of the proposed alignment area (i.e., to the north and the south), municipal services are available. The municipal water supplies are sourced from outside the proposed Project area. However, as noted below, there may be two domestic wells still in use (near Rocky Lake Drive).

NSE maintains a provincial well log database. A search was conducted by Stantec for the 2011 CEAA Screening Report and, within 1 km of the proposed alignment area, 141 logs from wells drilled between 1949 and 2009 were available (NSDNR, 2011). These logs included: domestic water supply wells (112), a geothermal well (1 in Burnside Business Park), industrial water supply wells (2), and public water supplies (2 that were likely no longer in use as they predated 1950). The water use types for the remaining 24 wells were not specified by NSE (in 2011).

It is not anticipated that any new wells would have been installed in the area of the proposed Project; however, the provincial well log database, which is now accessible online (via interactive Groundwater Maps and Databases), was checked to confirm this on May 25, 2017. The results of the 2011 well log review, outlined herein, are still considered relevant.

For the well logs (where recorded) the average well depth is 56.5 m (median 50.2 m, n=137) and static groundwater level was measured at an average depth of 8 m below the top of the casing (median 6.4 m, n=57). Bedrock was reported to be encountered, on average, at 15.8 m below surface (median 9.7 m, n=109). Average yield is reported to be 20.8 Lpm (median 11.4 Lpm, n =125). Three wells logs are located within a 300 m distance of this proposed Project (NSDNR, 2011). A fourth well log (#720519)

intersects the area in NSDNR Interactive Groundwater Map but was determined to be geo-referenced incorrectly and is in fact located outside of the Project area (G. Kennedy, pers. comm. 2011). Well construction data is available for two of these, identified as domestic water supply wells, located in the northernmost extent of the proposed alignment area. These wells are in a residential setting near Rocky Lake Drive and are likely in use. The shallower of the two wells (49.6 m depth, cased to 6.7 m below surface) has a reported yield of 11.4 Lpm. The deeper well (73.1 m depth, cased to 12.2 m below surface) has a reported yield of 2.3 Lpm. The third well has likely been decommissioned due to recent industrial developments at that location (drilled in 1975); this is likely one of the three wells assessed in the 1991 EA (P. Lane, 1991) near the intersection of Rocky Lake Drive and Duke Street. It was reported to be 4.6 m deep with a yield of 20.4 Lpm.

Groundwater from wells completed into the Goldenville Formation bedrock can be expected to be of good chemical quality with local exceedances in iron and manganese concentrations, particularly in areas recharged from wetlands (Stantec, 2011). Concentrations of arsenic can exceed the 10 micrograms per litre (ug/L) guideline, particularly in "Gold Districts" that occur along the crests of anticline structures (e.g., Waverley Anticline), which may host quartz veins containing gold and sulfide mineralization, including arsenopyrite. Higher than background concentrations of radon gas and other naturally occurring radionuclides may occur in Meguma Group bedrock in proximity to granite intrusive. Groundwater supplies in the proposed alignment area are likely to be affected by naturally occurring arsenic and radionuclides present in bedrock. Four domestic water supply wells in the proposed Project area were sampled for the 1991 EA (P. Lane, 1991). The results confirmed that the groundwater quality in the area is poor for consumption, associated with excessive turbidity and colour. High arsenic (greater than 0.05 milligrams per litre - mg/L) was measured in one of the sampled wells.

Groundwater quality can be influenced by many factors, such as the degree of urban development around a well. Well integrity can also degrade over time without proper maintenance (well heads should be protected, and wells should be adequately sealed to avoid surface water infiltration around the well casing).Proximity to potential sources of contamination can also influence groundwater quality (e.g., highway runoff, septic fields).

4.2.9 Surface Water Resources Summary (Watercourses and Wetlands Overview)

The Project is located within two major surface water watersheds. Most of the area occurs within lands draining to the Atlantic Ocean via Bedford Basin (NSE watershed designation 1EJ-11D12). The Atlantic drainage within the study area consists of subwatersheds to Wrights Brook and its headwater lake, Anderson Lake, and the Parkers Brook watershed with Lily Lake and its tributaries. Lands west of Rocky Lake Road drain to Rocky Lake. Rocky Lake and a small portion of the Project area located at the eastern transition with Highway 107, drains toward Lake William. Lake William is within the Shubenacadie River watershed and flows to the Bay of Fundy (NSE watershed designation 1EK-11D13).

During the EA field investigations for this report, three permanent watercourse crossings, two pond/wetland infills, over five seasonal watercourses or drainage channel crossings, and over 30 wetland crossings were identified. These features and those adjoining are located on **Figures 4-4a** and **4-4b**. Note that for ease of integration with previous data, watercourse and wetland numbers from the 2011 (Stantec) study were maintained where included in the currently proposed Project. Many watercourses are unnamed streams or surface drainage flows, and most drain to the Bedford Basin. The exceptions to flow to Atlantic watersheds are those flows towards Rocky Lake and Lake William (Shubenacadie Watershed) at the western and eastern boundaries of the Project; WC-20, 21 and 23 to the west and any intermittent flows to the east at the Akerley Boulevard interchange.

BEDFORD BASIN SUBWATERSHED

Anderson Lake

Wrights Brook

Pond

Trib to Anderson Lk

Trib to Wrights Bk

WC-01
WC-02
WC-03
WC-04
WC-05
WC-06
WC-07
WC-08

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FIGURE 4-4a

WATERCOURSES AND WETLANDS EAST EXTENT

WATER CROSSING	HIGHWAY	DRAINAGE CHANNEL (FIELD LOCATED)	CONTOUR (5M)	APPROXIMATE RIGHT OF WAY	OPEN WATER
PROPOSED HIGHWAY 107 ALIGNMENT	OTHER ROAD	PONTENTIAL OVERLAND FLOW	SUBWATERSHED BOUNDARY	NSDNR WETLANDS	DILLON FIELD DEFINED WETLANDS (SEPT 2013)
WATERCOURSE	TRAIL/TRACK	ELEMENTS OF PHASE 3	PROJECT FOOTPRINT (APPROX.)	WETLAND	STANTEC FIELD DEFINED WETLANDS (JUNE 2011)

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSTIR, NSDNR

MAP CREATED BY: SCM
MAP CHECKED BY: KLM
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 125 250 500 Metres

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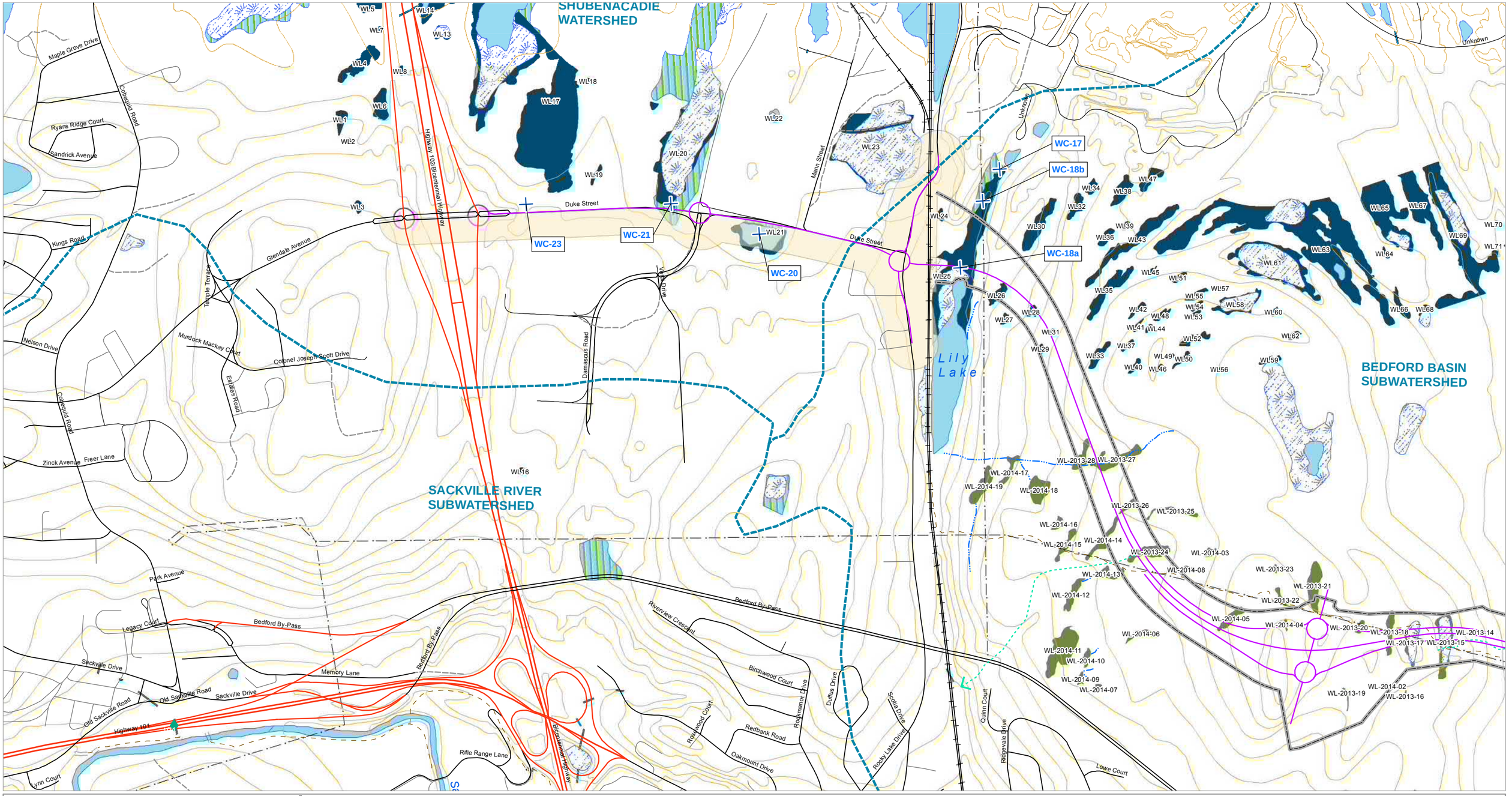

Nova Scotia Transportation and Infrastructure Renewal

Highway 107 Burnside to Bedford Environmental Assessment

FIGURE 4-4b

WATERCOURSES AND WETLANDS WEST EXTENT

NOVA SCOTIA

DILLON CONSULTING

WATER CROSSING	HIGHWAY	DRAINAGE CHANNEL (FIELD LOCATED)	CONTOUR (5M)	BUFFERED CENTRELINE STUDY AREA (75 M)	OPEN WATER	
PROPOSED HIGHWAY 107 ALIGNMENT	OTHER ROAD	PONTENTIAL OVERLAND FLOW	SUBWATERSHED BOUNDARY	NSDNR WETLANDS	DILLON FIELD DEFINED WETLANDS (SEPT 2013)	
WATERCOURSE	TRAIL/TRACK	ELEMENTS OF PHASE 3	APPROXIMATE RIGHT OF WAY	WETLAND	STANTEC FIELD DEFINED WETLANDS (JUNE 2011)	

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNR

MAP CREATED BY: SCM
MAP CHECKED BY: KLM
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 125 250 500 Metres

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PROJECT: 13-8348

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Table 4-5 lists the watercourses and wetlands in the RoW and identifies whether a crossing is anticipated. **Plate 1** provides photographs of the watercourses. Additional detail on fish habitat is provided in **Section 4.2.11** and on wetlands is provided in **Section 4.2.12**.

Table 4-5
List of Watercourses and Wetlands Within or Bordering the Project Right-of-Way (East to West)

WC No. & Name	Wetland No.	Location & UTM Coord. (~center NAD 83)	Dominant WC or WL Type	Water-course in RoW	Wetland in RoW
2011		Alignment		East	
-	WL149*	South of HWY 118/Akerley Boulevard 20T 454120 4952248	Shallow Marsh (vernal)	-	Yes
Existing drainage	WL150*	South of HWY 118/Akerley Boulevard 20T 454335 4952358	Mixed Treed Swamp (currently cleared/filled as part of Wilkinson Drive development)	Yes	Bordering
-	WL151*	South of HWY 118/Akerley Boulevard 20T 454485 4952468	Swamp (adjacent existing Wilkinson Drive)	-	Bordering
-	WL147*	Area of HWY 118/Akerley Boulevard connection to interchange 20T 454312 4952530	Swamp	-	Bordering
Drainage	WL144*	North of roundabout off Akerley Boulevard 20T 453924 4952390	Swamp	Intermittent	Yes
-	WL141*	West of roundabout off Akerley Boulevard 20T 453675 635815474952383	Bog	-	Yes
-	WL139*	North of Correctional Centre 20T453242 4952474	Swamp	-	Yes
-	WL136*	North of Correctional Centre 20T 453135 4952610	Shallow Water (vernal)	-	Yes
-	WL135*	North of Correctional Centre 20T 453046 4952713	Deciduous Swamp	-	Bordering
-	WL134*	North of Correctional Centre 20T 453990 4952625	Swamp	-	Yes
-	WL133*	North of Correctional Centre 20T 452949 4952607	Swamp	-	Yes
-	WL132*	North of Correctional Centre 20T 452705 4952486	Swamp	-	Yes
WC-01	-	Crossing on Burnside Drive constructed	Ditched headwater to Wrights Brook	Not part of Project	-
-	WL131*	Burnside Drive area constructed, new rotary	Marsh	-	Yes
Drainage	WL122*	~ 100 m northwest of Akerley Blvd 20T 453019 4951460	Shrub Swamp	Intermittent	Yes
-	WL120 *	~ 450 m northwest of Akerley Blvd 20T 452936 4951909	Treed Swamp to Marsh	-	Yes
-	WL119*	~ 750 m northwest of Akerley Blvd 20T 452854 4952079	Swamp	-	Yes
WC-04* Wiggins/ Wrights Brook	WL118*	~ 800 m northwest of Akerley Blvd 20T 452761 4952120	Permanent Stream (~5 m width) Treed and Shrub Swamp to Marsh	Yes	Yes
WC-05* Flat Lake	Above	~ 800 m northwest of Akerley Blvd 20T 452647 4952125	Pond connected to Wrights Brook	Bordering	-
WC-06* Unnamed	-	~ 1000 m north-west of Akerley Blvd 20T 452650 4952330	Intermittent/ subterranean (~3 m width) unconnected	Yes	-
-	WL117*	~ 1000 m northwest of Akerley Blvd 20T 452553 4952493	Treed Swamp	-	Yes
-	WL116*	~ 1000 m northwest of Akerley Blvd 20T 452500 4952495	Swamp	-	Yes
WC-07* Unnamed	WL114*	~ 1400 m northwest of Akerley Blvd 20T 452350 4952610	Intermittent/ subterranean (<2 m width)	Yes	Yes

WC No. & Name	Wetland No.	Location & UTM Coord. (~center NAD 83)	Dominant WC or WL Type	Water-course in RoW	Wetland in RoW
			Treed Swamp		
-	WL113*	~ 1400 m northwest of Akerley Blvd 20 T 452405 4952690	Treed Swamp	-	Yes
-	WL115*	~ 1450 m northwest of Akerley Blvd 20 T 452488 4952718	Treed Swamp	-	Yes
-	WL109*	~ 1400 m northwest of Akerley Blvd 20 T 452303 4952761	Treed Swamp	-	Yes
-	WL110*	~ 1400 m northwest of Akerley Blvd 20 T 452275 4952708	Treed Swamp	-	Yes
-	WL111*	~ 1500 m northwest of Akerley Blvd 20 T 452222 4952655	Treed Swamp	-	Yes
-	WL107*	~ 1600 m northwest of Akerley Blvd 20 T 452191 4952704	Treed Swamp	-	Yes
-	WL108*	~ 1700 m northwest of Akerley Blvd 20 T 452141 4952613	Swamp	-	Yes
WC-08* Unnamed	WL106*	~ 1700 m northwest of Akerley Blvd; adjacent Burnside rail 20 T 452109 4952599	Intermittent/ subterranean (< 2 m width) Treed Swamp	Yes	Yes
New	**ROW**	**South Of Anderson Lake**			
-	WL-2013-01	~200 m west of Burnside rail 20 T 451870 4952451	Bog	-	Yes
-	WL-2013-02	~350 m west of Burnside rail 20 T 451785 4952444	Treed Swamp	-	Yes
-	WL-2013-03	~450 m west of Burnside rail 20 T 451666 4952421	Treed Swamp	-	Yes
Drainage	WL-2013-04	~350 m east of CFAD Pewter Ln 20 T 450951 4952057	Intermittent/ subterranean (< 2 m) Shrub and Treed Swamp	Intermittent	Yes
Drainage	WL-2013-05	~350 m east of CFAD access - Pewter Lane 20 T 450829 4952045	Intermittent (< 2 m) Shrub and Treed Swamp	Intermittent	Yes
-	WL-2013-06	~200 m east of CFAD Pewter Ln; Little Lake shore 20 T 450818 4952085	Treed Swamp	-	Yes
-	WL-2013-07	~15 m east of CFAD Pewter Ln 20 T 450651 4952157	Treed Swamp	-	Yes
Trib. to Wrights Brook	-	~50 m east of CFAD Pewter Ln 20 T 450646 4952038	Permanent Stream (~5 m width) and Swamp	Yes	Yes
above	WL-2014-01	~20 m east of CFAD Pewter Ln 20 T 450624 4952007	Shrub Swamp	above	Yes
Pond S of Anderson Lake and associated drainage	Pond/ Marsh Complex	West edge of CFAD Pewter Ln 20 T 450540 4952104	Unconnected Pond/ Marsh Complex (100 x 130 m)	Yes	Yes
Drainage	WL-2013-08	~120 m west of CFAD Pewter Ln 20 T 450454 4952079	Treed Swamp	Yes	Yes
-	WL-2013-09	~200 m west of CFAD Pewter Ln 20 T 450384 4952125	Treed/Shrub Swamp	-	Yes
-	WL-2013-10	~250 m west of CFAD Pewter Ln 20 T 450399 4952227	Treed/Shrub Swamp	-	Yes
-	WL-2013-11	~300 m west of CFAD Pewter Ln 20 T 450304 4952217	Shrub Bog	-	Yes
Trib. to Anderson Lake	WL-2013-12	~450 m west of CFAD Pewter Ln 20 T 450230 4952351	Seasonal watercourse (< 2 m) Shrub to Treed Swamp	Yes	Yes
-	WL-2013-13	~850 m west of CFAD Pewter Ln 20 T 450064 4952676	Treed Swamp	-	Yes
-	WL-2013-14	~1700 m east of Rocky L. Dr. 20 T 449991 4952975	Shrub Bog	-	Yes

WC No. & Name	Wetland No.	Location & UTM Coord. (~center NAD 83)	Dominant WC or WL Type	Water-course in RoW	Wetland in RoW
-	WL-2013-15	~1600 m east of Rocky L. Dr 20 T 449917 4953021	Bog Complex	-	Yes
-	WL-2013-17	~1500 m east of Rocky L. Dr 20 T 449851 4953098	Shrub Bog	-	Yes
-	WL-2013-18	~1400 m east of Rocky L. Dr 20 T 449830 4953158	Treed Swamp	-	Yes
-	WL-2013-20	~1300 m east of Rocky L. Dr 20 T 449788 4953235	Shrub Bog	-	Yes
-	WL-2013-21	~1100 m east of Rocky L. Dr 20 T 449788 4953235	Shrub Bog	-	Yes
-	WL-2014-04	~1000 m east of Rocky L. Dr. 20T 44720086 63619319	TBD	-	Yes
-	WL-2014-05	~900 m east of Rocky L. Dr. 20T 44719583 63621456	TBD	-	Yes
-	WL-2014-08	~800 m east of Rocky L. Dr. 20T 449576 4953717	Treed Swamp	-	Yes
-	WL-2014-13	~600 m east of Rocky L. Dr. 20T 44725658 63630647	TBD	-	Yes
-	WL-2013-24	~650 m east of Rocky L. Dr 20 T 449551 4953827	Treed Swamp	-	Yes
-	WL-2013-25	~650 m east of Rocky L. Dr 20 T 449667 4953885	Swamp	-	Bordering
-	WL-2013-26	~650 m east of Rocky L. Dr 20 T 449608 4953964	Treed Swamp	-	Yes
-	WL-2014-14	~650 m east of Rocky L. Dr 20 T 449526 4953957	Treed Swamp	-	Yes
Drainage	WL-2013-27	~550 m east of Rocky L. Dr 20 T 449666 4954088	Seasonal watercourse (< 2 m) Treed Swamp	Yes	Yes
above	WL-2013-28	~500 m east of Rocky L. Dr 20 T 449618 4954160	Treed Swamp	-	Yes
Stantec	**2011**	**Alignment**		**West**	
-	WL29*	~500 m east of Rocky L. Dr 20 T 449782 4954448	Treed Swamp	-	Yes
-	WL31*	~500 m east of Rocky L. Dr 20 T 449838 4954461	Na	-	Yes
-	WL28*	~500 m east of Rocky L. Dr 20 T 449843 4954543	Na	-	Yes
Drainage	WL26*	~500 m east of Rocky L. Dr 20 T 449814 4954653	Treed Swamp	Intermittent	Yes
WC-18a* Parkers Brook	WL25*	~80 m east of Rocky L. Dr 20T 449807 4954764	Shallow Water (3 +m width)/ Marsh	Yes	Yes
WC-20* unnamed pond	WL21*	~350 m north of Rocky L. Dr. 20T 449478 4955272	Shallow Water (disturbed) (150 x 70 m) Marsh	Yes	Yes
WC-21* Unnamed	WL20*	~350 m north of Rocky L. Dr. 20T 449381 4955481	Existing culvert (< 2 m) Swamp	Yes	Yes
WC-23* Unnamed	-	~1100 m north of Rocky L. Dr. 20T 449130 4955817	Existing concrete culvert (<1 m)	Yes	-

- Stantec 2011 assessment

Plate 1 Watercourse Photos

Photo 2 WC-02

Photo 3 WC-03 Enchanted Lake

Photo 4 WC-04 Wrights, Wiggins Brook

Photo 5 WC-05 Flat Lake (Stantec, 2011)

Photo 6 WC-06

Photo 7 WC-07

Photo 8 WC-08

Photo 9 Tributary to Wrights Brook

Photo 10 Pond Wetland S. of Anderson Lake

Photo 11 Drainage W. of Pond

Photo 12 Trib. to Anderson Lake

Photo 13 WC-18 Lily Lake

Photo 14 WC-20 Duke St. pond wetland

4.2.9.1 Surface Water Quality

Surface water quality was assessed in fall of 2010 or spring of 2011 in the east and west ends of the alignment (Stantec, 2011) through in situ metered measurements for temperature, pH, conductivity, dissolved oxygen (DO) and flow. Water samples were collected in September 2013 along watercourses in the portion of the alignment south of Anderson Lake and analysed for basic parameters (general chemistry, metals, and Total Suspended Solids - TSS). The 2013 water samples were taken following Dillon sampling protocols and analyzed by a certified laboratory. **Appendix B** provides the analytical data. **Table 4-6** provides a summary of key parameters.

Table 4-6
Summary of Water Chemistry for Permanent Watercourses Crossed by RoW

Canadian Council of Ministers of Environment (CCME)
Freshwater Aquatic Life (FWAL) Guideline Exceedances in **Bold**

W/C ID	Watercourse Name	Water Temp. ^{0}C	pH	Cond. (uS/cm)	DO (mg/L; %)	Date
WC-04*	Wrights Brook	18.70	7.48	603	**5.22** (56.1)	September 2010
WC-06*	Unnamed Stream	12.52	**6.44**	92	**6.3** (59.6)	September 2010
WC-07*	Unnamed Stream	13.36	**6.20**	36	9.91 (94.9)	September 2010
WC-08*	Unnamed Stream	13.07	**6.33**	42	7.1 (67.2)	September 2010.
-	Trib. to Wrights Brook	12	**6.15**	54	10 (95)	September 2013
-	Pond S. of Anderson Lake	14	**5.65**	83	6.5 (65)	September 2013
-	Trib. to Anderson Lake	14	6.83	220	8.5 (87)	September 2013
-	Trib. to Lily Lake	14	**5.44**	27	8 (90)	September 2013
WC-18a*	Parkers Brook	17.84	6.50	664	6.8 (71.6)	September 2010
WC-20*	Unnamed Wetland adjacent to Duke St.	17.84	6.87	607	7.43 (84.9)	September 2010
WC-21*	Unnamed Stream	14.28	**5.12**	445	6.87 (67.7)	September 2010

- * Stantec 2011 meter data (YSI 556 MPS)

As typical for watercourses in the bedrock of the area, the pH identified for many watercourses is below the Canadian Council of Ministers of the Environment (CCME) Fresh Water Aquatic Life (FWAL) guideline of 6.5 to 9.5 units. As well, exceedances of FWAL for aluminum and iron occur which is typical for watercourses in this region given the local geology and acidic precipitation. Similar results were found for the DND property (CFAD) in October 2012 sampling (Genivar, 2013).

4.2.10 Generalized Habitat and Assessment

The methodology for addressing wildlife species and habitat follows the approach outlined in the NSE Guide to Addressing Wildlife Species and Habitats in an EA Registration Document (2009). As noted in this guidance, the focus for EA documents is to be on priority species and habitats. Priority species include those listed in the sources identified in **Table 4-7** below.

Table 4-7
Priority Species and Habitats that must be Considered

Lists	Designation
Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and Federal Species-at-Risk Act (SARA)	Endangered, Threatened or Vulnerable/Special Concern Species (and SARA Schedule)
Nova Scotia Endangered Species Act (NSESA)	Endangered, Threatened or Vulnerable/Special Concern Species
General Status of Wild Species in Canada (Previously Nova Scotia General Status)	At risk, May be at risk or Sensitive (Previously red or yellow)

Additionally, species listed by the Atlantic Canada Data Centre (ACCDC) as extremely rare (S1) to uncommon (S3) and those with undetermined (UD) status are also considered in the assessment. Priority/at risk species are considered under each of the categories except wetlands. Wetland species at risk are noted in one of the other relevant categories (priority fish, plants or animals).

Available background information on potential priority/at risk species for the study area was compiled from NSDNR's Significant Wildlife Habitat Database and the ACCDC as well as consideration of habitat types present in the study area. A radius of 100 km was considered initially in 2013 for review of known occurrences of priority species and is the basis of a long list of potential priority species for each taxonomic group. An update 5 km radius ACCDC listing was obtained in 2017. Recent ACCDC data correspondence is included in **Appendix C-1**. In addition to ACCDC data, previous studies in the area (including for the proposed Highway 107 alignment north of Anderson Lake) also contribute to the short-list of known and potential priority plant and animal species for the area. **Appendix C-2** presents the potential priority species short-list.

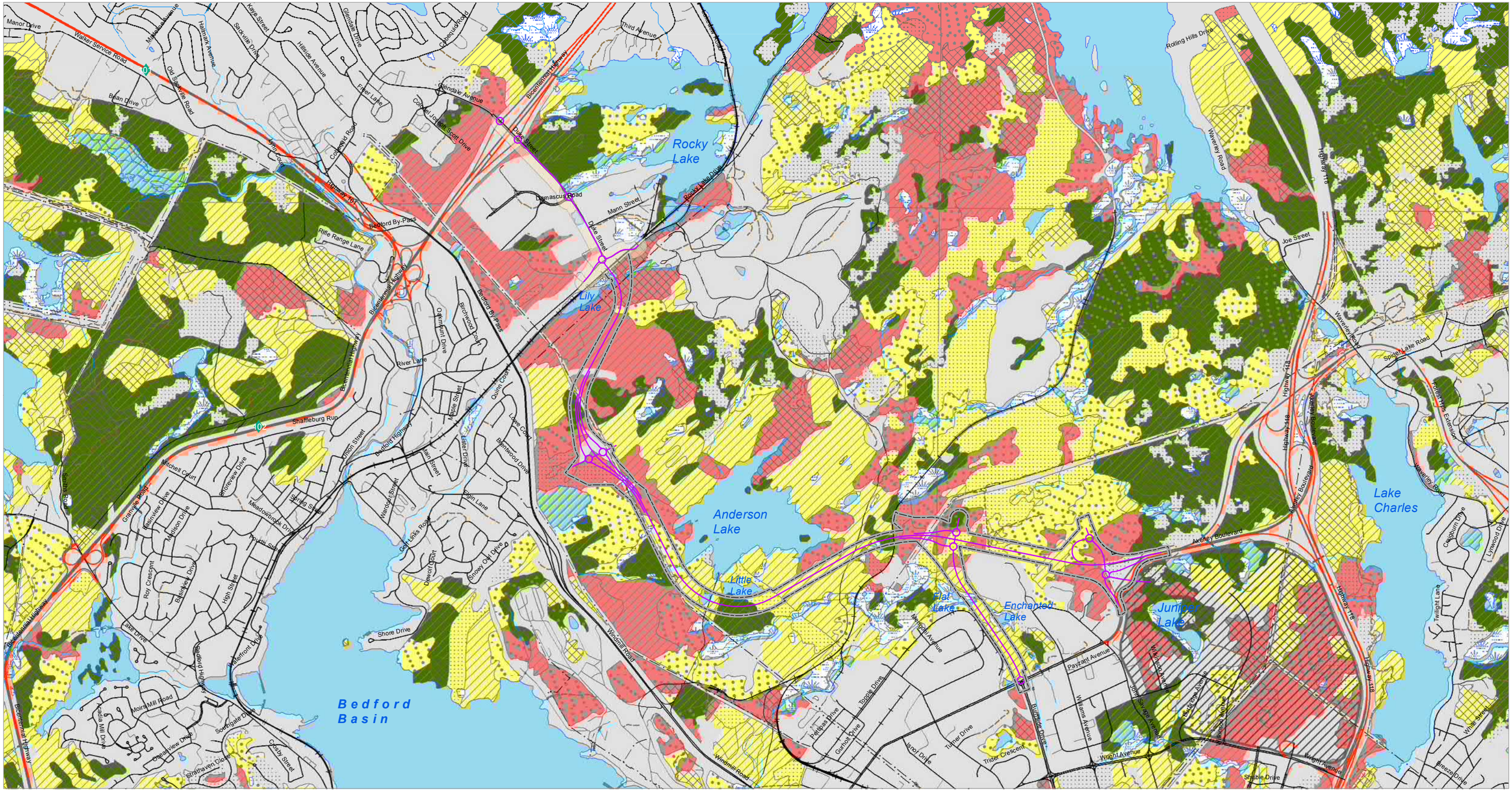
Base mapping and aerial photographs were also used to provide a preliminary assessment of forest cover and vegetation type. Habitat types were confirmed in the field through the study area assessment. Field inventories, where possible within the study time frame, were designed to target peak periods of optimal detection of the "short-list" priority species. Details of the field inventory methodologies are provided in the relevant sections below.

An assessment of habitats is provided in subsequent sections by general categories:

- Fish and Fish Habitat;
- Wetlands;
- At Risk/Priority Flora; and
- At Risk/Priority Wildlife and Migratory Birds.

4.2.10.1 General Habitats Present

Figure 4-5 indicates the general habitats present in the study area based on NSDNR forest cover. Note: the smaller habitat units (exposed bedrock ledges and riparian areas) are not identified in this mapping. The only identified NSDNR significant habitats in the immediate area are wetlands (http://novascotia.ca/natr/wildlife/habitats/hab-data/ and https://nsgi.novascotia.ca/plv/). **Table 4-8** summarizes the habitat types (note that plants are listed by common name, and the full scientific name is provided in the plant data **Appendix F**). **Photo Plate 2** provides typical habitat photographs.



Nova Scotia Transportation and Infrastructure Renewal

Highway 107 Burnside to Bedford Environmental Assessment

FIGURE 4-5

General Habitats

PROPOSED HIGHWAY 107 ALIGNMENT	TRAIL/TRACK	BUFFERED CENTRELINE STUDY AREA (75 M)	FOREST ESTABLISHMENT	WETLAND (NSDNR DATABSE)	AREA OF NEW DEVELOPMENT
Watercourse	POWERLINE	SOFTWOOD DOMINANT STAND	YOUNG FOREST	WETLAND (TOPOGRAPHIC DATABASE)	
HIGHWAY	RAIL LINE	MIXED FOREST	MULTI-AGE FOREST	OPEN WATER	
OTHER ROAD	APPROXIMATE RIGHT OF WAY STUDY AREA (AS PER NSTIR MAY 2017)	HARDWOOD DOMINANT STANDS	MATURE FOREST	NON-FORESTED/DEVELOPED	

NOVA SCOTIA

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNR

MAP CREATED BY: SCM
MAP CHECKED BY: KLM
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 125 250 500 Metres

N W E S

FINAL

PROJECT: 13-8348

DATE: June 2017

Table 4-8
Summary of Habitat Types in RoW

Habitat Type	Character	Key Forest Species	Key Under-story or Ground Plant Species	Key Habitat Features	~ Total Area (ha) in RoW *	~% RoW
Hardwood (Deciduous) Forest	Predominately mature; even-aged stands common. -Mature in well drained rocky upland areas; low productivity and moderate density. Open/sparse in areas close to ridgetops and dominated by shrubs; little vertical structure. -Second growth in disturbed and wetter areas and gullies; increased density; often uneven-aged stands.	Red maple, red oak, white birch, grey birch.	Prominent dense shrub understory - black huckleberry and blueberries. Gully areas include New York fern, lady fern, and hairy flat-top white aster.	Riparian areas surrounding intermittent flows.	10	9
Softwood (Coniferous) Forest	Predominately mature, but mix of even and uneven-aged stands. Mature often on slopes and in sheltered valleys, and particularly along the shoreline of Little Lake. Wind damage high in exposed areas. Mature areas with good vertical structure, coarse woody debris, and snags.	Red spruce dominated. White pine in isolated patches in bettered drained areas or minor component. Balsam fir particularly in the understory.	Dominated by mosses including feathermoss, braided moss, and stairstep moss. Often bunchberry and northern starflower. Shrubs present in more open areas – black huckleberry, blueberries.	Mature riparian areas adjacent to the lake/pond.	31	29
Mixedwood Forest	Variable - typically uneven-aged stands; second growth; immature/young common; limited mature stands (usually conifers amongst hardwoods). Generally low productivity due to poor soils. Often open understory; significant wind damage; patchy areas (usually coniferous) with good vertical structure, snag density, and coarse woody debris.	Red spruce, red maple, paper birch, balsam fir, red oak and white pine.	Varied - common herbaceous species include sarsaparilla, woodfern, bracken fern, bunchberry, northern starflower, and velvet-leaved blueberry. Shrub cover may be dense – huckleberry, lambkill, blueberry. Mosses include feathermoss, braided moss, and stairstep moss.	Riparian areas surrounding intermittent flows; Anderson Lake and Wrights Brook. Scattered large mature white pine, red spruce, yellow birch, beech.	48	44

Habitat Type	Character	Key Forest Species	Key Under-story or Ground Plant Species	Key Habitat Features	~ Total Area (ha) in RoW *	~% RoW
Semi-Barrens/ Rock	Exposed rock ridges with limited ground cover to dense shrub cover and sparse tree cover.	Stunted - Paper birch, red maple, red and black spruce. Also Jack Pine semi-barrens.	Dense shrub - predominately black huckleberry with sheep-laurel, blueberries, wild raisin Exposed bedrock – vegetation when present - broom crowberry blueberries, sheep-laurel, black huckleberry and reindeer lichen with scattered stunted black spruce.	Uncommon habitat type.	<1	<1
Wetland	Scattered throughout RoW; variable habitat type.	Variable – see wetland section. Black spruce predominately in wetland border areas.	Variable – see wetland section (**4.1.12**).	Variable – see wetland section (**4.1.12**).	20	18
Riparian/ Shoreline	Lake, pond and often stream/intermittent flow and wetland borders typically rocky composed of cobbles, boulders, and bedrock. Narrow fringe of riparian habitat.	Red spruce, red maple.	Shrubs – viburnum, huckleberry, underlain by mosses.	Important buffer habitat to aquatic areas.	Part of others	-
Aquatic/ Open Water	Lily Lake, Anderson Lake as well as smaller, unnamed waterbodies. Typically shallow (<2 m in depth) and often classified as shallow water wetland under the Canadian Wetland Classification System.	Not applicable.	Aquatic plants are found within or along the edges of these habitats, including pickerel-weed, bladderworts, white buttons, variegated pond-lily, and fragrant water-lily; vegetative cover is often scarce.	Fish habitat including SAR species.	1	1
Urban/ Disturbed (Anthro-pogenic)	Powerline corridor/woods roads.	Regenerating white birch, gray birch, red maple, white spruce.	Ericaceous shrubs dominate some weedy and exotic species.	-	<1	<1

Habitat Type	Character	Key Forest Species	Key Under-story or Ground Plant Species	Key Habitat Features	~ Total Area (ha) in RoW *	~% RoW
	Rail line/CFAD gravel access road.	Not applicable.	Weedy and exotic species where present.	-	<1	<1
	Residential areas.	Not applicable.	Ornamentals, exotics and lawn species.	-	<1	<1
	Commercial/industrial - Impervious surfaces and contains little vegetative cover.	Not applicable.	High diversity of early-successional, exotic and weedy species where present.	Potential SAR bird nesting areas.	3	3

- *** For generalized assessment, the Duke Street widening RoW study area is approximated as 75 m on the south side of the centerline.**

Habitat Photographs Plate 2

Photo 15 Hardwoods

Photo 16 Mixedwoods

Photo 17 Softwoods

Photo18 Power line

Photo 19 Rail and Residential

Photo 20 Anderson Lake Shore

Photo 21 Bedrock Ridge

Photo 22 Cove in Little Lake to Wrights Brook

Photo 23 Wetland

Approximately two-thirds of the area is comprised of forest cover at various stages of maturity. Boulders, exposed bedrock, and patchy soil occur throughout the area. Mixedwoods and shrubby hardwoods dominate the southern portion which is identified by the Nova Scotia ecological land classification as having imperfectly drained soil with medium texture and ridges (http://www.novascotia.ca/natr/forestry/ecological/ecolandclass.asp). Hardwoods dominate the northern area within land classified as having well drained medium textured soil and ridges. Pure softwood stands are limited.

Large portions of the forest are regenerating as a result of blow-down from storm events (such as Hurricane Juan – September 2003), historical fire events and the maturation process. The CFAD area was subject to the 1945 Rent Point explosion and subsequent fire (Dillon, 2008). As well a large fire affected the area in 1963.

Wetlands are frequent, reflecting the ridge-and-swale topography. The repeated undulating terrain derived from the eroded geologic bedrock syncline results in semi-barrens and exposed rock habitats occurring along parallel ridge tops, alternating with the wetlands and mature stunted hardwoods within the swales. The trees are generally established in hollows where soil and organic matter have accumulated, while the shrubs are most abundant on the ridges where the soil is thin and dry. Wetlands types are dominated by treed swamp and shrub swamp, with some marsh/shallow water and fewer bogs. Additional aquatic and riparian habitats within the area are provided by low-lying areas associated with waterbodies and watercourses.

Disturbed habitat areas (commercial/industrial/residential) occur at the Burnside Business Park connection and within the Duke Street portion where widening and roundabouts are proposed. Other small anthropogenic areas are associated with the powerline, woods roads, rail line easements and with an abandoned gravel pit occurring south of Duke Street.

4.2.10.2 Invasive Plant Species

Over 20 percent of the plant species observed along the RoW are not native to the province of Nova Scotia. Stantec (2011) observed 36 species of exotic plants within wetland habitats with dominant species including bittersweet nightshade, creeping buttercup, hairy willowherb, multiflora rose and purple loosestrife. Fewer exotics were observed in 2013, 2014, and 2016 surveys, however, the focus of later surveys in the disturbed areas previously assessed by Stantec was on the potential for priority species (defined in **Section 4.2.10**). Bittersweet nightshade was also prevalent in 2013/2014/2016 surveys particularly in disturbed areas adjacent ponds and wetlands.

Exotic plants identified as potentially problematic invasive species (Hill and Blaney, 2010) include; purple loosestrife, multiflora rose, glossy buckthorn, European buckthorn and common valerian. Purple loosestrife is a colonizer of open wet habitats and thrives in systems subject to disturbance. It was identified (Stantec, 2011) in wetlands north of Akerley Boulevard (WL122, WL125, WL131), the anthropogenic wetland/pond along Duke Street (WL21), and the wetland adjacent the rail line at Lily Lake (WL25). Multiflora rose is an edge species and was observed in WL20 along Duke Street, and west of Akerley Boulevard in WL115, WL117, WL118, WL119, WL120, and WL122. Glossy buckthorn is a potentially invasive shrub tolerating a wide range of conditions. This plant was observed by Stantec (2011) in WL118 west of Akerley Boulevard, and in 2014 along the Duke Street Pond/WL21, but was not abundant. Two European buckthorn plants, species with potential to shade native plants, were observed in WL120 west of Akerley Boulevard (Stantec, 2011). Common valerian is a garden escapee with the potential to invade wet meadow habitats. This plant was observed along the Duke Street area in 2011 (Stantec) near WL20.

Historic records of illegal and trespass marijuana cultivation have been reported at the CFAD property and in the general forested area between Duke Street and Burnside Business Park.

4.2.10.3 Exotic Animal Species

Numerous non-native animal species are expected to be associated with the developed portions of the RoW and in the adjacent area, including rats and feral cats. Two invertebrates (Phylum Arthropoda, Class Insecta, and Class Arachnida) are identified as requiring specific considerations in project planning:

Brown spruce longhorn beetle (BSLB) (*Tetropium fuscum*) has been reported in the vicinity of CFAD. This invasive forest insect from Europe is under regulatory control by the Canadian Food Inspection Agency (CFIA). There is a requirement for risk mitigation for movement and disposal of spruce logs and restrictions on firewood in BSLB infested areas. Movement and disposal restrictions on spruce bark and wood chips have been removed.

Blacklegged or deer ticks (*Ixodes scapularis*) have been reported at CFAD. This tick is known to carry and transmit to humans the bacterium that causes Lyme disease (*Borrelia burgdorferi*). The Admiral Cove area along Bedford Basin is identified as a hotspot for the tick. The ticks depend on its primary host, the white-tailed deer for reproduction. Immature ticks feed on birds and small mammals. CFAD has a high density of deer which move throughout the property and likely distribute the tick. Additional safety precautions related to preventing tick bites are recommended for work in the area.

4.2.11 Fish and Fish Habitat

Although a variety of fisheries (recreational, commercial, and traditional) depend on fish stocks in the watersheds in the general area; the Project study area has only minor recreational fishing.

Aboriginal Fishery
The Mi'kmaq Ecological Knowledge Study (MEKS) conducted for Highway 107 Sackville to Porter's Lake (CMM Environmental Services, 2010) does not identify any traditional or current Mi'kmaq fishing activity in the general area including the current study area.

Fish and fish habitat within the aquatic study area are described below.

4.2.11.1 Description of Fish and Fish Habitat Methodology

Fish habitat was examined within and downstream of the RoW. Streams were initially identified from mapping, aerial photographs and the previous 2011 assessment (Stantec, 2011) for relevant sections of the alignment. Field surveys were conducted for watercourses within the new portion of the RoW to confirm habitat characteristics using standard DFO parameters including stream character, substrate, cover and observations of habitat degradation, if appropriate. The habitat data evaluated the potential for spawning, rearing, nursery, food supply and migration areas. Water chemistry data was also collected as noted in the surface water section (**Section 4.1.9**).

Fish species were assessed, both in the 2011 Stantec study and for the new portion of the alignment in 2013, at the presence/absence level using electrofishing or minnow traps where habitat potential was in question. Habitat with potential for priority fish species as identified in the short-list (**Appendix C-2**) was also targeted for field survey. Where existing fish passage was uncertain, surveys were conducted downstream of the existing RoW. The relative distribution/abundance and composition of valued fish species were assessed.

Table 4-9 identifies field investigations within the general area.

Table 4-9
Summary of Field Investigations Relevant to Fish Habitat

Field Survey Location	Methodology	Field Survey Date	Reference
Anderson Lake	• Nets (unknown)	1971	Alexander 1971
CFAD property - Tributary to Anderson Lake, Anderson Lake, and Wrights Brook	• Minnow traps (overnight set)	October 17,18 2001	MGI 2002
CFAD property - Wrights Brook	• Physical habitat assessment using DFO habitat forms • Minnow traps • Invertebrate samples (surber)	October 5,6 2005	Dillon 2006
Anderson Lake	• Nets (gill)	July-August 2003, April 2004	Bradford et al. 2015
Anderson Lake	• Nets (gill)	June 2005	ACER 2006
Anderson Lake	• Trap nets and minnow traps	June 2007	Stantec 2007
Anderson Lake	• Trap nets	2006-2012	Bradford et al. 2015
Proposed study area for alignment north of Anderson Lake – including current alignment from Akerley Boulevard to Canadian National (CN) rail track and section east of Lily Lake to Highway102	• Physical habitat assessment (Stantec protocol based on DFO protocol) • Invertebrate samples (CABIN, OBBN protocol) • Electrofishing (presence-absence in potential fish stream habitat) • Minnow traps (overnight set; 4 per site) in lake/pond habitats	Fall 2010 supplemented by June 2011	Stantec 2011
CFAD property	• Visual assessment of fish habitat • Minnow traps • Invertebrate samples Wrights Brook (surber CABIN protocol)	Fall 2012	Genivar 2013
Current alignment area focusing on CN rail to Lily Lake	• Physical habitat review • Minnow traps (overnight sets; 2 per site) in pond habitat not covered above – pond and Wrights Brook at CFAD crossing and Anderson Lake outlet • Electrofishing (presence-absence) in potential fish stream habitat not covered above - Wrights Brook at CFAD crossing • Invertebrate samples for pond site (grab)	September 25 and October 2 & 3 2013	This assessment

4.2.11.2 Summary of Fish and Fish Habitat

Table 4-10 identifies the watercourses observed and potential implications for fish habitat and passage requirements. Further detail on key watercourse habitats is provided in subsections below. **Table 4-11** provides information on the seasonal sensitivity of fish species known for the area with field and other data specific to each of the habitat assessments provided in **Appendix D**.

Table 4-10
Summary of Watercourses and Fish Habitat Presence in RoW

ID	WC	In RoW	Key Physical Features at Approx. Crossing	Habitat Presence and Character at Approx. Crossing	Fish Observed	Priority Fish Species**	NSE Approval Required	Passage	Fisheries Review Required
WC-04*	Wiggins/ Wrights Brook	**Yes**	Permanent - Shallow Run between Enchanted Lake and Flat Lake Average depth 0.12 m, width 5 m	• Rearing	Electrofishing (2010) - Yes	American eel, brook trout	**Yes**	**Yes**	**Yes**
WC-06*	Unnamed stream	**Yes**	Subterranean - Narrow, shallow hard bottom Average depth 0.04 m, width 3 m	Not connected • Poor seasonal	Not applicable	No	**Yes**	Not applicable	No
WC-07*	Unnamed stream	**Yes**	Subterranean - Narrow, shallow hard bottom Average depth 0.1 m	Not connected • Poor seasonal	Not applicable	No	**Yes**	Not applicable	No
WC-08	Unnamed stream	**Yes**	Subterranean - Narrow, shallow soft bottom Average depth 0.07 m, width 2 m	Not connected • Poor seasonal	Not applicable	No	**Yes**	Not applicable	No
-	Drainage	**Yes**	Intermittent surface drainage Average depth <0.1 m, width 2.5 m	Not fish habitat	Not applicable	No	Wetland	Not applicable	No
-	Little Lake	No (will not be infilled in final foot-print)	Shallow rocky shore and mud bottomed nearshore Average depth ~0.5 m, width 15 m	Lake cove • Rearing	Not surveyed. Habitat is expected to be similar to Anderson Lake	Potential American eel, brook trout, and Atlantic whitefish	Not applicable	Not applicable	Not applicable
-	Drainage	**Yes**	Intermittent surface drainage Average depth 0.1 m, width 1.5 m	Not fish habitat	Not applicable	No	Wetland	Not applicable	No
-	Little Lake	No (will not be infilled in final foot-print)	Lake - Shallow rocky shore and mud bottomed nearshore Average depth ~0.5 m, width 25 m	Lake cove • Rearing	Not surveyed. Habitat is expected to be similar to Anderson Lake	Potential American eel, brook trout, and Atlantic whitefish	Not applicable	Not applicable	Not applicable
-	Trib. to Wrights Brook	**Yes**	Permanent Main outflow from Anderson Lake/Little Lake Predominately rock riffle in RoW with stillwater cove at mouth/Little Lake Average depth ~0.2 m, width 5 m	• Adult and juvenile forage fish and brook trout; American eel (COSEWIC Threatened); good • Rearing salmonid (brook trout); fair	Electrofishing (2013) - Yes	American eel Potential Atlantic whitefish, brook trout	**Yes**	**Yes**	**Yes** & SARA Review

ID	WC	In RoW	Key Physical Features at Approx. Crossing	Habitat Presence and Character at Approx. Crossing	Fish Observed	Priority Fish Species**	NSE Approval Required	Passage	Fisheries Review Required
				salmonid (brook trout) passage • Potential for Atlantic whitefish (Endangered, Sched. 1)					
-	Unnamed pond (South of Anderson Lake)	**Yes**	Pond and wetland marsh; mud bottomed; extensive aquatic vegetation Average depth 0.2 m, width 130 m	• Potential forage for birds	Minnow traps (2013) - No	No	**Yes,** Wetland	Not applicable	**Yes**
-	Intermittent Drainage	**Yes**	Intermittent surface drainage Average depth 0.1 m, width 1.5 m	Not fish habitat	Not applicable	No	No	Not applicable	No
-	Unnamed Trib. to Anderson Lake	**Yes**	Permanent, seasonal flow - Narrow, shallow hard bottom; some fines closer to the lake Average depth 0.1 m, width 1.5 m	• Seasonal brook trout rearing habitat near lake downstream of RoW • Seasonal forage	No (2013 electro-fishing)	No	**Yes**	Not applicable	Not applicable
-	Anderson Lake Cove	No (will not be infilled in final foot-print)	Lake - Shallow rocky shore and mud bottomed near shore Average depth ~0.5 m, width 30 m	• Rearing (brook trout and forage); fair, low productivity	Not surveyed but expect same as Anderson Lake	Potential American eel, brook trout, and Atlantic whitefish	Not applicable	Not applicable	Not applicable
-	Drainage	**Yes**	Intermittent surface drainage Average depth <0.1 m, width 1.5 m	Not fish habitat; potential downstream seasonal habitat	Not applicable	No	**Yes,** Wetland	Not applicable	No
WC-18a	Parkers Brook (Trib. to Lily Lake)***	**Yes**	Permanent - Narrow, shallow hard bottom run Average depth 0.1 m, width 3 m	• Rearing (brook trout and forage)	Yes (minnow traps and electrofishing 2010)	Potential brook trout	**Yes**	**Yes** (existing obstructions upstream and downstream)	**Yes**
WC-20*	Unnamed pond	**Yes**	Permanent – Unconnected pond Mud substrate over hard bottom, culvert at inlet Average depth < 1 m, width 10 m	• Forage species (brown bullhead plus other forage potential)	Yes (minnow traps 2010)	No	**Yes,** Wetland	No	**Yes**
WC-21*	Unnamed stream	**Yes**	Permanent – concrete culvert (1.6 m diameter) at Duke St. Narrow, shallow organic substrate Average depth ~0.1 m, width ~2 m	• Forage species (ninespine stickleback)	Yes (electro-fishing 2010)	No	**Yes**	**Yes**	**Yes**

ID	WC	In RoW	Key Physical Features at Approx. Crossing	Habitat Presence and Character at Approx. Crossing	Fish Observed	Priority Fish Species**	NSE Approval Required	Passage	Fisheries Review Required
WC-23*	Unnamed stream	**Yes**	Permanent (ditched upstream) – culvert (0.75 m diameter) at Duke St. Narrow, shallow hard bottom Average depth ~0.05 m, width <1 m	• Poor fish habitat and not connected to fish-bearing watercourse	Not habitat – Not surveyed	No	**Yes**	No	No

- *** Stantec 2011 watercourses ** See Table 4-12**
- ***** Stantec (2011) also examined this watercourse upstream and downstream of the proposed crossing (WC-17, 18b, & 19)**

Table 4-11
Summary of Spawning Times for Fish within the General Area (from Stantec 2011)

Status[3]	Scientific Name	Common Name	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
COSEWIC Threatened S2/Secure	*Anguilla rostrata*	American eel					1			2	2			
S5/Secure	*Catostomus commersoni*	White sucker												
S5/Secure	*Fundulus diaphanus*	Banded killifish												
S5/Secure	*Fundulus heteroclitus*	Mummichog												
S5/Secure	*Gasterosteus aculeatus*	Threespine stickleback												
S4/Secure	*Notemigonus crysoleucas*	Golden shiner												
S5/Secure	*Notropis cornutus*	Common shiner												
S5/Secure	*Perca flavescens*	Yellow perch												
S5/Secure	*Pungitius pungitius*	Ninespine stickleback												
S5/Secure	*Rhinichthys atratulus*	Blacknose dace**												
S3	*Osmerus mordax*	Rainbow smelt (landlocked)												
COSEWIC Endangered S1/May be At Risk	*Salmo salar*	Atlantic salmon (southern upland pop.)												
S3/Sensitive	*Salvelinus fontinalis*	Brook trout												
S5/Secure	*Ameiurus nebulosus*	Brown bullhead												
Endangered Sched. 1 NSESA Endangered	*Coregonus huntsmani*	Atlantic whitefish	***											***

Spawning
Eggs/Sacfry in substrate Source: Scott and Crossman 1998

** Blacknose Dace unconfirmed

*** Spawning in Anderson Lake unconfirmed (DFO 2016)

Notes 1: Upstream migration of immature fish 2 Downstream migration of mature spawners 3. Applicable Status as of May 2017
Notes: S-rank - S1 Extremely rare in province; S2 Rare in province; S3 Uncommon in province; S4 Widespread, common and apparently secure in province; S5 Widespread, abundant and secure General Status - "Sensitive" indicating they are potentially susceptible to human activities or natural events. "May be at Risk" therefore considered here to be of high conservation concern within the province. "Undetermined" indicating that there is currently insufficient data, information, or knowledge available to evaluate its status.

4.2.11.3 Wrights Brook Sub-watershed Streams (WC-03, 04, 05, 06, 07, 08 and Tributary to Wrights Brook/Outlet to Little Lake)

The eastern portion of the alignment crosses headwater tributaries of Wrights Brook, including the outflow of Anderson Lake and Little Lake. Fish passage into the upper portion of Wrights Brook is reported to be impeded by a perched culvert located under an old road upstream of Windmill Road and downstream of the Canadian National (CN) Rail line (Dartmouth Area Watersheds Network (DAWN) Management Plan Framework (undated) and DAWN and Clean Nova Scotia, undated).

The Wrights Brook system provides diverse fish assemblages. In addition to brook trout, American eel (priority species) and forage fish species were observed. Wrights Brook provides salmonid spawning and rearing habitat throughout the study area; primarily for brook trout. An estimate of benthic macroinvertebrate diversity (as a gauge of fish habitat quality), was made using an EPT (Ephermeroptera, Plecoptera, Tricoptera) Index and Shannon and Simpson Diversity Indices for the outlet to Little Lake (Genivar 2013). This site scored as having fair quality, but low food abundance for fish. Spawning habitat was not present or was considered poor at watercourse crossing locations; however, fish habitat is expected to be present at all permanent watercourse crossings.

Watercourses WC-06, 07 and 08 were observed to be isolated with the streams turning subterranean with fine organic substrates. These watercourses were identified as non-fish bearing (Stantec, 2011).

4.2.11.4 Anderson Lake and Little Lake (and tributaries to)

Anderson Lake is a large (61.7 ha), deep (maximum depth of 24 m) lake that drains to Wrights Brook. The accessibility of passage to the ocean (Bedford Basin) is not confirmed (perched culvert/natural obstructions), but at best there are low flow restrictions. The lake shoreline is rocky with limited aquatic vegetation even within coves in the vicinity of the RoW. **Appendix D** shows Anderson Lake bathymetry from historical NSDNR records. Anderson Lake provides habitat for brook trout and yellow perch as well as a variety of forage fish (DAWN and Clean Nova Scotia, undated). Historical records indicate rainbow trout were stocked for the recreational fishery. The current status of rainbow trout in the lake is unknown. More recently (2005-2006), DFO introduced Atlantic whitefish (priority species) as part of the federal Endangered Species Recovery Plan (http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=64; see also **Section 4.2.11.9).**

Little Lake is a ponded area downstream of Anderson Lake, and a short gut (approximately 70 m long) and a short (20 m) rocky channel separates the lakes. The gut portion likely formed by infilling activities for the DND access road. This channel may have limited low flow passage but full passage at other times of the year. Little Lake is expected to have the same fish species and similar habitat as Anderson Lake and may offer a more productive sheltered refuge habitat. It does not provide deep water areas but also includes coves/shoreline in the vicinity of the RoW. Bottom and shoreline substrates in this waterbody are also rocky. A small drainage channel that does not provide fish habitat enters Little Lake in the WL-2013-06 area.

A small tributary to Anderson Lake, which crosses the RoW, drains into a cove along the western border of the lake. The headwaters of this watercourse are within wetlands in the CFAD property near Windmill Road. Stream flow is low but likely present throughout much of the year. The channel is often undefined, through wetland areas and into rocky boulder areas. Fish habitat is not present except within 25 m of the Anderson Lake cove, where seasonal forage fish habitat may occur (and access to winter refuge habitat within the lake). No fish were captured during the 2013 surveys.

4.2.11.5 Unnamed Pond (Southwest of Anderson Lake)

This small pond occurs within the RoW just south-west of Anderson Lake. It is likely this pond was formed or expanded as a result of the historical CFAD access road construction. The pond does not have a permanent connection to other waterbodies. It has intermittent flows (at high flow seasons) leaving the pond along the north side towards Anderson Lake and from a wetland entering the northwest side. No passable connection to Anderson Lake was observed. The pond is shallow (<1 m deep), has extensive emergent, floating and submergent aquatic vegetation (also included as a wetland – shallow marsh) and an organic mud bottom underlain by rock. This pond has potential to provide forage fish habitat, however, none were captured during the minnow trap surveys. It is possible that fish populations have not been established or were subject to predation. Amphibians were observed in the pond, as well as raptors foraging in the area.

4.2.11.6 Lily Lake Tributaries/Parkers Brook (WC 17, 18 a,b and 19)

From Stantec (2011): "Lily Lake (WC-19) is a moderately sized lake that drains north to south adjacent to Rocky Lake Drive. The headwaters of Lily Lake and Parkers Brook originate from the Rocky Lake Quarry as overland drainage and slope drainage from the forested area to the south. WC-17 is utilized by Rocky Lake Quarry as a retention pond and receives surface drainage from the various office building's parking lots and garages located in the eastern portion of the quarry. The retention pond appears to have been created by building a large berm across the headwaters of Parkers Brook. This berm, which is approximately 2.5 m high at the time of the field assessments, was designed with the outlet on the south end of the berm. This outlet did not allow fish to pass into WC-17. Parkers Brook originates at the outlet of WC-17 and flows through Lily Lake and along Rocky Lake Drive further downstream it empties into Bedford Basin. The substrate within Parkers Brook is predominantly gravel and cobble in the upper regions and becomes silty sand in the flat lower region. The habitat within Parkers Brook would be suitable for brook trout, minnows, and juvenile white sucker. The substrate within the littoral zone in Lily Lake is composed of silty sand and occupied by submergent and emergent aquatic vegetation. This vegetation creates habitat for minnows and juvenile yellow perch. The depths of the lake provide habitat for brook trout, white sucker, and adult yellow perch. An electrofishing survey conducted in Parkers Brook yielded banded killifish, ninespine stickleback, and white sucker."

WC-18a and 18b are part of the upstream shallows and channel system within WL25. The streambed at WC-18a is within the proposed RoW area and will be altered with flow piped under the proposed Lily Lake-CNR overpass structure. Approximately 50 m downstream of Lily Lake, Parkers Brook enters a culvert adjacent to the rail line and is piped approximately 600 m downstream, likely affecting fish passage.

4.2.11.7 Rocky Lake Tributary - Pond (WC-20)

This small pond is located on the west side of Duke Street within the widening area. This watercourse likely receives drainage from the surrounding area during times of storm flow. An inlet or outlet was not observed during field surveys. Although a cross-drainage culvert in Duke Street was not noted it is likely that this area originally drained to Rocky Lake (via WL22). Stantec (2011) determined that the pond appears to have been a natural, low-lying feature altered to be used as a retention pond receiving drainage from the commercial development along Damascus Road (Bedford Commons).

The pond is shallow with cattails and other emergent aquatic growth. Minnow traps were set to capture any resident fish; only brown bullheads were caught in the overnight minnow trap-sets. Although passage to Rocky Lake is unclear, it is still likely that other forage fish are present.

4.2.11.8 Rocky Lake Tributaries (WC-21 and WC-23)

WC-21 receives drainage from the commercially developed areas along Damascus Road and WC-20 during high flow periods. The flow in a narrow stream following the south road ditch passes under Duke Street in a concrete culvert. Flow then enters a braided area within wetland WL20 and eventually discharges to Rocky Lake. Poor fish habitat was identified, with garbage and a high proportion of fines in the sediment. Fish captured in electrofishing were limited to ninespine stickleback. WC-23 originates from a spring in the south Duke Street ditch. The watercourse follows the ditch and crosses under Duke Street in a concrete culvert. Before WL17, the flow goes underground. The drainage is not directly connected to fish habitat and is not considered fish-bearing.

4.2.11.9 Priority Fish Species Findings

No fish species listed under SARA or NSESA naturally occur within the study area streams. However, as noted above, captive, reared Atlantic whitefish (SARA and NSESA Endangered) have been introduced to Anderson Lake as part of a federal recovery effort and may enter Wrights Brook.

Atlantic whitefish, a federally and provincially listed endangered species, are endemic to southwestern Nova Scotia in two river systems (Tusket-Annis and Petite Riviere watersheds). Numerous threats to the population occur including habitat loss, degradation (acid precipitation), dams, exotic species and incidental fishing. As part of the federal recovery efforts, nearly 12,000 captive-reared Atlantic whitefish of various age classes were released into Anderson Lake between November 2005 and 2008, followed by a release of a small number of old brood stock in 2012. Monitoring in the following year indicated that hatchery-raised fish can survive and grow for at least five years and sexually mature males and females were captured in 2009 and 2010 (DFO, 2016). DFO data, to date, indicates there has been no evidence of an established population within the lake (pers. comm. R. Bradford DFO Sept. 2013; DFO, 2016). Proposed critical habitat was identified for resident population in the Petite Riviere watershed but does not currently include the introduced population in Anderson Lake (DFO, 2016, DFO, 2016b). The population of captive-reared Atlantic whitefish in Anderson Lake continue to provide a backup recovery action. DFO monitoring in 2010 confirmed survival. DFO monitoring in 2012 did not indicate successful reproduction had occurred and suggested a decline in stocked fish numbers (Bradford et al., 2015). The Action Plan for the fish includes further measures to monitor the success of releases and to strive to achieve a self-sustaining population (DFO, 2016c).

American eel (COSEWIC Threatened) adults are known to occur in suitable habitat throughout the area including Anderson Lake, Wrights Brook and its tributaries and the Parkers Brook-Lily Lake system. As eels spawn at sea, habitat is primarily adult foraging.

Brook trout (General Status sensitive) occur in most permanent watercourses in the area; including Anderson Lake, Wrights Brook, and Lily Lake and their tributaries. Spawning habitat is limited and poor within the vicinity of the RoW.

Table 4-12 provides a summary of priority fish species in the general area.

Table 4-12
Priority Fish Species Identified within the Vicinity of the RoW

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location Identified within Study Area	Habitat	Potential for Additional Habitat in Project Area
Gaspereau	*Alosa pseudoharengus*	S3/Sensitive	No	Enter Sackville and Shubenacadie River systems to spawn.	Low ground, damp woods, and swamps.	Low
Rainbow smelt (land-locked)	*Osmerus mordax*	S3	**No**	Reported for Anderson Lake (Bradford et al., 2015)	Lake	No
American eel	*Anguilla rostrata*	COSEWIC Threatened S2/Secure	**Yes**	Wrights Brook and tributaries; anticipated in most permanent watercourses in area.	Adults enter freshwater streams.	High
Atlantic whitefish	*Coregonus huntsmani*	SARA Sched. 1 Endangered S1/ Exotic?	No	Anderson Lake (Stantec, 2011).	Not applicable.	Low
Atlantic salmon S. Upland pop.	*Salmo salar*	COSEWIC Endangered S1/May be at risk	No	Enter Sackville and Shubenacadie River systems to spawn.	Gravel bottomed streams, rivers.	Not likely
Brook trout	*Salvelinus fontinalis*	S3/ Sensitive	**Yes**	Habitat in larger watercourses or seasonally connected to larger watercourses.	Streams and lakes.	Low

1 Status Notes: Status as of May 2017
S-rank - S1 Extremely rare in province; S2 Rare in the province; S3 Uncommon in the province; S4 Widespread, common and apparently secure in province; S5 Widespread, abundant and secure in the province.
General Status - "Sensitive" indicating they are potentially susceptible to human activities or natural events
"May be at Risk" therefore considered here to be of high conservation concern within the province.
"Undetermined" indicating that there is currently insufficient data, information, or knowledge available to evaluate its status.

4.2.11.10 Additional Priority Fish Species with Potential Habitat in Project Area

No other priority fish species are anticipated within the project RoW or in the immediate vicinity.

Gaspereau (Status S3/Sensitive) were historically expected to make spawning runs into fresh watercourses from the Bedford Basin. However, no records are available for Wrights Brook and passage issues near Windmill Road may prevent access to the system. Similarly landlocked rainbow smelt (Status S3) were reported for Anderson Lake but are not expected to occur more widely in the area (Bradford et al., 2015).

Atlantic salmon (southern upland population; COSEWIC endangered) also historically made spawning runs into rivers from the Bedford Basin. Recent restoration efforts have improved the run into the nearby Sackville River. However, Wrights Brook is unlikely to have had a significant run, and no records of salmon are identified for the system.

4.2.12 Wetlands

Wetlands along the RoW are identified in **Table 4-5** above. Details of wetlands surveyed are provided in **Appendix E**.

4.2.12.1 Description of Wetland Assessment Methodology

Wetlands were identified based on NSDNR's wetland database, previous assessments in the area, satellite data and field surveys. Wetland field surveys conducted within the study area are summarized in **Table 4-13** below. Wetlands were determined to be present if vegetative, soil and hydrologic indicators occurred following the provincial process which is based on the US Army Corps of Engineers Wetland Delineation methodology. Wetland classes are based on the Canadian Wetland Classification System (NWWG, 1997) For wetlands potentially affected by the Project, additional information was collected on wetland function. Wildlife habitat and at risk species potential is based on background data, vegetation, bird and herpetile assessments. Assessment of hydrological and surface water function is based on watershed character.

Table 4-13
Summary of Field Investigations Relevant to Wetlands

Field Survey Location	Methodology	Field Survey Date	Reference
CFAD property – WL-2013-15, pond, 12, 4 & 5	Wetlands over 0.5 ha identified and plants surveyed.	July 2005.	Stantec (JWEL) 2005
Proposed study area for alignment north of Anderson Lake – including current alignment from Akerley Boulevard to CN rail track and section east of Lily Lake to Bicentennial Highway	Wetland delineation and functional assessment based on NovaWAM (precursor to NovaWET).	2010 and 2011 with functional assessments in fall 2010, and June to July 2011.	Stantec 2011
CFAD property	Wetland delineation and functional assessment for wetlands over 0.5 ha identified previously and rapid assessment for additional wetlands.	Fall 2012.	Genivar 2013
Current alignment area RoW focusing on CN rail to Lily Lake	Wetland delineation and summary of key functions based on NovaWET where not previously assessed.	September 16-19 and September 30, 2013.	This assessment
Additional assessment west of CFAD to Highway 101	Wetland delineation and summary of key functions based on NovaWET.	August 11-13, 2014	This assessment

4.2.12.2 Summary of Wetlands

Wetlands types within the RoW of the proposed project are summarized in **Table 4-14** and wetlands are located in **Figures 4-4a and b**. **Table 4-15** provides a summary of key functions in each of the wetlands within the RoW.

Table 4-14
Summary of Wetlands in RoW

Dominant Wetland Class in RoW	Count	Description[1]	Area (ha) [2]
Swamp (Shrub and Treed)	48	• Mixed treed and deciduous treed swamp habitat abundant. • Tall shrub swamp also common. • Occasional areas dominated by coniferous trees, low shrubs, and a mixture of low and tall shrubs are also present. • Tree cover within the swamps is primarily comprised of various amounts of red maple, black spruce, balsam fir, and American larch whereas common winterberry, mountain holly, speckled alder, black huckleberry, and possum-haw viburnum are the most prominent shrubs. • Ground vegetation varies amongst the specific swamp habitat types, but cinnamon fern is typically a dominant component along with some other herbaceous taxa, including three-seed sedge, dwarf dogwood, and royal fern. Peatmoss (*Sphagnum spp*.) typically forms a prominent ground layer throughout the swamps.	13.8
Bog	7	• Uncommon in the Study Area. • Dominated by ericaceous shrubs, particularly leatherleaf and stunted coniferous trees. • Variety of shrubs, forbs, and graminoids including coastal sedge, pale bog laurel, Bigelow's huckleberry, common Labrador tea, and late lowbush blueberry. • Peatmoss dominated the ground cover, with reindeer lichen (*Cladina spp.*) and hair-cap moss) also prominent within drier portions.	1.9
Fen	0	• Fens not identified as present.	0
Marsh	7	• Often in association with swamps and shallow water wetland classes. • Largest located at the north end of Lily Pond. • Dominated by graminoids but forb-dominated marsh habitats were also encountered in association with disturbed areas. • Species composition within the graminoid-dominated marshes was varied - typically broad-leaved cattail with some other graminoids, including bluejoint reed grass, common woolly bulrush, and soft rush. A variety of other graminoids and forbs were also found within these habitats, as was a diffuse shrub cover provided by species such as leatherleaf and sweet gale. • Species within forb dominated wetlands included variegated horsetail, purple loosestrife, common woolly bulrush, swamp yellow loosestrife, water horsetail, broad-leaved cattail, and others.	6.1
Other	In other count	• Vernal pools and riparian watercourse areas provide narrow wetland habitat throughout the area.	In other area
Total	**62**		**21.8**

Note 1: Stantec (2011).
Note 2: Area of the total wetland is included even if only partially within the RoW.

Table 4-15
Key Wetland Functions by Wetland within RoW Study Area [1]

No.	Dominant Wetland Type	Wetland Approx. Size (ha)	Landscape Position	Landform	Flow Path	Water Regime	Origin	Disturbed	Priority Species Habitat[1]	Surface Water Detention	Streamflow Maintenance	Sediment Retention	Shoreline Stabilization	Fish Habitat	Waterfowl Habitat	Other Wildlife Habitat	Community Use	Carbon Sequestration	Nutrient Transformation
WL149*	Marsh (shallow vernal graminiod)	0.02	Terrene	Basin	Isolated	Seasonally flooded	Likely formed by historic road con-struction	Nutrient input from adjacent road	-	●						●			
WL144*	Swamp (shrub with wet meadow)	0.02	Terrene	Basin	Inflow	Seasonally flooded	Potent-ially formed by Hwy con-struction	Ditching altered hydrology and fill from historic clearing	-	●						●		●	●
WL141*	Bog (coniferous treed)	0.13	Terrene	Basin	Isolated	Seasonally flooded	Natural	Old harvest	-							●		●	
WL139*	Swamp (mixed treed)	0.08	Terrene	Basin	Isolated	Seasonally flooded	Natural	Adjacent old forestry road	-							●			
WL136*	Marsh - shallow water (vernal)	0.01	Terrene	Basin	Isolated	Seasonally flooded	Natural	Low	-							●			
WL134*	Swamp (deciduous treed)	0.02	Terrene	Basin	Isolated	Seasonally flooded	Natural	Low	-							●			
WL133*	Swamp (mixed treed)	1.25	Terrene	Basin	Isolated	Seasonally flooded	Natural	Old forestry road; Storm Damage	-							●		●	●
WL132*	Swamp (shrub)	0.03	Terrene	Basin	Inflow	Seasonally flooded	Natural	Ditch storm flow input; adjacent correct-ional facility	-	●		●				●			

No.	Dominant Wetland Type	Wetland Approx. Size (ha)	Landscape Position	Landform	Flow Path	Water Regime	Origin	Disturbed	Priority Species Habitat[1]	Surface Water Detention	Streamflow Maintenance	Sediment Retention	Shoreline Stabilization	Fish Habitat	Waterfowl Habitat	Other Wildlife Habitat	Community Use	Carbon Sequestration	Nutrient Transformation
WL131*	Marsh, Swamp (emergent basin)	0.13	Terrene	Basin	Inflow	Seasonally flooded	Natural	Historic road impacts	-	●		●				●		●	●
WL122*	Swamp (tall shrub)	0.2	Terrene	Basin	Isolated	Temporarily flooded	Created	Likely infilled with Industrial develop-ment	-	●		●							
WL120*	Swamp (mixed treed) to Marsh	2.4	Lotic stream - Unconfined	Flood-plain	Through-flow	Seasonally flooded	Natural	Clearing in RoW area	B-TS	●		●		●		●		●	●
WL119*	Swamp (riparian)	0.03	Lotic stream - Unconfined	Flood-plain	Through-flow	Seasonally flooded	Natural	No	P-BA B-RK	●		●		●		●		●	●
WL118*	Swamp (treed and shrub) to Marsh (graminoid and floating –leaved)	5.3	Lotic stream - Unconfined	Flood-plain	Through-flow	Seasonally flooded	Natural	Borders encroached by Industrial develop-ment	B-CM P-BA out-side RoW	●		●		●		●		●	●
WL117*	Swamp (mixed treed)	0.1	Terrene	Basin	Isolated	Temporarily flooded	Created	Likely due to drainage from developed area	-	●		●				●			
WL116*	Swamp (mixed treed)	0.1	Terrene	Basin	Isolated	Temporarily flooded	Natural	No	-	●		●				●			
WL115*	Swamp (mixed treed)	0.8	Terrene	Basin	Isolated	Temporarily flooded	Natural	No	B-CW	●		●				●			
WL114*	Swamp (treed - immature deciduous)	0.4	Terrene	Basin	Isolated	Temporarily flooded	Natural	Powerline clearing	B-CM	●		●				●			
WL113*	Swamp (treed - deciduous)	<0.1	Terrene	Basin	Isolated	Temporarily flooded	Natural	No	-	●		●				●			
WL110*	Swamp (Treed - deciduous)	<0.1	Terrene	Basin	Isolated	Temporarily flooded	Natural	Rail line drainage	-	●		●				●			
WL109*	Swamp (treed)	0.06	Terrene	Basin	Isolated	Temporarily flooded	Natural	No	-	●		●				●			

No.	Dominant Wetland Type	Wetland Approx. Size (ha)	Landscape Position	Landform	Flow Path	Water Regime	Origin	Disturbed	Priority Species Habitat[1]	Surface Water Detention	Streamflow Maintenance	Sediment Retention	Shoreline Stabilization	Fish Habitat	Waterfowl Habitat	Other Wildlife Habitat	Community Use	Carbon Sequestration	Nutrient Transformation
WL111*	Swamp (treed - deciduous)	0.2	Terrene	Basin	Isolated	Temporarily flooded	Natural	Rail line drainage	B-CW	●		●				●			
WL107*	Swamp (treed - deciduous)	0.2	Terrene	Basin	Isolated	Temporarily flooded	Natural	Rail line drainage	-	●		●				●			
WL108*	Swamp (shrub)	<0.1	Terrene	Basin	Isolated	Temporarily flooded	Created	Rail line drainage	-	●		●				●			
WL106*	Swamp (treed)	1.2	Terrene	Basin	Isolated	Temporarily flooded	Natural	Rail line drainage	-	●		●		●		●		●	●
WL-2013-01	Bog (shrub - open)	0.3	Terrene	Basin	Isolated	Seasonally saturated	Natural	Rail line drainage	-							●		●	
WL-2013-02	Swamp (treed)	<0.1	Terrene	Basin	Isolated	Temporarily flooded	Created	Rail line drainage	B-CW	●		●				●			
WL-2013-03	Swamp (treed)	1.4	Terrene	Basin	Isolated	Seasonally saturated	Natural	Rail line drainage	B-CW	●		●				●		●	
WL-2013-04	Swamp (shrub)	1	Terrene to Lotic Pond	Basin	Outflow	Seasonally saturated	Natural	No	-	●	❍	●	●		●	●		●	
WL-2013-05	Bog (shrub)	0.4	Terrene	Basin	Isolated	Seasonally flooded	Natural	No	-	❍		❍				❍		●	
WL-2013-06	Swamp (treed - lakeshore)	0.1	Lentic lake	Flat	Outflow	Seasonally flooded	Natural	No	-	●		●	●		●	●		●	
Wrights Brook Riparian	Swamp/Vernal Pool	>1	Lotic stream - unconfined	Slope	Through-flow	Seasonally flooded	Natural	No	F-AE	●	●	●	●	●		●			
WL-2013-07	Swamp (treed)	<0.1	Terrene	Basin	Isolated	Temporarily flooded	Created	No	-	●		●				●			
WL-2014-01	Swamp (treed)	0.3	Lotic stream - unconfined	Flat	Through-flow	Seasonally flooded	Natural	No	-	●	●	●	●	●		●			
Pond	Marsh	~2	Terrene pond	Basin	Isolated	Permanently flooded	Mixed	Minor access road encroach-ment	bat feed-ing	●		●			●	●		●	●
WL-2013-08	Swamp (treed)	0.2	Terrene	Basin	Isolated	Seasonally flooded	Natural	Minor clearing associated with powerline	-	●		●				●		●	

No.	Dominant Wetland Type	Wetland Approx. Size (ha)	Landscape Position	Landform	Flow Path	Water Regime	Origin	Disturbed	Priority Species Habitat[1]	Surface Water Detention	Streamflow Maintenance	Sediment Retention	Shoreline Stabilization	Fish Habitat	Waterfowl Habitat	Other Wildlife Habitat	Community Use	Carbon Sequestration	Nutrient Transformation
WL-2013-09	Swamp (treed)	<0.1	Terrene	Basin	Isolated	Seasonally flooded	Natural	Minor clearing associated with powerline	-	●		●				❍		●	
WL-2013-10	Swamp (treed)	0.3	Terrene	Basin	Isolated	Seasonally flooded	Natural	No	B-CW	●		●				●		●	
WL-2013-11	Bog (shrub)	<0.1	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	Minor clearing associated with powerline	-	●		●				❍		●	
WL-2013-12	Swamp (treed)	1.2	Lotic stream – unconfined	Basin	Through-flow	Seasonally flooded/ saturated	Natural	Minor clearing associated with powerline	B-CW	●	●	●		❍		●		●	
WL-2013-13	Swamp (treed)	0.7	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	Minor clearing associated with powerline	-	●		●				❍		●	
WL-2013-14	Swamp (treed)	<0.1	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	No	-	●		●				●		●	
WL-2013-15	Bog complex (coniferous treed and low shrub)	0.6	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	Minor clearing associated with powerline	-	●		●				❍		●	
WL-2013-17	Bog (tall shrub)	0.3	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	Minor clearing associated with powerline	-	●		●				❍		●	
WL-2013-18	Swamp (treed)	0.2	Terrene	Basin	Isolated	Seasonally flooded/	Natural	Minor clearing	-	●		●				❍		●	

No.	Dominant Wetland Type	Wetland Approx. Size (ha)	Landscape Position	Landform	Flow Path	Water Regime	Origin	Disturbed	Priority Species Habitat[1]	Surface Water Detention	Streamflow Maintenance	Sediment Retention	Shoreline Stabilization	Fish Habitat	Waterfowl Habitat	Other Wildlife Habitat	Community Use	Carbon Sequestration	Nutrient Transformation
						saturated		associated with powerline											
WL-2013-20	Swamp (treed)	<0.1	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	Minor clearing associated with powerline	-	●		●				●		●	
WL-2013-21	Bog	0.4	Terrene	Basin	Isolated	Seasonally saturated	Natural	No	B-CW,TW	❍		❍				❍		●	
WL-2014-05	Swamp	0.36	Terrene	Slope	Isolated	Seasonally flooded/ saturated	Natural	No	-	●		●				●		●	
WL-2014-04	Swamp	0.03	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	-	-	●		●				●		●	
WL-2014-08	Swamp (treed)	0.04	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	No	-	●		●				●		●	
WL-2014-13	Swamp	0.14	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	No	-	●		●				●		●	
WL-2013-24	Swamp (treed)	0.3	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	Minor powerline drainage	B-CW	●		●				●		●	
WL-2013-26	Swamp (treed)	<0.1	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	No	-	●		●				●		●	
WL-2013-27	Swamp (treed)	0.4	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	No	-	●		●				●		●	
WL-2014-14	Swamp (treed)	0.05	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	No	B-TW	●		●				●		●	
WL-2013-28	Swamp (treed)	0.2	Lotic stream - unconfined	Basin	Through-flow	Seasonally flooded	Natural	No	-	●	●	●				●			

No.	Dominant Wetland Type	Wetland Approx. Size (ha)	Landscape Position	Landform	Flow Path	Water Regime	Origin	Disturbed	Priority Species Habitat[1]	Surface Water Detention	Streamflow Maintenance	Sediment Retention	Shoreline Stabilization	Fish Habitat	Waterfowl Habitat	Other Wildlife Habitat	Community Use	Carbon Sequestration	Nutrient Transformation
WL29*	Swamp (treed)	0.02	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	No	-	●		●				●		●	
WL31*	Swamp	<0.1	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	No	-	●		●				●		●	
WL28*	Swamp	<0.1	Terrene	Basin	Isolated	Seasonally flooded/ saturated	Natural	No	B-CN near	●		●				●		●	
WL26*	Swamp (treed deciduous)	0.1	Terrene	Basin	Isolated	Temporarily flooded	Natural	Powerline drainage	-	●		●				●			
WL25*	Marsh (shallow water)	3.5	Lotic Stream - Unconfined	Flood-plain	Through-flow	Seasonally flooded	Natural	Clearing and rail line encroach-ment	B-TS, CT P-CB, BA near	●		●	●	●	●	●		●	●
WL21*	Marsh (shallow water) (disturbed)	0.9	Terrene Pond	Basin	Outflow	Permanently flooded	Created	Duke St. and Industrial encroach-ment	B-TS	●		●				●			
WL20*	Swamp	2.6	Terrene	Basin	Isolated	Temporarily flooded	Natural	Near road	-	●		●				●			

- * Stantec 2011 survey

Note:
P – Plant: CB cursed buttercup, BA black ash.
B - Bird: CW Canada Warbler, TS Tree Swallow, CT Common Tern, CM Cape May Warbler, CN Common Nighthawk, RK Ruby-crowned Kinglet
F – Fish: AE American eel
● Moderate to high function ❍ Low function

4.2.13 Priority Flora

Vegetation within the general area is described based on the habitat types identified from mapping and dedicated botany surveys within the RoW described in **Appendix F**.

4.2.13.1 Description of Priority Flora Methodology

Appendix C-1 lists the potential at-risk plants "short-listed" for the study area, their likely habitat, flowering period, and at risk/priority status. The timing identified for optimal detection of "short-listed" plant species was spring and summer. Several field surveys have been conducted in the area and provide a baseline. This information was supplemented by surveys in the fall of 2013, and June 2014 and 2016, focussing on the Project area not previously surveyed in 2011. An additional plant survey was conducted within an area identified for alternate alignment consideration in August 2014 (**Figure 4-6**). In June 2016, the alignment was re-surveyed.

For baseline and supplementary plant surveys, the alignment was surveyed on foot by a qualified plant specialist, visually searching for significant plant habitats and species of interest. Although priority lichen species were not identified in the area; plant surveys in 2013, 2014 and 2016, and of the CFAD property in 2007 and 2008, included visual lichen searches based on habitat potential for uncommon lichens. Priority species were identified and located using a handheld GPS.

Vegetation surveys conducted within the study area are summarized in **Table 4-16** below and include coverage of the study area within early and late seasons.

Table 4-16
Summary of Field Investigations Relevant to Priority Plant Species

Field Survey Location	Field Survey Date	Reference
Proposed alignment north of Anderson Lake – including current alignment from Akerley Boulevard to CN rail track and section east of Lily Lake to Bicentennial Highway – Limited survey of habitat types	February 18, 1991 (botanist R. Newell)	P. Lane 1991
CFAD property – Limited survey including current study area sites along Wrights Brook, Anderson Lake, pond, gravel access road and powerlines	September 20, 22 2000 (botanist R. Newell)	Dillon 2001
CFAD property – Limited survey including current study area sites along Wrights Brook, Anderson Lake, pond, gravel access road and powerlines	October 3, 4 2001 (botanist T. Neily)	MGI 2002
CFAD property – Coniferous forest areas, edges of Anderson and Little Lakes	September 19, 20 2007 (botanist T. Neily)	Dillon 2008
CFAD property – Forest stands with potential Boreal Felt Lichen habitat	February 12, 2008 (botanist T. Neily)	Dillon 2008
Proposed alignment north of Anderson Lake – including current alignment from Akerley Boulevard to CN rail track and section east of Lily Lake to Bicentennial Highway	September 2010; June – July 2011 (botanist not identified)	Stantec 2011
CFAD property – representative habitats	Between October 30 and December 13, 2012 (botanist not identified)	Genivar 2013
Current alignment area focusing on CN rail to Lily Lake, plus roundabouts	September 16-19, 2013 September 30 2013 June 25-27, 2014 (botanist T. Neily)	This assessment
Alternate alignment area investigation west of CFAD	August 11-13, 2014 (botanist T. Neily)	This assessment

Field Survey Location	Field Survey Date	Reference
Alignment from Akerley Boulevard. to Hwy 102	June 2-3, 2016 (botanist T. Neily)	This assessment

4.2.13.2 Priority Plant Findings

Urban land use dominates the areas in Burnside Business Park and northwest of Rocky Lake Road. The area between Burnside and Rocky Lake Road is forested. No old growth forest habitat was identified within the study area. Most of the plant species identified during field surveys are listed as having secure populations within the province or are exotics (i.e. not native to the province). The vegetation list for the general area, including the area to the north of Anderson Lake (Stantec, 2011), totals over 450 vascular plant species.

Table 4-17 summarizes the priority plants found in the general area. One plant species listed under SARA, COSEWIC or NSESA was observed in the RoW. Black ash (NSESA Threatened) was observed in several locations, including north of Lily Lake within the RoW, and in WL118 approximately 100 m southwest of the Project RoW. One plant species listed by NSESA as Vulnerable (eastern white cedar) was also observed in the general area (Stantec, 2011). The cedar was located approximately 400 m north of the RoW at WL4 and is outside of the current Project area. The cedar was considered to represent non-native (ornamental) stock and thus not considered a priority species. Several priority plant species with general status and/or ACCDC rank of "at risk or sensitive" were encountered in the general area and were searched for but not observed within the RoW. **Figure 4-6** provides locations of priority plants in the RoW (as well as in the 2011 study area).

4.2.13.3 Conservation Concern Plants Observed within RoW

Priority plant species observed within the RoW include:

Mountain sandwort/Greenland stitchwort (S3/Sensitive) was observed in previous surveys in the vicinity of the power line RoW along exposed rock areas. This plant species is small and inconspicuous.

Several occurrences are within the RoW. Two observations were at the edge of the RoW south of WL-2013-24 in exposed rock areas identified as typical habitat. Over six plants were noted at this location. Additional locations were noted along the powerline trail south of the above observations; again over six plants and two additional locations approximately 100 m south of the powerline were noted; one with over six plants and one with one plant. Potential habitat for the plant is present in small isolated areas along the bedrock ridges southwest of Anderson Lake which has the potential to support additional individuals in low numbers.

Cursed buttercup (S1S2/May be at risk) were observed in wetlands north of Duke Street (not expected to be within the project footprint due to widening on the south side of Duke Street) with approximately 30 plants in 2011, and several occurrences in the wetland WL25 north of Lily Lake and at the border of the RoW. This area may be outside of the final footprint but is within an area hydrologically connected to the potential footprint by Lily Lake.

Lake William

Rocky Lake

Spider Lake

Lily Lake

Jack pine Barren

Anderson Lake

Little Lake

Flat Lake

Enchanted Lake

Juniper Lake

Bedford Basin

SARA/NSESA

- Eastern White Cedar
- Black Ash

Species of Conservation Concern

- Mountain Sandwort
- Blood Millkwort
- Boreal Aster
- Cursed Buttercup
- Large St. John's-wort

Secure/Undetermined Species

- Southern Twayblade
- Kalm's Hawkweed
- Arrow-Leaved Violet
- Fleshy Hawthorn
- Hay Sedge
- Highbush Blueberry
- Nova Scotia Agalinis
- Pale Bog-moss
- Variegated Horsetail

Nova Scotia Transportation and Infrastructure Renewal

HIGHWAY 107 BURNSIDE TO BEDFORD ENVIRONMENTAL ASSESSMENT

FIGURE 4-6

VEGETATION SPECIES OF INTEREST

NOVA SCOTIA

DILLON CONSULTING

PROPOSED HIGHWAY 107 ALIGNMENT

HIGHWAY

OTHER ROAD

WATERCOURSE

APPROXIMATE RIGHT OF WAY STUDY AREA (AS PER NSTIR MAY 2017)

BUFFERED CENTRELINE STUDY AREA (75 M EITHER SIDE)

OPEN WATER

WETLAND (TOPOGRAPHIC DATABASE)

WETLAND (NSDNR DATABSE)

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNR

MAP CREATED BY: SCM
MAP CHECKED BY: KLM
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 125 250 500 750 Metres

N W E S

FINAL

PROJECT: 13-8348

Date: June 2017

Table 4-17
Priority Plant Species Observed in the Vicinity of the RoW

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Locations	Background [2]	Potential for Additional Occurrence in Project Area
Black ash	*Fraxinus nigra*	NSESA Threatened S1S2/At Risk	Yes	**Along RoW:** Within or along the edges of wetlands (Stantec, 2011). -WL24 (north of Lily Lake) **Outside RoW**: Within or along the edges of wetlands (Stantec, 2011). -WL4 (west of 102) -WL118 (west of Akerley Blvd and just west of RoW) -WL11 and WL77 (north of Anderson Lake)	**Provincial distribution:** Throughout the province. **Habitat:** Low ground, damp woods and swamps. **Vulnerability:** Direct disturbance or alteration of hydrology.	Low
Large St. John's-wort	*Hypericum majus*	S2/ Sensitive	No	**Outside RoW**: Wetland WL23 - north of the Duke St. (Stantec, 2011).	**Provincial distribution:** Halifax and Big Baddeck areas. Nearest ACCDC record approximately 9 km away. **Habitat:** Perennial herb of wet or dry, open soil. In other parts of its range, large St. John's-wort habitat related to periodic water inundation. **Vulnerability:** Direct disturbance, invasive species or alteration of hydrology. **Observation Description:** > 35 plants in a 1-2 m radius along a rocky track and a couple individuals approximately 30 m away. Anthropogenic wetland site of historical quarrying activities. Bedrock at or near the surface with fluctuating water levels - completely inundated following precipitation events early in the growing season but complete absence of surface water during drier periods of the summer. Potentially sensitive to invasion by purple loosestrife (*Lythrum salicaria*)	Not likely

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Locations	Background [2]	Potential for Additional Occurrence in Project Area
					which were very common throughout portions of WL23.	
Mountain sandwort (Greenland stitch-wort)	*Minuartia groenland-ica*	S3/ Sensitive	**Yes**	**Along RoW:** Exposed bedrock south of WL-2013-24.	**Provincial distribution:** Subarctic species mostly known in Nova Scotia in rocky coast areas. **Habitat:** Granite ledges, open rock barrens, gravel, wind-swept areas. **Vulnerability:** At southern limit of range; likely restricted to severe habitats by competition from other plants; tolerant of moderate disturbance. **Observation Description:** Associated with small isolated areas along the exposed bedrock ridges east of Rocky Lake Drive. **Comment:** Small and inconspicuous.	Low
Blood milkwort	*Polygala sanguinea*	S3/ Sensitive	No	**Outside RoW**: Wetland WL23 (north of Duke St.).	**Provincial distribution:** Throughout the province **Habitat:** Annual herb associated with a variety of habitats, including poor or acidic fields, damp slopes, and open woods or brush. Nearest ACCDC record approximately nine kilometers away. **Vulnerability:** Direct disturbance or alteration of hydrology. **Observation Description:** Several hundred stems distributed amongst two patches along wetland edge. Although not typically associated with wetland habitat, the surficial geology of WL23 is comprised of bedrock (a result of past quarry practices) which results in the area experiencing periods of both inundation and dryness throughout the growing season.	Not likely
Cursed buttercup	*Ranunculus sceleratus*	S1S2/May be at risk	No	**Along RoW:** WL25 (Lily Lake). **Outside RoW**: Wetlands WL20 (northeast of Duke St.) (Note: Duke St. widening to southwest of existing lands).	**Provincial distribution:** Throughout the province **Habitat:** Cursed buttercup is known to occur in both freshwater and brackish habitats including marshes, ditches, and swampy meadows. Records indicate that it is scattered throughout Nova Scotia, including in the vicinity of the study area. **Vulnerability:** Direct disturbance or alteration of hydrology. **Observation Description:** 2011 observations - WL20 - Approximately 30 cursed plants encountered scattered throughout its extent and associated with both the exposed mud of the wetland's southern edge and inundated sections of	Low

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Locations	Background [2]	Potential for Additional Occurrence in Project Area
					its central and more northern portions. WL25 - Several occurrences.	
Boreal aster	*Symphyo-trichum boreale*	S2?/ Sensitive	No	**Outside RoW**: Wetland WL17 (western end of Rocky Lake).	**Provincial distribution:** Scattered throughout the province. Closest ACCDC recorded population approximately 76 km away. Although Stantec terrestrial ecologists have found boreal aster in various locations throughout HRM, much closer to the Project. **Habitat:** Associated with the gravelly soil of lake beaches, along streams and the edges of bogs. **Vulnerability:** Direct disturbance or alteration of hydrology.	Low

Note 1: Applicable Status Notes:
Status as of May 2017
S-rank - S1 Extremely rare in province; S2 Rare in the province; S3 Uncommon in the province; S4 Widespread, common and apparently secure in province; S5 Widespread, abundant and secure in the province. SNR Status not yet assessed.
General Status - "Sensitive" indicating they are potentially susceptible to human activities or natural events
"May be at Risk" or "At Risk" therefore considered here to be of high conservation concern within the province.
"Undetermined" indicating that there is currently insufficient data, information, or knowledge available to evaluate its status.
Note 2: Habitat and Distribution from Zinck 1998; Other occurrences from Stantec 2011.

4.2.13.4 Additional Priority Plant Species with Potential Habitat Identified in Project Area

Stantec (2011) evaluated priority species recorded within 100 km of the area and determined that the study area had potentially suitable habitat for coastal sweet pepperbush (*Clethra alnifolia* – SARA Special Concern, Schedule 1; NSESA Vulnerable) and prototype quillwort (*Isoetes prototypes* - SARA Special Concern, Schedule 1; NSESA Vulnerable). Consistent with the 2011 study area, neither species is likely to occur within the RoW; the pepperbush is easily identifiable throughout the growing season but was not encountered during field surveys. The quillworts were also not observed during the field surveys.

Boreal aster found in the general area in 2011 have potential habitat within the RoW. These plant species were not found during the 2013 to 2016 surveys within the RoW, and are considered have a low potential to occur based on surveys to date.

The potential for priority lichen and moss species was also evaluated. Mosses and lichens are found in specific micro-habitats. One non-vascular priority species, boreal felt lichen (*Erioderma pedicellatum* – COSEWIC/NSESA Endangered, SARA Sched. 1), has been recorded within the vicinity of the study area (approximately 14 km away). This foliose cyanolichen primarily grows on the trunks and branches of balsam fir within moist and mature forest stands (ECCC, 2014). Stantec (2011) obtained the results from a boreal felt lichen habitat model for the province (NSE 2008 for NTS 50K map sheets 11D12). The model is based on tree composition and maturity, distance from coastline, and proximity to peatlands. No areas of potential habitat for this species were identified within the study area. Potential habitat for this species was previously surveyed in the CFAD property in 2008 (Dillon 2008) where no plants were found. In addition, in the 2013 and 2014 field surveys, habitat for epiphytic lichen species of interest (such as boreal felt lichen, blue felt lichen, ghost antler and blistered tarpaper lichen and for the aquatic eastern waterfan) was examined, and no species of interest were observed. In general, the area has low lichen diversity, potentially due to the proximity to the urban area and associated air quality.

Of the mosses identified by ACCDC within 100 km of the study area: *Sphagnum wulfianum* (S5 /Sensitive*)*, *Paludella squarrosa* (S1? /Sensitive*)*, and *Timmia megapolitana* (S1S2/Sensitive); Stantec (2011) determined only *Sphagnum wulfianum* was considered to have potential to be found in the study area. Habitat potential is based on association with wetland habitats, particularly treed or shrub-dominated swamps. During the 2013 to 2016 field surveys, this plant was not observed and, based on the characteristics of habitat present, is considered unlikely.

4.2.13.5 Uncommon/Secure or Status Undetermined Plant Species Observed within RoW and Potential Habitat

Table 4-18 identifies additional plant species found in the general area that are listed as S3 (uncommon) but with secure populations in Nova Scotia or undetermined status. Two S3/Secure plant species were observed within the RoW; southern twayblade and Fernald's hay sedge. An S3S4/Secure species - Nova Scotia agaliniswas also observed. Additionally, a plant species with unknown distribution status (fleshy hawthorn) was also observed in the RoW.

Southern twayblade (S3/Secure) is one of Nova Scotia's Atlantic Coastal Plain Flora (ACPF). ACPF are a group of plants restricted to flat land along the coast from Florida to New Jersey, typically in wet habitats. In the United States, southern twayblade populations range from uncommon to rare. The population in Nova Scotia is disjunct or isolated from the New England population. The plant is inconspicuous, and only flowers during a short window so is less likely to be observed unless specifically targeted. Observations within the RoW were within wetland areas identified as typical habitat including:

- WL106 – Two locations in the Project footprint noted in 2014 totalling four plant stems;
- WL-2013-04 – One location at RoW edge noted in 2014 with two stems;
- WL-2014-01 – One location at RoW edge noted in 2014 with three stems;
- WL-2013-10 – One location in RoW noted in 2014 with two stems;
- WL-2013-21 - One location in RoW noted in 2014 with one stem;
- WL-2013-26 – One location in RoW noted in 2014 with one stem; and,
- WL-2013-27 – Two locations in RoW noted in 2014 totalling six plant stems.
- WL-2013-24 - Two locations in the RoW noted in 2014 totalling six plant stems.

Southern twayblade presence is variable from year to year, so there remains potential for this plant where habitat exists.

Nova Scotia agalinis (S3S4/Secure) is a small herb associated with moist sandy soil. A plant was found in 2011 in WL23 (outside of the RoW) and along the RoW at the connector off of Akerley Boulevard and at WL147 (Stantec, 2011). Seven plant occurrences in total were observed.

Fernald's hay sedge (S3/Secure) is a difficult to identify sedge of open, disturbed habitats (such as roadsides). Approximately 10 clumps of the sedge were observed scattered in a disturbed area in the southern end of the RoW at the connector to Akerley Boulevard.

Fleshy hawthorn (S3S4/Undetermined) was observed along the edge of WL25 in the vicinity of the proposed RoW at Lily Lake.

Potential Habitat for Secure Plant Species - During the 2013 late season plant surveys, potential habitat was identified for dwarf bilberry (*Vaccinium caespitosum* S3/Secure) in the rocky/bedrock substrates south of Anderson Lake. This small shrub flowers in late May to mid-June and was not observed by Stantec during their June 2011 surveys or during the June 2014 or 2016 surveys for this assessment. This species is considered unlikely to be present. An additional secure species – arrow-leaved violet (*Viola sagittata*, S3S4/Secure), was identified as having moderate potential for additional findings based on habitat present.

4.2.13.6 Other Plant Species and Communities of Interest

One additional plant species of interest and one plant community of interest were also observed.

Pale bog-moss (*Sphagnum strictum)* was observed in the vicinity of the RoW within the forest east of Rocky Lake Drive. Even though this species has an ACCDC status of S4S5/Secure, records indicate that it is a much rarer species. There have been less than ten records made for this moss in Nova Scotia. It is ranked S1 in New Brunswick where it has been found twice.

Table 4-18
Uncommon/Secure[1] or Status Undetermined Plant Species Identified within the Vicinity of RoW

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Locations	Background [2]	Potential for Additional Occurrence in Project Area
Nova Scotia agalinis (false-foxglove)	*Agalinis neoscotica*	S3S4/ Secure	No	**Along RoW**: off of Akerley Boulevard. access (Burnside), WL147 and north of RoW in Wetland WL23	**Provincial distribution:** Endemic to Nova Scotia; common throughout the province. ACCDC data does not include records of this species but it is known by Stantec botanists to be fairly common throughout the area (*e.g.*, it was commonly encountered during 2009 surveys along sections of Hwy 103 between Exits 5 and 6). **Habitat:** Small herb associated with moist, especially sandy soil (Gleason and Cronquist, 1991).	Low
Fernald's hay sedge	*Carex foenea*	S3/ Secure	No	**Along RoW**: Disturbed area off of Akerley Boulevard. access (Burnside)	**Provincial distribution:** Scattered throughout the province. Nearest ACCDC record approximately 14 km away. **Habitat:** Dry barrens and sandy areas; open, disturbed habitats, such as roadsides. **Observation Description:** Scattered with approximately 10 clumps identified. **Comment:** Sedge closely resembles other species and is difficult to identify while in the field therefore may be more abundant in the province than currently indicated.	Low
Fleshy hawthorn	*Crataegus succulenta*	S3S4/ UD	Possible	**Along RoW**: Wetland 25 (north end of Lily Lake).	**Provincial distribution:** Scattered throughout the province **Habitat:** Waste grounds and hedgerows. **Comment:** It is unknown whether or not these occurrences reflect its true distribution or habitat association. The lack of information for this species is likely attributable to challenges in its identification as species belonging to the genus *Crataegus* commonly hybridize.	Low
Variegated horsetail	*Equisetum variegatum*	S3/ Secure	No	**Outside RoW**: Wetland WL23 (north of Duke St.).	**Provincial distribution:** Common in habitat throughout the province. Nearest ACCDC record approximately 23 km away. **Habitat:** Stream banks, bogs, and wet thickets but also disturbed areas such as ditches. **Observation Description:** Dominant component of the vegetative cover in the wetland.	Low
Kalm's hawkweed	*Hieracium kalmii*	SU/ Undet.	No	**Outside RoW**: Disturbed area	**Provincial distribution:** Throughout the province including many locations in disturbed habitat in the vicinity of Halifax.	Low

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Locations	Background [2]	Potential for Additional Occurrence in Project Area
				north of the Duke St. area and south of Wetland WL23 (Stantec, 2011). Also in dredgate area of CFAD (Dillon, 2008).	**Habitat:** Roadsides, rough ground, clearings, and thickets; disturbed areas. **Vulnerability:** Direct plant/habitat removal. **Comment:** Uncertainty in status attributed to taxonomic changes and similarity to the common Canada hawkweed (*Hieracium canadense*).	
Southern twayblade	*Listera australis*	S3/ Secure	**Yes**	**Along RoW:** Wetlands: - WL106, - WL-2013-04 - WL-2014-01 (Wrights Brook) -WL-2013-10 -WL-2013-21 -WL-2013-24 -WL-2013-26 27 **Outside RoW**: Wetlands WL58, WL61, WL63, WL85 and WL93 (east of RoW and north of Anderson Lake).	**Provincial distribution:** Throughout the province. Nearest ACCDC records in the area are, approximately 17 km away and at least five other populations within 100 km. Stantec botanists have also encountered several other populations within the vicinity of the Project during recent surveys (*e.g.*, in wetlands along portions of Hwy 103 between exits 5 and 6). **Habitat:** Small orchid typically associated with the shaded sphagnum moss of bogs or treed swamps. **Vulnerability:** Direct disturbance or alteration of hydrology, nutrient status. **Observation Description:** Associated with mixed treed swamp, deciduous treed swamp, and tall shrub swamp habitats. Approximately ~20 plants were noted in 2013/14 along the RoW. Over 200 plants counted in 2011 outside the RoW - WL58 (61 stems), WL61 (6 stems), WL63 (51 stems), WL85 (10 stems), and WL93 (74 stems). **Comment:** Small and inconspicuous plant and only visible above ground for several weeks during early summer (mostly in June) prior to senescence, therefore may occur more frequently than current sources indicate.	Low
Highbush blueberry	*Vaccinium corymbosum*	S3S4/ Secure	No	**Outside RoW**: Wetland WL19 (north of Duke St. outside of widening area).	**Provincial distribution:** Common within southwestern parts of the province but scattered occurrences has been noted as far east as Halifax. **Habitat:** Variety including bogs, upland barrens, wet pastures, and lakeshores. **Observation Description:** Single occurrence in marginal basin swamp dominated by ericaceous shrubs.	Low

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Locations	Background [2]	Potential for Additional Occurrence in Project Area
Arrow-leaved violet	*Viola sagittata*	S3S4/ Secure	No	**Outside RoW**: Old gravel road north of Anderson Lake.	**Provincial distribution:** Southern half of the province. Nearest ACCDC record approximately 40 km away. However, populations of this species are known by Stantec botanists to occur in closer proximity (*e.g.,* it is known to occur in Point Pleasant Park, Halifax). **Habitat:** Variety including dry sterile woods, clearings, and fields.	Moderate

Note 1: Applicable Status Notes: Status as of May 2017. Note 2: Habitat and Distribution from Zinck 1998; Other occurrences from Stantec 2011.
S-rank - S1 Extremely rare in province; S2 Rare in the province; S3 Uncommon in the province; S4 Widespread, common and apparently secure in province; S5 Widespread, abundant and secure in the province. SNR Not yet assessed in province. SU Unrankable.
General Status - "Secure" population not at risk, UD "Undetermined" indicating that there is currently insufficient data, information, or knowledge available to evaluate its status.

A unique plant community is located to the west of the RoW (20T 0449408 4953606). Dominated by *Pinus banksiana* (S4/Secure), *Empetrum nigrum* (S5/Secure), *Vaccinium angustifolium* (S5/Secure) and *Cladonia* species this community is found growing on large expanses of exposed flat granite rock. This is also suitable habitat for mountain sandwort (as noted in the previous section) and several plants are found growing in cracks and accumulated humus. ACCDC has given a similar plant community; *Pinus banksiana/ Gaylussacia baccata/Empetrum nigrum/Cladina rangiferina* in New Brunswick, an S Rank of S1. *Sphagnum compactum* is also found in this community growing on the edge of the vegetation mats where it can benefit from moisture runoff. This species is found throughout North America and in Europe. In Nova Scotia, it is found on coastal headlands and less commonly in forested situations. ACCDC has given *S. compactum* a status of S5/Secure in Nova Scotia. Eleven collections are found in the Consortium of Bryophyte Herbaria (http://bryophyteportal.org/portal/) which suggests it may be less common.

Other bryophyte species observed include *Dicranum polysetum* (S5/Secure), *D.spurium* (S4?/Secure), *D.undulatum* (S5/Secure), *Gymnocolea inflata* (S5), *Bryum pseudotriquetrum* (S5/Secure), *Schistidium apocarpum* (S5/Secure), *Pohlia nutans* (S5/Secure), *Leucobryum glaucum* (S5/Secure) and *Andreaea rupestris* (S5/Secure) .

Trampling is a serious threat to many of the plant, lichen and bryophyte species found in this habitat. Despite close proximity to all-terrain vehicle and walking trails and a power corridor, at present, the plant community remains relatively undisturbed.

4.2.14 Migratory Birds, Priority Bird Species and Raptors

4.2.14.1 Description of Bird Survey Methodology

A variety of bird surveys have been conducted in the study area, including breeding and migratory assessment. During the breeding bird surveys, habitat types found within the study area were visited by birders experienced in conducting auditory breeding bird surveys. **Table 4-19** summarizes bird investigations conducted in the vicinity of the RoW.

Table 4-19
Summary of Field Investigations Relevant to Birds

Field Survey Location	Methodology	Field Survey Date	Reference
Proposed study area for alignment north of Anderson Lake – including current alignment from Akerley Boulevard to CN rail track and section east of Lily Lake to Bicentennial Highway	Breeding bird surveys – between 05:30 and 11:00, status following Maritime Atlas of Breeding Bird program	1992	Jacques Whitford (Stantec) 1992
CFAD property – wetlands along the powerline, Tributary to Anderson Lake, Anderson Lake shore and Wrights Brook area	Species recorded at representative sites.	October 3,4 2001	MGI 2002
CFAD property – Anderson Lake station, Wrights Brook wetland station	Migratory observation posts for 5 to 6 morning hours.	October 18, 31, November 19, December 5 2007; January 10 2008	Dillon 2008
Proposed study area for alignment north of Anderson Lake – including current alignment from Akerley Boulevard to CN rail track and section east of Lily Lake to Bicentennial Highway	Breeding bird surveys – between 05:30 and 11:00, status following Maritime Atlas of Breeding Bird program.	Breeding – June 6 and 8, 2011 Whip-poor-will/Nighthawk – July 13, 2011 Additional incidental	Stantec 2011

Field Survey Location	Methodology	Field Survey Date	Reference
		observations – May 13 to June 16, 2011	
CFAD property – Anderson Lake and pond stations, Wrights Brook wetland station, Connector area station	Day time visual counts for migratory, over-wintering and resident surveys, Jan. and Feb. dates owls surveyed – 3 hour evening survey with playback.	October 24, November 1, 21 December 11 2012 and January 14 2013, February 6 2013	Genivar 2013
Current alignment area focusing on Burnside to Lily Lake	Late summer migratory survey and habitat assessment; Breeding bird surveys (early morning point count and area searches and nocturnal survey).	September 10, 2013 May 15, 2014 (night), June 9, June 17 and June 24, 2014	This assessment
Current alignment area focusing on portion to the east of Anderson Lake and between Lily Lake and Anderson	Breeding bird surveys (early) morning point counts.	May 12, June 15, and June 16, 2016	This assessment

4.2.14.2 Summary of Birds

A wide variety of nesting bird habitat occurs within the Project RoW. The results of the applicable bird surveys conducted in the study area are provided in **Appendix G**. The Maritime Breeding Bird Atlas (http://www.mba-aom.ca/english/) identifies over 100 bird species which have been recorded within the two, 10 km x 10 km breeding bird atlas squares within which the study area is situated. These species along with their breeding status in the square and their provincial population status are listed in **Appendix G**. In terms of nesting species, the most abundant along the previous alignment (Stantec, 2011) were Ovenbirds, White-throated Sparrows, Common Yellowthroat, Black-and-White Warbler, American Robin, American Goldfinch, European Starling, Red-eyed Vireo, Hermit Thrush and Chestnut-sided Warbler. The previous breeding survey in 1992 (Stantec), also observed abundant Cedar Waxwing, Black-throated Green Warblers and Dark-eyed Juncos. Given common portions of the RoW and similar habitat, similar species are expected to be abundant along the current alignment.

As noted in previous studies (Stantec, 2011), the species composition is expected to reflect the abundance of hardwood and mixed wood forest in various age classes ranging from immature to mature stands. The relatively high numbers of American Goldfinches and European Starlings reflects the presence of developed areas (business/industrial parks) at either end of the alignment.

Overwintering birds include crows, ravens, blue jays, chickadees, and juncos as well as finches and ground sparrows (Genivar, 2013).

4.2.14.3 Priority Bird Species Findings

Table 4-20 summarizes the priority bird species observed during the avian surveys. **Table 4-21** highlights raptor species potentially observed as nests may be sensitive to noise disturbance. It was also noted that foraging hawk corridors occur along the shores of Anderson Lake and that tree duck nests may be found in the Lily Lake area.

Figure 4-7 provides locations of priority animal species identified for the general area.

Table 4-20
Priority Bird Species Identified within the Vicinity of the RoW

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Nesting Habitat in Project Area
Spotted Sandpiper	*Actitis macularius*	S3S4B/ Sensitive	No	**Outside RoW**: 2011 (Stantec) WL23 Probable breeder.	**Habitat:** Nest in herbaceous plant communities in riparian habitat and forage on river and lake shores. **Vulnerability:** Direct nest habitat disturbance or alteration of hydrology. **Observation Description:** Pair observed in 2011 along the shore of WL23. A single observation in 1992 occurred in disturbed habitat.	Not expected. Limited habitat potential and unlikely to be present.
Killdeer	*Charadrius vociferus*	S3B/ Sensitive	No	**Outside RoW**: 2011 (Stantec) Bedford Commons north of WL21 Probable breeder. Probable breeding habitat in Bedford Commons.	**Habitat:** Open disturbed areas such as gravel pits, agricultural land. **Vulnerability:** Direct disturbance of nests. **Observation Description:** Two records in 2011 in Bedford Commons. 1992 one observation, possibly in WL23 or WL125. Potential nesting habitat present in area, likely in Burnside as well as Bedford Commons.	Not expected.
Common Nighthawk	*Chordeiles minor*	Threatened Sched. 1 NSESA Threatened S2B/At risk	No (flyover)	**Outside RoW**: 2011 (Stantec) Flying over study area in July 2011 near WL28; several heard north of Anderson Lake. Likely not nesting at location. Potential nest habitat on exposed bedrock ridges.	**Habitat:** Nest on ground in open vegetation free habitats – recent burns, clear-cuts, rocky barrens/outcrops, peat bogs, lake shores, grasslands, urban gravel roofs. **Vulnerability:** Loss of insect food, loss of breeding habitat, climate change, predators. **Observation Description:** Recorded on 5 occasions in 2010/2011. Flying over in 1992 breeding survey. Possible nesting on roof structures in Burnside and Bedford Commons industrial areas.	Low potential on bedrock ridges and burnt over areas - such as along rock barrens along power line south of Anderson Lake.
Eastern Wood-Pewee	*Contopus virens*	COSEWIC Special Concern NSESA Vulnerable S3BS4B/	**Yes**	**Along RoW:** 2014 (Dillon) June 24 WL26, probable nester June 9 (5) between WL2013-22 and	**Habitat:** Deciduous or mixed wood forest often nesting in ornamentals, elms and associated with forest edge. **Vulnerability:** Direct nest disturbance. Fairly common in Nova Scotia, population declines elsewhere in Canada. **Observation Description:** 2014 observations probable nesters in RoW south of Lily Lake and adjacent RoW	Probable – good habitat throughout RoW in select habitat - shady broad leaved mature hardwoods.

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Nesting Habitat in Project Area
		Sensitive		24; probable nester **Outside RoW**: 2011 (Stantec) South of WL25, north of Anderson Lake.	along Wrights Brook wetlands north of Akerley Blvd. In 2011 recorded at 8 locations in mature hardwood forest in suitable nesting habitat – possible breeder. 1992 observations were associated with mature hardwood forest and deciduous treed swamp cover.	
Cape May Warbler	*Dendroica tigrina*	S2B/ Sensitive	No	**Along RoW:** 2011(Stantec) WL118; likely migratory, not nesting. **Outside RoW**: 2011 (Stantec) WL63; likely migratory, not nesting.	**Habitat:** Nests in mature coniferous forests. **Vulnerability:** Direct nest disturbance. **Observation Description:** Two individuals observed in 2011 in mature mixed wood cover (not typical habitat) and mature coniferous forest – likely migratory. None recorded in 1992. Possible breeder but unlikely nesting in area.	Unlikely nesting - very low potential around railway corridors.
Gray Catbird	*Dumetella carolinensis*	S3B/May be at risk	No	**Outside RoW**: 2011 (Stantec) WL23 Possible breeder.	**Habitat:** Associated with dense tall shrub thickets. **Vulnerability:** Loss of habitat due to maturation of abandoned farmland. **Observation Description:** Recorded on 2 occasions in 2010/2011, likely same bird. In alder and willow thicket around wetland edge. Also recorded in 1992.	Unlikely but possible nesting habitat along railway corridors at east and west ends of new RoW. Possible in alder thicket and willow edged wetlands.
Yellow-bellied Flycatcher	*Empidonax flaviventris*	S3S4B/ Sensitive	**Yes**	**Along RoW:** June 17, 2016: WL-2013-03 (1) June 16, 2016: WL-2013-24 (2) Pond south of Anderson Lake (1) 2014 (Dillon) June 24 WL2013-12,	**Habitat:** Variety of habitats including swamps and damp coniferous woods. **Vulnerability:** Direct nest disturbance or alteration of hydrology. **Observation Description:** 2014 multiple nesting observations along new RoW typically associated with wetlands. One observation in 2011 in mixed wood treed swamp providing potential nesting habitat; possible breeder. 5 observed in 1992 in mixed wood treed swamp and coniferous treed swamp cover. 9 observed in 2016 in	Possible nesting in more extensive wet areas.

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Nesting Habitat in Project Area
				WL2013-05, WL2013-13, WL2013-15, WL2013-18, WL2013-24, WL2013-25, WL2013-27, WL29, WL28, Anderson Lake Pond wetland Probable nesters. **Outside RoW**: June 17, 2016: Southeast of penitentiary (1) SW of WL118(2) S of WL-2013-01 (1) 2014 (Dillon) June 9 wetlands west of Burnside 2011 (Stantec) North of Anderson Lake and WL63.	mature mixed woods some of which were surrounding wetlands.	
Wilson's Snipe	*Gallinago delicata*	S3B/ Sensitive	No	Unknown.	**Habitat:** Nest in marshes, bogs and fens with grasses and sedges providing cover. **Vulnerability:** Direct nest disturbance or alteration of hydrology. **Observation Description:** No observations in 2011. Flight song heard in 1992, identified as possible breeder.	Unlikely.

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Nesting Habitat in Project Area
Common Loon	*Gavia immer*	Not at risk S4B,S4N/ May be at risk	No Possible nesting habitat	**Outside RoW**: Anderson Lake (Stantec, 1992, 2011; Genivar, 2013).	**Habitat:** Lake islands and fringing wetlands. **Vulnerability:** Disturbance/flooding of coastal nests. Indirect disturbance by boating/fishing. **Observation Description:** Individuals observed on Anderson and Rocky Lakes with no evidence of nesting. If nesting in area, likely on islands. Also flying over area in 1992. Probable occasional nesting along Anderson Lake shores outside of RoW.	Not expected in RoW.
Barn Swallow	*Hirundo rustica*	COSEWIC Threatened *NSESA* Endangered S2S3B/At risk	**Yes** (feeding)	**Along RoW:** 2014 (Dillon) June 24 WL25 feeding, nesting outside RoW **Outside RoW**: 2011 (Stantec) Bedford Commons; east of Duke St.	**Habitat:** Nest on manmade structures – buildings, culverts or rarely natural structures. **Vulnerability:** Direct nest disturbance. **Observation Description:** 2014 foraging observations in Lily Lake area, expected to be nesting outside RoW in Bedford Commons/Industrial Park. Four recorded in 2011 in Bedford Industrial Park. Buildings provided suitable nesting habitat. 18 recorded in 1992 in residential/disturbed areas.	Not expected in RoW.
Great Crested Flycatcher	*Myiarchus crinitus*	S1B/May be at risk	No	**Along RoW:** 2011 (Stantec) North of WL117. Possible (but un-common) breeder.	**Habitat:** Northern hardwoods; in NS often open woodlands and settled areas. **Vulnerability:** Population unknown. Rarely encountered in NS. **Observation Description:** Recorded at four locations on May 31, 2011; likely same bird. In mature hardwood forest and mixed wood treed swamp. Not encountered in 1992 survey.	Unlikely. Possible in good mature hardwood areas near Anderson Lake (particularly red oak and large maple dominated areas).
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	S2S3B/ Sensitive	No	**Outside RoW**:??? June 17, 2016: SW of WL118 (1) S of WL-2013-01 (1) 2014 (Dillon) June 17 WL126 2011 (Stantec)	**Habitat:** Nests in open deciduous forest with well developed shrub understory, often near waterbodies or wetlands. **Vulnerability:** Direct nest disturbance, fairly common in Nova Scotia, major population declines elsewhere in Canada. **Observation Description:** 2014 observation associated with Wrights Brook wetlands north of Akerley Blvd. One	Possible in Lily Lake area (particularly on east side).

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Nesting Habitat in Project Area
				Near WL20.	observation in 2011 of a possible breeder occurred in mature hardwood forest. None recorded in 1992. 2 observed in 2016 in mixed wood forests surrounding a wetland, consisting of both mature and regeneration trees.	
Black-backed Wood-pecker	*Picoides arcticus*	S3S4/ Sensitive	No	**Outside RoW**: 2011 (Stantec) WL66 (north of Anderson Lake).	**Habitat:** Mature softwood stands and burnt areas with dead trees. **Vulnerability:** Direct nest disturbance. **Observation Description:** One observed in 2011 foraging in mixedwood treed swamp. None observed in 1992.	Unlikely but possible in habitat.
Boreal Chickadee	*Poecile hudsonica*	S3/ Sensitive	No	**Outside RoW**: 1992 location unknown. 2012 observation at CFAD (south of Wrights Brook).	**Habitat:** Mature coniferous forests key winter and nest habitat. **Vulnerability:** Direct nest disturbance. **Observation Description:** Not observed in 2011. Five individuals observed in 1992 on mixedwood treed swamp and coniferous treed swamp (locations not recorded)	Possible nester in low numbers in conifers south and east of Anderson Lake.
Gray Jay	*Perisoreus canadensis*	S3/ Sensitive	No	**Outside RoW**: Unknown (JWEL, 1992) and along Anderson Lake access road (Genivar, 2013).	**Habitat:** Mature coniferous forest. **Vulnerability:** Direct nest disturbance. **Observation Description:** Not observed in 2011. One observation in 1992 in mature mixedwood forest during BBS; location not recorded. Other observation in January 2013 at CFAD.	Possible nester in low numbers in conifers south and east of Anderson Lake.
Ruby-crowned Kinglet	*Regulus calendula*	S3S4B/ Sensitive	**Yes**	**Along RoW:** May 12, 2016: Anderson Lake Powerline (3) Rocky Lake Powerline (4) 2014 (Dillon) June 17 WL2013-03 Probably nester **Outside RoW**: June 16, 2016: Anderson Lake (1) June 17, 2016:	**Habitat:** Mixedwood and coniferous forest cover. **Vulnerability:** Fairly common in province, status due to long-term concern. Direct nest disturbance. **Observation Description:** 2014 nesting observation along RoW wetland west of Burnside CN line. 2011 observations in mature mixedwood forest, mixedwood treed swamp and mature softwood forest. Possible breeder. 1992 observations were in immature hardwood forest, mature mixedwood forest, mature softwood forest, open mature mixedwood forest, deciduous treed swamp and mixedwood treed swamp. 9 observed in 2016, mostly in wooded or disturbed areas with the exception of one bird observed near WL-2013-01.	Probable in spruce dominated wetlands.

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Nesting Habitat in Project Area
				South of WL-2013-01 (1) 2011 (Stantec) Conifer forest and wetlands north of Anderson Lake.		
Golden-crowned Kinglet	*Regulus satrapa*	S5/ Sensitive	**Yes**	**Along RoW:** June 17, 2016: WL-2013-03 (2) May 12, 2016 Anderson Lake Powerline (1) **Outside RoW**: June 17, 2014 WL120, WL118 Conifer forest and wetlands north of Anderson Lake (Stantec, 2011). Coniferous forest along Anderson Lake access road (Genivar, 2013).	**Habitat:** Year round residents of dense coniferous stands. **Vulnerability:** Fairly common in province, status due to long-term concern. Direct nest disturbance. **Observation Description:** 2014 nesting observations in RoW wetlands along Wrights Brook west of Burnside. 2011 observations within mature coniferous forest, mature mixedwood forest and mixed wood treed swamp. Possible breeder. Other observations in Nov. 2012. 3 observed in 2016 to the south and east of Anderson Lake.	Probable nesting throughout corridor in habitat.
Bank Swallow	*Riparia riparia*	COSEWIC Threatened S2S3B/ May be at risk	Unknown Nesting unlikely	JWEL (1992) Unknown possibly Burnside of Bedford Industrial Park.	**Habitat:** Nest in steep embankments along eroding river/ocean shore. Forage in open areas. **Vulnerability:** Direct nest disturbance. **Observation Description:** 6 foraging birds in disturbed/residential area recorded in 1992. Possible in low numbers within Industrial areas and adjacent gravel pits.	Not expected.
Common Tern	*Sterna hirundo*	S3B/ Sensitive	No (flyover) Foraging only	**Inside RoW:** May 12, 2016: Anderson Lake (3) Anderson Lake Powerline (1)	**Habitat:** Nests on coastal islands, sand spits and salt marshes, occasionally islands on lakes. Forage in coastal areas and freshwater. **Vulnerability:** Primarily nest predation. **Observation Description:** Observations foraging over	Not expected.

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Nesting Habitat in Project Area
				Rocky Lake/Duke Street Intersection (1) **Outside RoW**: June 16, 2016: Anderson Lake (1) 2014 (Dillon) June 24 Flyover Lily Lake. WL25/Lily Lake (Stantec, 2011) CFAD (Genivar, 2013) Known colony in Wrights Cove on Bedford Basin (3-5 km to southeast).	Lily Lake in 2011 and 2014. Not observed in 1992. Suitable nesting habitat not in ROW. Limited potential for nest in Anderson Lake, likely forage throughout. In 2016, observed in the vicinity of Anderson Lake and Lily Lake.	
Tree Swallow	*Tachycineta bicolor*	S4B/ Sensitive	No	**Along RoW:** 2014 (Dillon) June 17 WL125 June 24 & 2011 (Stantec) WL25 2011 (Stantec) WL21, WL120, WL125 Confirmed nesters June 17, 2014 WL131 2011 (Stantec) **Outside RoW**: Wetland WL23; along Rocky Lake Drive	**Habitat:** Nest in unoccupied woodpecker holes and nest boxes often near open water feeding areas. **Vulnerability:** Direct nest disturbance. **Observation Description:** 2014 observations foraging but in area of potential nesting habitat near wetlands along RoW west of Burnside and Lily Lake. Primarily foraging over lakes and wetlands with open water in 2011. One observation of probable nest visit. 1992 observations associated with disturbed and residential areas.	Probable in wetlands at east and west ends of area.

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Nesting Habitat in Project Area
Tennessee Warbler	*Vermivora peregrina*	S3S4B/ Sensitive	**Yes**	**Along RoW:** June 17, 2016: South of WL-2013-01 (2) WL-2013-12 (2) **Outside RoW**: June 16, 2016: WL-2014-15 (1) WL-2013-22 (1) June 17, 2014: WL-2013-12 (2) WL118 2011 (Stantec) WL23 and north of Anderson Lake.	**Habitat:** Nest in thickets of small deciduous trees and shrubs in coniferous forest. **Vulnerability:** Direct disturbance or alteration of hydrology. **Observation Description:** 2014 observation in Wrights Brook wetlands west of Burnside, possibly nesting. Observed in 2011 outside RoW in immature deciduous treed swamp, mature mixed wood forest and tall shrub swamp. None of the observations were within good nesting habitat. One observation in immature hardwood forest occurred in 1992 (location not recorded). 2016 observations were in mixed wood forests surrounding wetlands.	Possible occasionally along railway corridors and in mature tamarack .
Canada Warbler	*Wilsonia Canadensis*	Threatened Sched. 1 *NSESA* Endangered S3B/At risk	**Yes**	**Along RoW:** 2014 (Dillon) June 9: WL-2013-12 (2) WL-2013--24 (1) WL-2013-10 (2) Jun 17, 2014: WL-2013-03 (2) WL111 (1) June 24: WL-2013-12 (2) WL-2013-21 (1) 2011 (Stantec): WL115 **Outside RoW**: June 17, 2016: WL-2013-12 (1) 2014 (Dillon) June 17: Wrights	**Provincial distribution:** Widely distributed in the province. **Habitat:** Nesting - forested area with open tree canopy, dense understory and structurally complex floor; often treed swamp with dense shrub understory; wetlands with sphagnum. **Vulnerability:** Direct disturbance or alteration of hydrology. **Observation Description:** In 2014, 11 probably nesting individuals observed in wetlands along the new RoW, typically treed swamps. Approximately 18 pairs estimated in 2011 breeding survey along a route north of Anderson Lake, in or associated with wetlands (mostly mixed wood treed swamp or deciduous treed swamp but also tall shrub swamp and immature hardwood forest). Also observed in 1992 breeding survey in mixed wood treed swamp, open mature mixed wood forest and mature hardwood. In 2016, one observation was made of an individual in a distance wetland while along the powerline; while the location of the survey was along the	Low potential in RoW wetlands not already identified as nesting habitat.

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Nesting Habitat in Project Area
				Brook wetland west of Burnside (1). 2011 (Stantec): WL17, wetlands north of Anderson Lake, WL148	RoW, the individual observed was greater than 100 m away in the section of WL-2013-12 that is outside of the RoW.	
Pine Siskin	*Carduelis pinus*	S2S3 / Sensitive	**Yes**	**Along RoW:** May 12, 2016 Anderson Lake Powerline (1), Rocky Lake and Duke St. intersection (1) **Outside RoW**: June 16, 2016: WL-2014-14 (1) 2014 (Dillon) June 17: WL118 potential migrantWL122 potential migrant	**Habitat:** Nests in coniferous forest areas. **Vulnerability:** Recent Nova Scotia population decline. Vagrant in southern portion of breeding range related to winter food availability – cones. **Observation Description:** One observed at each location in 2014 and in 2016. Likely foraging.	Limited nesting potential.

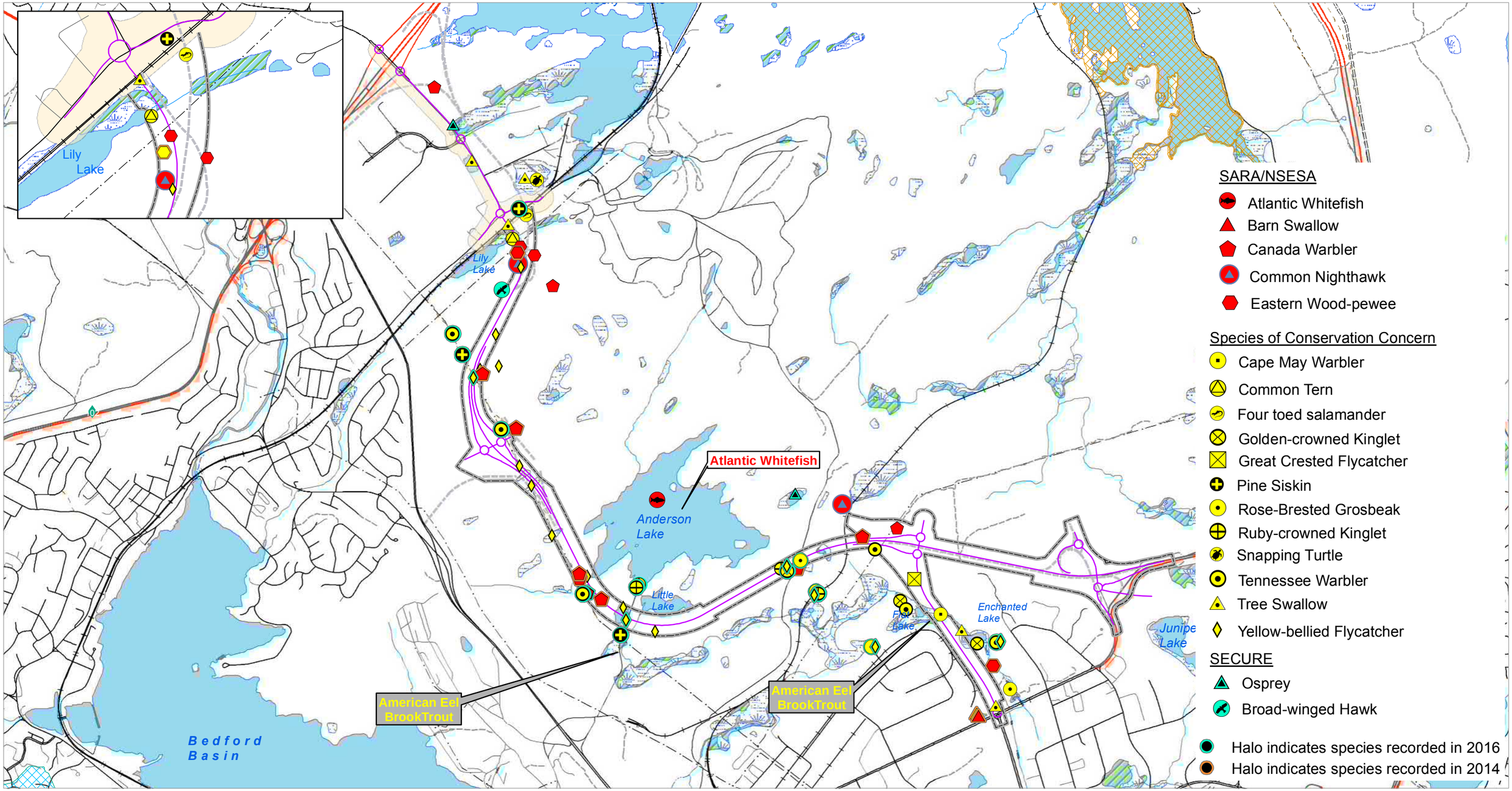
1. Sched. under SARA – Species at Risk Act*;* NSESA – Nova Scotia Endangered Species Act Legally Listed Species; COSEWIC - Committee on the Status of Endangered Wildlife in Canada assessed species Endangered; Threatened/Vulnerable: A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction; Special Concern: Sensitive but not endangered or threatened.
   Status (as of May 2017) S-rank - S1 Extremely rare in province; S2 Rare in the province; S3 Uncommon in the province; S4 Widespread, common and apparently secure in province; S5 Widespread, abundant and secure in the province. B Breeding; N Non breeding;? Unconfirmed.
   General Status - "Sensitive" indicating they are potentially susceptible to human activities or natural events; "May be at Risk" therefore considered here to be of high conservation concern within the province; "Undetermined" indicating that there is currently insufficient data, information, or knowledge available to evaluate its status.
2. Stantec 2011

Table 4-21
Raptors Identified within the Vicinity of RoW

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Habitat along Project Area
Saw-whet Owl	*Aegolius acadicus*	S4B/ Secure	No	Heard in general area (2013), likely not in RoW.	**Habitat:** Nest in cavity trees. **Observation Description:** Habitat observed in 2013 fall survey.	Potential for nest in mature forested area; forage throughout.
Great Horned Owl	*Bubo virginianus*	S4/ Secure	No	**Outside RoW**: Approx. 200 m south of ROW along Anderson Lake access road (Pewter Lane) and north of Little Lake (2012).	**Habitat:** Nest in crows nests. **Observation Description:** Owl presumed GHO in flight over access road observed during February 2012 night survey and north of Little Lake observed in October 2012.	Potential for nest in mature forested area; forage throughout.
Broad-winged Hawk	*Buteo platypterus*	S5B/Secure	**Yes**	**Along RoW:** May 12, 2016 Rocky Lake Powerline (2) 2014 (Dillon) June 24 nesting east of Lily Lake **Outside RoW**: Between Highway 102 and Rocky Lake; near Lily Lake (Stantec, 2011).	**Habitat:** Nest in woodland trees. **Observation Description:** 2014 nesting bird observed foraging in area east of Lily Lake. Agitated bird observed in 2011 and 1992 but no nest found. Probable breeder.	Potential for nest in mature forested area; forage throughout.
Bald Eagle	*Haliaeetus leucocephalus*	S5/ Secure	No (flyover)	**Outside RoW**: Old nest on north side of Anderson Lake (2013).	**Habitat:** Nest on large, tall trees or structures. **Observation Description:** 2014 flyover. Nest observed, inactive.	Potential for nest in mature forested area; forage throughout.
Osprey	*Pandion haliaetus*	S4B/ Secure	No (flyover)	**Along RoW:** June 16, 2016 Duke St northwest of Drysdale Avenue (1) May 12, 2016 Anderson Lake Powerline (2)	**Habitat:** Nest on tall trees or structures. **Observation Description:** 2014 flyover observations. Nest observed in 2011on power-pole at intersection of Duke St. and Damascus Road, with nearby nest observation in 1992.	Potential for nest in mature forested area; forage throughout.

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Habitat along Project Area
				Outside RoW: June 17, 2016 South of WL-2013-01 (1) 2011 (Stantec) Bedford Commons area; north of Anderson Lake.		
Barred Owl	*Strix varia*	S5/ Secure	No	Heard in general area (2013), likely not in RoW. May 24, 2014	**Habitat:** Nests in hardwood and mixed forest, large hollow tree or nest box. **Observation Description:** Habitat observed in 2013 fall survey.	Potential for nest in mature forested area; forage throughout.

1 Status (as of May 2017):
S-rank - S3 Uncommon in the province; S4 Widespread, common and apparently secure in province; S5 Secure - Widespread, and abundant in the province. SNR Not yet assessed in province.
General Status - "Secure" population not at risk.
"Undetermined" indicating that there is currently insufficient data, information, or knowledge available to evaluate its status.



Nova Scotia Transportation and Infrastructure Renewal

HIGHWAY 107 BURNSIDE TO BEDFORD ENVIRONMENTAL ASSESSMENT

FIGURE 4 -7
PRIORITY ANIMAL SPECIES

NOVA SCOTIA

PROPOSED HIGHWAY 107 ALIGNMENT
HIGHWAY
OTHER ROAD
WATERCOURSE
APPROXIMATE RIGHT OF WAY STUDY AREA (AS PER NSTIR MAY 2017)
BUFFERED CENTRELINE STUDY AREA (75 M)
OPEN WATER
WETLAND (TOPOGRAPHIC DATABASE)
WETLAND (NSDNR DATABSE)
OTHER HABITAT
SPECIES OF CONCERN

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNR

MAP CREATED BY: SCM
MAP CHECKED BY: KLM
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 125 250 500 750 Metres

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FINAL

PROJECT: 13-8348

Date: Jun 28 2017

4.2.14.4 Priority Birds Observed within the RoW

As noted in **Table 4-18** above, the following COSEWIC/SARA/NSESA listed birds were observed along the RoW:

- Eastern Wood Pewee – nesting
- Barn Swallow – foraging
- Canada Warbler – nesting

Also as noted in **Table 4-18** above, the following priority birds identified as sensitive in Nova Scotia were observed along the RoW:

- Cape May Warbler – likely migrant
- Yellow-bellied Flycatcher – nesting
- Great-crested Flycatcher – likely migrant
- Golden-crowned Kinglet – nesting
- Ruby-crowned Kinglet – nesting
- Tree Swallow – nesting
- Tennessee Warbler – possibly nesting
- Pine Siskin - likely migrant

4.2.14.5 Additional Priority Bird Species with Potential Habitat in Vicinity of RoW

Potential priority bird species identified in the short-list (**Appendix C**) based on a review of ACCDC and Maritime Breeding Bird Atlas records. In addition to priority bird species having been observed in the area, some of these short-listed species although not observed to date also had potentially suitable nesting habitat identified within the Project area.

A number of short-listed priority bird species were identified as having potential to occur in areas along the Project RoW. In addition to current observations (Stantec, 2011), American Bittern, Black-billed Cuckoo, Eastern Phoebe, Wilson's Warbler, Bay-breasted Warbler, Chimney Swift, Cliff Swallow, Baltimore Oriole, Olive-sided Flycatcher, Pine Grosbeak, Pine Siskin, Rusty Blackbird, and Whip-poor-will, and Pine Siskin were noted in the area. Assessment of potential for the other birds in the area is consistent with the 2011 conclusions.

American Bittern, Olive-sided Flycatcher, Rusty Blackbird, and Wilson's Warbler typically nest in wetlands. Wetlands within the 2011 alignment area were searched on at least two occasions, and most of the larger wetlands were visited three to four times. Wetlands within the new RoW area were also visited during the 2014 nesting season and these species not observed. It is unlikely that these species would have escaped detection. The potential for nesting habitat for these species is unlikely.

Bay-breasted Warbler and Pine Grosbeaks nest in coniferous forest. Limited areas of suitable coniferous forest are located south of Little Lake. These species were not observed in 2014 or 2016 breeding bird surveys and are unlikely to nest in the area. If present in the general area it is expected that there are low numbers.

Cliff Swallows nest in large colonies on buildings. Potential habitat would be in the Burnside and Bedford common areas, though , none were observed. They are quite conspicuous around their colony sites and would be easily detected.

Baltimore Orioles, Black-billed Cuckoos and Eastern Phoebes nest near the edges of deciduous and mixedwood forest. Edges of this type are present at the eastern and western ends of the Project area with the best habitat present near Lily Lake which were well surveyed in the 2011 breeding assessments (Stantec, 2011), in 2014, and again in 2016. These species are readily identifiable by song, and this area was visited by Stantec birders on at least four occasions, and they determined it is unlikely that these species were nesting in the Project area.

Chimney Swifts nest either in large masonry chimneys or large hollow trees. No suitable chimneys are present in the Project area. Large living trees and snags (mostly white pines) are scattered throughout the area, some of which may be hollow; consequently, there is some potential for Chimney Swifts to nest in the area. Chimney Swifts are highly vocal when they forage and spend much of their time flying above the tree canopy. As such, they are readily detected when present. No Chimney Swifts were observed in 2011 or 2013/2014 or 2016 bird surveys.

Whip-poor-wills nest in dry hardwood and mixed wood forest. This species has previously been recorded near the eastern Burnside area. Burnside was developed several decades ago, and Whip-poor-wills have not been recorded in this area since then. Whip-poor-wills are nocturnal and can be overlooked since they are inactive during the period when breeding bird surveys are conducted. This species is quite vocal, and its calls carry long distances. Periods of heavy vocalization occur just after dusk and just before dawn. To detect Whip-poor-wills in the Burnside area, a nocturnal survey was conducted on July 13, 2011 to listen for this species (Stantec, 2011). Nocturnal bird surveys were also conducted on May 15 2014. No Whip-poor-wills were detected during the surveys.

Willow Flycatchers are typically found in tall shrub thickets associated with open water bodies. The area most likely to support Willow Flycatchers was Wetland WL23 which is outside of the current RoW. This wetland contains a large shallow pond that is surrounded by tall shrub thickets dominated by alders and willows. Willow Flycatchers are difficult to distinguish visually from other *Empidonax* flycatchers but can be readily differentiated by their song and call notes. This area was visited by Stantec for breeding bird surveys (2011 and 1992), during the wetland surveys by biologists familiar with the song of this species, and during the breeding season when Willow Flycatchers would be singing. It was not encountered during these surveys.

Additional priority bird species identified as having some potential for nesting habitat in the Project area include:

- Rose-breasted Grosbeak;
- Black-backed Woodpecker;
- Boreal Chickadee; and
- Gray Jay.

4.2.15 Priority Terrestrial Wildlife (excluding Migratory Birds)

4.2.15.1 Description of Priority Terrestrial Wildlife Methodology

The assessment of wildlife, as with plants, focused on potential priority species. **Appendix C** lists the potential at-risk animal "short-listed" for the study area, their likely habitat, preferred investigation period, and priority status. Animal data was primarily obtained through existing data compilation (including previous alignment investigations – Stantec, 2011), assessment of habitat requirements and observations incidental to other field surveys. Priority species identified, were located using a handheld GPS.

Table 4-22 identifies investigations in the study area.

Table 4-22
Summary of Field Investigations Relevant to Priority Terrestrial Animal Species

Field Survey Location	Methodology	Field Survey Date	Reference
Proposed alignment north of Anderson Lake – including current alignment from Akerley Boulevard to CN rail track and section east of Lily Lake to Bicentennial Highway – Limited survey of habitat types	Incidental observations	1991	P. Lane 1991
CFAD property – Limited survey including current study area sites along Wrights Brook, Anderson Lake, pond, gravel access road and powerlines	Incidental observations	September 2000	Dillon 2001
CFAD property – Limited survey including current study area sites along Wrights Brook, Anderson Lake, pond, gravel access road and powerlines	Incidental observations	October 2001	MGI 2002
CFAD property – Coniferous forest areas, edges of Anderson and Little Lakes	Incidental observations	September 2007	Dillon 2008
Proposed alignment north of Anderson Lake – including current alignment from Akerley Boulevard to CN rail track and section east of Lily Lake to Bicentennial Highway	Incidental observations	September 2010; May – July 2011	Stantec 2011
CFAD property – representative habitats	Incidental observations	Between October 30 and December 13, 2012	Genivar 2013
Current alignment area focusing on Burnside CN rail to Lily Lake and new roundabouts	Incidental observations	September and October 2013; May and June 2014	This assessment
Alternate alignment area investigation west of CFAD	Incidental observations	August 11-13, 2014	This assessment
Alignment from Akerley Boulevard to Hwy 102	Incidental observations	May 12, June 2-3, and, June 15-16, 2016	This assessment

4.2.15.2 Summary of Wildlife

The mammal species in the study area are a mixture of species characteristic of forest and wetland habitats. Species considered secure in the province observed (or signs of) during the field surveys within the Project area included white-tailed deer, eastern coyote, red fox, American red squirrel, eastern chipmunk, snowshoe hare, American beaver and North American porcupine. In addition, species recorded during Stantec (2011) and CFAD (Dillon, 2008, Genivar, 2013) assessments of portions of the Project area may be expected and include: cinereus shrew, meadow jumping mouse, meadow vole, red-backed vole, muskrat, woodchuck, bobcat, American black bear, northern raccoon, mink and short-tailed weasel.

Observations of herpetiles (amphibians and reptiles) occurred during the fish habitat and wetland surveys. Common species observed in the vicinity included yellow spotted salamander, redback salamander, northern leopard frog, pickerel frog, green frog, bullfrog, wood frog, northern spring peeper, American

toad, common garter snake and redbelly snake (Stantec, 2011). A ring-necked snake juvenile was found along the Anderson Lake access road in 2013 investigations and is expected in habitat throughout the area.

Appendix H provides wildlife observation data.

4.2.15.3 Priority Terrestrial Wildlife (Excluding Birds) Findings

Priority wildlife (excluding birds) observed in the vicinity are summarized below in **Table 4-23. Table 4-24** identifies uncommon wildlife observed. **Figure 4-7** locates priority animal findings.

Although bat species were observed (and recorded) in the vicinity of the pond south of Anderson Lake, the most likely species have similar calls and the exact species is unconfirmed. The little brown myotis was once the most common bat in Nova Scotia and likely was the species observed in the Project area. Northern myotis are also fairly common. Both species typically forage in forested areas. Tri-coloured bats are less common and less likely to be present in the Halifax area. Tri-coloured bats use rivers and streams for feeding. Based on distribution and habitat preference, the tri-colored bat has the lowest potential to occur in the area. The general area provides suitable summer roosting and foraging habitat for bats. It is likely that the myotis species use the general area, and possible, that the tri-colored bats occasionally occur in the summer as well.

All three species are listed under SARA Schedule 1 and NSESA as Endangered, due to drastic population declines caused by a disease known as white-nose syndrome (a fungal infection of *Geomyces destructans*). This disease severely affects all bat species that congregate in caves and abandoned mine shafts for winter hibernation and has recently devastated bat populations in eastern North America.

Aside from white-nose syndrome, the bats are considered sensitive within their hibernating areas to disturbance during the late fall to early spring congregation period. Stantec (2011) investigated the potential for hibernating sites in the area and determined that the geology of the area does not support cave development, and that mine shafts are unlikely near the proposed Project. Stantec conducted a review of the abandoned mine opening database (NSDNR, 2008) which did not reveal the presence of any known abandoned mine shafts in the general area that could be used as hibernacula. The nearest abandoned mine shaft is located approximately 1.7 km east in Lower Sackville. This tungsten mine has been filled in and would not provide hibernation habitat for bats. Large numbers of mine shafts are present in Waverley approximately 3.7 km to the northeast. Gold and tungsten were mined in these shafts. Similarly, there is a large cluster of gold mine shafts at Montague (Fall River) approximately 4.8 km to the northeast of the Project. Most of these shafts have been plugged but some may be un-flooded and still accessible by bats and may provide suitable hibernation sites. Both of the gold mining areas are found in heavily populated areas with high levels of human activity.

Sensitivity to disturbance is reduced when the bats leave wintering areas and become widely distributed throughout the province. Distribution tends to be patchy reflecting favourable habitat conditions (particularly available insect food sources). Summer roosting habitat includes cavity trees and commonly buildings. Maternal colonies may be established near a good food supply (typically near water or wetlands). Male roosting sites consist of any suitable hiding place such as under tree bark or nooks in buildings. Bats leave summer sites by fall and head to hibernation. Thus they may be observed on-route in the fall and spring.

Table 4-23
Priority Terrestrial Animal (excluding birds) Species Identified within the Vicinity of the RoW

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Habitat in Project Area
Snapping turtle	*Chelydra serpentina*	Special Concern Sched. 1 NSESA Vulnerable S3/Sensitive	No	**Outside RoW**: Wetland WL23	**Habitat:** Nest in gravel areas near permanent water bodies during last half of June to first two weeks in July. **Vulnerability:** Due to longevity and low fecundity; susceptible loss of adults (vehicles, predation) as well as nest predation/loss. **Observation Description:** One large snapping turtle observed June 8, 2011, in shallow water in WL23. It was considered likely that the primary habitat is the nearby Rocky Lake and the turtle may have been looking for nesting habitat in the disturbed areas (Stantec, 2011).	Lily Lake
Little Brown Myotis; Northern Myotis; Tri-coloured Bat (Eastern Pipistrelle)	*Myotis lucifugus/ Myotis septentrionalis /Pipistrellus subflavus*	Endangered Sched. 1 NSESA Endangered S1/At Risk	**Yes**	**In RoW:** Foraging in vicinity of unnamed pond south of Anderson Lake	**Habitat:** Variety of foraging habitats; no hibernacula known. **Vulnerability:** Provincial vulnerability due to White Nose Syndrome. Most susceptible to disturbance at or loss of hibernation areas. **Observation Description:** A bat of unconfirmed species was observed north of the RoW on July 13, 2011. Most likely Little Brown as most abundant species. (Stantec, 2011). Bats were also recorded during September 2013 surveys foraging in pond/wetland area south of Anderson Lake (**Appendix H**).	Expected to forage throughout the area

1. Status notes (as of May 2017):
   S-rank –S1 Extremely rare in province; S2 Rare in the province; S3 Uncommon in the province; S4 Widespread, common and apparently secure in province; S5 Widespread, abundant and secure in the province. SNR Not yet assessed in province.
   General Status - "Secure" population not at risk.
   "Undetermined" indicating that there is currently insufficient data, information, or knowledge available to evaluate its status.
2. Stantec 2011 or as noted.

4.2.15.4 Additional Priority Terrestrial Animal Species with Potential Habitat in Vicinity of RoW

Potential priority animal species are identified in the short-list (**Appendix C**) based on review of ACCDC records. No additional priority terrestrial animal species are expected to rely on habitat within the Project area.

Although wood turtles (Sched. 1/NSESA Threatened) have been recorded in the general area and may travel widely, the preferred intervale forest and stream/river gravel nesting areas are not present.

The monarch butterfly (Special Concern) is expected to migrate through the Halifax area on the way to breeding and wintering grounds; the area is not expected to provide key habitat.

There have been numerous records of mainland moose passing through the general area. However, the area is not anticipated to provide key moose habitat or sustain a local population.

4.2.15.5 Other Uncommon Animal Species

An additional herptile was identified by Stantec (2011) in the general area and has potential to occur in other wetlands in the area. This finding is summarized in **Table 4-24** below.

Table 4-24
Uncommon Animal Species Identified within the Vicinity of RoW

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Habitat along Project Area
Four-toed salamander	*Hemidactylium scutatum*	S3/ Secure	No	**Outside RoW**: Wetland WL24	**Habitat:** Bogs and swamps and surrounding forest habitats. Females nest in sphagnum moss hummocks in semi-permanent or permanent soft bottomed ponds or slow flowing streams adjacent to sphagnum. At other times of the year occur under stones, logs or other cover in the forest. **Comment:** Cryptic species difficult to observe and probably more widely distributed than records indicate. Previous findings have occurred at the Burnside Business Park, and wetlands and ditches adjacent Highway 118 and sites near the Stanfield Airport. **Observation Description:** One four-toed Salamander was found adjacent to the Project area. A female guarding a nest was found	Pond south of Anderson Lake and Wetlands 2013-04 and 2013-28 highest potential.

Common Name	Scientific Name	Status[1]	Observed Within Project RoW	Location	Background [2]	Potential for Additional Habitat along Project Area
					in a sphagnum moss hummock at the edge of a shallow pool in WL24.	

1. Status notes (as of May 2017):
   S-rank - S3 Uncommon in the province; S4 Widespread, common and apparently secure in province; SNR Not yet assessed in province.
   General Status - "Secure" population not at risk.
   "Undetermined" indicating that there is currently insufficient data, information, or knowledge available to evaluate its status.
2. Stantec 2011

4.3 Socio-Economic Environment

Land use near the proposed Project is mainly undeveloped resource lands with a combination of industrial and commercial at either end, as well as light residential rear Rocky Lake Drive. This area falls within the Dartmouth Planning Districts 14 and 17 and the Bedford Planning Districts within HRM. The Burnside Business Park and the Bedford Commons and Industrial/Commercial Park are located at the south and north ends (respectively) of the proposed Project. Planning Districts 14 and 17 sit between the Town of Bedford and the City of Dartmouth and include General Industrial (I-2), Light Industrial (I-3) and Urban Reserve (UR) zoning. Zoning in the Bedford Industrial Park area (Bedford Planning District) includes Two Dwelling Unit Zone (RTU); General Business District Zone (CGB); Light Industrial Zone (ILI); High Industrial Zone (IHI); and Institutional Zone (SI).

The following builds on information provided in the 2011 Highway 107 Environmental Assessment report for an alternate RoW (Stantec, 2011). **Figure 4-8** shows the land cover in, and property ownership along, the Study Area. **Figure 4-9** shows designated land use (zoning boundaries).

The majority of the alignment is on public lands, either currently acquired by NSTIR or pending purchase from the federal government (DND). Smaller privately owned parcels (largely residential) exist along Rocky Lake Drive, and a parcel is owned by Nova Scotia Power Incorporated.

4.3.1 Land Use

4.3.1.1 Commercial and Industrial Land Use

Commercial services are focused in the Bedford Commons located near Exit 4C of Highway 102, off Duke Street, and in the Burnside Business Park. The Bedford Commons include commercial franchised enterprises such as fast food outlets, retail services, and personal care services. Development of the Bedford Commons is ongoing with plans for additional retail outlets (WikiMedia, 2011). Centrally located between the Halifax International Airport, downtown Halifax business district, and the Port of Halifax, Burnside Park is the largest business park north of Boston and east of Montreal with over 1,500 enterprises and over 15,000 employees (Halifax Regional Municipality, 2010). The Burnside Business Park, previously known as the Burnside Industrial Park, is located adjacent to Akerley Boulevard bounded by Highways 111 and 118. Commercial and industrial developments include those mostly specializing in sales, manufacturing, electronics, transportation, and services and are composed mostly of

Bedford Rifle Range
Bedford Common
Bedford Industrial Park
Rocky Lake
Lake William
Rocky Lake Quarry
Lily Lake
Anderson Lake
Little Lake
Flat Lake
Enchanted Lake
Juniper Lake
Lake Charles
CFAD Bedford
Bedford Basin
Burnside Business Park

Nova Scotia Transportation and Infrastructure Renewal

Highway 107 Burnside to Bedford Environmental Assessment

FIGURE 4-8
Land Cover

NOVA SCOTIA

DILLON CONSULTING

PROPOSED HIGHWAY 107 ALIGNMENT
WATERCOURSE
HIGHWAY
OTHER ROAD
TRAIL/TRACK
POWERLINE
RAIL LINE
BUFFERED CENTRELINE STUDY AREA (75 M)
APPROXIMATE RIGHT OF WAY STUDY AREA (AS PER NSTIR MAY 2017)
PROPERTY PARCELS
FORESTED
CUT OVER
NSDNR WETLANDS
WETLAND
OPEN WATER
TRANSMISSION LINE CORRIDOR
BARRENS
URBAN/DEVELOPED
HIGH PRESSURE GAS PIPELINE CORRIDOR
PIT/QUARRY
DND PROPERTY

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNR

MAP CREATED BY: SCM
MAP CHECKED BY: KLM
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 125 250 500 Metres

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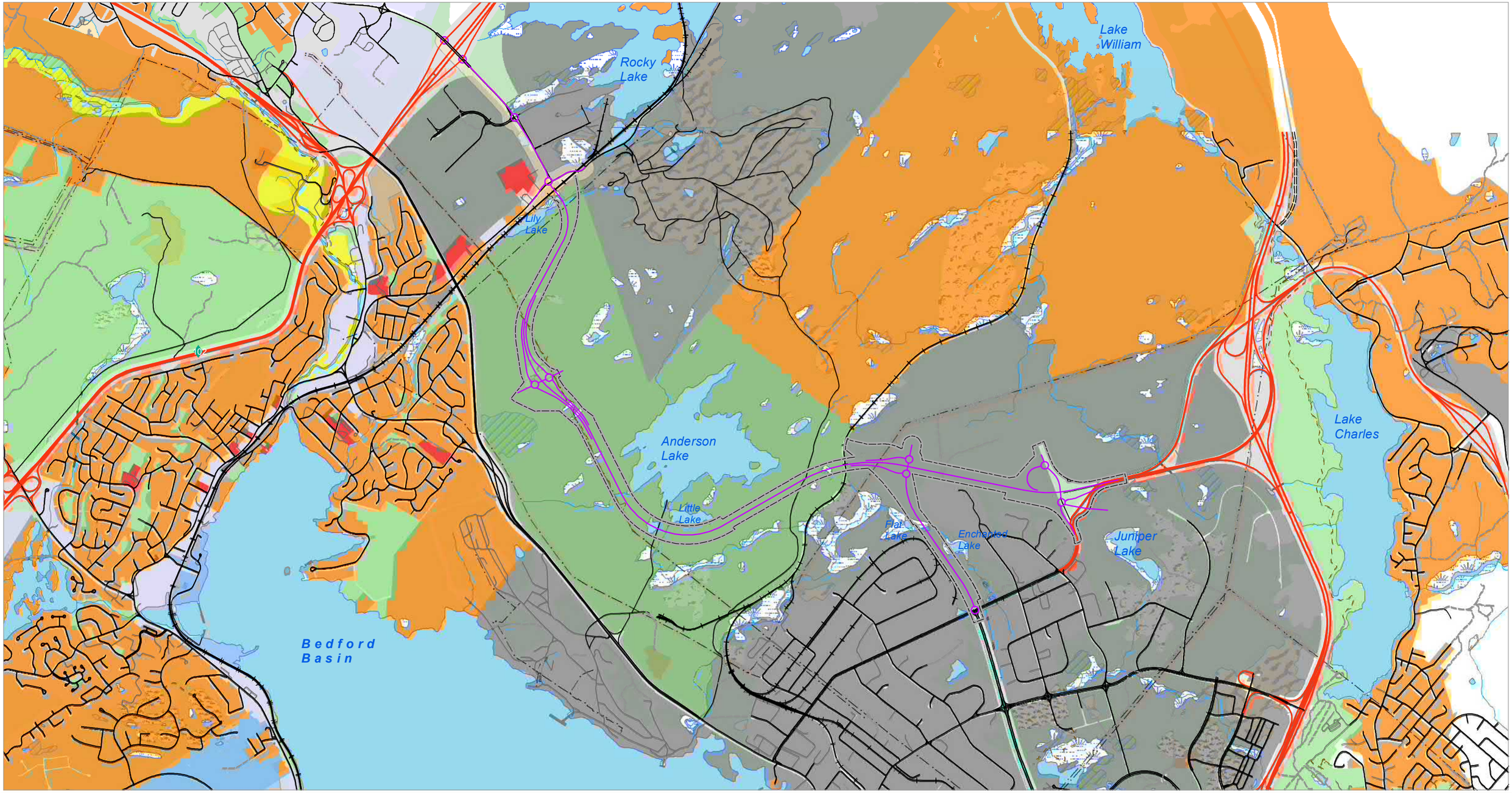
PROJECT: 13-8348

DATE: Jun 28 2017



Nova Scotia Transportation and Infrastructure Renewal

Highway 107 Burnside to Bedford Environmental Assessment

FIGURE 4-9

Zoning Boundaries

PROPOSED HIGHWAY 107 ALIGNMENT

APPROXIMATE RIGHT OF WAY STUDY AREA (AS PER NSTIR MAY 2017)

BUFFERED CENTRELINE STUDY AREA (75 M)

Residential
Parkland/Open Space
Institutional
Commercial
Utilities Zone
Urban Reserve
Floodway
Waterfront Development
Industrial

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNR, HRM Open Source Data

MAP CREATED BY: SCM
MAP CHECKED BY: KLM
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 125 250 500 750 Metres

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PROJECT: 13-8348

DATE: December 2013

low-rise office buildings, warehouses and retail stores (WikiMedia, 2011). With most of the major long-haul trucking firms located in the park, the Burnside Business Park is the transportation and warehousing centre of the Greater Halifax economy (Atlantic Business Parks, n.d).

The Burnside Business Park extends approximately 970 hectares (2,400 acres) and includes the smaller City of Lakes business incubator park. In 2006, the Burnside Business Park underwent an expansion at its eastern end with the adjacent development of the Dartmouth Crossing retail and office development (WikiMedia, 2011). In 2009 Dartmouth Crossing was rezoned to Industrial (I-2) zoning to allow 100 acres of industrial and commercial development (Dartmouth Crossing, 2008). The development of Dartmouth Crossing is ongoing with plans for additional retail outlets and commercial services.

The Bedford Industrial Park, located adjacent to Rocky Lake Rd., along Duke Street and Mann Street, is a 100-acre park offering light and heavy industrial enterprises. Originally designed as an intermodal rail hub, the Canadian National Railway retains a large interest in the park capitalizing on its rail access and good development potential (Atlantic Business Parks, n.d). Additionally, many tenants choose Bedford Industrial Park for the park's heavy industrial infrastructure (Atlantic Business Parks, n.d). Industrial enterprises are dominated by landscape contractors, concrete services, and cement manufacturing/ wholesale.

North of Rocky Lake Quarry, the Municipal Group owns and operates a liquid asphalt storage facility (General Liquids). General Liquids supply asphalt emulsion and asphalt binder to the construction industry as well as providing material performance research to promote new and more effective ways to construct, seal and preserve roads. The facility has 15 storage tanks with the capacity to hold 125,000 litres of asphalt products (Municipal Group Website, n.d.).

4.3.1.2 Resource Land Use

The Rocky Lake Quarry is an active quarry operated by the Municipal Group immediately adjacent to the proposed highway RoW. The quarry is a full-service aggregate quarry producing approximately two million tonnes per year of aggregate material. Tandem truck traffic averages 250 trucks per day (500 trips per day) from the Rocky Lake Quarry facility, with additional traffic from delivery trucks and employee vehicles (Municipal Group representative pers. comm. 2011). The quarry has been in operation since the 1960s, and in operation with the current owner since the 1970s. Municipal Group owns property on either side of the proposed highway corridor along with an access road that extends from the Rocky Lake quarry south to DND property, crossing the proposed highway corridor.

Sovereign Resources quarry is owned and operated by Sovereign Resources, a subsidiary of the Municipal Group, and is located northeast of Rocky Lake Quarry. Activities associated with this quarry includes clearing and grubbing; stripping and stockpiling of topsoil and overburden; drilling and blasting; and hauling of blasted rock. Rock blasted at this location is hauled to the Rocky Lake quarry (Municipal Group Website n.d.).

4.3.1.3 Residential Land Use

The description of residential land use considers existing and anticipated land use. Residential land use in the general Project area is limited to residential properties on Rocky Lake Drive. This area is zoned Residential R-2 zoning. There are 19 residential properties within 300 m of the proposed highway corridor. Approximately five residential properties are located within the proposed RoW and will potentially be acquired by NSTIR for the development of the proposed highway. Future residential development in the Bedford planning district is mainly in Bedford West and Bedford South, not within the proposed Project corridor of Bedford East. Various residential properties back on to the Bedford Bypass. Additional plans for a residential component of the Dartmouth Crossing development are

underway, with the preparation of a Development Agreement application to permit the proposed residential development (Dartmouth Crossing, 2008).

4.3.1.4 Institutional Land Use

There are several institutional uses in the vicinity of the Project area including the Nova Scotia Correctional Facility and East Coast Forensic Psychiatric Hospital located on Colford Ave., Burnside (approximately 220 m from the alignment) and Rocky Lake Junior High School located on Rocky Lake Drive in Bedford (175 m from the alignment). Additionally, St. Joseph's Daycare is located in the Bedford Commons along Damascus Rd. There is an active church (StoneRidge Fellowship) on Temple Terrace located at the north end the of proposed Project area located approximately 675 m from the alignment. St. Joseph's Daycare is the closest sensitive receptor to the proposed Project and is located approximately 160 m of the proposed alignment (along Duke Street).

4.3.1.5 Department of National Defence Property

Canadian Forces Ammunition Depot (CFAD), also informally known as the "Bedford Magazine", is a DND property occupying the entire northern shore of Bedford Basin immediately south of the proposed highway corridor. CFAD houses the weaponry for the Maritimes Forces Atlantic (MARLANT) vessels and has a loading jetty and several nearby anchorages (National Defence and the Canadian Armed Forces, 2014).

Although access to undeveloped CFAD property north of Windmill Road is restricted, with appropriate signage and gates to deter trespassers, the area is used by unauthorized recreation users for hunting, camping, ATV use, fishing, and illegal dumping.

4.3.1.6 Tourism and Recreational Land Use

There are two recreational areas near the existing highway. The Don Bayer Sports Field is located in Burnside south of the proposed Project area, and Rocky Lake Junior High School Park is located in Bedford, west of the proposed Project area. The Rocky Lake Dome Arena is located within the Bedford Commons. Informal recreational land use in the vicinity of the proposed Project consists of trails on the west side of the proposed alignment along a section of the transmission line corridor off of Rocky Lake Drive. Another informal trail is located parallel to Highway 102 at the north end of the alignment.

4.3.1.7 Linear Features and Other Infrastructure

Existing linear features in the vicinity of the Project include railways (Canadian National Rail - CNR) located in the Burnside area and in Bedford along Rocky Lake Drive, natural gas pipeline located near Akerley Boulevard (Heritage Gas) and a power transmission corridor (Nova Scotia Power - NSP) that parallels a significant portion of the proposed Project RoW at the south end of the alignment.

4.3.1.8 Special Considerations Relating to Unexploded Ordnance (UXO) Impacts at CFAD Bedford and Potential Contaminants

In 1945, a significant fire occurred at Rent Point, CFAD Bedford. The fire occurred at a time when large quantities of ordnance were being returned to CFAD following the end of World War II. The fire and resulting explosions resulted in UXO impacts being strewn across the property and adjacent water lot. Following the event, DND deemed the area of impact as a one-mile radius from Rent Point. As a result, the general area within one mile of Rent Point is identified as having a risk of UXO, and development within this zone must follow applicable assessment and mitigative measures.

The one-mile area of potential impact presented by DND encompasses lands south of Anderson Lake, and south of the proposed alignment; therefore, although caution must be taken when working in the area of

the alignment, the likelihood of encountering UXO during construction is considered low. Appropriate procedures will be implemented to address UXO related issues before land transfer from the federal government and during construction activities within the alignment.

DND has developed a contaminated sites program to address potential contaminants on its properties. CFAD has undergone assessment and follow-up remediation projects related to soil, water, and sediment contaminants. In the course of 2013 investigations at CFAD, an additional potential contaminant source was identified south of Anderson Lake. This was determined to be munitions-related material disposed of in the area. CFAD personnel were advised of the findings.

4.3.2 Traditional Land Use

Mi'kmaq Ecological Knowledge Study

The 2010 MEKS did not identify Mi'kmaq land or resource use in the study area (**Appendix I**).
As part of on-going consultation with aboriginal representatives, this document can be updated on request. As noted in **Section 5** Consultation (below), if black ash is identified within the RoW, First Nations will be contacted prior to removal.

4.3.3 Cultural/Archaeological Resources

Archaeological resources were investigated in 2013 and 2014 by Cultural Resource Management (CRM) Group Limited. Their full reports are provided in **Appendix J**. Key findings are noted below.

Previous archaeological assessments of portions of the Highway 107 study area were conducted by Laird Niven in 2011 and by Stephen Davis in 1991 while assessing an earlier alignment. The eastern quarter of the study area corridor, from the railway tracks to the western end of Burnside Drive, was ascribed 'no archaeological potential' during the archaeological assessment conducted by Niven under Heritage Research Permit A2011NS52 (Niven, 2011), as well as by Davis during his 1991 survey of the area (Davis, 1991). It was also asserted that the northwestern portion of the corridor, just off of Rocky Lake Drive had no potential for archaeological resources (Niven, 2011). These areas were re-assessed during CRM Group's 2013 impact assessment, paying particular attention to the northwestern portion, due to its proximity to Lily Lake (which drains directly into the Bedford Basin) and mention of an old road found during Niven's 2011 reconnaissance (Niven, 2011). Also, a modeling report written by CRM Group in 2001 for Sempra Atlantic Gas also identified an area of high potential on either side of Wrights Brook which the Highway 107 Project study area crosses (Stewart & Sanders, 2001).

Historic research and previous archaeological research in the Bedford Barrens area indicate that it was an important area for the Mi'kmaq. Although there are no known sites of significance in the area of Anderson Lake or Lily Lake, this is possibly due to a lack of research as opposed to a lack of sites.

It should be noted that although reported petroglyphs within the study area have been found to be either natural or modern features (i.e., graffiti), this does not mean that there are not petroglyph sites within the area. It should also be noted that natural features of interest or uniqueness may in themselves hold cultural significance. Natural land forms are commonly interpreted by aboriginal groups as having spiritual or supernatural origins (Molyneaux, 1993). This is of note particularly because of the known significance already ascribed to the area due to the similarity in land forms.

Based on the various components of the background study, including environmental setting, Native land use and historic settlement, a number of locations throughout the study area are considered to exhibit high potential for encountering Pre-contact and/or historic archaeological resources.

Archaeological reconnaissance of the Highway 107 Project study area was undertaken on November 5 and 6, 2013 under clear conditions. The goal of the visit was to assess the area for archaeological potential and investigate any topographical and/or cultural features that had been identified as areas of elevated potential during the background research. This was achieved through windshield and focussed pedestrian surveys within the entire Highway 107 Project corridor. Additional reconnaissance was undertaken in August 2014 of an area under consideration for alternative alignments east of Rocky Lake Drive. No archaeological potential was identified for the alternative alignment area.

As a result of the background research and field assessment, 11 areas of high archaeological potential, both Pre-contact and historic, were identified along the RoW during fieldwork for the Project. These areas were shovel tested in 2014. No archaeological resources were identified and it was recommended that the corridor be cleared of any further requirement for additional archaeological investigation.

5.0 CONSULTATION

NSTIR conducted a series of community consultations discussing Highway 107 as part of the recent twinning/tolling study:

- February 16, 2017 in Halifax,
- February 27, 2017 in Porters Lake, and
- March 1, 2017 in Dartmouth.

Aboriginal consultation was initiated in 2010. Aboriginal Consultation Letters were sent:

- February 22, 2010 - Letter to initiate consultation sent to Assembly of Nova Scotia Mi'kmaq Chiefs,
- April 15, 2011 - General highway update letter (included Highway 107) sent to Assembly of Nova Scotia Mi'kmaq Chiefs,
- November 9, 2011 - Update letter on Highway 103 Broad River to Port Joli phase I and Highway 107 sent to Assembly of Nova Scotia Mi'kmaq Chiefs,
- December 10, 2013 - Update letter sent to Assembly of Nova Scotia Mi'kmaq Chiefs,
- February 19, 2014 - General highway update letter (included Highway 107) sent to Assembly of Nova Scotia Mi'kmaq Chiefs,
- February 26, 2014 – Letter in response to some concerns on the project sent to Assembly of Nova Scotia Mi'kmaq Chiefs,
- October 20, 2014 - General highway update letter (included Highway 107) sent to Sipekne'katik First Nation,
- October 8, 2015 - Update letter sent to Assembly of Nova Scotia Mi'kmaq Chiefs,
- October 20, 2016 - General highway update letters (included Highway 107) sent to Assembly of Nova Scotia Mi'kmaq Chiefs and Sipekne'katik First Nation, and
- April 22, 2016 - Twinning/Tolling update study letter sent to Assembly of Nova Scotia Mi'kmaq Chiefs and Sipekne'katik First Nation.

Also, four public information sessions were completed previously for the Bayer Road/Highway 102/Highway 107 Corridor Study (Stantec 2009):

- February 11, 2009 in Halifax,
- February 12, 2009 in Bedford,
- March 25, 2009 in Sackville, and
- March 26, 2009 in Dartmouth.

There is on-going one-to-one consultation with stakeholder and NSTIR has updated the Bedford Business Association and the Greater Burnside Business Association on the Project. Additional stakeholder meetings included the Sackville/Burnside active transportation consultation, meetings with a broad range of stakeholders during the Highway 102 Corridor Study Project in 2009 (Stantec and Delphi-MRC, 2009), NSTIR meeting with business owners on September 12, 2014, and on-going First Nations consultation.

Summary of Concerns and Response
Excerpts from the Corridor Study and minutes from the September 2014 stakeholder meeting are provided in **Appendix K**. In general, the Project was seen to have a positive impact on Health and Safety conditions and the community.

Table 5-1 provides a summary of concerns identified and steps underway to address them.

Table 5-1
Summary of Key Concerns Identified During Consultation

Concern	Response
Property impacts (direct)	Compensation for loss of property would be based on a sum per square foot and an HRM and NSTIR process would be followed for purchase of properties or partial properties.
Compensation for indirect impacts	NSTIR does not compensate for indirect property value loss.
The slow pace of the implementation of the Project	NSTIR is proceeding based on available funds and provincially determined priorities.
Desire for trails and pedestrian access	The Active Transportation Trail has been included in the Project.
Potential for greenhouse gasses	NSTIR and HRM have a long term plan to address. Potential for greenhouse gas emissions is assessed as part of the EA
Connection to the Bedford Bypass	This is being considered as future traffic warrants.
Improved Health and Safety and reduction of congestion was seen as project benefits	NSTIR considered Health and Safety and improved traffic flow as benefits in assessing the purpose of the Project.
Traffic flow in relation to specific aspects, particularly Glendale Avenue and the Business Parks	NSTIR continues to work with business owners to address concerns.
Potential for petroglyphs and archeological assessment requirements	An archeological screening was conducted for this assessment (**Appendix J**).
Requirement for assessment of water quality, aquatic biota, wetland habitat and wildlife, particularly associated with Wrights Brook	These components were included in the Project EA.
Construction silt impacts to water quality	Erosion and sediment control is a component of NSTIR's EPP.
Involvement in fish habitat compensation planning	NSTIR commitment to work with KMKNO at the approvals stage.
First Nations interest in black ash	NSTIR to contact First Nations prior to clearing if black ash identified in clearing footprint.

6.0 ENVIRONMENTAL EFFECTS ASSESSMENT

6.1 Environmental Assessment Methodology

A central component of the EA process is to identify the anticipated impacts on the environmental features resulting from the construction and operation of the proposed Project. The approach taken involves identifying the potential for the Project to interact with the existing environmental components which are present at the Project locations. This step is shown in a simple matrix format. Following this identification of potential interactions, the effect of the interaction is evaluated with consideration of the time in which it may occur and the space in which it may occur. Mitigation is identified for each effect, and the significance of each interaction is established. Best management practices have been identified as appropriate mitigative measures. In the evaluation of impacts, this EA has incorporated standard highway construction/operations environmental management practices and mitigation into the Project description, as environmental protection has now become an integral part of any responsibly designed Project. These practices are referenced and summarized in **Section 3**. With the practice of proactive environmental planning and management, the mitigations to be added between impact identification and evaluation of residual impacts are minimized, and only mitigation that must be developed for a particular circumstance such as site-specific challenges or new regulatory requirements need to be identified.

The significance of the resultant effect was evaluated using the following questions as a guide:

1. Is the effect direct or indirect?
2. Is the effect reversible?
3. What is the magnitude of the effect?
4. What is the duration (short or long term) and frequency of the effect?
5. What is the geographic extent of the effect?
6. What is the ecological or socio-cultural context?

6.2 Scope of Project

Scope of the Project refers to the components of the proposed development that should be considered part of the Project for the purpose of EA. Scope of assessment refers to the determination of the environmental effects to be addressed, the scope of those effects to be addressed, and the effects to be considered in making decisions regarding the Project. A regulator-generated scoping document is not a component of this provincial process.

Table 6-1 outlines the components of the Project and related physical activities. Additional details about the Project are provided in **Section 3**. The scope includes all aspects of the Project related to the construction, operation and maintenance of this portion of Highway 107. Highway 107 is expected to remain in operation indefinitely. Therefore decommissioning and abandonment of the highway is not anticipated.

Table 6-1
Project Components and Related Physical Activities

Project Phase	Project Components	
	Physical Works and Activities	**Description**
Pre-construction and Construction	Pre-construction	Surveying and geotechnical investigations, final design, permitting.
	Site Preparation	Sediment and erosion control measure setup, Pre-UXO clearance clearing, UXO clearance to be completed by DND, clearing, grubbing.
	Roadbed Preparation	Excavation, blasting (if required), placement of fill, subgrade, subbase and base –grading, rail crossing structure construction.
	Watercourse Crossings	Bridges and open span structures, culverts and drainage installation.
	Surfacing and Finishing	Paving, shouldering, hydroseeding, signage, lighting and guide rail installation, highway marking and removal of ancillary structures.
Operation/Maintenance	Project Presence	Presence of the highway, presence of vehicle traffic.
	Infrastructure Maintenance	Paving, shoulder and drainage maintenance, watercourse crossing structure maintenance, highway marking, fencing, signage, lighting, guide rail maintenance.
	Winter Maintenance	Salting, sanding, plowing.
	Vegetation Management	Mowing, vegetation removal, planting.
Decommissioning/Abandonment	Not anticipated at this time	
Accidents, Malfunctions, and Unplanned Events	Hazardous materials spills Erosion and sediment control failure Fire/UXO hazard Vehicular accidents/wildlife encounters Disturbance of unknown sensitive features	

6.3 Valued Environmental Components

In order to focus on valued, vulnerable or representative components of the environment, the assessment will focus on Valued Environmental Components (VECs) for potential interactions with the Project. The VECs were evaluated to determine if potential pathways or linkages exist by which the Project activities or works may affect the VEC. **Table 6-2** summarizes the VEC scoping and pathway analysis for this Project identified through issues scoping; regulatory and public input; and, the study team's experience and professional judgment. The various components of the atmospheric, aquatic and terrestrial environments were evaluated to determine: the potential for interaction, the potential for effects, and the significance of effects, with consideration of feasible mitigation applied.

Table 6-2
VEC Scoping and Pathway Analysis

Environment	Component	Possible Source or Pathway	Rationale for Inclusion or Exclusion	Project VEC
Atmospheric	Air quality	Vehicle emissions, fugitive emissions, dust, vapour from spill	Included - protected by law; valued	✓
	Climate - GHG	Climate impacts from vehicle emissions, fugitive emissions, dust, vapour from spill	Included - valued	✓
	Sound quality	Activities resulting in disturbance/noise such as from blasting or compaction	Included - protected by law; valued	✓
Terrain/ Geology	Acid generating bedrock,r fine erodible soils, or contaminated soils	Sensitive geological features contribute potential contaminant runoff from bedrock or soil disturbance	Excluded as not identified as present, but follow-up required	
Aquatic	Groundwater resource - quantity and quality	Domestic wells present in adjacent areas – pathways contamination, spills, flow disruption, blasting	Included - valued, protected by law	✓
	Surface water resource - quantity and quality	No surface water supplies were identified – surface water quality and quantity a factor in fish habitat. Pathways include runoff of potential contaminants including sediment during construction and operation/maintenance	Included - NS *Environment Act*; valued	✓
	Fisheries, fish habitat and aquatic priority species	Fish habitat present - Pathways affecting surface water or groundwater through construction sediment generation; accidental release of contaminants; direct habitat loss from construction	Included - fish habitat likely to be removed and protected by *Fisheries Act* and Species at Risk Acts	✓
	Wetlands and associated species and habitats	Wetlands present; direct alteration or pathways affecting water quality	Included - protected by NS *Environment Act*, Species at Risk Acts, MBCA, valued	✓
Terrestrial	General vegetation and wildlife	Populations stable and will not be affected by highway	Excluded – priority species or habitat considered separately as per NSE direction on assessment of wildlife	
	Priority flora	Priority plant species present; direct effects through removal or indirect through pathways affecting habitat features	Included - protected by *Environment Act*, Species at Risk Acts, valued	✓
	Migratory birds and habitat	Migratory bird species present; direct effects through nest removal or indirect through pathways affecting habitat features for priority species	Included - protected by MBCA, *Nova Scotia Wildlife Act* and Species at Risk Acts, valued	✓
	Priority wildlife and habitat	Priority wildlife species present; direct effects through removal or indirect through pathways affecting habitat features	Included - protected by MBCA, *Nova Scotia Wildlife Act* and Species at Risk Acts, valued	✓
Socio-Economic	Land use, associated with recreation	Potential recreational land use present – potential pathways through physical changes	Included -Valued	✓
	Traditional Land Use	Potential pathways through physical changes	Included –Valued, provincial duty to consult	✓
	Cultural/ Archaeological Resources	None identified.	Excluded as not identified in RoW, but contingency plan required	

6.4 Potential Project-Environment Interaction Matrix

Table 6-3 outlines the Project-environmental interaction matrix that identifies the interaction between Project components and VECs.

6.5 Impact Evaluation/Effects Assessment

An analysis of the potential effects of the interactions identified in **Table 6-3** is presented for each VEC in the following sections. The 2011 (Stantec) assessment provides supplementary detail of potential effects. For each of these effects, proposed mitigation, and predicted residual effects were determined. The predicted residual effect assumes that each of the recommended mitigation measures is implemented by NSTIR and its contractors. The significance of the residual effect is based upon an evaluation of the effect's magnitude, geographic extent, duration/frequency, irreversibility and ecological context.

6.5.1 Atmospheric Resources

Construction related activities have potential to result in changes in air quality (dust and particulates); noise generation with potential to affect wildlife and humans; and, in GHG emissions with potential climate effects. Operations and maintenance activities have similar potential effects on a localized and temporary basis for dust and noise. Operations may result, on a consistent basis, in a limited contribution to GHG emissions, and in noise at some locations. Noise will be reduced in other areas due to the traffic shift from Magazine Hill and less congestion. **Table 6-4** provides the effects analysis for atmospheric resources.

Significant residual effects for noise are identified if there is a prediction of an exceedance of NSE noise guidelines or noticeable increase above existing background levels at identified receptors. Significant effects for air quality relate to the likelihood of regional exceedances of Nova Scotia or federal ambient air quality standards or significant contribution over background.

6.5.1.1 Key Atmospheric Effects Summary

Construction noise and dust impacts on residences are expected to be minimal using standard mitigation. Except at the roundabout at Rocky Lake Drive, houses are generally over 500 m from the RoW. Appropriate mitigative measures by NSTIR's contractors will be taken when required to ensure construction noise limits are met and nuisance dust levels are controlled. The mitigative measures used by NSTIR contractors have been proven to reduce construction-related noise and dust impacts on nearby residences and includes a methodology to report and address noise and dust complaints. These mitigation measures have been in place and used on numerous NSTIR lead projects over the last 10 years. It is unlikely that emissions will result above Nova Scotia or federal air quality standards.

The operation of the project is not expected to cause a regional increase in GHG and air emissions as it is not expected to cause an increase in traffic. The project's goal is to relieve congestion by moving a portion of the traffic to the new Highway 107 Project. Furthermore, there could be a net reduction in GHG emissions due to an operations impact on GHG and emissions are negligible contributions to overall atmospheric quality and the highway may contribute positively to reduction in idling due to improved transportation networks. The operation of the project is not expected to cause an increase in noise at any of the identified noise monitoring locations. Receptors DCL-01, DCL-3, SCL-03 are located adjacent to the Bedford Bypass, and it is anticipated they will see a reduction in baseline noise as approximate 28% of the traffic is diverted from the Bypass to the Highway 107 Project (Genivar, 2011). The traffic on Rocky Lake Road and rail traffic on the rail line adjacent to receptors DCL-02 and SCL-05 is the

predominant source of noise at these two receptors. From the traffic analysis traffic on Rocky Lake Drive is expected to increase by less than 10%, during peak times, with the completion of the Highway 107 Project which is not expected to increase the noise at the identified receptors greatly. Receptors SCL-01, SCL-02 and SCL-04 are all located along established highways that will not be altered due to the project, and therefore noise levels are not expected to increase at these receptors.

6.5.1.2 Groundwater Resources

Construction related activities such as blasting, have potential to result in changes in groundwater wells with potential effects related to degradation of drinking water well quality and/or quantity. Depending on the type of material (rock) being blasted, new fractures could lead to an increase in concentrations of leachable materials, such as, metals (e.g., arsenic from pyritic slate), and/or nitrates (from granite) due to the increased surface area. Water quality can be affected aesthetically (e.g., colour, taste, clarity/turbidity).

Table 6-3
Potential Project – Environmental Interaction Matrix (VEC) Matrix

Project Activities	VALUED BIOPHYSICAL COMPONENTS								VALUED SOCIOECONOMIC COMPONENTS	
	Atmospheric	Groundwater Resources	Surface Waters Resources	Fisheries, Fish Habitat and Aquatic Priority Species	Wetlands	Priority Flora	Migratory Birds	Priority Terrestrial Wildlife	Land Use - Recreation	Traditional Land Use
Pre-Construction and Construction										
Site Preparation: surveying; UXO clearance, vegetation clearing; grubbing	✓		✓	✓	✓	✓	✓	✓	✓	✓
Roadbed Preparation: blasting; ripping; placement of fill; grading	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Watercourse Crossing: site preparation; stream diversion; culvert installation; restoration	✓		✓	✓	✓	✓	✓	✓	✓	✓
Surfacing and Finishing Activities: paving; line painting; guard rail installation	✓							✓		
Operation and Maintenance										
Highway Operation: presence of RoW; vehicular traffic	✓						✓	✓		✓
Road and RoW Maintenance: paving repair; repainting; shoulder maintenance; ditch maintenance; bridge and culvert maintenance	✓		✓	✓	✓	✓	✓	✓	✓	
Winter Maintenance: salt application; snow plowing		✓	✓	✓	✓	✓	✓	✓	✓	
Vegetation Management: mowing; mechanical removal; herbicides			✓	✓	✓	✓	✓	✓		
Malfunctions and Accidents										
Chemical/Fuel Spill: spills or leaks of fuels, hydraulic fluid during construction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Failure of ESC		✓	✓	✓	✓	✓	✓	✓	✓	✓
Vehicular Accidents: Wildlife Collisions		✓	✓	✓	✓	✓	✓	✓		✓
Fires	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Environment on the Project										
Climate Change	✓	✓	✓	✓	✓	✓	✓			✓
Extreme weather (e.g. storms during construction)		✓		✓	✓				✓	✓

Table 6-4
Effects related to Atmospheric VEC Components

Comp-onent	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
Pre-Construction & Construction					
Air Quality	Most construction activities, particularly fill placement and grading	Dust (fugitive) generation and deposition in residential areas causing nuisance	Residential areas are only adjacent RoW in the Rocky Lake Road area. Following the contractors' EPP and applicable guidelines and regulations including; ● Stabilization of exposed soils as soon as practical, and ● Application of dust suppressants/water when appropriate.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible* Duration – short to medium term (specific construction activities typically less than month in given area) Geographic extent – local to construction area Context - partially industrial/commercial, partially undisturbed, limited residential; nearest residents at Rocky Lake Dr. interchange	Not Significant - Adverse
	Equipment exhaust	Particulate emissions with similar effects to dust	Following the contractors' EPP and applicable guidelines and regulations including; ● Vehicles and equipment will be maintained in proper working order.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible* Duration – short to medium term as noted for dust Geographic extent - site-specific Context - as noted for dust	Not Significant - Adverse
Climate	GHG Emissions by vehicles - NOx, SOx, CO, VOC	Contribution to degradation of climate	Concentrations of the primary pollutants immediately adjacent to the highway corridor are expected to be well within the province's maximum permissible ground-level concentrations. Following the contractors' EPP and applicable guidelines and regulations including; ● Anti-idling policy, and	Negligible. Indirect, Irreversible Magnitude - negligible* Duration – medium term construction phase Geographic extent - regional Context - component of larger municipal/industrial area	Not Significant - Adverse

Comp-onent	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
			● Vehicles and equipment will be maintained in proper working order.		
Sound Quality	Equipment activity	Noise at nuisance levels to local residences/ businesses or disturbance of local nesting birds	Following the contractors' EPP and applicable guidelines and regulations including; ● Notification of residents, ● Use of muffling devices where appropriate, and ● Following timing restrictions.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude – negligible* Duration – short term as for dust Geographic extent - site-specific Context - as for dust	Not Significant - Adverse
	Blasting	Noise disturbance	Following the contractors' EPP and applicable guidelines and regulations including; ● Notification of residents, ● Meeting NSE noise level requirements, and ● Following timing restrictions.	Low with standard mitigation applied. Indirect, Reversible Magnitude - moderate Duration – short-term (weeks) Geographic extent - local Context - as for dust	Not Significant - Adverse
	Operation/Maintenance				
Air Quality	General Traffic	Particulate emissions and potential nuisance deposition	The proposed highway may reduce negative impacts to atmospheric conditions by minimizing traffic queues and associated tailpipe emissions from idling. Vehicle emissions at typical 100 Series Highway speeds are much lower than those when traffic is congested and moving slower. Concentrations of the primary pollutants tend to be highest immediately adjacent to the highway, with a rapid decrease in concentration as one moves away from the highway corridor. Pollutant concentrations immediately adjacent to the highway corridor are expected to be well within the province's maximum permissible ground-level concentrations.	Low Indirect, Reversible Magnitude - low Duration – long term (life of highway) Geographic extent - site-specific Context - partially industrial/commercial, partially undisturbed, limited residential; nearest residents at Rocky Lake Dr. interchange	Not Significant - Positive
Climate	Operations and	GHG and Air Quality	GHG emissions from general traffic are not expected to increase based on specific	Negligible. Indirect, Irreversible	Not Significant - Adverse

Comp-onent	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
	Maintenance -Emissions by vehicles - NOx, SOx, CO, VOC		Highway 107 use. Maintenance to follow NSTIR procedures and applicable guidelines and regulations including; ● Vehicles and equipment will be maintained in proper working order.	Magnitude – negligible* Duration – long term (life of highway) Geographic extent - regional Context - as for particulates	
Sound Quality	General Traffic	Noise	Highway noise is not predicted to exceed guidelines or current baseline where guidelines currently exceeded.	Negligible. Indirect, Reversible Magnitude – negligible* Duration – long term (life of highway) Geographic extent - site-specific Context - as for particulates	Not Significant - Adverse
	Maintenance equipment	Noise	Following applicable guidelines and regulations including; ● Notification of residents, ● Use of muffling devices where appropriate, and ● Following timing restrictions.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude – negligible* Duration – long term (life of highway) Geographic extent - site-specific Context - as for particulates	Not Significant - Adverse
*Magnitude: Negligible - within normal variability of baseline conditions					

Operations and maintenance activities such as salting also have potential to affect drinking water quality in wells. Roadway runoff is of concern, primarily related to winter salting activities. Salt entering the water table can degrade local well water quality out of compliance with drinking water guidelines. **Table 6-5** provides the effects analysis for groundwater resources.

Significant residual effects are identified if there is a high likelihood of a loss of an active drinking water supply or potable water aquifer.

Table 6-5
Effects related to Groundwater Resources VEC Components

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
Construction					
Potable Water Supply	Blasting Surface water runoff	Loss of well supply quality or quantity due to well structural damage or infiltration of poor quality surface water	Following the contractors' EPP and applicable guidelines and regulations including; • Blasting design to limit ground vibration and air concussion in conjunction with provincial guidelines, • Ground vibration and air concussion to be monitored both near the blast site and at the closest structures, • If wells are damaged, these will be repaired or replaced, as appropriate, • Pre-blast survey to be conducted, and • Surface runoff control as addressed under surface water quality VEC.	Negligible with standard mitigation applied. Indirect, Irreversible Magnitude – negligible* Duration – long term Geographic extent – localized; well-specific Context – predominately municipally serviced water supply.	Not Significant -Adverse
Operation/Maintenance					
Potable Water Supply	Salt application	Degradation of well water quality below drinking water guidelines	Following applicable guidelines and regulations including; • Salt management plan.	Low Indirect, Reversible Magnitude – negligible* Duration – medium term (likely seasonal) Geographic extent - well-specific Context - predominately municipally serviced water supply.	Not Significant - Adverse
*Magnitude: Negligible - within normal variability of baseline conditions					

6.5.1.1 Key Groundwater Effects Summary

The potential for groundwater supply quality changes is unlikely as the area is generally municipally serviced from sources outside the Project area. However, there was potential for two domestic wells in the

Rocky Lake Drive area to remain. Preblast surveys and well abandonment will be conducted based on NSE requirements if required on NSTIR owned properties. Additional detail on follow-up requirements is provided in **Section 6.9**. Project impacts on groundwater supplies are expected to be minimal, and aquifer quality will be maintained through adherence to the Project EPP and applicable regulations, guidelines and industry standards for blasting and salt management.

6.5.2 Surface Water Resources

Surface water is considered from the perspective of water quality and quantity in relation to fish habitat. No potable surface water supplies were identified in relation to the Project. Additional considerations of Project effects on physical fish habitat are provided in **Section 6.5.4**.

Construction related activities have potential to result in changes in water quality (typically due to sediment generation). Operations and maintenance activities related to salting and vegetation removal also have potential to affect surface water quality. **Table 6-6** provides the effects analysis for surface water resources.

Significant residual effects relate to degraded water quality with long-term Project related (above existing background range) exceedance of FWAL guidelines or recreational guidelines or degraded water quantity to the level that fisheries habitat is affected.

Table 6-6
Effects Related to Surface Water Resources VEC Components

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
Construction					
Water Quality	Clearing, grading and other earthworks; watercourse crossings Blasting	Sediment generation and contaminants (POL, legacy or UXO derived) in run-off resulting in suspended sediment levels or other contaminants above provincial requirements/ CCME guidelines/ background or degradation of fisheries habitat	Following the contractors' EPP and applicable guidelines and regulations including; ● Pre-clearance of UXO and identified areas of potential contaminants before RoW tree clearing, ● Following the Department of National Defence protocol – Directive #E2 – Contaminated Sites Management about potential disturbance of contaminated soil on DND property, ● NSE Watercourse Alteration Specifications, ● ESC measures to meet water quality limits at 1 in 2-year storm and not incur damage in 1 in 10-year storm, ● Site-specific EPP measures to address drainage to Anderson Lake, ● Use of "clean" fill below	Low with standard mitigation applied. Indirect, Reversible Magnitude – negligible* Duration – short term to medium term (days to month) Geographic extent - local Context – appropriate disposal of contaminants/ UXO before clearing; limited fish-bearing watercourses along the RoW; SAR in Anderson Lake; potential recreation in Lily Lake	Not Significant -Adverse

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
			water level in watercourse crossings and infills, ● Augment erosion control along steep slopes or in erodible soil areas, ● Construction monitoring and stop work direction during extreme weather, ● Timing of watercourse crossing construction to reflect low flow window or other regulatory approval, ● No fording of watercourses, ● Storage of hazardous materials in contained areas over 30 m from watercourses, and ● Contingencies for emergency spill response.		
		Disturbance of contaminated soils or acid bedrock resulting in runoff degrading water quality for fisheries habitat or recreation	Identification before construction of potential contaminants areas and site-specific mitigative actions – may include infill or removal.	Low with standard mitigation applied. Indirect, Reversible Magnitude – negligible* Duration – short term (days) Geographic extent - local Context – limited fish-bearing watercourses along the RoW; SAR in Anderson Lake	Not Significant -Adverse
Operation/Maintenance					
Water Quantity	Drainage and watercourse crossing structure design	Disruption of drainage flow resulting in reduction in water quantity downstream of RoW affecting fisheries habitat or recreation	Following applicable guidelines and regulations including; • Design of drainage culverts to match existing subwatershed flow volumes, • Culvert extensions sizing equal or greater to existing structures, and • Design of ditching to end 30 m from a watercourse where possible and direct flow to vegetated areas.	Indirect, Reversible Magnitude - negligible Duration – short-term (structure maintenance period) Geographic extent - site-specific Context - limited fish-bearing watercourses along the RoW	Not Significant -Adverse
Water Quality	Winter maintenance	Elevated chloride concentrations in watercourses	Following NSTIR procedures and applicable guidelines and regulations including; • Salt management plan.	Indirect, Reversible Magnitude - negligible Duration – short term (hours to days)	Not Significant -Adverse

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
		degrading fisheries habitat		Geographic extent - site-specific Context - limited fish-bearing watercourses along the RoW; SAR in Anderson Lake; potential recreation in Lily Lake	
	Culvert/ bridge maintenance	Sediment generation and contaminants affecting water quality and degrading fisheries habitat or recreation	Following NSTIR procedures and applicable guidelines and regulations including; • Regular maintenance to ensure normal water flow, • Erosion control and buffer zones as for construction, • Instream work, if required, "in the dry", • Timing of works in and adjacent to watercourses will occur within designated low flow construction windows unless otherwise approved, and • NSTIR's spill contingency plan.	Indirect, Reversible Magnitude - negligible Duration – short-term (maintenance period) Geographic extent - site-specific Context - limited fish-bearing watercourses along the RoW; SAR in Anderson Lake; potential recreation in Lily Lake	Not Significant -Adverse
	Summer ditch maintenance	Sediment runoff degrading downstream watercourse fisheries habitat or recreation	Following NSTIR procedures and applicable guidelines and regulations including; • Conducting maintenance under low flow conditions, • Removal of sediment from areas adjacent watercourses, and • Erosion control where needed.	Indirect, Reversible Magnitude - negligible Duration – short-term (maintenance period) Geographic extent - site-specific Context - limited fish-bearing watercourses along the RoW; SAR in Anderson Lake; potential recreation in Lily Lake	Not Significant -Adverse
	Vegetation maintenance	Sediment or chemical runoff into watercourses degrading downstream fisheries habitat or recreation	Following NSTIR procedures and applicable guidelines and regulations including; • Manual and mechanical vegetation control, and • Herbicide use only under Integrated Roadside Vegetation Maintenance program including 30 m	Indirect, Reversible Magnitude - negligible Duration – short-term (maintenance period) Geographic extent - site-specific Context - limited fish-bearing	Not Significant -Adverse

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
			buffer to watercourse and 60 m buffer to protect sensitive areas.	watercourses along the RoW; SAR in Anderson Lake; potential recreation in Lily Lake	
*Magnitude: Negligible - within normal variability of baseline conditions					

6.5.2.1 Key Surface Water Effects Summary

NSTIR and its contractors have extensive experience with highway construction and operation and use well-established standard procedures for mitigation of potential for sediment impact, hazardous material handling and storage, operational management of salt applications, and vegetation control. These procedures include specifics related to watercourse crossing areas and augmented ESC requirements for areas with steeper soil slopes or fine-grained soils. The majority of the RoW is within coarse soils or bedrock and in general, fills will be generated from on-site rock cuts and therefore less prone to erosion.
NSTIR/DND will mitigate potentially contaminated soils and UXO associated with the CFAD property before RoW tree clearing activities through soil management which may include removal and appropriate disposal. Blasting, if conducted within the CFAD area (and in general), will require assessment and design by a qualified professional to mitigate impacts. If there is potential to disturb soils within the "Anderson Lake Former Pumphouse" contaminated site located outside of the Project RoW, the site will be managed in accordance with DND protocol (Maritime Forces Atlantic SEMS Directive #E2 – Contaminated Sites Management).

Highway drainage design targets the maintenance of existing surface water quantity and flow regimes. Stantec (2011) identified watercourses where the estimated percentage of additional flow exceeded 10% and require further consideration during highway drainage design - WC-04 and WC-07 (tributaries to Wrights Brook along the Burnside Drive extension and near the Akerley-Burnside interchange respectively). WC-07 is intermittent, and changes were considered unlikely to affect downstream water quality or habitat. For the other watercourse, evaluation of pre and post-drainage patterns and flow volumes will be undertaken, and final drainage design will minimize hydrologic and hydraulic changes.

The contractors will use site-specific EPP measures for work "in isolation" for the infill at Lily Lake, for watercourse crossing structure construction, and for general construction in areas with drainage towards Anderson Lake. NSTIR and its contractors have contingency plans for encountering contaminants (**Section 6.9**) and will identify the potential for acid bedrock, contaminants, and UXO before construction. Acid generation potential contingency options include encapsulation. UXO will be cleared by a qualified contractor (expected to be by DCC/DND) prior to construction initiation.

Residual Project impacts on surface water resources are expected to be insignificant. Potential adverse impact will be mitigated or avoided through adherence to best practices, contractors' EPP and approval requirements, and applicable regulations and guidelines. Monitoring as detailed in **Section 6.9**, will be conducted to confirm water quality remains within approval requirements and applicable limits noted in CCME freshwater aquatic life and recreation guidelines (considering background ranges).

6.5.3 Fisheries Habitat and Aquatic Species at Risk

The *Fisheries Act* focus is on managing threats to the sustainability and productivity of commercial, recreational and aboriginal (CRA) fisheries and the habitat that supports them. Section 35 states: *No person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, to fish that support such a fishery.*

> **Serious harm** to fish supporting fisheries is defined as *death of fish or any permanent alterations to, or destruction of, fish habitat.*
>
> **Fish habitat** is defined as *spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes.*

SARA and NSESA provide varying levels of protection to priority species, including aquatic species, listed under these acts.

Potential effects to fisheries include both direct and indirect effects. Direct effects are loss of fisheries or SAR aquatic habitat at the crossing location. Indirect downstream effects relate to potential disturbances at the crossing or along the alignment, resulting in impacts primarily to surface water aspects of habitat quality and fish passage, and secondarily to riparian habitat. NSTIR's contractors will use standard environmental protection procedures that target minimizing effects of potential surface water contaminants such as suspended sediments and winter maintenance runoff, and maintain riparian buffers to the extent possible. Considerations of water quality were addressed in the previous section. Wetland effects are considered in a subsequent section.

Table 6-7 provides the effects analysis for fish and fish habitat.

Significant residual effects if they occur, relate to *serious harm* to fisheries fish that are not authorized and cannot be offset, other *Fisheries Act* contravention, or to an unauthorized contravention under SARA or NSESA.

Table 6-7
Effects Related to Fisheries Habitat and Aquatic SAR VEC Components

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
Construction					
Physical Habitat	Excavation and fill construction activities (land-based)	Sediment or contaminants generation as noted in water quality effects. Sediment deposition degrading physical habitat through infilling of pools or spawning gravels.	Following the contractors' EPP and applicable guidelines and regulations including; ● Sediment and erosion control and other mitigation as noted for water quality effects, and ● Limiting disturbance in watercourse buffers (limit clearing within 30 m) until just prior to crossing construction and limit heavy machinery use to outside of 10 m from watercourse.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude – negligible* Duration – short term (days within a given area) Geographic extent – local Context – limited fish habitat present along RoW; recreational fishery in Wrights Brook; SAR in Anderson Lake	Not Significant -Adverse

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
	Infills at watercourses	Sediment or contaminants generation as noted in water quality effects Flow regime changes downstream potentially affecting lake levels and adjacent landowners	Site specific measures including: • Work "In Isolation" - Installation of silt curtains in Lily Lake prior to culvert infill, • Hydrologic analysis in fill and structure design to maintain existing regime, and • Evaluation of potential for contaminants and meeting provincial remediation requirement.	Negligible with site specific mitigation applied. Direct, Irreversible Magnitude - low Duration – permanent Geographic extent – local Context – limited fish habitat present along RoW; wetland compensation will address habitat	Not Significant -Adverse
	Watercourse crossing structure (culverts and bridges) construction	Loss of habitat where structure encroaches on the stream bed/banks Loss of riparian cover, shade and terrestrial food source	Following the contractors' EPP and applicable guidelines and regulations including; • NSE Watercourse Alteration Approval specifications and requirements, • Work "in the dry" where practical, • DFO's advice and standard mitigation measures, and • Construction in fish habitat during low flow windows unless specific regulatory approval.	Negligible with standard mitigation applied. Direct, Irreversible Magnitude - low Duration – permanent Geographic extent – less than 110 m of footprint length Context – Trib. To Wrights Brook crossing to be clear span; WC-04 and WC-18 poor habitat	Not Significant -Adverse
Fish Passage	Culvert construction/ extension Other structure work "in the dry"	Temporary disruption of fish passage	Following the contractors' EPP and applicable guidelines and regulations including; • Construction during low flow windows, • Provision of alternate fish passage if required by DFO, • NSE Watercourse Alteration Approval specifications and requirements, and • Design of fish bearing watercourse culverts in consultation with DFO.	Negligible with standard mitigation applied. Direct, Reversible Magnitude - negligible Duration – short-term Geographic extent – footprint area and connected waterbody Context – limited fish habitat and fisheries present – temporary passage disruption will not affect populations	Not Significant -Adverse

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
Fish and Priority Aquatic Species	Watercourse crossing/infill construction	Sediment or contaminants generation as noted in water quality effects Fish strandings and mortality Mortality of aquatic SAR (e.g. snapping turtle)	Following the contractors' EPP and applicable guidelines and regulations including; • Fish rescue prior to instream works, • Minimization of instream footprint, • Training of work crews on potential SAR species and appropriate contacts for mitigation, and • As noted for water quality effects.	Negligible with standard mitigation applied. Direct, Irreversible Magnitude – low Duration – permanent Geographic extent – local to regional if affect SAR Context – low potential for fish or SAR presence during construction	Not Significant -Adverse
	Blasting	Blasting vibration/ concussion impacts in adjacent watercourses and potential fish or aquatic SAR mortality Sediment and water quality affects	Following the contractors' EPP and applicable guidelines and regulations including; • Following DFO guidance for blasting near watercourses (Wright and Hopky, 1998) and consultation with DFO, EC regarding work in vicinity of Anderson Lake, • Pre-blast look-out procedure and training of work crews on potential SAR species and appropriate contacts for mitigation, and • As noted for water quality and sediment control effects.	Negligible with standard mitigation applied. Indirect, Irreversible Magnitude – low Duration – long-term if occurs Geographic extent - local to regional if affect SAR Context - low potential for fish or SAR presence during construction	Not Significant -Adverse
Operation/Maintenance					
Fish Passage	Culvert operation or maintenance	Culvert presence disrupts passage. Temporary disruption of fish passage during maintenance activity.	Following NSTIR maintenance procedures and applicable guidelines and regulations including; • Culverts in fisheries habitat designed to maintain passage following DFO culvert guidelines or other direction provided by DFO. • Mitigation for maintenance similar to construction with instream work "in the dry" and during low flow	Negligible with standard mitigation applied. Direct, Reversible Magnitude - negligible Duration – short-term (maintenance period) footprint area and connected waterbody Context – limited fish habitat and fisheries present – temporary passage disruption will not affect populations	Not Significant -Adverse

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
			windows.		
Physical Habitat	Operation, maintenance of drainage features or water-crossing structures and winter salting	Storm water runoff resulting in sediment generation and deposition degrading aquatic habitat.	Following NSTIR procedures and applicable guidelines and regulations.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible Duration – short to medium term (days to season for deposition) Geographic extent – crossing specific expected to be less than 500 m downstream Context – native geology dominated by bedrock; limited fish habitat present along RoW and recreational fishery in Wrights Brook; SAR in Anderson Lake	Not Significant -Adverse
*Magnitude: Negligible - within normal variability of baseline conditions					

6.5.3.1 Key Fisheries and Aquatic Habitat Effects Summary

Before initiation of construction, NSTIR will apply to NSE for Water Approval or Notification of Culvert Installation, as appropriate, for all watercourse crossings and drainage culverts. Construction activities will be conducted in a manner meeting approval requirements. Watercourse crossings for fish-bearing watercourses will meet DFO requirements for fish passage. NSTIR will ensure drainage culverts maintain local flow routes and match the existing downstream flow regime.

Preliminary discussions have been undertaken with DFO regarding federal fisheries requirements. NSTIR follows DFO's hierarchical approach in attempting to avoid *serious harm* to fish where practical through structure design and construction options, and employing mitigation and offset, where avoidance is not possible. Fish mortality is not anticipated based on application of standard mitigation. For the majority of watercourse crossings, fish habitat is either not present or seasonal in nature. Standard mitigation techniques at these crossings will result in negligible residual impact, and DFO authorizations are not anticipated.

The three larger watercourse crossings provide aquatic habitat for potential recreational and/or Aboriginal fisheries. NSTIR has discussed these with DFO and followed their guidance to meet fish passage requirements in design of these crossing structures. Design of the structures will be completed when the alignment design is finalized. These crossings are summarized in **Table 6-8**.

Table 6-8
Summary of Fisheries Habitat along RoW

Watercourse Crossing	Crossing Type	General Habitat Type Present	Approximate Area of Habitat in Footprint
WC-04 Wiggins Brook/Tributary to Wrights Brook	Culvert with infill - incorporating fish baffles	Rearing/foraging habitat/passage for brook trout/American eel	Footprint length ~85 m; Average stream width ~ 5 m; **Total 425 m^2**
Tributary to Wrights Brook - Outlet to Anderson Lake	Clear span structure	Brook trout and American eel rearing; various passage including potential SAR Atlantic whitefish	Not applicable
WC-18 Parkers Brook/Tributary to Lily Lake	Culvert with infill (embedded pipe)	Potential rearing/foraging habitat/passage for brook trout/American eel – overall passage in the watercourse is limited by upstream (200 m) structure and downstream (600 m) piping	Footprint length ~80 m for Parkers Brook; Average stream width ~ 3 m; Total 240 m^2 Lily Lake inlet ~ 30 m wide by 60 m long – 1800 m^2 total. Crossing **Total 2,050 m^2**

For WC-04 and WC-18, permanent alteration of aquatic habitat will occur and NSTIR will confirm with DFO if an authorization under the *Fisheries Act* is required. In both cases, the fish habitat in question is of marginal quality for fisheries production and will be off-set through incorporation in habitat compensation associated with wetland loss (**Section 6.5.5** below). The factors that are considered in issuing authorizations under the *Fisheries Act* (DFO, 2013) are:

- The contribution of the relevant fish to the ongoing productivity of CRA fisheries;
- Fisheries management objectives;
- Whether there are measures and standards to avoid, mitigate or offset serious harm to fish that are part of a commercial, recreational or Aboriginal fishery; and
- The public interest.

Based on these factors it is anticipated that if the DFO review indicates an approval is required, it is expected the work will be approved. For the Lily Lake infill, work will be conducted in isolation from the rest of the lake (e.g. use of silt curtain).

The unconnected wetland ponds to be infilled (WC-20 near the Bedford Commons and pond/wetland south of Anderson Lake) are not expected to require *Fisheries Act* approvals (pers. comm. C. Jacobi) but will follow NSE Wetland Alteration requirements and appropriate habitat compensation.

NSTIR will look for opportunities to involve aboriginal groups in the implementation of offset plans. Repairs to existing culverts on Wrights Brook could be included to improve fish passage as part of DFO offset plans, if required and on discussion with DFO, provided such passage would not be detrimental to the introduced Atlantic whitefish in Anderson Lake.

Where instream work is required, this will be conducted "In the Dry" and during the low flow construction windows (June 1 – September 30), following the EPP unless otherwise authorized in Approvals. Fish rescue (under DFO permit) will be undertaken in fish-bearing watercourses before use of isolation techniques.

Blasting, if required, will be conducted in accordance with the contractor's EPP and *Guidelines for the use of Explosives in or Near Canadian Fisheries Waters* (Wright and Hopky, 1998), or other DFO requirements.

Potential adverse impact will be mitigated or avoided through adherence to best practices, regulator "terms and conditions", and applicable regulations and guidelines. Work in the vicinity of Anderson Lake and infill at Lily Lake will be addressed with site-specific measures developed through consultation with DFO. Monitoring and follow-up will be required to ensure conditions of approvals are met as detailed in **Section 6.9**.

6.5.4 Wetlands

Construction related activities have potential to result in direct wetland loss or indirect effects on wetland function related to noise disturbance, water quality degradation or hydrological change. Potential water quality impacts may result from sediment deposition, contaminants, nutrient loading (e.g., from hydroseeding), or changes to natural wetland pH. Culvert and watercourse crossing structure design can change hydrology through drainage or flooding, or alter access (passage) to wetland habitat.

Operations and maintenance activities related to salting and vegetation removal also have potential to affect adjacent wetlands through indirect surface water and noise disturbance pathways. **Table 6-9** provides the effects analysis for wetlands.

Significant residual effects would be identified in relation to loss of a Wetland of Special Significance or un-mitigable (including compensation) wetland loss. Priority wetland species are identified as part of wetland function, but the significance of population impacts are addressed under the separate priority species sections (**Sections 6.5.6 and 6.5.7**).

Table 6-9
Effects Related to Wetlands VEC Components

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
Construction					
Priority Species Habitat	Clearing of the RoW and wetland infill	Loss of priority species habitat - bird nest, plants or turtle habitat Noise disturbance of adjacent wetland habitat Wetland function impacts as noted below affecting wetland priority species	Avoidance where possible. NSTIR will work with provincial and federal regulators regarding mitigation for priority species during wetland alteration approval process. Following the contractors' EPP and applicable guidelines and regulations including; • Clearing will occur during non-nesting season for birds (see Priority Wildlife and Migratory Birds below).	Negligible with standard site-specific mitigation applied. Direct, Irreversible Magnitude - moderate Duration – long-term (Project duration) Geographic extent – wetland specific Context - management plan to ensure overall viability of the population	Not Significant –Adverse (See **Sections 6.5.6 and 6.5.7**)

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
Wetland Function	Wetland infill	Complete or partial wetland function loss depending on the extent of infill	Compliance with regulatory approvals and EPP. Wetland alteration approvals will include appropriate compensation of function. Footprint is minimized where adjacent wetland infill can be avoided. Lily Lake mitigation as noted for fish habitat effects.	Negligible with standard mitigation applied. Direct, Irreversible Magnitude - moderate Duration – permanent Geographic extent – wetland specific Context – similar wetlands prevalent in surrounding area	Not Significant -Adverse
	Clearing and road bed preparation and watercourse crossing construction	Water quality impacts to downgradient wetlands including sediment deposition	Following the contractors' EPP and applicable guidelines and regulations including; • Establishment of wetland and watercourse buffers and clear field identification, • Cleaning of equipment between wetlands, • Progressive installation in areas of high peat, • Areas of peat excavation expected to be minimal (primarily at WL118), and • As noted for water quality effects.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - low Duration – medium term (clearing duration) Geographic extent – wetland specific Context – low erosion potential in area	Not Significant -Adverse
	Finishing activities (hydro-seeding)	Nutrient loading affecting wetland vegetation communities and potentially introducing invasive species	Following the contractors' EPP and applicable guidelines and regulations including; • Minimizing hydroseeding in wetland buffers and not applying in wetlands, and • Cleaning of equipment between wetlands. • Monitoring for invasives and appropriate control if required.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - low Duration – long term if invasive introduced Geographic extent – wetland specific Context – introduced species prevalent in disturbed portions of RoW	Not Significant -Adverse

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
Operation/Maintenance					
Wetland Function	Drainage structure and watercourse crossing operation	Hydrologic alteration affecting wetland function	Appropriate design of drainage and watercourse crossing structures to maintain existing hydrology and drainage orientation including for culverts within wetlands or other feeding drainage locations. Preventive maintenance to limit potential hydrological impacts.	Negligible with standard mitigation applied. Indirect, Irreversible Magnitude – low to moderate Duration – long term (Project duration) Geographic extent – wetland specific Context – crossing design to mimic natural drainage flow regime	Not Significant -Adverse
	Highway operation	Introduction of invasive species and disruption of adjacent wetland habitats	NSTIR standard operating procedures to avoid wetland disturbance and minimize, monitor and control invasive species dispersal	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - low Duration – long term (Project duration) Geographic extent - wetland-specific Context - introduced species prevalent in disturbed portions of RoW	Not Significant -Adverse
	Maintenance activities	Sediment, contaminant or salt impacts to wetland water quality	Following NSTIR standards and applicable guidelines and regulations as noted under Surface and Groundwater VECs. Following NSTIR Salt Management and Vegetation Management Plans. No use of herbicide in wetlands or buffer. Vegetation clearance manually if required.	Negligible with standard mitigation applied. Indirect, Irreversible Magnitude – negligible* Duration – moderate term (runoff related) Geographic extent - site-specific Context – Wetlands present adjacent to footprint and connected to by watercourses.	Not Significant -Adverse
*Magnitude: Negligible - within normal variability of baseline conditions					

6.5.4.1 Key Wetland Effects Summary

Where possible, wetlands were avoided or road design minimizes the footprint in wetland areas following Nova Scotia Wetland Conservation Policy. Due to the extensive presence of wetlands in the area and routing constraints, loss of some wetlands will be required. Unavoidable wetland direct loss (total or

partial) is summarized in **Table 6-10** below based on the RoW footprint. It is noted that this is a conservative estimate as the actual footprint is expected to be less than the RoW.

Table 6-10
Wetland Areas Potentially Affected [1]

No.	Dominant Wetland Type	Approx. Area In RoW (Conservative Footprint) (ha)	Approx. % of Wetland in RoW	Potential Functional Effect for full wetland
WL149*	Shallow water marsh	0.02	100	Yes
WL144*	Shrub basin swamp	0.02	100	Yes
WL141*	Bog	0.13	100	Yes
WL139*	Mixed treed swamp	0.08	90	Yes
WL136*	Shallow water	0.01	100	Yes
WL134*	Mixed treed swamp	0.02	100	Yes
WL133*	Mixed treed swamp	0.25	~30	No
WL132*	Shrub swamp	0.008	20	No
WL131*	Emergent basin marsh	0.13	~35	No
WL122*	Shrub Swamp (tall)	0.1	< 50	No
WL120 *	Treed Swamp (Mixed) to Marsh	0.6	< 25	No
WL119*	Riparian swamp	0.03	100	Yes
WL118*	Treed and Shrub Swamp to Graminoid and Floating -Leaved Marsh	1.3	~ 25	No
WL117*	Treed Swamp (Mixed)	0.1	100	Yes
WL116*	Swamp (Mixed)	~ 0.1	< 25	Yes
WL115*	Swamp (mixed)	0.5	< 50	Yes
WL114*	Treed Swamp (Immature Deciduous)	0.3	> 50	Yes
WL113*	Treed Swamp (Deciduous)	<0.1	100	Yes
WL110*	Treed Swamp (Deciduous)	<0.1	100	Yes
WL109*	Treed Swamp	<0.1	< 10	Yes
WL111*	Treed Swamp (Deciduous)	0.2	100	Yes
WL107*	Treed Swamp (Deciduous)	0.1	> 50	Yes
WL108*	Shrub Swamp	<0.1	100	Yes
WL106*	Treed Swamp	1.2	~ 100	Yes
WL-2013-01	Shrub Bog (Open)	0.2	> 50	Yes
WL- 2013-02	Treed Swamp	<0.1	100	Yes
WL- 2013-03	Treed Swamp	1.4	~ 100	Yes
WL- 2013-04	Shrub Swamp	1	~ 100	Yes
WL- 2013-05	Shrub Bog	0.4	100	Yes
WL- 2013-06	Treed Swamp (lakeshore)	<0.1	> 75	Yes
Wrights Brook Riparian	Swamp/Vernal Pool	>1	-	-
WL- 2013-07	Treed Swamp	<0.1	100	Yes
WL-2014-01	Treed Swamp	0.15	< 50	Yes
Pond	Marsh	~2	100	Yes
WL- 2013-08	Treed Swamp	0.2	100	Yes
WL- 2013-09	Treed Swamp	<0.1	~ 25	Yes
WL- 2013-10	Treed Swamp	0.3	100	Yes
WL- 2013-11	Shrub Bog	<0.1	100	Yes
WL- 2013-12	Treed Swamp	0.3	~ 25	No
WL- 2013-13	Treed Swamp	0.4	<50	Yes
WL- 2013-14	Treed Swamp	<0.1	100	Yes
WL- 2013-15	Bog complex (coniferous treed and low shrub)	0.4	> 50	Yes
WL- 2013-17	Shrub Bog (Tall)	0.2	> 50	Yes
WL- 2013-18	Treed Swamp	0.1	> 50	Yes
WL- 2013-20	Treed Swamp	<0.1	100	Yes
WL- 2013-21	Bog	0.1	~ 25	No

No.	Dominant Wetland Type	Approx. Area In RoW (Conservative Footprint) (ha)	Approx. % of Wetland in RoW	Potential Functional Effect for full wetland
WL-2014-04	Swamp	0.03	100	Yes
WL-2014-05	Swamp	0.15	>90	Yes
WL-2014-08	Treed Swamp	0.001	<10	Yes
WL-2014-13	Swamp	0.014	<20	Yes
WL- 2013-24	Treed Swamp	0.2	~80	Yes
WL- 2013-26	Treed Swamp	<0.1	100	Yes
WL- 2013-27	Treed Swamp	0.3	~ 75	Yes
WL-2014-14	Treed Swamp	0.05	< 25	No
WL- 2013-28	Treed Swamp	0.2	100	Yes
WL29*	Treed Swamp	0.02	100	Yes
WL31*	Swamp	<0.1	100	Yes
WL28*	Swamp	<0.1	100	Yes
WL26*	Treed Swamp (Deciduous)	0.1	100	Yes
WL25*	Shallow Water Marsh	1.75	~ 50	No
WL21*	Shallow Water Marsh (disturbed)	0.2	<25	Yes
WL20	Swamp	0.96	~ 20	No

1. Wetland area affected includes both direct footprint and likely area of impaired function
* Stantec 2011 wetlands

A preliminary conservative estimate of the area of total wetlands within the entire RoW (the actual footprint based on final Project design is expected to be a smaller area) is approximately 22 ha. Wetland alteration will be undertaken within the context of NSE approval requirements and fulfillment of compensation obligations for "no net loss". The wetland compensation plan will be developed prior to disturbance following Nova Scotia Wetland Conservation Policy and in consultation with NSE, NSDNR and ECCC-Canadian Wildlife Service (CWS).

At this time, NSTIR intends on using the habitat credits from its Sackville River Wetland Compensation Project (35,400 m^2 of credits remain in this Wetland Habitat Bank) to offset the unavoidable damage to wetlands. There are no feasible restoration, enhancement or creation options available on-site.

Wetlands will be clearly identified before and during construction and minimum 30 m buffer zones maintained whenever possible. Work in the vicinity of Anderson Lake and infill at Lily Lake will be addressed with site-specific measures developed through consultation with DFO/NSE. In all cases, potential adverse impacts will be mitigated or avoided through adherence to best practices, terms and conditions of approvals/authorizations, the contractors' EPP and applicable regulations and guidelines. Monitoring and follow-up will be required to ensure conditions of approvals are met as outlined in **Section 6.9**.

6.5.5 Priority Flora

Construction related activities with ground disturbance have potential to result in direct loss of vegetation. Priority plant species were identified within the Project RoW. Operations and maintenance activities related to salting and vegetation removal also have potential to affect vegetation including priority plants through indirect pathways such as contaminants in surface water runoff. **Table 6-11** provides the effects analysis for priority flora.

Significant residual effects if identified, relate to contravention of SARA or NSESA provisions or population impacts to non-SARA or non-NSESA listed priority flora species.

Table 6-11
Effects Related to Priority Flora VEC Components

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
	Construction				
Priority Plants	Clearing of the RoW and road bed preparation including wetland and watercourse crossings	Direct vegetation removal and loss of priority plants Indirect adjacent priority plant habitat changes due to microclimate changes	Loss of individual priority plants in RoW to be undertaken within the context of overall viability of the population. NSTIR to work with DNR concerning compensation during wetland alteration process and development of management plan. ESC as identified for Water Quality VEC and wetland mitigation as noted for Wetland VEC.	Negligible with standard mitigation applied. Direct and Indirect, Irreversible Magnitude - negligible Duration – permanent Geographic extent - site-specific Context - No SARA or NSESA plant species in RoW. Other priority plants in RoW and adjacent.	Not Significant -Adverse
	Road drainage design	Disruption of wetland or upland habitat with priority plants adjacent RoW through altering hydrology	Maintenance of surface water paths through culvert placement and appropriate structure sizing. Consideration of downgradient priority plants in design. Implementation of follow-up monitoring of RoW priority species outside footprint.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible Duration – lon term (Project duration) Geographic extent - site-specific Context - Priority plants in and outside of RoW	Not Significant -Adverse
	Re-vegetation	Establishment of invasive species degrading habitat for adjacent priority plants	Consideration of adjacent priority plants in design.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible Duration – short to long term Geographic extent - site-specific Context - Priority plants outside of RoW once developed	Not Significant -Adverse

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
Operation/Maintenance					
Priority Plants	Vegetation control Watercourse structure, shoulder and ditch maintenance	Potential for herbicides to affect downgradient priority plants in habitat adjacent the RoW Indirect drainage effects on priority plants downgradient or adjacent to the work	Mechanical mowing only. Appropriate ESC as noted for water quality.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible Duration – short term (maintenance duration) Geographic extent - site-specific Context - Priority plants will remain outside of RoW	Not Significant -Adverse
	Road salting	Potential for runoff with salt contaminants to affect downgradient priority plants in habitat adjacent the RoW	Priority plant management plan to include provisions for mitigating winter salting in potential habitat. Inclusion of operator environmental awareness training.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible Duration – moderate-term Geographic extent - site-specific Context - Priority plants will remain outside of RoW	Not Significant -Adverse

6.5.5.1 Key Priority Plant Effects Summary

Loss of several mountain sandwort (S3/Sensitive) plants during site clearance and roadbed preparation is a key potential floral Project impact, approximately 30 plants in total were identified, all but 7 within the Project RoW. The Nova Scotia population is not known for this inconspicuous plant, but several records occur in Halifax Regional Municipality and southwest Nova Scotia. The sandwort occurs in a limited exposed upland ridge area along the RoW. The alignment is restricted by design elements such as the radius of curve constrained by Anderson Lake and Wrights Brook. NSTIR has limited options for avoidance based on engineering considerations associated with safe design. **Section 3** provides additional detail on the constraints to routing, and alternative alignments examined. To the extent possible the footprint of the RoW was minimized in these priority plant areas.

To minimize impact on priority plant species, NSTIR will develop a management plan based on consultation with NSDNR following the general guidance principals of responsible stewardship of this valued component of biological diversity including:

- Prioritizing approaches to avoid impact to priority plants where possible including establishing buffers based on habitat conditions, plant specific climate conditions, local topography, hydrology and drainage considerations, around RoW populations not within the direct footprint.
- If avoidance is not possible, management measures, including potential tissue culture and transplanting of individuals to nearby compatible habitats (as conducted for priority species along the Highway 104 corridor near Antigonish), will be implemented to minimize impact on the priority plant

population. Where loss of individual plants is anticipated, this will be undertaken in consultation with NSDNR within a context of contributing to the long-term survival of the species and maintenance of the viability of the population.

- Management will focus on designation, protection, and conservation of affected priority plant species outside the Project footprint. This may include additional land purchase and protection; establishment of no-go buffer areas; control of off-road vehicle access to buffer areas; on-going monitoring of known populations on the property; management of runoff surface water quality to meet regulatory requirements; NSTIR erosion control measures will be in place prior to construction to protect any identified downgradient priority plant habitat. The area cleared for the Project will be limited to that required for the construction of the highway. No push offs or other disturbance would be permitted outside the clearing limits in the vicinity of the priority plants.

Secondarily, indirect effects may result due to sediment generation, change in habitat due to hydrology impact or other water quality pathway to downgradient wetlands or from microclimate changes in adjacent habitat related to vegetation clearance. Priority plants in downgradient wetlands include the black ash (NSESA Threatened) and cursed buttercup (S1S2). Black ash occurs in one downgradient wetland (WL118 over 50 m to south of RoW) and one location within the RoW but anticipated to be an upgradient wetland area (WL25) in relation to the Duke Street Roundabout. Stantec (2011) notes at least 17 other observations of black ash are known within 100 km of the area. Over 30 cursed buttercup plants were noted in WL20 approximately 30 m from the Damascus Road roundabout and several plants were noted in WL25 approximately 30 m north of Duke Street. Mitigation as noted under the wetland assessment section (**Section 6.5.5**) and water quality section (**Section 6.5.3**) is also applicable to downgradient wetlands with secure twayblade habitat. Particular attention will be paid to maintaining existing hydrology. Follow-up monitoring (**Section 6.9**) will be conducted for all priority plant species within the RoW. NSTIR will work with aboriginal groups with respect to black ash if identified within the Project footprint.

Potential operational or maintenance effects related to vegetation management or winter salting may also affect priority plant species adjacent to the RoW or within road infrastructure. Vegetation control has potential to destroy priority plants that get re-established within the road shoulders or ditches. Vegetation damage from salting typically occurs within 10 m of the road edge but may occur up to 80 m away (ECCC, 2001). Management for priority plant species will include mitigation for plants identified within 100 m of the road, such as limiting application of salt or providing alternative drainage paths as long as hydrology is maintained and access is limited to areas with known priority plants.

Based on available data, and proposed mitigation both standard and site-specific, residual environmental effects of the Project on priority plants are not likely to be significant.

6.5.6 Priority Wildlife and Migratory Birds

Potential effects to priority wildlife and migratory birds include direct habitat loss or nest disturbance through right-of-way clearance and maintenance as well as indirect disturbance to their habitat such as road salt effects, noise, changes to local environment or habitat fragmentation. **Table 6-12** provides the effects analysis for priority wildlife and migratory birds.

Significant residual effects if identified, relate to contravention of SARA or NSESA or MBCA or the *Nova Scotia Wildlife Act* provisions, or population impacts to non-SARA or non-NSESA listed priority wildlife or bird species.

Table 6-12
Effects Related to Priority Wildlife and Migratory Bird VEC Components

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
Construction					
Priority Wildlife (non-bird)	Clearing of the RoW and road bed preparation	Direct loss of non-mobile species or habitat within the footprint Noise disturbance during construction	Minimizing Project footprint. Using existing access where possible or the RoW for Project access. Following the contractors' EPP and applicable guidelines and regulations including; • Minimizing the area of disturbance, • Meeting noise requirements, and • Environmental awareness training.	Negligible with standard mitigation applied. Direct and Indirect, Irreversible Magnitude – negligible* Duration – permanent Geographic extent – small Context – limited priority wildlife species habitat present other than birds	Not Significant -Adverse
Migratory and Priority Birds and Bird Nesting	Clearing of the RoW and road bed preparation	Alteration of or disruption to migratory and priority birds, nests and/or their habitat	Following the contractors' EPP and applicable guidelines and regulations including; • Clearing outside of the May to August nesting season or requirements as determined by EC, • Meeting noise requirements, and • Environmental awareness training including direction that no one shall disturb, move or destroy migratory bird nests. If a nest or young birds are encountered, the Contractor shall cease work in the immediate area of the nest and contact the Project Engineer.	Negligible with standard mitigation applied. Direct and Indirect, Irreversible and Reversible Magnitude - low Duration – short term (one season) Geographic extent – Project footprint Context – limited potential for bird nest loss if clearing outside nesting season	Not Significant -Adverse

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
Operation/Maintenance					
Priority Wildlife	Highway presence and operation – vehicle traffic	Wildlife mortality through traffic collisions Habitat fragmentation Noise disturbance	Routing parallel to powerline easement for over half new RoW. Inclusion of wildlife fencing along the new RoW portion. Provision of additional wildlife crossing points at rail crossings and interchanges. Most wildlife and birds habituate to routine traffic noise.	Negligible with standard mitigation applied. Direct and Indirect, Irreversible Magnitude - low Duration – long term (Project duration) Geographic extent – entire RoW Context – existing roadways and easements along at least half the alignment	Not Significant -Adverse
	Operation/ maintenance of watercourse crossings	Habitat fragmentation and disruption of seasonal movement Winter salting affecting water quality and herpetile habitat	Design of bridges and culverts to facilitate wildlife crossing (clear spans over intact riparian corridors or oversized structures). Adherence to the NSTIR's Salt Management Plan.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible Duration – short term (as per water quality) Geographic extent - site-specific Context – snapping turtle is key priority wildlife other than birds	Not Significant -Adverse
Migratory Birds and Bird Nesting	Highway presence	Noise disturbance of adjacent nesting Habitat fragmentation Loss of priority bird nesting habitat	Highway design minimizing footprint particularly in areas of priority bird nesting habitat. Routing design to parallel existing easement and disturbed area.	Negligible with standard mitigation applied. Direct and Indirect, Irreversible Magnitude - low Duration – long term (Project duration) Geographic extent - RoW Context – over half the RoW in disturbed habitat or parallel existing powerline easement	Not Significant -Adverse
	Vegetation control and ditch maintenance	Destruction of bird nests within highway median and shoulders Disturbance of adjacent nesting	Use of mechanical clearing timed outside of the nesting season. Most wildlife and birds habituate to routine traffic noise.	Negligible with standard mitigation applied. Direct, Irreversible Magnitude - negligible Duration – short term (maintenance period) Geographic extent – local; site-specific Context – limited	Not Significant -Adverse

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
		habitats, including raptor nesting		potential for interaction with nest outside nesting season	
*Magnitude: Negligible - within normal variability of baseline conditions					

6.5.6.1 Key Priority Wildlife and Birds Effects Summary

Priority wildlife species expected to occur in the Project area include snapping turtle and bat species. The snapping turtle was observed in WL23 outside the Project RoW but likely occurs in other areas of suitable habitat including in the Lily Lake and Anderson Lake/Wrights Brook area. This species is susceptible to vehicular damage as it nests in graveled areas which may include road shoulders. Bats were observed foraging in the Anderson Lake pond area, but also likely have a more widespread foraging area wherever insect prey are abundant, and the RoW is not expected to provide important bat habitat.

Bird nests including priority species are expected throughout the Project RoW. General clearing activities will be conducted outside of the nesting season (May 1 to August 31). Limited clearing of watercourse and wetland buffers may be required within the nesting season depending on work progression. If clearing occurs during the nesting time frame, NSTIR will consult with EC for an appropriate protocol, which likely would involve pre-construction nest surveys and the requirement to leave buffers around nests, if identified. Similarly, environmental awareness training will emphasise the MCBA prohibition on nest, egg or young destruction and the potential that nesting birds may be found in most habitat types and potentially at other times of the year. In all cases once identified, work most stop to avoid nest destruction.

Over 20 priority bird species were identified in the general area, including two SARA/NSESA listed species nesting along the RoW – Canada Warbler and Eastern Wood-pewee. Due to the constraints on the routing (**Section 3**), a review of the alignment did not identify alternative with less potential to affect bird habitat. Eleven nesting Canada Warblers (COSEWIC Threatened, SARA Schedule 1, NSESA Endangered) were observed in 2014 in numerous wetlands (primarily shrub swamps) along the Project RoW. One Canada Warbler was observed in 2016, in a portion of WL-2013-12 that is outside the RoW as it was over 100 m away when observed. Other locations where Canada Warblers had been observed previously (e.g., wetlands south and east of Anderson Lake) were visited, and no individuals were observed in these locations in 2016. Six nesting Eastern Wood-pewee (COSEWIC Special Concern, NSESA Vulnerable) were observed in the Project RoW in 2014. No Eastern Wood-pewee were observed during the 2016 surveys. Pewee nesting sites included deciduous forest and wetland edge south of Lily Lake and along the Wrights Brook wetlands. Alternate habitat for both the pewee and Canada Warbler is widespread within the general area and loss of the ultimate footprint area is not expected to affect their populations. Similarly unique habitat was not identified for other priority birds nesting along the RoW (identified in **Table 4-20**).

Portions of the RoW within Bedford and Burnside Business/Industrial Parks are already highly disturbed. Additional habitat fragmentation for mobile species such as birds and bats is reduced by the alignment routing. At least a third of the new RoW portion closely parallels an existing powerline easement. Habitat fragmentation of forest interior (100 m buffers around edge) occurs in two small patches along the RoW – one between Anderson Lake and Wrights Brook and a larger one north of the powerline easement.

Habitat fragmentation is likely to be less of an issue for snapping turtles in the Bedford Commons and industrial area than vehicle collisions. The majority of local turtle habitat is on the north side of the RoW. In the Anderson Lake and Wrights Brook area, potential for turtle habitat fragmentation and movement restriction will be reduced by the presence of three major crossing structures and smaller culverts. The

installation of fencing along the RoW, although contributing to fragmentation, will effectively mitigate potential vehicle collision impacts and potential for human disturbance associated with the multi-use trail.

The proposed mitigation is expected to result in residual effects on priority wildlife and migratory bird that is not likely to be significant.

6.5.7 Land Use

The proposed highway is compatible and complementary to land uses within the Business/Industrial Parks at the east and west ends of the alignment. Planning undertaken by the municipality and province has considered overall land hold requirements and access to orphan properties. The portions of the Project that pass through private / resource land property and DND property will be acquired based on agreement with the existing landowners and land users (in the case of the powerline) including meeting access requirements. The majority of the existing resource land properties have current restrictions on recreational land uses due to active quarry and military uses as well as the potential UXO hazard. Recreational use of the area will be enhanced by the incorporation of the multi-use trail. Potential effects related to noise and nuisance dust generation are discussed under the atmospheric VEC (**Section 6.5.1**).

Table 6-13 outlines the assessment of land use VECs.

Significant adverse effects on land use relate to loss of existing recreational opportunities. Positive effects result from development of recreational activities that are not currently present.

Table 6-13
Effects Related to Land Use VEC Components

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
Construction					
Recreation	General construction activities	Disturbance of recreational activities	Recreation is limited or unauthorized within and adjacent to the footprint.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible Duration – short to moderate term (construction duration) Geographic extent - site-specific Context - authorized existing recreation is limited	Not Significant -Adverse
Operation/ Maintenance					
Recreation	Multi-use trail presence	Increased recreational opportunities along the RoW and connectivity to adjacent trails.	Not applicable.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - low Duration – long term (Project duration) Geographic extent –	Not Significant -Positive

Compt.	Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Category of Effect
				Project footprint Context – authorized existing recreation is limited	

6.5.7.1 Key Land Use Effects Summary

Project impacts on land use are expected to be minimal with implementation of standard mitigation. Positive effects will be realized through the construction of a multi-use trail, which will increase connectivity of AT routes in the region, bridging a significant gap between Sackville/Bedford and Dartmouth.

6.5.7.1.1 Traditional Land Use

Significant adverse residual environmental effects would be identified if current use of the land and resources for traditional purposes by Aboriginal people or First Nations communities is changed in a detrimental long-term manner by the Project.

The MEKS did not identify traditional resources within the Project RoW (**Appendix I**). As part of follow-up activities (**Section 6.9**), NSTIR will work with Aboriginal representatives if resources are identified during the Project.

6.6 Possible Malfunctions or Accidents

6.6.1 Chemical and Fuel Spills

Malfunctions or accidents may result in spills of hydrocarbons or other substances during construction and operation of the Project. Such spills may contaminate soils and groundwater and, through runoff, contaminate watercourses. Contaminants may adversely affect fish and fish habitat and waterfowl. Groundwater contamination may adversely affect on-site water supplies.

Fish and Fish Habitat: Chemical and fuel spills may enter a watercourse directly as a result of a motor vehicle accident, or a release during construction or maintenance operations. The effect on fish and their habitat depends upon the nature of the material and the quantity released. The impacts could range from a small localized spill, which is contained and remediated quickly, to a large release of a highly soluble material that affects the receiving watercourse and downstream watersheds. Possible negative effects to fish and fish habitat include direct mortality of fish and aquatic organisms that fish feed upon, and degradation of surface water quality.

NSTIR and NSE apply emergency spill response plans to contain and remediate releases of hazardous materials into the environment. NSTIR's spill contingency plan is detailed in the Generic EPP. Releases caused by motor vehicle accidents are addressed initially by local emergency response agencies and directed by NSE. Subsequently, NSTIR contractors contain the spill and remove contaminated soils and sediment for disposal. Typically, contamination is confined to road shoulders and ditches. NSTIR will review its existing Spill Contingency Plan with respect to aquatic and terrestrial habitats and modify this plan accordingly.

Wetlands: Impacts on wetlands from an accidental hazardous materials release include a reduction or loss of wetland function as a habitat for fish and wildlife and accretion of contaminants in wetland sediments. Contaminants are less likely to move through a wetland system at the same rate as riparian systems due to

the low mobility of water and sediments. Contaminants may build up in the sediments and be released into the ecosystem over time, rather than being flushed out over a season as with a riparian system.

As noted above, NSTIR and NSE apply emergency spill response plans to contain and remediate releases of hazardous materials into the environment. Releases caused by motor vehicle accidents would be addressed by local emergency response agencies and directed by NSE.

Groundwater/Soil: There is potential for groundwater to be impacted during construction by spill of petroleum hydrocarbons, e.g., fuel or lubricants, via runoff, although this risk is considered minimal compared to those listed below (road salt and motor vehicle accidents).

After the highway is constructed, passing vehicular traffic may leave oil or substances such as radiator coolant from automobiles on the surface of the highway, which may, after a precipitation event, impact groundwater in the form of runoff. This impact, which would also be considered minimal, could be mitigated by ensuring that wells in the area are properly constructed (i.e., are not influenced by surface water infiltration at the well head).

The risk of spills during operation of the Project is expected low. The risk of contamination from spills and leaks during construction will be reduced further by preventive measures, contingency planning and spill response and mitigation. With preventive and mitigative measures and the low probability of spills, the effects of accidental spills of contaminants during construction and operation are considered not significant.

6.6.2 Failure of Erosion and Sediment Control Measures

The discharge of sediment to watercourses during storm events or spring runoff can also be considered a spill.

Fish and Fish Habitat: During storm events, the failure of ESC measures is a possibility. The effects on fish and fish habitat include a temporary reduction in water quality due to increased sediment load. If the release were to occur during spawning, spawning beds would be negatively affected as sediment may cover the gravel beds and suffocate the eggs. Aquatic organisms may be adversely affected by a sediment release, potentially reducing the fish's food supply.

The potential for these discharges will be mitigated by appropriate ESC measures described previously. The Contractor will provide an outline of an appropriate Contingency Plan to the NSTIR and the regulators. Having a contingency plan and the resources for emergencies is a key principle of NSTIR. This plan will deal with extreme or long duration rainfall events and the failure of control measures, especially those in or near watercourses. Essential components of the plan will include the following:

- Staff training (e.g., 'tailgate' safety and environmental meetings to inform/educate all staff of potential problems and hazards; include list of personnel with NSTIR Green Card);
- Storm preparedness (conditions for work stoppages, pre-storm staff meetings, inspection of all ESC measures, preventative maintenance of measures, cover applied to highly erodible areas, clean-out of settling ponds and flow checks, and proactive measures that the Contractor shall implement to ensure critical ESC measures at or in watercourses will withstand storm runoff, changes in sediment control dictated by changing seasons, and wind conditions);
- Confirmed availability of equipment and operators that can be mobilized on short notice to create/repair berms, dams, diversion ditches, settling ponds and turbidity curtains;
- Stockpiles of erosion and sediment control materials (include quantities and locations for strategic placements);

  - Straw/hay bales, compost, and/or bark (to be used as mulch/cover material)
  - ESC blankets/matting and staples (or tarps/plastic sheeting)
  - Sandbags
  - Clear stone
  - Water pumps, hoses and fuel (the latter to be stored in a 'safe' location)
  - Turbidity curtains
- Typical approaches for temporary control of water flow and erosion until new ESC measures can be implemented (e.g., excavation of cross ditches to divert runoff away from water bodies and into settling ponds or vegetated areas, excavation of temporary water storage areas, berm construction, bank stabilization, and deployment of backup turbidity curtains). Note that approaches will vary depending upon season, and the Contractor shall indicate approaches for (a) summer, low flow periods, (b) spring-fall, high flow periods, and (c) frozen ground, high flow periods;
- Standard protocols for notification of ESC failure to the NSTIR, and NSE/DFO inspectors; and,
- Incident and 'Near Miss' reporting to the Project Engineer and Environmental Services staff to provide documentation of ESC failure (the Near Miss Report details failures that did not result in the loss/release of sediment; the intention is to identify the cause and help prevent future occurrences).

6.6.3 Vehicle Accidents

During the construction phase, the necessary barriers and signage will be displayed according to the contractors' EPP document to minimize the potential for vehicle accidents. During operation, appropriate road design and speed limit postings will be in place to minimise the potential for vehicle accidents.

Prevention of vehicle accidents and driver safety is the fundamental indicator in setting any speed zone limit on 100 Series Highways in Nova Scotia. These limits are set to ensure the optimum safety of drivers and their passengers. The 110 km/h speed limit is reserved for the best and safest sections of 100 series highway. The 100 km/h limit is the maximum posted on other sections of 100 series controlled-access highway, including the four-lane sections with a narrow or concrete median, sections that are less than 10 km, or sections where design does not support an increased speed limit. As motorists approach urban areas, speed limits are reduced to below 100 km/h. Speed limits on entry and exit ramps to the highway will be lower than 100 km/h and typically set the upper zone at 80 km/h to a low zone of 50 km/h (except for special circumstances, including sharp turns). This median separated 100 Series Highway will minimize vehicle accidents as opposing traffic will be separated, reducing the likelihood of head-on collisions. The reduced traffic volumes will also reduce potential for accidents on both this route and alternate routes. Emergency response time will be improved, and the highway will provide an alternate route when incidents occur on Highway 7.

6.6.4 Fires

Accidental fires could potentially be caused during construction or operation. During construction, sources of fire include hot exhaust or equipment, discarded cigarettes, or sparks. Operational phase causes include the above reasons during maintenance, or from motor vehicle accidents, which result in fire.

Fisheries Habitat, Priority Species and Surface Water Quality: Fish and their habitat may be impacted by fires if the fire results in a loss of vegetation in the riparian zone, or if runoff from the burned-over area enters a watercourse resulting in sedimentation. Runoff could negatively affect surface water quality if chemicals are used to fight fires (more likely at an accident scene rather than a forest fire).

Wetlands: Fire is more likely to have an impact during the summer dry season when the water table is lower; otherwise, it is less likely that fire would pose a significant risk to wetlands due to the amount of water in the system.

Migratory Birds and Priority Wildlife: Migratory birds and priority wildlife could be killed directly from fire, but a loss of habitat is a more likely result. Direct mortality of eggs or nestlings may occur if there is fire during nesting or rearing times.

Atmosphere: Atmospheric conditions would experience a temporary and localized reduction in quality. Smoke from a larger fire may reduce visibility to the point where the highway may be closed until conditions improve.

Preventative measures and contingency plans are included in the contractors' EPP. The Project area is in a developed area with access to HRM fire department locations and potentially DND emergency response; it is unlikely that any fire started as a result of a motor vehicle accident would be allowed to burn unchecked for very long.

6.6.5 UXO Hazards

Portions of the Project area have potential for UXO as a result of the historical Rent Point explosion. UXO may contribute to the fire hazard as discussed above and pose a direct safety risk. As part of the Project, NSTIR will engage an appropriately qualified clearance contractor (expected DCC/DND). As a result of clearance activity, the likelihood of residual UXO hazard is minimal; however, a UXO briefing will be a component of environmental awareness training for the Project.

The fencing proposed for the new RoW will also serve to restrict public access from potentially hazardous adjacent properties.

6.7 Summary of Residual Effects

The identified adverse residual effects are not significant and can be mitigated with a combination of standard measures or pre-established and approved by regulatory authority site specific measures. Small positive effects are anticipated related to improved recreational opportunities, as well as meeting Project goals of an efficient and safe highway system. In addition, significant positive benefits are provided to road users in the region.

6.8 Effects of the Environment on the Project

The potential effects of the environment on the Project are described below.

6.8.1 Climate Change and Hydrological Design

Climate change modelling for Atlantic Canada and prediction of short duration high-intensity storm events and future drainage flow requirements within the long-term Project life will be considered during the final design of drainage and watercourse crossing structures. For the 2011 assessment, RV Anderson (2011) suggested an increase the design peak flows of 20%.

6.8.2 Extreme Weather

Design aspects of the Project consider the range of temperatures expected for the Project area. Certain construction activities can be delayed by extreme weather events, primarily heavy rainfall or sub-zero temperatures. The suspension or delay of construction activities may result in additional environmental mitigation requirements (e.g., if delays result in clearing activities being required during the nesting season). Period of extended periods of hot, stagnant air masses may increase the potential for ground-

level smog formation. Measures to minimize impacts to air quality may include the adoption of anti-idling policy, conducting of refuelling activities during night time hours and/or the conducting of construction activities during nighttime hours only.

Extreme daily rainfall is unlikely to affect highway operation as the highway is designed to move water away from the road surface to prevent hydroplaning conditions caused by pooling water. Ditching and culverts are designed to move water away from the highway to avoid flood conditions which may result in erosion of the roadbed and unsafe driving conditions. The Project will reduce the negative impacts of extreme precipitation on public safety as opposing traffic will be separated, reducing the likelihood of head-on collisions.

6.8.3 Sea Level Rise and Flooding

Sea level rise is unlikely to affect the Project as the lowest elevation present is in the order of 40 m asl. As summarized by Stantec (2011), sea level rise by 2100 is likely in the order of 0.5 m to 1.3 m.

The hydrological report completed in 2011 (RV Anderson, 2011) indicated that the potential for flooding along small watercourses in the area (including the Wrights Brook WC-04 and Lily Lake WC-18) is low. Watercourses in the area typically do not have flood risk factors such as extensive floodplain development, drainage basins, steep channel slopes, or significant flood plains. It was identified that the naturally low permeability area is subject to flashy (rapid increases in flow following precipitation) peak runoff and design of watercourse crossing and drainage structures should consider potential for upstream flooding.

Summary
The Project will be designed to account for potential effects of the environment on the Project. Significant adverse effects on VECs due to effects of the environment on the Project are not considered likely.

6.9 Follow-up and Monitoring Summary

Environmental management is a critical component of NSTIR's approach to highway construction and operation. The objectives are to implement safe, environmentally responsible and sound engineering to the construction and operation phases. Management can be divided into two primary elements: regulatory environmental surveillance; and, self-regulatory environmental compliance monitoring (ECM). Regulatory environmental surveillance is carried out by regulatory authorities. Self-regulatory ECM is that which NSTIR undertakes to monitor its own activities against internal and external environmental standards. Self-regulatory ECM overlaps with regulatory environmental surveillance where the external standards which are being monitored are regulatory in nature (e.g., Conditions of Approval). However, self-regulatory ECM is a much broader concept and is an important tool for the successful implementation of mitigation, particularly where government regulations are vague or non-existent. Self-regulatory ECM involves:

- Monitoring of all environmentally-sensitive activities to ensure compliance with internal and external non-regulatory environmental standards;
- Coordination of communication with stakeholders, landowners and regulatory authorities; and
- Provision of on-site environmental advice to Project personnel.

In addition to ECM, there may be requirements for NSTIR or regulatory agencies to undertake Environmental Effects Monitoring (EEM). EEM will be conducted to validate impact predictions and to evaluate the effectiveness of and identify the need to alter or improve mitigative measures. NSTIR will be

committed to and responsible for the development and implementation of a focused EEM program for the Project, where required.

6.9.1 Well Water Surveys and Well Closures

Potential wells in the vicinity Project site have been identified from the NS well database. On finalization of design and grading details, a survey of all homes and all wells present within 300 m of the highway centreline will be carried out by NSTIR. This information will provide the baseline for future comparisons of water quality. The survey database will include the type of water supply and its age, condition and known history based on property owner surveys and information obtained during sample collections. Water samples will be obtained by an independent contractor from the kitchen tap and analysed for pH, general chemistry and metals (RCAP plus metals), as well as fecal and total coliform counts as per NSEL guidelines for sampling domestic wells. Water samples are analysed immediately following collection and are not to be frozen before analysis. All results are directed to the Project Engineer and subsequently entered into the provincial *Water Quality Monitoring Program* (WQMP) database. Should any samples indicate fecal coliforms, or concentrations of other parameters in excess of *Drinking Water Standards*, the Project Engineer will immediately notify the landowners.

If blasting is required, additional pre-blast and post-blast surveys of wells will be conducted by the contractor. Monitoring of blasts will be conducted according to municipal by-laws and DFO guidelines and authorizations (Wright and Hopky, 1998), and may include measurements of air concussion, ground vibration, and well water quality and quantity.

In the event wells are located on properties that are to become part of the new highway system and are located within 6.1 m of the highway, wells would be properly abandoned following the NSE protocol and the Well Construction Regulations, under Section 110 of the *Environment Act*. In particular, the components of the well (screen, casing, etc.) would be removed and the well filled with bentonite to provide a protective seal between the ground surface and the groundwater below surface. Any new or replacement wells would be constructed in accordance with the Well Construction Regulations, noted above.

6.9.2 Contingencies and Environmental Awareness Training

NSTIR and its contractors' contingency plans address a variety of potential hazards that may arise including those identified in the Accidents and Malfunctions Section.

Areas where bedrock is exposed along the RoW will be tested for ARD potential before construction activities. NSTIR contingencies for encountering acid bedrock include encapsulation and drainage control.

As noted previously, UXO will be cleared before construction activities, so additional hazard is unlikely. However, as part of Environmental Awareness Training, contractors and employees will be made aware of hazards and appropriate contacts. Similar Environmental Awareness Training will be provided related to priority species and archaeological resources.

With the exception of UXO, debris piles identified along the Anderson Lake access road which will be addressed prior to construction, and the Anderson Lake Former Pump House Site (outside of the RoW), no other contaminated soils have been identified within the Project RoW. If contaminated soils are encountered during construction and avoidance is not possible, the soil will be excavated and disposed at a facility approved to accept material by a licensed hazardous waste hauler in accordance with the Guidelines for Management of Contaminated Sites in Nova Scotia (NSDOE, 1996), or as noted for DND

site following DND's protocol. The contaminated soil will not be left on site to allow discharge into the watercourse.

6.9.3 Other Potential Monitoring Programs

6.9.3.1 Noise

Baseline noise measurements were conducted as part of this EA and will be updated prior to construction as land use, and background noise levels in the vicinity of the Project will change. Additional noise monitoring may be conducted during construction and operation to respond to complaints.

6.9.3.2 Sensitive Habitat and Priority Species

Construction in the vicinity of environmentally significant/sensitive areas will be monitored to ensure the spatial magnitude of the physical disturbance is limited to the extent possible. NSTIR will review the at-risk species list during the design of the highway and modify monitoring accordingly.

6.9.3.3 Wetlands

NSE may require follow-up monitoring of wetlands impacted by the Project, and NSTIR would engage an experienced consultant to meet approval requirements. However, as no new technology will be used and there is no uncertainty or unfamiliarity, post-construction monitoring is not recommended at the altered wetlands. Follow-up monitoring will be conducted at the wetland compensation site(s) for at least five years to ensure meeting the federal and provincial "no net loss" (NNL) policies.

6.9.3.4 Erosion and Sediment Control

NSTIR's contractors are responsible for the collection of TSS samples from watercourses on an event-basis to monitor the efficacy of ESC measures. These events will be defined as storms that are predicted to deliver more than 10 mm of rain or equivalent in snowmelt to areas that have exposed soils (note that soils should be protected at non-active construction sites). The purpose of this monitoring program is to identify areas that require additional protective measures (see also comments on Inspection and Maintenance in the TPW's Standard Specification, Division 1, Section 5, Item 8.0). All data will be submitted to the Project Engineer for further consideration and action (implementation of additional ESC measures).

All other ESC structures utilized by NSTIR contractors will be routinely inspected and maintained appropriately until exposed soils have been permanently stabilized. Particular focus will be given before, during and after storm events, and to erosion-prone areas (e.g., cutslopes, embankments, and riparian areas).

6.9.3.5 Operational Monitoring

As part of ongoing environmental management, NSTIR district staff conduct routine inspections for general environmental conditions such as soil erosion. They are assisted as needed by Environmental Services staff. These inspections are initiated as part of NSTIR policy.

Post construction monitoring will be undertaken based on approval requirements but is expected to include monitoring during the appropriate biological seasons of priority species within the RoW and wetlands adjacent to the footprint. Typically such monitoring is undertaken in years three and five following construction.

7.0 REFERENCES

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