November 2009

Environmental Impact Assessment Report

HIGHWAY 113

Submitted by:

NOVA SCOTIA

Transportion and Infrastructure Renewal

DILLON CONSULTING

Class I Environmental Impact Assessment
Highway 113 Project

November 13, 2009

Submitted to:
Nova Scotia Department of Transportation and Infrastructure Renewal

08-9611-1000

Submitted by:
Dillon Consulting Limited

November 13, 2009

NOVA SCOTIA TRANSPORTATION
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ATTENTION: Mr. Phil Corkum, P.Eng.

Highway 113–Environmental Assessment Report

Please find enclosed an Environmental Assessment Report for the proposed Highway 113. The report addresses the Terms of Reference issued by Nova Scotia Environment and Labour (now Nova Scotia Environment) on October 16, 2006 as well as issues raised by regulatory agencies, environmental non-governmental organizations, and the public with respect to the project.

If you have any questions on the report, do not hesitate to contact me.

Yours truly,

DILLON CONSULTING LIMITED

Robert Young, M.Sc., P.Geo.
Project Manager

RBY:jep
Our File: 08-9611

EXECUTIVE SUMMARY

Nova Scotia Transportation and Infrastructure Renewal (TIR) is proposing to construct a new twinned (four lane, wide median) highway (Highway 113) between Highway 103 near Exit 4 and Highway 102 near Exit 3 to improve the efficiency of travel between Highways 103 and 102 as well as to relieve increasing congestion on Hammonds Plains Road. Highway 113 will be a 9.9 km highway with interchanges located on Highway 103 west of Exit 4; at the Sheldrake Heights connector road (a half-diamond interchange); at Kearney Lake Road; and at Highway 102 west of Exit 3. The overall goal of the proposed highway is to allow through traffic from Highway 103 to Highway 102 (and vice versa) to bypass the Halifax urban core, thereby reducing travel time and reducing traffic volumes on the inner reaches of Highway 102 and Highway 103 and the Hammonds Plains Road. Nova Scotia Transportation and Infrastructure Renewal commenced needs assessment and initial planning activities for Highway 113 in 1998.

Need for the Project

The traffic which presently passes between Highway 103 along the South Shore and Highway 102 north of Bedford will experience the most benefit from the shorter route length, faster operating speeds, and higher levels of service along Highway 113. Commercial traffic traveling between Highways 102, Highway 103, and the proposed Highway 107 extension (east of Highway 102 and west of Highway 118) will similarly benefit from the traffic improvements resulting from Highway 113. While construction is not anticipated to happen for many years, early planning for the highway is important as the area has been developing quickly and possible routes for a future highway were becoming increasingly limited. Without TIR proactively preserving the corridor the majority of land required for the highway would have likely been privately developed making future highway construction very disruptive and expensive. The majority of the property necessary for the highway has now been acquired by TIR.

Highway 113 is consistent with the Halifax Regional Municipality's Municipal Planning Strategy, which indicates that the need for such a facility would be necessary to accommodate future growth areas such as Upper Tantallon, Hubley, Bedford West and the lands adjacent to Hammonds Plains Road in the vicinity of the Halifax peninsula. The plan identifies Highway 113 as a "Future Potential Project" that may be required beyond the Plan's 25 year horizon.

Alternatives

Alternatives to the construction of a new highway in this location include: implementing other modes of transportation; upgrading Hammonds Plains Road to 100 series highway standards; or do nothing. The alternatives were not deemed as sufficient or viable to address growing traffic volumes and to improve the efficiency in commercial traffic movement.

The chosen alignment takes into consideration a number of objectives: minimizing intrusion into crown lands; maintaining a balance of separation distances between Ragged Lake and Blue Mountain Hill; minimizing wetland impacts; and on-going cooperation with NSE, NSDNR, and HRM on highway planning and design.

Previous Environmental Assessment Activities

TIR had previously completed a Registration Document in 2000 in accordance with the Environmental Assessment Regulations in force at that time (Washburn and Gillis, 2000). The Registration Document was supplemented with 3 addenda issued between 2001 and 2004 to address specific questions regarding project funding; landowner discussions; wildlife movement and corridors; distribution of Mainland moose in the study area; encroachment on Blue Mountain Hill; and the deletion of a proposed connector road at the west end of the proposed highway (it was subsequently constructed). In addition, TIR completed a Focus Report in 2006 that examined how the proposed highway fit with Halifax Regional Municipality's Regional Planning Strategy (now Municipal Planning Strategy). On July 10, 2006 the Minister of Environment and Labour determined that an Environmental Assessment Report was required in accordance with Part IV of the Environment Act based on a review of the Focus Report and input received from provincial and federal agencies and the public. Subsequently, Nova Scotia Environment and Labour (now Nova Scotia Environment [NSE]) issued the Terms of Reference for this Environmental Assessment Report. The environmental assessment incorporates the findings and conclusions of this previously completed work and specifically addresses the requirements of the Terms of Reference.

Environmental Assessment Results

The overall approach taken for this environmental assessment was to focus on project-specific issues or concerns in a manner that is consistent with the NSE Terms of Reference. As a result this environmental assessment has been prepared following an 'issues based' framework that focuses the assessment of impacts on relevant project-specific issues and environmental concerns raised by the public, regulatory agencies and the environmental assessment team.

The issues-based methodology takes into account issues of concern raised by the public and regulatory agencies. The issues to be addressed are identified at the early stages of the assessment and it is those issues that were emphasized in the completion of the EA. This allows the EA to focus on not only VECs as identified in the Terms of Reference but also on important project and site specific issue. Prominent issues raised and their resolutions are summarized below.

Impacts on mainland moose and deer and fragmentation/impacts on existing ecological integrity of the area (includes Blue Mountain/Birch Cove Lakes)

Studies by NSDNR on the spatial distribution and abundance of Mainland Moose have shown that there is a small population that exists on Chebucto Peninsula but several winter aerial and radio-tracking studies have shown that this small population limits its range to the Chebucto Peninsula and the range would not be fragmented by the proposed highway as the population does not usually venture close to the proposed alignment or the Blue Mountain/Birch Cove Lakes Wilderness Area. TIR will provide a structure between Maple and Fraser Lake with an opening large enough for large mammals to pass. Therefore, impacts on mainland moose and deer are not significant. In addition, the use of open span culverts will allow for movement of small mammals and herpetiles. Hydraulic connectivity of wetlands crossed by the highway will be maintained.

Surface Water Quality and Quantity

It is predicted that there would be a low level of significance for this issue as erosion and sediment control measures will be implemented during construction and maintained throughout the construction period. These will be identified in Environmental Control Plans and Culvert Mitigation Plans and will consistent with the Generic EPP. Measures will be maintained through all seasons. Ongoing monitoring of upcoming weather conditions will occur to prepare for specific events.

Wetlands

There are no significant residual effects that are identified for wetlands that cannot be avoided or mitigated based on TIR working with NSE, DFO, NSDNR and EC staff to finalize appropriate compensation measures for wetlands within the footprint of the highway. TIR has minimized impacts by alterations made to the alignment requested by NSDNR. Where impacts to wetlands are unavoidable TIR will prepare detailed designs for the proposed work and submit wetland alteration approval applications to NSE.

Priority and At Risk Species and Migratory Birds

It is predicted that effects on these species are not significant and no significant residual effects have been identified for priority and at risk species that cannot be avoided or mitigated. TIR will work with NSDNR staff to finalize appropriate management planning for the Southern Twayblade on completion of detailed designs for the proposed highway. Construction work will be scheduled to be seasonally sensitive to nesting and migratory birds

Groundwater

Water wells within 300 m of the alignment are drilled wells and cased to bedrock. As a result run-off from highway construction and maintenance is not expected to impact well water. Should wells be impacting by blasting, TIR will replace the well. The effects of the project on groundwater are not significant.

Fish Habitat Assessment of Proposed Crossings

TIR will implement mitigation measures consistent with the protection of surface water quality noted above including site specific Erosion and Sediment Control measures. In addition, habitat loss associated with watercrossings will be addressed through DFO's HADD process or equivalent at the time of design. As a result, habitat loss is not considered significant.

Traffic/Transportation

The Highway 113 project will improve the traffic conditions of the area, primarily on Highway 102, Highway 103, and Route 213 (Hammonds Plains Road). The project will provide a safer and more efficient transportation corridor for commuters as well as for trucking goods and services. Therefore, the volume of traffic projected to be diverted to the new Highway 113 will reduce traffic demands on Hammonds Plains Road and other surrounding facilities in the future.

This is beneficial as the projected transportation demands along existing facilities are expected to exceed capacity in the near future. The project will reduce or delay the need for widening and upgrading of other roadways.

Land Use and Socio-Economic Considerations

The proposed alignment will likely have both positive and negative effects to property values along the alignment, depending on the existing and potential land use for property. For example, a negative effect to property values may occur as a result of the presence of the highway in the vicinity of residential dwellings. TIR will conduct further investigation of noise effects of the highway during the design phase of the project and will implement appropriate mitigation measures to minimize impacts on property value, if required. Conversely, there are expected to be positive effects associated with the shorter travel time or increased access resulting from the new alignment where interchanges are close by. For example, commercial property values in the Atlantic Acres Business Park could potentially increase in value due to improved access to the provincial highway network. In addition, there will be no access from the highway to adjacent private landholdings or crown lands and therefore the highway will not act as a catalyst for future development in these areas.

Air Quality

The construction phase of the project will have limited negative effects on local air quality through the potential for dust generation. Implementation of dust control practices will minimize these effects on air quality. There is expected to be an improvement in air quality with the reduction of congestion on existing routes. Therefore the effects of the project on air quality are considered not significant.

Public Consultation

As part of the planning process for the proposed Highway 113 and throughout the environmental assessment process, including during the preparation of this environmental assessment report, the public and regulators have had opportunities to voice their concerns regarding the Project and the potential impacts. All of the concerns and items brought forward during these consultations were noted and reviewed during this study. TIR is committed to the development of a Community Liaison Committee (CLC) when a decision is made to proceed with the project. The CLC will be composed of representatives from the community; HRM regional planning, traffic and transportation, parks; environmental interest groups; and watershed advisory committees. This will include third party facilitation to coordinate communication to and from the CLC with the broader community. TIR expects that representatives of NSE and NSDNR will also be involved in the CLC by providing information on provincial programs and activities relevant to the highway.

Conclusion

Through careful design and planning, engagement with the public, stakeholders and regulatory authorities and the use of TIR's Generic EPP, combined with application of appropriate site specific mitigation measures. TIR will address potential adverse environmental effects and reduce the predicted adverse impacts to a low level of significance through project planning and implementation. In summary therefore, the proposed Highway 113 Project has important overall social and safety benefits, both locally and regionally. This environmental assessment demonstrates that any adverse effects or significant environmental effects of the project can be adequately mitigated through compliance with the proactive planning and mitigation measures described in this environmental assessment.

List of Acronyms

AADT	Annual Average Daily Traffic
AB	Aggregate Base
AC	Asphalt Concrete
ACCDC	Atlantic Canada Conservation Data Centre
ADR	Alternate Dispute Resolution
AMD	Acid mine drainage
ARD	Acid Rock Drainage
ASB	Aggregate Subbase
BMPs	Best Management Practices
CDWQ	Canadian Drinking Water Quality
CEAA	*Canadian Environmental Assessment Act*
CEPA	Canadian Environmental Protection Act
CH_4	Methane
CLC	Community Liaison Committee
CMP	Culvert Mitigation Plan
CO_2	Carbon dioxide
COR	Conditions of Release
CWS	Canadian Wildlife Service
DFO	Department of Fisheries and Oceans (Federal)
EA	Environmental Assessment
EC	Environment Canada
ECP	Environmental Construction Plan
ECM	Environmental Compliance Monitoring
EEM	Environmental Effects Monitoring
EMP	Environmental Management Plan
EPP	Environmental Protection Plan
ESC	Erosion and Sediment Control
FA	*Canadian Fisheries Act*
GHG	Greenhouse Gas
GPS	Global Positioning System
HMVK	Million vehicle-kilometres
HRM	Halifax Regional Municipality
HRWC	Halifax Regional Water Commission
IRM	Integrated Resource Management
MBCA	*Migratory Birds Convention Act*
NDSI	Noise Depreciation Sensitivity Index
NMHC	Non-methane hydrocarbons
NOx	Nitrogen oxides
N_2O	Nitrous oxide
NSE	Nova Scotia Department of the Environment

NSESA	*Nova Scotia Endangered Species Act*
NSNR	Nova Scotia Department of Natural Resources
NSPI	Nova Scotia Power Inc.
TIR	Nova Scotia Department of Transportation and Infrastructure Renewal
NWPA	*Canadian Navigable Waters Protection Act*
PCC	Portland Cement Concrete
PID	Property Identifier
PM	Particulate matter
ROW	Right-of-Way
SARA	*Canadian Species at Risk Act*
SMP	Salt Management Plan
SOx	Sulphur oxides
SPP-HD	Special Places Program – Heritage Division
TAC	Transportation Association of Canada
TC	Transport Canada
TOR	Terms of Reference
TSS	Total Suspended Solids
VEC	Valued Ecosystem or Environmental Component
VOCs	Volatile organic compounds

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Appendices

1.0 Introduction

Nova Scotia Transportation and Infrastructure Renewal (TIR) is proposing to construct a new twinned (four lane, wide median) highway (Highway 113) between Highway 103 near Exit 4 and Highway 102 near Exit 3 (Figure 1-1) to improve the efficiency of travel between Highways 103 and 102 as well as to alleviate increasing congestion on Hammonds Plains Road. Highway 113 will be a 9.9 km highway with interchanges located on Highway 103 west of Exit 4; at the Sheldrake Heights connector road (a half-diamond interchange); at Kearney Lake Road; and at Highway 102 west of Exit 3.

TIR had previously completed a Registration Document in 2000 in accordance with the Environmental Assessment Regulations in force at that time (Washburn and Gillis, 2000). The Registration Document was supplemented by 3 addenda issued between 2001 and 2004 as well as a Focus Report requested by the Minister of Environment and Labour in 2006 that examined how the proposed highway fit with Halifax Regional Municipality's Regional Planning Strategy (TIR , 2006). On July 10, 2006 the Minister of Environment and Labour concluded a review of TIR's Focus Report for the proposed highway and consideration of input received from provincial and federal agencies and the public. The Minister determined that an Environmental Assessment Report was required in accordance with Part IV of the Environment Act. Subsequently, Nova Scotia Environment and Labour (now Nova Scotia Environment [NSE]) issued Terms of Reference for the Environmental Assessment Report.

Applicable project and environmental details provided in the 2000 Registration Document, addenda, and the 2006 Focus Report have been incorporated into this EA Report.

The purpose of this environmental assessment (EA) is to:

- Consider the potential for both positive and negative changes on the environment resulting from the construction and operation of the highway;
- Outline mitigation and impact management measures to address negative impacts;
- Assess residual environmental effects and determine their significance;
- Identify compliance and effects monitoring to be conducted during the construction and operation of the highway; and
- Satisfy the NSE's October, 2006 Terms of Reference for the project.

The EA has been organized in general concordance with the NSE Terms of Reference for ease of reference. Section 1 provides an overview of the project and its history. Section 2 provides a description of the project from pre-construction activities to operations. Section 3 describes the regulatory environment applicable to the project. Sections 4, 5 and 6 address the need for the project; alternatives to project; and other methods of carrying out the project respectively. Section 7 describes the assessment methodology utilized in this EA. Section 8 describes the existing environment within the study area of the project. Section 9 describes the assessment environmental effects and mitigation of the environmental effects. Section 10 describes environmental effects that may remain following the application of mitigation measures (residual adverse effects). Section 11 evaluates the advantages and disadvantages to the environment due to the project. Section 12 describes proposed compliance and environmental effects monitoring programs. Section 13 provides details on the public information program regarding the project. Section 14 summarizes the assessment and provides conclusions of the assessment.

1.1 Project History

Nova Scotia Transportation and Infrastructure Renewal commenced needs assessment and initial planning activities for Highway 113 in 1998 commencing with the Highway Environmental Database Study screening matrix. All relevant issues have been addressed through this and earlier reports. In 2000, TIR (then NSTPW) filed an Environmental Assessment Registration for the project with NSE. Highway 113 is going through the EA process now in order to preserve the corridor for the highway, should it be needed in the future. Development in the area is occurring so quickly that if TIR does not preserve the ROW corridor now, a highway in this area will become virtually impossible to locate outside of the ROW corridor proposed in the EA report.

The Registration document was followed by three addendums between 2001 and 2004. Addendum 1 was issued in April of 2001 and addressed:

- Sources of funding, at that time provincially funded;
- The status of developed or developable private land versus Crown lands in the vicinity of the project;
- The results of communications with developers that had land interests affected by the proposed highway;

- Confirmation that animal passage between Frasers and Maple Lake will be maintained and accommodated for in the design;
- Reviewing other wildlife or recreational crossing locations during the detailed design phase;
- Calculations demonstrating fuel emissions reductions resulting from the Highway; and
- A detailed list of plants identified during the original field surveys.

Addendum 2 was issued in June 2004 and addressed:

- Confirmation that there were no zoological Species at Risk of concern with the exception of Mainland Moose;
- The status of Mainland Moose in the study area, potential impacts, and mitigation options;
- An assessment of potential impacts on wilderness recreation specifically relating to the Blue Mountain area; and
- The effect the highway will have in limiting encroachment of development on the Blue Mountain area.

Addendum 3 was issued in October 2004 to advise NSE that a collector road from Trunk 3 to Highway 113 had been removed from the project and requested a re-registration of the project based on the revised scope of the project.

In November, 2005 the Minister of Environment and Labour issued a decision that a Focus Report would be required. The Focus Report was to address how the proposed Highway 113 fit within the context of the Halifax Regional Municipality's regional planning efforts, including but not limited to, consideration of parks and natural areas, recreational land-use, transportation corridors and private development. This decision was subsequently followed by Terms of Reference for the Focus Report which was issued in December, 2004. The final Focus Report was issued by TIR in March, 2006 (Environmental and Design Management, 2006).

On July 10, 2006, the Minister confirmed that a new Environmental Assessment Report would be required for the project and in October, 2006, NSE issued a Terms of Reference for the preparation of this environmental assessment report.

1.2 Project Summary and Location

The proposed Project consists of the design, construction, and operation of a new highway (Highway 113) which will connect Highway 102, near Exit 3, and Highway 103, just west of Exit 4. The overall goal of the proposed undertaking is to enable through traffic from Highway 103 to Highway 102 (and vice versa) to bypass the Halifax urban core, thereby reducing travel time and alleviating traffic on the inner reaches of Highway 102 and Highway 103 and the Hammonds Plains Road.

The following subsections provide a detailed description of the proposed undertaking, as well as general information related to typical highway projects of this nature.

1.2.1 Highway Corridor Location

The proposed highway connects Highway 102, near Exit 3 (Hammonds Plains), and Highway 103, just west of Exit 4 (Sheldrake Lake). As shown in Figure 1-1, the proposed route travels east from Highway 103, north of Exit 4, between Upper Sheldrake Lake and Sheldrake Lake, east between Maple and Frasers Lakes, south of Ragged and Ash Lakes, north of Kearney Lake, across Kearney Lake Road, and connects to Highway 102 south of Exit 3 (Hammonds Plains). The total length of the proposed highway is 9.9 km.

The proposed highway will be adjacent to the suburban communities of Sheldrake Lake, Five Island Lake and Timberlea where it connects with Highway 103. Between the interchange with Highway 103 and Ash Lake, the proposed highway passes through undeveloped land that has been the subject of forest harvest. Moving east, the alignment passes south of Kingwood subdivision between Ash Lake and Black Duck Brook. West Bedford Holdings Limited has a development (The Parks at Bedford West) planned for the land bounded by Kearney Lake Road, Highway 102, and Hammonds Plains Road. The alignment will pass through the planned development and has been incorporated into the developer's plan. It is expected that additional mixed development will happen on the lands between Kingswood and Kearney Lake Road.

The Blue Mountain – Birch Cove Lakes Wilderness Area (designated by the Nova Scotia Government in 2007) is located immediately to the south of the proposed alignment between Fraser Lake and Ragged Lake. The Blue Mountain - Birch Cove Lakes Wilderness Area comprises approximately 50% of the land use in the vicinity of the south of the corridor. The Blue Mountain-Birch Cove Lakes Wilderness Area is adjacent to approximately 30% of the alignment. There is a 40 m strip of land between the highway alignment and the Blue Mountain-Birch Cove Lakes Wilderness Area that was reserved as NSDNR crown land from the wilderness area at the request of TIR and HRM for the following reasons:

1. To accommodate a portion of an active transportation corridor as proposed by HRM.
2. To allow for modifications to the Highway 113 alignment that may be required following this EA.
3. To provide land that may be necessary to accommodate an interchange that HRM may wish to construct to provide access to developed land in the Kingswood Subdivision.

The reserve 40 m strip adjacent to Blue Mountain Hill is solely for the accommodation of active transportation and not for any TIR use. Lands surplus to these purposes will be added to the wilderness area. Similarly, TIR will support the transfer to the wilderness area of private lands, which are acquired by TIR and are surplus to TIR's needs.

The alignment is located in an area of mixed land use dominated by resource/recreational lands. Residential and commercial/industrial land uses are more prevalent at either end the highway corridor as well as to the north of the alignment (Kingswood subdivision). Residential land use is expected to increase at either end of the corridor as well as in select areas north of the corridor by the time the highway is constructed. Crown lands to the north are expected to remain mixed resource use. Parts of the Kingswood subdivision and the Sheldrake Heights subdivision abut the alignment.

1.3 Environmental Assessment Method

The overall approach taken for this environmental assessment was to focus on project-specific issues or concerns in a manner that is consistent with the NSE Terms of Reference. As a result this environmental assessment has been prepared following an 'issues based' framework that focuses the assessment of impacts on relevant project-specific issues and environmental concerns raised by the public, regulatory agencies and the environmental assessment team. Further discussion on this approach is provided in Section 7 – Assessment Methodology.

The use of valued ecosystem or environmental components (VECs) in EA is an established fundamental of EA methodology, and is recommended in EA practice guideline documents produced by NSE and the Canadian Environmental Assessment Agency. In addition, the use of VECs is specifically referenced in the NSE Terms of Reference for the project. The value of using VECs is to address potential project impacts on a selection of the key or valued components of the environment, rather than attempting to address every species and all their possible interactions with a proposed project.

A VEC, as originally intended by Beanlands and Duinker (1983), should be a species selected as representative of other species, such as a particularly sensitive species, or as a highly valued species. For example, the consideration of Atlantic salmon as a VEC meets the criteria as both a particularly sensitive and highly valued species.

An issues-based methodology takes a somewhat different approach in that the issues, and not necessarily VECs, that must be addressed are identified at the early stages of the assessment and it is those issues that are emphasized in the completion of the EA. This allows the EA to focus on not only VECs as identified in the Terms of Reference but also on important project and site specific issues. Many of the issues are reflected within a conventional environmental effects assessment framework e.g. existing conditions-impact assessment-mitigation-residual effects; however, some issues e.g. those that can be mitigated by project planning and design, may be fully addressed within the Project Description thereby foregoing the need to carry the issue any further in the assessment.

Measures that in the past have been described as mitigation are now environmental protection measures and are an integral part of any responsibly designed project. Since environmental protection measures will be considered during the design of the highway and will also be written into the construction specifications for the Project, these environmental protection measures are more appropriately described in the Project Description section rather than an Effects Mitigation section (For example, the Generic Environmental Protection Plan for 100 Series Highways (http://www.gov.ns.ca/tran/enviroservices/govEPP100.asp). Furthermore, with the practice of

Figure 1-1 Proposed Alignment

proactive environmental planning and management, the mitigation measures that would normally be added between impact identification and evaluation of residual impacts have been minimized. Therefore, only mitigation that must be developed for a specific issue, such as site-specific challenges or new regulatory requirements has been identified.

This rationale carries into the environmental effects assessment framework in that if an issue is fully addressed at any point within the impact assessment e.g. research indicates a certain species is not present or its habitat avoided through project design, then there is no requirement to carry the issue through the remainder of process.

In order to demonstrate conformance with the NSE Terms of Reference and applicable regulatory requirements the EA includes:

- A concordance table that identifies the issues raised during the EA process to date; the corresponding sections of the Terms of Reference; and where in the EA the issues are discussed;
- A detailed assessment of the environmental and socio-economic impact of the project identifying both positive and negative impacts; and
- Project planning or mitigation measures to address the potential negative impacts.

1.4 Table of Concordance

Since the commencement of project planning and the EA process, a number of pertinent issues related to the construction and operation of the highway have been identified by the public, stakeholders, and TIR. These issues include consist of environmental and socio-economic concerns common to highway planning and design; as well as unique to the Project. The identified issues; and the corresponding sections of the Terms of Reference (ToR) and the EA are summarized in Table 1-1. A second concordance table is provided to assist in reviewing this EA against the requirements ToR (Table 1-2).

9.3 -Socio-economic conditions;
9.8 - Flora and Terrestrial Habitat;
9.9 – Wildlife and Migratory Birds;
9.11 – Fish and Fish Habitat; and

Table 1-1 Highway 113 Issues List

Issue	Source(s)	NSE Terms of Reference	EA Report Section(s)
Biophysical			
Fragmentation/impacts on existing ecological integrity of the area (includes Blue Mountain/Birch Cove Lakes)	Public comments, Nature Nova Scotia, St. Margaret's Bay Stewardship Association, Halifax North West Trails, Halifax Field Naturalists	8.9 Flora, Fauna and Habitat Evaluation 9.3 Impacts on Socio-Economic Conditions and Mitigation 9.8 Impacts on Flora, Fauna and Habitat and Mitigation 9.10 Impacts on Aquatic Species and Habitat and Mitigation	9.3 -Socio-economic conditions; 9.8 - Flora and Terrestrial Habitat; 9.9 – Wildlife and Migratory Birds; 9.11 – Fish and Fish Habitat; and 12 Monitoring.
Surface water quality and quantity	Public comments, Nova Scotia Department of Environment, Clean Nova Scotia, St. Margaret's Bay Stewardship Association, Halifax North West Trails	8.7 Surface Water 9.6 Impacts on Surface Water and Mitigation	9.6 – Surface Water; and 12 Monitoring.
Wetlands	Public comments, Nova Scotia Department of Environment, Environment Canada, Clean Nova Scotia, St. Margaret's Bay Stewardship Association, Halifax Field Naturalists	8.9 Flora, Fauna and Habitat Evaluation 8.10 Wetlands 9.9 Impacts on Wetlands and Mitigation	9.8 - Flora and Terrestrial Habitat; 9.10- Wetlands; and 12 Monitoring.
Impact on mainland moose and deer	Public Comments, Clean Nova Scotia, Nova Scotia Department of Natural Resources	8.9 Flora, Fauna and Habitat Evaluation 9.8 Impacts on Flora, Fauna and Habitat and Mitigation	9.8 - Flora and Terrestrial Habitat; 9.9 – Wildlife and Migratory Birds; and 12 Monitoring.

Table 1-1 Highway 113 Issues List (cont.)

Issue	Source(s)	NSE Terms of Reference	EA Report Section(s)
Impact on mature and interior forest habitats; old-growth Acadian forest	Public comments, Environment Canada, Clean Nova Scotia	8.9 Flora, Fauna and Habitat Evaluation 9.8 Impacts on Flora, Fauna and Habitat and Mitigation	9.8 - Flora and Terrestrial Habitat;
Priority and at risk species	Nova Scotia Department of Natural Resources, Environment Canada	8.9 Flora, Fauna and Habitat Evaluation 8.10 Wetlands 9.8 Impacts on Flora, Fauna and Habitat and Mitigation	9.8-Flora and Terrestrial Habitat; 9.9-Wildlife and Migratory Birds; 9.10 Wetlands 9.11- Fish and Fish Habitat; and 12 Monitoring.
Groundwater	Public comments	8.8 Groundwater 9.7 Impacts on Groundwater and Wells and Mitigation	7.2.2 -Blasting 7.9.3 -Winter Maintenance; 9.7 – Groundwater 12.2-Pre-Blast and Water Well Surveys
Road salt – see also water quality and quantity	Public comments, Environment Canada	9.6 Impacts on Surface Water and Mitigation	7.9.3 - Winter Maintenance; 9.6 – Surface Water; and 12 Monitoring.
Migratory birds	Environment Canada	8.9 Flora, Fauna and Habitat Evaluation 9.8 Impacts on Flora, Fauna and Habitat and Mitigation	7.9.2-Vegetation Control; 7.10.4-Fires; 9.9-Wildlife and Migratory Birds; and 12 Monitoring.
Can highway be constructed as narrow median to reduce impact?	Clean Nova Scotia	6.0 Other Methods for Carrying Out the Project	2.2-Safety; and 4.2-Adjusting the Median Width.

Table 1-1 Highway 113 Issues List (cont.)

Issue	Source(s)	NSE Terms of Reference	EA Report Section(s)
Impact on wildlife corridor between Fraser Lake and Hammonds Plains Road	Clean Nova Scotia	8.9 Flora, Fauna and Habitat Evaluation 9.8 Impacts on Flora, Fauna and Habitat and Mitigation	9.8-Flora and Terrestrial Habitat; and 9.9-Wildlife and Migratory Birds.
Protection of natural geologic features, landmarks, look-offs, scenic vistas	Public comments	8.12 Bedrock and Surficial Geology 9.11 Geological Impacts and Mitigation	9.12-Bedrock and Surficial Geology.
Qualified professionals need to conduct field work	Public comments	7.0 Assessment Methodology	1.3 –Environmental Assessment Method; and Field Appendices.
Fish habitat assessment of proposed crossings	Fisheries and Oceans Canada	8.9 Flora, Fauna and Habitat Evaluation 8.11 Aquatic Species and Habitat 9.10 Impacts on Aquatic Species and Habitat and Mitigation 9.13 Blasting Impacts and Mitigation	9.6-Surface Water ; 9.11- Fish and Fish Habitat; 7.2.2-Blasting; and 12 Monitoring
Incomplete botanical surveys in previous EAs for project	Nova Scotia Museum	7.0 Assessment Methodology 8.9 Flora, Fauna and Habitat Evaluation	1.3 –Environmental Assessment Method; 9.8-Flora and Terrestrial Habitat; and Appendices A1, A2, B3, B4.
Potential for excavation of Halifax formation slates	Nova Scotia Department of Environment	8.12 Bedrock and Surficial Geology 9.11 Geological Impacts and Mitigation	7.5 Acid Producing Bedrock; and 9.12-Bedrock and Surficial Geology
Movement of species within the Birch Cove/Cox Lake corridor	Nova Scotia Department of Environment	8.9 Flora, Fauna and Habitat Evaluation 9.8 Impacts on Flora, Fauna and Habitat and Mitigation	9.9-Wildlife and Migratory Birds.

Table 1-1 Highway 113 Issues List (cont.)

Issue	Source(s)	NSE Terms of Reference	EA Report Section(s)
Traffic/Transportation			
Traffic justification for the project	Public comments, Clean Nova Scotia, St. Margaret's Bay Stewardship Association, Halifax North West Trails, Halifax Field Naturalists	4.0 Need for the Project 8.2 Transportation 9.1 Impacts on Transportation and Mitigation	2.0-Need for the Project; and 9.1 Transportation.
Effectiveness of use of tax revenue to construct the highway versus alternatives	Public comments, Halifax North West Trails	4.0 Need for the Project 5.0 Description of Alternatives to the Project 8.2 Transportation	2.0-Need for the Project; 3.0-Description of Alternatives to the Project; and 9.1 Transportation.
Ability to handle more traffic in Kingswood if there is an interchange	Public comments, Clean Nova Scotia	8.3 Existing and Planned Land Uses 9.1 Impacts on Transportation and Mitigation?? 9.2 Impacts on Land Use and Mitigation 9.3 Impacts on Socio-Economic Conditions and Mitigation	9.2-Existing and Planned Land Use; 9.1-Transportation; and 9.3-Socio-economic Conditions.
Public transit as an alternative	Public comments, Clean Nova Scotia	5.0 Description of Alternatives to the Project 8.2 Transportation	3.1-Other Modes of Transportation; and 9.1-Transportation.

Table 1-1 Highway 113 Issues List (cont.)

Issue	Source(s)	NSE Terms of Reference	EA Report Section(s)
Land Use/Socio-Economic			
Impact on property value	Public comments	8.3 Existing and Planned Land Uses 8.4 Socio-Economic Conditions 9.2 Impacts on Land Use and Mitigation 9.3 Impacts on Socio-Economic Conditions and Mitigation 9.5 Noise Impacts and Mitigation	9.2-Existing and Planned Land Use; 9.3-Socio-economic Conditions; and 9.5-Ambient Noise Levels.
Noise	Public comments	8.6 Ambient Noise Levels 9.5 Noise Impacts and Mitigation	7.2.2-Blasting; and 9.5-Ambient Noise levels
Justification for the project given Blue Mountain/Birch Cove Lakes	Public comments, Clean Nova Scotia	4.0 Need for the Project	2.0-Need for the Project;
Land use and socio-economic conditions specifically Blue Mountain/Birch Cove Lakes	Public comments	8.3 Existing and Planned Land Uses 8.4 Socio-Economic Conditions 9.2 Impacts on Land Use and Mitigation 9.3 Impacts on Socio-Economic Conditions and Mitigation	9.2-Existing and Planned Land Use; 9.3-Socio-economic Conditions; and 9.9-Wildlife and Migratory Birds.
Water wells	Nova Scotia Department of Environment	8.8 Groundwater 8.14 Pre-Blast Survey 9.7 Impacts on Groundwater and Wells and Mitigation 9.13 Blasting Impacts and Mitigation	7.2.2 –Blasting; 7.9.3 -Winter Maintenance; 9.7 – Groundwater; and 12.2-Pre-Blast and Water Well Surveys.

Table 1-1 Highway 113 Issues List (cont.)

Issue	Source(s)	NSE Terms of Reference	EA Report Section(s)
Light pollution and energy use of highway lighting	Clean Nova Scotia	9.2 Impacts on Land Use and Mitigation	9.2.3 Existing and Planned Land Use Impact Evaluation/Effects Assessment; 9.4.2.1-Micro-climate Modifications
Potential for increased access to backlands	Clean Nova Scotia	9.2 Impacts on Land Use and Mitigation	9.2.3 Existing and Planned Land Use Impact Evaluation/Effects Assessment
Development of the highway allowing access for private development of provincial crown lands	Public Comment	9.2 Impacts on Land Use and Mitigation	1.2.1 Highway Corridor Location
Will highway increase possibility of more trails/parks in the area?	Clean Nova Scotia	8.3 Existing and Planned Land Uses 9.2 Impacts on Land Use and Mitigation	9.2.3 Existing and Planned Land Use Impact Evaluation/Effects Assessment
Fate of lands if highway does not proceed	Clean Nova Scotia	9.2 Impacts on Land Use and Mitigation	9.2.2 Future Land Use Assessment
Will there be development south of the highway if it proceeds?	Clean Nova Scotia	8.3 Existing and Planned Land Uses	9.2.2 Future Land Use Assessment
Accurate description of benefits/negatives to Kingswood residents	Public comments	9.2 Impacts on Land Use and Mitigation 9.3 Impacts on Socio-Economic Conditions and Mitigation	9.3.2 Socio Economic Impact Evaluation/Effects Assessment
Archaeological monitoring in areas of potential petroglyphs	Nova Scotia Museum	8.13 Historical, Archaeological, Paleontolgoical and Architectural Resources 9.12 Impacts on Historical, Archaeological, Paleontological and Architectural Resources and Mitigation	9.13-Historical, Archaeological and Paleontological and Architectural Resources; and Appendix C.
Impacts on recreational use of area and access to proposed Blue Mountain/Birch Cove Lakes Wilderness area	Project Team	8.3 Existing and Planned Land Uses 9.2 Impacts on Land Use and Mitigation	9.2-Existing and Planned Land Uses.

Table 1-1 Highway 113 Issues List (cont.)

Issue	Source(s)	NSE Terms of Reference	EA Report Section(s)
First Nations Land Use	Project Team	8.3 Existing and Planned Land Uses 9.2 Impacts on Land Use and Mitigation	9.2-Existing and Planned Land Uses.
Air Quality			
Air Emissions	Public comments, Environment Canada	9.4 Impacts on Air Quality and Mitigation	9.4 Atmospheric Conditions.
Greenhouse gas emissions	Public comments, St. Margaret's Bay Stewardship Association	9.4 Impacts on Air Quality and Mitigation	9.4 Atmospheric Conditions.
Effect on driving patterns, fuel consumption, vehicle emissions, air quality	Nova Scotia Medical Officer of Health	9.1 Impacts on Transportation and Mitigation 9.4 Impacts on Air Quality and Mitigation	2.3 Efficiency of Travel; and 9.4 Atmospheric Conditions
Process			
Time between completion of EA and construction of the project	Environment Canada, St. Margarets Bay Stewardship Association	4.0 Need for the Project	1.5 Planning Horizon; and 7.3 Construction Schedule.
Use of Crown lands	Nova Scotia Department of Natural Resources	8.3 Existing and Planned Land Uses 9.2 Impacts on Land Use and Mitigation	Figure 9-2.
Intergovernmental cooperation in preparation of the EA	Halifax Regional Municipality		2.0 Need for the Project.
Overall justification for the project	Public comments	4.0 Need for the Project	2.0 Need for the Project
Public Consultation			
Consultation with residents needed	Public comments	13.0 Public Information Program	6.0 Public Information Program.
More consultation required	Public comments	13.0 Public Information Program	6.0 Public Information Program.

Table 1-2 Concordance of EA with NSE Terms of Reference

Terms of Reference	EA Section
1.0 Introduction	1.0 Introduction
2.0 Project Description	7.0 Project Description
2.1 Highway Corridor Location	7.1 Highway Corridor Location
2.2 Construction Methods, Schedule and Other Constraints	7.2 Construction Methods 7.3 Construction Schedule
2.2.1 General construction practices	7.2 Construction Methods
2.2.2 Description of vehicle types, truck routes, hours of operation of vehicles to be used in highway construction	7.2.13 Equipment Types and Truck Routes
2.2.3 Proposed construction schedules	7.3 Construction Schedule
2.2.4 Identification of areas requiring major cut and/or fill operations	7.2.1 Excavation
2.2.5 Timing and extent of surveys for flora, fauna, and ecologically sensitive areas	12.3.2 Sensitive Terrestrial Habitat
2.3 Structures	7.4 Ditches, Structures and Culverts
2.4 Acid Producing Bedrock	7.5 Acid Producing Bedrock
2.5 Borrow Material	7.6 Borrow Material
2.6 Paving Materials	7.7 Paving Material
2.7 Construction Waste Disposal	7.8 Construction Waste Disposal
- Excess/waste excavated rock and overburden.	7.8 Construction Waste Disposal
- Planned disposal sites including acid producing slate.	7.8 Construction Waste Disposal 7.5 Acid Producing Bedrock
- Disposal of organic soil, slash, grubbing and wood fibre.	7.8 Construction Waste Disposal
3.0 Regulatory Environment	5.0 Regulatory Environment
4.0 Need for the Project	2.0 Need for the Project
5.0 A Description of Alternatives to the Project	3.0 Description of Alternatives to the Project
6.0 Other Methods for Carrying out the Project	4.0 Other Methods for Carrying out the Project
7.0 Assessment Methodology	1.3 Assessment Methodology
a) Valued Environmental Components	8.1 Valued Environmental Components
b) Temporal boundaries	8.2.2 Temporal Boundaries
c) Study boundaries	8.2.1 Spatial Boundaries
d) Strategy for investigating interactions between the Project and each VEC	Table 8-1
e) Strategy for predicting and evaluating Project impacts	9.0 Environmental Effects Assessment
8.0 Existing Environment	9.0 Environmental Effects Assessment
8.1 Area Geography	1.2.1 Highway Corridor Location
8.2 Transportation	9.1 Transportation
8.3 Existing and Planned Land Uses	9.2 .1Existing Environment 9.2.3 Impact Evaluation/Effects Assessment
- Describe patterns of current and planned land use and settlement including First Nations.	9.2 .1Existing Environment 9.2.3 Impact Evaluation/Effects Assessment
- Describe how the project is consistent with HRM's planning objectives.	9.2 .1Existing Environment 9.2.3 Impact Evaluation/Effects Assessment
- Describe how the Project is consistent with HRM's objectives for the proposed Blue Mountain/Birch Cove Lakes Regional Park.	9.2 .1Existing Environment 9.2.3 Impact Evaluation/Effects Assessment
8.4 Socio-Economic Conditions	9.3.1 Socio-Economic Conditions

Table 1-2 Concordance of EA with NSE Terms of Reference (cont.)

Terms of Reference	EA Section
8.5 Atmospheric Conditions	9.4 .1 Atmospheric Conditions
8.5.1 Describe the air quality	9.4.1 Existing Environment
8.5.2 Describe weather patterns along the proposed route	9.4.1 Existing Environment
8.5.3 Evaluate affects of storm events	9.14.2 Impacts of the Environment on the Project
8.6 Ambient Noise Levels	9.5.1 Ambient Noise Levels
8.7 Surface Water	9.6.1 Surface Water
8.8 Groundwater	9.7.1 Groundwater
8.9 Flora, Fauna and Habitat Evaluation	9.8.1 Flora and Terrestrial Habitat
8.9.1 Include the required information as stated in the Guide to Addressing Wildlife Species and Habitat in an EA Registration Document	9.9.1 Wildlife and Migratory Birds
8.9.2 Survey migratory birds in the proposed project area	9.9.1 Wildlife and Migratory Birds Appendix B1
8.9.3 Identify any existing or planned wildlife management areas, regional parks, ecological reserves, wilderness areas, managed wetlands and significant wildlife habitat	9.2 .1Existing Environment
8.10 Wetlands	9.10 Wetlands
8.11 Aquatic Species	9.11 Fish and Fish Habitat
8.11.1 Identify fish habitat	9.11 Fish and Fish Habitat
8.11.2 Describe the relative distribution, abundance, composition and socioeconomic importance	9.11 Fish and Fish Habitat
8.12 Bedrock and Surficial Geology	9.11 Fish and Fish Habitat
8.12.1 Bedrock geology	9.12 Bedrock and Surficial Geology
8.12.2 Acid generating bedrock	7.5 Acid Producing Bedrock
8.12.3 Surficial cover including overburden depth, soil types, permeability and areas of high erosion risk	9.12.1 Bedrock and Surficial Geology
8.12.4 Potential for disturbance of known or suspected contaminated soil	9.12.1 Bedrock and Surficial Geology
8.12.5 Areas having known or proven economic mineral deposits	9.12.1 Bedrock and Surficial Geology
8.13 Historical, Archaeological, Paleontological and Architectural Resources	9.12.1 Bedrock and Surficial Geology
8.14 Pre-Blast Survey	9.13.1 Historical, Archaeological, Paleontological and Architectural Resources
9.0 Adverse/Environmental Effects Assessment and Mitigation	12.2 Pre-Blast and Well Water Surveys
9.1 Impacts on Transportation and Mitigation	9.1.3 Impact Evaluation/Effects Assessment
9.2 Impacts on Land Use and Mitigation	9.2.3 Impact Evaluation/Effects Assessment
9.3 Impacts of Socio-Economic Conditions and Mitigation	9.3.2 Impact Evaluation/Effects Assessment
9.3.1 Impact on residential property values and plans for compensation	9.3.2 Impact Evaluation/Effects Assessment
9.3.2 Effect of proposed interchange locations on commercial/recreational and resource land uses	9.3.2.3 Proposed Interchange Locations
9.3.3 Impact on the proposed Blue Mountain/Birch Cove Lakes Regional Park.	9.3.2.4 Blue Mountain- Birch Cove Lakes Wilderness Area
9.3.4 Impact on First Nations' current uses of land and resources for traditional purposes.	9.2.3 Impact Evaluation/Effects Assessment

Table 1-2 Concordance of EA with NSE Terms of Reference (cont.)

Terms of Reference	EA Section
9.3.5 Describe dispute resolution process for addressing Project-related complaints.	6.0 Public Information Program 9.3.2.5 First Nations Land Use - A Mi'kmaq Environmental Knowledge study is in progress
9.4 Impacts on Air Quality and Mitigation	9.4.2 Impacts Evaluation/Effects Assessment
9.4.1 Impact of dust generated from highway construction.	9.4.2 Impacts Evaluation/Effects Assessment
9.4.2 Discuss potential for micro-climate modifications in vicinity of the project	9.4.2.1 Micro-climate Modifications
9.4.3 Describe a management strategy to reduce Greenhouse Gases, estimate GHG emissions associated with various project phases	9.4.2.1 Micro-climate Modifications
9.4.4 Describe and estimate emissions such as NOx, SOx, CO,VOC and PM. Best Management Practices to reduce air emissions.	9.4.2.1 Micro-climate Modifications
9.5 Noise Impacts and Mitigation	9.5.2, 9.5.3, 9.5.3 Ambient Noise Levels
9.6 Impacts on Surface Water and Mitigation	9.6.2 Impact Evaluation/Effects Assessment
9.6.1 Identify receiving waters and associated watersheds for run-off; discuss all associated impacts.	9.6.1 Existing Environment
9.6.2 Discuss potential for soil erosion	9.12.1 Bedrock and Surficial Geology
9.6.3 Discuss criteria used for design of run-off control features; present an outline of siltation, erosion, and run-off control measures.	7.10.2 Failure of Sediment Control Measures
9.6.4 Impacts on surface water and vegetation resulting from the use of ice and snow control procedures, and other maintenance activities.	7.9 Operation Activities
9.6.5 Impacts resulting from the disturbance of contaminated soils.	Table 9-24
9.6.6. Indicate the watercourses to be impacted and provide a description of the impacts.	9.11 Fish and Fish Habitat 9.11.2 Impact Evaluation /Effects Assessment
9.6.7 Indicate and discuss the probabilities of spills/accidents and the environmental consequences of such events; discuss commitments to provide contingency and remediation plans.	7.10 Possible Malfunctions or Accidents
9.7 Impacts on Groundwater Wells and Mitigation	9.7.2/3 Groundwater
- Describe potential impacts from road construction and operation on quantity and quality.	9.7.2/3 Groundwater
- Describe groundwater monitoring, mitigation and contingency plans.	9.7.2/3 Groundwater
- Discuss the probabilities of spills/accidents and environmental consequences.	7.10 Possible Malfunctions or Accidents
- Describe actions to be taken to moderate negative impacts on groundwater.	9.7.2/3 Groundwater
- Describe measures to be employed in the event of accidental dewatering of domestic supply wells.	9.7.2/3 Groundwater
- Describe commitments to provide contingency and remediation plans for contamination of or drainage to groundwater resources.	9.7.2/3 Groundwater
- Establish a road salt management strategy.	9.7.2/3 Groundwater

Table 1-2 Concordance of EA with NSE Terms of Reference (cont.)

Terms of Reference	EA Section
9.8 Impacts on Flora, Fauna and Habitat and Mitigation	9.8.2/3 Flora and Terrestrial Habitat 9.9.2/3 Wildlife and Migratory Birds
-Predict the impacts of construction and operation of the Project on terrestrial and aquatic flora and fauna.	9.8.2/3 Flora and Terrestrial Habitat 9.9.2/3 Wildlife and Migratory Birds
- Discuss the impacts on the fragmentation of wildlife populations and habitats including alteration or destruction of wildlife corridors.	9.8.2/3 Flora and Terrestrial Habitat 9.9.2/3 Wildlife and Migratory Birds
- Discuss measures to be taken to minimize the impacts of road construction and operation on floral species; preservation of existing vegetation; demonstrate priority on native species.	9.8.2/3 Flora and Terrestrial Habitat 9.9.2/3 Wildlife and Migratory Birds
- Discuss measures to be taken to minimize the impacts of road construction and operation on terrestrial and aquatic fauna; include plans for habitat preservation and compensation.	9.8.2/3 Flora and Terrestrial Habitat 9.9.2/3 Wildlife and Migratory Birds
- Discuss commitments to provide contingency and remediation plans.	9.8.2/3 Flora and Terrestrial Habitat 9.9.2/3 Wildlife and Migratory Birds
9.9 Impacts on Wetlands and Mitigation	9.10.2/3 Wetlands
- Provide site-specific mapping demonstrating why wetlands cannot be avoided; methods to minimize impacts.	9.10.2/3 Wetlands
- Monitoring plan for impacts from highway construction.	9.10.2/3 Wetlands
- Identify plans for preservation of existing wetlands and compensation for loss; monitoring of mitigative actions proposed.	9.10.2/3 Wetlands
- Potential consequences of increased access to wetlands (e.g. ATVs) and necessary protective measures.	9.2.7.1 Recreational Use
9.10 Impacts on Aquatic Species and Habitat and Mitigation	9.11.2/3 Fish and Fish Habitat
- Predict impacts on freshwater anadromous species; species of concern.	9.11.2/3 Fish and Fish Habitat
- Provide timing of work.	9.11.2/3 Fish and Fish Habitat
9.11 Geological Impacts and Mitigation	7.5 Acid Producing Bedrock
- Potential for acidic run-off; and alternatives to disrupting net acid producing bedrock.	7.5 Acid Producing Bedrock
- Contingency and remediation plans for watercourses affected by acidic run-off.	7.5 Acid Producing Bedrock
- Commitments to protect natural geologic features with particular reference to Blue Mountain Hill.	4.2 Adjusting the Median Width
9.12 Impacts on Historical, Archaeological, Paleontological and Architectural Resources, and Mitigation	9.13.2/3 Historical, Archaeological, Paleontological and Architectural Resources
9.13 Blasting Impacts and Mitigation	7.2.2 Blasting
9.14 Impacts of the Environment on the Project and Mitigation	9.14 Impacts of the Environment on the Project
9.14.1 Effect of climate on the construction and operation phases of the project.	9.14.1 Projects Climate Change Impacts for the Study Area

Table 1-2 Concordance of EA with NSE Terms of Reference (cont.)

Terms of Reference	EA Section
9.14.2 Accommodation for the potential effects of climate change.	9.14.1 Projects Climate Change Impacts for the Study Area
10.0 Residual Adverse Effects and Environmental Effects	10.0 Residual Adverse Effects and Environmental Effects
11.0 Evaluation of the Advantages and Disadvantages to the Environment	11.0 Evaluation of the Advantages and Disadvantages to the Environment
12.0 Proposed Compliance and Effects Monitoring Programs	12.0 Proposed Compliance and Effects Monitoring Programs
12.1 Pre-Blast Survey	12.2 Pre-Blast and Well Water Surveys
12.2 Well Water Survey	
13.0 Public Information Program	6.0 Public Information Program
14.0 Assessment Summary and Conclusion	13.0 Assessment Summary and Conclusion

1.5 Planning Horizon

The Department of Transportation and Infrastructure Renewal is currently planning for the construction of Highway 113, a 100 series highway connection from Highway 103 near the Sheldrake Lake Interchange (Exit 4) to Highway 102 near the Hammonds Plains Road Interchange (Exit 3), as indicated on Figure 1. The roadway is to enable through traffic to bypass the Halifax urban core and to alleviate traffic on the Hammonds Plains Road. Traffic which presently passes between Highway 103 along the South Shore and Highway 102 north of Bedford will experience the most benefit from the shorter route length, faster operating speeds, and higher levels of service along Highway 113. Commercial traffic traveling between Highways 102, Highway 103, and the proposed Highway 107 corridor (east of Highway 102 and west of Highway 118) will similarly benefit from the traffic improvements resulting from Highway 113.

As demonstrated in the Bayers Road/Highway 102 Corridor Study, Highway 113 will alleviate some of the congestion due to commuters travelling to Halifax and to Dartmouth via the MacKay Bridge. Within the study's horizon of 2036, a section of Highway 102 will need to be widened to 8 lanes if Highway 113 is not constructed. With Highway 113 in place, Highway 102 widening can be limited to 6 lanes. It will also delay the need for a third harbour crossing by providing some relief to traffic volumes on the Mackay Bridge as commuters travel to Dartmouth via Highway 103, proposed 113, 102, proposed 107 extension (Burnside to Bedford).

Through traffic traveling on the provincial 100 series highway network between Highway 103 along the south shore and Highway 102 north of Bedford, must currently travel into and out of the inner reaches of the Halifax area and it's more densely developed and travelled areas. The only alternative road bypassing the Halifax area is Hammonds Plains Road (Route 213). Through truck traffic is prohibited on Hammonds Plains Road. The proposed 9.9 km long highway would reduce the travel distance from Highway 103 to Highway 102 by approximately 13 km with a corresponding travel time savings of eight to ten minutes. Highway 113 would also significantly reduce the through non-truck traffic on Hammonds Plains Road. If constructed today, Highway 113 would reduce traffic on the Hammonds Plains Road by approximately 3500 to 5500 vehicles per day. Highway 113 will primarily alleviate traffic pressures on some of the higher volume sections of Highways 102 and 103.

As part of the preliminary planning process for the project a functional analysis, environmental screening and public consultation have been completed. The functional analysis considered the proposed Highway 113 to be designed as a four-lane divided highway with a wide median, fully controlled access, with entrances and exits at interchanges only, and a design speed of 120 km/hr (posted at 100 km/hr to 110 km/hr). High speed "fly-overs" are proposed at both ends for connection to Highways 102 and 103. A full diamond interchange is being considered at Kearney Lake Road while a half diamond interchange is proposed to serve the future connector road west of Frasers Lake. A limited access connector road to Trunk 3 will enable area residents to access the proposed highway. A 150 m wide right-of-way is proposed that would provide a minimum 25 m undisturbed buffer on both sides of the highway alignment.

Corridor preservation work for the proposed Highway 113 began in 1998. TIR forecast that traffic would continue to grow on major arterial routes, primarily Highway 102, Highway 103 and Hammonds Plains Road, and that eventually another road would be required to keep these existing roads operating at acceptable safety and service levels. It is evident today that traffic volumes have grown since 1998 as predicted.

While construction is not anticipated to happen for many years, early planning for the highway is important as the area is developing quickly and possible routes for a new road were limited. The majority of the proposed highway alignment crosses private land and generally skirts existing development. Without TIR proactively preserving the corridor the majority of land required for the highway would have likely been privately developed making future construction very disruptive and expensive. The majority of the property necessary for the highway has now been acquired since it was impossible to restrict developers from advancing plans for their land.

In May 2001 the project was registered under the EA process as part of TIR's corridor preservation process. That registration included Addendum No. 1, as TIR provided information additional to the EA report as part of the original submission. At that time, NSEL (now NSE) determined more information was needed to make a decision about the project. This additional information was submitted in September 2004, as Addendum No. 2. In October 2004, TIR withdrew the project from the process in order to redefine the project by removing the connector road (Addendum No.3). The connecter road provides access to the highway for residents of the Timberlea, Hubley and Five Island Lake areas and was included in the original project description. It is also a primary road through the Sheldrake Heights subdivision and it was removed from the project description to enable the development of the subdivision to proceed and to maintain the connector as controlled access. The project was re-registered in October 2004. In November 2004, the Minister of NSEL (now NSE) decided that there may be limited adverse effects or significant environmental effects related to the proposal and directed TIR to prepare a focus report to examine how the proposed Highway 113 fits with the HRM's Regional Plan. Following the focus report submission, NSE has requested that TIR do a full Environmental Impact Assessment Report for this project (this report).

Highway 113 is going through the EA process now (i.e., this report) in order to identify potential environmental impacts and describe measures to mitigate the potential impacts for subsequent design stages of the project.

2.0 Need for the Project

The purpose of the proposed Highway is to provide a more efficient means of travel for motorists between Highway 103 and Highway 102 that bypasses the Halifax urban core. The proposed Project is part of an overall TIR strategy that addresses the transportation needs of the province and the local community. In addition, the proposed highway will alleviate traffic congestion on Hammonds Plains Road.

2.1 Traffic

TIR anticipates that traffic levels on key regional freeway, highway, and arterial transportation facilities will continue to grow. Within the vicinity of the Halifax peninsula, this growth is expected to occur primarily on Highway 102, Highway 103, and Route 213 (Hammonds Plains Road). In addition, long term development of residential communities is expected to continue in some areas of HRM, including the Hammonds Plains areas. Hammonds Plains Road is currently operating at, or very close to capacity. Hammonds Plains Road in its current configuration will not be able to accommodate these future transportation demands. As a result, additional transportation infrastructure is required to allow existing roadways to operate at acceptable safety and service levels. Highway 113 is proposed to address this expected need.

Currently, a significant portion (Washburn and Gillis, 2000) of motorists use Hammonds Plains Road in lieu of the Highway 102 and 103 corridors as Hammonds Plains Road is perceived to be an attractive and direct alternative route. Highway 113 will facilitate a more direct and operationally efficient link between the Highway 102 and Highway 103 corridors that will bypass the inner reaches of Halifax's 100 Series highway network.

The proposed Project is part of an overall TIR strategy that addresses the transportation needs for the Province as well as the Halifax Regional Municipality (HRM). Highway 113 would create an efficient and effective transportation corridor that will provide an important connection between communities and modes of transportation for passengers as well as goods and services. The Highway 113 connection would provide a trucking route that bypasses sections of Highway 102, Highway 103, and Hammonds Plains Road (which currently has truck traffic restrictions).

Highway 113 is consistent with the HRM's Regional Plan, which indicates that the need for such a facility would be necessary to accommodate future growth areas such as Upper Tantallon, Hubley, Bedford West and the lands adjacent to Hammonds Plains. The plan identifies Highway 113 as a "Future Potential Project" that may be required beyond the Plan's 25 year horizon. In the interim, HRM has placed development restrictions in the Hammonds Plains Road area to limit traffic volume growth. These development limitations are not likely to be lifted until Highway 113 is in operation.

In addition to the project's consistency with the Regional Plan, the TOR requires an examination of HRM's Water Resource Management Strategy. It is acknowledged that many of the recommendations in the Report have been implemented through the Regional Plan. Also, TIR's stormwater Management Guidelines contain recommendations from the Water resource Management Strategy.

According to the Traffic Volume and Capacity report (Washburn and Gillis, 2000), through traffic currently travelling on the provincial 100-series highway network from Highway 103 along the south shore to Highway 102 north of Bedford, must travel into the inner reaches of Halifax's 100 Series highway network. The only alternate road bypassing the Halifax area is Hammonds Plains Road (Route 213). Through truck traffic is prohibited on Hammonds Plains Road.

Traffic has been growing steadily on the routes that will benefit most from Highway 113: Highway 102; Highway 103 and Hammonds Plains Road. Assuming even a moderate increase in traffic growth and highly effective recent and planned mass transit initiatives, TIR expects that additional highway capacity will be needed. TIR traffic count records for the period between 1994 and 2006 show an increase in the Average Annual Daily Traffic (AADT) in the vicinity of the proposed Highway 113 from 32,000 to 33,700 on Highway 102 and an increase from 12,000 to 14,104 on Highway 103. AADT on Hammonds Plains Road (Route 213) between the Highway 102 interchange and the Lucasville Road has increased significantly from 12,000 to 16,292 reflecting the residential and commercial growth that has occurred along Hammonds Plains Road. Modelling completed by TIR in 2006 examined the impact of Highway 113 on projected traffic volumes on Highway 102, Highway 103 and Hammonds Plains Road in 2026 assuming full implementation of HRM's Municipal Planning Strategy (MPS). When compared with the scenario with no Highway 113 in place, in- bound traffic on portions of Highway 102 closer to the urban area of HRM (Exits 1A – 3) is projected to be reduced by up to 7%; inbound and outbound traffic on Highway 103 between Exits 1A and 4) is reduced by 13%; and traffic on Hammonds Plains Road reduced from between 9% to 12%.

Projects such as the Highway 101 Margeson Drive interchange and connector and the Highway 102 Larry Uteck Drive interchange (currently under construction) demonstrate the regional need for improved connections to the 100 Series Highway network. Growth of the 100 Series Highways must be strategically planned, in some cases such as Highway 113, several years in advance to identify potential constraints and to ensure sufficient lands are available for construction when traffic volume warrants.

2.2 Safety

Construction of the proposed Highway 113 would divert some through traffic from Hammonds Plains Road onto the new highway, thereby reducing accident risks and occurrences on the Hammonds Plains Road.

TIR accident records show that an uncontrolled two-lane rural route such as Hammonds Plains Road experienced a 5-year annual average vehicular accident rate of 83.0 accidents per 100 million vehicle-kilometres (HMVK) from 2001 to 2005. The average accident rate for a 100 series 4-lane divided wide median highway in Nova Scotia was 27.7 accidents/HMVK, over the same period.

2.3 Efficiency of Travel

The proposed Highway 113 would reduce the travel distance from Highway 103 to Highway 102 by approximately 13 km. This represents a potential travel time saving of 8 to 10 minutes per vehicle journey during free-flowing traffic, i.e. outside morning and afternoon rush hours. This travel time saving is expected to be greater during peak traffic times. Associated with the improved travel time are the corresponding reductions in emissions associated with idling and reduced vehicle wear and tear costs.

Provision of an interchange at Kearney Lake Road, which will be constructed as part of this Project, will improve access to the 100-series highway network for the expanding development of the area.

3.0 Description of Alternatives to the Project

Alternatives to the undertaking include the following:

- Other modes of transportation;
- Upgrading Hammonds Plains Road; and
- The null or "do nothing" alternative.

3.1 Other Modes of Transportation

Other modes of transportation that would potentially meet the same objectives include the increased use of mass transit (e.g., buses). The HRM Regional MPS highlights the importance of increased transit ridership in order to manage the growing traffic demands on Hammonds Plains Road. The construction of Highway 113 is not expected to influence the potential increase of transit ridership as the highway is expected to be completed beyond the time horizon considered in the Plan. Successful implementation of the transit objectives of the Regional Plan may delay the need for a new highway facility Based on projected growth in population and corresponding traffic volumes a new highway facility will be required even with increased transit ridership levels as confirmed by the 2006 modeling referenced in Section 2.1, which assumed successful implementation of transit improvement and increased ridership. In addition to supporting HRM transportation needs, Highway 113 will support broader regional and provincial transportation needs such as providing an important component of a ‘ring road’ around HRM’s urban core which will consist of Highway 113, Highway 102 and the proposed Highway 107 extension.

Increased use of mass transit is expected to reduce traffic volumes on Hammonds Plains Road and the urban sections of Highways 102 and 103. A slightly reduced accident rate along Hammonds Plains Road and decreased travel time between Highway 102 and 103 could result because of fewer vehicles using area roads. Currently HRM and Metro Transit are moving forward on the implementation of a comprehensive and strategic 5 year transit enhancement plan, which, pending budget approvals, will include a new rural express service for the Highway 103 corridor. In addition, a new Ragged Lake Transit Centre is scheduled for completion by May 2010 and will complement the existing Metro Transit facilities for the Highway 103 corridor

(Entra Consultants, 2007). However, this method of reaching the objective is not seen as a stand alone alternative to Highway 113 for the following reasons:

- The origins and destinations of much of the traffic on Highways 102 and 103 is to and from locations distant to the urban core where mass transit is not and will likely not be available within the planning horizon of the project;
- Projected traffic volumes that include a projection of transit ridership show that Hammonds Plains Road will remain over capacity in certain segments; and
- While transit may shift a portion of the traffic volume, it will not resolve the current inefficiencies for truck and passenger through traffic.

3.2 Upgrading Hammonds Plains Road

Upgrading the Hammonds Plains Road to a 100-series, controlled access highway and allowing truck through traffic would result in a comparable design and service level as that which would be provided by the proposed Highway 113. As a controlled access 100-series highway, this alternative will have a reduced accident rate, fewer vehicles on the urban sections of Highways 102 and 103, and decreased travel time between Highways 102 and 103.

Upgrading Hammonds Plains Road to meet the future traffic demand and allow truck traffic would require a minimum construction standard of a two-lane, controlled access, 100-series highway. This would necessitate the construction of two 3.7 m wide lanes and 2.5 m wide shoulders separated by a concrete barrier wall with passing lanes in the appropriate locations.

This option is not viewed as a viable alternative for a number of reasons:

- It would necessitate extensive reconstruction in an area already developed with residential and commercial land uses;
- There would be encroachment on most residential and commercial properties along the road for ROW requirements (Hammonds Plains Road has a 20 m ROW, a 100 Series highway requires a minimum of 90 m);
- There exists little or no access management measures along the majority of the corridor;

- Construction of storm sewers with curb and gutter for drainage control, to replace the existing ditches would require the acquisition of land from a large number of property owners;
- Loss of direct individual access to the road by residential and commercial property owners;
- Construction of access roads behind existing properties, to provide access to the landowners; and
- Extensive acquisition of developed properties for the road and interchanges that would pose considerable difficulties and disruption of private land uses and land owners.

3.3 Null Alternative/Status Quo (Do Nothing)

The null or "do nothing" alternative involves projecting traffic growth into the future, while assuming that the existing highway facilities will remain unchanged.

Traffic and population levels have been steadily growing in the region. Traffic levels have been steadily growing by 5%, 17.5%, and 35.7% for Highway 102, Highway 103, and Hammonds Plains Road respectively. Typical long term annual growth rates on North American highways range between 1-2%. Rates above the 2% mark are generally considered as aggressive growth (Delphi-MRC, 2006). As traffic and population levels continue to grow, the need for additional transportation infrastructure is anticipated in order to meet the mobility and access needs of the region. Therefore, the “do nothing” option is not viable as traffic projects demonstrate that a new highway facility will be required at some point in the future.

Additionally, traffic volumes along Hammonds Plains Road are expected to increase, although moderately due to significant development controls in the surrounding area. This increase in traffic may result in an increase in the number of accidents and travel delays, if the highway system is left unchanged.

Through traffic travelling on the provincial 100-series highway network between Highway 102 and 103 will continue to travel through the high volume sections near the Highway 102 to 103 interchange. Hammonds Plains Road will continue to be the only alternate route bypassing the inner reaches of Highways 102 and 103 for passenger vehicles. Accident levels will increase, as a minimum, in proportion to traffic growth and travel time delays will continue to increase. This will result in increased driver frustration, fuel inefficiencies, and local degradation of air quality over the highway network.

4.0 Other Methods for Carrying Out the Project

The following were considered whilst developing this proposed project:

- Process undertaken to determine the proposed corridor and discussion of other alignments considered;
- Environmental and socio-economic criteria; and
- Other methods e.g. reducing the median width; different watercourse crossings.

Other methods of carrying out the undertaking include the following:

- Alternative route alignments;
- Adjusting the median width; and
- Other construction techniques.

4.1 Alternative Route Alignments

Physical constraints related to topography (lakes, rivers, hills etc.) and community development dictate where the highway can be constructed to meet economic and operational objectives. Alternative route alignments (north and south) to the currently proposed Highway 113 were investigated by TIR during the planning process for the highway.

A northern alternative route was considered that would bypass Hammonds Plains Road and connect Highways 103 and 101. Traffic travelling from Highway 102 to Highway 103 would be routed through Highway 101. This alignment was considerably longer and, correspondingly, a more expensive alternative. It also entailed an expensive and difficult connection to Highway 103. In addition, traffic modeling performed by TIR indicated that a connection between Highways 101 and 103 would be significantly underutilized. While technically feasible, rapid development in the area to the north of Hammonds Plains Road during the early planning stages of the project precluded the establishment of an unrestricted alignment.

The southern alternative route would provide many of the same benefits of the proposed alignment, however, this alignment would have greater potential for environmental impact due to the extensive network of lakes and watercourses. As project planning proceeded, this area was subsequently identified as a potential urban park and a proposed provincial wildness area. The southern alternative would have reduced the recreational value by bisecting the area. An alternate alignment south of the proposed alignment is expected to provide many of the same benefits as the proposed alignment but go through the area previously proposed as a regional park, and which is now the designated wilderness area, rather than go along the northern boundary of it and would be complicated by many lakes present in that area.

4.2 Adjusting the Median Width

Narrowing the median width would result in a reduced land requirement for the highway ROW. Such a modification to the Project description would result in a reduced Project "footprint" and a smaller area disturbed by construction activities.

Reducing the median width could be accomplished by designing the highway such that the lanes are positioned closer together with a narrower grassed median or by aligning the lanes so that they are directly adjacent to each other, separated by a concrete barrier (i.e., Jersey barrier). Jersey barriers are normally used to provide lane separation where land is not available for the construction of medians.

Benefits of a reduced median width in general include a reduced potential for environmental impacts and reduced financial resources required to purchase the highway ROW. Disadvantages of a reduced median width include maintenance problems associated with snow removal and vegetation control, a slight decrease in the level of public safety associated with a greater likelihood of vehicle accidents, and a reduced posted speed of 100 km/hr. A Jersey barrier might also impede the movement of wildlife across the highway.

A wide median highway is the ideal cross section for this facility. However, at the detailed design stage a reduced median width will be considered in the vicinity of Blue Mountain Hill in order to reduce the impact on this locally important feature.

5.0 Regulatory Environment

5.1 Regulatory Environment

The requirements for project approvals at the provincial and federal levels are identified in this section of the report and are based on the evaluation of the existing environment, the team's knowledge of highway construction, and consultation with the relevant government departments. It is also important to note that the requirements for project approvals presented here for the proposed Highway 113 are based on the regulatory environment at the time of writing (September, 2009) and it is anticipated that legislation, regulations and policies will change between the completion of this EA and construction of Highway 113. For that reason, TIR will monitor regulatory changes and report to NSE on the implications of the regulatory changes to the conclusions and recommendations of this EA in the form of an addendum. In addition, TIR is not pursuing federal approvals e.g. Authorization to Harmful Alteration, Disruption and Destruction; Navigable Waters Protection Act, at this time and it is expected that additional environmental assessment(s) will be carried out specific to these approvals and as a result will reflect the regulatory environment in place at the time of approval application submission.

Similarly, this EA references documents, policies, guidelines, and specifications currently in place, e.g., TIR's Standard Specifications and Generic Environmental Protection Plan. These documents are 'living' documents and are routinely updated to reflect changing regulatory requirements and highway engineering, design, and construction practices.

As part of this EA the agencies contacted for confirmation of approval processes include the federal Departments of Fisheries and Oceans (DFO) and Environment Canada (EC), and the provincial Nova Scotia Departments of Environment (NSE), Natural Resources (NSDNR), and Tourism, Culture and Heritage.

Table 5-1 summarizes federal and provincial Acts and their applicability to the project for environmental approvals or permits.

Table 5-1 Applicable Acts, Regulations, and Guidelines

Legislation	Responsible Authority or Department	Potential Trigger	Schedule	Approval or Permit Required
Nova Scotia Wilderness Areas Protection Act (1998, c. 27, s. 1.)	Nova Scotia Environment	Equipment access, material storage, clearing, disturbance in Blue Mountain – Birch Cove Lakes Wilderness Area	Construction, Operation	Potential trigger activities are prohibited TIR has no need or intention of entering or using any part of the wilderness area
Canadian Environmental Assessment Act	Federal authority providing funding (Transport Canada), Fisheries and Oceans Canada (HADD)	Funding, Fish habitat	Pre-construction	Navigable Waters Protection Act; Harmful Alteration, Disruption or Destruction of Fish Habitat under the Fisheries Act.
Canadian Fisheries Act	Fisheries and Oceans Canada	Loss of fish habitat associated with water crossing design; malfunction during construction leading to loss of fish habitat	Pre-construction, Construction	Authorization for habitat alteration, disruption or destruction (HADD) from DFO
Canadian Navigable Waters Protection Act	Transport Canada	Crossing of a navigable waterway	Pre-construction	Approval under Navigable Waters Protection Act from TC
Canadian Species at Risk Act	Environment Canada	Effects on listed species. None identified on project.	Pre-construction, Construction	Permit required to disrupt or destroy habitat from EC.
Nova Scotia Environment Act	Nova Scotia Environment	Crossing Watercourse or Wetland	Pre-construction	NSE Watercourse or Wetland Alteration approval.

Table 5-1 Applicable Acts, Regulations, and Guidelines (cont.)

Legislation	Responsible Authority or Department	Potential Trigger	Schedule	Approval or Permit Required
Nova Scotia Special Places Act	Nova Scotia Tourism, Culture, and Heritage	Archaeological survey or disturbance of artefacts	Pre-construction, Construction	Permit required from Heritage Division to conduct archaeological investigations.
Nova Scotia Endangered Species Act	Nova Scotia Department of Natural Resources	Effects on listed species. Listera australis identified in spring botany surveys in the proposed ROW for Highway 113.	Pre-construction	Approval of management plan for listed species identified.
Canadian Environmental Protection Act	Environment Canada	Accidents or spills leading to potential pollution or impacts to the environment and human health	Construction, Operation	None.
Canadian Migratory Birds Convention Act	Environment Canada	Disturbance or destruction of nests or birds of listed species	Construction.	Permit to take nests and birds
Nova Scotia Dangerous Goods Transportation Act/ Dangerous Goods Transportation Act	Nova Scotia Department of Transportation and Infrastructure Renewal /Transport Canada	Transportation of dangerous goods to and on the site.	Construction	Appropriate placards and training.
Nova Scotia Wildlife Act	Nova Scotia Department of Natural Resources	Disturbance or destruction of wildlife	Construction	None.
Nova Scotia Occupational Health and Safety General Regulations Act	Nova Scotia Labour and Workforce Development	Applicable to all work on site.	Construction, Operation	None.

Table 5-1 Applicable Acts, Regulations, and Guidelines (cont.)

Legislation	Responsible Authority or Department	Potential Trigger	Schedule	Approval or Permit Required
Canadian Guidelines for Use of Explosives in Canadian Fisheries Waters	Fisheries and Oceans Canada	Blasting near or in watercourses.	Construction	Approval.
Environmental Protection Plan for the Construction of 100 Series Highways (as amended for this project)	Nova Scotia Department of Transportation and Infrastructure Renewal	Applicable to construction of 100 Series highways	Construction, Operation	None.
Transportation and Infrastructure Renewal Standard Specifications	Nova Scotia Department of Transportation and Infrastructure Renewal	Highway design and construction.	Construction, Operation	None.
NSE Pits and Quarry Guidelines	Nova Scotia Environment	Development and operation of offsite borrow pits and quarries.	Construction	Approval required from NSE.
NSE Erosion and Sedimentation Control Handbook for Construction Sites	Nova Scotia Environment	Clearing, grubbing, earthworks, watercrossings	Construction	None.
NSE Guidelines for Sampling of Domestic Water Supplies in Conjunction with Construction of Highways	Nova Scotia Environment	Wells within 300 m of ROW	Construction	None.
NSE Guideline for Environmental Noise Management and Assessment	Nova Scotia Environment	Noise associated with construction vehicles and blasting	Construction	None.

Table 5-1 Applicable Acts, Regulations, and Guidelines (cont.)

Legislation	Responsible Authority or Department	Potential Trigger	Schedule	Approval or Permit Required
NSE Environmental Construction Practice Specifications	Nova Scotia Environment	Clearing, grubbing, earthworks, watercrossings	Construction	None.
NSE Environmental Protection Guidelines for the Application and Removal of Protective Coatings during Bridge Maintenance Operations	Nova Scotia Environment	Bridge maintenance.	Operation	None.
Transportation Association of Canada (TAC) National Guide to Erosion and Sediment Control on Roadway Projects	Nova Scotia Department of Transportation and Infrastructure Renewal	Clearing, grubbing, earthworks, watercrossings	Construction	None.
Guidelines for Development on Slates in Nova Scotia	Nova Scotia Environment	Quantities of potentially acid generating slates in excess of 500 m3	Construction	Approval. Note: Unlikely to encounter acid generating bedrock in the alignment

Table 5-1 does not include municipal land use bylaws, policies or strategies as provincial highway projects do not fall under municipal jurisdiction. TIR will continue to work cooperatively with HRM to achieve their municipal bylaw objectives.

6.0 Public Information Program

The public at large was engaged at one formal public information session. However, during the planning process for the proposed Highway 113 and throughout the environmental assessment process, including EA addendums; the Focus Report; and the preparation of the draft and final Terms of Reference for this EIA, the public and regulators have had opportunities to provide their comments regarding the Project and the potential impacts. All of the comments brought forward have been reviewed during the course of the study (see Table 1-1). In some instances those concerns identified issues that became VECs - focal points for the Assessment.

6.1 Public Meeting

A Public Consultation Open House was held July 16, 1998 for the Proposed Highway 113 Project. The purpose of the Open House was to provide information to the public on the Project and to obtain input from local residents, businesses and landowners. During that session, the approximately 150 people in attendance were requested to complete a questionnaire, designed by TIR. Sixty-nine completed questionnaires and formal responses were received. Table 6-1 summarizes the general responses to the questionnaire. The questionnaire provided an opportunity for the public and especially local residents, to voice their opinions regarding matters such as:

- Perceived effects of the Project on properties and businesses;
- Concerns with respect to the proposed location;
- Benefits with respect to a new highway; and
- General approval or disapproval of the proposed alignment.

Table 6-1 General Questionnaire Responses

Item	# of Questionnaire Responses
Total Number of Questionnaires Returned	69
Approved of proposed highway location	34
Approved with some reservations (primarily about the Environment)	7
Disapproved of proposed highway location	28

The following presents a brief summary of the opinions noted on the questionnaires:

- People affected by existing traffic on Hammonds Plains Road were very positive about the Project;
- People living in the Sheldrake Heights subdivision had the following concerns:
- Increased highway noise;
- High traffic volumes, in particular landfill bound truck traffic, on the Connector;
- Loss of existing access to Maple Lake;
- Increased public access to Maple Lake;
- Environmental degradation of the area, in particular the lakes;
- Loss of property value;
- Remaining a small, isolated subdivision; and
- Decreased warrant for public park space due to size of the subdivision.

Following the receipt of the resident's concerns, TIR undertook additional analysis to determine the extent of impacts with respect to traffic concerns. A letter was sent to residents in nearby subdivisions acknowledging their concerns and presenting additional information on traffic volumes and an evaluation of the potential for landfill bound truck traffic on the Connector.

Public comments received following release of the Focus Report in 2006, were consistent with comments received following the Open House, indicating that public opinion and issues of concern were unchanged.

In addition to opportunities to comment on the project through the Open House and Focus Report review process, TIR undertook a series of stakeholder interviews in September, 2009. Summaries of the interviews and the issues raised are provided in Appendix G.

TIR is committed to the development of a Community Liaison Committee (CLC) when a decision is made to proceed with the project. The CLC could be composed of representatives from the community; HRM regional planning, traffic and transportation, parks; environmental interest groups; and watershed advisory committees. This would include third party facilitation to coordinate communication to and from the CLC with the broader community. TIR expects that representatives of NSE and NSDNR will also be involved in the CLC by providing information on provincial programs and activities relevant to the highway.

7.0 Project Description

7.1 Highway Corridor Location

The corridor for Highway 113 extends 9.9 km between Highway 103 near Exit 4 and Highway 102 near Exit 3. The highway will be located in a 150 m wide ROW with increases in ROW width in the vicinity of the interchanges to accommodate ramps. This ROW is a refined version of the corridor shown in the 2000 Registration document and addenda and has been developed in consultation with NSE, HRM, and major landowners whose holdings will be crossed by the highway. Figure 7-1 shows location of the ROW in relation to the surrounding environmental and socio-economic setting.

Constraints and goals considered in the functional design/corridor preservation process included the following as summarized from in the Focus Report:

- The alignment was kept as far north as possible to minimize the intrusion into the undeveloped crown land block and for this reason the alignment generally skirts the southern edge of the Kingswood subdivision. It should be noted that at the time the alignment was identified, residential development had not occurred on Lake Shore Drive south of Ragged Lake. Ragged Lake was avoided as it represented a constraint in locating the highway.
- TIR needed to strike a balance of separation distances between Ragged Lake and Blue Mountain Hill. To go south of Blue Mountain Hill would have meant greater intrusion into the crown land block. Blue Mountain Hill has scenic look-off value that TIR recognizes as important.
- The highway design was modified in the initial project stages to minimize wetland impacts at the request of NSDNR at a meeting with NSDNR on January 15, 1999 to discuss the alignment and it's potential impact on the Fishers Brook wetlands.
- TIR will continue to cooperate with NSE, DNR and HRM to address such issues as the appropriate location and design of pedestrian crossings in the context of the Blue Mountain-Birch Cove Lakes Wilderness Area, the potential regional park, and connectivity to active transportation links.

Figure 7-1 Project Location

- The final detailed design of the highway will reflect its location adjacent to the Blue Mountain Hill-Birch Cove Lakes Wilderness Area and context sensitive design principles will be applied.

The ROW is located in an area of mixed land use dominated by resource/recreational lands. Residential and commercial/industrial land uses are more prevalent at either end of the highway corridor as well as to the north of the alignment (Kingswood subdivision). Parts of the Kingswood subdivision and the Sheldrake Heights subdivision abut the ROW Approximately 30% of the directly adjacent land use to the south of the corridor comprises Blue Mountain - Birch Cove Lakes Wilderness Area. Residential land use is expected to increase at either end of the corridor as well as in select areas north of the corridor by the time the highway is constructed. Crown lands to the north are expected to remain mixed resource use.

The ROW crosses four Nova Scotia Power Inc. (NSPI) transmission lines:

- 1 line (#8002), 345 kV, located approximately 3.7 km east of Trunk 3;
- 2 lines (#6008 & 6016), 2 - 138 kV, located approximately 1.4 km west of Kearney Lake Road; and
- 1 line (#5004), 69 kV, located on the west side of Highway 102.

Bell Aliant maintains one telephone line on the NSPI's Trunk 3 distribution line which belongs to NSPI. Eastlink maintains above ground cable lines along Kearney Lake Road and the Sheldrake Lake subdivision near Exit 4.

Halifax Water (HW) owns and operates the existing water infrastructure in the vicinity of the proposed highway. The existing water transmission main from the J.D. Kline Water Supply Plant (Pockwock) follows the alignment of Kearney Lake Road between Hammonds Plains Road and Dunbrack Street. Through the alignment study area boundary, at the point of the proposed alignment, the existing transmission main is 1200 mm in diameter and is located along the west shoulder of Kearney Lake Road. The transmission main is the single supply line for water service for Halifax. In addition, Halifax Water has twinned the transmission main from Hammonds Plains Road to Kearney Lake.

With respect to planned infrastructure, HW has completed master plans of several areas in the vicinity of the proposed highway corridor. Details of this proposed infrastructure are as follows:

- Proposed 400 and 350 mm water mains from Hammonds Plains Road to Halifax constructed within future subdivision development just east of Highway 102;
- A future water main (400 mm diameter for local service) in Kearney Lake Road between Kearney Lake and Blue Water Road; and
- A proposed reservoir site on a high point of land approximately 700 metres northwest of the proposed highway alignment.

HRM and HW commissioned an Integrated Servicing Study in 1998 to examine long term servicing (25 years plus) on a regional basis. This study identified potential transmission main crossings of the proposed highway alignment and a proposed reservoir site near the highway alignment in the area south of Ash Lake. There is no present concern; however, future development plans of TIR and HW will have to consider these services relative to the proposed highway.

There are no community water supplies within the study area but a large number of residences at both the western and eastern ends of the alignment are on individual water wells.

There are no archaeological or heritage sites within the proposed footprint of the highway.

7.2 Construction Methods

7.2.1 Excavation

7.2.1.1 Excavation Activities

The removal of material for the construction of subgrade (bottom layer of material) may involve one or more methods of excavation, including common excavation, rock excavation, and swamp excavation. Common excavation is the removal of overburden, including till, smaller boulders, and topsoil. Rock excavation is the excavation of rock, which is considered to be bedrock or single pieces of rock greater than one cubic metre in size. Cuts in “soft” rock can be accomplished using ripper blades attached to larger heavy equipment, breaking up the rock so that it can be loaded onto trucks with an excavator or loader. This procedure tends to be successful in softer rock such as shales and sandstones, and in areas where the bedrock surface is highly weathered and/or fractured [which is uncommon in the granites and other bedrock in the alignment].

Swamp excavation occurs where soil is unsuitable for use as a subgrade. The soil is either excavated or replaced with a competent fill, or "floated over" using geogrids or berm construction. This may occur when peat is encountered or when exposed soil has been saturated with water. Excavated soils unsuitable for use as fill or dressing slopes are disposed of at a site approved by the Project Engineer. As indicated in the Department's Generic EPP, waste materials will not be placed in wetlands or other sensitive areas, nor adversely affect drainage patterns or adjacent properties. Disposal areas will also be stabilized to prevent erosion and have appropriate ESC measures to prevent siltation of streams and wetlands.

Stability of slopes for both cuts and embankments will be maintained along the proposed alignment. Conservation slopes for cuts and embankments will not exceed 3 to 1 in sands and gravel as well as in cohesive soils (silts and clays). Flatter slopes will be used if necessary.

7.2.1.2 Areas of Major Cut and Fill Operations

The proposed alignment will require extensive cut and fill operations to achieve the blend of horizontal and vertical alignment characteristics consistent with 100 Series highways. In particular, much of the highway construction process will involve sections of significant excavation, much of which is likely to be in rock. A summary of the approximate areas requiring significant excavation and fills (i.e. greater than 4 metres) based on preliminary design information presented in the 2000 Registration Document (AGRA Earth and Environmental Limited, 2000) are shown in Figure 7-2.

The results of the design stage geotechnical analysis will allow TIR to optimize the amount of cut and fill by adjusting slopes or making corresponding adjustments in the vertical and horizontal alignment.

Figure 7-2 Areas of Major Cut and Fill

7.2.2 Blasting

The use of blasting for rock excavation is dependent upon the competency of the rock. The contractor will determine whether or not blasting will be required for the construction of the proposed alignment. Wherever possible, rock excavation will be performed by ripping rather than blasting, due to the lower costs involved.

If blasting is deemed to be necessary, blasting operations will be conducted in accordance with the applicable regulations and guidelines. Blasting operations are governed by provincial regulations throughout Nova Scotia. Blasting in or near watercourses will require approval from DFO, and shall be conducted in accordance with the "Guidelines for Use of Explosives in or Near Canadian Fisheries Waters" (Wright and Hopky, 1998). Blasting shall also be conducted in accordance with the General Blasting Regulations made pursuant to the *Nova Scotia Occupational Health and Safety Act*. The Contractor performing the blasting will have a valid "Blaster's Licence" and will ensure that a pre-blast survey has been conducted, prior to blasting.

Before construction, it is the practice of TIR to determine the locations, chemical quality, discharge rates, and the physical condition of wells, if possible, within 300 m wide corridor on either side of the highway.

Blasts must be designed to limit ground vibration and air concussion below provincial guidelines, which are set to prevent damage to wells and structures. Blasting will be monitored for ground vibration and air concussion, both close to the blast site and at the closest structures.

7.2.3 Subgrade Construction

Subgrade is the bottom layer of material on a road, providing strength and stability. Subgrade is constructed by spreading acceptable fill, either from cuts or borrow 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, and compaction to a specified density. Subsequent layers are added until the desired elevation is reached.

Where feasible, as determined by suitability of the material and hauling costs, material excavated from the ROW is used for fill. If the excavated material is determined to be unacceptable for use as road building material along the alignment, materials will be obtained from nearby borrow sources.

7.2.4 Subbase and Base Construction

Once the subgrade has been developed, a granular graded structural base known as subbase and base is prepared. The subbase course (gravel) is placed immediately above the subgrade and consists of material superior in quality to that used for subgrade. The base course is placed immediately above the subbase and consists of a series of layers graded to provide structural integrity and good drainage beneath the paved surface.

7.2.5 Dust Control

A dust control plan will be implemented and enforced during dry weather periods. This will include, at a minimum, wetting of aggregate storage areas and haul roads to minimize the generation of fugitive dusts by construction vehicle traffic. The tracking of soils onto existing primary and secondary roads will be minimized to prevent the generation of fugitive dusts by roadway vehicle traffic. Dry sweeping of asphalt/concrete surfaces will not be conducted; wet sweeping will be employed as needed. Minimizing the quantity of soil or aggregate stockpiles at the project site will also reduce wind-generated dust emissions. Anti-idling policies will minimize the release of particulate matter from diesel construction equipment and/or truck exhausts.

7.2.6 Paving

Conventional asphalt concrete is made by mixing petroleum based liquid asphalt with sand and crushed stone in an asphalt plant. The hot mix is easily transported, spread and rolled to provide a smooth surface that can be used almost immediately. Since the surface is “flexible”, it is subject to wheel track rutting and frost action that may break the pavement and cause pot holes. Portland cement concrete is an alternative type of pavement. The material is made by mixing Portland cement, sand, gravel, and water at a concrete batch plant. The concrete mix material is transported by trucks and placed by a slip forming machine that automatically creates joints, complete with steel joint dowels, to ensure that adjacent slabs retain their alignment. Concrete must set or cure for several days before it can be opened to traffic. Although it has a higher initial cost than asphalt pavement, concrete pavement is rigid and provides a smooth riding surface that is not subject to rutting and generally resists frost action and pot holes. In recent years, TIR has been evaluating concrete pavement on an approximately 4 km long section on the Highway 104 westbound lanes east of Oxford. This section, constructed in 1995, has provided excellent performance. In 2003, TIR constructed a 10 km section of concrete pavement for the Highway 101 twinning project between Mount Uniacke and Ellershouse.

7.2.7 Shouldering

Shouldering requires the placement of gravels next to the pavement edge. This gravel material not only supports the pavement edge, but makes a more gradual transition from the paved driving surface to the side slopes or median, in the event of vehicle runoff. Gravels are generally placed using a shouldering machine, which conveys shoulder material from trucks to the shoulder area. The material is then graded and rolled.

7.2.8 Topsoil

Where practical, topsoil will be saved during the grubbing process and will be reused to dress medians and side slopes.

7.2.9 Hydroseeding

Hydroseeding is conducted as soon as possible after completion of surface preparation. Areas to be hydroseeded are dressed or otherwise left in a loosened condition conducive to seeding. Hydroseeding is not b performed under windy conditions or during periods of rainfall, on areas covered by standing water, over frozen surfaces or under other adverse conditions, as determined by the Project Engineer. Application rates and procedures as detailed by TIR's Standard Specifications (1997 and revisions) for hydroseeding will be implemented.

It is anticipated that revegetation practises of the future, such as hydroseeding, will ensure that species to be used will be native and not invasive species. Current practices also strive to meet these ecologically sustainable hydroseeding practices.

7.2.10 Vegetation Management

The Department has adopted the practice of Roadside Vegetation Management (NSTPW, 2003 [now TIR]). The goal is to maintain a healthy vegetative ground cover, but without trees and large shrubs that interfere with sight lines. Management is a continual process of vegetative enhancement of desirable species and control of unwanted species. Nova Scotia's roadsides provide suitable conditions for a large variety of native (and naturalized) vegetation that inhabits the roadside through seed and vegetative reproduction. In addition, TIR has been experimenting with a number of initiatives involving application of compost or fertilizer for enhancing vegetation and the use of bioengineering techniques using native shrubs.

7.2.11 Construction Vehicle Operation

Vehicles used in subgrade construction typically include excavators, bulldozers, rollers, trucks, and graders. Most of these vehicles operate on diesel fuel and require some form of daily maintenance. The vehicles typically operate continuously for 12-hour shifts. Truck traffic during subgrade construction will primarily be confined to on-site operations and to 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. The TIR standard highway design practice is to balance cut and fill areas as much as practical which minimizes the need to import fill material for construction.

Vehicles typically used in base and pavement construction include pneumatic tire and steel drum rollers, graders, trucks, and asphalt concrete pavers. If the asphalt concrete plant is located onsite and a suitable source of aggregate for the asphalt concrete and road base construction can be found onsite, 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 concrete plant is located off-site and/or aggregate must be obtained from another source, the amount of truck traffic on the access roads would increase accordingly.

7.2.12 Equipment Types and Truck Routes

Vehicles used in subgrade construction typically include excavators, bulldozers, rollers, trucks, and graders. Most of these vehicles operate on diesel fuel and require some form of daily maintenance. The vehicles typically operate continuously for 12-hour shifts. Truck traffic during subgrade construction will primarily be confined to on-site operations and to transportation of material for cut and fill operations. Some truck traffic may occur off-site to travel to borrow and/or disposal sites. Specific information on vehicle operation and trucking routes are not known at this time as this will depend on construction staging by the contractor.

Vehicles typically used in base and pavement construction include pneumatic TIR e and steel drum rollers, graders, trucks, and asphalt concrete pavers. If the asphalt concrete plant is located onsite and a suitable source of aggregate for the asphalt concrete and road base construction can be found onsite, 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 concrete plant is located off-site and/or aggregate must be obtained from another source, the amount of truck traffic on local arterial roads would increase accordingly.

7.3 Construction Schedule

The work required prior to construction includes completion and approval of this EA, and CEAA Environmental Screening Reports where approvals such as Navigable Waters and Fish Habitat alteration (i.e. HADD) may trigger an assessment under CEAA. Following the acquisition of required approvals and permits, TIR will undertake detailed field survey, geometric design, and acquisition of any remaining lands in the required right of way. This pre-construction work typically takes two to three years to complete depending on available funding and regulatory review. Following the approval of the EA by the Minister of Environment, any remaining ROW not currently owned by TIR will be purchased. Limited design work will be completed until the highway is required. The full completion of the highway for vehicle use is dependent on future traffic demand and other developments in the provincial highway system in HRM, e.g., the Highway 107 extension from the Burnside Industrial Park to Highway 102.

Participation by TIR with HRM and other members of the Strategic Joint Regional Transportation Planning Committee will be the primary method for determining the need for and construction timing of the proposed Highway 113. TIR will continue to be engaged in other processes such as HRM's Transportation Master Plan and five subsidiary Functional Plans, as well as HRM's Open Space Functional Plan and others where it is appropriate.

TIR is participating in the Strategic Joint Regional Planning Commission to consider the Provincial role in meeting the potential transportation needs throughout HRM as the Plan is implemented and progresses. Among the other projects, the needs of HRM as well as provincial requirements and responsibilities will be considered in the decision if and when Highway 113 will be constructed.

At present, TIR are projecting that construction will begin within 20 years and is expected to be completed in five years. Table 7-1 provides a proposed construction sequence over a five year time frame.

Typical contractor hours are 7am to 7pm Monday to Friday, no occasion, work might extend into weekends.

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

Table 7-1 Conceptual Construction Schedule

Theoretical Construction Year	Construction Element
Year 1	Clearing of the ROW
Year 2	Grading between Highway 103 near Exit 4 and Highway 102 near Exit 3
Year 3	Continued grading between Highway 103 near Exit 4 and Highway 102 near Exit 3. Construction of structures.
	Paving between Highway 103 near Exit 4 and Highway 102 near Exit 3. Construction of structures.
Year 4	Continued paving between Highway 103 near Exit 4 and Highway 102 near Exit 3.
Year 5	Completion of Highway 113 project.

7.4 Ditches, Structures, and Culverts

The construction of a drainage system and installation of bridges, open span structures and culverts is generally conducted during the earthwork (sub-grade) operation. Roadside ditches and cross culverts will be constructed to direct surface water away from the highway and into natural drainage systems. Watercourses to be crossed by the highway will require that the bridge, open span or culvert meet current NSE requirements for passage of 100-year storm events. All water crossings and in-stream structures will be conducted "in the dry" and for culverts will include fish passage features, e.g. baffles, where required. The proposed bridge crossing of the tributary between Fraser Lake and Maple Lake will have at least a 1:1 openness ratio to facilitate large mammal passage. Open span crossing structures of other watercourses will be provided to permit the passage of smaller animals. Openness ratio is the opening area under the bridge divided by the side to side width of the bridge structure.

In stream work, for example, connecting culvert inlet and outlet channels to the existing watercourse will be completed between June 1 and September 30. The highway will cross 16 watercourses by either: bridges, open span concrete structures, or concrete culverts. The proposed crossing type for each of the crossings is provided in Table 7-2.

Table 7-2 Summary of Watercourse Crossings

Watercourse (see Figure 9-2)	Structure Type	
	Bridge	Culvert
A1		√
Tributary Connecting Upper Sheldrake Lake and Sheldrake Lake (1)		√
A2		√
Tributary Between Maple Lake and Fraser Lake (2)	√	
Fishers Brook (3A, 3A2, 3B, 3C)		√ (3A open span, 3B culvert)
A5		√
Stillwater Run (4)		√ (open span)
Outlet of Ragged Lake (5)		√
5A		√ (open span)
Black Duck Brook (6)		√ (open span)
A8		
Tributary to Kearney Run (7)		√
Tributary to Papermill Lake (8)		√

The follow sections summarize key project activities and environmental protection measures associated for the proposed water crossings.

7.4.1 Bridges and Open Span Concrete Structures

7.4.1.1 Foundation Excavation

Foundation excavation involves excavation of materials and dewatering of excavations for the construction of foundations of open span culverts and bridges. In locations where the excavation is located adjacent to or in a watercourse cofferdams will be constructed to separate the work area from the watercourse. All work will be completed following the requirements of the Generic EPP.

7.4.1.2 Construction of Piers, Abutments and Foundations

Construction of piers, abutments and foundations, adjacent to or in a watercourse presents a greater risk of impact from construction. This risk will vary depending on the nature of the construction and the specific methods utilized.

Bridge abutment and pier construction generally includes the erection of forms and reinforcing steel and placement of concrete produced from off-site sources. The bridge abutments are built in conjunction with earth and rock embankments, or on bedrock foundations prepared as part of the roadway subgrade and drainage system development activities.

7.4.2 Culverts

All culverts will 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. The major environmental considerations in culvert construction relate to sediment and erosion control; fish passage; and the loss of habitat associated with the footprint of the culvert and associated fills. All culvert construction will follow the requirements for culvert construction detailed in TIR's Generic Environmental Protection Plan for 100 Series Highways (Generic EPP). In addition, site specific culvert mitigation plans (CMP) will be developed for each crossing. These plans will identify erosion and sediment control measures and construction sequencing specific to the water crossing.

Culverts requiring fish passage will be constructed in accordance with DFO's fish passage requirements in place when the highway is designed. TIR will develop site-specific fish habitat compensation plans as part of an application for the Authorization of Harmful Alteration, Disruption or Destruction of Fish Habitat (HADD).

7.5 Acid Producing Bedrock

The majority of the proposed Highway 113 study area is underlain by granites of the South Mountain Batholith, while the easternmost section is comprised of Goldenville Formation bedrock. Bedrock types with the highest potential for acid producing bedrock are those that contain sulphide bearing material (e.g., pyrite). Near Halifax, acid producing bedrock is typically associated with Halifax Formation bedrock, which contains arsenopyrite. Therefore, the potential for acid producing bedrock within the proposed alignment is low and will be verified by geotechnical borehole drilling during the design phase of the project.

In addition, layered bedrock observed within the ROW that may be disturbed or exposed will be tested for its potential to produce acid. Testing will comply with specifications outlined in the *Sulphide Bearing Material Disposal Regulations* under the *Nova Scotia Environment Act*. Exposure, removal and disposal of potentially acid producing bedrock, if identified, will be conducted in compliance with the *Guidelines for Development on Slates in Nova Scotia* (NSDOE and Environment Canada 1991) and the *Sulphide Bearing Material Disposal Regulations*.

7.6 Borrow Material

Construction of the alignment will consist of cut and fill operations to bring the area to subgrade level using materials within the ROW to the greatest extent possible as highways are designed to balance the cut and fill requirements within the ROW. Borrow material, required for subgrade construction, will be derived from glacial till found within the ROW. Borrow material will not be obtained from habitats of plants and wildlife at risk or from Blue Mountain Hill. TIR will work with the CLC in identifying an optimal cut and fill scenario in the Blue Mountain Hill area.

Aggregates for the project will be required for such items as sub-base and base gravels, shoulder gravel, asphaltic concrete, backfill for structures and culverts, erosion protection, and stream bank stabilization. The Contractor will source this material from existing approved aggregate operations and cut areas in bedrock on the ROW.

7.7 Paving Materials

Conventional asphalt concrete is made by mixing petroleum based liquid asphalt with sand and crushed stone in an asphalt plant. The hot mix is easily transported, spread and rolled to provide a smooth surface that can be used almost immediately. Since the surface is “flexible”, it is subject to wheel track rutting and frost action that may break the pavement and cause pot holes.

Portland cement concrete is an alternative type of pavement. The material is made by mixing Portland cement, sand, gravel, and water at a concrete batch plant. The concrete mix material is transported by trucks and placed by a slip forming machine that automatically creates joints, complete with steel joint dowels, to ensure that adjacent slabs retain their alignment. Concrete must set or cure for several days before it can be opened to traffic. Although it has a higher initial cost than asphalt pavement, concrete pavement is rigid and provides a smooth riding surface that is not subject to rutting and generally resists frost action and pot holes. In recent years, TIR has been evaluating concrete pavement on an approximately 4 km long section on the Highway 104 westbound lanes east of Oxford. This section, constructed in 1995, has provided excellent performance. In 2003, TIR constructed a 10 km section of concrete pavement for the Highway 101 twinning project between Mount Uniacke and Ellershouse.

7.8 Construction Waste Disposal

The most desirable use of unsuitable material such as organics, overburden, and rock is use within the ROW (e.g., buried in the toe of the slope), assuming it conforms to TIR standards. Disposal of waste materials from the construction of the proposed undertaking will be in accordance with TIR’s Standard Specifications (1997 and revisions) for highway construction and any provisions included in site-specific contracts. The current specifications for clearing and grubbing do not include any specific criteria for the selection of waste disposal sites. Disposal sites are to be located by the contractor and must be approved by TIR. As noted earlier, waste materials will not be placed in wetlands or other sensitive areas, nor adversely affect drainage patterns or adjacent properties. Disposal areas will also be stabilized to prevent erosion and have appropriate ESC measures to prevent siltation of streams and wetlands. There are currently no known or planned disposal sites outside of the ROW.

Non-salvageable material from the clearing operations, such as limbs and timber, are typically chipped within the ROW and left in place, except within buffer zones for watercourses and wetlands. Occasionally, large items that cannot be easily chipped (i.e., stumps) are buried adjacent to the highway within the ROW. According to the Nova Scotia Watercourse Alteration Specifications (1997), waste material areas must be located such that they do not interfere with any stream or drainage facility (i.e., >100 m away) and do not contribute to erosion and/or siltation, and must be left with a neat appearance. Disposal of potential acid generating bedrock, if encountered, will be conducted in compliance with the Sulphide Bearing Material Disposal Regulations.

7.9 Operational Activities

Operational activities for Highway 113 refer to the movement of traffic and maintenance of the surface, structures and ROW vegetation. The maintenance aspects of the operational phase consists of three components, which are; summer, winter, and bridge maintenance activities.

7.9.1 Summer Maintenance – General

Summer maintenance required on a regular or periodic schedule includes:

- Maintenance of the asphalt pavement (such as crack filling, line painting, pot hole repair, re-surfacing every 10 to 15 years, and re-paving every 20 to 25 years);
- Maintenance of the shoulders and environmental control features;
- Maintenance of structures such as underpasses and guard rails;
- Upkeep of ditches through weed control and re-ditching; and
- Mowing of shoulders and brush cutting of back slopes.

7.9.2 Summer Maintenance - Vegetation Control

TIR controls the development of vegetation along highways and roads to prevent the encroachment of trees and shrubs into the roadway and to maintain sight distances. TIR is also required under the Weed Control Act to destroy noxious weeds that might spread from the ROW to cultivated or pasture land. TIR primarily uses mowing for vegetation control. Spot spraying of herbicides is used to control the spread of some vegetation such as sweet clover, which cannot be adequately controlled by mowing. Spraying of herbicides adjacent to 100 series highways follows all of the recommendations provided by the manufacturer, provincial and federal agencies, and is conducted by trained personnel under the terms of approvals issued by NSE. Garlon 4, a Dow Elanco brand of herbicide, is used most frequently by TIR for weed control. This chemical is non-toxic to most animals and does not accumulate in body organs (Dow Elanco, 1991). In all situations, TIR attempts to minimize its use of pesticides.

7.9.3 Winter Maintenance - Snow Removal and Ice Control

Winter maintenance is primarily snow removal and ice control to ensure the required level of service and the safety of highway use. This combines plowing with the application of road salt (sodium chloride). The 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. On 100 series highways in suburban Halifax, salt is applied at an average rate of approximately 24 t/km/y.

Since a federal environmental assessment on road salt concluded that road salts are “toxic” to the environment, as defined under the *Canadian Environmental Protection Act* (CEPA), federal and provincial governments have developed management instruments to reduce the impacts of road salts on the environment. One of the federal government initiatives was the development of the Code of Practice for the Environmental Management of Road Salts (Canada Gazette, 2004) TIR has taken a pro-active approach to better manage the use of road salts including:

- Initial construction of 25 new salt/sand storage domes in various locations around the province over the last six years. The new sheds were primarily built to increase the amount of salt/sand mixture storage, as the majority of road salt is already stored indoors;
- The installation of 42 “Road Weather Information Systems (RWIS) with 2 to 3 sites added each year;
- Implementation of winter maintenance standards that require highway crews to provide consistent and measurable ice and snow removal to all areas of Nova Scotia;
- Conduct pre-wetting trials near the RWIS sites to reduce the loss of road salts applied to highways due to wind and traffic disturbance. Results to-date indicates savings of up to 10-12% with the same level of service. Further reductions in road salts can be realized if placed just prior to a storm event. This process is usually referred to as “anti-icing” as opposed to “de-icing”;
- Upgrading of its TIR salt-spreading truck fleet through the installation of computerized (CompuSpread TM) salt controls;
- Completion and implementation of a Salt Management Plan (SMP; June 2004) to more effectively manage salt usage across the province and meet the commitments that were previously made to Environment Canada. The three-volume SMP contains detailed information, monitoring and reporting, current winter maintenance practices, salt storage and handling, salt application, salt vulnerable areas, training and BMPs. Prior to construction, the

SMP will be reviewed and if required, a project – specific salt management plan will be prepared and implemented.

7.9.4 Bridge Maintenance

Bridge maintenance that may be required on a regular schedule or on as-needed basis will likely include:

- Superstructure maintenance to repair or replace damaged or deteriorated components;
- Deck maintenance for deck drains, weepholes, catch basins or other features to prevent water damage;
- Chipsealing of the pavement surface;
- Substructure maintenance if damages extend below the paved surface;
- Protective coatings removals and applications for corrosion control;
- Slope protection for stabilization (e.g., with armour stone or hydroseeding); and,
- Grouting of voids under approach slabs or inside piers and abutments.

If an underpass or overpass span is constructed of steel, it will need periodic maintenance or replacement of the coatings applied for corrosion protection. Coatings removal and application will follow the Environmental Protection Guidelines for the Application and Removal of Structural Steel Protective Coatings (NSDEL, 1997) to prevent the material and associated residue from entering watercourses.

Mitigative measures to minimize potential impacts to birds nesting on bridge structures include timing activities such as cleaning, and the application and removal of protective coatings for bridges outside of the breeding season where migratory birds are known to nest. It is expected that all bridge maintenance activities will comply with the accepted Environment Canada and Canadian Wildlife Service (CWS) environmental standards and protocols and will comply with all pertinent legislation and guidelines in place at that time.

7.10 Possible Malfunctions or Accidents

7.10.1 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.

The reduction in traffic volumes on other roadways, resulting from the construction of Highway 113 will reduce the probability of accidents. This would reduce the risk of accidental fuel spills.
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 affects to fish and fish habitat include direct mortality of fish and aquatic organisms that fish feed upon, and degradation of surface water quality.

TIR and NSE apply emergency spill response plans to contain and remediate releases of hazardous materials into the environment. TIR's spill contingency plan is detailed in Section 5.1 and Appendix F of the Generic EPP. Releases caused by motor vehicle accidents are addressed initially by local emergency response agencies and directed by NSE. Subsequently, TIR contractors contain the spill and remove contaminated soils and sediment for disposal. Typically, contamination is confined to road shoulders and ditches. TIR 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, TIR and NSE apply emergency spill response plans to contain and remediate releases of hazardous materials into the environment. TIR's spill contingency plan is detailed in Section 5.1 and Appendix F of the Generic EPP. 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; 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 resulting during operation of the project is expected to be reduced relative to existing conditions through the decreased risk of traffic collisions. The potential for all effects resulting from spills during the operation of the project is expected to be reduced, which is a positive effect of the project.

The risk of contamination from spills and leaks during construction will be reduced 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 are considered not significant.

7.10.2 Failure of Sediment and Erosion 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 erosion and sediment control measures described previously. The Contractor will provide an outline of an appropriate Contingency Plan to the Project Engineer and the Environmental Services Group. Having a contingency plan and the resources for emergencies is the last of the TIR Principles of ESC (refer to Section 3.2 of the Generic EPP). This plan will deal with extreme or long duration rainfall events and the failure of ESC 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 TIR Green Card);
- Storm preparedness (conditions for work stoppages, pre-storm staff meetings, inspection of all ESC measures, preventative maintenance of ESC 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 ESC 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 Project Engineer, TIR's Environmental Services Group, and NSE/DFO inspectors; and,

- Incident and 'Near Miss' reporting to the Project Engineer and Environmental Services Group 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).

7.10.3 Vehicle Accidents

During the construction phase the necessary barriers and signage will be displayed according to the Generic EPP document in order 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 Highway 113 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). A 100 series highway will minimize vehicle accidents as opposing traffic will be separated, reducing the likelihood of head-on collisions.

7.10.4 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.

<u>Fish and fish habitat and surface water quality:</u> 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 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: Migratory birds 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.

Atmospheric Conditions: 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 Project EPP for construction and maintenance. The project area is in a developed area with access to HRM fire department locations; it is unlikely that any fire started as a result of a motor vehicle accident would be allowed to burn unchecked for very long.

7.11 Decommissioning Activities

Assuming the need for the highway is great enough based on increased regional population, traffic patterns at that time and construction proceeds within 20 years (as predicted) then decommissioning of the highway is not anticipated in the long term. Once built, ongoing repair and maintenance is intended to support the operation of the highway indefinitely. Incremental replacement of structures and paving surfaces may be required for continued operation.

8.0 Valued Environmental Components and Assessment Boundaries

8.1 Valued Environmental Components

With the evolution of EA in Nova Scotia, the VEC concept has broadened from species specific to more generally applying to biophysical and socio-economic components of the environment that are important to project stakeholders. The concept of VECs has moved from Valued *Ecosystem* Components to Valued *Environmental* Components and encompasses a broader range of issues. The latter is reflected in the Project TOR developed by TIR and NSE. As an initial step in the identification of VECs, specific species/environmental components of concern were determined through:

- The requirements of the NSE TOR;
- The 2000 EA and addenda;
- Public comments received by TIR and NSE on the project;
- Regulatory agency input; and,
- The EA team knowledge and experience with highway projects in Nova Scotia.

The next step in the identification of VEC Project-environment interactions both direct and indirect were identified based on professional judgment; scientific literature; knowledge of Project activities and interactions with the environment; and environmental characteristics of the site and the surrounding areas. Project-environment interactions include direct and indirect effects of the Project. Table 8-1 summarizes the VEC scoping and pathway analysis for this project. Determining these interactions involved:

- Review of Project works and activities;
- Analysis of direct effects;
- Identification of pathways; and
- Assessment of effects through pathways.

Table 8-1 Highway 113 – Environmental Assessment VEC Scoping and Pathway Analysis

Environment	Component of Concern	Issue(s) (Table 1-1)	Possible Source or Pathway	Rationale for Inclusion or Exclusion	Direct or Indirect Effect	Project VEC	Regulatory	Proponent	Public	EA Team
Atmospheric	Air quality/human health, climate change	Air emissions, greenhouse gas emissions	Vehicle emissions; dust during construction	Included, protected by law, valued	Direct	☑	☑	☑	☑	☑
Atmospheric	Noise	Noise	Noise during operation	Included , valued	Direct	☑			☑	☑
Aquatic	Groundwater quantity and quality	Groundwater, water wells	Contamination, spills; supply disruption	Included – protected by law; valued	Direct	☑	☑	☑	☑	☑
Aquatic	Surface water quantity and quality	Surface water quantity and quality; road salt	Construction sediment generation; accidental release of contaminants.	Included – protected by Fisheries Act and NS Environment Act; valued	Direct	☑	☑	☑	☑	☑
Aquatic	Fish and Fish habitat	Fish habitat	Pathways affecting surface water or groundwater; direct habitat loss from construction of watercrossings	Included, - habitat likely to be removed and protected by *Fisheries Act*	Direct	☑	☑	☑	☑	☑
Aquatic	At risk species	Priority and at risk species	Pathways affecting surface water, fish habitat	Included (under Fish and Fish Habitat VEC) – American Eel (COSEWIC, Special Concern)	Direct		☑			☑
Aquatic	Fisheries (Commercial, recreational)		Pathways affecting fish; sediment from construction; accidental release	Included – protected by *Fisheries Act*	Direct	☑	☑			☑
Aquatic	Other resource use (Recreation, navigation, water use)	Recreation use of area waterways	Pathways affecting water quality and quantity	Included – valued; public concern	Indirect	☑	☑	☑	☑	☑

Table 8-1 Highway 113 – Environmental Assessment VEC Scoping and Pathway Analysis (cont.)

Environment	Component of Concern	Issue(s) (Table 1-1)	Possible Source or Pathway	Rationale for Inclusion or Exclusion	Direct or Indirect Effect	Project VEC	Regulatory	Proponent	Public	EA Team
Aquatic	Aquatic vegetation		Pathways affecting water quality	Excluded – protection of water quality addressed under other VECs	Direct					
Terrestrial / Aquatic	Wetlands	Impact to wetlands, direct loss of Wetland habitat, fragmentation of existing ecological integrity	Pathways affecting water quality, fish, migratory birds and at-risk species	Included – protected by Environment Act, SARA, MBCA, valued.	Direct	☑	☑	☑	☑	☑
Terrestrial	Birds and Bird Habitat	Fragmentation of existing ecological integrity; migratory birds	Habitat loss from construction	Included – protected by MCBA	Direct and indirect	☑	☑	☑	☑	☑
Terrestrial	At risk species	Fragmentation of existing ecological integrity; priority and at risk species	Construction	Included – protected by Environment Act, SARA	Direct	☑	☑	☑	☑	☑
Terrestrial	Faunal habitat	Impact on mainland moose and deer; fragmentation of existing ecological integrity; wildlife corridor between Fraser Lake and Hammonds Plains Road; movement of species within the Birch Cove/Cox Lake corridor	Construction of highway may impact movement	Included – protected by Wildlife Act, valued	Direct	☑	☑	☑	☑	☑
Terrestrial	Bedrock Geology	Protection of natural geologic features, landmarks, vistas; potential for excavation of Halifax Formation slates	Excavation of bedrock during construction	Excluded – no excavation of Blue Mountain Hill; no Halifax Formation bedrock present						

Table 8-1 Highway 113 – Environmental Assessment VEC Scoping and Pathway Analysis (cont.)

Environment	Component of Concern	Issue(s) (Table 1-1)	Possible Source or Pathway	Rationale for Inclusion or Exclusion	Direct or Indirect Effect	Project VEC	Regulatory	Proponent	Public	EA Team
Social	Transportation	Justification for the project; effective use of tax revenue; increase in traffic volume in Kingswood if interchange constructed; public transit as an alternative	Construction of highway may impact movement and numbers of vehicles	Excluded – reduced accident rate and improved safety, addressed in Need for Project, Project Description, interchange in Kingswood is not part of project.						
Social	Land Use	Land use and socio-economic conditions specifically Blue Mountain/Birch Cove Lakes; increased access to backlands; increase in trails/parks in area; fate of lands if highway does not proceed; impacts on recreational use of Blue Mountain/Birch Cove Lakes Wilderness Area; use of Crown lands	Habitat loss from construction; presence of highway	Included – protected by *Nova Scotia Wilderness Areas Protection Act*	Direct	☑	☑	☑	☑	☑
Social	First Nations Land Use	First Nations land use	Loss of access and traditional plants.	Included – protected by *Nova Scotia Special Places Protection Act*	Direct	☑	☑	☑	☑	☑
Social	Economic Conditions	Benefits/negatives to Kingswood residents	Presence of highway	Included – valued	Direct and indirect	☑	☑	☑	☑	☑
Social	Cultural Resources	Archaeological monitoring in areas of potential petrogylphs	Loss or disturbance of archaeological, historical, paleontological or architectural resources	Included – protected by *Special Places Act.*	Direct	☑	☑	☑		☑

8.2 Boundaries for Environmental Effects Assessment

8.2.1 Spatial Boundaries

The spatial boundaries of the study, which represent the area in which potential effects could occur, were selected by professional judgment and scientific literature review, considering the potential for effects. The assessment considers interactions and potential effects of the project relating to project, local and regional study areas.

The project study area is a 150 m wide corridor corresponding to the width of the ROW. In cases where features or VECs may be affected outside of this area, the study area was expanded to include such features.

The local study area is broader than the project study area as appropriate to the component considered. The local study area is not specifically defined but varies with the potential interactions of the environment with the project.

The regional study area varies with the component addressed and is based on administrative or political boundaries for indirect socio-economic effects or natural system boundaries for cumulative biophysical effects.

8.2.2 Temporal Boundaries

The temporal boundaries of the assessment are the duration of the construction of the project and into the operation and maintenance phase. While decommissioning is considered as part of the project and the assessment, the duration of operation of the project is indefinite and the timing and nature of decommissioning is not predictable.

Temporal boundaries vary according to project phase. In the construction phase, specific construction-related effects are short. Effects associated with the operational period are long term, as the highway is intended to be operational indefinitely.

8.2.3 Regulatory Boundaries

The project will be completed in accordance with the requirements of the following federal and provincial environmental legislation and the regulations made pursuant to them:

- *Canadian Environmental Assessment Act* (CEAA);
- *Canadian Environmental Protection Act* (CEPA);
- *Canadian Fisheries Act* (FA);
- *Canadian Navigable Waters Protection Act* (NWPA);
- *Canadian Species at Risk Act* (SARA);
- *Canada Wildlife Act*;
- *Nova Scotia Environment Act*;
- *Migratory Birds Convention Act* (MBCA);
- *Canadian Guidelines for Use of Explosives in Canadian Fisheries Waters*;
- *Nova Scotia Endangered Species Act* (NSESA);
- *Nova Scotia Special Places Act*; and,
- *Nova Scotia Wildlife Act*.

The construction of Highway 113 will adhere to the most recent versions of the Transportation and Infrastructure Renewal guidelines and specifications, Department of Fisheries and Oceans (DFO) Guidelines and the relevant Nova Scotia Department of the Environment (NSE). Current guidelines and specifications include:

- Environmental Protection Plan for the Construction of 100 Series Highways (as amended for this project);
- Transportation and Infrastructure Renewal Standard Specifications;
- Transportation and Infrastructure Renewal Highway Design Standards;
- Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads;
- NSE Pits and Quarry Guidelines;
- NSE Erosion and Sedimentation Control Handbook for Construction Sites;
- NSE Guidelines for Sampling of Domestic Water Supplies in Conjunction with Construction of Highways;
- NSE Guideline for Environmental Noise Management and Assessment;

- NSE Environmental Construction Practice Specifications;
- NSE Environmental Protection Guidelines for the Application and Removal of Protective Coatings during Bridge Maintenance Operations;
- Transportation Association of Canada (TAC) National Guide to Erosion and Sediment Control on Roadway Projects;
- Guidelines for Development on Slates in Nova Scotia;
- Environmental Construction Practice Specifications Guidelines for blasting near watercourses;
- Culvert design and installation will follow the Protection of Fish and Fish Habitat;
- Design Criteria for Fish Passage in New or Retrofit Culverts in the Maritime Provinces, Canada (2002);
- Placement and Design of Large Culverts (2005);
- Transportation and Infrastructure Renewal's design for Enhanced Energy Dissipation Pools; and
- All work will be conducted in accordance with the Nova Scotia Occupational Health and Safety Act General Regulations, or the relevant legislation in force at the time of construction.

9.0 Environmental Effects Assessment

This section of the report assesses the '*Environmental Effects*' derived from the Project activities during the construction and operational phases of the Project for each identified VEC that applies to this Project. For each VEC, the '*Existing Environment*' is discussed and identified that could be potentially impacted within the Project boundaries. For each VEC identified, there follows an '*Impact Evaluation/Effects Assessment'* which identifies the potential project interactions for each VEC and addresses these interactions. For each potential project interaction, mitigation measures are applied in tabulated form, which aim to offset, minimize or reduce potential impacts.

Mitigation measures are defined as actions or activities that, with respect to the undertaking, result in:

> *"… the elimination, reduction or control of the adverse effects or the significant environmental effects of the undertaking, and may include restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means"*.

Potential project interactions identified during the construction or operational phases of the Project are then evaluated according to the level of '*Significance'* that those interactions pose to any given VEC.

Significant environmental effects are defined as:

> *"…an adverse impact in the context of its magnitude, geographic extent, duration, frequency, degree of reversibility, possibility of occurrence or any combination of the foregoing"*.

For each VEC, a table of Significance of Potential Effects is assessed according to:

- Magnitude;
- Geographic Extent;

- Duration and Frequency;
- Reversibility;
- Ecological Context; and
- Significant Effect.

The following definitions further define the parameters for determining significance listed above:

Magnitude: Low: i.e.., not significantly affecting use or enjoyment of property; Moderate: i.e., moderately affecting use or enjoyment of land within a significant portion of the community; High: i.e., severe and lasting effects on use and enjoyment of land for a significant portion of the community;

Geographic Extent: <500 m^2; 500 m^2 -1 km^2; 1-10 km^2; 11-100 km^2; 101-1000 km^2; >1000 km^2;

Duration and Frequency: One time during construction; Continuous during operation;

Reversibility: Yes = Reversible; No = Irreversible;

Ecological Context: Yes = Pristine area; None = Area already affected by human activity; and,

Significant Effect Rating: Yes = Significant Adverse Environmental Effect; No = Non-significant Adverse Environmental Effect; P = Positive Environmental Effect

An example of s **significant** adverse environmental effect is one in which:

- The traffic flow is altered at many areas that currently have satisfactory levels of traffic performance so that the levels of performance are reduced to levels unacceptable or undesirable by engineering standards or professional judgment; or
- The collision rate at one or more locations throughout the study area increases above existing rates for the location(s), or Provincial average rates for the road class, so as to increase the number of collisions in the study area.

An example of a **positive** environmental effect is one that:

- Provides improved levels of service or performance, by increasing capacity or diverting or reducing traffic volumes; or,
- Improves safety by reducing the number of collisions throughout the study area.

9.1 Transportation

9.1.1 Planning Context

TIR anticipates that traffic levels on key regional freeway, highway, and arterial transportation facilities will continue to grow. Within the vicinity of the Halifax peninsula, this growth is expected to occur primarily on Highway 102, Highway 103, and Route 213 (Hammonds Plains Road). In addition, long term development of residential communities is expected to continue in HRM, including the Hammonds Plains area. Hammonds Plains Road is currently operating at, or very close to capacity. Hammonds Plains Road will not be able to accommodate future transportation demands. As a result, additional transportation infrastructure will be required to allow existing roadways to operate at acceptable safety and service levels. Highway 113 is proposed to address this expected need.

Currently, a significant portion of motorists use Hammonds Plains Road in lieu of the Highway 102 and 103 corridors as Hammonds Plains Road is perceived to be an attractive and direct alternative route. Highway 113 will facilitate a more direct and operationally efficient link between the Highway 102 and Highway 103 corridors that would bypass the inner reaches of Halifax's 100 Series highway network .

The proposed Project is part of an overall TIR strategy that addresses the transportation needs for the Province as well as the HRM. Highway 113 would create an efficient and effective transportation corridor that will provide an important connection between communities and modes of transportation for passengers as well as goods and services. The Highway 113 connection would provide a trucking route that bypasses sections of Highway 102, Highway 103, and Hammonds Plains Road (which currently has truck traffic restrictions).

Figure 9-1 Transportation Network

Highway 113 is consistent with the HRM's MPS, which indicates that the need for such a facility would be necessary to accommodate future growth areas in the vicinity of the Halifax peninsula. The plan identifies Highway 113 as a "*Future Potential Project*" that may be required beyond the Plan's 25 year horizon.

9.1.2 Existing Transportation Environment

This section outlines the existing transportation environment in the vicinity of the proposed Highway 113 alignment.

***Highway 102*:** Highway 102 between Hammonds Plains Road and Highway 103 is a four-lane divided freeway facility with a posted speed limit of 100 km/h. It is the only Provincial north-south high speed freeway facility linking Halifax to the north end of the Bedford Basin. Due to on-going development and continuous population growth in adjacent areas, Highway 102 is approaching its capacity. There is, however, a significant constraint in widening Highway 102 due to residential and commercial development that has occurred since planning for Highway 113 commenced in 1998.

***Highway 103*:** Highway 103, between Highway 102 (Exit 1) and Hammonds Plains Road (Exit 5), is a north-south four-lane divided freeway with posted speed limits of 100 and 110 km/hr. Highway 103 facilitates regional travel between Halifax and St. Margaret's Bay area and the rest of the South Shore.

***Hammonds Plains Road (Route 213)*:** Hammonds Plains Road is an east-west two-lane collector highway that connects to Highway 102 west of Bedford (Exit 3), and Highway 103 in the Upper Tantallon Region (Exit 5). Hammonds Plains Road is considered by many local and regional commuters as a more convenient route than the Highway 102/103 corridors. As a result, this facility is exceeding capacity and has the potential for increased safety risks. There are currently no plans to widen Hammonds Plains Road and to do so would create significant property impacts.

Table 9-1 Existing AADT Traffic Volumes for Select Location

Facility	Location	Facility Classification	Typical Range (AADT)[1]	Existing AADT[2]
Highway 102	Between Exit 1 and Exit 3	4-Lane Freeway	> 8000	33,700
Highway 103	Between Exit 3 and Exit 4	4-Lane Freeway	> 8000	14,104
Route 213 (Hammonds Plains Road)	Between Hwy 102 and Lucasville Road	2-Lane Collector Highway	< 12,000	**16,286**

As shown in Table 9-1, current traffic levels on Hammonds Plains Road are higher than the range of volumes typically found on 2-lane collector roadways. The results of estimating available roadway capacity and traffic demands on Hammonds Plains Road indicates that the facility is nearing or operating at its theoretical capacity and that no residual capacity exists to accommodate future development.

9.1.3 Impact Evaluation/Effects Assessment

The effects of the proposed Highway 113 project were examined according to the following traffic scenarios, paying particular attention to future forecasting required by this project.

9.1.3.1 Future Transportation Demand

In March 2006, a report entitled *Highway 113: A Demand and Strategic Context Focus Study* (Delphi-MRC, 2006), was prepared for NSTPW (now TIR) which presented the preliminary results of a transportation demand analysis for Highway 113. The study assessed the transportation demands and travel patterns that are expected to occur as a result of constructing Highway 113 in the 2026 time horizon. The modeling exercise forecasted 2026 regional transportation demands based on population and employment levels adopted in the HRM Regional Plan. The study determined that a base demand of 8,000 – 14,000 daily trips is forecasted to make use of the Highway 113 facility.

It is worth noting that the transportation forecasting exercise was strategic and high level in nature, and did not assess cross-regional transportation demands (i.e. external to external trips) or

1 Transportation Association of Canada (TAC), 1999. *Geometric Design for Canadian Roads, page 1.3.4.2.*
2 Delphi-MRC, 2006. *Highway 113: A Demand and Strategic Context Focus Study, page 9.*

the potential transportation demands that may be attributed to the extension of Highway 107 to Highway 102. Despite the exclusion of these key assumptions, the study determined that there will be significant demand for a high speed corridor linking Highway 102 and Highway 103.

Subsequent to this, an update to the QRS-II transportation demand model was undertaken in 2008 as part of the *Bayers Road/Highway 102 Corridor Study* (Delphi-MRC). The updates reflected additional future development areas that were previously not accounted for, as well as a more refined assignment of future trips.

Two future 2026 scenarios were considered:
Scenario 'A' – Highway 113 is not in place.
Scenario 'B' – Highway 113 in place.

Table 9-2 provides a summary of updated directional peak hour link volumes.

The model shows that all study area roadways are currently operating below capacity, with the exception of a few localized sections along Route 213 (i.e., west and east of Lucasville Road).

It is anticipated that Highway 103 and Kearney Lake Road will continue to operate satisfactorily both with and without Highway 113 in place. It is anticipated, however, that sections of Highway 102 (between exits 2A and 3) and Trunk 3 (east of Timberlea Village Parkway), will operate over capacity without the new Highway 113 link in place. The construction of Highway 113 is anticipated to resolve these capacity constraints.

Some sections of Route 213 (west of Highway 102) are forecasted to operate over capacity notwithstanding the construction of Highway 113, likely as a result of the construction of planned new roads and interchanges. Further mitigation measures and/or road network improvements may be required in the future to address these localized capacity deficiencies.

Table 9-2 – Highway 102 Corridor Study
2026 Directional PM Peak Hour Link Volumes

Roadway	Road Classification	Maximum Lane Capacity	Theoretical Lane Capacity	No. of Mainline Lanes (1 way)	1 Way Link Capacity	Location	Scenario A No Hwy 113 in Place		Scenario B Hwy 113 in Place	
							Inbound	Outbound	Inbound	Outbound
Highway 113	Freeway	1,600 vphpl	1,440 vphpl	2 Lanes	2,880 vph	West of Trunk 3 Connector	~	~	330	530
						West of Kearney Lake Roach Interchange	~	~	520	870
						East of Kearney Lake Road Interchange	~	~	470	1,603
Trunk 3 Connector	Rural Highway	1,000 vphpl	900 vphpl	1 Lanes	900 vph	Between Trunk 3 & Highway 113	~	~	340	200
Highway 103	Freeway	1,600 vphpl	1,440 vphpl	2 Lanes	2,880 vph	Between Exits 5 & 6	360	620	360	570
						Between Exits 4 & 5	480	800	670	1,080
						Between Exits 3 & 4	810	1,610	640	1,240
						Between Exits 2 & 3	1,050	1,870	790	1,370
						Between Exits 1A & 2	790	1,660	700	1,440
Highway 102	Freeway	1,600 vphpl	1,440 vphpl	2 Lanes	2,880 vph	Between Exits 1A & 2A	1,850	2,690	1,580	2,380
						Between Exits 2A & 2	2,000	**3,030**	1,680	2,720
						Between Exits 2 & 3	1,855	**3,125**	1,650	2,790
Kearney Lake Road	Urban Arterial	1,000 vphpl	900 vphpl	2 Lanes	1,800 vph	Between Highways 102 & 113	1,050	420	530	240
						West of Highway 113	950	370	950	310
Route 213 (Hammonds Plains)	Rural Highway	1,000 vphpl	900 vphpl	1 Lanes	900 vph	East of Highway 102	850	480	710	560
						West of Highway 102	**1,900**	**1,040**	**1,830**	**1,230**
						East of Lucasville Road	773	360	730	450
						West of Lucasville Road	370	370	250	230
						East of Highway 103	390	520	360	470
						West of Highway 103	150	210	370	280
Trunk 3	Rural Highway	1,000 vphpl	900 vphpl	1 Lanes	900 vph	West of Highway 103	880	390	780	370
						Between Highway 103 & Trunk 3 Connector	150	140	120	110
						East of Trunk 3 Connector	150	140	210	340
						West of Exit 3 Connector	870	410	630	300
						East of Exit 3 Connector	**915**	395	795	370

Table 9-3 summarizes Average Annual Daily Traffic (AADT) volumes for the study area roadways as well as future 2026 conditions both with and without Highway 113 in place. As shown in Table 9-3, the most recent update to the regional transportation demand model predicts that **8,600** to **20,700** daily trips are forecasted to make use of the Highway 113 facility.

Table 9-3 2026 Scenario Average Annual Daily Traffic (AADT)

Roadway	Road Classification	Location	Scenario A No Highway 113	Scenario B Highway 113
Highway 113	Freeway	West of Trunk 3 Connector	~	8,600
		West of Kearney Lake Road Interchange	~	13,900
		East of Kearney Lake Road Interchange	~	20,730
Trunk 3 Connector	Rural Highway	Between Trunk 3 & Highway 113	~	5,400
Highway 103	Freeway	Between Exits 5 & 6	9,800	9,300
		Between Exits 4 & 5	12,800	17,500
		Between Exits 3 & 4	24,200	18,800
		Between Exits 2 & 3	29,200	21,600
		Between Exits 1A & 2	24,500	21,400
Highway 102	Freeway	Between Exits 1A & 2A	45,400	39,600
		Between Exits 2A & 2	50,300	44,000
		Between Exits 2 & 3	49,800	44,403
Kearney Lake Road	Urban Arterial	Between Highways 102 & 113	14,700	7,700
		West of Highway 113	13,200	12,600
Route 213 (Hammonds Plains)	Rural Highway	East of Highway 102	13,300	12,700
		West of Highway 102	29,400	30,600
		East of Lucasville Road	11,333	11,800
		West of Lucasville Road	7,400	4,800
		East of Highway 103	9,100	8,300
		West of Highway 103	3,600	6,500
Trunk 3	Rural Highway	West of Highway 103	12,700	11,500
		Between Highway 103 & Trunk 3 Connector	2,900	2,300
		East of Trunk 3 Connector	2,900	5,500
		West of Exit 3 Connector	12,800	9,300
		East of Exit 3 Connector	13,100	11,650

9.1.3.2 Changes in Traffic Patterns

It is anticipated that the volume of local trips using Hammonds Plains Road will remain largely unchanged. Local traffic in the Hammonds Plains area will continue to use Hammonds Plains Road as there are a limited number of alternative routes. It is anticipated, however, that a significant portion of through traffic currently using Hammond Plains Road would divert to the new Highway 113 facility, thus alleviating traffic demands on Hammonds Plains Road. This shift in travel patterns would be due to the travel time savings, faster operating speeds and higher levels of service associated with using Highway 113.

Construction of Highway 113 is expected to result in a significant shift in regional travel patterns. A select screenline link analysis was undertaken as part of the 2006 *Highway 113: Demand and Strategic Context Focus Study* (Delphi-MRC, 2006). This assessment was undertaken to determine the anticipated shift in travel patterns that would occur from Hammonds Plains Road and the Highway 102/103 corridors to the proposed Highway 113 in the 2026 time horizon. The analysis indicates that the Highway 102/103 corridor would experience up to a 100 percent reduction in trips (i.e. – travellers currently traveling east-west via Highway 102 and Highway 103 will shift to using Highway 113). Hammonds Plains Road is expected to experience a 75-80% reduction in trips (i.e. through traffic on Hammonds Plains Road will be diverted to using Highway 113). Traffic which presently passes between Highway 103 along the South Shore and Highway 102 north of Bedford, will experience the most benefit from the shorter route length, faster operating speeds, and higher levels of service along Highway 113. Commercial traffic traveling between Highways 102, Highway 103, and the proposed Highway 107 corridor (east of Highway 102 and west of Highway 118) will similarly benefit from the traffic improvements resulting from Highway 113.

Construction of Highway 113, with the future Highway 107 connection, will complete an encompassing highway system connecting the Burnside, Bedford, Sackville, and Hammonds Plains areas with reliable, high speed freeway facilities.

It is anticipated that close to 100% of all trips that are forecast to use Highway 113 are regional trips that originate in Bedford/Sackville, Dartmouth, or the Halifax Peninsula and are destined to the St. Margaret’s Bay area or beyond.

9.1.3.3 Traffic Speed, Level of Service, and Safety

Highway 113 will reduce the required time of travel between Highways 103 and 102 by approximately 8 to 10 minutes per trip. In addition, through traffic will bypass the central core of the HRM, enabling regional travelers to avoid peak hour congestion near the Highway 102 and 103 interchange. There will be a reduction in traffic volume and an improvement in traffic flow along Hammonds Plains Road due to the change in the nature of the traffic (presumably local, with much less through traffic).

Highway 113 will provide a new facility with good safety performance and it will increase the safety performance of the existing Hammonds Plains Road. It is not expected that travel speed will change along any of the local roads within the study area due to the construction of Highway 113. The traffic volumes will change on local roads as discussed above, however, they are not expected to change within subdivisions in the study area.

Table 9-4 discusses potential project interactions, effects, and associated mitigation related to transportation. This table addresses issues required in the Terms of Reference for this proposed Highway 113 EA.

Table 9-4 Potential Project Interactions with Transportation (Project TOR Section 9.1)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Construction Phase		
Construction traffic resulting in changes in driving patterns including traffic speed and density in adjacent residential and commercial areas	Frequency of heavy construction traffic in the area during the construction phase may cause disturbance of nearby residents and the recreational users of the Blue Mountain-Birch Cove Lakes Wilderness Area Movement of construction traffic in the area may cause delays to local and through traffic near the construction site	Mitigation for impacts due to construction traffic will include project scheduling to avoid times of peak use where practical (i.e. limiting the time for construction periods on evenings, weekends and holidays) construction work) Mitigate unnecessary traffic delays through the use of strategic road or lane closures leading to access points for the new highway; issuing of traffic delay alerts; appropriate use of signage and potential diversion/alternate routes for motorists

Table 9-4 Potential Project Interactions with Transportation (Project TOR Section 9.1) (cont.)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Operation/Maintenance Phase		
Changes in driving patterns including traffic speed and density in adjacent residential and commercial areas	Maintenance activities such as snow ploughing, salting and re-surfacing may cause delays to local and through traffic	Mitigate unnecessary traffic delays through the use of strategic road or lane closures leading to access points for the new highway; issuing of traffic delay alerts; appropriate use of signage and potential diversion/alternate routes for motorists Adherence to operation/maintenance standards and procedures for Provincial Highway facilities.

9.1.4 Significance

The proposed Highway 113 project will alter the transportation environment of the area, primarily on Highway 102, Highway 103, and Route 213 (Hammonds Plains Road). The project will provide a safer and more efficient transportation corridor for vehicular travel as well as for trucking goods and services.

The volume of traffic projected to be diverted to the new Highway 113 will reduce traffic demands on Hammonds Plains Road and other surrounding facilities in the future. This is beneficial as the projected transportation demands along existing facilities are expected to exceed capacity in the near future. Table 9-5 discusses significance of potential effects on transportation (addressing issues required in the Terms of Reference for this proposed Highway 113 EA).

Table 9-5 Significance of Potential Effects on Transportation (Project TOR Section 9.1)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Construction Activities						
Changes in driving patterns including traffic speed and density in adjacent residential and commercial areas such as movement of construction traffic in the area	Moderate – Low	Moderate - Low	One time during construction	No	Adjacent residents and recreational users of the Blue Mountain-Birch Cove Lakes Wilderness Area	No

Table 9-5 Significance of Potential Effects on Transportation (Project TOR Section 9.1) (cont.)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Operation/Maintenance Activities						
Changes in driving patterns including traffic speed and density in adjacent residential and commercial areas resulting from maintenance activities (i.e. snow ploughing, salting and re-surfacing)	Low	Low	Continuous for operation and annually/seasonally for maintenance	Yes	None	No
Changes in driving patterns such that Highways 102/103 and Hammonds Plains Road will experience a reduction in trips	Moderate-High	Moderate-High	Continuous for operation	Yes	Improved trucking efficiency and corresponding reduction in GHGs	Positive Effect

The overall residual effects on transportation will be beneficial due to improved connectivity to planned and existing business parks, planned residential development to the east of the corridor, improved access to rural communities in the area, and reduction in GHG emissions through improved driving patterns (e.g., better traffic flow at optimal speeds instead of idling and inefficient engine use in congested traffic). There will also likely be a beneficial residual effect on commercial property values (through improved customer access) and certain residential property values where residents would directly benefit from improved connectivity of the highway system.

9.1.5 Follow-up and Monitoring

No follow-up or monitoring activities are required for transportation.

9.2 Existing and Planned Land Uses

9.2.1 Existing Environment

The proposed alignment links two major transportation routes in Nova Scotia (Highways 103 and 102) and forms a buffer between the Blue Mountain-Birch Cove Lakes Wilderness Area to the south and Kingswood subdivision to the north. West of Kingswood, the alignment passes though undeveloped resource land. The eastern and western ends of the alignment are areas of future development. The intersection of Highway 103 and the proposed 113 is adjacent to the suburban communities of Five Island Lake, Sheldrake Lake and Hubley.

As the alignment passes east of Blue Mountain Hill, the land is currently undeveloped between Lakeshore Drive (near to Ragged Lake) and Highway 102, with the exception of Kearney Lake Road, Harmony Park, and the Atlantic Acres Business Park to the north of the alignment.

Highway 113 has been identified as a future transportation route in HRM’s MPS. As a future route, it is expected to be required beyond the MPS’s 2026 planning horizon. This is consistent with TIR’s expectations for the timing of the need for the highway. These expectations are based on the transportation demand management measures, such as providing for increased transit use, which form part of the Regional Plan. The Department’s position is that Highway 113 will not be constructed before the need is present. Ultimately the timing of construction will depend on how quickly traffic volumes grow, the availability of funding, and the project's priority among other government projects at the time the highway is required. The project will be scheduled in consultation with HRM through the Strategic Joint Regional Transportation Planning Committee and other means.

9.2.1.1 Forestry

Areas of forested land outside the Blue Mountain-Birch Cove Lakes Wilderness Area and to the north of the alignment are actively being harvested by local companies. Except for a small portion of privately held land south of the alignment, the highway will not impact area forestry activity. TIR’s common practice is to provide access to lands severed by a controlled access 100 Series highway or to purchase the lands to mitigate impacts on resource land use. However, in this case the piece of private land will not be provided access once the highway is constructed. Compensation for loss of access to the land will form a portion of the overall land settlement.

9.2.1.2 Mining/Aggregate Production

The proposed alignment does not conflict with any known mineral interests and the area is not currently under any mineral exploration license or mining permit.

9.2.1.3 Agriculture

There is no agricultural land use along the proposed alignment. The Canada Lands Inventory Map Series for the Atlantic Provinces states that due to the stoniness and shallowness of the bedrock, soils in the study area have limited capability for crop use or permanent pasture.

9.2.1.4 Commercial/Industrial

While there has been a significant increase in the construction and utilization of commercial and industrial developments in the area, there are no commercial lands on the proposed alignment with the exception of the area between Kearney Lake Road and Highway 102.

Commercial lands near the study area are concentrated on the Hammonds Plains Road and in Bedford, east of the study area. Atlantic Acres Industrial Park, located to the north the alignment, approximately 3 km west of Highway 102, is a mixed-use industrial site with emphasis on light manufacturing and commercial industries.

9.2.1.5 Residential

As discussed previously, the communities of the Hammonds Plains and Upper Tantallon areas have experienced a considerable amount of residential growth since the early 1980s which has resulted in a significant increase in population.

Parts of the area continue to experience development pressure in the form of new residential subdivisions. Historic land use development patterns have been along the main roads, focusing in Hammonds Plains Road, Kearney Lake Road and Trunk 3. The following residential developments are located in proximity of the proposed Highway:

- Kingswood (north of the proposed Highway), located off of Hammonds Plains Road;
- Kearney Lake Estates (south of the proposed Highway), located off of Kearney Lake Road, adjacent to and north of Kearney Lake;
- Blue Mountain Estates (north of the proposed Highway), located off of Kearney Lake Road;
- Bedford West - Bedford West has been identified as Urban Settlement Designation in the HRM Regional Plan; and,
- Sheldrake Heights, located south of proposed highway, east of Highway 103.

While proposed construction of the alignment is not anticipated to occur until sometime in the future, real estate developers along the alignment have incorporated the proposed highway development into their plans. Specifically, the alignment has been incorporated into planned residential developments at Bedford West and Sheldrake Heights.

TIR will not be providing access to private and crown lands outside the ROW and proposed interchanges. No access is possible towards the south and east to private lands as the wilderness area stretches from Fraser's Lake to Kearney Lake. Furthermore, for the lands to the north and west, NSDNR has informed TIR that it will not trade or sell crown land for private development purposes.

9.2.1.6 Institutional

There is no institutional land use along the proposed alignment. Five schools and several churches are located more than 500 m from the alignment. Northwood is building a new continuing care centre within the Parks at Bedford West development in 2010. The proposed site is in the northwest corner of the business campus portion of the Parks of Bedford West.

9.2.1.7 Recreational Use

Canoeing

There is a canoe route between Maple and Frasers Lake, which will be crossed by the proposed highway. This is a section of the canoe route from Cox Lake off the Hammonds Plains Road to St. Andrews Anglican Church in Timberlea. TIR will provide improved routing for canoeists along this section.

Camping

Within the Blue Mountain area, there are no designated camping areas and there have been no reports of campers using this area. While some wilderness camping may occasionally occur in this area, it is more likely that, due to its limited size and multiple access points, this area is more conducive and suitable for day use, as opposed to overnight camping (AMEC, 2004).

Hiking and Mountain Biking

There are several walking and mountain biking trails that are traversed by the proposed alignment. One trail provides access to Blue Mountain Hill from Kingswood. Blue Mountain

Hill, a 152 m outcrop south of Ragged Lake, is a popular destination for hikers. From Blue Mountain Hill, the area's highest elevation, hikers can view Timberlea, Bedford and the Halifax region. Additional scenic vistas also occur in the Blue Mountain area overlooking Fraser Lake with elevations of approximately 125 m in height.

In addition, the Minister Hill Trail is a multi-use trail that is used by hikers, mountain bikers and cross-country skiers. The primary access point is off the Hammonds Plains Road near Stillwater Lake, and begins in the Halliburton Hills Subdivision, at a roadway that is blocked by a gate. The trail is approximately 16 km in length and continues around Ministers Hill towards Maple Lake. The trail continues on towards Sheldrake Heights where it terminates near the residences on Maple Lake Drive and Merganser Avenue. This trail also provides access to Maple Lake for Sheldrake Heights Subdivision residents.

Recreational Opportunities

Rural Resource land use is considered to be a high-quality resource area in terms of recreation and open space potential. A significant portion of the land traversed by the proposed Highway 113 is considered to be a high quality resource area in terms of recreation and open space potential. These values have been recognized and protected by the creation of the Blue Mountain-Birch Cove Lakes Wilderness Area.

Off Highway Vehicles

Off highway vehicle (OHV) use on provincial highways is not permitted under the *Motor Vehicle Act.* If access to the wilderness area by OHVs via highway 113 becomes an issue, TIR, in consultation with NSDNR and NSE will eliminate the access point of concern.

9.2.1.8 Utilities

Nova Scotia Power Inc. (NSPI) maintains four power line ROWs through the study area and two distribution lines along Kearney Lake Road and Trunk 3. Descriptions of the NSPI ROWs are as follows:

- 1 line (#8002), 345 KV, 285 ft wide ROW, located between Fraser Lake and Ash Lake;
- 2 lines (#6008 and 6016), 2 - 138 KV, 325 ft wide ROW, located east of Ragged Lake;

- 1 line (#5004), 69 KV, 66 ft wide ROW, located adjacent to the west of Highway 102; and
- 60 ft ROW retained, located adjacent the east of Trunk 3.

BellAliant maintains one telephone line on the Trunk 3 distribution line which belongs to NSPI. This telephone line can be raised to accommodate the construction of the proposed connector road. Eastlink Cable maintains above ground cable lines along Kearney Lake Road and the Sheldrake Lake subdivision. These lines can be moved to accommodate the construction of the proposed highway. Halifax Water owns and operates the existing water infrastructure in the vicinity of the proposed highway. The existing water transmission main from the J.D. Kline Water Supply Plant (Pockwock) follows the alignment of Kearney Lake Road and crosses the alignment. At the point of the proposed alignment, the existing transmission main is 1200 mm in diameter and is located along the west shoulder of the roadway with a minimum of 1200 mm of cover.

9.2.1.9 Parks and Protected Areas

On April 21st, 2009, Blue Mountain-Birch Cove Lakes Wilderness Area was created under the province's *Wilderness Areas Protection Act*. It lies between Highway 103 and the Bicentennial Highway, adjacent to the Bayer's Lake Business Park. The total area of this near-urban wilderness area is approximately 1750 hectares (4300 acres), or almost 3/4 the size of Halifax Peninsula. The new wilderness area includes forests, lakes, barrens, and wetlands. It protects valued wildlife habitat and a range of wilderness recreation opportunities, all within minutes of Atlantic Canada's largest urban centre.

The wilderness area will be complemented by municipal plans to establish a regional park, as stated in the MPS. The new wilderness area is part of progress toward meeting the government's commitment to protect 12% of Nova Scotia's land base by 2015, as stated in the *Environmental Goals and Sustainable Prosperity Act*. The proposed highway alignment is located along the northern edge of the Blue-Mountain-Birch Cove Lakes Wilderness Area (Figure 9-2)

The nearest provincial park to the alignment is Jerry Lawrence Provincial Park (formerly named Lewis Lake Provincial Park). It is a small day use park with picnic areas and trails located in Upper Tantallon, approximately 3 km west of the proposed alignment.

9.2.2 Future Land Use

Land use developments are proposed for the area which includes: The Parks at Bedford West (including the Bedford West Business Park, Stonington Park and additional parcels scheduled for development from 2011 and beyond), the Research in Motion (RIM) development, and the proposed expansion of Bedford South, which is contingent on the completion of the Highway 102/ Larry Uteck Blvd interchange (under construction late 2009). In addition, there are privately held lands that have development potential adjacent to the alignment.

9.2.3 Impact Evaluation/Effects Assessment

The proposed alignment may result in limited access to the Wilderness Area potentially affecting a variety of recreational uses including mountain biking, hiking and cross country skiing. While access will be more limited, access to the Wilderness Area will be maintained at key access points, including via Kingswood subdivision. Access to Maple Lake from the Sheldrake Heights subdivision will be maintained by the Highway 113 overpass. Highway 113 will sever the access to Maple Lake from Sheldrake Heights. (AMEC, 2004). Other trails in the study area include the Beechville Lakeside Timberlea (BLT) Trail and Kearney Lake Trail. These will be unaffected by the proposed Highway 113. Access across the existing canoe route connecting Stillwater-Maple-Fraser-Governor Lakes is not expected to be impacted during construction or operation of the highway.

Potential effects on existing and planned land use include the fragmentation of undeveloped land holdings, impacts on utilities (existing and planned), disturbance to recreational users of the Blue Mountain – Birch Cove Lakes Wilderness Area and residents of adjacent existing and future residential developments. Table 9-6 provides a summary of potential project interactions, effects, and associated mitigations relating to existing and planned land use for the construction and operational phases of the project. Potential operational impacts on adjacent existing and planned land uses can be mitigated by standard TIR mitigation procedures. Mitigation measures as cited for noise and dust control will also apply to protect existing and planned land uses in the area.

Figure 9-2 Existing and Future Land Use

Table 9-6 Potential Project Interactions with Existing and Planned Land Uses (Project TOR Section 9.2)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Construction Activities		
Location of alignment	Fragmentation of landholdings on Planning Strategies, proposed development and development boundaries	Mitigation measures for impacts to existing and future planned land uses due to land fragmentation will involve purchase of land or provision of access. Applies to one property and TIR is in negotiations with the landowner. Highway has been accounted for in future development plans and HRM's MPS.
Construction in vicinity of utilities	Impact on utility infrastructure	Coordination with HW, NSPI, BellAliant, Eastlink.
Construction of the highway	Disturbance of users of the Blue Mountain-Birch Cove Lakes Wilderness Area	No direct impact from highway on Blue Mountain-Birch Cove Lakes Wilderness Area as boundary reflects highway alignment. Noise from highway expected to meet NSE guidelines based on noise assessments conducted on 100 series highways in similar settings.
Watercrossing impact on canoe route	Loss of access for recreational users	Bridge over watercourse between Maple and Frasers Lakes will have adequate clearance for users.
Potential impacts on private and commercial property and on human activities in the study area	Modification to several walking, canoe routes and mountain biking trails that are traversed by the proposed alignment.	Access across the existing canoe route connecting Stillwater-Maple-Fraser-Governor Lakes is not expected to be impacted during construction. Where the passageway crosses the proposed alignment, access across the alignment will be maintained over the interconnecting waterways during the operation of Highway 113.

Table 9-6 Potential Project Interactions with Existing and Planned Land Uses (Project TOR Section 9.2) (cont.)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Operation/Maintenance Activities		
Fragmentation of landholdings	Fragmentation of landholdings on planning strategies and proposed development boundaries	Mitigation for impacts to existing and future planned land uses identified above.
Operation of the highway	Disturbance of nearby residents and the recreational users of the Blue Mountain-Birch Cove Lakes Wilderness Area	No direct impact from highway on Blue Mountain-Birch Cove Lakes Wilderness Area as boundary reflects highway alignment. Noise from highway expected to meet NSE guidelines based on noise assessments conducted on 100 series highways in similar settings. Access to Maple Lake from Sheldrake Heights subdivision will be maintained with the existing connector road off St. Margarets Bay Road and the partial diamond interchange. Access across the existing canoe route connecting Stillwater-Maple-Fraser-Governor Lakes will be maintained over the interconnecting waterways during the operation of Highway 113.

9.2.4 Significance

A significant adverse residual effect on land use is defined as one where the proposed land use is incompatible with existing and/or future adjacent land uses, from the perspective of the landowners, business owners or other key stakeholders. Table 9-7 identifies the likelihood of the potential of proposed project activities to cause significant adverse environmental effects to land use after mitigation is in place (Section 9.2 in the TOR). Significant residual adverse effects to land use are not likely to result from this project with implementation of the mitigative measures described above.

Table 9-7 Significance of Potential Effects on Existing and Planned Land Uses (Project TOR Section 9.2)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Construction						
Fragmentation of landholdings on planning strategies and development boundaries	Low	Low	One time	No	None	No
Impact on utility infrastructure	Low	Low	One time	No	None	No
Disturbance of users of Blue Mountain-Birch Cove Lakes	Low	Med	During construction	Yes	None	No
Watercrossing impact on canoe route	Nil	Nil	N/A	Yes	None	No
Operation/Maintenance Activities						
Fragmentation of landholdings on planning strategies and development boundaries	Low	Low	Nil	No	None	No
Disturbance of users of Blue Mountain-Birch Cove Lakes	Low	Low	Continuous for operation	No	None	No

Currently, official access to the Blue Mountain-Birch Cove Lakes Wilderness Area does not exist. Therefore the appropriate access for recreational users of the adjacent hiking trails and waterways will be developed across the Highway 113 alignment in cooperation between TIR and NSE, NSDNR and HRM, thus providing a beneficial residual effect. The overall residual effects related to existing and planned land use will be beneficial due to improved connectivity to planned and existing business parks, planned residential development to the east of the corridor and improved access to rural communities in the area.

9.2.5 Follow-up and Monitoring

Follow-up and monitoring as related to existing and planned land use in the project area is not required.

9.3 Socio-Economic Conditions

9.3.1 Existing Environment

The study area for the socio-economic environment includes the local communities in the immediate project area (Hammonds Plains and Kearney Lake Road subdivisions and businesses, and the Kingswood and Sheldrake Heights subdivisions). Socio-economic impacts may be experienced outside of the study area depending upon the issue.

The proposed alignment passes through largely undeveloped land, however, it is abutting the southern edge of the Kingswood subdivision and adjacent to neighbourhoods in the Sheldrake Lake and Five Islands Lake area.

9.3.1.1 HRM Regional Municipal Planning Strategy

The Highway 113 alignment is included in the overall Regional Municipal Planning Strategy's (MPS) Transportation and Transit Map (Map 7) but the Plan anticipated that Highway 113 would not be required within the 25-year planning horizon of the MPS. Instead, HRM is controlling growth along the corridor (Hammonds Plains area) and also increasing the level of transit service to ease pressure on the existing Route 213.

Section 3.5.3 of the MPS is entitled Other Growth Management Mechanisms. This section notes: "Until a substantive change is made in the infrastructure capacity within Hammonds Plains…, due to the safety concerns…it is appropriate to limit all further residential subdivision activity involving new public roads in these areas." This statement is supported by HRM Policy S-25, which states: "HRM shall, through the Subdivision By-law, limit development within portions of the Hammonds Plains…to prohibit residential development on new roads".

HRM is implementing a comprehensive Transportation Master Plan to create the foundation for the overall transportation system in HRM, including the provincial highway network, to improve the competitive position of HRM over the 25 year time frame of the MPS.

The Transportation Master Plan includes five functional plans which are intended to improve traffic movements and shift the trend away from single occupant vehicles to other modes of transportation. These functional plans are the Road and Road Network Functional Plan, Public

Transit Functional Plan, Active Transportation Functional Plan, Transportation Demand Management Functional Plan and Regional Parking Strategy Functional Plan (HRM, 2006).

Other MPS initiatives relate to transportation demand management with a focus on improved transit. HRM introduced a rural express bus service to Tantallon in 2009. There is also a commitment to meeting minimum service standards for transit in HRM (Delphi MRC, 2006).

9.3.1.2 Integrated Resource Management Land Use Plan

In September 2000 the Nova Scotia Department of Natural Resources (DNR) proposed its long term Integrated Resource Management (IRM) land use plan for Nova Scotia's public lands. The provincial lands within the study area were classified as Category II Lands – Multiple and Adaptive Resource Use. The lands were recognized for recreational and scenic values. Since the creation of this plan the provincial lands to the south of the alignment have been incorporated into the Blue Mountain Birch-Cove Lakes Wilderness Area, providing a significant area of land that focuses on conservation. The current land use classification of the crown lands to the north of the proposed ROW is resource use.

9.3.1.3 Socio-Economic Setting

This section provides a description of the existing socio-economic environment. The section is based largely on socio-economic baseline setting from the previous related studies including:

- Highway 113 Environmental Assessment Registration Project: EA-99-002, Washburn and Gillis Associates Limited, April 2000;
- Highway 113 Assessment of Potential Impact On The Wilderness Recreational Potential Of The Blue Mountain Area, AMEC, June 2004;
- Highway 113: a Demand and Strategic Context Focus Study, Delta MRC, March 2006;
- Blue Mountain/Birch Cove Assessment Study, EDM Environmental Design and Management Ltd, March 2006; and,
- Highway 113 - Focus Report, Nova Scotia Department of Transportation And Public Works, March 2006.

Where appropriate, information has been updated to reflect the current conditions. The study area for the socio-economic environment includes the local communities in the immediate vicinity of the alignment: Hammonds Plains, Timberlea, Tantallon, and Bedford with an emphasis on subdivisions nearest the proposed alignment, including Kingswood (Hammonds Plains), Sheldrake Heights (Tantallon), and Kearney Lake Road subdivisions. Community profiles, population demographics, and land use information are provided below.

9.3.1.4 Community Profiles

In 1996 the provincial government amalgamated all municipal governments within Halifax County to create HRM, a regional municipality comprising approximately 200 individual communities grouped into 18 planning areas for zoning purposes. The dense urban part of HRM is an area surrounding Halifax Harbour in the western part of the municipality, and includes the Halifax Metropolitan Area, the Dartmouth Metropolitan Area, and the Bedford-Sackville areas. Rural areas lie to the east, west and north of this area. The communities closest to the proposed alignment are described below:

9.3.1.5 Bedford

Bedford lies on the northwestern end of Bedford Basin, which is part of the Halifax Harbour. Development in the surrounding new communities of Bedford West and Bedford South is expected to add more than 17,000 residents in an estimated 7,300 households over the next 25 years.

9.3.1.6 Hammonds Plains

Hammonds Plains lies at the neck of the Chebucto Peninsula along a road that runs from Bedford to the Head of St. Margaret's Bay. A number of small businesses align Hammonds Plains Road. The primary water supply for HRM comes from Pockwock Lake which lies north of Hammonds Plains. There are several new subdivisions within Hammonds Plains, including the Kingswood subdivision which is located north of the proposed alignment.

9.3.1.7 Upper Tantallon

Upper Tantallon is a community that extends from the Hammonds Plains Road to the crossroads of Trunk 3 and Route 333, approximately 22 km west of Halifax. Sheldrake Heights Subdivision is located at the western end of the proposed alignment. Timberlea is another community located on the urban fringe of HRM, along the St. Margaret's Bay Rd (Trunk 3), which extends from the Armdale Roundabout to the Head of St. Margaret's Bay. The majority of residents of these urban fringe communities work in HRM's urban area.

9.3.1.8 Population Growth

HRM had a relatively stable population growth over the last 25 years. In 1976, the population was less than 280,000, rising to 372,679 in 2006. This growth has not occurred uniformly across HRM, but has instead been focused mainly in suburban and rural areas within commuting distance of the Regional Centre, including the communities surrounding the west and east ends of proposed Highway 113 alignment. In the HRM urban fringe, including communities surrounding the west and east ends of the proposed Highway 113 alignment, the population grew rapidly in the 1990s, particularly in subdivisions of Hammonds Plains.

Population growth in HRM has been affected by: public policy, taxation and finance, geography, land ownership and the market, all providing incentives or disincentives for residency. In the 1950s, HRM was very compact and most people lived in the former cities of Halifax and Dartmouth, what is now called the Regional Centre. By the 1960s, suburban subdivisions developed and rural commutershed subdivisions began to emerge.

As rural areas grew, the population of the Regional Centre began to decline and development moved further out from the Regional Centre. HRM's past population growth trend has resulted in dispersed settlement patterns in some areas, where increasingly larger amounts of land are used by individual households. Since 2000, residential development in the Regional Centre has begun to grow again, but suburban communities have continued to develop and spread across HRM. Recent population data for surrounding communities are provided in Table 9-8 below.

Table 9-8 Census Population Data, 2001 and 2006

	2001	2006	% Change
Halifax Regional Municipality	359,183	372,858	+3.8
Bedford	15,954	16,589	+4.0
Hammonds Plains	7,907	10,295	+30.2
Upper Tantallon	6,696	8,062	+20.4
Timberlea	8,141	9,089	+11.6

9.3.1.9 Local Economy

HRM's urban area is a major economic centre in eastern Canada with a large concentration of government services and private sector companies. Major employers and economic generators include the Department of National Defence, various levels of government, and the Port of Halifax. Regional prominence in new producer service industries (e.g., research activities in the health, marine and university sectors) as well as the traditional functions of government, trade, distribution, transportation and finance all sustains the local economy. Agriculture, fishing, mining, forestry and natural gas extraction are major resource industries found in the rural areas of HRM.

9.3.2 Impact Evaluation/Effects Assessment

9.3.2.1 Property Values

The proposed alignment will likely have both positive and negative effects to property values along the alignment, depending on the existing and potential land use for property. For example, a negative effect to property values may occur as a result of elevated noise levels and aesthetics in the vicinity of residential dwellings. Conversely, there may also be positive effects associated with the shorter travel time or increased access resulting from the new alignment where interchanges are close by. For example, commercial property values in the Atlantic Acres Business Park could potentially increase in value due to improved access to the Clayton business park.

Studies conducted throughout jurisdictions in North American and Europe have attempted to quantify the impact of noise on valuation of properties affected by noise, in particular the impact of traffic noise (Nelson, 1982; The European Environmental Noise Directive (2002/49/EC). A common expression for the negative impact of noise on a valuation is expressed in terms of percentage decrease per decibel of noise increase also stated as the Noise Depreciation Sensitivity Index (NDSI). The NDSI is based upon Hedonic Price indices. Hedonic price index is any price index, which uses information from hedonic regression which describes how product price could be explained by the product's characteristics. Hedonic price indexes proved to be very useful when applied to information and communication products (e.g. personal computers) to calculate price indexes, because they can successfully mitigate such problems as new goods and rapid quality change. The hedonic technique derives from the observation that whilst some environmental goods, take peace and quiet as an example, are not traded directly in their own markets they may be traded indirectly in other markets.

Studies of nine housing markets in the US and Canada have determined the average depreciation to range from 0.08 – 1.05% per decibel over baseline noise levels, with a weighted mean average of 0.4% per decibel (USEPA, 1974). Theebe (2004) in a review of house prices in several cities in the Netherlands found that a depreciation of 0.1% - 1% in house prices in areas where traffic noise ranged between 61 – 65 dB (the expected upper range of average noise on Highway 113).

Given the early stages of the project and the fact that residential and commercial land uses are projected to grow in the vicinity of the highway alignment, it is too early in the process to assign noise values to the highway. While estimates are made in this EA based on noise levels of 100 series highways in similar settings, actual projected noise levels will depend on a number of factors: level of background noise in the area when the highway is slated to be constructed; median width; cut and fills; and pavement. As a result, an assessment of projected noise will be completed during the design stage of the highway and appropriate mitigation measures will be implemented, where required.

9.3.2.2 Dispute Resolution Mechanism

As part of TIR’s overall consultation efforts for the highway during the design, construction, and operations phases, TIR will establish a Community Liaison Community (CLC) which will act as a mechanism for stakeholders to gain information on the project as it proceeds and to address issues directly with TIR during construction and operation of the highway.

It is the Department’s preference to informally resolve a dispute through discussions between the parties concerned. If there is a dispute from stakeholders potentially affected by the proposed alignment that cannot be resolved through the CLC, then TIR will work with the stakeholder to resolve the dispute through a more formal Alternate Dispute Resolution (ADR) mechanism, such as negotiation or mediation using a third party facilitator that is mutually acceptable to the two parties.

9.3.2.3 Proposed Interchange Locations

The proposed interchange at Kearney Lake Road will result in a positive effect for commuters by improving access to the 100 series highway as development growth increases in the area. This is particularly true for the planned development of the Parks of Bedford West, which will see the construction of over 6,000 units (18,000 people) over 25 yrs (beginning in 2009). The Kearney Lake Road/113 interchange will compliment the new 102/Larry Uteck Blvd. interchange in reducing traffic congestion on Hammonds Plains and Kearney Lake Roads. Likewise, the connector roads proposed for the western end of the alignment will provide access to Highway 113 and the 100 series Highway network from Sheldrake Heights and Haliburton Heights subdivisions. Adverse impacts on existing and future land use from the proposed interchanges are not expected. The highway alignment and interchanges have been considered in the design of the Bedford West development, and TIR is in negotiations with the land owner at the western end of the alignment (between Maple and Fraser Lakes and Highway 103) to purchase the required land for the alignment, including the interchanges with Highway 103 and the proposed access roads.

9.3.2.4 Blue Mountain- Birch Cove Lakes Regional Park

In the period between the development of the Terms of Reference and production of this document, the plans for the proposed Blue Mountain – Birch Cove Lakes Regional Park have been altered in that the lands set aside for the regional park have been designated by the Province of Nova Scotia as a Wilderness Area. The potential effect and mitigation measures for the Wilderness Area are described in Section 9.2. Safe access to the Wilderness Area will be provided. The details of access locations, number and type will be determined through consultation between, TIR, NSDNR, HRM and NSE.

9.3.2.5 First Nations Land Use

There are no land claims that affect the highway alignment. A Mi’kmaq Environmental Knowledge Study will be commissioned by TIR. TIR has initiated the consultation process with the First Nations in keeping with the Province’s obligation to consult with the Mi’kmaq people. TIR will follow the consultation process laid out in the Terms of Reference for a Mi’kmaq-Nova Scotia-Canada Consultation Process (Nova Scotia, 2007).

Potential construction and operation related project interactions, effects, and associated mitigation measures as they relate to socio-economic conditions in the project area are outlined in Table 9-9.

Table 9-9 Potential Project Interactions with Socio-Economic Conditions (Project TOR Section 9.3)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Construction Activities		
Potential impacts on private and commercial property related to access	Restricted access to commercial or private property potentially affecting businesses or quality of life	Access restrictions to private or commercial property will be of short duration and scheduled to minimize effects.
Elevated noise levels in the vicinity of residential dwellings	Decrease in residential property values	Noise associated with the construction phase will be over the short term. TIR does not directly compensate for property devaluation; however, the impact of traffic noise on property valuation is affected by a number of factors that may need to be incorporated into the final analysis including existing and future noise levels for the impacted dwellings and the effectiveness of proposed mitigation measures if required.

Table 9-9 Potential Project Interactions with Socio-Economic Conditions (Project TOR Section 9.3) (cont.)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Proposed interchange locations affecting present and future development	Interchanges modifying opportunity for expansion of commercial/residential/institutional/ recreational and resource land uses within the study area	The location of the planned interchanges have been carefully considered in relation to current and future commercial/business development Proposed Highway 113 is considered to be a high quality resource in terms of accessing recreation and open space potential. TIR has consulted and negotiated with affected stakeholders regarding the locations of the interchanges
Conflicts between construction of the alignment and existing residential, commercial use of lands	Disputes from stakeholders potentially affected by the proposed alignment	Use of formal dispute resolution process: TIR recommends concerned residents or corporations bring issues to the department directly to provide an opportunity for TIR to informally resolve directly with the stakeholder. If this informal process does not resolve the dispute, it is recommended that the dispute be resolved through a more formal Alternate Dispute Resolution (ADR) mechanism, such as negotiation or mediation using a third party facilitator that is mutually acceptable to the two parties
Operation/Maintenance Activities		
Presence of highway	Effect on residential and commercial property values; effect of interchanges, noise effects	The impact of traffic noise on property valuation is affected by a number of factors that will need to be incorporated into a study during the design phase of the highway. Commercial property values in the Atlantic Acres Business Park could potentially increase in value due to improved access to the business park May be positive effects on property values associated with the shorter travel time or increased access resulting from the new alignment where interchanges are close by. Issues related to highway impacts to be addressed through a CLC and ADR if required.

9.3.3 Significance

A significant adverse residual effect on the socio-economic environment is defined as one where the project has a long term negative effect on the components making up the socio-economic environment (e.g., property values, success of businesses) with a direct linkage to project effects. Table 9-10 identifies the likelihood for the proposed project activities to cause significant adverse environmental effects to the socio-economic conditions of the study area (Project TOR Section 9.3).

Table 9-10 Significance of Potential Effects on Socio-Economic Environment (Project TOR Section 9.3)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Construction Effects						
Restricted access to commercial or private property potentially affecting private property, businesses, or quality of life	Low	Low	Construction Period	Y	Adjacent land	No
Decrease in residential property values	Low	Kingswood, Kearney Lake Road	Temporary	N	N/A	No
Interchanges modifying opportunity for expansion of commercial/residential/institutional/ recreational and resource land uses within the study area	Low	Access Points	Temporary	Y	N/A	Positive Effect
Disputes from stakeholders potentially affected by the proposed alignment	Low	Low	Construction Period	No	Adjacent land	No
Operation/Maintenance Activities						
Effect on residential and commercial property values; effect of interchanges, noise effects	Low	Low	Life of Project	Y	N/A	No

It is anticipated that the overall residual effects on the socio-economic environment will be beneficial due to improved connectivity to planned and existing business parks, planned residential development to the east of the corridor and improved access to rural communities in the area. There may be some adverse residual effects related to the reduction in property values resulting from the operation of the highway. These residual effects are anticipated to be minor in nature.

9.4 Atmospheric Conditions

9.4.1 Existing Environment

On a global scale, the Atlantic Region lies within the zone of prevailing westerly winds. This zone is characterized by the passage of a series of high and low pressure systems. Paths taken by these systems are further influenced by ocean currents and continental topography. Cyclonic passages (low pressure systems moving through an area) may track across the continent or up the eastern seaboard. Typical cyclonic passages are marked by the onset of wind from an easterly direction, thickening cloud, and a gradual fall in pressure. Strong north-easterly winds and heavy precipitation are familiar accompaniments to these storms. Should the storm centre pass to the south, the wind direction will change in a counter-clockwise manner and precipitation may persist for several days. If the low pressure centre tracks to the north of the observing station, the wind direction usually veers (changes in a clockwise manner). The cyclonic passages typically last from a few days to a week (Lewis, 1997).

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

Winters have been cold with frequent snowfall. The average annual snowfall amount over the period from 1971 to 2000 is 182 cm. Climate normals are developed from meteorological data covering a 30-year period and are used to characterize climatic elements and eliminate any year-to-year variations. The temperature normal for Halifax for the period 1971 to 2000 is 6.4°C (Environment Canada, 2003). The daily maximum is 10.5ºC and the daily minimum is 2.2ºC. The total precipitation normal for Halifax is 153.8 cm annually. The majority of the total precipitation is in the form of rainfall, which may occur in any month of the year. The monthly rainfall totals are highest during the fall months.

Climate normals are developed from meteorological data covering a 30-year period and are used to characterize climatic elements and eliminate any year-to-year variations. Environment Canada's weather station at Halifax Citadel was chosen as a representative site for climate normal data. The annual temperature normal for the monitoring station at Halifax Citadel for the period from 1971 to 2000 is 7.2º C. The daily maximum is 11.2º C and the daily minimum is 3.2º C.

Temperature Normals for the area are shown in Table 9-11. The annual temperature range is normally between +22ºC and -9ºC. However, extreme temperatures of +33ºC in summer and -26ºC in winter have been recorded.

Precipitation normals and extremes are presented in Table 9-12. Although rain may occur in any month of the year, the rainfall in the area is highest during fall and early winter. Total average rainfall is 1356 mm. Snow and freezing precipitation can occur between October and May, with the largest amounts falling between December and March. The average annual snowfall amount over the period from 1971 to 2000 is 151.8 cm. Since the project location is situated further inland than the monitoring station, more snowfall could be expected.

Wind statistics from the Shearwater Airport station were used to represent the wind data for this area as this information was more complete than that of the Halifax Citadel station. The data from Shearwater indicated that the prevailing winds in the area are westerly to northwesterly in the colder months and south to southwesterly in the warmer months. The winds from the west and northwest tend to be stronger than winds originating from the south and southwest. The average and extreme wind speed and direction values are shown in Table 9-13.

Table 9-11 Temperature Normals

Temperature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
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
Standard Deviation	1.7	1.9	1.4	1	1.1	1	1	0.8	1.2	1.1	1.3	2.1	0.7
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
Extreme Maximum (°C)	14	16	23.5	26.1	33.3	**34**	33	33.9	32.2	24	20	16.7	
Date (yyyy/dd)	1995/16	1994/20	1998/31	1938/28	1977/23	**2001/27**	2001/25	1935/19	1969/01	1983/04+	1938/06+	1950/30	
Extreme Minimum (°C)	**-26.1**	-25	-21	-12	-2.8	1.7	7.2	6.1	1	-5	-13.9	-23.3	
Date (yyyy/dd)	**1951/31**	1993/07	1989/07	1995/06	1966/08+	1973/18	1970/02	1965/30+	1980/29	1976/29	1936/19	1933/30	

Table 9-12 Precipitation Normals

Precipitation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
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
Average Snow Depth (cm)		9	8	0	0	0	0	0	0	0	0		
Median Snow Depth (cm)		9	7	0	0	0	0	0	0	0	0		
Snow Depth at Month-end (cm)	5	12	1	0	0	0	0	0	0	0	0	4	
Extreme Daily Rainfall (mm)	88.6	59.2	82.6	73.2	72.1	65.8	93.8	**118.1**	96.3	81.3	99.1	95.3	
Date (yyyy/dd)	1978/18	1965/25	1972/23	1984/16	1971/17	1972/10	1982/20	**1971/15**	1936/19	1970/04	1972/09	1975/10	
Extreme Daily Snowfall (cm)	39	41.2	31	22.9	20.3	0	0	0	0	12.7	22	**44**	
Date (yyyy/dd)	1981/17	1992/01	1993/13	1972/03	1972/09	1934/01+	1934/01+	1933/01+	1933/01+	1974/20	1989/23	**1983/24**	
Extreme Daily Precipitation (mm)	93.7	59.2	82.6	73.2	72.1	65.8	93.8	**118.1**	96.3	81.3	99.1	95.3	
Date (yyyy/dd)	1978/18	1965/25	1972/23	1984/16	1971/17	1972/10	1982/20	**1971/15**	1936/19	1970/04	1972/09	1975/10	
Extreme Snow Depth (cm)	62	66	**89**	20	0	0	0	0	0	0	29	31	
Date (yyyy/dd)	1981/18	1987/11+	**1987/17**	1985/02	1964/01+	1964/01+	1964/01+	1964/01+	1964/01+	1964/01+	1989/27	1988/18	

Table 9-13 Wind Normals from Shearwater Airport

Wind	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Speed (km/h)	18.1	17.7	17.8	16.9	14	12.8	11.3	11.1	12.8	14.8	16.5	17.7	15.1
Most Frequent Direction	W	NW	NW	N	S	S	S	SW	SW	W	NW	W	W
Max. Hourly Speed	83	97	78	85	72	77	87	60	**97**	80	89	89	
Date (yyyy/dd)	1990/30	1963/20	1986/07	1962/13	1961/20	1964/12	1975/28	1956/08	**1954/11+**	1962/07	1958/29	1956/30+	
Max. Gust Speed	127	146	148	122	106	111	114	93	126	132	121	**150**	
Date (yyyy/dd)	1960/03	1976/02	1976/17	1962/13	1961/03	1964/12	1975/28	1986/09	1958/29	1963/29	1963/08	**1956/30**	
Direction of Max. Gust	S	S	SW	NE	W	NW	S	SW	N	S	NE	SW	SW
Days with Winds >= 52 km/h	3.1	2.4	1.9	1.6	0.5	0.2	0.1	0.1	0.5	1	2.1	3	16.4
Days with Winds >= 63 km/h	0.9	0.7	0.4	0.1	0	0.1	0	0	0	0.3	0.3	0.7	3.6

Note: Wind direction refers to point of wind origin

Table 9-14 provides a summary of Nova Scotia's Ambient Air Quality Standards for regulated air contaminants. These contaminants can contribute to a variety of health and environmental effects depending on the nature of the pollutant, its concentration, the exposure period, the presence of other pollutants and receptor sensitivity.

Table 9-14 Maximum Permissible Ground Level Concentrations

Contaminant	Averaging Period	Maximum Permissible Ground Level Concentration	
		$\mu g/m^3$	Pphm
Carbon Monoxide (CO)	1 hour	34 600	3000
	8 hours	12 700	1100
Hydrogen Sulphide (H_2S)	1 hour	42	3
	24 hours	8	0.6
Nitrogen Dioxide (NO_2)	1 hour	400	21
	Annual	100	5
Ozone (O_3)	1 hour	160	8.2
Sulphur Dioxide (SO_2)	1 hour	900	34
	24 hours	300	11
	Annual	60	2
Total Suspended Particulate (TSP)	24 hours	120	-
	Annual	70*	-

* - geometric mean
$\mu g/m^3$ - micrograms per cubic metre
pphm - parts per hundred million

The air quality on mainland Nova Scotia is generally very good. It is likely that air quality in the Project area falls within the desirable objectives of the federal classification and well within provincial limits. There are no major industries in the immediate area which may influence air quality, however, the proximity of the site to two major highways (Highways 103 and 102) and the urban area of HRM may influence local air quality.

There are no ambient air quality monitoring sites in the vicinity of the project. Currently, the nearest ambient air quality monitoring sites are in downtown Halifax. Parameters measured include SO2 (1 hour and 24 hour); NO2 (1 hour); ozone (1 hour) and CO 91 hour and 24 hour), however, data from downtown Halifax monitoring stations is not representative of the project area as levels of pollutants are higher in the urban area than in suburban/rural settings.

9.4.2 Impact Evaluation/Effects Assessment

The proposed Highway 113 will operate throughout the year with traffic moving along the highway at relatively high speeds. Traffic at on and off-ramps will move at reduced speeds, but experience no stoppages under normal operations. The level of air pollutants at any point in the environment at any particular time is dependent on source emission rates, dispersion characteristics and removal (scavenging) rates. Atmospheric emissions along roadways are resultant of vehicle tailpipe emissions and road dust due to passing vehicles.

Air pollution is generally considered the main environmental impact of motor vehicle transportation. During the combustion process, automotive engines emit several types of pollutants, including: carbon monoxide, nitrogen oxides (NOx), volatile organic compounds (VOCs or non-methane hydrocarbons - NMHC), particulate matter (PM), carbon dioxide (CO2) and sulphur oxides (SOx). Typically, exhaust pipe emissions of CO, NMHC/VOCs and NOx are considered for both roadway traffic and construction equipment, as these contaminants have the greatest environmental impact on nearby receptors and act as precursors to ground-level ozone and smog formation.

As previously identified, the primary pollutants emitted directly from motor vehicles include oxides of nitrogen, carbon monoxide and VOCs, and to a lesser extent SO2 and particulate matter. Most of the primary pollutants are transformed in the atmosphere, through a series of physical and chemical reactions, to secondary pollutants including smog, ozone and various nitrogen and sulphur compounds. 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.

Similar to tailpipe emissions, re-suspended particulate matter is highest in concentration immediately adjacent to the roadway, with reduced concentrations as the distance from the highway corridor increases.

During the construction phase of the project, there exists a greater potential for increased levels of airborne particulate matter along the highway corridor due to the handling of soils and aggregate as these tend to release fine particulate matter, especially during dry periods and under windy conditions. High winds can also generate particulate matter from any exposed surfaces of storage piles or cleared surfaces during dry weather periods. The areas affected by these fugitive dust releases tend to be quite localized and can be mitigated by the use of dust control techniques.

Surface dust emissions will be controlled by the use of water sprays and/or dust suppressants, as required. If material processing plants are required, such as batch concrete or asphalt plants, aggregate crushing plant, etc., they will be located away from populated areas and sensitive receptors and will be operated in accordance with NSE requirements. The quantity of aggregate stockpiled at the construction site will be minimized and good engineering practices will be employed for material transfer (minimize drop distances) and stockpile formation (slope angles and direction). Wet dust suppression of stockpiles and transfer points will be employed as practicable.

As some project areas are close to residents' dwellings (e.g., Kingswood), by employing appropriate mitigation measures, the particulate emissions will not result in significant impacts off the site. It is understood, however, that in the interest of industrial hygiene, and to reduce the aesthetic impacts of dust generation, a responsible degree of particulate control will be undertaken.

9.4.2.1 Micro-climate modifications

Cooling

There is potential for micro-climate modifications in the vicinity of the Project due to the construction of large fills. Large fills can cause significant long-term blockage of sunlight in areas which can reduce the temperature of the ambient environment. This micro-climate modification can have impacts on light and temperature sensitive biota.

Potentially, the most significant fill area within the proposed alignment is a section of highway surrounding Black Duck Brook. Due to the depth of fill and the horizontal positioning of the proposed highway in this location (northeast to southwest) this potential fill area is not expected to have a significant impact on the micro-climate of the area.

Warming

Forest clearing and grubbing can increase solar radiation in the vicinity of the Project as wind speed and exposure to air advected from clearings, typically causing increases in summertime air, soil, and stream temperatures and decreases in relative humidity. Temperature increases following forest clearings are primarily controlled by changes in insolation but also depend on hydrology and landscape topography (Moore et al., 2005).

Microclimate changes, to some extent are therefore caused by forest clearing and grubbing and may have some short-term impacts on terrestrial and aquatic environments but it is not expected to have a significant impact on the micro-climate of the area in the longer term.

Estimated Greenhouse Gas (GHG) Emissions

During the last few decades, concerns have been voiced concerning the concentration of greenhouse gases (GHG) in the atmosphere that may result in a change in climatic conditions as a result of Project related activities. Various government agencies including Natural Resources Canada and Environment Canada forecast long-term changes in climatic conditions including the frequency of extreme climate events that could have serious impacts on the environment, economy and society.

The temperature on Earth is partially regulated by the “greenhouse effect”. Greenhouse gases in the atmosphere, primarily water vapour, carbon dioxide, methane and nitrous oxide, trap the heat of the sun, preventing radiation from dissipating into space. Concentrations of greenhouse gases have increased significantly since the industrial age and some scientific evidence shows that human activities may be accelerating climate change (IPCC, 2007).

Impacts on GHG emissions for the highway project are considered for both operational aspects and construction activities. In terms of GHG emissions, an increase in fuel economy will correlate directly to a decrease in GHG emissions. Motor vehicles achieve peak fuel economy when traveling at moderate and steady speeds (highway driving). Stop and go travel, typical of driving in urban centres, tends to reduce fuel economy. The construction of Highway 113 will provide a preferred route of travel without stoppages, which should result in improved vehicle fuel economies and correspondingly reduced GHG emissions. The primary contaminants associated with tailpipe emissions that contribute to GHG emissions and global warming are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). These compounds, along with water vapour and ozone, are naturally occurring greenhouse gases and these compounds are continuously emitted to and removed from the atmosphere by natural processes.

GHG emissions are generated by all fossil fuel combustion sources. Both vehicle emissions during the operational period and construction equipment emissions during the construction phase are sources of GHG emissions. During the summer months, especially during smog events or ozone-action days, diesel truck or equipment idling will be minimized. Refuelling activities should be conducted during cooler morning or evening hours as much as possible. For this impact assessment, only these compounds that are produced as a result of fuel combustion are considered, with the exception of CO_2 which is also considered in terms of loss of a carbon sink associated with the clearing of woodland and grassland areas.

Canada's Greenhouse Gas Inventory 1990 -1999 provides emission factors for GHG emissions from mobile combustion sources. These emission factors are provided in units of grams of pollutant per litre of fuel burned for a range of vehicle types from light duty gas automobiles to heavy duty diesel vehicles. US EPA Report AP-42 "Compilation of Air Pollutant Emission Factors, Volume II: Mobile Sources", Office of Transportation and Air Quality, Fifth Edition, Updated November 24, 2000, contains the percentage breakdown of each vehicle type in a standard fleet mix of vehicles. From these two data sources, fleet averaged emission factors for GHG contaminants were calculated (US EPA, 2000).

To apply the fleet averaged emission factors to the existing and future traffic scenarios, an estimate of the fleet fuel economy is required. From the "Foundation Paper on Climate Change – Transportation Sector", December 1998, fleet-wide fuel consumption for cars and light trucks of

9.5 L/100 km was obtained. From Figure 4-6 of the same document, fuel economy by vehicle speed was obtained for speeds of 50 km/hr, 100 km/hr and 110 km/hr. This graph indicated reductions in fuel economy of about 2.5% and 10% when vehicle speeds are increased from 50 km/hr to 100 km/hr and 50 km/hr to 110 km/hr, respectively. The fleet-wide fuel economy ratio of 9.5 L/100 km was increased by 2.5% and 10% for the existing and future highway speed limits of 100 km/hr and 110 km/hr, respectively. These emission factors along with the traffic volume and highway segment distance data were employed to estimate the tailpipe emission rates of GHGs for the existing and future operational scenarios.

For the construction-related GHG emissions, the diesel internal-combustion engines were considered for impacts on air quality. US EPA Report AP-42 provides emission factors for carbon dioxide for diesel industrial engines. Emission factors for CH_4 and N_2O are not provided in AP-42, however, they are provided along with CO_2 emission factors in units of g/L of fuel burned in Appendix I of Canada's Greenhouse Gas Inventory 1990 – 1999. Emission rates for CH4 and N2O were obtained using a ratio of these fuel-based emission factors and the CO2 emission rate calculated using the AP-42 emission factors.

The highway project is estimated to result in a loss of "green" space of forest cover. This vegetated area is described as a "carbon sink" because it removes CO_2 from the atmosphere by natural biological processes (e.g. photosynthesis and carbon "draw down" from the atmosphere).

An ecosystem represents a sink for carbon dioxide if its assimilation of carbon through photosynthesis (gross production - P) exceeds its loss of carbon through respiration (community respiration - R) and harvest. In aquatic ecosystems, R is scaled as the approximate two-thirds power of P, implying that the role of aquatic biota as carbon dioxide sources or sinks depends on their productivity. Thus, productive aquatic ecosystems (P>R) tend to function as sinks and unproductive aquatic ecosystems (R>P) tend to function as sources (Duarte and Agusti, 1998). While wetlands constitute a major carbon reservoir, they can function as either greenhouse gas sinks or sources depending on their type, their use and ambient conditions. Some wetlands are characteristically sources (e.g. Northern peat lands are the best-understood wetlands from a climate change perspective. They are characteristically large carbon sinks holding 35% of the total terrestrial soil carbon, but can be sources of methane [WGBU, 1998]). For this reason, wetlands were not included in the assessment of carbon sinks.

The loss of carbon sinks or green space can be related to CO_2 emissions using emission factors developed for various land classification types. For example, a Foundation Paper by the National Sinks Table under the National Climate Change Process dated November 17, 1998, provides in Table 4.1, potential soil CO_2 gains for various land types. These soil gains can be directly related to CO2 removal from the atmosphere. Emission factors for woodland used in this assessment are 1.47 tonnes/ha/yr.

Table 9-12 summarizes GHG emission rates (ER) associated with the various stages of the project. The total GHG emissions, expressed as CO_2-equivalents, are obtained using the 100-year global warming potentials (GWPs) for CO_2, CH_4 and N_2O of 1, 21 and 310, respectively. The calculation for CO_2-equivalents is:

Tonnes CO_2 Eq. = (Tonnes CO_2 x 1) + (Tonnes CH_4 x 21) + (Tonnes N_2O x 310)

Results are provided for construction and future scenarios. A final row is provided to describe the estimated loss of carbon sinks as CO_2-equivalents due to the new highway alignment. The figures used in Table 9-15 are based on typical ER rates for a 10 km section of twinned highway in Nova Scotia. However, it should be noted that these anticipated emission rates are based on today's current technology and fuel standards and with projected greater fuel efficiencies in the automobile industry these ER could be lower. Also note that emissions from the proposed Highway 113 are effectively being transferred from other area roads. The estimate on the loss of carbon sink was derived by available habitat mapping and the current proposed footprint of the highway. The carbon sinks (and subsequent potential losses) are likely to decrease prior to construction as land use is likely to change (except for the wilderness area).

Table 9-15 Summary of Annual Greenhouse Gas Emission Rates (ER) for the Proposed Highway 113

Scenario	ER (CO_2) (tonnes/yr)	ER (CH_4) (tonnes/yr)	ER (N_2O) (tonnes/yr)	ER (CO_2 Eq.) (tonnes/yr)
Construction	3,339	0.2	1.0	2,634
Predicted Future Operation	33,650	5.7	2.7	34,596
Loss of Carbon Sinks	**Approximately 100 ha forest cover**			88

Note: *Assumes and average Highway 113 footprint width of 100 m (0.1 km) and a highway length of 10 km*

Annual GHG emissions due to construction activities are estimated to temporarily increase existing annual emissions as there are currently no existing highway routes through the proposed alignment. However, due to the predicted offsetting of GHG emissions from congested traffic and associated idling on the Hammonds Plains Road, the future traffic scenario with higher posted speed limits is estimated to result in a slight reduction in GHG emissions. Not included in this study are the short-term impacts from vehicle emissions. The proposed highway 113 is expected to reduce the frequency and length of traffic back-ups caused by accidents and turning vehicles on the Hammonds Plains Road. This in turn will improve travel time and reduce GHG emissions caused by highway traffic.

Management Strategy for GHGs

TIR will implement a GHG emissions reduction strategy for the project. This strategy will be developed during the design stage of the highway and include: initial GHG emission estimates related to construction and maintenance of the highway, a review of measures and technologies that can be implemented to reduce GHGs, an implementation plan, and a monitoring program to track progress. The strategy would focus on factors that TIR has direct control of such as highway lighting or is in a position to influence such as driving habits, car pooling etc. Some typical GHG reduction measures that can be included in the plan include: LED or solar LED highway lighting; use of bio-fuels, where feasible, for TIR fleet; and tree planting within the ROW.

Table 9-16 identifies mitigation measures associated with project interactions as they relate to atmospheric conditions during the construction and operations phases of the project.

Table 9-16 Potential Project Interactions with Atmospheric Conditions (Project TOR Section 9.4)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Construction Activities		
Generation of dust/particulate matter from surface and emissions on residential, agricultural, recreational and institutional areas, and on human health	Increased levels of airborne particulate matter from surface sources and heavy diesel construction equipment engine exhaust	Mitigative measures to reduce negative impacts due to surface dust emissions will be controlled by the use of water sprays and/or dust suppressants, as required Areas affected by fugitive dust releases are generally localized and short term. Vehicle or equipment idling will be minimized as much as possible. Vehicles and equipment will be maintained in proper working order. Additional mitigation for impacts to atmospheric conditions are identified under section (Section 9.4.2)
Potential for micro-climate modifications in the vicinity of the Project	Air turbulence created by moving vehicles passing over roadway will re-entrain PM that has been deposited on the roadway surface. Presence of these particulate deposits can be from wear of vehicle tires or roadway itself, or from airborne PM settling onto road surface	Re-suspended particulate matter from construction activities will be short term and localized. It is highest in concentration immediately adjacent to the roadway, with reduced concentrations as the distance from the highway corridor increases
	Cooling - Large fills can cause significant long-term blockage of sunlight reducing the ambient temperature of the environment	Mitigative measures include appropriate use of re-vegetation and landscaping to lessen or reduce the impacts of micro-climate change
	Warming - Forest clearing and grubbing can increase temperatures in the vicinity of the Project	Mitigative measures include appropriate use of re-vegetation and landscaping to lessen or reduce the impacts of micro-climate change

Table 9-16 Potential Project Interactions with Atmospheric Conditions (Project TOR Section 9.4) (cont.)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Greenhouse Gas (GHG) emissions related to the Project Emissions such as NOx, SOx, CO, VOC	Increase in greenhouse gas (GHG) emissions generated by vehicles/equipment reducing air quality in project area	Increases in GHGs during construction will be short term and localized. During the summer months, especially during smog events, diesel truck or equipment idling will be minimized. Re-fuelling activities should be conducted during cooler morning or evening hours as much as possible
	Transformation of primary pollutants (NOx, CO and VOCs, and to a lesser extent SOx and PM.) to secondary pollutants including smog, ozone and various nitrogen and sulphur compounds reducing air quality in the project area.	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
Operation/Maintenance Activities		
Tailpipe emissions from vehicular traffic (emissions such as NOx, SOx, CO, VOC and PM)	Greenhouse gas (GHG) emissions are generated by fossil fuel combustion sources resulting in reduction in air quality in area of highway alignment	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 Vehicles of the future are likely to be more fuel efficient, environmentally friendly or operate using alternate power sources that emit less GHGs
	Transformation of primary pollutants (NOx, CO and VOCs, and to a lesser extent SOx and PM.) to secondary pollutants including smog, ozone and various nitrogen and sulphur compounds reducing air quality in the project area.	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.

Table 9-16 Potential Project Interactions with Atmospheric Conditions (Project TOR Section 9.4) (cont.)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Potential for micro-climate modifications in the vicinity of the Project	Air turbulence created by moving vehicles passing over roadway will re-entrain PM that has been deposited on the roadway surface. Presence of these particulate deposits can be from wear of vehicle tires or roadway itself, or from airborne PM settling onto road surface	Re-suspended particulate matter is highest in concentration immediately adjacent to the roadway, with reduced concentrations as the distance from the highway corridor increases

9.4.3 Significance

A significant adverse effect is a change in the air quality that would result in an exceedance of the regulated limits of the NSE on a repeated or sustained basis at any location outside the property boundaries of the project. An adverse effect that does not meet the above criteria is evaluated as not significant. A positive effect is a net reduction in air pollutants at any location influenced by the construction of this undertaking.

The construction phase of the project will have a temporary negative effect on air quality via the potential for excessive particulate generation on-site and on the approach roads (i.e. surface dust source). Vigilant attention to standard dust control practices, industrial hygiene, and traffic control can minimize these effects on air quality. This negative effect will be localized and short term only extending through the construction phase of the project. Through the use of BMPs to control fugitive dust and diesel exhaust emissions, such as wet suppression of exposed surfaces and travel routes, speed limit control and anti-idling policies, the impact of air emissions due to construction activities should be insignificant. Therefore the Project will have no significant impacts. During normal operation, the highway will have only those sources of emissions associated with normal traffic use, which will result in an overall improvement when compared to traffic congestion on the existing routes. Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on air quality are likely to occur.

Table 9-17 identifies the likelihood of the proposed project to result in significant adverse environmental effects related to atmospheric conditions (air quality) after mitigation is in place.

Table 9-17 Significance of Potential Effects on Atmospheric Conditions (Project TOR Section 9.4)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Construction Effects						
Increased levels of airborne particulate matter from surface sources and heavy diesel construction equipment engine exhaust	Moderate	Moderate - Low	One time	Yes	Effects are short term and localized	No
Re-entrainment of particulate matter	Moderate	Moderate	One time	Yes	Effects are short term and localized	No
Potential for micro-climate modifications related to construction	Low	Low	One time	Yes	Effects are short term and localized	No
GHG emissions related to construction	Moderate	Moderate - Low	One time	Yes	Effects are short term and localized	No
Operation/Maintenance Effects						
Greenhouse gas (GHG) emissions are generated by fossil fuel combustion sources resulting in reduction in air quality in area of highway alignment	Low	Low	Continuous for operation and less than once a year for maintenance	No	GHG emissions have local and global effects	No
Potential for micro-climate modifications in the vicinity of the Project	Low	Low	Continuous for operation and seasonally for maintenance	No	local effects	No
Transformation of primary pollutants (NOx, CO and VOCs, and to a lesser extent SOx and PM.) to secondary pollutants including smog, ozone and various nitrogen and sulphur compounds reducing air quality in the project area.	Low	Low	Continuous for operation and seasonally for maintenance	No	Vehicle emissions have local and global effects	No

Significant residual adverse effects to atmospheric conditions are not likely with proper implementation of the mitigative measures identified previously. Therefore, the overall residual effects on atmospheric conditions will be beneficial due to the significant reduction in GHG emissions through improved driving patterns (e.g., better traffic flow at optimal speeds instead of idling and inefficient engine use in congested traffic).

9.4.4 Follow-up and Monitoring

During normal operation of the highway there will be emissions to the atmosphere experienced by similar well designed bypass highways. Normally air quality for local residents will improve after traffic congestion problems begin to decline. Continuous monitoring is not deemed to be necessary unless there are significant changes in the highway design or alignment.

9.5 Ambient Noise Levels

9.5.1 Existing Environment

Ambient noise levels have been assessed at 15 sites surrounding the proposed project. NSE established pre-determined distances from the proposed alignment at which sampling locations would be distributed (see Figure 9-3). Sound levels were measured with Quest Q-300 dosimeters. These provide free-field microphones with ±1.5 dB accuracy. The baseline noise level conditions were compared to the Nova Scotia Department of Environment Guidelines (NSDOE 1998). These guidelines provide sound level thresholds in dBA units for three periods of the day: day (7:00 a.m. - 7:00 p.m.) at 65 dBA, evening (7:00 p.m. - 11:00 p.m.) at 60 dBA, and night (11:00 p.m. - 7:00 a.m.) at 55 dBA. Representative samples were collected for periods of two or more continuous hours for three periods during average traffic days (weekdays of Monday to Thursday) for comparison with the guidelines.

The results of the sound level monitoring were below the NSE guidelines set for each of the three sampling periods at all 15 sampling sites Table 9-18 illustrates the average A-weighted LAVG values results for the 15 sites over the three separate sampling periods.

Figure 9-3 Noise Survey Locations

Table 9-18 Baseline Ambient Noise Levels

Location	Daytime 7:00 a.m. - 7:00 p.m. Sampling Period (dBA)	Evening 7:00 p.m. - 11:00 p.m. Sampling Period (dBA)	Nighttime 11:00 p.m. - 7:00 a.m. Sampling Period (dBA)
NSEL Guidelines (1998)	65	60	55
Site 1	46.0	41.6	42.2
Site 2	48.9	41.4	42.9
Site 3	40.9	41.4	42.3
Site 4	50.4	46.8	42.3
Site 5	42.4	40.8	41.3
Site 6	41.1	40.0	40.0
Site 7	41.5	40.3	40.1
Site 8	58.0	53.5	45.0
Site 9	44.2	40.5	40.3
Site 10	40.6	40.1	40.2
Site 11	40.6	39.9	40.2
Site 12	40.4	39.9	40.3
Site 13	41.3	40.8	40.4
Site 14	41.4	41.2	40.6
Site 15	54.7	51.0	44.1

9.5.2 Impact Evaluation/Effects Assessment

9.5.2.1 Construction

Noise disturbance associated with construction can be expected for residential properties in close proximity to the alignment. The highest density of noise receptors adjacent to the alignment includes the residential areas in the vicinity of Ragged Lake; the area adjacent Exit 4 at Hwy 103 and, to a lesser extent, the residential areas off Kearney Lake Road between Kearney Lake and Hammonds Plains Road. Brief increases in noise emissions that will exceed Nova Scotia's Noise Guideline of 65 dBA for daytime noise levels are anticipated for the residences located adjacent to the alignment during construction. The duration of these increases will depend upon the nature of the construction activity. Roadbed preparation and grading is the activity of longest duration and therefore has the highest potential for affecting nearby residents.

Mitigative measures for construction noise is broken down into three categories; source, path and receptor. Mitigating noise at the source is typically the first priority because it is generally the easiest to address. If source control itself isn't sufficient to address noise exceedances, pathway control measures are implemented by employing screens or barriers to block and/or absorb sound from the project. Intervening pathways over which construction noise propagates to sensitive receptors can be effectively interrupted with noise barriers and/or curtains, providing care is taken to completely block the line-of-sight between the noise source and the affected receptors. In cases where the combination of source and pathway controls are not sufficient to mitigate construction noise or possible (due to circumstances), controls at the receptor(s) must be put in place. Because window openings are typically a building's weakest link for noise infiltration, acoustical window treatments can significantly reduce the outside-to-inside noise contribution. The following are examples of controls for each of the three cases:

Source Controls:

- Time Constraints – prohibiting work during sensitive night-time hours
- Scheduling – performing noisy work during less sensitive time periods (i.e. weekdays, mid-day)
- Equipment Restrictions – restricting the type of equipment used
- Emission Restrictions – specifying stringent noise emission limits
- Substitute Methods – using quieter methods/equipment when possible
- Exhaust Mufflers – ensuring equipment have quality mufflers installed
- Lubrication & Maintenance – well maintained equipment is quieter
- Reduced Power Operation – use only necessary size and power
- Limit Equipment On-Site – only have necessary equipment on-site
- Noise Compliance Monitoring – technician on site to ensure compliance
- Quieter Backup Alarms – manually-adjustable or ambient sensitive types

Path Controls:

- Noise Barriers – semi-permanent or portable wooden or concrete barriers
- Noise Curtains – flexible intervening curtain systems hung from supports
- Enclosures – encasing localized and stationary noise sources
- Increased Distance – perform noisy activities farther away from receptors

Receptor Controls:

- Window Treatments – reinforcing the building's noise reduction ability
- Community Participation – open dialog to involve affected residents
- Noise Complaint Process – ability to log and respond to noise complaints
- Temporary Relocation – in extreme otherwise unmitigatable cases

Mitigative measures for construction noise will include: Reduced Power Operation; Limit Equipment On-Site; Noise Compliance Monitoring; Time Constraints; Equipment Restrictions; Noise Barriers; and Enclosures.

Potential construction-related effects on ambient noise and proposed mitigation are outlined in Table 9-19.

Table 9-19 Potential Project Effects on Ambient Noise (Project TOR Section 9.5 - Construction

Project Interaction	Potential Effect	Mitigative Factor and Measure
Noise from construction	Noise from construction equipment during all aspects of the work, including: clearing, grubbing, blasting/breaking, earthworks, road bed preparation.	Mitigative measures for construction noise is broken down into three categories addressing the source, path and receptor, as detailed in the text below: *Source Controls:* • Time Constraints – prohibiting work during sensitive nighttime hours • Scheduling – performing noisy work during less sensitive time periods (i.e. weekdays, mid-day) • Equipment Restrictions – restricting the type of equipment used • Emission Restrictions – specifying stringent noise emission limits • Substitute Methods – using quieter methods/equipment when possible • Exhaust Mufflers – ensuring equipment have quality mufflers installed • Lubrication & Maintenance – well maintained equipment is quieter • Reduced Power Operation – use only necessary size and power • Limit Equipment On-Site – only have necessary equipment on-site • Noise Compliance Monitoring – technician on site to ensure compliance

Table 9-19 Potential Project Effects on Ambient Noise
(Project TOR Section 9.5 – Construction (cont.)

Project Interaction	Potential Effect	Mitigative Factor and Measure
		• Quieter Backup Alarms – manually-adjustable or ambient sensitive types
		Path Controls: • Noise Barriers – semi-permanent or portable wooden or concrete barriers • Noise Curtains – flexible intervening curtain systems hung from supports • Enclosures – encasing localized and stationary noise sources • Increased Distance – perform noisy activities farther away from receptors *Receptor Controls:* • Window Treatments – reinforcing the building's noise reduction ability • Community Participation – open dialog to involve affected residents • Noise Complaint Process – ability to log and respond to noise complaints • Temporary Relocation – in extreme otherwise unmitigatable cases

9.5.2.2 Operation and Maintenance

In order to quantify the significance of noise impact, many jurisdictions including the US Federal Transit Authority have established limits based on a percentage of people 'highly annoyed' from traffic noise impacts. A lower limit of 55 dBA, which equates to NSE's criteria for 11 p.m. to 7 a.m., is commonly used to establish a threshold for which sensitivity to traffic noise level would be become moderately to highly significant. Based on noise samples obtained from within 100 m of other 100 series highways (Highway 101 between Hortonville and Coldbrook; Highway 125 Sydney River to Grand Lake Road) noise levels on Highway 113 are expected to range from 66 dBA during peak hours to 46 dBA during the lowest traffic hours and generally meet NSE noise guidelines. Potential operational related effects on ambient noise and proposed mitigation are outlined in Table 9-20.

Table 9-20 Potential Project Effects on Ambient Noise (Project TOR Section 9.5) - Operation/Maintenance

Project Interaction	Potential Effect	Mitigative Factor and Measure
Highway Operation	Noise from traffic will increase ambient noise above baseline levels and may be considered a nuisance by residents in nearby subdivisions. Main potential interaction with the atmosphere relating to noise is increased noise levels at residences, businesses, the Blue Mountain Hill Area and recreational areas from increased traffic during operation.	Noise mitigation options include the use of: • noise walls; • berms; • vertical and horizontal alignment shifts; • road cuts; and, • quieter highway pavement surfaces. Noise levels on Highway 113 are expected to range from 66 dBA during peak hours to 46 dBA during the lowest traffic hours and generally meet NSE noise guidelines.
Seasonal Maintenance: Mowing/clearing, ditch maintenance, ploughing, re-surfacing	Maintenance operations to result in increased noise levels that are considered a nuisance to nearby residents, businesses.	Seasonal activities are short term, infrequent, and generally localized Mitigation measures for maintenance will follow those identified in Table 9-16

9.5.3 Significance

Potential effects on the environment resulting from construction noise will be localized and short term and are not expected to persist into the operational phase of the project. No significant impacts from noise are expected as a result of the construction of the project. Table 9-21 identifies the likelihood of proposed project activities to cause significant adverse environmental effects relating to ambient noise after mitigation. It is anticipated that there will be minor residual effects related to noise during operation as noise levels for 100 series highways are reported to be slightly above the NSE threshold guidelines for peak hours of operation.

Table 9-21 Significance of Potential Effects on Ambient Noise (Project TOR Section 9.5)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Construction Effects						
Noise from construction equipment during all aspects of the work (including: clearing, grubbing, blasting/breaking, earthworks, road bed preparation) on various receptors.	Moderate	Low	One time	No	Localized	No with mitigation measures in place
Operation/Maintenance Effects						
Maintenance operations to result in increased noise levels that are considered a nuisance to nearby residents, businesses.	Negligible	Negligible	Less than once a year	Yes	Not likely to exceed noise guidelines for extended periods of time.	No
Noise from highway traffic will increase ambient noise above baseline levels and may be considered a nuisance by residents in nearby subdivisions.	Moderate	Low	Dependent upon traffic levels	Yes	Not likely to exceed noise guidelines for extended periods of time.	No, with mitigation measures in place

9.5.4 Follow-up and Monitoring

It is not anticipated that follow-up or monitoring activities will be required related to ambient noise as a result of the project.

9.6 Surface Water

9.6.1 Existing Environment

The proposed project lies within the Nine Mile River primary watershed (1EJ) and passes through five tertiary watersheds. Primary surface water systems in the project area include: The Sheldrake Lakes; the upper reaches of the Nine Mile River system (Maple and Frasers Lakes; Fishers Brook; the Stillwater run system; and, the Birch Cove Lakes/Kearney Lake system. Based on 1:10,000 scale mapping and field reconnaissance, there are 12 watercourse crossings on the proposed alignment (Refer to Figure 9-4). Table 9-22 provides a summary the watercourse crossings and their respective drainage area. All watercourses are within the Nine-Mile River Watershed or within the Papermill Lake sub-watershed. There will be no drainage from the highway to the Birch Cove Lakes sub-watershed.

Table 9-22 Summary of Watercourse Crossings

No.	Watercourse	Watershed Area
1	Tributary to Sheldrake Lake	1.65 km^2
2	Tributary between Maple and Fraser Lakes	20.0 km^2
3A	Fishers Brook	3.15 km2
3A2	Tributary to Fishers Brook	0.12 km^2
3B	Fishers Brook	1.51 km^2
3C	Fishers Brook	1.24 km^2
4	Stillwater Run	2.52 km^2
5	Outlet of Ragged Lake	2.60 km^2
5A	Tributary to the Outlet of Ragged Lake	0.16 km^2
6	Black Duck Brook	2.74 km^2
7	Tributary to Kearney Run	0.67 km^2
8	Tributary to Papermill Lake	1.15 km^2

9.6.1.1 Surface Water Quality

Surface water samples were collected at 10 of the 12 proposed sample locations along the proposed highway route in December 2008 or April 2009. The remaining locations were dry. Samples were analysed for general inorganic chemistry and metals and total suspended solids. Results were compared to Canadian Council of Ministers of the Environment (CCME) Freshwater Aquatic Life (FWAL) Guidelines (CCME, 2008). A summary of parameters in exceedance of the FWAL Guidelines is presented in Table 9-23 below.

Figure 9-4 Aquatic Environment

Table 9-23 Summary of parameters in exceedance of the FWAL Guidelines

Parameter	FWAL Guideline	# of Samples	Concentration or Range in Concentration
pH	6.5-9 units	All samples, except SW11 and SW12	4.45 to 6.45 units
Aluminum	0.005-0.1 mg/L	All, except SW12	0.105 to 0.338 mg/L
Cadmium	see Note 2	All, except SW8, SW11, SW12	0.026 to 0.293 ug/L
Copper	0.002-0.004 mg/L	One sample (SW7)	0.0088 mg/L
Iron	0.3 mg/L	One sample (SW7)	0.329 mg/L
Lead	0.001-0.007 mg/L	One sample (SW7)	0.00104 mg/L
Zinc	0.03 mg/L	One sample (SW7)	0.0361 mg/L

Notes:
1. Aluminum guideline varies dependant on pH
2. Cadmium guideline is dependent on hardness: Cd guideline (ug/L) = $10^{\{0.86 [\log(\text{hardness in mg/L})] -3.2\}}$
3. Copper and lead guidelines are dependent on hardness

Slightly acidic waters (low pH) were prevalent, as well as elevated aluminum and cadmium in the surface water samples. Only one station exhibited copper, iron, lead and zinc in exceedance of the FWAL guidelines; however, iron, lead and zinc concentrations were only slightly above the guideline.

Low pH, below the guideline range, is typical of surface waters throughout the province. Elevated aluminum and iron are also common occurrences in Nova Scotia surface waters and are generally reflective of suspended clay matter. Other parameters that are not typically present in Nova Scotia surface waters include: cadmium, copper, lead and zinc. In some cases, however, metals (such as, copper, iron, lead, manganese) can be naturally elevated depending on the type of soil and/or bedrock in the local area. Others, such as, cadmium, can be elevated due to air emissions/fall out and surface water conditions (pH, hardness), which affect solubility.

9.6.1.2 Surface Water Quantity

Estimates of surface water quantity at each watercourse are provided in Appendix E. The estimates were performed using the Rational Method and include estimates for both the 1 in 2 year and 1 in 100 year events based on the 1990 intensity-duration-frequency (IDF) information for the Halifax Airport. At this time climate change effects have not been evaluated. Noting that future climate models for Atlantic Canada predict an increase in precipitation (Lines et al., 2008) and, more importantly, under these changing climate scenarios that rainfall events will be more intense with the potential to increase flood risk (NRCan, 2007) Future highway design will consider climate change effects as reflected in new IDF curves and approaches that are currently under development. It is anticipated that these curves will be available during the design phase of the project.

There are no existing water withdrawals from the watercourses crossed by the proposed highway.

9.6.2 Impact Evaluation/Effects Assessment

Principal interactions with surface water are most likely to occur in the construction phase of the proposed highway project. Initial construction will require the clearing of vegetation. Earthworks, such as grubbing and stripping topsoil/overburden and the placement of excess material in stockpiles, may lead to increased erosion and sedimentation of water bodies.

Erosion and siltation of surface water (fish habitat) can adversely affect fish directly, or cause a degradation of habitat. These effects can be caused directly during crossing installation and disturbance of stream banks and substrate, or indirectly during adjacent work where soils or vegetation may be disturbed. Blasting, if required near stream crossings, can also harm fish and habitat. If required, blasting will be conducted according to Guidelines for Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky, 1998). Stream crossings will be conducted according to applicable guidelines (e.g., maintaining water flow, fish passage, and implementing erosion control).

9.6.2.1 Construction

Potential construction related interactions with surface water and proposed mitigation are outlined in Table 9-24. It is expected that all watercourses will have similar project interactions and potential effects.

Table 9-24 Potential Project Interactions on Surface Water relating to specific sections in the TOR (Section 9.6) - Construction

Project Interaction	Potential Effect	Mitigative Factor and Measure
Clearing and grubbing, sub-grade placement, construction of access and service roads in alignment, construction of structures up gradient of watercourses	Erosion of surface soils in the vicinity of the watercourse may lead to sedimentation of the surface water	Erosion and sediment control measures will be implemented prior to construction and effectively maintained throughout the construction period. These will be identified in an Environmental Protection Plan for the project. These measures will include but not be limited to: • Plan construction to minimize clearing and grubbing. • Keep clean water clean. • Minimize amount of exposed soil. • Minimize time of exposure (of soil). • Keep sediment on site. • Avoid steep slopes. • Have a contingency plan and the resources for emergencies. • Construction monitoring Measures will be maintained through all seasons as the regional climate includes precipitation in every month of the year. Ongoing monitoring of upcoming weather conditions will occur in order to prepare for specific events. Construction monitoring will include water quality testing after significant rain events. Results will be compared to CCME Canadian Water Quality Guidelines

Table 9-24 Potential Project Interactions on Surface Water relating to specific sections in the TOR (Section 9.6) – Construction (cont.)

Project Interaction	Potential Effect	Mitigative Factor and Measure
	Degradation of water quality due to sediment or other contaminants both at the crossing and downgradient due to blasting	Blasting is expected to be needed at various locations of the proposed alignment. Where blasting is required in watercourse crossing areas DFO's Blasting Guideline will be followed
	Sediment deposition may alter fish habitat by affecting spawning beds, rearing habitat, winter or summer refuge or by affecting food species	Timing of works in and adjacent to watercourses will occur within designated low flow construction windows (seasons) to avoid sensitive periods for fish migration or spawning. Utilize erosion and sediment control measures as described above
Storm water runoff during clearing and grubbing, sub-grade placement, construction of access and service roads	Erosion effects and degradation of habitat (water quality) due to sediment or other contaminants	Utilize erosion and sediment control measures as described above Specific mitigation measures for managing stormwater runoff will be detailed in a Stormwater Management Plan
Installation of Watercourse Crossing Structures	Reduction in water quantity at the crossing site and downstream	Timing of works in and adjacent to watercourses will occur within designated low flow construction windows (seasons). Crossings will be installed in the dry while flows will be maintained in the diversions as construction proceeds at the crossing.
Disturbance of contaminated soils	Degradation of water quality due to release of contaminants	No contaminated soils have been identified within the construction zone. Where avoidance is not possible, the soil will be excavated and disposed at a facility approved to accept material by a licensed hazardous waste hauler. The contaminated soil will not be left on site to allow discharge into the watercourse
Accidental release of hazardous substances due to a spill/accident	Degradation of water quality due to release of contaminants	The project will follow TIR and NSE emergency spill response plans to contain and remediate releases of hazardous materials into the environment. The project will follow TIR 's spill contingency plan as detailed in the Generic EPP

9.6.2.2 Operations and Maintenance

The principal interactions between the Project and surface water quality and quantity, beyond the construction phase and commissioning, are stormwater disposal throughout the operation of the facility. Drainage ditches and culverts will be designed to manage surface drainage, based on the drainage within the watershed. These will be designed to carry flows to the natural drainage network. A Stormwater Management Plan will be developed to prevent sediment-laden runoff from the highway from entering streams. This plan will be designed to meet provincial requirements for surface runoff quality. Standard mitigation measures will be applied to minimize operation-related environmental effects on surface water in the Project area. Potential operational related effects on surface water and proposed mitigation are outlined in Table 9-25. It is expected that all watercourses will have similar project interactions and potential effects.

Table 9-25 Potential Project Interactions on Surface Water (Project TOR Section 9.6) - Operations

Project Interaction	Potential Effect	Mitigative Factor and Measure
Runoff from precipitation events/snowmelt	Degradation of surface water quality resulting from highway surface contaminants, sediment washing across highway and into receiving waters	A site-specific erosion and sediment control plan will be developed to prevent contaminant and sediment-laden runoff (from the highway) from entering streams or other freshwater bodies. This plan will be designed to meet provincial requirements for surface runoff quality.
Summer Road Maintenance - vegetation control	Removal of vegetation could increase potential for erosion and sedimentation	Minimize vegetation removal. Re-stabilize soils immediately when vegetation is removed. Where possible perform this activity in drier periods of the year.
Summer Road Maintenance - periodic asphalt and shoulder repair	Erosion and sedimentation of newly placed soils/ aggregate. Sediment effects and degradation of habitat (water quality) due to sediment or other contaminants	Utilization of effective erosion and sediment control measures as described above. Compact material and re-stabilize as soon as possible after installation
	Degradation of water quality due to release of contaminants	The project will follow TIR and NSE emergency spill response plans to contain and remediate releases of hazardous materials into the environment. The project will follow TIR 's spill contingency plan as detailed in the Generic EPP
Summer Road Maintenance – ditch maintenance	Erosion of ditches and sedimentation of receiving water	Timing of works in and adjacent to watercourses will occur within designated low flow construction windows (seasons), as practical. Utilization of effective erosion and sediment control measures as described above.

Table 9-25 Potential Project Interactions on Surface Water (Project TOR Section 9.6) – Operations (cont.)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Culvert/Bridge Maintenance	Degradation of water quality due to release of contaminants, sediment.	Timing of works in and adjacent to watercourses will occur within designated low flow construction windows (seasons), where practical. Utilization of effective erosion and sediment control measures as described above.
		The project will follow TIR and NSE emergency spill response plans to contain and remediate releases of hazardous materials into the environment. The project will follow TIR 's spill contingency plan as detailed in the Generic EPP
Winter Maintenance – Use of Road Salt/Sand	Degradation of water quality due to release of contaminants	The ongoing maintenance will follow TIR 's Salt Management Plan (SMP; June 2004)

9.6.3 Significance

A significant adverse effect for surface water quality and quantity is one that affects this VEC such that the CCME Guidelines for the Protection of Freshwater Aquatic Life are exceeded, or impacts of the project contravene section 36(3) of the Federal Fisheries Act or provisions of the provincial Environment Act. A significant adverse effect is also one that affects the surface water (freshwater fish and fish habitat) physically, chemically, or biologically, in quality or extent, to such a degree that there is a decline in the species diversity of the habitat. Such an effect would be reflected by a decline in abundance and/or change in distribution of one or more populations of species dependent upon that habitat. Natural recruitment would not return the population(s), or any populations or species dependent upon the habitat, to their former level within several generations. An adverse effect that does not meet the above criteria is evaluated as not significant. A positive effect is one that may enhance the quality of habitat, increase species diversity, and increase the area of valued habitat.

Table 9-26 identifies the likelihood for the potential of proposed project activities to cause significant adverse environmental effects to surface water quality/quantity after mitigation.

Table 9-26 Significance of Potential Effects on Surface Water (Project TOR Section 9.6)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological context	Significant Effect
Construction Effects						
Erosion of surface soils in the vicinity of watercourses as a result of various aspects of the highway construction/crossing installation may lead to degradation of the surface water , due to sediment or other	Low	Low	One time	Yes	Watercourse fish habitat not unique in area Water quality to meet provincial/ federal guidelines	No
contaminant release (including contaminated soils)						
Degradation of water quality both at the crossings and downgradient due to blasting	Low	Low	One time	Yes	Watercourse fish habitat not unique in area Water quality to meet provincial/ federal guidelines	No
Sediment deposition may alter fish habitat by affecting spawning beds, rearing habitat, winter or summer refuge or by affecting food species	Low	Low	One time	Yes	Watercourse fish habitat not unique in area Loss of habitat to be addressed in fisheries Act Authorization if required	No
Installation of watercourse crossing structures affecting fish passage	Low	Low	One time	Yes	Structure to maintain habitat and/or passage	No
Accidental release of hazardous substances due to a spill/accident	Low	Low	One time	Yes	Water quality to meet provincial/ federal guidelines	No

Table 9-26 Significance of Potential Effects on Surface Water (Project TOR Section 9.6) (cont'd)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological context	Significant Effect
Operation/Maintenance Effects						
Degradation of water quality resulting from sedimentation and erosion and contaminant releases associated with various Summer Road Maintenance activities (vegetation control, periodic asphalt and shoulder repair, ditch maintenance, culvert/bridge maintenance)	Low	Low	Periodically during summer season as conditions dictate	Yes	Water quality to meet provincial/ federal guidelines	No
Degradation of water quality as a result of Winter Maintenance – Use of Road Salt/Sand	Low	Low	Frequently during winter season	Yes	Water quality to meet provincial/ federal guidelines	No

Magnitude High-population affected; moderate – community affected; Low – individuals affected
Extent –High-at ecosystem level; Moderate – critical habitat level; Low-local

Project effects on surface water are generally not considered potentially significant unless the intersecting or down gradient watercourses are affected. Fish and fish habitat are the most sensitive to potential changes in water quality. If appropriate standard feasible measures are applied to address concerns related to surface water quality/quantity (as noted above), no significant residual adverse environmental effects on surface water/freshwater habitat are predicted to result from the proposed highway construction or operation.

9.7 Groundwater

9.7.1 Existing Environment

The proposed Highway 113 is located within remote/wilderness areas between Highway 102 and Highway 103. The buffer zone for the proposed highway (400 m from the centreline on either side of the proposed route) extends into some residential areas and areas of future residential development (i.e., Kingswood and Halliburton Heights subdivisions in Hammonds Plains and Stillwater Lake, respectively). Communities along the buffer zone include: Hammonds Plains, Sherwood Heights, Timberlea, Hubley, Five Island Lake, and Stillwater Lake.

According to Halifax Water (HW) Operations Department (pers. comm. Feb. 5th, 2009), the majority of the study area is unserviced, with the exception of properties near Kearney Lake Road. In particular, properties on Bluewater Road (Town of Bedford) and Arbour Way (Community of Hammonds Plains) are serviced by the municipal water supply; however, these properties are not serviced by municipal sewer.

The following discussion of groundwater quantity and quality is focused on the information available for the communities within and along the edge of the buffer zone (the study area).

9.7.1.1 Water Quantity

Two Nova Scotia Environment (NSE) databases were reviewed to determine the physical characteristics of the wells in the study area (i.e., the Well Log Database, 2008 and the Pumping Test Database, 2008). The NSE Well Log Database (2008) was analysed in relation to the unserviced communities of Hammonds Plains, Sherwood Heights, Timberlea, Hubley, Five Island Lake, and Stillwater Lake. The NSE Pumping Test Database (2008) was analysed in relation to the County of Halifax. A summary of the NSE well log findings are presented in Table 9-24.

Upon review of this information, it is noted that the majority of individual, privately-owned wells are cased within bedrock with average depth to bedrock ranging from 3 m (Hubley and Five Island Lake) to 9 m (Hammonds Plains) and average well depths ranging from 44 m (Timberlea) to 73 m (Stillwater Lake). Average fracture depths range from 33 m (Hubley) for fracture 1 to 51 m (Five Island Lake) for fracture 2. It is noted that information regarding depth to bedrock and fracture depth is limited (not necessarily provided on each well log). Average well yields range from 1.3 m^3/hr. (Timberlea and Stillwater Lake) to 3.0 m^3/hr. (Five Island Lake), with a maximum of 101 m^3/hr. (Five Island Lake).

An attempt was made to match the NSE well log location information to specific properties within the study area buffer zone, using the Service Nova Scotia and Municipal Relations Property Online website. This task was conducted to augment previous data collected by Washburn & Gillis Associates Ltd. (Highway 113 Environmental Assessment Registration Final Report, April 2000), which, at that time, was based on the 1999 well log database for communities near the study area. Information as presented in the April 2000 report is presented in Table 9-27.

Table 9-27 NSE Well Log Database Information Summary

	Hammonds Plains		Timberlea		Hubley		Five Island Lake		Stillwater Lake	
Physical Attribute	**Range**	**Average**	**Range**	**Average**	**Range**	**Average**	**Range**	**Average**	**Range**	**Average**
Well Depth (m)	5-191	61	5-130	44	6-183	57	10-137	56	19-146	73
Well Casing Depth (m)	0.6-59	14	0.8-43	8	3-37	8	2-34	7	6-24	9
Well Yield (m^3/hr.)	0.03-78	2.0	0.1-8	1.3	0.03-68	2.2	0.03-101	3.0	0.1-14	1.3
Fracture Depth 1 (m)	3-102	37	2-122	40	0.03-90	33	7-104	34	NA	NA
Fracture Depth 2 (m)	4-130	50	5-107	48	12-92	47	15-110	51	NA	NA
Depth to bedrock (m)	0.5-49	9	0.3-27	4	0.03-14	3	0.3-15	3	0.3-20	4
Well Log Stats										
# of records with depth to bedrock information	384		118		111		70		94	
# of records with fracture information	273		105		175		130		NA	
Total # of records	**783**		**290**		**308**		**239**		**99**	

Table 9-28 Summary of Water Well Data for Communities near the Study Area

Name/Lot	Date Drilled	Depth (ft)	Depth to Bedrock (ft)	Yield (igpm)
Sheldrake Heights/Sheldrake Lake/Sheldrake Estates				
Lot # 7 Sheldrake Estates	90/04/01	100	8	12
Lot # 8, Sheldrake Heights	92/05/21	240	17	0.7
Lot # 13 Sheldrake Heights	95/07/03	165	3	12
Lot # 14 Sheldrake Lake	97/07/14	160	4	3
Lot # 24A, Sheldrake Lake Sub.	89/06/15	145	28	12
Lot # 30 Maple Lake Rd, Sheldrake Heights	98/08/03	367	12	1
Lot # 31 Sheldrake Heights	96/08/10	160	11	2
Lot # 32 Maple Lake Rd, Sheldrake Heights	97/07/21	222	9	1.2
Lot # 33 Maple Lake Rd, Sheldrake Heights	97/10/14	300	10	0.5
Lot # 51 Merganser Ave, Sheldrake Heights	94/02/21	307	6	0.5
Lot # 52 Merganser, Sheldrake Heights	88/11/29	146	4	4
Lot # 79, Sheldrake Lake	86/08/14	400	5	1.5
Kearney Lake Estates				
Lot # 5	98/10/05	200	6	15
Lot # 8	97/08/27	200	8	4
Lot # 11	96/11/14	120	15	5
Lot # 16	97/03/09	140	4	3.5
Kingswood Subdivision				
Lot # 33	97/04/24	240	40	3
Lot # 204	97/06/05	140	1	7
Lot # 906	96/04/25	240	4	1
Lot # 916	96/07/22	300	20	0.2
Lot # 956	96/09/16	300	5	0.5
Lot # 957	96/09/13	200	9	6
Lot # 967	96/08/12	300	4	0.2
Lot # 1004	96/08/28	300	8	0.1
Lot # 1030	97/01/16	220	12	1
Lot # 1037	96/07/25	260	8	0.5
Lot # 1039	96/08/07	100	10	9
Lot # 1042	96/07/18	300	30	0.3
Lot # 1046	96/08/16	300	7	0.1
Lot # 1058	97/11/13	320	3	0.5
Lot # 1063	98/02/24	140	2	2
Lot # 1069	96/07/14	300	4	0.3
Lot # 1070	98/01/21	300	7	0.7

Source: NSE Well Log Database, 1999
Conversion factors: 1 ft = 0.3048 m; 1 igpm = 0.272766 m^3/hr

The additional well logs found by comparing the 2008 database to the study area buffer zone are summarized in Table 9-29 below. For these records, the average well depth is 59 m, depth to bedrock 3 m and well yield 2.2 m^3/hr.

Table 9-29 Summary of Water Well Data for Properties within the Buffer Zone

Name	Date Drilled	Depth (ft/m)	Depth to Bedrock (ft/m)	Yield (igpm/ m^3/hr)
Five Island Lake/Timberlea				
23 Maple Lake Rd	00/10/26	145/44	-	10/27
24 Maple Lake Rd	00/11/30	-	-	15/4.1
29 Maple Lake Rd	99/12/09	300/91	-	0.5/0.14
37 Maple Lake Rd	99/01/28	175/53	-	2.5/0.68
64 Maple Lake Rd	07/01/28	120/37	10/3	10/2.7
Hammonds Plains				
129 Lakeshore Dr	04/06/25	260/79	21/6	1.5/0.41
265 Lakeshore Dr	05/09/22	100/31	8/2	8/2.2
395 Lakeshore Dr	04/10/16	120/37	11/3	20/5.5
Hubley				
11 Sunset Lane	05/02/05	150/46	9/3	8/2.2
12 Sunset Lane	99/07/03	175/53	-	10/2.7
24 Eden Lake	06/10/06	360/110	12/4	1.5/0.41
3653 St. Margarets Bay Rd	05/06/24	245/75	4/1	2.5/0.68
Stillwater Lake				
459 Abbey Rd	04/09/01	165/50	14/4	20/5.5
9 Bramsbury Lane	04/07/28	200/61	5/2	4/1.1
- denotes information not available Source: NSE Well Log Database, 2008				

Well classification (in terms of surficial vs. bedrock wells) for all wells in the unserviced communities identified within the NSE Well Log Database (2008) is presented in Table 9-30 below. This evaluation was made using an average depth to bedrock of 3 m (based on the surficial geology of the study area – see Section 9.12.1.3). For 10 of the 1719 well records, there was not enough information to classify, while the remaining wells were identified as drilled wells. Therefore, it is anticipated that all of the wells in the study area have been drilled.

Table 9-30 Well Classification for NSE Well Log Database Results – Unserviced Communities

		Number Per Well Type		
Community	**# of Well Log Records**	**Bedrock**	**Surficial**	**Not Available**
Hammonds Plains	783	780	0	3
Timberlea	290	289	0	1
Hubley	308	307	0	1
Five Island Lake	239	235	0	4
Stillwater Lake	99	98	0	1

Notes:
1. Classification based on average depth to bedrock of 3 m (10 ft).
2. Information not available for some of the older well logs.
3. Well logs not available for the community of Sherwood Heights.

The NSE Pumping Test Database (2008) was reviewed for Halifax County, with 158 pumping test records identified. Only 14 of these records matched communities within the study area. Specifically, there were eight records for Hammonds Plains, five records for Timberlea and one record for Five Island Lake. For the wells within granite (7), depths ranged from 15.9 m (Five Island Lake) to 131 m (Hammonds Plains); well yields (Q20) ranged from 0.65 m^3/hr to 4.1 m^3/hr (both Timberlea) for a 72-hour pumping test; and short-term yields (Q short) ranged from 0.93 m^3/hr to 5.7 m^3/hr (both Timberlea). For the wells within the Goldenville Formation (2), depths ranged from 76 m to 137 m (both in Hammonds Plains); well yields (Q20) ranged from 2.7 m^3/hr. to 3.5 m^3/hr. for a 72-hour pumping test; and short term yields (Q short) ranged from 1.9 m^3/hr. to 2.0 m^3/hr. The remaining five records were within other bedrock types, thus are anticipated to be outside the study area.

9.7.1.2 Water Quality

In general, uranium naturally occurs in granite bedrock and granite-derived glacial till or soil. When the uranium in soil, rock or water breaks down, a naturally occurring, colourless, odourless and tasteless radioactive gas called radon is created. The study area is underlain (for the most part) by granite bedrock and is, therefore, mapped by NSE as an area with potential for uranium in groundwater.

As part of a TIR Highway 103 study (Exit 5 – Hammonds Plains Rd) conducted in 2005, water quality information was gathered by Dillon from several water supply wells (18). Overall, groundwater general chemistry and metals results identified the following exceedances to the

Canadian Drinking Water Quality (CDWQ) guidelines (guideline or recommended range provided in parentheses):

- Sodium (200 mg/L) and cadmium (5 ug/L) in 1 well sample each;
- Chloride (250 mg/L), TDS (500 mg/L) and uranium (20 ug/L) in 4 well samples;
- Low pH (6.5 to 8.5 units) in 8 well samples;
- Colour (15 TCU) and lead (10 ug/L) in 3 well samples;
- Turbidity (1 NTU) in 11 well samples;
- Arsenic (10 ug/L)* in 5 samples;
- Iron (300 ug/L) in 8 well samples; and
- Manganese (50 ug/L) in 13 well samples.

*The guideline for arsenic was revised in May 2006 from 25 ug/L to 10 ug/L. For this discussion, a comparison was made to the newer guideline.

The CDWQ guidelines have been established on either aesthetic criteria or the protection of human health with respect to potable groundwater supplies. In particular, the limits for chloride, sodium, TDS, colour, iron and manganese, as well as the recommended pH range, are in effect for aesthetic reasons only. Elevated levels of chloride, sodium and TDS may cause unpleasant taste. Low pH (or acidic) water tends to be corrosive. Elevated colour, iron and manganese may cause staining of clothing and household fixtures. A limit for turbidity is in effect for both aesthetic and health-based reasons, although the latter generally only applies for chlorinated water supplies. Elevated concentrations of the other parameters above the guidelines may represent a human health issue.

Iron and manganese are commonly found in both shallow (i.e., dug wells) and deep (i.e., deep wells) groundwater supplies throughout Nova Scotia. Low pH is often associated with shallow water sources. In addition to uranium, elevated arsenic is also often naturally found in association with granite bedrock. Elevated cadmium and lead are not common but, once again, may be naturally occurring. While high concentrations of chloride and sodium (along with TDS) may be natural, their association with granite aquifers is not common. Potential unnatural sources include, but may not necessarily be limited to, road salt and septic effluent.

9.7.1.3 Blasting

If blasting should be required during highway construction in an unserviced area, TIR will require its contractor to conduct a pre-blast survey, which will include a well water quality and quantity survey. A pre-blast survey could involve:

a) Well identification;
b) Well head inspection;
c) Water level measurement by a certified pump installer;
d) Limited pumping test and collection of samples for general chemistry, metals and coliform bacteria;
e) Building condition assessment; and/or
f) Survey questionnaire.

9.7.2 Impact Evaluation/Effects Assessment

A majority of wells in the project area are drilled wells, which are less likely to be contaminated via surface run off. If dug wells are identified in the study area (which is not anticipated based on the well classification herein), the proximity of this type of well to the proposed highway should be examined to determine whether drilling a new, deeper well is warranted to offer additional protection of the groundwater quality.

Table 9-31 summarizes potential project interactions related to groundwater for the construction and operations phases of the project. Mitigation measures to address potential project effects are also listed.

Table 9-31 Potential Project Interactions on Groundwater relating to specific sections in the TOR (Section 9.7) – Construction and Operation/Maintenance

Project Interaction	Potential Effect	Mitigative Factor and Measure
Construction Activities		
Blasting	Ground vibration and fracturing of bedrock, which could lead to increased or decreased well yields and/or impacts on groundwater quality in the area.	Blasting (where required) will be designed to limit ground vibration and air concussion in conjunction with provincial guidelines. Ground vibration and air concussion will be monitored both near the blast site and at the closest structures. If wells are damaged, these will be repaired or replaced, as appropriate. A pre-blast survey will aid in determining the amount of damage caused by blasting.
Exposure of Bedrock to Environment	If sulphide bearing materials are found (e.g., pyrite), acid rock drainage (ARD) may be a concern.	The majority of proposed highway is underlain by granites. If sulphide bearing materials are encountered (which is unlikely), these materials will be managed in accordance with the *Guidelines for Development on Slates in Nova Scotia* The regulation outlines measures to properly handle the material to limit exposure to air/water.
Construction site – heavy equipment refuelling	Potential for accidental spill or leak of petroleum hydrocarbons or other contaminant during heavy equipment refuelling.	Petroleum handling will follow the *Petroleum Management Regulations* under the provincial *Environment Act*, and an emergency response or contingency plan will be developed to deal with any accident spill or release of contaminants at the site.
Operation/Maintenance Activities		
Application of road salt	De-icing activities can affect groundwater quality (i.e., increase chloride concentration in groundwater) via rainwater runoff.	As surficial (or dug) wells are more prone to surface water runoff, dug wells within 6.1 m (20 ft) of the highway should be abandoned and replaced with deeper (bedrock) wells, following NSE protocol and the *Well Construction Regulations*, under Section 110 of the provincial *Environment Act*. TIR will follow its Salt Management Plan (SMP, 2000) Refer to section 7.9.3 for details regarding mitigation of potential salt impacts on groundwater. Accidental releases or spills during operation will be managed by the emergency response agencies on site (i.e. fire department, NSE, DFO). NSE is responsible for directing remediation of contamination resulting from such incidents.

9.7.3 Significance

A significant adverse effect for groundwater quality and quantity is one that affects this VEC such that the Canadian Drinking Water Quality Guidelines are exceeded, or impacts of the project affect the yield of wells situated in the zone of influence of the project. An effect that does not meet these criteria is considered not to be significant. Table 9-32 identifies the likelihood of the proposed project activities to cause significant adverse environmental effects to groundwater quality and quantity after mitigation. As groundwater resources in the area are mostly tapped into by drilled wells, and drilled wells are less sensitive to surface/run off contamination, it is not anticipated that the project will result in residual effects to groundwater.

9.8 Flora and Terrestrial Habitat

9.8.1 Existing Environment

Description of Flora/Habitat Methodology

The methodology for addressing flora and fauna species and their habitat follows the NSE Guide to Addressing Wildlife Species and Habitats in an EA Registration Document (2005). As noted in this guidance, the focus for EA documents is to be on priority species and habitats. Priority species are characterized as those listed by legislation/authorities noted in Table 9-33 below.

Table 9-32 Significance of Potential Effects on Groundwater (Project TOR Section 9.7)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Construction Effects						
Ground vibration and fracturing from blasting	Moderate	Low	If required, several blasts over several days.	No	Ground vibration will be limited and monitored as per provincial guidelines	No
Exposure of sulphide bearing rock to atmospheric conditions creating ARD	Moderate	Low	One time during construction	No	ARD potential to be monitored.	No -Not anticipated.
Potential for accidental spill or leak of petroleum hydrocarbons or other contaminant during heavy equipment refuelling	Low	Low	Ongoing	No	Spills or releases should be reported and a contingency plan in place.	No, with contingency plans in place.
PAHs in construction materials, such as, asphalt and tar, could leach into rainwater runoff.	Low	Low	Ongoing	No	Spills or releases should be reported and a contingency plan in place.	No, with contingency plans, stormwater management plans in place .
Operation/Maintenance Effects						
Increase in chloride concentrations from application of road salt	Low	Moderate	Winter months	No	Potentially contaminated runoff (chlorides) – water quality to meet provincial/ federal guidelines	No

Magnitude High-population affected; moderate – community affected; Low – individuals affected
Extent –High-at ecosystem level; Moderate – critical habitat level; Low-local

Table 9-33 Priority Species and Habitats that must be Considered

Lists	Designation
Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Federal Species-at Risk Act (SARA 2003)	Endangered, Threatened or Vulnerable/Special Concern Species
Nova Scotia Endangered Species Act (NSESA 1999)	Endangered, Threatened or Vulnerable Species
Nova Scotia General Status of Wild Species	Red (at risk) or Yellow (sensitive)

Additionally, species listed by the Atlantic Canada Data Centre (ACCDC) as rare, for which the provincial listing is undetermined, were also considered in the assessment. Priority / at risk species are considered for terrestrial habitats as well as wetlands and aquatic habitat (as noted in subsequent sections).

Available background information on potential priority / at risk species for the study area was compiled from the previous EA (Washburn and Gillis 2000) and associated documents, NSDNR's Significant Wildlife Habitat Database, contact with NSDNR staff and the ACCDC, as well as consideration of habitat types present in the study area. The ACCDC data correspondence is included in Appendix A1. A radius of 100 km was considered for review of known occurrences of priority species. A long list of potential priority species was identified for each taxonomic group. Based on the review of potential priority species and potential available habitat in the study area, a "short-list" was generated. Base mapping and aerial photographs were 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 were designed to target peak periods of optimal detection of the "short-list" priority species. The short-lists of potential at-risk species for the study area, their likely habitat, flowering period, and at risk / priority status are provided in Appendix A2.

Vegetation surveys were conducted in the study area targeting at risk (priority) plant species habitat and included development of a list of plants during summer and late summer flowering periods (July and August, 2008 and June and July 2009).

The alignment was surveyed on foot by a qualified plant specialist, visually searching for significant plant habitats and species of interest. Routes were selected to best reach any significant habitats identified. Priority species locations observed in the field were provided using a handheld GPS. Priority plants typically occur at places where the local habitat is suitable for their establishment and growth. Similarly, rare or sensitive habitats develop in areas having unique combinations of soil, geologic, topographic, and climatic conditions. Habitats with a relatively high likelihood of supporting rare species in the study area are wetlands and riparian habitats. These areas were most intensively investigated during the field surveys; however, all habitats with the exceptions of residential areas and developed urban lands were also surveyed. The plant survey also included visual lichen searches based on habitat potential for uncommon lichens and, potentially, the Boreal Felt Lichen.

General Habitats Present

The study area is primarily forested with considerable barrens habitat. Residential development occurs adjacent to the study area. A vegetation list for the study area including a total of 164 vascular plant species is provided in Appendix B3.

Generalized habitats within the study corridor are identified on Figure 9-5 based on NSDNR cover types and include:

Softwood forests – These areas are generally dominated by red/ black spruce and balsam fir with minor amounts of red maple. Remnant white pine and hemlock from the original forest cover remains in ravines particularly in the Black Duck Brook area. Poorly drained and treed wetland areas support black spruce and tamarack. Ground cover includes a variety of shrub species (where more open areas occur) and bunchberry and sphagnum (in forested areas).

Mixed wood forests – Mixed woods occur throughout the area with tree species including red/black spruce, red maple, red oak and balsam fir. Shrub species such as false mountain holly, lambkill and lowbush blueberry are present. Wild sarsaparilla and ferns are also prevalent throughout the habitat.

Hardwood Forests – Hardwood dominated forests occur in the area east of Kearney Lake. Stands are generally dominated by red maple, white birch and grey birch with minor amounts of red/black spruce and balsam fir. Exposed slopes support limited stands of beech, sugar maple and red oak. Ground cover is generally similar to the mixed woods dominated by shrub species.

Disturbed Forest – Both fire burns and hurricane/storm blowdown occurs throughout the study area. Fire burns are most evident in the Fisher Brook area. Stands of red oak, red maple, white birch, white pine and black spruce occur in forested burns. Barrens species dominate burned barrens areas.

Barrens – Extensive barrens habitats are present throughout the study area where granite bedrock is close to the surface. Vegetation is dominated by dense low shrub species.

Aquatic habitats - Occur within and adjacent to the watercourses along the ROW which are listed in Section 9.11. The watercourses crossing the study area are typically small with the largest being the stream between Maple and Fraser Lake. Eight main brooks were identified in the previous EA with potential fish habitat. Numerous other intermittent watercourses were noted during the 2008 field surveys (Figure 9-4); however these are generally not fish habitat. Brook trout (NSDNR, sensitive) and American eel (COSEWIC, 2008; Special Concern) are the key fish species present and habitat quality varies from good to poor quality. Additional detail on aquatic habitats is provided in Section 9.11.

Wetlands – Wetlands occur both within and adjacent to the ROW (Figure 9.8). Those within the proposed ROW include bogs, treed bogs and shrub swamps. Additional detail on wetland habitats is provided in Section 9.10.

Manmade Disturbed habitats – Disturbed habitats occur in the vicinity of the proposed alignment including residential and commercial development located primarily along roads crossing and adjacent to the study area.

Significant Habitats

Based on information available from the previous EA updated with current ACCDC and NSDNR data, the following significant habitats were considered in this environmental assessment:

Figure 9-5 General Terrestrial Habitats

- The area south of the study area is a Species At Risk Habitat for an isolated population of mainland moose (NSESA Endangered);
- The Fraser Lake/Maple Lake system is identified by NSDNR as a Habitat of Concern. This system is inhabited by sensitive fish species, brook trout and gaspereau. As well, the previous EA identified the area between Fraser Lake and Hammonds Plains Road as an important wildlife corridor.

Figure 9-6 illustrates the location of these habitats in relation to the project. The habitats are discussed in the Wildlife and Aquatic Habitat Sections (Sections 9.9 and 9.11). No forest stands greater than 60 years old were identified within the study area. The Blue Mountain-Birch Cove Lakes Wilderness Area is located adjacent to the study area. This is discussed further in Section 9.2).

No old growth forest habitat was identified for the study area or will be impacted by the project. Softwood stands south of the study area along Fraser Lake were noted as potential old growth (Washburn and Gillis 2000, pers. comm. NSDNR).

Priority Plant Survey Results

No plants (or lichens) listed under SARA, NSESA or COSEWIC were observed or expected in the alignment either in 1999 or in 2008/9.

One plant listed as a NSDNR red (at risk) species was observed in 2008/9:

- The Southern Twayblade (*Listera australis*).

In addition to the NSDNR status, the plant is also listed nationally as S1 (extremely rare) in Nova Scotia, New Brunswick, Ontario and in Vermont and ranked S2 (rare) in Quebec. The Southern Twayblade is a small orchid considered part of the coastal plain flora of Nova Scotia. The observations were within the wetlands at the eastern end of the alignment (see Figure 9-6). In 2008, two plants were observed in Wetland T-17 and one in Wetland T-0. In 2009, two plants were noted in Wetland T-11 and three in T-20. The wetlands in this area were the focus of

Figure 9-6 Significant Habitats and Species at Risk

additional survey and no additional Southern Twayblade plants were found. It is noted that there is typically variation from year to year in the location of these orchids based on seasonal conditions and microclimates present. Thus these individual records are considered representative of a potential colony. The characteristic habitat of the Southern Twayblade is wetlands dominated by Black Spruce, Balsam Fir, False Holly and Cinnamon Fern. It thrives in damp Sphagnum moss patches lacking competition from other plant species. It should be noted that mountain sandwort (*Arenaria groenlandica*) is known to inhabit Blue Mountain Hill; however, no colonies of mountain sandwort were identified in the proposed alignment during the botanical surveys.

No NSDNR yellow plant species were identified.

No invasive species were identified although the encroachment of urban habitats results in non-native species potentially occurring in several areas.

9.8.2 Impact Evaluation/Effects Assessment

Based on the existing environment and the project description, an assessment was made of potential effects on each of the flora and terrestrial environment VECs and significance of those effects. It is noted that effects due to accidents and malfunctions are considered separately in Section 7.10.

General project effects on (non-rare) vegetation and plant communities are considered, as relevant, to other VECs including Fish and Fish Habitat (e.g., effects on watercourses as a result of loss of vegetation); Herpetiles, Rare or Sensitive Mammals and Critical Habitat, and Rare or Sensitive Birds (e.g., habitat fragmentation); and Wetlands (e.g., sedimentation, effects on wetland function, biodiversity).

9.8.2.1 Vegetation and Priority Plants

Potential effects on vegetation include direct disturbance through ROW clearing and maintenance as well as indirect disturbance such as road salt effects, changes to local environment or introduction of invasive species. The disturbance / loss of vegetative cover is not identified as a VEC or considered to have an environmental effect except when related to the following VECs - fish habitat (Section 9.11), wildlife habitat (Section 9.9), wetland function (Section 9.10) and priority plants. Southern Twayblade (Listera australis), has several colonies located within the project footprint at Wetlands T-0, T-17, T-11 and T-20. Potential project effects on priority plant species are discussed in this section. Potential construction related interactions with at risk plant species and proposed mitigation are outlined in Table 9-34.

Table 9-34 Potential Project Interactions with Priority Plant Species (Project TOR Section 9.8) – Construction

Project Interaction	Potential Effect	Mitigative Factor and Measure
Clearing and grubbing in ROW	Habitat fragmentation for priority plant species, direct loss of priority plants (e.g., Southern Twayblade); effects to existing wildlife corridors	TIR to work with NSDNR to minimize population loss of Southern Twayblade (see 'Species Specific Management Plan' outlined below which addresses potential interruption, alteration or destruction of wildlife corridors specifically relating to the Southern Twayblade) TIR to work with NSDNR to preserve existing vegetation to maintain wildlife corridors. Landscaping and preservation of existing vegetation guidelines are addressed in the generic EPP
Alteration to surface water flow as a result of storm drainage design	Changes to Southern Twayblade wetland habitat hydrology adjacent to alignment	Maintenance of surface water paths through culvert placement
Invasive Species resulting from re-vegetation efforts	Disruption of native populations	TIR has developed an invasive species policy as part of their re-vegetation efforts, as such, priority will be placed on the use of native species for re-vegetation efforts
Potential impacts of fragmentation	Clearing and grubbing in alignment footprint – landscaping and preservation of existing vegetation	

Loss of a portion of the Southern Twayblade population in wetlands at the eastern end of the alignment is the key potential impact associated with the project interaction with flora. Avoidance of this area is not possible. The wetland section (Section 9.10) provides additional detail on the constraints to routing in this area and alternative alignments examined. In terms of the known total population observed in the vicinity of the project (<10 plants), this is a very small isolated population. It is possible that other small pockets of this plant occur in the general area. In order to minimize impact on this priority species, TIR will develop a management plan based on consultation with NSDNR following the general guidance outlined below.

9.8.2.2 Management Plan Outline for Southern Twayblade

TIR recognizes the significance of this species and is committed to responsible stewardship of this valued component of biological diversity. Consistent with an overall goal of sustainable development, and in consultation with NSDNR, TIR proposes a species specific management plan. This plan prioritizes approaches to avoid impact to the plant where possible. If avoidance is not possible, management measures will be implemented to minimize impact on the plant population. Where loss of individual plants is anticipated, this will be undertaken within a context of contributing to the long-term survival of the species and maintenance of the viability of the population.

Avoidance

The Southern Twayblade colonies observed primarily inhabit the eastern end of the alignment area. The area where Southern Twayblade occurs is located between an interchange and fly-over and at this location TIR has limited options for avoidance based on engineering considerations associated with safe design for the ramps.

Management

Management will focus on designation, protection and conservation of Southern Twayblade colonies outside the project footprint. The colony within the footprint will provide a research opportunity as discussed below (Research and Monitoring). Should the status of the Southern Twayblade change in the future, then protection and mitigation measures will also change accordingly.

An initial delineation of colonies in the area of interest has been undertaken. The known plant locations are indicated on Figure 9-6. Of those identified in 2008/9, all are located within the project footprint. No additional plants were observed in the immediate adjacent area. As the project is not likely to proceed for several years, TIR will consider, as part of land purchase, including the Southern Twayblade within a protected area and to conduct additional research on those located within the footprint in the interim period.

Footprint Area – Given the current schedule for construction, this area will initially provide a research plot. No vehicle access or other disturbance, such as vegetative cover removal will be permitted by project personnel. Foot traffic such as monitoring surveys will be permitted. Buffer areas will be identified based on habitat conditions, plant specific climate conditions, local topography, hydrology and drainage considerations and as noted above, input from NSDNR. Within the buffer areas, activity will also be guided by considerations of habitat, such as local topography and drainage, to avoid disturbing plants and minimizing habitat disruption. Research will be developed in consultation with NSDNR to contribute to the overall understanding of the habitat requirements of Southern Twayblade focusing on long term sustainability of populations. An assessment will be made of community structure and survivability, including documentation of size and numbers of plants within the footprint to be undertaken annually (late June). Observations will also be made of surface water level/extent of flooding at representative sites in this area. If determined to be of value through consultation with university and other scientific experts, immediately prior to clearing required, the Southern Twayblade plants within the footprint will be relocated either to the Irving Centre Herbarium at Acadia University for further study or other suitable location. Permits under provincial Wildlife Act (or the provincial Endangered Species Act if listed) will be in-place prior to relocation. In addition to the management identified above, the following management measures are proposed related to potential habitat issues:

Surface water quality – Surface water quality, including total suspended solids levels and pH, within storm water directed to the Southern Twayblade habitat area will be monitored and meet regulatory requirements.

Erosion control – TIR erosion control measures will be in place prior to construction to protect any identified downgradient Southern Twayblade 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.

Flow regimes – Existing storm water drainage patterns shall be maintained, rather than mimic natural flow regimes in the existing wetland. Additionally preliminary cut/fill design will need to be carefully considered.

Awareness – TIR is committed to environmental training to educate staff about the significance and recognition of this plant, sensitive areas and mitigation initiatives, environmental regulations and on-going monitoring and research at the site related to stewardship of the plant.

Regulatory Consultation - As part of environmental protection planning, contingency planning and monitoring, the proponent will work with regulatory agencies such as NSDNR, Wildlife Division for on-going development of appropriate protection strategies. Monitoring reports will be submitted to NSDNR. If additional plants or populations are encountered during initial monitoring and research, the Management Plan will be reviewed on consultation with NSDNR.

As an alternative, TIR will also investigate protection of Southern Twayblade at other locations in cooperation with NSDNR and conservation agencies. As mentioned above, should the status of plants within protected areas change in the future, then protection and mitigation measures will change accordingly.

Potential operational related interactions with at risk plant species and proposed mitigation are outlined in Table 9-35. Potential operational impacts on down gradient Southern Twayblade populations are mitigated by standard TIR mitigation procedures.

Table 9-35 Potential Project Interactions with Priority Plant Species (Project TOR Section 9.8) – Operation/Maintenance

Project Interaction	Potential Effect	Mitigative Factor and Measure
Vegetation clearance	Potential impacts to down gradient habitat	Use of mechanical clearance only adjacent to Southern Twayblade habitat
Landscaping and Ditch maintenance	Contribution of sediment to down gradient habitat	TIR ditch maintenance mitigation program
Storm drainage – quality	Changes to Twayblade wetland habitat water quality adjacent to alignment	Monitoring of surface water quality (TSS, pH) and TIR ESC measures
Introduction of invasive species	Degradation of native plant communities	TIR has development and will implement an invasive plant policy
Habitat fragmentation	Landscaping and preservation of existing vegetation during operation and maintenance	TIR has developed and will implement its landscaping and preservation of existing vegetation policy as per the generic EPP

9.8.3 Significance

Significant adverse effects are identified based on the following criteria (as established at the time of this document):

- Contravention of prohibitions in related regulatory requirements (e.g. SARA, NSESA, Fisheries Act, Migratory Bird Convention Act, Nova Scotia Wetland Alteration Approval, Nova Scotia Wildlife Act; listed in Section 5);
- Activities not in compliance with objectives of existing management/recovery plans developed for SARA or NSESA species;
- Activities that negatively effect overall populations of existing yellow or red NSDNR general status species; and,
- Loss of currently designated significant habitats.

An effect of the project that does not meet the above criterion is considered not to be significant. Table 9-36 identifies the likelihood of potential project activities to cause significant adverse environmental effects to priority plant species after mitigation.

Table 9-36 Significance of Potential Effects on Priority Plants (Project TOR Section 9.8)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Construction Effects						
Habitat fragmentation for priority plant species, direct loss of priority plants (e.g., Southern Twayblade)	High	Low	One time	Yes (with management plan)	Not expected to affect Southern Twayblade at a population level	No (with management plan)
Changes to Southern Twayblade wetland habitat hydrology adjacent to alignment (as a result of storm drainage design)	Moderate	Low	One time	Yes	Adjacent Habitat to be maintained	No
Introduction of invasive species	Moderate	Moderate	One time	Yes (with management plan)	Local	No (with management plan implementation)
Potential impacts of fragmentation on other plant species	Low	Low	One time	Yes	Adjacent Habitat to be maintained	No
Operation/Maintenance Effects						
Vegetation maintenance affecting downgradient habitat	Negligible	Negligible	Less than once a year	Yes	Adjacent habitat to be maintained	No
Landscaping and ditch maintenance contributing to sedimentation of downgradient habitat	Low	Negligible	Less than once a year	Yes	Adjacent habitat to be maintained	No
Changes to Twayblade wetland habitat water quality adjacent to alignment as a result of storm drainage	Low	Negligible	Frequently throughout year	Yes	Adjacent habitat to be maintained	No
Introduction of invasive species from re-vegetation efforts	Low	Low	Intermittent	Yes (with management plan)	Local	No (with management plan implementation)
Potential impacts of fragmentation	Low	Negligible	Frequently throughout year	Yes	Adjacent habitat to be maintained	No

Magnitude High-population affected; Moderate – community affected; Low – individuals affected
Extent –High-at ecosystem level; Moderate – critical habitat level; Low-local

No significant residual effects are identified for priority plant VECs that cannot or will not be avoided/mitigated based on existing programs (e.g. ditch maintenance, invasive plant policy). As well, TIR will work closely with NSDNR staff to finalize appropriate environmental management planning for Southern Twayblade on completion of detailed designs for the proposed work.

9.8.3.1 Follow-up and Monitoring

In order to confirm that populations of Southern Twayblade outside the immediate ROW foot print, if identified, are not being negatively affected, on-going monitoring is proposed. Monitoring will be initiated prior to project initiation in order to provide a baseline and is proposed to meet several objectives. For example, to verify impact predictions and apply the precautionary principle where uncertainty exists; and to evaluate potential effects of development on an at risk species and allow for an interactive mechanism to minimize effects. Annual monitoring and research reports related to at risk species will be submitted to the Director of Wildlife. Follow-up monitoring associated with Southern Twayblade will be undertaken to establish groundwater monitoring wells along the up gradient perimeter of the wetlands adjacent the project footprint and quarterly monitoring of water levels. TIR will prepare a discharge and storm runoff water quality monitoring program. Water quality monitoring will include parameters which may be important to habitat suitability (e.g., pH and TSS). TIR will implement their invasive plant control policy.

9.9 Wildlife and Migratory Birds

9.9.1 Existing Environment

Description of Wildlife/Migratory Bird Methodology

The methodology for addressing flora and fauna species and their habitat follows the NSE Guide to Addressing Wildlife Species and Habitats in an EA Registration Document (2005) as noted in Section 9.8.1 above. The focus of the wildlife assessment is priority /at risk species and on significant habitats and migratory birds. Wildlife assessment is based on existing data, habitat suitability and targeted field surveys. The assessment is based on habitat potential for priority species as identified using the short-listing priority species process noted above. Assessment of wildlife (as with plants) was focused on potential priority species as well as migratory birds.

Appendix A2 lists the potential at-risk animals "short-listed" for the study area, their likely habitat, preferred investigation period, and at risk / priority status. At risk animal species data was primarily obtained through existing data compilation and incidental to other field surveys. Priority species were located, where identified, using a handheld GPS. Migratory bird surveys were conducted as field surveys by habitat type. Figure 9-7 (in Vegetation Section 9.8) shows the generalized habitat within the study area.

All migratory birds present (not just priority species) are included in the assessment due to the Migratory Birds Convention Act (MBCA, Environment Canada 1994). The MBCA provides protection for the migratory birds, their eggs, and young. Protected birds are described in the Canadian Wildlife Service (CWS) Occasional Paper, Birds Protected in Canada under the Migratory Birds Convention Act. Under the Act, it is illegal to kill, take or hunt migratory birds or destroy nests or young by project activities. It is also prohibited under the Act, except as authorized by regulations, to "be in possession of a migratory bird or nest". In addition, raptors (including eagles, osprey, hawks and owls) are protected under the Nova Scotia Wildlife Act.

Generally, the rationale for conducting migratory bird surveys are threefold and include: long term decline of certain species; loss of habitat and the species which depend upon those habitats; and to gather more information on species for which there is little data on localized populations. Breeding bird surveys of the areas to be disturbed by construction were completed, following Environment Canada's General Guidelines for Migratory Bird Surveys for Environmental Assessment (2003). The breeding surveys were conducted by recognized birders (Fulton Lavender, and for early spring survey focusing on owls and woodpeckers, John Kearney), who identified birds visually and by their vocalizations. For the owl survey, species specific calls were used to initiate a response from owls within the study area or beyond. The early survey was conducted on May 8 and 9, 2009 and the breeding surveys on May 29, and June 20 and 23, 2008. Conditions were considered typical for the breeding season at these times. The breeding survey was conducted over the study area to establish a list of species occupying the project footprint. The survey was done by listening for birds, starting before dawn, when avian activity begins. Numbers of each species were recorded for those found within the auditory range of the ornithologist. The passerine surveys were conducted in a similar fashion to the owl survey (listening for 5 minutes within representative habitats).

Figure 9-7 Avian Survey Locations

Wildlife Survey Results

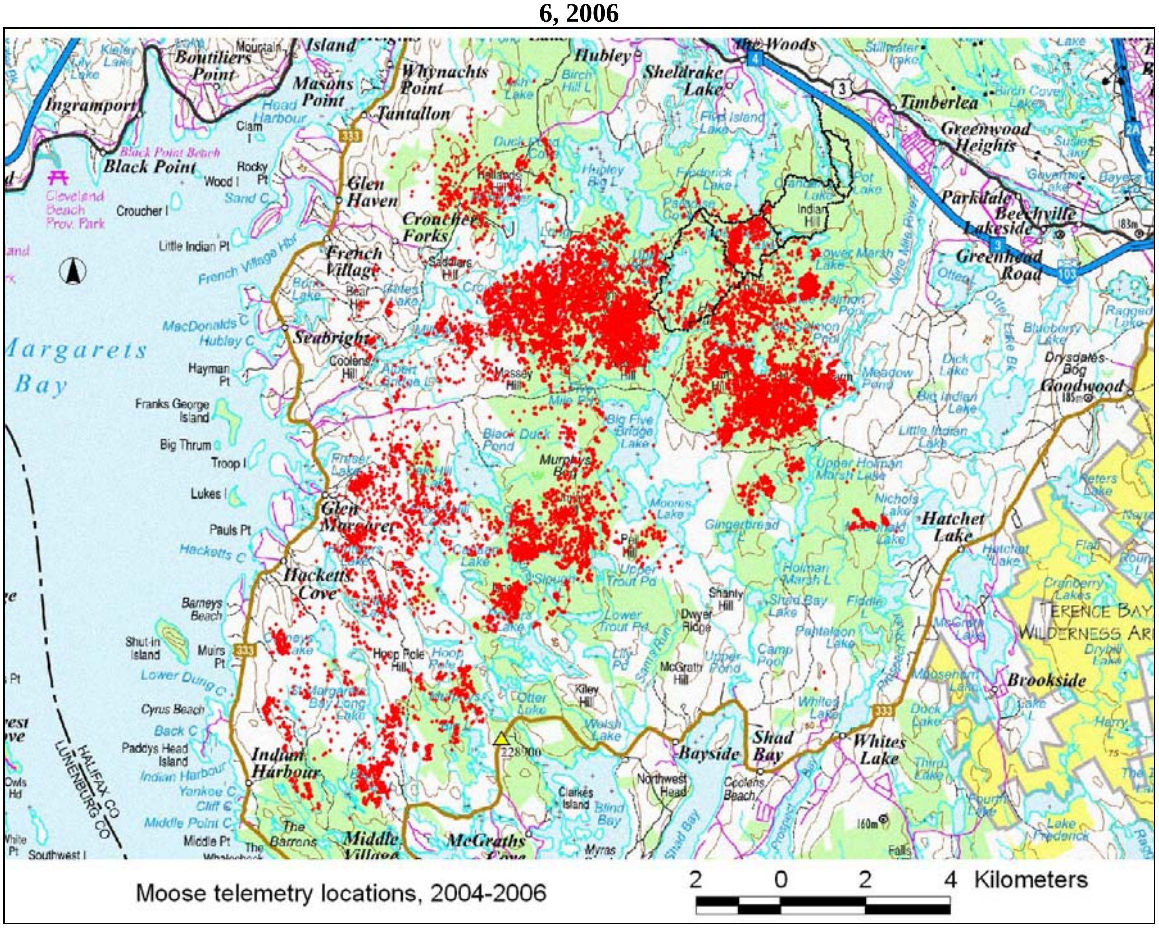
Wildlife present in the area includes species typical of the habitats present (deer, hare, bear, bobcat, bats, beaver, muskrat and fox). Herpetiles observed or expected based on habitat in the area include a variety of common species including frogs, salamanders and snakes. Herpetile survey results are provided in Appendix B2. Previous reports from the Nova Scotia Museum (Washburn and Gillis 2000) indicate a low diversity of small mammals in the area and a high concentration of white-tail deer. NSDNR also identifies this area as having abundant deer populations but no defined deer yards.

There are only about 1000 Mainland Moose in Nova Scotia and the Chebucto group, about 30 animals, is exceptionally small (Snaith, 2001; Tony Nette, NSDNR personal communication, 2009). The Mainland Moose was listed as endangered in 2003, which provides some legal protection to the moose and their habitat. (The Cape Breton moose are a western subspecies which was introduced into Cape Breton after the eastern moose went locally extinct. That population is now about 5000 and is not endangered.)

Winter aerial survey programs were conducted by NSDNR in January 2003 and 2009 to assess the numbers and distribution of moose in the Chebucto Peninsula and within the vicinity of the proposed highway alignment of Highway 113. A total of 24 to 25 moose were observed, with the majority (22) of the population being identified in the western portion of the peninsula, between Route 333 and St. Margaret's Bay, in the vicinity of the Five Island Lake and the Terence Bay Wilderness Area and not along the proposed Highway 113 (AMEC, 2004; Tony Nette, NSDNR personal communication, 2009).

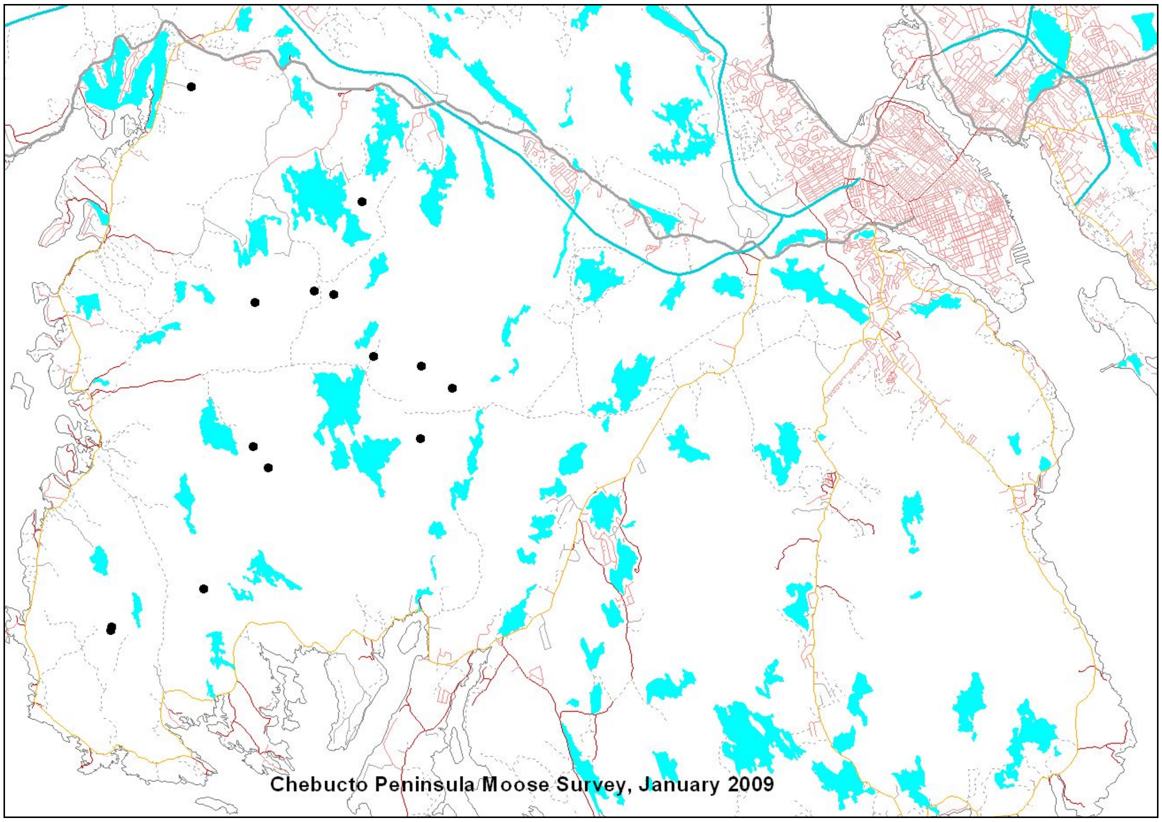
Recent investigations undertaken by NSDNR with radio-collared moose (NSESA Endangered) between 2004 and 2006 and winter aerial surveys (2003 and 2009) do not indicate that the small population in the Chebucto Peninsula frequent the Highway 113 study area. Figure 9-5.1 illustrates GPS collar data of six different moose instrumented between January 28, 2004 and March 6, 2006. Figures 9-5.2 and 9-5.3 show results of winter survey, January 2003 (100% search) where a minimum of 25 moose at 12 locations were found and results of winter survey, January 2009 (100% search) where a minimum of 28 moose at 13 locations were found.

Figure 9-5.1 GPS Collar Data of Six Different Moose Instrumented between January 28, 2004 and March 6, 2006



Figures 9-5.2 Results of Winter Survey, January 2003 (100% search) Where a Minimum of 25 Moose at 12 Locations Were Found

Figure 9-5.3 Results of Winter Survey, January 2009 (100% search) Where a Minimum of 28 Moose at 13 Locations Were Found



This population on the Chebucto Peninsula are not considered sustainable by NSDNR and as such there is no area specific recovery plan in place (Tony Nette, NSDNR personal communication, 2009). Specifically, the surveys conducted in 2003, 2008 and 2009 suggest the Chebucto population is more or less stable. A combination of ground and winter aerial surveys along with radio tagging suggests they are no longer moving off of the Chebucto Peninsula. The NSDNR continue to solicit sightings from the public of live animals, scat or antlers as part of its ongoing surveys. The NSDNR suggest that the Chebucto moose in particular seem very wary of humans, whether on foot or on ATVs and off-highway vehicles (OHVs) (Tony Nette, NSDNR personal communication, 2009).

Sixty-two species of birds were identified in the general area during the bird surveys. Bird survey data, listing avian species observed/heard in 2008/9, is provided in Appendix B1. The 2000 EA report identified 118 species as potentially having breeding habitat in the general area and noted the majority of species present were transitional range species. These are species that are neither at the southern or northern extent of their natural ranges.

Priority/At Risk Species that were identified during bird surveys included:

- Canada Warbler (DNR Sensitive, COSEWIC threatened) – typically nesting in mature to mid-aged mixed forest habitat and may occur within the ROW;
- Common Nighthawk (DNR Sensitive, COSEWIC/NSESA threatened) – typically nesting on open ground, cutovers, or buildings, is unlikely in the ROW but may occur in adjacent urban habitat;
- Olive-sided Flycatcher (DNR Sensitive, COSEWIC threatened) – typically nesting in forest edge habitat and may be within the ROW;
- Gray Jay (DNR Sensitive) – typically nesting in mature conifer habitat and may be within the ROW;
- Boreal Chickadee (DNR Sensitive) – typically nesting in nest cavities in rotting tree stumps and may be within the ROW; and,
- Common Loon (DNR Sensitive) – typically nesting on islands or similar protected areas is unlikely in the ROW but may occur in adjacent lake habitat.

The forested areas, barrens and wetland areas within the study area serve as nesting habitat for passerines. During the migratory bird survey, no owls were observed or heard within the study area. The early survey identified one owl (Great Horned Owl, DNR stable population) as breeding in the general area. The 2000 EA identified a large stick nest on power lines near Ragged Lake. No other raptor nests were identified, however Red-tailed Hawk and Osprey were observed foraging in the area.

9.9.2 Impact Evaluation/Effects Assessment

Potential effects to wildlife and migratory birds include direct 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.

Construction

Potential construction related interactions with migratory bird species and proposed mitigation are outlined in Table 9-37.

Table 9-37 Potential Project Interactions with Wildlife and Migratory Birds (Project TOR Section 9.8) - Construction

Project Interaction	Potential Effect	Mitigative Factor and Measure
Clearing and grubbing in ROW footprint, highway construction and surfacing	Direct loss of priority wildlife or its habitat Alteration of or disruption to migratory birds and/or their habitat in contravention of the MBCA Disturbance of adjacent nesting habitats, including raptor nesting Reduction in quantity/quality of habitat within and in proximity to the ROW	Mitigation for aquatic priority species/habitats identified under fisheries section (Section 9.11).
		Mitigation for potential wetland priority species/habitats identified under wetland section (Section 9.10). Clearing will be undertaken outside the breeding season to minimize potential effects on migratory birds. 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 DNR and the Project Engineer. Clearing activities will occur outside of the breeding season (May 1st to August 31st). If clearing is required in May (e.g., within 30 m of watercourse buffers), disturbance of active nests will be avoided and work will be conducted in compliance with the MBCA. Should a nest be encountered, a 20 m buffer zone will be flagged around identified active nests and work in the area will be delayed until after the birds have fledged. Construction crews and machinery are to use designated roadways and access-points to limit disturbance off the ROW.

Table 9-37 Potential Project Interactions with Wildlife and Migratory Birds (Project TOR Section 9.8) – Construction (cont'd)

Project Interaction	Potential Effect	Mitigative Factor and Measure
		Construction will be generally distant from potential waterfowl nesting on most adjacent ponds and lakes. No nesting waterfowl were observed during nesting season field reconnaissance, however, it is reasonable to assume that there is potential for isolated nesting waterfowl in the general area.

Mitigation measures as cited for watercourses and wetlands will also apply to protect migratory bird species in these habitats.

9.9.2.1 Operation and Maintenance

Potential operational related interactions with migratory birds and proposed mitigation are outlined in Table 9-38. Potential operational impacts on adjacent wildlife habitat will be mitigated by standard TIR mitigation procedures. A bridge structure structures (i.e., Fraser – Maple tributary,) will be sized to allow passage of large animals, and small animals. In addition,
Open span structures will be constructed at various locations (see Section 7.4) which will be sized to permit wildlife crossings (primarily small animals, but the Black Duck crossing may provide larger animal crossing). Open span structures will consist of an arch span or open bottom box which will be oversized for the stream to allow riparian areas on either side. These crossing locations generally correspond to areas where it is expected that topography dictates natural animal movement. Open span structures over shrub bog wetland watercourse crossings may have limited ability to provide high flow wildlife passage due to the width of the bog area, however, additional open span crossings are proposed within the same general area at smaller watercourses to supplement the wildlife crossing potential during the high flow period.

Table 9-38 Potential Project Interactions with Wildlife, Migratory Birds relating to specific sections in the TOR (Section 9.8) – Operation/Maintenance

Project Interaction	Potential Effect	Mitigative Factor and Measure
Presence of Highway 113	Fragmentation on wildlife populations and habitats including modification of wildlife corridors	Provision of wildlife corridors for large and small animals
Vegetation clearance during operation and maintenance	Potential destruction of bird nests	Mitigation measures include the use of mechanical clearing outside of the nesting season
Landscaping and ditch maintenance during operation and maintenance	Potential contribution of sediment run off through sediment erosion to downgradient habitats	Mitigation measures include TIR ditch maintenance mitigation program as per generic EPP
Salt application (or other de-icing agents) during winter months	Reduced water quality, change in roadside vegetation, salt attracting wildlife to highway	TIR to follow Salt Management Plan

9.9.3 Significance

A significant adverse effect on wildlife species at risk is one that results in a change that is in violation of the prohibitions in Sections 32 to 36 of SARA, the NSESA, Fisheries Act, Migratory Bird Convention Act, Nova Scotia Wetland Alteration Approval, and/or the Nova Scotia Wildlife Act. As stated in Section 9.8, a significant adverse effect would also include: activities not in compliance with objectives of existing management/recovery plans developed for SARA or NSESA species; Activities that negatively effect overall populations of existing yellow or red NSDNR general status species; and, loss of currently designated significant habitats A significant adverse effect on wildlife species of concern, or a species considered secure is one that affects a population or portion thereof in such a way as to cause a decline or change in abundance or distribution of the population over time such that natural recruitment may not re-establish the population to its original level in the project area. An adverse effect that does not meet the above criteria is evaluated as not significant.

Table 9-39 identifies the likelihood of the potential for proposed project activities cause significant adverse environmental effects on wildlife and/or migratory birds after mitigation.

Table 9-39 Significance of Potential Effects on Wildlife, Migratory Birds (Project TOR Section 9.8)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Construction Effects						
Direct loss or fragmentation of wildlife populations and habitats including modification of wildlife corridors	Moderate	Moderate - Low	One time	No	No significant species or habitats expected to be affected at a population level	No
Reduction in quantity/quality of habitat within and in proximity to the ROW	Moderate	Moderate - Low	One time	No	No significant habitats expected to be affected at a population level	No
Alteration of or disruption to migratory birds and/or their habitat in contravention of the MBCA	Moderate	Moderate - Low	One time	No	No significant disturbance of bird nests/nesting habitats	No
Disturbance of raptor nesting	Moderate	Moderate - Low	One time	No	No significant disturbance of raptor nests	No
Operation/Maintenance Effects						
Potential destruction of bird nests through vegetation management	Negligible	Negligible	Seasonally throughout year as required	Yes	Adjacent Habitat to be maintained	No
Potential contribution of sediment run off through sediment erosion to downgradient habitats	Low	Negligible	Less than once a year	Yes	No significant species or habitats expected to be affected at a population level, sediment and erosion control measures to be followed.	No
Reduced water quality, change in roadside vegetation, salt attracting wildlife to highway	Low	Negligible	Less than once a year	Yes	No significant species or habitats expected to be affected at a population level, Salt Management Protocol to be followed	No

Magnitude High-population affected; Moderate – community affected; Low – individuals affected
Extent –High-at ecosystem level; Moderate – critical habitat level; Low-local

Priority wildlife species and significant habitat impacts are not anticipated as a result of the project.

While a minor loss of migratory and non-migratory bird habitat is expected through physical removal, this habitat is not unique to the study area. The 2000 EA determined that although some breeding habitat for migratory birds will be lost, the transitional habitat available in the region and is not limiting to the populations identified. This is applicable to the priority bird species identified for the area as well as general migratory bird species and raptors. For concerns related to mainland moose, studies by NSDNR on Moose populations on the Chebucto Peninsula demonstrate that these individuals do not commonly migrate to the areas affected by the proposed project.

Clearing will not occur during the nesting season. With the mitigation of winter clearing, and applicable measures detailed in the EPP, it is not anticipated that the project will result in significant adverse residual effects on at-risk birds, migratory birds and available bird habitat.

9.9.3.1 Follow-up and Monitoring
No specific monitoring is identified or required for wildlife and migratory birds.

9.10 Wetlands

9.10.1 Existing Environment
Wetlands are defined under the *Environment Act* as "land that is saturated or covered with water long enough to promote vegetation and biological activity adapted to a wet environment".

Wetlands are valued by the public and a variety of stakeholders and perform important ecological functions, including providing important habitat. The *Federal Policy on Wetland Conservation* and the provincial *Wetland Alteration Approval* process stress conservation of wetlands and their functions. An objective of wetland conservation is "no net loss" of wetland function.

Topographic and NSDNR mapping and the previous EA identified 16 main wetlands within the corridor. Many additional small wetlands were identified in the field as noted as located in Figure 9-8.

Description of Wetland Survey Methodology

Wetlands were examined within the study corridor and within a potential zone of influence of 500 m downgradient for those with significant habitat. Wetlands were identified based on NSDNR's wetland database, air photos and field surveys. Wetlands were determined to be present if vegetative, soil and hydrologic wetland indicators occurred. For wetlands potentially requiring a provincial Wetland Alteration Approval, additional information was collected on wetland function including:

- Wetland identifier, location, type and key boundaries;
- Estimated footprint (based on TIR August 2008 mapping), potential impacts, and overall wetland size;
- Surrounding land use and historic impacts on the wetland;
- Species at risk where observed;
- Fish habitat and fisheries where present;
- Dominant vegetation and plants observed;
- Birds and critical nesting periods from breeding bird surveys;
- Other wildlife and habitat concerns if identified; and
- Hydrological and hydrogeological character based on watershed character.

Wetland Survey Results

The 2000 EA provided an assessment of 16 wetlands, of which 6 were identified as intersected by the ROW. Wetland survey results for the wetland intersected by the ROW including an additional twelve wetlands identified in 2008/9 are provided in Appendix B4. Wetlands were identified based on NSDNR's wetland database, air photos and field surveys in July 2008. Additional surveys were conducted in concert with the Listera australis survey (noted above) in the spring of 2009.

Figure 9-8 Wetlands in the Study Area

The NSNDR wetlands within the study area were characterized as a variety of types; predominantly bogs but also shrub swamps and open water to shallow marsh. The larger wetlands were typically associated with stillwater shrub habitat (often including beaver influences). Other smaller bogs and alder shrub swamps occurred in localized depressions, particularly in lows in bedrock ridges. Characteristic bog shrubs included wetland species - sheep laurel, leather leaf, rhodora and bayberry. Hydric soils were typically extensive peat deposition. The watertable was identified within 30 cm of the surface at the wetlands identified.

The only at risk species identified specifically in the wetlands was;

- Southern Twayblade as discussed in **Section 9.8**., identified in Wetlands T-0, T-11, T-17 and T-20.

Plant and animal surveys conducted in 2008 along the ROW (**Appendices B**) found additional species or potential habitat for those identified as at risk by the federal *Species At Risk Act* (SARA) or by the *Nova Scotia Endangered Species Act* (NSESA) within the general vicinity of wetlands. Three bird species were identified in breeding bird surveys in the vicinity of wetlands:

- Canada Warbler – identified near Wetlands T-2, T-25, WL10, T-12; this mixed forest nester is not likely to nest within these wetlands but may occur adjacent;
- Olive-sided Flycatcher – identified near Wetland T-25, WL10 as a forest edge nester; and,
- Common Nighthawk – identified near Wetland WL11 is not likely nesting within the wetland.

Two provincially sensitive birds were identified in the vicinity of a wetland (in addition to those listed above):

- Boreal Chickadee – identified near Wetland T-12 and based on potential nesting in rotting tree stump may nest in this wetland, and,
- Gray Jay – identified near Wetland T-5. This small wetland is unlikely to provide the mature coniferous forest nesting habitat.

No significant habitats are identified specifically for the wetlands in NSDNRs Significant Habitat Database. No significant staging or rearing areas for waterfowl were identified adjacent to the ROW. Animal species present include those typical of the habitat. Although good habitat was identified for some herpetiles, habitat was not determined to be critical at a population level. The herpetile field survey notes are included in Appendix B2. Bird species associated with the wetlands are listed in the wetland assessments (Appendix B4).

9.10.2 Impact Evaluation/Effects Assessment

Wetlands potentially affected by the proposed alignment are identified and evaluated in Appendix B4. Potential effects include both direct loss of wetland area or function and indirect effects related to potential disturbances. Effects of accidents and malfunctions are considered in a separate section (Section 7.10).

Key to wetland assessments is TIR's recognition of the EC hierarchical approach to mitigation alternatives with avoidance of wetlands considered least disruptive and then minimization of impacts, and as a last resort, compensation.

The proposed Highway 113 joins the 102 bypass at a wetland – TIR investigated alignments to minimize the impact on the wetland; However, the realignment would have resulted in unacceptable short separation distances between interchanges. Of the 21 wetlands within the ROW, all will be impacted to varying degrees. Wetlands that are either within 100 m of the ROW or within 500 m and directly connected by a watercourse may also have potential for indirect disturbance effects.

9.10.2.1 Construction

The wetland evaluation (Appendix B4) shows the footprint of the project and encroachment on wetlands based on current TIR design. To compensate for unavoidable losses, compensation proposal(s) will be developed for subsequent Wetland Alteration Approvals by NSE.

The Nova Scotia Wetland Alteration Approval Application provides direction on mitigation and compensation requirements. A key guideline is that the mitigation objectives ("no net loss, no loss, enhancement of wetland functions") can be best achieved using the hierarchical sequence of mitigation alternatives – avoidance, minimization and compensation.

Indirect impacts such as fuel leaks from excavation equipment or the spread of invasive plant species will be mitigated through the project EPP. For example, equipment shall be in good working order and free of leaks. No equipment maintenance including fuelling shall be carried out within 30 m of a wetland unless adequate precautions are developed to retain drips and spills (e.g. for generators and pumps). The general mitigation measures for conducting work in and around wetlands are identified in Section 2.1.1 of the Generic EPP. Temporary disruption of drainage may occur during construction activities, but this will be short term and will be conducted during the low flow construction window for watercourses. Erosion and sediment control measures are outlined in Section 3.2 of the Generic EPP. In addition to standard EPP procedures, TIR will ensure that appropriate ESC measures are provided at locations where wetlands abut the work area. Where appropriate, site-specific environmental protection plans may be developed. Typical measures include: minimizing grubbing activities; replacement of wetland layers; winter clearing activities; use of less disruptive equipment; as well as development of measures to minimize siltation and erosion through runoff control, storm drainage management and ongoing stabilization of slopes. A description of wetland specific measures to be undertaken to protect ecological and hydrological wetland integrity and decrease impact on terrestrial habitat will be incorporated into the final TIR design and NSE applications**.** These applications will include a plan 6 or monitoring impacts and effectiveness of compensation projects.

Potential construction related interactions with wetlands and the proposed mitigation are outlined in Table 9-40.

Table 9-40 Potential Project Interactions with Wetlands (Project TOR Section 9.9) - Construction

Project Interaction	Potential Effect	Mitigative Factor and Measure
Clearing and grubbing in alignment footprint	Direct loss of wetlands (totalling approx. 8 ha depending on final design)	Compensation for loss in wetland function TIR to work with NSDNR to minimize population loss of Southern Twayblade (see At Risk Plant Section)
	Loss of bird nests, Southern Twayblade	Clearing of wetland areas during the non bird nesting season TIR to work with NSDNR to minimize population loss of Southern Twayblade (see 'Species Specific Management Plan' outlined in Section 9.8 which addresses potential interruption, alteration or destruction of wildlife corridors specifically relating to the Southern Twayblade)
	Loss of recreational hunting, trapping or berry picking sites	No significant recreational activities identified for wetland habitat in the study area (e.g., TIR public consultation Section 6.0)
	Noise disturbance in adjacent wetlands or portions of wetlands crossed	Blasting is expected to be minimal and not in wetland area
		No sensitive wildlife identified other than nesting birds
		Construction will generally not occur until after June 1, if nesting birds identified, CWS will be contacted for appropriate mitigation
Storm drainage design	Degradation of habitat due to sediment in storm water	Wetlands other than those crossed generally over 50-100 m from alignment
	Changes to wetland habitat hydrology adjacent to alignment	Maintenance of surface water paths through culvert placement to wetlands to maintain ecological and hydrological integrity
Storm water control during clearing and grubbing, sub-grade placement, structure placement, construction of access and service roads	Degradation of habitat due to sediment in storm water	As per TIR s EPP sediment and erosion control measures will be implemented in the vicinity of wetlands or downgradient wetlands
		Open water or defined drainage are not present in wetlands crossed by alignment
Introduction of invasive species	Disruption of native populations	TIR has developed an invasive species policy

9.10.2.2 Operation and Maintenance

The Generic EPP provides general mitigation for potential indirect impacts to wetlands (EPP Section 2.1.1) associated with operation/maintenance. Potential operational related interactions with wetlands and proposed mitigation are outlined in Table 9-41.

Table 9-41 Potential Project Interactions with Wetlands (Project TOR Section 9.9) – Operation/Maintenance

Project Interaction	Potential Effect	Mitigative Measure
Vegetation clearance and management	Potential impacts to downgradient habitat	Mitigation measures include the use of only mechanical clearance adjacent to wetland habitat
	Potential introduction of invasive species	TIR invasive species mitigation (EPP Section 2.1.1)
Ditch or culvert maintenance	Contribution of sediment to downgradient habitat	TIR ditch maintenance mitigation program (EPP Section 2.1.1)
	Disturbance of bird nests	If nesting birds identified, CWS will be contacted for appropriate mitigation
Ice and snow control procedures	Changes to wetland habitat water quality adjacent to alignment	Mitigation measures include the use of sand adjacent to wetland areas
Storm drainage – quality	Changes to wetland habitat water quality adjacent to alignment	Monitoring of surface water quality (TSS, pH) and TIR erosion control measures
Invasive species	Disruption of native populations	TIR has developed an invasive species policy

9.10.3 Significance

A significant adverse effect on wetlands is a change in the quality and/or quantity of the wetland habitat that would result in a net loss of wetland function in a wetland considered to provide significant value to the surrounding ecosystem as determined through the evaluation of the wetland's function. An adverse effect that does not meet the above criteria is evaluated as not significant. Table 9-42 identifies the likelihood of potential of proposed project activities to cause significant adverse environmental effects on wetlands after mitigation. Wetlands with direct impact will meet the policy of "no net loss" through provision of compensation in consultation with NSDNR, EC, and NSE. Indirect impacts are mitigated through measures outlined in Sections 2.1.1 and 3.0 of the Project EPP.

Table 9-42 Significance of Potential Effects on Wetlands (Project TOR Section 9.9)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Construction Effects						
Direct loss of wetlands	Moderate	Low	One time	Yes (with compensation plan)	Wetland function in adjacent areas to be maintained; wetland type not unique	No (with compensation plan)
Loss of bird nests, Southern Twayblade	Low	Low	One time	Yes	With work outside nesting period and Management Plan for Southern Twayblade, effects not anticipated at the population level	No
Loss of recreational hunting, trapping or berry picking sites	Low	Low	One time	Yes	Local	No
Noise disturbance in adjacent wetlands or portions of wetlands crossed	Low	Low	One time	Yes	Local	No
Operation/Maintenance Effects						
Changes to wetland habitat water quality adjacent to alignment from ice and snow control procedures, contribution of sediment, ditch/culvert maintenance, vegetation management	Low	Negligible	Several times as seasonally applicable	Yes	Local, Water quality to meet provincial/ federal guidelines, adjacent habitat to be maintained	No
Introduction of invasive species	Low	Low	Intermittent	Yes (with management plan)	Local	No (with management plan implementation)

Magnitude High-population affected; Moderate – community affected; Low – individuals affected
Extent –High-at ecosystem level; Moderate – critical habitat level; Low-local

No significant residual effects are identified for wetland VECs that cannot, or will not, be avoided/mitigated based on TIR working with NSE, DFO, NSDNR and EC staff to finalize appropriate environmental management planning. This management planning will be done on completion of detailed designs for the proposed work and submission of wetland alteration approval applications. For example, the compensation associated with wetland alteration approval applications would be considered as "*other acceptable means*" under the definition in the TOR which states that "*…those adverse effects or significant environmental effects which cannot or will not be avoided or mitigated through the application of environmental control technologies or* ***other acceptable means****"*.

9.10.3.1 Follow-up and Monitoring

Follow-up monitoring is limited to the compensation project(s) to confirm meeting of "no net loss" policy and long-term stability. Additional follow-up with respect to invasive species will be implemented as per TIR's management plan.

9.11 Fish and Fish Habitat

9.11.1 Existing Environment

Fish Habitat Assessment Methodology

Fish habitat was examined within the ROW and downstream within a potential zone of influence of the study ROW. The criteria for determining the zone of influence of the project on fish habitat depends on the watercourse characteristics. For small to moderate streams typical of the study area, potential upstream effects are expected to be limited to 50 m upstream of the footprint and downstream effects to be generally attenuated within 100 m of the ROW.

Streams were initially identified from mapping, aerial photographs and DFO data. Fish habitat assessments were conducted following DFO protocols to identify stream size, habitat character, cover and bottom composition at proposed watercourse crossings. Habitat data evaluated potential for spawning, rearing, nursery, available food supply and migration areas. Water chemistry data was collected as noted in the Surface Water Section.

Electrofishing was conducted on selected watercourses in the fall of 2008 using spot survey techniques to identify presence/absence of fish species and confirm previous EA findings. The relative distribution, abundance and composition of valued fish species were assessed. Individual's life stage and general health was noted.

Results

Fish and their habitat are protected under the federal *Fisheries Act*. Aquatic habitat, as defined by DFO's Fish Habitat Policy (1996), includes environmental components "on which fish depend, directly or indirectly, in order to carry out their life processes".

Watercourses along the ROW (listed in the Surface Water section along with known fish species), flow to the Atlantic Ocean via St. Margarets Bay, Shad Bay and the Bedford Basin (NSEL watershed IEJ – see Figure 9-4).

The study area primarily supports recreational fishing. The downstream marine environment in Bedford Basin also primarily supports recreational fishing, although limited commercial lobster fishing has occurred. The Shad Bay and St. Margaret's Bay marine environment supports commercial lobster as well as groundfish and bait fisheries. The river mouth at Shad Bay, Woodens River and Bedford Basin are closed to shellfish harvest due to bacterial contamination. The remainder of Shad Bay and St. Margaret's Bay are open to shellfish harvest.

No aquatic federal SARA or NSESA species are known for the study area. One federally COSEWIC listed species is present:

- American eel (COSEWIC, 2008; Special Concern) – expected in most permanent watercourses.

Provincially sensitive priority species identified for the study area include:

- Brook trout (NSDNR sensitive) – expected in most permanent watercourses; and
- Gaspereau (NSDNR sensitive) – although not observed during 2008, were captured in 2000 field surveys in the Fraser Lake/Maple Lake connector area. Gaspereau run up the Nine Mile River system.

The NSDNR Significant Habitat Database identifies Fraser Lake and Maple Lake system as habitat for species of concern (brook trout, gaspereau) and the Woodens River system as at risk species habitat (Atlantic salmon). Salmon were not captured in 2000 or 2008 field investigations. Anadromous smelt were historically known for the Paper Mill Lake Run. The dam at the mouth of Papermill Lake may prevent upstream movement of smelt.

Table 9-43 summarizes key features of the major crossings and implications for fish habitat and passage requirements. Appendix F provides physical and flow information for each proposed crossing and information on habitat and fish data specific to each of the watercourses is provided in Appendix B5.

Table 9-43 Summary of Major Watercourse Crossings

WC No.	Watercourse (RFP ID)/ Wetland	Habitat Character	Key Habitat within 150 m corridor	Electrofishing Results	HADD	Passage Required
1	Tributary to Sheldrake Lake	Existing Culvert	Poor adult brook trout habitat; fair eel habitat	1999 – 3 American eel 2008 – 1 American eel upstream	NA	NA
2	Tributary between Maple and Fraser Lakes	Depends on actual location; Stillwater to Riffle/Run	Poor to fair adult brook trout; poor to fair salmonid rearing; fair eel habitat	1999 – 4 brook trout, 14 American eel, 1 white sucker, 1 Gaspereau, 9 banded killifish 2008 – 10 American eel	YES	YES
3A	Fishers Brook	Riffle/ Stillwater	Fair to poor adult brook trout, eel (limited low flow access)	1999- 2 brook trout 2008 – not fished (no flow or too deep)	YES	YES
3B	Fishers Brook	Stillwater	Fair adult brook trout, eel	1999-0 2008 – not fished (too deep)	YES	YES
3C	Fishers Brook	Stillwater	Fair adult brook trout, eel	1999-0 2008 – not fished (too deep)	YES	YES
4	Stillwater Run	Stillwater (and small Riffle/Run section)	Fair adult brook trout, eel	1999-14 brook trout, 3 American eel 2008 – downstream brook trout, sucker and American eel; upstream killifish and eel; to deep to fish at crossing	YES	YES
5	Outlet of Ragged Lake	Stillwater	Fair adult brook trout, eel in Stillwater.	1999 – 3 brook trout, 5 American eel, 15 9-spine stickleback 2008 - not fished (too deep)	YES	YES

Table 9-43 Summary of Major Watercourse Crossings (cont'd)

WC No.	Watercourse (RFP ID)/ Wetland	Habitat Character	Key Habitat within 150 m corridor	Electrofishing Results	HADD	Passage Required
6	Black Duck Brook	Riffle/Flat (Dry in summer)	Limited habitat (habitat present upstream and downstream)	1999 – 0 2008 – 0 (brook trout captured upstream)	NO (if limited to dry section)	YES
7	Tributary to Kearney Run	Riffle/Flat	Limited habitat (seasonal potential for eels, minnows); intermittent upstream	1999 – 0 2008 - 0	YES (limited)	NO
8	Tributary to Papermill Lake	Stillwater	Poor adult brook trout, eel	1999 – 2 brook trout 2008 - 0	YES	YES

*brook trout -DNR yellow species, **American eel - COSEWIC Special Concern Species

Ten watercourse crossings were identified as having fish habitat, although Black Duck Brook and the tributary to Kearney Lake likely provide seasonal habitat at best. Generally, habitat was fair and reflects underlying low nutrient bedrock. Low populations of brook trout were present in most streams with habitat. Spawning habitat was generally limited at the crossing areas. Minnows, suckers and perch were identified in addition and may occur in other watercourses.

9.11.2 Impact Evaluation/Effects Assessment

DFO's guiding principle when considering impacts to fish habitat is "No Net Loss" to preserve habitat and productivity. In order to satisfy the "No Net Loss" guiding principle, the habitat manager's first priority is to avoid or reduce the project's potential for Harmful Alteration, Disruption or Destruction (HADD) of habitat through routing and appropriate mitigation measures. If a HADD is still expected to occur and is justified, authorization is typically granted if appropriate compensation is available.

Potential effects to fish and fish habitat include both direct loss of habitat at the crossing location and indirect effects related to potential disturbances downstream of the crossing, particularly related to surface water quality. TIR has developed standard Environmental Protection procedures which target minimizing effects of potential surface water contaminants such as suspended sediments and winter maintenance runoff as well as following DFO guidelines for fish passage requirements in crossing structures. These procedures form the basis for mitigation of downstream impacts. TIR follows DFO's hierarchical approach in attempting to avoid in-stream work where practical through structure design and construction options. Where fish habitat loss is unavoidable, TIR will work through the HADD process to appropriately compensate for habitat loss. Effects of accidents and malfunctions have been previously described in Section 7.10

9.11.2.1 Construction

The principal interactions between Project activities and fish habitat are associated with the construction phase of the Project and include:

- the habitat loss at the watercourse crossing locations as a result of culvert installations in the streambed;
- fish mortality associated with infrastructure installation at the watercourse crossings;
- earthworks, such as grubbing and stripping topsoil/overburden resulting in modified habitat due to shade loss, decreased slope stability and increased sedimentation and erosion into surface waters; and,
- the placement of excess material in stockpiles leading to increased erosion and sedimentation of waterbodies.

Erosion and siltation of fish habitat can adversely affect fish directly, or cause a degradation of habitat. These effects can be caused directly during crossing and disturbance of stream banks and substrate, or indirectly during adjacent work where soils or vegetation may be disturbed. Blasting, if required near stream crossings, can also harm fish and habitat. Blasting near stream crossings, if required, will be conducted according to Guidelines for use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky, 1998). Stream-crossings required by the Project will be subject to follow-up habitat assessments. A provincial Watercourse Alteration Approval (under the Environment Act) will be required as well as an Authorization under Section 35(2) of the Fisheries Act for the harmful alteration, disruption, destruction (HADD) of fish habitat pursuant to DFO's No Net Loss Policy. Stream crossings will be conducted according to all other applicable guidelines (e.g., maintaining water flow, fish passage, and implementing erosion control).Potential construction related interactions with fish habitat and proposed mitigation are outlined in Table 9-44.

Table 9-44 Potential Project Interactions with Fish Habitat (Project TOR Section 9.10) - Construction

Project Interaction	Potential Effect	Mitigative Factor and Measure
Structure installation immediately adjacent to watercourses	Direct loss of fish habitat	Compensation to meet "no net loss" and monitoring of compensation effectiveness
	Potential for fish stranding or mortality during construction	Fish rescue during culvert construction
Clearing and grubbing, sub-grade placement, construction of access and service roads in alignment footprint up gradient of watercourses	Sediment effects such as abrasion of eyes and gill surfaces, inability to find food organisms, feed or find cover, exposure to predation	Timing of works in and adjacent to watercourses within designated the designated low flow construction windows to avoid sensitive periods for fish migration or spawning
	Degradation of habitat (water quality) due to sediment, acid rock drainage, or other contaminants both at the crossing and downgradient	Blasting is anticipated. If blasting is required near watercourses (not anticipated as watercourse crossings will primarily be in areas of fill.) DFO Blasting Guideline will be followed Acid bedrock is not anticipated – If exposed bedrock shows iron staining (indicating possible dispersed iron pyrites) the rock will be tested for net acid generation and appropriate measures will be taken for removal and disposal of the bedrock removed.
	Sediment deposition may alter fish habitat by affecting spawning beds (fill the interstitial spaces in spawning gravel, reducing subsurface oxygen flow and negatively affecting egg development), rearing habitat, winter or summer refuge (infilling of deep pools used during summer for refuge from warmer water or in winter from ice) or by affecting food species (reducing the amount of invertebrate species in substrate)	Soils present are not highly erodible however on the steep slopes associated with the ravines the use of common material covered with rock will be used to minimize erosion potential

Table 9-44 Potential Project Interactions with Fish Habitat (Project TOR Section 9.10) – Construction (cont.)

Project Interaction	Potential Effect	Mitigative Factor and Measure
		Sediment and Erosion Control implementation and monitoring as outlined in the Surface Water section including: • Measures in-place prior to construction activity • Minimize time soils exposed Clearing to be restricted to construction area and minimal work space • Daily work area stabilization • Use of clean rock for riprap/armour stone/backfill Contingency for predicted and unpredicted storm events: • No equipment in watercourse unless "in the dry" • Stabilized inlets and outlets • No fording Construction monitoring
Crossing structure design	Potential for barriers to fish passage	Use of clear span structures over fish habitat where practical. Meeting requirements for fish passage (DFO guidelines)
	Potential for loss of riparian habitat within the footprint	Restoration of riparian habitat and provision of culvert pools as required
Storm water control during clearing and grubbing, sub-grade placement, construction of access and service roads	Sediment effects and degradation of habitat (water quality) due to sediment or other contaminants	Timing of works in and adjacent to watercourses within designated t low flow construction windows to avoid sensitive periods for fish migration or spawning

Indirect impacts are mitigated through the project EPP. General mitigation for watercourse crossing is identified in EPP Section 2.1. Erosion and sediment control measures are outlined in Section 3.2 of the EPP. The EPP details proper design and implementation, including monitoring of erosion and sediment control measures required to mitigate potential sediment impacts.

Table 9-45 identifies the watercourses where fish habitat loss is predicted based on current TIR design (footprint width x average stream width). This assessment is based on TIR s preliminary design and ultimate fish habitat protection will be based on TIR s final design and commitment to compensation appropriate to the rules in place when the highway is constructed. Avoidance is not possible at these locations. Where possible TIR has redesigned its planned crossing methods to minimize habitat loss**.** Because of these unavoidable habitat losses, on confirmation from DFO that applications under the Section 35 (2) of the *Fisheries Act* will be required as the work will likely result in harmful alteration, disruption or destruction (HADD) of fish habitat, compensation proposals will be developed in consultation with DFO.

Table 9-45 Project Footprints on Watercourses and Required Compensation

No	Watercourse	Project Activity	Estimated Maximum Footprint (m^2)	Estimated Required Compensation (m^2) {Assuming 3 to 1}
1	Tributary to Sheldrake Lake	culvert already constructed	NA	NA
2	Tributary between Maple and Fraser Lakes	bridge construction – expected to be clear span	NA	NA
3A	Fishers Brook	culvert construction	80 m by 7 m - 560	1680
3B	Fishers Brook	culvert construction	60 m by 6 m - 360	1080
3C	Fishers Brook	culvert construction	65 m by 10 m - 650	1950
4	Stillwater Run	culvert construction	90 m by 6 m - 540	1620
5	Outlet of Ragged Lake	culvert construction	100 m by 9 m - 900	2700
6	Black Duck Brook	bridge construction - expected to be clear span	NA	NA
7	Tributary to Kearney Run	culvert construction	70 m by 5 m - 350	1050
8	Tributary to Paper Mill Lake	culvert construction	500 m by 30 m - 15000	45000
	TOTAL		18360	55080

9.11.2.2 Operation and Maintenance

The principal interaction between the Project and fish habitat quality, beyond the construction phase and commissioning, is stormwater disposal throughout the operation of the drainage ditches. Ditching and culverts will be designed to manage surface drainage, based on the drainage within the watershed. These will be designed to carry flows to the natural drainage network. A Stormwater Management Plan will be developed to prevent sediment-laden runoff from the Highway from entering streams. This plan will be designed to meet provincial requirements for surface runoff quality. Standard mitigation measures will be applied to minimize operation-related environmental effects on freshwater habitat in the Project area. Potential operational related interactions with fish habitat and proposed mitigation are outlined in Table 9-46.

Table 9-46 Potential Project Interactions with Fish Habitat (Project TOR Section 9.10) - Operation/Maintenance

Project Interaction	Potential Effect	Mitigative Factor and Measure
Vegetation clearance and management immediately adjacent to watercourses	Potential impacts to downgradient habitat	Use of mechanical clearance only adjacent to fish habitat
Ditch or culvert maintenance immediately adjacent to watercourses	Contribution of sediment to downgradient habitat	TIR ditch maintenance mitigation program (EPP Section 2.1.2 and 3.0)

The Project EPP provides general mitigation for potential indirect impacts to fish habitat (EPP Section 2.1.2) associated with operation/maintenance.

9.11.3 Significance

A significant adverse effect for fish habitat is one that affects this VEC such that the CCME Guidelines for the Protection of Freshwater Aquatic Life are exceeded, or impacts of the project contravene section 36(3) of the Federal *Fisheries Act* or provisions of the Environment Act. A significant adverse effect is one that affects freshwater fish and fish habitat physically, chemically, or biologically, in quality or extent, to such a degree that there is a decline in the species diversity of the habitat. Such an effect would be reflected by a decline in abundance and/or change in distribution of one or more populations of species dependent upon that habitat. Natural recruitment would not return the population(s), or any populations or species dependent upon the habitat, to their former level within several generations. Table 9-47 identifies the likelihood of proposed project activities to cause significant adverse environmental effects to fish habitat after mitigation. Watercourses with direct impact will meet the policy of "no net loss" through provision of compensation in consultation with DFO. With mitigation, the effect of

Table 9-47 Significance of Potential Effects on Fish Habitat (Project TOR Section 9.10)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Construction Effects						
Direct loss of fish habitat	Moderate	Low	One time (or twice if lanes expanded in future)	Yes (with compensation plan)	Watercourse fish habitat not unique in area	No (with compensation plan)
Potential for fish stranding or mortality during construction	Low	Low	One time (or twice if lanes expanded in future)	Yes	Watercourse fish habitat not unique in area	No
Barriers to fish habitat	Low	Low	One time (or twice if lanes expanded in future)	Yes	Structure to maintain habitat and/or passage	No
Storm water control during clearing and grubbing, sub-grade placement, construction of access and service roads	Low	Low	One time (or twice if lanes expanded in future)	Yes	Water quality to meet provincial/ federal guidelines	No
Degradation of habitat (water quality) due to sediment. No acid rock drainage, or other contaminants.	Low	Low	One time (or twice if lanes expanded in future)	Yes	Water quality to meet provincial/ federal guidelines	No
Operation/Maintenance Effects						
Impacts to downstream habitat from vegetation clearance and management immediately adjacent to watercourses (sedimentation, destabilization of riparian habitat)	Negligible	Negligible	Seasonally	Yes	Adjacent riparian habitat to be maintained	No
Sedimentation of downstream habitat from ditch or culvert maintenance immediately adjacent to watercourses	Low	Negligible	Less than once a year	Yes	Water quality to meet provincial/ federal guidelines	No

Magnitude High-population affected; moderate – community affected; Low – individuals affected
Extent –High-at ecosystem level; Moderate – critical habitat level; Low-local

erosion and sedimentation on fish and fish habitat is considered not significant. Other indirect impacts are mitigated through measures outlined in Sections 2.1.2, 2.7 and 3.2 of the Project EPP. No significant residual effects are identified for fish VECs that cannot or will not be avoided/ mitigated based on TIR meeting DFOs requirement for "no net loss" of fish habitat through the HADD approval process. For example, the compensation associated with fish habitat compensation would be considered as "*other acceptable means*" under the definition in the TOR which states that "*…those adverse effects or significant environmental effects which cannot or will not be avoided or mitigated through the application of environmental control technologies or* ***other acceptable means****"*.

9.11.3.1 Follow-up and Monitoring

Follow-up monitoring of water quality will include construction inspection and monitoring during construction as noted in Section 7.0 and in the EPP In addition, monitoring will be conducted in relation to compensation projects to confirm meeting of "no net loss" (to be detailed in the HADD application).

9.12 Bedrock and Surficial Geology

9.12.1 Existing Environment

9.12.1.1 Bedrock Geology

The majority of the proposed Highway 113 study area is underlain by granites of the South Mountain Batholith, while the easternmost section is underlain by Goldenville Formation bedrock. The following is a more detailed discussion regarding these rock types in order of age (oldest to youngest) and the method of emplacement, as well as comments on land use and potential for acid rock drainage.

Meguma Group – Goldenville Formation - The Cambro-Ordovician Goldenville Formation is part of the Meguma Group and is comprised of greenish-grey metagreywacke bedrock (quartzite) with minor interbedded slates. It is present in the eastern portion of the study area (Highway 102 to the west side of Kearney Lake Road).

South Mountain Batholith - The Devono-Carboniferous South Mountain Batholith (SMB) granites are massive and extend from Halifax to the South Mountain of the Annapolis Valley and comprise the majority of inland Nova Scotia bedrock from Halifax to Yarmouth counties. The granites are subdivided, based on mafic mineral content (e.g., biotite), into the following units:

- Leucomonzogranite – buff orange, fine- to medium-grained equigranular to porphyritic two-mica (biotite, muscovite) leucomonzogranite. This unit displays the most variability in colour, grain size, texture and mineralogy.
- Monzogranite – light to medium grey, medium- to coarse-grained and megacrystic. Biotite is dominant, constituting 10-12% of the rock.
- Granodiorite – medium-grained and equigranular with less than 5% alkali feldspar megacrysts. Biotite content approaches 15% and muscovite is present in trace amounts only.
- Mafic Porphyry – medium- to dark-brown or grey rock with porphyritic texture. Biotite content usually exceeds 15%.

In the area of proposed Highway 113 (from east to west), the following units outcrop: Granodiorite, Sandy Lake Monzogranite, and Halifax Peninsula Leucomonzogranite. Also, to the south of Ragged Lake, a small area of Tantallon Leucomonzogranite outcrops. The most prominent granite in the study area is the Halifax Peninsula Leucomonzogranite, which underlies the central and western portions of the study area (from Ragged Lake to Hubley).

9.12.1.2 Relationship between Goldenville Formation and SMB

According to geological mapping by N.S. Dept. of Mines and Energy (MacDonald and Horne, 1987), the contact between the Goldenville Formation and the SMB (in the eastern part of the study area) is marked by the Transverse Anticline and Transverse Syncline. Outside of the study area, no deformation of the country rocks is observed and the granite/metasediment contact is sharp and discordant. Thermal (contact) metamorphism, however, has occurred at all locations along the granite/metasediment contact.

The Transverse Anticline and Transverse Syncline are approximately 3.5 km in length, parallel to the granite/metasediment contact, and are perpendicular to regional structures arising from the regional Acadian deformation, whereas, the SMB granites show no sign of the Acadian orogeny (mountain building). Therefore, in addition to thermal metamorphism arising from emplacement of the SMB, structural deformation has occurred in the eastern part of the study area, west of Kearney Lake Road (MacDonald and Horne, 1987).

The proposed highway is located within remote/wilderness areas. There are no mines, pits or quarries shown within the study area (MacDonald and Horne, 1987). Bedrock types with the highest potential for acid rock drainage (ARD) are those that contain sulphide bearing material (e.g., pyrite). Near Halifax, ARD is typically associated with Meguma Group Halifax Formation bedrock, which contains arsenopyrite. Therefore, the potential for ARD within the proposed Highway 113 study area is low. Figure 9-9 illustrates bedrock geology within the Project area.

9.12.1.3 Surficial Geology

According to Pleistocene geology mapping (Stea and Hemworth, 1978), bedrock is overlain by quartzite till in the east and by granite till in the west. Both are classified as sandy tills with a matrix of 80% sand, 15% silt and 5% clay. The quartzite till is light bluish grey, loose, with angular clasts (largely cobble sized) and a siltier matrix in metamorphosed terrain. The granite till is greyish orange to yellowish brown, loose, with angular (cobble sized) clasts. In general, topography is controlled by bedrock and till thickness ranges from 1 to 10 m (average of 3 m).

9.12.1.4 Soils

Information regarding soils has been derived from Soils of Halifax County mapping (MacDougall and Cann, 1963). Soil types present in the study area include:

- **Halifax Series** – Brown sandy loam over yellowish loam; parent material derived mainly from quartzite. Topography is gently undulating to gently rolling with good to excessive drainage.
- **Gibraltar Series** – Brown sandy loam over strong-brown sandy loam; parent material derived from granite. Topography is gently undulating to gently rolling with good to excessive drainage.
- **Peat** – Brown, 12 inches or more of semi-decomposed fibrous material over dark-brown fibrous material, chiefly sphagnum. Topography is level to depressional with poor drainage.

Figure 9-9 Bedrock Geology

- **Rockland** – areas where at least 60 percent of the land is exposed bedrock or the till is extremely stony. Topography and drainage are variable.

Both the Halifax and Gibraltar Series have developed from moderately coarse-textured parent materials. Gibraltar profiles are shallow, usually 20 inches or less in thickness (MacDougall and Cann, 1963).

The major soil type in the study area is the Gibraltar Series, which is found west of Ragged Lake to Hubley. Small areas of peat are located east of Fraser Lake. Most of the area between Highway 102 and Ragged Lake is rockland, with the Halifax Series located northwest of Kearney Lake and east of Lewis Lake. Figure 9-10 illustrates surficial geology within the Project area.

9.12.2 Impact Evaluation/Effects Assessment

Acid rock drainage is the result of exposure of sulphide rich rocks to oxidizing environments such as rainwater. Earthwork activities around these sulphide rich rocks can increase the rock's exposure and thus the acid generation potential. Not all sulphide-containing rocks end up producing acid drainage. In many cases, rocks contain enough carbonate minerals to buffer the sulphide effect, and in these instances acid rock drainage is not produced. In Nova Scotia, acid rock drainage is most commonly associated with slate from the Halifax Formation of the Meguma Group and coal bearing shales. As noted in Section 9.12.1.1, bedrock underlying the proposed corridor belongs to the Goldenville Formation of the Meguma Group and the South Mountain Batholith granite units. Goldenville Formation bedrock is unlikely to result in acid rock drainage like the Halifax Formation rocks.

The predominant soil units (Halifax and Gibraltar Series) are both sandy loam soils, which are less likely to be subject to erosion than silty clay soils due to their drainage properties. Table 9-48 identifies potential project interactions and mitigation related to bedrock and surficial geology of the study area.

Figure 9-10 Surficial Geology

Table 9-48 Potential Project Interactions with Bedrock and Surficial Geology (Project TOR Section 9.11)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Construction Activities		
Clearing and grubbing in alignment footprint	Potential ARD within local bedrock types. Local bedrock types with the highest potential for AMD are those that contain sulphide bearing material	Near Halifax ARD is generally associated with the Meguma Group Halifax Formation bedrock which contains arsenopyrite. Bedrock in the project area belongs to the Goldenville Formation, which is unlikely to result in ARD.
	Erodibility of soils based on surficial geology.	Soil types in the project area not considered highly erodible. Effects will be prevented or will be mitigated in accordance with the appropriate guidelines documented in the Environmental Protection Plan.
Aesthetic disturbance during construction activities	Protection of natural geologic features, including natural landmarks and look-offs, and scenic vistas, with particular reference to the Blue Mountain Hill	TIR will work with its contractors to minimise the amount and extent of the aesthetic disturbance wherever possible
Operation/Maintenance Activities		
Maintenance activities	Potential adverse affects on bedrock, surficial geology or soils, most likely from maintenance activities involving ground disturbance	Operation activities are not expected to adversely affect bedrock, surficial geology or soils
Aesthetic disturbance during construction activities	Protection of natural geologic features, including natural landmarks and look-offs, and scenic vistas, with particular reference to the Blue Mountain Hill	TIR will work NSE to minimise the amount and extent of the aesthetic disturbance wherever possible NSE chose the location of the Blue Mountain Birch Cove Lakes Wilderness Area based on studies which have confirmed that scenic vistas are optimized with limited views of downtown Halifax. TIR will work with NSE to maintain this by the use of forested buffers

9.12.3 Significance

A significant adverse effect on bedrock and surficial geology is one that affects this VEC such that the quality of adjacent habitats (terrestrial or aquatic) are degraded, and wildlife species using those habitats are affected to such a degree that there is a decline in the species diversity of the habitat. Such an effect would be reflected by a decline in abundance and/or change in distribution of one or more populations of species dependent upon that habitat. Natural recruitment would not return the population(s), or any populations or species dependent upon the habitat, to their former level within several generations. An adverse effect that does not meet these criteria is not considered significant. Table 9-49 identifies the likelihood of proposed project activities to cause significant adverse environmental effects to bedrock and surficial geology after mitigation.

Provided the recommended mitigative measures are implemented, it is not anticipated that the project will result in significant adverse residual environmental effects on bedrock, surficial geology or soils. There are no expected residual effects on geology, particularly acid rock drainage as acid producing rock is not found within the project area. In the unlikely event that acid producing rock is discovered through geotechnical investigations these can be mitigated through appropriate techniques.

9.12.4 Follow-up and Monitoring

Follow-up monitoring of storm water quality in the vicinity of the highway may be required dependent on the presence of sulphide-bearing rock. This is considered unlikely given the local geology. Soil stabilization practices and erosion control measures will be monitored and maintained until slopes have stabilized.

9.13 Historical, Archaeological, Paleontological and Architectural Resources

9.13.1 Existing Environment

The archaeological assessment was conducted by Cultural Resource Management (CRM) Group archaeologists and was used to evaluate archaeological potential within the proposed construction limits. The assessment involved both background research and field investigations (see Appendix C).

Table 9-49 Significance of Potential Effects on Bedrock and Surficial Geology (Project TOR Section 9.11)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Construction Effects						
Erodibility of soils based on , surficial geology. local bedrock types	Low-Negligible	Low-Negligible	One time	No	Local Underlying soils not considered highly erodible	No
Potential disruption of net acid producing bedrock	Low-Negligible	Low-Negligible	One time	No	Local Low probability to encounter sulphide-bearing rock	No
Alteration to natural geologic features, including natural landmarks and look-offs, and scenic vistas, with particular reference to the Blue Mountain Hill	Moderate	Moderate - Low	One time	No	Adjacent land to be maintained; Construction landscaping will be new and will require several years to become established	No
Operation/Maintenance Effects						
Potential adverse affects on bedrock, surficial geology or soils, most likely from maintenance activities involving ground disturbance	Low-Negligible	Low-Negligible	Continuous	No	Adjacent land to be maintained	No
Alteration to natural geologic features, including natural landmarks and look-offs, and scenic vistas	Moderate	Moderate - Low	Continuous	No	Adjacent land to be maintained and road side landscaping will have become established	No

The 2009 archaeological assessment was intended to re-evaluate the results of an earlier archaeological assessment, conducted in 1999 (Washburn and Gillis, 2000). The 2009 archaeological assessment fieldwork was undertaken in April and May of 2009. The fieldwork was conducted according to the terms of Heritage Research Permit A2009NS19 (Category "C") issued to Mike Sanders by the Special Places Program – Heritage Division (SPP-HD).

The background research component of the 2009 archaeological assessment was designed to investigate the land use history of the study area and its immediate environs. It involved a review of the 1999 archaeological assessment (Washburn and Gillis, 2000) and examination of historical records available at Nova Scotia Archives and Records Management and the Nova Scotia Land Information Centre. The documents examined included legal survey records, census records and historic maps, as well as local and regional histories. Despite the size and geographic complexity of the study area, the historic research provided the cursory overview necessary to identify the reported locations of known archaeological sites, burial grounds and historic roads and buildings. This information, when combined with environmental data from modern topographic maps and air photos, was used to delineate archaeological potential (high or low) across the study area.

Archaeological reconnaissance of the Highway 113 ROW was undertaken between April 20 and 28, 2009. The team walked the TIR ROW, examining ground conditions to further evaluate and delineate areas of high and low archaeological potential. Areas of high archaeological potential were identified on the basis of exposed archaeological features, signs of historic land use (e.g. levelled ground, anomalous mounds or depressions, structural features, artifact exposures, vestige populations of domestic plants) and the presence of environmental conditions recognized as being conducive to past settlement - relatively flat, dry land close to transportation routes such as watercourses or early roads. The reconnaissance was undertaken soon after the spring snow melt and before the emergence of spring foliage. This timing facilitated ground surface inspection and GPS positioning.

Following reconnaissance, confirmed areas of high archaeological potential were subjected to systematic sub-surface testing (shovel testing), which was designed to locate and identify archaeological resources. All field activities during the reconnaissance and testing were recorded in the form of field notes, photographs and site plans. Detailed methodology is provided in the archaeological assessment report in Appendix C.

According to the Washburn and Gillis (2000) EA report an extensive literature review and field program was undertaken to characterize actual and potential human heritage and archaeological resources along the proposed highway alignment. This involved a pre-field determination of areas of high potential based on predictive modelling and background research, followed by a walk-through and surface reconnaissance of the ROW for a distance of 50 m on both sides of the proposed centreline. Judgmental shovel testing of high potential areas had been anticipated, although no sections within the proposed route warranted such investigation, due to the shallow soil deposits and exposed bedrock. Background research was conducted prior to fieldwork to identify recorded sites within the study area. Archival and museum databases were consulted. A number of individuals were contacted based on their knowledge and heritage interest in the study area. These included Museum personnel, Government officials, historical society members, and Native contacts. Due to the extent of the study area and limited available information on heritage resources, predictive modelling was used to identify areas of elevated potential. The modelling criteria adapted from Cox (1989), is based on historical, cultural, and environmental factors frequently associated with the occurrence of heritage sites.

Using 1:50,000 mapping as a working base, the 9.9 km long corridor was divided into 500 m long sections (Washburn and Gillis, 2000). Weighted criteria, based on the cultural and environmental data outlined above, were applied to each section. Then the 500 m sections were ranked according to resulting scores. The proposed route passes in the vicinity of several lake systems, which increases the potential for archaeological resources. The rocky nature of the shorelines is not typical of encampments or canoe landing areas. However, the lakes and streams in the area of the proposed alignment provide sources of fish, especially the thoroughfare between Frasers and Maple lakes and may have offered food resources to pre-Contact groups. Points of high elevation such as the Blue Mountain Hill area would have provided a vantage point (look off) for sighting large game within the surrounding areas including several of the major lakes.

The following presents the results of the archaeological assessment conducted from September 10 to September 14, 1999, under Heritage Research Permit A1999NS43 (Washburn and Gillis, 2000). The Nova Scotia Museum reported that although there are no known pre-Contact sites within the proposed corridor, a recorded Susquehanna Period (BeCw-1, ca. 4000 years before present BP) grooved axe was found in a stream bed in Bedford 10 km northeast of the study area.

The discovery of the Bedford Barrens petroglyphs (BeCw-2), 3 km northeast of the study area, suggests similar sites could be present on exposed bedrock outcrops (David Christianson, NS Museum, personal communication, 1999).

On A. F. Church's 1865 map of the area, a paper mill (BeCw-3, c.1818) was located near Paper Mill Lake to the east of the corridor (Washburn and Gillis, 2000). Moss covered cut stumps indicative of timber harvesting were found throughout the study area. No sections of the proposed route showed evidence of land alteration from previous agricultural activity. Shallow soil development, wetlands, and uneven terrain would have rendered the area undesirable for crop farming. The predictive model identified four areas as having elevated potential for heritage resources, including:

- 500 m section south of Upper Sheldrake lakes;
- 1 km section between Maple Lake and Frasers Lake;
- 1 km section along the northern slope of Blue Mountain Hill; and
- 500 m section northeast of Ragged Lake.

Three archaeologists conducted a surface reconnaissance and walk through of the TIR proposed alignment. Focussing upon the centre line and expanding the survey at points of high potential (streams, lake shores and vantage points), the three crew members were spaced at 25 m to 35 m abreast, covering an area 75 m to 105 m in width. Exposed rock faces were examined for the possible location of petroglyphs or lithic raw material source. Sections of lake shorelines (Upper Sheldrake, Maple, Frasers and Ragged), which occurred less than 300 m from the presumed centre line of the alignment, were surveyed.

9.13.2 Impact Evaluation/Effects Assessment

No artefacts were observed during the heritage resource assessment (Washburn and Gillis, 2000). Based on a surficial investigation, the study area was evaluated as being of low potential for heritage resources. No potential impact to heritage resources was identified during the surficial survey of the study area. The slope of Blue Mountain Hill, however, possess elevated potential for pre-contact resources because of the vantage (view) provided of the lakes and surrounding areas. Although the surficial examination of area did not identify suitable locations for testing (bedrock with very little soil development) there remains potential for impact on potential hunting or camp sites on isolated ridges or terraces on the hill slope. The poor soil development over bedrock prevented adequate shovel testing in areas deemed as high potential. The exposed bedrock and rocky nature of the terrain is rarely associated with cultural activity. The archaeological assessment and background historical research did not identify any heritage resource, archaeological or national historic sites, old burial grounds/cemeteries, heritage rivers or fossils within the study area. In general, the area was evaluated as having too low potential for heritage resources. Certain areas, however, may have been used as vantage or "lookout" points (Blue Mountain Hill) or travel routes (thoroughfare between Maple Lake and Frasers Lake).

Based on the background research component of the 2009 archaeological assessment by Cultural Resources Management Group the following areas were ascribed high archaeological potential: the shoreline of Upper Sheldrake Lake; and, areas along Maple Run and Black Duck Brook. The northern slope of Blue Mountain Hill, an area of higher elevation, was ascribed high archaeological potential (Appendix C). The remainder of the study area was also ascribed diminished potential for encountering Pre-contact and/or early historic archaeological resources.

Based on the 2009 Native land use study and the absence of registered Pre-contact archaeological sites within the immediate vicinity of the study area, it was determined that there was low potential for encountering Pre-contact archaeological resources within the study area, except for those areas of high potential previously noted.

Based on the property history, segments of the Highway 113 ROW adjacent to historic road alignments were ascribed high archaeological potential. These segments included areas adjacent to St. Margarets Bay Road and Kearney Lake Road. It also included areas adjacent to early roads located during the course of fieldwork, such as the original alignment of the Lunenburg Road west of Maple Run or the original alignment of the Annapolis Road in the vicinity of the Black Duck Brook valley. The remainder of the Highway 113 study area was ascribed low potential for encountering historic archaeological resources.

Based on the various components of the background study, including environmental setting, Native land use and property history, eight specific locations within the Highway 113 study area were ascribed high potential for encountering Pre-contact and/or historic archaeological resources. These included the section of the Upper Sheldrake Lake shoreline and areas along Maple Lake Run and Black Duck Brook. The northern slope of Blue Mountain was also ascribed high potential due to the possible vantage point it could have provided. Areas proximal to St. Margaret's Bay Road (now Trunk 3) and Kearney Lake Road were ascribed high potential for encountering historic archaeological resources, as were areas proximal to the early roads located during the course of fieldwork, such as the original alignment of the Lunenburg Road west of Maple Run or the original alignment of the Annapolis Road in the vicinity of the Black Duck Brook valley. The remainder of the study area was ascribed low potential for encountering Pre-contact and/or early historic archaeological resources.

The 2009 archaeological reconnaissance confirmed the existence of four localized areas of high archaeological potential within the proposed Highway 113 ROW, each of which was previously identified as an area of concern on the basis of background research. Although shovel testing was undertaken within each of the four areas, no archaeological resources were identified. The reconnaissance within the ROW also identified historic road segments that probably represent the original alignment of the Lunenburg Road and the original alignment of the Annapolis Road which were two roads leading out of Halifax that were established during the eighteenth century. The road segments did not require archaeological testing or registration as archaeological sites, but did warrant interpretation and documentation.

Based on the results of 2009 archaeological reconnaissance, the remainder of the ROW was ascribed low archaeological potential. This includes several areas that had previously been ascribed high archaeological potential on the basis of background research.

Table 9-50 identifies potential project interactions and mitigation related to historical, archaeological, paleontological and architectural resources in the study area.

Table 9-50 Potential Project Interactions with Historical, Archaeological, Paleontological and Architectural Resources (Project TOR Section 9.12)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Construction Activities		
Clearing and grubbing, other earthworks in the alignment footprint	Accidental disruption/destruction of archaeological resources	In general, the area was evaluated as having too low potential for heritage resources (see Appendix C, Archaeological Impact Assessment). It is recommended that signs be posted to mark the suspected original alignments of the Lunenburg Road and the Annapolis Road at the points where they are crossed by Highway 113 (Appendix C, Archaeological Impact Assessment). The slopes of Blue Mountain Hill possess elevated potential for pre-contact resource because of the vantage (view) provided of the lakes and surrounding areas although the surficial examination of area did not identify suitable locations for testing (bedrock with very little soil development). There remains potential for impact on potential hunting or camp sites on isolated ridges or terraces on the hill slope
	High archaeological potential: the shoreline of Upper Sheldrake Lake; and, areas along Maple Run and Black Duck Brook. The northern slope of Blue Mountain Hill, an area of higher elevation, was ascribed high archaeological potential	The mitigation measures in the event that any archaeological resources or human remains are encountered during construction or other ground disturbance within the Highway 113 construction area, would be that all work in the associated areas(s) should be halted and immediate contact should be made with the Manager of Special Places (Robert Ogilvie: 424-6475) (Appendix C, Archaeological Impact Assessment). TIR will work closely with the Manager of Special Places to decide what mitigation measures would be required to preserve, protect, or recover any features of socio-economic, cultural, archaeological or paleontological value that are identified in the proposed highway corridor.

Table 9-50 Potential Project Interactions with Historical, Archaeological, Paleontological and Architectural Resources (Project TOR Section 9.12) (cont.)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Operation/Maintenance Activities		
Operation and maintenance vehicle activities	Potential impacts to shoulder and off shoulder sections of the highway during maintenance operations (e.g. tree and shrub cutting)	In the event that any archaeological resources or human remains are encountered during operation or maintenance, all work in the associated areas(s) should be halted and immediate contact should be made with the Manager of Special Places (Robert Ogilvie: 424-6475) (Appendix C, Archaeological Impact Assessment). TIR will work closely with the Manager of Special Places to decide what mitigation measures would be required to preserve, protect, or recover any features of socio-economic, cultural, archaeological or paleontological value that are identified in the proposed highway corridor.

9.13.3 Significance

Table 9-51 identifies the likelihood of proposed project activities to cause significant adverse environmental effects to historical, archaeological, paleontological and architectural resources after mitigation. Based on the results of 2009 archaeological reconnaissance, the ROW was ascribed low archaeological potential. This includes several areas that had previously been ascribed high archaeological potential on the basis of previous background research.

Provided that the proposed mitigation measures are implemented, no significant residual environmental effects on historical, archaeological, paleontological and architectural resources are likely to occur.

Table 9-51 Significance of Potential Effects on Historical, Archaeological, Paleontological and Architectural Resources (Project TOR Section 9.12)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Construction Effects						
Disturbance to resources from clearing and grubbing and other earthworks in alignment footprint	Moderate	Moderate - Low	One time	No	Local - Project ROW has overall low potential for archaeological resources	No (with implementation of contingency plan to contact Robert Ogilvie, Manager of Special Places in the event of any discoveries)
Operation/Maintenance Effects						
Potential impacts to shoulder and off shoulder sections of the highway during maintenance operations (e.g. tree and shrub cutting)	Low	Low	Continuous for operation and less than once a year for maintenance	No	Local - Project ROW has overall low potential for archaeological resources	No (with implementation of contingency plan to contact Robert Ogilvie, Manager of Special Places in the event of any discoveries)

9.13.4 Follow-up and Monitoring

Given that Pre-contact burials have previously been found at high points and esker-like ridges along waterways elsewhere in Nova Scotia, it is recommended that any ground impacts in the area of the narrow ridge on the western side of Maple Lake Run be monitored by an archaeologist.

The remainder of the proposed Highway 113 ROW as described and illustrated in this report be cleared of any requirement for future archaeological investigation. The suspected original alignments of the Lunenburg Road and the Annapolis Road at the points where they are crossed by Highway 113 should be marked by appropriate signage.

Any expansion of the impact zone beyond the study area described should be addressed by archaeological assessment prior to ground disturbance. This includes impact areas for access roads, alignment changes, borrow material excavation and staging areas.

In the event that any archaeological resources or human remains are encountered during construction or other ground disturbance anywhere within the proposed Highway 113 construction area, all work in the associated area(s) would be halted and immediate contact should be made with the Manager of Special Places (Robert Ogilvie: 424-6475).

9.14 Impacts of the Environment on the Project

9.14.1 Projected Climate Change Impacts for the Study Area

The overall regional trend for temperature in Atlantic Canada is an increase of 0.3^{o} C between 1948 and 2005; however, there are seasonal differences in the data. For example summers have increased in temperature 0.8^{o} C while winters have decreased in temperature by 1.0^{o} C. The findings of Lines et al. (2003) and (2005) show that based on climate change modeling average annual temperatures in the Kentville area are expected to increase with minimum annual temperatures increasing by 4.0^{o} C and maximum annual temperatures increasing by 5.3^{o} C. An increase in winter temperatures raises the potential for precipitation to fall as rain or freezing rain but this potential has not been quantified.

Between 1948 and 1995, precipitation in Atlantic Canada has increased by 10%, however, several studies have noted that there is a large degree of variation across the region (Vasseur and Catto, 2008). Based on Lines et al. (2005), the trend of increasing precipitation is expected to continue with increases of 15% by 2020, a further 11% by 2050 and another 15% by 2080. Based on downscaled climate model data for Halifax Regional Municipality the increase in precipitation may be more intense and separated by longer dry periods (Dillon and de Romilly, 2007). In addition, heavy precipitation events may be more common, for example, in the study cited above 1 in 50 year and 1 in 100 year events may become 1 in 10 year events based on current modeling projections with a 30% increase in the 1 in 100 rainfall event by 2080.

9.14.2 Extreme Weather

Design aspects of the project consider the range of temperatures expected for the project area. Although the operational aspect of the highway is affected by heavy rainfalls or snowstorm events, as is any other highway or roadway, extreme weather events are not expected to cause serious damage to the highway structures. Certain construction activities can be delayed by extreme weather events, primarily heavy rainfall or sub-zero temperatures. The suspension or delay of construction activities does not create an adverse impact on air quality. The greater potential impact to air quality occurs during extended periods of hot, stagnant air masses which 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 night time hours only.

Extreme daily rainfall ranges from 60 mm in January to 90 mm in November for the years recorded, while the maximum daily snowfall is 50 cm. The proposed highway will be 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. Design of new culverts, as opposed to culvert extensions, to carry surface drainage from the project will include appropriate capacity to compensate for predicted increases in runoff that may result from climate change. Predicted changes in climate include increasing mean temperatures and potential increases in precipitation by between 10 and 20% (Lines et al., 2003; Lines and Pancura, 2005).

A 100 series highway will reduce the negative impacts of extreme precipitation on public safety as opposing traffic will be separated, reducing the likelihood of head-on collisions.

9.14.3 Karst Topography

The rock types in Nova Scotia which are likely to form Karst terrain are within the Windsor Group, and the overlying Watering Brook Formation of the Canso Group. The Windsor and the Canso Group do not underlie the proposed highway. Therefore Karst terrain is unlikely within the study area.

9.14.4 Impact Evaluation/Effects Assessment

Table 9-52 identifies potential project interactions and mitigation related to the effects of the environment on the project.

Table 9-52 Potential Impacts of the Environment on the Project (Project TOR Section 9.14)

Project Interaction	Potential Effect	Mitigative Factor and Measure
Construction Activities		
Projected Climate Change Impacts (including extreme weather) for the Study Area during ground disturbing activities and before stabilization	Future climate models for Atlantic Canada predict an increase in precipitation and more importantly under these changing climate scenarios that rainfall events will be more intense with the potential to increase flood risk	As part of mitigative measure, future highway design should consider the climate change effects as new IDF curves are developed Weather forecasts are to be monitored for periods of extreme weather. Certain construction activities can be delayed by extreme weather events, primarily heavy rainfall or sub-zero temperatures TIR has standard mitigation measures in their Generic EPP to address site stabilization and sedimentation and erosion control. As part of mitigative measure, future highway design should consider extreme weather events. A

Table 9-52 Potential Impacts of the Environment on the Project (Project TOR Section 9.14) (cont.)

Project Interaction	Potential Effect	Mitigative Factor and Measure
		100 series highway will reduce the negative impacts of extreme precipitation on public safety as opposing traffic will be separated, reducing the likelihood of head-on collisions
	Potential for disturbing Karst Topography	Mitigative measures are not required as the rock types which are likely to form Karst terrain are not found within the study area
Operation/Maintenance Activities		
Projected Climate Change Impacts (including extreme weather) for the Study Area during ground disturbing activities and before stabilization	Potential impacts to shoulder and off shoulder sections of the highway during maintenance operations (e.g. tree and shrub cutting	As part of mitigative measure future highway design should consider the climate change effects as new IDF curves are developed. Although the operational aspect of the highway is affected by heavy rainfalls or snowstorm events, as is any other highway or roadway, extreme weather events are not expected to cause serious damage to the highway structures
		Mitigative measures to include winter salt application and snow removal during snowstorm events. The ongoing maintenance will follow TIR's Salt Management Plan (SMP; June 2004). As part of mitigative measure future highway design should consider extreme weather events (e.g., storm water, culverts and bridges).
Disturbance of Karst Topography during operation and maintenance	Operation and maintenance will include landscape and tree and shrub cutting with the potential to disturb Karst Topography	Mitigative measures are not required as the rock types which are likely to form Karst terrain are not found within the study area

9.14.5 Significance

Table 9-53 identifies the likelihood of the environment to cause significant adverse environmental effects to the proposed project.

Table 9-53 Significance of Potential Effects of the Environment on the Project (Project TOR Section 9.14)

	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significant Effect
Construction Effects						
Projected Climate Change Impacts for the Study Area during clearing and grubbing in alignment footprint	Moderate	Moderate - Low	One time	No	Local	No
Extreme weather during clearing and grubbing in alignment footprint	Moderate	Moderate - Low	One time	No	Local	No
Disturbance of Karst Topography	Negligible - Low	Negligible - Low	One time	No	Not applicable	No (Karst terrain are not found within the study area)
Operation/Maintenance Effects						
Projected Climate Change Impacts for the Study Area during operation and maintenance	Low	Low	Continuous for operation and less than once a year for maintenance	No	Local	No
Extreme weather during operation and maintenance	Low	Low	Continuous for operation and less than once a year for maintenance	No	Local	No
Disturbance of Karst Topography during operation and maintenance	Negligible - Low	Negligible - Low	Continuous	No	Not applicable	No (Karst terrain are not found within the study area)

10.0 Summary of Residual Adverse Effects and Environmental Effects

Residual impacts refer to those environmental effects predicted to remain after the application of proposed mitigation measures outlined in this EA. The predicted residual effects are considered for the construction and operation phases of the Project. As noted in Section 7.11, decommissioning of the highway is not anticipated and therefore this phase of work was not considered in the assessment.

In accordance with the Provincial EA regulations and Canadian Environmental Assessment Agency guidelines (1994, 1997), the significance of the residual effects was evaluated for each VEC. For adverse impacts, significance was determined based on the following criteria:

- magnitude;
- geographic extent;
- timing, duration and frequency;
- reversibility; and,
- ecological and socio/cultural context.

For magnitude, a relative rating was established and these ratings are defined in Table10-1. Geographic extent, frequency, and duration are defined in terms of distance or area and timing. Reversibility was considered as the ability of a VEC to return to an equal or improved condition once the interaction with the Project has ended. The judgement about the reversibility was based on previous experience and research and stated as "reversible" or "irreversible."

Those effects that were considered significant underwent additional consideration of the likelihood of their occurrence and the level of confidence underlying the effects prediction.

Table 10-1 Definitions for Levels of Magnitude

Rating	Magnitude
High	An environmental effect affecting a whole stock, population, or definable group of people, or where a specific parameter is outside the range of natural variability determined from local knowledge over many seasons.
Medium	An environmental effect affecting a portion of a population, or one or two generations, or where there are rapid and unpredictable changes in a specific parameter so that it is temporarily outside the range of natural variability determined from local knowledge over many seasons.
Low	An environmental effect affecting a specific group of individuals in a population in a localized area, one generation or less, or where there are distinguishable changes in a specific parameter; however, the parameter is within the range of natural variability determined from local knowledge over many seasons.
Nil	No environmental effect
Unknown	An environmental effect affecting an unknown portion of a population or group or where the changes in a specific parameter are unknown.

For adverse residual effects, the evaluation for the individual criteria was combined into an overall rating of significance as noted below. For beneficial residual effects, there was no application of the significance rating criteria.

Significant

Major: Potential impact could jeopardize the long term sustainability of the resource, such that the impact is considered sufficient in magnitude, aerial extent, duration and frequency, as well as being considered irreversible. Additional research, monitoring, and/or recovery initiatives should be considered.

Not Significant

Medium: Potential impact could result in a decline of a resource in terms of quality/quantity, such that the impact is considered moderate in its combination of magnitude, aerial extent, duration and frequency, but does not affect the long term sustainability (that is, it is considered reversible). Additional research, monitoring, and/or recovery initiatives may be considered.

Minor: Potential impact may result in a localized or short-term decline in a resource during the life of the project. Typically, no additional research, monitoring, and/or recovery initiatives are considered.

The following sections provide a summary of the residual effects (both beneficial and adverse) of the project by VEC as identified in the Effects Assessment (Section 9). The text describing the residual environmental effect includes, as applicable, any ratings of significance which have been identified by regulatory authorities or through other applicable standards.

Table 10-2 presents a summary of the residual effects likely to result from the Project. The table includes a description of the type of predicted effect, the Project phase or phases to which the identified effect applies, the type of impact (adverse or beneficial) and the significance of residual effects based on the rating criteria described above. Based on the Terms of Reference for this project, residual effects are *"…..those adverse effects or significant effects which cannot or will not be avoided or mitigated through the application of environmental control technologies or other acceptable means."* For the purposes of this assessment, a Fish Habitat Compensation Plan and/or Wetland Compensation Plan have been considered to be mitigation measures (i.e. 'other acceptable means') for components of the Project affecting those VECs. Therefore, effects of the Project on fisheries or wetland habitat have not been considered as residual effects.

The environmental assessment of the Project has identified the following residual effects:

- Existing and Planned Land Use – The predicted residual effects of the Project relating to existing and future land use will be beneficial in nature. The proposed highway alignment is a planned land use and is referenced in the Municipal Planning Strategy for the area. Construction of the new alignment will result in improved transportation for the commercial/industrial industrial sector, and planned residential communities, particularly at the eastern end of the project.

- Transportation – There will be a benefit related to transportation in the local and regional context. The new highway will provide improved safety features associated with the 100 series design standards, decrease GHGs, will decrease congestion in the Halifax urban core, and improve traffic volume (reduction) and flow along Hammonds Plains Road.

- Socio-economic Conditions - There are beneficial and adverse residual effects anticipated in the local and regional socio-economic conditions as a result of the new highway. Effects on property values may be both positive (residential and commercial property values increased due to improved access to the provincial highway network) and negative (potential for decreased residential property values resulting from the proximity of the highway to some residences, particularly Lakeshore Drive). This residual effect is considered minor as the highway corridor was identified on property mapping prior to the development in the area. and has been included in Nova Scotia property registry documents for the homes on Lakeshore Drive In addition, the noise levels of the highway during operation, based on noise levels of other 100 series highways, are expected to be at or below the NSE guidelines for daytime and night time operations, 65 dB and 55 dB, respectively. The overall significance of predicted residual effects on the socio-economic environment are determined to be minor.

- Ambient Noise – The Project will result in residual effects related to ambient noise. Currently noise levels are categorized to be that of a rural area with noise levels approximated at 40 dB. During the operation of the highway, the noise levels will be elevated above background, but based on noise monitoring of other 100 series highways, noise levels are not expected to exceed the NSE criteria guidelines. The Nova Scotia Department of Environment Guidelines (NSDOE 1998) provide sound level thresholds in dBA units for three periods of the day: day (7:00 a.m. - 7:00 p.m.) at 65 dBA, evening (7:00 p.m. - 11:00 p.m.) at 60 dBA, and night (11:00 p.m. - 7:00 a.m.) at 55 dBA.

Table 10-2 summarizes the residual effects for the Project VECS noted above.

Table 10-2 Summary of Residual Effects

VEC	Residual Effect Description	Effect Type Beneficial/Adverse	Significance Of Residual Effect
Existing and Planned Land Use			
	Highway 113 is consistent with overall regional transportation planning needs.	Beneficial	N/A – Beneficial
	Improved access to provincial highway network for commercial/industrial sector and businesses.		
Transportation			
	Changes in driving patterns including traffic speed and density in adjacent residential and commercial areas, as well as on Highways 102/103.	Beneficial	N/A - Beneficial
	Decrease in GHGs.		
Socio-economic Conditions			
	Potential decrease in residential property values associated with proximity to highway.	Adverse	Minor
	Potential increase in commercial property values due to improved access (shorter travel times) to provincial highway network.	Beneficial	N/A - Beneficial
Ambient Noise			
	Increase in background levels potentially affecting residents in the area.	Adverse	Minor

11.0 Evaluation of the Advantages and Disadvantages to the Environment

This section provides a summary of the evaluation of the advantages and disadvantages to the environment drawn from the benefits or impacts identified in Sections 9 and 10 of the EA and professional judgment of the study team. The advantages and disadvantages listed incorporate TIR's commitments to regulatory compliance and environmental planning and management principles it adheres to when designing, constructing and operating highways. It also assumes that the mitigation measures described in the Generic EPP and site specific measures that may be required at the time of construction will be successfully implemented. TIR will implement site specific mitigation measures and monitoring programs that reflect the regulatory and general environmental management environment at the time of construction.

Predicted disadvantages to the environment are short-term, localized and not considered significant with mitigation. In contrast, the advantages are long-term and will have regional implications such as reduction in GHG emissions, highway safety, and positive socio-economic benefits for business.

A summary of the Advantages and Disadvantages to the environment of the project is provided in Table 11-1 for the construction phase and Table 11-2 for the operations phase of the project.

Table 11-1 Advantages and Disadvantages to the Environment – Construction

VEC	Advantages	Disadvantages
Transportation		Short term traffic disruptions may occur at interchange sites.
Existing and Planned Land Use		
Socio-Economic Conditions	Economic benefit for contractors and suppliers.	
Atmospheric Conditions		Localized short-term impacts on air quality due to dust from earthworks operations and stockpiles.
Ambient Noise		Localized short-term noise associated with construction operations and blasting.

Table 11-1 Advantages and Disadvantages to the Environment – Construction (cont.)

VEC	Advantages	Disadvantages
Surface Water		Potential impact on surface water due to erosion during earthworks but minimized with implementation of erosion and sediment control measures.
Groundwater		Potential for short-term disruption in water wells due to blasting. Wells affected by blasting will be replaced.
Flora and Terrestrial Habitat		Loss of terrestrial habitat associated with footprint of highway. Loss of habitat for Southern Twayblade will be addressed through compensation. Potential short-term disruption to large mammal movement.
Wildlife and Migratory Birds		
Wetlands		Loss of wetland habitat minimized by aligning route to avoid wetlands. Wetland habitat lost will be addressed through compensation.
Fish and Fish Habitat		Habitat loss at culvert crossing locations will be addressed through HADD compensation.
Bedrock and Surficial Geology		
Historical, Archaeological, Paleontological, and Architectural Resources	Identification and documentation of potential archaeological features in highway ROW prior to construction.	

Table 11-2 Advantages and Disadvantages to the Environment – Operation

VEC	Advantages	Disadvantages
Transportation	Improved traffic flow; eliminates need to widen Highway 102 in Halifax urban area; reduced traffic impacts on Hammonds Plains Road; improved access to provincial highway network; improved public safety	
Existing and Planned Land Use	Improved access to provincial highway network for businesses and residences. Highway recognized in MPS and property developer plans.	Loss of forestry resource lands within highway ROW. Addressed through property purchase process.
Socio-Economic Conditions	Improved access to provincial highway network for business. Highway will provide for more efficient trucking around HRM urban area.	
Atmospheric Conditions	Reduction in GHGs due to improved traffic flow.	
Ambient Noise		Increase in noise levels above current background conditions but within regulatory limits.
Surface Water		
Groundwater		
Flora and Terrestrial Habitat	Maintenance of large mammal access along Maple Lake and Fraser Lake corridor.	
Wildlife and Migratory Birds		
Wetlands		
Fish and Fish Habitat		
Bedrock and Surficial Geology		
Historical, Archaeological, Paleontological, and Architectural Resources		

12.0 Proposed Compliance and Effects Monitoring Programs

Environmental management is a critical component of TIR's approach to highway construction and operation. The objectives are to implement safe, environmentally responsible and sound engineering, 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 environmental compliance monitoring is that which TIR 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 regulatory authorities; and
- Provision of on-site environmental advice to Project personnel.

The principle mechanism for ECM will be the Generic EPP, which provides the practical framework for the implementation of the environmental requirements of the Project. The Generic EPP will also provide a common reference document against which compliance can be judged by both regulatory authorities and TIR.

The objective of TIR environmental management efforts is to implement safe, environmentally responsible, and sound engineering, construction, and operation practices. The major components of the environmental management structure for this Project that will ensure environmental matters are considered throughout all phases of the Project include:

- Environmental Protection Plans; and
- Contingency Plans.

TIR has developed a detailed Environmental Protection Plan (EPP) for the Construction of 100 Series Highways (TIR, 2007) and an updated (reflecting regulatory requirements and environmental protection methods in place when the project is to be constructed) project specific version of the Generic EPP will be prepared prior to construction.

TIR will continue discussions throughout construction with government agencies, stakeholder groups, interested parties, and landowners, to ensure the effectiveness of the proposed mitigation measures. A team of environmental inspectors will ensure the success of the mitigation measures.

All Contractors will be required to have supervisors or foremen involved with earthworks attend an erosion and sedimentation control workshop before construction begins. During the workshop, plans and procedures will be emphasized for minimizing impacts on sensitive features and areas. Specific environmental commitments related to the Highway 113 Project will be highlighted during pre-construction meetings with TIR and a reporting system will be created to track implementation. Contractors' staff will also be briefed by TIR environmental personnel to ensure environmental protection measures are identified and understood by all personnel involved in the Project.

Once the highway is in service, on-going environmental training programs will be established. TIR will provide regular employee training on environmental awareness, spill handling and reporting, clean-up procedures, waste management, easement maintenance activities, and hazardous material handling. The highway will be designed, operated, and maintained to provide safe and efficient service over the long term.

12.1.1 Environmental Effects Monitoring

In addition to ECM, there may be requirements for TIR 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. TIR will be committed to and responsible for the development and implementation of a focused EEM program for the Project, where required.

An EEM program normally involves the collection of repetitive measurements of environmental variables to detect changes caused by external influences directly or indirectly attributable to a specific human activity or development, in this case, the construction and operation of Highway 113. An EEM program will be developed and implemented to meet the following primary objectives:

- To update baseline data so the construction schedule can be refined to avoid conflict with VECs identified in this EA or VECs that arise with changes in legislation;
- To verify impact predictions;
- To evaluate the effectiveness of mitigation and to identify the need for improved or altered mitigation; and
- To provide an early warning of undesirable change in the environment.

Each EEM program component will have clear and achievable objectives and hypotheses, temporal and spatial controls, and practical methodologies. Careful consideration will be given to the availability of previously collected parameters or ability to collect baseline data. The boundaries of each program component will be defined to ensure that the potential interaction of the Project with each VEC is adequately assessed. Boundaries will vary for each VEC according to the nature and extent of the potential interaction or impact. Generally, the process for EEM program implementation will include:

- Visual examination of the environmental features near the highway, after construction;
- Identification of recovery trends and sites that require more detailed study, based on aerial observations and field surveys;
- Development of air, land, and water sampling programs, where necessary, to monitor site conditions; and
- Development of site specific rehabilitation programs, where required, based on the results of sampling programs and controlled on-site experiments.

The results of EEM program will allow correction of any construction-related problems and assist in preparing post-construction regulatory reports. In addition, environmental management for the project includes commitments to pre-blast and well water surveys and to follow up studies.

12.2 Pre-Blast and Well Water Surveys

The locations of buildings and wells situated within 800 m of the highway of the Project site have been identified. The design and grading details of the Project site are not yet available. However, upon defining these criteria, and thus blasting requirements, a full pre-blast survey of all homes and all wells present within 800 m of the blast zone boundaries will be carried out following the NSE guidelines for blasting. Environmental compliance monitoring includes the pre-construction commitments as noted below as well as regulatory Conditions of Approval. This type of survey will include:

- An inspection of all buildings located within the pre-blast survey areas by qualified persons; and
- A complete inventory and testing, as appropriate, of all wells to determine individual pre-blast well condition and nearby aquifer capacity.

Before any blasting begins, a copy of all pre-blast survey results along with complete description of the arbitration and resolution methods to be used (to be reviewed and approved in advance by appropriate regulatory authority) will be delivered to both building and well owners and appropriate regulatory authorities.

Blasting programs will be reviewed by qualified engineers and/or geoscientists. Trained and qualified personnel using appropriate equipment will be deployed to the field to monitor air and ground vibrations during all blasting. Blasting programs will be modified according to monitoring results so as to avoid impacts to nearby buildings and water supply wells. Copies of all monitoring results will be delivered to the appropriate regulatory authorities.

Should any nearby building or water supply well owner claim deleterious effects from blasting activities, then qualified individual follow-up assessments of buildings (cosmetic and structural inspections and comparison to pre-blast documentation) and wells (water quality testing and other hydrogeologic evaluations as needed) will be done. These assessments will evaluate damage and recommend mitigative and/or corrective measures.

12.3 Other Potential Monitoring Programs

12.3.1 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.

12.3.2 Sensitive Terrestrial Habitat

The construction in the vicinity of environmentally significant / sensitive areas will be monitored to ensure the spatial extent of the physical disturbance is limited to the extent possible. At present, this includes locations of Southern Twayblade. TIR will review at risk species list during the design of the highway and modify monitoring accordingly.

12.3.3 Wetlands

Follow-up monitoring will include monitoring of storm water quality in the vicinity of wetlands crossed by the alignment (quarterly TSS, pH) and monitoring of compensation projects to confirm meeting of no net loss.

12.3.4 Freshwater Quality

Baseline water quality information has been collected for mapped watercourses along the alignment. TIR is committed to collecting four-seasons of surface water quality data prior to construction to ensure that contemporary water quality data is used as a baseline for monitoring. Water quality will be monitored during and after construction to ensure protection of aquatic life. Samples will be collected during storm conditions during construction.

12.3.5 Sediment and Erosion Control and Stream Crossings

Erosion and sediment control structures will be routinely inspected and maintained appropriately. Surface water quality (e.g., total suspended solids, pH), site and habitat restoration, and bank stability and protection will be monitored regularly during construction and thereafter until soils have been permanently stabilized.

12.3.6 Operational Monitoring

As part of ongoing environmental management, routine inspections are conducted for general environmental conditions such as soil erosion. These are initiated as part of TIR policy.

13.0 Assessment Summary and Conclusion

13.1 Assessment Summary

This section of the report summarizes the overall findings of the Highway 113 EA with an emphasis on the main environmental issues as identified in Table 1-1. For example, issues raised by members of the public, stakeholders and regulatory authorities.

The Environmental Assessment report has been compiled in accordance with the Nova Scotia Environmental Assessment Regulations and the project TOR. The methodology applied to this assessment has considered the regional and local context for each VEC and issue raised to identify potential effects with other projects and activities and in consideration of the regional and local distribution of the VEC. The Environmental Assessment has described the effects of the project on the environment, whether positive or negative, on the following broad components:

- Biophysical
- Air Quality
- Transportation
- Land Use
- Socio-Economic; and
- Public Consultation

The Environmental Assessment has also identified mitigative measures for these effects and predicted the significance of the remaining residual environmental effects. Residual impacts refer to those environmental effects predicted to remain after the application of mitigation outlined in this Environmental Assessment. The predicted residual effects have been considered for each Project Phase (Construction, Operation and Maintenance events). As per the criteria established, the Significances of each adverse effect have been determined. The existing environment has been described and a detailed assessment of potential impacts presented throughout this report. Specifically, mitigative measures for VECs and major issues have been addressed for expected effects and are detailed in Section 9 and Section 10.

The major issues identified in Table 1-1 have been addressed and potential project impacts and their significance have been assessed in Section 9. A summary of the findings of the EA are provided by issue below.

Impacts on mainland moose and deer and fragmentation/impacts on existing ecological integrity of the area (includes Blue Mountain/Birch Cove Lakes)

Studies by NSDNR on the spatial distribution and abundance of Mainland Moose have shown that there is a small population that exists on Chebucto Peninsula but several winter aerial and radio-tracking studies have shown that this small population limits its range to the Chebucto Peninsula and the range would not be fragmented by the proposed highway as the population does not usually venture close to the proposed alignment or the Blue Mountain/Birch Cove Lakes Wilderness Area. TIR will provide a structure between Maple and Fraser Lake with an opening large enough for large mammals to pass. Therefore, impacts on mainland moose and deer are not significant.

Surface Water Quality and Quantity

It is predicted that there would be a low level of significance for this issue as erosion and sediment control measures will be implemented during construction and maintained throughout the construction period. These will be identified in Environmental Control Plans and Culvert Mitigation Plans and will consistent with the Generic EPP. Measures will be maintained through all seasons as the regional climate includes precipitation in every month of the year. Ongoing monitoring of upcoming weather conditions will occur to prepare for specific events.

Wetlands

There are no significant residual effects that are identified for wetland VECs that cannot be avoided or mitigated based on TIR working with NSE, DFO, NSDNR and EC staff to finalize appropriate compensation measures for wetlands within the footprint of the highway. TIR has minimized impacts by alterations made to the alignment requested by NSDNR. Where impacts to wetlands are unavoidable TIR will compile detailed designs for the proposed work and submit wetland alteration approval applications to NSE.

Priority and At Risk Species and Migratory Birds

It is predicted that effects on these species are not significant and no significant residual effects have been identified for priority and at risk species that cannot be avoided or mitigated based on TIR working with NSDNR staff to finalize appropriate management planning for the Southern Twayblade on completion of detailed designs for the proposed work. In the case of Mainland moose, the population based on the Chebucto Peninsula does not commonly migrate into the project area. Construction work will be conducted in a way that is seasonally sensitive to nesting and migratory birds

Groundwater

Water wells within 300 m of the alignment are drilled wells and cased to bedrock as a result run-off from highway construction and maintenance is not expected to impact well water. Should wells be impacting by blasting, TIR will replace the well. The effects of the project on groundwater are not significant.

Fish Habitat Assessment of Proposed Crossings

TIR will implement all mitigation requirements to minimize direct effects on fish habitat. Some effects on components of the environment serve as pathways for effects on other components. For instance, while project exposure of soil to erosion may affect water quality, surface water containing suspended sediments may serve as the pathway for adverse effects on fish and fish habitat. However, implementation of the Generic EPP and site specific ESC measures will mitigate these potential effects and the effect of the project on fish and fish habitat is not significant. In addition, habitat loss associated with watercrossings will be addressed through DFO's HADD process or equivalent at the time of design. As a result, habitat loss is not considered significant.

Traffic/Transportation

Highway 113 project will improve the transportation environment of the area, primarily on Highway 102, Highway 103, and Route 213 (Hammonds Plains Road). The project will provide a safer and more efficient transportation corridor for commuters as well as for trucking goods and services. Therefore, the volume of traffic projected to be diverted to the new Highway 113 will reduce traffic demands on Hammonds Plains Road and other surrounding facilities in the future. This is beneficial as the projected transportation demands along existing facilities are expected to exceed capacity in the near future.

Land Use and Socio-Economic Considerations

The proposed alignment will likely have both positive and negative effects to property values along the alignment, depending on the existing and potential land use for property. For example, a negative effect to property values may occur as a result of elevated noise levels in the vicinity of residential dwellings. TIR will conduct further investigation of noise effects of the highway during the design phase of the project and will implement appropriate mitigation measures if required. Conversely, there is expected to be positive effects associated with the shorter travel time or increased access resulting from the new alignment where interchanges are close by. For example, commercial property values in the Atlantic Acres Business Park could potentially increase in value due to improved access to the provincial highway network.

Air Quality

The construction phase of the project will have limited negative effects on local air quality via the potential for dust generation on-site and on the approach roads. Implementation of dust control practices will minimize these effects on air quality. During normal operation, the highway will have only those sources of emissions associated with normal traffic use, which will have an overall improvement when compared to traffic congestion on the existing routes. Therefore the effects of the project on air quality are considered not significant.

Public Consultation

As part of the planning process for the proposed Highway 113 and throughout the environmental assessment process, including during the preparation of this environmental assessment report, the public and regulators have had opportunities to voice their concerns regarding the Project and the potential impacts. All of the concerns and items brought forward during the public meetings were noted and reviewed during this study. In some instances those concerns identified issues that became focal points for this environmental assessment report.

13.2 Conclusion

Through careful design and planning, engagement with the public, stakeholders and regulatory authorities and the use of TIR's Generic EPP, combined with application of appropriate mitigation measures. TIR will address potential adverse environmental effects and reduce the predicted adverse impacts to a low level of significance through project planning and implementation. In summary therefore, the proposed Highway 113 Project has important overall social and safety benefits, both locally and regionally. This environmental assessment demonstrates that any adverse effects or significant environmental effects of the project can be adequately mitigated through compliance with the proactive planning and mitigation measures described in this environmental assessment.

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14.1 Personal Communication

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Appendix A1
ACCDC Background Data Report

Appendix A2
Potential At-Risk Flora and Fauna List for Study Area

Appendix B1
Breeding Bird Reports

Appendix B2
Herpetile Report

Appendix B3
Plant List from Vegetation Surveys

Appendix B4
Wetlands Information

Appendix B5
Fish Habitat Assessment Results

Appendix B6
Blue Mountain-Birch Cove Lakes Wilderness Area Newsletter

Appendix C
Archaeological Impact Assessment

Appendix D
Highway 113 Project Issues Update

Appendix E
Water Quality Data

Appendix F
Surface Water Assessment