APPENDIX E

HIGHWAY 104 ANTIGONISH SOUTH RIVER IMPACT STUDY

Nova Scotia Department of Transportation and Public Works

FINAL REPORT
HIGHWAY 104 ANTIGONISH
SOUTH RIVER IMPACT STUDY

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NGNS Job # 16053

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EXECUTIVE SUMMARY

Introduction

The purpose of the work described in this report was to carry out a detailed analysis of the proposed South River Crossing for what is known as the "Blue Route" for Highway 104 approximately 6 kilometres east of Antigonish. The analysis was to determine the magnitude and extent of environmental impacts, what mitigation measures might be required, and the cost implications. In addition, a proposed general arrangement of the bridge structure was prepared.

The work consisted of field work, data analysis, environmental impact prediction, conceptual design, and mitigation planning for the proposed bridge structure. The study involved detailed work in the following areas:

- Geology and Physiology;
- Hydrology;
- Vegetation;
- Benthic Invertebrates;
- Fish and Aquatic Habitat;
- Amphibians and Reptiles;
- Birds;
- Mammals;
- Rare or Endangered Species; and
- Coastal Freshwater Marsh.

Environmental Findings

The South River appears to define the geological contact between limestone bedrock on the west and siltstone bedrock on the east. The potential for Karst topography is greater in the limestone bedrock. Notwithstanding, Karst topography was not encountered during the borehole program carried out for this assessment.

The hydrologic functions of the South River at this location are primarily for conveyance and flood storage purposes. Construction of the bridge will not impact conveyance and will displace a negligible amount of flood storage capacity.

The study site is a highly productive tidal section of the South River. The mixing of denser saltwater provides nutrients to support aquatic production, which in turn provides food to mummichogs, a small common estuarine fish found in high numbers in the area. The site does not, however, provide critical habitat, such as spawning or breeding areas, for important species. Many species of birds and estuarine fish species feed in the area, and a number of highly valued recreational fish species migrate upstream and downstream in the spring and fall.

The study site also has an interesting diversity of species because of its mix of fresh and salt water. For example, both fresh and salt water tolerant species of invertebrates are found in the river substrate. Plant diversity, however, is predominantly salt intolerant, indicating that the area should not be classified as salt marsh.

In terms of unique habitats, the study site is typical of many small sections of Nova Scotia estuaries. Nearby Pomquet estuary provides more unique habitats and supports a number of rare and endangered species. Uncommon species, such as the Nelson Sharp-Tailed sparrow, do occur in the area of the study site, but none are known to be dependent on the site for reproduction.

Within the South River, areas upstream and downstream of the study site provide more critical habitat, especially spawning habitat for fish and breeding habitat for birds. The true salt marsh area downstream of the study site is definitely more important in terms of waterfowl. Above the head of tide, spawning habitat for salmonids, especially the increasingly threatened Atlantic salmon, occurs in many areas.

Construction of a bridge within the study site is less likely to have significant environmental impacts than a site upstream or downstream.

Proposed Structure

A four-span steel girder structural system with a concrete deck was proposed. The use of weathering steel has some advantages in terms of foundation loading where karst conditions are possible and provides a relatively maintenance free structural system.

The major elements of the structure consist of the following:

- Four 60 m spans of weathered steel
- Abutments at the east and west ends of the structure
- Piers and abutments founded on piles
- Concrete deck
- Jersey barrier style guard rails

The estimated cost to the structure was in the order of $5,500,000. The bridge structure layout was designed to avoid impacting on the main channel of South River because of its function in the local fishery. The only residual impact of the bridge will be the displacement of approximately 2,500 m^2 of marsh area primarily from the island marsh habitat located between the back and main channels.

A Certificate of Approval under the Fisheries Act should not be required because there will be no net loss of aquatic habitat. Application will be required under the Navigable Waters Protection Act, although it is anticipated that approval will not be required under this act either.

1.0 INTRODUCTION

1.1 Background

The Nova Scotia Department of Transportation and Public Works (NSTPW) has been carrying out a Highway Planning Process for Highway 104 from Antigonish to Lower South River. The NSTPW considered three alignment options for this area and after evaluation of numerous impact factors approved one for environmental assessment registration. This route is known as the "Blue Route". The preferred alignment crosses the South River approximately six kilometres east of the Town of Antigonish just downstream of the existing Highway 104. There were concerns regarding the environmental impact of the South River crossing at this location. The purpose of the work described in this report was to carry out a detailed analysis of the proposed South River Crossing at this location to determine the magnitude and extent of environmental impacts, what mitigation measures might be required, and the cost implications. The general location of the study area is indicated on Figure 1.

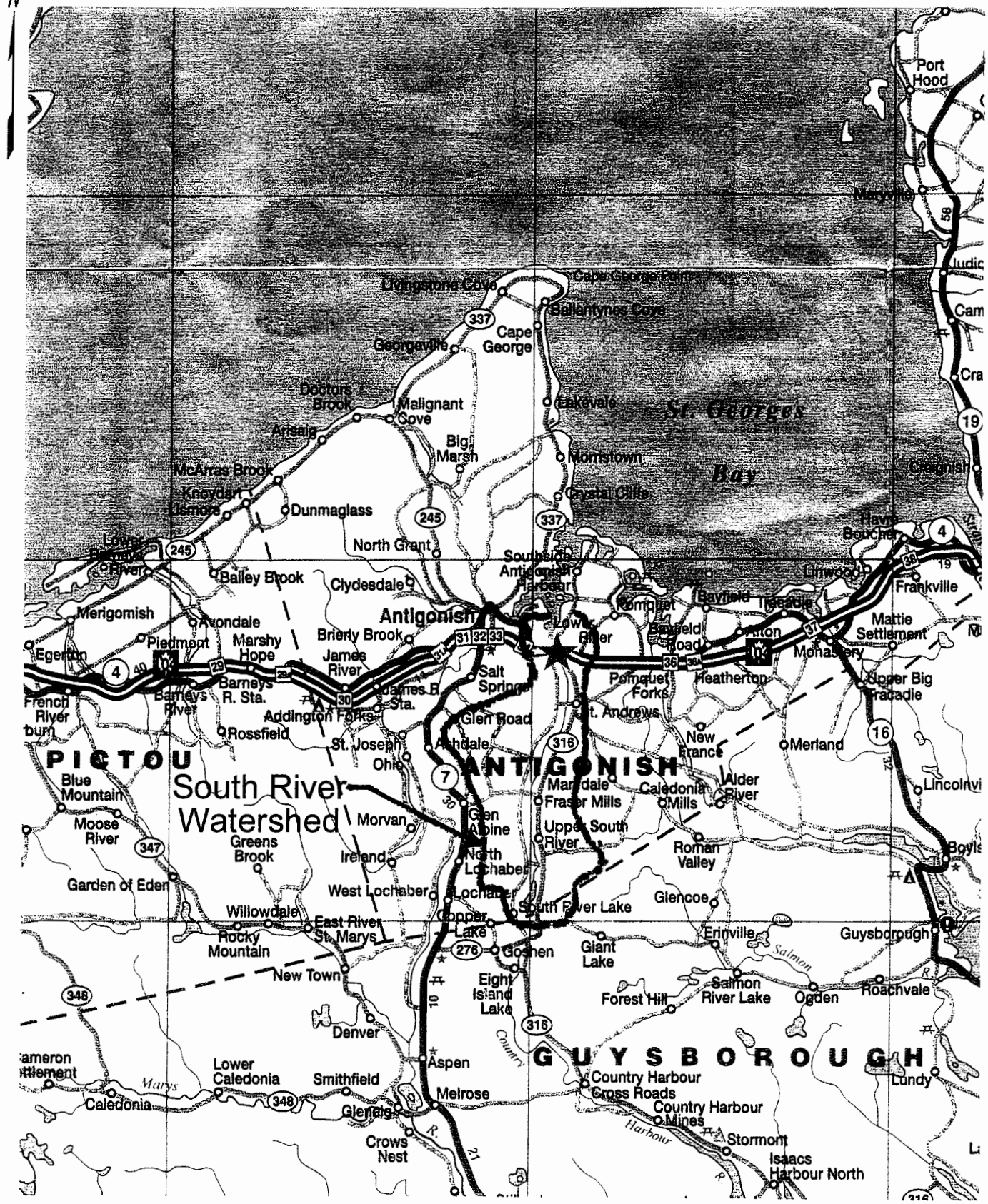
1.2 Study Objectives

The primary objectives for this project as defined in the terms of reference were as follows:

- Identify the environmental impacts of the recommended Blue Route on South River including the salt marsh habitat;
- Identify any previously undetected avoidance constraints within the study area that may force realignment of the recommended Blue Route;
- Determine the environmental and other mitigation measures required at the South River Crossing including associated costs; and
- Determine the general configuration of the structures (two 2-lane structures) at South River including preliminary cost estimates.

1.3 Report Contents

Chapter 1 (this chapter) provides a brief introduction to the project and the objectives of this report. The methodology used to carry out the field analysis and impact assessment is presented in Chapter 2. Chapter 3 provides a detailed description of the study area in terms of the biophysical and social environments. An evaluation of the wetland is provided in Chapter 4. Chapter 5 draws together the Valued Environmental Components (VECs) that emerged through the data analysis and wetland evaluation. Chapter 6 provides the guiding principles for, and the conceptual design of, the bridge structure. Chapter 7 provides recommendations for impact mitigation both during construction and operation of the new structure. Finally, conclusions are provided in Chapter 8.



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STUDY AREA LOCATION	DES	DWG NO FIGURE 1	REV A

2.0 METHODOLOGY

The methodology used to carry out the environmental assessment work consisted of the following tasks:

- Field Survey and Data Collection;
- Sensitivity Analysis;
- Conceptual Design
- Impact Analysis; and
- Mitigation Plan.

The methodology used for each of these tasks are discussed in the following sections.

2.1 Field Survey and Data Collection

The data collection and field program was carried out in order to assess the environmental sensitivities of the study area. Field work was carried out according to the following schedule.

September 29 – Hydrology, water quality, set minnow traps, flora and fauna survey
October 4 – Hydrology and water quality
October 5 – Aquatic species and habitat survey, water quality
October 14 – Bird survey
October 19 – Geological Investigation/Drilling program
October 20 & 21 – Archaeological investigations

The specific tasks undertaken in each field of investigation are described in the following sections.

Physiography/Geology

Detailed geological mapping available from the Nova Scotia Department of Natural Resources was reviewed and a reconnaissance was conducted of the surrounding environs.

A drilling program consisting of two boreholes to depths of 15 to 20 m at the location of the approaches on both sides of the river was carried out. The holes were advanced with a CME75 drill rig operated by Logan Geotech of Enfield, Nova Scotia. The two Boreholes were augered and split spoon samples were collected from surface to bedrock. Bedrock was cored and visually inspected for karst topography and subsurface geology. Borehole locations are indicated on Map 1.

Stream Profiles/Hydrology

Existing hydraulic information for South River was obtained from the Department of Fisheries and Oceans. The measurement station was at St. Andrews (approximately 4 km upstream of Highway 104) – Station No. 01DR001 and had a period of record dating back to 1917 excluding 1934 to 1964.

Stream gauging was carried out across two transects of the main channel using a Watermark Velocity Meter with digital read out. A velocity profile and cross section was developed for each transect. A portable salinity meter (Beckman RS5) was used to measure salinity, conductivity and temperature at several locations in the main channel and back channel. A salinity profile was prepared for both the main and back channel areas.

Vegetation

The vegetation survey was conducted by Jim Jotcham. Two areas were surveyed, these were the 'island'; a fresh-water/brackish marsh with a wooded center, and the river banks; a mixed/hardwood forest with a hayfield on the west side. The results of the survey are tabulated in Appendix A.

Benthic Invertebrates

Benthic samples of Lower South River were collected by Norval Collins of CEF Consultants Ltd. and analyzed by Pat Stewart of Envirosphere Consultants Ltd. (Appendix B). Sediment and benthic samples were taken using a stainless Ponar (grab) sampler from a canoe at seven sampling stations in the marsh. The grab sampler has an effective surface sampling area of $0.03m^2$. Samples were transferred to a plastic ziplock bag. Analysis of particle size and enumeration and identification of invertebrates were completed by Envirosphere Consultants in Windsor, Nova Scotia.

Fish and Aquatic Habitat

The fish survey was conducted by Norval Collins and James Thorbourne. Minnow traps were set by Norval Collins at six locations throughout the marsh on 29 September, and were retrieved by Norval Collins and James Thorbourne on October 5th. Fish were identified, counted and measured at the site and several were taken back in a cooler for identification by John Gilhen of the Nova Scotia Museum of Natural History.

Visits were made to Shane O'Neil of the Bedford Institute of Oceanography (BIO) and to John Gilhen in order to get information on fish species that are known to occur in South River. Don McLean and Charles MacInnis of the Department of Fisheries and Ocean were also consulted by telephone. Previous reports of the South River area were referred to in order to obtain a better representation of fish species.

Amphibians and Reptiles

John Gilhen of the Nova Scotia Museum of Natural History was visited in order to obtain information on herpetile species known to occur in the South River area.

Birds

The bird survey was completed by Randy Lauff on October 14th. The personal records of Mr. Lauff (who resides in the area and commutes to work daily past the study site), historic Christmas Bird Count data (the site is at the center of the Antigonish Christmas Bird Count which has run for 25 years), the Atlas of Breeding Birds data (Erskine 1992; Appendix C), and the known habitat affiliations of birds, were used to give an overall picture of the use of the site. The Canadian Land Inventory provided general grading of the capability for waterfowl in the area.

Mammals

The Canadian Land Inventory, The Natural History of Nova Scotia: Northumberland Plain and Antigonish Upland theme regions, and Dalhousie University's Technical Report for Maintenance of Beaches: Pomquet, Antigonish County were used as sources for mammal habitat and occurrence in the area.

Wetland Evaluation

The wetland evaluation considered the various possible functions of the wetland, and then examined the potential impact of the proposed project on each of them. The study site was considered as part of a regional complex and its relative uniqueness was determined. In this regard, the wetland area was assessed in terms of its relationship to other wetlands in St. Georges Bay. The evaluation process also considered the principle of critical values, "a service or function that is very important to society or where an important threshold or function may be exceeded, resulting in the loss of the function and value".

Major wetland components that were evaluated include biological, hydrological and social/cultural.

Biological assessments centered around the role of the wetland in contributing to the well-being of plants, benthic macroinvertebrates, fish, migratory birds, reptiles, amphibians, and mammals. From an ecological perspective, the assessment considered the role of the study site within its complete landscape and regional setting.

Hydrological assessment centered around the value of the wetland in contributing to surface and groundwater stocks and the value of the wetland in contributing to surface water and groundwater quality.

The social/cultural assessment considered aesthetic, recreational, education and public awareness, public status or cultural values.

These three views are the primary basis for the overall assessment of the importance of the study site. In addition to these three views, potential use of the wetland for agriculture or other harvesting is considered.

Archaeological Assessment

The archaeological assessment of the study area was carried out by Davis Archaeological Consultants Ltd. and included background research, interviews, and field testing. Background research was completed at the Public Archives and the Nova Scotia Museum. Interviews were conducted with area residents and local historians. Field inspections and a test pitting program was conducted on October 20 and 21, 2000.

2.2 Analysis and Sensitivity Mapping

The culmination of the field work was the preparation of environmental sensitivity mapping of the study area and immediate environs. The sensitivity map was based on an interpretation of the background research and the scientific data collected during the field work. It included the following:

- Geological section through the study area indicating both bedrock and surficial deposits. Aquatic habitat types, fresh water, estuarine, salt water.
- Critical habitat for fish species and bird species.
- Typical salinity/conductivity profiles at high and low tides.
- Rare and/or endangered flora and fauna.
- Land use, archaeological significance

Valued Evironmental Components (VECs) were derived from the sensitivity mapping and the wetland evaluation process. The VECs were used as surrogates for the prediction of environmental impacts and the development of environmental design criteria for the bridge structure.

2.3 Conceptual Design

A conceptual design scenario that addressed underlying foundation conditions present, environmental conditions and future maintenance considerations was prepared. To effectively provide a design that met all the criteria including future maintenance impacts, the following considerations were evaluated and where possible incorporated into the resultant design suggestions:

- Effects and impacts of migratory avian species and timing of access for construction
- Effects and impacts of seasonal fish migration on timing and access for construction
- Effects and impacts of riparian species and how that will impact on construction
- How to minimize impacts caused by necessary access to install piers and abutments
- How to minimize and prevent the generation of siltaceous run off
- How to capture and contain siltaceous runoff and sediment transport materials
- How to allow access for maintenance in future and minimize potential impacts
- Selection of design spans and materials of construction
- Construction techniques that minimize disturbance and accomplish design goals
- Construction equipment service areas that prevent fuel and oil impacts

The result of the process was a design that satisfied the highway transport requirements and served to protect and maintain the Valued Environmental Components (VECs) identified in the study area.

2.4 Impact Analysis

Although the bridge structure conceptual design was prepared to respect the VECs as much as possible, there were inevitable impacts identified both during construction and during the long-term operation and use of the structure. These impacts were identified and assessed in terms of their significance and potential mitigation measures. Residual impacts were identified.

3.0 DESCRIPTION OF STUDY AREA

This section of the report provides a description of the study area in terms of:

- Geology/physiography;
- Hydrology/water quality;
- Vegetation;
- Benthic Invertebrates;
- Fish and Aquatic Habitat;
- Amphibians and Reptiles;
- Birds;
- Mammals;
- Rare or Endangered species;
- Wetland Evaluation;
- Land Use; and
- Archaeological Assessment.

A regional and local context is provided where appropriate and Valued Evironmental Components (VECs) that play an important role in the design of the structure and in the environmental impact evaluation are highlighted throughout the text.

3.1 Geology and Physiography

The study area lies in the physiographic unit called the Antigonish Lowland, bounded by the Pictou Highlands to the west, the Guysborough Highlands to the east and the Southern Upland to the south. St. Georges Bay (of which Antigonish Harbour forms the inner extremity) was originally formed through erosional processes on rocks of the Windsor and Canso Group that underlie this area. Detailed geological mapping from the Nova Scotia Department of Natural Resources (NSDNR) indicated that the Windsor formation underlies the area around Antigonish Harbour while the Canso Group formation underlies areas east of South River. In fact, the contact between these two groups underlies the South River. This was confirmed through the drilling program (see Map No. 1 for borehole locations).

The south portion of the site, near the intersection of South Side Harbour Road, consists of the Canso Group, Hastings Formation. This geology was confirmed in Borehole 1 (BH-1), which was located between the main channel of the South River and South Side Harbour Road.

BH-1 consisted of brown coloured, interbedded river sediments (fluvial deposits) of the South River. Historic channel lag was detected at approximately 3 to 6 metres from surface, and is related to the meandering and continuous formation/change of the South River. A dense silty sand layer was noted between 6 and 8.5 metres from surface and is believed to be an ablation till. Underlying the silty sands red siltstone (mudstone) bedrock was intersected. This bedrock was very severely fractured. The approximate bedding dip was between 20 to 30 degrees to the south, southwest. The regional geology map of the area also notes the bedding dip to be of similar degree and direction. This borehole confirmed the presence of the Hastings Formation Geology, which consists of grey to red siltstone and shale. This formation may also include limestone,

but none was detected in BH-1. BH-1 was drilled to a depth of 15.24 metres from surface.

North and west of the South River, Main River channel and BH-1, Windsor Group, Hood Island Formation exists. This geology was confirmed in BH-2, which was located west of the backwater channel of the South River. BH-2 was located approximately 20 metres north of Highway 104.

BH-2 consisted of one metre of flood plain deposits at surface. Beneath the surface soils an ablation till was intersected. These soils consisted of red and grey colour layers of silty sands containing minor sandstone clasts. Limestone bedrock was intersected at approximately 14 metres from surface. The limestone was grey to dark grey in colour and was very severely fractured. This limestone contained a weak petroleum odour when broken for inspection. Natural petroleum is typical of Windsor Group limestone. BH-2 was drilled to a depth of 17 metres in depth from surface.

Figure 2 presents a geological section through the study area based on interpretation of the two boreholes drilled at the site and existing geological mapping. Borehole logs are presented in Appendix D.

Karst topography was not encountered during the intrusive investigation carried out for this assignment. Based on the regional setting, the potential for karst topography is possible, but was not detected in our borehole program. It would be more likely on the west side of the river in the Windsor Group, Hood Island formation. A detailed geotechnical program will be required to better define the geotechnical characteristics of the soils and bedrock in support of detailed design.

3.2 Hydrology

Regional

The study area lies in the lower reaches of the South River Watershed and has an upstream drainage area of approximately 200 km^2. The river flows from its headwaters near Crooked and Stewart Lakes a distance of about 30 km to its discharge to Antigonish Harbour. The watershed area upstream of Highway 104 is illustrated on Figure 1. The watershed is relatively undeveloped, however, it can be accessed throughout its entire length by Highway 316 running south off of Highway 104 at South River Station. Historical hydrologic data for South River was obtained from the Department of Fisheries and Oceans based on a former Water Survey of Canada flow gauging station located at St. Andrews, approximately 5 km upstream of Highway 104. The are no hydraulic structures in the river that restrict flow and the flow can be classified as natural.

The data from the flow gauging station at St. Andrews was prorated (based on watershed area) to provide a reasonable approximation of the flow regime at the study area. The watershed area between the St. Andrews flow gauging station and the 104 is about 25 km^2. Given that the watershed area at the St. Andrews station is 177 km^2, the measured flows may be pro-rated by a factor of 1.14 to get a reasonable approximation of flows at the study area. Figure 3 illustrates the annual hydrograph based on data collected at St. Andrews from 1917 to 1933 and 1965 to 1990 and pro-rated to the 104

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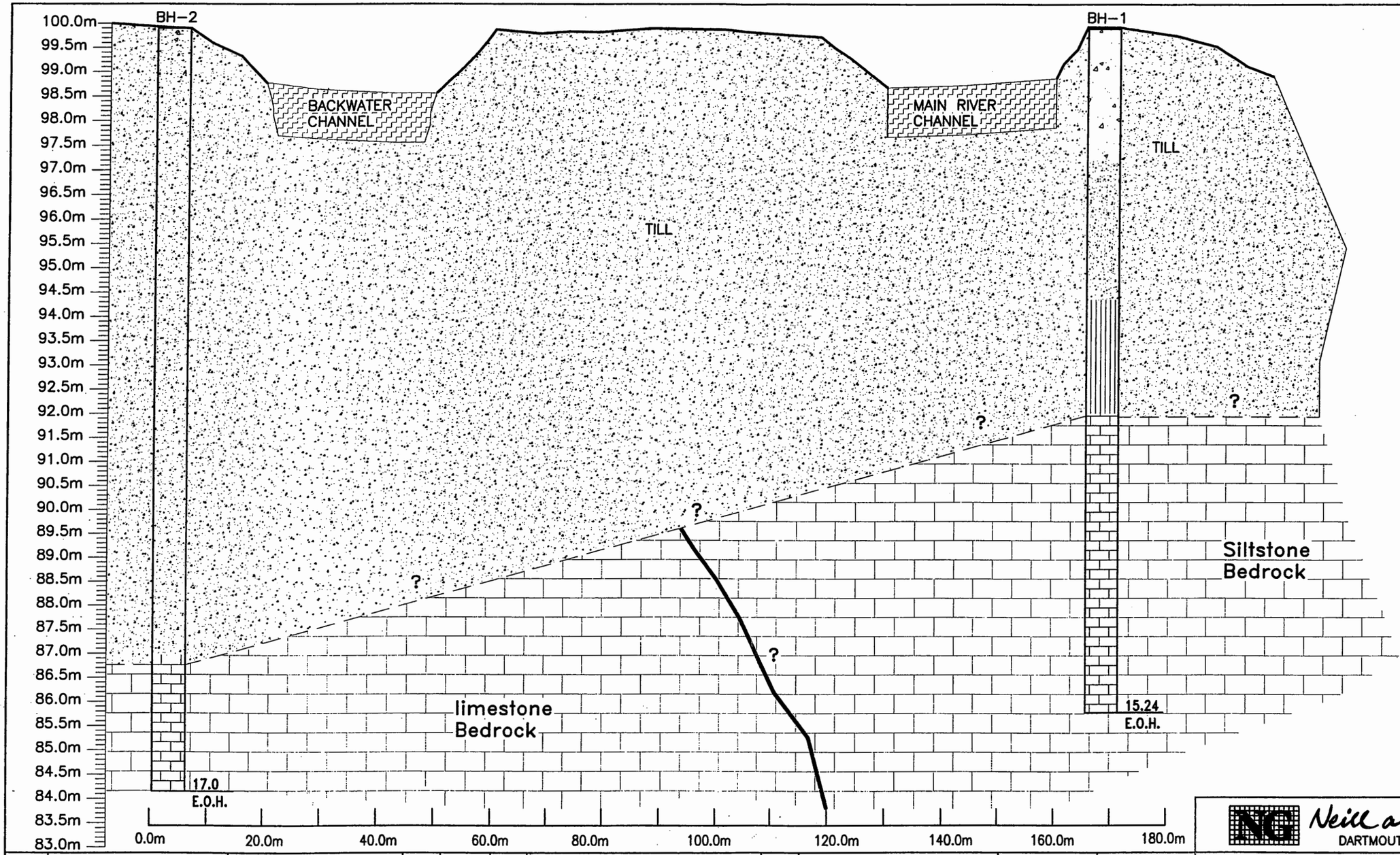

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Neill and Gunter
DARTMOUTH, N.S., CANADA

HIGHWAY 104 ANTGONISH SOUTH RIVER IMPACT STUDY

SUBSURFACE PROFILE
MAP-1, SECTION B-B
HIGHWAY 104 ANTIGONISH, NOVA SCOTIA

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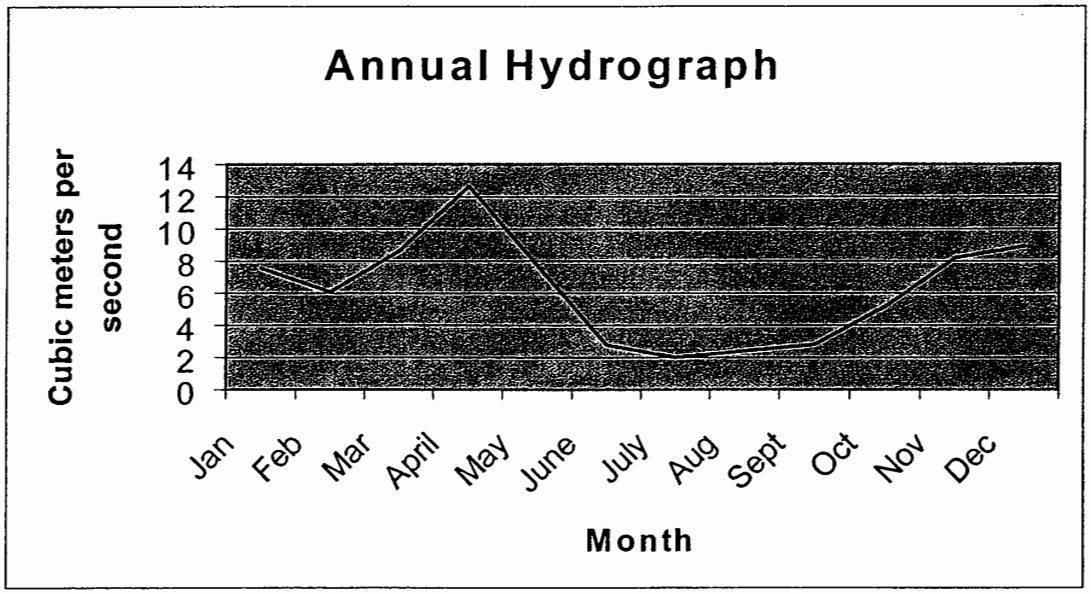
location. The annual hydrograph is typical of a natural flowing river in Nova Scotia with spring peak flows occurring in April and the low (predominantly base flows) occurring in July, August and September.

The study area is located in the lower reaches of the South River watershed. Although not proven through measurements during this investigation, it is typical of the lower portions of the watershed to be regional groundwater discharge areas. Groundwater recharge generally occurs in the upper reaches of the system and tends to discharge through the base of the riverbed in the middle and lower reaches of the system. In this context, one of the hydrologic functions of the wetland area at this location would therefore be ground water discharge. This function will be of particular importance during the summer low flow months when stream flow is almost entirely dependent on ground water discharge.

Figure 3 - South River at Highway 104



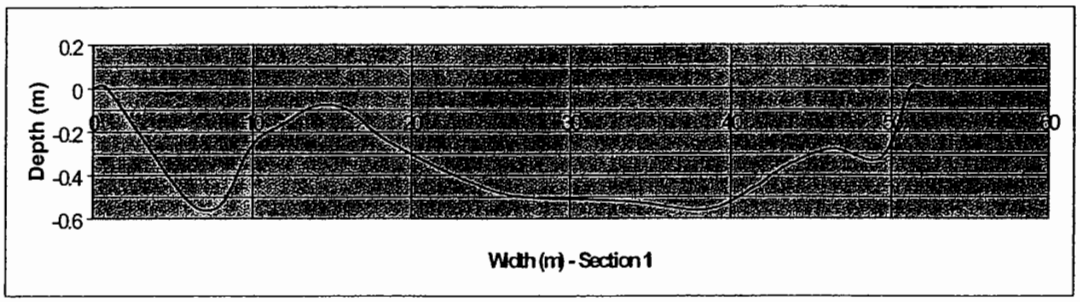
Local

The main channel of the South River at the study area location is approximately 50 m wide. Review of historical photos of the study area and visual observations at the site indicate that prior to construction of the existing Highway 104 and bridge, that the South River flowed through two channels (main channel and back channel) at this location. The back channel was infilled in the course of constructing the existing bridge, causing the entire South River flow to be diverted to the main channel. The original back channel is still in existence downstream of the existing Highway 104 bridge structure, however does not serve a hydraulic function in terms of flow conveyance. The back channel now serves as a "back water" to the main channel.

Two attempts were made to measure flow in the main channel on September 29 and October 4, 2000. On each occasion, water velocities were too low to record a velocity reading on the stream flow equipment used. Moderate northerly winds funnelled up the river valley on both days and contributed to the difficulties in measuring flow. Given the

geometry of the river cross section as measured during the field visits and illustrated on Figure 4, average flows for September and October of approximately 2 m^3 per second (see annual hydrograph) would yield velocities of slightly less than 0.1 m/sec. This low velocity approaches the lower limit of the stream gauging equipment used at 0.06 m/sec. It suffices to say that the velocities would be low at this time of year and given the wind conditions on the days of the field visits, stream velocities were not high enough for accurate measurements.

Figure 4 - Section through Main Channel (Water elevation = 0)



The peak flows in South River typically occur in April, with flows reaching 11 m^3 per second (5 times the late summer base flows). Interviews with local residents indicated that the dry land between the main and back channel often floods during the spring high flows. Field observations and discussions with Mr. Partridge (owner of home on the east side of channel) indicated that the typical spring high water mark was estimated to be 0.75 meters higher than the top of bank. At this point in time, the flood plain inundates the dry land or island between the main channel and back channel yielding a flood plain width of approximately 150 meters to accommodate the higher flows. Given the width of the floodplain, stream flow velocities during the spring peak flows are anticipated to be similarly low (less than 0.1 m/sec).

The substrate of the main channel is predominantly gravelly and given the relatively low stream velocities at this location, are not at risk to mobilization throughout the course of the hydrograph.

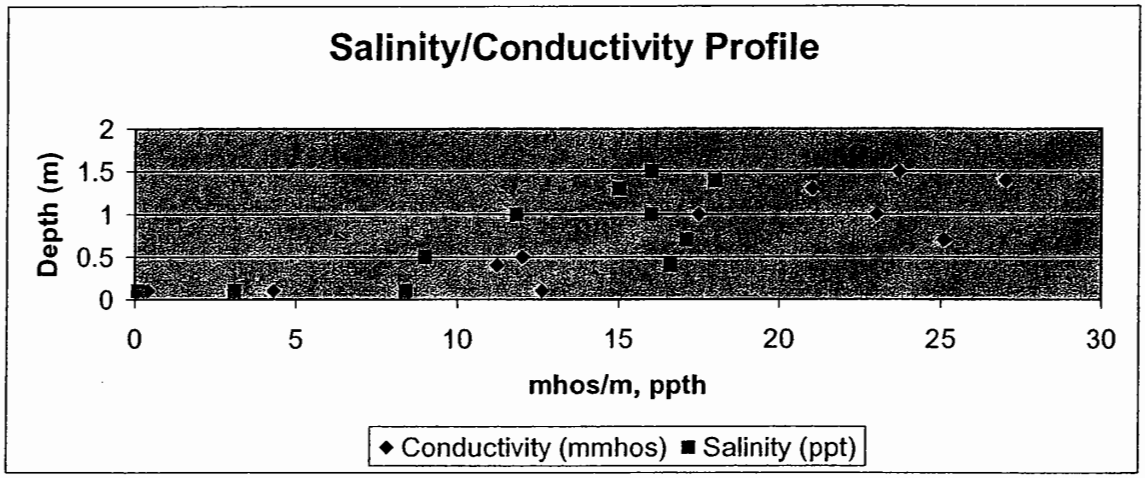
Water Quality

Salinity, conductivity and temperature measurements were collected at regular intervals across the main channel and back channel sections, at varying depths and at several times during the tidal cycle. The water quality measurements confirmed the estuarine nature of South River at this location. The study area is in a transition zone from a fresh water environment to a salt water environment. Typically, in such situations, the upper portion of the water column is predominantly fresh water and the lower portion of the water column is brackish (mixture of salt water and fresh water).

Salinity measurements ranged from 0.1 parts per thousand (ppt) at the surface to 18 ppt at depths of 1.6 m. Salinity measurements in typical ocean water are in the range of 30 to 35 ppt. Conductivity measurements ranged from 4 millimhos per cm (mmhos/cm) at surface to 28 mmhos/cm at depths of 1.6 m. There were no discernible differences in the salinity profile between locations in the main channel and back channel. Salinity and

conductivity data are tabulated in Appendix E. The salinity and conductivity both indicate the water to be brackish with the salt content higher at depth than at the surface. The shallow nature of the channel and the wind conditions on the days of the measurements likely created a significant amount of mixing in this fresh water/salt water interface. As a result, the physical conditions lending to a clear layering of waters that might be found in deeper less agitated estuaries were not present at this location. The data does point to an increase in salinity and conductivity with depth with deeper waters still a mixture of fresh water and salt water (brackish). Figure 5 depicts the results of the salinity and conductivity measurements with depth.

Figure 5 - Salinity/Conductivity Profile at Study Area



The brackish water quality as a result of tidal and fresh water influences is indicative of a fresh water tidal marsh. Other characteristics of a fresh water tidal marsh are described in the following sections of this report.

Important hydrologic characteristics and functions of the study area include:

- Average flow conveyance in the main channel;
- Flood storage and conveyance in the main channel, back channel, and island; and
- Characterised as brackish water indicating an intertidal zone.

3.3 Vegetation

South River is a sub-unit of the Antigonish Uplands. It falls within Loucks' sugar maple-hemlock, pine zone, at the boundary between two ecoregions; a northerly one in which conifers predominate among scattered deciduous stands, and a more southerly one in which shade-tolerant species are found on a wider range of sites. To the west, sugar maple, yellow birch, and American beech are common, with spruce, eastern hemlock, pine, red maple and birch on less well-drained sites. Oldfields regenerating in white spruce are common (Nova Scotia Museum of Natural History, 1997).

The island site at the proposed bridge location is characterized by plant species common to many marsh areas. Five of these plants are salt-tolerant and can be found in brackish water, although none are restricted to such habitats. These include freshwater cord grass, *Spartina pectinata*, bluejoint grass, *Calamagrostis canadensis*, wild rose, *Rosa virginiana*, and the two bulrushes, *Scirpus acutus* and *S. validus* .

The riverbanks site is characterized mainly by mixed/hardwood forest. Vegetation found during the field survey include trees such as balsam poplar, red oak, speckled alder, sugar maple, and white spruce, as well as plants such as Canada goldenrod, chokecherry, coltsfoot, quackgrass, bayberry, orchard grass, and wild carrot.

The general vegetation units (marsh and mixed wood) are indicated on Map No. 1. It is important to note that the vegetation types, particularly in the island and near shore areas are typical of intertidal areas with a mixture of salt and fresh water species.

3.4 Benthic Invertebrates

Benthic invertebrate analysis were carried out on samples collected from seven stations as indicated on Map No. 1.

No benthic species were found in Stations 1 and 2. Stations 3 and 4 had six marine benthic species (*Hydrobia totteni, Nereis diversicolor, Corophium lacustre?, Gammarus tigrinus,* Platyhelminthes, marine oligochaeta) and one freshwater benthic species (chironomidae). Station 5 had four marine benthic species (*Hydrobia totteni, Corophium lacustre?, Gammarus tigrinus,* marine oligochaeta) and three freshwater benthic species (chironomidae, elmidae, trichoptera). Station 6 had two marine benthic species (*Gammarus tigrinus*, marine oligochaeta) and two freshwater benthic species (anisoptera, chironomidae). Station 7 had three marine benthic species (*Corophium lacustre?, Gammarus tigrinus,* marine oligochaeta) and three freshwater benthic species (ceratopogonidae, chironomidae, elmidae).

It is important to note here as well that benthic species are indicative of both salt and fresh water environments that were identified in the study area. This is in keeping with the water quality data and the vegetation units identified earlier.

3.5 Fish and Aquatic Habitat

Fish and aquatic habitat are described in relation to field investigations of the study area and a review of upstream and downstream fish migration in the South River.

Aquatic habitat consists primarily of a main river channel on the east and a backwater channel to the west. Both channels conveyed water prior to construction of the existing Highway 104 bridge. Construction of the bridge blocked the west channel, which has since accumulated a 10 cm layer of organic/silt deposits over an original substrate of medium to fine gravel. Apart from this relatively thin deposition layer, the substrate is consistent throughout the study area, but water depths vary from between 0.3 and 2 m at mean tide. A backwater channel, similar to the west channel, enters the center of the study area's island from the north.

Six minnow traps distributed around the study area caught between 62 and 115 mummichog, *Fundulus heteroclitus.* Fish ranged in size from 3.5 cm to 11 cm. The average size was 5.35 cm. Large numbers of mummichog were also observed in the central island channel during trap collection.

The mummichog is an inhabitant of marshy areas and brackish-water ponds, preferring regions where there is submergent or emergent vegetation (Scott and Scott, 1988). It may live in situations where it is likely to be trapped by tidal movement or by the drying up of small ponds. They are common in estuaries throughout Nova Scotia. Spawning occurs in midsummer.

One white sucker, *Catostomus commersoni*, of length 7 cm was caught in the minnow trap closest to the highway bridge, but not in any other trap.

White suckers are usually fish of warmer, shallow lakes or warm, shallow bays, and tributary rivers of larger lakes. They spawn in the spring, usually from early May to early June (Scott and Crossman 1973).

During salinity profiles and recovery of minnow traps, temperatures ranged from 16 degrees Celcius at the east channel to 20 degrees Celcius at the middle bay. Conductivity ranged from 0.4 at the main channel at the bridge to 27 at the outer west channel. Salinity ranged from 0.1 at the main channel at the bridge to 18 at the outer west channel.

Overall, the study area appeared to be equally productive for fish in the main and side channels. The area does not likely provide spawning habitat for any species, but the large numbers of mummichog undoubtedly provide an important source of food for other fish and birds.

Fish Migrations

A counting fence was operated between 1983 and 1987 on the South River, approximately one km upstream of the TransCanada Highway where tidal influence is minimal. Movements of Atlantic salmon, *Salmo salar*, brook trout, *Salvelinus fontinalis*, rainbow trout, *Salmo gairdnerii*, brown trout, *Salmo trutta*, gaspereau, *Alosa pseudoharengus*, rainbow smelt, *Osmerus mordax*, white perch, *Morone americana,* yellow perch, *Perca flavescens*, white sucker, and American eel, *Anguilla rostrata*, were monitored through a two-way fish fence from May to November. Table 1 shows the time and direction of fish movement in South River during these years. Only results for prevalent fish species are given.

Table 1: Upstream and Downstream Movements of Major Fish Species at the South River Counting Fence, 1983-87.

Date	Atlantic Salmon	Brook Trout	Rainbow Trout	Brown Trout	Gaspereau	Smelt
May	Downstream	Downstream Upstream	Downstream Upstream	Downstream Upstream	Downstream Upstream	Downstream Upstream
June	Downstream	Downstream Upstream	Downstream Upstream	Downstream Upstream	Downstream Upstream	Downstream Upstream
Jul 1-15	Downstream	Downstream Upstream	Downstream Upstream		Downstream Upstream	
Jul 16-31					Downstream	
Aug 1-15						
Aug 16-31						
Sep 1-15						
Sep 16-30						
Oct 1– 15	Upstream					
Oct 16–31	Upstream			Downstream		
November	Upstream					

Atlantic Salmon move up rivers in order to spawn from spring through fall. Spawning occurs during October and November usually in gravel-bottom at the head of riffles or tail of a pool. After about 3 years in fresh water, salmon parr turn into smolts and prepare for life in saltwater. During the spring run-off, smolts form schools and migrate downstream at night. In South River, the majority of salmon smolts migrated downstream in May, with low numbers continuing in June and early July. Upstream migration in October was primarily large salmon.

In 1997, anglers only reported a total of 4 salmon on South River in comparison with 46 in 1996. The low number for 1997 is not unusual for the South River where catch reports are often just a handful of fish; the 1987-96 average total catch for the river was 11 fish as a result of a number of years when no fish were angled (DFO, 1998).

Brook trout usually move downstream to the sea in spring in order to feed and return to freshwater streams in July and August. Spawning takes place in late summer or fall. Not all brook trout in a population will go to sea, some may choose to remain in fresh water (Scott and Scott, 1988). In South River, major upstream and downstream movements occurred concurrently during May, June and early July.

Rainbow trout spawn from March to May in small tributaries of rivers, or in inlets or outlets of lakes. Spawning can also take place in late fall or early winter (NS Department of Fisheries and Aquaculture, 2000). Rainbow trout are not native to South River. They are released annually from the hatchery on the river for recreational

purposes. Major upstream and downstream movements of rainbow trout occurred concurrently during May, June and early July.

Brown trout is an introduced species in Atlantic Canada. Some migrate to sea (sea trout) and return to fresh water in the fall. Spawning takes place in late fall or early winter (Scott and Scott, 1988). Apart from moving upstream to spawn, adults tend to stay at the same place in a river with very little movement to other stream areas. Others move to or from estuaries in the spring or fall. In South River, major upstream and downstream movements of brown trout occurred concurrently during May and June. Another downstream movement by brown trout occurred in late October. Sea trout movements through the study area peak in June (Charles MacGinnis, *pers. comm.*).

Rainbow smelt are anadromous and move into estuaries in the fall and to streams after the spring thaw. Spawning occurs from February to June at night in fast moving water (NS Department of Fisheries and Aquaculture, 2000). In South River, major upstream and downstream movements of smelt occurred concurrently during May and June.

Gaspereau are an anadromous species living most of its adult life at sea, entering fresh water only to spawn. Spawning takes place in the spring in lakes, ponds, rivers, and streams above the head of tide. They may also live throughout their lives in fresh water, when they are referred to as 'landlocked' (Scott and Scott 1988). Gaspereau began to arrive upstream in South River during mid-May and stayed for only a few weeks before migrating downstream. Population numbers of gaspereau reached thousands downstream by late June and movement continued at lower levels throughout July. Gaspereau in South River are usually quite active in June and July (Charles MacGinnis, DFO Antigonish, *pers. comm.*).

Low numbers of white perch, yellow perch, white sucker, and American eel were also counted from 1983 to 1987. White perch is an anadromous species but is mainly restricted to freshwater lakes and rivers. Yellow perch are generally found into the lakes, but often move into tributary rivers to spawn. White sucker are widespread in Nova Scotia, but are restricted to freshwater habitats.

American eels leave the sea, enter fresh water early in development, and remain there throughout life, returning to the sea to spawn and presumably die (Scott and Scott, 1988). In South River, upstream movement occurred in July, August, and September, however, the maximum number of eels trapped in any year was only 2. Eels were travelling downstream from May to July and from September to November.

American shad may also be found in South River (Charles MacInnis *pers. comm.*). American shad migrate from the sea into coastal rivers in spring to spawn. Spawning normally occurs in May, June, or even July (Scott and Scott 1988). Fourspine stickleback, *Apeltes quadracus*, and Atlantic silversides, *Menidia menidia*, might also be found in South River. These fish are found in many lakes and streams throughout Nova Scotia. Atlantic silversides are found in West River, Pictou County.

Important characteristics and functions identified through the fish and aquatic habitat analysis included:

- The main channel and back channel areas are equally productive in terms of fish habitat;
- The area supports a relatively high quality recreational fishery for game species like brook trout, brown trout and Atlantic Salmon; and
- The primary function for game species is fish passage (spawning habitat is not present for these species).

3.6 Amphibians and Reptiles

The study area is not particularly important for amphibians and reptiles, but wood turtle, snakes, salamanders and frogs occur in the area. Wood turtle, *Clemmys insculpta*, habitat surrounds the study area. Snapping turtles, *Chelydra serpentina serpentina* are generally found south of the St. Mary's River, but at least one specimen has been observed near the study area (Mr. Pulsiver, *pers. comm.*). No uncommon snakes are known to occur in the area.

Yellow-spotted salamanders, *Ambystoma maculatum*, and blue-spotted salamanders, *Ambystoma laterale*, are common at South River. Eastern redback salamanders, *Plethodon cinereus*, may be found in the forest. There is no sphagnum to provide sufficient habitat for four-toed salamanders, *Hemidactylium scultatum*.

The northern leopard frog, *Rana pipiens*, and pickerel frog, *Rana palustris*, may occur along the river sides but in general, amphibians don't like salt water.

3.7 Birds

The bird survey was done in the late season on a date very much after most breeding birds had left. Therefore, it was too late to confirm breeding of any species. The eleven species seen on that date represent a small portion of the avifauna of the study site.

Bird species seen on 14 October, 2000 were great blue heron, *Ardea herodias*, American black duck, *Anas rubripes*, green-winged teal, *Anas crecca*, common merganser, *Mergus merganser*, herring gull, *Larus argentatus*, rock dove, *Columba livia*, American crow, *Corvus brachyrhychos*, black-capped chickadee, *Poecile atricapilla*, golden-crowned kinglet, *Regulus satrapa*, European starling, *Sturnus vulgaris*, and red-winged blackbird, *Agelaius phoeniceus*. All but the great blue heron and the golden-crowned kinglet are listed as confirmed breeding birds by Erskine (1992) in the 10 km square in which the study site is located.

Bird species previously recorded using the study area by Randy Lauff and that have confirmed breeding bird status by Erskine (1992) include the pied-billed grebe, *Podilymbus podiceps*, mallard, *Anas platyrhychos*, osprey, *Pandion haliaetus*, bald eagle, *Haliaeetus leucocephalus*, red-tailed hawk, *Buteo jamaicensis*, belted kingfisher, *Ceryle alcyon*, blue jay, *Cyanocitta cristata*, common raven, *Corvus corax*, American robin, *Turdus migratorius*, cedar waxwing, *Bombycilla cedrorum*, common yellowthroat, *Geothlypis trichas*, Nelson's sharp-tailed sparrow, *Ammodramus nelsoni*, song sparrow, *Melospiza melodia*, swamp sparrow, *Melospiza georgiana*, common grackle, *Quiscalus quiscula*, and American goldfinch, Carduelis tristis.

Bird species previously recorded using the study area by Randy Lauff but not listed as confirmed breeders by Erskine (1992) include rose-breasted grosbeak, *Pheucticus ludovicianus*, rusty blackbird, *Euphagus carolinus*, wood duck, *Aix sponsa,* black-headed gull, *Larus ridibundus*, ring-billed gull, *Larus delawarensis*, and yellow-rumped warbler, *Dendroica coronata.*

The area immediately to the west and to the south of the proposed bridge location is classified by the Canadian Land Inventory (CLI) as having moderately severe limitations to the production of waterfowl. Limitations are due to adverse topography; either steepness or flatness of the land may limit the development of permanency of wetlands, and landform; poor distribution or interspersion of marshes or basins may be a limiting factor of the land and may prevent the development of optimum waterfowl habitat.

To the north of the study area is Antigonish Harbour, which has been classified by CLI as being an important migration or wintering area for waterfowl, although they may not be useful to waterfowl production. Lands immediately to the west and east of Antigonish Harbour have severe limitations in which almost no waterfowl are produced. Limitations to the west are due to adverse topography whereas limitations to the east are due to adverse topography, landform, as well as inundation in which the limiting factor is excessive water level fluctuation or tidal action, which adversely affects the habitat or the nesting success of waterfowl.

Salinity and tidal action keep coastal waters open later in fall and earlier in spring than most freshwater areas. Generally, the areas most frequented by waterfowl and other aquatic birds – the shallow, sheltered waters and adjacent shores – are the first to become ice-bound and the last to open (Nova Scotia Museum of Natural History 1997).

The marsh at Lower South River acts as a thoroughfare for brood-rearing waterfowl such as American black ducks. In addition, green-winged teals likely breed here. Perhaps most importantly, the area is a small migratory stopover site for ducks in both spring and autumn. In particular, the spring migration at this site hosts many wood ducks, a species which never returned to numbers seen prior to hunting becoming regulated.

Staging of migratory dabbling ducks, especially black ducks and the teals, mostly occurs in salt marshes and adjacent open-water areas. Green-winged teals depart in October, but many black ducks remain all winter, withdrawing to the southwest as other areas are closed to them.

Two bald eagle nests are within two kilometres of the study site. The adults forage at the study site throughout the nesting season (April – August) and throughout the rest of the year as long as the river is not frozen. The study site also provides many snags and live trees that osprey can use as hunting perches.

3.8 Mammals

The Northumberland Strait is an excellent area for coyote, muskrat, beaver, mink, fox and raccoon. Squirrels, rabbits, fox, deer and bear have also been found in the area. There are undoubtedly numerous other mammals in the area, particularly rodents, insectivores, and mustelids (NS Museum of Natural History, 1997).

South River is a sub-unit of Antigonish Uplands. The Antigonish Uplands provides mainly forested habitats, with cliffs along St. Georges Bay. Information on small mammals is lacking, but diversity is thought to be moderately high (NS Museum of Natural History, 1997).

The Canada Land Inventory classifies South River as an area of high capability with lands that have very slight limitations to the production of ungulates. Slight limitations are due to excessive soil moisture.

3.9 Rare or Endangered Species

Rare animals are those non-introduced or non-domesticated species which occur in only a few localities in the province and/or are represented by relatively few individuals (NS Museum of Natural History 1997). No authoritative list has yet been published of the animals considered to be rare in Nova Scotia. COSEWIC has assigned status (endangered, threatened, vulnerable) to a portion of our plant and animal species.

No plants listed by COSEWIC or by the Nova Scotia Endangered Species Act were found at the study site, however the ground-nut, found at the island site, was a new record for Antigonish County. This should not be a problem since it is common further west in Nova Scotia and in Canada.

No fish listed by COSEWIC or by the Nova Scotia Endangered Species Act were found at the study site, however, Atlantic salmon and brook trout are protected by seasons and/or by bag limits under the Fisheries Act. In 2000, sport fishing in South River, downstream from the bridge that marks the outlet of Lock Katrine (South River Lake), began on April 15th, unlike the common date of April 1st that occurred throughout most of the province. The delay was set in order to protect Atlantic salmon and sea-run trout stocks in the area that are particularly vulnerable at that time of year.

Due to overfishing and the destruction of habitat, salmon no longer can be found in much of its original range and the numbers of fish have seriously declined (NS Department of Fisheries and Aquaculture, 2000). The salmon fishing season has therefore been restricted to September and October and only catch and release is allowed.

Many populations of brook trout in Nova Scotia have declined. They are vulnerable to overfishing and human practices that affect their habitat (Nova Scotia Department of Fisheries and Aquaculture, 2000). In September, anglers were reminded to catch-and-release brook trout, and restrict the use of bait when angling in freshwater for brook trout, brown trout, rainbow trout and landlocked salmon. Brook trout are particularly vulnerable to angling in September when they school near the mouths of streams prior to spawning. In October, no brook trout can be retained.

There are no threatened or endangered herpetile species at or surrounding the study area.

Erskine lists the common loon, *Gavia immer*, common tern, *Sterna hirundo*, arctic tern, *Sterna paradisaea*, and piping plover, *Charadrius melodus* as having confirmed breeding status in the 10 km square in which the study area is located (Appendix B). The

common loon, common term, and arctic tern have been given yellow (cautionary) status by NSDNR and the piping plover has been listed as endangered by Canadian Species at Risk (COSEWIC). Although listed as confirmed breeding birds, none have been reported breeding within the study area, and the site does not provide sufficient breeding habitat. Common loons mainly breed on islands within freshwater lakes, common and arctic terns breed very close to open bodies of water, mainly on beaches of coastal islands, and piping plovers breed on sandy beaches. Nelson's sharp-tailed sparrow likely breeds at or near the study site. Singing males have been heard which is an indicative of at least a desire to nest. This species has been given yellow (cautionary) status by the Nova Scotia Department of Natural Resources (NSDNR). Nelson's sharp-tailed sparrow usually arrives in numbers during the first two weeks of June and last sightings are usually in October (Tufts, 1986).

3.10 Coastal Freshwater Marsh

The study area can be classified as coastal freshwater marsh. Coastal freshwater marshes are marine intertidal areas with soft substrate, colonized predominantly by grasses. They occur only where there is regular flooding and nearby sources of fine sediment. They are widely distributed in small areas all around the province, especially associated with salt marshes, and form when the effect of salt water on the low-lying coast is moderated by freshwater runoff. Where this occurs, the salt-tolerant plants of the intertidal zone give way to non-tolerant species (Nova Scotia Museum of Natural History, 1997)

Coastal fresh marshes are highly productive systems with abundant nutrients. The primary production is largely carried out by grasses, sedges and rushes, and is either consumed or accumulates on site, adding organic material to the soil. Consumers on site include insects, waterfowl and small mammals.

The aquatic fauna in coastal fresh marshes is generally poor, being restricted to insects and their larvae – water boatmen (Corixidae), flies and mosquitoes and succineid snails. The bird and mammal life is important, particularly waterfowl, muskrat, raccoon, mink and small mammals. The Northern Harrier nests on the ground in this habitat. Erskine (1992) lists the Northern Harrier as being a probably breeder in 10 km square in which the study site is located.

3.11 Uses of the Area

Recreation

The Canadian Land Inventory defines South River as having lands in which there is moderately low to low capability for outdoor recreation. These lands can provide and sustain moderately low total annual use based on dispersed activities.

Positive aspects of the land at or surrounding the study area include frequent small water bodies or continuous streams occurring in upland areas; water affording an opportunity for angling or viewing of sport fish; landscape patterns of agricultural, industrial, or social interest; interesting rock formations; a variety, in topography or land and water relationships, which enhances opportunities for general outdoor recreation such as hiking and nature study or for aesthetic appreciation of the area; and a vantage

point or area which offers a superior view, or a corridor or other area which provides frequent viewing opportunities (Canada Land Inventory).

Fishing is the major recreational activity within the study area. The recreational fishing season in 2000 for South River for species other than Atlantic salmon, downstream from the bridge that marks the outlet of Lock Katrine (South River Lake), was from April 15th to October 15th.

April is the most popular month for sport fishing at which time anglers are seen lining the riverbed at the existing bridge and at the trestle downstream from the study site (Charles MacInnis *pers. comm.*). During this time, brook trout, rainbow trout, brown trout, gaspereau, and smelt are highly active travelling both upstream and downstream. In June, angling effort is focused on searun brown trout, which move up and down the river (Charles MacInnis *pers. comm.*). Striped bass are fished primarily from the railway trestle downstream of the study area.

Throughout July, August, and early September, little angling occurs at the existing bridge. The salmon fishing season is from September 1st to October 31st, but anglers mainly begin to fish for salmon in October (Charles MacInnis *pers. comm.*).

Land Use

Coastal areas of the Northumberland Plain had traditionally been the summer camps of the Mi'kmaq. Settlers of largely English and Scottish descent cleared much of the land for agriculture, which continues to be an important economic activity. Farming, forestry, and fishing also serve as the economic base for most communities here.

Logging and small farming in valley intervales characterize much of the land use in the Antigonish Uplands. In the South River area, limestone is quarried at Antigonish. The Fraser Mills Fish Hatchery raises small fish for lake stocking programs throughout the province and an exhibition centre at the operation provides information on the hatchery and local angling.

In terms of agriculture, soils at and surrounding the study area are defined by CLI as having moderately severe limitations that restrict the range of crops, require special conservation practices, or both. Flooding by streams and steepness or patterns of slopes or lakes limit agriculture use. Soil limitations may be due to either low permeability, a restricted rooting zone because of soil characteristics, low natural fertility, low moisture-holding capacity, or salinity.

3.12 Archaeological Investigation

Much of the land on the western side of the river within the development area has been disturbed by recent plowing as well as by erosion resulting from the river's action. Although the eastern area was once the site of much cultural activity, little evidence of that activity remains. Previous construction has resulted in the destruction of many of the nineteenth century buildings that were located here. The only observed remnant of past features is an 1853 bridge footing which has, for the most part, been destroyed by previous construction and/or the tidal action of the river. Due to the recent age of the feature in question as well as the impact it has been subjected to by past construction activities, it is of low archaeological significance.

The area (intersection of existing Highway 104 and driveway for Partridge residence) in which the nineteenth century carriage house was located is of concern since it is located within the study area. There have been high levels of modification to this area by way of construction of nearby houses and associated landscaping as well as by construction of the Trans-Canada Highway. It is possible that evidence of this structure remains beneath the existing highway and will be impacted by construction.

Although the cemetery to the north of the study area as well as the early nineteenth century house to the west are located outside the study area, they are of high archaeological significance.

The entire report an Archaeological Resources is contained in Appendix F.

4.0 WETLAND EVALUATION

The Wetland Evaluation Guide (Bond et al., 1992) provides a comprehensive methodology for reviewing potential impacts on wetlands based on a project's effect on functions. Functions are divided in those providing life support, social-cultural uses, and resource production. The evaluation compares effects on functions compared to project benefits. Functions viewed as particularly important are identified as critical values, and are summarized at the end of this section. Detailed information on the wetland evaluation process in the tables provided in Appendix F.

The Regional Context

In terms of evaluating the regional significance of the South River Coastal Freshwater Marsh area, it is helpful to consider it in terms of other coastal wetlands/marshes in the region. Two such areas include Pictou Harbour Estuary and Pomquet Harbour. Pictou Harbour is approximately 100 km to the west of the study area, and Pomquet Harbour is eight kilometres to the east.

Pictou Harbour

Pictou Harbour Estuary is in a lowland area bordering the Northumberland Strait and abutting the Pictou-Antigonish Highlands. Recreational fishing for trout and salmon is popular and the East River has an important salmon run. Mackerel, eels, smelt, and gaspereau are fished commercially in the estuary and recreational fisheries for mussels and oysters occur. Boating and sailing are popular, and the harbour supports a yacht club and a marina. High-use beaches are along the Northumberland Strait Shore.

The Pictou Estuary is also a migratory bird staging area and is locally important for ducks and geese. Open water in winter at the Pictou causeway and in the East River at the mouth of Lowden's Brook attracts a variety of migratory waterfowl including black ducks, goldeneye and mergansers. A breeding colony of double-crested cormorants occurs next to the causeway, and bald eagles and osprey nest and feed in the area. Lighthouse Beach is known to have supported breeding piping plover.

Pomquet Area

Perhaps the wetland with the greatest value within the Northumberland Plain region is *Pomquet Beach*. Pomquet Beach is located at the southwestern corner of St. George's Bay and consists of a numerous series of parallel dune ridges forming a very wide, barrier beach across Pomquet Harbour. Pomquet Beach has a complete dune succession from beach to forest (Dalhousie University, undated). The Grey dune grades gradually into an open grassland community in the eastern half of the system. The grassland in the east and grey dune in the west merge into a belt of heath shrubs and scrub forest which separates them from the main forest. The rare bastard toadflax is common in the heath area, its only known location in mainland Nova Scotia.

The Pomquet area salt marsh is narrow at the east becoming progressively wider along the harbour channel and then expanding at the eastend in the lagoon area. There are numerous zones of vegetation in this marsh, the most noticeable of which are a cord grass community, a *Spartina patens* community, and an upper band of rushes. The frequent flats are dominated by arrow grass and sea milkwort.

The rich and varied habitat contains a wealth of wildlife. There are at least 8 species of warblers, 4 species of sparrows, 3 species of thrush, several species of flycatchers and several other songbirds breeding in the area. Common and roseate terns, willets, semi-palmated plovers and spotted sandpipers breed in the salt marsh and lagoon area. Blue heron, ospreys and marsh hawks are commonly seen and presumably breed nearby. The freshwater swamps support populations of breeding black and blue-winged teal ducks. Saw-whet, barred and great-horned owls also occur in the area. Squirrels, rabbits, fox, deer and bear have been found at Pomquet Beach. There are presumably numerous other mammals in the area particularly rodents, insectivores, and mustelids.

South River Coastal Freshwater Marsh

The South River Coastal Freshwater Marsh is typical of the estuarine environments in the Georges Bay area. In comparison to other coastal features, for example the Pomquet Beach Marsh is more unique and sensitive with its sand dune structures. Although, the South River Coastal Freshwater Marsh is not rare or unique in a regional context, it does provide important local habitat, hydrologic and social/cultural functions as described in the detailed wetland evaluation.

4.1 Life-Support Functions

Life-support considerations include hydrological, biogeochemical, habitat, and ecological functions. Hydrological functions examine the function of the wetland primarily in relation to its effect on downstream flows. The study area is located at the lower end of the watershed, minimizing its role in flood reduction. It has a role in reducing tidal effects in upstream areas, but the influence of tidal effects is relatively small. The marsh does contribute to usable surface water but it is a small proportion of the saltwater wetlands in Antigonish Harbour. All hydrological functions are relevant at the local levels.

The study area is typical of the freshwater saltwater interface in most estuaries of the province, but nonetheless, the mix of salt and fresh water is relatively uncommon aquatic habitat. The intrusion and mixing of the heavier salt water provides nutrients that support high levels of production, notably in forage fish species, such as mummichogs. In terms of biogeochemical function the study area has high nutrient levels which support significant wildlife populations at a regional level. As a result, it is an important feeding area for various bird and fish species, however, larger populations of migratory birds and a greater diversity of fish species exist seaward (downstream) of the study area. It may also be possible that the marsh provides storage for agricultural run-off since there is a field nearby. In terms of wildlife habitat, the marsh contains high quality significant habitat for migratory birds as well as habitat for sport and/or commercial fish. The marsh provides a feeding area for migratory birds and may also serve as a breeding ground for some species such as green-winged teal. The marsh also acts as a critical migration route for several important recreational fish species such as Atlantic salmon and brook trout.

More significant bird habitats within the Northumberland Plain are located around Fox Harbour, Wallace Harbour, Tatamagouche Bay, Brule Harbour, and John Bay, where large numbers of ducks and geese congregate in late March and early April, and again in September until ice forms in December. Other important areas include Coldspring Head and the mouth of the Shinimicas River, Pugwash Harbour, River Philip, West

River; Little Harbour and Merigomish Harbour (NS Museum of Natural History, 1997). Important wildlife management areas within the Northumberland Plain region include: Wallace in Cumberland County, Abercrombie in Pictou County and the Brule Point Game Sanctuary in Colchester County. Rare or vulnerable animal or plant species may occur in or near the study area. Nelson's sharp-tailed sparrow likely breeds in the area and has been given cautionary status by the Nova Scotia Endangered Species Act. Wood turtles, are listed as vulnerable by COSEWIC, have been seen near the area (Mark Pulsifer, NS Natural Resources, *pers. comm.*). Plant species listed as rare in Roland and Smith (1969) have also been found near the study area (Barry Taylor, St. Francis Xavier University, *pers. comm.*). These include blue vervain, *Verbena hastata*, bluegrass, *Poa alsodes* and feverwort, *Triosteum aurantiacum*. It is also possible that the marsh provides significant habitat for crustaceans and mammals, and may also help to protect natural shorelines. The study area also has a high biological diversity, but still probably lower than many other parts of Antigonish Harbour where true salt marsh exists.

4.2 Social/Cultural Values

Social/Cultural functions considered include aesthetics, recreational, education and public awareness, public status, and cultural attributes. The study area is visible from Highway 104, a provincial highway. The marsh provides a valuable aesthetic or open space function that adds to the visual diversity of the landscape. The view is not unique in the region, however, and other nearby views are of equal of greater value. The study area also provides opportunities for recreation, such as canoeing and high quality sport fishing. Recreational fishing could be disturbed by construction, but a relatively large window exists during the summer when little or no activity occurs. The marsh may also provide a base for viewing or photographing wildlife, such as migratory birds, but access to the area will remain largely unchanged.

The study area is close to Antigonish, a relatively large urban population providing potential roles in education and public awareness.

The marsh forms part of the historical/cultural heritage of the region because it rivers and estuaries have all been important areas to First Nationals and early settlers. The study area may also provide traditional use, such as fishing for food or ceremonial purposes, for aboriginal peoples.

4.3 Wetland Production Values

Wetland production functions considered include agriculture, renewable and non-renewable resource extraction, tourism and recreation, and urban values.

Agricultural, non-renewable resource, and urban use of the study area has not been identified. The study area provides opportunities for non-commercial uses of fish, wildlife, and/or water resources primarily through sport fishing. The marsh also has the potential to be used for commercial or subsistence hunting, trapping and fishing by aboriginal peoples. Recreational fishing in the area is the primary tourism and recreation use of the study area. The large number of anglers suggests a regional importance, and purchase of equipment, services, food and accommodations no doubt provides benefits to the regional economy.

4.4 Project Benefits

Project benefits considered include employment, economic, production, and urban/industrial infrastructure development benefits. Employment benefits will result from the stimulation of new employment opportunities or stabilization of existing employment levels in the region. The role of the project in stimulating job benefits is low because the project is short-term. Possible economic and production benefits may result from improved transportation into and through the area. The road will improve a major transportation link in the region, generally improving the urban/industrial infrastructure. Alternative routes for the highway would probably have similar benefits.

4.5 Summary of Critical Values

In the wetland evaluation process, some issues and functions are considered more important than others, and are identified as critical values marked by an asterisk (*) in the detailed tables in Appendix G. Critical value notation indicates a wetland value whose product, service, or function is very important to society or where an important threshold or function may be exceeded, resulting in the loss of the function and value (Bond et al., 1992). A total of five critical values were identified in the wetland analysis of potential impacts on functions (Table 2).

Table 2: Summary of Wetland Significance and Expected Impact.

	Number of Critical Values	Level Criterion	Expected Impact
		N, P, R, L, NE	H, M, L
LIFE-SUPPORT VALUES			
Hydrological Values	2	L	L
Biogeochemical Values			
Habitat Values	1	R	L
Ecological Values	1	L	L
SOCIAL/CULTURAL VALUES			
Aesthetic Values			
Recreational Values			
Education and Public Awareness Values			
Cultural Attribute Values			
PRODUCTION VALUES			
Agricultural Values			
Renewable Resource Values			
Non-renewable Resource Values			

	Number of Critical Values	Level Criterion	Expected Impact
Tourism & Recreational Values	1	R	L
Urban Values			
TOTAL OCCURRENCES	5		

Legend

N	=	National
P	=	Provincial
R	=	Regional
L	=	Local
NE	=	Negligible
H	=	High
M	=	Moderate
L	=	Low

Two critical values were noted under hydrological values because the marsh provides flood protection benefits and serves to reduce tidal impact. Only minor displacement of flood and tidal water occurs, therefore expected impact due to bridge construction is low.

One critical value was listed under habitat values since the marsh contains high quality significant habitat for migratory birds. Expected impact from bridge construction is again low because there is more suitable habitat for migratory birds further downstream and within Antigonish Harbour.

One critical value was listed under the ecological values section of the wetland analysis. Due to a mixing of salt and freshwater, there is an increase of biological diversity in the marsh. Again, areas further downstream and within Antigonish Harbour are considered more important and impact of bridge construction within the study area is expected to be negligible.

One critical value was also designated under tourism and recreational values. The marsh represents an important regional tourism and recreation attraction due to the sports fishery. Expected impact would be low as long as construction avoids the period of angling activity.

Table 3 provides a summary of the project benefits.

Table 3: Summary of Project Benefit Significance and Expected Impact.

	Number of Critical Values	Level Criterion	Expected Impact
		N, P, R, L, NE	H, M, L
Employment Benefits	1	R	L
Economic Benefits			
Production Benefits			
Urban Development Benefits			
TOTAL OCCURRENCES			
***Critical Value Totals**	1		

Only employment benefits were considered to represent a critical value. Construction of the bridge will provide new employment opportunities or stabilize existing employment levels in the region; however, the magnitude of the employment stimulation is expected to be low and temporary.

5.0 VALUED ENVIRONMENTAL COMPONENTS

The assessment of the study area detailed in the previous sections identified a number of Valued Environmental Components (VECs) for the study area. These are summarized in the following table.

Table 4: Valued Environmental Components

VEC	Function and Level of Importance
Recreational Fishery	The South River supports a thriving recreational fishery for a number of game species including trout and Atlantic salmon. Although the study area does not provide critical breeding habitat for these species, it is important for fish passage and to a lesser degree, rearing habitat. It was reported that the banks of the river at the study area are often lined with people in the fall during the recreational salmon fishery. It is important that the main channel in particular maintain its function in providing fish passage and continued opportunities for recreational fishing.
Terrestrial Habitat	The marsh area supports a variety of species.
Migratory Birds	The general area is known to provide a staging area for migratory birds. Although not documented in the exact study area, migratory birds are known to utilize the habitat provided in the South River area nearer to Georges Bay.
Flood Storage	The land between the main channel and the back channel serves a significant flood storage function during the spring peak flows in South River. Any infilling in the flood plain will displace a volume that would otherwise provide flood storage. Displacement should be minimized.
Nature Viewing	The South River Coastal Freshwater Marsh provides opportunities for wildlife viewing in the local area. Its proximity to the Town of Antigonish and sight lines from Highway 104 and South Station Road make wildlife viewing a valued local use.
Rare and Endangered Species	No rare or endangered species have been observed within the study area although the sharp-tailed sparrow has been heard in the vicinity.

6.0 CONCEPTUAL DESIGN

6.1 Guiding Design Principles for Environmental Protection

Based on the VECs identified above and in order to provide a conceptual design that respects the environmental features and functions of the study area, the following design principles were adopted:

- The bridge structure and foundations should avoid displacing aquatic habitat in both the main and back channel portions. It is preferable to span these watercourses in an effort to maintain the fish passage and rearing functions.

- Of the two watercourses, the main channel is more sensitive to disturbance than the back channel because it provides for both fish passage and rearing while the back channel area provides for rearing habitat only. In addition, the main channel is more complex because of its hydraulic functions in water conveyance whereas the back channel does not provide this function.

- The structure should try to avoid filling in the flood plain in order to maintain the flood storage function of the area as well as to minimize displacement of terrestrial habitat.

- It is desirable to align the structure to minimize the total area of terrestrial habitat maintained beneath the structure. This means aligning the structure at the narrowest portion of the ROW.

- In terms of noise and vibration impacts additional to the existing bridge, would be desirable to locate the new structure in close proximity to the existing structure (within the existing impacted area) in order to minimize the total additional area impacted.

- Discussions were held with representatives of the NSTPW regarding span lengths and cost implications for bridges in Nova Scotia. It was decided that a maximum span length of 60 meters was preferable.

6.2 Proposed Layout and Design

A four-span steel girder structural system with a concrete deck is proposed. The use of weathering steel has some advantages in terms of foundation loading where karst conditions are possible and provides a relatively maintenance free structural system. The proposed layout is depicted in plan and sections on Drawing No. G-301, Sheets 1 and 2.

The major elements of the structure consist of the following:

- Four 60 m spans of weathered steel
- Abutments at the east and west ends of the structure
- Piers and abutments founded on piles
- Concrete deck
- Jersey barrier style guard rails

Given the consistency of the environmental sensitivity at all sections across the river valley, the exact location of the structure was determined by finding a location where the main channel could be traversed with a 60 meter span. This allows the hydraulic integrity of the main channel to be maintained and achieve a span length that is not cost prohibitive. Given the skew of the ROW to the river valley, it was not possible to traverse the back channel with the 60 meter spans. The proposed layout would see the back channel shifted slightly from its present location to be aligned with the 60 meter span opening. This realignment is shown on Drawing G301.

7.0 PREDICTED IMPACTS AND MITIGATION

7.1 Predicted Impacts

Environmental impacts will result from the process of constructing the bridge and during the operation of the bridge. These predicted impacts are described in the following paragraphs.

Impacts During Construction

Given the proximity of the construction activity to the watercourse, the construction activities pose the greatest risk to the environment.

Recreational Fishery

Construction activities will take place on both sides of the main and back channels. Access to the watercourse at these locations will be cut off during construction. Construction of the bridge piers and abutments will require work to be carried out at the river's edge on both sides of the main channel. Disturbance of soils and operation of machinery could lead to soil loss to the river as well as the potential for contaminants (petroleum products) from the machinery.

Construction Debris

Much of the bridge construction will take place above the watercourses, thus providing the potential for construction debris to fall into the water.

Habitat Displacement

The process of construction will require access to the pier and abutment locations by heavy machinery. Access will be required across the back channel from the west to the piers on the island between the back and main channels. This will require a temporary access road and crossing of the back channel. Wetland habitat will be temporarily displaced by the access road. Aquatic habitat may also be affected depending on the crossing method selected.

Impacts During Operation

Habitat Displacement

The piers and abutments will displace tidal marsh and mixed wood habitat, although permanent habitat displacement will be limited to the footprint of these support structures. In addition, approximately 2500 m^2 of marsh habitat will be displaced from the island area between the main and back channels by infilling and realignment of the back channel.

Flood Storage Impacts

The abutments and piers will be constructed in the flood plain of the South River and result in the displacement of flood storage that would otherwise be available during spring peak flows. The volume displaced, however, is negligible relative to the total flood storage capacity at this location.

Impacts to Back Channel and Marsh Habitat

The proposed bridge layout requires a small realignment of the back channel as described in the previous section. The realignment is such that there will be no net loss of aquatic habitat, simply the shifting of the channel approximately 20 m east so that it is aligned with the span opening. There will be the obvious temporary displacement of back channel aquatic habitat during the bridge construction. Approximately 2,500 m^2 of back channel aquatic habitat will be temporarily displaced. The back channel will be replaced in an area that is currently marsh habitat.

In addition, the proposed layout requires some infilling on the west side of the back channel. Fill will be placed in the area between the western abutment and the high ground further to the west, primarily in the area from the back channel was moved. The end result of will be the displacement of 2,500 m^2 of marsh habitat.

Cumulative Encroachment

The new bridge structure is located immediately north of the existing Highway 104 bridge structure. The level of disturbance of the tidal marsh and upland habitat areas will increase as a result of the encroachment of the new bridge structure and road by approximately 100 meters.

7.2 Proposed Mitigation

During Construction

Recreational Fishery

Timing of construction will play an important role in mitigating potential adverse impacts on the recreational fishery in South River at this location. Table 4 summarizes the timing of the various fish species as they utilize the South River for migration.

There are two windows of opportunity identified during which migration and the primary angling effort can be avoided. These are winter months of January, February and March and the summer months (mid July to mid September). The salmon fishing season beings September 1st but angling generally begins around mid September at the earliest. Construction carried out during these two time periods would minimize any impacts on the function of the river for fish passage as well as the use of the river for recreational fishing. In addition, these construction windows will avoid breeding birds.

Sediment and erosion control measures should include:

- Silt fencing around all construction areas including the access road, piers and abutments;
- Use of sheet piling around excavations for piers and abutments
- Use of mulch on exposed areas in order to stabilize soils and reduce erosion
- Silt fence across back channel on the downstream side of the construction work

Water Management During Construction

It is inevitable that some dewatering will be required in the excavations for the piers and abutments. This water will be sediment-laden and will require treatment onsite before it can be discharged to South River. An onsite siltation pond and/or filtration system will be required for each of the west side, island area and east side of the construction area. Discharge through filter bags will likely be required in order to remove finer soil particulate. The system will need to reduce the total suspended solids concentration to less than 25 mg/L before the water can be discharged to the South River system.

Construction Technique

It will be possible to avoid the use of heavy equipment in the main channel through the use of two cranes, one on the east bank and the other on the island area. It should not be necessary for heavy equipment to be in the main channel at all.

Construction Roads and Access

Construction of temporary roads will be necessary to gain access to the piers and abutments. The existing driveway may be utilized on the east side of the main channel, however, the west side will require access through the field, across the back channel to the island area. The back channel will be temporarily infilled for access to the island area and then realigned. A silt curtain consisting of filter fabric and straw bales should be used in the back channel on the downstream side in order to isolate impacts during construction.

7.3 Summary of Cost Estimates

The budget estimate for the proposed bridge structure as describe above is $5,500,000. This includes materials, construction, and environmental protection measures.

Table 5: Cost Summary

Unit	Quantity	Cost
Bridge Railing (concrete)	960 m	$72,000
Parapet, Curbs, Decks, Haunches		$508,300
Parapet, Curbs, Decks, Haunches, Piers	1,350 m^3	$405,000
Abutments	1,680 m^3	$504,000
Abutment Piles		$216,000
Pier Piles		$388,800
Pier Excavation	3,000 m^3	$75,000
Fill Against Structures	12,000 m^3	$300,000
Steel	705 tonnes	$1,762,000
Temporary Roads, Bridges, Signs		$200,000
Silt Fencing, Ponds, Discharge Socks		$100,000
Sheet Piling	1,050 m^2	$186,500
Subtotal		$4,718,100
Contingency		$756,000
Total		**$5,473,100**

8.0 CONCLUSIONS

The South River appears to define the geological contact between limestone bedrock on the west and siltstone bedrock on the east. The potential for Karst topography is greater in the limestone bedrock. Notwithstanding, Karst topography was not encountered during the borehole program carried out for this assessment.

The hydrologic functions of the South River at this location are primarily for conveyance and flood storage purposes. Construction of the bridge will not impact conveyance and will displace a negligible amount of flood storage capacity.

The study site is a highly productive tidal section of the South River. The mixing of denser saltwater provides nutrients to support aquatic production, which in turn provides food to mummichogs, a small common estuarine fish found in high numbers in the area. The site does not, however, provide critical habitat, such as spawning or breeding areas, for important species. Many species of birds and estuarine fish species feed in the area, and a number of highly valued recreational fish species migrate upstream and downstream in the spring and fall.

The study site also has an interesting diversity of species because of its mix of fresh and salt water. For example, both fresh and salt water tolerant species of invertebrates are found in the river substrate. Plant diversity, however, is predominantly salt intolerant, indicating that the area should not be classified as salt marsh.

In terms of unique habitats, the study site is typical of many small sections of Nova Scotia estuaries. Nearby Pomquet estuary provides more unique habitats and supports a number of rare and endangered species. Uncommon species, such as the Nelson Sharp-Tailed sparrow, do occur in the area of the study site, but none are known to be dependent on the site for reproduction.

Within the South River, areas upstream and downstream of the study site provide more critical habitat, especially spawning habitat for fish and breeding habitat for birds. The true salt marsh area downstream of the study site is definitely more important in terms of waterfowl. Above the head of tide, spawning habitat for salmonids, especially the increasingly threatened Atlantic salmon, occurs in many areas.

Construction of a bridge within the study site is less likely to have significant environmental impacts than a site upstream or downstream.

The only residual impact of the bridge will be the displacement of approximately 2,500 m^2 of marsh area primarily from the island marsh habitat located between the back and main channels.

A Certificate of Approval under the Fisheries Act should not be required because there will be no net loss of aquatic habitat. Application will be required under the Navigable Waters Protection Act, although it is anticipated that approval will not be required under this act either.

APPENDIX A

VEGETATION UNITS

Table A-1: 'Island': fresh-water/brackish marsh with wooded centre.

Common Name	Scientfic Name
Agrimony	Agrimonia striata Michx.
American elm	Ulmus americana L.
Apple	Pyrus malus L.
Blue flag iris	Iris versicolor L.
Bluejoint grass**	Calamagrostis canadensis (Michx.)Nutt.
Blunt-leaved dock	Rumex obtusifolius L.
Bulrush**	Scirpus acutus Muhl.
Bulrush**	Scirpus validus Vahl.
Canada goldenrod	Solidago canadensis L
Cat-tail	Typha latifolia L.
Chokecherry	Prunus virginiana L.
Cow-parsnip	Heracleum lanatum Michx.
Dwarf raspberry	Rubus pubescens Raf.
Fireweed	Epilobium angustifolium L.
Freshwater cord grass**	Spartina pectinata Link
Fringed loosestrife	Lysimachia punctata L.
Ground-nut*	Apios americana Medic.
Hawthorn	Crataegus sp.
Joe-pye-weed	Eupatorium maculatum L.
Lady's thumb	Polygonum persicaria L.
Loosestrife	Lysimachia terrestris (L.)BSP.
Meadow-rue	Thalictrum pubescens Pursh.
Meadowsweet	Spiraea alba Du Roi
New England aster	Aster novae-angliae L.
Ninebark	Physocarpus opulifolius (L.)Maxim
Purple avens	Geum rivale L.
Raspberry	Rubus idaeus L.
Red osier dogwood	Cornus sericea L.
Sedge	Carex scoparia Schkuhr.
Sensitive fern	Onoclea sensibilis L.
Speckled alder	Alnus incana (L.) Moench
Strawberry	Fragaria virginiana Duchesne
Tall white aster	Aster umbellatus P. Mill.
Tansey	Tanacetum vulgare L.
Tansey ragwort	Senecio jacobaea L.
Tear thumb	Polygonum sagittatum L.
Touch-me-not	Impatiens capensis Meerb.
Water parsnip	Sium suave Walt.
Water pepper	Polygonum hydropiper L.
White ash	Fraxinus americana L.
Wild morning-glory	Calystegia sepium (L.)R.Br.
Wild rose **	Rosa virginiana Mill.
Willow	Salix sp.

* New record for Antigonish County (Species not rare or threatened)

** Salt-tolerant

Table A-2: River banks: mixed/hardwood forest with hayfield on west side.

Common Name	Species Name
Apple	Pyrus malus L.
Balsam poplar	Populus balsamifera L.
Bayberry	Myrica pensylvanica Mirbel
Canada goldenrod	Solidago canadensis L
Chokecherry	Prunus virginiana L.
Coltsfoot	Tussilago farfara L.
Common comfrey	Symphytum officinale L.
Large-toothed aspen	Populus grandidentata Michx.
New England aster	Aster novae-angliae L.
Orchard grass	Dactylis glomerata L.
Paper birch	Betula papyrifera Marshall
Quackgrass	Elynus repens Gould
Red oak	Quercus rubra L.
Red osier dogwood	Cornus sericea L.
Speckled alder	Alnus incana (L.) Moench
Sugar maple	Acer saccharum Marsh.
Tansey ragwort	Senecio jacobaea L.
Toadflax	Linaria vulgaris Mill.
Timothy	Phleum pratense L.
White ash	Fraxinus americana L.
White spruce	Picea glauca (Moench)Voss
White sweet clover	Melilotus alba Dest.
Wild carrot	Daucus carota L.
Wild rose**	Rosa virginiana Mill.
Willow	Salix sp.
Yarrow	Achillea millefolium L.

** Salt-tolerant

APPENDIX B

SOUTH RIVER BOTTOM

AND

MACROINVERTEBRATES

Table B-1. Sample descriptions of aquatic sediment from South River, Nova Scotia.

Site	Station	Date	Description
West Mid	1	16/10/00	Gravel to rocks, fine sediment, organic matter, reeds, grass, sticks, shell debris and detritus.
Mid Bay 3 ft	2	16/10/00	Fines, medium sand to rocks, organic matter, grass, reeds, leaf parts, shell debris, detritus and clay balls.
Mid Chain 5 ft	3	16/10/00	Fine sand to pebbles, organic matter, seaweed and detritus.
West Outer 5 ft	4	16/10/00	Medium sand to rocks, organic matter, wood bits and detritus.
East Outer 3 ft	5	16/10/00	Medium sand to rocks, mud tubes, organic matter, weeds, moss and detritus.
By Bridge	6	16/10/00	Medium sand to rocks, organic matter, grass, shell debris and detritus.
East Outer	7	16/10/00	Medium sand to rocks, mud tubes, organic matter, algal mats, strands of grass and detritus.

Table B-2. Abundance of biological organisms in aquatic sediment samples from South River, NS

Area Description	West Mid Chain	Mid Bay 3 ft	Mid Chain 5 ft	West Chain Outer 5 ft	East Outer Chain 3 ft	East Chain-Bridge	East Outer Chain
Station Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Species							
MARINE							
Gastropoda							
Hydrobia totteni			9	1	2		
Polychaeta							
Nereis diversicolor			22	120			
Marine Oligochaeta			4	6	13	1	7
Platyhelminthes			1	14			
Amphipoda							
Gammarus tigrinus			28	50	17	23	72
Corophium lacustre?			35	64	779		32
FRESHWATER							
Odonata-Anisoptera						1	
Diptera-Ceratopogonidae							2
Diptera-Chironomidae			96	4	431	73	1064
Coleoptera-Elmidae					1		2
Trichoptera					5		
Total (number/sample)	0	0	195	259	1248	98	1179
Number of Taxa	0	0	7	7	7	4	6
Biomass (grams/sample)	0	0	0.492	0.952	2.481	0.423	1.605

APPENDIX C

SOUTH RIVER BIRDS

Table C-1 Birds recorded using the study area.

Scientific Name	Common Name
Podilymbus podiceps	Pied-billed Grebe
Ardea herodias*	Great Blue Heron
Aix sponsa	Wood Duck
Anas rubripes*	American Black Duck
Anas platyrhynchos	Mallard
Anas crecca*	Green-winged Teal
Mergus merganser*	Common Merganser
Pandion haliaetus	Osprey
Haliaeetus leucocephalus	Bald Eagle
Buteo jamaicensis	Red-tailed Hawk
Larus ridibundus	Black-headed Gull
Larus delawarensis	Ring-billed Gull
Larus argentatus*	Herring Gull
Columba livia*	Rock Dove
Zenaida macroura	Mourning Dove
Ceryle alcyon	Belted Kingfisher
Cyanocitta cristata	Blue Jay
Corvus brachyrhynchos*	American Crow
Corvus corax	Common Raven
Poecile atricapilla*	Black-capped Chickadee
Regulus satrapa*	Golden-crowned Kinglet
Turdus migratorius	American Robin
Sturnus vulgaris*	European Starling
Bombycilla cedrorum	Cedar Waxwing
Dendroica coronata	Yellow-rumped Warbler
Geothlypis trichas	Common Yellowthroat
Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow
Melospiza melodia	Song Sparrow
Melospiza georgiana	Swamp Sparrow
Pheucticus ludovicianus	Rose-breasted Grosbeak
Agelaius phoeniceus*	Red-winged Blackbird
Euphagus carolinus	Rusty Blackbird
Quiscalus quiscula	Common Grackle
Carduelis tristis	American Goldfinch

* indicates species observed during the survey of 14 October, 2000

Table C-2. Birds listed in Erskine (1992) that were found in the 10 km square in which the study site is located. C confirmed breeders; Pr probable breeders; Po possible breeders.

Scientific Name	Common Name	Status
Gavia immer	Common Loon	C
Podilymbus podiceps	Pied-billed Grebe	C
Botaurus lentiginosus	American Bittern	C
Anas americana	American Wigeon	C
Anas rubripes	American Black Duck	C
Anas platyrhynchos	Mallard	C
Anas discors	Blue-winged Teal	C
Anas crecca	Green-winged Teal	C
Lophodytes cucullatus	Hooded Merganser	C
Mergus merganser	Common Merganser	C
Mergus serrator	Red-breasted Merganser	C
Pandion haliaetus	Osprey	C
Haliaeetus leucocephalus	Bald Eagle	C
Circus cyaneus	Northern Harrier	Pr
Accipiter striatus	Sharp-shinned Hawk	Pr
Accipiter gentilis	Northern Goshawk	Pr
Buteo platypterus	Broad-winged Hawk	Po
Buteo jamaicensis	Red-tailed Hawk	C
Falco sparverius	American Kestrel	C
Falco columbarius	Merlin	Po
Bonasa umbellus	Ruffed Grouse	C
Falcipennis canadensis	Spruce Grouse	Po
Rallus limicola	Virginia Rail	Po
Porzana carolina	Sora	Pr
Charadrius melodus	Piping Plover	C
Charadrius vociferus	Killdeer	C
Catoptrophorus semipalmatus	Willet	C
Actitis macularia	Spotted Sandpiper	C
Gallinago gallinago	Common Snipe	Pr
Scolopax minor	American Woodcock	Pr
Larus argentatus	Herring Gull	C
Larus marinus	Great Black-backed Gull	C
Sterna hirundo	Common Tern	C
Sterna paradisaea	Arctic Tern	C
Columba livia	Rock Dove (I)	C
Coccyzus erythropthalmus	Black-billed Cuckoo	Po

Table C-2 continued

Scientific Name	Common Name	Status
Bubo virginianus	Great Horned Owl	Po
Strix varia	Barred Owl	Po
Chordeiles minor	Common Nighthawk	Po
Chaetura pelagica	Chimney Swift	Po
Archilochus colubris	Ruby-throated Hummingbird	C
Ceryle alcyon	Belted Kingfisher	C
Sphyrapicus varius	Yellow-bellied Sapsucker	Pr
Picoides pubescens	Downy Woodpecker	Po
Picoides villosus	Hairy Woodpecker	C
Colaptes auratus	Northern Flicker	Pr
Empidonax alnorum	Alder Flycatcher	Po
Empidonax minimus	Least Flycatcher	Po
Tyrannus tyrannus	Eastern Kingbird	Po
Vireo gilvus	Warbling Vireo	Po
Vireo olivaceus	Red-eyed Vireo	C
Perisoreus canadensis	Gray Jay	Po
Cyanocitta cristata	Blue Jay	C
Corvus brachyrhynchos	American Crow	C
Corvus corax	Common Raven	C
Tachycineta bicolor	Tree Swallow	C
Hirundo rustica	Barn Swallow	C
Poecile atricapilla	Black-capped Chickadee	C
Poecile hudsonica	Boreal Chickadee	C
Sitta canadensis	Red-breasted Nuthatch	C
Cistothorus palustris	Marsh Wren	Po
Regulus calendula	Ruby-crowned Kinglet	Po
Catharus ustulatus	Swainson's Thrush	Pr
Turdus migratorius	American Robin	C
Dumetella carolinensis	Gray Catbird	Pr
Sturnus vulgaris	European Starling (I)	C
Bombycilla cedrorum	Cedar Waxwing	C
Vermivora peregrina	Tennessee Warbler	Po
Parula americana	Northern Parula	Po
Dendroica petechia	Yellow Warbler	C
Dendroica pensylvanica	Chestnut-sided Warbler	Po
Dendroica magnolia	Magnolia Warbler	Po
Dendroica tigrina	Cape May Warbler	Po

Table C-2 continued

Scientific Name	Common Name	Status
Dendroica coronata	Yellow-rumped Warbler	Po
Dendroica virens	Black-throated Green Warbler	Po
Dendroica fusca	Blackburnian Warbler	Po
Dendroica palmarum	Palm Warbler	Po
Dendroica castanea	Bay-breasted Warbler	Po
Mniotilta varia	Black-and-white Warbler	Po
Setophaga ruticilla	American Redstart	C
Seiurus aurocapillus	Ovenbird	Pr
Oporornis philadelphia	Mourning Warbler	Po
Geothlypis trichas	Common Yellowthroat	C
Wilsonia pusilla	Wilson's Warbler	Po
Wilsonia canadensis	Canada Warbler	Po
Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow	C
Melospiza melodia	Song Sparrow	C
Melospiza georgiana	Swamp Sparrow	C
Junco hyemalis	Dark-eyed Junco	Po
Pheucticus ludovicianus	Rose-breasted Grosbeak	Pr
Dolichonyx oryzivorus	Bobolink	Po
Agelaius phoeniceus	Red-winged Blackbird	C
Euphagus carolinus	Rusty Blackbird	
Quiscalus quiscula	Common Grackle	C
Icterus galbula	Baltimore Oriole	Pr
Carpodacus purpureus	Purple Finch	C
Loxia curvirostra	Red Crossbill	Po
Carduelis pinus	Pine Siskin	C
Carduelis tristis	American Goldfinch	C
Coccothraustes vespertinus	Evening Grosbeak	Pr
Passer domesticus	House Sparrow (I)	Pr

APPENDIX D

BOREHOLE LOGS

Neill and Gunter
DARTMOUTH, N.S., CANADA

BOREHOLE LOG

Project: 16053 Borehole: BH-1 Date: Oct. 19/00 FIGURE: 1

Borehole diameter: 0.11
Borehole depth: 15.24m
Top of well screen: –
Bottom of well screen: –
Installation type: BOREHOLE
Drill Type: CME 75

Well screen length: –
Casing length above ground surface: –
Top elevation of casing: –
Casing diameter: –
Top elevation of protective casing: –
Logged by: Dana Wright

Analysis:
G: Grab Sample
C: Chemical
SS: Split Spoon
ND: Non Detected

Depth (m)	Symbol	Description	Borehole	N / RQD	Sample number Analysis	Sample Type	% Recovery	Odour
0		Rootmat –gravel with soft organic brown mud –fluvial deposit	Fill/Till	8	1	SS	40	
1				5	2	SS	50	
2		Till: –wet brown silty sands and clay –grey/brown in colour –peat layer –fluvial deposit		1	3	SS	50	
				1	4	SS	40	
3				Refusal	5	SS	2	
		Till: –coarse grained sand with cobbles –fluvial deposit (channel lag)		26	6	SS	30	
4				33	7	SS	60	
				41	8	SS	35	
5				54	9	SS	40	
				64	10	SS	20	
6		Till: –dense silty sand (Ablation till)		67	11	SS	50	
7				65	12	SS	60	
				76	13	SS	40	
8				Refusal	14	SS	20	
9		Bedrock: –red siltstone –very severely fractured bedrock –Dip is approximately 20–30 degree Southeast	bentonite	25	RC1	RC	19	
10				87	RC2	RC	22	
11				68	RC3	RC	10	
12								
13				35	RC4	RC	10	
14								
15	15.24			73	RC5	RC	10	
16		EOH						

Neill and Gunter
DARTMOUTH, N.S., CANADA

BOREHOLE LOG

Project: 16053 Borehole: BH-2 Date: Oct. 19/00 FIGURE: 2

Borehole diameter: 0.11
Borehole depth: 17.0m
Top of well screen: –
Bottom of well screen: –
Installation type: BOREHOLE
Drill Type: CME 75

Well screen length: –
Casing length above ground surface: –
Top elevation of casing: –
Casing diameter: –
Top elevation of protective casing: –
Logged by: Dana Wright

Analysis:
G: Grab Sample
C: Chemical
SS: Split Spoon
ND: Non Detected

Depth (m)	Symbol	Description	Bedrock	N / RQD	Sample number Analysis	Sample Type	% Recovery	Odour
0		Rootmat: –grass at surface –silty sand –fluvial deposit	Fil/Till	5	1	SS	40	
1				13	2	SS	60	
2		Till: –brown and gray in colour –silty sand with clay –sandstone clasts (pebble to cobble in size) (Ablation till)		34	3	SS	30	
				12	4	SS	50	
3				10	5	SS	30	
				15	6	SS	40	
4				19	7	SS	30	
				20	8	SS	40	
5				22	9	SS	50	
				16	10	SS	40	
6				19	11	SS	40	
				25	12	SS	60	
7				22	13	SS	50	
				24	14	SS	70	
8				40	15	SS	80	
				44	16	SS	60	
9				48	17	SS	60	
				29	18	SS	70	
10				67	19	SS	60	
				39	20	SS	40	
11				Refusal	21	SS	40	
				66	RC1	RC	0	
12				100	RC2	RC	0	mud
13								
14		Bedrock: –very severely fractured limestone	Bentonite	68	RC3	RC	10	
15								
16	16.0	Continued on Page 2						

Neill and Gunter
DARTMOUTH, N.S., CANADA

BOREHOLE LOG

Project: 16053 Borehole: BH-2 Date: Oct. 19/00 FIGURE: 3

Borehole diameter: 0.11
Borehole depth: 17.0m
Top of well screen: –
Bottom of well screen: –
Installation type: BOREHOLE
Drill Type: CME 75

Well screen length: –
Casing length above ground surface: –
Top elevation of casing: –
Casing diameter: –
Top elevation of protective casing: –
Logged by: Dana Wright

Analysis:
G: Grab Sample
C: Chemical
SS: Split Spoon
ND: Non Detected

Stratigraphic profile			Borehole						
Depth (m)	Symbol	Description			N / RQD	Sample number Analysis	Sample Type	% Recovery	Odour
0									
		Bedrock: –fractured limestone	Bentonite		40	RC4	RC	13	
17	17.0	E.O.H.							
18									
19									
20									
21									
22									
23									
24									
26									
27									
28									
29									
30									
31									
32									
33									

APPENDIX E

SALINITY AND CONDUCTIVITY DATA

Table E-1: Salinity and Conductivity

Location	Depth (m)	Conductivity (mmhos)	Salinity (ppt)	Temp (C)
East Channel	0.1	4.3	3.1	16.1
East Channel	0.5	12	9	16
East Channel	1	17.5	11.8	17.6
Middle Channel	1.5	23.7	16	18.7
Middle bay	1	23	16	20
Outer Back Channel	0.1	12.6	8.4	18.6
Outer Back Channel	0.7	25.1	17.1	18.6
West Channel Outer	1.4	27	18	18
Back Channel inner - adjacent to highway	0.4	11.2	16.6	18
Main Channel at Bridge	0.1	0.4	0.1	19
Main Channel at Bridge	1.3	21	15	19

Plate 1 – Early nineteenth century cemetery north of study area, looking north east

Plate 2 – Bulldozed area at intersection of north – south and east – west tree lines, looking south east

Plate 3 – Test units on summit of high ground, west side of river, looking west

Plate 4 – Test units on summit of high ground, west side of river, looking east

Plate 5 – Line of vertical cut test units on west river terrace, looking south

Plate 6 – Line of test units on low ground of west river terrace, looking south

APPENDIX D:
Test Unit Level Records

Excavation / Test Unit # 1-1

Borden#/Site Name :

Location : South River

Project : Hwy 104 Antigonish Bi-pass

Client : Neill & Gunter Consulting Engineers

Team Leader : S. Davis

Excavated By : S. Davis

Excavation Date : Oct. 21/00

Excavation Type : 50 x 50 cm shovel

SUBSURFACE PROFILE						ARTIFACTS		SAMPLES	
Depth (cm) Scale	Symbol	Depth in cm	Layer/ Lot #	Description (e.g.- Brown Forest Podzol, light brown silty sand)	Inclusions (e.g.- Charcoal, Cultural Stones)	Description	Bag #	Description	Bag #
10		2	1	Sod (grass & roots),					
		10	2	mo. brown organic					
		16	3	orange sterile					
20		23	4	1cm gravel					
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									

Remarks No cultural materials present

Photographic Record : Roll # Frame #('s) **Reference to Map :** **Recorder's Initials:** AM

Excavation / Test Unit # 1-2

Borden#/Site Name :

Team Leader : S. Davis

Location : South River

Excavated By : S. Davis

Project : Huoy 104 Antigonish Bi-pass

Excavation Date : Oct. 21/00

Client : Neill & Gunter Consulting Engineers

Excavation Type : 50 x 50 cm shovel

SUBSURFACE PROFILE						ARTIFACTS		SAMPLES	
Depth (cm) Scale	Symbol	Depth in cm	Layer/ Lot #	Description (e.g.- Brown Forest Podzol, light brown silty sand)	Inclusions (e.g.- Charcoal, Cultural Stones)	Description	Bag #	Description	Bag #
		2	1	Sod (grass & roots),					
10		12	2	md. brown organic					
20		21	4	Gravel (<1cm size)					
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									

Remarks No cultural materials present. Lot 2 disturbed.

Photographic Record : Roll # Frame #('s) **Reference to Map :** **Recorder's Initials:** AM

Excavation / Test Unit # 1-3

Borden#/Site Name :

Team Leader : S. Davis

Location : South River

Excavated By : S. Davis

Project : Hwy 104 Antigonish Bi-pass

Excavation Date : Oct. 21/00

Client : Neill & Gunter Consulting Engineers

Excavation Type : 50cm x 50cm shovel

SUBSURFACE PROFILE						ARTIFACTS		SAMPLES	
Depth (cm) Scale	Symbol	Depth in cm	Layer/ Lot #	Description (e.g.- Brown Forest Podzol, light brown silty sand)	Inclusions (e.g.- Charcoal, Cultural Stones)	Description	Bag #	Description	Bag #
		2	1	Sod (grass & roots)					
10		12	2	md. brown organic					
20		21	4	<1 cm-sized gravel					
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									

Remarks No cultural materials present. Lot 2 disturbed.

Photographic Record : Roll # Frame #('s) **Reference to Map :** **Recorder's Initials:** AM

Excavation / Test Unit # 1-4

Borden#/Site Name :

Location : South River

Project : Hwy 104 Antigonish Bi-pass

Client : Neill & Gunter Consulting Engineers

Team Leader : S. Davis

Excavated By : S. Davis

Excavation Date : Oct. 21/00

Excavation Type : 50cm x 50cm shovel

SUBSURFACE PROFILE						ARTIFACTS		SAMPLES	
Depth (cm) Scale	Symbol	Depth in cm	Layer/ Lot #	Description (e.g.- Brown Forest Podzol, light brown silty sand)	Inclusions (e.g.- Charcoal, Cultural Stones)	Description	Bag #	Description	Bag #
0		2	1	Sod (grass & roots),					
10		16	2	md. brown organic					
20		30	4	4cm-sized gravel					
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									

Remarks No cultural materials present Lot 2 disturbed.

Photographic Record : Roll # Frame #('s) **Reference to Map :** **Recorder's Initials:** AM

Excavation / Test Unit # 1-5

Borden#/Site Name :

Team Leader : S. Davis

Location : South River

Excavated By : S. Davis

Project : Hwy 104 Antigonish Bi-pass

Excavation Date : Oct. 21/00

Client : Neill & Gunter Consulting Engineers

Excavation Type : 50cm x 50cm shovel

SUBSURFACE PROFILE						ARTIFACTS		SAMPLES	
Depth (cm) Scale	Symbol	Depth in cm	Layer/ Lot #	Description (e.g.- Brown Forest Podzol, light brown silty sand)	Inclusions (e.g.- Charcoal, Cultural Stones)	Description	Bag #	Description	Bag #
		3	1	Sod (grass & roots)					
10		10	2	md. brown organic					
20		22	4	< 1cm - sized gravel					
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									

Remarks No cultural materials present. Lot 2 disturbed.

Photographic Record : Roll # Frame #('s) **Reference to Map :** **Recorder's Initials:** AM

Excavation / Test Unit # 1-6

Borden#/Site Name :

Team Leader : S. Davis

Location : South River

Excavated By : S. Davis

Project : Hwy 104 Antigonish Bi-pass

Excavation Date : Oct. 21/00

Client : Neill & Gunter Consulting Engineers

Excavation Type : 50x50cm shovel

SUBSURFACE PROFILE						ARTIFACTS		SAMPLES	
Depth (cm) Scale	Symbol	Depth in cm	Layer/ Lot #	Description (e.g.- Brown Forest Podzol, light brown silty sand)	Inclusions (e.g.- Charcoal, Cultural Stones)	Description	Bag #	Description	Bag #
		3	1	Sod (grass & roots),					
10									
20		25	2	md. brown organic					
		29	4	< 1cm-sized gravel					
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									

Remarks No cultural material present. Lot 2 disturbed.

Photographic Record : Roll # Frame #('s) **Reference to Map :** **Recorder's Initials:** AM

Excavation / Test Unit # 1-7

Borden#/Site Name :

Team Leader : S. Davis

Location : South River

Excavated By : S. Davis

Project : Hwy 104 Antigonish Bi-pass

Excavation Date : Oct. 21/00

Client : Neill & Gunter Consulting Engineers

Excavation Type : 50 x 50cm shovel

SUBSURFACE PROFILE						ARTIFACTS		SAMPLES	
Depth (cm) Scale	Symbol	Depth in cm	Layer/ Lot #	Description (e.g.- Brown Forest Podzol, light brown silty sand)	Inclusions (e.g.- Charcoal, Cultural Stones)	Description	Bag #	Description	Bag #
		3	1	Sod (grass & roots)					
10		12	2	md. brown organic					
20		25	4	<1cm-sized gravel					
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									

Remarks No cultural materials present. Lot 2 disturbed.

Photographic Record : Roll # Frame #('s) **Reference to Map :** **Recorder's Initials:** AM

Excavation / Test Unit # 2-1

Borden#/Site Name :

Team Leader : S. Davis

Location : South River

Excavated By : S. Davis

Project : Hwy 104 Antigonish Bi-pass

Excavation Date : Oct. 21/00

Client : Neill & Gunter Consulting Engineers

Excavation Type : 60cm vertical cut

SUBSURFACE PROFILE						ARTIFACTS		SAMPLES	
Depth (cm) Scale	Symbol	Depth in cm	Layer/ Lot #	Description (e.g.- Brown Forest Podzol, light brown silty sand)	Inclusions (e.g.- Charcoal, Cultural Stones)	Description	Bag #	Description	Bag #
10		3	1	Dark brown organic					
20		23	2	medium brown organic					
30			3	sterile (orange-brown sandy silt)					
40									
50									
60									
70									
80									
90									
100									
110									
120									

Remarks Lot 1 heavily eroded and disturbed. No cultural Materials present.

Photographic Record : Roll # Frame #('s) **Reference to Map :** **Recorder's Initials:** AM

Excavation / Test Unit # 2-2

Borden#/Site Name :

Location : South River

Project : Hwy 104 Antigonish Bi-pass

Client : Neill & Gunter Consulting Engineers

Team Leader : S. Davis

Excavated By : S. Davis

Excavation Date : Oct. 21/00

Excavation Type : 50cm x 40cm shovel

SUBSURFACE PROFILE						ARTIFACTS		SAMPLES	
Depth (cm) Scale	Symbol	Depth in cm	Layer/ Lot #	Description (e.g.- Brown Forest Podzol, light brown silty sand)	Inclusions (e.g.- Charcoal, Cultural Stones)	Description	Bag #	Description	Bag #
10		8	1	Dark brown organic					
20		28	2	medium brown organic					
30			3	sterile (orange-brown sandy silt)					
40									
50									
60									
70									
80									
90									
100									
110									
120									

Remarks No cultural materials present. Lot 1 in this unit has not been disturbed.

Photographic Record : Roll # Frame #('s) **Reference to Map :** **Recorder's Initials:** AM

APPENDIX E:
Archival Sources Consulted

Archival Sources Consulted

Anonymous

Antigonish Harbour and Vicinity. (PANS V7/239 - und.)

Brief History of Antigonish Town. (PANS CS 90 W57 W57).

Crown Land Grants. Sheet No. 99. (PANS V/11 Sheet No. 99).

History of Antigonish County. (PANS MG 4 Vol. 243).

"History of the County of Antigonish". (PANS Nova Scotia Scrapbook MG 9 Vol. 37, Pp. 231-250).

Sketch of Farm Lots on Antigonish Harbour c. 1820. (PANS MG 9 Vol. 103 #28; micro reel #15,162).

1830 Great Map of Nova Scotia. (PANS Drawers 2.1.1 to 2.1.19; S114[4]).

1878 Church's Map of Antigonish County.

Geological Survey of Canada

1985 Geological Map of the Antigonish Highlands 1982 -5. (PANS Geological Filing Cabinet).

MacDonald, J.W.

1876 History of Antigonish County. Antigonish: Formac Limited. (PANS F5248 A613 M135).

References Cited

Anonymous
"History of the County of Antigonish". (PANS Nova Scotia Scrapbook MG 9 Vol. 37).

MacDonald, J.W.
1876 History of Antigonish County. Antigonish: Formac Limited. (PANS F5248 A613 M135).

Nova Scotia Museum
1996 The Natural History of Nova Scotia, Volume 2: Theme Regions. Halifax: Nimbus.

APPENDIX G

WETLAND EVALUATION

APPENDIX G – WETLAND ANALYSIS

Are Criteria Present?
Choices = Yes (Y), Likely (L), Possibly (P), No (N), Unknown (U)
Level of Criterion Significance:
Choices = National (N), Provincial (P), Regional (R), Local (L), Negligible (NE)
Expected Impact of Project Upon Wetland Values:
Choices = High (H), Moderate (M), Low (L)

LIFE-SUPPORT VALUES

Hydrological Values: Value of the wetland in contributing to surface and groundwater stocks.

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
*Does the wetland contribute to recharge of regional water supply?	**N**			The wetland is at the bottom of a watershed
*Does the wetland provide flood protection benefits?	**Y**	**L**	**L**	There is only minor displacement of flood water
Does the wetland contribute to usable surface water?	**P**	**L**	**L**	The wetland is a small proportion of Antigonish Harbour
Does the wetland provide erosion control?	**N**			
Does the wetland provide flow augmentation to users through a headwater position in the catchment basin?	**N**			
*Does the wetland reduce tidal impacts?	**Y**	**L**	**L**	There is only minor displacement of tidal water
***Critical Value Totals**	**2**			

Biogeochemical Value: Value of the wetland in contributing to surface water and ground-water quality.

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
*Does the wetland receive significant pollution of a type amenable to amelioration by wetlands?	**N**			There is no indication of pollution.
Does the wetland provide storage for agricultural run-off?	**p**	**L**	**L**	There is a field nearby.
*Does the wetland provide for containment of toxics contained in surface run-off or through discharge flow?	**N**			
Does the wetland provide for sediment flow stabilization?	**N**			
Does the wetland have high nutrient levels which support significant wildlife populations?	**Y**	**R**	**L**	The wetland is an important feeding area for birds and fish
***Critical Value Totals**	**0**			

Habitat Value: Role of the wetland in contributing to the well-being of important plant and animal values.

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
*Are there any rare, threatened or endangered animal or plant species present?	**P**	**P**	**L**	Nelson's sharp-tailed sparrow has cautionary status by DNR
Does the wetland provide habitat for sport and/or commercial fish?	**Y**	**R**	**L**	Important fish species migrate through the area.

Does the wetland provide significant habitat for reptiles and amphibians?	**N**			
Does the wetland provide significant habitat for crustaceans?	**P**	**R**	**L**	Mix of salt and freshwater provides an unusual habitat
Does the wetland provide significant habitat for mammals?	**P**	**L**	**L**	Not much known about mammals occurring in the South River area.
*Does the wetland support a significant animal or plant species in unusual abundance?	**N**			Typical of Northumberland Strait tributaries
Does the wetland and its associated vegetation protect natural shorelines?	**P**	**L**	**L**	Wetland forms shoreline of back and main channels
*Is the wetland ranked as a Class I, II, or III wetland by Canada Land Inventory or other accepted evaluation system?	**N**			
***Critical Value Totals**	**1**			

Ecological Values: Role of the wetland in stimulating relations of plant and animal communities.

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
Does the wetland support an extensive ecosystem including uplands?	**N**			
*Has a regional threshold been reached where the significance of wetland ecosystems for the entire region will be com-promised by further degradation?	**N**			
*Is the wetland considered a classic example of its type?	**N**			The wetland is already affected by the existing highway
Are there few remaining natural, unimpacted wetlands of this type in the region?	**N**			
Does the wetland contain, owe its existence to, or is it a part of or ecologically associated with, a geological feature which is an excellent representation of its type?	**N**			
Does the wetland form an integral part of an important water drainage system?	**N**			
*Does the wetland display biological diversity that is of interest?	**Y**			A mix of salt and freshwater increases diversity
***Critical Value Totals**	**1**			

SOCIAL/CULTURAL VALUES

Aesthetic Values: Role of the wetland in the quality of the scenic environment.

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
Is the wetland visible from a provincial/ territorial highway, a designated scenic highway/road or passenger railroad?	**Y**	**P**	**L**	Minimal effect on view
Does the wetland provide a valuable aesthetic or open space function?	**Y**	**L**	**L**	
Does the wetland add substantially to the visual diversity of the landscape?	**Y**	**L**	**L**	
*Is the wetland an important sightseeing locale?	**N**			
***Critical Value Totals**	**0**			

Recreational Values: Role of the wetland in stimulating recreational activities.

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
Does the wetland provide a base for viewing or photographing large numbers of wildlife?	**P**	**L**	**L**	Good access increases the potential
Does the wetland provide opportunities for boating?	**Y**	**L**	**L**	Canoeing
Does the wetland provide winter recreation opportunities?	**N**			
Does the wetland provide high quality sport hunting or	**Y**	**R**	**L**	Low impact as long as construction avoids

fishing?				angling activity
***Critical Value Totals**	**0**			

Education and Public Awareness Values: Role of the wetland in stimulating public values and understanding

	Criteria Present?	**Level Criterion**	**Expected Impact**	**Describe Function**
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
Is the wetland used for scientific research?	**N**			
*Is the wetland used for educational and interpretation purposes?	**N**			
Does the wetland exist close to a large urban population?	**Y**	**L**	**L**	Antigonish is 6 km west of the marsh
Does the wetland receive large numbers of visitors?	**N**			
***Critical Value Totals**	**0**			

Public Status Values: Role of the wetland in creating a sense of public ownership.

	Criteria Present?	**Level Criterion**	**Expected Impact**	**Describe Function**
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
Is the wetland part of the pattern of settlement and rural/urban lifestyle?	**N**			
Is the wetland a designated site of special public interest?	**N**			

Public Status Values (continued)

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
*Is the wetland a unique national, provincial or regional resource?	**N**			
Does the wetland provide for easy public access?	**Y**	**L**	**L**	The marsh is located close to Highway 104
Is the wetland public land?	**N**			
***Critical Value Totals**	**0**			

Cultural Attribute Values: Role of the wetland in the identity of the people in the area.

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
Does the wetland form part of the historical/ cultural heritage of the regional population?	**Y**	**R**	**L**	Rivers and estuaries were important historic/ cultural features
*Does the wetland contain archeological or paleontological resources?	**N**			A 19th century graveyard is located outside of the study area.
Is the wetland utilized for cultural events or cultural renewal?	**N**			
*Does the wetland form part of a native traditional use area?	**P**	**L**	**L**	A native food fishery could use the area.
***Critical Value Totals**	**0**			

WETLAND PRODUCTION VALUES

Agricultural Values: Role of the wetland in contributing to agricultural production

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
Does the wetland provide water for livestock?	**N**			
Does the wetland provide a source of forage?	**N**			
*Does the wetland provide a source of water for crop irrigation?	**N**			
Does the wetland serve to reduce topsoil erosion?	**N**			
Does the wetland serve to increase soil moisture and enhance agricultural crop production?	**N**			
***Critical Value Totals**	**0**			

Renewable Resource Values: Role of the wetland in contributing to the viability of renewable resource harvest.

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
*Is the wetland used for commercial or subsistence hunting, trapping and fishing?	**P**	**L**	**L**	The wetland could be used by first Nations
Does the wetland provide opportunities for non-commercial uses of fish, wildlife, crustacean and/ or water resources?	**Y**	**L**	**L**	Opportunities are present for non-commercial fishing and trapping in the wetland
Can forest resources of the wetland be harvested?	**N**			
*Are there other commercial uses of the wetland, such as har-vesting opportunities for wild rice, cranberries, or gathering crabs and oysters?	**N**			
***Critical Value Totals**	**0**			

Non-renewable Resource Values: Role of the wetland in contributing non-renewable resources for consumption

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
*Is the wetland used as a commercial source of peat for horticulture or energy?	**N**			
Does the wetland occur over known mineral or gas and oil deposits?	**N**			
***Critical Value Totals**	**0**			

Tourism and Recreational Values: Role of the wetland in stimulating tourism and recreation economic benefits

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
*Does the wetland represent an important local, regional, or provincial tourism or recreation attraction?	**Y**	**R**	**L**	Fishery
Does the wetland contribute to the local, regional, or provincial tourism and recreation economy?	**Y**	**R**	**L**	Through purchase of equipment.
Does the wetland contribute to national and international tourism development?	**N**			
***Critical Value Totals**	**1**			

Urban Values: Role of the wetland in contributing to urban economic values.

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
*Is the wetland used to provide water for industry?	**N**			
*Is the wetland used as a means of sewage treatment?	**N**			
*Is the wetland a direct source of domestic water supply	**N**			
Does the wetland enhance residential, commercial or industrial development values?	**N**			
Does the wetland contribute to urban flood protection and associated land values?	**N**			
***Critical Value Totals**	**0**			

PROJECT BENEFITS

Employment Benefits: Role of the project in stimulating Job Benefits

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
*Will the project stimulate new employment opp-ortunities or stabilize existing employment levels in the region?	**Y**	**R**	**L**	
Will the project provide for high income jobs?	**N**			
Will the project stimulate employment upgrading?	**N**			
Will the project stimulate additional research and educational spin-offs?	**N**			
***Critical Value Totals**	**1**			

Economic Benefits: Role of the project in stimulating economic benefits.

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
Will the construction of the project stimulate the local and regional economy	**P**	**R**	**L**	The project will be short-term only
*Will the operation of the project stimulate the local and regional economy?	**N**			
Will the operation of the project stimulate value-added production to the provincial or national economy?	**N**			
Will the project generate significant	**N**			

new taxes and/or enhance the tax base?				
***Critical Value Totals**	**0**			

Production Benefits: Role of the project in enhancing training opportunities.

	Criteria Present?	**Level Criterion**	**Expected Impact**	**Describe Function**
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
Will the project stimulate agricultural production?	**N**			
Will the project stimulate forest production?	**N**			
Will the project stimulate energy production?	**N**			
Will the project stimulate tourism and recreational benefits?	**P**	**R**	**L**	
Will the project stimulate manufacturing production?	**N**			
Will the project stimulate other production?	**N**			
***Critical Value Totals**	**0**			

Urban/Industrial Infrastructure Development: Role of the project in enhancing urban/industrial development.

	Criteria Present?	Level Criterion	Expected Impact	Describe Function
	Y, L, P, N, U	N, P, R, L, NE	H, M, L	Provide Highlights Only
Will the project provide accommodation and ease housing shortages?	**N**			
Will the project facilitate a major transport link for the region?	**Y**	**N**	**M**	Most benefits are not restricted to this site.
Will the project provide a harbour for the region?	**N**			
Will the project solve regional waste disposal problems?	**N**			
Will the project provide an alternate location for infrastructure which in incompatible with the urban built-up areas?	**N**			
***Critical Value Totals**	**0**			

TERMS OF REFERENCE

NOVA SCOTIA

Department of Finance
Procurement Branch - Public Tenders Office

6176 Young Street
Suite 100
Halifax, Nova Scotia
B3K 2A6

Telephone (902) 424-3333
Facsimile (902) 424-0608

REQUEST FOR PROPOSAL
For
Highway 104 Antigonish, South River Impact Study
Department of Transportation and Public Works
Tender No. 60076691

Request for Proposal Issue Date: *August 23, 2000*

Responses to this Request for Proposal must be Received in the Office of:
Public Tenders Office, 6176 Young Street, Halifax, N.S., B3K 2A6

Not later than
Closing Date and Time: *September 6, 2000; 10:00am, local time*
Public Opening: *September 6, 2000; 10:30am, local time*

Department Contact:
Michael Croft, P.Eng.
Tel. (902)424-3548
Fax. (902)424-0571

Facsimile bids **will not** be accepted

If conflicting information occurs between this page and the remainder of the document, this page is considered correct

TABLE OF CONTENTS

1.0 Background

Highway 104 from Antigonish to Lower South River currently experiences poor levels of service during peak traffic flow and relatively high accidents rates. In order to improve traffic flow and safety in this area a planning study was initiated several years ago to identify and preserve a corridor for a new Highway 104 alignment from Antigonish to Lower South River. The design standard selected for this new highway is a rural freeway divided with a 22.6m wide median, design speed of 120km/hr, and grade separated access.

The planning process to date has included an environmental screening, identification of corridors, functional design of alignment options, public consultations, and various studies including a safety review of alignment options and a peer assessment of TPW's highway planning process. Three alignment options, commonly referred to as Brown, Red, and Blue, were considered for the routing of the proposed Highway 104. After evaluation of numerous impact factors the Blue Route was approved for environmental assessment registration.

Because of the project's size it must be registered as a Class 2 undertaking with the Nova Scotia Department of Environment (DOE) and undergo a full Environmental Assessment (EA). Also, due to anticipated Federal cost sharing, this project is subject to the requirements of the Canadian Environmental Assessment Act (CEAA) and must receive Federal environmental approval.

South River is located approximately 6km east of the Town of Antigonish. The recommended Blue Route crosses South River just downstream of the existing Highway 104. The river at this location is a salt marsh which supports an abundance and variety of fish, birds, and other wildlife. Potential impacts to this section of the South River were identified as a major concern during the environmental screening and peer assessment.

The consultant conducting the peer assessment recommended a realignment of the Blue Route be considered. A study of alternative routes across the South River was conducted and only one feasible realignment was identified that avoids the salt marsh. This realignment, however, has significant deficiencies related to design characteristics, safety, and access considerations that, based on information available to date, appear to outweigh the potential negative environmental impacts of the Blue Route.

Although the proposed Blue Route through South River was approved by TPW, there are significant concerns regarding the environmental impacts of the Blue Route at the South River crossing. Due to these concerns it has been decided to conduct a detailed analysis of the Blue Route South River crossing, prior to environmental registration with DOE, to determine the magnitude and extent of environment impacts at the South River crossing, what mitigation measures will be required, and the cost implications.

2.0 Objective

The primary objectives of this study are to:

1. Identify the environmental impacts of the recommended Blue Route on South River including the salt marsh habitat.

2. Identify any previously undetected avoidance constraints within the study area that may force realignment of the recommended Blue Route.

3. Determine environmental and other mitigation measures required at the South River crossing including associated costs.

4. Determine the general configuration of the structures (two 2-lane structures) at South River including preliminary cost estimates.

3.0 Study Area

The geographic extent of the study area is generally defined as a 200m wide corridor, centered along the recommended Blue Route, extending from 200m west of South River to 200m east of South River. The Study Area is shown on Figure 1. This Study Area is intended to indicate the limits within which the proposed alignment may move, and should be used for **site specific criteria only.** Many criteria to be investigated as part of this study will have areas of potential impact outside this Study Area, and the Consultant should use their judgement and expertise to develop these impact areas.

4.0 Scope of Work

The Scope of Work is defined in attached Appendix A.

5.0 Duties of the Consultant

-Meet with the Project Management Team as per the schedule specified in Section 8.0 (Meetings and Reports).

-Become familiar with the study area, environmental elements, and concerns.

-Review existing information regarding the proposed alignment and any relevant studies previously conducted.

-Contact landowners regarding accessing their property to conduct field work.

- Liaise directly with the appropriate authorities in the performance of the work including local officials with the Department of Natural Resources, Department of Environment, and

the Department of Fisheries and Oceans

-Conduct required field work, research and analysis.

-Identify preventive, mitigative or avoidance measures that will be required as a result of the proposed undertaking and associated costs.

-Identify additional regulatory approvals or permits that may be required prior to construction of the proposed highway.

- Prepare preliminary structural designs (general arrangement) including costs estimates.

- Provide recommendations/conclusions

6.0 Duties of TPW

- Meet with the consultant on an arranged schedule.

- Provide the consultant with any required documentation (reports, studies, plans, etc.) related to the project.

7.0 Guidance

A project management team will administer the technical and analytical work of the consultant. The team will consist of representatives from TPW . The consultant will report to the project management team chair who will be responsible for overall administration of the study.

Acceptance and approval of the work will take place after the project management team has been satisfied that the requirements, as specified in the contract, have been met.

8.0 Meetings and Reports

The Consultant shall meet with the project management team for the project initiation, the draft final report review, and other meetings as required during the duration of the project. All meetings will be held in Halifax, Nova Scotia. The consultant shall meet with the project management team within two weeks of notification of award of contract. The initial meeting with the consultant will be to finalize the study requirements, data requirements and the methodologies to be used.

The following reports shall be required:

Three (3) copies of a draft final report for the Study must be submitted for comment and possible amendments before the final version is submitted. The Consultant must be prepared to submit a second draft if requested. Required copies of the draft final report shall be

submitted 5 working days prior to the review meeting.

Ten (10) bound copies and one unbound copy of the final report. The Consultant shall also have a copy on hand should additional copies be required at short notice. All copies of the draft and final report shall be on letter size paper and appropriately titled. The final report shall include an executive summary and a list of references. All reports shall contain copies of supporting plans and figures. The Terms of Reference shall be attached as an appendix to the final report.

9.0 Study Schedule

The consultant shall meet with the project management team within two weeks of notification of award of contract. The study shall be completed and the required copies of the final report presented within four (4) months of award of contract.

10.0 Ownership of Information

The consultant agrees that all information collected, materials gathered and reports produced shall be the property of the Province of Nova Scotia. The consultant shall not be permitted to publish or in any way use said information without the expression or prior approval of TPW.

All documents, including proposals, submitted to the Province are subject to disclosure under the Nova Scotia Freedom of Information and Protection of Privacy Act. By submitting a proposal the proponent thereby agrees to public disclosure of its contents. Any information the proponent considers 'personal information' because of its proprietary nature should be marked as "confidential", and will be subject to appropriate consideration as defined within the Nova Scotia Freedom of Information and Protection of Privacy Act.

Information pertaining to this competition or any Department obtained by the proponent as a result of participation in this project is confidential and must not be disclosed without written authorization from the Province.

11.0 Consultant Expertise/Eligibility

Project teams should have considerable expertise in environmental assessments in general and in the various issues/elements under consideration in this Study, in particular. As a minimum, the project team must contain a structural engineer experienced in bridge design, a hydrologist, a hydrogeologist, an archaeologist eligible to practice in Nova Scotia, and biologists specializing in wetlands, habitat assessment, and identifying rare and endangered species. The engineering principal shall be a registered member of the Association of Professional Engineers of Nova Scotia (APENS).

Prospective proponents are not eligible to submit a proposal if current or past corporate or

other interests may, in the Province's opinion, give rise to a conflict of interest in connection with this project.

The successful proponent may be required to demonstrate financial stability and may be required to register to conduct business in Nova Scotia.

Occupational Health and Safety

The contracted party must have either a Certificate of Recognition issued jointly by the Nova Scotia Department of Labour and an occupational health and safety organization approved by Nova Scotia Department of Labour, or the contracted party must have a Letter of Good Standing from an occupational health and safety organization approved by Nova Scotia Transportation and Public Works indicating that the contracted party is in the process of qualifying for the Certificate of Recognition.

The successful bidder will be expected to develop a safety plan for the project, to be reviewed by TPW. This plan must deal with hazard recognition, assessment and control, provision of first aid services, and handling of emergencies and it must meet all requirements prescribed by the Occupational Health and Safety Act and regulations.

Workers Compensation

The successful bidder must provide proof that they have either:
i) Registered with the Workers' Compensation Board and are in good standing (for at least the duration of this project), or
ii) Received a letter from the Workers' Compensation Board stating that the type of work they are undertaking does not meet their criteria for required coverage.

12.0 Proposal Requirements

Failure to provide information outlined in this section may result in disqulification.

Four (4) copies of your proposal (fax copies are not acceptable) are to be delivered by 10:00 am local time, September 6, 2000 to;

Public Tenders Office
6176 Young Street, Suite 100
Halifax Nova Scotia
B3K 2A6
Tender 60061440

Proposals and their envelopes should be clearly marked with the name and address of the proponent, the Request for Proposal number, and the project or program title. A public opening will be held on September 6, 2000 at 10:30 am local time at the Public Tenders Office. Late proposals will not be accepted and will be returned to the proponent.

Proponents are solely responsible for their own expenses in preparing, delivering or presenting a proposal and for subsequent negotiations with the Province, if any. Proposals must be open for acceptance for at least **90** days after the closing date. Upon acceptance, prices will be firm for the entire contract period unless otherwise specified.

To facilitate efficient review of the proposals, proponents are requested to use the following format. The proposal shall be organized into four chapters and such chapters limited where indicated.

1 Introduction

This chapter shall include, but not necessarily be limited to, background information, a description of the study area, and understanding of the project and its objectives, including potential key issues.

2 Qualifications

This chapter shall include, but not necessarily be limited to, company/companies corporate profile, client references, and the proposed team members. Corporate information not relevant to the proposed project is not necessary, however may be included in an Appendix if the Consultant feels it appropriate.

A summary of relevant company experience. This shall be a maximum of three pages.

A summary of project team member experience in areas related to these terms of reference. This summary shall be a maximum of one page per team member, focussing on the team member's relevant experience and expected contribution to the project. Curricula vitae of team members, preferably outlining only relevant experience, shall be included in an Appendix.

3 Methodology

This chapter shall include, but not necessarily be limited to:

A list of all information and data sources available to the Consultant and expected to be used in the Study.

A detailed work plan, identifying planned field work, and including intended approach, methodology and schedule for the study. See Appendix A for required work.

A draft table of contents for the report.

A concordance table (or similar) linking proposal to this RFP.

4 Project Management

This chapter shall include, but not necessarily be limited to, a discussion of quality assurance/quality control, cost control, scheduling, insurance, and safety certification. Copies of certificates are not required as part of the proposal, but shall be provided by the successful Consultant upon award of the contract.

Number of person-days for each team member by task assigned to the project. For consistency, the basis of remuneration will be per **8 hour day** for all team members.

One copy of the cost proposal shall be provided, **to be separately sealed in an envelope,**

including labour costs, related expenses, printing costs and professional services obtained outside of the firm. In order to assess level of effort, time commitments for all team members (**excluding labour costs**) shall be included in the main body of the proposal. Prices quoted are to be in Canadian dollars and **exclusive of federal and provincial taxes**. Expenses shall not exceed the Nova Scotia provincial rates ($0.315/km, breakfast $6.00, lunch $7.00, supper $13.50, incidentals $4.00 per night)

By submitting a proposal, the proponent warrants that all components required to deliver the services requested have been identified in the proposal or will be provided by the Consultant at no additional charge. The proposal must be signed by the person(s) authorized to sign on behalf of the proponent and to bind the proponent to statements made in response to this Request for Proposal.

13.0 Liability for Errors

While considerable effort to ensure the accuracy of the information in this Request for Proposal has been made, the information contained in this Request for Proposal is supplied solely as a guideline to Proponents. The information is not guaranteed or warranted, nor is it necessarily comprehensive or exhaustive.

14.0 Extra Work

The consultant may be required to undertake additional work not specified in the contract. Prior to starting this additional work the consultant shall submit a detailed breakdown of the costs, including all expenses, to complete the extra work and obtain written approval from the project management team.

15.0 Request for Proposal Amendments

All proponents will be notified by the Public Tenders Office regarding any changes made to the Request for Proposal or any appendices or any change in the closing date or time. When these changes occur within **five** government business days of the close of the proposal, the proposal closing date will be extended to allow for a suitable number of bid preparation days between the issuance of the change and the closing date. All amendments must accompany each proposal. Proposals that do not contain all the amendments will be immediately returned and the proponent eliminated from further consideration.

16.0 Payment Schedule

Payments for professional services rendered will be made monthly in arrears upon receipt of invoices detailing progress work completed, and subject to the following conditions;

(a) Monthly payments will be issued for up to 90 % of the amount invoiced. The remaining amount will be paid upon completion of and acceptance of the work, as indicated in (b),

and;

(b) The total of such payments is not to exceed 80% of the fixed price for the contract. The remaining 20% will be paid upon acceptance of the final report by the project management team.

(c) Receipts shall be provided for all expenses if requested.

The consultant is expected to provide a level of service consistent within a budget of **$30,000**.

17.0 Evaluation of Proposals

Proposals shall be evaluated based on the "Government Procurement Process: Architects and Professional Services" (June 15, 1998).

All proposals will be initially assessed based on the experience and expertise of the project team. Any proposals not meeting minimum qualifications will not be evaluated further.

The criteria for evaluating proposals, based on technical and managerial merit, will be the following;

- Experience and expertise of the consulting firm on similar projects.	5 points
- Qualification and experience of team members on similar projects.	20 points
- Understanding of project and objectives.	20 points
- Proposed methodology and approach.	20 points
- Quality of the proposal/level of effort.	15 points
- Local knowledge and content.	5 points

After meeting initial qualifications, proposals will be evaluated on the basis of their technical and managerial merit and then on the basis of price. The technical submission shall be rated as shown above, out of 85 points, and the remaining 15 points shall be allotted based on price. Only those proposals achieving an aggregate score of 68/85 (80%) or greater will have their sealed cost envelopes opened. The lowest price shall be awarded 15 points (all prices within 5% will receive the same price points). The next lowest price (beyond 5%) will receive 12 points. Points for other submissions will be assigned with 3 fewer points for each successively higher priced price proposal. But again, each time the same score will be awarded if successive prices are within 5% of the last highest price. The proposal with the highest total points will be awarded the contract. Proposals not meeting the required 68/85 will have their unopened cost envelopes returned.

Not withstanding the technical/managerial and price scores TPW reserves the right to reject any proposal where prices are deemed unreasonable relative to other prices bid, typically a 25% variance from the average qualified bid (excluding the bid in question).

TPW reserves the right to negotiate any or all conditions of the consultant's proposed work plan and reject all submitted proposals. Unsuccessful proponents may request a debriefing meeting following execution of a contract with the successful proponent.

18.0 Contract Procedures

Notice in writing to a proponent of the acceptance of its proposal by the Province and the subsequent full execution of a written contract will constitute a contract for the goods or services, and no proponent will acquire any legal or equitable rights or privileges relative to the goods or services until the occurrence of **both** such events.

If a written contract cannot be negotiated within **thirty** days of notification of the successful proponent, the Province may, at its sole discretion at any time thereafter, terminate negotiations with that proponent and either negotiate a contract with the next qualified proponent or choose to terminate the Request for Proposal process and not enter into a contract with any of the proponents.

19.0 Inquiries

All enquiries related to this Request for Proposal are to be directed to the following person. Information obtained from any other source is not official and may be inaccurate. Enquiries and responses may be recorded and may be distributed to all proponents at the Province's option.

Department Contact:

Michael Croft, P.Eng. (Project Management Team Chair)
Infrastructure Planning Engineer
Telephone: 902-424-3548
Fax: 902-424-0571
Email: croftmi@gov.ns.ca

Appendix A
Scope of Work

- Provide a general description of the project as it is planned to progress through the construction and operational phases with emphasis on the section through the study area.

- Provide a general description of the existing terrain within and adjacent to the study area including a discussion of the area affected by the undertaking and the sensitive aspects of the biophysical environment that may be adversely affected by the project. The description shall include, but not necessarily be limited to, area geography, existing and anticipated land use, atmospheric conditions, ambient noise levels, surface water (hydrological, hydraulic, water quality, drainage areas, etc.), groundwater (hydrogeological and water quality), valued environmental components, habitat identification (flora, bird, fish and terrestrial fauna), bedrock and surficial geology, archaeological sites, transportation, and regulatory environment.

- Conduct field work, research and analysis required to identify and predict the magnitude and importance of project impacts, both positive and negative, on the bio-physical environment and archaeological resources. This analysis shall also include an investigation of the current use of lands and resources for traditional purposes by aboriginal persons. Field work shall include, but not necessarily be limited to, flora and fauna surveys (including migratory birds), fish habitat evaluation (including abundance, distribution, and composition of fish species), archaeological surveys, and subsurface testing to determine bedrock geology (the presence of karst terrain is a major concern) and soil characteristics. The cumulative effects of this project together with past projects, such as the existing Highway 104 structure at South River, and potential future projects within the study area shall be considered.

Any wetlands that are adversely affected by the Undertaking are to be evaluated according to the 1995 Nova Scotia Department of the Environment Wetlands Directive; or the North American Wetlands Conservation Council (Canada) Wetland Evaluation Guide or an equivalent process acceptable to the Nova Scotia Department of the Environment.

Assessment of impacts of the South River structure shall include a.) an estimate of the area of salt marsh, estuary channel, and main channel within the structure's footprint (approaches, piers, and abutments) b.) timing considerations for construction work with respect to fisheries, wildlife, and migratory bird windows, c.) access considerations for construction of the structure, d.) potential requirements under the Navigable Waters Protection Act.

- Provide a detailed description of those measures that will be required to prevent or minimize adverse impacts on the environment including a description of appropriate compensation that could be provided when environmental damage is unavoidable. This section shall include, but not necessarily be limited to, required mitigation measures related to regulatory compliance, dust and airborne pollution control, accidental spills, noise, surface water quality, fish habitat, groundwater quantity and quality, storm water runoff, erosion and sedimentation control, acid producing bedrock, disturbance of contaminated soil, impacts of contaminated groundwater, impacts to flora (in particular any rare or endangered species),

impacts to terrestrial and aquatic fauna, migratory bird habitat, and archaeological resources.

Both approaches to the proposed crossing are over moderately steep terrain and in areas of highly erodible clay soils. Particular attention is required to the assessment of potentially complex sediment and erosion control measures required to protect the South River during construction.

- Identify additional regulatory approvals or permits that may be required prior to construction within the study area.

- Prepare general arrangement designs for the two structures at the South River crossing including order of magnitude cost estimates based on TPW design standards (preliminary discussions with DFO indicate a complete spanning of the back channel and retention of the maximum area of salt marsh will be required). Subsurface investigations shall be conducted as required to determine general foundation design requirements at abutments and piers.

PARTIAL PLAN
SCALE: 1:2000

REFERENCE DRAWINGS

DWG.NO.	TITLE	BY
2 OF 2	CONCEPTUAL DESIGN PROFILES, SECTIONS AND DETAILS	NGNS

NOTES:

1. FOR GENERAL NOTES SEE DWG. 1 OF 2.
2. FOR SECTION B–B, SEE SUBSURFACE PROFILE DWG. No. MAP–2.

LEGEND:

- MTL–2 – MINNOW TRAP LOCATION
- SSL–2 – SEDIMENT SAMPLE LOCATION
- BH–2 – BOREHOLE LOCATION
- MARSH VEGETATION
- BACKWATER CHANNEL
- MAIN RIVER CHANNEL
- MIXED WOODS
- PROPOSED AREA TO BE BACKFILLED.
- PROPOSED AREA TO TURN INTO BACK CHANNEL

REV.	ISSUED TO	ISSUED FOR

NO.	DATE	BY	REVISIONS	CKD

DESIGNED	DRAWN
CHECKED (DESIGN / DFTG.)	DATE: DEC. 05/00
	SCALE: AS SHOWN
APPROVED (P.M. / P.T.)	SPEC.: –

Neill and Gunter
DARTMOUTH, N.S., CANADA

NOVA SCOTIA
Transportation and Public Works

Infrastructure Management Section

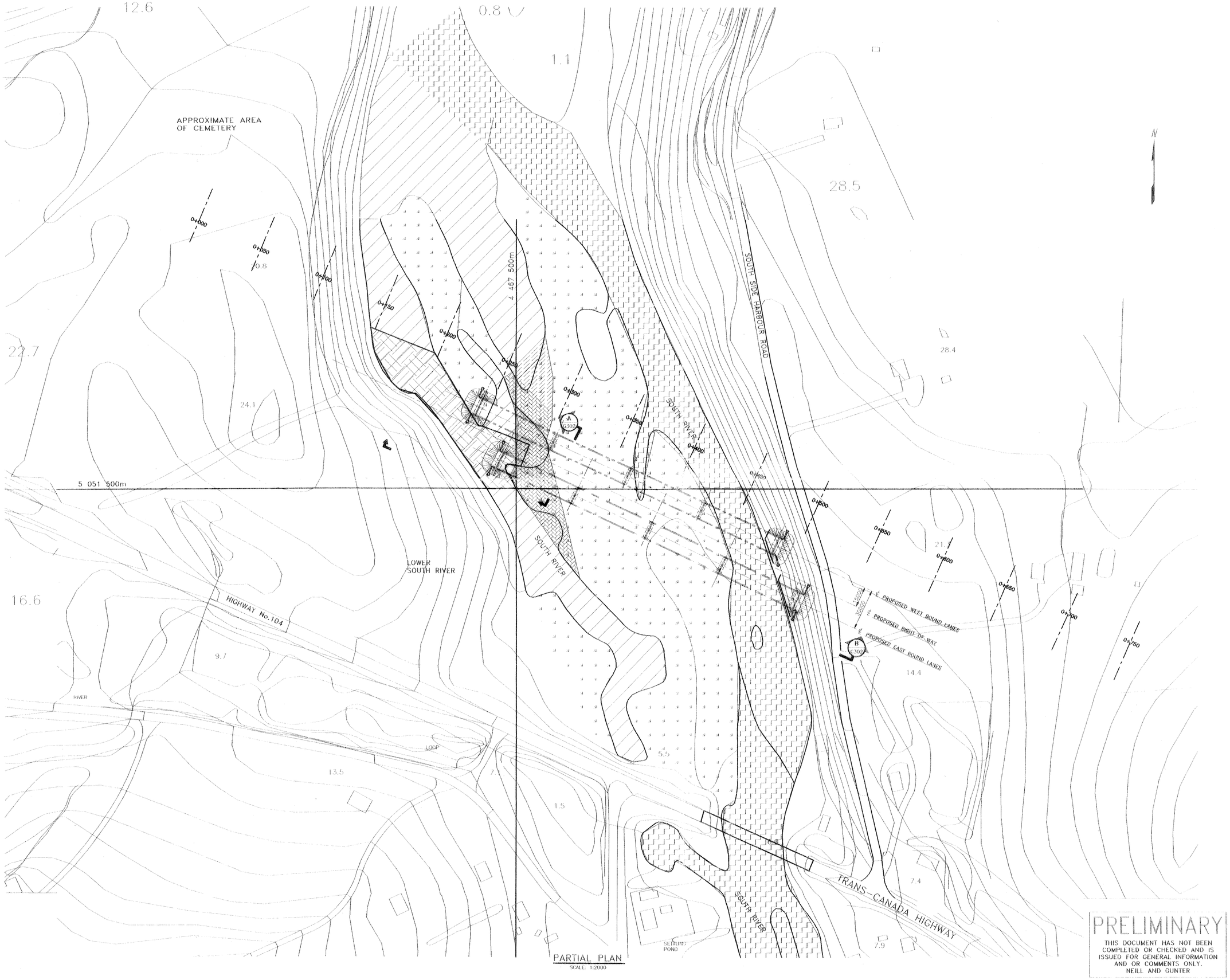
HIGHWAY 104 ANTIGONISH SOUTH RIVER IMPACT STUDY

HIGHWAY 104 ANTIGONISH
BIOLOGICAL SAMPLING SITES
AND GENERAL HABITAT TYPES

JOB NO. 16053 | DWG. NO. MAP–1 | REV. A

PRELIMINARY

THIS DOCUMENT HAS NOT BEEN COMPLETED OR CHECKED AND IS ISSUED FOR GENERAL INFORMATION AND OR COMMENTS ONLY.
NEILL AND GUNTER



PARTIAL PLAN
SCALE: 1:2000

REFERENCE DRAWINGS

DWG.NO.	TITLE	BY
2 OF 2	CONCEPTUAL DESIGN PROFILES, SECTIONS AND DETAILS	NGNS

NOTES:

1. DISTURBANCE TO SALT WATER MARSH TO BE MINIMIZED.
2. INSTALL SEDIMENT TRAPS AT DOWNSTREAM END OF ALL CONSTRUCTION SLOPES.
3. INSTALL SILT FENCING AROUND ALL MAJOR STRUCTURES. REMOVE ALL EXCAVATED MARSH MATERIAL FROM SITE.
4. PROTECT SALT WATER MARSH BY INSTALLING TEMPORARY ROADS ON 60ML HDPE OR CORDUROY ROADS.
5. USE TREMIE CONCRETE METHODS FOR PIER FOUNDATIONS BELOW WATER TABLE.
6. FOR BIOLOGICAL SAMPLING AND HABITAT SITES, SEE MAP 1.
7. ALL LOCATIONS ARE APPROXIMATE ONLY.

LEGEND:

- PROPOSED AREA TO BE BACKFILLED
- PROPOSED AREA TO TURN INTO BACK CHANNEL
- SOUTH RIVER BACK CHANNEL
- SOUTH RIVER

PRELIMINARY

THIS DOCUMENT HAS NOT BEEN COMPLETED OR CHECKED AND IS ISSUED FOR GENERAL INFORMATION AND OR COMMENTS ONLY.
NEILL AND GUNTER

REV.	ISSUED TO	ISSUED FOR
C	CLIENT JAN. 2001	REVIEW NOT FOR CONSTRUCTION

NO.	DATE	BY	REVISIONS	CKD

DESIGNED DCT	DRAWN DJC
CHECKED DCT	DATE DEC. 05/00
DESIGN ENGR. DCT	SCALE AS SHOWN
APPROVED P.M. JWI	SPEC. P.T. DJC

Neill and Gunter
DARTMOUTH, N.S., CANADA

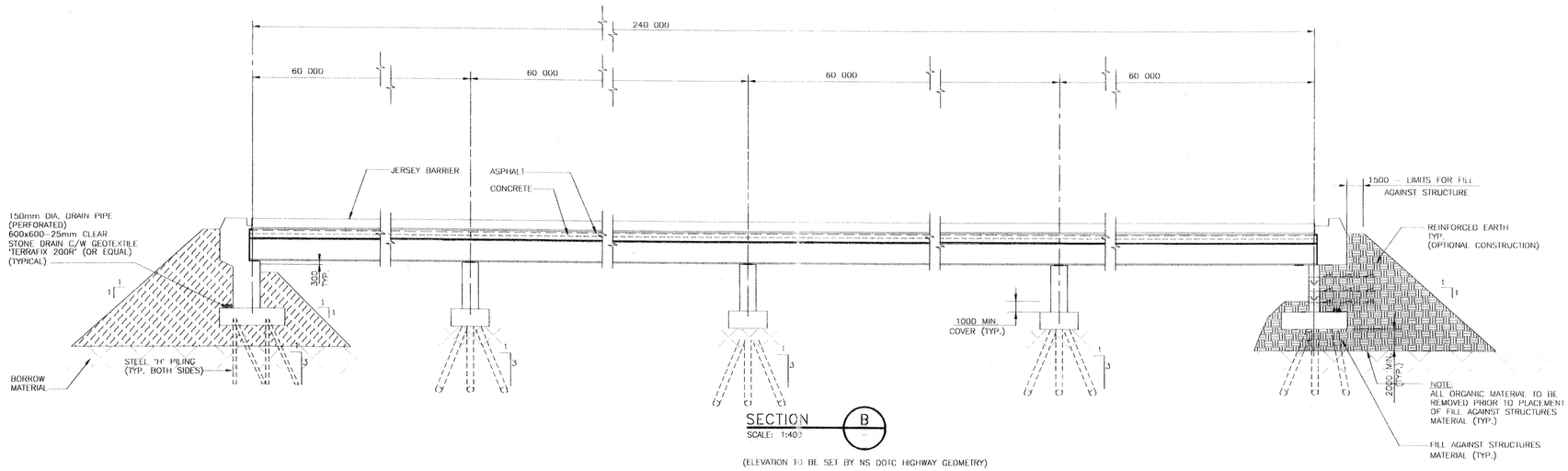
NOVA SCOTIA
Transportation and Public Works

Infrastructure Management Section

HIGHWAY 104 ANTIGONISH SOUTH RIVER IMPACT STUDY

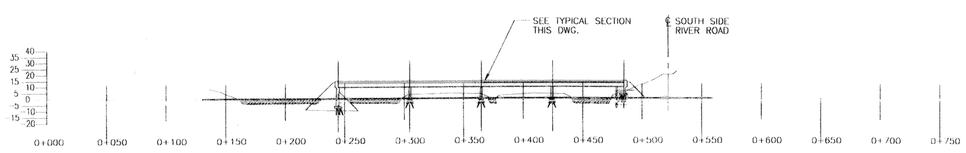
HIGHWAY 104 ANTIGONISH
SOUTH RIVER IMPACT STUDY
PARTIAL PLAN & STUDY AREA

JOB NO. 16053 | DWG. NO. G-301 | REV. C

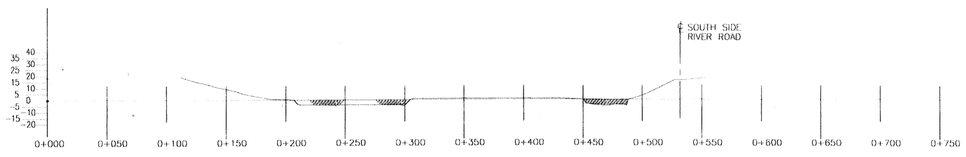


SECTION B
SCALE: 1:400

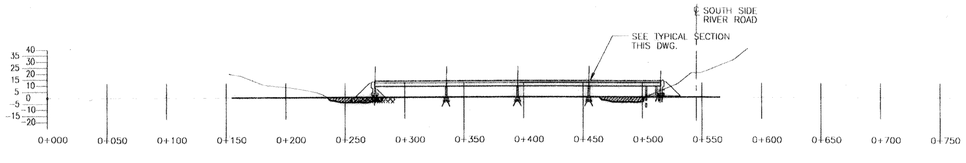
(ELEVATION TO BE SET BY NS DOTC HIGHWAY GEOMETRY)



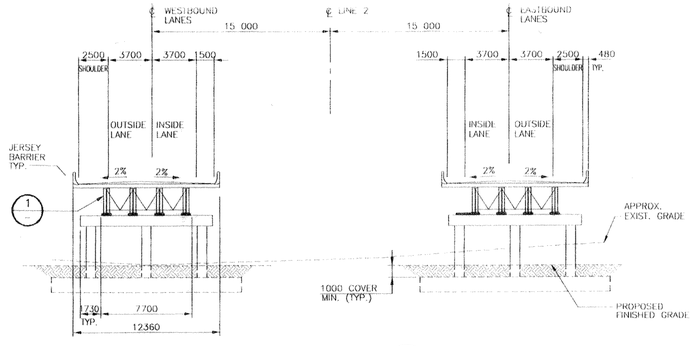
℄ PROFILE @ PROPOSED WEST BOUND LANES
SCALE: 1:4000



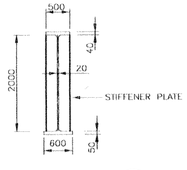
℄ PROFILE OF RIGHT OF WAY
SCALE: 1:4000



℄ PROFILE @ PROPOSED EAST BOUND LANES
SCALE: 1:4000



SECTION A
SCALE: 1:400



DETAIL 1
SCALE: 1:100

REFERENCE DRAWINGS

DWG.NO.	TITLE	BY
1 OF 2	HIGHWAY 104 ANTIGONISH SOUTH RIVER IMPACT STUDY PARTIAL PLAN AND STUDY AREA	NGNS

NOTES:

1. FOR GENERAL NOTES AND PARTIAL PLAN SEE DWG. G-301.
2. THIS DRAWING FORMALLY KNOWN AS DWG. 2 OF 2.

REV.	ISSUED TO	ISSUED FOR
C	CLIENT JAN. 2000	REVIEW NOT FOR CONSTRUCTION

NO.	DATE	BY	REVISIONS	CKD

DESIGNED	DRAWN
DCT	DJC
CHECKED	DATE
	NOV. 30/00
DESIGN DFTG.	SCALE
DCT DCT	1:2000
APPROVED	SPEC.
P.M. P.T.	
JWT DJC	

Neill and Gunter
DARTMOUTH, N.S., CANADA

NOVA SCOTIA
Transportation and Public Works

Infrastructure Management Section

HIGHWAY 104 ANTIGONISH SOUTH RIVER IMPACT STUDY

CONCEPUAL DESIGN
PROFILES,SECTIONS
AND DETAILS

JOB NO. 16053 | DWG. NO. G-302 | REV. C

PRELIMINARY

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