

*The Evaluation of Wetland Restoration Potential within the
Sackville River Secondary Watershed*



Report Prepared by:
McCallum Environmental Ltd.

**EVALUATION OF WETLAND RESTORATION POTENTIAL
WITHIN THE SACKVILLE RIVER SECONDARY WATERSHED**

Proponents:

Twin Brooks Development Ltd.

Armco Capital Inc.

Ramar Developments Ltd.

Report Prepared by:

McCallum Environmental Ltd.

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EXECUTIVE SUMMARY

The purpose of this Evaluation of Wetland Restoration Potential (EWRP) study was to identify cost effective, practical and ecologically significant wetland restoration opportunities within the Sackville River Secondary Watershed, Nova Scotia. The EWRP is not a new study methodology in the North American context, but it is a relatively new methodology and study for Atlantic Canada.

In Nova Scotia, the Department of Natural Resources owns and operates the Wetlands Inventory Database. This database is currently used to identify wetland habitat in Nova Scotia. However, it is commonly understood within industry and government that this database significantly underrepresents the quality and quantity of wetlands throughout the province of Nova Scotia. Therefore, EWRP first identified and evaluated a GIS tool, the potential wetland layer (PWL), to aid in the identification of potential wetland habitat. This PWL was created for the entire Sackville River Secondary Watershed.

In addition to the PWL, a modeled stream layer that was developed by Mr. Raymond Jahncke of Dalhousie University, was also relied upon. It is crucial to note that the PWL is a desktop planning tool only and cannot replace field assessment and appropriate wetland delineation efforts. The PWL can be used to focus field efforts and begin to understand surface water systems across a property.

The PWL was then used to evaluate development activities within a Priority Area for Restoration (PAR) to determine potential opportunities where development (roads, buildings, trails, parking lots etc) had impacted wetlands as identified by the potential wetland layer. The PAR was identified across an area of the watershed where the Study Team determined cost effective, practical and ecologically valuable wetland restoration opportunities would be present. 65 potential restoration opportunities were identified through this desktop exercise within the PAR. Each potential opportunity was assessed in the field (recognizing limitations associated with access).

An evaluation checklist was generated by the Study Team in order to provide qualitative and quantitative analysis of each site to determine the significance of the restoration potential. This evaluation checklist provides general information about each site. A quantitative evaluation was identified by the Study Team adapted from data provided in *Wetlands Restoration Strategy: A Framework for Prioritizing Efforts in Minnesota*, Minnesota Board of Water and Soil Resources, December 2008. The Study Team included a fourth category of assessment, Practicality of Solution, in order to meet the Study goals. This evaluation was completed for each identified site and each opportunity has been described in this report.

Sites can be evaluated by the reader by individual category or overall scores. Sites identified lower in the watershed have lower total scores for stream association and are draining larger areas, thus giving lower scores for categories of water quality and quantity. This reinforces the importance of protecting and restoring sites higher in the watershed in order to maximum watershed health.

EWRP identified thirty seven (37) opportunities for Wetland Restoration, Enhancement and overall Watershed Health improvements inside the Sackville River Secondary Watershed: 25 Restoration opportunities, 8 Enhancement opportunities, and 4 Watershed Health opportunities. These opportunities appear to be practical and ecologically significant. Those with higher point totals will allow for the most practical and likely cost effective opportunities, as well as the most ecologically significant. However, all of these identified opportunities are valuable, and some score lower primarily due to their small size. This should not deter the reader from exploring these opportunities, especially in cases where a small restoration project is needed for compensation requirements.

Property owners have not provided approval for restoration activities to take place at these 37 sites. Summaries for each identified opportunity have been provided. *These summaries are high level recommendations only to provide guidance for the reader.* Feasibility studies are required for each site, including property owner approval, prior to



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detailed planning for restoration projects. In some cases, access was not granted and the site was not assessed, or not fully assessed. In these cases, additional work is necessary just to confirm if an opportunity exists worth exploring.

Urban restoration opportunities require more planning and detailed design work than most rural restoration projects currently being completed, due to a combination of numerous factors. These factors include, but are not limited to, significant rock and bedrock in HRM, anthropogenic surface water influences and interferences, potential contaminant issues in soils and sediment, urban stormwater inputs and the potential for contaminated stormwater, multiple landowners and the developed nature of urban watersheds, community expectations, landowner expectations, the municipal regulatory system and questions relating to jurisdiction (HRM/Halifax Water), and urban infrastructure including roads, buildings, sidewalks, railways, stormwater infrastructure, businesses, energy (power poles and electrical systems), and underground utilities (gas lines, sewer lines, water lines etc.). As a result of these factors, the restoration opportunities identified within this report will be more complex, time intensive and costly than an equivalent sized rural restoration project. *A new mechanism needs to be offered by Nova Scotia Environment in order for these urban restoration projects to be implemented in favour of rural options.* The standard 2:1 ratio based on restoration size alone will not be successful to see the planning and execution of urban restoration projects including these identified within this study. There must be a mandate from government and political will to ensure that urban wetland losses are compensated with appropriate urban restoration projects. As a start, NSE could offer compensation credit for several phases of an urban restoration project including feasibility studies, detailed design and engineering studies, Phase II environmental site assessments (ESA) to determine contaminant levels, environmental baseline studies, preparation of remedial action plans (RAPs) if necessary, and then the actual on-the-ground implementation of the restoration project and associated monitoring.

Additional restoration, enhancement and watershed health opportunities exist within the Sackville River Secondary Watershed. The list provided in this report is not meant to be exhaustive. EWRP was tailored to a specific portion of the watershed for identification of restoration sites, so therefore, the areas outside of this priority area for restoration were not evaluated, but restoration opportunities may be present. Restoration opportunities within the headwaters (Lewis Lake north) would be very valuable to identify, due to their location in the watershed. The Study Team expects that the total number of these opportunities would be low, based on the level of development in this area, but recognize these opportunities are very valuable from an ecological perspective.

Also, the watershed health opportunities identified in this report were confirmed while the Study Team assessed sites for restoration opportunities. These four watershed health opportunities were left on this list for information purposes and at the request of John Brazner at NSE. Additional watershed health opportunities are certainly present across the PAR and the larger SWR.

All restoration opportunities and enhancement opportunities were also not identified within the PAR. The Study Team completed as much assessment as was possible within the time and budgetary constraints allowed for in the EWRP study. A full ecological history of the Sackville River Secondary Watershed would be necessary in order to fully identify and quantify restoration opportunities.

The intent of this report is to identify wetland restoration potential. How and why wetlands have been previously impacted is beyond the scope of this study. Although historical aerial photos were used as a component of the desktop analysis, no attempt was made to determine when a wetland may have been impacted. As such there is absolutely no intent for this document and the results to be used as a regulatory compliance mechanism. This study and report does not render a legal opinion or intent to confer any legal obligations on the owner of the sites identified. It is the opinion of McCallum Environmental Ltd. that using this document and its findings as a compliance mechanism defeats the spirit and intent of the findings.



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Walter Reagan and Damon Conrad, Sackville Rivers Association
Kevin Keys, Nova Scotia Department of Natural Resources
Andrew Robinson, Nova Scotia Geomatics Centre

Also, we would like to extend a large thank you to our stakeholder organizations who volunteered their time to meet on two occasions to review and provide input on the study methodology and results. Thank you very much for your interest and input into this Study.

Halifax Regional Municipality
Municipality of East Hants
Sackville Rivers Association
Nova Scotia Department of Environment
Nova Scotia Department of Natural Resources

STUDY TEAM

McCallum Environmental Ltd.
Meghan Milloy, BSc., MES, Vice President
Melanie MacDonald, MREM
Robert McCallum, P.Biol, President

Boreal Environmental Incorporated
Derrick Mitchell, BSc. F, RPF



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LIST OF ACRONYMS

CWS	Canadian Wildlife Service
DEM	Digital Elevation Model
EGSPA	Nova Scotia Environmental Goals and Sustainable Prosperity Act
EWRP	Evaluation of Wetland Restoration Potential
GIS	Geographic Information System
HRM	Halifax Regional Municipality
LiDAR	Light Detection and Ranging
LSR	Little Sackville River
NSDNR	Nova Scotia Department of Natural Resources
NSE	Nova Scotia Environment
NSTIR	Nova Scotia Department of Transportation and Infrastructure Renewal
PAR	Priority Area for Restoration
PID	Property Identification Number
PWL	Potential Wetland Layer
RAP	Remedial Action Plan
SR	Sackville River
SRA	Sackville Rivers Association
SRW	Sackville River Secondary Watershed
SSHD	Significant Species and Habitat Database
WAM	Wet Areas Mapping



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1 INTRODUCTION

This project, the Evaluation of Wetland Restoration Potential (EWRP), was completed within the Sackville River Secondary Watershed, in Nova Scotia, from July to December 2012. This project was initiated as part of compensation requirements for altered wetland habitat associated with five development projects completed independently by Twin Brooks Development Ltd., Armco Capital Inc. and Ramar Developments Ltd (“Proponents”) within the Halifax Regional Municipality (HRM).

The EWRP project (Project) was completed by McCallum Environmental Ltd. and Boreal Environmental Incorporated (“Study Team”) for the Proponents. This report provides details of the background, stakeholder roles, study components, methodology, as well as the final list of potential wetland restoration opportunities that were deemed to exist within the Sackville River Secondary Watershed.

2 PURPOSE OF STUDY

The primary goal of EWRP was to identify technically feasible and cost effective options for future wetland restoration projects within the Sackville River Secondary watershed.

The objectives of EWRP were as follows:

1. To complete geospatial analysis to identify potential wetland habitat.
2. To identify areas within the Sackville River Secondary watershed where natural wetland and surface water systems have been degraded by human activity.
3. To establish a priority list of degraded wetland and surface water habitat for restoration potential.

This study is important because:

- It is understood that wetlands will continue to be partially or completely in-filled/altered as part of urban development;
- Stormwater management and watershed health within urban watersheds will continually be degraded if restoration opportunities are not identified and restoration projects completed within the same watersheds where urban impacts are occurring;
- There is a requirement of “no net loss” of wetland habitat and function legislated through the Nova Scotia Environmental Goals and Sustainable Prosperity Act (EGSPA);
- Urban restoration sites are difficult to find within the Halifax Regional Municipality. Furthermore, urban restoration sites that have been identified in the past are costly and technically difficult to achieve, and often deal with many landowners, which also increase the complexity and feasibility of those projects.
- Many opportunities that have been previously identified are ill-placed (i.e. low in watershed) and very costly due to significant urban infrastructure.

3 BACKGROUND OF PROJECT AND STUDY AREA

The Proponents, through the development of five independent projects completed in 2011, 2012 and 2013 (two projects pending construction in Summer 2013) within the HRM collectively totaled wetland losses in the order of 7 hectares. Actual on the ground compensation for wetland losses for these projects was provided at a 1:1 ratio through Ducks Unlimited projects in the rural landscape. The remaining compensation requirements are being met by completion of this Project, which was negotiated with Nova Scotia Environment (NSE) Wetland Program Coordinator John Brazner and the local NSE inspector, Craig Curley.

The Study Area for the entire project was defined as the Sackville River Secondary Watershed through consultation with the Proponents and NSE. A narrower Study Area for identification of restoration opportunities was identified and is described in Section 5.3.



3.1 Sackville River Secondary Watershed

The Sackville River Secondary Watershed (SRW) is located northwest the metropolitan area of the City of Halifax, Nova Scotia, the largest urban centre in Atlantic Canada, and is the primary source of freshwater to the Bedford Basin and Halifax Harbour. Most of the SRW is found within the Halifax Regional Municipality (HRM), however, its headwaters lie within the Municipality of East Hants. The SRW is approximately 147 sq km (14,700 hectares) in area and its main stem, the Sackville River (SR), stretches approximately 44km (see Figure 1 attached in Appendix A). The Sackville River discharges into the Bedford Basin in the Town of Bedford.

3.1.1 Demographics

The Sackville River flows through the Town of Lower Sackville, the largest urban centre in the watershed, which has a population of approximately 40,000. Lower Sackville is a highly developed suburban community. The smaller communities of Mount Uniacke, Upper and Middle Sackville, Hammonds Plains, Lucasville, and Bedford also have components located in the SRW.

3.1.2 Natural Features

The SRW is made up of 15 tertiary (sub) watersheds and contains 15 lakes, numerous ponds and wetlands, and many tributaries and feeder brooks. A main tributary to the Sackville River is the Little Sackville River (LSR) which flows through the Town of Lower Sackville and is 11km in length.

The geology of the SRW is mainly comprised of granite bedrock and glacial till, most of which is found in the drumlins that surround surface water features. Because drumlins are comprised of mixed sizes and types of glacial deposits, erosion and the transportation of exposed soil adjacent to surface water features can be problematic.

3.1.3 Current State

Both the Sackville and Little Sackville Rivers are considered urban rivers, having both historical and present development and degradation along their banks. The middle and upper portions of the watershed remain in a less developed state although recent development and planning has commenced in the middle portion of this watershed. The watershed supports 16 fish species, including Atlantic salmon (*Salmo salar*).

3.1.4 Other Research

Two studies were recently completed by the Sackville Rivers Association (SRA- John-William Brunner) for the Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR) to identify potential sites for wetland restoration in several tertiary watersheds of the Sackville River Secondary Watershed. These studies were completed in March 2010 and August 2011.

- Sackville River Watershed Wetland Inventory, Sackville Rivers Association, March 2010
- Sackville River Watershed Wetland Inventory Pt. 2, Sackville Rivers Association, August 2011

The Study Team reviewed the methodologies of these studies as well as their resulting inventory of potential wetland restoration sites and considered these studies while developing the methodologies for the EWRP study. We ensured that any potential restoration site identified by SRA within the identified focus areas of EWRP, and met the EWRP objectives, was reviewed by the Study team for inclusion into the final EWRP list.



4 STAKEHOLDER ROLE

The Evaluation of Wetland Restoration Potential (EWRP) within the secondary Sackville River Watershed is not a new study methodology in the North American context, but it is a relatively new methodology and study for Atlantic Canada. As such, the Study Team wanted to ensure that the stakeholders who may contribute to the success of the Project were knowledgeable in wetlands, wetland restoration, the watersheds in question, and municipal planning and development. The contributions provided from all stakeholders allowed the Study Team to revise the methods and processes along the way to ensure the final product was valuable for the Proponents, NSE, other provincial government departments, SRA and other non-governmental organizations, the municipalities involved (HRM and East Hants), the wetlands specialist community, and the general public.

Several stakeholders were involved in the early planning and development stages of the EWRP study. John Brazner worked with the Study Team to confirm the scope, methodologies and reporting outcomes through the planning and implementation stages of this study. Walter Reagan and Damon Conrad at the Sackville Rivers Association (SRA) were contacted upon commencement of the Project and provided invaluable knowledge of the current state of the watershed and its history.

External stakeholders included:

- Walter Regan, President, Sackville Rivers Association
- Damon Conrad, Sackville Rivers Association
- Robert Jahncke, Landscape Architect, Halifax Regional Municipality
- Jan Skora, Coordinator Real Estate, Planning & Infrastructure, Halifax Regional Municipality
- John Woodford, Director Planning and Development, Municipality of East Hants
- Dale Smith, Trails and Open Space Coordinator, Municipality of East Hants
- Kevin Keys, Site Productivity Forester, Nova Scotia Department of Natural Resources
- Randy Milton, Manager - Wildlife Resources, Ecosystems and Habitats Program, Nova Scotia Department of Natural Resources
- John Brazner, Wetland Program Coordinator, Protected Areas and Wetlands Branch, Nova Scotia Environment
- Peter Bush, Protected Areas Coordinator - Central Region Protected Areas and Wetlands Branch, Nova Scotia Environment
- Raymond Jahncke, GIS Laboratory Coordinator and Researcher, Dalhousie University.

The Proponents were represented in stakeholder meetings by Chris Millier, Armco Capital Inc. and Chris Marchand, Ramar Developments Ltd.

Two external stakeholder presentations were held as a part of EWRP in order to gather information and feedback from selected stakeholders who represented these groups. The first stakeholder presentation was completed on October 11, 2012 and the second was completed on December 13, 2012. The presentation at the first session focussed on the general methodology of the Study and the process of identifying the Potential Wetland Layer. Preliminary potential restoration opportunities were identified and shared with the group. The presentation at the second session was focussed mostly on the results of the aerial photo interpretation and field evaluations, and introduced the groups of identified opportunities to the stakeholders, and shared several example projects.

Both stakeholder meetings involved a presentation from the Study Team with questions and answers throughout the presentation with the collective group. The Study Team received valuable feedback and questions from the stakeholders and the Proponents and these comments and questions influenced the Study's methodology, goals, and ultimately, the final results. The stakeholders were also able to offer specific information about certain properties of interest, details of the watershed(s) and invaluable help with GIS methodologies and available provincial



information (soils, vegetation).

5 STUDY COMPONENTS

EWRP consisted of five components that are introduced in this section. More detailed methodologies for each component are described in Section 6. The Study Team identified the components of this study and the details of the methodologies were confirmed through consultation with John Brazner at NSE, Kevin Keys at NSDNR (GIS methods and use of the Wet Areas Mapping data), Raymond Jahncke at Dalhousie University (GIS), Peter Bush at NSE, and other stakeholders as described in Section 4.

5.1 Geospatial analysis: Potential Wetland Layer

In order to identify potential degraded wetland habitat that could be restored, the first step was to identify areas within the Sackville River secondary watershed where wetlands may have historically existed, as well as identify areas where wetlands likely currently exist.

The Nova Scotia government (NSDNR) maintains a wetlands database for this purpose, but it is understood that this database under-represents many wetland types, especially forested wetlands. The Study Team recognized that in order to find viable wetland restoration opportunities, a new approach would be needed to understand the potential extent of wetlands before development activities occurred within the watershed.

The Study Team identified multiple GIS datasets that could aid in the identification of potential wetland areas. These GIS datasets were then evaluated and amalgamated and revised until the best methodology was identified to generate a Potential Wetland Layer (PWL).

Details of the PWL methodology can be found in Section 6. The following GIS datasets were evaluated for use in EWRP:

- HRM LiDAR/Digital Elevation Model (DEM) 2007;
- 2003 Aerial photos (1:10,000);
- Forest inventory (DNR) FORNON layer and upland species layers;
- Wet areas mapping (WAM) (NSDNR);
- Dalhousie University Raymond Jahncke slope analysis methodology (LiDAR);
- DNR Significant Habitats database and wetland inventory;
- Nova Scotia Property parcels/roads;
- Geonova streams and wetlands (1:10,000 aerial);
- Nova Scotia Department of Natural Resources Ecological Land Classification; and,
- Available soils mapping (NSDNR, Agriculture Canada).

5.2 Field Verification of Potential Wetland Layer (PWL)

Once the potential wetland layer was identified through the geo-spatial analysis, a team of qualified biologists completed field assessments (audits) to field verify the developed wetland layer. This involved several field audits of properties within the Sackville River Secondary Watershed. This wetland layer was also compared to known wetland locations on several properties where wetland delineation activities had previously taken place by the Study Team. Details of the locations and methodologies of the field audits are found in Section 6.2.

5.3 Identification of Potentially Degraded Wetland Habitat (Desktop)

The Study Team identified a Priority Area for Restoration (PAR) within the SRW to evaluate degraded wetland habitat and therefore opportunities for restoration. The team narrowed the focus of this portion of EWRP to the approximate middle third of the SRW. The Study Team used this PAR because it appeared to have potential for



impacts from forest harvesting and general development, but still enough available land to cost effectively and practically offer restoration opportunities.

The Study Team also narrowed potential sites by land ownership to include those lands owned by one or a combination of the HRM, Province, developers, single ownership, or large tracts of land, in order to increase the chances of practical restoration opportunities being identified without major land owner impediments.

Finally, the PWL was layered on top of digital geo-referenced 2003 aerial colour photographs (1:10,000) and property boundary information (PIDs) within the identified PAR of the Sackville River Secondary Watershed. Each aerial photo was analyzed to identify areas where the PWL encountered road or other development (buildings, parking lots, power corridors, sports fields, and trails/paths) impacts. These aerial photos were also analyzed for evidence of flooding along road edges – which suggested hydrology issues due to road placement, infilling activities, and/or other signs of obvious degradation of wetland habitat or potential wetland habitat. 2012/2013 Google Earth imagery was also reviewed to ensure the Study Team reviewed the most recent level of development for each area.

5.4 Identification of Restoration Opportunities (Field Evaluation)

A broad list of potential restoration opportunities was established based on the review of aerial photos and the PWL. Each of these potential restoration sites was visited in the field in order to determine if an actual restoration opportunity was available. Site visits were completed by qualified ecologists, wetland specialists and biologists. Evaluation criteria were established (based on the methodologies outlined in Section 6.4.1) and utilized at each site to describe and quantify the opportunity.

Based on the field evaluation of potential sites, three general categories of opportunities were identified:

1. restoration;
2. enhancement; and,
3. watershed health.

Each site was then described after the field evaluation and given a score based on established evaluation criteria (Section 6.4.1). While several sites involve components of restoration, enhancement and watershed health, sites were categorized based on the most suitable category.

5.5 Reporting

Details of the EWRP study scope, objectives, stakeholder involvement, methods and results and the final list of opportunities have been compiled in this report for submission to Nova Scotia Environment (NSE) Wetland Program Coordinator John Brazner.

6 DETAILED METHODOLOGY

Several iterations of the EWRP methodology were identified, reviewed and discarded before confirmation of the final methodology for each study component of EWRP. In some cases, a particular method was attempted and then halted by the Study Team after determining a weakness in the process or a better way to get more accurate results. In many cases, the methodology was also edited based on stakeholder feedback and questions. The final detailed methodologies for each study component are described in the following sections.

6.1 Geospatial Analysis: Potential Wetland Layer

In Nova Scotia, the databases listed in this section can be used to identify known wetland habitat. For the purposes of EWRP, it was determined early in the planning process for this study that these databases were limited for the



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purpose of determining a list of potential wetland restoration opportunities. This is because both wetland biologists and regulators in Nova Scotia understand that these databases significantly underrepresent wetland habitat in Nova Scotia, especially forested wetlands, which are very common across Nova Scotia.

As a result, the Study Team identified that the first step in the process of identification of wetland restoration opportunities required a GIS predictor tool for wetland habitat to more accurately estimate where wetland habitat might be present. This process of creating a potential wetland layer (PWL) is described in detail below.

6.1.1 Existing Wetland Inventories

Environment Canada & Nova Scotia Lands and Forests

Through the 1970s and early 1980s, a province-wide wetland inventory was undertaken in Nova Scotia. The inventory was initiated by the Nova Scotia Department of Lands and Forests (now Nova Scotia Department of Natural Resources (NSDNR)) and completed in collaboration with Environment Canada's Canadian Wildlife Service. Based upon photo interpretation of 1:10,000 colour aerial photography, the inventory was mapped on 1:50,000 hardcopy topographic sheets. The inventory still has value today but users must be aware of its limitations in accuracy and precision (*Sackville Rivers Association, Sackville River Watershed Wetland Inventory, March 2010*).

Nova Scotia Topographic Map Series

The wetland layer in the Nova Scotia Digital Topographic Series was also based on the digitization of aerial photography. The aerial photography was captured during flyovers in 1991 and 1997 at a scale of 1:40,000. The data includes various wetlands in the SRW but does not specify wetland types. Some wetlands in the topographic map are not inventoried in the NSDNR digital inventory, making the data another useful source of wetland information which is available from the Nova Scotia Geomatics Centre (*Andrew Robinson, NS Geomatics Centre*).

Nova Scotia Department of Natural Resources

In 2000, the Nova Scotia Department of Natural Resources (NSDNR) replaced the previous wetland survey with a digital inventory (1:10,000) integrated into the Department's GIS forest inventory as part its ongoing forest mapping program. The inventory is comprised of a visual interpretation of aerial photography, and an inventory that classifies wetlands by applying to the digitized wetlands an object-based approach to satellite (Landsat ETM+) imagery. The new digital inventory has improved accuracy and versatility as the data can be easily downloaded and manipulated in a GIS. The satellite based classification can be viewed online and GIS shapefiles are available for download. There are, however, still issues with data precision and the identification of some types of wetlands (treed and shrub swamps for example are underrepresented). Through the next cycle in the forest inventory update, additional attention is being placed on identifying treed and shrub swamps.

6.1.2 Other Sources of Information

The FORNON (non-forested attributes) field in the Nova Scotia Department of Natural Resources Forest Inventory was queried to produce an additional wetland layer. This layer was then merged with the existing wetland inventory layers described above to create a complete known wetlands layer based on available provincial government inventories.

6.1.3 Potential Wetland Layer

Halifax Regional Municipality (HRM) provided the Study Team with a digital elevation model (DEM) that was created from LiDAR data. This DEM was provided to McCallum Environmental Ltd. for use in the EWRP study. The LiDAR was flown May 12-15th 2007.

Initially, the Study Team commenced with building the potential wetland layer with the Wet Areas Mapping



(WAM) provided by NSDNR as the base layer (similar to Sackville River Watershed studies completed in 2010-2011). However, during the first stakeholder meeting, a question was raised by a stakeholder trying to understand how the Study Team was going to incorporate the DEM derived from LiDAR provided by HRM.

After this first stakeholder meeting, the Study Team contacted Raymond Jahncke at the Dalhousie University GIS Centre, who has also completed GIS research inside the Sackville River Secondary Watershed. Mr. Jahncke had previously developed a model using LiDAR data for the Sackville River Watershed. His model uses slopes less than or equal to 2% to identify areas where water may accumulate. Once his model was reviewed by the Study Team, it was determined to be a better base layer from which to build the potential wetland layer than the Wet Areas Mapping from NSDNR.

This modeled layer provided by Mr. Jahncke was then merged with the resultant layer described above resulting from the identified wetland inventories.

As a result of field audits and further evaluation of the PWL, the Study Team determined that the slope model described above generally tended to over-estimate potential wetland on plateaus where slopes are less than or equal to 2%. This over-estimation caused commission errors (i.e., the model indicated a potential wetland where one did not actually exist) to be present in the potential wetland layer. To reduce these commission errors, two additional layers were produced to use as clip features (to be removed from the potential wetland layer).

The first layer produced as a clip feature to remove from the potential wetland layer was derived from the Nova Scotia Forest Inventory. Because vegetation can be used as a predictor of hydric conditions, an upland vegetation layer was produced using the NS forest inventory data to clip out of the potential wetland layer which would reduce the inclusion of the upland plateaus originally included in layer based on slope alone. Although the forest inventory is produced at a relatively coarse level, when relevant data was queried, the Study Team found it was useful for removing commission errors.

A Topographic Position Index (TPI) was produced as the second layer to remove potential wetland features located on plateaus. Using the Topographic Position Index Tool, a six category slope position raster was produced: valleys; lower slopes; gentle slopes; steep slopes; upper slopes; and ridges. Steep slopes, upper slopes, and ridges were extracted from the classified raster and converted to a polygon feature. This layer was merged with the upland forest layer described above. The resultant layer was overlaid on the potential wetland layer and used to remove entire or partial features from the potential wetland layer that intersected with the upland features layer.

The Study Team observed a noticeable qualitative improvement in the PWL once the commission errors associated with plateaus were removed. However, many errors still remain as evidenced by final field audit results described in more detail in Section 7 of this report.

6.1.4 Sources of Information That Were Not Used

An attempt was made to incorporate available soils data into the potential wetland layer. The Study Team understood that soils are able to provide significant clues to areas where wetlands form, and in areas where poorly or incompletely drained soils are found, wetlands may form. This information would provide further validation of the PWL. However, the soils data available from NSDNR and Agriculture Canada is available at such a coarse scale that the data did not improve the PWL.

6.2 Field Audits of Potential Wetland Layer (PWL)

Field audits were completed by Meghan Milloy, Derrick Mitchell and Melanie MacDonald. All three of these individuals are qualified and experienced wetland assessors and delineators. Permission was received from



property owners where audits were completed. One additional 200 hectare property was also delineated and used for the purpose of a field audit for EWRP. Although specific details and field audit results associated with this 200 ha property are not discussed herein, general conclusions relating to the accuracy of the PWL were drawn from this work and are provided in this report. Field audits were completed on the following three properties:

- PID 45155801: Elmsdale Lumber property (headwaters of the SRW).
- PID 00478552: Armco Property, Highway 1 near exit 3 Mount Uniacke.
- Confidential 200 hectare PID: headwaters SRW (separate project).

The field audits were not completed across the entire PID, just a portion to sample the accuracy of the PWL. The sample size for audits was not based on a number required for statistical significance.

Several delineation projects had also been previously completed by the Study Team or had been completed for the Proponent(s) on properties within the Sackville River Secondary Watershed were also reviewed and analysed to help understand how well the PWL predicted the locations of wetland habitat. These included, but were not limited to:

- PID 00475715 and PID 00458281: McCabe Lake Development, Upper Sackville.
- PID 40152829 and PID 40152811: McCabe Lake Development, Upper Sackville.
- PID 00475442: Ramar Developments Ltd. property, Middle Sackville.
- Several PIDs owned by Armco Capital Inc. along Lucasville Road.
- Several PIDs owned by Armco Capital Inc. on the western shores of Big Sandy Lake.
- PIDs owned by a private developer at headwaters of the Little Sackville River.

All audit results were evaluated and conclusions were drawn as to the accuracy of the PWL. The two final edits to the PWL described in Section 5.1.3 (clipping out of upland species and running the Topographic Position Index (TPI)) were completed based on audit conclusions. The prediction of wetlands on upland plateaus was the most significant issue identified with the PWL during field audits. Some additional limitations with the PWL were identified and are described in Section 7.

6.3 Identification of Potentially Degraded Wetland Habitat (Desktop)

This section describes the desktop methodologies associated with the process of identifying a list of potential restoration opportunities.

6.3.1 Priority Area for Restoration (PAR)

The Study Team identified three key components for identification of wetland restoration opportunities. The team agreed that land ownership was, and continues to be, a key component that could not be overlooked when contemplating restoration in the Sackville River Secondary Watershed. Projects where many landowners are involved can often add complexity to the restoration goals, outcomes and cost of the project. Land ownership was determined to be a key selection factor for the EWRP project.

The Study Team was committed to the EWRP goal of establishing restoration opportunities that are also practical and cost efficient. Restoration opportunities in urban watersheds are often more expensive and complex when compared to projects identified in rural landscapes (especially agricultural) due to urban infrastructure considerations, stormwater complexities, and contaminant issues. However, the Study team was confident that if practicality and cost efficiency were identified early as key selection factors for site selection that appropriate opportunities within the SRW would be identified.

Based on these three key components for EWRP (cost, practicality and land ownership), a Priority Area for



Restoration (PAR) was identified.

6.3.1.1 Land Ownership

The Study Team decided to focus on properties that were owned by the Federal Government, the Provincial Government, Halifax Regional Municipality (HRM), developers, corporations/industry, and large single owner tracts of land (greater than 1 hectare). The goal was to identify opportunities where only a single landowner would be involved in the decision making processes for restoration, thus potentially reducing complexity, costs and overall time associated with each project.

6.3.1.2 Practicality and Cost Effectiveness

Restoration projects identified in the past within urban HRM have often been situated in locations with significant infrastructure (buildings, parking lots, water lines, sewer lines, power lines, roads, culverts etc) in highly developed urbanized areas (pers. comm., J. Brazner, NSE). These restoration options, while potentially ecologically valuable, are often very costly and impractical.

Restoration work that provides the most benefit tends to be in the headwaters (upper reaches) of watersheds. In general, the lower in a watershed that a wetland restoration occurs, the relative value to groundwater retention, surface water quality, and wildlife habitat decreases (Minnesota Board of Water and Soil Resources, 2008). In the case of the SRW the most highly urbanized and developed areas are in the lowest position in the watershed (Towns of Lower Sackville and Bedford). Based on this knowledge, the Priority Area for Restoration (PAR) was narrowed to remove the highly urbanized lower portions of the watershed (Figure 2 attached in Appendix A)

The headwaters of the SRW are quite rural in nature with rural settlements including Mount Uniacke, Etter Settlement and South Uniacke present in the headwaters of this watershed. Development to date in these areas is generally rural residential in nature. The Study Team presumed that very few restoration opportunities were likely to be found within this area of the watershed based on the low level of development at the present time. Based on this knowledge, the study area for restoration opportunities was further narrowed to remove the headwaters (areas north of Lewis Lake).

The remaining middle third of the watershed was identified as the Priority Area for Restoration (PAR) with the assumption that this area provided the best chance at ecologically significant, cost effective and practical restoration opportunities. The only other area that was removed from the study area for restoration opportunities was the Tomahawk Lake sub-watershed (Figure 2 Appendix A). The land within this sub-watershed is owned by Halifax Water Commission and this area is a protected emergency water supply for the Pockwock Lake primary surface water supply. After discussions with Barry Geddes, Watershed Manager at Halifax Water, the Study Team determined that should restoration opportunities be identified within this watershed, Halifax Water would not be interested in having these opportunities pursued as they have their own mandate and requirements for the watershed in order to manage it as an emergency water supply.

Please refer to Figure 2 attached in Appendix A for the Priority Area for Restoration (PAR) identified for the evaluation of restoration opportunities.

6.3.2 Desktop Evaluation Methodology: Potential Restoration Opportunities

Within the identified PAR, the Study Team overlaid the potential wetland layer with 2003 1:10,000 geo-referenced colour aerial photographs in order to identify intersections between the PWL and development (roads, buildings, trails, sport fields, infill areas). Google Earth (2012) imagery was also reviewed to understand the change in development patterns since 2003 across the PAR. The imagery was also layered with the property parcel boundaries (provided by Nova Scotia Geomatics Centre) in order to identify opportunities consistent with the established land ownership criteria outlined in Section 6.3.1.1.



Finally, Wet Areas Mapping data and a modelled stream layer were also layered in order to understand the movement of surface water through the watershed and at each particular location of interest.

The Study Team reviewed each aerial photo within the identified PAR in order to identify potential restoration sites. All potential opportunities identified with the right land ownership criteria were listed and given a number.

6.4 Identification of Restoration Opportunities (Field Evaluation)

Each field evaluation was completed during the Fall of 2012. Prior to commencing field evaluation of each of the potential restoration opportunities, the Study Team prepared an evaluation criteria checklist for use in the field when a restoration opportunity was identified. The checklist is described in detail in this section, along with the methods for field evaluation of each potential restoration opportunity.

6.4.1 Development of Evaluation Criteria Checklist

The Study Team created an evaluation checklist to quantify the ecological value and practicality of each identified restoration opportunity. The template for the checklist is included in Appendix B (completed evaluation checklists for each site are included as Appendix C).

The checklist provides basic information about the opportunity including PID, address, ownership information, and waypoint (UTM NAD 83). It also provides information about where the opportunity sits in the SRW (upper, middle, low) and what tertiary watershed with the SRW the opportunity is located in. Each opportunity is identified in a category: restoration, enhancement, or watershed health. A definition of each category is provided in Section 7.3.

The next section of the checklist is a short qualitative discussion about the current and remnant condition of the site, the wetlands and any other ecological features identified on the property. This includes a description of land use, water sources or potential water sources, wetland habitat, buffers, and adjacent land use. This information is then used to complete a checklist describing the observed condition of wetland habitat on site including hydrology (flooded, drained, re-routing of inlets/outlets), vegetation (destroyed, altered, and presence of invasive species) and the physical condition of soils (infill or partial infill, excavation or disturbance of soils, or intersection of development (roads/pipelines/trails) with the wetland (with or without culverts). There is a section for general comments relating to the restoration potential/opportunity for this site and then a section to outline the qualitative description of the proposed restoration solution.

The quantitative evaluation of the restoration opportunity is the final section of the evaluation checklist. This evaluation is divided into four categories: Practicality of Solution (in order to meet the EWRP study goal of identifying practical and cost effective opportunities); Functional Benefit: Wildlife; Functional Benefit: Water Quality; and Functional Benefit: Water Quantity (to determine ecological value). This approach was adapted for the EWRP study from the *Wetlands Restoration Strategy: A Framework for Prioritizing Efforts in Minnesota*, Minnesota Board of Water and Soil Resources, December 2008. This strategy recommended that a methodology be established in order to prioritize restorable wetlands within a watershed based on three categories of functional benefits as described above. The Study Team added the fourth category, Practicality of Solution.

Originally, the Study Team wanted to include cost as a specific criterion under the Practicality of Solution category, in order to meet the desired objective of practical and cost effective solutions. However, it was determined by the Study Team to be too difficult with the base level of assessment that was completed at each site to identify, with any accuracy, a cost estimate for restoration work. Therefore, cost was dropped as a specific criterion on the evaluation checklist, but was considered in a general sense for each opportunity and is tacitly included as aspects of the Practicality of Solution category (access, infrastructure, restoration feasibility). As an example, sites with larger areas available for restoration scored higher in terms of practicality of solution based on expected efficiencies when



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completing the work and economies of scale.

Prioritizing sites is a complex decision making process. Practitioners and planners can identify a restoration site based on one category such as water quality, or can look for an overall higher point count across all categories. Each category has several criteria identified with point thresholds in order to score each category and potential sites in a manner that is repeatable and consistent. These criteria and point thresholds were also adapted from the Minnesota Wetlands Restoration Strategy by the EWRP team, with the exception of the Practicality of Solution category. The Study Team identified the criteria and point thresholds for this category.

The Study team completed an evaluation checklist and quantitative evaluation for each identified restoration opportunity. The criteria and point thresholds for the four categories of quantitative evaluation for each opportunity are described in the EWRP Identified Sites Scoring Guidance below.

Table 1: Identified Site Scoring Guidance Information for Evaluation Checklist

Evaluation of Wetland Restoration Potential (EWRP) Identified Site Scoring Guidance		Points
A: Infrastructure Infrastructure is defined as buildings, roads, highways, pipelines, underground services based on land area impacted (hectares) and necessary easements and setbacks. As the amount of infrastructure increases on a site, the practicality and cost-effectiveness of restoration efforts will be reduced.	0 to 25% of restoration area affected by infrastructure	3 points
	25-50% of restoration area affected by infrastructure	2 points
	50-75% of restoration area affected by infrastructure	1 point
	75-100% of restoration area affected by infrastructure	0 points
B. Land Ownership The goal of EWRP is to identify restoration opportunities where multiple owners will not hamper progress.	Provincial or Federally Owned	3 points
	HRM, corporation or developer	2 points
	Land > 1 ha, single owner	1 points
	Land < 1 ha, single owner	0 points
C: Restoration Feasibility Parameters: hydrology, soils, and vegetation Feasibility of proposed opportunity will be increased if only one parameter requires restoration. Complexity will increase with additional parameters needing restoration.	One parameter requires restoration	3 points
	Two parameters require restoration	2 points
	Three parameters require restoration	1 point
D: Access Equipment is defined as tandem trucks and a medium sized excavator. Construction of access roads, removal of barriers to access increase complexity, practicality and costs associated with the restoration opportunity	Fully accessible to equipment	3 points
	<50% construction required to achieve access	2 points
	>50% construction required to achieve access	1 point
	No access: total construction required	0 points
E: Surface Area of Restoration Opportunity Surface are of the proposed wetland restoration opportunity is an important functional benefit for wildlife habitat and water quality. E ₁ : Use the size of area <i>requiring physical work</i> . Larger sites are scored higher based on efficiency and economies of scale. E ₂ : Use the size of the <i>wetland</i> to be impacted.	greater than 2 ha	3 points
	1 to 2 ha	2 points
	0.5 to 1 ha	1 point
	less than 0.5 ha	0 points
F: Buffer Size and Condition Situations where partial buffers exist in natural states and portions are destroyed, assessor should use professional judgment to identify appropriate classification and provide written explanation of justification based on the average width of buffers surrounding the wetland habitat.	greater than 40 m/natural	3 points
	20m to 40 m/natural	2 points
	less than 20 m/natural	1 point
	less than 3 m natural or disturbed/destroyed (any width)	0 points



G: Proximity to Other Wetlands Wetland restoration work is more valuable when completed in locations where other wetland habitat is located within close proximity to the restoration opportunity.	less than 250 m	3 points
	250m to 500 m	2 points
	500m to 1000m	1 point
	greater than 1000m	0 points
H: Watershed/Wetland Ratio Restoration opportunities are more valuable for water quality and water quantity (storage) within a watershed if the wetland size is large in comparison to the watershed size. Use the most immediate drainage basin for this criteria, following the standard calculation for sizing of culverts in Nova Scotia ¹ .	less than 5:1	3 points
	5:1 to 10:1	2 points
	10:1 to 20:1	1 point
	greater than 20:1	0 points
I: Restoration Location (stream association) If the restoration opportunity is riparian in nature and associated with a 1 st or 2 nd order stream ² , this provides added benefit to water quality within the watershed. 1 st order streams in a high position in the watershed are the preferred choice for increasing water quality. For the purposes of evaluating EWRP sites, use the tertiary watershed basin.	1 st order stream in upper 1/3 of watershed	3 points
	1 st order stream in middle 1/3 of watershed	2 points
	2 nd order stream in upper 1/3 of watershed	1 point
	All other streams	0 points
J: Wetland Volume Water volume is the appropriate parameter to measure to determine utility of wetland restoration for water quantity (storage) purposes. Wetlands with the ability to store greater volumes of water should be priority restoration opportunities within a watershed.	less than 2000m ³	0 points
	2000m ³ to 5000m ³	1 point
	5000m ³ to 10000m ³	2 points
	greater than 10000m ³	3 points

Point thresholds adapted from data provided in *Wetlands Restoration Strategy: A Framework for Prioritizing Efforts in Minnesota*, Minnesota Board of Water and Soil Resources, December 2008

1. Nova Scotia Watercourse Alteration Activity Standards (Draft), October 2012, Nova Scotia Environment.

2. <http://water.epa.gov/type/rs/monitoring/vms21.cfm>

6.4.2 Access to Potential Restoration Sites

Sites that were owned by the provincial government were fully accessible to the Study Team. A request was submitted to Halifax Regional Municipality (HRM) to access sites identified as potential restoration opportunities based on desktop evaluation. This request was granted and therefore access was provided to all necessary HRM properties. Access was also granted for any properties owned by the Proponents. However, access was not requested from private corporate, industrial, forestry, or single land owner properties. These sites were assessed from publically available vantage points (usually public roads) to the best of the Study Team’s abilities. Two sites were not accessible and the evaluation checklist was completed based on desktop available tools only.

6.4.3 Field Evaluations and Determination of Final Opportunities

The Study Team evaluated the wetland restoration potential at each site respecting access issues described in Section 6.4.2. Photographs were collected. During all field evaluations, available historical aerial photos and satellite imagery from Google Earth (2003-2012) were reviewed in order to understand how the observed development had changed the landscape and what the area and wetland looked like before the development was present. This review helped immensely when evaluating the restoration opportunity and filling out the evaluation criteria checklist. In many cases, it wasn’t until the Study Team reviewed the historical aerials that the restoration opportunity became apparent.

Opportunities were identified based on the following categories, defined in Section 7.3:

- Restoration.
- Enhancement.



- Watershed Health.

6.5 Reporting

The evaluation checklist was completed for each identified opportunity and a final score was given for each site. The Study Team determined that costs could be estimated only after a more detailed feasibility study was completed at each site. This feasibility study was beyond the scope of this study. Photographs were organized and provided with each checklist and a short summary for each opportunity is provided in Section 7.5 of this report.

7 RESULTS

This section of the report provides details regarding the modeled potential wetland layer (PWL), the accuracy of the potential wetland layer based on the field audit results, and defines the three categories of opportunities that were identified by the Study Team within the SRW. Limitations identified with the EWRP study methodology and results are discussed.

Each identified opportunity (37 in total) are described, photographs for each opportunity are included, along with the completed evaluation checklist for each site (Appendix C), a site map showing each restoration opportunity, and the aerial photograph with the intersection of development with the potential wetland layer (Appendix A).

7.1 Potential Wetland Layer (PWL)

The PWL was generated for the entire SRW. For the EWRP study, it was then used within the identified Priority Area for Restoration (PAR) (Figure 2, Appendix A) to establish intersections with development and potential restoration opportunities.

The headwaters of the SRW are located in the communities of Mount Uniacke, Etter Settlement and South Uniacke. Identification of wetland habitat and watercourses in the headwaters is important for overall watershed health and quality municipal planning. The potential wetland layer is provided for this area of the watershed in Figure 3 attached in Appendix A.

Another important headwaters area in the watershed is the headwaters of the Little Sackville River tertiary watershed. This area is particularly important as the water quality of the Little Sackville River (LSR) has been severely degraded over the years, and the watershed health of the LSR watershed has decreased (pers. comm. W. Reagan, SRA 2012.). The LSR suffers from severe flooding during rain events and significant siltation issues. Protection and restoration of wetland habitat in the headwaters of the LSR watershed is important for the long term protection and possible recovery of this tertiary watershed. The potential wetland layer is a useful tool that can help support these efforts. The PWL in the headwaters of the Little Sackville River area is provided in Figure 4 attached in Appendix A.

7.2 Field Audit Results: Potential Wetland Layer

As described in Section 5.2, field audits were completed on several properties with the SRW in order to confirm the accuracy of the modeled potential wetland layer.

Delineation efforts were completed in 2009 on a 600 hectare parcel of land on the north shores of McCabe Lake owned by Twin Brooks Developments Ltd. (Armco Capital and Ramar Developments joint venture) by Genivar Inc. McCallum Environmental Ltd. completed some follow up delineation work and wetland alteration approval permitting in 2012. Figure 5 (Appendix A) shows an area of this property near the shores of McCabe Lake. The grey potential wetland layer is layered with the actual field delineation results in black (outlined). The PWL identified correctly the position of four of the five most sizable wetlands (presence/absence). In this particular



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location, the PWL appears to underestimate the overall size of wetland habitat. The Study Team concluded in this case that the PWL underestimated the wetland habitat due to the fact that the northern portion of the largest wetland exists on a slope (greater than 2%). Many of the smaller wetlands in this area exist on gently slopes draining towards the lake. These types of slope wetlands will not be identified by the PWL.

Figure 6 shows a second area associated with the McCabe Lake property. This area is further north and near the top of the tertiary watershed (McCabe Lake North). All wetland habitat delineated in this small area of the McCabe Lake property was identified by the PWL (presence/absence). In this location, the PWL overestimates the size of wetland habitat. This observation is consistent with the Study Team experience working with auditing the PWL in the field. In headwater landscape positions where the topography is quite flat, the PWL tends to overestimate wetland habitat. However, as so much of the vegetation in Nova Scotia is facultative and not indicative one way or another as to wetland habitat, many areas in headwater positions that are flat will be included based on presence of facultative vegetation, but will actually not be determined to be wetland.

The Study Team walked a small portion of the property PID 45155801 identified in Figure 7 (Appendix A) to verify the accuracy of the PWL. This property is located at the headwaters of the SRW in the Mount Uniacke area and is on the watershed divide between the Sackville River Watershed and the St. Croix River Watershed. The Study Team did not walk the entire area shown in the Figure. The results from this property are consistent with the conclusions drawn from the review of McCabe Lake headwater areas. . in that the PWL overestimates the presence of wetland habitat in these headwater landscape positions.

A large parcel of land (200 hectares) in the community of South Uniacke was assessed for wetlands and watercourses by McCallum Environmental Ltd in the Fall of 2012. This site was also located at the watershed divide between the SRW and the Shubenacadie River Watershed and therefore the property was in a headwater position for both of these watersheds. The Study Team was able to use the PWL as a desktop planning tool on this property. Although the site and specific results are not available to this Study as a result of client confidentiality, conclusions were drawn from extensive time on this site (2 weeks) and use of the PWL to predict wetland habitat. These conclusions support those previously stated; that the PWL overestimates the presence of wetland habitat in these headwater landscape positions.

Across the entire McCabe Lake property (600 hectares) there were 75 wetlands identified. The PWL predicted the presence of 56 of these wetlands (74.6%). At the undisclosed property near South Uniacke (200 hectares), there were 14 wetlands identified within the portion of the property found within the SRW boundary. The PWL predicted the presence of 9 of these wetlands (64.3%).

In general terms, the PWL provides a good presence/absence indicator of wetland habitat and generally overestimates wetland habitat (overall numbers and size). In some landscape positions it overestimates the individual size of wetlands (example: headwater positions), and in some landscape positions, it may underestimate the individual size of wetlands. It will not identify wetlands occurring on slopes greater than 2%. Additional research and field work would be required to draw further conclusions relating to the accuracy of the PWL.

7.3 Identified Wetland Restoration Opportunities

A total of 65 potential restoration opportunities were identified based on the aerial photo interpretation and analysis. Each potential restoration opportunity was subsequently visited and evaluated by Meghan Milloy, Derrick Mitchell and Melanie MacDonald.

During the field evaluations, many potential sites ended up not making the final list of wetland restoration opportunities. This was as a result of several different possible field observations and Study Team conclusions.



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In most cases, the potential opportunity was identified during aerial photo analysis based on an overlap of development with the PWL. However, in some cases, upon field evaluation, no wetland habitat was present or where it was present it didn't overlap significantly with the surrounding development.

Other sites, when evaluated by the Study Team, did not have a practical solution available. For example, several sites were identified during aerial photo analysis where the PWL was isolated from the larger surface water system by development. During the field evaluation, the practicality of re-establishing surface connectivity was assessed. In cases where the outlet was routed into stormwater pipes and channeled under major roads, for example, the potential opportunity was not brought forward to the final list of restoration opportunities, as there was a general understanding that there wasn't a practical solution to re-naturalize this connectivity. This also occurred with several potential opportunities where infilling activities and subsequent new development were present. There was no practical solution identified if the development was present on top of the infill area; therefore, the Study Team did not include these opportunities on the final list.

In other cases, the PWL intersected as expected with the surrounding development, but upon inspection, the wetland was functioning well and appropriate measures had been taken to ensure hydrologic connectivity was maintained (cross culverts in place). No final wetland restoration opportunities were identified in these cases.

Upon field evaluation, a few sites presented good opportunities for work that would improve water quality and general watershed health (for example, culvert upgrades or replacements) or stream restoration to reduce siltation. The Study Team identified that these sites were not wetland restoration opportunities. However, these sites were discussed with John Brazner and he requested they remain on the final opportunities list. Each of these sites were classified as Watershed Health (defined below) opportunities and identified as such on the evaluation checklist.

A total of thirty seven (37) total opportunities were identified and have been included on the final list of restoration opportunities. Figure 8 (Appendix A) provides a visual representation of the identified opportunity locations within the SRW. All opportunities were within the identified Priority Area of Restoration (PAR) with the exception of three opportunities. Two opportunities were identified in the headwaters of the SRW near South Uniacke. These locations were mentioned to the Study Team by a colleague, Nick Hill, a wetland specialist and botanist from the Fern Hill Institute. The Study Team completed a field evaluation and included two opportunities at these locations on the final wetland restoration list. The third opportunity was identified lower in the SRW in the urban core of Lower Sackville. This opportunity was identified and introduced to the Study Team at the recent Urban Wetland Restoration Course (NSE, Fern Hill Institute, April 2012). It was evaluated in the field and included in the final restoration list because it was determined to have the potential for a practical solution, even outside of the PAR.

The nature of the final opportunities varied. The Study Team established three categories for the opportunities, as defined below. While some opportunities involved components of restoration, enhancement and watershed health, the Study Team determined the most suitable category for each opportunity.

Restoration: The re-establishment of previously existing wetland and its functions and services by human intervention at a site where a wetland no longer exists, or exists only in a highly degraded state (NSE 2011).

Opportunities that fall into this category are standard restoration sites where a wetland was once present and has been highly degraded and requires physical work to re-establish wetland hydrology, soils, vegetation or a combination of all three parameters. This would also apply to a portion of a wetland that has been degraded.

Enhancement: The implementation of projects conducted in existing wetlands to achieve specific management objectives or to promote conditions that previously did not exist. Such projects



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increase one or more wetland functions or services. Enhancement may involve trade-offs that result in a positive change in one wetland function or service and a negative change in another (NSE, 2011).

Several opportunities identified as enhancement projects were related to work within and surrounding a wetland for stormwater management purposes, or opportunities where wetland function(s) has been severely degraded.

Watershed Health:

Work associated with the improvement of overall watershed health, but where wetland restoration and enhancement are not involved.

These opportunities were left on the final list at the request of John Brazner at NSE. John agreed these sites were important to document and relevant to the overall broader goal of watershed health within the SRW.

A total of twenty five (25) *Restoration* opportunities are included on the final list. Eight (8) *Enhancement* opportunities have been identified, and four (4) *Watershed Health* opportunities are included, for a total of thirty seven (37) final opportunities. Each site is described in Section 7.5 and is shown on Figure 8 across the SWR.

7.4 EWRP Specific Limitations

Potential Wetland Layer PWL

- The Study Team was unable to find a good “building or developed GIS layer” that could be clipped out of the PWL. Therefore, these areas still are present within the layer (pre-2007 when the LiDAR was flown).
- This PWL is a *desktop tool only* to predict the locations of potential wetlands. It would not be appropriate to replace proper field evaluations and wetland delineation based on the existence of this PWL.
- Wetlands on slopes greater than 2% will not be picked up by PWL.
- PWL in headwater landscape positions generally overestimate size of wetlands.
- So much of the vegetation in Nova Scotia is facultative and not indicative one way or another as to wetland habitat, so many areas in headwater positions that are flat will be included based on presence of facultative vegetation, but will actually not be determined to be wetland.
- The PWL is limited by the quality of the forest stand delineations performed by aerial photography interpretation in the Forest Inventory. For example, white spruce is easily mistaken for black spruce.
- Species such as red maple or an indicator of frequency of disturbance, in addition to site conditions as it relates to wetland habitat. As a result, upland plateaus which have been disturbed by fire, blowdown or harvesting may be temporarily dominated by a facultative (FAC) species such as red maples, and therefore, this area will remain in the PWL. However, the ultimate mature stand would likely be dominated by a tolerant hardwood such as yellow birch, sugar maple or beech. Therefore, in this instance, the PWL overestimates wetland habitat.
- The PWL is built from LiDAR data which was flown in 2007 by HRM. Development since 2007 will not be included in the PWL.

Identification of Opportunities (Desktop)

- A detailed ecological history was not completed within the Priority Area for Restoration (PAR). A historical understanding of what the surface water systems looked like pre-development would have allowed for a more thorough evaluation of potential restoration sites and would have provided a more comprehensive list of potential opportunities. This ecological history was not part of the EWRP scope.
- Areas outside of the identified PAR were not evaluated for restoration opportunities. However, opportunities almost certainly do exist in the headwaters area, and in the lower portions of the watershed



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excluded from this Study (Town of Lower Sackville and Bedford).

- The Study's objective was to identify cost effective and practical restoration opportunities on properties with single land ownership. Additional opportunities are sure to exist within the PAR that did not meet the objectives of EWRP

Field Evaluation of Opportunities

- Access was not granted for all potential restoration opportunities. Sites on private land were assessed to the best of the Study Team's abilities and in many cases, full assessment was not possible. All conclusions drawn in this report must be considered with this access limitation in mind.
- The Study Team completed a basic ecological history of each final opportunity, but did not complete a thorough historical review.
- Due to the timing of some field visits, snow limited visual assessment of ground cover, vegetation and surface water movement.
- It is important to note that the field evaluation completed for the purposes of the Evaluation of Wetland Restoration Potential (EWRP) Study was not an exhaustive and complete feasibility study. This was beyond the scope of this assessment.
- Detailed feasibility studies are required for each opportunity to determine the scope and details for restoration activities.

7.5 Identified Sites: Summary of Restoration Opportunity

Thirty seven (37) restoration opportunities were identified in EWRP and each site is described below. Each identified opportunity has a corresponding Figure (9-33) in Appendix A, and a completed evaluation checklist in Appendix C.

Please note, the descriptions and associated evaluation checklists and figures do not constitute a feasibility study for restoration work at each opportunity. The circle placed on each figure is a general representation of the area identified only. The purpose of each summary is to give the reader a general description of the site and the restoration opportunity, and to provide the results of the quantitative evaluation completed by the Study Team in order to provide information on restoration potential. Higher scores in the quantitative portion of the checklist suggest in general terms a higher restoration value (both from an ecological perspective as well as a practicality perspective). Watershed Health opportunities have a lower maximum point total as several criteria are not applicable to these opportunities.



7.5.1 Site #1a

This opportunity was identified at PID 00588459 owned by Vernon K. Davis. This opportunity falls within the Restoration category. The site was observed from the main access road only.



Photo 1: Open Pond Area



Photo 2: Outlet from Pond along ditch

The site is an active quarry located in South Uniacke, NS and is shown on Figure 9. The quarry appears to have been operational since before 2003.

The quarry area is identified as potential wetland on the PWL and there is an actual stream outlet from the pond that drains west and south towards the Sackville River (Photo 2). The pond does not appear to be natural and may have been at one time part of a larger headwater wetland across the quarry area with a stream outlet. The outlet has been channelized and ditched before draining into another channelized ditched watercourse towards the southwest.

Restoration work could be completed to re-naturalize the quarry area. The total available restoration size will be dependent on total available water across this area. The pond should be re-graded and the water levels reduced in order to re-establish wetland functionality in pond area and to the north of the pond location. Restoration could be completed along the ditch/watercourse network to re-naturalize and re-establish natural riparian wetland habitat and stream functions.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	10	15
Wildlife	3	6
Water Quality	8	9
Water Quantity	5	6
Total Score	26	36



7.5.2 Site 1b

This opportunity was identified at PID 00588558, owned by Harry Zinn and others. This opportunity falls within the Restoration category. The site was observed from the main access road only.



Photo 3: Wetland Habitat North of road



Photo 4: Wetland Habitat between roads looking north

This wetland habitat was observed along the roads leading to Site #1a (Figure 9). Wetland habitat is present to the north of the northern road as shown in Photo 3, and also in between the two access roads to Site #1a (Photo 4). The wetland habitat was in reasonable condition with culverts present under both roads. The outlet of this wetland is a channelized stream outlet approximately 1 m wide and of unknown depth. There was some minor back up of water observed on the north side of the wetland (as observed in Photo 3) but this was not a major impact. The 1964 historical photograph shows this wetland habitat and the road was present at this time.

This site was included on the opportunity list after the field visit was based on a review of the surrounding area. An abandoned gold mine site is located just west of this wetland habitat, and Nova Scotia Department of Natural Resources (NSDNR) has identified this wetland habitat as a possible location of 2000 tons of crushed tailing deposits associated with these gold mining activities (B. Matlock, NSDNR, pers. comm, 2013). Documentation of these tailing locations is attached as Appendix D. Gold mine tailings are generally high in mercury and arsenic. Further work would be required to confirm if tailings are present and what environmental impacts have resulted from the tailings on wetland habitat and surface water since they were deposited in this habitat. A specific Remedial Action Plan (RAP) could be prepared to restore the wetland and reduce potential risk to the ecosystem and human health from these tailings.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	10	15
Wildlife	5	6
Water Quality	5	9
Water Quantity	2	6
Total Score	22	36



7.5.3 Site 2

This opportunity was identified at PID 41164039, owned by Shirestone Developments. This opportunity falls within the Restoration category. This property was assessed from the abandoned paved road centrally located on the property.



Photo 5: Abandoned road intersecting property



Photo 6: Remaining natural stream channel

In the 2003 aerial photograph and on Google Earth imagery from 2012, this property appears overgrown and the road is clearly abandoned. In 1973, this road is in use as a secondary exit road (ramp) from Highway 101. Highway 101 is a single 2-lane highway in 1973. With the exception of the abandoned road, the property is undeveloped and forested.

As shown in Figure 10, there are two modeled streams draining south onto the property. These stream systems were confirmed during the field visit. The western stream follows the constructed ditch line of the abandoned road and therefore offers lower habitat in-stream quality. The eastern stream meanders in and out of the constructed ditch line and offers better habitat quality, but there is still room for improvement. Some wetland habitat was observed on either side of the abandoned road, especially to the east. Work could be completed on this property to re-naturalize the stream bed(s) and also, in areas where slopes allowed, riparian wetland habitat could be expanded and created. This work could be completed on one or either side of the abandoned road, leaving the road in place with some work to create a channel across the road to move water from west to east into the eastern stream network. Ideally, this work could be completed in conjunction with development of this property which would see the road removed, allowing for re-integration of the two stream systems into one system with the development and extension of riparian wetland habitat.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	9	15
Wildlife	5	6
Water Quality	7	9
Water Quantity	4	6
Total Score	25	36



7.5.4 Site 3

This opportunity was identified at PID 40140113, owned by Brycon Investments Ltd. This opportunity falls within the Restoration category. This property was assessed from the road during work being completed on the adjacent property.



Photo 7: Created Pond at base of Quarry Face



Photo 8: Berm located at west end of pond restricting outlet into associated stream

This area appears to be actively used as a pit or quarry for collection of gravel and other rock products as shown in Figure 11. At the base of this large rock face is what appears to be a human made pond. The other three sides of this pond are surrounded by a built up earthen berm. The pond is the headwater surface system for a stream that drains directly into the Sackville River. The stream was observed on the western edge of the pond, disconnected to the pond due to the presence of the berms. The pond appears to be 2-3 metres in depth with no emergent vegetation present. A review of a historical photograph from 1973 shows that this pond was not present and the area was undisturbed forest.

Work could be completed to re-establish wetland habitat at this location by re-graded and reducing water levels in the pond, and re-establishing a naturalized outlet to the stream present west of the pond.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	9	15
Wildlife	4	6
Water Quality	3	9
Water Quantity	1	6
Total Score	17	36



7.5.5 Site 4

This opportunity was identified at PID 40846115, owned by KCB Developments and is used as a golf driving range. This opportunity falls within the Restoration category. This property was assessed from Beaverbank Road only and no visual confirmation of the potential opportunity was identified due to the grade of the property and a property fence. Therefore, no photos were collected of the potential opportunity.

Based on a desktop review of aerial photos and the modeled stream and potential wetland layer, the Study Team identified that a modeled ephemeral stream draining west to Feely Lake originates from the subject property (Figure 12). The top of this modeled stream and potential wetland area intersects directly with southwest corner of the driving range present on the property. Field assessment is required in order to understand the specific condition of the property in this south west corner, and to determine the presence and condition of the stream and wetland habitat. Based on the developed nature of the driving range (the property appears to be graded and landscaped), there is the potential for restoration opportunities in this section of the property.

A review of historical photographs from 1974 shows this area as undeveloped. The property was undeveloped and forested in the area of the top of the modeled stream and potential wetland habitat. Wetland habitat was not confirmed based on the review of the historical aerial photos.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	9	15
Wildlife	4	6
Water Quality	3	9
Water Quantity	0	6
Total Score	16	36

Scoring was completed based on aerial photograph and PWL review only. No field assessment was completed. Therefore, the size of restoration opportunity was estimated only.



7.5.6 Site 5

This opportunity was identified at PID 40140113 owned by Brycon Investments Ltd. and is used as a pit or quarry. This opportunity falls within the Restoration category. This property was assessed from the road during work being completed on the adjacent property.



Photo 9: Quarry and Road looking west



Photo 10: Wetland Habitat observed in Quarry

As shown in Figure 11 attached, the majority of the area identified as the quarry is also potential wetland habitat and the top of several modeled streams that drain southwest into the Sackville River. As of 1973, the site was undeveloped, with a natural diagonal wetland system present, running from northwest to southeast. During the field assessment, several small pockets of wetland habitat were observed in low depressions across the quarry area dominated by cattails and some standing water. A stream was observed at the south end of the quarry. All water moving through this quarry area appeared to be collecting and draining south into this stream. Wetland habitat was fragmented by piles of rock, roads, and ditches. There was a lot of standing water and ditched water observed within the quarry area and the total area is quite flat.

Work could be completed across the quarry to restore wetland habitat and enhance existing wetland habitat. Significant intrusion of invasive species was observed at this property. Inlet and outlet streams require significant restoration work to create valuable stream habitat and to reduce siltation and excessive peak flows into wetland habitat and into the Sackville River. The quarry area could be re-graded and designed to restore valuable wetland habitat.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	12	15
Wildlife	5	6
Water Quality	8	9
Water Quantity	6	6
Total Score	31	36



7.5.7 Site 6

This opportunity was identified at PID 00475442 owned by Ramar Developments Ltd. and is currently undeveloped. The south half of the property is forested, and the front half has been cleared and leveled/graded. This opportunity falls within the Restoration category. This property was fully accessed as it is owned by one of the Proponents of this study. Three opportunities were identified on this property (Sites 7 and 8 as well). These sites could be restored individually but the optimum ecological (and cost) value would be to complete all three opportunities concurrently.



Photo 11: Looking NW at wetland and infill area



Photo 12: channelized inlet into wetland

Figure 13 shows this restoration opportunity. This wetland habitat is located near the watershed boundary within the North McCabe Lake tertiary watershed. The outlet from this wetland drains southeast and is a first order stream forming Christina's Brook and draining into Webber Lake. As a headwater wetland, this habitat is significant. During the field visit, it was observed that the majority of this wetland habitat is natural with little anthropogenic impact identified. However, there is no natural buffer along the east side of the wetland as the cleared/leveled portion of the property extends up to the eastern edge of this wetland. Historical observations of farming activities were identified in this area. The site appears to be level and graded and possible agricultural activities on going in the 1973 aerial photograph. According to the current owner, the site was altered and cut down by 2-3 metres in 2006 in order to provide fill for another project.

Infill is present within the wetland along the southern edge. As well, a small trail is present just south of this infill area that crosses over the outlet stream. Large boulders and/or a small culvert are present under the trail and appear to allow reasonable drainage under the trail. A secondary inlet of stormwater from the western adjacent property is also present as shown above in Photo 12 draining into the south edge of this wetland. Restoration activities could be completed to remove the infill material and trail to restore wetland habitat. Evaluation of trail and outlet stream should be completed to ensure the quality of the connectivity from the wetland to the associated stream should it be left in place.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	10	15
Wildlife	5	6
Water Quality	5	9
Water Quantity	3	6
Total Score	23	36



7.5.8 Site 7

This opportunity was identified at PID 00475442 owned by Ramar Developments Ltd. and is currently undeveloped. The south half of the property is forested, and the front half has been cleared and leveled/graded. This opportunity falls within the Restoration category. This property was fully accessed as it is owned by one of the Proponents of this study. Three opportunities were identified on this property (Sites 6 and 8 as well). These sites could be restored individually but the optimum ecological (and cost) value would be to complete all three opportunities concurrently.



Photo 13: Watercourse Channel Looking NW



Photo 14: Trail at Watercourse Intersection

The watercourse connects wetlands associated with Site 6 and 8 (Figure 13). The watercourse has been channelized with infill present along the northeast edges, and a berm is present along the other (SW) edge of the watercourse. There is a trail present intersecting the watercourse without a culvert installed. The watercourse could be restored into a more natural meandering watercourse with riparian wetland habitat or perhaps a vegetated swale (depending on total amounts of water in the system). Infill could be pulled back from the edges of the watercourse and the berm removed. The trail should either be removed or constructed with an appropriate water crossing and culvert(s).

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	11	15
Wildlife	5	6
Water Quality	3	9
Water Quantity	0	6
Total Score	19	36



7.5.9 Site 8

This opportunity was identified at PID 00475442 owned by Ramar Developments Ltd. and is currently undeveloped. The south half of the property is forested, and the front half has been cleared and leveled/graded. This opportunity falls within the Restoration category. This property was fully accessed as it is owned by one of the Proponents of this study. Three opportunities were identified on this property (Sites 6 and 7 as well). These sites could be restored individually but the optimum ecological (and cost) value would be to complete all three opportunities concurrently.



Photo 15: Area of Infill: Remnant Wetland



Photo 16: Wetland Vegetation Growing Through Infill

When the property was cleared and leveled in 2006, a large portion of a wetland was infilled (Figure 13). A small portion of this wetland (mixed wood treed swamp) is still present along the watercourse described as Site 7, but the majority of this wetland habitat has been infilled. A berm has been built along the south side of the wetland and the watercourse that was the inlet for this wetland has been channelized and currently bypasses this in-filled wetland habitat. Obligate and facultative wetland plants including *Vaccinium oxycoccus* and *Juncus effusus* were observed growing through the fill material clearly defining a remnant wetland edge. Hydric soils and a seed plant of wetland plants are likely present under or within the fill material. Removal of the fill material would allow natural wetland vegetation and hydrology to be restored fairly easily.

This opportunity would be best completed in conjunction with Site 7 to allow the naturalization and re-introduction of the watercourse inlet into this wetland habitat.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	13	15
Wildlife	5	6
Water Quality	6	9
Water Quantity	2	6
Total Score	26	36



7.5.10 Site 9

This opportunity was identified at PID 00459370 owned by Denis Morin. The property appears to be partially infilled and leveled and the northern portion of the property is wetland habitat- shrub swamp dominated by alders. A residential home is located in the northeast corner of the property. The south end of the property may have been used as a gravel pit/quarry in the past. This opportunity falls within the Restoration category. This property was observed from the northwest property line and from the south at the end of the cul-de-sac on MacIntosh Road.



Photo 17: Looking N at site from MacIntosh Rd



Photo 18: Looking N- Note Infill Piles

As shown in Figure 14, wetland habitat at this property is in a throughflow position with a watercourse inlet draining from the NW (and Site 8) and exiting the property under a culvert on Orchard Drive. The wetland appears to have been infilled to some degree along the southern edge, and the northwestern inlet and edge of the wetland has been altered and piles of slate and fill are present in this area. The inlet watercourse flows down a bank which appears to have been excavated in the past, as there is exposed soil and slate. Some evidence of acid rock drainage is present. Some areas around the inlet watercourse have been infilled.

The site was previously impacted by clearing and grading as early as 1973.

The re-establishment of wetland soils and vegetation in the northwest corner of the wetland near the inlet location where there is exposed slate will serve as passive treatment of acid rock drainage, reducing impact on the outlet watercourse. Piles of fill and slate can be removed from the wetland habitat. There is also the possibility of wetland restoration or creation along the south side of the existing wetland habitat where infilling and leveling is currently present. This wetland system has the capacity to accept additional stormwater from surrounding developments, as it is part of a headwater system with generally low inflow, especially if additional wetland habitat was created or restored.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	11	15
Wildlife	5	6
Water Quality	7	9
Water Quantity	3	6
Total Score	26	36



7.5.11 Site 10

This opportunity was identified at PID 40423857 owned by the Halifax Regional Municipality (HRM). The property consists of forested land across the northern half of the property and riparian shrub wetland habitat associated with the Little Sackville River (LSR) across the southern half. This opportunity falls within the Enhancement category. This property was fully assessed with permission from HRM staff.



Photo 19: Property looking N to Millwood Drive



Photo 20: Marginal Wetland Habitat

Figure 15 shows the property and Jackladder Brook as it drains south onto the property and enters into the Little Sackville River. Riparian wetland habitat along the LSR was observed across the southern half of this property. The northern portion of the property as shown in Photo 19 and 20 can be described as marginal wetland habitat with severely braided stream habitat. It appears that this area was not originally wetland habitat but with additional stormwater and other water inputs from surrounding residential development into Jackladder Brook upstream of this property, the area has been flooded and now supports a marginal wetland habitat. However, this marginal wetland habitat is not equipped to fully filter sediments and potential contaminants (road salt, grease/oils) due to a very fast residence time through this habitat. The habitat is forested, with hummocky micro-topography, braided streams throughout and little understory vegetation.

Enhancement of this marginal wetland habitat can be completed in order to increase residence time for stormwater and water inputs from Jackladder Brook before entering the Little Sackville River. The area could be altered to increase understory vegetation and alter water levels by grading to slow down water and act as a filter for possible contaminants and sediment.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	10	15
Wildlife	4	6
Water Quality	2	9
Water Quantity	3	6
Total Score	19	36



7.5.12 Site 11

This opportunity was identified at PID 40015208 owned by the Barrett Enterprises Ltd. The property consists of a small pond along the east side of the Little Sackville River and is part of several properties that make up the Barrett Lumber property on Beaverbank Road. There is a road along the south side of the pond that provides access to several residential homes to the southwest. This opportunity falls within the Enhancement category. This property was assessed from the road intersecting the property.



Photo 21: Pond on property east of LSR



Photo 22: Little Sackville River West of Pond

Figure 16 shows the property, the pond and the Little Sackville River draining west of the pond to the south across the access road present on the property. A review of historical aerial photos shows the pond present back as far as 1974. The original purpose of the pond is unknown, and it is difficult to know for sure whether the pond is natural or man-made. Based on the current usage of the area and the condition of the pond, the Study Team concluded it was likely human made and does not appear to be used for any industrial fashion. The Little Sackville River (LSR) is running west of the pond and connected to it by a small ditch. The LSR runs under the access road through a culvert draining south into a larger pond on the Barrett Lumber property. The pond is surrounded to the east and south by industrial storage areas. The LSR is located to the north and west.

Work could be completed at the pond and surrounding southern buffer area to restore or enhance this pond into a shallow water wetland with vegetated buffers where possible. Work could also include potentially increasing the connectivity with the LSR and incorporating the pond and shallow wetland into this riverine system.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	9	15
Wildlife	4	6
Water Quality	1	9
Water Quantity	0	6
Total Score	14	36



7.5.13 Site 12

This opportunity was identified at PID 40015364 owned by the Barrett Lumber Company. The property consists of a lumber mill, distribution centre and a log pond associated with the Barrett Lumber property on Beaverbank Road. This opportunity falls within the Restoration category. This property was assessed from the access road to the north of the pond, as well as from Beaverbank Road. The entire pond and outlet was not accessible.



Photo 23: Logging Pond looking North



Photo 24: Pond looking West towards outlet

Figure 16 shows the log pond and the Little Sackville River across the Barrett Lumber Company property. An historical review of aerial photos shows the edges and shape of this pond shifting over the past four decades. The 1974 aerial photograph shows Barrett Lumber actively using the property and the pond. The log pond currently has essentially no vegetated buffer, with the exception of a narrow section on the eastern edge of the pond. The remainder of the pond edges has been built up, cleared and infilled for storage and handling of logs. Emergent vegetation is present on the northern and eastern edges of the pond, presumably due to a lack of log-booming activity on that side of the pond.

The LSR was presumably historically dammed in order to create this log pond for industrial purposes. The dammed outlet also provides an opportunity to store water, increase retention time, and settle out potential contaminants and sediment by establishing a shallow water wetland system that can still maintain the necessary log-booming functions for the industrial client. The opportunity to restore and enhance wetland habitat around the edges of the pond will increase its functionality as a natural wetland system. The backfill from pond edges could be removed and regarded to provide a natural vegetated wetland edge. If the water level could be altered with permission from the property owner, additional shallow wetland habitat may be able to be created within the pond without limiting its industrial usage.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	10	15
Wildlife	3	6
Water Quality	4	9
Water Quantity	2	6
Total Score	19	36



7.5.14 Site 13

This opportunity was identified at PID 40117236 and PID 40443258 and is owned by the Roman Catholic Episcopal Corp. and NSTIR respectively. The property consists of a vacant property with signs of remnant asphalt driveway and a trail system present on it. Fragmented wetland habitat is present across the property and an outlet stream is also present. This opportunity falls within the Restoration category. This property was assessed from Beaverbank Road.



Photo 25: Outlet from Fragmented Wetland Habitat



Photo 26: Wetland Habitat with Fill/Asphalt

Wetland habitat is particularly fragmented across the northern portion of the property, the PID owned by NSTIR. Trails and an asphalt driveway are observable on this property, although very overgrown and vegetated. Across the southern portion of the wetland, less fragmentation and human disturbance is present. In 1974, this site was cleared and a driveway and buildings (residence and barn) were present on the northern portion of the property.

Figure 16 identifies the area of interest for potential restoration activities associated with these properties. Restoration work could be completed to remove old trails and asphalt and associated infill from the property and re-grade the land and re-establish connected wetland habitat. This site would be capable of accepting additional stormwater drainage from surrounding developments as well.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	9	15
Wildlife	4	6
Water Quality	5	9
Water Quantity	5	6
Total Score	22	36



7.5.15 Site 14

This opportunity was identified at PID 40490898 and is owned by the Halifax Regional Municipality (HRM). The property consists of a vacant property with a shallow water wetland present across the southern half of the property, and a large fill pile on the north side of the property. This opportunity falls within the Enhancement category. This property was fully assessed with permission from HRM.



Photo 27: Looking South from Fill



Photo 28: Shallow Water Wetland. Note ATV usage

Figure 17 shows the property and the shallow water and shrub swamp wetland complex currently present. The wetland is the headwater system for an outlet stream that forms a feeder stream into Christina's Brook. A review of historical photos shows that the property was cleared by 1973, but the open water portion of the wetland was not present on site. A stream is observable draining from northeast to southwest. From 2003-present, aerial photography shows changes to the size and configuration of the fill pile to the north of the wetland habitat.

Recent clearing and borrow activities have caused this wetland habitat in the southern half of the property to be reduced to a marginal shallow water wetland with minimal habitat value due to a lack of vegetation, exposed shale rock buffer zone to the west, and a very large fill pile present to the north of this wetland habitat. The northern half of the wetland habitat exists as a shrub swamp. Surface water inlets are present in open ditches from stormwater from Westwood Drive. The western boundary of the wetland is exposed slate rock. Evidence of acid rock drainage was observed.

Work could be completed to re-grade the wetland habitat to reduce water depths and maximize emergent vegetation across the southern portion of the wetland habitat. The western buffer zone could be re-graded and vegetated to reduce the presence of exposed slates. The northern portion of the wetland habitat is in reasonable shape as a shrub swamp. Ideally, removal of the large pile of rock fill across the northern portion of the property would be completed, and additional wetland habitat could be considered should enough water be present up-stream of this location as input. Potential contaminant inputs from drainage from the fill pile should be investigated as part of feasibility studies.



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The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	11	15
Wildlife	5	6
Water Quality	6	9
Water Quantity	2	6
Total Score	24	36



7.5.16 Site 15

This opportunity was identified at PID 40450579 and is owned by the Halifax Regional School Board (HRSB). The property consists of a local high school, Millwood High School. The Little Sackville River runs south on the eastern side of the school. A permanent asphalt footpath is present spanning the LSR joining residential development on the east side of the river with the school property. This opportunity falls within the Restoration category. This property was accessed from the footpath from the residential neighbourhood.



Photo 29: Looking west from Bridge over River



Photo 30: Looking East towards Residences

Figure 15 shows the location of this identified opportunity at the east edge of the Millwood High School property. There is a bridge over the Little Sackville River that allows access to the high school property from the residential subdivisions to the east. Riparian wetland habitat is present on both sides of the LSR, especially on the high school (west) side of the river. The footpath is asphalt and has been landscaped on either side with grass (as shown in Photo 29). This development was not present in 1973 and was present in 2003 in what appears to be its current state.

Work could be completed especially on the school board property to install a low impact pathway and allow riparian wetland habitat to re-establish where landscaping is present. This opportunity might be hampered by the presence of unknown buried infrastructure.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	8	15
Wildlife	4	6
Water Quality	1	9
Water Quantity	0	6
Total Score	13	36



7.5.18 Site 16

This opportunity was identified at PID 41048235 and is owned by Barrett Lumber Company. The property consists of a lumber mill, distribution centre and a log pond associated with the Barrett Lumber property on Beaverbank Road. Near the southwest corner of this property open water wetland habitat is present surrounded by the industrial infrastructure for the lumber mill and residential properties. This opportunity falls within the Restoration category. This property was assessed only from Millwood Drive and was not fully observed due to a fence and trees obstructing the view. No photographs were collected and therefore, this opportunity was identified and classified based only on aerial photography interpretation and the Study Team’s knowledge of the watershed.

Based on aerial photograph interpretation, this area appears to be a vegetated swale or narrow wetland habitat consisting of alders and other shrub vegetation (Figure 18) and also appears similar in the 1974 aerial photo. The area was not identified in the potential wetland layer due to steeper slopes surrounding this swale/wetland. However, this area is clearly wet and is potentially disconnected from the LSR or has limited connectivity to the larger system (to the west). How this system specifically connects to the Little Sackville River is not known. The condition of this connection should be investigated further to identify if a restoration opportunity exists on site. Work could also be completed on the buffer areas to re-vegetate if necessary. Investigation in the wetland habitat could be completed to determine the integrity of wetland vegetation and determine if invasive species are present which is likely, given the highly developed nature of the surrounding properties.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	8	15
Wildlife	2	6
Water Quality	0	9
Water Quantity	0	6
Total Score	10	36

Scoring was completed based on aerial photograph and PWL review only. No field assessment was completed. Therefore, the size of restoration opportunity was estimated only.



7.5.19 Site 17

This opportunity was identified at PID 00475715 and is owned by Nova Scotia Limited 3102479 (Twin Brooks Developments Ltd.). The property currently consists of an undeveloped property with forestry roads and clearing/grading activities at the northern extent of the property nearest Highway 101. This opportunity falls within the Restoration category. This property was fully assessed with permission from the Proponent.



Photo 31: Infill area- note forestry access road



Photo 32: Wetland Habitat at infill edge

As shown in Figure 19, this opportunity is located at the northern end of an undeveloped property owned by Twin Brooks near Highway 101. A NSTIR access road is present along the north end of this property, and an area has been in-filled and leveled at this location degrading headwater wetland and watercourse habitat associated with the McCabe Lake North tertiary watershed system. This watercourse is a headwater stream of Christina’s Brook which flows south into Webber Lake. Forestry access roads are also present on this property and at the location of this opportunity, culverts are not present and surface water has adjusted and flows along roads and pathway ditches until it reaches wetland habitat southeast of the opportunity area.

Historical aerial photos show this area as being completing undeveloped in 1973 and forested. By 1981, this area had been in-filled and leveled. From the aerial photograph, it appears that headwater wetland habitat was present at the upper reaches of this watercourse system. Remnant wetland habitat was observed during the field assessment between the infill area and the NSTIR access road.

Work could be completed at this site to restore headwater wetland habitat and a natural outlet stream corridor to connect this habitat to the downstream wetland habitat known to exist to the southeast of this site. Infill would need to be removed from this area and wetland vegetation re-established. Surface water would have to be rerouted into the restoration area and proper culverts would be required downstream of the restored wetland habitat at forestry and access roads. A natural vegetated buffer could also be re-established.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	11	15
Wildlife	2	6
Water Quality	6	9
Water Quantity	3	6
Total Score	22	36



7.5.20 Site 18

This opportunity was identified at PID 40423899 and is owned by Minister of Community Services. The property currently consists of an undeveloped property with a tall shrub wetland located across the eastern half of the property, and forested habitat across the western half of the property. This opportunity falls within the Enhancement category. This property was fully assessed as it is provincially owned.



Photo 33: Area between Stormwater Inlets

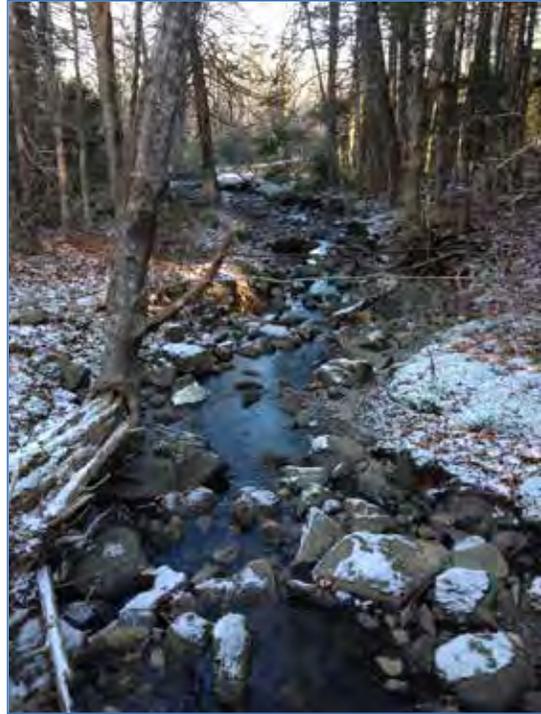


Photo 34: One of Inlet Streams

As shown in Figure 20, wetland habitat (tall shrub swamp) is present across the eastern portion of this property adjacent to Millwood Drive. A trail is present north of the wetland habitat that runs west across the property to Sackville Drive. The area directly west of the wetland and east of Sackville Drive consists of a forested habitat with three stream systems stemming from storm-water and up-gradient feeder streams associated with Sackville Drive. The area between these inlet streams has a very steep gradient at Sackville Drive but levels out to a flat plateau before dropping down again to the wetland habitat to the east.

Work could be completed between these streams to level out the grade and intercept the stream inlets into created wetland habitat on the edge of the current wetland habitat in order to enhance stormwater management upstream and within the wetland habitat on this property. Observations during field assessments demonstrated that the outlet condition of the water was significantly murky and sediment laden. Work to increase retention time and filtration capacity of the overall system by creation of additional wetland habitat in the western surrounding area would be beneficial to reduce overall sediment loads into the Little Sackville River immediately downstream.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	8	15
Wildlife	5	6
Water Quality	5	9
Water Quantity	3	6
Total Score	21	36



7.5.21 Site 19

This opportunity was identified at PID 40422230 and is owned by NS Housing and Municipal Affairs. The property currently consists of an undeveloped property with a stream corridor identified as Highrigger Brook (also the outlet from Site 18 described above). This opportunity falls within the Enhancement category. This property was fully assessed as it is provincially owned.



Photo 35: Looking SE from Millwood Dr.



Photo 36: looking NW from Highrigger Cr.

Highrigger Brook is the outlet from the shrub swamp wetland that is present on the west side of Millwood Drive (Site #18), as shown on Figure 20. This brook leads into the main Little Sackville River corridor and exits into the river immediately downstream of this location. During the site evaluations for this property, backup of water was observed at and under Millwood Drive in the three culverts present. Water movement through this property appears limited. The water observed at this location was also very cloudy. The stream area is highly channelized for most of this brook length on this property. General inquiries suggest that infrastructure (sewer/water lines) is buried in this corridor. The presence of pipes would limit potential work opportunities for this property.

Without infrastructure, work could be completed to widen the channel and increase emergent vegetation across a wider channel to aid with filtration of sediment. Water movement through the corridor could be increased if widening was possible. If infrastructure limits the ability to de-channelize the brook in this corridor, work could be completed to remove any build up of sediment in the brook near Millwood Drive and re-vegetation on the banks of the brook could be completed to increase habitat value of this system.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	9	15
Wildlife	4	6
Water Quality	1	9
Water Quantity	0	6
Total Score	14	36



7.5.22 Site 20

This opportunity was identified at PID 00475715 and is owned by Nova Scotia Ltd. 3102479 (Twin Brooks Developments Ltd.). The property currently consists of an undeveloped property with some timber harvesting and the opportunity exists at a mad-made pond and associated outlet watercourse. This opportunity falls within the Restoration category. This property was fully assessed as it is owned by the Proponent.



Photo 37: View of Pond looking east from trail

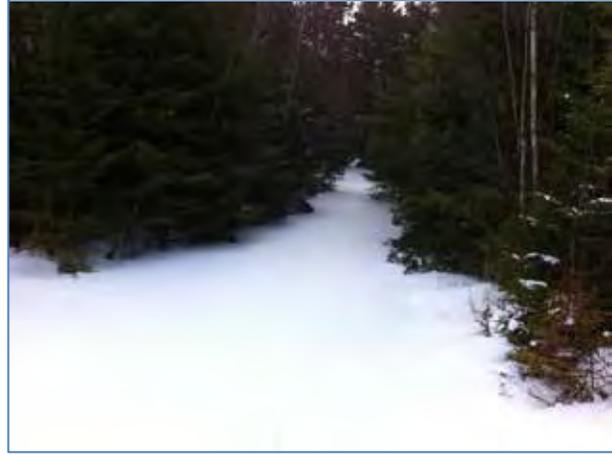


Photo 38: outlet draining south along old road

As shown on Figure 19, the pond is present just east of access trails leading to McCabe Lake. It is presumed that this pond was dug out for fill to create access and forestry trails in this vicinity of this pond. The water level in this pond is estimated at 3m. Some vegetation exists along the edges of the pond, but generally, the pond is surrounded by trails and exposed soils along the northern and western sides and is lacking vegetation. The outlet from this pond is along an old logging road which joins into a more natural stream south of this opportunity. The inlet is a natural stream channel connecting this pond to up-gradient natural wetland habitat. According to the 1973 aerial photograph, a wetland is present at this location and the general area around it is unaltered, and the pond is not present.

Work could be completed in this area to re-grade and naturalize the pond by reducing water levels and remove the steep banks along the edges. Wetland habitat can be restored along with natural vegetated buffers. Wetland vegetation would likely grow naturally considering the presence of significant surrounding wetland habitat. Planting could occur to help re-vegetate and establish wetland conditions.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	10	15
Wildlife	5	6
Water Quality	3	9
Water Quantity	1	6
Total Score	19	36



7.5.23 Site 21

This opportunity was identified at PID 41287129 and is owned by Bruce Stanbury. The property currently consists of an undeveloped property just southeast of the new Margeson Road interchange on Highway 101. The opportunity exists within the wetland habitat present across the majority of this property. This opportunity falls within the Enhancement category. This property was assessed from the NSTIR access road and easement to the south of the property.



Photo 39: NW portion of wetland- flooded

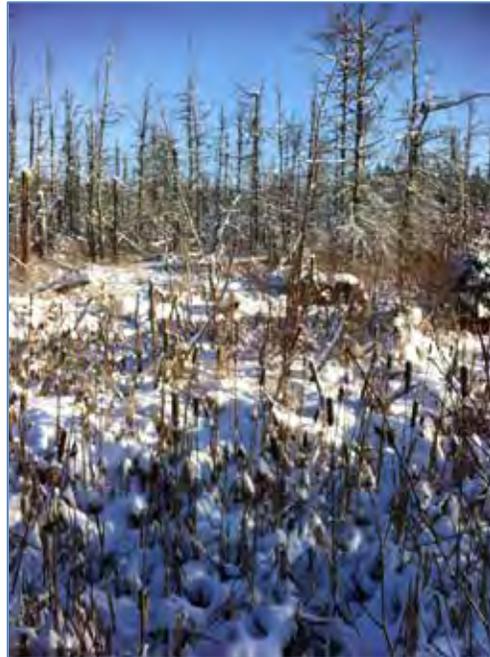


Photo 40: wetland habitat from south

The property consists of a treed fen and the wetland habitat is generally intact but surrounding buffer areas have been affected by road construction (Highway 101 and Margeson Road). Based on the Study Team’s visual assessment and discussions with local experts, it appears this wetland habitat is prone to flooding, which is expected to be from a combination of natural and anthropogenic stressors. Anthropogenic impacts include the construction and twinning of Highway 101 (post 1981), Margeson Road (2011) and the channelization of streams and stormwater as a result. Beavers are also known to dam the outlets (two culverts along the NSTIR access road) as well which exacerbates flooding.

The northwestern portion of this wetland, as shown in Photo 39 and Figure 21, is dominated by black spruce, which have largely died as a result of the continual flooding. This area presents an opportunity to remove the dying vegetation and create a more open-water or a wetland with emergent vegetation with increased water storage potential. There is also the possibility of working to de-channelizing portions of Christina’s Brook that drains through this wetland habitat.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	7	15
Wildlife	4	6
Water Quality	5	9
Water Quantity	3	6
Total Score	19	36



7.5.24 Site 22

This opportunity was identified at PID 41279720 and is owned by NS Transportation & Infrastructure Renewal (NSTIR). The property currently consists of the road parcel directly south of Highway 101 just west of the new Margeson Road interchange and between the highway and the NSTIR access road. This opportunity falls within the Restoration category. This property was assessed from the NSTIR access road.



Photo 41: looking NW from Margeson Road



Photo 42: Opportunity Area- infrastructure limitations

Figure 21 shows this opportunity. Based on a review of historical aeriels, wetland habitat was present in this area prior to 1981 when the NSTIR road and power line corridor first is identified on aerial photography. This area was further impacted by twinning of the highway (post 1981) and the construction of the Margeson Road interchange (2011). Surface water is present in a ditch between the NSTIR access road and the highway draining southeast. This system provides surface water to the Christina’s Brook system to the southeast. This area is prone to flooding and some remnant wetland habitat is present at the base of the hill as shown in Photo 42. An ATV trail is present that crosses over this ditch.

The soils in this area could potentially be re-graded to restore additional wetland habitat, although the majority of this area will be limited by infrastructural considerations (transmission tower and roads). Wetland vegetation could be re-established. If maintenance of the ATV trail is necessary, a culvert and proper watercourse crossing should be installed across this ditch/watercourse. If the ATV trail is not necessary, barricades could be installed to discourage ATV traffic from passing through this location. The ditch/watercourse could be naturalized with a riparian or upland buffer to provide better habitat and slow water movement through this area.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	8	15
Wildlife	4	6
Water Quality	2	9
Water Quantity	0	6
Total Score	14	36



7.5.25 Site 23

This opportunity was identified at PID 40695504 and is owned by Armco Capital Inc. The property currently consists of an undeveloped parcel of land with an abandoned access road. This opportunity falls within the Watershed Health category. This property was fully assessed as it is owned by Armco Capital Inc. (Proponent).



Photo 43: On access road at culvert/WC crossing



Photo 44: access road and riparian wetland habitat

At this site, as shown on Figure 22, a small access road crosses a feeder stream of Christina’s Brook. Residential development is present along Lindforest Crescent to the west and northwest. Two culverts were observed at this crossing location. While the crossing appears to be functioning well, the purpose of the road is unknown. The removal of the road and culverts would allow the feeder stream to re-naturalize along with the riparian habitat observed on the eastern edge of the watercourse.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	10	15
Wildlife	6	6
Water Quality	2	3
Water Quantity	n/a	n/a
Total Score	14	24



7.5.26 Site 24

This opportunity was identified at PID 41052267 and is owned by Edith Hefler. The property currently consists of residential development along the road, light industrial properties, and an NS Power corridor and substation. This opportunity falls within the Restoration category. This property was assessed from the road.



Photo 45: Looking N towards substation



Photo 46: example of outlet from wetland

This wetland system, as shown in Figure 23, is a headwater system that receives overland drainage from the surrounding upland habitats. Surface water drains out of the wetland habitat south across Hefler Lane and into the Sackville River on the eastern (outlet) end of Webber Lake. The wetland system is a graminoid marsh that appears to be for the most part functioning well and intact. Some smaller areas of wetland habitat have been fragmented south of the NS Power substation by ATV trails, tire ruts, and small piles of infill/logs (Photo 45). The most significant concern identified at this site was the condition of the surface water outlets draining south from headwater wetland habitat near Hefler Lane. These outlets join together on the north side of Hefler Lane and then drain under the road at a culvert location. The watercourse system to the north of the road is un-vegetated and braided with observed impacts from trails, tire ruts, and has been significantly channelized into a ditch system. This system was observed to be carrying large amounts of sediment.

A review of an aerial photograph from 1973 shows a more channelized watercourse draining from NW to SE along the NS Power corridor. This watercourse is not present in the 2003/2013 imagery and the wetland habitat appears to have been affected by changes to this watercourse channel when the substation and associated road infrastructure was built.

Work should be completed to restore pockets of wetland habitat as identified on the southern side of the substation by removing fill and wood piles and re-grading to remove ruts in soils. Re-vegetation could then be completed. The watercourse outlets require work to restore an effective vegetated channel to reduce sedimentation.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	9	15
Wildlife	5	6
Water Quality	6	9
Water Quantity	4	6
Total Score	24	36



7.5.27 Site 25

This opportunity was identified at PID 41063983 and is owned by Crombie Developments. The property currently consists of a commercial shopping mall with large box store retailers, and a large parking lot to the north of the opportunity. The opportunity is located south and west of the shopping mall and is associated with stormwater management. This opportunity falls within the Enhancement category. This property was fully assessed from the parking lot.



Photo 47: Outlet from Detention Pond



Photo 48: Stormwater Corridor

Two opportunities exist on this property and could be completed together or individually. The parking lot and commercial development collects significant stormwater that is funneled to a detention pond along the south end of the parking lot just north of the Little Sackville River. This stormwater then drains through an outlet channel (Photo 47) and into the LSR. At the same time, other stormwater sources are directed southeast from Downsview Drive and the Beaver Bank Connector through a corridor that is located west of the commercial shopping complex. This corridor provides some wetland habitat along its length, but the majority of this stormwater is currently underground in a piped system. This system also drains into the LSR near the outlet for the detention pond.

As shown on Figure 24, work could be completed at both locations to improve and enhance stormwater management before it exits into the LSR. The outlet from the detention pond could be re-graded and shaped to remove high berms, increase the area of wetland habitat, and allow a slower rate of release of stormwater into the LSR. Some stormwater could also be re-routed out of the stormwater pipes at Downsview Drive and directed above ground along the wetland corridor to establish a natural vegetated swale or wetland corridor. Work would also be required along the western banks of this corridor to stabilize slopes and vegetate the natural upland buffer along the slope.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	8	15
Wildlife	4	6
Water Quality	1	9
Water Quantity	2	6
Total Score	15	36



7.5.28 Site 26

This opportunity was identified at PIDs 40852105 and 40852097 and is owned by Wallace Lucas and Allan Lucas et al. The property currently consists of an undeveloped property with timber harvesting throughout. Two forestry roads are present across this property perpendicular to each other. This opportunity falls within the Restoration and Watershed Health category. This property was assessed from the forestry roads.



Photo 49: Potential area for Restoration



Photo 50: Culvert and Bridge Opportunities

Several feeder streams are present flowing southeast across this property towards Marsh Lake and Big Sandy Lake, as shown on Figure 25. These streams are intersected by two perpendicular forestry access roads present on this property. Culverts or wooden bridges are present at the majority of crossing location (minimum of 6 identified). As shown in Photo 50, the bridges observed were in need of repair, and several culverts identified were also eroded and needed repair. At one location, no culvert or bridge was present.

At the intersection of the two forestry roads, the potential wetland layer (PWL) identifies possible wetland habitat associated with a headwater stream that was observed on site. Photo 49 shows the area of the road where this wetland habitat would be present. This area appeared to be consistently flooded.

Work can be completed on this property to improve watershed health at each crossing location by replacing eroded culverts, installing new culverts as needed, and replacing damaged bridges. Alternatively, the road could be removed if no longer needed. Work can also be completed to restore the identified headwater wetland habitat along the road. The road could be removed if possible and wetland vegetation restored in this area. If road removal is not possible, installation of proper cross drainage infrastructure and ditching to encourage natural flow between isolated wetland fragments should be completed.

The evaluation checklist provided the following scores in each category and overall for the restoration opportunity:

Category	Site Score	Maximum Score
Practicality	7	15
Wildlife	5	6
Water Quality	6	9
Water Quantity	3	6
Total Score	21	36



7.5.29 Site 27a

This opportunity was identified at PID 41351404 and is owned by Bernie McPhee. The property currently consists of an undeveloped property with a small wetland and an inlet stream draining along the edge of a forestry access road. This opportunity falls within the Enhancement category. This property was assessed from Cranley Road.



Photo 51: Wetland Habitat



Photo 52: Inlet Stream along Access Road

As shown on Figure 26, this property consists of a shallow water wetland habitat and a partially cleared residential lot. The wetland is fed from the south through a small, channelized feeder stream along the edge of an access road (as shown in Photo 50). The outlet from this wetland drains in a channelized fashion into a culvert under Cranley Road to the northeast towards Site 27b and eventually drains into Big Sandy Lake.

A review of available historical aerial photographs shows that this wetland was present in 1977 but without any open water present and no surrounding road infrastructure was observed. Development of Cranley Road and/or the access road to the west of the wetland habitat has contributed to a significant change in wetland characteristics. The edges of the wetland have been built up for the construction of the access road, and the inlet and outlet watercourses have been severely channelized.

Work could be completed at this property to remove the access road if possible and restore a naturalized wetland habitat comparable to the historical condition of the property by re-grading and increased vegetation across the wetland habitat. The inlet could be restored into a natural channel with riparian habitat.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	9	15
Wildlife	5	6
Water Quality	3	9
Water Quantity	0	6
Total Score	17	36



7.5.30 Site 27b

This opportunity was identified at PID 40149743 and is owned by A-Bek Drywall Limited. The property currently consists of an industrial property with a building located in the northeast corner. The remainder of the property consists of pockets of wetland habitat and in-filled areas. This opportunity falls within the Restoration category. This property was assessed from Cranley Road and Lucasville Road.



Photo 53: Assessment Area – filled and cleared



Photo 54: watercourse outlet channel

As shown on Figure 26, this property consists of a cleared partially infilled property in a residential area. Pockets of wetland habitat were observed on site, but the majority of the western half of the property has been cleared, filled and graded. Remaining wetland habitat is fed by a channelized watercourse which originates from Site 27a and flows east through a culvert under Cranley Road onto the subject property. Within the site, water is channelized before it flows into an open water wetland area behind the industrial facility, and then flows through a culvert under Lucasville Road.

The eastern portion of the site has been cleared since at least 1977. The western portion of the site was forested in 1977 but has been cleared and partially in-filled by 2003. Cranley Road intersected the wetland when it was constructed between 2005 and 2010.

Work could be completed at this property to remove the infill from this property and complete subsequent re-grading and restoration work in order to natural drainage across the site and re-establish wetland habitat across the property.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	12	15
Wildlife	6	6
Water Quality	6	9
Water Quantity	3	6
Total Score	27	36



7.5.31 Site 28

This opportunity was identified at PID 40203630 and is owned by Donna Anderson. The property currently consists of residential property with a commercial landscaping/concrete storage yard behind the residence. This opportunity falls within the Watershed Health category. This opportunity was not fully assessed due to access limitations, but is summarized based on desktop reviews, what was observable from Lucasville Road, and the Study Team’s knowledge of the local area and the surface water systems.

Figure 27 shows that land use at this property is commercial and residential in nature and is surrounded by undeveloped forested land to the east with some evidence of timber harvesting. A watercourse flows east from Cranley Road, across Lucasville Road and continues east at the back edge of this property with eventual discharge into Big Sandy Lake, as shown on Figure 27. The eastern end of this property intersects with a Nova Scotia Power easement as well, at the location of the watercourse on this property.

No observable wetland habitat was identified at this site through aerial photograph interpretation, but the watercourse appears to have been impacted by infilling along the southeastern edge of the property. This infilling appears to include possible encroachment of the watercourse and its riparian zone.

A full assessment of the property would be necessary in order to determine what impacts are present and to develop a detailed restoration plan. This plan could involve removal of fill and re-vegetation of the riparian habitat, or placement of riprap to prevent erosion and sedimentation into the watercourse.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	9	15
Wildlife	4	6
Water Quality	2	3
Water Quantity	n/a	n/a
Total Score	15	24



7.5.32 Site 29

This opportunity was identified at PID 40857138 and is owned by the Halifax Regional Municipality (HRM). The property consists of a large undeveloped track of land with some timber harvesting observed. This opportunity falls within the Restoration category. This opportunity was fully assessed with permission from the property owner.



Photo 55: Headwater Wetland Habitat



Photo 56: Identified Impacts to Wetland Soils

Figure 28 shows headwater wetland habitat within a cleared area identified just northeast of Jack’s Lake. A review of historical aerial photography identified that in 1974 this area was not cleared and was fully forested. The reason for the clearing of this area is unknown and site observations did not provide any additional clues to the site usage, with the exception of the obvious removal of timber from the area.

Wetland habitat was present in the southeast corner of the cleared area and presented itself as herbaceous marsh habitat. Wetland habitat extended to the southeast, beyond the cleared area and was observed to be fully forested (treed swamp). Outlet streams were observed leaving this wetland habitat as several small feeder streams towards the southeast. This headwater wetland system is valuable wetland habitat for overall watershed health. Inlet overland drainage into the wetland system from the northwest was observed to be interrupted and altered by roads, trails and ATV/truck tracks and rutting (Photo 54).

Work could be completed to re-establish appropriate and natural overland drainage into the wetland habitat from the northwest, and also, re-vegetation of the cleared portion of the wetland habitat could be completed. Finally, the buffers to the north and northwest of the wetland habitat could be re-vegetated to provide better overall functionality of the headwater wetland.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	13	15
Wildlife	5	6
Water Quality	7	9
Water Quantity	6	6
Total Score	31	36



7.5.33 Site 30

This opportunity was identified at PID 40857138 and is owned by the Halifax Regional Municipality (HRM). The property consists of a large undeveloped track of land with some timber harvesting observed. This opportunity falls within the Watershed Health category. This opportunity was fully assessed with permission from the property owner.



Photo 57: Looking West into Cleared Area



Photo 58: View looking NE towards Access Road

This opportunity exists near the northeastern corner of this property owned by HRM. Clearing activities have taken place in this area and ATV usage across the property is significant and appears to be a regular occurrence. The opportunity area is shown on Figure 29. A Nova Scotia Power access road and property is present along the northern edge of this property and a buried water line is also present along the southern edge of this access road.

As shown on Figure 29, watercourses are present draining from west to east across the property and then continuing north across the Nova Scotia Power access road towards the main branch of the Sackville River. This portion of the property is cleared and devoid of vegetation, and the soils are exposed due to continuous usage of the area by ATVs. Based on a review of historical aerial photography, the area was partially cleared as early as 1963 and fully cleared by 1973. Sedimentation into the Sackville River has been documented as a problem at this location as watercourses and overland drainage flow across this cleared area, pick up sediment and then deposit it directly into the River.

Work could be completed here to create wetland habitat in the cleared area (by diverting watercourse inlets into this area in a more continuous and orderly fashion). Work could also be completed to naturalize and vegetate the upland cleared areas and the watercourse buffers in order to reduce overall sedimentation. However, dialogue and education would have to occur to reduce ATV usage of the area in order for any remedial activities to be sustainable.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	10	15
Wildlife	4	6
Water Quality	2	3
Water Quantity	n/a	n/a
Total Score	16	24



7.5.34 Site 31

This opportunity was identified at PID 00416222 and 41214404 and is owned by 3184135 Nova Scotia Ltd. (Besim Halef) and Banc Developments Ltd. respectively. The property consists of a large undeveloped track of land. This opportunity falls within the Restoration category. This opportunity was assessed from the access road.



Photo 59: Wetland Habitat with Infill



Photo 60: Channelized Outlet from Wetland



Photo 61: Wetland Habitat at North End of Opportunity with Infill

This opportunity is located on the south side of the newly developed Bedford Common shopping plaza. This area is undeveloped, with a small access road leading to the south into a cleared area. This opportunity is shown on Figure 30. In 1977, this area was completed undeveloped and forested. This site is located at the headwaters of an ephemeral stream system that drains south, crosses the Bedford Bypass and Highway 102, eventually draining into the Sackville River. Wetland habitat was observed at the northern extent of the area as shown on Figure 30, and streams were observed draining south into cleared wetland habitat just east of the access road. The outlet from this habitat has been altered into a rock lined drainage channel (Photo 58).

Work could be completed to remove fill observed at the northern extent of this area (Photo 59) and within the wetland habitat in the cleared area. Re-naturalization of the outlet channel is recommended. Re-vegetation of the cleared wetlands habitat could also be completed.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	8	15
Wildlife	5	6
Water Quality	5	9
Water Quantity	3	6
Total Score	21	36



7.5.35 Site 32

This opportunity was identified at PID 40202806 and is owned by Armco Capital Inc. The property consists of a decommissioned concrete plant (Lefarge Canada). This opportunity falls within the Restoration category. This opportunity was fully assessed with permission from the property owner.



Photo 62: View of Decommissioned Concrete Plant Site

Photo 63: Access Road Network on Property

The Lefarge Concrete Plant was operational on this property from before 1977 and was decommissioned in 1995. The site has remained as a cleared property since this time and is shown on Figure 31. Overland surface water was observed across the cleared area draining south where it collects in the northern ditch along the access road. This drainage then flows across the access road and partially drains into an identified mixed wood treed swamp south of the cleared area, and also continues east and forms a natural stream channel that eventually flows into Big Sandy Lake. As the water drains through the cleared area and access road ditches, sediment is being picked and deposited into the wetland habitat and stream habitat downstream.

Work could be completed within the cleared area to re-establish appropriate vegetated buffers for the identified treed swamp. Also, re-establishment of natural patterns of surficial water drainage towards and through the wetland would reduce sedimentation into the wetland habitat and associated outlet stream habitats. The drainage across the access road should be properly culverted and actual ditches installed. Alternatively, the road could be removed allow for natural inlet of water into the wetland and re-establishment of wetland habitat at the location of the road.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	8	15
Wildlife	5	6
Water Quality	4	9
Water Quantity	2	6
Total Score	19	36



7.5.36 Site 33

This opportunity was identified at PID 40098287 and is owned by the Halifax Regional Municipality (HRM). The property consists of an access road with a buried water main. This opportunity falls within the Watershed Health category. This opportunity was fully assessed with permission from the property owner.



Photo 64: View looking E on N side of Access Road

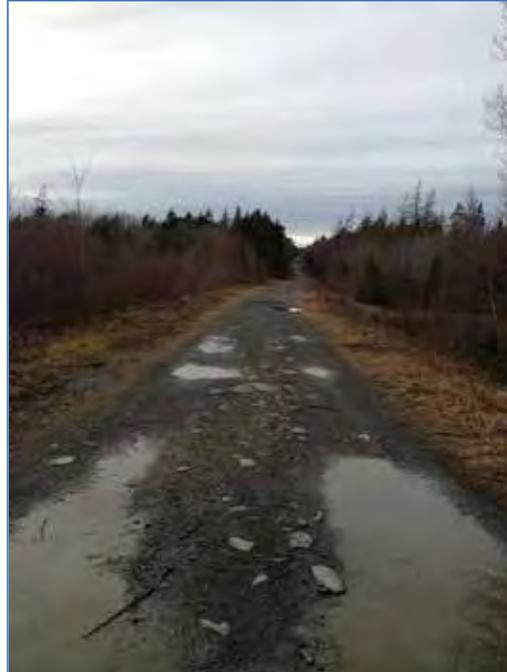


Photo 65: Access Road looking W

This opportunity was viewed from the access road itself. The Study Team identified that a culvert or culverts were present based on observed water movement and bubbling of water on the downstream (north) side of the access road that runs east/west through a forested parcel of land owned by Armco Capital Inc. The culverts were not observed at all and appeared to be entirely underwater. The culvert(s) appear to be undersized or placed too low in the watercourse.

The culverts should be assessed and either replaced with a larger size, or a bridge should be installed.

As a side note, significant sedimentation was observed on the upstream side of this culvert crossing coming from the east (Farmer's Dairy Lane) in the tributary shown on Figure 32. This tributary drains from the east side of Farmer's Dairy Road (Site #34).

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	9	15
Wildlife	6	6
Water Quality	0	3
Water Quantity	n/a	n/a
Total Score	15	24



7.5.37 Site 34

This opportunity was identified at PID 00428284 and is owned by 2271948 Nova Scotia Ltd (David Giles). The property consists of an industrial property. This opportunity falls within the Restoration category. This opportunity was assessed from Farmer's Dairy Lane.



Photo 66: Channelized water flow



Photo 67: Access Road in Wetland Habitat



Photo 68: Wetland Habitat in Forefront, Industrial Area Behind

This site is currently occupied by Giles Trucking, an industrial property with stockpiles of soil, debris and other materials present across the property. This opportunity is shown in Figure 32. The site was observed from Farmer's Dairy Lane and channelization of the stream was observed (Photo 64), with high banks of infill to the east. A small access road, shown in Photo 65 is present within wetland habitat. The water draining through this property was observed to be laden with sediment (as observed further downstream – Site 32).

During an historical review of this property, aerial photography interpretation from 1964 and 1973 shows the property with a small clearing and development in the NE corner of the property. The rest of the property appears



forested and generally consistent with the treed swamp habitat known to exist to the west of Farmers Dairy Road. In 1981, a warehouse is present in the NE corner of the property and houses are present along Hammonds Plains Road. The remainder of the property remains forested, but appears stressed as if water levels have risen. In 1992, infilling has occurred north of the residences along Hammonds Plains Road and further south near the north end of the property. The remaining habitat on site has changed dramatically. Either the presumed wetland habitat was cleared of vegetation (trees) or they have died. In 2003, additional infill has occurred in the central portions of the property and channelization of the water is evident. Currently, this remaining habitat has been fully in-filled, leaving a channelized watercourse and minor fragments of wetland habitat.

Work could be completed here to remove fill across the property and restore wetland habitat. This process, however, does not likely meet the set out goals and objectives of this project, which is to identify practical and cost effective opportunities for wetland restoration. It is the Study's Team's opinion that removal of this fill would be quite expensive. However, work could be completed around the channelized watercourse to pull back the infilled banks and re-establish riparian wetland habitat and/or upland buffers to reduce observed siltation in the stream. The small access road identified in Photo 65 could also be removed from the wetland habitat.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	9	15
Wildlife	3	6
Water Quality	3	9
Water Quantity	3	6
Total Score	18	36



7.5.38 Site 35

This opportunity was identified at PID 41287418 and is owned by the Halifax Regional Municipality (HRM). The property consists of an undeveloped property with a wetland present. This opportunity falls within the Restoration category. This opportunity was assessed from Hammonds Plains Road and the parking lot at the BMO arena facility.



Photo 69: Flooded Wetland Habitat



Photo 70: Outlet of Wetland

This wetland habitat is flooded and trees within the wetland are dying and falling down. The outlet is overwhelmed and appears to be avoiding the installed culvert. This opportunity is shown on Figure 33. Wetland habitat at this location was observed in aerial photos in 1964, 1973 and 1992 as treed wetland habitat. In 2011, the BMO Centre was built and upstream wetland habitat associated with that property appears to have been altered as part of this development, based on the presence of the potential wetland layer. Stormwater from the parking lot at BMO is held in a detention pond on the west side of the parking lot. The location of the outlet from this pond was not confirmed but it is presumed to enter into the wetland habitat shown in Photo 67.

Work should be completed to identify the sources of water entering into this wetland and determine a course of action to remove, divert or reduce water inflow into this system to halt flooding activities within the wetland. Alternatively, work could be completed within the wetland habitat to attempt to enhance the habitat to better manage increased water inputs.

The evaluation checklist provided the following scores in each category and overall for this opportunity:

Category	Site Score	Maximum Score
Practicality	9	15
Wildlife	3	6
Water Quality	1	9
Water Quantity	1	6
Total Score	14	36

8 SUMMARY AND CONCLUSIONS

The purpose and objective of the Evaluation of Wetland Restoration Potential (EWRP) study was to identify cost effective, practical and ecological significant wetland restoration opportunities within the Sackville River Secondary Watershed.

In Nova Scotia, the Department of Natural Resources owns and operates the Wetlands Inventory Database. This database is currently used to identify wetland habitat in Nova Scotia. However, it is commonly understood within industry and government that this database significantly underrepresents the quality and quantity of wetlands throughout the province of Nova Scotia. Therefore, EWRP first identified and evaluated a GIS tool, the potential wetland layer (PWL), to aid in the identification of potential wetland habitat. This PWL was created for the entire Sackville River Secondary Watershed.

In addition to the PWL, a modeled stream layer that was developed by Mr. Raymond Jahncke of Dalhousie University, was also relied upon. It is crucial to note that the PWL is a desktop planning tool only and cannot replace field assessment and appropriate wetland delineation efforts. The PWL is a model of potential wetland habitat that takes LiDAR elevation data, existing data sets and combines and infers the potential for a wetland based on topography and other characteristics. The PWL can be used to focus field efforts and begin to understand surface water systems across a property.

The PWL was then used to evaluate development activities within a Priority Area for Restoration (PAR) to determine potential opportunities where development (roads, buildings, trails, parking lots etc) had impacted wetlands as identified by the potential wetland layer. The PAR was identified across an area of the watershed where the Study Team determined cost effective, practical and ecologically valuable wetland restoration opportunities would be present. 65 potential restoration opportunities were identified through this desktop exercise within the PAR. Each potential opportunity was assessed in the field (recognizing limitations associated with access).

An evaluation checklist was generated by the Study Team in order to provide qualitative and quantitative analysis of each site to determine the significance of the restoration potential. This evaluation checklist provides general information about each site. A quantitative evaluation was identified by the Study Team adapted from data provided in *Wetlands Restoration Strategy: A Framework for Prioritizing Efforts in Minnesota*, Minnesota Board of Water and Soil Resources, December 2008. The Study Team included a fourth category of assessment, Practicality of Solution, in order to meet the Study goals. This evaluation was completed for each identified site and each opportunity has been described in this report.

Sites can be evaluated by the reader by individual category or overall scores. Sites identified lower in the watershed have lower total scores for stream association and are draining larger areas, thus giving lower scores for categories of water quality and quantity. This reinforces the importance of protecting and restoring sites higher in the watershed in order to maximum watershed health.

EWRP identified thirty seven (37) opportunities for wetland Restoration, Enhancement and overall Watershed Health improvements inside the Sackville River Secondary Watershed: 25 Restoration opportunities, 8 Enhancement opportunities, and 4 Watershed Health opportunities. These opportunities appear to be practical and ecologically significant. Those with higher point totals will allow for the most practical and likely cost effective opportunities, as well as the most ecologically significant. However, all of these identified opportunities are valuable, and some score lower primarily due to their small size. This should not deter the reader from exploring these opportunities, especially in cases where a small restoration project is needed for compensation requirements.

Summaries for each identified opportunity have been provided. *These summaries are high level recommendations only to provide guidance for the reader.* Property owners have not provided approval for these restoration activities to take place at these 37 sites. Feasibility studies are required for each site, including property owner approval, prior to detailed planning for restoration projects. In some cases, access was not granted and the site was not assessed, or not fully assessed. In these cases, additional work is necessary just to confirm if an opportunity exists worth exploring.

Urban restoration opportunities require more planning and detailed design work than most rural restoration projects



currently being completed, due to a combination of numerous factors. These factors include, but are not limited to, significant rock and bedrock in HRM, anthropogenic surface water influences and interferences, potential contaminant issues in soils and sediment, urban stormwater inputs and the potential for contaminated stormwater, multiple landowners and the developed nature of urban watersheds, community expectations, landowner expectations, the municipal regulatory system and questions relating to jurisdiction (HRM/Halifax Water), and urban infrastructure including roads, buildings, sidewalks, railways, stormwater infrastructure, businesses, energy (power poles and electrical systems), and underground utilities (gas lines, sewer lines, water lines etc.). As a result of these factors, the restoration opportunities identified within this report will be more complex, time intensive and costly than an equivalent sized rural restoration project. *A new mechanism needs to be offered by Nova Scotia Environment in order for these urban restoration projects to be implemented in favour of rural options.* The standard 2:1 ratio based on restoration size alone will not be successful to see the planning and execution of urban restoration projects including these identified within this study. There must be a mandate from government and political will to ensure that urban wetland losses are compensated with appropriate urban restoration projects. As a start, NSE could offer compensation credit for several phases of an urban restoration project including feasibility studies, detailed design and engineering studies, Phase II environmental site assessments (ESA) to determine contaminant levels, environmental baseline studies, preparation of remedial action plans (RAPs) if necessary, and then the actual on-the-ground implementation of the restoration project and associated monitoring.

Additional restoration, enhancement and watershed health opportunities exist within the Sackville River Watershed. This list is not meant to be exhaustive. EWRP was tailored to a specific portion of the watershed for identification of restoration sites, so therefore, the areas outside of this priority area for restoration were not evaluated, and restoration opportunity would likely be present. Restoration opportunities within the headwaters (Lewis Lake north) would be very valuable to identify, due to their location in the watershed. The Study Team expects that the total number of these opportunities would be low, based on the level of development in this area, but recognize these opportunities are very valuable from an ecological perspective.

Also, the watershed health opportunities identified in this report were confirmed while the Study Team assessed sites for restoration opportunities. These four watershed health opportunities were left on this list for information purposes and at the request of John Brazner at NSE. Additional watershed health opportunities are certainly present across the PAR and the larger SWR.

All restoration opportunities and enhancement opportunities were also not identified within the PAR. The Study Team completed as much assessment as was possible within the time and budgetary constraints allowed for in the EWRP study. A full ecological history of the Sackville River Secondary Watershed would be necessary in order to fully identify and quantify restoration opportunities.

The intent of this report is to identify wetland restoration potential. How and why wetlands have been previously impacted is beyond the scope of this study. Although historical aerial photos were used as a component of the desktop analysis, no attempt was made to determine when a wetland may have been impacted. As such there is absolutely no intent for this document and the results to be used as a regulatory compliance mechanism. This study and report does not render a legal opinion or intent to confer any legal obligations on the owner of the sites identified. It is the opinion of McCallum Environmental Ltd. that using this document and its findings as a compliance mechanism defeats the spirit and intent of the findings.

9 GENERAL LIMITATIONS

Constraints Analysis

- Conflicts that might exist between objects in a database are typically of a logical nature, such as topological inconsistencies or duplicate identifiers. We attempted to ensure that our database has addressed any potential inconsistencies, however inconsistencies may still occur. In map generalization, the vast majority of conflicts are physical, spatial consequences of reducing map scale. The greater the degree of scale change, the more cluttered an un-generalized map will be, and this signals the extents of potential conflicts in presentation of the data.



McCallum Environmental Ltd.

Limitations incurred at the time of the assessment include:

- McCallum Environmental Ltd. has relied in good faith upon the evaluation and conclusions in all third party assessments. McCallum Environmental Ltd. relies upon these representations and information provided but can make no warranty as to accuracy of information provided;

General Limitations incurred include:

- Classification and identification of soils, vegetation, wildlife, and general environmental characteristics (i.e. vegetation concentrations) have been based upon commonly accepted practices in environmental consulting. Classification and identification of these factors are judgmental and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may not identify all factors;
- All reasonable assessment programs will involve an inherent risk that some conditions will not be detected and all reports summarizing such investigations will be based on assumptions of what characteristics may exist between the sample points.

10 GLOSSARY

Enhancement: The implementation of projects conducted in existing wetlands to achieve specific management objectives or to promote conditions that previously did not exist. Such projects increase one or more wetland functions or services. Enhancement may involve trade-offs that result in a positive change in one wetland function or service and a negative change in another (NSE, 2011).

Restoration: The re-establishment of previously existing wetland and its functions and services by human intervention at a site where a wetland no longer exists, or exists only in a highly degraded state (NSE 2011).

Wetland: An area commonly referred to as marsh, swamp, fen or bog that either periodically or permanently has a water table at, near or above the land's surface or that is saturated with water. Such an area sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation and biological activities adapted to wet conditions (NSE, 2011).

References

Minnesota Board of Water and Soil Resources, *Wetlands Restoration Strategy: A Framework for Prioritizing Efforts in Minnesota*, December 2008.

Nova Scotia Environment, *Nova Scotia Wetland Conservation Policy*, September 2011.

Website References

GeoNova – Nova Scotia Geomatics Centre

http://www.gov.ns.ca/geonova/home/products/softpage/data_locator.asp

Google Maps

<http://maps.google.ca/maps?hl=en&tab=w1>

Nova Scotia Dept. of Natural Resources (NSDNR) Mineral Resources Digital Products

<http://gov.ns.ca/natr/meb/pubs/pubs3.asp>