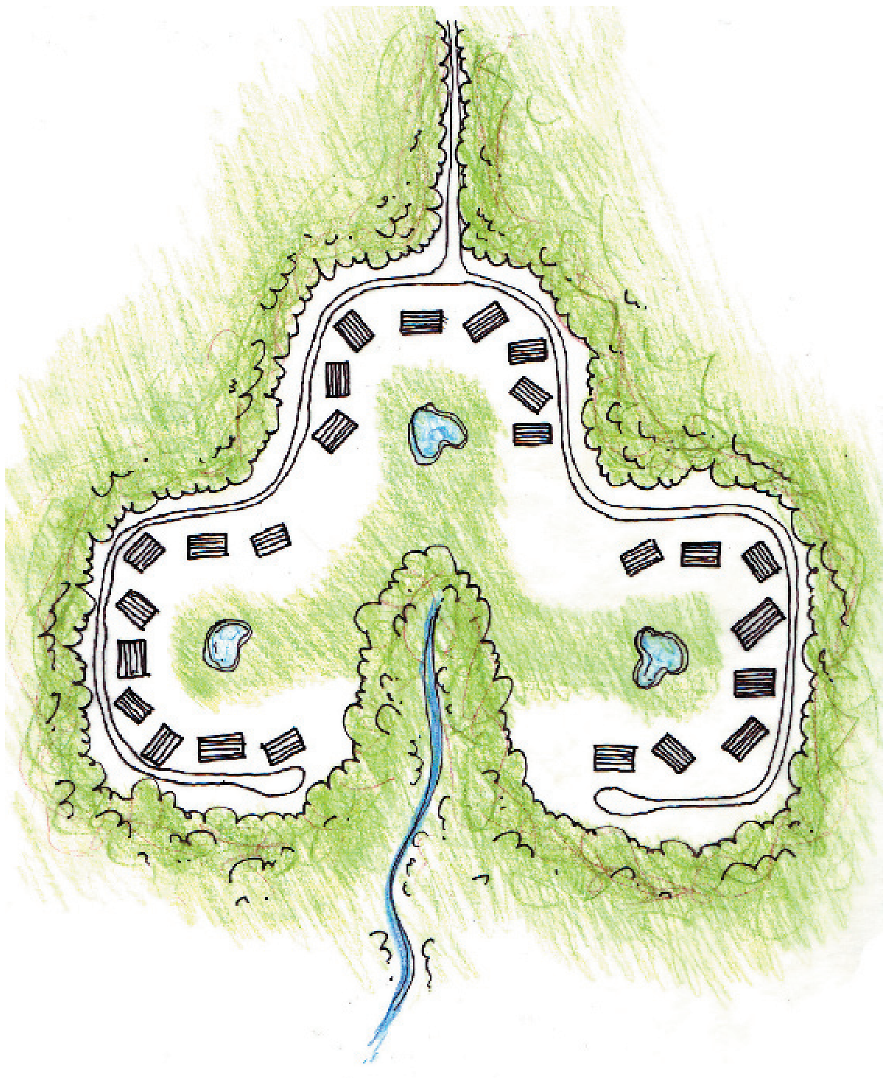
Debert Eco-Industrial Park

A Land Capability Analysis



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Abstract

This report includes a complete a site analysis, recommendations, and concepts for an ecologically based industrial park in Debert, Nova Scotia as researched by the students of the Dalhousie Community Design, Environmental Planning Studio completed the study for the proposed Debert Eco-Industrial Park (DEIP). There are currently two industrial parks in the study area, one provincially owned and one municipally owned by the Colchester Regional Development Agency (CoRDA). The Municipality of the County of Colchester and CoRDA want to acquire the provincially owned land and develop the site as a single park. A group of researchers headed by Ray Côté, a professor at Dalhousie University's School for Resource and Environmental Studies are working with the municipality to develop an eco-industrial park, the first of its kind in Canada. The information gathered was used to prepare a set of recommendations to propose future concept plans for the site. At present, there is no municipal planning document for the Colchester County region. The purpose of this report is to analyze the land capability and develop a sustainable plan for the proposed DEIP. This report focuses on the land capability aspect of eco-industrial development and not the processes involved in the operations of an eco-industrial park. The report was prepared for the Colchester Regional Development Agency to assist with the promotion of community and industrial development while also carefully considering the potential environmental impacts that future development may have on the community.

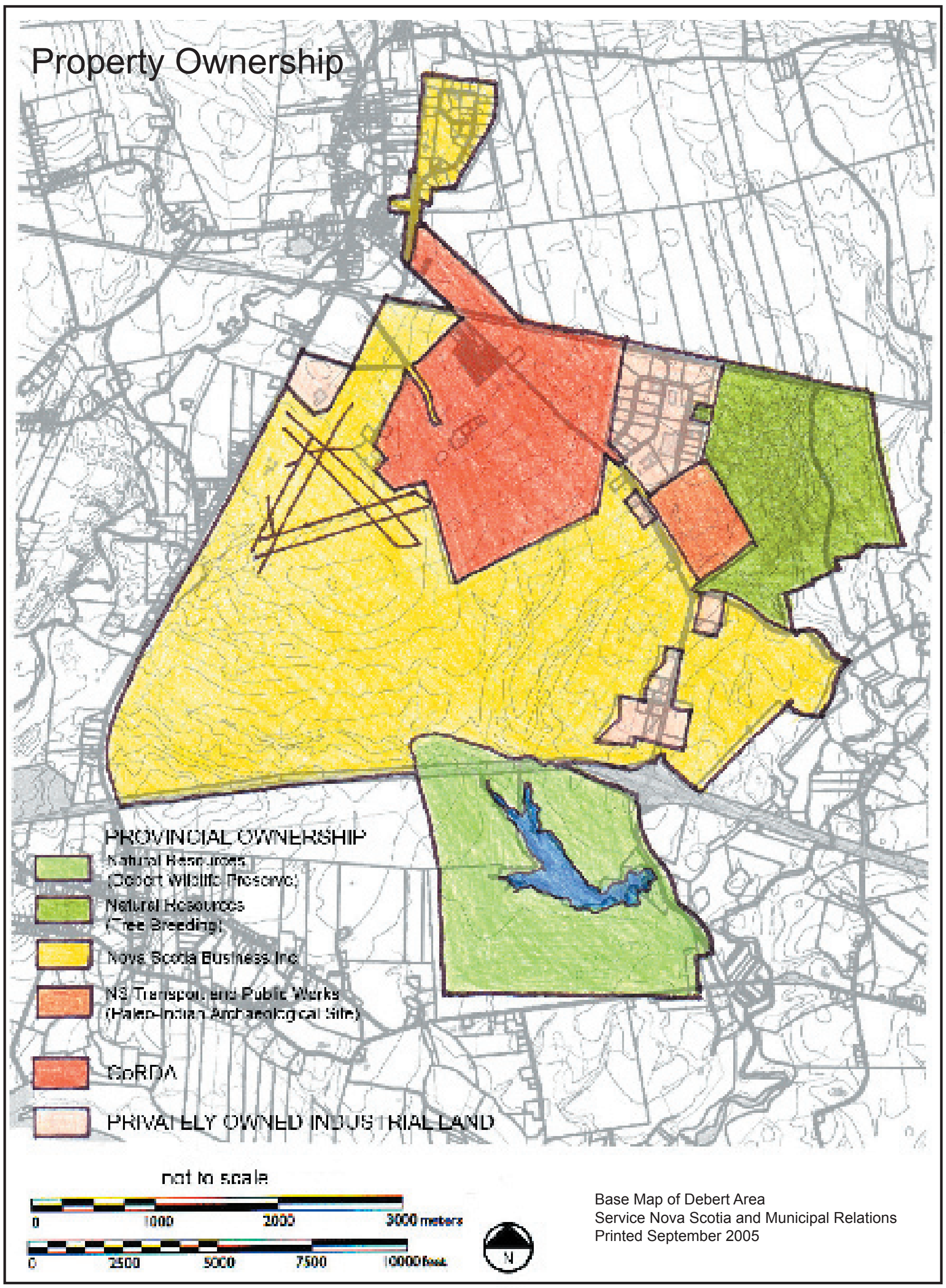
Contents

Location Map

(Nova Scotia Debert Map, 2005)

Background of Debert

The Colchester Regional Development Agency (CoRDA) has indicated that they wish to acquire the provincially owned land and combine it with the municipally owned land to develop an industrial park. The park is located in central Nova Scotia, 16 km northwest of Truro, and approximately 100 km from downtown Halifax (McGhie, et al., 2005). The study area is divided into the following sections: Provincially owned land, privately owned industrial land, and land owned by CoRDA. CoRDA hopes to acquire a portion of the provincially owned land to expand the industrial park. Much of the land owned by CoRDA is located at the former Canadian Forces Station Debert, mainly active during the mid-twentieth century.



Base Map of Debert Area
Service Nova Scotia and Municipal Relations
Printed September 2005

A Description of the Debert Palaeo-Indian Site

Debert is one of North America's earliest known settlements based on historical artifacts found on the site (McGhie, et al., 2005). Radiocarbon dating puts the age of these artifacts at approximately 10,600 years old (Nova Scotia Museum, 1996). The archaeological site, known as the Debert Palaeo-Indian Site, is located three miles southwest of the town of Debert. Since its discovery in 1948 over 4500 artifacts have been recovered. This is the only Palaeo-Indian site in Nova Scotia and is the earliest known archaeological site in the province. The site is currently protected under The Nova Scotia Special Places Protection Act which protects archaeological sites from development or disturbance. The protected area now covers 130 hectares. An adjacent 520 hectares belongs to the Department of Natural Resources Tree Breeding Centre. (Nova Scotia Museum, 1996).

The local Mi'kmaq community have established an interpretative trail adjacent to the archaeological site highlighting the cultural significance of the site.

[See Appendix A for further archaeological information]

Mi'kmawey Interpretive Trail

(Authors' Photo)

What is an Eco-industrial Park?

The future Debert Industrial Park has the potential to be one of the first eco-industrial park in Canada and to act as a model for other industrial parks around the world. Industries within an eco-industrial park cooperate closely to improve their environmental and economic performance by reducing waste and increasing resource efficiency. They may coordinate their activities to increase efficient use of raw materials, reduce outputs of waste, conserve energy and water resources, and reduce transportation requirements (Spohn, 2005). Resource efficiency translates into economic gains for businesses while the surrounding community benefits from improvements in environmental health and new employment opportunities (Spohn, 2005). Components of this approach include carefully placed infrastructure, cleaner production, pollution prevention, energy efficiency, and inter-company partnering (Lowe, 2005).

Eco-industrial parks also aim to develop within the capability of the landscape to support an intended industrial use. In this respect industrial development is dependent on the natural systems in which it operates. Development works as a participant in conjunction with the surrounding ecosystem. Eco-industrial development attempts to minimize disturbance to natural systems, cultural landscapes, and community social structures while integrating human economic activity with environmental sensitivities. This eco-industrial park will include residential and recreational uses along with other amenities.

The Problem

Industrial development has traditionally had a negative impact on the ecosystems in which it is situated. By using the concepts of industrial ecology as an alternative, this report will help CoRDA guide the location, form, and composition of future development on the Debert site. The challenge is how to match land capability and land-use with sustainable industrial development.

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A New Approach to Industrial Development

We are taking an environmentally conscious approach to managing industrial, residential and recreational developments. This approach requires that the location and physical form of human intervention in the landscape works in conjunction with existing natural systems to promote healthy places for people to live, work, and play. Eco-industrial development will also include the provision of local housing for employees. The optimum locations for development will be identified to take advantage of natural processes, and reduce negative environmental, social, or economic impacts.

Current Industrial Development at Debert
(Authors Photo)

Goals

Our goal for DEIP is to identify potential industrial development areas that will impact minimally on natural systems. Our research has revealed that DEIP possesses several sensitive areas that should be preserved. Based on the information gathered in our inventory we have developed a list of site specific primary, secondary and tertiary environmental goals for DEIP:

Primary Goals: Maintain the integrity of the water processes within the study area
- Protect the supply and quality of groundwater resources
- Protect McElmon's Pond and its watershed
- Protect wetlands

Secondary Goals: Protect important site Features
- Preserve the Debert Wildlife Management Area
- Preserve the Archaeological Site and adjacent trails
- Preserve tree breeding centre
- Preserve Intervale Habitats

Tertiary Goals: Take advantage of past activities within DEIP
- Utilize existing infrastructure
- Retain and reuse old military buildings

Many of these goals were derived from the US Green Building Council's Leadership in Energy and Environmental Design (LEED) Documents. LEED is a rating system for new commercial construction that encourages builders to utilize green building practices such as increasing energy and water efficiency (LEED-ND, 2005).

Based on the LEED documents for green neighbourhood development (LEED-ND, 2005), we plan to incorporate the following principles into our final recommendations:
- Location efficiency by encouraging development within already serviced existing urban area.
- Development should minimizes environmental impacts and physical disturbance to the landscape.
- Development must include compact, complete, and connected neighbourhoods including a mix of residential, commercial, industrial, recreational, and cultural opportunities. These neighbourhoods should be walkable and well connected to their surroundings.

McElmon's Pond
(Authors' Photo)

Method

A 1:20 000 scale base map with 5 metre contour intervals was obtained from Service Nova Scotia and Municipal Relations. Background information was collected and inventory maps were produced including:

- Current land-use
- Context
- Bedrock
- Soil
- Surficial geology
- McElmon's Pond Watershed
- Wet zones
- Habitat
- Slope
- Elevation
- Slope aspect

A study area boundary combines the McElmon's Pond watershed boundary with the provincial, municipal, and privately owned property boundaries. Although some of the watershed lies outside the property boundaries it is important to include this area to ensure the protection of water resources. After establishing primary, secondary and tertiary goals, the inventory maps were combined to produce an environmental sensitivities map and opportunities for development map. These maps were synthesized into a land capability map that identifies: buffer zones around stream corridors, well heads, existing sewage treatment facilities, and suitable areas for development. Based on information from the land capability analysis, recommendations were formed and issues requiring further study were identified. Several concepts for development were proposed and the best characteristics of each were combined into a final concept plan.

Report Process

Land Use
Context

Bedrock
Soil
Surficial Geology

Water Processes

Slope
Slope Aspect
Elevation

Habitat

Goals

Opportunities for Development Map

Environmental Sensitivities Map

Land Capability Map

Recommendations

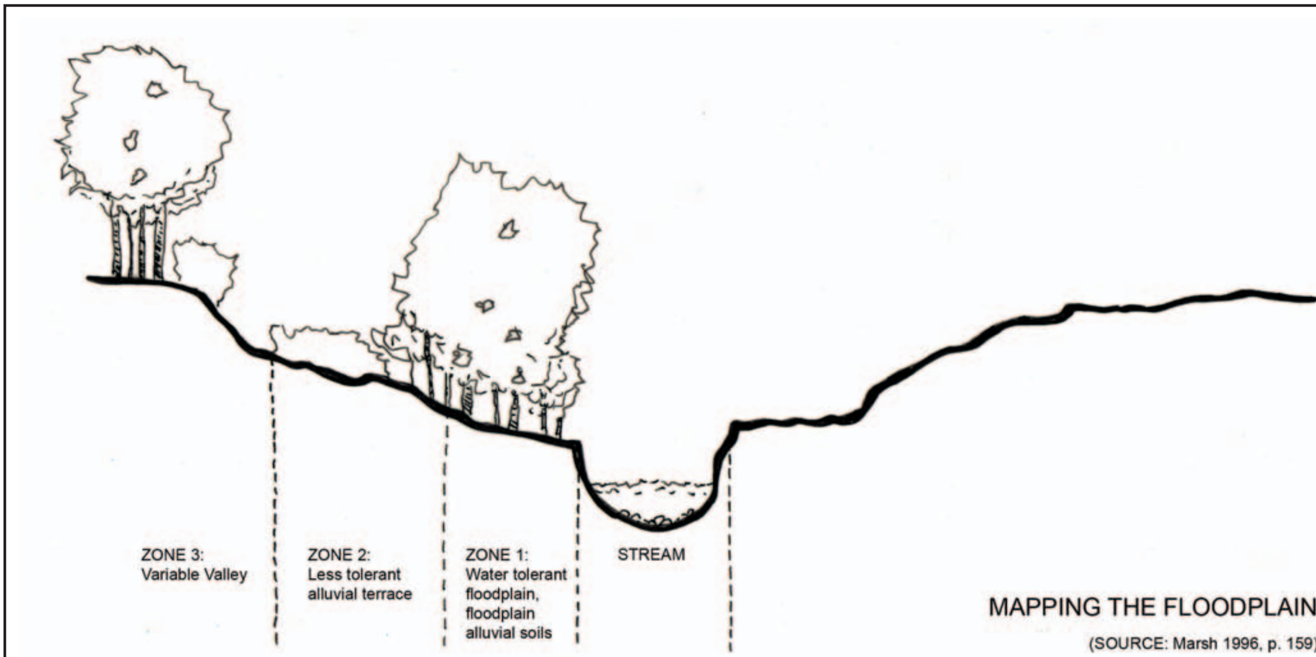
Final Concept

Inventory: A Description of the Debert Eco-Industrial Site

Context: *Map Appendix 1*
DEIP's location is important within the Maritime region. DEIP is geographically a regional centre and is well connected to many major maritime centres by road and rail. Debert is also centrally located along the Halifax-Moncton Economic Development Corridor. This highway/rail corridor efficiently links Halifax, Moncton and all of the cities and towns in between. DEIP is also central to both North America and Europe.

Water Processes; *Map Appendix 2-3*
McElmon's Pond is located south of Highway 104. The pond is an important habitat for various waterfowl including the rare American Widgeon. Most of DEIP drains to McElmon's Pond. As the streams flow toward McElmon's Pond their valleys become deeper, with steep sides. Some of DEIP drains to the Debert River to the west, and some of it drains to the Chiganois River to the east. Streams flowing into McElmon's Pond from the west and from the north begin as wetlands. There are also wetlands located around the banks of McElmon's Pond. Wetzones are flood plain areas and/or areas which produce high amounts of runoff. They are also prevalent throughout DEIP.

Military History of Canadian Forces Station Debert:
DEIP was once the site of an active military base: Canadian Forces Station (CFS) Debert. During construction of the base large tracts of previously forested land were cleared for development. The structures on the base consisted of soldiers' barracks, garages, ammunitions stores, fuel stores, communication buildings, and repair shops. CFS Debert was closed in the mid 1990s and decommissioned in 1998. (McGhie, et al., 2005). Many of the roads now used to access the industrial park and the airport were once part of the base. A number of military buildings remain intact and some, such as the ammunition storage sheds, have been adapted for light industrial use. It is important to note that military activities on the



MAPPING THE FLOODPLAIN
(SOURCE: Marsh 1996, p. 159)

site occurred during a period of weaker environmental regulations and practices. Some possible sources of contamination include: oil and gas storage tanks and sheds; abandoned septic tanks, chemical, paint, and munitions stores; repair garages; and railway repair shops. Existing buildings may have been constructed using materials now considered hazardous, such as asbestos and lead paint.

The historically significant buildings associated with CFS Debert include the Diefenbunker, the hospital, and the engineers' quarters. The Diefenbunker is an underground fallout shelter built during the cold war for the protection of Canadian dignitaries in the event of nuclear attack. CFS Debert was closed in the mid 1990s and decommissioned in 1998. The remaining facilities were transferred CoRDA (McGhie, et al., 2005).

For a brief history of the base and its relationship with the town of Debert, see Donald Davidson's testimony to the Standing Committee on Veteran's Affairs, March 1, 2001: Appendix B.

<u>Geology:</u> *Map Appendix 4-6*

The underlying bedrock of the study area is the Wolfville geologic formation. This distinct red-coloured Triassic sandstone spans from the Annapolis-Cornwallis Valley to the Minas Basin and Cobequid Bay (Davis, 1996: Ch. 6). The bedrock is composed primarily of soft, permeable, medium-grained sandstone, greywacke, shale, and conglomerates (Davis , 1996: 22). The clean, well-sorted sediments of the Wolfville Formation provide the most productive water storage and transmitting properties of any bedrock type in the county (Davis, 1996: 64). Existing gravel packed wells in the Wolfville Formation yield up to one million gallons of water per day (Davis, 1996: 64).

Overlying the Wolfville Formation are four types of surficial material: Saints Rest till, Eatonville-Hants till, alluvial deposits, and organic deposits. Eatonville-Hants till is closely related to the Wolfville formation. Saints Rest till is well sorted sand and gravel deposited by glacial melt-water. Alluvial material has been deposited along the banks of the Debert River and adjoining streams feeding McElmon's Pond. The organic deposits are formed in wetland areas within the region.

There are four types of soil found within DEIP: Castley, Diligence, Hebert, and Woodville. Woodville soil developed from Eatonville-Hants till surficial material. Hebert soil developed from glacial-fluvial sands and gravel belonging to Saints Rest till. Castley soil consists of poorly decomposed organic matter. Diligence soil is derived from Carboniferous shale. The mineral soils are generally well drained except in low-lying areas. Organic soils are poorly drained (NS Department of Agriculture and Marketing, 1991).

[See Appendix C for further information on geology]

<u>Elevation</u>*: Map Appendix* 7

DEIP lies on a gently inclined plain, descending 122 m over 15 km from to the base of the Cobequid Mountains, 8 km to the north, to the Cobequid Bay 7 km to the south (NS Government, 2003). Elevation change determines the general direction of water flow. Surface drainage follows this slope to the southwest (NS Government, 2003). As a result of the well drained soils, very little ponding of surface water occurs in DEIP (NS Government, 2003).

<u>Slope:</u> Map Appendix 8

DEIP is generally flat (<3 % slope). The steepest slopes occur in the valley walls of the stream corridors and in the northern section of the watershed.

Slope Aspect: *Map Appendix 9*
The south facing slopes in DEIP generally receive more solar radiation than those facing north. East and west facing slopes adjacent to streams receive greater morning and evening sun respectively. Water bodies, such as McElmon's Pond, can be expected to absorb solar radiation during the day and reradiate this energy during the evening.

Climate
DEIP is located north of Cobequid Bay at the eastern end of the Bay of Fundy and is affected by the marine influences of the Cobequid Basin (Davis, 1996: Ch. 6). Climate data for Debert shows that spring often arrives early and is warm; the summers tend to have clear skies, hot temperatures, and minimal precipitation (Davis, 1996: Ch. 6). Winters tend to be cold, but not severe, with an equal chance of rain or snow falling on wet days. The annual precipitation in the region is usually less than 1200mm/year (Davis, 1996: Ch. 6). Wind direction across DEIP is westerly (Environment Canada, 1985).

The Triassic Lowland Region where DEIP is located has the most favoured bio-climate in the province. The frost-free period and the growing season (145 and 195 days, respectively) are both long in comparison to other regions. Summer precipitation in the eastern end of the region is low. This can lead to occasional drought conditions. The warm temperatures and low elevations create a high potential for evapotranspiration and a moderate climate, lacking extremes of hot and cold. Poor air drainage on the valley floors creates frost pockets (Davis, 1996).

[See Appendix D for further climate information]

Rare American Widgeon (US Fish and Wildlife Service)

Habitat : *Map Appendix 10*
DEIP is noted for being important to local wildlife. Waterfowl and shorebirds are present within the site boundaries. The Debert Wildlife Management Area contains a unique population of American Widgeon and several hundred geese use this wetland in the fall (Davis, 1996: 165). Gray Partridge are also present in the area. Freshwater fish species include Creek Chub and Brook Trout. Atlantic Salmon are also known to enter the nearby Debert and Chiganois rivers. (Davis, 1996: Ch. 6).
In addition to the Wildlife Management Area, DEIP supports a rich diversity of plant and animal habitats. Ten different habitat types were identified.

[See Appendix E for further information on Habitat]

Land Use: *Map Appendix 11*
Military land uses were predominant throughout DEIP from the 1930s until the late 1990s. Industrial land use has only developed over the past 30 years. There are currently four main industrial areas on the site. Industrial development has taken the form of purpose-built structures and as adaptive reuses of

existing decommissioned military buildings. As a result, many of these currently developed areas are connected to the sewage and water infrastructure within DEIP.

Stream Corridor (Authors' Photo)

The Wildlife Management Area around McElmon's Pond, the Palaeo-Indian archaeological site, the Mi'kmaq interpretive trail, and the tree breeding area have been identified as protected areas. The Wildlife Management Area protects the pond and the surrounding natural habitat. The archaeological site is protected due to its historical significance in Nova Scotia and North America as an early settlement site. The interpretive loop trail north of the highway was built by the Mi'kmaq First Nation as an opportunity to highlight the historical significance of the area. There is also agricultural land throughout the northern section of the study area.

Transportation infrastructure within DEIP includes train, road, and air. The Canadian National Rail line crosses through DEIP on an east-west axis. The airport is currently used by the air cadets and local flight schools. It is the only airport between Moncton and Halifax. The airport was designed using a common triangular runway formation. This type of configuration provides alternate takeoff and landing options depending on varying wind conditions. Local and arterial roads connect DEIP to the national highway system; the Trans-Canada Highway passes through the southern part of DEIP.

Forest Habitat (Authors' Photo)

Interpretations:

Opportunities and Limitations for Development of Debert Eco-Industrial Park

The information collected in the inventory will help inform our recommendations for DEIP.

Regional Context of DEIP

DEIP is centrally located within the maritime region and is well connected to the rest of Atlantic Canada. People and goods can easily move in and out of the site using a range of transportation options such as air, truck, rail, and automobile. DEIP is also well connected to the large population centre of Truro. This allows employees to commute from Truro, the Town of Debert, or live in one of the adjoining subdivisions on the base. DEIP is ideally located along the Halifax-Moncton corridor and benefits from its proximity to major transportation routes. This economic corridor is an important connection between the major centres of Nova Scotia, New Brunswick and points in between. Halifax is one hour away by road and has a major port which connects to other ports of the world. Debert is connected to the national rail network which links it to the rest of Canada and the United States. The airport, currently used by a local flying club and a cadet training school, connects DEIP with a network of other airports.

Previous Canadian Forces Station Debert

A portion of DEIP was previously used as a Canadian Forces Station. As a result of weak environmental regulations during construction, the possibility exists that storage of hazardous materials may have resulted in the contamination of soil and groundwater. If disturbed these materials may further endanger workers' health and contaminate soil and groundwater. The existing military buildings and remaining foundations also have historical military significance and potential for reuse and interpretation.

Old military facility converted to new industrial (Authors' Photo)

The Debert Airport

Due to the triangular formation of the runways, only one runway can be used at a time. The runways were originally designed for frequent military use in a period when planes needed large runways for takeoff and landings. Today's light planes and business jets require less runway length for take-off and landing.

Existing Airport Hangers (Authors' Photo)

Geology

The geological characteristics of DEIP are important because of their susceptibility to pollution. Caution is required to maintain groundwater quality and to preserve future agricultural opportunities. The organic and poorly drained soils in wetland areas maintain water quality and wildlife habitat.

Interpretations continued

Water Processes
The streams, wetlands, watercourses, and wetzones need to be protected as valuable wildlife habitats. These areas are susceptible to contamination and special measures are needed for protection. Groundwater in DEIP is used as a drinking water supply for the surrounding communities. Therefore it is important to protect the groundwater resource in the aquifer below DEIP from contamination.

Elevation
Elevation change within DEIP slopes downward from north to south. Water runoff rate and direction will be affected by topography and needs to be considered in future development proposals for DEIP.

Slope
While the majority of DEIP is flat, the valley walls of the streams and at the northern watershed headlands have steep slopes. Steep slopes (>15%) within DEIP should be protected because of their proximity to watercourses and the potential for soil erosion and damage to water quality if disturbed. See adjacent table for ideal slope percentages.

Ideal Slope for Land-use

	Maximum	Minimum	Optimum
House	15%	1%	2%
Playground	2-3%	1%	1%
Parking Lot	4%	1%	2%
Sidewalk	8%	1%	2%
Street	8-12%	2%	2-8%
Industrial Sites:			
Factory	3-4%	1%	2%
Lay-down Storage	3%	1%	1%

(after Marsh, 1998)

Slope Aspect
The opportunities for solar access are relatively uniform across the entire site due to the flat topography. The southerly orientation of DEIP allows for good solar access as long as no vegetation or other built obstructions are present to the south.

Climate
The climate of DEIP makes it an attractive place to live and work. Warm summers and fertile soils are attractive for agriculture. Relatively mild winters, with an equal probability of rain or snow, indicate that snow-based transportation and recreational opportunities are limited in this area. The prevailing westerly wind direction will affect the location of natural and artificial windbreaks that might be included as part of any development proposal.

Wildlife Habitat
Sensitive habitats should be protected from development. Hardwood forests within DEIP require further study to determine the presence of old-forest. Old-forest hardwood stands, especially those in floodplains, have been identified as sites of ecological significance (Davis, 1996: H6.1 vol.1). The wetlands, streams, and water bodies in DEIP are important habitats for a variety of rare plants and animals.

Existing Development and Infrastructure
Areas currently serviced with roads, sewage and water infrastructure offer excellent opportunities for development. Future development on these sites will minimize infrastructure costs and site disturbance for new services. The airport and the previously developed base area have been identified as excellent candidates for immediate redevelopment.

As additional information becomes available, other areas may need to be protected in order to comply with the eco-industrial park objectives.


Current sewage treatment facility (Authors' Photo)

Cultural

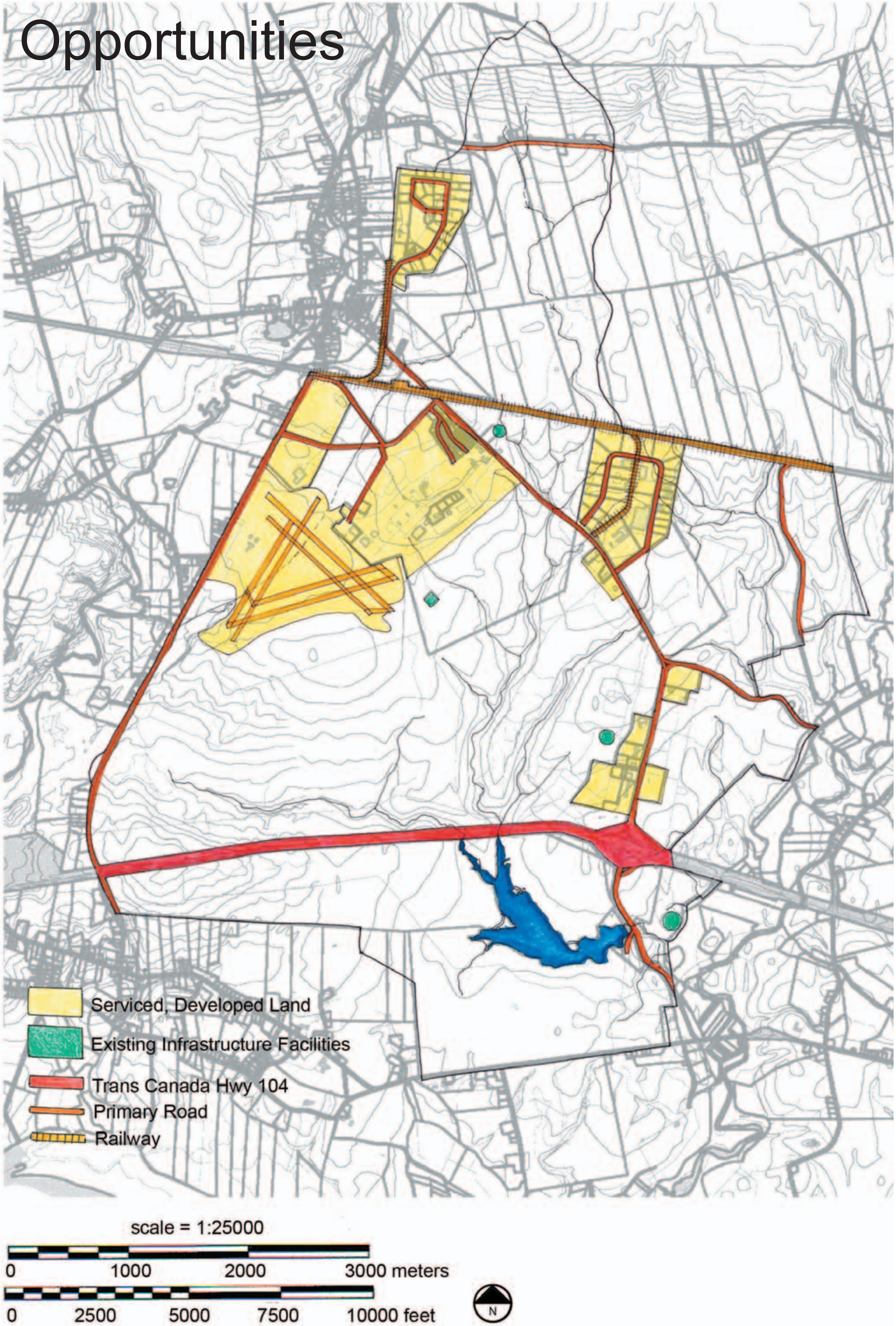
An archaeological assessment of any proposed development parcel is required to ensure that archaeological artifacts are identified and protected.

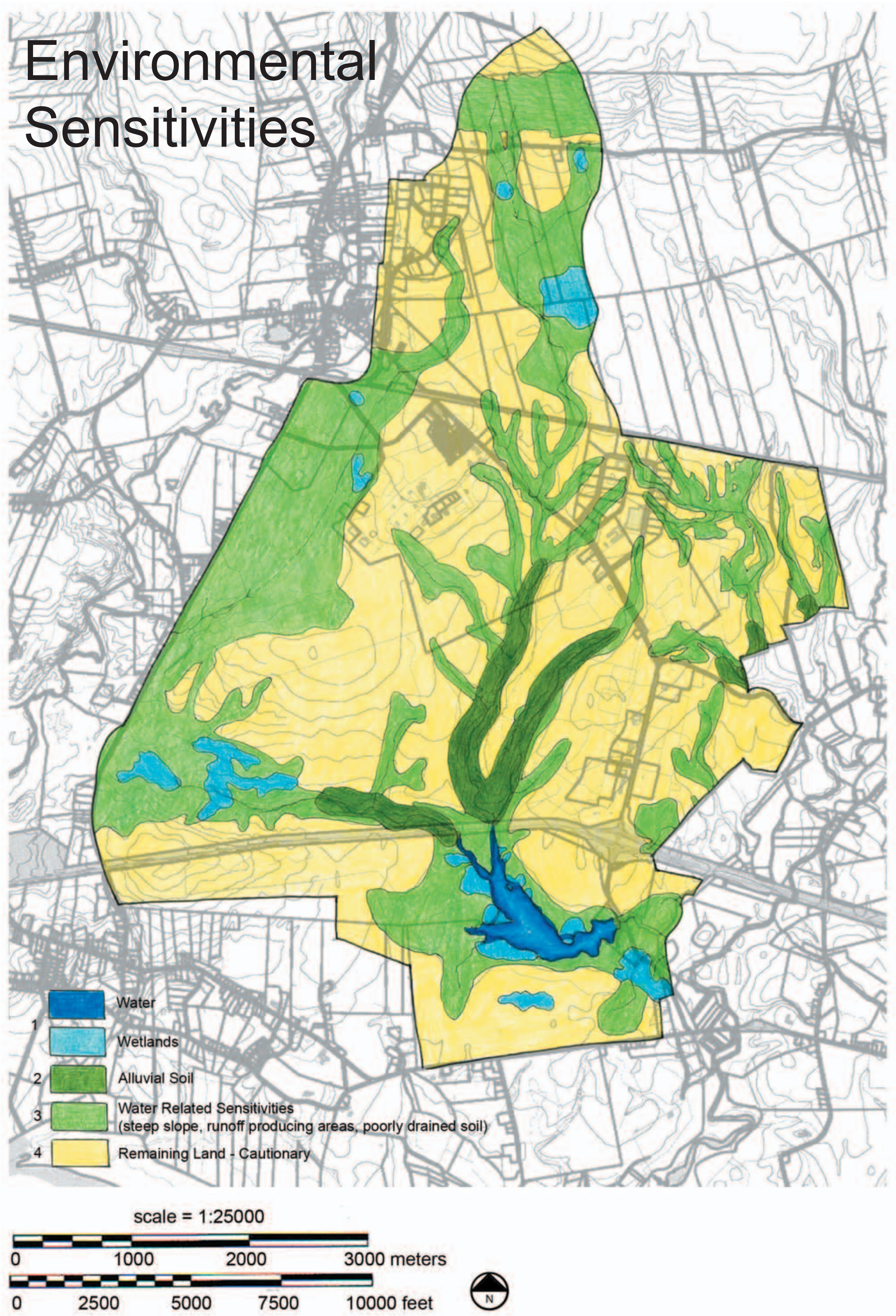
Summary of DEIP Opportunities Map

The current infrastructure in DEIP presenting opportunities for future development include: direct access to the Trans Canada Highway, primary roads, and the railway. Other major opportunities include: the land currently serviced with water and sewage infrastructure, the existing buildings, and the interpretive trail. The archeological site, the historical military base, and the museum offer cultural opportunities. The airfield also offers areas for future industrial development and recreational use. See page 17 for map.

Summary of DEIP Environmental Sensitivities Map

The environmental sensitivities in DEIP present four priorities for protection. The first priority is water sensitivity, including McElmon's Pond, the streams within the watershed and wetlands. The groundwater resources within DEIP are also a first priority for protection. The second protection priority areas are floodplains including areas with alluvial soils. The third priority includes wet areas, run-off producing areas, steep slopes, and well-drained soils. The fourth priority protects unique habitats, including select stands of hardwood forest. Other general sensitivities include potential environmental contamination and potential archaeological resources. See page 19 for map.


Opportunities
Serviced, Developed Land
Existing Infrastructure Facilities
Trans Canada Hwy 104
Primary Road
Railway
scale = 1:25000
0
1000
2000
3000 meters
0
2500
5000
7500
10000 feet
N


Environmental
Sensitivities
Water
1
Wetlands
2 Alluvial Soil
3 Water Related Sensitivities
(steep slope, runoff producing areas, poorly drained soil)
4 Remaining Land - Cautionary
scale = 1:25000
0 1000 2000 3000 meters
0 2500 5000 7500 10000 feet
N

Recommendations:

For Debert Eco-Industrial Park and Community Development

The following recommendations are the result of the data collected and analyzed. The findings have been compiled to direct the development of a future concept plan for DEIP.

Land Capability Priorities

Recommended protected areas include:

- watercourses
- wetlands
- well heads
- significant wildlife habitats
- slopes greater than 25%

These areas must not be developed.

Buffer Zones:
Buffer zones have been established around streams, wells, sewers and slopes greater than 15%. Caution will be taken when developing in proximity to these areas.

To protect water quality drawn from existing wells it is recommended that development not occur within a 50m radius of wells. This will allow natural filtration of any contaminants before water is extracted for consumption.

Current Development:
Development will be encouraged on currently serviced land to promote the protection of undisturbed habitat zones. Where existing development already occurs on or near these zones, caution will be used to mitigate the negative environmental impacts.

Future Development:
Future development should be directed to areas where it will not influence the protected areas and buffer zones.

Development Principles and Guidelines

Protect Aquifer:
Maintaining existing water quality and processes within DEIP and the underlying aquifer is the primary environmental goal. Water processes within DEIP will be protected from future development by buffer zones surrounding the existing surface water systems.

Restore Damaged Streams:
Existing development that intersects streams and wetland areas may have disrupted stream flow rates and water quality. It is recommended that stream regeneration occur in these problem areas. There is possibly a stream buried beneath the airfield. It has been identified as an area for further investigation and a possible stream restoration project.

Expand Infrastructure:
The current sewage treatment plants are nearing capacity. Therefore, it is recommended that on-site treatment centres be developed within the new industrial and residential clusters. This presents an opportunity to build site specific sewage treatment facilities that respond to the unique requirements of each site. Further sewage treatment options include: composting facilities, peat based septic systems, and solar aquatics for the treatment of sewage sludge. The waste from these systems may be recycled on site. For example, wastewater may be used to irrigate grassy areas or wood lots, or sludge can be treated by a solar aquatics facility.

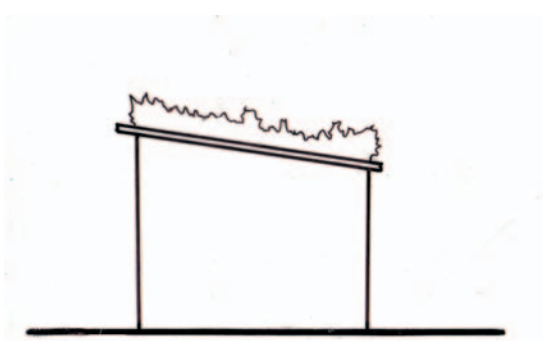
Improve Vehicular Transportation to, from, and within DEIP
Parking requirements will be reduced at the industrial sites in order to encourage people

Recommendations continued

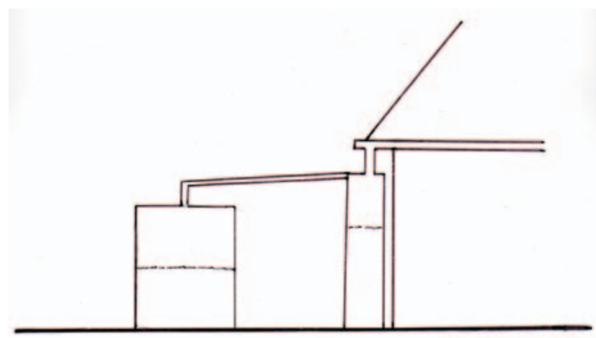
to carpool, use transit, walk or ride bicycles to work. A multi-modal transportation hub will link different forms of transportation allowing people and goods to be redistributed throughout the park.

Develop an Expanded Trail Network and Facilitate Active Transportation:
It is recommended that a trail network be developed that connects the transportation hub, industrial nodes, and residential centres. Active transport will be facilitated within DEIP by providing changing and showering facilities at the cluster centres throughout the park. Due to the lack of snow in the winter seasons, it is not recommended that cross-country skiing facilities be developed.

Demonstrate Better Management Practices (BMPs) of Storm and Wastewater
Environmentally sensitive storm water and wastewater facilities will be used throughout the park. Storm and wastewater management guidelines will be set to preserve water quality and to reduce runoff and pollutants from entering the water system. Industries and residential developments will use Better Management Practices (BMPs) such as: storm and wastewater retention ponds, infiltration basins, engineered wetlands, and roof-top vegetation to reduce runoff. Catchment areas could be used to reuse and reduce water consumption within industrial buildings or residential areas. Industries can select the most effective and efficient storm and wastewater management and technology for their industry type and the requirements of their site.


GREENROOF

Where development currently exists within stream buffer zones mitigation measures can be implemented to restore stream ecology. For example, engineered wetlands could be installed around damaged water courses and promoted as opportunities for environmentally sensitive storm water management. Furthermore, culverts under the rail lines will be widened and graded as required so that fish can pass through uninhibited.


RAINWATER CISTERN

Promote Climate Responsive Building Design:
Building orientation and design will maximize solar access to take advantage of passive solar energy gain during the winter. Landscaping will provide shade from summer sun and wind protection in winter. This will help decrease building heating and cooling costs and may help extend the comfortable outdoor living season by creating sheltered microclimates for outdoor activities. Dense evergreen ground-oriented bushes located to the west side of buildings and outdoor living areas can provide effective wind breaks. In addition, tall deciduous trees will be planted to the

south and south east of buildings and outdoor spaces to provide shade in summer.

Promote Energy Self-sufficiency:
The opportunities for on-site energy generation and a district heating distribution system will be explored to balance heating load. This system will link groups of buildings to a community generating facility. Large investments in fossil fuel based energy systems will be avoided to reduce future costs, conserve non-renewable resources, and decrease green house gas emissions.

Preserve Cultural Resources:
The archaeological site will be preserved along with the expansion of the interpretive trail network throughout DEIP. An interpretive centre will include information about the park trail network, the Mi'kmaq First Nations People, and the Palaeo-Indian Archaeological Site.

Diefenbunker at CFS Debert (Authors' Photo)

The previous military use of DEIP presents further opportunities for interpretation of sites such as the Diefenbunker. It is recommended that the military museum be moved to the Diefenbunker and that the existing operating systems be upgraded to increase energy efficiency, reduce operating costs, and reduce greenhouse gas emissions. This museum will be linked to other attractions throughout DEIP.

Encourage Commercial Opportunities:
Increased industrial development will bring further economic activity to the community. The economic benefits of industrial development will provide opportunities for commercial development within DEIP. Small manufacturers and businesses within the park can expand local commercial opportunities within DEIP and the Town of Debert.

Protect Wildlife:
A corridor will be maintained along the stream network ensuring the movement of wildlife. The corridor will allow wildlife to safely cross roads and rail lines. Waterfowl viewing platforms will be constructed around McElmon's Pond to highlight bird populations within the management area. Fish will be reintroduced into damaged streams after the streams have been restored.

Further Investigations:
It is recommended that a series of future studies be conducted before development of DEIP begins, including:

Railway Noise:
It is recommended that CN Rail and CoRDA undertake a study to determine the effects of train speed and noise in proximity to DEIP.

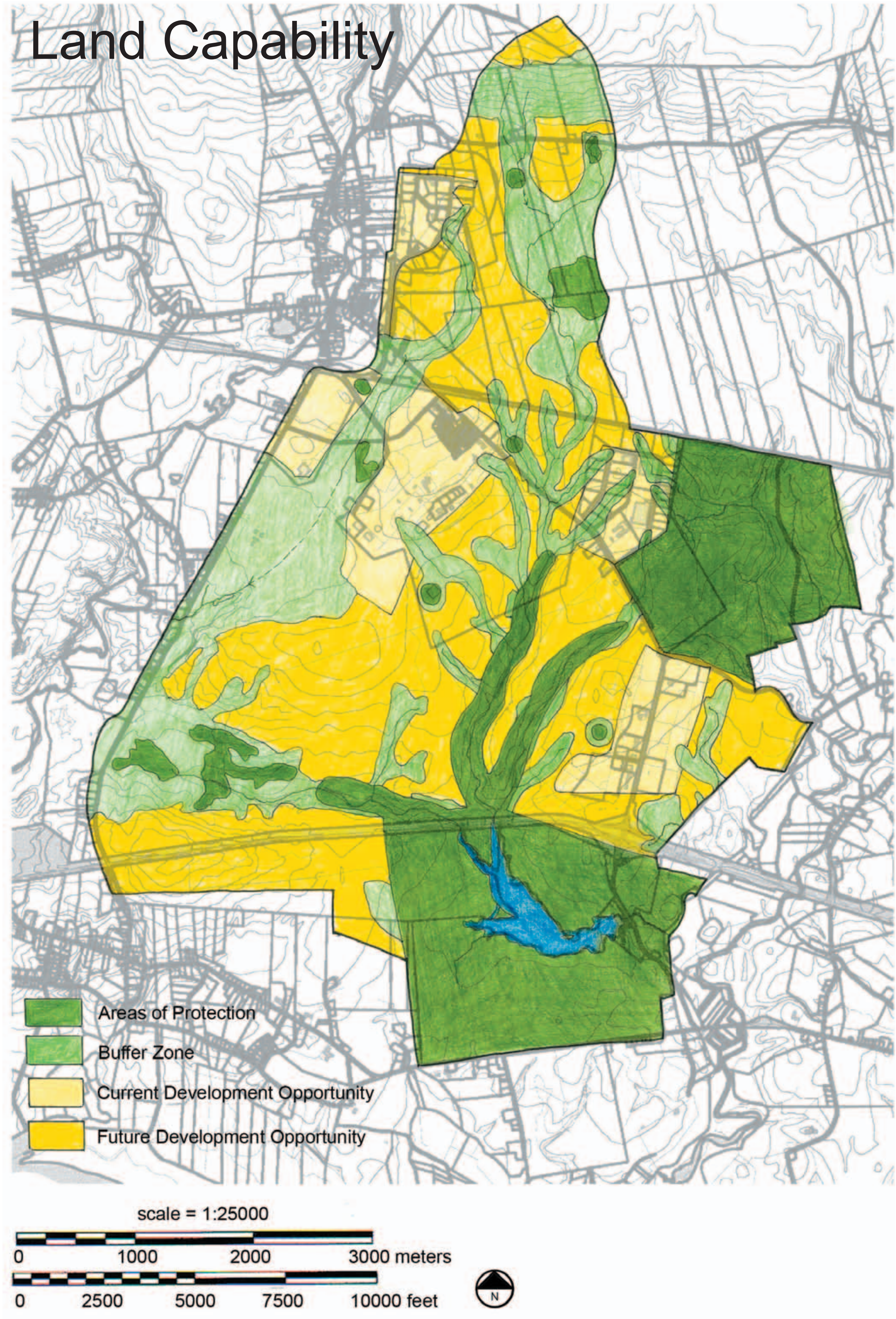
Groundwater Analysis
It is recommended that a groundwater analysis be preformed to determine the source, direction and depth of the underlying aquifer. This study will allow for the more efficient use of existing wells and will aid in the development of futures wells. It is also important to ensure the protection of the aquifer consider-

Recommendations continued

ing the highly permeable nature of the surficial geology.

CFS Debert:
It is recommended that a Formal Phase I Site Investigation be completed for any proposed redevelopment on former fuel or chemical storage facilities. This investigation would determine the possible risks of petroleum, chemical, or hazardous material contamination within a proposed development site. In the interest of protecting human health and groundwater resources, contaminated sites should be remediated before any redevelopment occurs. If a proposed development site is not contaminated or has been satisfactorily remediated, the CFS Debert buildings and grounds are recommended as primary opportunities for development.

The Debert Airport:
It is recommend that an investigation into the future use of the airport be undertaken to assess potential for expanded use. Our investigation has determined that due to the current under-utilization of the airport there are possibilities for alternative site uses. Air transport is an energy intensive mode of transportation in comparison to other forms. An expansion of the airport would increase air traffic and noise levels. This could negatively affect the area's residents and wildlife. Therefore, it is recommended that only one of the three runways be restored. This runway will continue to be used by residents and the community flying club and could accept private planes visiting DEIP. The maintenance of one runway will decrease the negative environmental impacts associated with expansion of the airport. The remaining two runways should be decommissioned and used as a developable area for industrial and recreational purposes.


Land Capability
Areas of Protection
Buffer Zone
Current Development Opportunity
Future Development Opportunity
scale = 1:25000
0
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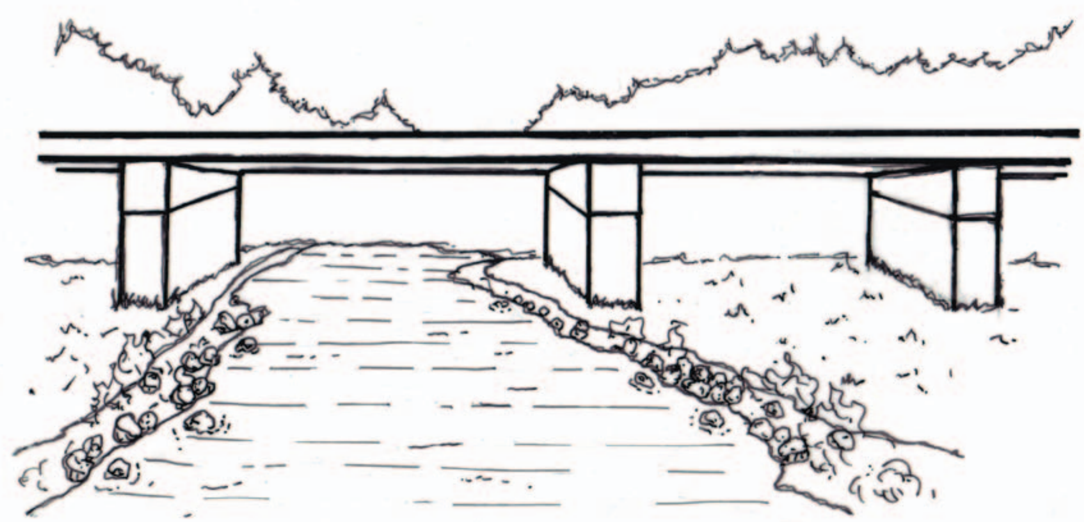
Design Concepts

Wildlife Corridors:
Buffer zones around water bodies will be expanded in order to create wildlife corridors throughout the site. Corridors will provide wildlife with a well-connected route through the site. These corridors will also preserve much of the existing plant life and allow continued successional forest growth. Extended forested areas adjacent to streams will protect fish habitat and water quality.

Stream Regeneration:
Development in DEIP will occur only in places where water processes are not negatively affected. In areas where development has already interrupted important water processes, streams will be restored. Bridges and large culverts will be constructed to allow wildlife to pass through these areas and to re-establish stream flow for fish habitat and overall stream health. A bridge or large culvert will also be developed under Highway 104 to connect the Wildlife Management Area with the new conservation areas north of the highway.

Encourage Environmentally Sensitive Building Design:
An environmentally responsive set of building performance criteria will be developed for DEIP. Industrial buildings in the park will follow eco-industrial park guidelines for development set out by Ray Côté et al. (2001). The town centre and residential development will be developed using the guidelines such as those set out by the US Green Building Council's Leadership in Energy and Environmental Design Green Building Rating Systems for New Construction and Neighourhood Development (LEED-NC: 2002)

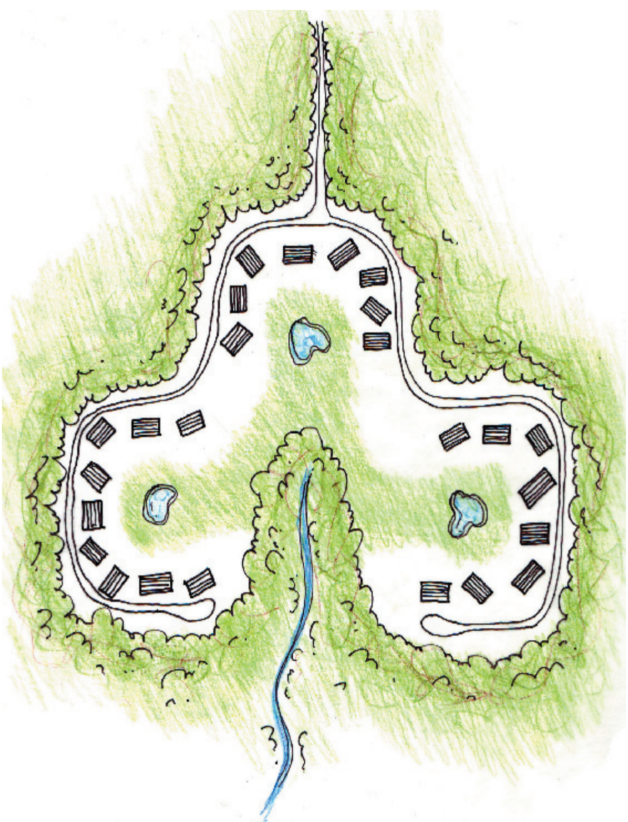
Clusters of Compatible Industries:
Industrial development will cluster compatibles industries in the same node to decrease transportation and allow for large wilderness



NEW INFRASTRUCTURE TO MAINTAIN WILDLIFE CORRIDORS
(Source: Dramstad et.al., 1996, p. 60)

Design Concepts continued

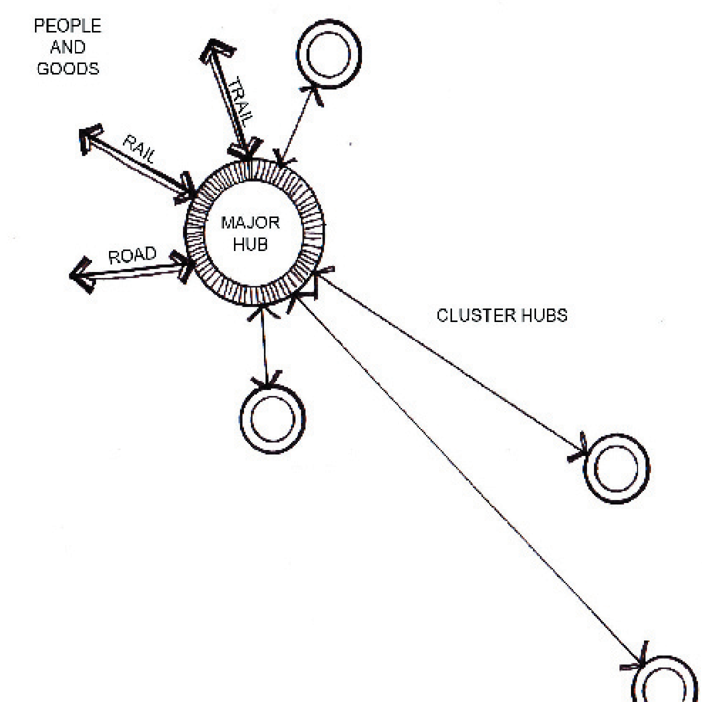
corridors. The clustered industries will co-operate with each other through material sharing and recycling. One industry's waste will be another's production material. These industrial nodes will include smaller green spaces. These green spaces will showcase Better Management Practices (BMPs) that demonstrate innovative solutions to traditional infrastructure requirements.



Clusters of Compatible Industries

Town Centre & Transport Hub:

A new compact mixed-use town centre on the south side of the railway will be developed to encourage residential development within DEIP. New residential development will be predominantly medium density ground-oriented units and some single family dwellings. Most of the residential development will be located within and adjacent to the town centre. Employees working in DEIP will be able to live in the new residential developments. This will reduce the need for lengthy commutes. The new town centre will be connected to the existing town of Debert with a pedestrian/bicycle rail overpass. This overpass will be necessary with the anticipated increase in commuter rail from the surrounding area. This centre will also be located adjacent to a transport hub where commuter trains from Truro will transfer passengers working throughout DEIP. A flexible road-based shuttle service will be implemented to move people and goods between nodes of development. Shuttle buses will run on either bio-diesel or natural gas. The transportation network will allow for multi-modal forms of transportation by providing bike racks on the shuttle buses. At drop off points throughout park shower and locker facilities will be provided for employees who choose active transportation.



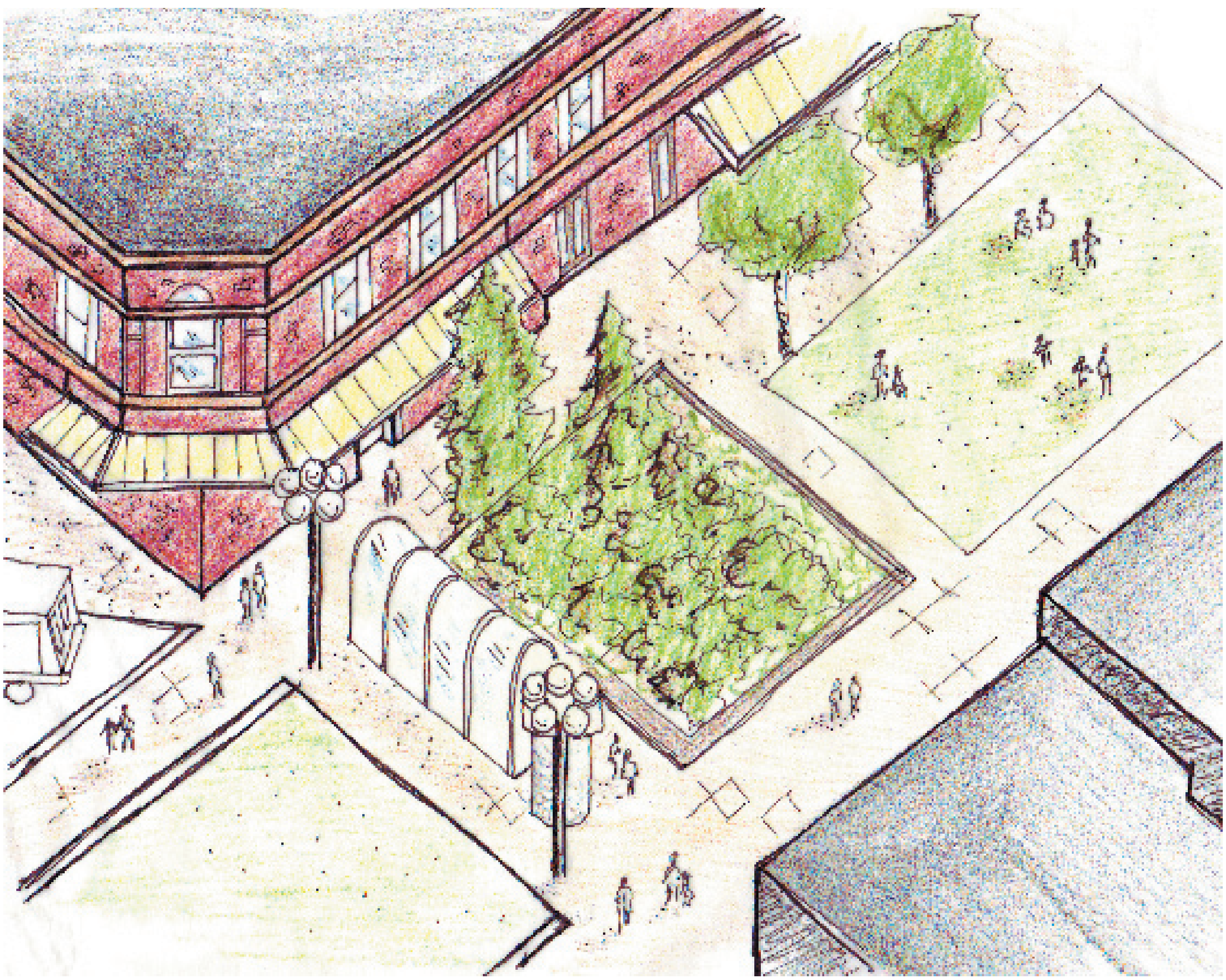
Town Center with Connections to Industrial Clusters

Archaeological Site Interpretation Centre and Eco-Industrial Park Information:

The archaeological site is significant as one of the earliest known settlements in North America. This area will be protected from development. An information centre will be established near Highway 104 in order to attract visitors. Signs along the highway will alert drivers of the interpretation centre and the park. The centre will explain the historical significance and natural history of the Debert area and provide an overview of human interaction within the landscape in DEIP. The interpretation centre will illustrate eco-industrial processes and innovative features found throughout DEIP. There will be trails connecting the interpretive centre with trails within the corridor.

Extended Trail Network and Improved Recreational Facilities:

People will be able to move throughout the park easily and safely without the constraint or expense of operating a motorized vehicle. Therefore an extended trail system will be developed to encourage active transporta-



Town Centre perspective

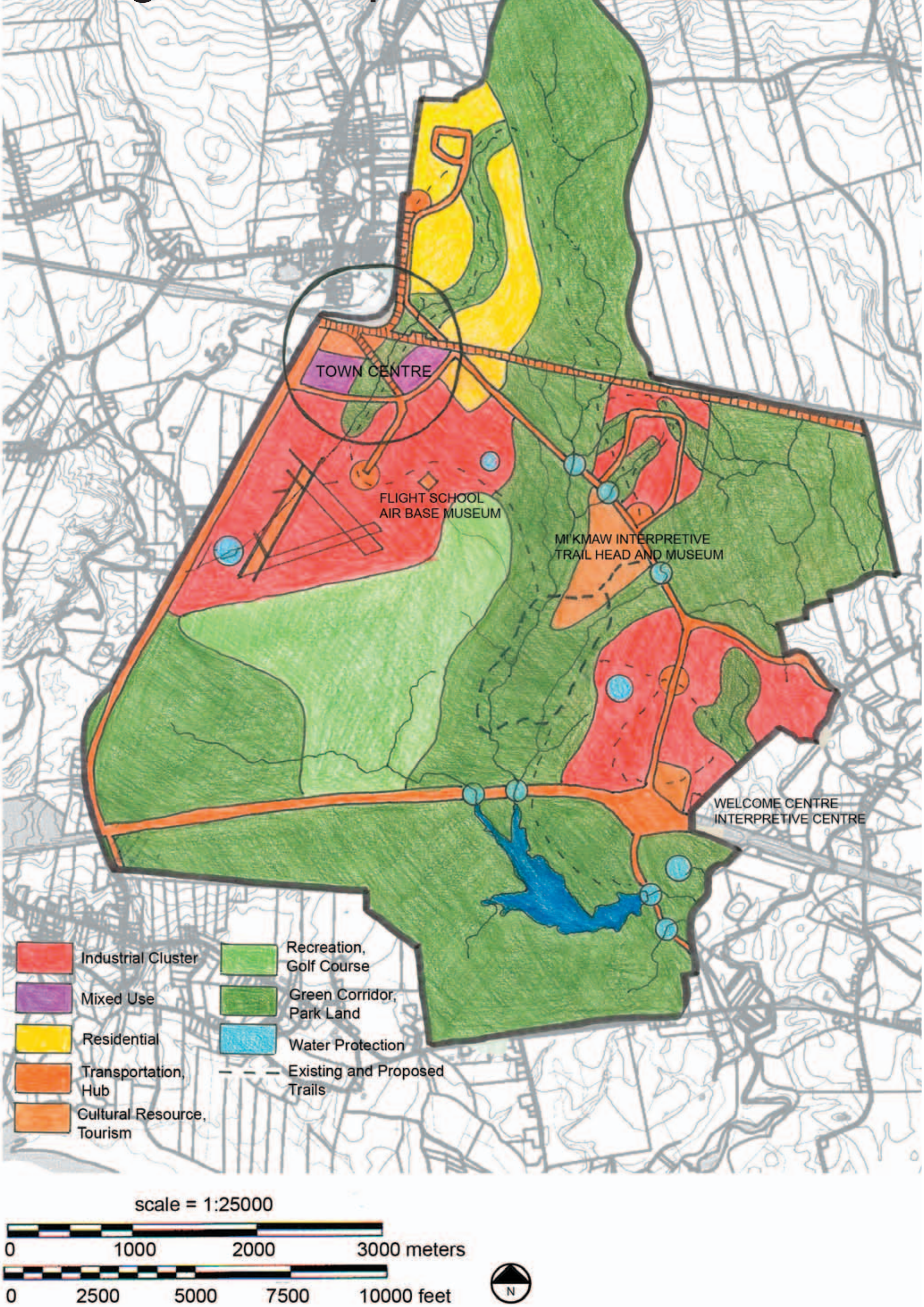
tion within DEIP. The trails will link the various nodes of development so that people can travel easily between destinations. Trails will have permeable surfaces to allow rainwater and snow to re-enter the ground and waterways. Selected trails will have a semi-permeable hard surface to allow clearing in the winter, encouraging their year round use. Sand will be used instead of salt to provide traction. This will ensure that runoff will not increase the salinity of waterways. Paved trails will also have lighting for added safety after dark.

Environmentally Conscious Golf Course:
DEIP will develop and operate a golf course to increase tourism. Much like the eco-industrial park itself, this golf course will consider and attempt to reduce the negative environmental impacts of golf course development. Using guidelines set out by the Royal Canadian Golf Association, the golf course will "communicate and promote practices to ensure that an equilibrium is sustained between maintaining quality playing conditions and a healthy environment" (RCGA, 2005). There will be environmental guidelines set out for the course designers and developers, and the directors, managers and superintendents. These guidelines will include strict rules regarding site selection, design considerations, construction, pest control, fertilizer and pesticide use, wildlife, habitats, and water use. The golf course also offers the opportunity to use irregularly shaped developable lands near the highway. This will increase visibility from the road, attract visitors, and enhance the aesthetics of the park.

[For complete environmental guidelines see Appendix F]

Improved Museum Facilities and Bunker Restoration:
There is currently a small military museum located in DEIP. This museum will relocate and expand into the Diefenbunker currently used by the cadets and the flying school as temporary accommodation. The military museum will occupy part of the bunker and the remaining section will be maintained as residences with conference space. The residences and conference space will be used by different companies within DEIP or as a conference destination for companies from elsewhere in the Maritimes.

Design Concept



Conclusion

This document was prepared to assist CoRDA in the development of an eco-industrial park. The proposed concepts include the location, form, and composition of future development within the Debert Eco-Industrial Park (DEIP). The purpose of this project was to protect environmentally sensitive areas within the proposed park while assessing the ability of the land to support different forms of development.

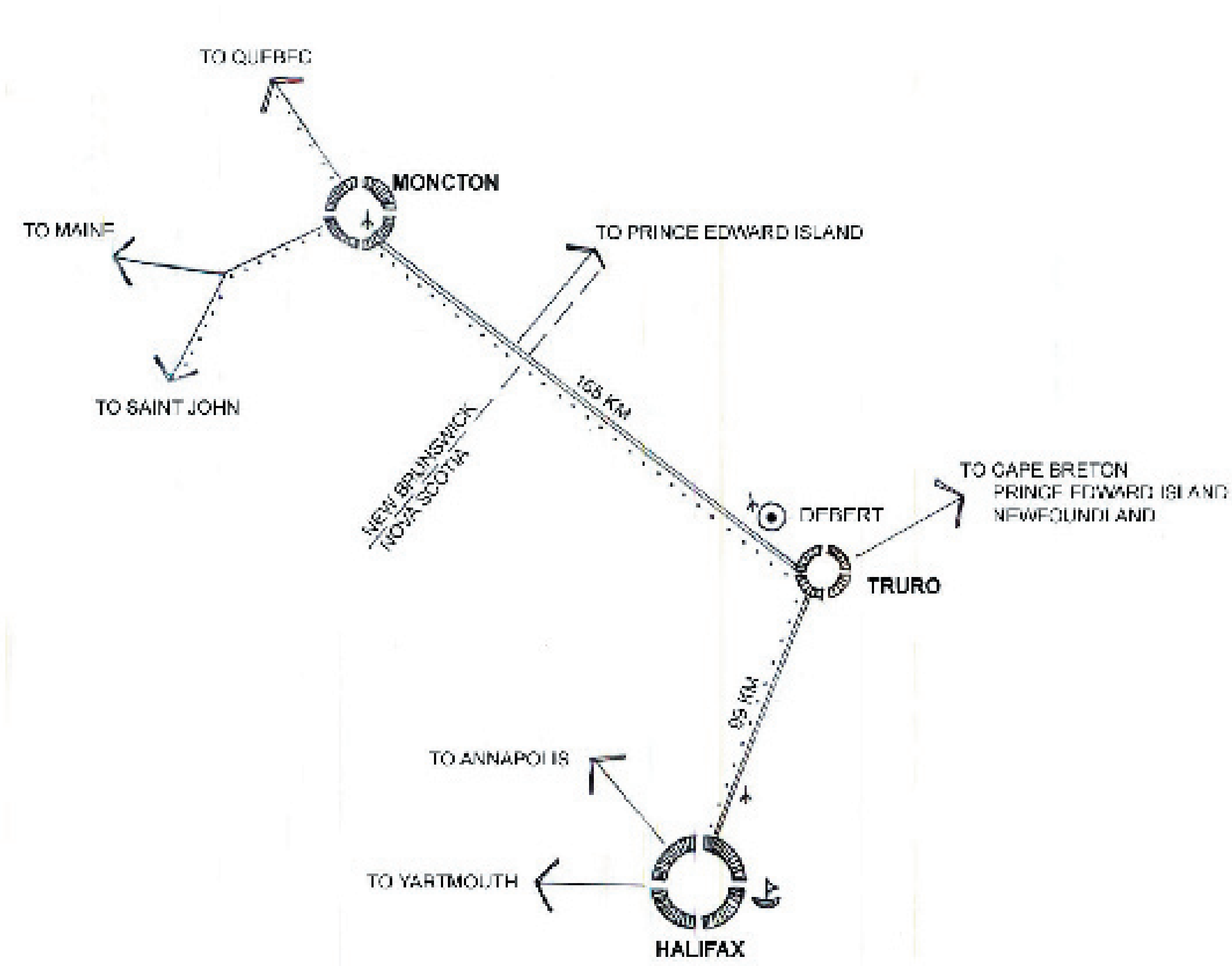
An eco-industrial park involves industries that work in conjunction with natural systems and attempt to minimize disturbance to natural systems. Industries in an eco-industrial park cooperate closely to improve their environmental and economic performance by reducing waste and increasing resource efficiency.

The first step of this project was to collect background information. An inventory was compiled including the physical and cultural characteristics of the DEIP. From this inventory we developed goals and recommendations to direct the completion of a concept plan for future development. The goals of the proposed concept plan include: the protection of the water resources, the preservation of culturally and environmentally significant areas, and use of existing infrastructure whenever possible. Optimum locations for development were identified that reduce negative environmental, social, and economic impacts.

In summary, this report offers an alternative to traditional industrial development by showing consideration for environmental sensitivities and impacts. The approach taken has demonstrated that it is possible to develop land for industrial purposes while minimizing environmental impacts. CoRDA can now use this land capability analysis to proceed with the next stage of development.

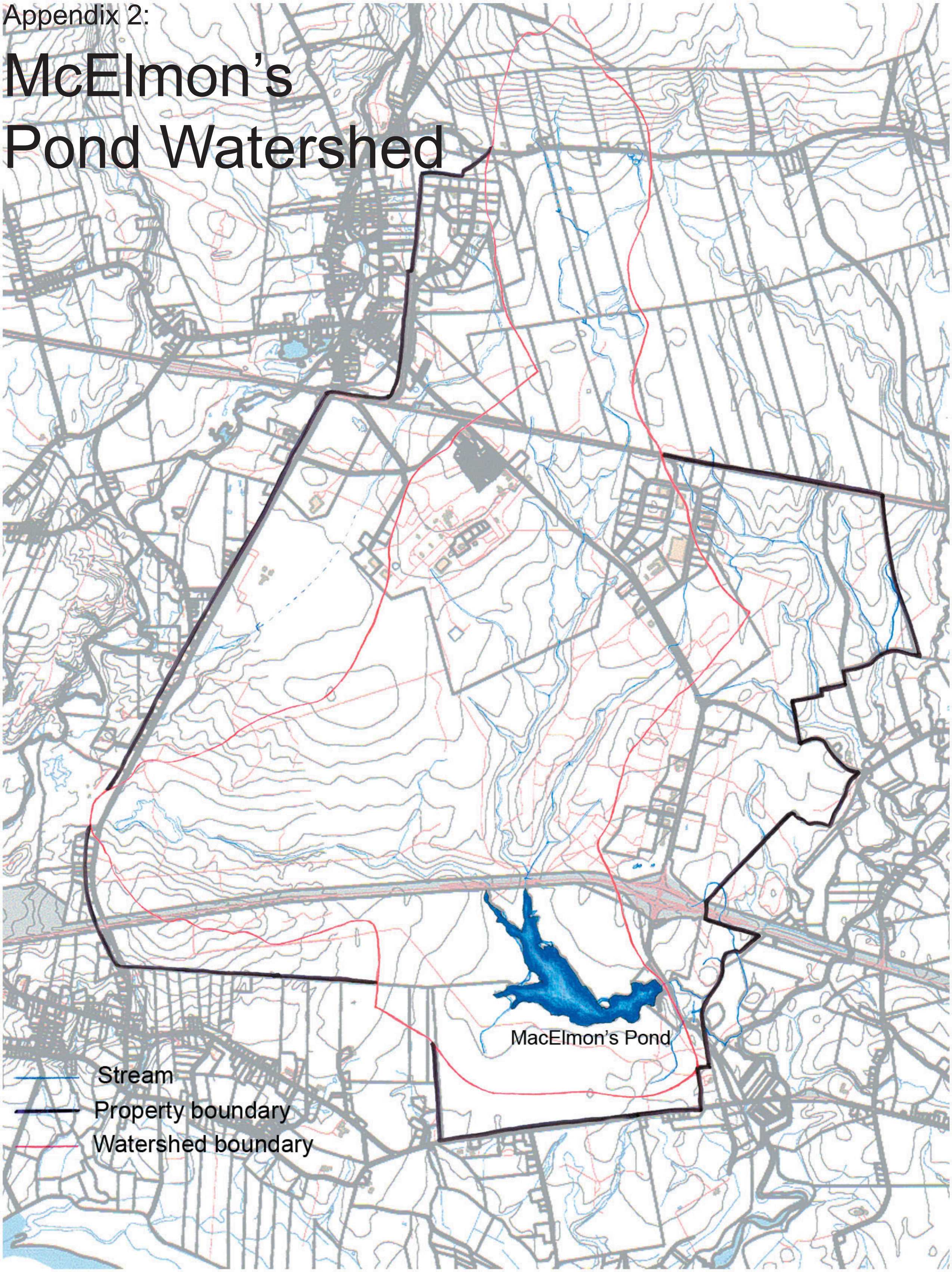
Appendix 1:

Context



Appendix 2:

McElmon's Pond Watershed



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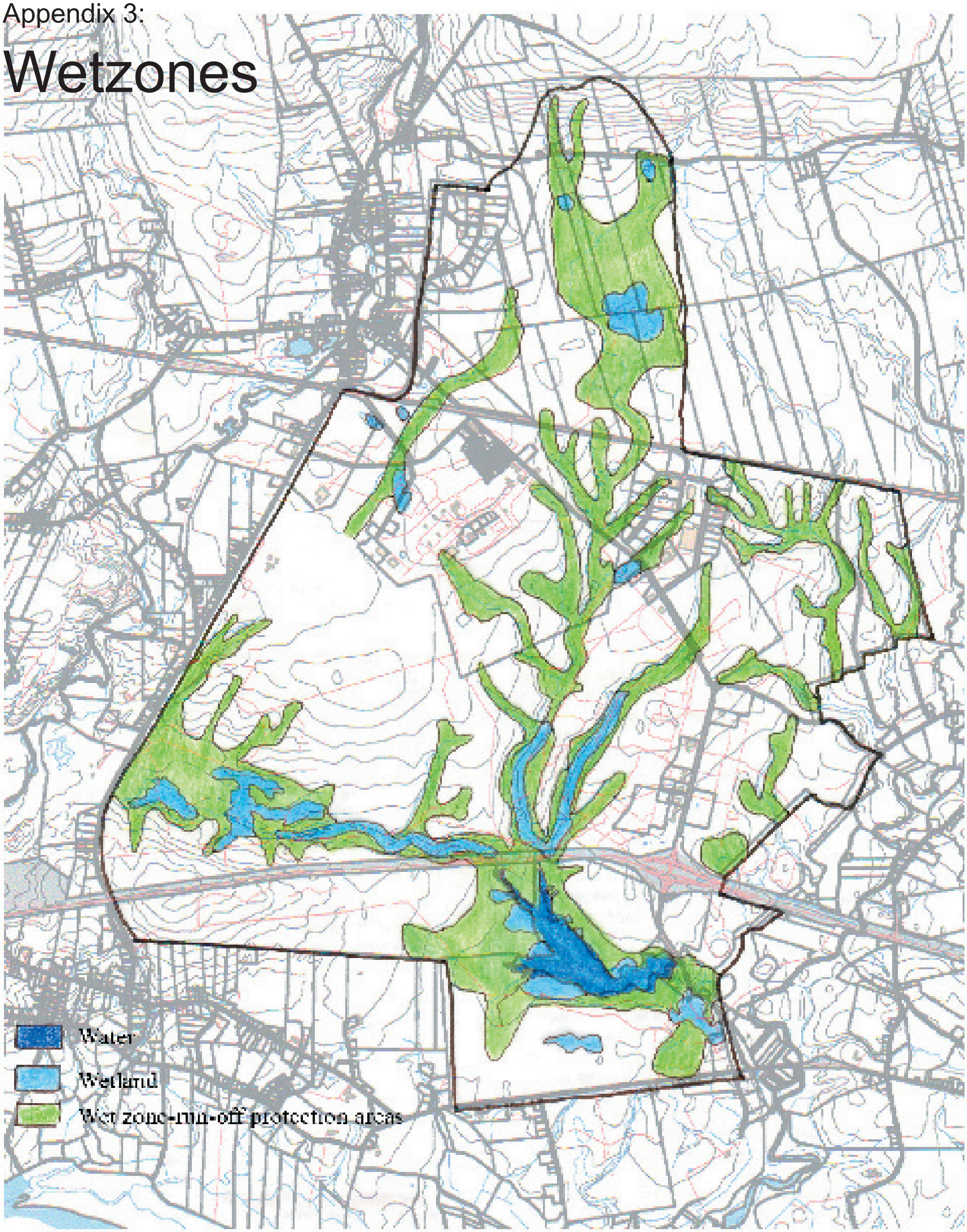
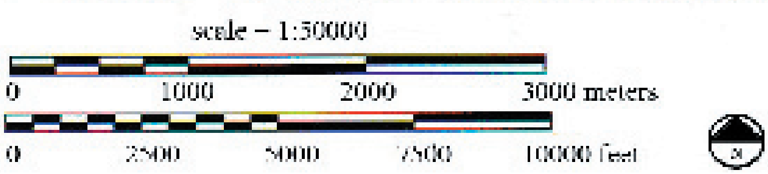
Base Map of Debert Area
Service Nova Scotia and Municipal Relations
Printed September 2005

Appendix 3:

Wetzones

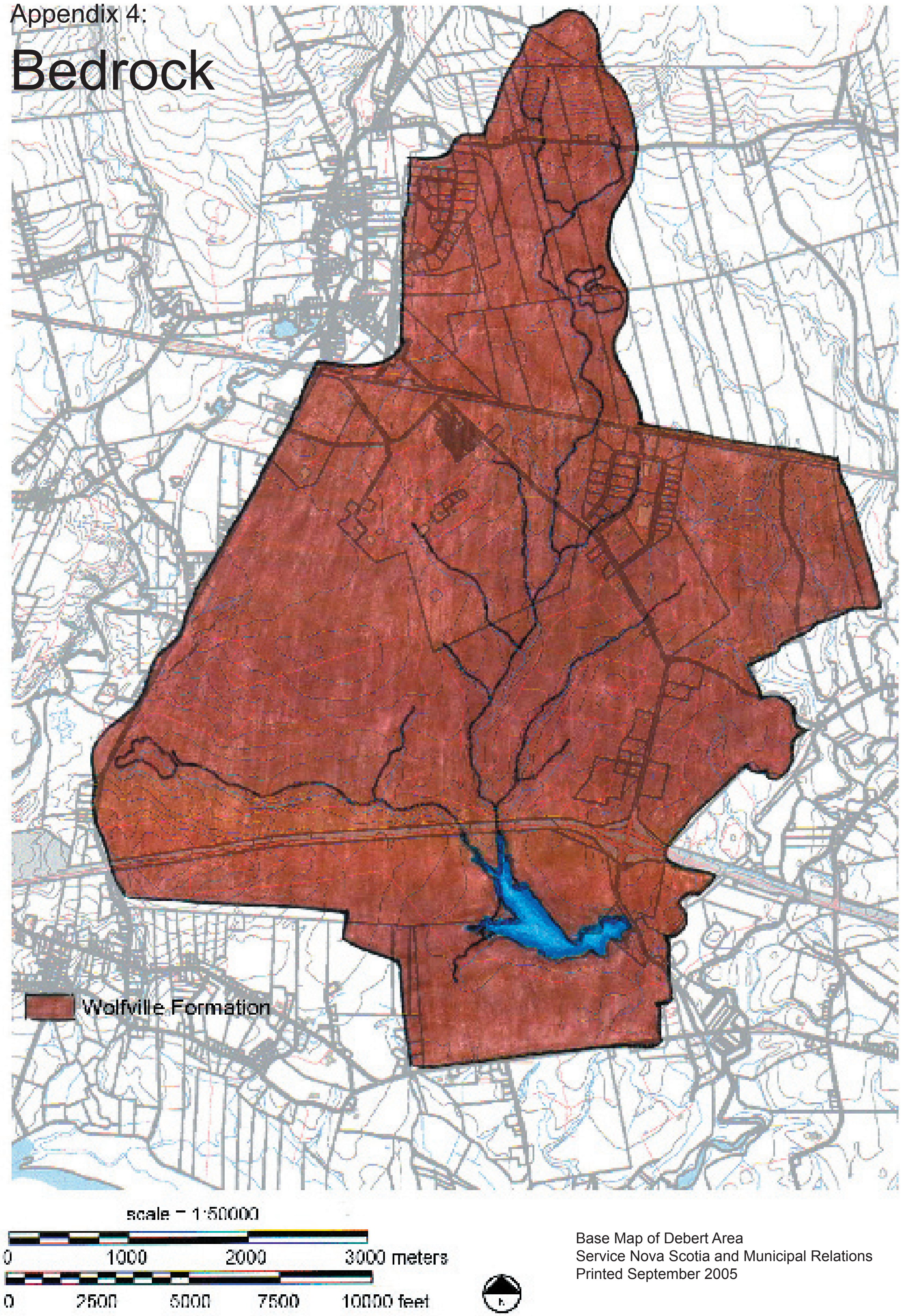




Base Map of Debert Area
Service Nova Scotia and Municipal Relations
Printed September 2005

Appendix 4:

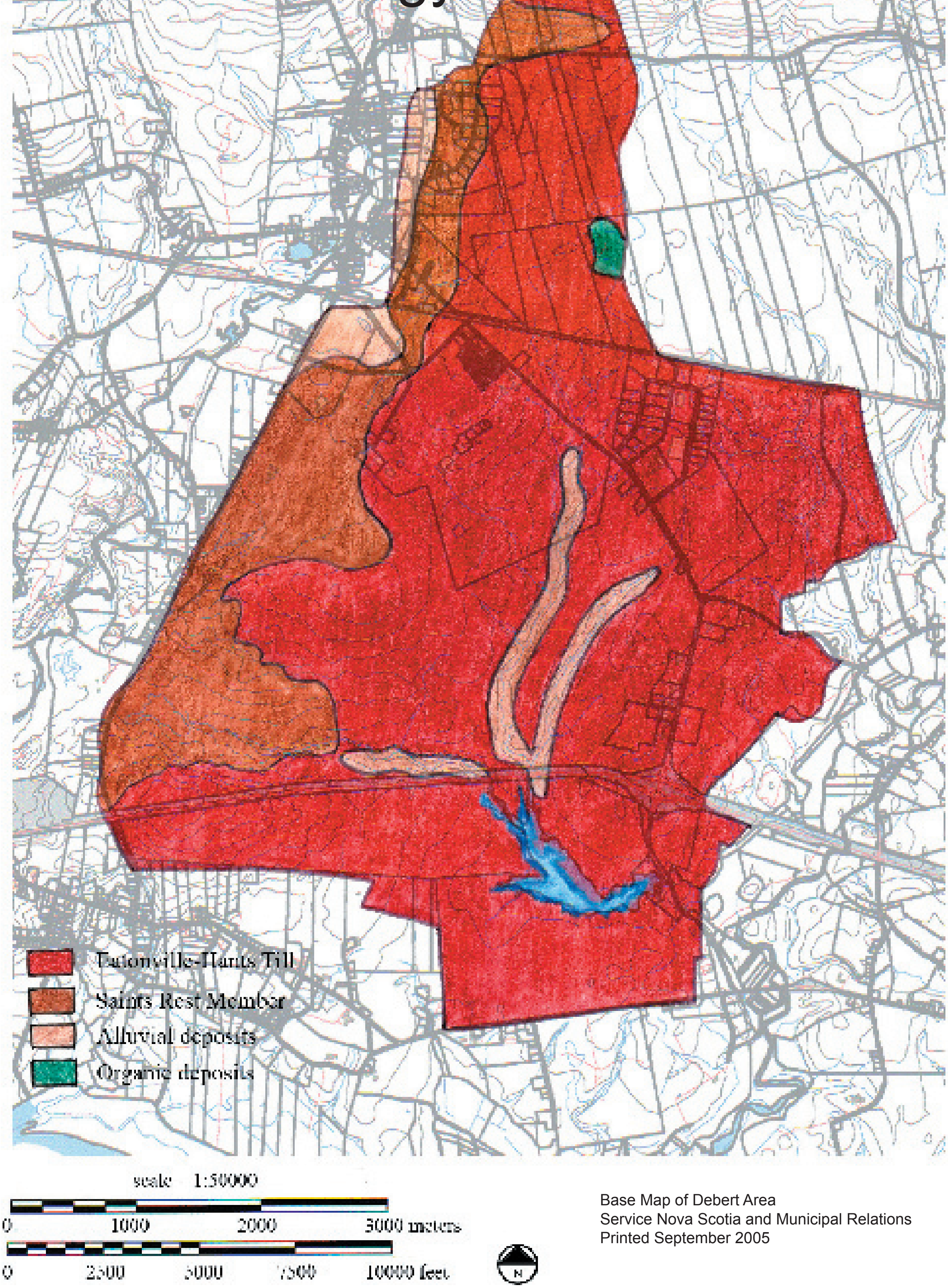
Bedrock



Base Map of Debert Area
Service Nova Scotia and Municipal Relations
Printed September 2005

Appendix 5:

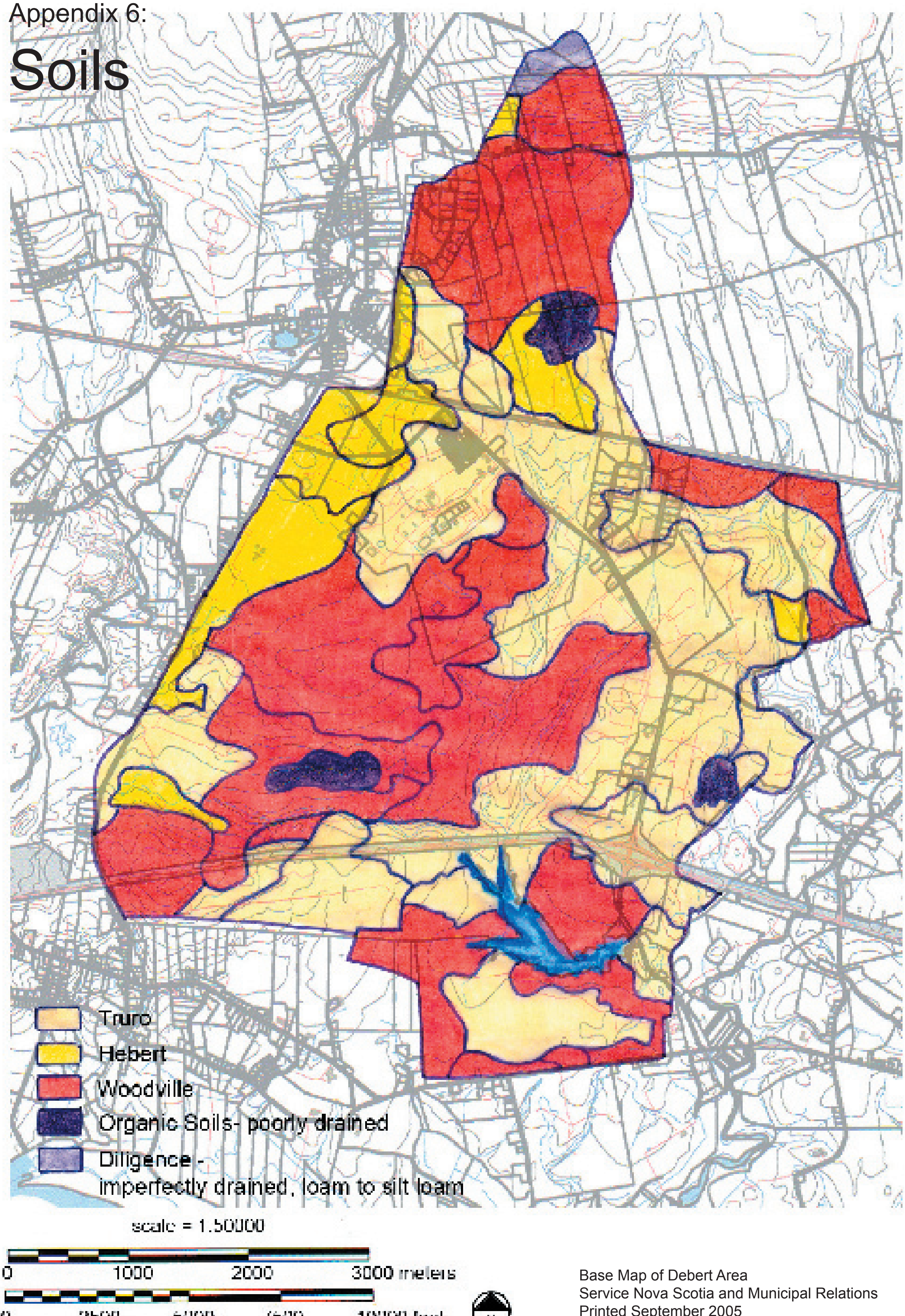
Surficial Geology



Base Map of Debert Area
Service Nova Scotia and Municipal Relations
Printed September 2005

Appendix 6:

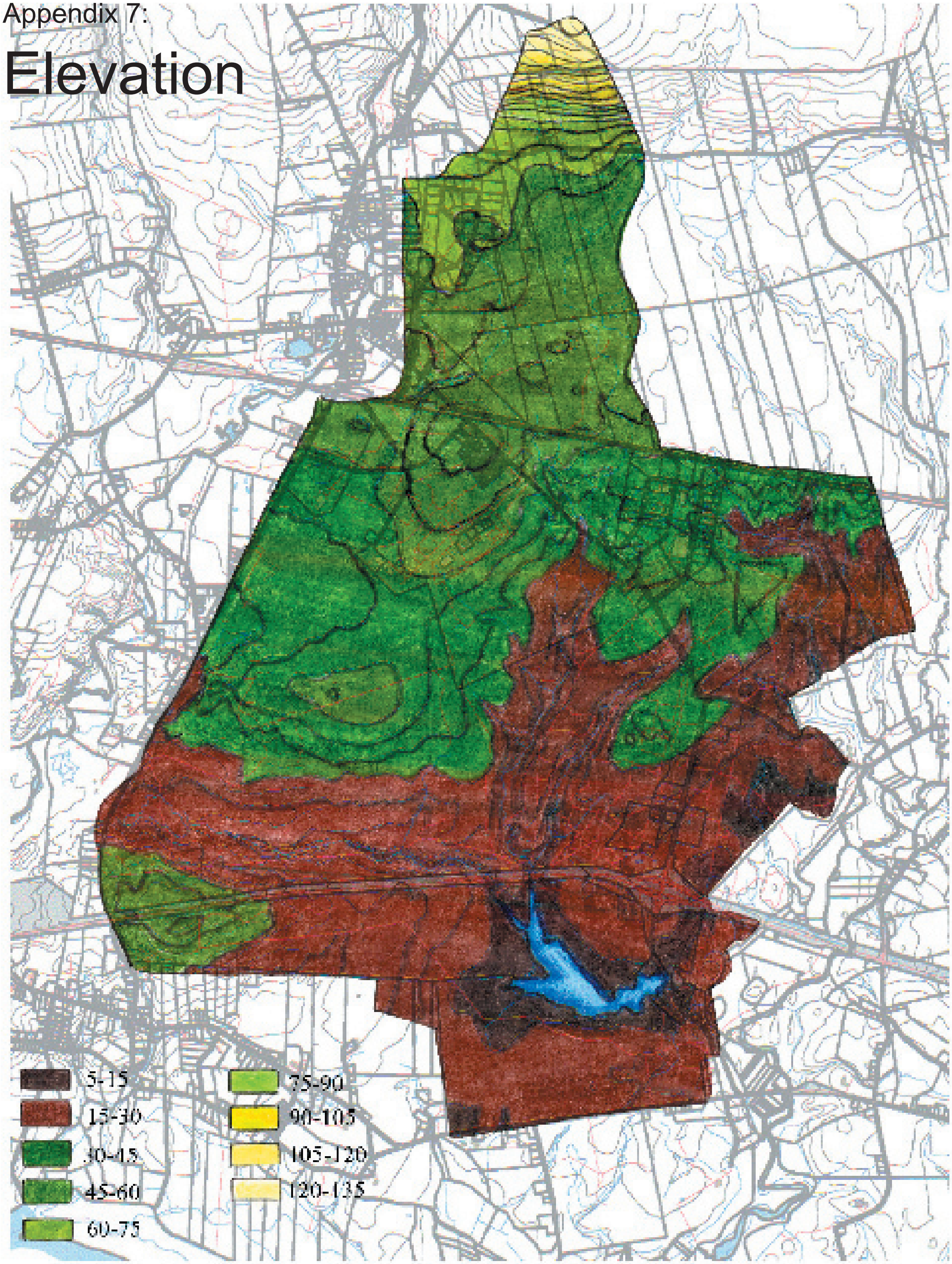
Soils



Base Map of Debert Area
Service Nova Scotia and Municipal Relations
Printed September 2005

Appendix 7:

Elevation



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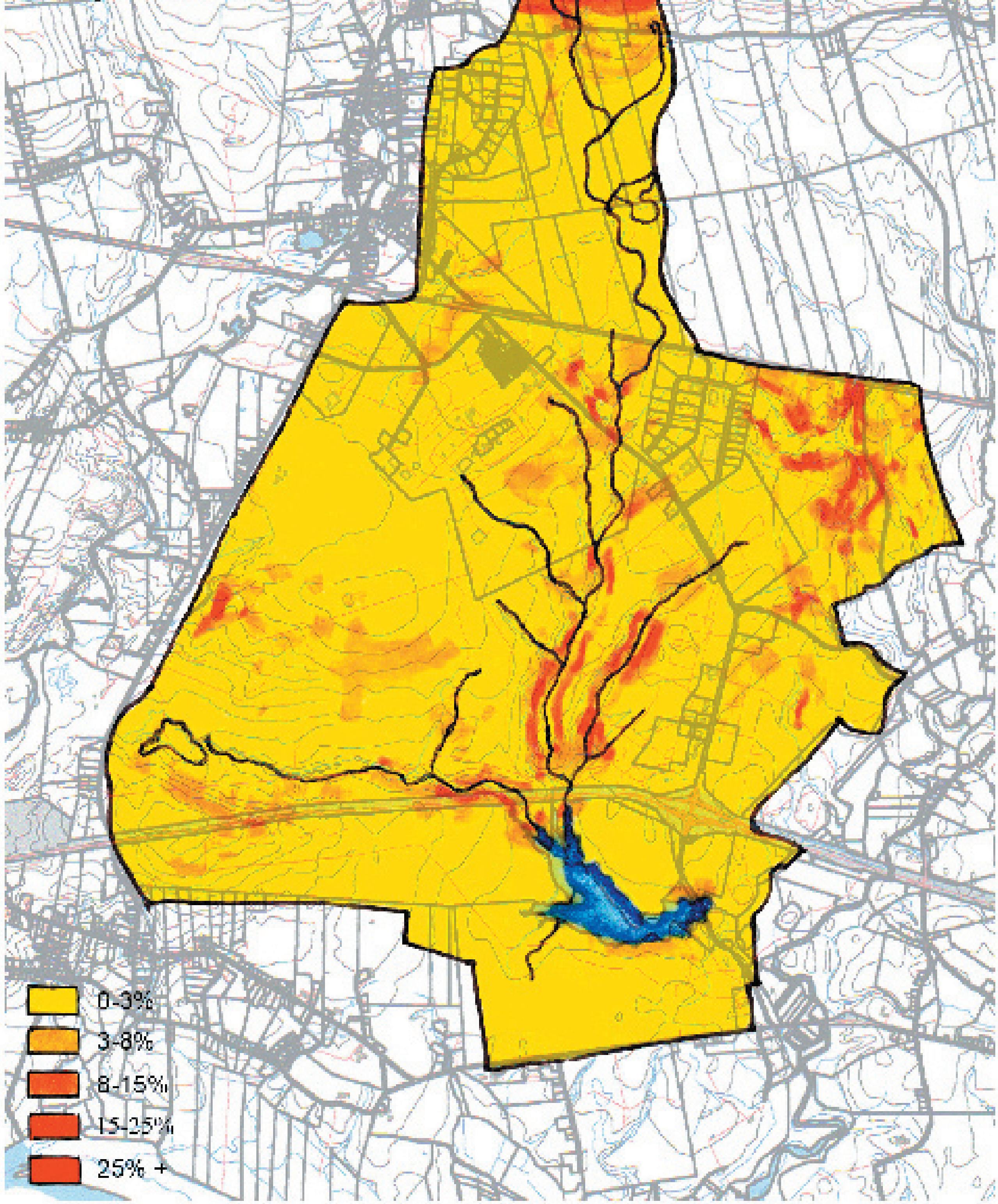
Base Map of Debert Area
Service Nova Scotia and Municipal Relations
Printed September 2005

Appendix 8:

Slope



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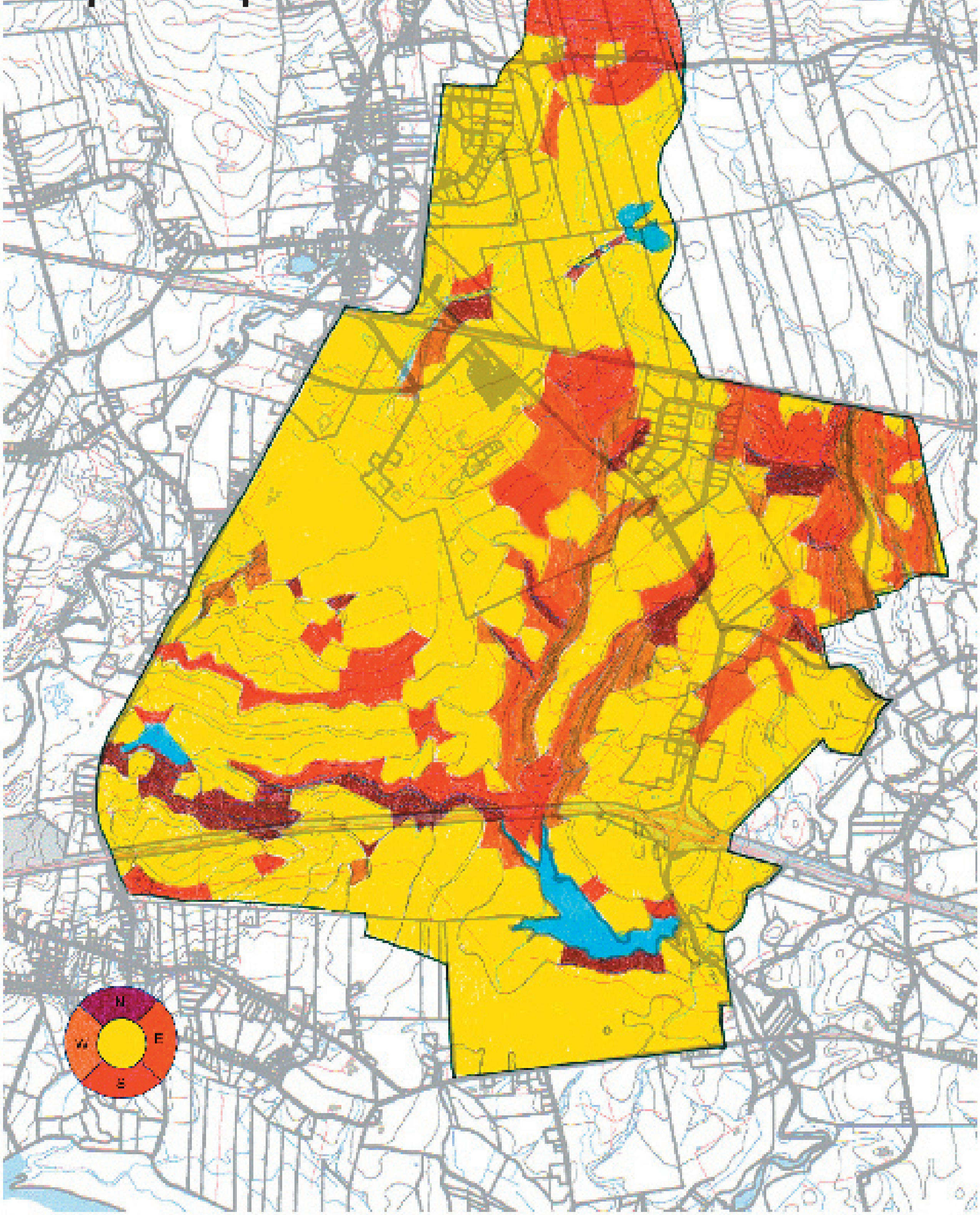
Base Map of Debert Area
Service Nova Scotia and Municipal Relations
Printed September 2005

Appendix 9:

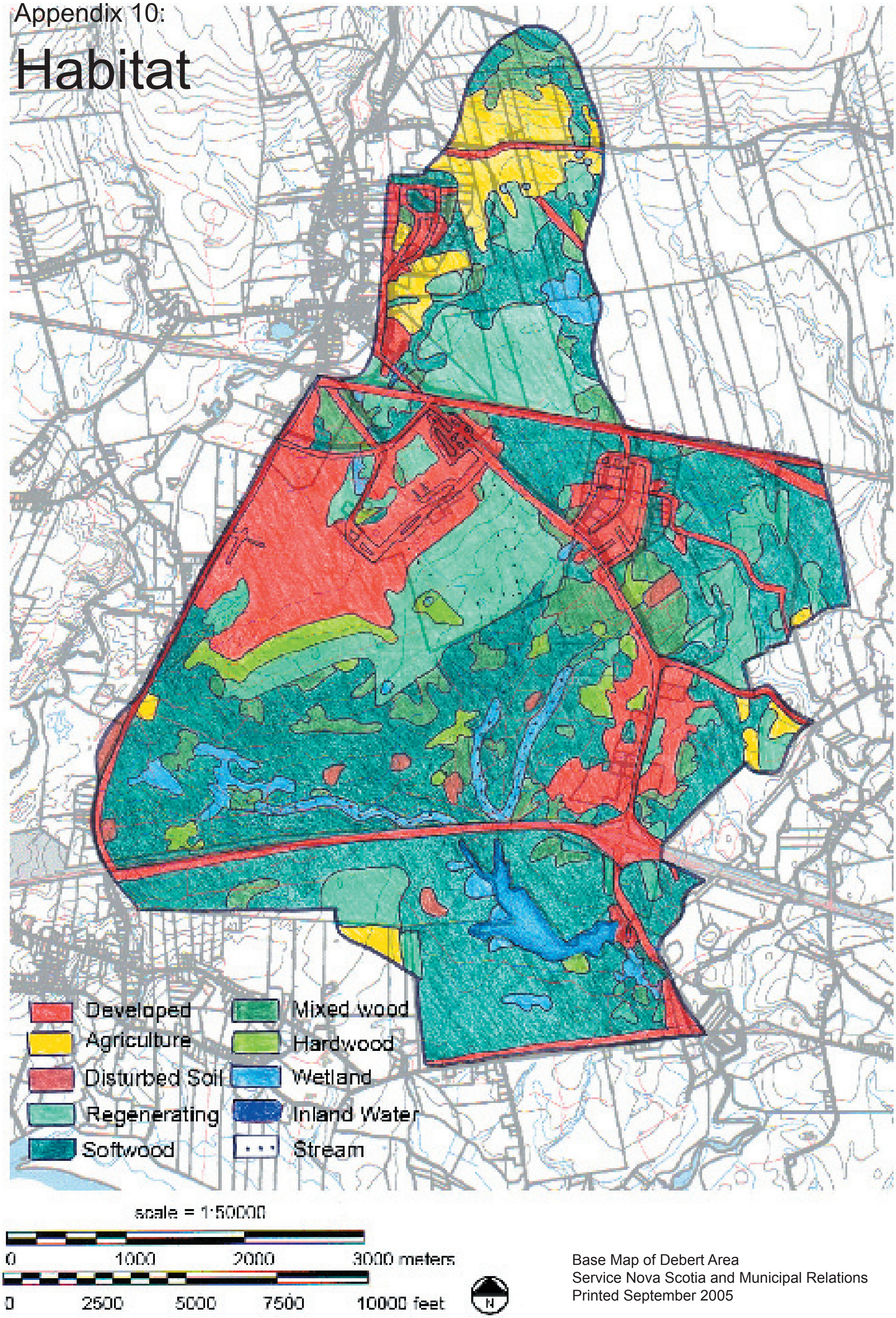
Slope Aspect



Base Map of Debert Area
Service Nova Scotia and Municipal Relations
Printed September 2005

Appendix 10:

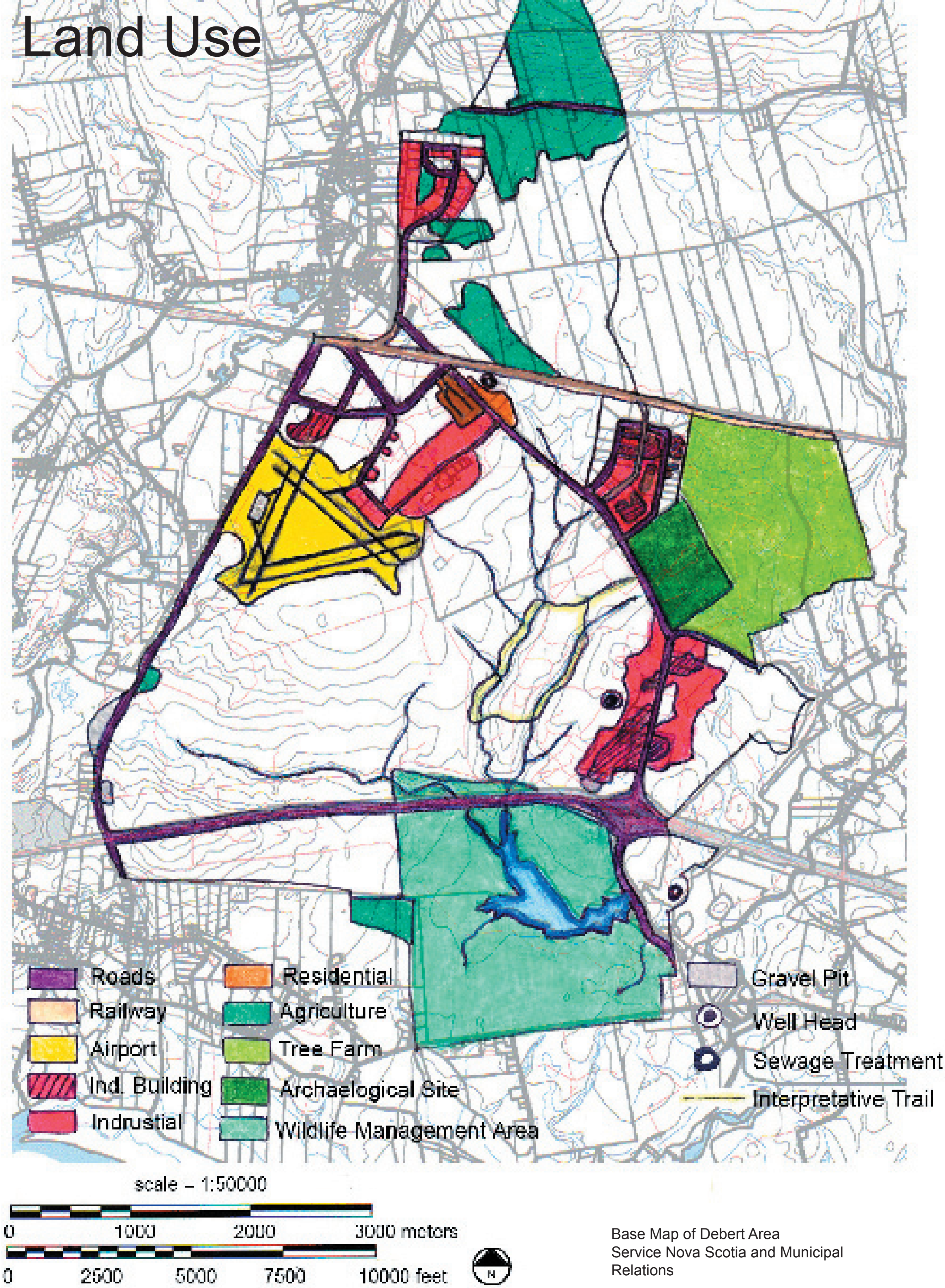
Habitat



Base Map of Debert Area
Service Nova Scotia and Municipal Relations
Printed September 2005

Appendix 11:

Land Use



Base Map of Debert Area
Service Nova Scotia and Municipal Relations

Appendices

Appendix A - Archaeology

The Debert site was discovered in 1948 by E.S. Eaton and his wife, when an abundance of blueberries attracted them to the old base. Wind “exposed some of the artifacts on the surface of what was then an old parking lot used at the base. Much of what was to become the Debert Palaeo-Indian site had been destroyed during the construction of a parking lot, and what remained was seriously compromised by its use as a mortar range (Nova Scotia Museum, 1996). The significance of the site was recognized in 1955 but archaeological testing did not take place until 1962. Full-scale excavation took place in 1963 and 1964, identifying and recovering 4,500 artifacts covering 22 acres of land (Nova Scotia Museum, 1996). In 1989 the presence of two new Palaeo-Indian sites was confirmed in the tree-breeding centre and 700 artifacts were collected.

APPENDIX B Extended History of Debert

The area surrounding Debert, Nova Scotia gained prominence as an air base and staging location for troops and materials during the Second World War (McGhie, et al., 2005). Canadian Forces Station (CFS) Debert was completed in late 1940 to accommodate more than 40,000 personnel during their training prior to being sent overseas. The area encompassed thirty square miles, requiring the re-location of existing residential buildings on the base site. In the winter of 1941, the Debert airway was built consisting of three runways each measuring 4,200 feet (1280 m) in length and 500 feet (152m) wide (MacDonald, 2005).

During the Cold War following WWII, some of the remaining military facilities were transformed into communication and emergency government headquarters (McGhie, et al., 2005). Many of these structures still exist on the site and are currently either small industrial centres or are abandoned. The “Diefenbunker” is one of the remaining structures and was designed for protection in case of nuclear attack. Today, the Diefenbunker occasionally houses students of the flight school and the cadet training centre based out of the Debert Airport. From the 1950s to 1970s much of the original Camp Debert training area was sold as surplus.

A brief History of Debert as described by Mr.. Donald Davidson to the Standing Committee on Veterans Affairs Thursday, March 1, 2001

MR.. DONALD DAVIDSON: Mr.. Chairman, ladies and gentlemen, thank you for the invitation to come here this morning. I have written down some notes, mostly from memory. I figure I should read most of it or I will forget half of it.

I lived in Debert all my life. I grew up there and when the war came along I was just a teenager, 15 or 16 years of age. I have been asked to come and give you a brief history, so starting off, my name is Donald Davidson and I would like to speak today on the economic impact the Second World War had on the civilian population. During the 1930’s, the Village of Debert had a population of about 500 to 600 people and was mostly supported by mixed farming and lumbering operations. Many portable sawmills operated on the Debert Mountain with the lumber being hauled by team to the Debert station where it was shipped by rail.

The village was also supported by a permanent lumber mill and factory located near the Debert railway station, employing about 12 men. The village had three stores, a post office, a railway station, two churches and a gospel hall, a barber shop, two room school, a community hall and a blacksmith shop. A daily jitney service was provided for the high school students and the general public running between Oxford Junction and Truro. The jitney was an extra service to the regular passenger trains.

Debert was noted for its gravel beds. A number of gravel pits and a permanent crusher operated by the Department of Highways and the Canadian National Railway shipped gravel by train during the 1930’s.

In 1939, at the start of the Second World War, Debert was really put on the map. Commencing with the clearing of the site for the Debert airport and the building of the Debert military camp, during the next few years the population of Debert exploded. Approximately 6,000 civilians were employed during the construction of the airport and the building of the military camp. During the construction period, many of the civilian employees commuted daily and came from within a radius of 35 miles to 40 miles. A large number relocated to the Debert area from all over Nova Scotia, Prince Edward Island, and some from New Brunswick and Newfoundland.

Many homes in Debert and area took in boarders. Cabins sprung up throughout the community, all creating extra income for the local people. Also a number of new homes were built during the war. At this time, the trucking business was booming with much demand for gravel trucks for road building, service trucks were hired and many lumber trucks were engaged for hauling the lumber from the railway station to the building sites. By the way, the lumber came in pretty well by the trainload and it was hauled to the various areas in the camp.

Troops started moving to the area as the construction proceeded and with the completion of the camp and the RCAF station, the military population of service personnel was approximately 22,000 plus the civilian employees. The Village of Debert would never be the same again. This large increase in population created a huge demand on the existing services provided in the village and a need for many more.

The demand for more services created an opportunity in the business sector of the local economy and with the construction of about 10 restaurants; two drug stores with lunch counters; two meat markets; another grocery store was added; a hotel was built, and it was noted on the hotel, with telephones and running water; two barber shops; a telephone office; a bank; there were three taxi businesses, each operating several cars; also a laundry service; a bus line service to Truro; and a charter service. The railway station was greatly enlarged with many new offices including a ticket office, freight office, express office, also a baggage and a telegraph office.

The new business establishments and services created a major demand on the labour force and provided much new employment in the area. There were also many service centres throughout the military camp such as the Salvation Army's Sally Ann, the YMCA, a Hostess House, et cetera. A large military hospital was also located in the camp. The military camp was a training ground and a holding area for the troops going overseas. Daily route marches were a common site in the village, often breaking in front of the store for refreshments. A Coca-Cola sold for 6 cents a bottle in those days.

Civilian guards were posted around the clock at the railway bridge for security. Also safety guards were posted at the railway crossing by the station. Traffic was extremely heavy on both the railroad and the highways. Six regular passenger trains stopped daily at the Debert station. Also, a daily shunter train worked the many sidings involved. I might add that our general store was located right across the road from the railway station. We were kept very busy, especially on days when special trains arrived to load troops for overseas. Also many trains were dispatched for Christmas and embarkation leave for the troops.

I remember the Air Force personnel prior to boarding the trains for overseas. The boys would buy all the chocolates and candy bars they could get hold of as they were rationed here and very scarce in England. We were fortunate as we had a large quota which was based on sales during the year in 1941. Nylon stockings were very scarce, also on a quota basis and not available in England, we were told. The Air Force boys were hot after these items to take overseas to the English lassies. The story goes the boys gave only one nylon on their dates.

During the war, many servicemen's families were accommodated in private homes, usually renting a room or two, some even had fixed up their garages, they had them rented.

After the war, the military camp was maintained on a much smaller scale and phased down. The next 50 years, the base provided a source of economic stability for the Village of Debert. The military was closed by the federal government around 1997. Many civilian employees lost their jobs with the closing.

The industrial park. During the late 1970's and with the military being phased down, the Debert Industrial Park was born and has been a success story ever since. Employment at the industrial park is currently running around the 1,000 mark. It may be of interest to note that at a joint council meeting held in Truro in the late 1960's, a Canadian National survey team of the development division reported that the Debert military area, which is now part of the industrial park, was the best site for an industrial park east of Montreal due to its central location, infrastructure and served by the Trans-Canada Highway, the Canadian National Railway and an airport. I might add that this park has much growth potential in the near future. I would say it is a very important area today.

Appendix C: Geology

Approximately 225 million years ago when North America was part of the super continent, Pangaea, the red beds were deposited under arid conditions in a narrow, hill-fringed basin. The early deposits washed down from the South Mountain and the Cobequids. Course sands in the area were later consolidated into a crumbly sandstone (Davis, 1996: Ch. 6). Volcano eruptions in the Fundy region created faults. These faults in the sandstone, shale and basalt created a 5 degree dip toward the Bay of Fundy. Much of this trough has since been filled by the ocean water (Davis, 1996: Ch. 6).

The Wolfville Formation is crudely stratified and shows lateral changes in thickness throughout the Colchester Region with at least 1000 feet of sediment exposed along the Debert River (Davis, 1996: 22-23). Sandstone refers to a sedimentary rock with grains between 1/16 millimetre and 2mm in size. Most sandstone is made up of quartz and small amounts of other minerals such as feldspar, mica, and clay (New York Times Company, 2005). Greywacke is also a fine-grained material composed primarily of quartz, feldspar, and clay. Shale is the most abundant of all sedimentary rocks and is composed mainly of soft clay minerals and may include quartz, calcareous and organic material (University of Kentucky, 2000).

Outwash Sand and Gravel - Outwash normally consists of a rocky or sandy material carried, sorted, and deposited by meltwater that flowed from the glaciers (Geographic, 2002). The outwash sand and gravel deposits are found in the north westerly section of DEIP near the Debert river. The areas covered with the outwash sand and gravel are very well drained.

Stream Alluvium - The Stream Alluvium is located on the floodplains of the rivers feeding McElmon's Pond. In general, the material consists of clay, silt, sand, and gravel deposited by the stream at periods of high flow when the rivers overflow their normal channels. Deposits along the North River and the Debert River are commonly the coarsest found in the area. They consist mainly of material about 2-6 inches in diameter (Davis, 1996: 30).

Soil - Soil is a natural aggregate of mineral grains with or without organic constituents, which can be separated by gentle mechanical means such as agitation by water (Davis, 1996: 10). Soil can range in thickness from a few millimeters to a few meters.

- The Woodville is light in texture and consists of sandy loam soil developed on red sandy loam till (Davis, 1996; 33). The well drained Woodville is one of the most important agricultural upland soils in the county (Davis, 1996: 33). Sandy loam soil contains a high percentage of sand and silt and a small percentage of clay (Agriculture and Agri-Food Canada, 1997).
- The Hebert soil is a well developed podzol developed from gravel and cobblestone parent material deposited by a water source (Davis, 1996: 46). It is present as a result of a Fluviatile deposit along the Debert river and may be most prominent in the kames (Davis, 1996: 46).
- The Poorly Drained associates are located near McElmon's pond. Found mainly under forest vegetation, these areas are referred to as poorly drained because of flat topography and few well defined drainage channels (Davis, 1996: 33). The profile possesses a thick leached horizon with a textural range from loamy sand to sandy loam. An iron pan layer is usually present at a depth of twelve inches which is soft when wet but becomes cemented when soil dries out (Davis, 1996: 33).

Hydrogeology - Hydrogeology is the study of the interrelationships between the layers of soil, surficial material, and bedrock and the movement of water, especially groundwater, throughout these regions (Groundwater Foundation, 2004). The clean, well-sorted sediments of the Wolfville formation provide the most productive water storage and transmitting properties (hydraulic conductivity) of any bedrock type in the county (Davis, 1996: 64). This is due to the weakly cemented and loosely consolidated sandstone and conglomerate that allows water to move through the intergranular pore spaces with ease (Davis, 1996: 64). Water also flows through bedding plane fractures and joint systems in the bedrock (Davis, 1996: 64). Gravel packed wells in the Wolfville Formation yield up to approximately one million gallons of water per day from one of the large freshwater underground reservoirs in the county (Davis, 1996: 1&64).

Appendix D: Climate

The January mean daily temperature is -6.6°C, compared to -8°C in northern Nova Scotia, and -5°C in southern Nova Scotia (Davis, 1996: Ch. 6). Mean daily temperatures rise above freezing in late April and by July the mean daily temperature is 18.6°C (Davis, 1996: Ch. 6). Mean daily temperatures fall below freezing during the first week of December (Environment Canada, 1985). The daily average temperature for Debert from 1971-2000 was 6.1°C (Environment Canada, 1985). An average of 155.4 cm of snowfall is expected throughout the winter months. The prevailing wind direction in DEIP is from the west throughout the year. Wind speeds average 13-16 km/hr throughout the year. Peak wind speeds occur in February. June, July and August have the most hours bright sunshine, while November and December the least. The probability of either rain or snow during the winter is roughly equal.

Appendix E: Habitat

Wildlife within the park include deer, hare, hawks, owls, mice, frogs, snakes, and several bird species. (Davis, 1996: vol.1, H5.1)

URBAN/DEVELOPED LAND
This includes industrial, residential, and other elements that relate to these built up features, such as streets, railroads, airports, sidewalks, buildings, etc. Most of this development has occurred along the major road corridors, which have divided some of the other habitats.

AGRICULTURE
This includes hay fields, pastures, crops, orchards, and areas used for blueberry production. Most of the agricultural land is located at the north end of the site, but there are smaller areas located along the southern, western, and eastern edges of the site. This type of land could contribute chemicals or other additives to the water runoff.

DISTURBED SOIL
There are a few pockets across the site where there is less than 25% tree cover. This may have resulted for several reasons, including disturbance from human activity, erosion, gravel pits, or poor soil quality. This type of habitat does not provide extensive wildlife habitat however it does provide open space for forage.

REGENERATION
This includes areas that have been clear-cut, abandoned plantations or fields, areas containing mostly brush, or alders. Opportunistic pioneer species such as shrubs species, groundcover, or successional hardwoods would be found in these areas. If left undisturbed, these areas will eventually mature into old growth forest. This type of habitat provides habitat for bird species and foraging areas for deer, as well as small mammals such as mice. The range of species found on a regenerating site is dependent on the age of the regeneration and the characteristic vegetation (Davis, vol.1, H5.2, H6).

SOFTWOOD FOREST
Softwood forests cover most of the site and are either old pine plantations or a natural softwood stands. The pine plantations contain mostly red pine. The three types of native softwoods most likely to occur in this area are Red Spruce, Eastern Hemlock, and White Pine. (Davis, 1996: vol.2, 620) Forest stands might also contain species such as white spruce and fir in the early succession forest. Spruce, hemlock, balsam fir, and pine would be found in the old growth forests. The softwood forests in wet areas could include species such as black spruce and larch. Most softwood forests soils are acidic in nature resulting from the decomposition of needles. This results in low small-mammal species diversity. Animals such as red squirrels, voles, birds, hare, and deer can be found visiting this type of habitat. Old growth softwood stands have relatively fertile soils resulting from the decomposition of organic matter. These habitats support increased insect species diversity. The older trees also provide habitat for woodpeckers and other birds that use these trees as nesting sites. (Davis, 1996: vol.1, H6.2)

MIXED WOOD FOREST
This type of forest covers a small percentage of the site. These are early to mid successional forests. This forest could include plant species such as spruce, fir, pine, maple, and birch. This type of habitat does not support a large diversity of animal species. Species that could be found here include small birds, mice, shrews, and red squirrel. (Davis, 1996: vol.1, H6.3)

HARDWOOD FOREST
There are very few hardwood stands within the park. Some of the hardwood forests are currently in a state of regeneration. There is a late successional or climax hardwood forest which is noted as “Site of Ecological Significance” in the Nova Scotia Museum Site Files and could occur in the floodplains of the park. This site could contain species such as sugar maple, American elm, Alleghenian floral ground vegetation, hazelnut, hophornbeam, and herbs such as bloodroot, rough goldenrod, nodding trillium, dog’s-tooth violet, and several other species. Wildlife that use this habitat include amphibians, insects, and birds. (Davis, 1996: vol.1, H6.1)

WETLANDS
There is a range of wetland types and sizes within the study area. They include swamps, marshes and treed bogs. Further investigation is required to determine which wetland habitats are present within the park. Wetlands are important because they support a wide variety of animal and plant species including endangered species. They also restore water to the aquifer and cleanse runoff water before it enters McElmon’s Pond.

Swamps most likely occur within the park and contain a wide variety of plant and animal species. Plant species in these areas could include Balsam Fir, Black Spruce, Red Maple, Larch, several types of herbs and shrubs, and mosses. Swamps also support abundant wildlife including aquatic animals and bird species such as Swamp Sparrow, Swallows, Common Yellowthroat, and warblers in areas with older trees. Small mammals can be found in some swamps. (Davis, 1996: vol.1, H4.3)

Freshwater Marshes are areas periodically submerged by water. They support a wide diversity of wildlife, and are very important to the hydrological systems of the area. Plants such as cattails and bulrushes, White Water Lily, Sweet Flag, and other water loving plants can be found in this type of habitat. Many insects, amphibians, and mollusks can also be found here. Several species of waterfowl use freshwater marshes as breeding grounds and areas of protection. Mammals such as otter, beaver, and muskrat occur here as well. (Davis, 1996: vol.1, H4.4)

Treed bogs could contain Black Spruce, Larch, Blueberry, moss, plants that eat insects, and other plants within the plant association Sphagnum Cranberry. Bogs do not support a wide variety of animal life. Aquatic insects and other insects occur along the bog edge, butterflies, moths, and mosquitoes can be found here as well. Frogs, salamanders, moose, and bear are other animals that could be found in the bog or along the edges. Several species of birds can be found in bog areas such as the Rusty Blackbird, Black Ducks, and Yellowthroat. The Blanding's Turtle is a rare species that live in bog habitat (Davis, 1996: vol. 1, H4.1).

STREAMS
Streams will be defined as including: open water habitat, the stream bed, and the water's edge habitat. Streams supply the water that fill McElmon's pond and are susceptible to impacts from surface water runoff.

Open water - Phytoplankton is usually the only plant species found in open water. Fish in Nova Scotia streams include Trout, Salmon, and Perch. Birds such as black ducks and mergansers, among others can be found here as well. Otters, moles, muskrats, beavers, and other mammals can be found in open water habitat as well. (Davis, 1996: vol.1, H3.1)

Stream Bed - Stream bed vegetation is usually absent except in fast-moving streams where algae, mosses, riverweed, and pondweed can be found adhered to rock surfaces and crevices. The animal species found on a stream bed depends on stream flow velocity. Many aquatic insects in their nymph or larvae stage can be found on stream beds as well. Other species of protozoa, mussels, worms, nematodes, newts, tadpoles, and sponges are often found here as well. Many of these stream-bed creatures are important because they consume organic detritus and provide food for other animals, such as fish. (Davis, 1996: vol.1, H3.2)

Water's Edge – This habitat is important in reducing pollution from runoff entering the stream as well as preventing stream bank erosion. Mosses, rushes, and sedges are often found here as well as plant species found in other freshwater habitats. Many insects, amphibians, birds, and small mammals can be found here. The insect larvae provide food for many of the fish species in the area. The edge also provides a place for breeding Wood Turtles. (Davis, 1996: vol.1, H3.5)

INLAND WATER
Inland water habitat includes ponds and lakes, including McElmon's Pond, and the habitats within. The habitat of McElmon's Pond supports the American Wigeon, a rare waterfowl species, and several hundred geese during the fall. (Davis, 1996: vol.2, 620).

Open Water – Open water vegetation includes several phytoplankton species, as well as blue-green algae. Animals that rely on this type of habitat include insects in adult and larval form, amphibians, fish species, Black Duck, Bald Eagles (for feeding), and other birds (Davis, 1996: vol.1, H.3.2)

Bottom – Decomposition of organic matter occurs in inland water bottom habitat and an abundance of biological processes are supported within this habitat. Anaerobic bacteria that break down detritus are most active in this area. There is no vegetation in this type of environment resulting from the lack of light. The bottom also provides habitat for amphibian larvae. Other species found in this area include: bloodworms, small clams, phantom midges, and other bottom dwelling species. (Davis, 1996: vol.1, H3.4)

Appendix F: RCGA Environmental Golf Guidelines

ENVIRONMENTAL GUIDELINES FOR GREEN GOLF COURSES:
Interest in the game of golf has risen dramatically in Canada and the golf industry is faced with the challenge of providing facilities to all participants while safeguarding our natural resources. The Royal Canadian Golf Association recognizes the need for a partnership between golfers, the general public, designers, developers, managers and superintendents of golf courses in a shared responsibility to conserve and protect the environment.

Statement of Intent
The Royal Canadian Golf Association is committed to taking every practical precaution towards ensuring that products and techniques used in the development and maintenance of golf courses present the lowest possible risk to their employees, golfers, the public or the environment.

Strategy
It is the goal of the Royal Canadian Golf Association to develop programs to communicate and promote practices to ensure that an equilibrium is sustained between maintaining quality playing conditions and a healthy environment. The Association acknowledges the need to blend

a certain level of government regulation with self-initiated action plans to achieve and maintain this balance. We also recognize that all regulations and plans should be based on scientifically supported data and to this end will continue to support turfgrass research.

We realize that everyone using, constructing or maintaining a golf course has a responsibility to ensure this balance is kept. Discussions with national, provincial and regional stakeholders have resulted in three sets of recommended guidelines for golfers, golf course managers, superintendents, and golf course designers and developers, based upon the following principles.

Guiding Principles

The Royal Canadian Golf Association and its member clubs subscribe to the following principles:

- Ensure that all operations present the lowest possible risk to employees, golfers, the public and the environment.
- Comply with all legal requirements affecting operations and products.
- Develop and implement self-initiated action plans to conserve and enhance natural resources.
- Communicate with both the golfing and non-golfing public on issues concerning golf development or maintenance and the environment.
- Be responsive and sensitive to community concerns.
- Communicate with and assist governments to encourage fair and attainable standards based on scientifically supported data.

GUIDELINES FOR GOLFERS

The game of golf is enhanced by, and indeed, is dependent upon the natural surroundings. The quality of golf and life is enhanced by the preservation and conservation of our natural resources. The Royal Canadian Golf Association and the Canadian golf industry have developed a code of practice to ensure that the golf course continues to afford us the same natural experience for future generations. You can help to continue to provide the highest quality golfing experience by considering the following guidelines.

- Enjoy the natural environment and help to enhance and protect it by respecting all local regulations.
- Avoid activities which endanger plant, fish and wildlife populations or can potentially threaten their habitat.
- Assist in our conservation efforts by the efficient use of all water and energy resources.
- Work with the management and directorship of your golf club to develop and implement environmental enhancement programs.
- Golf was meant to be played in a natural environment. A natural environment is by definition imperfect. Support your club's efforts to balance course conditioning with environmental enhancement and conservation strategies.

GUIDELINES FOR DESIGNERS AND DEVELOPERS

Golf course development employing effective principles of environmental design can complement our natural environment. A golf course can enhance urban development and heal scarred landscapes such as former quarry sites. A golf development can also be an attractive and effective barrier between agricultural and urban lands. A dense, established turf provides one of the most effective filters for water impurities in nature and the abundant forest edge along fairways can be enhanced to provide useful wild life habitats.
The Royal Canadian Golf Association and the Canadian golf industry recognize that vigilance is required to develop and maintain the highest possible level of environmentally sensitive golf. To help achieve the goals of preserving our natural heritage and conserving our natural resources we encourage you to adhere to the following guidelines.

1. Site Selection

- Assess the physical and economic viability of a golf course on a particular site.
- Endeavor to select sites outside of agricultural land use zones where possible. Should agricultural land be the only option, follow local and provincial agricultural guidelines when selecting development sites.
- Respect unique wetland qualities and other sensitive natural areas, avoid the disturbance of these areas and incorporate these features into the design.
- Consider present or potential aggregate resources when determining location.
- Ensure the project conforms with all provincial and local land use plans and zoning bylaws.
- Ensure adequate water supply is available for both potable and irrigation needs of the golf facility and neighboring properties.
- Be available to meet with the public and answer their concerns regarding the development site.

2. Design Considerations

- Select plant species that are best suited to the local climate and require the minimum of inputs.
- Design the irrigation to efficiently use water only where and when needed.
- Investigate the feasibility of alternative or supplemental sources of irrigation water, e.g., on-site storage reservoirs for storm water run-off collection or effluent.On-

site retention of storm water run-off should be considered on soils with low infiltration rates.

- Maintain a vegetative buffer zone of at least ten metres adjacent to all water courses to assist in filtering any nutrients or pesticides from storm water run-off, and to moderate water temperatures.
- Retain as much natural cover as possible and enhance vegetation through supplementary planting of trees, shrubs and grasses, especially along fairways, to provide wildlife habitat and along water courses supporting a fish habitat.
- Incorporate as many natural features and areas in the design as possible to minimize disturbance of the existing ecology.
- Consider future maintenance requirements of all golf course design features. Low-maintenance features that require less intensive management are preferred.

3. Construction

- Protect and/or re-establish native groundcover and understorey species during and after construction.
- Schedule construction to protect soils by minimizing the time ground is left without cover. Protect soils during construction through the use of mulching materials, hydro-seeding or sod.
- Monitor groundwater quality before and after construction.
- Avoid construction near water courses, especially during fish spawning season. However, if construction is necessary, ensure adequate mitigative measures are in place to protect water quality, fisheries and streamside habitats. Contact the local regulatory agencies for guidance.

GUIDELINES FOR DIRECTORS, MANAGERS AND SUPERINTENDENTS

A properly maintained golf course with established turfgrass cover and mature tree stands provides much-needed greenspace relief from urban development. The filtering ability of dense, healthy turf and its thatch layer can be utilized to ensure pollutant s do not reach groundwater or enter rivers and streams. A golf course can be an attractive and effective transition between agricultural and urban landscapes and provides for the preservation or creation of areas useful to wildlife. When managed in an environmentally conscious manner, golf courses can enhance the quality of life within a neighborhood.

The Royal Canadian Golf Association and the Canadian golf industry are striving to preserve and enhance the natural resources with which we are entrusted. To help us achieve these goals we encourage you to adopt the principles outlined in the following guidelines.

1. Planning and Policies

- Commit to the enhancement of your club by incorporating Environmentally Responsible Golf principles in all aspects of planning and policy-making.
- Prepare an environmental policy statement and action plan for your club. Establish an environmental committee to develop programs and foster staff and member support.
- Establish a monitoring and evaluation process to assess the club's progress.

2. Alternative Pest Controls - Endeavour to employ Integrated Pest Management (IPM) techniques to minimize pest problems. This includes:

- Reliable and accurate pest identification
- Monitoring pest populations and related damage to ensure treatments will only be applied when necessary and when they will be most effective.
- Establishment of injury levels that can be tolerated before control measures are implemented.
- Use of combinations of the following treatment methods to control pests in a manner that achieves a high level of effectiveness while minimizing environmental impact.
- *Biological Controls* - release of predatory/parasitic insects, conservation of natural enemies.
- *Cultural Controls* - use of resistant cultivars, encouragement of diverse plant communities, optimal management of irrigation, aeration and other management techniques to maximize plant vigor and reduce susceptibility to pests.
- *Physical Control*s - use of sanitation, pruning, protective weed barriers, etc.
- *Mechanical Controls* - rototilling areas repeatedly to kill perennial weeds during renovations, etc.
- *Chemical Controls* - use of products that are target specific, have short residual lives and have low environmental impacts.
- Evaluation of turf management and pest treatment effectiveness to document program successes and determine if changes are necessary.

3. Fertilizer and Pesticide Use

- Use only products registered for use in Canada for only their specified and approved function.
- Store all fertilizer and pesticides in an area conforming to all provincial and local regulations that include but are not necessarily limited to:
    - a locked area clearly marked to indicate chemical storage;
    - an operating ventilation fan discharging exhaust to

the outside clear of windows of other buildings or public areas;
- a solid floor impermeable to liquid and surrounded by curbing to contain any spilled or leaked material.
- All mixing and loading of pesticides should be performed in accordance with all provincial regulations and, at a minimum, on a concrete rinse pad capable of containing and recovering spillage or overflow.
- Dispose of all pesticide containers and pesticide wastes in accordance with provincial regulations.
- All handling and spraying of pesticides to be performed under the strict supervision of trained and licensed pesticide applicators.
- Pesticides to be applied only when wind conditions ensure a minimum of drift and when there are as few golfers and general public present as possible.
- Protect water quality by maintaining a buffer zone between all water bodies and areas of fertilizer and pesticide application. When applying pesticides near water, use low-pressure spray nozzles to further reduce chance of drift.
- Communicate with members of the golfing and non-golfing community the nature of your application. This may be done by posting signs at the pro shop, first and 10th tees and the entrance to the golf club indicating the date of the application, the product to be used and a contact person and phone number.
- Apply only the amount necessary to control the target pest and only apply when pest population warrants treatment, as determined by pest monitoring.
- Apply fertilizer only in quantities that can be utilized by the plant to minimize leaching potential.
- Reeds and sedges are excellent filters and useful wildlife habitats. However if algae is of concern in ponds, substitute cultural measures such as aerating the pond instead of the use of aquatic herbicides.

4. Wildlife and Wildlife Habitats

- Allow native vegetation to grow to provide habitat for indigenous species whenever possible.
- Replace native groundcover or shrubs that may be removed during any construction or renovation projects involving non-golf areas. Indigenous plant species are preferred.
- Avoid disturbance of riverbanks whenever possible. If bank impacts cannot be avoided, employ mitigating measures against siltation. Check with provincial and local regulatory agencies for permit requirements.
- Participate in programs such as the Audubon Co-operative Sanctuary Program for Golf Courses which provide information and environmental expertise to conserve and enhance fish and wildlife habitats on your property

5. Water Use

- Irrigate only the areas requiring water and limit the amount applied to the current requirements of the plant.
-
- Investigate the feasibility of alternative or supplemental irrigation water sources such as effluent or on-site storage reservoirs for storm water run-off collection.

6. Clubhouse Operations

- Develop and implement a waste management program to reduce, re-use and recycle waste where possible
- Develop and implement a program of water and energy conservation.
- Ensure drainage from asphalt or concrete areas around buildings filters through vegetation before reaching cool water rivers and streams to avoid disruption to aquatic habitat.

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