Mark-Lyn Construction Limited
Environmental Assessment
Registration Report

Centennial Year Photo of Baltzer Bog

April 2004
Terry W. Hennigar Water Consulting

Mark-Lyn EA Registration
Coldbrook, Nova Scotia

Aerial Photo, Contours & PID Lines

Legend

Small Buildings
Gravel Pit
PID Lines
5 Meter Contours
31.4 Spot Elevations
Railway (Abandoned)
7725 Control Survey Monument
MW 1 Monitoring Well
X 1 Surface Water Monitoring Location 2001-2003
X 2 Proposed Surface Water Monitoring Location
Past Active Area
Proposed Active Area

Aerial Photography Taken
August 2, 2002

Date: April 2004
Scale: As Shown

Webster Engineering Consulting

Figure 02

PROJECT NO. NSD 99-IAW-042 TOPSOIL
PROJECT NO. NSD 2001-019546 AGGREGATE

REPORT TO

MARK-LYN CONSTRUCTION LIMITED

ON

SOUTH BISHOP ROAD SOIL/PEAT AND AGGREGATE OPERATIONS ENVIRONMENTAL ASSESSMENT REGISTRATION

COLDBROOK
KINGS COUNTY
NOVA SCOTIA

TERRY W. HENNIGAR WATER CONSULTING

IN ASSOCIATION WITH

WEBSTER ENGINEERING CONSULTING, *SOILS*
W. GEORGE ALLISTON, *FAUNA*
MARBICON INC., BOTANICAL
OCEAN VALLEY AQUATICS, *FISH HABITAT*
HELEN SHELDON, *ARCHAEOLOGY*

APRIL 2004

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EXECUTIVE SUMMARY

Mark-Lyn Construction limited proposes to expand its previous soil/peat extraction footprint in order to continue operation activities at its site on the South Bishop Road in Coldbrook, Kings County, Nova Scotia. Mark-Lyn Construction is also planning to expand its aggregate extraction operation to another nearby site, with access off Lovett Road as part of its soil mixing and production business. The proposal will allow continued soil/peat and aggregate production, stockpiling, screening, and trucking product from the existing sites and the new nearby site. Continued operation of soil/peat and aggregate production at the current sites is limited by the supply of soil/peat and access to suitable aggregate for mixing. Expansion of the footprints of the sites and the proposed activities will take place over the next several decades involving approximately an additional 100 Acres (40ha) of land immediately adjacent to, and nearby, the existing operation.

The current and expected production rate is 25,000 cubic yards (yd^3) of peat per year, which equals an advancement rate of approximately 2.5 acres per year. The current and expected production rate is 25,000 cubic yards (yd^3) of aggregate per year, which equals an advancement rate of approximately 1.5 acres per year. The operating schedule will be based on 10 hours per day, 6 days per week, excluding Sundays, during the growing season from May to October, weather permitting. This operating schedule is consistent with the current schedule that has been used over the past three years.

Proposed project activities will be consistent with previous extraction operations approved by the Nova Scotia Department of the Environment and Labour (NSDEL) and in accordance with the Nova Scotia Pit and Quarry Guidelines (NSDEL 1999). Aggregate production of common fill, silt, and sand will be carried out on the site with access from South Bishop Road for the next several years after which access will be from Lovett Road. Peat production will be carried out on the portion of the site with access from South Bishop Road. Various grades of soil (landscaping, garden, and potting) will be produced on another site and stockpiled until they are sold and/or transported to local markets via tandem trucks. The total market for soil produced at this site is within the province of Nova Scotia. No additional facilities are needed on site to accommodate the proposed expansion.

Mark-Lyn Construction Limited is required to register this project as a Class I undertaking pursuant to the Nova Scotia Environment Act and Environmental Assessment Regulations. Other relevant provincial regulations include the Activities Designation regulations, which requires an industrial Approval from the NSDEL for the aggregate removal and soil removal activities. Provincial guidelines to be adhered to include the Nova Scotia pit and Quarry Guidelines (NSDEL 1996).

This environmental assessment registration evaluates the potential environmental effects of the project and identifies appropriate mitigation and monitoring to minimize these effects. The report focuses on those aspects of the environment of most concern. Components evaluated include:

- Rare and sensitive flora;
- Wildlife species at risk;
- Freshwater fish and fish habitat;
- Hydrogeology and groundwater resources;
- Soils, previous land use, and wetlands;
- Archaeological and heritage resources;
- Air quality;
- Socio-economic environment; and
- Public consultation.

Environmental effects from the soil/peat and aggregate expansion operations will include the loss of terrestrial habitat within the footprint of the soil/peat deposit and the aggregate extraction areas. These areas do not include unique habitat, rare or sensitive species, nor species at risk. The effects of the proposed expansion of the operations are therefore not anticipated to be significant. Assuming the mitigative measures specified in this report are implemented, and the soil and peat extraction operations are operated according to provincial guidelines and approvals, no significant adverse residual environmental or socio-economic effects are likely to occur as a result of the proposed undertaking.

1.0 INTRODUCTION

Mark-Lyn Construction Limited (Mark-Lyn, the proponent) proposes to expand its previous soil/peat and aggregate extraction operations at South Bishop Road, Coldbrook, Kings County, Nova Scotia. The general location of the site in the Annapolis-Cornwallis Valley is shown in Figure 01. The proposed expansion of the soil/peat extraction operation is shown as area A1 in Figure 02. In addition Mark-Lyn proposes to expand the aggregate extraction operations at two other sites, areas A2 and A3 as shown on Figure 02. The topography, cultural features, drainage patterns, and property boundaries of the areas in and around the sites are also shown on Figure 02.

Continuation of the soil/peat and aggregate extraction operations require an expansion of the previous approved facility footprints which were limited to 10 acres (4 hectares) for each operation. The new extraction operations require approval(s) as an undertaking greater than 10 acres (4 ha). The materials to be produced at the sites include soil/peat and sand/silt which are screened and mixed in varying proportions for use as soils for landscaping, gardening, and potting of new plants. The entire market for these products is within the province of Nova Scotia, mainly in the Halifax Regional Municipality, the South Shore areas, and in the Valley.

These soil/peat and aggregate extraction operations are scheduled to take place over the next ten to twenty years depending on the market demand. Soil and peat resources over an additional 50 acres (20ha) of land, area A1 in Figure 02, are to be extracted adjacent to the previous permitted operation. The source of soil/peat is from a previous property used for agricultural purposes during the 1960's, 1970's and 1980's. Drainage ditches were constructed in these peat deposits during the late 1960's and/or early 1970's and the area was cultivated for the purpose of growing various vegetable crops, i.e. mainly carrots. The proposed expanded aggregate extraction area is North of the A1 and is shown as area A2 on Figure 02. The new proposed aggregate extraction operation is planned for an area of approximately 60 acres (25ha), and is shown as area A3 on Figure 02. Area A3 has been used by 3048483 Nova Scotia Limited as a source of aggregate for the past number of years by Lawson Bennett Trucking Limited.

This project must be registered for environmental assessment under the Environmental Assessment Regulations of the Nova Scotia Environment Act as a Class I Undertaking. This report fulfills the primary requirement for the project registration under provincial environmental legislation.

Mark-Lyn EIA Registration Application
Coldbrook, Nova Scotia

Site Location Mapping

Date: February 2004

Scale: 1:50,000

Webster Engineering Consulting

Figure

01

2.0 REGISTRATION INFORMATION

Name of the Undertaking:	Mark-Lyn Proposed Soil/Peat Extraction Expansion & Aggregate Extraction Operation
Location of the Undertaking:	South Bishop Road & Lovett Road, Coldbrook, Kings County, NS
Name of the proponent:	Mark-Lyn Construction Limited
Postal Address:	1820 Gerald Drive Coldbrook NS B4R 1A3
Tel.:	902 679 2693
Fax.:	902 679 6453

Company President, Chief Executive Officer and/or Environmental Assessment Contact

Name:	Peter Thomas
Official Title:	President
Address:	As above
Tel. :	As above
Fax. :	As above

Environmental Consultant Contact:

Name:	Terry W. Hennigar, P.Eng.
Title:	Principal Engineer
Address:	59 Birch Drive RR 2 Wolfville NS B4P 2R2
Tel.:	902 542 3003
Fax.:	902 542 1100

May 05, 2004

Signature of President,
Mark-Lyn Construction Limited

Date:

3.0 NATURE OF THE UNDERTAKING

3.1 Reason for the undertaking

The purpose for the project is for Mark-Lyn Construction Limited to extend the life of its previous soil/peat extraction operations at South Bishop Road, and to expand another aggregate extraction operation off Lovett Road, Coldbrook. The soil/peat and aggregate extraction undertakings have been operating under approvals from the Nova Scotia Department of the Environment and Labour (NSDEL) since 1999. Soil/peat removal has been carried out under Approval issued on November 19, 1999, as Approval Number 99-IAW-042, and amended on October 01, 2001. Aggregate removal has been carried out under Industrial Approval Number 2001-019546 issued on June 21, 2001 on the Mark-Lyn property. These two properties are shown as areas A1 and A2 on Figure 02. Copies of the NSDEL Approvals are included in Appendix A. The proposed expansion for A1 and A2 is within parcels of land owned by Mark-Lyn Construction Limited.

The proposed expansion to area A3 is on land owned by 3048483 Nova Scotia Limited. A purchase/lease agreement between Mark-Lyn and Mr. Dennis Ells, President of 3048483 Nova Scotia Limited is being negotiated in anticipation of approval of this project. Aggregate extraction on the current Ells property, area A3, is currently being carried out under a permit reportedly issued to Lawson Bennett, by the NSDEL.

The proponent is required to register this project as a Class I Undertaking Pursuant to the Nova Scotia Environment act and Environmental Assessment Regulations. Other relevant provincial regulations include the Activities Designation Regulations, which requires an Industrial Approval from the NSDEL for the Aggregate removal. The soil/peat removal undertaking also requires an Industrial Approval from the NSDEL. Provincial guidelines to be adhered to include the Nova Scotia Pit and Quarry Guidelines (NSDEL 1996). Relevant federal legislation includes the Fisheries Act and the Migratory Birds Convention Act.

Mark-Lyn Construction Limited anticipates the source materials to be of similar quality to adjacent materials currently removed at the existing sites. These materials are primarily glacial sand, and silt for mixing with the soil and peat to make useful soil products. The lands to the north and to the east are underlain by Quaternary deposits of silt, sand and gravel. The land to the south is underlain by similar deposits of silt, sand and gravel currently being extracted by another company in the aggregate business.

3.2 Project Alternatives

Other methods for carrying out the undertaking may include different methods of extraction of the resources and alternative facility locations. The current method of extraction at the Bishop Road site is use of a track mounted excavator. Alternative methods for extraction of the peat and soil materials (i.e., mechanical techniques) are not feasible or practical in this case due to the nature and characteristics of the soil/peat deposits, which are relatively shallow in nature. Larger scale equipment cannot be justified because of the limited volume of material available and the demand for the finished products in the local markets. The current method of extraction of aggregate at the Lovett Road site includes the use of an excavator and trucking using tandem size dump trucks.

A strong demand in the marketplace exists for good top-soil-grade products for gardening and landscaping purposes throughout Nova Scotia. Sources of topsoil include: 1. Stripping from agricultural areas, which is not permitted; 2. Composting products from organic wastes, which is unpopular to many of the public; and 3. Mixing soil/peat and aggregate, which is more acceptable to the public.

Alternative facility locations are also not feasible for the type and size of the operation and nature of the soil business. The expansion is occurring in areas that are already exposed to the extraction of both soil/peat and aggregate materials. Expansion of the soil/peat and aggregate extraction operations will not require the construction of any new facilities since the existing facilities are sufficient for the current and expanded operations. Relocation of the soil/peat and aggregate extraction operations to another location may likely require development of a new site, construction of new facilities, and would potentially have greater effect on the surrounding biophysical and socio-economic environment. The Mark-Lyn Construction Limited topsoil operation is a well-established business with a recognized high quality product, in Nova Scotia.

4.0 DESCRIPTION OF THE UNDERTAKING

4.1 Project Location And Scope

The Mark-Lyn Construction Limited soil/peat and aggregate operations in Coldbrook are located on the east side of South Bishop Road, immediately south of Highway 101. Access to the site is from Highway #1, and approximately 1 kilometre from the intersection along South Bishop Road. The property lies north of the Cornwallis River in an area on the Valley floor approximately 20 to 25 metres above sea level. The local topography is flat to rolling with hills of glacial sand and gravel deposits that are 10 to 15 metres high.

Mark-Lyn Construction Limited proposes to expand its previous operating footprints to allow for continued soil/peat and aggregate production, stockpiling, and occasional screening of soil/peat (if permitted), prior to trucking to market. Estimated peat reserves at the proposed expansion area are in excess of 400,000 yd^3. Based on the current and anticipated production rate of 25,000 yd^3 per year it will take approximately 16 years to extract the available soil/peat and aggregate resources form the expanded area. The desired approved land area, A1, A2, and A3, will cover a total of approximately 120 acres (50 ha) as shown in Figure 02. The proposed expansion will be 100 percent privately funded.

The project is located in an area zoned as Country Residential, Resource Extraction, and Agricultural between the Cornwallis River, on the east, and South Bishop Road on the west. The north portion of the site is bounded by Highway 101. Lands South of the proposed site are zoned as Resource Extraction. Property Identification numbers and approximate boundaries are shown on Figure 02.

4.2 Project Schedule

Approval of the expanded footprints will allow for operations at the sites to continue for over a decade. Expansion will be initiated immediately following approval from NSDEL. The operating schedule will be based on 10 hours per day, 6 days/week (not including Sundays), and 26 weeks per year, weather permitting, during the growing season from May to October which is consistent with the previous operating schedule.

4.3 Project Activities

4.3.1 Site Development

The soil/peat and aggregate operations of Mark-Lyn Construction Limited at Coldbrook had been in operation November 19, 1999 to September 26, 2003. Site development began with upgrading construction of an access road, cleaning of previously constructed drainage ditches, installation of a security gate, and appropriate signage. Mark-Lyn Construction Limited was previously carrying out a soil mixing operation using composted materials at a site in the Kentville Industrial park. Changes of the land uses permitted within the park were made in early 2000 which prohibited the stockpiling and mixing of composted soils at the site, and forcing Mark-Lyn to acquire another property for the topsoil business.

The soil/peat deposits have been used during the early 1970's as a cultivated soil project for the purpose of growing various vegetable crops. In January 2000 Mark-Lyn was advised of the change of land use in the Kentville Industrial Park. This launched a search for a parcel, or parcels of land nearby which provide sources of soil/peat and aggregate for the growing topsoil market in the Valley, Halifax, and South Shore areas. An area nearby the Kentville office, which is used as a mixing, distribution, or trucking centre was deemed crucial for the survival of the topsoil business.

The first permitted approvals to remove soil/peat and aggregate applied to an area of approximately 9.8 acres in the Southwest quadrant of the soil/peat deposit. Thickness of the peat on the south side was in the order of one metre (three feet), with the thickness increasing in a northerly direction. Small and non-merchantable tree and bush cover from the site was chipped for mulch during the initial clearing of the site. As the working face advanced North and East from the beginning point, local sand was used to form a roadbed for truck access. A 15 cm (6 inch) thick layer of soil/peat was left overlying the sand substrata for future restoration, re-vegetation, and rehabilitation of the site. Rock and stumps screened from the peat were placed in the worked area to achieve grades for future use of the site.

Security of the property was provided by construction of a gate at the entrance to area A1 as shown on Figure 02 which is accessed from South Bishop Road. Signage was also placed at appropriate locations around the perimeter of areas A1 and A2 indicating 'No Trespassing'. These actions were taken to enhance safety to the public and to prevent and deter vandalism and indiscriminate disposal of garbage on the site by unauthorized persons.

4.3.2 Operation

Proposed project activities will be consistent with previous soil/peat and aggregate extraction operations approved by the NSDEL (Approval No. 1999-IAW-042 and Approval No. 2001-019546) and in accordance with the Nova Scotia Pit and Quarry Guidelines (NSDEL 1999).

Production flow for the soil/peat begins with the excavator extracting soil/peat from the source, loaded on a truck and transported to a laydown area where the material is allowed to dry. Laydown areas are established beside the access road at various points across the bottom of the worked area. The soil/peat source is west of Wood Lake and identified as Area 1, as shown on Figure 02. The previous extraction occurred in the Southwest quadrant of the bog. The proposed work is in the Northwest quadrant and will start in June during the peak of the gardening and landscaping season when the market demand for product is under way for the season.

Production flow for the aggregate begins with the excavator extracting silt and fine sand from the Quaternary glacial deposits on the North portion of the property, identified as Area 2, and shown in Figure 02. The silt/sand is loaded onto tandem trucks and transported to the mixing and storage site at the Kentville Industrial Park. During the current operation the sand is transported along an access road from the pit to the North end of South Bishop Road near Highway 101. Under the new proposed plan the sand would be transported from the pit through the soil/peat working area and out to the South Bishop Road along an existing access road currently being used to transport soil/peat. This routing change for trucking silt/sand aggregate will reduce truck traffic along an approximate one-kilometre stretch of the North end of South Bishop Road.

At times screening of the peat will be carried out near the laydown/stockpiling and drying areas near the peat deposits. Mixing of the silt/sand and peat may also be carried out on the south portion of the property during periods prior to expected market demands.

4.3.3 Hydrology of the site

No natural stream channels occur on the properties. Surface runoff at the silt/sand pit area and from the soil/peat extraction area is collected in a ditch system constructed on the site during the late1960's or early 1970's when the site was used for agricultural purposes. The main collector ditch extends in an easterly direction for a distance of approximately 3,800 feet where it discharges to the Cornwallis River. This ditch flows around the East side of a feature named Wood Lake on the topography map and is shown in Figure 02. However, during field investigations in September 2003 no significant depth of water was evident in this feature identified on maps as a lake.

Out flow from the site through the main ditch was previously monitored for total suspended sediment (TSS) and pH as required in the previous Approvals. Outflow in the ditch from the new expanded working area will be monitored and sampled according to the new Approvals to ensure total suspended solids do not exceed the final effluent discharge limits as indicted in the Approval permit. In the unlikely event that outflows exceed final effluent discharge limits as determined through monitoring, action will be taken to correct the situation. Contingency measures may include pumping of sediment laden water to a settling pond(s) or to a vegetated area (away from water courses) or other settling ponds for additional filtration and/or use of additional filtration devices or structures. The past and proposed future surface water monitoring locations are shown as X1 and X2 on Figure 02.

Surface drainage from the peat extraction area is entirely by way of the ditch network constructed over 30 years ago. The flat topography in the area, and the low gradient of the ditch network has resulted in very low water flow velocities. These low gradients and long distance conditions create ideal opportunities for settlement of sediment along the course of the ditch. This is evident in the high maintenance (cleaning) required to keep the ditches open to allow flow from the site. From this experience it is apparent that the ditch has been serving as a settlement area for total suspended solids.

The absence of natural streams on the site is a reflection of the high natural infiltration capacities of the underlying soils and the flat topography. As seen in the discussions on soils types and Quaternary geology of the site most precipitation in the area most likely infiltrates to the groundwater flow system underlying the site and flows towards the Cornwallis River as baseflow. The largest portion, if not all, surface water flow from the site occurs within the drainage ditch constructed during the 1960's. Quality of the water flowing in the ditch is documented in the sector reports on fish habitat and hydrogeology. The water level in a small northern portion of 'Wood Lake', a pond east of Baltzer Bog was less than 0.3m in September 2003. The largest portion of the 'lake' was without any significant depth of water on the surface. This shallow surface water feature is most likely a reflection of a perched water table within the confines of the lake, which is subject to high water evapotranspiration losses during the summer.

4.3.4 Effluents and Emissions

Dust emissions on the access roads will be controlled with the application of water, calcium chloride, and/or a dust suppressant approved by the NSDEL, when required. Dust has not been a significant problem to date because of the moisture content in the soil/peat, and the high sand content of the materials in the access road and the aggregate extraction area. However on the few occasions when dust on the access road was a problem, calcium chloride was applied as an effective method of dust control. Monitoring of particulate emissions (dust) will be conducted at the request of NSDEL.

4.3.5 Hazardous Materials and Contingency planning

There is no storage of hazardous materials or petroleum products at the soil/peat or aggregate extraction sites other than a small (250 gallon) fuel tank. The equipment used on the sites is either owned and/or leased by Mark-Lyn Construction Limited for purposes of working at the site. All equipment working on the site is also operated by staff of Mark-Lyn Construction Limited. Regularly scheduled maintenance of the equipment is carried out on the equipment by Mark-Lyn Construction Limited staff at the garage in the Kentville Industrial Park. There are no used oil filters, air filters, or other replaceable service parts stored on the sites. In addition, there are no used oils, solvents, or other hazardous materials handled or stored on the site of this operation.

Refuelling of equipment is normally conducted at the service facility in the Kentville Industrial Park. Refuelling of equipment as may be required on the sites is not, and will not be, carried out within 100 metres of any surface water and/or ditch. Equipment operators will remain with the equipment at all times during refuelling in accordance with the Petroleum Management Regulations of the Nova Scotia Environment Act.

In the unlikely event that a leak or spill occurs during refuelling, maintenance, or general equipment operation, immediate action will be taken to stop and contain the spilled material. All contaminated material will be collected and stored in an appropriate manner so that it is not re-released back into the environment until such time as it will be hauled to an approved treatment/disposal facility. All spills will be reported to the 24-hour environmental emergencies reporting system (1 800 565 1633) in accordance with the Emergency Spill Regulations of the Nova Scotia Environment Act.

4.3.6 Decommissioning and Abandonment

Mark-Lyn Construction Limited has undertaken a progressive rehabilitation program at the previous soil/peat extraction site and at the aggregate extraction site. The rehabilitation process at the soil/peat extraction site has been ongoing since site development and consists of preservation of soil/peat and placement on the worked areas for future re-vegetation of the area. Rehabilitation at the aggregate extraction site consists of grading the working face to a stable slope.

As distinct areas within the extraction sites become inactive, the areas are graded to a stable slope. At the end of the soil/peat extraction operation (within twelve months of abandonment) rehabilitation will consist of the necessary grading and contouring of slopes, and seeding as required to allow for future commercial, industrial, recreational, residential land use, or to left as a natural site. Three options are currently being considered for future use of the sites. One option for future use of the sites is as a residential development; another use is as a cranberry production area; a third use is as a tree & shrub nursery, or possibly a combination of the three uses.

4.4 Employment

Mark-Lyn Construction Limited currently employs 12 staff who depend on the source of aggregate and peat for a product which is a main revenue stream for the company. Staff at the soil/peat and aggregate sites includes a loader operator, and 2 truck drivers full time while the operation is open during the growing season. An additional 9 employees are on site at the office and storage yard in the Kentville Industrial Park for the purpose of performing general labour, screening soil and peat, and producing the various product grades (which includes mixing varying proportions of topsoil/peat and aggregate), and trucking product to market.

5.0 EXISTING ENVIRONMENT AND IMPACT MANAGEMENT

5.1 Methodology

Several potential environmental issues regarding the current and proposed soil/peat and aggregate extraction operation were raised during preliminary consultations with staff of the Nova Scotia Department of the Environment & Labour (NSDEL), and review of the 'Draft Environmental Assessment Registration Report' dated February 2004. These issues included: potential impacts on rare and sensitive flora; wildlife at risk; fish and fish habitat; groundwater resources; soils and wetlands; archaeological and heritage resources; and feedback from a public consultation meeting. Field studies were conducted by a team of specialists who are trained and experienced in various aspects of the environment. The team reports, and the sectors of environment studied for this environmental assessment, are included in appendices at the back of this report.

Field studies were conducted by the various team members between May 2003 and January 2004 to investigate existing conditions and to determine appropriate mitigation, if necessary, to minimize environmental effects from the proposed expansion project. These surveys included: vegetation; breeding bird, mammal, amphibian & reptile; fish and habitat; hydrogeology and groundwater review; soils, previous land use, and wetland review; and an archaeological and heritage site survey.

Additional information was gathered through a review of air photographs; topographic maps of the area; reports and records from various government departments; and the former owner and operator of the site.

5.2 Rare and Sensitive Flora

5.2.1 Description of the Existing Environment

In the summer of 2003, Marbicon Inc. was contracted to perform a botanical survey of three properties of interest to Mark-Lyn Construction, in Cambridge, Kings Co. Nova Scotia, located at about N 45°04.5' and W 64°35.7'. These three properties were treated as a whole during this study. Two of these properties are on South Bishop Road. The northern property (by Highway 101) contained a silt pit. The southern property is known as the Baltzer Bog, and is the location of a peat-removal operation. The third property is separated from the other sites by a red pine stand (owned by the Shaw Group), and is accessed from Lovett Road, just south of Highway 101.

The sites were inventoried by botanists Jim Jotcham and Twila Robar on June 26, 2003, and checked by Jim Jotcham on September 23, 2003. No rare plant species or special habitats were identified on the properties. The sites were sampled by random transects, and aerial photos were checked to ensure that all habitat types were explored. No quantitative sampling was performed. The botanical report with photos is included in Appendix B of this report.

5.2.2 Potential Effects and Proposed Mitigation

No rare or unusual plants or habitat were found on the sites included in the study area. The sites of study contain, in part, vegetation typical of a wetland. However, except for the pond, referred to as 'Wood Lake', and the drainage ditches, no water or wet areas were identified. There is no old-growth forest, since the entire area has been cut over at least once. Since there are no rare or unusual plant species or habitat, there are no floristic reasons to restrict further development of the soil/peat and aggregate extraction operations in the area as proposed.

5.3 WILDLIFE

5.3.1 Description of the Existing Environment

A faunal analysis of three Mark-Lyn Construction extraction sites was carried out during the summer of 2003. Species groups investigated included- amphibians, reptiles, breeding birds, and mammals. The scope of work included:

1. A census of the properties for the above species groups with special emphasis on species considered at risk in Nova Scotia;
2. Assessment of the potential impact of the extraction operations on species at risk identified on or immediately adjacent to the sites.
3. Suggestion of mitigative measures that might be taken;
4. Presentation of the above information in a report to be submitted to the Nova Scotia Department of Environment and Labour as part of an environmental assessment (see Appendix C).

All fieldwork was carried out by Dr. George Alliston who was accompanied on bird surveys by Mr. Bernard Forsythe, a very experienced and highly respected amateur ornithologist and naturalist. While Mr. Forsythe’s knowledge of local natural history is very broad, he is particularly interested in birds of prey and has conducted studies of these species, particularly owls, for almost 30 years.

The work program utilized for this project is outlined as follows:

1. Approach - A preliminary look at the property suggested that there was potential habitat for at least three species at risk: one reptile (Wood Turtle), one species of raptorial bird (Long-eared Owl), and one mammal species (Southern Bog Lemming). The likelihood of any of these species occurring here is low; however, the planning of information gathering was structured to optimize the information collected on these species at risk while not being confined strictly to these species.

2. Schedule of Field Work
    a) May - survey of woodlands for breeding birds of prey (particularly owls);
    b) May - survey of ponds, ditches for reptiles and amphibians (particularly Wood Turtles);
    c) June - general survey of birds nesting on the property.
    d) October - survey of Baltzer Bog area for Southern Bog Lemmings.

The five amphibian species recorded during the site visits did not include the only amphibian species at risk in Nova Scotia: the Four-toed Salamander. The only area on the properties that provided only marginal potential habitat for this species was the shoreline of Wood Lake and this should not be impacted by the proposed extraction operations.

No basking Wood Turtles were observed during a survey for this species conducted along the shoreline of Wood Lake and the drainage ditches of Baltzer Bog. Not even the generally ubiquitous Eastern Painted Turtle was observed.

During the May and June site visits, 57 bird species were recorded all of which could be breeding on or adjacent to the extraction sites. None of these breeding bird species are considered to be at risk. A nocturnal survey was conducted, mainly to detect the presence of owls. No owl species was detected. Some potential nesting for Rusty Blackbirds exists adjacent to Wood Lake, however, this species was not observed in 2003, and this habitat should not be impacted by peat extraction operations.

Ten species of mammals were recorded during the 2003 site visits and none was a species at risk. The only mammal species at risk for which a special search was conducted was the Southern Bog Lemming. Potential habitat for this species which is believed to prefer “low damp bogs and meadows” (Peterson, 1966) was confined to the peat extraction site and, even there, appeared to be rather limited. The search produced no evidence of the presence of Southern Bog Lemmings. No bats were observed during the nocturnal survey.

The potential for impact on wildlife species from noise generated from extraction operations on these sites would appear to be limited. Firstly, the noise levels generated by the machinery currently being used in the pit operations (loader, screener, small bulldozer, two tandem trucks) are not particularly high. Secondly, current activities in areas surrounding the pit sites are the source of relatively high levels of noise. Highway 101 is the northern boundary of two of the properties. A very large and active aggregate extraction operation extends along the entire southern boundary of the properties and northwards to occupy the property that separates the pit sites being considered.

A secondary road and residential area forms the western boundary. By far the highest levels of noise experienced during the site visits was at the silt pit and was generated by dirt bikes and ATV’s being used for recreation. It is therefore believed that any noise generated by extraction activities at the three sites will have little incremental impact on wildlife beyond the boundaries of these properties.

Summary

1) The one amphibian species at risk in Nova Scotia, the Four-toed Salamander, is not believed to occur on any of these extraction properties. Marginal habitat for this species exists in one location (Wood Lake) and proposed extraction operations should not directly affect this location.
2) None of the three reptiles species at risk in Nova Scotia are believed to occur on these properties.

3) No bird species at risk are known to nest on or immediately adjacent to these properties. Potential nesting habitat for Rusty Blackbirds exists around Wood Lake; however, this habitat will not be affected by extraction operations.
4) The only mammal species at risk that might use these sites are bats during their nocturnal foraging. It is most unlikely that maternity colonies of the Little Brown Bat and the Northern Long-eared Bat would be found on or immediately adjacent to these properties.
5) Given their apparent lack of use of the extraction properties, no amphibian, reptile, breeding bird, or mammal species considered at risk in Nova Scotia should be impacted detrimentally by the proposed extraction operations.

5.3.2 Potential Effects And Proposed Mitigation

Since no amphibian, reptile, breeding bird, or mammal species at risk is believed to use the extraction properties or areas immediately adjacent to them, no mitigative measures are proposed for these select species. However, to meet its obligations under the Migratory Birds Convention Act, Mark-Lyn Construction should consider:

1) not removing material from embankments used for nesting by such species as Belted Kingfisher and Bank Swallows during the period when nests are active (May through July);
2) stripping areas of their vegetation cover, and the wildlife and bird nesting habitat it supports, only during the period when birds are not nesting (August through March);
3) avoiding, where possible, the nests of ground-nesting species that are attracted to extraction sites (e.g. Killdeer, Spotted Sandpiper, Common Nighthawk);
4) assuring that all toxic materials that are used in the extraction operations (gasoline, diesel fuel, engine oil, hydraulic fluid, etc.) are not accessible to birds and other wildlife. Any accidental spills of toxic materials should be dealt with expeditiously using protocols that are described elsewhere in this submission.

5.4 Fish and Fish Habitat

5.4.1 Description of the Existing Environment

A fish and fish habitat study was carried out as part of the environmental assessment for this project by Derick Fritz of Ocean Valley Aquatics, Aquaculture, Fisheries, and Environmental Consulting. A copy of this report is included in Appendix D. Field work for this study was carried out during the summer of 2003. The study included a survey for the presence of fish and fish habitat in waters and the lake located on or near the site of the current and proposed peat excavation site, operated by Mark Lynn Construction. A fish sampling program was designed and carried out on Sept 2, 2003 sampling the waters in lower, upper and in the Wood Lake areas of Baltzer Bog. The site was separated in to 7 random testing sites, and a number of water quality and fish habitat parameters were measured.

The fish survey was carried out and the results show that Baltzer Bog has no aquatic fish life in any of the water ways on the property of the proposed site. The water quality tests had shown very acidic pH and low dissolved oxygen, as well as high water temperatures and an abundance of algae in the water columns.

The reason this bog is absent of fish may be due to a natural process that makes a bog uninhabitable for fish. This may also be the reason that the body of water on the property, referred to as Wood Lake is no more than a shallow pond. It seems that it is a possibility that what is referred to as Baltzer Bog now may have been a lake 100 or 200 years ago, and what is left of Wood Lake is what would be referred to as the eye of a bog.

The biological and geological process that changes some lakes and ponds with steep banks and poor drainage into a bog is the same process that makes the water in any bog uninhabitable for fish. Bogs usually form in areas that once had been covered by glaciers up to about ten thousand years ago. After glaciers retreat they often leave behind kettle-hole lakes that fill with water and usually have neither an inlet nor an outlet.

A bog may start as a lake or a large pond, but over time as the water grows stagnant and the vegetation grows thicker, the body of water may turn into a wetland or marsh. At this point in time fish may still inhabit the waters that used to be a lake, but as the wetland slowly turns into a bog a chemical change takes place. This chemical change takes place when thick mats of moss start covering the water.

Over the years this process will fill in a body of water and create very high acidic pH levels from the rotting material. The low dissolved oxygen is due to the substantial use of oxygen by the bacteria that is involved in the decomposition process.

So due to the process that has changed Baltzer Bog in to what it is today, it may also have degraded the water quality and fish habitat to the point that no fish could live in it. This study has shown the absence of fish in the waters located on the site. It was found that there was poor fish habitat and most fish could not survive in the waters located in the Bog.

5.4.2 Potential Effects And Proposed Mitigation

Since no fish species was found at risk or believed to exist on the site within or near the proposed extraction areas, no mitigative measures are proposed for these select species. However, to meet its obligations under the Nova Scotia Environment Act, Mark-Lyn Construction should consider:

1. Not removing materials from near the shores of Wood Lake.
2. Controlling sediment runoff from the site into receiving waters.
3. Ensuring that all toxic materials used on site in the extraction operations (gasoline, diesel fuel, engine oil, hydraulic fluid, etc.) are not released into the drainage ditches.
4. Any accidental spills of toxic materials should be dealt with expeditiously using protocols that are described elsewhere in this submission.

5.5 Hydrogeology And Groundwater Resources

5.5.1 Description of the Existing Environment

A review of the hydrogeology and groundwater of the study area was carried out by Terry W. Hennigar Water Consulting. This work included a review of existing and readily available geological maps, hydrogeological maps and reports, water well records, pumping test data, and groundwater hydrograph records of the area. The report is included in Appendix E.

The Valley floor is underlain by soft Triassic sediments, which have been eroded to form an open-ended valley, bounded by the Minas Basin in the east. These sediments are made up of weakly cemented, and easily eroded, sandstones, and sandy shales, which are the most common rock types. The Cornwallis Valley in the vicinity of Coldbrook is drained by the Cornwallis River, and contributing tributaries, flowing east. Overlying the bedrock units in the vicinity of the sites are surficial glacial materials, collectively referred to as Quaternary deposits. These deposits are reported to be over 100 feet thick in various well logs reviewed for this study.

Today, ridges and hills of sand and gravel deposits called eskers and kames respectively, form the topography on the valley floor in the vicinity of the proposed soil and aggregate extraction sites. These deposits vary widely over short distances both laterally and vertically. The distribution of these deposits both laterally and with depth are of particular interest from two divergent views: 1. Because of the potential as aquifers to store and transmit large quantities of good quality groundwater, and 2. As a source of sand and gravel aggregate for various construction and commercial purposes. A conceptual hydrogeologic cross section of the area, showing thickness of the Quaternary deposits, groundwater levels, surface and bedrock topography, and surface landmarks, is presented in Figure 6 (Appendix E).

As seen in the data presented, seven water wells are reported in the vicinity of Coldbrook where the soil and aggregate sites are located. The data recorded for wells in the area also show that well depths vary considered, from 92 feet to 215 feet. Depths to water level in wells also vary from 27 to 53 below ground surface within the grids containing the study area. Two wells reported in the grid west of the study area are reported as flowing artesian wells. Reported well yields ranged from 6 to 20 gallons per minute. All seven wells are reportedly drilled into the underlying bedrock aquifers.

Groundwater hydrograph data recorded in the Coldbrook area indicate periods of recession during the summer months followed by recovery during the autumn over a 16 year period from 1965 – 1981. This groundwater level monitoring well was constructed in the Quaternary sand and gravel aquifer underlying the Scotian Gold property. During this period of record water level fluctuations of approximately 10 feet were documented, where water levels fluctuated between 40 and 50 feet above mean sea level.

Water quality from wells constructed in the Quaternary sand and gravel aquifers in the area is expected to be good, with most parameters meeting Canadian Drinking Water Quality Guidelines (Health Canada 2001). Water quality from wells constructed in the underlying Triassic Wolfville Formation hydrostratigraphic unit (Wolfville HU), consisting of conglomerate, sandstone, and siltstone, is typically of a lesser quality. It is characterized by higher hardness, more total dissolved solids, and at times high iron and manganese values.

Groundwater quality can change significantly over a very short horizontal and or vertical distance because of the influence of minerals in the host bedrock or overburden materials. A distinctive difference between water from the Wolfville HU and the Quaternary HU is often the presence of higher hardness and total dissolved solids in the former HU. Alkalinity and pH are normally higher as well in water from the Wolfville HU.

As seen in the hydrogeologic cross section (Figure 6, Appendix E), Baltzer Bog and Wood Lake appear to be located in a groundwater recharge area with the bog and lake occurring as a perched water system above the water table of the Quaternary deposits. A groundwater monitoring program is presented to predict and detect impacts to the water systems in the area and minimize impacts to the hydrologic integrity of the bog, lake, and groundwater systems. The intent of the proposed project is to extract the peat resource from Baltzer Bog and not impact Wood Lake in the process. At the end of the project, Baltzer Bog will remain as a bog, but with a reduced thickness of peat deposits within it, and no other significant environmental impacts on the water resources, or environment, of the area.

5.5.2 Potential Effects and Proposed Mitigation

Because of the nature of the peat and aggregate extraction operations at the Coldbrook sites, and the limit of depth excavation to a point above the water table outside of the bog, groundwater contamination and impact on the groundwater system is not expected to be a problem. There are no chemical constituents in the materials that are known to be a concern that may also be introduced into the groundwater and the nearby aquatic ecosystem as contaminants.

Wells that may be at potential risk include those located along South Bishop Road west of the soil/peat deposit extraction area, and the existing Mark-Lyn aggregate extraction site. These wells appear to be up gradient of the peat deposit and the aggregate deposit. All wells in this area are residential water supply sources. Records located for water wells in the area indicate that flowing artesian wells exist west of the study site. Other wells reported in the area have depths to water averaging approximately 40 feet below ground surface. The properties on the east side of South Bishop Road border on the peat deposits and the existing aggregate deposit.

Accordingly, as a precaution against potential impact on shallow groundwater supplies In the area the following is recommended:

1. Maintain a buffer zone of 30 metres between the proposed extraction area and the properties bordering along the west side of the extraction operation.
2. The maximum depth of excavation in the west portion of the operation be limited to 20 feet below existing natural ground surface, or three feet above the mean groundwater level, which ever is the shallower.

The potential impacts from the peat and sand extraction operations in the area are not expected to have any detrimental effects on water supply potential, either impacted quality or decreased yields, from wells in the area. Both peat and sand extraction operations are above the current groundwater table in the area and are therefore not expected to significantly change or affect the groundwater levels or groundwater flow patterns in the area.

The potential impacts from spilled or released petroleum products on the site may pose a threat to wells where the zone of influence may extend to the area of impacted groundwater. Potential impacts to water supply wells in the area will be a function of distance, location of a well with respect to groundwater flow directions, volume of deleterious substance accidentally released, and individual well construction characteristics.

Mitigation of water quality impacts caused by the peat and/or sand extraction operations would likely involve temporary provision of bottled water to affected residents, or provision of an acceptable in-line water treatment unit to correct the problem. In the unlikely event of a persistent long-term water quality impact of a drinking water supply well, the proponent will be required to replace or repair any water supply well found to be adversely affected by this project to the satisfaction of the owner.

5.5.3 Water Monitoring

It is a common practice for regulatory agencies when approving projects of this type to require monitoring of the project including a residential well survey prior to expansion activities to establish baseline conditions. Monitoring is also required as part of a program of groundwater monitoring using either dedicated site monitoring wells and/or selected residential wells. The proposed monitoring program includes a ground-truthing exercise to locate/confirm all residential/domestic water supplies, whether they be wells or springs, within 300 meters of the working area. Should a water supply well or spring be identified within this area, owners/users of the supply will be interviewed for the purpose of collecting well construction data (if available), water quantity data, and water quality information. All domestic water supply sources will be sampled and analyzed for general chemistry and bacteria.

5.5.4 Groundwater

Due to the nature of these operations being above the current water table, construction of dedicated monitoring wells may not be considered necessary. However, should groundwater monitoring be required by the NSDEL for this project, existing wells along the west side of the site could be used for monitoring purposes. Alternatively, a monitoring well could be constructed at a strategically located point between the working area and the nearest residential well along the South Bishop Road. Monitoring would consist of quarterly water level measurements and general chemistry.

Assuming that the operation and all peat and sand removal will be confined to the zone above the water table on the site, and no deleterious substances are accidentally spilled and allowed to enter the groundwater flow system, no significant adverse effects on the groundwater resources in the area are anticipated. A groundwater monitoring program, including construction of monitoring wells, is presented in the Hydrogeology And Groundwater Overview Report (Appendix E).

Two of the proposed monitoring wells are located within the footprint of Baltzer Bog. Information from these monitoring wells will assist in determining potential impacts of the extraction operations on water levels in the bog and Wood Lake. This information will also be useful in determining the depth of excavation of aggregates in area A2.

5.5.5 Surface Water

Activities during extraction operations on the sites will be carried out in a manner to prevent siltation of the surface water being discharged from the property boundaries into the nearest water course(s). If required soil erosion and sedimentation controls as approved by the NSDEL, including settling ponds, will be installed to prevent off-site surface water quality impacts.

A monitoring program of surface water leaving the sites will be carried out at selected sites as approved by the NSDEL. Monitoring and analyses will be carried out for total suspended solids (TSS) and pH. It is understood that the following liquid effluent levels are desired:

Parameter	Maximum in a Grab Sample	Monthly Arithmetic Mean	Monitoring Frequency
TSS	50-mg/L	25 mg/L	Weekly
PH	5 - 9	6 - 9	Weekly

The pH values listed above are greater than the background values recorded in the bog and Wood Lake and therefore should be reviewed for purposes of this project.

5.6 SOILS, HISTORIC LAND USE, AND WETLANDS

5.6.1 Description of the Existing Environment

A report addressing the agricultural soils, historic use, and wetland evaluation review report was prepared by Webster Engineering Consulting in February 2004. This report is included as Appendix F to this Environmental Assessment report.

Soils survey maps prepared by Canada Department of Agriculture and the Nova Scotia Department of Agriculture were reviewed for the area. The entire area within the footprints of A2 and A3 is underlain by soils classified as Cornwallis type. These soils are reported to occupy nearly 4% of the County of Kings. They are droughty, and for cropping they need to have organic matter, lime, and fertilizer added and usually must be irrigated. These soils have been classed as 4m soil type, because of their severe limitations restricting agricultural use.

Area A1 of the study area is underlain by peat type soils as mapped and classified in the "Soil Survey of Kings County" 1965. Peat soils are reported to occupy approximately 2%

of the area of Kings County, 65% of this area is on the Valley floor. The larger peat areas occur along the Cornwallis River, north of Coldbrook, and in the Aylesford - Auburn area.

Generally the surface layer of these soils consists of 12 to 20 inches of sphagnum moss and sedges. This is underlain by poorly decomposed material of the same kind. The deposits range from about two to several feet deep and overlie mineral soil. In a few areas the surface layers are well decomposed and are practically muck. Some cash crops have been grown experimentally on these areas and seem to do well, but require careful management for an adequate supply of nutrients.

A more recent soil survey, 1988, classifies the peat deposit as a Dufferin soil type. This new soil description and classification is very similar to the older class. A soil inspection report was also prepared by a soil scientist from Agriculture and Agri-Food Canada in 2002. This report describes the peat deposits as extremely acid and poorly drained, and land use as peat extraction. Also in 1988 Baltzer Bog was included in an evaluation of peat land resources of Nova Scotia conducted by the Nova Scotia Department of Mines and Energy. This report describes the peat deposits in the study area as almost entirely moss grade peat, but too small for commercial moss peat production.

Historic use of the peat deposits in the study area are documented in the reported included in Appendix F. Aerial photos of the area from as far back as 1967 show activity that has modified the bog from its natural state. Native vegetation has been removed over the years and a series of drainage ditches has altered the water levels within the peat deposits and around the perimeter of the deposits. Wetland inventories and evaluations carried out by the Nova Scotia Department of Lands and Forests, Wildlife Division, and the Canadian Wildlife Service, Environment Canada, rate the wetland at 'something less than good wetlands' for wildlife and development for wildlife habitat.

5.6.2 Potential Effects and Proposed Mitigation

There are no apparent potential environmental effects related to extraction of the peat deposits on the site identified as area A1. Although some wetland area will be lost, the wetland area is of low value compared to other wetlands in Kings County. The area to be avoided and protected from extraction and other potentially destructive activity is the area identified as Wood Lake. Accordingly, peat extraction and vehicular activity should be excluded within the area of Wood Lake.

Notwithstanding the low wetland evaluation assigned to Baltzer Bog, and the fact that no faunal nor botanical species at risk were identified, the bog may be of scientific interest to wetlands specialists and ecologists. It is recognized by the proponent that this wetland may contain a geo-chronological and an environmental history record of interest to the scientific community involved in wetland studies and research. *To this end the proponent is prepared to assist in preparation of a peat archival record of Baltzer Bog that will add to the understanding of the historic environmental conditions under which bogs have developed in Nova Scotia.*

5.7 Archaeological Assessment

5.7.1 Description of the Existing Environment

An archaeological assessment of the Mark-Lyn site, and adjacent site of interest, was carried out by Helen Sheldon during October 2003. The methodology for the archaeological reconnaissance survey consisted of two major components:

(1) visual examination of the ground surface for evidence of past human activity; and
(2) excavation of shovel test pits in areas believed to have some archaeological potential.

The field reconnaissance consisted of a visual inspection of the ground surface through walking over the site. Since the majority of the area had already been cleared, with earth disturbance, visual inspection of the soils was possible over most of the project area without further excavation. The shores of Wood Lake were inspected for archaeological remains, with none being found. Shovel tests were dug in both area 2 and 3 and on the shores of Wood Lake to examine previously undisturbed soil profiles. Nothing of archaeological significance was identified. Baltzer Bog (Area 1) has low potential for archaeological resources. This report is included in Appendix G.

No archaeological resources were identified within the development area. The area appears not to have been used prior to the twentieth century and any pre-contact occupations probably would have existed closer to the shores of the Cornwallis River. The majority of the project area has low potential for archaeological remains.

5.7.2 Potential Effects and Proposed Mitigation

Development of the property into a peat and aggregate extraction operation will have no adverse effect upon archaeological resources. No archaeological resources were observed during the archaeological reconnaissance survey of the property. Therefore, it is recommended that development can proceed without further archaeological work. It should be noted that, since no archaeological survey is completely infallible, should anything of an archaeological nature be discovered during development or operation of the peat and aggregate extraction site, the Curator of Archaeology at the Nova Scotia Museum (David Christianson 424-7374) should be contacted immediately.

5.8 Air Quality

5.8.1 Description of the Existing Environment

Air quality is monitored by the NSDEL at ten stations across Nova Scotia susceptible to air quality problems. Common air pollutants monitored regularly are sulphur dioxide (SO_2), particulate matter (PM), carbon monoxide (CO), ground level ozone (O_3), nitrogen dioxide (N_2O), and hydrogen sulphide (H_2S). Generally, exceedances for these contaminants are generally small and infrequent in Nova Scotia. The closest NSDEL air quality monitoring site is located at Aylesford Mountain, approximately 20 km west of the project site. Emissions from sources not related to the top soil/peat and aggregate extraction operations have caused concern regarding air quality, particularly with respect to ground level ozone. Occurrences of ground level ozone are attributed to emissions generated outside of Nova Scotia and carried to the region by the long-range transport of air pollutant from the U.S. and or Central Canada (NSDEL 1998). It is these parameters that contribute smog and acid rain to our area in amounts that make them the two major air quality concerns in the Valley.

Particulate emissions have not likely significantly changed since the State of the Environment Report was published by NSDEL in 1998. It is not anticipated that the common air pollutants are exceeded at the top soil/peat and aggregate extraction sites due to the nature of the operations and the characteristics of the materials being extracted.

5.8.2 Potential Effects and Proposed Mitigation

As per the existing Industrial Approval conditions, particulate emissions will not exceed the following limits at the property boundaries of the sites:

- Annual Geometric Mean 70 µg/m^3.
- Daily Average (24hour) 120 µg/m^3.

Efforts to minimize the generation of dust at the site have been made by applying water and/or calcium chloride to the access road, covering laydown and working area with damp peat, and reducing speed on the access roads. Fugitive dust emissions will be controlled with the application of compounds as approved by the NSDEL. Monitoring of particulate emissions (dust) will be conducted at the request of NSDEL.

5.9 Socio-economic Environment

5.9.1 Description of the Existing Environment

The soil/peat and aggregate extraction sites are located immediately north of the Growth Centre identified as Coldbrook, Kings County. Adjacent communities are Cambridge to the west, and Kentville to the east. The population of the Coldbrook Growth Centre is 2,189 while the population of Kentville is 5,610 according to the Statistic Canada Census 2001. The population of the Coldbrook area has increased by approximately 8 per cent over the past five years from 1996 to 2001, or 19% over the 10 years between 1991 and 2001. The population of Kings County has increased approximately 4.5 % of the same ten-year period.

The Coldbrook area is zoned as various classes of Residential land use ranging from R1, permitting residential single dwellings, to R5 permitting residential high-density development. The current top soil/peat and aggregate extraction operations are located in a residential zone, which also allows high-density residential development. A large parcel of land located to the east and south of the Mark-Lyn site is zoned as M7 resource extraction. A large aggregate extraction operation has been worked by the Shaw Group on this site since the early 1980's.

The only residences bordering the Mark-Lyn site occur along the South Bishop Road on the west side of the property. The nearest residence to the current working area of the topsoil/peat operation is located a distance greater than 500 feet to the southwest. Under the proposed operation this distance will be decreased to at least 300 feet from the working area. The nearest residence to the current working area of the aggregate extraction operation is greater than 500 feet to the west. Under the proposed operation

this separation distance will also decrease to about 300 feet or more from the working face. These separation distances will increase for extraction activities in the northeast and southeast quadrants of Area 1 as shown on Figure 01.

5.8.2 Potential Effects and proposed Mitigation

Excavation operations associated with the proposed expansion will be conducted in accordance with current operations at the two facilities as permitted by the NSDEL (Approval No. 1999-IAW-042, and Approval No.2001-019546) and in accordance with the Nova Scotia Pit and Quarry Guidelines (NSDEL 1999).

As per the requirements of the current operating Industrial Approval and standard provincial guidelines, sound levels from the operation in the expansion area will be maintained at a level not to exceed the following sound levels (Leq) at the property boundaries:

Leq 65dBA 0700-1900 hours (Days)
60dBA 1900-2300 hours (Evenings)
55dBA 2300-0700 hours (Nights)

Sound monitoring will be conducted at the request of NSDEL.

No new aesthetic impacts are anticipated due to the expansion. The existing top soil/peat extraction and aggregate extraction operations are not visible from Highway 101 or from the South Bishop Road. The proposed expansion, which will extend a horizontal distance of approximately 1000 feet (300m), when completed, parallel to Highway 101 and further away from the South Bishop Road.

Traffic associated with this project is not anticipated to increase above the present level associated with the current operation. The proposed expansion will allow operation of the soil and aggregate extraction business at the current rates. Traffic associated with

the new proposed aggregate extraction operation will actually decrease along the north portion of the South Bishop Road. Under the expanded operation aggregate will be trucked across the site to the south access road to South Bishop road, approximately 0.5 km from the current access road to the aggregate site. Access to the soil and aggregate extraction areas is an approximately 1km paved South Bishop Road from Provincial Highway Trunk 1. This road was truncated with construction of Highway 101 in the early 1970's, and has been developed primarily as a residential area. From the current and proposed expansion areas products will be transported by tandem and tractor-trailer trucks to markets or to storage at the Industrial Park in Kentville.

Aggregate materials extracted from the pit east of the peat deposits will be removed from the site by truck along the parallel access road south of Highway 101 to Lovett Road and then south to Highway No.1. Activity in the east pit will therefore reduce truck traffic on the South Bishop Road from the Mark-Lyn operation. The Mark-Lyn extraction operation in area A3 is expected to replace the current extraction operation from that area. Accordingly, there is no expected increase in truck traffic on Lovett Road from the proposed undertaking.

Recreational activities such as fishing are not expected to be affected by the proposed project due to the lack of viable fish habitat in and adjacent to the proposed expansion area.

Another, much larger, aggregate extraction operation owned and operated by the Shaw Group Limited, is located adjacent to, and south of, the current soil/peat extraction site. It is not anticipated that the operation of both provincially approved facilities within the same general region will result in combined environmental effects that are unacceptable. For example, the Mark-Lyn operation is on a much smaller scale than the Shaw Group operation in terms of tonnes of product trucked and the number of trucks moving in the area. In addition the Mark-Lyn extraction operation is a seasonal business from May until October of each year.

No significant adverse environmental effects are predicted for the socio-economic environment.

6.0 PUBLIC CONSULTATION

On February 24, 2004 a public information meeting was held in Coldbrook to review the various aspects of the project. The meeting was facilitated by Mr. Hendricus Van Wilgenburg and attended by 45 persons from the area. Information was presented for their review and comment.

Feedback from the public included concerns regarding groundwater contamination, loss of a wetland, noise, traffic, and reduced property values. Most of the negative comments expressed about the proposed project related to nuisance issues. Many people attending the meeting from the community expressed their appreciation for the chance to meet and discuss this project. The public was also reminded they will be provided an opportunity to review the Registration Report for this project and provide comments to NSDEL through a formal process established in the Environmental Assessment Regulations. In particular, newspaper ads will be placed notifying residents where this document can be reviewed (including two local locations) and how to provide comments. In addition Mark-Lyn Construction will continue its practice of public consultation with the Community Liaison Committee, and response to concerns brought to the attention by local residents.

A summary of the public meeting held on February 24 and comments and concerns as expressed by the members of the community during the public information meeting are included and addressed in Appendix H of this document. The proponent is confident that the community will be more receptive to this project once the scope, detail and protection of the Environmental Assessment carried out to ensure minimum environmental impacts from the operation are realized.

7.0 CONCLUSIONS

Based on the findings of this environmental assessment report, and the commitments of the proponent Mark-Lyn Construction Limited, the following conclusions are presented:

- Operations associated with this proposed undertaking will be conducted in accordance with terms and conditions of the Industrial Approvals issued for the Mark-Lyn Construction Limited soil/peat and aggregate operations at the Coldbrook sites.

- Environmental effects from the aggregate expansion will include the temporary loss of terrestrial habitat within the footprint of the extraction areas. This area does not include unique habitat or rare or sensitive species; therefore, these effects are not anticipated to be significant.

- Environmental effects from the soil/peat expansion will include the temporary disruption of wetland habitat within the footprint of the extraction areas. This area does not include high-grade wetland, unique habitat, or rare or sensitive species; therefore, these effects are not anticipated to be significant.

- No water supply of a domestic, industrial, recreational, or public nature is known to exist within the footprint of the proposed extraction areas or within a distance of the site where a potential impact is apparent.

- Assuming the mitigative measures specified in this report are implemented, and the soil and aggregate extraction operations are operated according to existing provincial guidelines and approvals, no significant adverse residual environmental or socio-economic effects are likely.

- Given their apparent lack of use of the proposed extraction sites, no amphibian, reptile, breeding bird, or mammal species considered at risk in Nova Scotia should be impacted detrimentally by the proposed extraction operations.

- No fish species, nor suitable fish habitat was found at risk on the site or near the proposed extraction areas.

- An existing water well survey and a groundwater monitoring program are proposed to ensure the valuable water resources of the area are not impacted to the detriment of existing and future users.

- No archaeological resources were identified within the proposed development area.

- The issues identified during the public consultation meeting are being addressed by various mitigation measures outlined in this registration document.

Appendix A

Industrial Approvals and Terms and Conditions for the Previous Topsoil and Aggregate Removal Operations.

Nova Scotia

DEPARTMENT OF ENVIRONMENT AND LABOUR

Industrial Approval

AMENDMENT

Pursuant to the Environment Act and Regulations made pursuant thereto, and subject to the Terms and Conditions contained in the Approval, this Amendment is granted to Mark-Lyn Construction Limited, to construct and operate a Top Soil Stripping Operation, at South Bishop Road, Coldbrook, in the Municipality of the County of Kings, in the Province of Nova Scotia.

Granted at Kentville, in the Municipality of the County of Kings, Province of Nova Scotia, this 01 day of October, A.D. 2001.

1999-IAW-042 Amendment
APPROVAL NUMBER

ADMINISTRATOR

Nova Scotia

DEPARTMENT OF ENVIRONMENT AND LABOUR

Industrial Approval

Pursuant to Part V of the Environment Act, S.N.S. 1994-95, c.1 as amended from time to time, approval is granted to Mark-Lyn Construction Limited, to construct and operate an Aggregate Pit, at Bishop Road, Coldbrook, in the Municipality of the County of Kings, in the Province of Nova Scotia.

Granted at Kentville, in the Municipality of the County of Kings, Province of Nova Scotia, this 21st day of June, A.D. 2001.

2001-019546
APPROVAL NUMBER

ADMINISTRATOR

COPY

Appendix B

Botanical Survey of Baltzer Bog, Coldbrook, 2003

Marbicon Inc.

Shipping: 4287 Brooklyn St., Somerset NS, B0P 1E0
Mailing: P.O. Box 280, Berwick, NS, B0P 1E0
CANADA

Tel. (902) 538-7101
Fax. (902) 538-8801
marbicon@eastlink.ca

Botanical survey
Baltzer Bog
Coldbrook NS
2003

Jim Jotcham
January, 2004

In the summer of 2003, Marbicon Inc. was contracted to perform a botanical survey of three properties owned by Mark-Lyn Construction, in Coldbrook, Kings Co. Nova Scotia, located at about N 45°04.5' and W 64°35.7'. These three properties were treated as a whole during this study. Two of these properties are on South Bishop Road. The northern property (by Highway 101) contained a silt pit. The southern property is known as the Baltzer Bog, and is the location of a peat-removal operation. The third property is separated from the other sites by a red pine stand (owned by the Shaw Group), and is accessed from Lovett Road, just south of Highway 101.

The sites were inventoried by botanists Jim Jotcham and Twila Robar on June 26, 2003, and checked again by Jim Jotcham on September 23, 2003. No rare plant species or special habitats were identified on the properties. The sites were sampled by random transects. Aerial photos (see Figure 1) were checked to ensure that all habitat types were explored. No quantitative sampling was performed.

The sites had been heavily disturbed by logging and by removal of peat and silt. The silt and peat operations have resulted in the complete removal of the original vegetation in parts of the bog. Figure 2 shows part of the peat operation, and Figure 3 shows part of the silt operation. The logged areas not mined were recovering primarily with birch and poplar. Some of the silt removal areas were recovering with weedy field species (shown in Figure 4). The remaining property could be divided into 4 vegetation habitats: Mixed secondary forest (Figure 5), shrub bog (Figure 6), sand barren (directly beside Highway 101), and weedy field / roadside. Drainage ditches (Figure 7) have been constructed on the site in the past, which has disturbed the natural drainage patterns.

A small pond (called Wood Lake) exists directly to the east of the peat extraction area at Baltzer Bog, but is not under threat of direct development at the current time. The north end of the pond is shown in Figure 8. The pond is reputed to be dry every summer, and is heavily impacted by ATV's, especially at the south end (Figure 9). In spite of seasonal drying, cow lily (an aquatic plant) and wetland plants such as narrow-leaved sundew, marsh St John's-wort, and rushes were abundant in the pond.

A large shrub bog with abundant heath plants is situated north of the current peat operation, but no unusual plants were found. The bog is shown in Figure 6. The bog was dry when inventoried in 2003.

Some of the surrounding area (owned by the Shaw Group?) was also surveyed. This included the woods to the south of the property, and the red pine stand in the centre of the three Mark-Lyn properties. The red pine stand extends as a narrow strip from beside Wood Lake, and enlarges just south of Highway 101. No rare or unusual plants or habitat was found in the areas surrounding the study area.

In summary, the site contains, in part, vegetation typical of a wetland. However, except for the pond and the drainage ditches, no water or wet areas were identified. There is no old-growth forest, since the entire area has been cut over at least once. Since there are no rare or unusual plant species or habitat, there are no floristic reasons to restrict further development.

Appendix 1 shows the list of plant species identified, and is grouped by general habitat. Many of these plants are found in more than one habitat or area. Scientific names are from Zinck (1998).

Appendix 1. List of species identified June 26/03 and September 23/03. Although sorted by general habitat, some species are found in more than one area. Scientific names are from Zinck (1998).

Woodland plants (found throughout):

Balsam-fir	Abies balsamea (L.) Mill
Bracken	Pteridium aquilinum (L.) Kuhn
Bunchberry	Cornus canadensis L.
Bush-honeysuckle	Diervilla lonicera P.Mill.
Clintonia-lily	Clintonia borealis (Aiton)Raf.
Club-moss	Lycopodium clavatum L.
Common blackberry	Rubus allegheniensis Porter
Common juniper	Juniperus communis L.
Common speedwell	Veronica officinalis L.
Common woodrush	Luzula multiflora (Retz)Lejeune
Dewberry	Rubus hispidus L.
Downy alder	Alnus viridis (Villars) Lam.
Fly-honeysuckle	Lonicera canadensis Bartr.
Hazelnut	Corylus cornuta Marshall
Huckleberry	Gaylussacia baccata (Wang.) K.Koch
Large-toothed aspen	Populus grandidentata Michx.
Lion's-paw	Prenanthes trifoliolata (Cass.)Fern.
Lowbush blueberry	Vaccinium angustifolium Ait.
Mayflower	Epigaea repens L.
Paper birch	Betula papyrifera Marshall
Pin-cherry	Prunus pensylvanica L.
Pine-sap	Monotropa hypopithys L.
Pussy willow	Salix discolor Muhl.
Red maple	Acer rubrum L.
Red oak	Quercus rubra L.
Red pine	Pinus resinosa Ait.
Red raspberry	Rubus idaeus L.
Sheep laurel	Kalmia angustifolia L.
Smooth serviceberry	Amelanchier laevis Wieg.
Star-flower	Trientalis borealis Raf.
Sugar maple	Acer saccharum Marsh.
Tall buttercup	Ranunculus acris L.
Teaberry	Gaultheria procumbens L.
Trembling aspen	Populus tremuloides Michx.
White pine	Pinus strobus L.
White spruce	Picea glauca (Moench)Voss
Wild lily-of-the-valley	Maianthemum canadense Desf.
Wild sarsaparilla	Aralia nudicaulis L.
Wire birch	Betula populifolia Marshall
Witherod	Viburnum nudum L.

Bog plants (found in shrub bog and in wet woods):

Beak-rush	Rhyncospora alba (L.)Vahl
Black spruce	Picea mariana (Mill.) BSP.
Bog huckleberry	Gaylussacia dumosa (Andr.)T&G
Eastern larch	Larix laricina (DuRoi) K.Koch
Labrador-tea	Ledum groenlandicum Oeder
Leather-leaf	Chamaedaphne calyculata (L.)Moench
Peat moss	Sphagnum spp.
Rhodora	Rhododendron canadense (L.)Torr.
Sedge	Carex scoparia Schkuhr

Plants in sandy barren area (just south of Highway 101):

Bearberry	Arctostaphylos uva-ursi (L.)Sprengl.
Black crowberry	Empetrum nigrum L.
Bristly sarsaparilla	Aralia hispida Vent.

Plants in open / weedy / disturbed areas:

Alsike clover	Trifolium hybridum L.
Barnyard grass	Echinochloa crusgalli (Link)Beauv.
Birdsfoot-trefoil	Lotus corniculatus L.
Canada thistle	Cirsium arvense (L.)Scop.
Common plantain	Plantago major L.
Common St. John's-wort	Hypericum perforatum L.
Common wormwood	Artemisia vulgaris L.
Cow-wheat	Melampyrum lineare Dest.
Crab grass	Digitaria sanguinalis (L.)Scop.
Creeping white clover	Trifolium repens L.
Dandelion	Taraxacum officinale Weber
Evening primrose	Oenothera biennis L.
Fall dandelion	Leontodon autumnalis L.
Grass-leaved stitchwort	Stellaria graminea L
Kentucky bluegrass	Poa pratensis L.
King-devil	Hieracium floribundum Wimm. & Grab.
Low hop clover	Trifolium campestre Schreber
Mouse-eared hawkweed	Hieracium pilosella L.
Narrow-leaved goldenrod	Euthamia graminifolia (L.)Nutt.
Narrow-leaved plantain	Plantago lanceolata L.
New York aster	Aster novi-belgii L.
Old-field goldenrod	Solidago nemoralis Ait.
Ox-eye daisy	Chrysanthemum leucanthemum L.
Pearly everlasting	Anaphalis margaritacea (L). Benth. & Hook.
Pink corydalis	Corydalis sempervirens (L.)Pers.
Red clover	Trifolium pratense L.
Sheep-sorrel	Rumex acetosella L.
Spreading dogbane	Apocynum androsaemifolium L.
Spurry	Spergula arvensis L.

Sulphur cinquefoil	Potentilla recta L.
Sweetfern	Comptonia peregrina (L.)Coult.
Timothy	Phleum pratense L.
Tufted vetch	Vicia cracca L.
White goldenrod	Solidago bicolor L.
Wild carrot	Daucus carota L.
Wire grass	Danthonia spicata (L.)Beauv.
Yarrow	Achillea millefolium L.
Yellow rocket	Barbarea vulgaris R.Br.

Species restricted to pond to east of property:

Bulrush	Scirpus cyperinus (L.)Kunth.
Cow-lily	Nuphar variegata Durand
Marsh St. John's-wort	Triadenum virginicum (L.)Raf.
Narrow-leaved sundew	Drosera intermedia Hayne
Rush	Juncus canadensis J.Gray
Small cranberry	Vaccinium oxycoccus L.
Soft rush	Juncus effusus L.
Tawny cotton-grass	Eriophorum virginicum L.

Figure 1. Aerial view of the study area, August 2002.

The study area is south of Highway 101. The peat extraction area can be seen east of the South Bishop Road. Wood Lake is directly farther east. The silt extraction areas are closer to Highway 101, and are separated by a red pine stand and another small silt pit, owned by the Shaw Group. The two large pits along the south edge of the photograph are also owned by the Shaw Group.

Figure 2. Peat extraction at Baltzer Bog, September 2003.A drainage ditch is shown on the left.

Figure 3. Silt extraction at the north side of Baltzer's Bog, September 2003.

Figure 4. Area cleared of vegetation and recovering with field and weedy species. North side of Baltzer Bog, September 2003.

Figure 5. Mixed secondary forest at Baltzer Bog, June 2003. The dominant vegetation is wire birch and large-toothed aspen with occasional white spruce and balsam fir.

Figure 6. Bog area at Baltzer Bog, before peat or silt extraction, September 2003.

Figure 7. Drainage ditch at Baltzer's Bog, June 2003.

Figure 8. North part of Wood Lake, June 2003.

Figure 9. South part of Wood Lake showing ATV damage, September 2003.

Appendix C

Faunal Analysis of Peat, Sand and Silt Extraction Pits, Coldbrook

Faunal Analysis of Peat, Sand and Silt Extraction Pits

Coldbrook, Kings County, Nova Scotia

prepared for

Mark-Lyn Construction Ltd.

by

W. George Alliston, Ph.D.

5 January 2004

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INTRODUCTION

This report assesses the potential use of properties currently used for peat, sand and silt extraction by Mark-Lyn Construction Ltd., and some woodlands immediately adjacent to these sites, by species of amphibians, reptiles, breeding birds and mammals currently considered at risk in Nova Scotia and the possible impacts the continuing operations and expansion of the extraction sites might have upon these species.

PIT OPERATIONS

Mark-Lyn Construction Limited's main business is the production and sale of topsoil products. These products are synthesized by various combinations of three main materials: peat, sand and silt. The materials for preparing the topsoil are obtained from three extraction sites in Coldbrook, Kings County, and are transported to a site in the Kentville Industrial Park, Kings County, where they are combined to form the various topsoil products, and sold.

Site Descriptions

The peat extraction operation takes place on a 28-hectare property locally known as "Baltzer's Bog" (PID # 55149611). The sand extraction operation is located on a 5-hectare property (PID # 55300321) which is contiguous with a portion of the north boundary of the property used for peat extraction. Mark-Lyn Construction has owned and operated these properties for the past three years. A third property (PID # 55433619) from which silt is obtained, and on which Mark-Lyn Construction has an option to purchase the northern approximately 22 hectares, lies a short distance to the east of the other two properties (see Figure 1).

Most of the 28-hectare peat extraction site was cleared and drained approximately 30 years ago and used for intensive agriculture (cash crop production). A major drainage ditch bisects the property in an east-west direction (see Figure 1) and a connecting major drainage ditch forms the eastern boundary of the property. Prior to purchase by Mark-Lyn Construction Ltd., this property had not been used for agriculture for a number of years and is in the very early stages of becoming forest. The area north of the main drainage ditch is dominated by a dense growth of young birch approximately 3 to 5 m in height. In the southeast quadrant, succession to forest, while still at an early stage, is more advanced than to the north of the major drainage ditch. Here the trees include White Spruce, Balsam Fir and poplars, as well as birches, and reach heights of over 7 m.

Figure 1. The Mark-Lyn Construction Ltd. peat, sand and silt extraction properties (2002 Aerial Photo)

The southwest quadrant of the previously agricultural area retains some wetland characteristics and contains a small cattail marsh. Trees growing in this area are mainly birches, poplars and willows which reach heights of 5m to 7m. The dominant ground cover in all these areas is trailing blackberries.

The only area of this property that may bear some resemblance to what existed here prior to conversion to agriculture is the small wetland known as “Wood Lake” at the eastern extremity of the property. This shallow wetland has no surface inflow or outflow. Its north and west shorelines are dominated by a dense mat of ericaceous shrubs: almost pure Leatherleaf at the water’s edge but further back including other species such as Labrador Tea and Sheep Laurel. In this area there is no herbaceous layer. Trees in this area are scattered and include White Pine, Eastern Larch and Red/Black Spruce which reach heights of up to about 12m. The shallows of the eastern and southern edges of the wetland support sedges and rushes. Trees that border this portion of the wetland are early successional species which include poplars, birches, Balsam Fir and White Spruce. Sphagnum moss is found along the shallows and shore line of much of the wetland. The waters of Wood Lake are highly acidic (pH = 4.5), low in oxygen and are believed to support no fish species (Fritz, 2003).

Much of the 5-hectare property that is being used for sand extraction has been cleared of trees. Those areas that remain in forest cover support a relatively young growth of trees which include Eastern Larch, Red and White Pine, White Spruce, poplar, birches and Red Oak.

Except for a “beauty strip” along Highway 101, and a section along its eastern boundary, the property to be used for silt extraction is either currently being used for extraction or has been recently clear cut. The western portion of the “beauty strip” is a small even-aged stand (recently thinned) heavily dominated by Red Pine. The eastern end of the “beauty strip” and the forested area near the eastern boundary is dominated by Red Pine, White Pine, Red Maple and poplars. Near the southwest corner of the property is a small gorge where White Pine, Eastern Hemlock, Red Oak and Red Maple dominate. Much of this area along the eastern boundary has recently been selectively cut.

Extraction Activities

Extraction of materials from these sites is for the preparation of topsoils, the demand for which is seasonal, hence the operations of these extraction sites will reflect this seasonality. Operations are expected to be conducted from May through October on weekdays between the hours of 0700h and 1700h. Operations on the sites will not be continuous but on an "as needed" basis. Equipment used at each of the sites will be a loader, a screener and, from time to time a small (D6 equivalent) bulldozer. Two tandem trucks will be used to haul materials from the pit sites to the Kentville Industrial Park. There will be no blasting or crushing operations required at these sites.

METHODS

During the spring, summer and early autumn of 2003, the three extraction sites were visited by the author on four occasions. While information was gathered during each visit on all taxa being investigated, the primary focus of these efforts varied among visits.

24 May 2003 (13:18 hrs to 16:35 hrs; hazy, overcast, winds light, temperature ~ 17° - The main purpose of this visit was to search the shoreline of Wood Lake and man-made drainages on the properties for basking Wood Turtles; a species at risk. Wood Turtles are well known for their tendency to bask on the embankments of water bodies in the weeks following their emergence from winter hibernation in mid- to late April. The surveys were conducted by following the edges of the lake and drainage ditches, scanning the embankments and shorelines ahead with binoculars (8x). Since the basking behaviour of these turtles is associated with thermoregulation (thermal uptake), the survey was conducted in the afternoon on a comparatively warm day.

27 May 2003 (19:10 hrs to 22:20 hrs; overcast, calm) – The main purpose of this visit was to survey the extraction sites and immediately surrounding areas for nocturnal species of birds (mainly owls), mammals and amphibians. The author was accompanied by Mr. Bernard Forsythe, a very experienced amateur ornithologist and field naturalist who has studied raptorial birds (mainly owls) for almost thirty years. Survey routes were traversed at the three extraction sites and amphibian and bird species were identified mainly by their calls although, while light permitted, brief searches of potential raptor nesting habitat were made for nest structures. In an attempt to elicit a response from any owl species in the area (in particular, the secretive Long-eared Owl which is a species at risk), calls of the Long-eared Owl, Great Horned Owl, Barred Owl and Northern Saw-whet Owl were made periodically. Imitations of rodent sounds were also made periodically; this can sometimes entice owls to approach the source of these sounds.

21 June 2003 (4:55 hrs to 9:37 hrs; clear, calm) – The main purpose of this visit was to conduct a survey of the breeding birds using the extraction sites and the areas immediately adjacent to these sites. The author was again accompanied on this survey by Bernard Forsythe. Survey routes traversed various habitats of the sites and bird

species and numbers were recorded based mainly on songs and calls. Binoculars (8x) were used to aid visual identification. The survey was conducted in early morning hours when the frequency of bird song is the greatest.

1 October 2003 (14:25 hrs to 17:05 hrs; clear, light breeze, temperature ~ 17°) – The main purpose of this visit was to determine if Southern Bog Lemmings (a species at risk) occurred on the property being used for peat extraction. While this species is very difficult to capture, its fresh feces are a unique lime green colour and are easily differentiated from other small mammal species. The survey for Southern Bog Lemmings consisted of locating rodent runs, finding areas within the run that had been used recently for feeding as indicated by fresh plant "clippings" and examining the fecal material present at these sites. The survey was conducted in early autumn when rodent populations are generally at their annual peak.

Evidence of the presence of other mammal species was obtained during the site visits mainly by observation of sign: tracks, scats, browse.

In this report "species at risk" refers to any amphibian, reptile, breeding bird and mammal species that is designated as colour rank red (at risk) or yellow (sensitive to human activities) by the Province of Nova Scotia or those that are ranked as being "extremely rare" (S1), "rare" (S2) or "uncommon" (S3) in the Province of Nova Scotia by the Atlantic Canada Conservation Data Centre (ACCDC) and those species that occur in Nova Scotia that have been designated as "endangered", "threatened", or of "special concern" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The definitions of the various rankings of these three systems are presented in another section of this report (see **Amphibian, Reptile, Breeding Bird and Mammal Species At Risk in Nova Scotia**).

Assessment of the possible use of this property, or properties immediately adjacent, by species at risk is based on the census work conducted on the property, the availability of suitable habitat for these species, and their known ranges as determined from personal knowledge, the literature, the Atlantic Canada Conservation Data Centre database, and communications with knowledgeable individuals. Lists of the amphibians, reptiles, breeding birds and mammals currently considered at risk in Nova Scotia and assessments of their actual or potential occurrence at the three pit properties are presented.

The common names of plants and animals are used in this report. The common and scientific species names are listed alphabetically in Appendix 1.

SPECIES OF FAUNA RECORDED DURING SITE VISITS

Amphibians and Reptiles

No amphibian or reptile species at risk was recorded during our site visits.

The five amphibian species recorded during our site visits are listed in Table 1. Several Green Frogs were present in a small cattail marsh near the southwestern extremity of the property used for peat extraction. Spring Peepers were particularly numerous in the area around Wood Lake. During the nocturnal survey of the lake area, the din from calling Spring Peepers made it difficult to hear the calls of other wildlife species although Northern Leopard Frogs and a single (very early) Mink Frog were heard. No Four-toed Salamanders were recorded during the visits to the Wood Lake area.

No reptile species was observed during the site visits. No Wood Turtles were observed during the 24 May 2003 survey of the shoreline of Wood Lake and the drainage ditches of the property used for peat extraction. This survey was conducted primarily to document the possible presence of basking Wood Turtles (see **METHODS**). Not even the generally ubiquitous Eastern Painted Turtle was observed.

Table 1. Amphibians and Reptiles Recorded on Mark-Lyn Properties

	Seen	Heard
American Toad		√
Spring Peeper		√
Green Frog	2	√
Mink Frog		√
Northern Leopard Frog		√

Breeding Birds

No breeding bird species at risk was recorded during our site visits.

Most of the information gathered on breeding birds was from a survey conducted on 21 June 2003. The routes taken during this survey are shown in Figure 2.

Figure 2. Routes taken during breeding bird surveys, 21 June 2003.
(2002 Aerial Photo)

Additional information on nocturnal species was gathered during our evening survey on 27 May 2003. The routes followed during our nocturnal survey are approximated by survey routes B, C and the northern and eastern portions of survey route E as shown in Figure 2.

During our May and June site visits, 57 bird species were recorded all of which could be breeding on or adjacent to the extraction sites (see Table 2).

The most numerous species observed was the Bank Swallow. While Bank Swallows were observed at all three pit sites, most were seen at the silt pit site where about 200 nest excavations were observed in an exposed pit face. No nest excavations were observed at the other sites.

White-throated Sparrows, American Robins, American Goldfinch and Song Sparrows, all birds that are associated with edge habitat and forest openings, were among the most numerous species observed. Veerys, which are associated with deciduous forests, were also numerous in the scrubby young deciduous growth that covered much of the peat extraction site.

Our nocturnal survey of 27 May 2003 produced only two bird species not seen on our early morning survey of 21 June 2003 or during other site visits: the American Woodcock and the Common Nighthawk.

During the nocturnal survey of the silt pit our normal practice of making owl calls and listening for a response could not be used. Noise from dirt bikes and ATVs racing in the pit, along with the background noise from Highway 101, made this impossible. Instead the surveyors conducted a pre-dusk visual survey for owls and possible owl nests in the small open woodlands along the north and east boundaries of this pit. No owls or owl nests were observed. At the other two pit sites conditions were favourable for calling owls although none was heard.

During our work on the pit properties, and properties immediately adjacent, we found only one nest, believed to be that of an American Crow, that might be used by raptorial birds for nesting. Some raptorial birds such as the Log-eared Owl, a species at risk, often use nests constructed by other birds. This nest was located high up in a Red Pine tree on an adjoining property, immediately adjacent to the sand and peat extraction sites (co-ordinates N 45°04.581´, W 64°35.751´; see Figure 2). Observation of the nest site and a search of the area surrounding the nest site for feathers, fecal material and “pellets” indicated that this nest site was not being used in 2003. The habitat on or immediately adjacent to all these pit properties would be unattractive to nesting Long-eared Owls.

Table 2. Breeding birds recorded on or adjacent to Mark-Lyn pit site properties: May-June 2003. (Unless otherwise indicated, observations are from 21 June 2003 survey.)

	Survey Routes						
Common Name	**A**	**B**	**C**	**D**	**E**	**Total**	**Notes**
Canada Goose	12		Ø			12	
Green-winged Teal			2 *			2	
American Black Duck	1	3		3		7	
Mallard				3 *		3	
Herring Gull				2	1	3	
Gull spp.	3					3	
Red-tailed Hawk	1 *					1	
Ring-necked Pheasant	4		1	1	2	8	
Killdeer			1			1	
Spotted Sandpiper	4					4	
American Woodcock	1 **					1	
Mourning Dove	6	1	1	2	1	11	
Common Nighthawk				1 **		1	
Belted Kingfisher	1					1	
Northern Flicker	2	1	3	1	2	9	
Yellow-bellied Sapsucker	1					1	
Downy Woodpecker				1		1	
Hairy Woodpecker			1 *			1	
Pileated Woodpecker					1	1	
Eastern Wood-Pewee		1	1	1	5	8	
Alder Flycatcher	7		1			8	
Least Flycatcher			2		3	5	
Blue-headed Vireo				1	2	3	
Red-eyed Vireo		2	3	1	2	8	
Blue Jay	3		2		5	10	
American Crow	10	2	1	2	2	17	
Common Raven		2				2	
Bank Swallow	2		2	2	50	56	Note 1
Black-capped Chickadee				4		4	
Red-breasted Nuthatch			1			1	
Veery	13	5	7	1		26	
Hermit Thrush					3	3	
American Robin	15	6	7	2	7	37	
Gray Catbird	2		2			4	
Cedar Waxwing				6	1	7	

Table 2 (cont.). Breeding birds recorded on or adjacent to Mark-Lyn pit site properties: May-June 2003. (Unless otherwise indicated, observations are from 21 June 2003 survey.)

	Survey Routes						
Common Name	**A**	**B**	**C**	**D**	**E**	**Total**	**Notes**
European Starling		10				10	
Nashville Warbler	1	1				2	
Northern Parula				1	1	2	
Chestnut-sided Warbler			3			3	
Magnolia Warbler			1	2		3	
Yellow-rumped Warbler					1	1	
Black-and-white Warbler	2	2	3		4	11	
Black-throated Green Warbler					3	3	
Palm Warbler	4	1				5	
Yellow Warbler	7		1			8	
Ovenbird	3	4	3	2	3	15	
Common Yellowthroat	7	2	4	3	1	17	
American Redstart	8	4	5			17	
Song Sparrow	13	5	5	3	3	29	
Swamp Sparrow	1					1	
White-throated Sparrow	25	5	7	5	9	51	
Dark-eyed Junco	2	3			4	9	
Rose-breasted Grosbeak					1	1	
Common Grackle	11		2	2	1	16	
Brown-headed Cowbird				1	5	6	
Purple Finch	1	1	3	1	2	8	
Pine Siskin					1	1	
American Goldfinch	16	4	9	2	9	40	
TOTALS	189	65	84	56	135	529	

Note 1 - 50+ Bank Swallows on Survey Route E. An estimated 200 Bank Swallow nest burrows were observed in the pit face of the silt extraction site.

Ø pair of adult Canada Geese with three recently hatched goslings observed on 24 May 2003.

* recorded on 24 May 2003.

** recorded during nocturnal survey, 27 May 2003.

Mammals

No mammal species at risk was recorded during our site visits.

The ten species of mammals whose presence was documented during our 2003 visits to the three extraction properties are listed in Table 3. Tracks, sightings and fecal material suggested considerable use of the area by White-tailed Deer. There was also considerable Varying Hare sign (fecal material, browse) evident in parts of the peat extraction site.

The only mammal species at risk for which a special search was conducted was the Southern Bog Lemming (see **Methods**). Potential habitat for this species, which is believed to prefer "low damp bogs and meadows" (Peterson, 1966) was confined to the peat extraction site and, even there, appeared to be rather limited. Except for a small area around Wood Lake, the entire peat land had been cleared, drained and used for agriculture, then abandoned and is now in the very early successional stages of becoming a forest. The herbaceous layer over much of this area is heavily dominated by trailing blackberries. Only a few small, meadow-like areas were found where grasses and clovers dominated. A narrow band along the east and south boundary of Wood Lake was dominated by sphagnum/sedge/reed that might be used by these mammals. The west and north borders of the lake supported a dense growth of ericaceous shrubs (Leatherleaf, Labrador Tea, Sheep Laurel, etc.) and was lacking a herbaceous layer and thus did not provide good potential habitat for the Southern Bog Lemming.

Population levels of small mammals using the east and south borders of Wood Lake appeared to be low. It was with some difficulty that thirty small mammal runs were found, followed and feeding areas with fresh "clippings" and feces were observed. A similar search was conducted of fifteen small mammal runs in small grass/clover-dominated patches on the peat extraction site. The diagnostic lime-green feces of the Southern Bog Lemming were not found in either of these locations.

Table 3. Mammals Recorded on Mark-Lyn Properties

	Seen	Sign
Varying Hare		√ (much)
American Red Squirrel	1	√
Eastern Chipmunk	3	
Meadow Vole		√
Muskrat	1	√
American Porcupine	1	
Coyote		√
Raccoon		√
Striped Skunk		√
White-tailed Deer	2	√ (much)

AMPHIBIAN AND REPTILE, BREEDING BIRD, AND MAMMAL SPECIES AT RISK IN NOVA SCOTIA

Derivation of Species at Risk Lists

As indicated above, I have derived species at risk lists for amphibians, reptiles, breeding birds and mammals from three sources: the General Status of Wild Species in Nova Scotia as defined by the Province of Nova Scotia, the Nova Scotia (sub-national) rankings defined by the Atlantic Canada Conservation Data Centre (ACCDC), and the Canadian rankings as defined by the Committee of the Status of Endangered Wildlife in Canada (COSEWIC).

I have considered all species designated by the Province of Nova Scotia as colour ranks Red and Yellow as “species at risk”. The definitions of the Province of Nova Scotia colour rankings are as follows:

“**BLUE** (Extirpated/Extinct) – Species that are no longer thought to be present in the province or in Canada, or that are believed to be extinct. Extirpated species have been eliminated from a given geographic area but may occur in other areas. Extinct species are extirpated worldwide (i.e. they no longer exist anywhere). Species listed by COSEWIC as extinct or nationally extirpated automatically receive an Extirpated/Extinct general status rank. This rank applies at the national level and in whichever province or territory the species formerly existed. Nationally Extirpated/Extinct species are not considered part of Nova Scotia's species richness.

RED (At Risk or Maybe at Risk) – Species for which a formal detailed risk assessment has been completed (COSEWIC assessment or a provincial equivalent) and that have been determined to be at risk of extirpation or extinction and are therefore candidates for interim conservation action and detailed risk assessment by COSEWIC or the Province.

YELLOW (Sensitive) – Species that are not believed to be at risk of immediate extirpation or extinction, but which may require special attention or protection to prevent them from becoming at risk.

GREEN (Secure) – Species that are not believed to be at risk, or sensitive. This category includes some species that have declined in numbers but remain relatively widespread or abundant.

UNDETERMINED – Species for which insufficient data, information, or knowledge is available to reliably evaluate their status."
(http://www.gov.ns.ca/natr/wildlife/genstatus/background.htm)

For further information on the Province of Nova Scotia status assessment process, see the above Government of Nova Scotia web site.

I have also considered all species designated by the Atlantic Canada Conservation Data Centre as sub-national (S) ranks S1, S2, S3 for the Province of Nova Scotia as "species at risk". The sub-national rank definitions used by ACCDC are as follows:

"**S1** – Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.

S2 – Rare throughout its range in the province (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.

S3 – Uncommon throughout its range in the province, or found only in a restricted range, even if abundant in some locations. (21 to 100 occurrences).

S4 – Usually widespread, fairly common throughout its range in the province, and apparently secure with many occurrences, but the Element is of long-term concern (e.g. watch list). (100+ occurrences).

S5 – Demonstrably widespread, abundant, and secure throughout its range in the province, and essentially ineradicable under present conditions.

S#S# - Numeric range rank: A range between two consecutive numeric ranks. Denotes uncertainty about the exact rarity of the Element (e.g., S1S2).
SH - Historical: Element occurred historically throughout its range in the province (with expectation that it may be rediscovered), perhaps having not been verified in the past 20 - 70 years (depending on the species), and suspected to be still extant.

SU – Unrankable: Possibly in peril throughout its range in the province, but status uncertain; need more information."

Qualifiers for these ranks include:

"**B** – Breeding: Basic rank refers to the breeding population of the element in the province.

? – Inexact or uncertain: for numeric ranks, denotes inexactness, e.g. SE? denotes uncertainty of exotic status. (The ? qualifies the character immediately preceding it in the S rank)." (http://www.accdc.com/products/lists/ranks).

In addition, the ACCDC provides both national (N ranks) and global (G ranks) for those species. The N and G rank definitions are similar to the S ranks but applied at a national or global level. For more information on the ACCDC ranking system, see the above web site.

I have also considered those species which occur in Nova Scotia that have been designated by COSEWIC as being endangered (E), threatened (T) or of special concern (SC). The definitions for the designations used by COSEWIC are as follows:

Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)	A species for which there is insufficient scientific information to support status designation.

(http://www.cosewic.gc.ca/eng/sct0/index_e.cfm)

COSEWIC's mandate is at the national level so its rankings may vary from the other two sources that take a provincial viewpoint. Further information can be obtained regarding COSEWIC at the above web site.

The following lists include the common name of each species at risk, their status rankings by the Province of Nova Scotia, the ACCDC and COSEWIC and an assessment of their possible occurrence at or immediately adjacent to the three pit sites. Assessments of the occurrence of each species is based on our survey work, the known distribution of the species and its habitat preferences.

Amphibians and Reptiles

	Status			
	Prov. of N.S.	ACCDC	COSEWIC	
Amphibian Species	Colour Ranking	N.S. S Ranking	Canadian Ranking	Possible Occurrence At or Adjacent to Sites
Four-toed Salamander	Yellow	S3	NAR	unlikely

	Status			
	Prov. of N.S.	ACCDC	COSEWIC	
Reptile Species	Colour Ranking	N.S. S Ranking	Canadian Ranking	Possible Occurrence At or Adjacent to Sites
Blanding's Turtle	Red	S1	T	highly unlikely
Wood Turtle	Yellow	S3	SC	unlikely
Northern Ribbon Snake	Yellow	S2S3	T	highly unlikely

	Status			
	Prov. of N.S.	ACCDC	COSEWIC	
Breeding Bird Species	**Colour Ranking**	**N.S. S Ranking**	**Canadian Ranking**	**Possible Occurrence At or Adjacent to Site**
Peregrine Falcon	Red	S1B	T	highly unlikely
Piping Plover	Red	S1B	E	n/a
Roseate Tern	Red	S1B	E	n/a
Common Loon	Yellow	S4B	NAR	highly unlikely
Black-crowned Night Heron	Yellow	S1B	-	highly unlikely
Northern Goshawk	Yellow	S3B	NAR	unlikely
Common Tern	Yellow	S3B	NAR	n/a
Arctic Tern	Yellow	S3B	-	n/a
Razorbill	Yellow	S1B	-	n/a
Atlantic Puffin	Yellow	S1B	-	n/a
Long-eared Owl	Yellow	S1S2B	-	unlikely
Short-eared Owl	Yellow	S1S2B	SC	highly unlikely
Purple Martin	Yellow	S1S2B	-	highly unlikely
Eastern Bluebird	Yellow	S2S3B	NAR	highly unlikely
Bicknell's Thrush	Yellow	S1S2B	SC	highly unlikely
Vesper Sparrow	Yellow	S2S3B	-	unlikely
"Ipswich" Savannah Sparrow	Yellow	S1S2B	SC	highly unlikely
Nelson's Sharp-tailed Sparrow	Yellow	S2S3B	NAR	highly unlikely
Bobolink	Yellow	S3B	-	highly unlikely
Eastern Meadowlark	Yellow	S1S2B	-	highly unlikely
Least Bittern	Green	S1B	T	highly unlikely
Northern Pintail	Green	S2B	-	highly unlikely
Northern Shoveler	Green	S2B	-	highly unlikely
Gadwall	Green	S2B	-	highly unlikely
Common Goldeneye	Green	S2B	-	highly unlikely
Red-breasted Merganser	Green	S2S3B	-	highly unlikely
Cooper's Hawk	Green	S1?B	NAR	highly unlikely
Merlin	Green	S3S4B	-	unlikely

continued on next page

	Status			
	Prov. of N.S.	ACCDC	COSEWIC	
Breeding Bird Species (*cont.*)	**Colour Ranking**	**N.S. S Ranking**	**Canadian Ranking**	**Possible Occurrence At or Adjacent to Site**
Virginia Rail	Green	S2B	-	highly unlikely
Common Moorhen	Green	S1B	-	highly unlikely
American Coot	Green	S2B	-	highly unlikely
Semipalmated Plover	Green	S2B	-	highly unlikely
Greater Yellowlegs	Green	S2B	-	highly unlikely
Solitary Sandpiper	Green	S1B	-	highly unlikely
Upland Sandpiper	Green	S1B	-	highly unlikely
Least Sandpiper	Green	S1B	-	highly unlikely
Wilson's Phalarope	Green	S1B	-	highly unlikely
Black-legged Kittiwake	Green	S2B	-	n/a
Black Tern	Green	S1B	NAR	highly unlikely
Black-billed Cuckoo	Green	S3B	-	unlikely
Boreal Owl	Green	S1?B	-	highly unlikely
Whip-poor-will	Green	S2B	-	highly unlikely
Willow Flycatcher	Green	S1B	-	highly unlikely
Eastern Phoebe	Green	S2S3B	-	unlikely
Great Crested Flycatcher	Green	S2S3B	-	unlikely
Horned Lark	Green	S2B	-	unlikely
Boreal Chickadee	Green	S3S4B	-	unlikely
Marsh Wren	Green	S2B	-	highly unlikely
Wood Thrush	Green	S2B	-	highly unlikely
Northern Mockingbird	Green	S3B	-	unlikely
Brown Thrasher	Green	S1S2B	-	highly unlikely
Loggerhead Shrike	Accidental	SHB	E	highly unlikely
Warbling Vireo	Green	S2B	-	highly unlikely
Philadelphia Vireo	Green	S2B	-	highly unlikely
Scarlet Tanager	Green	S3B	-	unlikely
Northern Cardinal	Green	S3B	-	unlikely
Indigo Bunting	Green	S2S3B	-	highly unlikely
Rusty Blackbird	Green	S3S4B	-	possible
Baltimore Oriole	Green	S3B	-	unlikely

Mammals

	Status			
	Prov. of N.S.	ACCDC	COSEWIC	
Mammal Species	**Colour Ranking**	**N.S. S Ranking**	**Canadian Ranking**	**Possible Occurrence At or Adjacent to Site**
Eastern Cougar	Undetermined	SU	DD	highly unlikely
American Marten	Red	S1	-	highly unlikely
Lynx	Red	S1	NAR	highly unlikely
Moose	Red	S1	-	highly unlikely
Eastern Pipistrelle	Yellow	S1?	-	possible
Fisher	Yellow	S2	-	unlikely
Gaspé Shrew	Yellow	S2	SC	highly unlikely
Hoary Bat	Yellow	S2?	-	unlikely
Little Brown Bat	Yellow	S4	-	possible
Long-tailed Shrew	Yellow	S1	-	highly unlikely
Northern Long-eared Bat	Yellow	S2	-	possible
Red Bat	Yellow	S2?	-	unlikely
Silver-haired Bat	Yellow	S1?	-	unlikely
Southern Flying Squirrel	Yellow	S1	SC	unlikely
Southern Bog Lemming	Green	S3S4	-	unlikely
Rock Vole	Green	S2	-	highly unlikely

IMPACT OF PIT OPERATIONS

Nature of Potential Impacts

The main impacts of extraction operations on wildlife are:

1) the direct removal of habitat
2) an increase in noise levels and hence disturbance of wildlife in adjacent habitats.

Removal of habitat generally leads to a decrease in the numbers of those species dependent upon that habitat. Noise can similarly lead to the exclusion of sensitive individuals or species from appropriate habitats or lead to increased mortality or depressed reproductive rates in those individuals occupying the disturbed habitats.

Vegetation that will be removed during the expansion of the three extraction sites will consist mainly of dense growths of early successional tree saplings on the abandoned agricultural lands in the peat extraction site (I understand that peat extraction operations will be conducted in such a manner as not to impact the Wood Lake area.), very early regeneration in the areas that have recently been clear cut on the silt extraction site, and some very small patches of young mixed forest on the sand extraction site. Wildlife habitats provided by this vegetative cover are common in this highly disturbed area where resource extraction, residential development and agriculture prevail.

The potential for impact on wildlife species from noise generated from extraction operations on these sites would appear to be limited. Firstly, the noise levels generated by the machinery currently being used in the pit operations (loader, screener, small bulldozer, two tandem trucks) are not particularly high. Secondly, current activities in areas surrounding the pit sites are the source of relatively high levels of noise: Highway 101 is the northern boundary of two of the properties, a very large and active aggregate extraction operation extends along the entire southern boundary of the three properties and northwards to occupy the property that separates the pit sites being considered , and a secondary road and residential area forms the western boundary (see Figure 1). By far the highest levels of noise that I experienced during my site visits was at the silt pit and was generated by dirt bikes and ATV's being used for recreation. I therefore believe that any noise generated by extraction activities at the three sites will have little incremental impact on wildlife beyond the boundaries of these properties.

Amphibians and Reptiles

The only amphibian species at risk in Nova Scotia is the Four-toed Salamander (yellow, S3S4). Four-toed Salamanders have been found in scattered locations in Nova Scotia with only a single record from Kings County (August 2002) and this was from the southeastern boundary of the county (Nova Scotia Herptofaunal Atlas). The only possible breeding habitat for this species on these properties would be along the shoreline of Wood Lake. No Four-toed Salamanders were found in our studies of this area; however, this small secretive species is easy to overlook.

Four-toed Salamanders require a layer of sphagnum situated over water in which to lay their eggs during April and early May (Gilhen, 1984). During my visits to Wood Lake in late May and June, water levels were such that all sphagnum along the water's edge was submerged. This changed during the summer months; however, I believe that water levels during the time when eggs are being laid would have been as high or higher than those witnessed in late May and June. If this is so, then any potential egg-laying habitat would be unavailable to Four-toed Salamanders during their egg-laying period.

As noted previously, Wood Lake is highly acidic. High levels of acidity are known to affect the growth of salamanders and, presumably, their viability. These factors, together with the apparent scarcity of this species within Kings County makes it most unlikely that it would inhabit Wood Lake. Even in the most unlikely event that the Four-toed Salamander does occur in the Wood Lake area, this area should not be directly impacted by the peat extraction operations currently proposed by Mark-Lyn Construction.

Two of the reptile species at risk, Blanding's Turtle (red, S1) and the Northern Ribbon Snake (yellow, S2S3), are relic disjunct populations confined to central southwestern Nova Scotia. The third species, the Wood Turtle (yellow, S3), is widely dispersed with most records coming from the northeastern mainland and southeastern Cape Breton.

The ACCDC database identifies the Wood Turtle as a species at risk that might possibly occur in this area. This is based on a single dead specimen found in this general area in 1950. In the late summer of 2002, a live Wood Turtle was found in Coldbrook near the Cornwallis River (Tom Herman, *pers. comm.*). Although it is not absolutely certain that this turtle had not been released from captivity, Dr. Herman's opinion is that it was indeed a wild specimen.

As already indicated, no basking Wood Turtles were found in our 24 May 2003 search of the Wood Lake shoreline and the drainage ditches in the peat extraction property. Dr. Tom Herman (*pers. comm.*) advised that surveys conducted in northeastern Nova Scotia during this time period were quite successful in locating basking Wood Turtles.

The habitats provided by Wood Lake and the drainage ditches of the peat extraction property would not appear to be appropriate for Wood Turtles. Wood Turtles prefer clear, slow-moving streams with sand or gravel bottoms and embankments upon which they can bask on warm spring days. Wood Lake is essentially an isolated acidic pond and the ditches draining the peat extraction property are filled with acidic water that is black in colour (peat tannins) and the near vertical peat embankments that form the main ditches would make basking or even escape from these ditches difficult if not impossible. I think it most unlikely that Wood Turtles would be found using habitats on these extraction sites.

Breeding Birds

As indicated above, 57 bird species that probably breed on or adjacent to the extraction properties were identified during our site visits of May and June 2003. None of these are species at risk.

A search of the ACCDC database indicated that seven bird species at risk had been recorded within the general vicinity of these sites. These species are Northern Goshawk (yellow, S3B), Eastern Bluebird (yellow, S2S3B), Bobolink (yellow, S3B), Eastern Phoebe (green, S2S3B), Scarlet Tanager (green, S3B), Rusty Blackbird (green, S3S4B) and Baltimore Oriole (green, S3B). In studies I have conducted recently (Alliston, 2003) in the vicinity of these sites I have found two additional species at risk apparently nesting: Vesper Sparrow (yellow, S2S3B) and Horned Lark (green, S2B). With minor exceptions, appropriate nesting habitat is not available for these uncommon species either on or immediately adjacent to the pit sites.

Nesting Northern Goshawks can have very large home ranges, sometimes exceeding 2000 ha. Although these home ranges can include a variety of habitats, the nest site is generally confined to very specific habitat. Their preferred nesting habitat is in sizeable tracts of tall mature trees with a somewhat open understory. Nesting Northern Goshawks are particularly sensitive to human disturbance in the vicinity of their nest sites (Mark Elderkin, *pers. comm.*). The current levels of human activity and the lack of appropriate nesting habitat on or adjacent to these extraction sites make it most unlikely that the Northern Goshawk would nest within the vicinity of these extraction sites.

Open areas with low vegetation and scattered trees containing nesting cavities are required habitat for Eastern Bluebirds. Bobolinks require lush hayfields, pastureland or meadows in which to nest. Eastern Phoebes generally nest near water, often on man-made structures: culverts, bridges, overhangs on buildings, and rock walls as well as naturally occurring rock faces. Scarlet Tanagers prefer mature deciduous forest while Baltimore Orioles prefer open deciduous forest and show a marked preference for nesting in American Elm trees. Horned Larks prefer large, open sparsely vegetated areas in which to nest. Within about 3km of these sites, I have recorded this species apparently nesting in a large field used for cash crop production (Alliston, 2003). These habitat requirements are not met either on or immediately adjacent to the three properties.

The small boggy area to the southwest of Wood Lake might be moderately attractive to nesting Rusty Blackbirds. This species, which reaches the southern limit of its breeding range in Nova Scotia, appears to be even less abundant in the Annapolis Valley in recent years, possibly as a result of the hotter drier summers we have been experiencing. Wood Lake, and the small boggy area to the southwest of the lake, should not be materially affected by the peat extraction operations proposed by Mark-Lyn Construction.

It is possible that Vesper Sparrows might find some nesting habitat on the silt pit property, either in the sparsely vegetated areas around the pit or the clear cut areas. Habitats such as these are quite widely available in this part of the Annapolis Valley. The only Vesper Sparrows I have observed in this area (about 3km from this site) were apparently nesting in large fields in which cash crops were being grown (Alliston, 2003).

Mammals

Although no bats were seen during our nocturnal survey of the sites, it is possible that several bat species considered to be at risk in Nova Scotia could frequent these three properties during their nocturnal foraging.

There is, however, little information available concerning the distribution, numbers and habitat use of bats in Nova Scotia. Recent work by Broders *et al.* (2003) confirms that, in southwestern Nova Scotia, the two *Myotis* species (Little Brown Bat and Northern Long-eared Bat) are the most common species and the Eastern Pipistrelle may be locally common. Broders *et al.* suggest that the small numbers of observations recorded for the other three species (Hoary, Red and Silver-haired Bats) in Nova Scotia might represent extralimital occurrences.

Three migratory bat species (Silver-haired, Red and Hoary) that are solitary during June and July, when the young are reared, roost singly in trees during daylight hours. Noise from the pit operations could cause these bats to change their day roost sites. In the unlikely event that these species were to occur at these sites, alternate roost sites would probably be found easily and the potential for impact on these species is probably minimal.

The females of the two *Myotis* species often form "maternity" colonies where the young are reared. Disturbance of these colonies could impact the survival of the young. Although maternity colonies of both species can be in tree cavities, female Little Brown Bats show a decided preference for buildings (Peterson, 1974; Schowalter *et al.*, 1979.). In southern New Brunswick, Broders and Forbes (*in press*) found that female Northern Long-eared Bats that had maternity colonies in tree cavities showed a very marked preference for shade tolerant hardwood trees in mature hardwood dominated stands. Conversely, the males of both the Northern Long-eared Bat and the Little Brown Bat showed a marked preference for roosting sites in softwood trees in softwood stands or softwood dominated mixed stands. Since there are no mature shade-tolerant hardwood stands on or adjacent to these sites, it would appear that the pit sites and adjacent woodlands would provide much better habitat for roosting males than for maternity colonies of females. Alternate roost sites for singly roosting male Northern Long-eared and Little Brown Bats would probably be easily found.

Female Eastern Pipistrelles are also known to form maternity colonies; in other parts of North America colonies have been recorded in buildings, tree foliage and rock crevices. Rock crevices are not present on or immediately adjacent to these properties. Current thinking is that roosting colonies are "often (hidden) inside a clump of dead leaves in an otherwise healthy (deciduous) tree" (Kurta, 2001.) although this is based on rather limited data. Alternate tree roost sites would probably be found easily.

There are no known caves on the property that could provide roosts or hibernacula for any of the resident bat species.

While it was previously thought that the Southern Flying Squirrel (yellow, S1) was restricted to southwestern Nova Scotia, in the mid-1980's this species was found in Kings County. Recent studies have shown this species to be more wide spread with scattered records from various locations in the Annapolis Valley and elsewhere (Amanda Lavers, unpublished). Southern Flying Squirrels have been recorded as close to the extraction sites as Kentville (~ 11 km).

This secretive nocturnal species is generally associated with older mixed forests where snags and cavities in old living trees provide it with shelter, and fungi from the forest floor and mast crops from Red Oak and American Beech provide a food supply. Current thinking is that the two essential elements of habitat required to support a Southern Flying Squirrel population in Nova Scotia are the presence of tree cavities and acorn-producing Red Oaks (Tom Herman, *pers. comm.*). A few Red Oaks of seed-producing size are found on these sites, mainly at the southeastern extremity of the silt pit property, as scattered trees in what remains of the forest cover at the sand pit property, and on an adjacent property immediately south of the current peat extraction operations. The forest fragments in which the Red Oaks occur are very small and far from being mature. I therefore believe it is most unlikely that Southern Flying Squirrels inhabit either the extraction sites or areas immediately adjacent to them.

The search for the Southern Bog Lemming in the few, very small fragments of habitat on the peat extraction property that might support this species, produced no evidence that this species exists on this site. If this species were to occur here, it would most likely be found along the south and east shoreline of Wood Lake, The peat extraction operation is not expected to have a direct impact on Wood Lake. Thus, in the unlikely event that Southern Bog Lemmings do occur on the site, it is still unlikely that the peat extractions operations, as proposed, would have any impact upon them.

Summary

1) **The one amphibian species at risk in Nova Scotia, the Four-toed Salamander, is not believed to occur on any of these extraction properties. Marginal habitat for this species exists in one location (Wood Lake) and proposed extraction operations should not directly affect this location.**
2) **None of the three reptiles species at risk in Nova Scotia are believed to occur on these properties.**
3) **No bird species at risk are known to nest on or immediately adjacent to these properties. Potential nesting habitat for Rusty Blackbirds exists around Wood Lake; however, this habitat will not be affected by extraction operations.**
4) **The only mammal species at risk that might use these sites are bats during their nocturnal foraging. It is most unlikely that maternity colonies of the Little Brown Bat and the Northern Long-eared Bat would be found on or immediately adjacent to these properties.**
5) **Given their apparent lack of use of the extraction properties, no amphibian, reptile, breeding bird, or mammal species considered at risk in Nova Scotia should be impacted detrimentally by the proposed extraction operations.**

IMPACT MITIGATION

Since no amphibian, reptile, breeding bird, or mammal species at risk is believed to use the extraction properties or areas immediately adjacent to them, no mitigative measures are proposed for these select species. However, to meet its obligations under the Migratory Birds Convention Act, Mark-Lyn Construction should consider:

1) not removing material from embankments used for nesting by such species as Belted Kingfisher and Bank Swallows during the period when nests are active (May through July);
2) stripping areas of their vegetation cover, and the wildlife and bird nesting habitat it supports, only during the period when birds are not nesting (August through March);
3) avoiding, where possible, the nests of ground-nesting species that are attracted to extraction sites (e.g. Killdeer, Spotted Sandpiper, Common Nighthawk);
4) assuring that all toxic materials that are used in the extraction operations (gasoline, diesel fuel, engine oil, hydraulic fluid, etc.) are not accessible to birds and other wildlife. Any accidental spills of toxic materials should be dealt with expeditiously using protocols that are described elsewhere in this submission.

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Web Sites

Atlantic Canada Conservation Data Centre – http://www.accdc.com

COSEWIC – http://www.cosewic.gc.ca

Environment Canada - http://www.speciesatrisk.gc.ca/

Environment Canada - http://www.on.ec.gc.ca/wildlife/wildspace/

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Nova Scotia Department of Natural Resources - http://www.gov.ns.ca/natr/wildlife/

Nova Scotia Museum of Natural History - http://museum.gov.ns.ca/mnh/

University of Michigan, Museum of Zoology - http://www.ummz.lsa.umich.edu/

U.S. Forestry Service - http://www.fs.fed.us/database/feis/

Herptofaunal Atlas - database - http://landscape.acadiau.ca/herpatlas/

APPENDIX 1
COMMON AND SCIENTIFIC NAMES OF PLANTS AND ANIMALS CITED IN THIS ANALYSIS

Trees

Common Name	Scientific Name
American Beech	*Fagus grandifolia*
American Elm	*Ulnus americana*
Balsam Fir	*Abies balsamea*
Birch species	*Betula spp.*
Black Spruce	*Picea mariana*
Eastern Hemlock	*Tsuga canadensis*
Eastern Larch	*Larix laricina*
Poplar species	*Populus spp.*
Red Maple	*Acer rubrum*
Red Oak	*Quercus rubra*
Red Pine	*Pinus resinosa*
Red Spruce	*Picea rubens*
White Pine	*Pinus strobus*
White Spruce	*Picea glauca*

Other Plants

Common Name	Scientific Name
Blackberry species	*Rubus spp.*
Labrador Tea	*Ledum groenlandicum*
Leatherleaf	*Chamaedaphne calyculata*
Sheep Laurel	*Kalmia angustifolia*
Sphagnum species	*Sphagnum spp.*

Amphibians

Common Name	Scientific Name
American Toad	*Bufo americanus*
Four-toed Salamander	*Hemidactylium scutatum*
Green Frog	*Rana clamitans*
Mink Frog	*Rana septentrionalis*
Northern Leopard Frog	*Rana pipiens*
Pickerel Frog	*Rana palustris*
Spring Peeper	*Pseudacris crucifer*

Reptiles

Common Name	Scientific Name
Blanding’s Turtle	*Emydoidea blandingi*
Eastern Painted Turtle	*Chrysemys picta picta*
Northern Ribbon Snake	*Thamnophis sauritus septentrionalis*
Wood Turtle	*Clemmys insculpta*

Birds

Common Name	Scientific Name
Alder Flycatcher	*Empidonax alnorum*
American Black Duck	*Anas rubripes*
American Coot	*Fulica Americana*
American Crow	*Corvus brachrhynchos*
American Goldfinch	*Carduelis tristis*
American Redstart	*Setophaga ruticilla*
American Robin	*Turdus migratorius*
American Woodcock	*Scolopax minor*
Arctic Tern	*Sterna paradisaea*
Atlantic Puffin	*Fratercula arctica*
Baltimore Oriole	*Icterus galbula*
Bank Swallow	*Riparia riparia*
Barred Owl	*Strix varia*
Belted Kingfisher	*Ceryle alcyon*
Bicknell's Thrush	*Catharus bicknelli*
Black Tern	*Chlidonias niger*
Black-and-white Warbler	*Mniotilta varia*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Black-capped Chickadee	*Poecile atricapilla*
Black-crowned Night Heron	*Nycticorax nycticorax*
Black-legged Kittiwake	*Rissa tridactyla*
Black-throated Green Warbler	*Dendroica virens*
Blue Jay	*Cyanocitta cristata*
Blue-headed Vireo	*Vireo solitarius*
Bobolink	*Dolichonyx oryzivorus*
Boreal Chickadee	*Poecile hudsonica*
Boreal Owl	*Aegolius funereus*
Brown Thrasher	*Toxostoma rufum*
Brown-headed Cowbird	*Molothrus ater*
Canada Goose	*Branta canadensis*
Cedar Waxwing	*Bombycilla cedrorum*
Chestnut-sided Warbler	*Dendroica pensylvanica*
Chimney Swift	*Chaetura pelagica*
Common Goldeneye	*Bucephala islandica*
Common Grackle	*Quiscalus quiscula*
Common Loon	*Gavia immer*
Common Moorhen	*Gallinula chloropus*
Common Nighthawk	*Chordeiles minor*

Birds (continued)

Common Name	**Scientific Name**
Common Raven	*Corvus corax*
Common Yellowthroat	*Geothlypis trichas*
Common Tern	*Sterna hirundo*
Cooper's Hawk	*Accipiter cooperii*
Dark-eyed Junco	*Junco hyemalis*
Downy Woodpecker	*Picoides pubescens*
Eastern Bluebird	*Sialia sialis*
Eastern Phoebe	*Sayornis phoebe*
Eastern Meadowlark	*Sturnella magna*
Eastern Wood-Pewee	*Contopus virens*
European Starling	*Sturnus vulgaris*
Gadwall	*Anas strepera*
Gray Catbird	*Dumetella carolinensis*
Great Crested Flycatcher	*Myiarchus crinitus*
Great Horned Owl	*Bubo virginianus*
Greater Yellowlegs	*Tringa melanoleuca*
Green-winged Teal	*Anas crecca*
Hairy Woodpecker	*Picoides villosus*
Hermit Thrush	*Catharus guttatus*
Herring Gull	*Larus argentatus*
Horned Lark	*Eremophila alpestris*
Indigo Bunting	*Passerina cyanea*
"Ipswich" Savannah Sparrow	*Passerculus sandwichensis princeps*
Killdeer	*Charadrius vociferus*
Least Bittern	*Ixobrychus exilis*
Least Flycatcher	*Empidonax minimus*
Least Sandpiper	*Calidris minutilla*
Loggerhead Shrike	*Lanius ludovicianus*
Long-eared Owl	*Asio otus*
Magnolia Warbler	*Dendroica magnolia*
Mallard	*Anas platyrhynchos*
Marsh Wren	*Cistothorus palustris*
Merlin	*Falco columbarius*
Mourning Dove	*Zenaida macroura*
Nashville Warbler	*Vermivora ruficapilla*
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*
Northern Cardinal	*Cardinalis cardinalis*
Northern Flicker	*Colaptes auratus*

Birds (continued)

Common Name	Scientific Name
Northern Goshawk	*Accipiter gentilis*
Northern Mockingbird	*Mimus polyglottos*
Northern Parula	*Parula americana*
Northern Pintail	*Anas acuta*
Northern Saw-whet Owl	*Aegolius acadicus*
Northern Shoveler	*Anas clypeata*
Ovenbird	*Seiurus aurocapillus*
Palm Warbler	*Dendroica palmarum*
Peregrine Falcon	*Falco peregrinus*
Philadelphia Vireo	*Vireo philadelphicus*
Pileated Woodpecker	*Dryocopus pileatus*
Pine Siskin	*Carduelis pinus*
Piping Plover	*Charadrius melodus*
Purple Finch	*Carpodacus purpureus*
Purple Martin	*Progne subis*
Razorbill	*Alca torda*
Red-breasted Merganser	*Mergus serrator*
Red-breasted Nuthatch	*Sitta canadensis*
Red-eyed Vireo	*Vireo olivaceus*
Red-tailed Hawk	*Buteo jamaicensis*
Ring-necked Pheasant	*Phasianus colchicus*
Roseate Tern	*Sterna dougallii*
Rusty Blackbird	*Euphagus carolinus*
Scarlet Tanager	*Piranga olivacea*
Semipalmated Plover	*Charadrius semipalmatus*
Short-eared Owl	*Asio flammeus*
Song Sparrow	*Melospiza melodia*
Spotted Sandpiper	*Actitis macularia*
Swamp Sparrow	*Melospiza georgiana*
Upland Sandpiper	*Bartramia longicauda*
Veery	*Catharus fuscescens*
Vesper Sparrow	*Pooecetes gramineus*
Virginia Rail	*Rallus limicola*
Warbling Vireo	*Vireo gilvus*
Willow Flycatcher	*Empidonax trailii*
Wilson's Phalarope	*Phalaropus tricolor*
Whip-poor-will	*Caprimulgus vociferus*
White-throated Sparrow	*Zonotrichia albicollis*

Birds (coninued)

Common Name	Scientific Name
Wood Thrush	*Hylocichla mustelina*
Yellow Warbler	*Dendroica petechia*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Yellow-rumped Warbler	*Dendroica coronata*

Mammals

Common Name	Scientific Name
American Marten	*Martes americana*
American Porcupine	*Erethizon dorsatum*
American Red Squirrel	*Tamiasciurus hudsonicus*
Coyote	*Canis latrans*
Eastern Cougar	*Felis concolor*
Eastern Chipmunk	*Tamias striatus*
Eastern Pipistrelle	*Pipistrellus subflavus*
Fisher	*Martes pennanti*
Gaspé Shrew	*Sorex gaspensis*
Hoary Bat	*Lasiurus cinereus*
Little Brown Bat	*Myotis lucifugus*
Long-tailed Shrew	*Sorex dispar*
Lynx	*Lynx canadensis*
Moose	*Alces alces*
Muskrat	*Ondatra zibethicus*
Northern Long-eared Bat	*Myotis septentrionalis*
Raccoon	*Procyon lotor*
Red Bat	*Lasiurus borealis*
Rock Vole	*Microtus chrotorrhinus*
Silver-haired Bat	*Lasionycteris noctivagans*
Striped Skunk	*Mephitis mephitis*
Southern Bog Lemming	*Synaptomys cooperi*
Southern Flying Squirrel	*Glaucomys volans*
Varying Hare	*Lepus americanus*
White-tailed Deer	*Odocoileus virgianus*

Appendix D

Fish and Fish Habitat Assessment Of Baltzer Bog and Wood Lake

Aquatic Habitat and Fish Assessment of Baltzers Bog and Wood Lake

April 2004
Final Report

Prepared for:

Mark-Lynn Construction and
Terry Hennigar, M.Sc P.ENG F.C.S.C.E
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By
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Ocean Valley Aquatics
Aquaculture, Fisheries, and Environmental Consulting

Fish and Fish Habitat Assessment
Of Baltzers Bog and Wood Lake

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Executive Summary

A survey for the presence of fish and fish habitat in waters and the lake located on or near the site of the current and proposed peat excavation site, operated by Mark Lynn Construction, was requested by Terry Hennigar acting on behalf of Mark Lynn Construction (the proponent).

A fish sampling program was designed and carried out on Sept 2, 2003 sampling the waters in lower, upper and in the Wood Lake areas of Baltzers Bog. The site was separated in to 7 random testing sites, and a number of water quality and fish habitat parameters were measured.

The fish survey was carried out and the results show that Baltzers Bog has no aquatic fish life in any of the water ways on the property of the proposed site. The water quality tests had shown very acidic Ph and low dissolved oxygen, as well as high water temperatures and an abundance of algae in the water columns.

The reason this bog is absent of fish may be due to a natural process that makes a bog uninhabitable for fish. This may also be the reason that the body of water on the property, referred to as Wood Lake is no more than a shallow pond. It seems that it is a possibility that what we refer to as Baltzers Bog now may have been a lake 100 or 200 years ago, and what is left of Wood Lake is what would be referred to as the eye of a bog.

The biological and geological process that changes some lakes and ponds with steep banks and poor drainage into a bog is the same process that makes the water in any bog uninhabitable for fish. Bogs usually form in areas that once had been covered by glaciers up to about ten thousand years ago. After glaciers retreat they often leave behind kettle-hole lakes that fill with water and usually have neither an inlet nor an outlet.

A bog may starts as a lake or a large pond, but over time as the water grows stagnant and the vegetation grows thicker, the body of water may turn into a wet land or marsh. At this point in time fish may still inhabit the waters that use to be a lake, but as the wet land slowly turns into a bog a chemical change takes place. This chemical change takes place is when thick mats of moss start covering the water.

These mats covered in shrubs and sedges eventually die or sink to the bottom and start the decomposition process along with all the other vegetation that may fall to the bottom. This process of growth and die off contributes large quantities of fertilizer for the next year's seasonal growth of moss, sedges, water lilies and algae. Over the years this process will fill in a body of water and create very high acidic pH level from the rotting material and low dissolved oxygen is due to the substantial use of oxygen by the bacteria that is involved in the decomposition process.

So due to the process that has changed Baltzers Bog in to what it is today, it may also have degraded the water quality and fish habitat to the point that no fish could live in it.

Introduction

As part of the environmental assessment of the Mark Lynn Construction site, a fish survey was undertaken within the surface water of Baltzers Bog. The purpose of the survey is to determine if fish species are found within these waters. The aim of this study was to evaluate the quality of the water and the fish habitat (i.e., good or poor) and find evidence of fish populations in the waters on the property where the proposed peat excavation expansion is to take place.

Methodology

The survey consisted of a walk through of the entire area on August 28, 2003 followed by a day of water sampling and a fish habitat survey, as well as a day of fish seining. Tests and equipment utilized are; dissolved oxygen (DO) levels and temp where recorded using a (YSI Model 95 handheld DO and temp system) ph was recorded with a (Lamont ph titration kit). The fish seining was carried out with a seining net and a dip net, a presents/absence method was utilized.

August 28, 2003

The walk-through was made by Derick Fritz, Aq.t/Biol (Ocean Valley Aquatics). Beginning at Baltzers Bog entrance that leads into Ditched area, the general water course was "walked" from the entrance in a zig zag pattern over the whole property up to the Wood Lake and along the main ditch that runs across Shaws Resources and down to the Cornwallis River. Visual observations were made as to the general quality of the habitat and any fish seen were noted.

September 2, 2003

Water quality and a fish habitat survey was carried out by Derick Fritz, Aq.t/Biol. Water was sampled by use of YSI Model 95 handheld DO and Temp system and a Lamont PH titration kit. Sampling was carried out at 7 sites in Baltzers Bog (Figure1). Quality of the fish habitat was noted looking at canopy cover, riparian growth, substrate, and flow.

September 3, 2003

Fish sampling was carried out by Derick Fritz, Aq.t/Biol and Derrick Andrews " Technician" (Ocean Valley Aquatics). Fish were sampled by use of dipping nets and seining nets. Sampling was carried out at 7 sites in the Baltzers Bog area (Figure1). A presence absence method was utilized.

Results

This study has shown the absence of fish in the waters located on the site. Table 1 summarizes the observations made at each sampling site, including the number and species of fish found at each location. It was found that there was poor fish habitat and most fish could not survive in the waters located in the Bog.

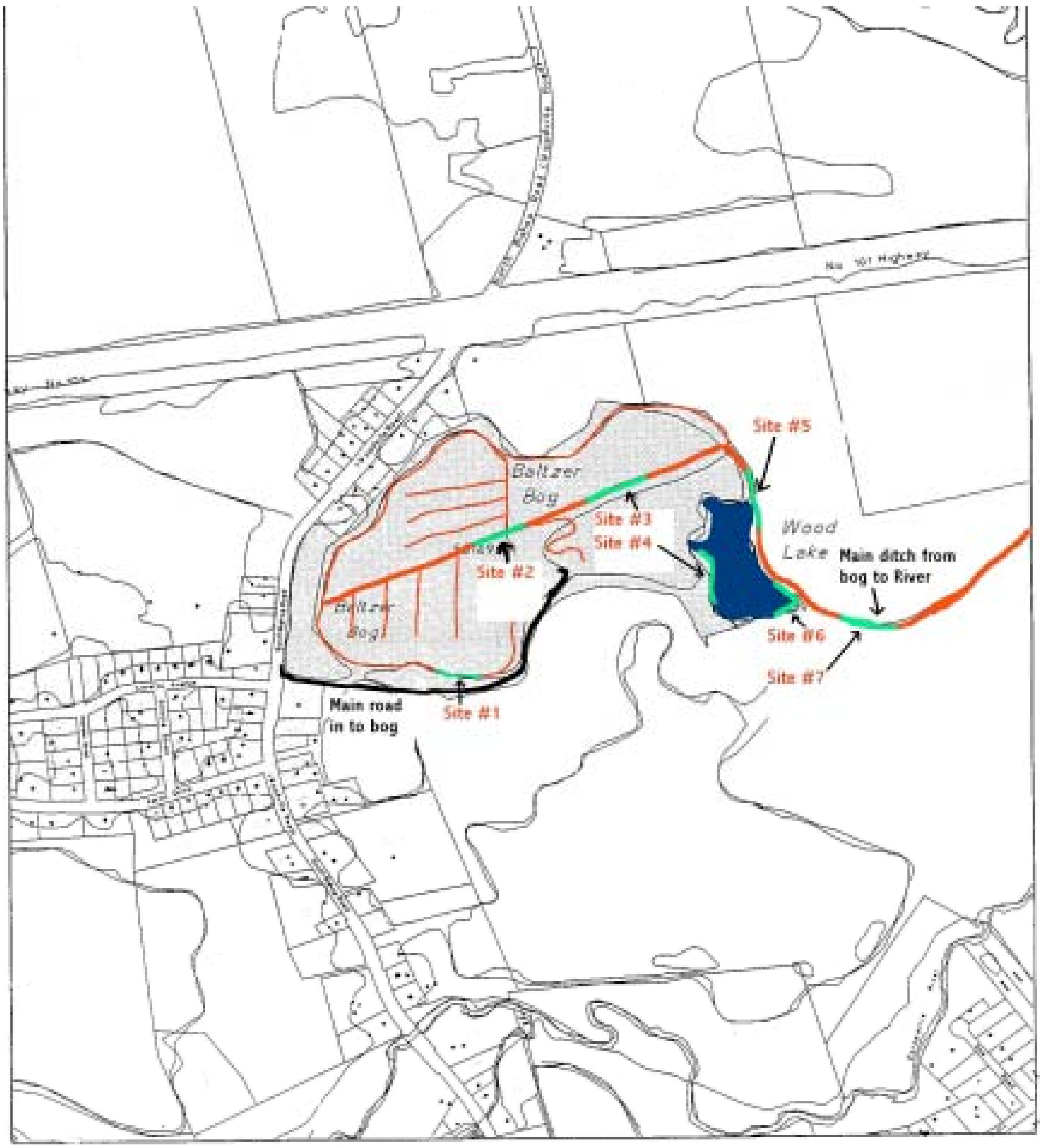

Figure 1. Baltzers Bog testing sites # 1 to #7. (Not to scale)

Table 1. Observations from fish sampling at 7 sites within Baltzer Bog.

Site	Location	Suckers	Creek Chubs	Eel	Stickle Back	Lake Trout	length/meters FS
1	left off road in to bog	0	0	0	0	0	15/m
2	in main ditch at "t"	0	0	0	0	0	25/m
3	main ditch north east	0	0	0	0	0	35/m
4	west side of Wood Lake	0	0	0	0	0	15/m
5	main ditch east side bog	0	0	0	0	0	25/m
6	south east side of Lake	0	0	0	0	0	15/m
7	main ditch on Shaw's pro	0	0	0	0	0	35/m

Site	Canopy cover %	Substrate dominant/sec dominant	Riparian growth %	comments
1	97 %	Silt/peat	100%	dense growth no flow
2	5 %	Silt/peat	2%	limited flow orange growth
3	20%	Silt/pebble	0%	limited flow high sediment loa
4	0%	Peat/ Other organic material	100%	no flow dense growth in lake
5	90%	Silt/pebble	0%	little flow silty water
6	0%	Peat/ Other organic material	100%	no flow dense growth in lake
7	65%	Pebble/cobble	0%	no flow

Site	Dissolved Oxygen mgl/%	Water Temp	PH	Observations
1	4.85 mgl/46%	16.1ºC	<4.5	Acidic
2	6.26 mgl/70%	20.5ºC	<4.5	Acidic
3	5.53 mgl/60%	21ºC	<4.5	Acidic
4	6.3 mgl/70%	21ºC	<4.5	Acidic
5	5.0 mgl/55%	23ºC	<4.5	Acidic
6	6.34 mgl/70%	21ºC	<4.5	Acidic
7	4.93 mgl/58%	26ºC	5.6	ok ph water is shallow

The fish species listed above are some that may be found in some local wet lands. The reason that are listed when presence of fish were absent is to give some kind of idea how far beyond a wetland/or lake this bog may have evolved. The absence of any species of fish was of no surprise after examining the habitat, and water quality. The lack off habitat was a limiting factor, but the water quality is at the point that it can not sustain fish life. The PH levels are to high, the DO is to low, and most of the water temp recorded are very high.

The lack of even minnows such as stickle backs that can tolerate degraded water quality show just how poor the water quality is. Although there was an abundance of frog, snakes, and water skippers observed, the water is just to acidic from the decomposition process of organic material surrounding the waters. One of the contributing factors of the absence of fish is the seasonal flow and the steep gradient at the mouth of the channel leading to the Cornwallis River.

We also sampled Wood Lake in two areas along the edge but do to the soggy unstable structure of the ground surrounding the body of shallow water any further attempts would have put my self and crew at risk. It was also observed that the body of water referred to as Wood Lake lacks an inlet and/or an outlet, thus meaning Wood Lake is land locked. This means that there is no opportunity for fish to migrate in or out of the lake.

Presence of Fish

With regards to the ditch that originates on the Baltzers Bog property and runs across adjacent lands emptying into the Cornwallis River, this area of the Cornwallis River is very similar to the rest in water chemistry and geology. From a fisheries point of view, the Cornwallis River is considered an Inner Bay of Fundy Atlantic Salmon run river. The river also possesses a large population of Brown Trout, and Brook Trout as well as numerous other species of fishes. Some of the species of fish that populate the Cornwallis River are; (Note list is not conclusive).

Table 2. Table of Fish found in the Cornwallis River Watershed.

Anadromous fish	**Freshwater fish**	**Estuarine fish**
Sea lamprey	Brook trout	Mummichog
Blueback herring	Banded killifish	Atlantic silverside
	Golden shiner	White perch
Alewife	Blacknose shiner	
American shad	Yellow perch	
Atlantic salmon	Brown trout	
Rainbow smelt	Small mouth bass	
Striped bass	White perch	
Gaspereau		
Atlantic tomcod	**Catadromous fish**	
	American eel	

Blomidon Naturalists Society, 1993.

Fish Habitat

The Cornwallis Rivers base level (at the intersection of the ditch and river) is considerably lower in elevation to the mouth of the drainage ditch (approximately 20 feet). The Cornwallis River could be considered a spring fed river, meaning the influence of cool springs feeding the river keeps the river considerably cool and thermally stable year around. The Dissolved Oxygen (DO), pH, and water temperatures are suitable for the local populations of fresh water fish to thrive. This is partly due to the coldwater springs and recharge areas feeding the river and tributaries. There is an abundance of

Calcium Carbonate deposits found in the Sand Stone underling most of the Cornwallis Watershed helping to buffer pH in the surface water.

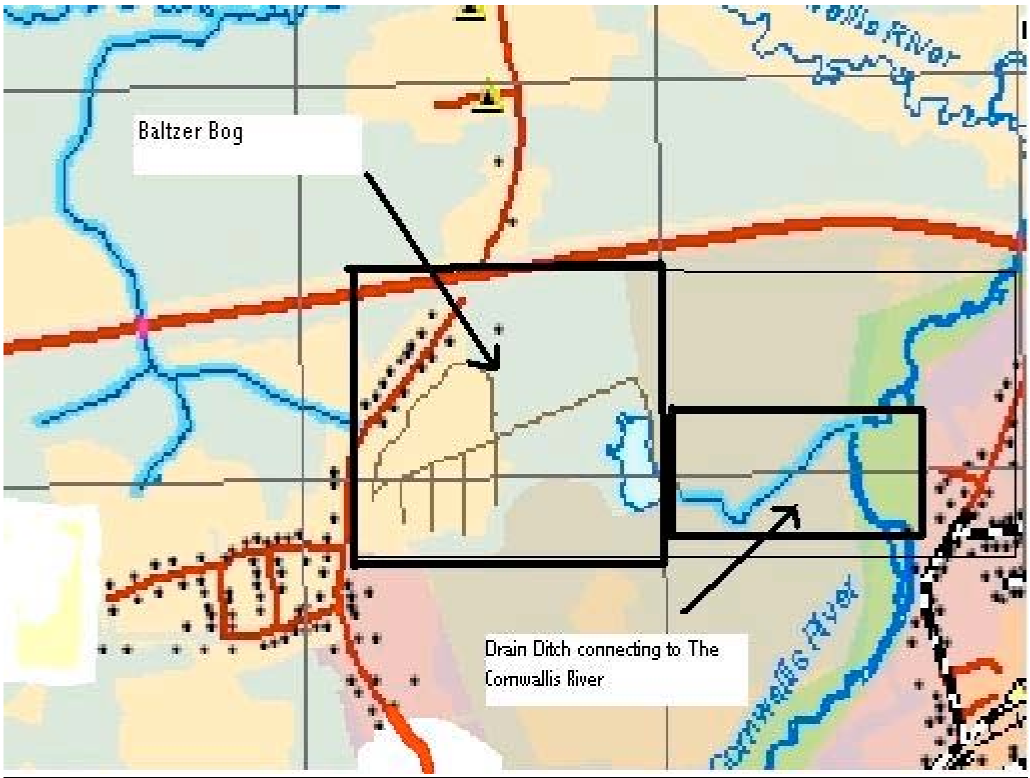

Figure 2. Map of Baltzer Bog, Drainage Ditch, and the Cornwallis River.

Conclusion

The most important conclusion from this study is the absents of fish species within the Baltzers Bog site. The secondary conclusion is that due to the processes that are part of the evolution of most bogs, the waters located on the Baltzers Bog site cannot sustain fish life at this time. Since sampling was done only along the edge of Wood Lake, one can not be certain that some type of fish species do not inhabit the lake bottom. It is my conclusion that, do to the poor water quality, lack of inlet or an outlet, and high dense aquatic growth, that any native fish species would not populate this lake.

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Appendix E

Hydrogeology and Groundwater Review of the Mark-Lyn Site, Coldbrook, Kings County, NS

Appendix E

Hydrogeology and Groundwater Review of the Mark-Lyn Site,
Coldbrook, Kings County, NS

HYDROGEOLOGY and GROUNDWATER REVIEW
OF THE
MARK-LYN CONSTRUCTION LIMITED
COLDBROOK AGGREGATE PIT EXPANSION PROJECT
KINGS COUNTY
NOVA SCOTIA

BY

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April 2004

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Figures

Tables

Appendicies

1.0 INTRODUCTION

This report addresses the requirement for a hydrogeology and groundwater review component of the environmental assessment for the proposed expansion of the Mark-Lyn Construction Limited soil/peat and aggregate extraction operation in Coldbrook. This site is located south of Highway 101, and east of the South Bishop Road. A groundwater monitoring program is also presented as typically required in the terms and conditions included in Environmental Assessment Approvals issued by the Nova Scotia department of the Environment and Labour for similar aggregate pit operations.

1.1 Description of the Aggregate Extraction Operation

Mark-Lyn Mountain Construction Limited has been operating a soil/peat and aggregate extraction facility under approval from the Province of Nova Scotia under the Environment Act, S.N.S. 1994-95, c.1. This environmental assessment is for an expansion of the soil/peat and aggregate extraction operation and associated works at Coldbrook, Kings County.

1.2 Location of site:

The Mark-Lyn Construction Limited soil/peat and aggregate extraction operations and facilities are located in the village of Coldbrook, approximately 5 kilometres west of the town of Kentville. The site is specifically located south of Highway 101. There are no surface water courses flowing through the existing or proposed sites. Figure 01 shows the general location of the existing and proposed topsoil/peat and aggregate extraction operation. Figure 02 shows the three areas of the existing soil/peat and aggregate extraction operation and the proposed expansion areas of interest for the expansion, in relation to the topography, drainage, highways, property lines, and structures in the Coldbrook area.

1.3 Precipitation:

Table 1 shows the amount of precipitation, and the variance from the long-term average, as reported at the Agriculture Research Station at Kentville during the growing seasons of the years 2002 and 2003. Several points of interest are worthy of note from this data.

The growing season for year 2002 was considered by many in the agricultural community to be a drought year for growing many crops in the valley. The growing season for year 2003 was considered as a wet year by most growers of field crops. The major influence during year 2002 may be the lack of precipitation received during the middle of the growing season during June, July, and August. Precipitation during May and September in year 2002 was well above average, while the precipitation during June, July, and August in year 2002 was well below average. What may be the most critical period of low precipitation occurs during three successive months during the growing season as seen during 2002. Precipitation during September 2002 and during August 2003 was nearly double the normal for those months.

Precipitation reported at the Kentville Agricultural Research Centre during the growing seasons for years 2002 and 2003 is presented in Appendix A. Knowledge of the precipitation patterns in the area during the growing season will help understand the potential groundwater recharge periods when high water tables may interfere with extraction operations, and increase the potential for contaminants on the surface to be carried down into the groundwater system underlying the site.

Mark-Lyn EIA Registration Application
Coldbrook, Nova Scotia

Site Location Mapping

Date: February 2004

Scale: 1:50,000

Webster Engineering Consulting

Figure 01

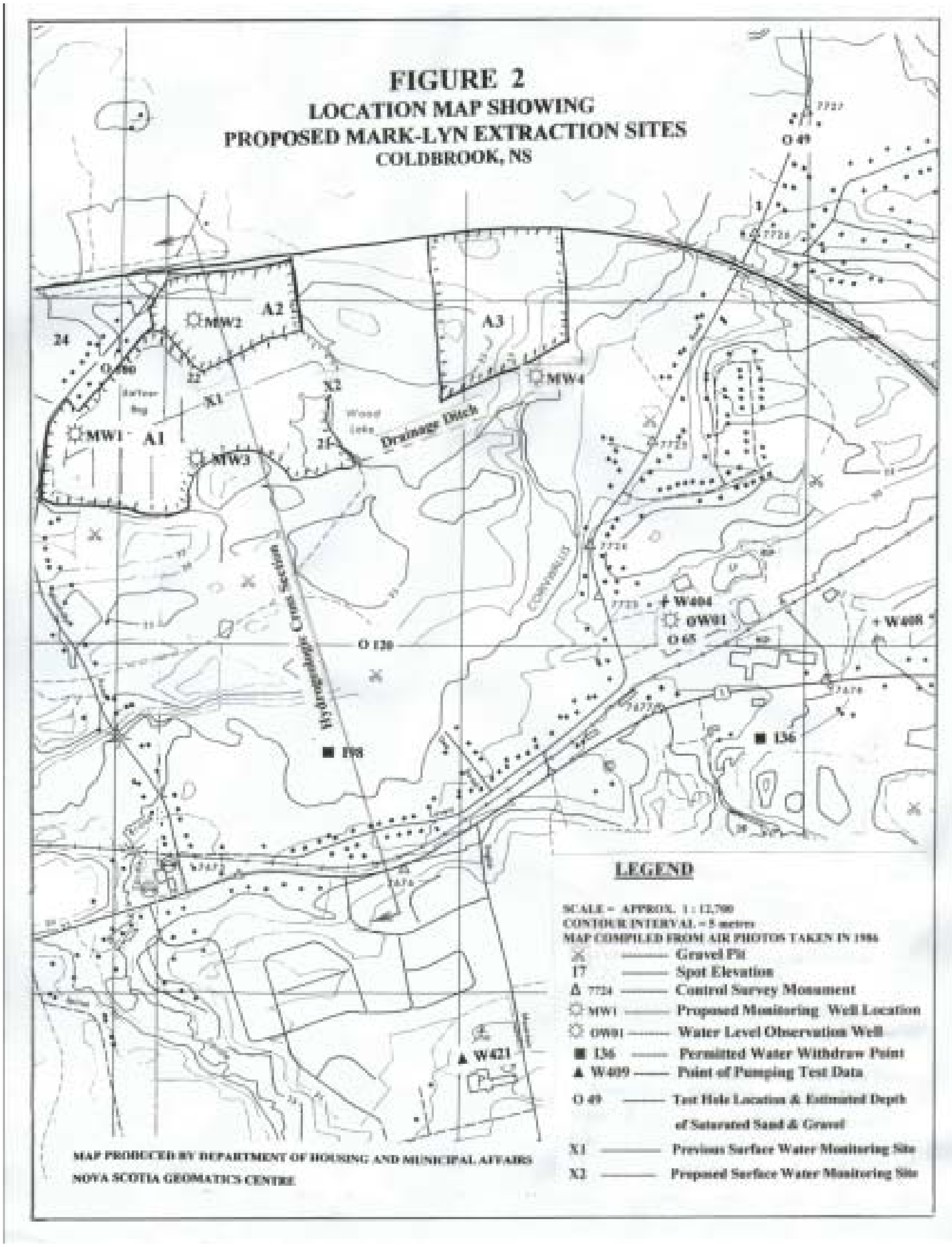


FIGURE 2
LOCATION MAP SHOWING
PROPOSED MARK-LYN EXTRACTION SITES
COLDBROOK, NS
A1
A2
A3
MW1
MW2
MW3
MW4
X1
X2
Drainage Ditch
W404
OW01
W408
O 120
O 65
O 49
I36
I98
W421
LEGEND
SCALE = APPROX. 1 : 12,700
CONTOUR INTERVAL = 5 metres
MAP COMPILED FROM AIR PHOTOS TAKEN IN 1986
Gravel Pit
17 Spot Elevation
7724 Control Survey Monument
MW1 Proposed Monitoring Well Location
OW01 Water Level Observation Well
I36 Permitted Water Withdraw Point
W409 Point of Pumping Test Data
O 49 Test Hole Location & Estimated Depth of Saturated Sand & Gravel
X1 Previous Surface Water Monitoring Site
X2 Proposed Surface Water Monitoring Site
MAP PRODUCED BY DEPARTMENT OF HOUSING AND MUNICIPAL AFFAIRS
NOVA SCOTIA GEOMATICS CENTRE

TABLE 1 Summary Of Precipitation Data From The AGRI-Food Canada Research Station, Kentville.

Month	Precipitation	Long-Term Average	Variance From Long-Term Average	
			Mm	Percentage
YEAR 2002				
MAY	85.2	78.9	6.3	+ 8
JUNE	45.8	67.5	21.7	- 32
JULY	58.1	69.1	11.0	- 16
AUGUST	59.3	88.9	29.6	- 33
SEPTEMBER	175.4	93.0	82.4	+ 87
YEAR 2003				
MAY	57.5	79.0	21.5	- 27
JUNE	66.3	67.0	0.7	< 1
JULY	78.5	68.8	9.7	+ 14
AUGUST	165.3	88.2	77.1	+ 87
SEPTEMBER	92.8	95.0	2.2	- 2.3

1.4 Land use and zoning in the area:

A map of the study area showing the properties on which aggregate extraction is planned, and adjacent properties, with the PID numbers is included in Figure 3.

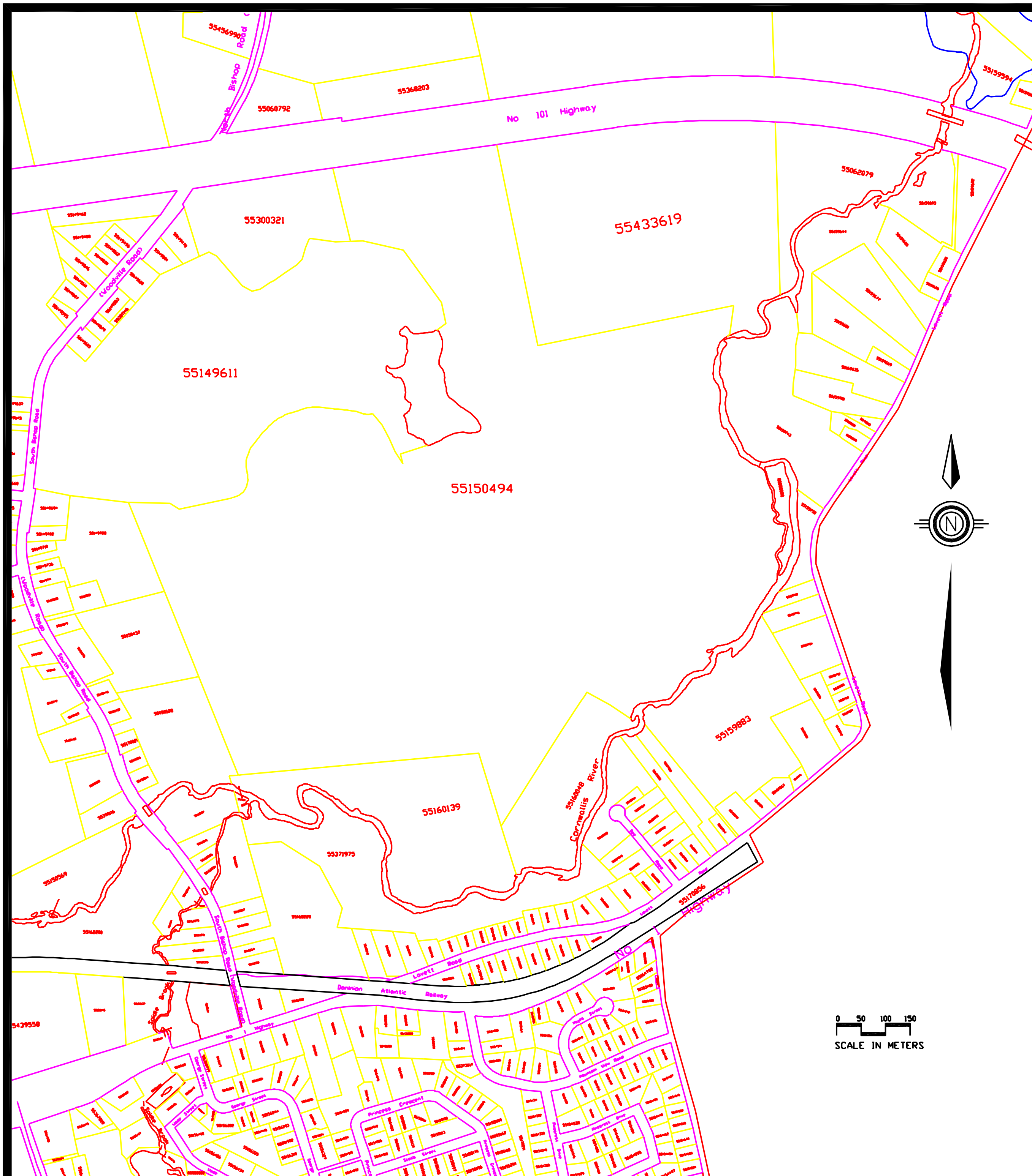
The area of the Mark-Lyn Construction Limited soil/peat and aggregate extraction operation is located north of the Coldbrook Growth Centre. Land use in the area of the Coldbrook Growth Centre is a mix of residential, country residential, resource extraction, commercial, open space, and institutional develoments. The area surrounding the Mark-Lyn Construction topsoil/peat and aggregate extraction operation is a mix of residential one and two unit (R2), country residential (CR), and resource extraction (M7). The extraction operation is located entirely within an area zoned as residential which permits topsoil and aggregate extraction operations. Figure 4 shows the mix of land use and urban zoning in the area as mapped by the Municipality of the County of Kings. Properties immediately adjacent to the site are zoned as follows:

East side: Zoning is M7, Resource Extraction.

North side: Zoning is CR, Country Residential.

West side: Zoning is CR, Country Residential.

South side: Zoning is R2, Residential one and two unit, and M7, Resource Extraction.



Mark-Lyn EA Registration
Coldbrook, Nova Scotia

PID Mapping

Date: February 2004

Scale: As Shown

Webster Engineering Consulting

Figure

03

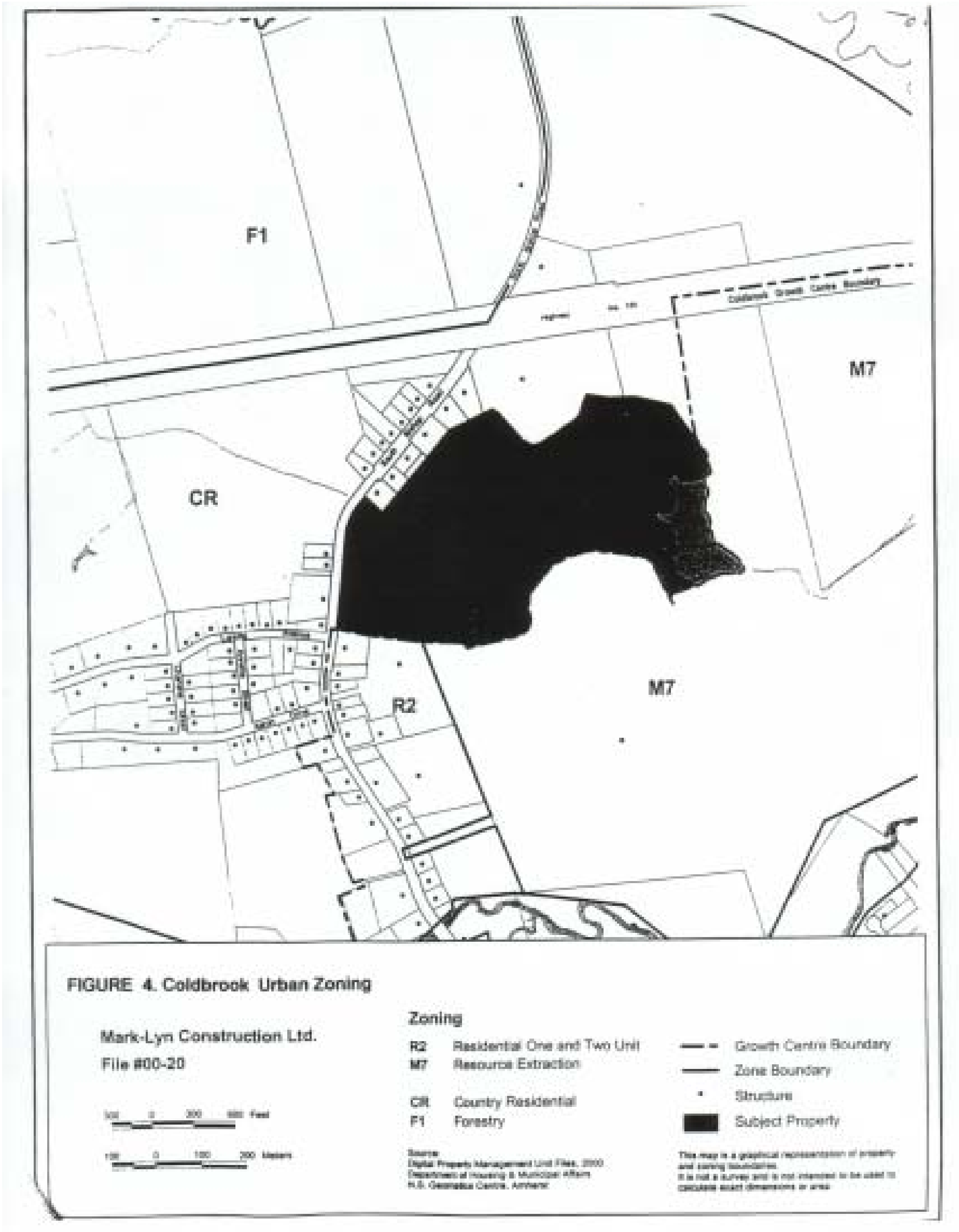


FIGURE 4. Coldbrook Urban Zoning

1.5 Physiography:

The Mark-Lyn Construction Limited soil/peat and aggregate extraction operation is located on the north side of the Cornwallis River Valley watershed. The entire portion of the site is located on the valley floor and is part of the Annapolis Valley physiographic region which is underlain by Triassic sediments of mainly sandstones, siltstones, and shales.

Relief on the valley floor is flat to gently rolling depending on the nature and depth of the Quaternary glacial materials. Glacial deposits of sands and gravels have the greatest influence on topography of the Coldbrook area. Elevations in the area range from approximately 20 to 35 metres above mean sea level in the general area of the of the property. Elevations of the bog are approximately 22 meters above mean sea level. Hills and ridges in the area are deposits of glacial ice-contact stratified drift consisting of sand and gravel materials as mapped and classified by Trescott, 1967. Elevations of the hills and ridges reach approximately 35 meters above mean sea level. The elevation of Wood Lake is approximately 21 meters above mean sea level. General slope of the land surface in the study area is towards the southeast as seen in Figure 2.

2.0 SOIL TYPES AND CHARACTERISTICS

The soils are mapped and described most recently in two Agriculture Canada Soils Reports. The first was published in 1988 by D Holmstrom which covers Map Sheet 21H/02-T3 at a scale of 1:20,000 and is listed as Nova Scotia Soil Survey Report No. 25. The second report is Report No.26, Supplement to: Soils of the Annapolis Valley Area of Nova Scotia, 1993, authored by D. R. Langille, K. T. Webb, and T. J. Soley. A summary of the description and characteristics of Cornwallis soils and two other types commonly found on the Valley floor are shown in Table 2.

TABLE 2 Summary Of Soil Characteristics Mapped In The Study Area

Soil Type	Sand Percentage		Dominant Size	Organic Carbon Percentage
	Range	Mean		
Cornwallis 85				
A Horizon	75-95	84	Fine	2.1
B Horizon	72-97	90	Very Coarse	0.6
C Horizon	67-99	91	Very Coarse	NA
Hebert 86				
A Horizon	76-93	81	Very coarse	3.3
B Horizon	78-98	87	Very coarse	1.3
C Horizon	78-99	91	Very Coarse	NA
Truro 84				
A Horizon	79-89	84	Fine	2.3
B Horizon	76-90	84	Fine	1.4
C Horizon	72-98	90	Fine	NA

One of the characteristics of the Cornwallis and Hebert soils that make them distinctive from the Truro soils in the Valley is the dominant coarse sand size. Of the three soil types summarized in Table 2 the Cornwallis soils has the highest percent of sand overall in the A, B, and C horizons and increasing with depth, as does those of the Hebert series. These attributes of coarse sand and low percentage of finer grained soil particles contributes to the well drained nature, and low soil moisture holding capacity, of the soils.

Table 3 shows a summary of information on thickness and hydraulic conductivity of the same three soil types summarized above. This information also shows the higher order of hydraulic conductivity of Cornwallis soils compared to the Hebert and Truro soils in the area. The two attributes of Cornwallis Soils that account for heavier water demands in agricultural use include their high hydraulic conductivity and low silt/clay content.

A review of the data in Table 3 shows that the thickness of the three soils types is very similar. The average thickness of the Cornwallis soils to the bottom of the B Horizon is 29.5 cm while the thickness of the Hebert soils is 30.5 cm, and the Truro soils is 29 cm. Again the main distinctive difference among these soil types is the hydraulic conductivity of the soils. For the Cornwallis soils the average hydraulic conductivity is 11.9 cm/hr, as compared to 4.5 cm/hr for the Truro soils. General drainage of the Hebert soils in the Valley is reported as being rapid.

Table 3. Summary of Hydraulic Conductivity of Three Soil Types in The Study Area (After Holmstrom and Thompson, 1989).

Soils Type	Thickness (cm)		Hydraulic Conductivity (cm/hr)	
	Range	Mean	Range	Mean
Cornwallis 85				
A Horizon	12-57	26	7.2 - 24.9	14
B Horizon	6 - 75	33	8.2 - 23.0	14.1
C Horizon	NA	NA	5.2 - 9.3	7.6
Hebert 86				
A Horizon	10 - 40	24	NA*	NA
B Horizon	11 - 50	37	NA*	NA
C Horizon	NA	NA	NA*	NA
Truro 84				
A Horizon	10 - 55	26	0.6 - 4.4	2.6
B Horizon	10 - 70	32	1.0 - 9.4	4.3
C Horizon	NA	NA	5.0 - 7.9	6.7

Note: * indicates hydraulic conductivity measurements not available. However drainage of Hebert soils is reported as rapid.

3.0 GEOLOGY OF THE AREA

3.1 Overview:

The Annapolis-Cornwallis Valley is bounded on the south by the South Mountain, which is composed of a mix of igneous and metamorphic rocks. These resistant rocks form a large part of the watersheds that drain the Valley's south flank. The structural geological orientation of these rocks trend approximately parallel to the axis of the Valley in a northeast-southwest direction. These rocks are classed as non-porous, but fractured which host small aquifers defined entirely by the nature of structural stress breaks that occurred during the past several hundred million years of tectonic activity in Nova Scotia.

The thickness of these igneous and metamorphic rocks is believed to be several tens of thousands of feet thick in total. A number of Formations have been mapped in the metamorphic class of rocks. These include, from the oldest to the youngest, the: Goldenville Formation; Halifax Formation; White Rock Formation; Kentville Formation; New Canaan Formation; and Torbrook Formation. The angle at which the surface of these rocks dip underneath the Valley is reported to be approximately 25 degrees. However, the subsurface topography of their eroded surface, and the nature of their contact with the overlying rocks, is not known.

These igneous and metamorphic rocks are generally overlain by glacial till deposits, which vary in thickness from 0 to approximately 5 metres. Thickness of these deposits may be over 10 metres where drumlins have formed. Along the Valley flanks and in glacial valleys cut into these rocks, local deposits of glaciofluvial sands and gravels may be found to depths of 100 feet (30 m) or more.

3.2 Bedrock Units Under The Site:

The Valley floor is underlain by soft Triassic sediments, which have been eroded to form an open-ended valley, bounded by the Minas Basin in the east. These sediments are made up of weakly cemented, and easily eroded, sandstones, and sandy shales, which are the most common rock types. The Cornwallis Valley in the vicinity of Coldbrook is drained by Cornwallis River, and contributing tributaries, flowing east. The lower reaches of the river, and tributaries, have been drowned as sea level has risen during the past 4,000 years or so, leaving the stream channels below present day sea level. These Triassic rocks dip 4 to 12 degrees to the northwest towards the Bay of Fundy and overlie with angular unconformity the deformed much older Paleozoic metamorphic rocks forming the South Mountain, which dip beneath the Valley.

The Triassic sediments under the Valley floor in the Coldbrook area have been classified into the Wolfville Formation. The Wolfville Formation increases in thickness northward across the outcrop belt to a maximum of over 3,000 feet in places at the base of the North Mountain escarpment. This formation is composed of interbedded red and grey conglomerates, sandstones, siltstones, and claystones. The sandstones and conglomerates are poorly sorted, cross-stratified, contain intraformational claystone and siltstone, and show lateral changes in stratification, composition, and thickness. The composition of the Wolfville Formation may vary widely from place to place along the Valley floor.

Although the formation has been described as being composed almost entirely of coarse clastics the majority of the section in some places is made up of silty sandstone, arenaceous sandstone, siltstone, and claystone. Test holes drilled into the Wolfville Formation and logged by geologists show the type of variation in rock types over relatively short distances. For example, a test hole (T.H. #372) was drilled near OW01 as shown in Figure 02, and logged by a qualified hydrogeologist with the Nova Scotia Department of Mines, in 1968. This rest well is located aapproximately 1.5 km southeast of the Mark-Lyn aggregate site, on the Scotian Gold property. The log from this test hole showed a percentage of sandstone and conglomerate, at 22% over a drilled depth of 314 feet in the Triassic sediments. The entire property is underlain by bedrock units of the Wolfville Formation.

3.3 Quaternary Units Under The Site:

Over lying the bedrock units in the vicinity of the soil/peat and aggregate extraction operation are surficial glacial materials, collectively referred to as Quaternary deposits. These deposits are reported to be greater than 100 feet thick in various water well records submitted by drilling contractors. Saturated sand and gravel depoits up to approximately 80 feet are reported in the area by Trescott, 1968. Test well locations showing depths of saturated sand and gravel deposits in the area are presented in Figure 02. The depths to bedrock, as reported by water well drilling contractors, for other water supply wells reportedly constructed in the area are presented later in the report.

During the Quaternary Period, which covers the last 1.6 million years of earth history, the climate cooled and large glaciers periodically covered Eastern Canada. Nova Scotia was affected by at least four ice advances from 75,000 to 10,000 years ago. During these glacial periods ice advanced from different directions. During the first and second glacial periods the ice advanced from the North. During the third period ice advanced from the Scotian Ice Divide to the South, which extended from Yarmouth easterly to Canso. Ice advanced from the Antigonish Highland Ice Cap during the last ice period about 30,000 years ago.

Today, ridges and hills of sand and gravel deposits called eskers and kames respectively, form the topography on the valley floor in the vicinity of Baltzer Bog, Wood Lake, and the extraction operations. These deposits vary widely over short distances both laterally and vertically. The distribution of these deposits both laterally and with depth are of particular interest because of the potential as aquifers to store and transmit large quantities of good quality groundwater. The entire property, and surrounding area, is underlain by ice-contact stratified drift (sand and gravel deposits). These deposits are the attraction and reason for the extraction activities that are ongoing in the area of Coldbrook. An example of the complex stratigraphy in the Quaternary sand and gravel deposits is shown in Photo #1, Appendix B.

4.0 HYDROGEOLOGY OF THE SITE

Two major hydrostratigraphic units, as previously mapped within the study area by Trescott (1968), underly the entire portion of the site. These units include shallow and deeper aquifer systems, and were reviewed for this study area. The deeper aquifer system is included in bedrock sediments referred to as the Wolfville Formation, or the Wolfville Hydrostratigraphic Unit (Wolfville HU). The shallower aquifer system is contained within the glacial sand and gravel deposits of ice-contact stratified drift materials referred to as the Quaternary Hydrostratigraphic Unit (Quaternary HU).

In addition, values of transmissivity, storativity, and safe yield have been summarized from the Pumping Test Database provided by the Nova Scotia Department of the Environment. Data from one of the high capacity wells for which pumping test data exists in the database is reported to be from the Quaternary HU in the area. This well, #404 (see Table 5) is located approximately 1.5 kilometers southeast of the Mark-Lyn Construction Limited site. One pumping test data set from the Wolfville HU, #421, is from a well located approximately approximately two kilometers south of the site. A summary of the available records for water wells in the area as reported to, and obtained from the NSDEL data base, is presented in Table 4. A summary of all readily available pumping test data for high capacity wells in the Coldbrook area is shown in Table 5.

A partial record of a time series of groundwater hydrographs from the 1960's to the early 1980's are in various databases maintained by the Nova Scotia Department of the Environment & Labour. These records were published in a report entitled 'Groundwater Hydrographs In Nova Scotia 1965-1981, by the NSDOEL. The closest groundwater hydrograph records available to the soil/peat and aggregate extraction operation are in the Coldbrook, Berwick, and Prospect areas. These records were reviewed and interpreted to determine natural seasonal changes in the groundwater reservoir in the study area. A summary of the published hydrograph data from (McIntosh, 1984) for the observation well located in Coldbrook is presented in Figure 5. Hydrographs for observation wells in Prospect (Sharpe Brook), and Berwick are also presented in the McIntosh (1984) report and included in Appendix C.

4.1 Water Well Records

Any well constructed since 1965 should have a well record on file with the Nova Scotia Department of the Environment & Labour (NSDOEL). The record will be entered under the name of the original owner of the well. Well records submitted between 1965 and 1978 were published in annual reports available from NSDOEL. Records submitted since 1978 are on a computerized database and have been assigned a unique well log number.

For domestic well records there is no detailed geological log required under the well construction regulations in Nova Scotia. It is the responsibility of the applicant for a groundwater withdrawal permit to provide the water well record along with a hydrogeological description of the site. If no record is available, a well log can be obtained by a TV video well inspection carried out by a certified person.

Available databases on groundwater resources and existing supply records were reviewed, interpreted, and assessed in terms of capability of these records to assist in providing an understanding of the hydrogeological framework of the sand and gravel extraction area, and designing a groundwater monitoring plan for the site.

The Nova Scotia Water Well Records database maintained by the Department of the Environment & Labour was reviewed and summarized. Records were abstracted from this database and summarized on a grid basis to determine the number of wells in the area, range of values for total depth, yield, and depth to bedrock for Coldbrook area. These records available for the Coldbrook area and presented in Table 4.

The Water well records database for Nova Scotia includes information on over 60,000 wells throughout the province. This database was initiated and set up when the Well Drilling Act was first passed in 1963. At that time, well drillers were required to register with the regulatory agency and to keep records of wells constructed, documenting the geological conditions encountered, groundwater occurrences, well construction details, and an estimate of well yield.

Up until about 1988, well locations were determined by using the National Topographic Map Series, and locating the well site down to the nearest mining tract, which covers an area of one square mile. The proposed soil/peat and aggregate extraction operation is located in primarily mining tract 21H2A68. Three records of wells constructed prior to 1978 were located in the database referenced to mining tract #68. Another well record was located in this mining tract which was reported drilled in 1979. The information summarized from these records is shown in Table 4.

In 1988 a new map reference system was introduced based on the 1: 250,000 scale provincial map booklet. This system allows location by page number and site within a 10 square kilometer area, and further by a secondary grid determining the well site within a one square kilometer area. The sand and gravel extraction operation is mostly located in grid # P13C5K14. Three records of water supply wells reportedly drilled in 1997 within this grid were located in the database. Three other records of water supply wells were located for grid # P13C5J14 which includes the area along the west side of South Bishop Road west of the study area. Table 4 shows a summary of water well data as recorded in the NSDEL records for wells reported to be drilled in the grids surrounding the study area. This table shows the number of wells, and summarizes range of depth to bedrock, range of depth to water level, and range of well yield in each grid area. Printouts from the water well databases are presented in Appendix D.

Depth of casing used in well construction was selected as the indicator parameter to give an estimate of the depth to bedrock, or the depth of the overlying Quaternary deposits in Kings County. In most cases of well construction, the amount of casing required is dependent on the depth of these unconsolidated and unstable glacial deposits of clay, silt, sand, and gravel. Since approximately 95%+ wells drilled in the Province are for domestic water supplies, the target aquifer is the underlying bedrock. It is therefore assumed that this depth of casing is considered as a reasonable estimate of the depth to bedrock.

Table 4. Summary Of Water Well Records In The Study Area.

Area	Number of wells	Range of depth to bedrock	Range of depth to water level	Range of yield
Grid 21H2A68	4	48 - 85	15 - 53	5 - 15
Grid P13C5K14	3	109 - 161	40 - 45	5 - 20

Notes: 1. Depths in feet.
2. Includes wells on record since 1965.
3. Yield in gallons per minute.

As seen in the data presented in Table 4, seven water wells are reported in the vicinity of Coldbrook where the soil and aggregate sites are located. The data recorded for wells in the area, as presented in Appendix D, also show that well depths vary considered, from 92 feet to 215 feet. The depth to bedrock in the area of study also varied from 48 to 85 feet below ground surface, and averages 61 feet. Depths to water level in wells also vary from 15 to 53 below ground surface, averaging 42 feet, within the grids containing the study area. Two wells reported in the grid west of the study area (P13C5J14) are reported as flowing artesian wells. Reported well yields ranged from 6 to 20 gallons per minute. During a field reconnaissance of the study area on September 18, 2003, the depth to the water table was observed to occur below the drainage ditch along the east side of the bog. As seen in Photo #2, Appendix B, no water is evident in the ditch at that time.

4.2 Pumping Test Data

The pumping test database for large capacity wells and public water supplies was initiated in the 1960's. Geological data collected for such wells was often logged by a professional hydrogeologist. In addition a properly organized and conducted pumping test was carried out, the data interpreted and analyzed, and a safe yield based on a continuous 20 year production life was determined. This database was reviewed and all data sets for the Coldbrook area were interpreted and summarized. Four sets of pumping test data from test wells, or large capacity wells, were found for the Coldbrook area. Three pumping tests were carried out on wells constructed in the Wolfville Hydrostratigraphic Unit (HU), and one test was carried out on a well constructed in the Quaternary sand and gravel Hydrostratigraphic Unit. A summary of the pertinent and related information from this database for the Coldbrook area is presented in Table 5.

The information in Table 5 shows the hydrostratigraphic units, transmissivity, storativity, and expected yields from wells drilled into these units. Expected well yields shown in the tables are based on the average T and a total available drawdown of 100 feet. No wells found in this database are located within the study area, but are located nearby and are considered to be representative and typical of the hydrogeological conditions found within the site. Three of the locations are shown on Figure 2.

Based on the pumping test data available for wells constructed in the Wolfville Hydrostratigraphic Unit in the Coldbrook area, the average Transmissibility (T) is 1,750 imperial gallons per day per foot (igpd/ft). The range of T is from 1,300 to 2,200 igpd/ft. No storativity data is available from these pumping test data. However, the average storativity (S) for wells in the Wolfville HU in the Kentville to Berwick area is approximately 1.7×10^{-4}, and may be representative of the Coldbrook area.

The specific capacities of wells tested in the Wolfville HU averaged 0.79 imperial gallons per minute per foot of drawdown(igpm/ft), and ranged from 0.60 to 0.97 igpm/ft. Using the above values of T and S and an available drawdown of 100 feet the average 20 year continuous safe yield of the wells constructed in the Wolfville HU is approximately 50 imperial gallons per minute (igpm), with a range of approximately 10 to 100 igpm.

Based on the pumping test data available for wells constructed in the Quaternary (sand and gravel) Hydrostratigraphic Unit in the Kentville to Berwick area, the average Transmissibility (T) is approximately 24,000 imperial gallons per day per foot (igpd/ft).

The range of T is from approximately 6,000 to 63,000 igpd/ft. The one T value for the Quaternary HU from pumping test data in the Coldbrook area is 16,246 igpd/ft.

The average storativity (S) value for wells in the Wolfville HU in the Kentville to Berwick area is approximately1.2 x 10^{-2} with a range of 4.5 x 10^{-4} to 3.3 x 10^{-2}. The one S value from a well drilled into the Quaternary HU in the Coldbrook area is 2.6 x 10^{-3}.

The average specific capacity of wells tested in the Quaternary HU is approximately 23.7 imperial gallons per minute per foot of drawdown (igpm/ft). Specific capacities of well constructed in the Quaternary deposits range from 1.6 to 65.3 igpm/ft. Based on the above values of T and S and an available drawdown of 100 feet the average 20 year continuous safe yield of the wells constructed in the Quaternary HU is approximately 600 imperial gallons per minute (igpm), with a range of approximately 150 to 1,500 igpm.

Aquifer testing is a very important component in development of any water supply that withdraws more than 23,000 liters per day from an aquifer. Under the Well Construction Regulations of Nova Scotia, a pump test of not less than 72 hours duration is required for all non-domestic wells, unless otherwise approved in writing (variance) by an inspector. The purpose of the test is to determine the long-term safe yield of the well, potential impacts on other existing wells in the area, and other environmental impacts. Municipal and industrial wells may require a longer test, if there is a perceived, or potential, environmental concern related to the withdrawal of large volumes of groundwater in the area.

Pumping tests are carried out by certified individuals and follow a well established protocol. The typical data and procedure followed in conducting such a test includes the following:

- Regulating and monitoring pumping rate;
- Measuring and recording water levels in the pumping well and nearby observation wells;
- Collection of samples for water quality analyses;
- Interpretation and analysis of the pumping test data;
- Determination of the sustainable yield of the well; and
- Reporting to the Nova Scotia Department of the Environment.

The above data is required by the Nova Scotia Department of the Environment & Labour for the processing of water approvals to withdraw groundwater for non-domestic water supply purposes.

The Wolfville HU contains the major bedrock aquifers under the Valley floor and is the source of water for most domestic supplies. The wells reported to be completed in a Quaternary sand and gravel aquifer may or may not overlie the Wolfville Formation on the Valley floor. Some of these Quaternary aquifers are, although thought to be extensive over the Valley floor, are also found on the south flank of the Valley overlying other bedrock types, such as the Halifax Formation. The Quaternary aquifers are also known to produce large quantities of very good quality water in other parts of the province of Nova Scotia.

TABLE 5. SUMMARY OF PUMPING TEST DATA FOR THE COLDBROOK AREA Sept. '03

RECOR	LOCATION	MAP REF.	HYDRO.	DEPTH	STATIC	AVAIL.	AVEI	T	S	SPEC.	D.D.	Q20	% DD
383	COLDBROOK	21 H 2 A 51	WOLFVILLE	180	51.8	98.0	30.0	1300	0.000000	0.970	30.8	48.3	31
404	COLDBROOK	21 H 2 A 46	SAND & GR.	79	10.2	60.0	400.0	16246	0.002600	65.250	6.1	369.0	10
421	COLDBROOK SCHOOL	21 H 2 A 53	WOLFVILLE	200	44.0	126.0	15.0	2200	0.000000	0.600	25.0	105.0	20
408	COLDBROOK PARK	21 H 2 A 52	WOLFVILLE	232	43.6	159.0	2.0	0	0.000000	0.170	11.4	0.0	7

NOTES:

NOTES:

1. Hydro. = Hydrostratigraphic unit
2. Static = Depth to static water level in well in feet.
3. Depth = Depth of well in feet.
4. Avail. = Available drawdown in well in feet.
5. T = Transmissivity of aquifer as calculated from pumping test data units in gallons per day per foot
6. S = Storativity of the aquifer as calculated from the pump test data, units are dimensionless.
7. Spec. = Specific capacity of the well in imperial gallons per minute per foot of drawdown.
8. D.D. = Maximum drawdown, in feet, recorded during the pump test.
9. Q20 = Estimated safe yield of the well in igpm.
10. % DD = % of the available drawdown used during the pumping test.
11. REC 383 = Location of well not known.
12. REC 404 = Location of well on Scotian Gold property, well abandoned.
13. REC 408 = Well located at N-Coldbrook Park.
14. REC 421 = Well located at Coldbrook school.

Summary of pumping Test Data for the Coldbrook Area, Sept. '03

4.3 Groundwater Hydrographs

The Province of Nova Scotia initiated, in 1964, a systematic evaluation of regional groundwater resources through the Groundwater Section of the Department of Mines. This work continued with the assistance of various federal programs and Departments until the mid 1980's. Exploratory wells developed for the various regional projects were monitored to obtain specific baseline data of groundwater elevations and to document groundwater level fluctuations. A report "Groundwater Hydrographs in Nova Scotia 1965-1981" was published by the Nova Scotia Department of the Environment in 1984. This report presents a summary of recorded groundwater levels in tabular and graphical formats. These data and graphs illustrate the probable occurrence, by extension, of groundwater levels in the hydrogeologic units surrounding the wells.

Groundwater hydrograph records in the general area of Coldbrook indicate periods of recession during the summer months followed by recovery during the autumn over a 16 year period from 1965 – 1981. The groundwater level monitoring wells were constructed in different hydrostratigraphic units in the Valley. Observation well #001 (OW#001) was constructed in the Quaternary sand and gravel HU aquifer, in 1964, underlying the Coldbrook area north of Highway #1. It is located approximately 1.5 km east of the Mark-Lyn Construction aggregate site at Coldbrook. Observation well #011 was constructed in the Halifax HU underlying the Prospect/Lloyds area (Sharpe Brook) in 1971. It is located approximately 4 km southwest of the study area. Observation well #032 was constructed in the Wolfville HU underlying the Berwick area in 1964. It is located approximately 7 km west of the study area.

During the period of record water level fluctuations of approximately 10 feet were documented, in the Coldbrook area, where water levels fluctuated between 40 and 50 feet above mean sea level. Over the sixteen year period of record a maximum water level of 49.90 feet above mean sea level was recorded on 31 May 1971. The minimum water level was recorded at 39.62 feet above mean sea level on 28 November 1965. The range of fluctuations and seasonal trends in groundwater levels are shown in the hydrograph included in Figure 5.

Observation well #001 was drilled to a depth of 86 feet through Quaternary sand and gravel deposits. Triassic sandstones (Wolfville Formation) was encountered between 86 and 93 feet where drilling was discontinued. A well screen was installed in the well over the interval between 81 and 93 feet below ground surface. The well was used as an observation well during a pumping test of a nearby well also constructed in the Quaternary HU. From these data a value for T was calculated as 85,000 igpd/ft, and a value of S was calculated to be 2.21×10^{-4}.

Observation well #011 (OW#011) was constructed in the Halifax HU, on the south flank of the Valley at Prospect near Sharpe Brook. This well was drilled during September 1970, to a depth of 100 feet below ground surface. The well penetrated Quaternary sand and gravel deposits from 0 to 11 feet, where slates of the Halifax Formation were encountered to the bottom of the well at 100 feet. The graphical hydrograph records of these groundwater observation wells are shown in Appendix C.

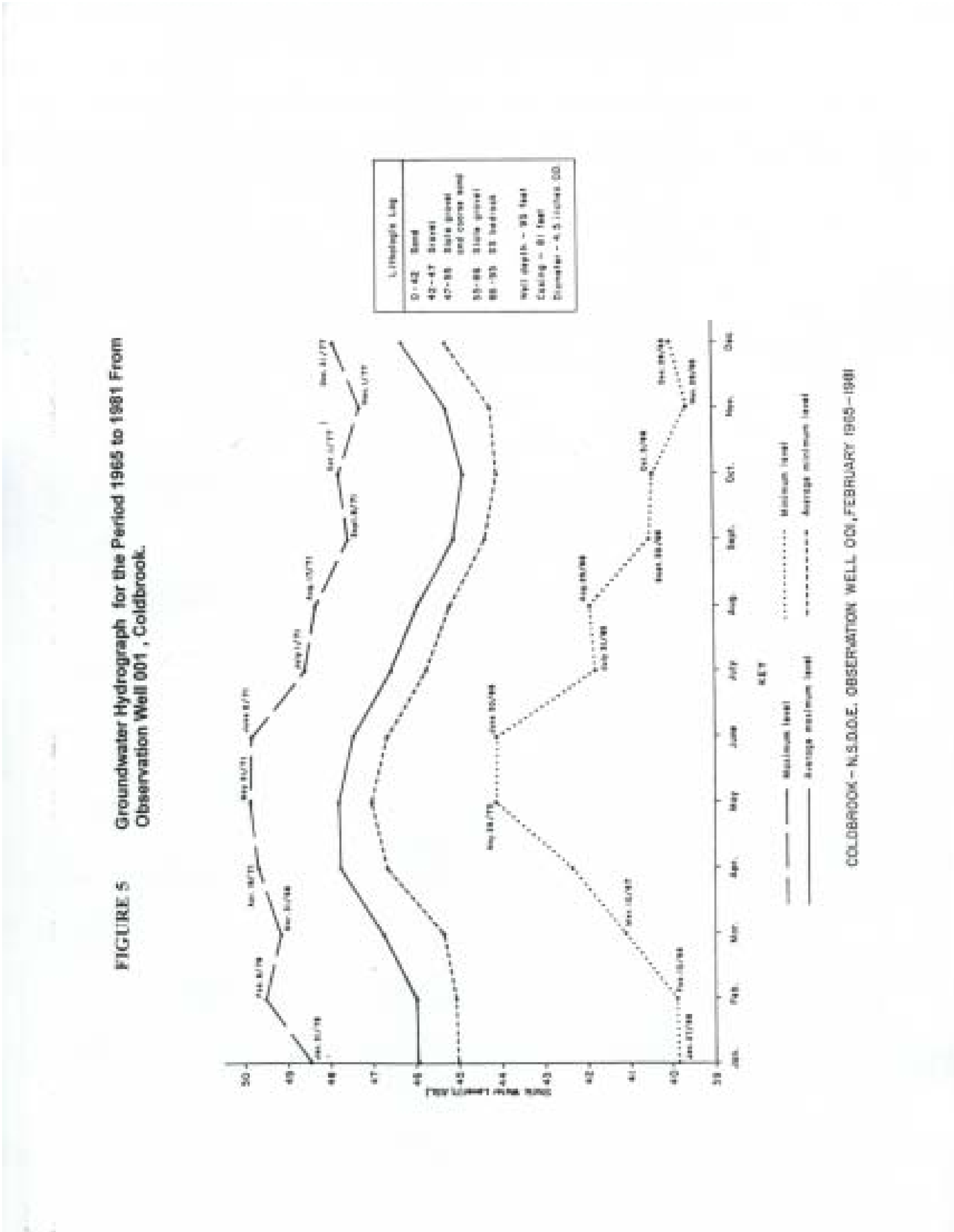


FIGURE 5
Groundwater Hydrograph for the Period 1965 to 1981 From Observation Well 001, Coldbrook.
Lithologic Log
KEY
Maximum level
Minimum level
Average maximum level
Average minimum level
COLDBROOK – N.S.D.O.E. OBSERVATION WELL 001, FEBRUARY 1965–1981

During the ten year period of record at the Prospect site (Sharpe Brook) water level fluctuations of approximately 8.6 feet were documented, where water levels in that well fluctuated between 430.09 and 438.66 feet above mean sea level. The maximum water recorded was 438.66 feet ASL on 29 January 1979. The minimum water recorded in OW #011 during the period of record was 430.09 feet ASL on 31 October 1973. No pumping test was carried out on OW #011. However T values from wells constructed in the Halifax HU south of the Valley average approximately 415 igpd/ft, and S values average approximately 4×10^{-5}.

During the period of record water level fluctuations of approximately 13 feet were documented, in the Berwick area, where water levels fluctuated between 128 and 141 feet above mean sea level. Over the nine year period of record a maximum water level of 141.12 feet above mean sea level was recorded on 16 March 1965. The minimum water level was recorded at 127.60 feet above mean sea level on 2 November 1970. The water level hydrograph record for OW #032 is shown in Appendix C.

Observation well #032 was drilled to a depth of 705 feet through siltstones, sandstones, and conglomerates of Triassic Age (Wolfville HU). Bedrock was encountered at approximately 20 feet below ground surface. Casing was installed in the well to a depth of 84 feet below ground surface because of soft, weathered, and unstable bedrock. No pumping test was conducted on this well. However pumping tests carried out on wells constructed in the Wolfville HU throughout the valley typically show values for T in the range of 2,000 to 3,000 igpd/ft, and values of S in the range of 1.5×10^{-4} to 2.5×10^{-4}.

Note that the minimum recorded low water levels fall on dates late in the growing season Whereas the maximum recorded high water levels occur during the winter or spring seasons. This distribution of lows and highs strongly suggests that there is no downward trend in groundwater levels in the area during that period. These lows are related to climatic cycles of low precipitation rather than increased withdrawals of groundwater.

Table 6 identifies four groundwater observation wells near the study area that have been, or are now being, monitored by staff of the NSDEL. The status of a number of other former monitoring wells is being reviewed and their condition assessed for reactivation and upgrading with new digital recording equipment.

TABLE 6. Groundwater Observation Wells Near The Study Area.

Site	Well Number	Status	Aquifer
Coldbrook	001	Abandoned	Quaternary HU
Sharpe Brook	011	Abandoned	Halifax HU
Berwick	032	Abandoned	Wolfville HU
Kentville Industrial Park	048	Active	Quaternary HU

In 1984 eleven groundwater observation wells were being monitored were located in Kings County. Water level changes documented in these observation well network records show fluctuations in groundwater levels due to precipitation, tidal influence, seasonal variations, and water removal from nearby pumping wells. Many of these observation wells were installed in the vicinity of newly constructed, large capacity industrial or municipal water supply wells, the purpose being to monitor and observe drawdown trends in the aquifers being pumped at high rates for the first time on a sustained basis.

Of the eleven monitoring wells in Kings County, five were constructed in Quaternary HUs. Another five of the wells were constructed in Wolfville HUs, and one monitoring well records water level changes in the Halifax Formation (Halifax HU) near Sharpe Brook. Records of water level changes in the five wells located in the Quaternary sand and gravel deposits are of particular importance to this study.

4.4 Bedrock Aquifers

Bedrock aquifers underlying the Coldbrook area are located in Triassic sediments of the Wolfville HU. The most reliable and complete information on the characteristics of these aquifers comes from water well and pumping test records maintained by the Nova Scotia Department of the Environment and Labour. Records were found for 12 wells in the water well records database within the map reference grids immediately adjacent to and in which the study area lies. These are shown in Appendix D.

All of these wells were constructed in the Wolfville HU within, or very near, the southern portion of the study area. The average depth of well constructed in the Wolfville HU is 158 feet, with a range of 92 to 215 feet. The deepest reported well is 215 feet deep and was rated at 20 igpm based on a preliminary air lift test. Three bedrock wells were reported with yields of 20 igpm. These wells are all located within grid P13C5J14 in the immediate area of the site. Estimated well yields in the area range from 6 to 20 igpm, averaging approximately 14 igpm. The bedrock surface topography under the area is approximated in the conceptual hydrogeologic cross section shown in Figure 6.

Three pumping test records were found for wells constructed in the Wolfville HU within the Coldbrook area. The yield of a well is primarily dependent on the transmissivity (T) of the aquifer supplying water to the well, and the saturated thickness of the section penetrated. As seen in Table 5, T values vary significantly from site to site thus giving higher yields for shallower wells with higher T values. The variation of T in these aquifers is related to the grain size and fracturing, which can be seen to vary over short vertical and horizontal distances in local outcrops. The range of T values in the Wolfville HU underlying the Coldbrook area varies from 1300 igpd/ft to 2,200 igpd/ft.

4.5 Quaternary Aquifers

The shallow Quaternary deposits, those most recently deposited by the last glacial activity on the Valley floor have been mapped in two dimensions at a reconnaissance scale by Trescott, 1968. The depth, stratigraphy, subsurface extension, and distribution of older deposits are not known. However, water well records and pumping test data suggest a complex system of interstratified deposits of different ages underlying the Valley floor in the vicinity of the aggregate study area in Coldbrook.

The most productive wells, i.e. highest capacity, have been constructed in Quaternary aquifers from Wolfville through to Greenwood. There was no record found in the water well records data base for a well constructed in Quaternary deposits near the study area of the topsoil/peat and aggregate extraction operation in Coldbrook. One record was found in the pumping test database for a high capacity well constructed in the

Quaternary HU. This record is included in Table 5, as pumping test record #404. The location of this well is also shown on Figure 2. The depths of wells constructed in the Quaternary HU are significantly less than that for bedrock wells, and the yield is much higher, which is normal for well constructed in these types of aquifers. As seen in Table 5 the highest yield is for a well in the Quaternary HU and is only 79 feet deep, as compared to bedrock wells with depths averaging over 200 feet. The range of T values in the Quaternary HU underlying the Kentville to Berwick area varies from approximately 6,300 igpd/ft to greater than 100,000 igpd/ft.

The conceptual hydrogeological cross section presented in Figure 6 shows the general geological structure of the Quaternary and Wolfville Hydrostratigraphic Units under the study area. The depths to bedrock, thickness of Quaternary sand and gravel deposits, and expected depths to water in wells constructed in the area are interpreted from information obtained from water well records, and test holes located in the Coldbrook area. This cross section shows three water levels in the area: one in the peat deposits of Baltzer Bog; a deeper one in the Quaternary deposits; and a deeper one in the upper Wolfville bedrock units. Water well records near the area also show deeper bedrock wells to be flowing artesian in nature.

It is common to have a perched water system within peat deposits because of the low hydraulic conductivity of the peat deposits at depth, and a mineralized soil profile underneath the peat deposits. The actual depths to water, and the vertical groundwater gradients, under the footprint of the site will be determined from data collected during construction of the monitoring wells proposed as part of this environmental assessment.

4.6 Groundwater Quality

Groundwater quality can change significantly over a very short horizontal and or vertical distance because of the influence of minerals in the host bedrock or overburden materials. A distinctive difference in chemistry between water from the Quaternary HU and the Wolfville HU often the presence of hardness in water from the latter HU. For example, as seen in Table 7, the average hardness of water from the Wolfville HU is 117 mg/L as compared to only 62mg/L for water from the Quaternary HU. No metals or constituents of concern from a health and environmental perspective are known to occur naturally in units of the Wolfville and or Quaternary HU's.

Because of the nature of the sand and gravel extraction operation at the Coldbrook site, and the distance from the contact to the Halifax Formation, there are no main chemicals of concern with respect to groundwater contamination.

The only available data of unbiased background groundwater general chemical quality in the valley is that collected and reported by Trescott (1968) as part of the Groundwater and Hydrogeology Study of the Annapolis-Cornwallis Valley. A summary of the findings of groundwater quality based on the Trescott study is presented in Table 7 for the hydrostratigraphic units occurring under the area of Coldbrook. The parameters selected for comparison as shown in Table 8 are pH, total hardness (T.H.), iron (Fe), manganese (Mn), sulphate ($S0_4$), chloride (Cl), total dissolved solids (TDS), and nitrate-nitrogen ($N0_3$-N).

Table 7. Summary of Groundwater Quality in the Coldbrook Area.

	PH	T.H.	Fe	Mn	$S0_4$	Cl	TDS	$N0_3$-N
Wolfville HU	7.4	117	0.22	0.02	20.0	33.7	190	2.1
Quaternary HU	6.8	62	0.30	0.04	11.7	19.2	120	1.7
Halifax HU	6.6	57	0.34	0.09	6.3	23.8	100	1.2

5.0 WATER MONITORING PROGRAM

5.1 Groundwater Monitoring

Water quality monitoring in the vicinity of the sand and gravel extraction operation will serve four main purposes. These are listed as:

- To determine the background quality of groundwater in the area up-gradient of the extraction operation.
- To assess whether groundwater contamination is occurring from the sand and gravel extraction operations.
- To assess and characterize potential migration pathways of potential contaminants off the site.
- To determine presence of, and risk to, receptors of contamination if it does exist.

The groundwater monitoring program planned for the aggregate extraction operation is scheduled to operate during the life of the aggregate extraction activities. This report presents the results of a reconnaissance of the area, a review of groundwater data available, and selection of sites for future monitoring wells. Procedures and protocols for field methods implemented as part of the groundwater monitoring program for this project are presented in Appendix E.

During the first year of topsoil/peat and aggregate extraction operations in the expansion area, a groundwater monitoring plan will be implemented. This work will include: drilling and logging of bore holes; construction of monitoring wells; sample collection from the monitoring wells for chemical analyses; water level observations will be taken and recorded; groundwater flow patterns will be determined; and vertical field hydraulic gradient determinations will be made in strategic areas of the site. A report will be prepared and submitted to NSDEL reporting progress, results, and interpretation of the data over the first quarter for water quality and water level data.

5.1.1 Monitoring Wells

5.1.2 Overview

Strategic general locations for bore holes, in which monitoring wells will be constructed, are identified at proposed sites as shown in Figure 2. These have been selected based on the hydrogeological setting of the site, existing water supply wells near the site, soils types, drainage patterns, topography, and proposed active extraction areas. Final locations and construction details of monitoring wells constructed on the site for this phase of the project will be documented. All of the monitoring wells will be multi-level structures which penetrate the water table in the underlying surficial and/or bedrock materials. The multi-level monitoring wells will be equipped with a shallow and a deeper portion designed to determine vertical groundwater gradients in a selected area of the site. Following well development, water levels will be determined for each of the monitoring wells. Water samples will be collected and analysed for selected chemical and physical parameters. Elevations of all monitoring wells will be determined to assist in calculating groundwater flow gradients and groundwater flow directions.

Well construction will be accomplished with either a hydraulic rotary drill using a tricone bit, or a hollow stem auger drill, operated by an experienced drilling company. Temporary six inch diameter casing, or a hollow stem auger, will be advanced into the geological materials, and the samples will be collected from inside the casing by drilling out the plug at 10 foot intervals, or when a change in geology is noted. Two-inch diameter PVC casing and screens will be installed at selected depth intervals in the wells, gravel packing will be installed around the screen, and the upper cased portion of the wells will be grouted with bentonite. Once the casing, screen, gravel, and bentonite are in place the six inch diameter casing will be withdrawn to expose the screen to the water bearing zone to be monitored. Well development will be carried out by pumping with a bailer and/or a Waterra sampling device. Design and construction of monitoring wells to be used for this project will be consistent with standard practices in the industry as shown in Figure 7.

5.1.3 Existing wells:

No approved monitoring wells are located on the site. There appears to be a number of existing water supply wells in strategic areas along the west side of the property that may be considered suitable for monitoring groundwater quality of relevance to this project. A record for one of these wells was located in the water well records database, and is shown in Appendix D as well number 961267. Another potential existing well is well number 861461 also shown in Appendix D. It was reported by the proponent that potential building lots exist west of the soil/peat extraction site along the east side of South Bishop Road. New water supply wells drilled in this area could also be used as monitoring wells as part of requirements for monitoring groundwater conditions in the area of the proposed project. Construction characteristics of the new potential monitoring wells located along the western perimeter of the soil/peat extraction site could be made available for inclusion in the groundwater monitroing program.

All private water supply wells in the area within 300 metres of the site will be included in a water supply investigation. Construction characteristics of the wells in the area will be documented as they are available and presented in the monitoring report. Assuming that each residence in the area has a water supply well, it can be expected that a number of wells west of the site will be within 300 metres (1,000 feet) of the active working face at some stage during the history of the excavation project. During work for the groundwater monitoring program it is proposed that a 'Water Supply Investigation' be carried out for wells within a 300 metre radius of the proposed active extraction area. There are no wells reported to be within 300 metres (1,000 feet) of the proposed active working area of other parts of the site to the north or east. The separation distances from the sand and gravel pit operations can be seen in a general sense on Figure 02.

A review was carried out of the Public Drinking Water registration data base for Kings County as maintained by the NSDEL. Based on this review there are no apparent public drinking water supplies registered in the immediate study area. The nearest public drinking water supplies registered are along Highway No.1, at distances greater than 1,000 meters from the site of interest for this study.

5.1.4 New Monitoring Wells

The location, design, and construction of monitoring wells will follow approved methods adopted as standard operating procedures for the industry and are appropriate for the site and nature of groundwater monitoring planned for the site. Basic criteria for the location, design, and construction of the monitoring wells include the following:

- Separation distances in compliance with well construction regulations.
- Location and number of monitoring wells based on consideration of the hydrogeological frame work of the site and sensitive area identified in the environmental assessment report.
- Depths of wells determined by the stratigraphic sequence encountered during drilling, depth to water table, and expected annual and seasonal groundwater level range of fluctuations.
- Minimum diameter of wells to be 50 mm inside diameter.
- Use of PVC schedule 40 flush joint pipe and screens with a minimum 50 mm thick gravel pack and bentonite grout in the appropriate sections of the borehole surrounding the well casing and screen.
- An approved plug on the bottom and an approved cap on the top of the casing will be placed to ensure the integrity of the monitoring well from the intrusion of surface water.
- The selection of screened sections will be based on the hydrogeologic conditions encountered and the stratigraphic section penetrated.
- Groundwater and well head elevations, and horizontal references for the well head, will be determined and documented as part of the record of the monitroing well construction.
- Typical monitoring well construction, as used in the environmental industry, is planned during this project.
- Well heads will be protected from traffic in the area by use of locking plugs in above grade steel casing serving as manholes to provide protective cover and security.

Monitoring well design and construction applied during this project are those that are typical of acceptable standards in the environmental industry. Figure 7 shows the typical design characteristics for monitor well construction planned for use during this project. All monitoring wells completed will have protective steel casing installed with caps locked in place to ensure security and protection of the monitoring system, intake areas are to be screened and sand packed, and grouted with bentonite to the surface.

Monitoring well locations will be selected after consideration of local hydrogeological conditions of the site, traffic patterns in the area, and sensitive environmental components identified in the review of the Environmental Assessment Report prepared for this project. For planning purposes at this point in the environmental assessment, one area of the proposed operation is identified as being a potential concern for impacting on groundwater supplies adjacent to the site. This area is west of Area 1 as shown on Figure 02. The proposed locations for monitoring wells to be constructed

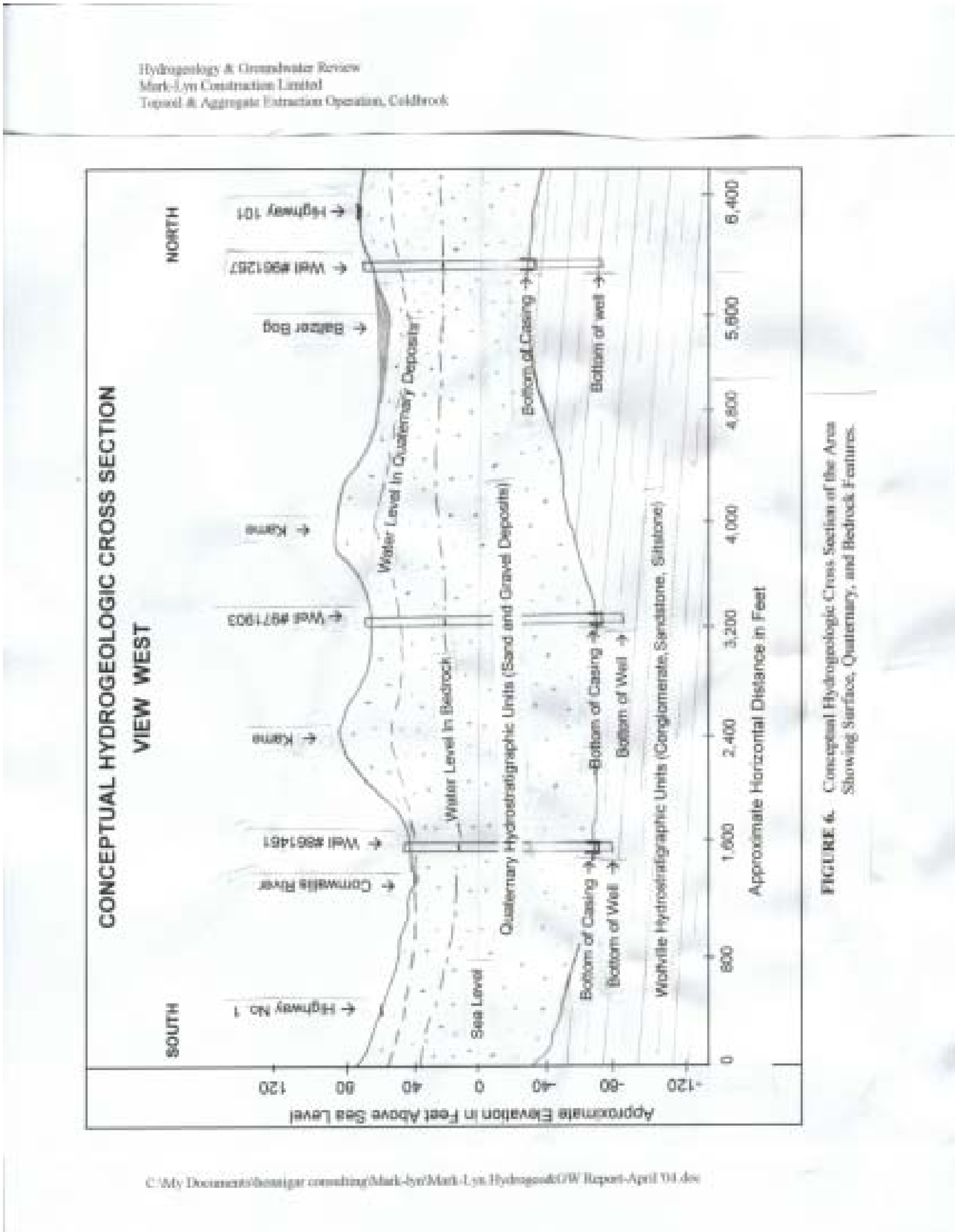


FIGURE 6. Conceptual Hydrogeologic Cross Section of the Area Showing Surface, Quaternary, and Bedrock Features.

during implementation of the groundwater monitoring program for this project are also shown in Figure 02.

The proposed groundwater monitoring area is located east of South Bishop Road near the proposed topsoil/peat extraction area and west of Wood Lake. Based on land elevations and surface drainage patterns in the area it is anticipated that the shallow groundwater flow systems immediately under the site is unconfined and within the Quaternary ice-contact stratified deposits of sand and gravel. It was also expected that the shallow groundwater flow system along the south Bishop Road on the east side is towards Baltzer Bog, away from the residences located along the road. Groundwater flow is suspected to flow eastward and southward under the study area towards the Cornwallis River contributing directly to flows to the river east of the site. The only water well record available and located for the area on South Bishop Road is reportedly cased to a depth of 117 feet below surface and draws water from the deeper bedrock aquifer to depths of 160 feet.

The groundwater flow system in the vicinity of the northwest corner of the site is considered most likely to be in a local recharge zone, based on a review of hydrogeological factors from existing maps. Three monitoring wells, MW-1, MW-2, and MW-3 are therefore proposed for construction in the general area of A1. MW-1 is proposed to be constructed as a multi- level monitoring well and will be located between the working face and the nearest residence with a water supply well. MW-2 is proposed to be located northeast of MW-1 near the existing aggregate site A2 also as a multi-level monitoring well. MW-3 is planned for the eastern part of A1 in the existing soil/peat extraction site, also as a multi-level monitoring well. Water levels in these monitoring wells, together with water levels at other strategic points from available existing wells, if available, will be used to determine groundwater gradients and flow direction. The proposed locations of MW-1, MW-2, and MW-3 shown on Figure 02.

The supply of aggregate from area A2 is projected to be sufficient for the next several years. Aggregate extraction therefore from area A3 is not projected to begin until after the source at area A2 is exhausted, which may be after the 2007 season. Accordingly, the need for and strategic locations of monitoring wells in the area of A3 will be assessed over the period prior to extraction activities at that site. As a proposed site at this stage, MW-4 is shown on Figure 2 to monitor groundwater from the site at A3.

5.1.5 Groundwater Flow Patterns

Elevations and horizontal location coordinates of the monitoring well reference points and surface water points of interest will be determined. Elevations will be referenced to mean sea level within approximately 1.2 inch (3.0cm). Horizontal location coordinates will be determined within 0.40 inch (10 mm). The locations and elevations of the points of interest will be shown in the groundwater monitoring report.

Groundwater flow patterns will be determined for the general area within the soil/peat and aggregate extraction operation. A general groundwater flow pattern, and gradient, will be determined for the area by using data from the monitoring wells and the surface reference point. An assessment of groundwater flow in the vicinity of existing water supply wells near South Bishop Road and the monitoring area will also made based on water heads and the stratigraphic sections interpreted in the monitoring wells.

Static water levels for the monitoring wells will be measured using an electronic water level meter in as short a time interval among readings as is practical. The static water levels will be referenced to the top of the monitoring well casings, and converted to head above mean sea level.

The groundwater elevations from the monitoring wells and the surface water reference points will be used to calculate the hydraulic gradient and determine groundwater flow direction in the vicinity of each designated area. The control point locations, separation distances of the control points, equipotential lines, and groundwater flow direction in the area will be shown on a map.

The vertical groundwater flow gradient will be determined in each monitoring well to assess whether the area is located in a recharge or a discharge part of the groundwater flow system in the area. This information will also allow interpretation of flow between the overlying peat deposits and the Quaternary sand deposits underlying the site.

In addition to the monitoring wells, a line consisting of a minimum of three piezometers will be installed from Wood Lake northwest into the Southeast quadrant of Baltzer Bog. These piezometers will be used to determine the hydraulic conductivity of the peat deposits, and monitored to determine the hydraulic connectiveness between the lake and the bog. Interpretation of the piezometer and monitoring well information will allow an assessment of the 30 meter offset from the working face of the peat deposit to the lake being considered as a safe separation distance to prevent an impact on Wood Lake. Extraction of peat from the Southeast quadrant of the bog is not expected to begin until probably 2007. Extraction of peat from the Northeast quadrant will follow rehabilitation of the Southeast quadrant. This time line will allow several years to assess the proposed set back as being a safe distance from the lake.

5.2 WATER QUALITY

5.2.1 Sampling Protocols and Procedures

All monitoring wells will be developed by pumping at rates varying between one and two gallons per minute. Pumping will be carried out initially by bailing with one litre volume disposable plastic bailers. After this initial development, a dedicated Waterra sampling device will be installed in each well for the purpose of purging and sampling.

When collecting samples from monitoring wells for chemical analyses, protocols developed and used in the industry will be followed to ensure representative samples of groundwater are obtained. At the time of entry to a monitoring well a measurement of the depth to water will be taken and recorded for later use in determining groundwater flow. Prior to sampling the well will be purged to remove at least 3 pore volumes of water from the monitoring well before a sample is collected.

Water samples will be collected using approved equipment. For this project dedicated Waterra tubing and foot valves will be installed in all monitoring wells for the purposes of well development and collection of water samples. Samples will be collected in clean plastic bottles, as supplied by an approved Laboratory. These bottles are of sufficient quantity for the desired suite of parameters for RCAP analyses. Storage of the samples will be in a controlled cool environment and delivered to the analytical laboratory within 24 hours of sample collection for analyses.

There is no apparent concern with respect to groundwater quality from the soil/peat and aggregate extraction operation in this area. The proximity to Highway 101 and South Bishop Road, and apparent downgradient locations to both, as shown in Figure 02, gives rise to the concern of influence from deicing salt in the form of elevated sodium and chloride, and other anthropogenic impacts on groundwater in the area. The potential is most likely the greatest for the northern and western portions of the soil/peat site A1 and the aggregate site A2. For example, a significant portion of the soils along Highway 101 and South Bishop Road are sand and gravel deposits at a higher elevation than the peat deposits in the bog.

5.2.2 Surface Water Monitoring:

The only surface water flow from the site is in the ditch draining the peat deposits of Baltzer Bog. Soil/peat extraction in this area may from time to time result in total suspended solids (TSS) reaching the drainage ditch. This is seen from results of the water quality monitoring carried out as required in permit Approval No. 99-IAW-042 during the period August 2001 to September 2003. Water samples during this period were collected by staff of Mark-Lyn Construction Limited, and analyzed by Envirosphere Consultants Limited in Windsor, Nova Scotia. The results of this monitoring program are summarized in Table 8.

The other water quality parameter monitored during the above period was pH. The results of TSS and pH monitoring during the operational period until September 2003 are presented in Table 8. It should be noted that all 44 samples collected during this period indicate pH values below the final effluent discharge limits as stipulated in Permit Approval No. 99-IAW-042. This clearly shows the natural acidic (low pH) characteristics of drainage from the bog, and is consistent with the pH values less than 5.0 as recorded in the fish habitat study by Ocean Valley Aquatics. Accordingly, the pH limit established for this project should be reassessed in light of the natural background values at the site.

Of the 44 grab samples collected and analyzed for TSS, six values exceed the final effluent discharge limit for a grab sample of 50 mg/L. Two of these exceeded values occurred following precipitation events of greater than 50 mm as recorded at the Kentville Agricultural Research station. Samples were collected when water was available in the drainage ditch during 16 months from August 2001 to September 2003. The monthly means of these samples exceeded the final effluent discharge limits on five occasions.

Table 8. Baltzer Bog Surface Water Monitoring Results.

Month	No. of Samples	Total Suspended Solids		pH		Antecedent Precipitation
		Maximum	Monthly Mean	Maximum	Monthly Mean	
Aug. '01	4	**81.3**	**33.3**	**4.3**	**4.7**	1.4
Sept. '01	4	26.6	16.8	**4.0**	**4.8**	-
Oct. '01	2	8.0	6.2	**4.2**	**4.2**	-
Mar. '02	2	16.5	10.3	**3.9**	**4.0**	-
Apr. '02	4	11.0	8.5	**4.1**	**4.2**	-
May '02	4	11.5	9.3	**4.2**	**4.3**	-
June '02	2	38.5	24.8	**4.2**	**4.2**	-
July '02	3	**59.4**	**32.0**	**4.2**	**4.9**	9.0
Aug. '02	2	7.2	6.7	**3.8**	**4.0**	-
Sept. '02	3	**61.9**	23.6	**3.8**	**3.9**	58.9
Oct. '02	3	6.5	4.3	**4.3**	**4.7**	-
May '03	3	25.0	13.5	**4.5**	**4.6**	-
June '03	3	**84.0**	**36.8**	**3.9**	**4.5**	0.0
July '03	2	**125.0**	**95.6**	**4.6**	**4.7**	11.9
Aug. '03	1	21.3	21.3	5.1	**5.1**	-
Sept. '03	2	**90.0**	**51.0**	**4.5**	**4.8**	60.3
Final Effluent Discharge Limit		50.0	25.0	5 - 9	6 - 9	

Notes: 1. TSS values expressed as mg/L.

2. Samples collected on a weekly basis when water available in ditch.

3. Bold numbers represent values exceeding limit.

4. Antecedent precipitation in mm during four days prior to sampling.

5.2.3 Monitoring Schedule

For operation of the facility the suite of parameters and frequency of sampling and analyses is based on requirements to determine the chemical characteristics of ground and surface water in the vicinity of the site. This information will be used for future comparisons of water quality within the area of influence of the soil/peat and aggregate extraction operation and the quality of water within, and in the immediate vicinity outside of, the footprint of the extraction operations. The water quality parameters of interest include those of general chemical and physical nature.

During the groundwater monitoring program, or the first month of monitoring, a water sample will be collected from each of the monitoring wells. Analyses for these samples will include the following parameters: calcium; magnesium; sodium; potassium, chloride;

sulphate; iron; manganese; copper; nitrate; nitrite; ammonia; alkalinity; pH; total hardness; total dissolved solids; specific conductance; heavy metals, petroleum hydrocarbons, and temperature.

Sampling frequency, wells to be sampled, and parameters of interest during the first year of monitoring, will be determined on the basis of results obtained during discussions with staff of the NSDEL. In the interim a schedule of monitoring requirements is presented in Table 9.

As a guide for future seamless planning and operation of the water monitoring program for the Mark-Lyn Construction soil/peat and aggregate extraction undertaking at the Coldbrook site, a schedule of monitoring is being proposed. This schedule will assist future work and allow for a continuity of sampling and analyses of the environmental water conditions of the site. This schedule is outlined in Table 9 below.

Water quality monitoring in the vicinity of the soil/peat and aggregate extraction operation will serve four main purposes. The first objective is to determine the background quality of water in the area up-gradient of the extraction operations. The second objective is to assess whether water contamination is occurring from the sand and gravel extraction operations. The third objective is to assess and characterize potential migration pathways of potential contaminants off the site. The fourth objective is to determine presence of, and risk to, receptors of contamination if it does exist. The water monitoring program planned for the soil/peat aggregate extraction operation is scheduled to be fully implemented over a one month period following approval of the project by NSDEL.

Table 9. Proposed Monitoring Requirements During Extraction Operations.

Parameter	Source	Frequency	Reporting
Quantity			
Water Level	MWs	Quarterly	Quarterly
Quality			
Field Measurements:			
Conductance	All MWs	"	"
Temperature	All MWs	"	"
PH	All MWs	"	"
Laboratory Analyses:			
RCAP	All MWs	Quarterly	Quarterly
Metal Scan	"	"	"
BTEX & TPH	Shallow MW's	Semi Annual	Semi Annual
Total Susp. Solids	Drainage Ditch	Weekly	"

This report is intended to serve as an overview of the hydrology and groundwater conditions in the area which documents the physical setting, describes the related available data bases for the area. Accordingly this report also serves as a Phase I of the water monitoring program, and outlines the scope of work to be carried out during Phase II and Phase III.

Phase I - Completed during April, 2004, and included compilation of data and documentation on geology, hydrogeology, and water quality in the area. This information was assessed and interpreted to design a drilling and monitoring well construction program. This report is to be submitted to the NSDEL, as part of the Environmental Assessment of the project, to outline the plan and maintain dialogue on the monitoring program.

Phase II - During June 2004, construct a minimum of three (3) groundwater monitoring wells, prepare a log of the stratigraphy under the site, determine groundwater levels, sample groundwater for initial water quality characteristics, determine groundwater flow patterns and gradients, and identify potential down gradient receptors. Surface water samples will be collected and analyzed as per the proposed schedule. A report would be prepared and submitted to the NSDEL for review and information.

Phase III - During the first year of soil/peat and aggregate extraction operations, June 2004 to June 2005, samples would be collected from the monitoring wells and surface drainage sites for chemical analyses. A report will be prepared and submitted to NSDEL reporting progress, results, and trends in data over the one year period for water quality and water level data.

6.0 SUMMARY OF FINDINGS

The following summarizes the findings of this review of hydrogeology and groundwater conditions and outline of a water monitoring plan for the proposed expansion of the soil/peat and aggregate extraction operation by Mark-Lyn Construction at the Coldbrook site:

- The aggregate materials of interest under the site are classified as Ice-contact Stratified Drift of Quaternary age.
- No existing, private or public, water supplies are believed to exist within the footprint of the proposed expanded aggregate extraction area.
- The nearest private water supply well to the proposed expanded area appears to be in the west portion of the site identified as Area A1, along South Bishop Road.
- Bedrock aquifers underlying the entire site are classified as the Wolfville Hydrostratigraphic Unit, which are believed to be artesian in the area.
- Surficial aquifers underlying the entire site are classified as the Quaternary Hydrostratigraphic Unit.
- Depths of saturated surficial deposits in the area are reported to be in the range of approximately 50 to 100 feet.
- No points of permitted water withdraw as allocated by the NSDEL are reported to be located within approximately 1000 metres of the site.
- A groundwater monitoring program has been outlined for implementation, if required by the NSDEL, as part of the environmental assessment for this project.
- Groundwater sampling protocols, procedures, and a monitoring schedule have been outlined for this project if required.
- There are no apparent potential effects or impacts on the groundwater resources in the study area from the proposed expansion of the soil/peat and aggregate extraction operations.

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APPENDIX A

Summary of Monthly Weather Data Recorded at Kentville For Growing Seasons 2002 and 2003.

08/10/03 WED 10:57 FAX 902 679 5784 AGRI-FOOD CANADA

Atlantic Food & Horticulture Research Centre, KENTVILLE, N.S.

MONTHLY SUMMARY - MAY 2002

	Degree C			Heat Units Degree C				Precipitation				
				Growing		Heating		Snow	Total*	SUN	Wind	Evap
Day	Max	Min	Mean	5.0	10.0	18.0	CHU	cm	mm	Hr	Km/h	mm
1	10.8	-1.0	4.9	0.0	0.0	13.1	2	0.4	0.7	5.8	6.3	0.0
2	13.8	1.1	7.5	2.5	0.0	10.6	6	0.0	13.8	4.0	7.1	1.6
3	8.8	3.5	6.2	1.2	0.0	11.8	0	0.0	3.3	13.1	19.7	1.3
4	12.6	0.4	6.5	1.5	0.0	11.5	5	0.0	0.0	11.8	18.1	5.8
5	14.7	-0.4	7.2	2.1	0.0	10.8	7	0.0	0.0	11.0	7.4	3.6
6	21.8	8.3	15.1	10.1	5.1	2.9	17	0.0	0.0	11.0	16.0	7.2
7	22.5	7.7	15.1	10.1	5.1	2.9	18	0.0	0.9	8.2	16.9	5.7
8	14.8	0.6	7.7	2.7	0.0	10.3	7	0.0	0.0	12.8	11.4	3.6
9	16.7	7.6	12.2	7.1	2.1	5.9	13	0.0	11.9	9.6	13.5	19.1
10	19.1	7.4	13.3	8.3	3.3	4.8	14	0.0	4.7	4.3	11.5	1.3
11	11.8	1.8	6.7	1.7	0.0	11.3	3	0.0	0.0	13.1	19.3	8.8
12	11.6	3.0	7.3	2.3	0.0	10.7	3	0.0	0.0	8.0	12.5	0.0
13	14.3	1.3	7.8	2.8	0.0	10.2	6	0.0	12.7	8.0	11.2	8.7
14	9.7	2.0	5.9	0.8	0.0	12.2	0	0.0	6.5	0.7	10.2	0.0
15	12.2	4.5	8.4	3.4	0.0	9.7	4	0.0	3.0	7.0	18.6	4.9
16	15.8	6.1	11.0	6.0	0.9	7.1	10	0.0	0.8	7.1	14.4	5.0
17	18.1	5.4	11.8	6.8	1.8	6.3	11	0.0	4.4	5.2	13.4	2.0
18	9.2	4.9	7.1	2.1	0.0	11.0	1	0.0	21.4	0.0	9.9	0.0
19	13.6	3.7	8.6	3.6	0.0	9.4	6	0.0	0.8	7.4	11.8	5.6
20	15.1	-0.2	7.6	2.5	0.0	10.8	7	0.0	0.0	13.6	7.2	4.8
21	15.4	6.2	10.8	5.8	0.8	7.2	9	0.0	0.0	12.5	13.6	4.0
22	18.1	8.8	13.5	8.5	3.5	4.5	15	0.0	0.0	13.6	14.6	7.2
23	24.5	6.9	15.7	10.7	5.7	2.3	16	0.0	0.0	13.4	15.8	9.2
24	26.3	8.2	17.3	12.3	7.3	0.8	19	0.0	0.0	11.5	11.0	5.4
25	16.3	2.3	9.3	4.3	0.0	8.7	8	0.0	0.0	11.9	9.2	8.2
26	18.4	11.3	14.9	9.9	4.9	3.2	17	0.0	0.0	6.9	11.9	4.8
27	23.8	10.1	16.9	11.9	6.9	1.1	20	0.0	0.0	10.4	6.4	6.0
28	21.9	7.0	14.5	9.5	4.6	3.6	18	0.0	0.0	6.9	3.4	2.4
29	25.4	13.8	19.6	14.6	9.6	0.0	24	0.0	0.6	9.4	10.6	7.2
30	28.6	16.1	20.4	15.4	10.4	0.0	25	0.0	0.0	5.2	9.4	4.8
31	27.0	16.1	21.6	16.6	11.6	0.0	27	0.0	0.0	12.1	15.4	*
SUM				196.6	83.2	214.1	338	0.4	85.2	274.4		149.8
MEAN	17.1	5.6	11.3								12.2	
SAME MONTH LAST YEAR												
	16.2	8.1	12.2	221.7	86.9	181.4	376	0.0	137.7	225.6	9.0	0.0
41 YEAR AVERAGE (1961-2001)												
	16.2	4.9	10.6	179.4	69.0	231.7		2.2	78.9	201.9		
5 YEAR AVERAGE (1997-2001)												
	17.5	6.4	11.5	221.3	88.2	184.5	372	0.0	84.5	213.1	8.7	46.4
EXTREME												
MAX	27.0	16.1	21.6	16.6	11.6	13.1	27	0.4	21.4	13.6	19.7	19.1
MIN	8.8	-1.0	4.9	0.0	0.0	0.0	0	0.0	0.0	0.0	3.4	0.0

+ 8 %

09/10/03 WED 10:55 FAX 902 679 5784 AGRI-FOOD CANADA
Atlantic Food & Horticulture Research Centre, KENTVILLE, N.S.

MONTHLY SUMMARY - JUNE 2002

	Degree C			Heat Units Degree C				Precipitation			
				Growing		Heating		Rain	SUN	Wind	Evap
Day	Max	Min	Mean	5.0	10.0	18.0	CHU	mm	Hr	Km/h	mm
1	25.4	8.9	17.2	12.2	7.1	0.9	20.0	0.0	11.4	14.8	6.8
2	18.2	4.7	11.5	6.5	1.4	6.6	11.0	1.8	4.2	13.1	2.5
3	14.2	4.9	9.5	4.6	0.0	8.5	6.0	0.0	6.7	13.3	3.6
4	18.2	4.0	11.1	6.1	1.1	6.9	11.0	0.0	12.2	6.5	4.8
5	16.2	10.3	13.3	8.3	3.3	4.8	13.0	0.7	0.0	11.8	1.7
6	16.2	9.8	13.0	8.0	3.0	5.0	13.0	2.3	0.0	5.0	0.0
7	14.8	1.2	8.0	3.0	0.0	10.0	7.0	0.0	1.3	5.8	0.0
8	19.1	9.6	14.4	9.4	4.4	3.6	17.0	0.0	10.4	6.0	0.0
9	19.5	9.1	14.3	9.3	4.3	3.7	17.0	6.8	2.9	10.4	0.4
10	15.3	5.1	10.2	5.2	0.2	7.8	8.0	0.4	4.0	10.0	2.8
11	14.1	6.6	10.4	5.4	0.3	7.7	8.0	0.6	0.0	3.8	0.6
12	17.1	1.7	9.4	4.4	0.0	8.6	10.0	0.0	2.6	6.2	3.6
13	20.6	6.6	13.6	8.6	3.6	4.4	16.0	0.0	11.6	6.0	4.8
14	21.9	4.5	13.2	8.2	3.2	4.8	14.0	0.6	11.6	4.7	6.6
15	16.2	6.4	11.3	6.3	1.3	6.7	10.0	16.1	0.9	9.0	1.7
16	11.7	6.6	9.2	4.1	0.0	8.9	5.0	0.7	0.0	4.0	0.0
17	16.2	8.8	12.5	7.5	2.5	5.5	12.0	0.0	0.7	4.4	1.6
18	20.5	8.2	14.4	9.4	4.4	3.7	16.0	0.0	8.1	5.0	2.3
19	20.9	7.5	14.2	9.2	4.2	3.8	16.0	0.0	8.2	6.2	1.6
20	26.7	9.0	17.9	12.9	7.9	0.1	20.0	0.0	12.6	6.2	2.5
21	28.6	14.6	21.6	16.6	11.6	0.0	26.0	0.0	12.8	10.9	12.9
22	23.8	7.4	15.6	10.6	5.6	2.4	17.0	0.0	4.1	6.1	4.9
23	25.3	13.7	19.5	14.5	9.5	0.0	24.0	10.6	7.2	11.4	1.0
24	18.1	12.9	15.5	10.5	5.5	2.5	18.0	0.0	3.8	19.8	7.0
25		9.3	9.3	4.3	0.0	8.7	16.0	0.0	12.2	9.8	4.8
26	27.2	15.0	21.1	16.1	11.1	0.0	26.0	3.7	11.8	6.9	6.3
27	29.1	16.6	22.5	17.5	12.5	0.0	27.0	0.7	6.1	13.0	2.6
28	24.1	15.4	19.8	14.8	9.8	0.0	25.0	0.7	3.0	4.0	3.1
29	24.3	12.5	18.4	13.4	8.4	0.0	23.0	0.0	9.7	9.0	9.6
30	26.6	11.5	19.1	14.1	9.1	0.0	23.0	0.0	9.8	4.1	4.8
SUM				280.5	136.1	128.3	476	46.8	187.3		105.0
MEAN	20.3	8.0	14.4							8.1	
SAME MONTH LAST YEAR											
	24.1	12.6	18.3	400.3	250.6	46.2	664	80.4	212.8	8.0	133.8
41 YEAR AVERAGE (1961-2001)											
	22.0	10.2	16.1	332.9	184.8	79.9		67.6	211.9		
5 YEAR AVERAGE (1997-2001)											
	22.8	11.3	17.0	361.0	213.7	68.1	568	51.4	213.2	8.0	133.2
EXTREME											
MAX	29.1	15.8	22.5	17.5	12.5	10.0	27.0	16.1	12.8	19.8	12.9
MIN	11.7	1.2	8.0	3.0	0.0	0.0	5.0	0.0	0.0	3.8	0.0
T=trace											

- 32 %

08/10/03 WED 10:59 FAX 902 679 2311 AGRI-FOOD CANADA
Research Centre, KENTVILLE, N.S.

MONTHLY SUMMARY - JULY 2002

	Degree C			Heat Units Degree C							
				Growing		Heating		Rain	SUN	Wind	Evap
Day	Max	Min	Mean	5.0	10.0	18.0	CHU	mm	Hr	Km/h	mm
1	24.3	14.5	19.4	14.4	9.4	0.0	25	0.0	3.6	6.7	2.4
2	27.9	15.3	21.6	16.6	11.6	0.0	28	0.0	6.1	4.7	4.8
3	30.2	18.6	24.4	19.4	14.4	0.0	30	0.0	8.8	4.6	3.4
4	32.6	18.1	25.4	20.4	15.4	0.0	28	0.0	8.9	6.0	6.0
5	26.8	15.3	21.0	16.0	11.0	0.0	26.0	0.0	6.0	6.1	4.8
6	22.9	12.8	17.9	12.9	7.9	0.1	22.0	0.0	10.5	7.7	6.8
7	21.1	12.7	16.9	11.9	6.9	1.1	21.0	0.6	3.7	4.7	0.0
8	25.9	16.6	21.3	16.3	11.3	0.0	27.0	3.1	8.0	8.6	7.9
9	25.7	16.6	21.2	16.2	11.2	0.0	27.0	4.6	3.6	8.3	0.0
10	23.9	9.7	16.8	11.8	6.8	1.2	20.0	0.7	10.4	11.3	9.5
11	20.2	12.6	16.4	11.4	6.4	1.6	20.0	0.0	8.7	14.2	7.2
12	23.6	11.7	17.7	12.7	7.6	0.4	22.0	0.0	12.6	10.5	8.2
13	27.8	15.3	21.6	16.6	11.6	0.0	26.0	0.0	10.6	10.6	7.3
14	26.8	15.6	21.2	16.2	11.2	0.0	27.0	0.0	10.9	5.3	4.8
15	27.3	14.3	20.8	15.8	10.8	0.0	25.0	0.0	10.9	9.0	7.1
16	22.4	14.0	18.2	13.2	8.2	0.0	23.0	5.7	4.4	6.1	3.3
17	22.1	14.6	18.4	13.4	8.4	0.0	23.0	0.0	4.1	6.6	2.4
18	23.7	11.0	17.4	12.4	7.4	0.6	21.0	0.0	3.6	1.0	2.4
19	25.5	14.6	20.1	15.1	10.1	0.0	25.0	41.4	9.0	6.4	5.4
20	18.4	8.8	13.6	8.6	3.6	4.4	15.0	0.6	1.5	7.3	2.6
21	24.9	12.0	18.5	13.5	8.5	0.0	22.0	0.0	12.3	4.6	6.4
22	28.3	18.5	23.4	18.4	13.4	0.0	29.0	0.0	11.3	13.0	7.2
23	33.5	13.8	23.7	18.7	13.7	0.0	24.0	0.6	8.8	11.7	8.0
24	22.8	8.2	15.5	10.5	5.5	2.5	18.0	0.0	12.9	6.1	7.2
25	21.9	7.1	14.5	9.5	4.5	3.5	16.0	0.0	13.5	13.5	4.8
26	23.6	9.7	16.7	11.7	6.6	1.4	20.0	0.0	12.1	5.5	9.6
27	19.3	9.5	14.4	9.4	4.4	3.6	17.0	0.0	3.7	5.0	2.4
28	23.1	14.2	18.7	13.7	8.7	0.0	23.0	0.0	8.0	6.1	4.8
29	23.4	18.6	21.0	16.0	11.0	0.0	26.0	0.0	2.9	7.2	2.4
30	26.9	18.6	22.8	17.3	12.3	0.0	29.0	0.4	3.6	4.5	2.6
31	28.3	17.0	22.7	17.7	12.7	0.0	28.0	0.0	12.4	10.2	9.8
SUM				446.7	291.8	20.8	733	58.1	244.4		161.4
MEAN	25.0	12.9	19.4							7.5	
SAME MONTH LAST YEAR											
	26.0	12.9	19.0	433.4	278.4	19.2	703	27.0	252.4	8.0	160.2
41 YEAR AVERAGE (1961-2001)											
	25.0	13.6	19.3	442.7	287.7	19.8		68.1	232.8		157.4
5 YEAR AVERAGE (1997-2001)											
	26.0	13.8	19.9	462.4	307.4	10.7	743	36.7	267.8	8.2	160.7
EXTREME											
MAX	33.5	18.6	25.4	20.4	15.4	4.4	30	41.4	13.5	14.2	9.8
MIN	18.4	7.1	13.6	8.6	3.6	0.0	15	0	1.5	1	0

– 16 %

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MONTHLY SUMMARY - AUGUST 2002

	Degree C			Heat Units Degree C							
				Growing		Heating		Rain	SUN	Wind	Evap
Day	Max	Min	MEAN	5.0	10.0	18.0	CHU	mm.	Hr	Km/h	mm
1	24.9	11.6	18.3	13.3	8.3	0.0	27	0.0	9.1	7.0	4.0
2	24.3	15.8	20.1	15.1	10.1	0.0	28	0.0	10.3	7.6	7.2
3	23.8	18.4	21.1	16.1	11.1	0.0	27	0.0	0.0	6.0	2.4
4	29.1	17.5	23.3	18.3	13.3	0.0	29	0.6	7.5	4.6	5.4
5	29.2	18.5	23.9	18.9	13.9	0.0	30	8.1	1.8	9.8	3.3
6	19.9	13.2	16.6	11.5	6.5	1.5	20	31.2	0.2	10.1	2.4
7	20.2	9.6	14.9	9.9	4.9	3.1	17	0.7	9.6	10.0	4.7
8	24.0	9.7	16.9	11.9	6.9	1.1	20	0.0	9.0	5.9	4.0
9	22.7	10.2	16.5	11.5	6.5	1.6	20	0.0	12.8	5.9	4.8
10	27.8	13.8	20.8	15.8	10.8	0.0	25	0.0	12.0	7.0	7.2
11	30.8	17.0	23.8	18.8	13.8	0.0	28	0.0	12.2	9.4	7.2
12	30.3	14.8	22.6	17.6	12.6	0.0	26	0.0	10.8	4.7	7.2
13	31.6	18.6	25.1	20.1	15.1	0.0	29	0.0	11.6	5.2	8.0
14	33.9	18.0	26.0	21.0	16.0	0.0	28	0.0	10.3	5.2	7.2
15	32.6	21.3	27.0	22.0	17.0	0.0	31	0.0	9.8	6.0	7.2
16	31.4	20.9	26.2	21.2	16.2	0.0	31	0.0	7.7	6.8	6.4
17	32.1	16.5	24.3	19.3	14.3	0.0	28	0.0	11.3	6.7	7.2
18	32.4	18.6	25.5	20.5	15.5	0.0	29	0.0	11.2	4.7	4.2
19	30.7	17.2	24.0	19.0	14.0	0.0	28	0.0	9.6	5.6	5.6
20	25.0	11.4	18.2	13.2	8.2	0.0	21	0.0	3.8	6.1	2.8
21	25.5	10.5	18.0	13.0	8.0	0.0	22	0.0	12.6	6.9	4.6
22	27.0	15.2	21.1	16.1	11.1	0.0	26	2.1	8.8	10.3	6.9
23	22.2	8.7	15.5	10.5	5.5	2.6	18	0.0	11.3	5.9	4.6
24	24.4	14.4	19.4	14.4	9.4	0.0	24	10.0	5.7	5.9	5.2
25	19.6	11.7	15.7	10.7	5.7	2.4	19	1.4	1.3	7.4	0.0
26	25.6	13.1	19.5	14.5	9.5	0.0	24	0.6	11.5	9.4	7.8
27	25.3	10.6	17.9	12.9	7.9	0.1	21	0.4	10.7	5.9	6.2
28	23.3	9.7	16.5	11.5	6.5	1.6	20	0.0	6.7	5.7	6.6
29	23.6	14.0	18.8	13.8	8.8	0.0	24	2.7	5.8	5.1	0.3
30	21.2	6.5	13.9	8.9	3.9	4.2	16	1.5	4.0	6.0	5.3
31	19.1	5.6	12.4	7.4	2.4	5.6	13	0.0	10.8	7.8	4.8
SUM				467.7	312.7	23.6	741	59.3	259.8		182.5
MEAN	26.2	13.9	20.1							6.9	
SAME MONTH LAST YEAR											
	27.5	15.1	21.3	526.5	360.6	11.1	789	11.8	239.4	7.6	163.9
41 YEAR AVERAGE (1961-2001)											
	24.2	13.2	18.7	424.4	269.4	27.5		88.9	217.4	8.1	
5 YEAR AVERAGE (1997-2001)											
	25.2	14.1	19.7	454.4	299.4	15.8	736	62.9	223.1	7.7	129.8
EXTREME											
MAX	33.9	21.3	27.0	22.0	17.0	5.6	31	31.2	12.8	10.3	7.8
MIN	19.1	5.6	12.4	7.4	2.4	0.0	13	0.0	0.0	4.6	0.0

- 33 %

09/10/03 WED 11:00 FAX 902 679 2311 AGRI-FOOD CANADA

Atlantic Food & Horticulture Research Centre, KENTVILLE N.S.

MONTHLY SUMMARY - SEPTEMBER 2002

	Degree C			Heat Units Degree C						
				Growing		Heating		Rain	SUN	Wind
Day	Max	Min	Mean	5.0	10.0	18.0	CHU	mm	Hr	Km/h
1	22.1	6.9	14.5	9.5	4.5	3.5	18.0	0.0	2.2	7.1
2	22.0	10.9	16.5	11.5	6.5	1.5	20.0	0.0	11.0	4.7
3	24.4	17.2	20.8	15.8	10.8	0.0	26.0	0.6	3.2	8.0
4	25.4	17.4	21.4	16.4	11.4	0.0	20.0	3.6	8.5	12.4
5	21.6	10.6	16.1	11.1	6.1	1.9	20.0	0.0	8.2	12.4
6	20.0	9.2	14.5	9.5	4.6	3.4	17.0	0.0	11.3	9.2
7	25.7	12.0	18.9	13.9	8.9	0.0	23.0	0.0	8.3	5.7
8	29.6	19.6	24.6	19.6	14.6	0.0	31.0	0.0	6.8	12.6
9	22.3	14.9	18.6	13.6	8.6	0.0	23.0	0.0	3.3	8.2
10	33.2	17.9	25.6	20.6	15.6	0.0	29.0	0.0	10.7	10.5
11	23.7	8.2	16.0	11.0	6.0	2.1	18.0	71.3	0.0	12.1
12	14.7	3.9	9.3	4.3	0.0	8.7	7.0	5.4	3.6	11.1
13	21.6	8.0	14.8	9.8	4.8	3.1	17.0	0.7	7.6	11.1
14	20.9	11.8	16.3	11.3	6.3	1.7	20.0	0.0	9.4	6.3
15	23.6	16.1	19.9	14.9	9.9	0.0	25.0	17.1	4.3	11.2
16	20.6	11.0	15.8	10.8	5.8	2.3	18.0	16.7	0.0	5.2
17	19.6	10.1	14.9	9.9	4.9	3.1	17.0	0.6	8.3	5.3
18	18.1	5.0	11.6	6.6	1.6	6.5	11.0	0.0	10.1	7.2
19	22.0	9.4	15.7	10.7	5.7	2.3	18.0	0.0	10.6	6.9
20	25.3	16.4	20.9	15.9	10.9	0.5	26.0	0.0	7.1	13.6
21	27.6	15.6	21.6	16.6	11.6	0.0	27.0	0.0	8.2	7.0
22	27.4	16.8	22.1	17.1	12.1	0.0	27.0	0.0	9.3	6.1
23	27.8	14.6	21.2	16.2	11.2	0.0	26.0	37.4	7.7	6.3
24	15.4	10.3	12.9	7.9	2.9	5.1	12.0	5.1	0.0	6.1
25	19.9	5.7	12.8	7.8	2.8	5.2	14.0	0.6	10.6	6.1
26	20.1	10.8	15.5	10.5	5.5	2.5	16.0	0.0	9.0	3.4
27	21.7	12.7	17.2	12.2	7.2	0.8	22.0	15.8	0.0	5.4
28	17.9	4.5	11.2	6.2	1.2	6.8	11.0	0.0	1.0	12.6
29	12.2	0.4	6.3	1.3	0.0	11.7	3.0	0.0	10.3	10.6
30	16.3	4.4	10.4	5.4	0.4	7.6	8.0	0.6	8.2	9.9
SUM				347.5	201.8	79.9	670	176.4	189.5	
MEAN	22.1	11.1	16.6							8.3
SAME MONTH LAST YEAR										
	23.3	9.8	16.0	329.2	180.2	84.2	648.0	77.4	232.5	7.0
41 YEAR AVERAGE (1961-2001)										
	18.8	9.3	14.6	285.7	141.2	116.9		93.0	164.6	10.4
5 YEAR AVERAGE (1997-2001)										
	21.3	10.7	15.9	326.4	181.7	86.5	546.2	108.8	185.4	7.7
EXTREME										
MAX	33.2	19.6	25.6	20.6	15.6	11.7	31.0	71.3	11.3	13.6
MIN	12.2	0.4	6.3	1.3	0.0	0.0	3.0	0.0	0.0	3.4
T=trace										

Atlantic Food & Horticulture Research Centre, KENTVILLE, N.S.

+ 87%

09/10/03 WED 10:54 FAX 902 679 5784 AGRI-FOOD CANADA

Atlantic Food & Horticulture Research Centre, KENTVILLE N.S.

MONTHLY SUMMARY - MAY 2003

	Degree C			Heat Units Degree C				Precipitation			
				Growing		Heating		Snow	Total*	SUN	Wind
Day	Max	Min	Mean	5.0	10.0	18.0	CHU	cm	mm	Hr	Km/h
1	14.0	7.3	10.7	5.7	0.7	7.4	8	0.0	3.2	2.9	11.3
2	11.2	3.5	7.4	2.4	0.0	10.7	2	0.0	3.9	0.0	8.2
3	8.2	-0.7	3.7	0.0	0.0	14.3	0	0.0	0.7	6.3	11.4
4	17.5	0.8	9.2	4.2	0.0	8.8	11	0.0	0.0	13.9	10.0
5	19.3	1.5	10.4	5.4	0.4	7.6	12	0.0	0.0	11.5	5.0
6	17.9	7.4	12.7	7.6	2.6	5.4	13	0.0	1.4	3.8	10.5
7	14.6	8.0	11.3	6.3	1.3	6.7	10	0.0	0.0	5.2	13.4
8	13.5	2.7	8.1	3.1	0.0	9.9	6	0.0	0.0	4.3	7.5
9	7.2	3.1	5.2	0.2	0.0	12.9	0	0.0	0.0	0.0	15.7
10	5.7	2.6	4.2	0.0	0.0	13.9	0	0.0	2.1	0.2	17.1
11	7.7	3.4	5.6	0.6	0.0	12.5	0	0.0	0.0	0.2	9.0
12	6.6	4.3	5.5	0.4	0.0	12.6	0	0.0	11.4	0.0	8.1
13	9.6	4.6	7.1	2.1	0.0	10.9	1	0.0	0.0	0.6	7.2
14	12.2	4.5	8.4	3.4	0.0	9.7	4	0.0	0.0	1.8	6.7
15	6.9	1.1	4.0	0.0	0.0	14.0	0	0.0	0.0	0.0	12.7
16	12.3	0.3	6.3	1.3	0.0	11.7	3	0.0	0.0	8.4	6.1
17	21.4	4.0	12.7	7.7	2.7	5.3	13	0.0	0.0	13.4	4.3
18	25.2	2.7	14.0	9.0	3.9	4.1	16	0.0	0.7	13.1	7.3
19	24.7	8.9	16.3	10.3	6.3	2.7	17	0.0	0.0	13.4	5.2
20	28.2	8.0	16.1	11.1	6.1	1.9	17	0.0	0.0	8.8	4.1
21	25.6	7.7	16.7	11.7	6.7	1.3	19	0.0	0.0	4.9	5.9
22	17.2	6.6	11.9	6.9	1.9	6.1	12	0.0	0.0	5.3	6.2
23	17.8	3.4	10.6	5.6	0.6	7.4	11	0.0	0.0	7.2	6.2
24	16.4	8.9	12.7	7.6	2.6	5.4	13	0.0	1.9	0.0	7.0
25	9.2	6.9	8.1	3.1	0.0	10.0	2	0.0	11.8	0.0	12.4
26	11.0	7.0	9.0	4.0	0.0	9.0	4	0.0	0.0	0.0	7.6
27	14.9	6.6	10.8	5.8	0.8	7.3	10	0.0	0.0	0.0	4.5
28	16.7	8.7	12.7	7.7	2.7	5.3	14	0.0	14.0	1.0	4.0
29	15.1	10.3	12.7	7.7	2.7	5.3	12	0.0	0.0	0.0	5.6
30	20.2	11.6	15.9	10.9	5.9	2.2	19	0.0	6.8	6.1	4.8
31	20.4	9.4	14.9	9.9	4.9	3.1	17	0.0	0.6	6.3	4.6
SUM				161.3	51.6	244.8	266	0	67.5	137.0	
MEAN	15.1	5.1	10.1								8.1
SAME MONTH LAST YEAR											
	17.1	5.6	11.3	196.6	83.2	214.1	335	0.4	65.2	274.4	12.2
42 YEAR AVERAGE (1961-2001)											
	16.3	4.9	10.6	176.6	69.6	231.3		2.1	79.0	203.7	
5 YEAR AVERAGE (1997-2002)											
	17.9	6.4	12.1	227.6	96.5	179.7	366	0.1	87.1	233.1	6.9
EXTREME											
MAX	28.2	11.6	16.7	11.7	6.7	14.3	19	0.0	14.0	13.9	17.1
MIN	5.7	-0.7	3.7	0.0	0.0	1.3	0	0.0	0.0	0.0	4.0

* Rain plus snow melted T=trace

-27 % of mean

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Atlantic Food & Horticulture Research Centre, KENTVILLE, N.S.

MONTHLY SUMMARY - JUNE 2003

	Degree C			Heat Units Degree C				Precipitation			
				Growing		Heating		Rain	SUN	Wind	Evap
Day	Max	Min	Mean	5.0	10.0	18.0	CHU	mm	Hr	Km/h	mm
1	17.9	9.7	13.8	8.8	3.8	4.2	16	28.1	0.0	8.2	8.3
2	17.9	8.6	13.3	8.3	3.3	4.6	16	0.0	7.3	15.6	4.8
3	17.1	5.3	11.2	6.2	1.2	6.8	10	0.0	13.1	14.6	6.6
4	19.8	4.4	12.1	7.1	2.1	5.9	12	0.0	12.5	8.7	5.6
5	18.0	10.6	14.3	9.3	4.3	3.8	17	3.5	0.4	6.7	0.1
6	19.6	8.0	13.8	8.8	3.8	4.2	16	0.6	2.6	11.0	2.8
7	24.5	11.1	17.8	12.8	7.8	0.2	21	0.0	4.4	4.8	2.4
8	19.5	11.0	15.3	10.3	5.3	2.8	18	0.0	5.0	6.4	2.4
9	15.1	9.8	12.5	7.5	2.4	5.6	12	0.0	0.0	6.5	1.6
10	20.4	10.2	15.3	10.3	5.3	2.7	17	0.0	7.0	11.5	4.4
11	24.7	13.8	19.3	14.3	9.3	0.0	24	10.2	8.4	10.8	5.8
12	20.5	7.2	13.9	8.9	3.9	4.2	16	0.0	7.4	6.5	2.4
13	20.9	9.9	15.4	10.4	5.4	2.6	18	0.0	12.0	6.7	6.6
14	13.6	7.0	10.3	5.3	0.3	7.7	8	12.4	0.0	10.7	2.0
15	12.8	7.7	10.3	5.3	0.3	7.8	8	0.0	0.2	10.4	1.0
16	19.8	9.1	14.5	9.5	4.5	3.6	17	0.0	8.6	9.2	4.5
17	24.8	11.9	18.3	13.3	8.3	0.0	22	0.6	12.0	13.1	7.8
18	25.3	16.3	20.8	15.8	10.8	0.0	26	0.0	10.1	12.9	7.2
19	24.0	14.1	19.1	14.1	9.1	0.0	24	0.0	1.6	7.9	1.6
20	24.4	10.5	17.5	12.5	7.5	0.6	21	0.0	12.6	5.4	4.8
21	27.9	12.8	20.4	15.4	10.4	0.0	24	0.0	10.8	4.9	8.2
22	26.6	11.6	19.1	14.1	9.1	0.0	25	0.0	8.2	5.3	4.6
23	25.0	12.9	19.0	14.0	9.0	0.0	23	0.0	7.7	8.5	4.0
24	27.1	11.1	19.1	14.1	9.1	0.0	22	0.0	9.4	5.9	7.2
25	26.0	13.0	19.5	14.5	9.5	0.0	24	0.0	6.7	4.4	2.4
26	29.2	14.9	22.1	17.1	12.1	0.0	26	0.0	11.7	3.1	6.0
27	31.4	16.1	23.8	18.8	13.8	0.0	27	0.0	12.0	4.7	6.2
28	27.3	15.7	21.5	16.5	11.5	0.0	27	0.0	4.1	5.0	4.8
29	29.4	14.8	22.1	17.1	12.1	0.0	26	0.0	11.8	4.4	7.0
30	29.0	15.2	22.1	17.1	12.1	0.0	26	10.8	7.3	7.1	4.1
SUM				358.8	206.8	67.1	586	68.3	214.7		140.3
MEAN	22.8	11.1	16.9							8.0	
SAME MONTH LAST YEAR											
	20.3	8.6	14.4	260.5	135.1	126.3	478	45.8	187.5	8.1	105.0
42 YEAR AVERAGE (1961-2002)											
	21.9	10.2	16.1	331.6	183.6	81.0		67.0	211.3		
5 YEAR AVERAGE (1998-2002)											
	22.6	11.0	16.8	353.2	205.8	75.3	577	49.2	209.6	8.1	129.2
EXTREME											
MAX	31.4	16.3	23.8	18.8	13.8	7.8	27.0	28.1	13.1	15.6	8.3
MIN	12.8	4.4	10.3	5.3	0.3	0.0	8.0	0.0	0.0	3.1	0.1

T=trace

0.01

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Atlantic Food & Horticulture Research Centre, KENTVILLE, N.S.

MONTHLY SUMMARY - JULY 2003

	Degree C			Heat Units Degree C							
				Growing		Heating		Rain	SUN	Wind	Evap
Day	Max	Min	Mean	5.0	10.0	18.0	CHU	mm	Hr	Km/h	mm
1	26.5	15.6	21.1	16.1	11.1	0.0	27	0.0	10.5	10.8	8.6
2	23.6	12.6	18.1	13.1	8.1	0.0	23	0.0	7.5	7.1	4.8
3	27.9	18.0	23.0	18.0	13.0	0.0	29	0.7	7.0	7.0	4.8
4	29.9	17.3	23.6	18.6	13.6	0.0	28	0.0	10.6	6.8	7.2
5	30.3	16.1	23.2	18.2	13.2	0.0	27.0	0.0	8.7	4.8	7.2
6	28.6	15.9	22.3	17.3	12.3	0.0	27.0	0.0	12.8	11.9	9.2
7	26.8	12.1	19.5	14.5	9.5	0.0	25.0	0.0	12.7	7.1	7.2
8	27.0	18.8	22.9	17.9	12.9	0.0	29.0	0.0	5.1	10.2	5.8
9	24.5	12.1	18.3	13.3	8.3	0.0	22.0	0.0	5.0	10.9	8.2
10	24.1	10.0	17.1	12.1	7.1	0.9	20.0	0.0	10.3	5.4	5.5
11	21.8	14.4	18.1	13.1	8.1	0.0	23.0	11.9	1.0	6.5	0.0
12	27.8	13.5	20.7	15.7	10.7	0.0	26.0	0.7	10.6	7.2	4.8
13	28.9	15.1	22.0	17.0	12.0	0.0	26.0	0.0	9.6	4.9	4.5
14	27.4	16.6	22.0	17.0	12.0	0.0	27.0	0.0	6.6	5.6	4.6
15	22.4	15.4	18.9	13.9	8.9	0.0	23.0	13.2	0.3	4.7	1.2
16	27.0	16.2	21.6	16.6	11.6	0.0	32.0	0.0	8.2	3.1	4.4
17	25.8	17.3	21.5	16.5	11.5	0.0	27.0	19.9	2.6	4.2	0.7
18	26.7	17.8	22.3	17.3	12.3	0.0	28.0	0.6	8.2	3.7	6.0
19	28.2	18.3	21.3	16.3	11.3	0.0	26.0	15.9	2.7	3.5	3.9
20	24.7	14.4	19.6	14.6	9.6	0.0	24.0	0.0	7.0	3.4	2.4
21	27.9	14.9	21.4	16.4	11.4	0.0	26.0	0.6	8.3	4.7	3.0
22	28.9	18.4	23.7	18.7	13.7	0.0	29.0	6.0	9.5	10.5	7.4
23	29.2	20.8	25.0	20.0	15.0	0.0	31.0	6.5	5.4	12.8	3.7
24	28.9	22.7	25.8	20.8	15.8	0.0	33.0	0.7	3.6	13.0	8.3
25	26.3	15.9	21.1	16.1	11.1	0.0	26.0	0.0	2.0	10.0	4.0
26	28.7	18.3	23.5	18.5	13.5	0.0	29.0	0.6	9.6	9.7	7.8
27	25.2	17.4	21.3	16.3	11.3	0.0	27.0	0.0	1.1	12.1	2.4
28	22.7	15.2	19.0	14.0	9.0	0.0	24.0	0.0	13.1	19.1	7.2
29	24.6	11.4	18.0	13.0	8.0	0.0	21.0	0.0	13.0	7.6	4.2
30	27.8	12.6	20.2	15.2	10.2	0.0	24.0	0.0	12.5	5.0	7.2
31	27.2	13.0	20.1	15.1	10.1	0.0	24.0	0.0	13.3	4.9	7.2
SUM				500.7	345.7	0.9	810	78.5	243.3		161.2
MEAN	26.6	15.7	21.2							7.7	
SAME MONTH LAST YEAR											
	25.0	13.9	19.4	446.7	291.6	20.5	733	66.1	244.4	7.5	151.4
42 YEAR AVERAGE (1961-2002)											
	25.0	13.6	19.3	442.8	287.8	19.8		88.8	233.0		157.6
5 YEAR AVERAGE (1998-2002)											
	25.6	13.9	19.7	457.2	302.2	13.4	741	42.5	246.8	8.0	150.2
EXTREME											
MAX	30.3	22.7	25.8	20.8	15.8	0.9	33	19.9	13.3	19.1	9.2
MIN	21.8	10.0	17.1	12.1	7.1	0.0	20	0	0.3	3.1	0

T=trace

+ 14 %

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Atlantic Food & Horticulture Research Centre, KENTVILLE, N.S.

MONTHLY SUMMARY - AUGUST 2003

	Degree C			Heat Units Degree C							
				Growing		Heating		Rain	SUN	Wind	Evap
Day	Max	Min	MEAN	5.0	10.0	18.0	CHU	mm	Hr	Km/h	mm
1	27.9	15.7	21.8	16.8	11.8	0.0	27	10.6	5.9	4.8	8.8
2	18.6	16.0	17.3	12.3	7.3	0.7	22	7.6	0.0	2.8	0.0
3	20.7	17.0	18.9	13.9	8.9	0.0	26	0.0	0.0	2.0	0.0
4	24.8	18.2	21.5	16.5	11.5	0.0	28	82.0	0.8	3.4	22.0
5	20.8	18.4	19.6	14.6	9.6	0.0	25	21.4	0.0	4.6	0.0
6	28.2	18.8	23.5	18.5	13.5	0.0	29	3.5	3.9	3.8	2.3
7	22.0	20.3	21.2	16.2	11.2	0.0	28	3.3	1.3	3.6	0.0
8	24.3	20.3	22.3	17.3	12.3	0.0	29	6.9	0.0	1.9	1.7
9	25.3	20.5	22.9	17.9	12.9	0.0	30	0.6	0.4	4.0	0.8
10	30.2	21.3	25.8	20.8	15.8	0.0	31	0.0	7.4	10.4	3.4
11	26.3	19.1	22.7	17.7	12.7	0.0	29	0.6	0.7	7.5	3.0
12	25.8	17.3	21.5	16.5	11.5	0.0	27	0.0	2.7	4.0	2.4
13	28.6	18.4	21.5	16.5	11.5	0.0	27	4.9	3.2	4.8	0.0
14	25.8	13.3	19.6	14.5	9.5	0.0	24	0.0	10.6	6.7	4.8
15	25.7	13.1	19.4	14.4	9.4	0.0	24	0.0	11.5	5.7	7.2
16	28.8	20.3	24.6	19.6	14.6	0.0	30	0.7	10.2	11.3	7.2
17	23.9	14.8	19.3	14.3	9.3	0.0	25	0.0	1.4	8.8	1.4
18	20.1	9.6	14.9	9.9	4.9	3.1	17	0.0	4.8	6.3	2.4
19	26.7	17.5	22.1	17.1	12.1	0.0	28	0.0	12.1	9.6	6.4
20	27.0	16.6	21.8	16.6	11.6	0.0	27	0.0	8.9	6.3	4.4
21	29.6	18.6	24.1	19.1	14.1	0.0	30	0.0	4.8	5.5	3.4
22	29.3	19.6	24.5	19.5	14.5	0.0	30	5.8	10.3	9.2	3.4
23	25.4	8.2	16.8	11.8	6.8	1.2	19	0.6	9.2	12.9	7.8
24	15.3	8.0	11.7	6.7	1.7	6.4	10	0.0	0.0	12.0	6.0
25	19.7	12.7	16.2	11.2	6.2	1.8	20	0.0	12.1	8.3	4.4
26	22.2	12.9	17.6	12.6	7.6	0.4	22	0.0	2.7	2.8	1.4
27	25.7	13.6	19.7	14.7	9.7	0.0	24	0.7	6.2	9.3	4.5
28	21.1	10.4	15.8	10.8	5.8	2.3	18	0.0	12.0	12.8	6.2
29	21.7	13.6	17.6	12.6	7.6	0.3	22	13.9	10.4	10.9	6.4
30	20.8	8.3	14.6	9.6	4.6	3.4	16	2.1	0.0	9.0	0.0
31	20.2	7.6	13.9	8.9	3.9	4.1	16	0.0	10.3	9.2	4.8
SUM				456.7	303.7	23.7	760	166.3	104.0		119.5
MEAN	24.2	15.4	19.8							8.7	
SAME MONTH LAST YEAR											
	26.2	13.9	20.1	467.7	312.7	23.6	741	59.3	209.8	6.9	152.5
42 YEAR AVERAGE (1961-2002)											
	24.3	13.2	18.7	425.4	270.6	27.4		88.2	210.4	9.0	
5 YEAR AVERAGE (1998-2002)											
	25.7	14.2	20.0	484.0	309.0	16.9	745	94.5	241.6	7.7	136.2
EXTREME											
MAX	30.2	21.3	25.8	20.8	15.8	6.4	31	82.0	12.1	12.9	22.0
MIN	15.3	7.6	11.7	6.7	1.7	0.0	10	0.0	0.0	1.9	0.0
T-base											

+ 87 %

Atlantic Food & Horticulture Research Centre, KENTVILLE,

MONTHLY SUMMARY - SEPTEMBER 2003

	Degree			Heat Units Degree C							
				Growing		Heating		Rain	SUN	Wind	Evap
Day	Max	Min	Mean	5.0	10.0	18.0	CHU	mm	Hr	Km/h	mm
1	20.2	10.8	15.5	10.5	5.5	2.5	18.0	0.0	1.1	9.2	2.2
2	18.5	4.4	11.5	6.5	1.4	6.6	12.0	0.0	5.2	4.2	2.4
3	21.9	7.8	14.9	9.9	4.9	3.2	17.0	0.0	11.4	3.4	4.0
4	21.0	13.6	17.3	12.3	7.3	0.7	22.0	56.6	0.0	7.3	0.0
5	20.0	13.6	16.8	11.8	6.8	1.2	21.0	3.7	0.3	4.1	0.0
6	23.3	10.5	16.9	11.9	6.9	1.1	20.0	0.0	10.2	4.2	4.8
7	23.1	9.5	16.3	11.3	6.3	1.7	20.0	0.0	11.6	9.4	4.8
8	19.3	6.2	12.8	7.8	2.8	5.3	13.0	0.0	8.9	8.0	4.0
9	17.3	3	10.2	5.2	0.2	7.9	10.0	0.0	11.3	5.5	3.8
10	19.8	6.0	12.9	7.9	2.9	5.1	14.0	0.0	9.6	10.6	4.4
11	17.4	4.2	10.8	5.8	0.8	7.2	10.0	0.0	10.7	7.3	4.8
12	21.8	9.0	15.4	10.4	5.4	2.6	18.0	0.0	10.5	8.1	3.6
13	25.4	8.9	17.2	12.2	7.1	0.9	20.0	0.0	11.1	8.3	4.8
14	25.4	13.4	19.4	14.4	9.4	0.0	23.0	0.0	10.7	7.8	2.4
15	27.5	16.5	22.0	17.0	12.0	0.0	28.0	0.0	9.8	6.5	2.4
16	27.4	17.6	22.5	17.5	12.5	0.0	28.0	0.7	7.4	6.7	3.1
17	24.4	8.3	16.4	11.4	6.4	1.6	18.0	0.0	10.1	8.1	5.8
18	23.8	8.6	16.2	11.2	6.2	1.8	19.0	0.0	10.0	3.8	3.8
19	24.9	7.0	16.0	11.0	6.0	2.1	18.0	0.0	8.3	3.6	5.4
20	21.3	13.4	17.4	12.4	7.4	0.6	21.0	1.5	0.7	2.6	0.5
21	21.0	15.8	18.4	13.4	8.4	0.0	24.0	0.0	0.5	2.9	1.2
22	22.9	13.1	18.0	13.0	8.0	0.0	22.0	0.0	8.9	4.2	4.0
23	24.6	18.3	21.5	16.5	11.5	0.0	28.0	4.6	6	10.6	2.2
24	22.0	7.1	14.6	9.6	4.6	3.4	16.0	0.6	9.8	7.8	5.2
25	19.9	5.7	12.8	7.8	2.8	5.2	14.0	0.6	9.2	6.1	4.8
26	25.0	14.4	19.7	14.7	9.7	0.0	24.0	0.0	8.3	4.1	2.4
27	25.5	19.2	22.4	17.4	12.4	0.0	29.0	0.0	7.7	7.6	4.0
28	23.7	18.3	21.0	16.0	11.0	0.0	27.0	23.1	1.3	13.2	6.3
29	26.7	12.2	19.5	14.5	9.5	0.0	23.0	1.4	7.3	9.2	2.7
30	20.2	6.0	13.1	8.1	3.1	4.9	14.0	0.0	10.1	6.3	2.4
SUM				348.8	198.8	65.5	591	92.8	228.0		103.0
MEAN	22.5	10.7	16.6							6.7	
SAME MONTH LAST YEAR	22.1	11.1	16.6	347.5	201.8	79.9	570.0	175.4	189.5	8.3	112.1
42 YEAR AVERAGE (1961-2002)	19.8	9.3	14.6	287.2	142.6	116.0		95.0	165.2	10.3	
5 YEAR AVERAGE (1998-2002)	21.7	10.8	16.2	336.5	189.7	83.7	558.2	131.8	197.4	7.7	70.0
EXTREME MAX	27.5	19.2	22.5	17.5	12.5	7.9	29.0	56.6	11.6	13.2	6.3

-2%

APPENDIX B

Selected Photos of the Study Area

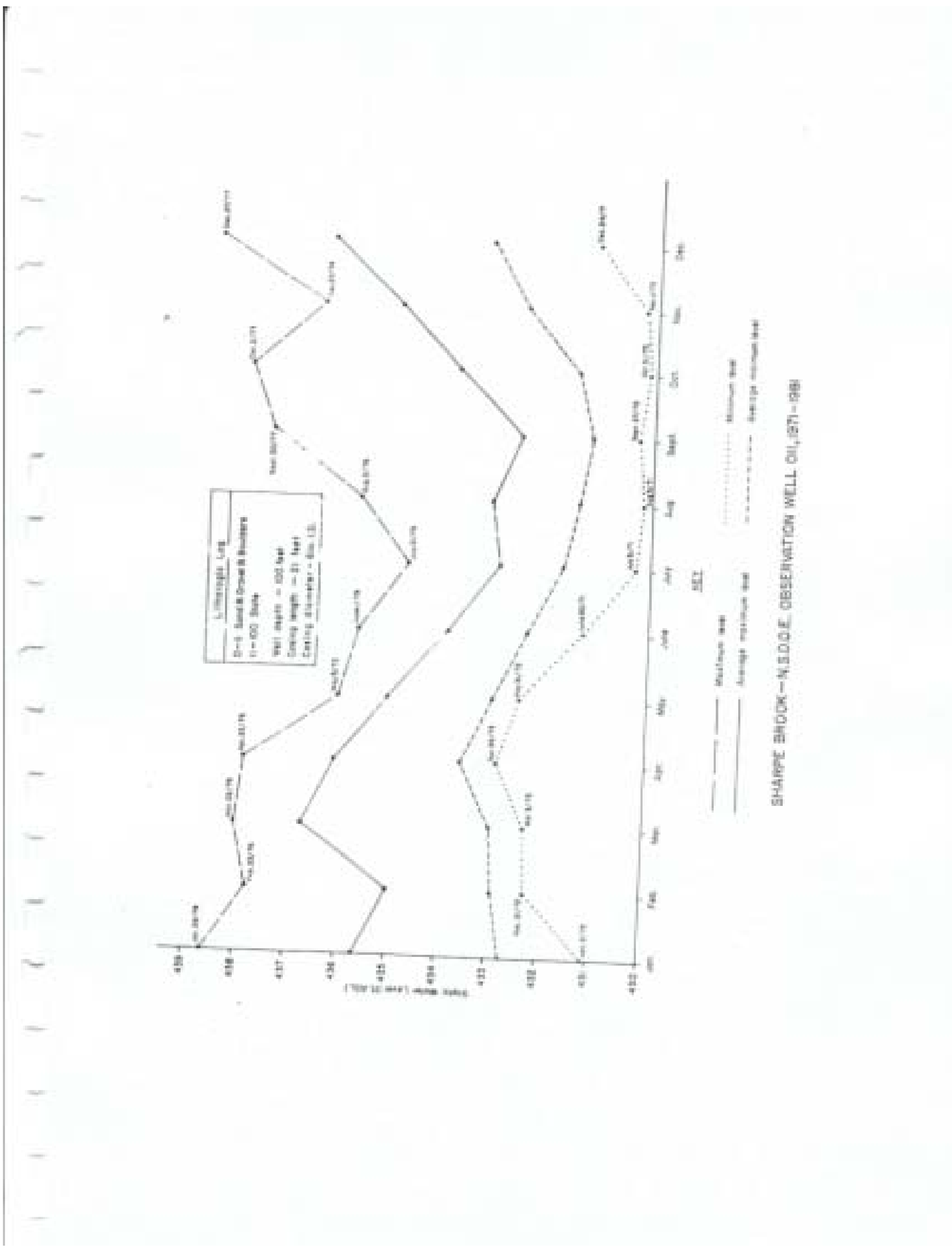
Hydrogeology & Groundwater Review
Mark-Lyn Construction Limited
Topsoil & Aggregate Extraction Operation, Coldbrook

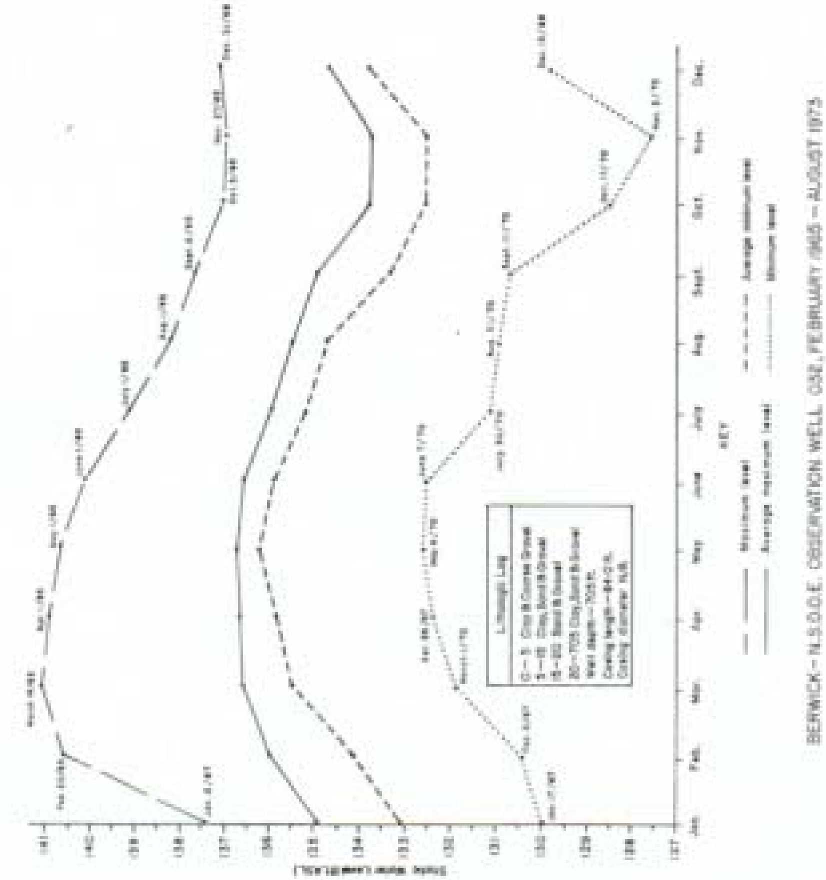
Photo #1. An example of the complex stratigraphy in the Quaternary sand and Gravel deposits in which shallow groundwater flow systems occur.

Photo #2. The ditch along the east side of the bog showing the sand bottom, shallow peat, and no water, when photo was taken on September 18, 2003.

APPENDIX C

Groundwater Hydrographs for the Period 1965 to 1981 From Observation Wells #011, Sharpe Brook at Lloyds, and Observation Well #032, Berwick





BERWICK – N.S.D.O.E. OBSERVATION WELL 032, FEBRUARY 1965 – AUGUST 1973

APPENDIX D

Water Well Records For The Study Area

SUMMARY OF WATER WELL RECORDS COLDBROOK, POST 1978

MARK-LYN SITE-BALTZER BOG

WELL #	DREG	OWNER	WADDRESS	WCOMPLET	WMAPLOC	WDEPT	WCASI	WDIA	WYIEI	WYM	STATDI	WSTATUS
961267	307	HOGEBOOM, MRS. J.	COLDBROOK	9/7/1996	P13C5J14	160.0	117.0	6.0	12.0	A	0.0	A1
970218	307	MOODY, MIKE	CAMBRIDGE	5/6/1997	P13C5J14	150.0	129.0	6.0	10.0	A	0.0	A1
971903	110	TWIN MOUNTAIN CONSTR. ((	BISHOP RD. SOUTH, COLDBROOK	6/27/1997	P13C5J14	175.0	160.0	6.0	10.0	A	40.0	A1
971875	110	TWIN MOUNTAIN CONST. (C	BEST VIEW S/D, COLDBROOK	3/20/1997	P13C5K14	155.0	120.0	6.0	20.0	A	40.0	A1
971975	110	TWIN MOUNTAIN CONST. (C	WARD STREET, BEST VIEW S/D	11/10/1997	P13C5K14	140.0	109.0	6.0	20.0	A	40.0	A1
971876	110	TWIN MOUNTAIN CONST. (C	BEST VIEW S/D NORTH END COLDI	3/21/1997	P13C5K14	215.0	161.0	6.0	20.0	A	45.0	A1
791730	110	JOHNSON, KAY	COLDBROOK STATION	3/22/1979	21H2A68	130.0	68.0	6.0	12.0	A	15.0	A1
830613	59	SPINNEY, EUGENE	BISHOP RD	11/30/1983	21H2A67	92.0	50.0	4.0	6.0	B	18.0	A1
861461	255	N S SAND AND GRAVEL	HALIFAX	6/2/1986	P13C5L15	140.0	134.0	6.0	10.0	A	39.0	A1

NOTES:

Lic. No.	Drilling Contractor
307	K. D. Rogers Well Drilling Ltd.
110	Valley Well Drillers Ltd.
255	Spencer's Well Drilling Ltd.
59	Harry F. Spencer

WELL # — UNIQUE REFERENCE NUMBER IN COMPUTER DATABASE
DREG — WELL DRILLER REGISTRATION NUMBER
WDEP — WELL DEPTH IN FEET
WCAS — LENGTH OF CASING INSTALLED IN WELL
WDIA — WELL DIAMETER IN INCHES
WYIE — ESTIMATED WELL YIELD IN GALLONS PER MINUTE
WYM — METHOD OF ESTIMATING WELL YIELD WITH AIRLIFT TECHNIQUE
STATD — DEPTH TO STATIC WATER LEVEL IN WELL AT TIME OF DRILLING

Sheet1Summary of Water Well Records-Coldbrook-Post 1978-Mark-Lyn1/27/2004

SUMMARY OF WATER WELL RECORDS IN THE COLDBROOK AREA- PRE 1979

MARK - LYN SITE GRID LOCATION 21 H 2 A 68

REF NO.	DATE	OWNER	DRILLER #	WELL DEPTH	WATER DEPTH	DIAM.	CASING LENGTH	YIELD	GEOLOGIC LOG
1	1966	C. CLEVELAND	17	165	37	2	63	5	0-50 Sd&Gr; 50-165 Ss
2	1973	GREGORY SPINNEY	18	135	53	4	89	3	0-85 Sd&Gr; 85-135 Sh&Ss
3	1974	GLEN SILVER	18	195	27	4	53	10	0-48 Sd; 48-180 Sh; 180-195 Ss

NOTES:
DRILLER # 17 = EDSON J. REEVES
DRILLER # 18 = S.G. t TRASK & SONS LTD.
WELL DEPTH = FEET
WATER DEPTH = FEET
DIAMETER = INCHES
CASING LENGTH = FEET
YIELD = ESTIMATED GALLONS PER MINUTE
GEOLOGIC LOG = DESCRIPTION OF GEOLOGICAL MATERIALS BY DRILLER

Water Well Records Coldbrook pre 1979

APPENDIX E

Procedures and Protocols For Field Methods

PROCEDURE FOR DOCUMENTATION OF FIELD DATA

Documentation of field information should include sufficient material so that the field program can be reconstructed without relying on the memory of field personnel. Data must be collected and documented in a clear, concise and organized manner. Ideally this information should be recorded in a bound logbook. For legality reasons, the pages of the field book should be numbered consecutively. All entries in logbooks should be made in waterproof ink and corrections should be lined-out deletions that are initialled and dated. Field books should be kept in a secure place and copied as soon as possible. The completion of daily logs may be beneficial. Entries in the logbook may include the following:

- Site name
- Borehole or well number
- Field Supervisor's name and company affiliation
- Date and time of sample collection
- Sample number, location, and depth
- Sampling method
- Observations at the sampling site
- Unusual conditions
- Information concerning drilling decisions
- Decontamination observations
- Weather conditions
- Names and addresses of field contacts
- Names and responsibilities of field crew members
- Names and titles of any site visitors
- Location, description, and log of photographs
- References for all maps and photographs
- Information concerning sampling changes, scheduling modification, and change orders
- Summary of daily tasks and documentation on any cost or scope of work changes required by field conditions
- Signature and date by personnel responsible for observations

PROCEDURE FOR SITE CLEARANCES

In addition to overhead services, a variety of underground utilities such as electrical, telephone, water and sewer lines, pipelines and tanks may exist at any particular site. As well, in some areas contaminants may have been buried in the subsurface. Accordingly subsurface drilling and excavation sites MUST BE cleared prior to proceeding with the designated field work. Completion of this screening is almost always the responsibility of the Field Site Supervisor.

Screening may consist of one or all of the following:

- contacting the appropriate agencies such as telephone, electrical and hydro companies;
- review of Facility drawings that show the position of known underground services, or
- geophysical reconnaissance using electromagnetic or magnetic methods.

If unknown utilities or contaminant sources (e.g., drums, pipelines, tanks) are contacted during the investigation, work must stop until the appropriate persons are contacted. The locations of such utilities or sources are generally marked and included in subsequent site plans.

PROCEDURE FOR DECONTAMINATION

The overall objective of multimedia sampling programs is to obtain samples which accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminant materials can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g., by bailing or pumping of groundwater with equipment previously contaminated at another sampling site). Trace quantities of these contaminant materials can consequently be captured in a sample and lead to false positive analytical results and, ultimately to an incorrect assessment of the contaminant conditions associated with the site. Decontamination of sampling equipment (e.g., bailers, pumps, tubing, soil and sediment sampling equipment) and field support equipment (e.g., drill rigs, vehicles) is therefore generally required prior to use at sites to ensure that sampling cross-contamination is prevented and that on-site contaminants are not carried off-site.

The following is a list of equipment that may be needed to perform decontamination:

- brushes
- wash tubs
- buckets
- scrapers, flat bladed
- hot water - high-pressure sprayer
- disposal drums (205 litre with secure lids)
- sponges or paper towels
- detergent (simple green)
- potable tap water
- garden-type water sprayers
- spray bottles
- methanol

Personnel

A temporary personnel decontamination line may be set up around the exclusion zone at each site. If contamination is not encountered, a dry decontamination station may be established which consists of discarding of disposable personal protective equipment (PPE).

If HNu or Gastector readings indicate that contamination has been encountered (i.e., action levels are exceeded requiring an upgrade from initial PPE levels), or if the initial PPE is B or C, a complete personnel decontamination station will be established.

The temporary decontamination line should provide space to wash and rinse rubber boots, gloves, and all sampling or measuring equipment prior to placing the equipment into a vehicle. It should provide a container to dispose of used disposable items such as gloves, tape or tyvek (if used).

The decontamination procedure for field personnel may include:

1. glove and rubber boot wash in a detergent solution
2. glove and rubber boot rinse
3. scraping soil from non-rubber boots
4. duct tape removal, if appropriate
5. outer glove removal
6. coverall removal
7. respirator removal (if used)
8. inner glove removal (if used)

Sampling Equipment
The following steps will be used to decontaminate sampling equipment:

- Personnel will dress in suitable PPE to reduce personal exposure
- Gross contamination on equipment should be scraped off at the sampling or investigation site.
- Equipment that will not be damaged by water should be placed in a wash tub containing a low-sudsing detergent along with potable water and scrubbed with a bristle brush or similar utensil. Equipment should be rinsed with tap water in a second wash tub, followed by a potable water rinse.
- Equipment such as split spoons and stainless steel trowels that will not be damaged by solvents may be sprayed with methanol, using a spray bottle. The equipment should then rinsed with potable water, wiped and allowed to air dry. Heavy equipment (i.e., augers, drill rods, excavator buckets should not be cleaned using methanol. In highly contaminated sites, drilling rigs and/or excavators should be decontaminated at a central decontamination area.
- Equipment that may be damaged by water should be carefully wiped clean using a sponge first rinsed in detergent water, then rinsed with potable water. Care will be taken to prevent any equipment damage.
- Rinse and detergent water should be replaced with new solutions between borings or sample locations.

Following decontamination, equipment should be placed in a clean area or on clean plastic sheeting to prevent contact with potentially contaminated soil. If the equipment is not used immediately, the equipment should be covered or wrapped in plastic sheeting or heavy-duty garbage bags to minimize contact with potential airborne contamination.

Equipment Leaving the Site
Vehicles used for non-contamination activities may be cleaned on an as-needed basis, using soap and water on the outside and vacuuming the inside. On-site cleaning may be required for very dirty vehicles which will be leaving the area. On-site investigation equipment such as trucks, drilling rigs, backhoes, trailers, etc., may need to be pressure washed on-site before the equipment is removed from the site to limit exposure of off-site personnel to potential contaminants.

Wastewater
Liquid waste water from decontamination activities, monitoring well development and purging, and rinse water are generally considered to represent substantially reduced sources of contaminants than existing on-site sources. The two most feasible means of disposing waste water include on-site sewer collection systems and ground surface discharge in away from the well that overlie areas of known soil and/or groundwater

Waste waters containing separate phase liquids (e.g., LNAPL, DNAPL or visibly contaminated water) should be contained for off-site disposal at an approved facility.

Other Wastes
Solid wastes from heavy equipment decontamination, drilling cuttings or test pit activities with evident contamination should be contained and segregated for subsequent disposal. When the containers are full, they should be labelled with its contents and date, using paint or another permanent maker.

Other solid wastes, such as used personal protective clothing, water sample filters, spent sampling materials, that are obviously contaminated should also be containerized and disposed of in an appropriate manner.

Documentation

Decontamination of sampling and drilling equipment should be documented in the field notebook. The information entered may include the following:

- Field Supervisor and company affiliation
- date and start and end times
- type of decontamination procedure used
- number and type of samples collected
- decontamination observations
- weather conditions

Quality Assurance Requirements

Equipment rinsate samples should be taken of the decontaminated sampling equipment to verify the effectiveness of the decontamination procedures. The rinsate procedure should include rinsing potable water through or over a decontaminated sampling tool (e.g., a split spoon sampler or bailer) and collecting the rinsate water in sample bottles, which will be sent to the laboratory for analysis. The rinsate procedure, including the sample number, should be recorded in the field notebook.

PROCEDURE FOR ENVIRONMENTAL DRILLING

This procedure describes the methodologies associated with drilling and typical monitor well installations used for environmental testing purposes. The following is a list of materials which may be required during an environmental drilling program:

- drill rig capable of installing wells to the desired depth
- well construction materials:
- threaded PVC casing (typically 50 mm diameter & minimum schedule 40)
- screen (typically 50 mm diameter, slot size to vary dependant on geological formation)
- bentonite pellets/chips
- filter pack sand (no. 2 or coarser)
- cement/bentonite mixture for grouting
- stainless steel centralizers, if appropriate
- protective well casing with locking cap
- high-pressure steamer/cleanser
- decontamination equipment/supplies
- wash/rinse tub
- detergent
- sampling containers (ie plastic ziplock bags) & labels
- weighted tape
- water level tape
- deionized water
- appropriate health and safety equipment
- log book
- borehole log sheets
- geotechnical field guide

The most common methods of drilling within surficial deposits involve the use of either *hollow stem auger flights (HSA)* or *continuous flight augers (CFA)*. Auger drilling allows for borehole penetration without introducing water which could inhibit the collection of representative soil samples.

The flanges of the HSAs are welded onto a larger diameter pipe than the CFAs. The flights are linked together such that the stem is hollow throughout the drill string. The cutting bit has a finger plug which prevents loose soil from entering the stem. A split-spoon sampling device may be lowered inside the drill string and driven through the finger plug and ahead of the cutting bit for an in situ sample as required. The HSA string, therefore, serves as a form of casing because it does not have to be withdrawn each time a sample is collected. One can obtain more accurate samples using this method.

There are several advantages of HSA boreholes. First, the method is rapid in most unconsolidated, fine to medium-grained geologic materials. Second, drilling fluids are not used to remove cuttings and, therefore, the in situ chemical conditions of the borehole are not further degraded by either diluting contaminants with added water or contributing suspended solids from drilling muds used to stabilize the borehole walls in soft materials. Third, HSA flights are easily cleaned and decontaminated. Fourth, the auger flights serve as a form of casing, which allows monitoring wells to be constructed by raising the flights as needed. Fifth, the drilling rate is better than with the CFA because the drill string remains in the boring until it is completed.

One minor disadvantage of the HSA is that clearing and decontamination require more time than with the CFA due to the interior surfaces present. Another disadvantage is that drilling below the water table, especially in fluid soils such as supersaturated or "flowing" sands, may be difficult if the head in the string is less than the head in the formation. Such a head difference may result in the inflow of groundwater and sediment around the cutting bit and finger plug. .

The most common methods of drilling within bedrock involve the use of either a *tricone or diamond drill bit* for coring. Coring provides several advantages. Most importantly, it allows for the retrieval of in-situ bedrock samples rather than drill cuttings.

The core barrel is approximately 1.5 m in length and is equipped with a diamond coring bit. The nominal core diameter will be 8 cm (i.e., 3 inches - NQ size). The water supply should be obtained from a source known to be clean (free of contaminants). Optimally it should be sampled prior to use. If not, obtain a sample and have it analysed as part of the testing program.

Monitor Well Installations

The procedure for monitoring well installation using HSAs is as follows (a typical construction diagram is shown on Figure 1):

1. Measure and record depth of completed boring using a weighted tape.

2. Prepare all well construction materials. All personnel that handle the casing should don a clean pair of rubber or surgical gloves.

3. Assemble screen and casing as it is lowered into the boring inside the hollow stem augers. Attach stainless steel centralizers as required. Be sure that the end cap is well secured on the bottom length of pipe. The tops of all well casings will be fitted with slip caps which can be easily removed by hand.

   The screen length of the monitoring wells will vary, dependant on the design and overall objectives of the field testing program. For instance, where the presence of volatile compounds less dense than water (LNAPLs) is a potential concern, care must be taken to ensure that the screen zone spans the water table surface. Enough screen must be installed to allow for seasonal fluctuations of the water table.

4 Record level of top of casing and screened interval. Adjust screen interval by raising assembly to desired interval, if necessary, otherwise add 15 cm of sand to raise the bottom of the boring to the base of the end cap.

5. Calculate and record the volume of the sand pack, bentonite seal, and backfill in grout required for existing boring conditions.

6. Add filter pack sand around the annulus of the screen, repeatedly taking depth soundings to monitor the level of the sand (allow sufficient time for the filter sand to settle through the water column outside the casing before measuring the sand level). Extend the filter pack sand to at least 0.6 m above the top of the well screen.

7. Following sand filter pack placement, slowly add a 0.6 to 1 m high bentonite seal on top of the sand filter. **Adding the bentonite pellets or chips too quickly may cause bridging**. If required, add 5 litres of potable water per 0.3 m of bentonite to initiate swelling of the pellets or chips. The completed bentonite seal should be allowed to hydrate for approximately 30 minutes. If required, grout should be placed in the well annulus with a tremie pipe initially located about 3 m above the top of a bentonite seal. The grout should be pumped through the pipe which is pulled up incrementally until the desired height is reached. The grout may consist of a mixture of Portland cement and bentonite grout or a high-yield bentonite grout. The grout should be prepared in an above-ground rigid container by first thoroughly mixing the high-yield bentonite with water and then, if appropriate, mixing in cement.

8. Add first a 3 or 4 cm thick layer of sand to facilitate identifying the top of the bentonite seal. Then add an additional 26 or 27 cm of sand above the seal.

9. If grout is not used above the bentonite seal to complete the well installation, backfill the annular space using drilling cuttings or by allowing the natural sand formation to collapse around the well screen when the augers are pulled. Repeated depth soundings should be taken to monitor the level of backfilling and detect possible bridging. The final level of backfilling should be approximately 1 m below ground surface. It may be advantageous to repeat one or more bentonite seals if the distance to ground surface is greater than several meters. Typically in unconsolidated materials, the annular space above the bentonite or grout seal, between the borehole and well will be backfilled with drilling cuttings generated during the drilling. Alternatively and depending upon the character of the geologic material, collapse of native materials into the annular space, above the bentonite or grout seal, can serve as backfill.

10. After backfilling, a surface seal should be installed using either cement/bentonite mixture. This will deter surface water leakage into the well.

11. The well head should be protected with either an above ground casing or flush mount cover. The surface seal will depend upon whether a flush or above ground completion is required. For an above ground well completion and following placement of the backfill, the boring diameter of the upper 1 m should be filled with a sand or sand/bentonite mixture. If a flush mount completion is required and following placement of the backfill, the boring diameter of the upper 0.6 to 1 m of the hole annulus will typically be filled with concrete consisting of a cement and sand mix. A water-tight security plug should be installed on top of the PVC riser when using flush mount covers.

12. A reference point for surveying should be clearly established at each monitor well location. This point is often located on the lip of the PVC riser pipe and represents the mark in which water level measurements are taken.

The following information may be recorded in the field book:

- Bottom of the boring
- Casing depth (if intermediate steel casing is left in the hole)
- Screen details; location(s), slot size
- Sand packs
- Bentonite seals
- Sand units above bentonite seals
- Backfill material and origin (i.e., cuttings or collapse)
- Height of riser without slip cap (above ground surface)
- Protective casing detail
- The quantity and composition of the grout, seals, and sand pack actually used during construction
- Start and completion dates
- Discussion of all procedures and any problems encountered during drilling and well construction

PROCEDURE FOR SOIL AND/OR BEDROCK SAMPLING

The procedure for collecting, labelling, storing, and transporting subsurface soil samples is described below:

- Select the appropriate sampler (split spoon or continuous soil sampler) and sampling interval
- Decontaminate the drilling and sampling equipment and ensure that appropriate health & safety precautions are applied
- The resistance to soil penetration should be measured using a split-spoon sampler in accordance with ASTM D-1586. Penetration resistance (i.e., blow counts) for each 15 cm increment should be recorded. Typically, a count of 50 blows for 15 cm indicates refusal.
- Open the split-spoon or continuous soil sampler and measure the recovery. Scrape off any soil from the recovered sample with a stainless steel knife.
- Determine and identify the use of the recovered sample. This will either be for soil classification and stratigraphic logging, chemical, head space, or geotechnical analysis
- If chemical analysis of the sample is required, the sample must be handled quickly, especially if it is loose or crumbling, to avoid losing volatile contaminants. The following procedures should be followed:
  - For volatile organic analysis, fill vials completely full with soil from the split spoon. If required, duplicate samples will be collected from the same split spoon, adjacent to the initial sample interval.
  - Obtain sufficient soil for subsequent head space analysis, if applicable. If only relative field values are required, it is appropriate to store these samples in a plastic zip lock bag
  - For inorganic parameter analysis, composite the remaining soil by thoroughly mixing the soil from the split spoon or continuous sampler in a decontaminated stainless steel bowl with a decontaminated stainless steel spatula or spoon. If required, duplicate samples will be collected from the remaining composite soil.
  - Label, store, transport and document the samples as appropriate
- Soil sample descriptions may include the following observations:

- ***colour*** - soil colours should be described using a single colour description preceded, when necessary, by a modifier to denote variations in shade or colour mixtures. Since colour may be helpful in correlating stratigraphic units, it is important to be consistent. A colour chart is often useful. Colour should be described when the sample is still moist. If it is a split spoon sample, break the sample in half vertically.

- ***texture*** - texture is described as the relative angularity of the particles; ie: sand sized grains or larger may be rounded, sub-rounded, angular or sub-angular

- ***composition & consistency***- describes the nature of the sample; ie: clay, silt, sand, gravel etc, and the approximate amounts. For example a sample composed primarily of silt but with some sand and clay components could be described as a sandy clayey silt

- ***bedding*** - describes the existence of beds or layers (strata), laminae, or other tabular and essentially horizontal units

- ***cohesiveness*** - describes the capacity to stick or adhere together

- ***fabric*** - describes the orientation of the particles composing a soil or rock

- ***friability*** - describes how easily the sample crumbles

- ***grading*** - describes the degree of mixing of size classes in a sedimentary material. Well graded implies more or less uniform distribution from coarse to fine; poorly graded implies uniformity in size or lack of a continuous distribution

- ***plasticity*** - is the property of material which enables it to undergo permanent deformation without appreciable volume change or elastic rebound, and without rupture

- ***moisture*** - describes the water content; terms such as dry, damp, wet and saturated apply

- ***visual contamination*** - includes observations regarding the presence/absence of staining and/or other obvious indications of contamination ie: petroleum hydrocarbons

- Where appropriate, colour, texture or bedding terminology discussed above can be used in describing the rock core. In addition the following information may be recorded.

  - ***rock type*** - core should be classified in terms of the rock type (e.g, sandstone, siltstone, granite)

- ***rock quality designation (RQD)*** - the classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting or weathering in the rock mass and are not counted. Care must be exercised to identify breaks in the core due to the drilling or recovery process. The following descriptions will be used for appropriate RQD values:

RQD (%)	ROCK QUALITY DESCRIPTIONS (one term for each RQD value as appropriate)
90 - 100	Excellent, intact, very sound
75 - 90	Good, massive, moderately jointed or sound
50 - 75	Fair, block and seamy, fractured
25 - 50	Poor, shattered and very seamy or block, severely fractured
0 - 25	Very poor, crushed, very severely fractured

- ***bedding*** - this terminology is based upon the spacing between beds, as follows:

SPACING (mm)	BEDDING, LAMINATIONS, BANDS	DISCONTINUITIES
2000 - 6000	Very thick	Very wide
600- 2000	Thick	Wide
200 - 600	Medium	Moderate
60 - 200	Thin	Close
20 - 60	Very thin	Very close
< 20	Laminated	Extremely close
< 6	Thinly laminated	

- ***weathering*** - slightly weathered implies limited surface discontinuities, such as iron staining. Moderately weathered implies discontinuities throughout the rock mass, although the rock is not friable. Highly weathered implies discontinuities throughout the rock mass, and friable rock.

- ***apertures*** - describes orientation, spacing, persistence of the fracture or joint and mineral presence

Examples of a borehole record and typical well construction diagram are included with this procedure.

PROCEDURE FOR GROUNDWATER SAMPLING

A typical sample collection exercise involves a number of steps including pre-trip planning and preparation, on-site work, sample storage and shipping and laboratory analysis.

Pre-trip preparations include identifying the location of the site, how many wells are to be sampled, their sizes and construction details, the required analyses, what duplicate or control samples are needed and where the samples will be sent for analysis. The field equipment needed for the job should also be identified and prepared. Preparation may include the decontamination of equipment or the acquisition of equipment designed for one-time use only. Environment Canada's TABS on Contaminated Sites, TABS #5 provides a good summary of pre-trip planning and equipment decontamination techniques.

On-site work includes measuring static groundwater levels, inspecting wells, collecting samples and storing samples for transport to the laboratory. These steps, and quality assurance and quality control procedures, are described in detail in the sections that follow.

Measuring Static Water Levels

Upon arriving at a site to collect groundwater samples from monitoring wells, the first step should be to locate each monitoring well and remove the well covers and caps. Sealed well caps, such as rubber J-Plugs should be removed with caution as pressure may have built up in the well since the well was last opened. Reasons for this include rising groundwater levels in the well resulting in compression of the air above the water surface or the potential build-up of hydrocarbon vapours in the air space. All well caps should be removed to allow the water levels to stabilize.

Static water levels should be recorded in all wells over as short a time period as possible. This is particularly important in coastal areas, such as Nova Scotia, where tidal fluctuations could result in changes in groundwater levels over a short period of time. Groundwater levels may also change as recently infiltrated rainwater discharges from the system or in response to changes in atmospheric pressure. Although these variations may be small, they may be significant in areas with very shallow groundwater gradients and could result in the misinterpretation of groundwater flow directions.

Water levels should be measured twice in each well to verify the accuracy of the reading. It is also a good practice to re-measure the static water level in the first well at the end of the procedure to verify that the level has not changed.

When using measuring devices that must contact the water, it is important to thoroughly clean the device between monitoring wells. The method of decontamination will vary depending on the contaminants in question and may involve the use of soaps, alcohol or special solvents to ensure all traces of the contaminant are removed. Rinsing with distilled water is often done as a final step of the decontamination process. If relative contaminant levels are known in the monitoring wells, starting with the least contaminated well and moving to progressively more contaminated wells is one approach to minimizing the potential for cross-contamination.

A number of methods are available for determining static water levels, however the most common is to use a water level probe and meter. These devices usually consist of a plastic or fiberglass tape measure connected to a probe. Wires running inside the tape connect the probe to an audible and/or visual indicator that signals when the probe touches the water surface. The depth to the water at this point is measured off of the tape. Water levels are usually recorded relative to the top of the well casing which has been previously surveyed. This allows for the comparison of relative water levels in the monitoring wells so that groundwater flow directions and gradients may be determined. It is good practice to mark the top of the well casing, in a permanent manner, at the location where the elevation was surveyed. All subsequent water levels are then recorded relative to this position to ensure accurate water level elevations are calculated.

Other methods are available for measuring water levels. A weighted tape measure, coated with water finding paste or chalk, may be lowered into the well until the end of it is definitely below the water surface. The tape is read at the position of the top of the casing and the tape is withdrawn. The location of the water surface, relative to the tape, is determined from the location where the chalk or paste is still present. The difference between the two readings is the depth to the water from the top of the well. Another method involves the use of ultrasonic devices that do not contact the water but rather measure the time it takes sound waves to travel to the water surface and back again. These devices are calibrated to convert this time to a distance.

At some sites, the measurement of free product thickness may also be necessary. Free product refers to free phase hydrocarbons floating on the surface of the water as opposed to being dissolved in it. Again a number of methods are available for determining free product thickness. Product probes are available that emit a specific sound when in contact with hydrocarbons and another sound in the presence of water. The difference between the locations where each sound is first heard is the free product thickness. Another method is to use a weighted tape measure coated with chalk on one side and water finding paste on the other. After submerging the tape a sufficient distance to ensure it has fully penetrated the free product layer, the tape is withdrawn and the two sides of the tape are compared. The chalk will be washed away from that portion of the tape that penetrated both the free product and the water whereas the water finding paste will only be washed away from the portion of the tape that contacted the water. The difference between the two readings is the free product layer thickness.

Monitoring Well Inspections

While measuring the static water level in each well, it is also a good time to inspect the well for damage or other potential problems. This could include damage from vehicles, vandalism or frost heaving. In addition the ground in the vicinity of the well may be washed away or caving in allowing surface water to move down the outside of the well casing. The integrity of the well seal must be determined whenever any damage is found. If the possibility exists that water in the well is being influenced by the entry of surface water, soil particles and/or soil organisms, a decision will have to be made as to whether a sample should be collected. In some cases, analytical costs may be low enough that it is worth submitting the sample and then interpreting what effects, if any, the damage has had on water quality from the results. In other cases, however, analytical costs may be high enough that it is not worth the risk of submitting a sample for which the results may not be valid. In still other cases, such as regulatory compliance monitoring programs, anomalous results may result in problems for yourself and the client and it may not be worth the risk of collecting samples from damaged wells.

In any event, the damage should be recorded. If possible, well repairs may be carried out at the time, the well thoroughly purged, and samples collected as usual. If immediate repair is not possible, subsequent site visits should include provisions to repair the damaged well.

Well Purging

The purpose of purging a well prior to sample collection is to ensure that samples are representative of groundwater conditions. Purging may not always be necessary. In deeper wells, the use of dedicated submersible pumps allows sample collection within the screened portion of the well without disturbing stagnant water at the air-water interface. This is more appropriate in coarse grain geologic materials. Purging should always be carried out in low to moderate permeability formations.

In some cases purging will be completed when the well goes dry. However in many cases the well will recover at a rate faster than it is being purged. In these cases an accepted rule of thumb is to purge three to five times the volume of the water in the well (see below). Another approach is to monitor groundwater physical or chemical properties, such as temperature, conductivity and/or dissolved oxygen, during the purging process. Purging may be considered complete when these parameters stabilize.

The volume of water in a monitoring well may be calculated as:

$$\text{Volume (L)} = \frac{\text{(Total well depth (cm) - depth to water (cm)) x 3.14 x well radius (cm)}}{1000}$$

Purging may be done using a bailer that will eventually be used for collecting the sample from that well, or using dedicated sample collection tubing and foot valves (Waterra® tubing) if they have been installed in the well. In large diameter wells (e.g. 300 mm or greater) a pump may be required to purge the well sufficiently.

Purging should be done over the entire depth of water in the well. This ensures that water from the deepest portions of the well is removed and replaced with 'fresh' water from the surrounding formation.

Sample Collection

Types of Samples

There are two general types of samples that may be collected, **Grab Samples** and **Composite Samples**. Grab samples are collected over a very short time period and represent a snapshot of the groundwater quality at a specific place and time. Grab samples may be further designated as **Discrete Samples**, samples collected from a specific depth only, or **Depth-Integrated Samples**, samples that are collected over a predetermined portion of the well. Depth-integrated samples may be collected over the entire depth of the well. Grab samples are generally less expensive to collect than composite samples as they require less time to collect.

Composite samples are actually the combination of a number of grab samples. These may be collected by mixing equal water volumes collected at regular time intervals. These samples are referred to as **Sequential Composite Samples**. In situations where water is constantly being pumped from a well, the collected water volumes should be proportional to the total volume of water discharged over the previous time period. These samples are referred to as **Flow Proportional Composite Samples**.

Composite sampling is not suitable for the collection of volatile organic samples, as these substances will be lost from the sample between sample collection events.

Sampling Devices

Samples may be collected using either bottom loading bailers, dedicated sample collection tubing and foot valves (Waterra® tubing) or submersible pumps. The choice of sampling device is often dictated by the intended analytical technique or by physical well conditions. The use of Waterra® tubing causes some aeration of the sample, making it inappropriate for the collection of samples such as those intended to undergo Volatile Organic Carbon analysis. In situations where the saturated zone is very deep, the head required to push the water to the surface may be so great that Waterra® tubing will not work.

Bailers may be disposable or designed to be decontaminated and reused. Reusable bailers should be thoroughly cleaned, before going to the site, using a procedure appropriate for the analysis being conducted. The use of disposable bailers is generally preferred as it minimizes the potential for the cross contamination of samples. Even with very diligent decontamination practices, re-usable bailers become scratched over time. Contaminants can collect in these scratches making decontamination difficult or impossible. In the case of disposable bailers, only new bailers should be used. A different bailer and rope should be used for each monitoring well.

The practice of leaving dedicated bailers in a monitoring well for extended periods of time may or may not be appropriate depending on the contaminants in question. In some cases the bailers may become contaminated through the adsorption of contaminants onto the bailer. Samples collected for the analysis of heavy hydrocarbons, solvents, pesticides and/or metals are some examples of cases where a new bailer should be used for each sampling event.

A variety of pumps are available for collecting groundwater samples. Peristaltic pumps may be used with dedicated sample collection tubing to ensure that the pump never contacts the sample. An added benefit of peristaltic pumps is that multiple sample collection tubes may be installed in a well, with each tube terminating at a different depth. Some type of seals should be present in the well to ensure water from different levels in the well is not mixed. A major drawback of these pumps is that they require power to operate and may be bulky, making their use impractical in remote settings.

Submersible pumps may also be used for sample collection, however the expense associated with these pumps, and the power needed to operate them, makes their use limited in practice. Controllers are available to regulate the speed at which these pumps operate. Operating these pumps at low flow rates minimizes sample aeration and the entrainment of sediment in the sample.

Another sample collection technique involves the use of hand operated vacuum pumps. These pumps are not suitable for the collection of volatile samples due to the fact that these substances will volatilize very easily in the presence of a vacuum.

Regardless of the sample collection method employed, every effort should be made to ensure that the sample collection device does not come into contact with the opening on the sample bottle. Sampling devices should not be used for more than one well. If this is necessary, such as when using submersible pumps, the sample collection device must be thoroughly decontaminated between wells. Again, a good practice in these cases is to always start at the well with the lowest expected concentration and finish at the most contaminated well.

Sample Containers

The intended analysis and the laboratory that will be providing the analysis usually dictate the choice of sample container. Factors that must be considered include:

- the volume of sample needed for the analytical technique,
- potential interactions between the sample and the sample container material,
- the affect of light on the sample, and
- the need to ensure there is absolutely no air bubbles in the sample container

Environment Canada TABS on Contaminated Sites, TABS #5 provides examples of the types of sample containers needed for specific analytical techniques. In any event the chosen laboratory should be consulted to determine the types, sizes and number of sample containers necessary for an intended sampling program.

Sampling Procedure

1. Allow the well to recover following purging.
2. Clean gloves (latex, nitrile, or similar) should be worn for each monitoring well. Not only will this minimize the possibility of cross-contamination of samples, in some cases it will also protect the sampler.

3. Ensure that the proper sample bottles are ready.
4. If filtering is necessary, place the filter in the sampling device. Note that field filtering is not possible when using bailers. Filters are designed to be used only once and they should not be re-used, even for the same well. This is due to the fact that once a filter has been saturated and allowed to dry, there will likely be deposits on the filter media that will affect concentrations in subsequent samples. Samples collected for organic analyses, suspended solids or total metals should not be filtered. Samples collected for the analysis of dissolved metals, particularly very turbid samples, should be filtered in the field.
5. If preservatives are required, they should be added to the bottle first. One exception to this is when collecting samples for metal analysis in polyethylene bottles. In this case, the nitric acid (used to preserve samples for metal analysis) should be added after the sample has been collected.
6. Collect the sample, minimizing sample aeration and air contact to avoid the loss of volatile compounds.
7. The level to which a particular sample bottle is filled will vary depending on the intended analysis. Some parameters (for example volatile organics) will volatilize into any headspace left in the bottle. In these cases bottles must be filled so that no air bubbles remain after the bottle has been capped. In other cases, some headspace is desirable. Reasons for this may include the need for the analytical laboratory to add reagents upon receiving the sample, or to allow lab personnel to handle a sample with minimal spillage in the case of hazardous samples.
8. Duplicate samples may be required depending on the needs of the client and the number of samples included in the monitoring program.
9. A sample record log should be filled out immediately.
10. The samples should be kept cool and in the dark. Portable coolers and ice are ideal for this. The use of ice cubes or crushed ice is preferable to ice packs to ensure that samples remain in contact with the ice and are kept cool. Steps should also be taken to ensure that sample labels remain legible in the presence of melting ice and water. Permanent markers or ink should be used when filling out labels. Procedures such as wrapping clear cellophane packing tape over the labels or placing sample containers in sealed 'zip-lock' plastic bags will protect sample labels.
11. Samples should be delivered to the laboratory as soon as possible and always within the recommended maximum holding time recommended for the intended analytical technique.

Sampling Free Product

The following procedure should be used when collecting samples of free product. It should be noted that bottom loading bailers must be used for this purpose. The use of Waterra® tubing or pumps may result in mixing of the free product and water in the sample. Even the use of low flow sampling pumps may not be appropriate as it will be difficult to ensure the pump intake remains in the free product layer only.

1. Carefully lower a bottom loading bailer to the product layer (as determined during the measurement of static water levels and free product layer thickness). Lower the bailer an addition 150 mm.
2. Withdraw the bailer. Measure the oil thickness.
3. Carefully remove the water from the bailer by opening the check valve slightly. This water should be collected in a container for proper disposal.
4. Transfer the recovered free product to a suitable sample bottle, typically a 45 ml septum vial, ensuring that there is no air space in the vial.

Free product samples should not be stored in the same shipping containers as water samples as cross contamination may occur.

Quality Assurance/Quality Control (QA/QC)

Control Samples

A proper Quality Assurance/Quality Control (QA/QC) program is necessary to ensure that data obtained are accurate and representative of actual groundwater conditions. An integral part of a QA/QC program involves the collection of quality control samples such as duplicates, blanks, spikes and background samples.

Duplicates samples are collected from the same well, assigned a different sample number, and submitted for analysis. A general rule of thumb is to collect duplicates for 5%of the total number of samples.

Blank samples are useful to determine if extraneous contamination is affecting the samples. There are a variety of blank samples, including trip blanks, used to determine if cross contamination has occurred during sample shipping and storage; field blanks, used to determine if contamination has occurred due to contaminated preservatives or from air-borne contaminants at the site; and equipment blanks, used to ensure equipement decontamination procedures are effective.

Spike samples are samples that prepared by adding a known mass of the contaminant in question to contaminant free water. These samples should be prepared at a concentration ten times the analytical detection limit. Spiked samples provide a measure of the accuracy of the analyses. When prepared in the field, spiked samples also provide an indication of the effects of losses during sample handling and transport. Losses may occur due to microbial degradation, volatilization, adsorption, photo degradation or other processes.

Background samples (also referred to as control site samples) are necessary to determine baseline groundwater quality at the site. These samples are collected from a well or wells up gradient of the contaminant source.

<u>Sample Tracking</u>

Proper record keeping and documentation is also an important part of any QA/QC program. These records ensure analytical results are credible and defensible by providing details of sample collection and handling procedures.

Sample record logs should be completed for each sample collected. These logs should contain the following information:

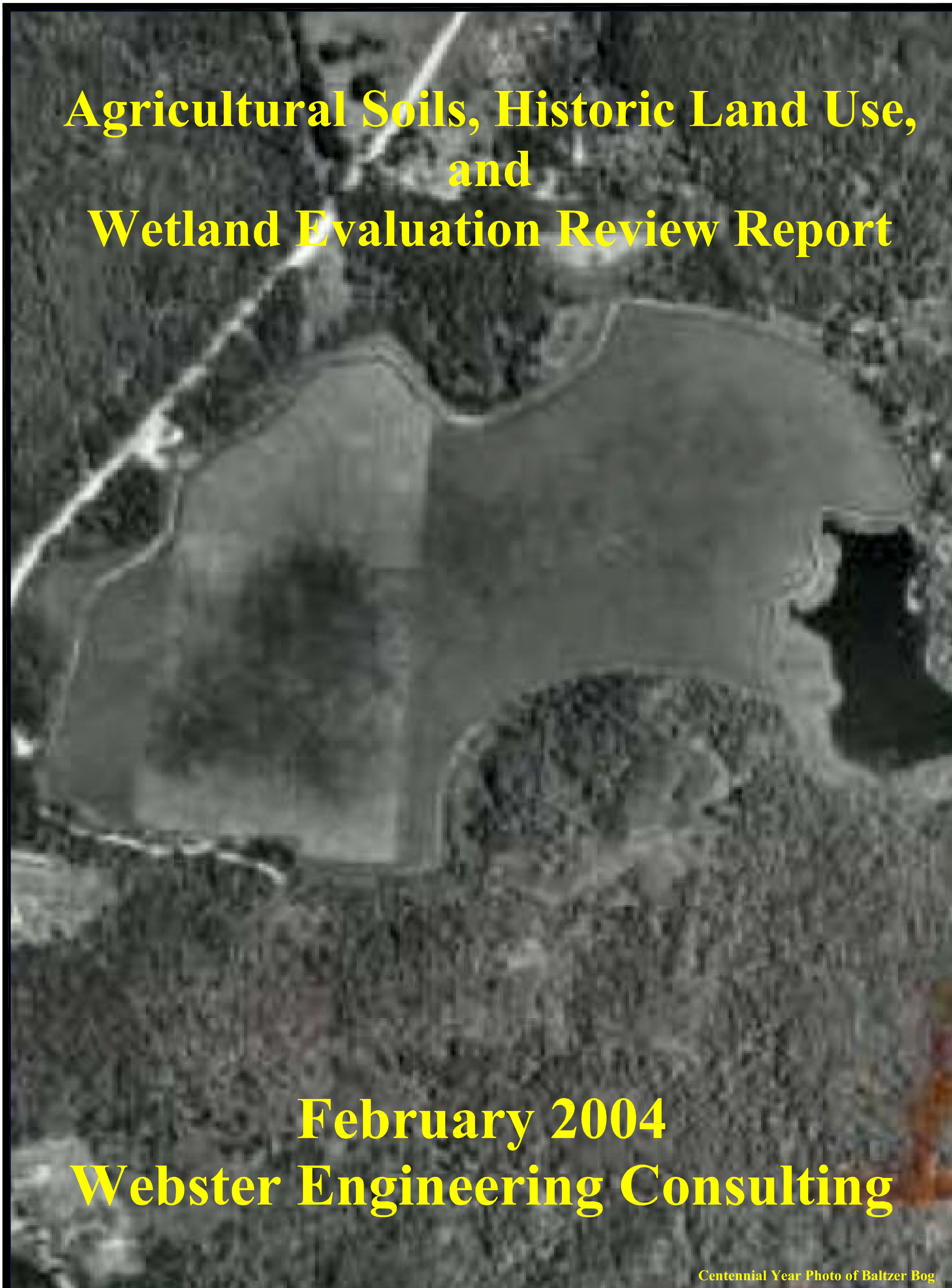
- sampler
- site location
- date
- well identification number
- unique sample number
- type of sample (field sample, duplicate sample, blank, spike, grab sample, composite sample)
- type of analysis to be conducted
- preservatives used
- whether the sample was filtered or not

Chain of custody records are used to identify all personnel responsible for handling the samples and to provide the information necessary to track the samples. These records contain areas to be filled out each time the samples change hands. The person handing over the samples and the person accepting them both sign the form and indicate the date and time. These forms also show the sample numbers assigned by the sampler, the laboratory internal sample numbers and the required analyses. These records must accompany the samples at all times.

Appendix F

Agricultural Soils, Historic Land Use, Wetland Evaluation Review Report

Agricultural Soils, Historic Land Use, and Wetland Evaluation Review Report



February 2004
Webster Engineering Consulting

Centennial Year Photo of Baltzer Bog

Mark-Lyn Construction Limited
Environmental Assessment Registration

Agricultural Soils, Historic Land Use, and Wetland Evaluation Review Report

February 2004

By: Trent Webster, P.Ag., P.Eng.

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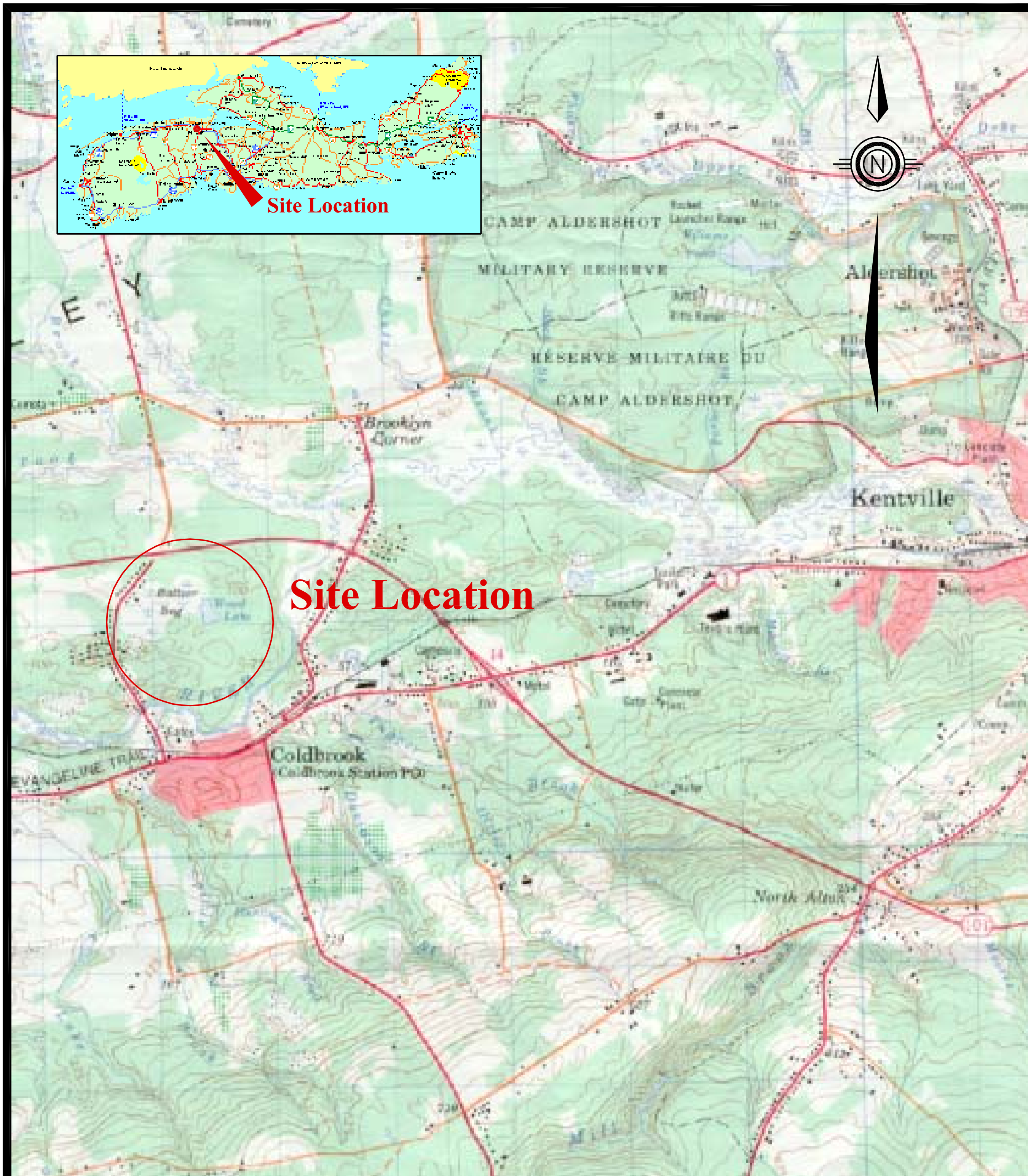
1.0 Site Location Mapping

For those not familiar with the Mark-Lyn Site, a site location map is provided in Figure 01 on the following page. This figure shows the site at both the provincial level and on a 1:50,000 scale level. The 1:50,000 scale map used in Figure 01 was the 21 H/2 Berwick map sheet.

Figure 02 is an aerial photograph, contour and PID line drawing of the site. Figure 02 shows the property boundaries in yellow lines and five meter contours in red lines. The digital data was obtained from the Nova Scotia Department of Housing and Municipal Affairs Land Information Services. Figure 02 contains three photos, all of which were flown in August of 2002, at the approximate scale of 1:10,000. The upper photo number is 106 from flight line L-46, flown on August 8, 2002. Very little of this photo is actually seen in Figure 02. The two main photos are numbers 82 and 83 from flight line L-45, which was flown on August 2, 2002.

The peat extraction site is designated as A1, and the silt extraction site is designated as A2, in Figure 02.

Figure 03 is the site PID Mapping. Again, the digital data was obtained from the Nova Scotia Department of Housing and Municipal Affairs Land Information Services, and was plotted through AutoCAD. The peat extraction site is PID number 55149611, and the silt extraction site is PID number 55300321.



Mark-Lyn EA Registration
Coldbrook, Nova Scotia

Site Location Mapping

Date: February 2004

Scale: 1:50,000

Webster Engineering Consulting

Figure 01

Mark-Lyn EA Registration
Coldbrook, Nova Scotia

Aerial Photo, Contours & PID Lines

Legend

- Small Buildings
- Gravel Pit
- PID Lines
- 5 Meter Contours
- 31.4 Spot Elevations
- Railway (Abandoned)
- △ 7725 Control Survey Monument

Aerial Photography Taken
August 2, 2002

Date: February 2004
Scale: As Shown

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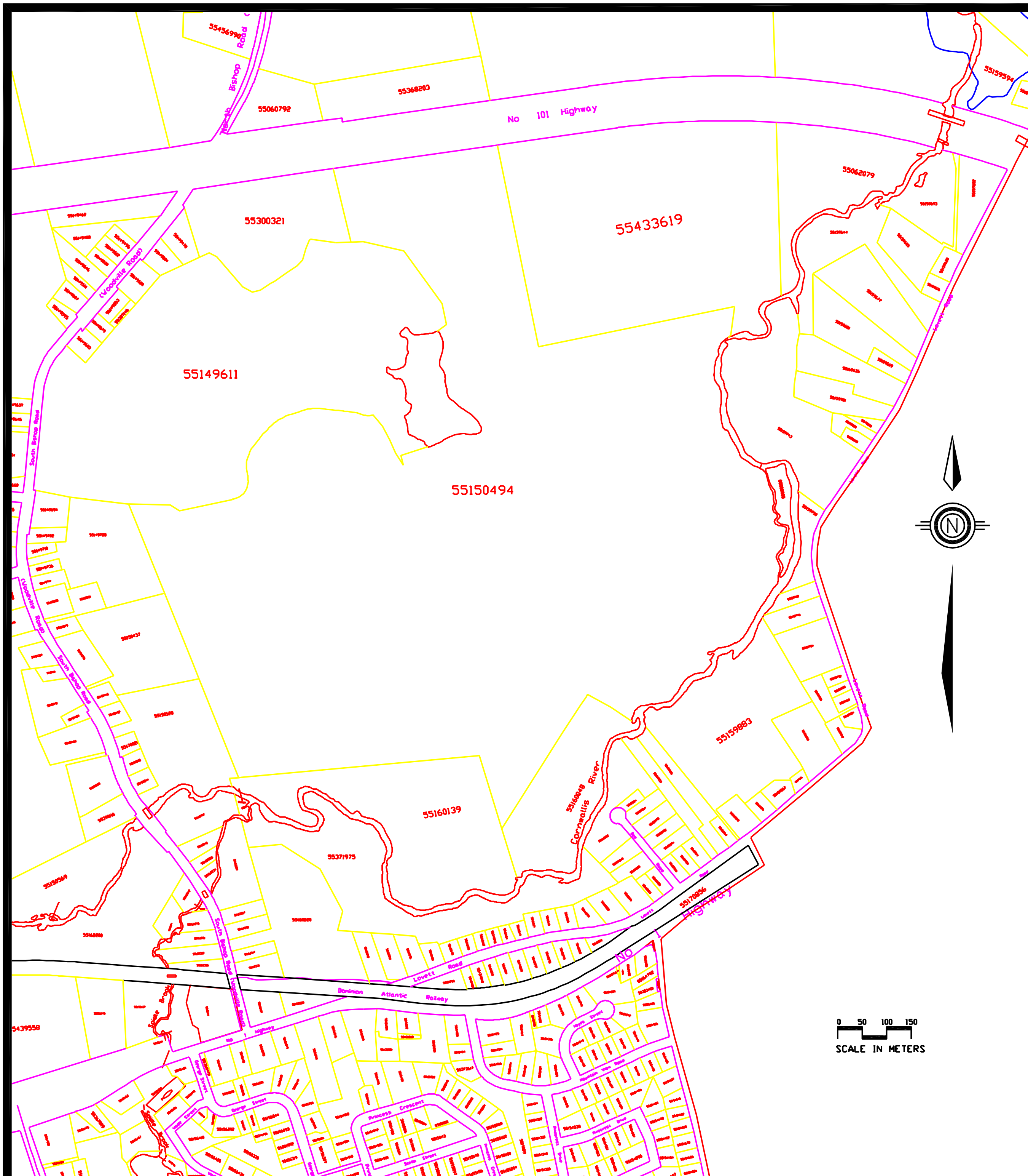
Figure
02



Mark-Lyn EA Registration
Coldbrook, Nova Scotia

PID Mapping

Date: February 2004

Scale: As Shown

Webster
Engineering
Consulting

Figure

03

2.0 Agricultural Soils

This section is to provide a background on the types of soils that are being utilized by the Mark-Lyn topsoil manufacturing business.

The sites that are being utilized by Mark-Lyn may be seen on Figures 02 and Figure 03. Specifically the sites are PID numbers 55149611 and 55300321.

From these two sites the raw materials are obtained for the manufacturing of a screened top quality topsoil product. The two primary ingredients include sand soils and peat.

PID number 55149611 is the source of the peat, while PID number 55300321 is the source of the Cornwallis sand soil type, referred to by others as the silt pit.

These two soils are mixed in a ratio of 2:1 (sand/peat), after the peat material has been screened of roots and rocks.

2.1 The 1965 "Soil Survey of Kings County" Report

The "Soil Survey of Kings County" was written 1965 by Cann, MacDougall, and Hilchey and was one of the governments first efforts to describe soils in Nova Scotia. The authors Cann and MacDougall worked for the Canada Department of Agriculture, and Hilchey worked for the Nova Scotia Department of Agriculture and Marketing. Accordingly, agriculture was the main focus of their work, as they collected information about the soils. While the report is dated, the soils remain unchanged since that time, and as such the soils documentation remains valid to this day.

The soils were mapped with an east and west sheet for Kings County, at a scale of one inch equal to one mile, or 1:63,360. This site lands exactly on the divide of the east and west map sheets.

2.1.1 Cornwallis Soil Type

As already stated the mapping indicates that PID 55300321 consists entirely of the Cornwallis type soils. The mapping states that the topography is gently undulating to undulating with a three to five percent slope limit. The soils are further classified as stone free.

The PID mapping indicates that the Cornwallis soils site is approximately 5.4 hectares, equal to 13.4 acres in size.

Cornwallis soils occupy 18,950 acres, or nearly 4 percent, of Kings County. The soils consist of approximately 96 percent total sand with a particle size range of 2 to 0.05 mm. On average, 65 percent of the total sand consists of fine sand, with a particle size of 0.25 to 0.05 mm. The remaining 3 percent of the soil consists of silts and clays, with approximately 3 percent silt and 1 percent clay.

These soils were developed from coarse-textured parent materials similar to the Canning, Nictaux, Torbrook, Gulliver, Kingsport and Millar soil series.

The "Soil Survey of Kings County" states the following:

"The Cornwallis soils occupy nearly 4 percent of the County. They occur mainly on the Valley floor in two large areas, one from Kentville to west of Waterville and the other from the western boundary of the County to near Greenwood. They have developed from yellowish-red to yellowish-brown sand. The ratio of coarse to fine sand in the parent material varies somewhat, and affects the water-holding capacity. The drainage ranges from moderately rapid to excessive. The land ranges mainly from nearly level to rolling, a few areas having steep slopes and hummocks. The soils are largely free from stones. The forested areas are covered with pine, wire birch and poplar.

The Cornwallis soils are droughty, and for cropping they need to have organic matter added and usually must be irrigated. They also require lime and fertilizers. They have been used for hay, grain, potatoes, cash crops and tree fruits. Orchards are unprofitable because the soils are porous and droughty. The soils are easily cleared and cultivated, and with adequate moisture and fertilization they give good yields of field crops. Usually the cost of maintaining these conditions is not warranted when other soils are available, and wide use of the soils for agriculture must await economic conditions that make it profitable to cultivate them. Only 44 percent of the acreage has been cleared."

2.1.2 Cornwallis Soils Classification

The "Soil Survey of Kings County" also produced a soil classification map, which rated the agricultural capability of all of the soils in Kings County. This rating system is still used today, with a Class 1 soil being the best for the purposes of Agriculture, and a Class 7 soil being the worst.

The Cornwallis soils have been rated as a Class 4m soil type. Class 4 Soils are described as follows from the "Soil Survey of Kings County".

"Soil Capability, Class 4: Soils in this class have severe limitations that restrict the choice of crops or require special conservation practices, or both. They are suited for only a few crops, or the yield for a range of crops may be low, or the risk of crop failure is high. The limitations may seriously affect such farm practices as timing and ease of tillage; planting and harvesting; and application and maintenance of conservation practices. These soils are low to medium in productivity for a narrow range of crops but may have higher productivity for a specially adapted crop."

The M designation in the Class 4M rating stands for Moisture, drouthiness owing to inherent soil characteristics limits crop growth.

Therefore, the one of the greatest constraints of this soil type for agricultural production was its rapid drainage, and being prone to drought. The Mark-Lyn business has sought to address this limitation of the Cornwallis soil by the addition of peat.

2.1.3 Peat Soils

The "Soil Survey of Kings County" contains a very brief section in regard to peat soils in Kings County. Their survey inventory accounted for 11,000 acres of peat type soils in Kings County, with 7,150 acres found on the valley floor. By comparison, the peat bog located at PID number 55149611 is estimated to be approximately 50.8 acres in total. The entire property, PID number 5149611, is estimated to be 70.9 acres in total. The acreage estimates were obtained with AutoCAD from the digital PID files as obtained from the Nova Scotia Land Information Services division.

The "Soil Survey of Kings County" states the following:

"Peat soils occupy about 2 percent of the County and more than 65 percent of this is on the Valley floor. The larger areas occur along the Cornwallis River west of Kentville, north of Coldbrook, near Aylesford and south of Auburn. Smaller areas are scattered throughout the County, particularly in the southern part.

These soils occur in depressions where moisture is excessive for most of the year. The depressions are now filled with partly decomposed remains of water- loving plants such as sedges, reeds, moss and, occasionally, trees. The surface is usually covered with a thick layer of sphagnum moss and other plants such as labrador tea, crowberry, lambkill, bog rosemary and cotton grass. The trees found are black spruce, tamarack, red maple and alder. Some of the larger bogs are treeless.

Generally, the surface layer of these soils consists of 12 to 20 inches of sphagnum moss and sedges. This is underlain by poorly decomposed material of the same kind. The deposits range from about two to several feet deep and overlie mineral soil.

In a few areas the surface layers are well decomposed and are practically muck. Some cash crops have been grown experin1entally on these areas and seem to do well, but require careful management for an adequate supply of nutrients."

The general description of peat bog is indeed similar to the type of peat that is found at the Mark-Lyn owned peat bog. With the Mark-Lyn peat bog is estimated to equal 50 acres, its land area represents less than half a percent of the total peat bog acreage in Kings County.

2.2 1988 Nova Scotia Soil Survey Report

A more recent soil survey was completed in some parts of Nova Scotia, and this area was reported on in 1988. Report Number 25, from the Nova Scotia Soil Survey is titled "Soils of the Cambridge Station Map Sheet (21H/02-T3) Nova Scotia". This soil survey was conducted at a sampling density of one site per 12.5 hectares.

D. Holstrom produced the report, which includes soils mapping at the 1:20,000 scale.

The peat site is mapped as DFN8P/B, which represents a Dufferin soil type with a depth of surface material greater than 80 centimeters, and a particle size described as peat. The site is rated as a having a slope of 0.5 to 2.0 percent, and is very poorly drained.

The silt extraction site is reported to be a CNW85/D, which represents a Cornwallis soil type, with a depth of surface material greater than 80 centimeters, and a particle size described as sandy. The site is rated as having as slope of 5 to 9 percent, and is well drained due to its medium to coarse sandy texture. These soils are variable in composition. While they typically contain up to 97% sands, they may also contain up to 30% silts and clays, which helps to explain the description of the site as a silt extraction site by laymen.

These newer soil descriptions are very consistent with the older soil descriptions.

2.2.1 Soil Inspection for Baltzer Bog

K. Webb, Agriculture Canada Soil Scientist, inspected the site in November of 2000. For reference purposes only, his report of the visit may be found in Appendix A.

He has described the soils as the Dufferin 8P peat with a von Post rating ranging from 4 to 6. This is consistent with other field observations, however a von Post rating of 6 is more decomposed than other assessments.

His report indicates that the land use at the time of his visit was peat extraction, which is consistent with the date of the approval of the topsoil removal application from the site.

2.3 Nova Scotia's Peatland Resources

A.R. Anderson and W.A. Broughm jointly co-authored Bulletin 6, on behalf of the Nova Scotia Department of Mines and Energy in 1988, titled "Evaluation of Nova Scotia's Peatland Resources." This report was the product of five years of inventory data regarding Nova Scotia's previously "poorly documented" peatland resource.

From 1980 to 1985, 267 individual peat deposits were investigated, mapped, peat samples taken, graded, and peat inventories determined. The sites were evaluated for their potential use for either a fuel grade peat source, or for a horticultural moss grade peat.

The inventory investigated approximately 20 percent of the peatland resource of Nova Scotia, which has been estimated to equal 400,000 acres, based on the previous Nova Scotia Soil Surveys.

This inventory utilized the 1926 von Post method for determination of humification for raw peat samples. The von Post method rates the decomposition of peat moss on a scale from 1 to 10, with 1 equal to no decomposition and 10 equal to completely decomposed.

The inventory had included the Baltzer Bog in Coldbrook, just one of four sites that were visited in Kings County. The Kings County report from the "Nova Scotia Peatland Inventory" is included in its entirety next.

"Kings County:
Kings County deposits surveyed included the Auburn, Aylesford, Berwick (Annapolis Valley Peat Moss), ***and Baltzer Bogs****, totalling roughly 1,500 acres (600 ha). The largest deposit, Berwick (I14-01G), was 734 acres (295 ha), of which 600 acres (240 ha) are currently under production for peat moss. A small part of this deposit (25 acres) is being used for vegetable production. There is an average of 5 feet (1.5 m) of peat moss remaining in this deposit, but in the centre of the bog moss peat depths still average over 10 feet (3 m). The bog also has a substantial fuel peat resource. Roughly 5 million cubic yards (3.8 Mm3) of fuel peat was found in areas of the bog where peat depth exceeded 3 feet (1 m). This represents about 770,000 tons (700,000 tonnes) of in situ fuel peat (at 50 percent moisture content). The potentially mineable fuel peat resources are shown in Table 2.9.*

"The Auburn Bog (I14-02) is a small deposit of 310 acres (124 ha), located in Auburn on the east side of Highway 101 immediately south of the railway tracks. A small area of the bog was once used for cranberry production, but for the most part the bog has remained undisturbed. Approximately 1.7 million cubic yards (1.3 Mm3) of peat, has been delineated in this deposit, of which 1.2 million cubic yards (0.95 Mm3) occurs in areas of the bog where peat is deeper than 3 feet (1 m). The surficial grade peat resource in areas of the bog where peat depth exceeds 3 feet (1 m), is 800,000 cubic yards (610 000m3), an equivalent of 1.5 million bales of peat moss. This deposit is a potential source of peat moss to complement the Berwick production.

At the time of the survey the Aylesford (I14-3) ***and the Baltzer (I16-1) bogs were used for agricultural crop production.*** *The Aylesford bog (343 acres [139 ha]) has only 2 feet (0.6 m) of peat moss over 3 feet*

(1 m) of fuel peat, an insufficient quantity for development for fuel production at a commercial scale. ***The Baltzer deposit is almost entirely moss grade peat, but is too small for commercial moss peat production. This deposit has a total area of only 110 acres (44 ha), of which 64 acres (26 ha) had peat layers thicker than 3 feet (1 m).*** *"*

Table 2.9 from the report suggest that just 3 points in total were investigated at the Baltzer Bog, the average humification was a von Post of 4.0, and that there were 1.23 million bale equivalents of peat moss that could be harvested at this site.

2.3.1 Peat Site Soil Sampling

On January 6, 2004, Terry Hennigar and the author visited the peat bog to take a firsthand look at the peat resource. Two peat probe borings were made, one in the northeast quadrant and one in the northwest quadrant. One peat sample was analyzed at the Nova Scotia Department of Agriculture and Fisheries laboratory in Truro, and the results may be found in Appendix B.

The hand augering in the first location in the Northwest quadrant found mineral soils at a depth of 1.8 meters. The peat was still very fiberous with some shallow layers that were slightly more decomposed. The von Post scale was estimated to be 3.5 for the full 1.8 meter depth. This observation is consistent with the peat resource inventory assessment.

The second hole in the Northeast quadrant went to a depth of 2.65 meters when the mineral soil base was reached. Again, the peat was still very fiberous with some shallow layers that were slightly more decomposed. The von Post scale was estimated to be 3.5 for the full 2.65 meter depth. This observation again was consistent with the peat resource inventory assessment.

The sample that was analyzed indicated that the pH of the soil was 4.5 and that the peat is naturally low in most mineral nutrients such as nitrogen, phosphorus, and potassium, which is quite common for most peat soils.

This site represent primarily moss grade peats, suitable for horticultural purposes. This makes this peat resource ideal for the purpose in which the Mark-Lyn company desires it to be used.

3.0 Historic Use of the Bog

One is able to obtain a fairly good idea of the activities that have been undertaken on the bog by reviewing the series of aerial photographs that have been taken over the past half century or more.

The following series of pictures presents the aerial photos that have been taken over time of this site for the years 1955, 1967, 1977, 1987, 1992, and 2002.

Figure 04 Baltzer Bog 1955

In Figure 04 the bog appears to be in its natural state. The picture is from 1955 at a scale of 1:15,840. There is no development on the bog itself, just a woods road cut in beside the southern most boundary of the bog. Woods Lake is full in this photo.

Figure 05 Baltzer Bog 1967

Figure 05 shows the bog in 1967, the Centennial year. In this photo it is clear that the western portion of the bog has been modified from the natural state. A local farmer was developing the bog for agriculture purposes. The resolution of the scanned photo blurs whether or not there is a road and a ditch around the property. It would be reasonable to expect that the bog would have at least a perimeter ditch around it, in order to be farmed at all. The small lake appears to be as full as in the photo from 1955. The bog by this time, already has been impacted, in terms of functioning as a natural wetland. The native vegetation has been removed from approximately half of the bog, and a perimeter ditch has altered the natural water table height along that perimeter.

Figure 06 Baltzer Bog 1977

Figure 06 indicates that the bog has been significantly impacted by agricultural development activities since 1967. There appears to be a perimeter ditch around the bog. A large central ditch now runs east and west, cutting the bog into distinct north and south halves. Another significant ditch runs north and south near the center of the bog, further dividing the bog into quadrants, forming what may now be referred to as the Northwest, Northeast, Southeast, and Southwest quadrants of the bog.

The south portion of the bog appears to be the most recently cultivated in this photo. The Southwest portion of the bog has three smaller ditches dug to the central east-west oriented ditch, and looks to have been recently cultivated. The Southeast quadrant appears to have a single ditch running its length, in an east-west direction. The entire quadrant appears to have been recently cultivated, similar to the Southwest quadrant. The Northwest quadrant, while previously worked, now appears to have been let go into a fallow or untilled state, when compared to the south side.

The central portion of the Northeast quadrant appears to remain in its natural state, however even that remains questionable, with close examination of the photo. Cultivation marks clearly parallel the Northeast corner of the bog, from the aerial photograph, in approximately 100 feet from the edge of the field. Stereoscopic viewing of the original photography may reveal that the entire Northeast quadrant was cultivated, prior to this photo. The northern perimeter has been recently cleared of trees in several areas, apparently in an effort to gain additional cultivated land area. The natural vegetation on the perimeter of the Northeast quadrant certainly appears to have been disturbed just prior to this photo.

The level of water in the very small Woods Lake remains the same as in the previous two photos.

Figure 07 Baltzer Bog 1987

As may be seen in Figure 07, by 1987 the bog appears to be no longer involved with any recent agricultural cultivation practices, with the possible exception of the Northwest field. Young trees are proliferating in areas that were effectively drained by the agricultural ditches. Tree growth is most apparent in the southern portion of the bog, but is also noted along the northern perimeter of the Northeast quadrant, where physical disturbances were the most evident from the previous 1977 photo.

Some peat extraction is evident by new small pond in the Southeast corner of the bog, close to the sand pit on the adjoining property.

The water level in the small lake appears to be unchanged from the previous photos.

Figure 08 Baltzer Bog 1992

Figure 08 suggests a new level of activity at the site. The Southwest quadrant shows the greatest level of activity, with the trees removed and wind rowed, and new ditches dug within the section. The shallow peat deposits from the Southwest end appear to have been removed. Trees continue to grow in areas previously ditched and drained by the agricultural activities. The Northwest perimeter ditch is clearly visible now, and it wasn't visible in 1987. The water level in the small lake is visibly lower than in the previous photo. The water appears to contain an algae bloom, possibly due to the time of year of the photo, or because of the lowered water levels.

Figure 09 Baltzer Bog 2002

Figure 09 shows the site as of August 2, 2002. By now the peat has been removed from the Southwest quadrant of the bog. Stockpiles of peat are seen in the Southwest portion of the bog itself. The small lake appears to be dry, or very close to being dry. The Northwest quadrant now has a series of shallow east-west orientated ditches that were not visible in the earlier photos, apparently to better drain the bog. Trees now dominate the Southeast quadrant of the bog. Trees continue to spread southward, from the previously disturbed Northeast edge of the bog.

3.1 Summary of the Historic Use of the Bog

The bog was originally disturbed from its native state sometime prior to 1967. The bog was irreversibly altered sometime before the 1977 photo was taken, by the construction of significant drainage ditches throughout the bog. The drainage patterns established in the bog, together with the removal of the natural vegetation from the majority of the bogs surface area, set the stage for the complete change of the natural peat bog environment. The discontinuation of agriculture on the site allowed for the site to begin to return to its current botanically altered state.

Environmental approval to allow the removal of the topsoil from the site in November 1999 up to 9.9 acres in area, has allowed the development to proceed to its current state. Further environmental approvals are required to allow the Mark-Lyn to continue its operations beyond the existing environmentally approved footprint.

4.0 Wetland Evaluations of the Bog

4.1 Wetlands

Wetland is defined as "land that has the water table at, near, or above the lands surface or which is saturated for a long enough period to promote wetland or aquatic processes as indicated by hydric soils, hydrophytic vegetation, and various kinds of biological activity that are adapted to the wet envionment." The National Wetlands Working Group (1988) provides the above definition.

Another simpler definition of a wetland is that they are areas dominated by plants that can grow in saturated soils.

There are five wetland classes in Canada. These are bog, fen, swamp, marsh, and shallow open water.

The Nova Scotia Wildlife Habitat Conservation Manual describes bogs in the following manner.

"Description:

Four types of bog are described with their distinct features and characteristic plant communities. These are Raised (Domed) Bogs, Flat Bogs, Sloped Bogs and Blanket Bogs.

Bogs are usually acidic, nutrient-poor peatlands, usually with the water table at or near the surface. Most of their water supply is received in the form of precipitation and most is lost through evaporation. Bogs are virtually unaffected by the nutrient-rich groundwater of the surrounding mineral soils. Bogs consist of accumulations of peat, partially decomposed plant material (mainly spbagnum mosses). Bogs may be treed or treeless and are usually covered wth ericaceous shrubs.

Status:

Bogs are ***common*** *in Nova Scotia, accounting for more than 21,600 wetands covering about 160,000 ha. They occur throughout the province, but are most abundant on Cape Breton Island, Southwestern mainland, and Guysborough, Hants, and Cumberland counties.*

All bogs in Nova Scotia have been mapped, classified, and evaluated for their potential wildlife value in the Nova Scotia Wetland Atlas and the Nova Scotia Wetland Inventory Summary Data."

4.2 Important Freshwater Wetlands of Nova Scotia, 1982

In 1982, the Nova Scotia Department of Lands and Forests Wildlife Division compiled the "Important Freshwater Wetlands & Coastal Wildlife Habitats of Nova Scotia". This map based document was a first level of effort by the provincial government to rate all of the wetlands in Nova Scotia for their potential wildlife habitat. This provincial map book covers the province with the same map sheet reference numbering system, i.e. 21 H/2, as the 1:50,000 scale maps, however the booklet is mapped at the scale of 1:100,000.

The following is excerpted directly from the above stated document.

"FRESHWATER WETLANDS

Freshwater wetlands provide habitat essential for more than 50 wildlife species. In addition, wetlands are valuable because of their actions in serving as flood and stream controls, protecting subsurface water resources, serving as pollution treatment sites, controlling erosion and providing recreational, educational and scientific opportunities.

All freshwater wetlands within the province have been inventoried and, based on a scoring system, rated from 37 up to 108 according to their value to wildlife. Those wetlands with total scores above 65 should receive consideration as important wildlife areas when alternate land uses are proposed.

Wetlands scoring 80+
- Best wetlands. Areas of outstanding wildlife value which are of provincial significance. Wetlands in this category should be completely protected.

Wetlands scoring 70-79.5
- Better wetlands. Areas of local wildlife value or ones that have outstanding wildlife potential. Wetlands in this category should be reserved for wildlife unless a high priority use justifies other developments on these sites.

Wetlands scoring 65-69.5
- Good wetlands. Areas of value to wildlife which often have the potential for development as better wildlife habitats. The value of wetlands in this category to wildlife should be reviewed before considering any developments on these sites."

The focus of this wildlife valuation report appears to be primarily in regard to migratory bird habitats, piping plover nesting, and eagle habitats, as these habitats are specifically mentioned in the atlas legend.

While the Baltzer Bog, Woods Lake site is found on this mapping system, the site is not delineated at all. This implies that the site rated a wildlife habitant score of less than 65, which implies a wildlife habitant ranking of less than "Good wetlands."

This is contrasted to the Cornwallis River that passes in close proximity to the site, and has a rating of 96.5, equal to the "Best wetlands".

4.3 Nova Scotia Wetland Inventory, 1988

In 1988, the "Important Freshwater Wetlands & Coastal Wildlife Habitats of Nova Scotia" map atlas was updated. The updating was to include important coastal wetlands, as well as important freshwater wetlands, and a broader range of wildlife habitat. This version is referred to as a wetland inventory, as all wetlands over 0.25 hectares were to be inventoried with this mapping system.

The wildlife scoring system was identical to the 1982 version of the "Important Freshwater Wetlands & Coastal Wildlife Habitats of Nova Scotia".

In this 1988 revision, the Baltzer Bog is delineated and classified as a meadow. The bog is numbered for inventory purposes, however no wildlife rating score was provided. This again implies that the bog has a wildlife habitant rating score of less than 60, or less than "Good wetlands". While this site is indeed a wetland, its significance as potential wildlife habitant is less than nearby habitat, such as the Cornwallis River, which in this mapping system rated a score of 87.5.

A meadow *"refers to wetlands dominated by meadow emergents with up to 0.15 meters of surface water during the late fall, winter and early spring. The soil is saturated during the growing season, and the surface is exposed except in shallow depressions and drainage ditches."*

Oddly enough, the classification system also includes a classification for bogs. *"Bog – refers to wetlands where the accumulation of sphagnum moss as peat determines the nature of the plant community. Floating sphagnum mats may encroach over the surface of any open water."*

The rating of the wetlands was performed through aerial photography interpretation, in this case 1977 aerial photography. It appears that this site was inappropriately classified as a meadow, when it should have been classified as a bog.

4.4 Nova Scotia Wetland Atlas, 1991

The Wetland Atlas was again updated in 1991, with an identical scoring system to the to the previously referred two atlas books. It was simply titled the "1991 Wetland Atlas".

This 1991 mapping system does not delineate Baltzer Bog at all. This again suggests that the site has a wildlife rating of less than 60, or less than "Good wetlands". The adjacent Cornwallis River is rated as 87.5, equal to the "Best wetlands.

4.5 Wetland Rating Observations and Conclusions

Upon the review of the above resources, it can be concluded that from a wildlife habitant perspective, that the site must be rated as less than "Good wetlands". All three references indicate this. While the site is indeed a wetland, it has been clearly rated by the wildlife professionals as less than "Good wetlands".

In fact, the "Best wetlands" are located just adjacent to this site, all along the Cornwallis River. There is no question that the Cornwallis River should be protected as prime wildlife habitat for future generations to enjoy.

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Appendix A

Soil Inspection for Baltzer Bog

SOIL INSPECTION FOR BALTZER BOG
by K. T. Webb
November 28, 2000

Soil inspection results

The soil inspection site at the Baltzer Bog is within a Dufferin 8P soil map unit (i.e., DFN8P/B) as depicted on the 1:20 000 scale soil survey map (Holmstrom 1988). Dufferin 8P soils are described as very poorly drained organic soils greater than 80 cm deep that have developed in medium to well decomposed peat derived from forest swamp vegetation.

The following soil profile, described at the site, supports the map unit delineation reported by Holmstrom (1988).

Soil name:	**Dufferin 8P**
Location/date:	Baltzer Bog, Coldbrook, Nova Scotia; 27 November 2000
Slope/position/aspect:	0%; level; all
Land use:	peat extraction
Parent material:	extremely acid, mesic forest peat derived from mosses and woody trees and shrubs
Stoniness/rockiness:	nonstony; non rocky
Drainage:	poorly drained; surface ditched
Classification:	Typic Mesisol

Soil profile description:

Horizon	*Depth (cm)*	*Description*
Om	0–20	Black (5YR 2.5/1 m); moderately decomposed mesic peat; [z]von Post 5;
Of	20–60	Reddish black (2.5YR 2.5/1 m); slightly decomposed fibric peat; von Post 4; 10–20% hard, poorly decomposed root and stump wood.
Om	60–100	Reddish black (10R 2.5/1 m); moderately decomposed mesic peat; von Post 5; 10–20% hard, poorly decomposed root and stump wood.
Om	100–200+	Reddish black (2.5YR 2.5/1 m); moderately decomposed mesic peat; von Post 6

[z] the von Post scale is used to classify the degree of decomposition of peat materials on a scale of 1–10, where (1) is undecomposed and (10) is completely decomposed.

Background

For horticultural peat development, a suitable deposit would contain substantial quantities of poorly decomposed peats (von Post 1-4) greater than 1 m thick composed principally from *Sphagnum* mosses. The deposit must have sufficient size to support the annual production requirements. Dense tree cover or stumps within the peat would increase production costs and should be avoided if possible (Keys 1982).

Conclusions

The soil inspection is representative of the immediate area being excavated in the southern portion of the bog. In this area, the level of peat decomposition (von Post 5 to 6) and the content of wood fragments would reduce the suitability of the soils for peat moss extraction. The land use pattern on Baltzer Bog, as depicted on the soil map base (Holmstrom 1988), indicates that the northern half (approx. 10 ha) of the bog has been managed for agricultural production. This area may have different soil properties than those noted at the inspection site due to the effects of soil management required for crop production. Drainage and fertilizer application are known to accelerate the decomposition and subsidence of peat materials.

References

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Appendix B

Greenhouse Soil Analysis Report

NOVA SCOTIA
Agriculture and Fisheries
Quality Evaluation Division

Greenhouse Soil Analysis Report

PO Box 550
Truro, Nova Scotia
Canada
B2N 5E3

URL: http://www.gov.ns.ca/nsaf/
Tel: 902-893-6565
Fax: 902-893-4193

WEBSTER ENGINEERING CONSULTING
TRENT WEBSTER, FAX: 895-0009
130 BURNYEAT STREET
TRURO, NS B2N 4R1

FAXED

Client Number: 28792
Accession: 428
Samples Reported: 1/19/2004
Samples Received: 1/ 9/2004

Lab #	1											
Crop	UNKNOWN											
Sample ID	Peter Thomas											
	Analysis		Normal Range	Analysis		Normal Range	Analysis		Normal Range	Analysis		Normal Range
Cond. (mmhos)	0.07	-	0.75-3.50									
pH	4.50	-	5.2-6.5									
Nitrate-N (ppm)	0.31	-	60-175									
Phosphorus (ppm)	<= 0.30	-	5.00-15.00									
Potassium (ppm)	0.99	-	75.0-200.0									
Calcium (ppm)	1.43	-	75-250									
Magnesium (ppm)	0.52	-	40-75									
Sulfate (ppm)	4.51											
Chloride (ppm)	11											
Sodium (ppm)	5.22											
Iron (ppm)	0.05	-	0.5-3.0									
Manganese (ppm)	0.01	-	0.50-3.00									
Copper (ppm)	<= 0.02	-	0.100-0.500									
Zinc (ppm)	<= 0.01	-	0.5-2.0									
Boron (ppm)	0.02	-	0.10-0.50									
Aluminum (ppm)	0.02											

Comments:
Method of analysis for this report is Saturated Media Extraction (SME

ppm = mg/l = g/t
Kg/t = results given in % x 10
mmhos = mSiemmens

Copies To:

Analysis Approved By:
Loretta Robichaud, P.Ag. Manager

Appendix G

Archaeological Assessment of the Mark-Lyn Site

Archaeological Assessment
of the Mark-Lyn Site

Heritage Research Permit A2003NS61

Prepared for:
Terry W. Hennigar Water Consulting
59 Birch Drive
RR2 Wolfville, N.S.
B4P 2R2

Prepared by:
Helen Sheldon, M.A.
35 McInnis Road
RR#2 Malagash, N.S.
B0K 1E0

October 2003

Table of Contents

List of Figures

1.0 Introduction

Mark-Lyn Construction of Coldbrook, N.S. currently operates a peat and aggregate extraction operation in Coldbrook. The company plans to expand these operations to a further 60 acres for each operation (total 120 acres) (Figure 1). Because the development area encompasses a large body of water and lies close to the archaeologically significant Cornwallis River, an archaeological reconnaissance survey was required in order for the project to receive environmental approval.

A one day archaeological reconnaissance survey of the project area was conducted by Helen Sheldon on October 26, 2003 under Heritage Research Permit A2003NS61.

2.0 Project Area

The project area consists of approximately 120 acres of bog and surrounding higher lands adjacent to active extraction operations. The development area is bordered on the north by Highway 101, on the west by the Woodville Road and lies east of the Lovett Road in Coldbrook, N.S. The majority of the property has been cleared, with the few remaining stands of trees consisting of pine and oak with some maple and aspen. The soils are almost pure sand, and very well drained, except for Baltzer Bog. The bog has been cleared and supports a regrowth of small pine and scrub. The project area contains only one major body of water, Wood Lake, which drains through a small stream into the Cornwallis River to the east. Most of the shoreline of Wood Lake is low lying and wet. The lake itself is shallow and during a dry summer can be walked across (Terry Hennigar, personal communication).

3.0 Methodology

The methodology for the archaeological reconnaissance survey consisted of two major components:

(1) visual examination of the ground surface for evidence of past human activity; and

(2) excavation of shovel test pits in areas believed to have some archaeological potential.

The archaeological survey was conducted on October 26, 2003 by Helen Sheldon.

4.0 Resource Inventory

The field reconnaissance consisted of a visual inspection of the ground surface through walking over the site. Since the majority of the area had already been cleared, with earth disturbance, visual inspection of the soils was possible over most of the project area without further excavation.

The property was reached by an access road leading west from Lovett Road, along the southern edge of Highway 101.This western section, Area 3, was walked and the surface inspected for archaeological remains. The majority of the area was cleared with most vegetative cover removed. Area 2 was reached by walking west through a semi-wooded section. Area 2 was also mostly cleared, again with no evidence of historic human activity. The shores of Wood Lake were inspected for archaeological remains, with none being found. Shovel tests were dug in both area 2 and 3 and on the shores of Wood Lake to examine previously undisturbed soil profiles. Nothing of archaeological significance was identified. Baltzer Bog (Area 1) has low potential for archaeological resources.

5.0 Resource Evaluation

No archaeological resources were identified within the development area. The area appears not to have been used prior to the twentieth century and any precontact occupations probably would have existed closer to the shores of the Cornwallis River. The majority of the project area has low potential for archaeological remains.

6.0 Impact Identification and Assessment

Development of the property into a peat and aggregate extraction operation will have no adverse effect upon archaeological resources. Expansion of the peat and aggregate operation is to take place as soon as possible.

7.0 Conclusions and Recommendations

No archaeological resources were observed during the archaeological reconnaissance survey of the property. Therefore, it is recommended that development can proceed without further archaeological work. It should be noted that, since no archaeological survey is completely infallible, should anything of an archaeological nature be discovered during development or operation of the peat and aggregate extraction site, the Curator of Archaeology at the Nova Scotia Museum (David Christianson 424-7374) should be contacted immediately.

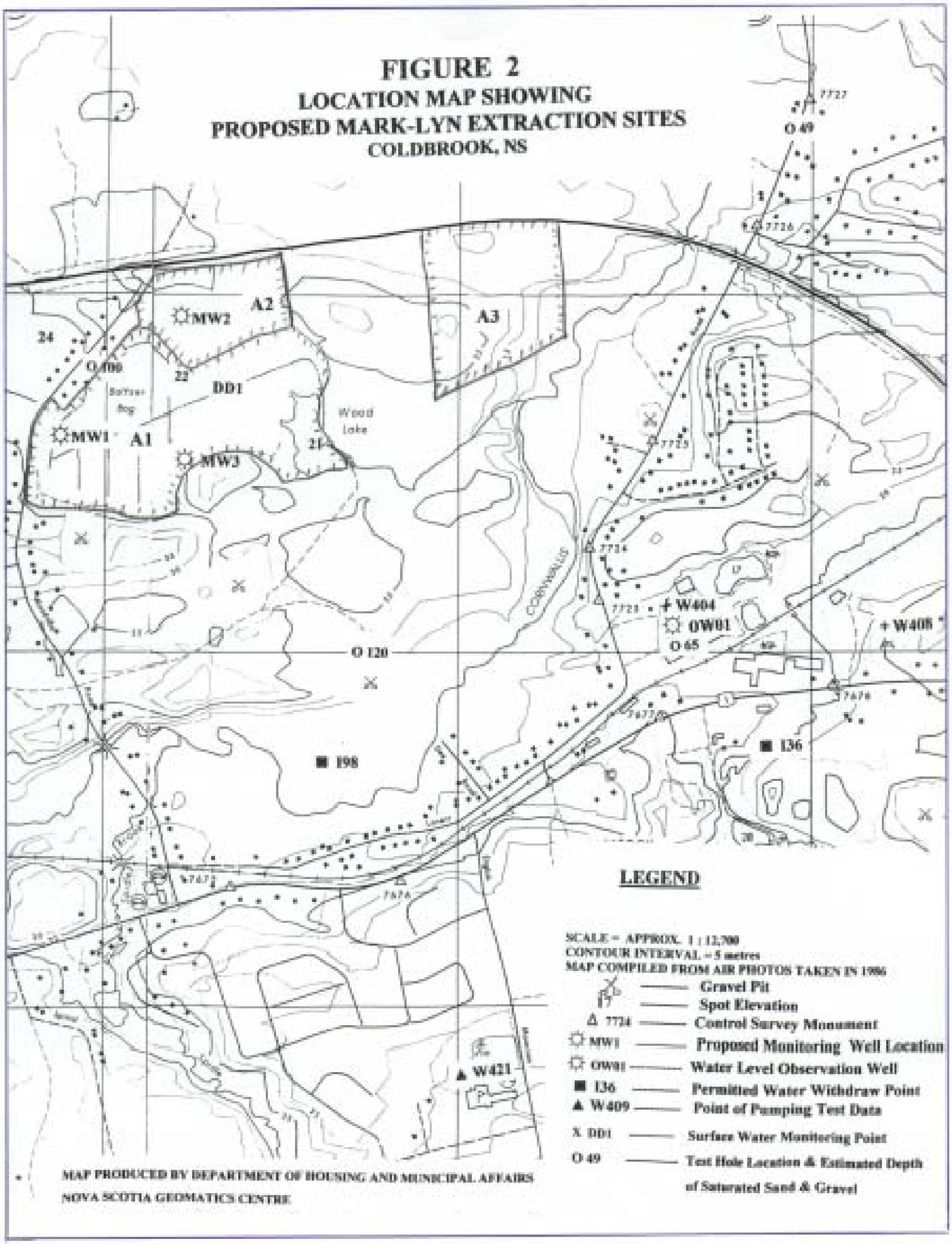


FIGURE 2
LOCATION MAP SHOWING
PROPOSED MARK-LYN EXTRACTION SITES
COLDBROOK, NS
A1
A2
A3
MW1
MW2
MW3
DD1
W404
OW01
W408
W421
I36
I98
LEGEND
SCALE = APPROX. 1 : 12,700
CONTOUR INTERVAL = 5 metres
MAP COMPILED FROM AIR PHOTOS TAKEN IN 1986
Gravel Pit
Spot Elevation
7724 Control Survey Monument
MW1 Proposed Monitoring Well Location
OW01 Water Level Observation Well
I36 Permitted Water Withdraw Point
W409 Point of Pumping Test Data
X DD1 Surface Water Monitoring Point
O 49 Test Hole Location & Estimated Depth of Saturated Sand & Gravel
MAP PRODUCED BY DEPARTMENT OF HOUSING AND MUNICIPAL AFFAIRS
NOVA SCOTIA GEOMATICS CENTRE

NOVA SCOTIA
MUSEUM

1747 Summer Street
Halifax, Nova Scotia
Canada B3H 3A6

Tel 902 424-
Fax 902 424-0560

http://museum.ednet.ns.ca

December 5, 2003

Ms. Helen Sheldon
35 McInnis Road
Malagash, NS B0K 1E0

Dear Ms. Sheldon

RE: Heritage Research Permit
A2003NS61 – Baltzer Bog, Coldbrook

We have received and reviewed your report your report on work conducted under the terms of Heritage Research Permit (A2003NS61) for an Archaeological Resource Impact Assessment of the Baltzer Bog, Coldbrook

Staff concur with your assessment that the development area contains no significant cultural resources and your recommendation that the development be allowed to proceed.

If you have any questions, please let me know.

Sincerely,

Robert Ogilvie
Curator, Special Places

c. D. Christianson, Nova Scotia Museum
S. Powell, Nova Scotia Museum

Appendix H

Report on Public Information Meeting

INFORMATION MEETING REPORT
FOR MARK-LYN CONSTRUCTION LIMITED, COLDBROOK, KINGS CO., NS

RE: PROPOSED TOPSOIL AND AGGREGATE OPERATIONS
SOUTH BISHOP ROAD

DATE:	February 24, 2004
PROPONENT:	Mark-Lyn Construction Ltd., Coldbrook, Kings Co., NS
FACILITATOR:	Hendricus Van Wilgenburg
ATTENDANCE:	beginning: 35 end: 46
NOTED ATTENDEES:	David Morris (representative for local MLA and community member)
TIME/DURATION:	start: 7:06 pm end: 8:35 pm

GROUNDWORK

Attendees were asked to register upon arrival, in order to record their participation in the meeting. A comment sheet, contact information and a draft Executive Summary (prepared by the proponent) were provided to each registrant. Proceedings of the meeting were recorded on behalf of the facilitator by Ms. Christine Bray.

The facilitator described his role in the meeting, namely to take comments and answer questions related to the proposed project. The meeting structure was described and the objectives of the meeting were explained. It was noted that the proceedings relate to the creation of an Environmental Registration Document, and that this part of the process is not in and of itself an Environmental Assessment. Participants were asked to keep their comments issue specific.

The purpose of the project and the development's location, size and boundaries were provided through a power point presentation delivered by the facilitator. The presentation included a map clearly indicating the current operational site and the proposed site.

Assessments which are to be included in the completed registration document were outlined and a brief description of each category of assessment was given. The name of the expert/specialist undertaking the assessment in each area of specialization was also provided.

Mr. Terry Hennigar, Project Manager and Water Consultant, spoke to the community members and outlined a number of aspects of the project proposal to date:

project focus:	• no excavation below the water table • depth will be limited • no interference with ground water
proposed area:	• east side of South Bishop Road
recommendations:	• well survey to be done to monitor existing conditions • effects to be documented in environmental assessment stipulations ("Schedule B")
observations:	• sand and gravel deposits are a clean resource for industry and other uses • database for wells not taking from upper 150 feet (water system is artesian and isolated in area noted above)
scope:	• no new construction on site, only expansion of existing • current and expected production rate is 25,000 cubic yards (yd^3) of peat per year, advancing at the rate of approximately 2.5 acres per year. • current and expected production rate is 25,000 cubic yards (yd^3) of aggregate per year, advancing at the rate of approximately 1.5 acres per year
schedule:	• 10 hours per day • 5 days per week • 26 weeks per year • no work on Sundays
timeframe:	• registration: April 2004 • approval: June 2004 • monitoring will be ongoing
of note:	• the active footprint of the Site will be rehabilitated

Mr. Hennigar asked community members to consider the following question:
What are the opportunities for the community and the proponent?

SPECIFIC ISSUES

A number of specific issues were brought forward for discussion at the meeting.

General nuisance issues were raised such as increased traffic, noise and dust as well as the resulting effects of these influences on property values. It was noted that the bridge and area roads will incur additional wear and tear due to increased use. It was suggested that the proponent contribute financially (if allowable by law) to the upkeep and maintenance of those infrastructures that are heavily used by the company.

Health concerns were also brought forward. The questions asked related to overall health effects but focused in particular on issues of air quality.

A number of biophysical concerns were brought forward; water issues predominated and included concerns related to both surface and groundwater. In particular, further clarification may be needed to explain the water and drainage systems of the area in detail in order to help the residents understand the existing conditions and to address possible areas of focus for further discussion.

Information was provided by Mr. Hennigar as to the possible sources of contamination in water systems. A distinction was made between the two types of contamination: bacterial and chemical. It was noted that the risk of contamination as a result of implementing this project is relatively low, and that other potential contaminants such as those caused by construction and excavation (e.g. new home), inadequately functioning septic systems and farming should be of greater concern to residents.

It was stated by Mr. Hennigar that "well monitoring" will be undertaken and that such monitoring will clearly reflect dynamics of the water system in question.

Clarification is needed regarding the specifics of the operation and the resulting land use. Attendees were unclear as to whether the operation involved topsoil removal or the removal of peat moss. It was stated by the proponent that the permits currently held by Mark-Lyn are AI (maximum reached) and AZ. Questions were raised by the participants about the appropriateness of the permits currently held; conflicting points of view were presented with regards to the zoning of the area. Are the areas in question wetlands and do they qualify for protected status as defined by Environment Canada? In short, the status of the lands must be clearly defined in order to garner support for the proposed use of the lands.

The Community objected from the outset to operations proposed by Mark-Lyn Construction. The community was not consulted initially about the project. In general, they do not support the development of new or expanded industry within the residential boundaries of their community. Specifically, residents requested that the proponent address existing environmental and social issues created by the current operation in a way that is more respectful of the residents of this area. With this change in approach, a foundation of trust could be built which would likely result in gains toward community support. An existing business within the area, Shaw Brick, has been a good corporate citizen and has handled community relations in a more satisfactory way. As a result they have enjoyed some acceptance by the community. The proponent will be held to this pre-existing, higher standard.

It should be noted that many attendees have requested further information and additional opportunities for discussion and community involvement.

An itemized list of issues is included in the table on page 5.

ISSUES TABLE

1 Nuisance	2 Socio-economic	3 Biophysical	4 Health	5 Other
dust/dirt	real estate values	bog should not be developed- size/zoning	poor air quality (asthma)	trucks beds should be enclosed when transporting product **1**
noise	industry incompatible with residential area	topsoil vs. peat moss (revue initial permit)	calcium chloride on road	opportunities for community involvement/discussion
traffic	restricted use of proponent lands for recreational purposes	peat extraction is rare-issues of sustainability		alternate solid waste strategies (composting off site) could provide topsoil more effectively
bridge (overuse) **2**	reduction in quality of life	preservation of wetlands **2**		community comments included in report?
roads (overuse) **2**	clean up of existing site **1,3**	depth of dig		process to obtain government approval
	public or private financing	groundwater/well contamination		
	(Shaw) is a better corporate citizen	effects on ground water movement		
		general environmental effects/water table		
		clarification of current water /drainage systems		
		location of monitor wells/third party reporting system		
		on-site oil storage		
		restoring site **2**		

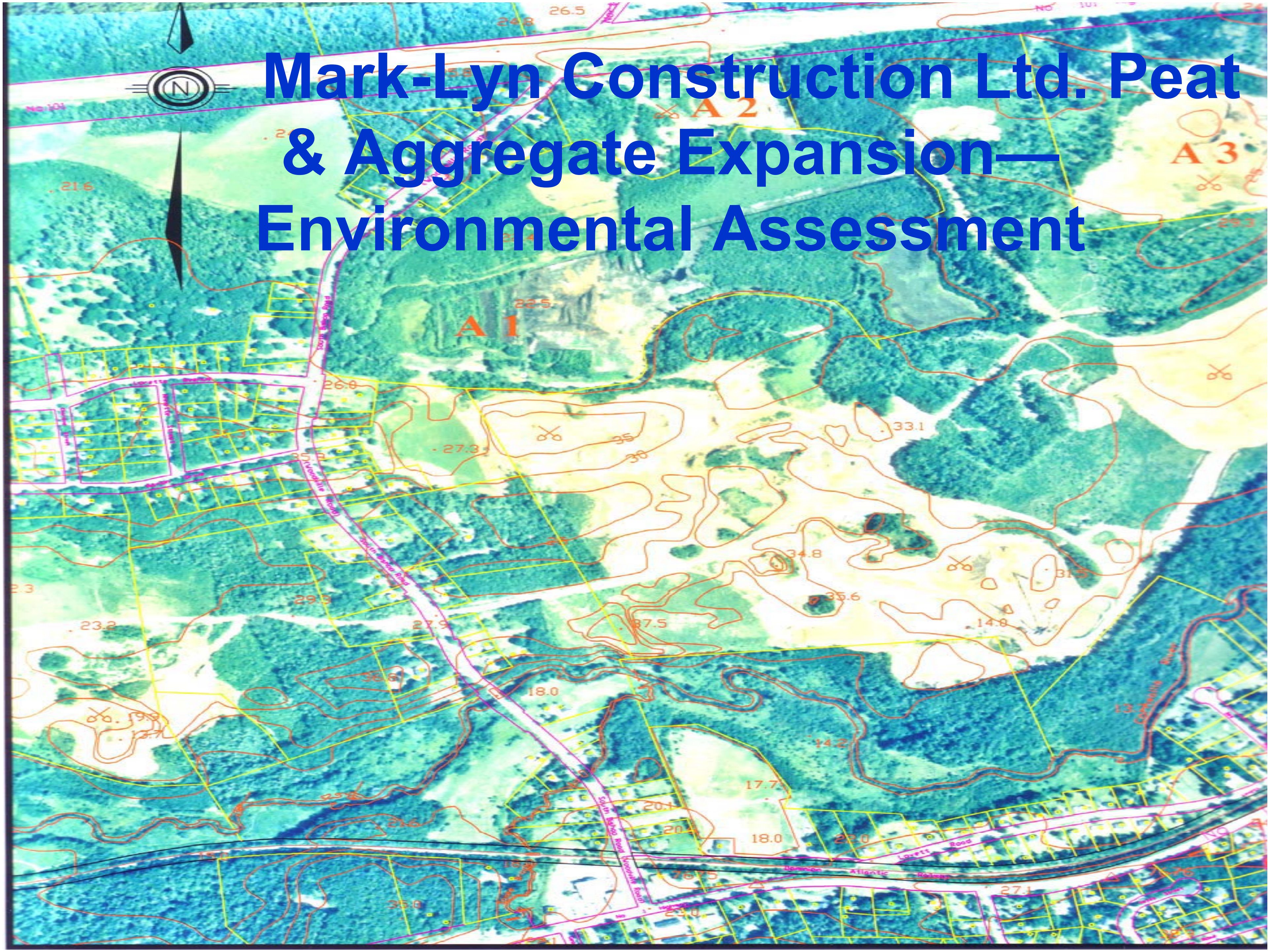
A bold number under an issue indicates that it may fall under additional headings/categories.

MARK-LYN CONSTUCTION LTD.
Peat & Aggregate Expansion

Proponent: Peter Thomas

INTRODUCTIONS

Facilitator: Hendricus Van Wilgenburg BA, MA, MES

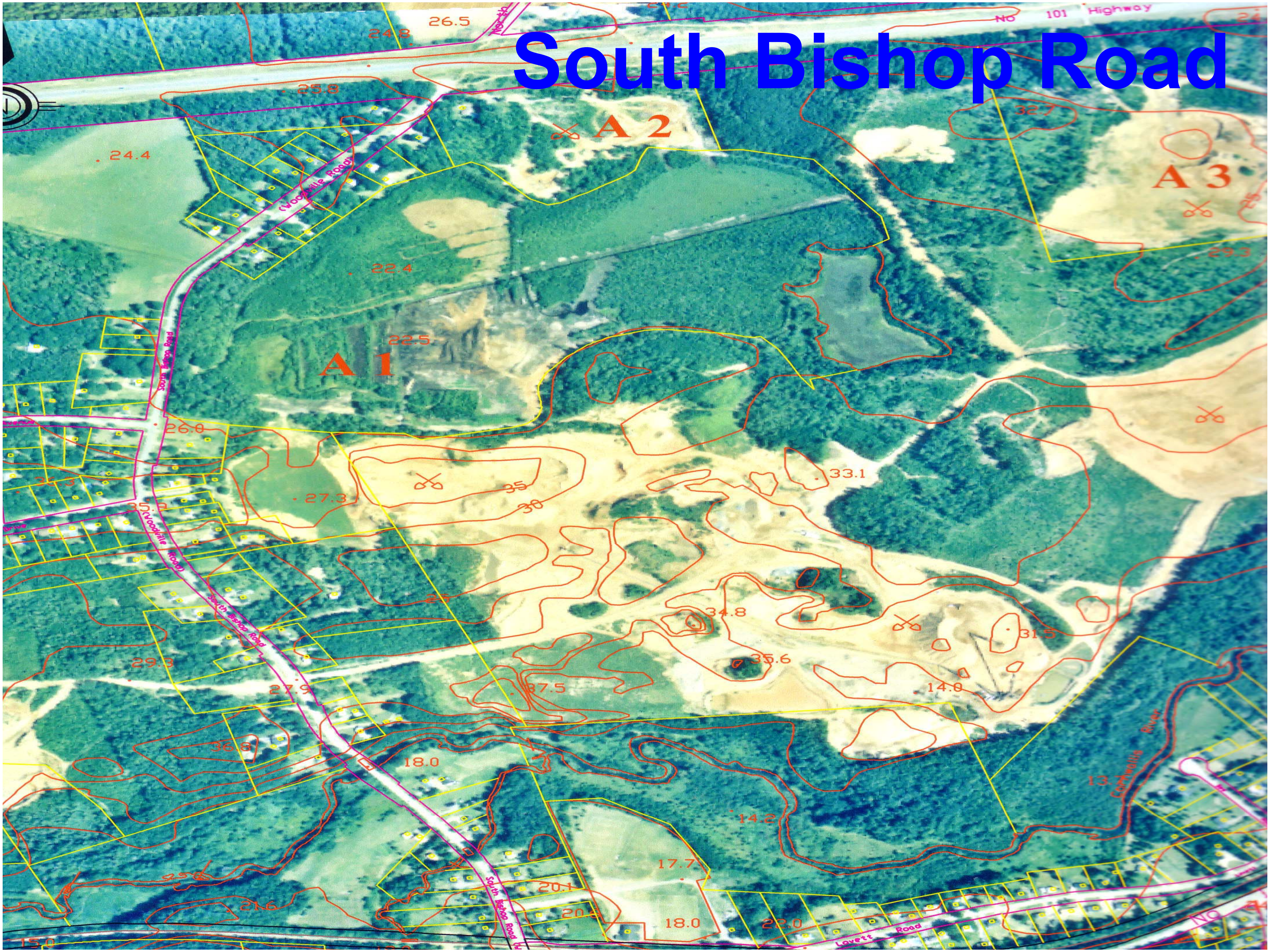

Mark-Lyn Construction Ltd. Peat
& Aggregate Expansion—
Environmental Assessment
A 1
A 2
A 3
N

THIS MEETING

- Purpose:
  - To provide information,
  - To take comments, &
  - To answer questions
- Time: 7:00 to 8:30
- Format: semi-structured

PURPOSE OF THE PROJECT

- To extend the life of top soil extraction operations at South Bishop Road
- To expand another aggregate extraction operation off Lovett Road
- This project—Class I Undertaking


South Bishop Road
A 1
A 2
A 3
No 101 Highway
South Bishop Road
(Woodville Road)
Lovett Road
Cornwallis River
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22.4
22.5
26.5
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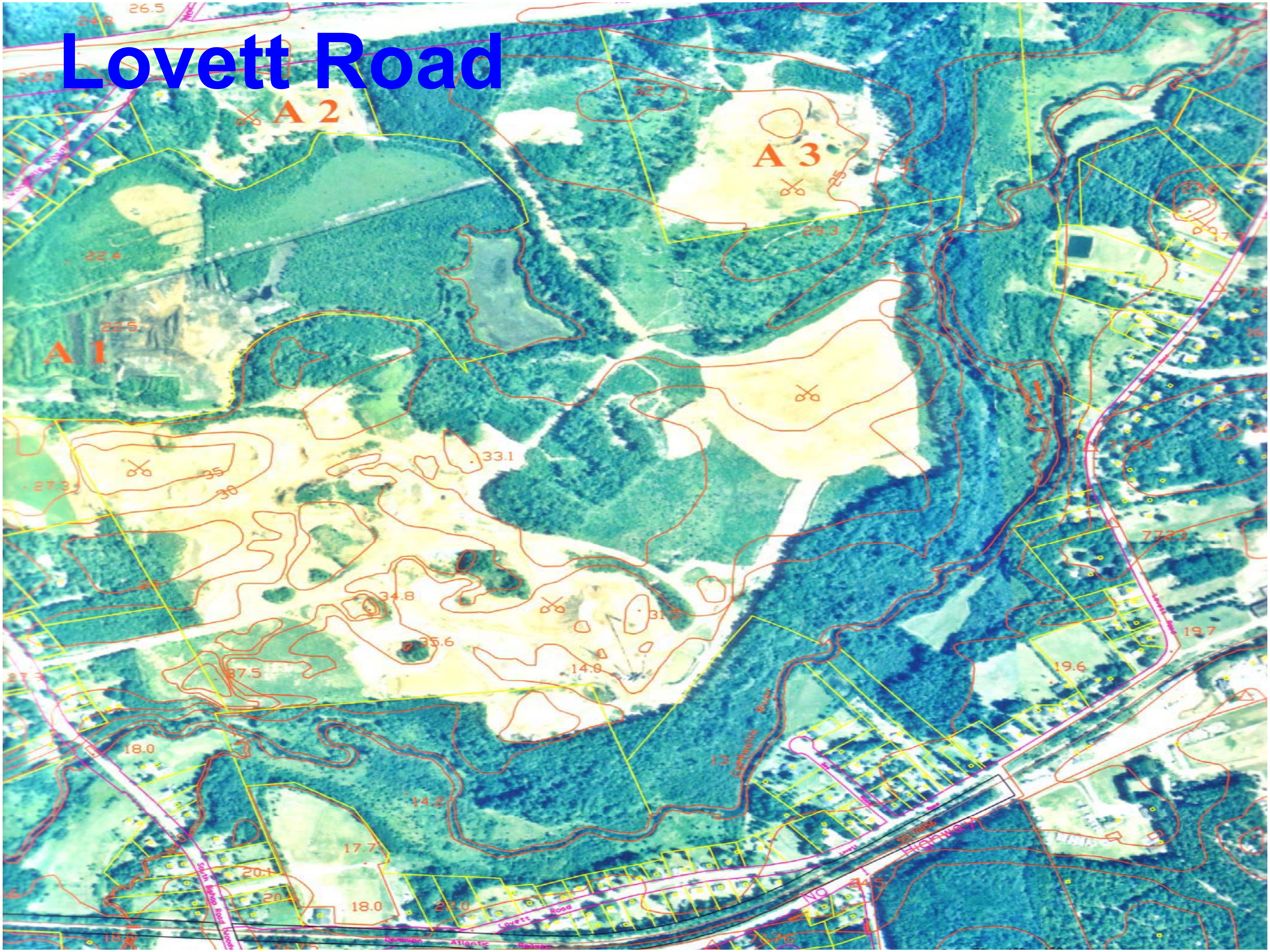
Lovett Road



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Lovett Road
Highway
Dominion Atlantic Railway

The Study

- This is *not* an quantitative study—Environmental Assessment (EA)
- Rather, this is a qualitative study—an Environmental Assessment Registration document

The Study Team & Components Evaluated

- Botanical/plants—Marbicon Inc.
- Fauna/wildlife—W. George Alliston Ph.D.
- Fish & fish habitat—Ocean Valley Aquatics
- Archaeological & Heritage resources—Helen Sheldon
- Soils & wetlands—Webster Engineering Consulting
- Air quality
- Socio-economic environment
- Hydrogeology—Terry W. Hennigar

RESULTS Of STUDY

- No rare & sensitive plant species
- No rare & sensitive animal species
- Potential habitat for: wood turtle & long-eared owl
- Likelihood of either is low
- No aquatic fish life
- Wells potentially at risk are located along South Bishop Road

PROJECT ALTERNATIVES

- Use current methods of extraction
- No additional construction
- Relocation would require additional construction

PROJECT LOCATION & SCOPE

- Estimated peat reserves in excess of 400,000 yd^3.
- At 15,000 yd^3 per year, it will take in excess of 10 years to extract the available topsoil/peat and aggregate resources.
- The expanded area will cover a total of approximately 120 acres (60 ha).

Project Schedule

- 10 hours per day
- 5 days/week (not including Sundays)
- 26 weeks per year (weather permitting)

DECOMMISSIONING & ABANDONMENT

- A progressive rehabilitation program
- Preservation of top soil for reclamation
- Rehabilitation—grading & contouring of slopes, and seeding

WHAT WE WANT TO ACHIEVE

- An objective environmental assessment
- A timely review
- Minimal environmental impact
- A successful business
- Community acceptance

TIME FRAME

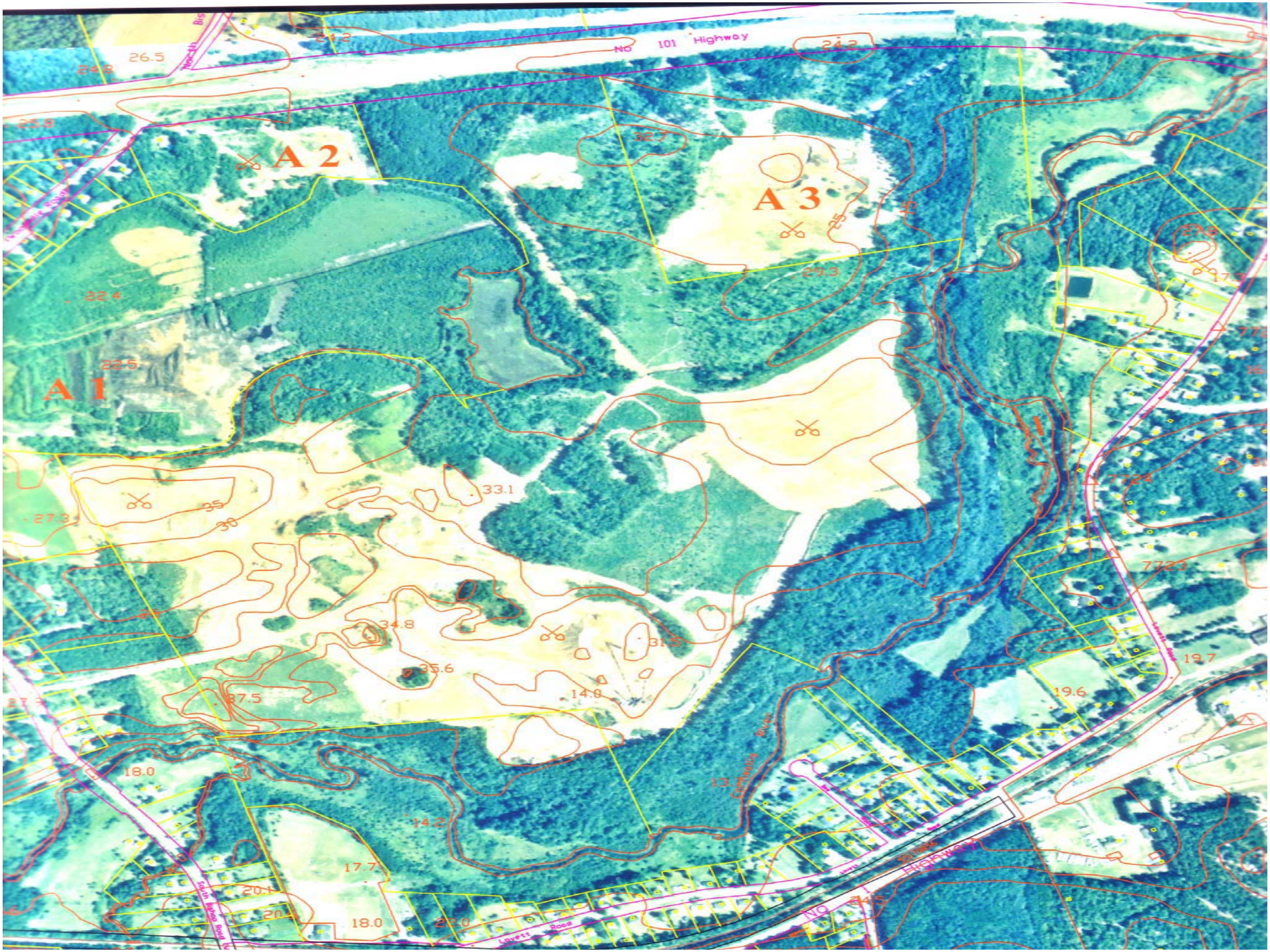
- Draft EA submission—March ‘04
- Project registration—April ‘04
- Approval to proceed—June ‘04
- Project initiation—June ‘04
- Environmental monitoring—life of the project
- Site rehabilitation—ongoing

OPPORTUNITIES

- For the proponent?
- For your community?
- For you?

THANK YOU

- Lets work together to encourage wise development of our natural resources
- There is a role for the community liaison committee



No 101 Highway
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Lovett Road