nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

June 9, 2011

Township of Schreiber
204 Alberta Street
P.O. Box 40
Schreiber, ON P0T 2S0

Attn: Mr. Jon Hall, Clerk/Administrator

Re: **Adaptive Phased Management Initial Screening – The Corporation of the Township of Schreiber**

Dear Mr. Hall,

Further to the Township of Schreiber's request to Learn More about the Adaptive Phased Management program and request for an initial screening, I am pleased to attach a report outlining the findings from the initial screening, as described in the *Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel* (May, 2010). As you know, the purpose of the initial screening in Step 2 of the process is to determine whether, based on readily-available information and five screening criteria, there are any obvious conditions that would exclude the Township of Schreiber from further consideration in the site selection process.

As the report indicates, the review of readily-available information and the application of the five initial screening criteria did not identify any obvious conditions that would exclude the Township of Schreiber from further consideration in the NWMO site selection process. The initial screening suggests that the Schreiber area contains portions of lands that are potentially suitable for hosting a deep geological repository for Canada's used nuclear fuel. It is important to note that this initial screening has not confirmed the suitability of your community. Should your community choose to continue to explore its potential interest in the project, your area would be the subject of progressively more detailed assessments against both technical and social factors. Several years of studies would be required to confirm whether a site within your area could be demonstrated to safely contain and isolate used nuclear fuel.

The process for identifying an informed and willing host community for a deep geological repository for the long-term management of Canada's used nuclear fuel is designed to ensure, above all, that the site which is selected is safe and secure for people and the environment, now and in the future. The NWMO expects that the selection of a preferred site would take between seven to ten years. It is important that any community which decides to host this project base its decisions on an understanding of the best scientific and social research available and its own aspirations. Should the Township of Schreiber continue to be interested in exploring the project, over this period there would be ongoing engagement of your community, surrounding communities and others who may be affected. By the end of this process, Schreiber as a whole community would need to clearly demonstrate that it is willing to host the repository in order for this project to proceed.

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The next evaluation step would be to conduct a feasibility study as described in Step 3 of the site selection process. This feasibility study would focus on areas selected in collaboration with the community. As your community considers whether it is interested in advancing to the feasibility study phase, the NWMO encourages you to continue community discussion and further learning about the project. Support programs are available to assist your community to reflect on its long-term vision and whether this project is consistent with achieving that vision. Programs and resources are also available to engage your community residents in learning more about this project and becoming involved. We would be very pleased to provide further information about these programs.

Once again, I thank you for taking the time to learn about Canada's plan for the safe, secure management of Canada's used nuclear fuel.

Sincerely,

Kathryn Shaver

Kathryn Shaver,
Vice President, APM Public Engagement and Site Selection

c. Mayor Don McArthur

April 2011

INITIAL SCREENING FOR SITING A DEEP GEOLOGICAL REPOSITORY FOR CANADA'S USED NUCLEAR FUEL

Township of Schreiber, Ontario

Submitted to:
Nuclear Waste Management Organization
22 St. Clair Avenue East, 6th Floor
Toronto, Ontario
M4T 2S3

REPORT

Report Number: 10-1152-0110 (5000)

Distribution:

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Golder Associates

Executive Summary

On September 28, 2010, the Township of Schreiber expressed interest in learning more about the Nuclear Waste Management Organization (NWMO) site selection process to find an informed and willing community to host a deep geological repository for Canada's used nuclear fuel (NWMO, 2010). This report summarizes the findings of an initial screening, conducted by Golder Associates Ltd., to evaluate the potential suitability of the Schreiber area against five screening criteria using readily available information. The purpose of the initial screening is to identify whether there are any obvious conditions that would exclude the Township of Schreiber from further consideration in the site selection process. The initial screening focused on the Township of Schreiber and its periphery, which are referred to as the "Schreiber area".

The review of readily-available information and the application of the five initial screening criteria did not identify any obvious conditions that would exclude the Township of Schreiber from further consideration in the NWMO site selection process. The initial screening indicates that the Schreiber area contains portions of lands with geological formations that are potentially suitable for hosting a deep geological repository. Examples of these formations include the Whitesand Lake and Crossman Lake granitic Batholiths at the periphery of the Township. Within the Township, the potential suitability is limited to a small area underlain by the granitic Gwynne Mountain Pluton. The metavolcanic rocks of the greenstone belt that dominate the geology of the Township have been found unsuitable due to their heterogeneity, spatial variability and their potential for natural resources.

It is important to note that at this early stage of the site evaluation process, the intent of the initial screening was not to confirm the suitability of the Schreiber area, but rather to identify whether there are any obvious conditions that would exclude it from the site selection process. Should the community of Schreiber remain interested in continuing with the site selection process, several years of progressively more detailed studies would be required to confirm and demonstrate whether the Schreiber area contains sites that can safely contain and isolate used nuclear fuel. The process for identifying an informed and willing host community for a deep geological repository for Canada's used nuclear fuel is designed to ensure, above all, that the site which is selected is safe and secure for people and the environment, now and in the future.

The five initial screening criteria are defined in the site selection process document (NWMO, 2010) and relate to: having sufficient space to accommodate surface and underground facilities, being outside protected areas and heritage features, absence of known groundwater resources at repository depth, absence of known natural resources and avoiding known hydrogeologic and geologic conditions that would make an area or site unsuitable for hosting a deep geological repository.

A brief summary of the assessment against each of the initial screening criterion is provided below.

Availability of Land

The review of available mapping and satellite imagery shows that the developed areas and large water bodies occupy only a small portion of the Township. However, the availability of potentially suitable lands within the Township to support the construction of the repository's surface facilities could be constrained by topography. A more detailed assessment would be needed to determine the feasibility and practicality of developing the repository facilities within the Township. The lands at the periphery of the Township of Schreiber are largely undeveloped, accessible and contain areas with favourable topography.

Protected Areas, Heritage Sites, Provincial Parks and National Parks

The Schreiber area contains sufficient land outside of protected areas, heritage sites, provincial parks and national parks to accommodate the repository's facilities. Four protected areas were identified in the Schreiber area, all bordering Lake Superior. Parks and conservation reserves in the Schreiber area occupy a small portion of the land. In addition, all the shoreline and water of Lake Superior in the Schreiber area is part of the Lake Superior National Marine Conservation Area. Known archaeological sites are small and generally concentrated around the Lake Superior shoreline. There are no National Historic Sites in the Schreiber area. The absence of locally protected areas would need to be confirmed in discussion with the community and Aboriginal peoples in the area during subsequent site evaluation stages, if the community remains interested in continuing with the site selection process.

Absence of Known Groundwater Resources at the Repository Depth

The review of available information did not identify any known groundwater resources at repository depth (approximately 500 m) for the Schreiber area. The Ontario Ministry of Environment Water Well Records indicates that no potable water supply wells are known to exploit aquifers at typical repository depths in the Schreiber area or anywhere else in Northern Ontario. Water wells in the Schreiber area source water from overburden or shallow bedrock aquifers at depths of 65 m or less. Based on experience in similar crystalline rock settings in the Canadian Shield, the likelihood that exploitable aquifers are present at typical repository depth is low throughout the Schreiber area. The absence of groundwater resources at repository depth would need to be confirmed during subsequent site evaluation stages if the community remains interested in continuing with the site selection process.

Absence of Economically Exploitable Natural Resources as Known Today

Based on the review of readily-available information, the Schreiber area contains sufficient areas, free of known economically exploitable natural resources, to accommodate the required repository facilities. There are currently no operating mines within the Township of Schreiber or in its periphery. The potential for economically exploitable natural resources in the Township of Schreiber and its periphery is associated with specific geological units such as the rocks of greenstone belts. The natural resource potential of the large granitic batholiths in the area is limited, except in localized areas along their margins.

No Known Geological and Hydrogeological Characteristics That Would Prevent the Site from Being Safe

Based on the review of readily available geological and hydrogeological characteristics and available experience from other similar rocks in the Canadian Shield the Schreiber area contains portions of land that do not contain known unsafe geological and hydrogeological conditions. There are a number of geological units with geoscientific characteristics that are potentially suitable for hosting a deep geological repository within the Schreiber area. Examples of these units include the Whitesand Lake Batholith, and Crossman Lake Batholith. Within the Township, the potential suitability is limited to a small area underlain by the granitic Gwynne Mountain Pluton. The metavolcanic rocks of the greenstone belt that dominate the geology of the Township are likely unsuitable due to their heterogeneity, spatial variability and their potential for natural resources.

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1.0 INTRODUCTION

On September 28, 2010, the Township of Schreiber expressed interest in learning more about the Nuclear Waste Management Organization (NWMO) nine-step site selection process to find an informed and willing community to host a deep geological repository for Canada's used nuclear fuel (NWMO, 2010). This report presents the results of an initial screening, conducted by Golder Associates Ltd., as part of Step 2 in the site selection process to evaluate the potential suitability of the Schreiber area against five screening criteria using readily-available information. The initial screening focused on the Township of Schreiber and its periphery, which are referred to as the "Schreiber area".

1.1 Background

The ultimate objective of Adaptive Phased Management (APM) is long-term containment and isolation of used nuclear fuel in a deep geological repository in a suitable rock formation. The NWMO is committed to implementing the project in a manner that protects human health, safety, security and the environment, while fostering the long-term well-being of the community and region in which it is implemented (NWMO, 2005).

In May 2010, the NWMO published and initiated a nine-step site selection process to find an informed and willing community to host the repository (NWMO, 2010). The site selection process is designed to address a broad range of technical, social, economic and cultural factors as identified through dialogue with Canadians and Aboriginal peoples, and draws from experiences and lessons learned from past work and processes developed in Canada to site facilities for the management of other hazardous material. It also draws from similar projects in other countries pursuing the development of deep geological repositories for used nuclear fuel. The suitability of potential candidate sites will ultimately be assessed against a number of site evaluation factors, both technical and social in nature.

The geoscientific suitability of candidate sites will be assessed in three main phases over a period of several years, with each step designed to evaluate the site in progressively greater detail upon request of the community. The three site evaluation phases include: Initial Screenings to evaluate the potential suitability of the community against a list of initial screening criteria, using readily-available information (Step 2); Feasibility Studies to determine if candidate sites within the proposed areas are potentially suitable for developing a safe deep geological repository for used nuclear fuel (Step 3); and Detailed Site Evaluations, at one or more selected sites, to confirm suitability based on detailed site evaluation criteria (Step 4)). It is up to the communities to decide whether they wish to continue to participate in each step of the process.

1.2 Objectives and Approach for Conducting Initial Screenings

The overall objective of the initial screening is to evaluate proposed geographic areas against a list of screening criteria using readily-available information. Initial Screening criteria (NWMO, 2010) require that:

1) The site must have enough available land of sufficient size to accommodate the surface and underground facilities.

2) This available land must be outside of protected areas, heritage sites, provincial parks and national parks.

3) This available land must not contain known groundwater resources at the repository depth, so that the repository site is unlikely to be disturbed by future generations.

4) This available land must not contain economically exploitable natural resources as known today, so that the repository site is unlikely to be disturbed by future generations.

5) This available land must not be located in areas with known geological and hydrogeological characteristics that would prevent the site from being safe, considering the safety factors outlined in Section 6 of the Site Selection Document (NWMO, 2010).

The initial screening step involves the systematic consideration of each of the five Initial Screening Criteria on a qualitative basis using readily-available information from provincial, federal, municipal and other sources of information. It is not the intent of the initial screening study to conduct a detailed analysis of all available information, but rather to identify any obvious conditions that would exclude a community from further consideration in the site selection process. For example, a site with known economically exploitable natural resources or geological or hydrogeological characteristics that are clearly unfavourable would be excluded from further consideration.

For cases where readily-available information is limited and where assessment of some of the criteria is not possible at the screening stage, the area would be advanced to the feasibility study stage for more detailed evaluation, provided the community remains interested in participating in the siting process.

The initial screening commences with an analysis of readily-available information in order to develop an overall understanding of the geoscientific and other relevant characteristics of the site. The initial screening criteria are then applied in a systematic manner based on the understanding of the proposed area or site. The tasks involved include the following:

- Reviewing the regional and local physical geography, geology, seismicity, structural geology and Quaternary geology (surface geology);
- Reviewing the hydrogeology, including, regional groundwater flow, deep and shallow aquifers and hydrogeochemistry;
- Reviewing the economic geology, including petroleum resources, and metallic and non-metallic mineral resources;
- Applying the screening criteria; and
- Summarizing the findings with regards to potential suitability.

2.0 PHYSICAL GEOGRAPHY

2.1 Location

The Township of Schreiber is located along the north shore of Lake Superior approximately 150 km east of Thunder Bay as shown on Figure 2.1. The Township is approximately 40 km^2 in size and is bordered by the Township of Terrace Bay to the east. Nearby and to the west of Schreiber are the unincorporated settlement of Rossport, and Pays Plat First Nation Reserve, both located along the north shore of Lake Superior approximately 18 km and 23 km west of the settlement area of Schreiber, respectively. The settlement area of Schreiber is accessed by the Trans Canada Highway (Highway 17) as well as rail and secondary roads. Satellite imagery for the Schreiber area (Landsat 7, taken in 2006) is presented on Figure 2.2.

2.2 Topography

The Township of Schreiber is located in the Canadian Shield physiographic region, a low-relief, dome-like, gently undulating land surface with an elevation of about 150 masl (meters above sea level) in the north, increasing to about 450 masl towards the south. Figure 2.3 shows the general physiographic regions of Ontario (Thurston, 1991), including the subdivision of the Canadian Shield physiographic region into the Severn Upland, the Nipigon Plain, the Abitibi Upland and the Laurentian Highlands.

The Township of Schreiber lies in the Abitibi Uplands, a broadly rolling surface of Canadian Shield bedrock that occupies most of north-central Ontario (Natural Resources Canada, 2011). Within this area, bedrock is typically either exposed at surface or shallowly covered with Quaternary glacial deposits or post-glacial organic soils. Lands to the west of Schreiber are part of the Port Arthur Hills which consist of a characteristically rugged topography produced by the underlying Precambrian bedrock (Thurston, 1991).

The topography of the Schreiber area is presented on Figure 2.4. The land surface is rugged with elevation ranging from around 590 masl on the northern limit of the Township to 183 masl along the shore of the Schreiber Peninsula. The settlement area of Schreiber is located within a valley at approximately 300 masl elevation. Lower elevations also occur in the southeast part of the Township along the east side of the Schreiber Peninsula bordering Worthington Creek. The maximum difference in elevation is approximately 300 m with the greatest elevation contrast occurring along the western side of the Schreiber Peninsula between the greater than 400 masl uplands and the Lake Superior shore on Collingwood Bay at 183 masl. Near-vertical cliffs in this area exceed 60 m (Gartner, 1979).

Topographic highs generally correspond to exposed bedrock while topographic lows are typically areas of thicker overburden. The areas of least relief are typically underlain by glaciofluvial and glaciolacustrine overburden deposits including the glacial lake terraces that are the origin of the name Terrace Bay.

2.3 Drainage

The Township of Schreiber is located within the Lake Superior drainage basin of the Atlantic Ocean Watershed. The overall surface water drainage is shown on Figure 2.5. Drainage is southerly into Lake Superior from the height of land between the Lake Superior drainage and that of the Hudson Bay system further to the north. The main drainage is carried by the Aguasabon River, Big Duck Creek, and the Hewitson River. The Aguasabon River rises in the headwaters of the Kenogami River portions of which have been artificially diverted south to Long Lac and then to Lake Superior via the Aguasabon River which outlets to Lake Superior at Terrace Bay. The Hewitson River rises from a number of small lakes and wetlands located above 500 masl in the area to the northeast of Winston Lake. From this area it follows a southwesterly course as the Whitesand River to

Whitesand Lake. The outlet from Whitesand Lake flows over a series of falls as the Hewitson River to Lake Superior approximately 10 km west of Schreiber. Big Duck Creek rises from a number of small lakes and wetlands to the north of Big Duck Lake (approximately 25 km north of Schreiber) and flows in a southerly direction to Hays Lake where it is joined by Ansell Creek. Hays Lake outlets to Lake Superior via the Agasabon River.

In addition to these larger drainage systems, much of the land bordering Lake Superior drains directly to the lake via a number of small creeks, including Cook Creek, which flows through the settlement area of Schreiber, Worthington Creek, Blind Creek, and a number of short unnamed streams.

2.4 Protected Areas

Parks and Reserves

Four protected areas occur in the Schreiber area, as shown on Figure 2.1. These include two parcels of land along the north shore of Lake Superior that have been designated under Ontario's Living Legacy Approved Land Use Strategy and designated as “Superior North Shore C2222”, as well as the Rainbow Falls Provincial Park and Schreiber Channel Natural Reserve west of the Schreiber settlement area. In addition, all the shoreline and water of Lake Superior in the Schreiber area is part of the Lake Superior National Marine Conservation Area.

Rainbow Falls Provincial Park is a 575 ha recreation-class provincial park located along the Hewitson River between Whitesand Lake and the Lake Superior shore. The park is located approximately 8 km west of the settlement area of Schreiber.

Heritage Sites

The Cultural Heritage component of the initial screening examined known archaeological and historic sites for the Schreiber area. Information on archaeological sites in Ontario is provided by the Ontario Ministry of Tourism and Culture, through their Archaeological Sites Database (Ontario Ministry of Tourism and Culture, 2011). Information on First Nations reserve lands is also included as it can assist in identifying lands used by Aboriginal peoples in the past and present. The background research indicates that there are 13 known archaeological sites within the area of interest (Figure 2.1): two sites in the Township of Schreiber, at Worthington Bay; plus another 11 sites at the periphery of the Township; nine sites located on the Lake Superior shoreline; one site located on Copper Island, and one site located on the lakebed floor (shipwreck).

There are no known National Historic Sites in the Schreiber area. The closest First Nation Reserve is Pays Plat which is located 23 km west of Schreiber (not shown on the figures).

The potential for archaeological and historical sites within the Schreiber area is considered to be high given the sites already documented, the proximity to the Lake Superior shoreline, and the proximity to a known source of chert for lithic tool manufacture. The presence of local heritage sites would need to be further confirmed in discussion with the community and Aboriginal peoples in the area, if the community remains interested in continuing with the site selection process.

3.0 GEOLOGY AND SEISMICITY

3.1 Regional Bedrock Geology

The Township of Schreiber is situated along the north shore of Lake Superior within the Wawa Subprovince of the Superior Province of the Canadian Shield – a stable craton that forms the core of the North American continent. The Canadian Shield is a collage of plates and accreted juvenile arc terranes and sedimentary basins of Archean age that were progressively amalgamated between approximately 3.0 to 2.5 billion years ago. The Superior Province is bordered to the south by younger Proterozoic age rocks of the Southern Province and the late Precambrian Grenville Province.

The Superior Province covers an area of approximately 1,500,000 km^2 stretching from the Ungava region of northern Québec through the northern part of Ontario and the eastern portion of Manitoba, and extending south through to Minnesota and the northeastern part of South Dakota. The Superior Province has been divided into various subprovinces based on lithology, age, genesis, and metamorphism (Stockwell, 1961; Card, 1990; Thurston, 1991). These subprovinces are shown on Figure 3.1.

The Township of Schreiber is situated in the east-central portion of the Wawa Subprovince. The Wawa Subprovince is about 900 km long and 150 km wide, extending from central Minnesota in the United States to the Kapuskasing area in northeastern Ontario. The Wawa Subprovince is bounded on the north by the metasedimentary rocks of the Quetico Subprovince, and to the south by Proterozoic aged (1.9 to 1.1 billion-year-old) rocks of the Southern Province and rocks associated with the Mid-Continent Rift system. To the east, the Wawa Subprovince is truncated by the Kapuskasing Structural Zone that separates the Wawa Subprovince from the Abitibi Subprovince (sometimes this volcanic belt is also referred to as the Abitibi-Wawa Belt).

The Wawa Subprovince is composed primarily of Archean greenstone belts and granitic intrusions, with smaller mafic intrusive rocks locally present. Diabase dikes, largely of Proterozoic age, occur in "swarms" in the entire Superior Province. Based on field mapping and interpretation from aeromagnetic data, in the Schreiber area, these dikes may be up to 15 km long.

The Quetico Subprovince consists primarily of clastic metasedimentary rocks that have undergone regional metamorphism to amphibolite facies and have been partially melted. Granitic intrusions are widely present while mafic to ultramafic intrusions occur sporadically (Williams, 1989; Sutcliffe, 1991).

The Southern Province is a complex assemblage of Proterozoic aged (1.9 to 1.1 billion-year-old) metasedimentary and metavolcanic rocks that post-date and overlie the earlier Archean-age rocks of the Superior Province.

3.2 Local Bedrock Geology

3.2.1 Lithologies

The Schreiber area is located in the Schreiber Assemblage (Williams et al., 1991) that constitutes the western part of the Schreiber-Hemlo Greenstone Belt (Figure 3.3) within the Wawa Subprovince. Most of the Township of Schreiber (approximately 70%) is underlain by rocks of the greenstone belt, which extend well beyond the Township boundaries to the north and northeast. The remainder of the Township is underlain by granitic intrusions. These include the Gwynne Mountain Pluton and small portions of two large intrusions, the Whitesand Lake Batholith on the northwest of the Township, and the Terrace Bay Batholith on the southeast. The Crossman Lake Batholith is a third large intrusion that lies approximately 10 km north of the Township of Schreiber.

Geophysical surveys for the Schreiber area support the mapped lithologies. Figure 3.4 shows gravity survey results for the Schreiber area. Gravity variations are due to the relative density of rock types, with felsic rocks (e.g., granites) having a lower density and thus a negative gravity response, and mafic rocks (e.g., gabbro) having a higher density and thus a positive gravity response. It is noted that gravity responses in themselves do not uniquely define geology, and could be derived from multiple geological configurations.

A slight negative gravity response is present to the east of Schreiber that corresponds to the outline of the Terrace Bay Batholith, which suggests this batholith likely extends to some depth. A large positive gravity response is present to the southwest of the Township of Schreiber, extending beneath Lake Superior to the figure limits and beyond. This response is presumed to be associated with the thick sequence of mafic metavolcanics associated with the 1.1 billion-year-old Mid-Continent Rift, whose axis follows Lake Superior. A negative gravity response extends to the northwest of the Township toward the Whitesand Lake Batholith, and extends over a much larger area including the Quetico Subprovince, as far north as Highway 11 near Jellicoe, Ontario. As this large negative gravity response crosses the regional stratigraphy it likely reflects deep crustal features more closely than the mapped surficial geology.

Detailed aeromagnetic surveys (Ontario Geological Survey, 2003) indicate the presence and concentration of magnetic minerals such as magnetite and pyrrhotite. The residual total magnetic field (Figure 3.5) shows a generally subdued response over the granitic intrusions (i.e., the Whitesand Lake, Crossman Lake, and Terrace Bay Batholiths). The noisy magnetic response of the area underlain by the Whitesand Lake Batholith probably reflects the presence of metavolcanic rocks or stoped roof pendants. The elevated magnetic response over the south margin of the Gwynne Mountain Pluton and in the southwest corner of the Terrace Bay Batholith is due to metavolcanic rocks. An elevated magnetic response is also present within the greenstone belt in the area to the northeast of the Township of Schreiber, north of Hays Lake, and extending to just south of Sand Lake where an especially strong response correlates with an area of felsic to intermediate metavolcanics. Diabase dikes show up both as a normally magnetized anomaly as well as a reversely magnetized anomaly in the Schreiber-Terrace Bay area. Iron formations can be evident in the area as intense linear magnetic highs.

Airborne radiometric data for the Schreiber area (equivalent uranium) is provided on Figure 3.6. The gamma-ray spectrometry parameters (potassium, uranium and thorium) often reflect variations in lithology and are typically elevated in granitic rocks compared to volcanic rocks and this relationship is seen in the Schreiber area. Radiometrically elevated responses appear to correlate with the granitic intrusions while the greenstone belt corresponds to a radiometric low. There is a radiometric high associated with a small portion of the southern margin of the Whitesand Lake Batholith along the Lake Superior shore some 7 km west of the settlement area of Schreiber. The source of this radiometric high is not known, but the level of equivalent uranium (approximately 4 parts per million) is on the same order of magnitude as other local highs in northwestern Ontario, and the ratio of equivalent uranium to potassium is consistent with the remainder of the Schreiber area.

The main metavolcanic assemblages and intrusive bodies occurring in the Schreiber area are further described below.

Schreiber-Hemlo Greenstone Belt

About 70% of the Township area is underlain by metavolcanic rocks of the Schreiber-Hemlo Greenstone Belt which extends for 130 km eastward from the settlement area of Schreiber to the settlement area of White River. The belt is subdivided into a number of assemblages, with the Schreiber area lying entirely within the Schreiber Assemblage. Rocks of the Schreiber Assemblage are heterogeneous and variable in type, and are arranged in units of variable thickness and lithological compositions. Past tectonic events deformed these units, making their stratigraphic interpretation difficult.

Hopkins (1922), Bartley (1939, 1942), Harcourt (1939), Carter (1988), Schnieders et al. (1991), and Williams et al. (1991) described the Schreiber metavolcanic rocks as consisting of massive to pillowed tholeiitic mafic metavolcanic flows with minor, intercalated, basaltic komatiites, and calc-alkalic mafic to felsic metavolcanic rocks, which display great spatial variation. Carter (1988) divided the rocks of the Schreiber Assemblage into three main groups: a Tholeiitic suite, a Calc-alkaline suite, and a Tholeiitic and Calc-alkaline suite. The Tholeiitic suite is composed of massive or schistose, aphanitic to medium-grained basalt and andesite, including minor amounts of amygdaloidal flows, which occupy most of the Schreiber area. The Calc-alkaline suite in the Schreiber area comprises mostly massive, aphanitic to fine-grained, andesitic and dacitic flows, including minor amounts of amygdaloidal flows, which are best developed in the Schreiber Peninsula, south and southeast of settlement area of Schreiber. The Tholeiitic and Calc-alkaline suite occurs as minor layers within the former two suites. In addition to the mafic (generally gabbroic) intrusions described in the preceding section, the internal portions of the greenstone belt have also been intruded by a number of small late, variably deformed, felsic to intermediate plugs, stocks and dyke-like bodies related to the Crossman Lake, Whitesand Lake and Terrace Bay Batholiths. These greenstone sequences are interpreted to have developed about 2.75 to 2.670 billion years ago (Marmot, 1984; Williams et al., 1991; Polat and Kerrich, 2001). Records of exploration drilling in metavolcanic rocks some 4 km northwest of the Township boundary report thicknesses in excess of 1,000 m.

Carter (1988) interpreted the stratigraphic and structural relations among the different units of the Schreiber Assemblage as a succession of two volcanic cycles separated by a sulphide facies ironstone marker layer. Metasedimentary rocks are thought to overlie the volcanic rocks and are composed of greywacke turbidite, interlayered slate and sulphide facies iron formation. They are considered to postdate volcanism, but evidence is sparse because the stratigraphic contacts are commonly sheared (Williams, 1989).

Gwynne Mountain Pluton

The Gwynne Mountain Pluton lies entirely within the Township, and is located in the area of the Schreiber Peninsula, in the south of the Township bordering Lake Superior (Figure 3.3). The pluton is about 5 km long by 1.5 km wide and is composed of massive, medium grained rock varying in composition from granite to granodiorite, quartz monzonite and quartz diorite (Carter, 1988). The pluton is fault-bounded on its northern, eastern and western sides, and intrudes the metavolcanic rocks on its southern boundary. Carter (1988) interpreted this pluton to be underlain by granitic rocks similar to those of the Terrace Bay, but the thickness of this batholith is not known. Although its absolute age of emplacement is not known, it was emplaced sometime during the period 2.890 – 2.677 billion years (Turek et al., 1992; Zaleski et al., 1999; Davis and Lin, 2003).

Terrace Bay Batholith

The Terrace Bay Batholith extends southwest into the Township of Schreiber where it becomes truncated by the Worthington Bay Fault and extends eastward beyond the Township boundary for approximately 26 km to the Jackfish Lake area. The batholith reaches a maximum width of approximately 8 km to the east of Terrace Bay.

The batholith is composed of a massive, medium-grained, biotite-hornblende granodiorite to biotite alkali-feldspar granite with minor hornblende-biotite quartz diorite to hornblende-biotite quartz monzonite (Marmot, 1984; Carter, 1988). Minor phases of the batholith occur as dikes and irregular intrusive bodies cutting the main intrusion itself at its contact with the metavolcanic rocks or as independent dikes intruding the metavolcanic rocks within 1.5 km at the contact. The batholith is described (Marmont, 1984; Schnieders et al., 1991) as foliated near the contacts with the surrounding rocks, and in these areas the intrusion contains numerous, partially altered pieces of hornblende gneiss or amphibolite. Elsewhere the batholith is massive with no preferred fabric or mineral lineation, leading Marmont (1984) to suggest that the intrusion post-dates the main regional structural deformation of the greenstone belt. Thickness of this batholith is not known. Although its absolute age of emplacement is not known, its emplacement date would have occurred sometime during the period 2.75 – 2.677 billion years (Turek et al., 1992; Polat and Kerrich, 1999; Zaleski et al., 1999; Davis and Lin, 2003).

A recent released magnetic survey of the Schreiber area (Ontario Geological Survey, 2003) reveals that the Terrace Bay Batholith has been intruded by multiple diabase dikes and the majority of them trend east/west across the batholith at about 30 degrees to the major axis of the batholith. The remainder of the dikes are sub-parallel to the minor axis of the batholith. All are reversely polarized and show up as linear magnetic lows. A third set of dikes intruding the Terrace Bay Batholith are normally polarized and trend in a northeasterly direction. The elevated magnetic response in the southwestern sector of the batholith is probably due to a series of sub-parallel diabase dikes. Most of these dikes crop out along the Lake Superior shore, but have not been traced geologically along strike, although the magnetics suggest that these dikes are present.

Whitesand Lake Batholith

The Whitesand Lake Batholith covers approximately 8.5% of the Township area and extends for about 25 km in an east-west direction from the northwest corner of the Township of Schreiber to the Pays Plat area in the northwest. It is approximately the same size as the Terrace Bay Batholith and reaches around 8 km wide at its widest point. The Whitesand Lake Batholith consists mostly of massive biotite-chlorite alkali-feldspar granite with lesser porphyritic biotite granite and hornblende-biotite monzodiorite to biotite-hornblende quartz monzonite with minor aplite. Foliation is generally absent except along the contact with the surrounding country rock (Carter, 1988). Thickness of this batholith is not known. Although its absolute age of emplacement is not known, its emplacement date would have occurred sometime during the period 2.75 – 2.677 billion years (Turek et al., 1992; Polat and Kerrich, 1999; Zaleski et al., 1999; Davis and Lin, 2003).

The magnetic noise within the area outlined as the Whitesand Lake Batholith (Figure 3.5) suggests that the batholith is not a homogenous granitic intrusion, but rather consists of different phases; volcanic roof pendants are present as well.

Crossman Lake Batholith

The Crossman Lake Batholith is located approximately 5 to 10 km to the north of the settlement area of Schreiber (Figure 3.2). The batholith extends for approximately 45 km in an east-west orientation, with a southwesterly-projecting lobe north of Ellis Lake 7 km to the northeast of the settlement area of Schreiber.

The batholith is massive and medium to coarse-grained, ranging in composition from granite to quartz monzonite, monzodiorite, granodiorite, alkali-feldspar granite to tonalite. Tonalite and granodiorite phases have weak foliation, while granite phase has been affected by brittle deformation. Gneissosity and porphyritic facies are seen only in the southwestern and southern part of the batholiths to the west of the Township, where the rocks are associated with partially melted metasedimentary rocks (Carter, 1988). Minor phases comprise micrgranitic rocks, porphyries, aplites, pegmatites and irregular bodies of quartz are noted within the contact zone (Carter, 1988). Metamorphism is constrained to an aureola at the contact of the intrusion with the greenstone belt. Thickness of this batholith is not known. Williams et al. (1991) did not differentiate the Whitesand Lake Batholith from the Crossman Lake Batholith and instead mapped it as a southern lobe of the Crossman Lake Batholith. Carter (1988) considered the Whitesand Lake and Crossman Lake Batholiths to be of the same age. Although its absolute age of emplacement is not known, its emplacement date would have occurred sometime during the period 2.75 – 2.677 billion years (Turek et al., 1992; Polat and Kerrich, 1999; Zaleski et al., 1999; Davis and Lin, 2003).

A review of the aeromagnetic data suggests that the Crossman Lake Batholith has been intruded by a swarm of late diabase dikes. Magnetic responses in the Deep Lake/Bluff Lake area, approximately 14 km north of the settlement area of Schreiber, are suggestive of the presence of a large diabase/gabbro dike.

Cameron Lake Gabbro and Related Mafic Intrusives

The metavolcanic rocks of the Schreiber-Hemlo Greenstone Belt are intruded by stocks of gabbro and peridotite that are generally concordant with enclosing metasedimentary and metavolcanic rocks (Williams, 1989), and which vary from irregular plutonic bodies covering small areas to areas exceeding 7 km by 2 km. These intrusions are generally deformed and metamorphosed, and are considered by Williams et al. (1991) to be possibly subvolcanic in origin. The largest of these gabbroic intrusions is the Cameron Lake gabbro located along the northern margin of the Crossman Lake Batholith approximately 20 km north of the settlement area of Schreiber and extending to the area of the former Zenith Mine near Winston Lake. Carter (1988) believed the Cameron Lake gabbro to have originally underlain the area now occupied by the Crossman Lake Batholith. Diabase dikes of Archean to Proterozoic age are widespread in the Schreiber area, extending in length up to 5 km and ranging in width from about 8 m to 90 m, averaging 45 m. At least four different orientations have been identified (Carter, 1988): west-northwesterly to east-west; northwesterly; northeasterly; and north-south.

3.2.2 Deformation and Metamorphism

Structures in the Schreiber area have been developed in multiple periods of deformation. At least three main deformation periods have been recognized, although overprinting of multiple structures may have hindered the existence of evidence of additional deformation phases (Polat and Kerrich, 2001; Polat, 2009).

The first (2.695 – 2.688 billion years) and second (2.690 - 2.680 billion years) deformation periods created intense faulting and folding of the metavolcanic and metasedimentary rocks of the Schreiber-Hemlo Greenstone belt and produced steeply dipping foliation in these rocks. The faults that formed during the second deformation phase (2.690-2.680 billion years) allowed the emplacement of intrusive bodies, to which the Whitesand Lake, Terrace Bay and Crossman lake Batholiths might belong (Polat and Kerrich, 2001; Polat, 2009). The third deformation phase is not well time-constrained in the Schreiber area, and it was not as pervasive as the previous deformation events (Polat and Kerrich, 2001; Polat, 2009). In the Schreiber area it may be associated to local foliation reported by Carter (1988) in contact aureolas around batholiths. The exact time of emplacement of the Whitesand Lake, Crossman Lake and Terrace Bay Batholiths is not reported in the readily available literature, but the lack, or weakness, of foliation observed in these intrusions suggests that they formed during the later deformation periods.

A younger episode of localized deformation in the Schreiber area is related to an 800 to 450 million years old meteor impact in the area now known as the Slate Islands in Lake Superior, approximately 20 km southeast of the Township of Schreiber. The Slate Islands are interpreted to be the central uplifted portion of the impact site with the actual crater having a diameter of more than 30 kilometres (Sage, 1991).

Faulting is a major structural feature in the Schreiber area. The Township of Schreiber is cross-cut by three major faults: the northeast-trending Schreiber Point and Worthington Bay Faults, and the southeast-trending Cook Lake Fault (Figure 3.3). The latter two extend well beyond the Township boundaries. At the periphery of the Township there are other major faults, including the Sox Creek, Ross Lake, Syenite Lake and Ellis Lake

Faults. All these major faults affect both the rocks in the Schreiber-Hemlo Greenstone Belt and the granitic batholiths in the Schreiber area. No absolute age dating of these faults has been found in available literature.

In addition to the above mentioned faults, Carter (1988) identified numerous other lineaments in the Schreiber area. These occur in conjugate pairs with predominant northwesterly-northeasterly directions. Estimated spacings are about 1.5 to 2 km in lineaments trending northwest and about 0.5 to 1.5 km in those trending northeast. Smaller scale lineaments accompany major lineaments, and their orientation and spacing is highly variable. On the basis of abrupt terminations, offsetting of lithological units, and shearing of the rocks, some of these lineaments are interpreted by Carter (1988) to be faults.

Faults and lineaments in the Schreiber area are mostly developed in the rocks of the Schreiber-Hemlo Greenstone Belt, although some cross-cut the granitic intrusions. No evidence of late- or post- Proterozoic (less than one billion years old) activity along any of the mapped fault zones has been reported in the available literature.

The grade of metamorphism in the Schreiber area is in general of upper greenschist facies, but this grade locally increases to upper amphibolite facies in contact aureolas around the granitic intrusions (Pye, 1964; Williams et al., 1991). Carter (1988) suggested that metamorphic grade generally increases northwards.

In summary, at least three deformation periods have been observed in the Schreiber area. These created a system of northeast and northwest trending major faults that cross-cut both the metavolcanic rocks and the granitic intrusions in the area. Three of these faults cross-cut intersect the Township of Schreiber (Figure 3.3). Smaller-scale lineaments and faults of variable spacing and orientation have also been mapped (Carter, 1988) in the Schreiber area and mostly affect the rocks within the greenstone belt, although some cross-cut the granitic intrusions.

3.3 Quaternary Geology

The Quaternary cover in the Township of Schreiber and its surrounding area mostly comprises different types of glacial deposits that accumulated with the progressive retreat of the ice sheet during the Wisconsinan glaciation. This period of glaciation began approximately 115,000 years ago and peaked about 20,000 years before present, at which time the glacial ice front extended south of Ontario into what is now Ohio and Indiana (Barnett, 1992). The retreat of glacial ice from the Schreiber area began approximately 9,500 years ago. Morris (2000) reported that the last glacial ice flow direction across the Schreiber area varied in direction between 165 – 238° with an average of 194° based on the orientation of striae, grooves, chattermarks and streamlined bedrock. Any earlier deposits in the Schreiber area have been largely or entirely removed by glacial erosion which stripped away the pre-existing overburden and exposed the bedrock.

Figure 3.9 shows the extent and type of Quaternary deposits in the Schreiber area, while Figure 4.1 shows the location of wells from the Ministry of Environment (MOE) and diamond drill holes (MNDMF) from which information on overburden thickness was obtained. Bedrock in the Schreiber area is either exposed or covered by a thin discontinuous layer of ground moraine till that comprises a mixture of sand, gravel and boulder of granitic origin (Carter, 1988; Morris, 2000). The only prominent feature in the Schreiber area is a belt of glaciofluvial and glaciolacustrine deposits running along the Trans Canada Highway between the settlement areas of Schreiber and Terrace Bay, where overburden thicknesses of up to 30 m are encountered.

Several well-developed eskers occur within a broad valley extending southwest from Long Lac some 70 km to the north of the settlement area of Schreiber to Gurney on Lake Superior roughly 40 km west of the settlement area of Schreiber. Glaciofluvial channel deposits were also identified within several narrow bedrock controlled valleys, while coarse-grained glaciolacustrine materials have been associated with historic lake levels of the ancestral Lake Superior.

3.4 Neotectonic Activity

No neotectonic structural features are known to occur within the Schreiber area. Neotectonics refers to deformations, stresses and displacements in the earth's crust of recent age or which are still occurring. The geology of the Schreiber area is typical of many areas of the Canadian Shield, which have been subjected to numerous glacial cycles during the last million years (Shackleton et al., 1990; Peltier, 2002).

During the maximum extent of the Wisconsinan glaciations, approximately 21,000 years ago (Barnett, 1992), the earth's crust was depressed by more than 340 m in the Minnesota/North Dakota area (Brevic and Reid, 1999), due to the weight of glacial ice. The amount of crustal depression in the Schreiber area would be of a similar magnitude, but somewhat greater due to its closer proximity to the main centre of glaciation.

Post-glacial isostatic rebound began with the waning of the continental ice sheets and is still occurring across most of Ontario. The greatest rates of crustal rebound (approximately 12 mm/a) are recorded in the Hudson Bay region, where the thickest glacial ice occurred (Sella et al., 2007). As a result of the glacial unloading, horizontal stresses are created locally in shallow bedrock in many areas of Ontario. Natural stress release features include elongated compressional ridges or pop-ups such as those described in White et al. (1973) and McFall (1993).

No detailed identification and interpretation of neotectonic structures was found in the readily-available literature for the Schreiber area. It is therefore useful to review the findings of previous field studies involving fracture characterization and evolution as it may pertain to glacial unloading. McMurry et al. (2003) summarized several studies conducted in a number of plutons in the Canadian Shield and in the crystalline basement rocks in Western Ontario. These various studies found that fractures below a depth of several hundred metres in the plutonic rock were ancient features. Early-formed fractures have tended to act as stress domain boundaries. Subsequent stresses, such as those caused by plate movement or by continental glaciation, generally have been relieved by reactivation along the existing zones of weakness rather than by the formation of large new fracture zones.

3.5 Seismicity

The Schreiber area lies within the Superior Province of the Canadian Shield where large parts have remained tectonically stable for the last 2.5 billion years (Percival and Easton, 2007). Although Hayek et al. (2009) indicate that the general Western Superior Province has experienced a number of low magnitude, shallow seismic events, all recorded earthquakes in the Schreiber area are of a magnitude less than 3. Figure 3.7 presents the location of earthquakes with magnitude greater than 3 that have occurred in Canada from 1627 until 2007; a singular, localized event of magnitude 5 is observed to have occurred about 150 km to the south of the Township of Schreiber, in the geological Southern Province. Figure 3.8 shows the locations and magnitudes of detectable earthquakes between 1985 and 2010 for the Schreiber area.

In summary, available literature and recorded seismic events indicate that the Schreiber area is located within a region of low seismicity, the tectonically stable northwest portion of the Superior Province of the Canadian Shield.

4.0 HYDROGEOLOGY

The Township of Schreiber obtains its municipal water supply from Cook Lake. The lake is located 2 km north of the settlement area of Schreiber at an approximate elevation of 18.5 m above the settlement area of Schreiber (OCWA, 2009), enabling water to flow by gravity to the municipality's water treatment plant for filtration and chlorination.

Information concerning groundwater in the Schreiber area was interpreted from the MOE Water Well Record (WWR) database. The locations of known water wells are shown on Figure 4.1. The overburden and shallow bedrock form the primary source of exploitable groundwater in the area. Review of the MOE WWR database revealed 26 discrete water well records in the Schreiber area, of which 16 contained useful information regarding depth, aquifer, yield, etc. A summary of these wells is provided in Table 4.1.

Table 4.1 - Water Well Record Details

Water Well Type	Number of Wells	Depth (m)	Static Level (m below surface)	Tested Yield (L/min)	Depth to Bedrock (m)
Overburden	8	1.2 to 22	2.1 to 9.1	9 to 719	N/A
Bedrock	8	10.5 to 65.5	0 to 9.1	45 to 716	0 to 39

Few overburden wells exist except along the Trans Canada Highway corridor where a number of wells obtain water from glaciolacustrine and glaciofluvial sands and gravels. These wells range up to 22 m in depth with recorded pumping rates between 9 and 719 L/min. Overburden aquifers are expected to be localized based on the limited extent of Quaternary deposits.

The review of available information did not identify any known groundwater resources at repository depth (approximately 500 m) in the Schreiber area. There are no records of deep water wells in the Schreiber area nor in the Ontario part of the Canadian Shield. In the Schreiber area, there are eight (8) well records that can be confidently assigned to the shallow bedrock aquifer. These wells range from 10.5 to 65.5 m in depth. Measured pumping rates in these wells are variable and range from 45 L/min to 716 L/min. These values reflect the purpose of the wells - in many cases, private residential supply with limited water demand or construction dewatering with high but short term demands. The tested yields, therefore, do not necessarily reflect the maximum sustained yield that might be available from the shallow bedrock aquifers. Long-term groundwater yield in fractured bedrock will depend on the number and size of fractures, their connectivity, transmissivity, storage and on the recharge properties of the fracture network in the wider aquifer.

Experience from other areas in the Canadian Shield has shown that active groundwater flow is generally confined to shallow fractured localized systems. In these regions, flow tends to be dependent on the secondary permeability created by fractures (Singer and Cheng, 2002). For example, in Manitoba's Lac du Bonnet Batholith, groundwater movement is largely controlled by a fractured zone down to about 200 m depth (Everitt et. al., 1996). The low topographic relief of the Canadian Shield tends to result in low hydraulic gradients for groundwater movement in the active region (McMurry et al., 2003). In deeper regions, hydraulic conductivity tends to decrease as fractures become less common and less interconnected (Stevenson et al., 1996; McMurry et al., 2003). Increased vertical and horizontal stresses at depth tend to close or prevent fractures thereby reducing permeability and resulting in diffusion-dominated groundwater movement (Stevenson et al., 1996; McMurry et al., 2003).

4.1 Hydrogeochemistry

No information on groundwater hydrogeochemistry was found for the Schreiber area. Existing literature, however, has shown that groundwater within the Canadian Shield can be subdivided into two main hydrogeochemical regimes: a shallow, generally fresh water flow system that extends to a depth of about 150 m, and a deep, saline water flow system (Singer and Cheng, 2002).

Gascoyne et. al. (1987) investigated the saline brines within Precambrian plutons and identified a chemical transition at around 300 m depth marked by a uniform, rapid rise in total dissolved solids and chloride. This was attributed to advective mixing occurring at above 300 m, with a shift to diffusion-controlled flow below that depth. It was noted that major fracture zones within the bedrock can, where present, extend the influence of advective processes to greater depths.

In the deeper regions, where groundwater transport in unfractured or sparsely fractured rock tends to be very slow, long residence times on the order of a million years or more have been reported (Gascoyne, 2000; 2004). Groundwater research carried out in AECL's Whiteshell Underground Rock Laboratory (URL) in Manitoba found that crystalline rocks from depths of 300 to 1,000 m have total dissolved solids (TDS) values ranging from 3 to 90 g/L (Gascoyne et al. 1987; Gascoyne 2000; 2004). However, total dissolved solids exceeding 250 g/L have been reported in some regions of the Canadian Shield at depths below 500 m (Frape et al., 1984).

5.0 ECONOMIC GEOLOGY

5.1 Petroleum Resources

The Schreiber area is located in an Archean-aged crystalline rock geological setting where the potential for petroleum resources is negligible and where no production or exploration activity is known to have occurred to date.

5.2 Metallic Mineral Resources

Mining in the Schreiber area has historically focussed on metals (especially gold) within the Schreiber-Hemlo Greenstone Belt and the contact aureolas with surrounding batholiths, where most of the occurrences have been found and where most of the current exploration activity is centered. In the case of the Crossman Lake and Whitesand Lake Batholiths, the large volumes toward the centre of the intrusions seem devoid of metallic mineralization, as no such mineralization has been reported. Quartz veins that carry chalcopyrite and molybdenum with traces of gold occur throughout the Terrace Bay batholith, but seem to be more concentrated in the western portion of the batholith (Marmont, 1984). Base metal deposits also exist in the area including the Winston Lake Zn-Ag-Cu mine approximately 19 km northwest of Schreiber (closed in 1996). The Schreiber area is linked to the historic Schreiber-Hemlo mining camp which produced a number of mines over the past century. Figure 5.1 shows the areas of active exploration interest as evidenced by active mining claims, abandoned working listed in the Ontario Ministry of Northern Development, Mines, and Forestry's (MNDMF) Abandoned Mines Inventory (AMIS) and known mineral occurrences identified in the Ontario Geological Survey's Mineral Deposit Inventory Version 2 (OGS, 2004).

There are currently no producing mines in the Schreiber area. The potential for economically exploitable mineralization remains high, however, and mineral exploration continues today with particular emphasis on gold and volcanogenic massive sulphide (VMS) deposits within the Schreiber-Hemlo Greenstone Belt, copper-nickel deposits within the gabbroic intrusive that border the Crossman Lake Batholith, and copper-molybdenum deposits near the contact between the granitic batholiths and the surrounding metavolcanic country rock. Active mining is still occurring within the Wawa Subprovince in the Hemlo area approximately 80 km east of the settlement area of Schreiber.

Metallic mineralization and occurrences in the Schreiber area include: iron formation, zinc-copper-lead-silver, cobalt-copper-nickel-platinum group metals, and gold. Molybdenite occurs in quartz veins as well as disseminations in granitic rocks and gneisses in the Sox Lake area.

Precious Metals and Base Metals

According to Carter (1988), gold, in places accompanied by silver, occurs in four associations:

1) Mineralized quartz veins and quartz stringers in shear zones and faults in mafic metavolcanic rocks;

2) Quartz veins in shears in mafic metavolcanic rocks within 400 m or close to the contact aureole of the Terrace Bay Batholith, such as the past Harkness-Hays, Gold Range, and Derraugh Mines, with the former two and the latter located some 4 km and 8 km east of the settlement area of Schreiber, respectively;

3) Veins either inside or in the border zone of the granitic rocks, such as the past North Shores Mine (mix host of metavolcanic and granitic rocks) in the Gwynne Mt. Pluton, and Gale and Worthington Bay No.1 occurrences in the Terrace Bay Batholith; and

4) In some interflow ironstone units interlayered within the metavolcanic rocks; for example, gold of the abandoned Otisse Mine, adjacent to the west shore of Hays Lake, occurs in several veins, associated to highly sheared basalts interlayered with graphitic and ferruginous metasedimentary rocks (Marmont, 1984).

Silver, associated with gold and copper, occurs as vein-type deposits in two settings:

5) With massive argentiferous sphalerite and galena and chalcopyrite in quartz and carbonate veins in fractures and mineralized shears in calcalkalic rocks in the lower volcanic sequence southeast of the settlement area of Schreiber; and

6) As native silver with massive pyrite and chalcopyrite in diabase dikes.

The silver occurrences are all located in the eastern half of the Schreiber Peninsula in fractures in calcalkalic andesites and dacites (Carter, 1988). Two occurrences of silver occur in diabase dikes. One is the Longworth Vein located in the east half of the Schreiber Peninsula about 3 km south-southeast of the settlement area of Schreiber. The other is Worthington Bay No. 2 Occurrence located in the shore about 1.5 km northwest of the Les Petits Ecrits Islands (Carter, 1988).

Base metal (copper-lead-zinc) mineralizations comprising sulphide and oxides of iron with minor chalcopyrite occur as narrow bands interlayered with chert, silicified argillite, carbonatized wacke and graphitic schist. These composite units together define sulphide and oxide iron formation units that are interlayered with the mafic metavolcanic rocks. Base metals comprising massive sulphide mineralization of copper and zinc are also associated with clastic interflow sediments and ironstone units interlayered with the mafic metavolcanic rocks about 1 km south-southwest of Big Bruin Lake, approximately 4 km northeast of the settlement area of Schreiber (Carter, 1988).

Copper, as chalcopyrite, and frequently associated with gold, occurs in veins, stringers and disseminations in shears in basalt and rhyolite at the Ansell Lake Occurrence, adjacent to the north boundary of the Township. This type of copper mineralization is related to shearing and is not of the VMS type (Carter, 1988).

Occurrences of molybdenum-copper vein-type deposits are spatially related to the granitic rocks of the Crossman Lake, Whitesand Lake and Terrace Bay Batholiths. They occur at the margins in the case of the first two batholiths, and both at the margins of and within the main mass of the granitic rocks in the Terrace Bay Batholith. The molybdenite occurs as disseminated blebs, flakes, and rosettes, and the copper as disseminated grains and stringers impregnating quartz veins, aplite, pegmatite, and feldspar porphyry (Carter, 1988).

Nickel-copper mineralization occurs as nickel sulphide deposits comprising nickeliferous pyrrhotite, pentlandite and chalcopyrite, associated with magnetite, ilmenite, and pyrite in metagabbro and granitic rocks, as for example at the Nicopor occurrence, located 1.5 km northwest of the northwest Township boundary corner (Carter, 1988).

Uranium

No uranium mineralization has been identified within the Schreiber area. The closest known uranium mineralization occurs approximately 20 km to the east of Terrace Bay.

Rare Metals

Rare earth elements (REE) mineralization has not been identified in the Schreiber area. The chemical composition of the main granitic intrusions (Terrace Bay, Whitesand Lake, and Crossman Lake Batholiths) suggests a low potential for REE-bearing pegmatites in the area.

5.3 Non-Metallic Mineral Resources

Known non-metallic mineral resources within the Schreiber area include sand and gravel, stone, amethyst, and potentially industrial minerals such as garnet, fluorite, and barite.

The Gwynne Mountain Pluton and the Whitesand Lake and Terrace Bay Batholiths were evaluated as a potential source of manufactured aggregate by Jagger Hims Ltd. in 2001. The rock was found to be potentially suitable for high quality aggregate but the absence of deepwater port facilities and the presence of protected areas were expected to limit economic quarrying opportunities (Jagger Hims, 2001).

Several sand and gravel pits are located within glaciolacustrine sand and gravel deposits near the southwest corner of Hays Lake and north of Les Petits Ecrits. Such extraction is limited to unconsolidated overburden deposits of shallow depth.

An occurrence of fluorite approximately 13 km west of the settlement area of Schreiber (the Thunder Project) was evaluated by diamond drilling in 1973. Narrow seams and breccia filling of fluorite were encountered within fine to medium grain granite along the south margin of the Whitesand Lake Batholith, but economic grades/tonnages were not identified. Other occurrences of fluorite have been identified in the Schreiber area; for example, the Davidson Lake occurrence in the southwesterly-projecting lobe of the Crossman Lake Batholith, around 12 km northeast of the settlement area of Schreiber, and around 2.5 km west of Terrace Bay.

The potential for the Canadian Shield to host economic diamond deposits has been demonstrated by a number of mines in the Northwest Territories and Ontario. An assessment of overburden heavy mineral data by Morris et al. (2002) identified potential for diamond-bearing kimberlites in the area to the east of Terrace Bay, although no kimberlites or lamproites that could be diamond bearing have been identified in the Schreiber area. The closest diamondiferous kimberlitic rock to the settlement area of Schreiber has been found several kilometres southwest of Killala Lake, about 54 kilometres northeast of the settlement area of Schreiber.

In summary, the potential for economically exploitable natural resources in the Township of Schreiber and its periphery is associated with specific geological units such as the greenstone belt. The natural resource potential of the large granitic batholiths in the area is limited except along their margins.

6.0 INITIAL SCREENING EVALUATION

This section provides an evaluation of each of the five initial screening criteria (NWMO, 2010) for the Schreiber area based on the readily-available information presented in Sections 2 to 5. The intent of this evaluation is not to conduct a detailed analysis of all available information or identify specific potentially suitable sites, but rather to identify any obvious conditions that would exclude the Township of Schreiber from further consideration in the site evaluation process.

Initial screening criteria (NWMO, 2010) require that:

1) The site must have enough available land of sufficient size to accommodate the surface and underground facilities.

2) This available land must be outside of protected areas, heritage sites, provincial parks and national parks.

3) This available land must not contain known groundwater resources at the repository depth, so that the repository site is unlikely to be disturbed by future generations.

4) This available land must not contain economically exploitable natural resources as known today, so that the repository site is unlikely to be disturbed by future generations.

5) This available land must not be located in areas with known geological and hydrogeological characteristics that would prevent the site from being safe, considering the outlined safety factors in Section 6 of the site selection document (NWMO, 2010).

For cases where readily-available information is limited and where the assessment of some of the criteria is not possible at the initial screening stage, the area would be advanced to the feasibility study stage for more detailed evaluation provided the community remains interested in participating in the siting process.

6.1 Screening Criterion 1: Land Availability

The site must have enough available land of sufficient size to accommodate the surface and underground facilities.

Surface facilities associated with the deep geological repository will require a surface land parcel of about 1 km by 1 km (100 ha), although some additional space may be required to satisfy regulatory requirements. The underground footprint of the repository is about 1.5 km by 2.5 km (375 ha) at a typical depth of about 500 m.

This criterion was evaluated by assessing whether the Schreiber area contains parcels of land that are large enough to accommodate the surface facilities and whether there is a sufficient volume of rock at depth to accommodate the underground facilities. The available land areas should be accessible for the construction of surface facilities and for the various field investigations that are necessary to characterize the rock volume required to accommodate the footprint of the repository (e.g., drilling of boreholes).

Availability of land was assessed by identifying areas where surface facilities are unlikely to be built due to constraints such as the presence of natural features (e.g., large water bodies, topographic constraints), land use (e.g., developed areas, infrastructure), accessibility and construction challenges based on the information presented in Section 2.

The review of available mapping and satellite imagery shows that the developed areas and large water bodies occupy only a small portion of the Township. However, the availability of potentially suitable lands within the Township to support the construction of the repository's surface facilities could be constrained by topography which ranges between approximately 183 and 590 masl. A more detailed assessment would be needed to determine the feasibility and practicality of developing the repository's surface facilities within the Township. Lands at the periphery of the Township of Schreiber contain limited constraints that would prevent the development of the repository's surface facilities. The lands are largely undeveloped, accessible and contain areas with favourable topography. As discussed in Section 6.5, readily-available information suggests that the Schreiber area has the potential to contain sufficient volumes of host rock to accommodate underground facilities associated with a deep geological repository. This would have to be confirmed in subsequent site evaluation stages.

Based on the review of readily-available information, the Schreiber area contains sufficient land to accommodate the repository's surface and underground facilities.

6.2 Screening Criterion 2: Protected Areas

Available land must be outside of protected areas, heritage sites, provincial parks and national parks.

The assessment of this criterion is needed to assure that the remaining available land, after excluding protected areas, is large enough to allow for the construction of the repository's facilities. For the purpose of this initial assessment protected areas are considered to be ecologically sensitive or significant areas, as defined by provincial or federal authorities.

The Schreiber area was screened for federal, provincial and municipal parks, conservation areas, nature reserves, national wildlife areas and archaeological and historic sites using available data from the Ontario Ministry of Natural Resources (Land Information Ontario) and the Ontario Ministry of Tourism and Culture.

Four protected areas are found in the Schreiber area, all bordering Lake Superior (Figure 2.1). These comprise two parcels of land designated under the Ontario's Living Legacy Approved Land Use Strategy (Lake Superior North Shore Conservation Reserve), as well as Rainbow Falls Provincial Park and Schreiber Channel Provincial Nature Reserve. These protected areas occupy a small portion of the Schreiber area. In addition, all the shoreline and water of Lake Superior in the Schreiber area is part of the Lake Superior National Marine Conservation Area.

As discussed in Section 2.4, almost all the land in the Schreiber area is free of known heritage constraints. Known archaeological sites are small and generally concentrated around the shoreline of Lake Superior, with two of these sites lying within the Township at Worthington Bay. There are no National Historic Sites in the Schreiber area.

The absence of locally protected areas would need to be confirmed in discussion with the community and Aboriginal peoples in the area during subsequent site evaluation stages, if the community remains interested in continuing with the site selection process.

Based on the review of readily-available information, the Schreiber area contains sufficient land outside of protected areas, heritage sites, provincial parks and national parks to accommodate the repository's facilities.

6.3 Screening Criterion 3: Known Groundwater Resources at Repository Depth

Available land must not contain known groundwater resources at the repository depth, so that the repository site is unlikely to be disturbed by future generations.

In order to minimize the future risk of human intrusion during the long post-closure period, the repository should be sited in a host rock formation that does not contain significant groundwater resources at repository depth (typically 500 m) that may encourage future generations to access those resources and potentially compromise the long-term performance of the repository.

The review of available information did not identify any known groundwater resources at repository depth for the Schreiber area. As discussed in Section 4.2, the Ontario Ministry of the Environment (MOE) Water Well Record (WWR) database shows that all water wells known in the Schreiber area obtain water from overburden or shallow bedrock sources at depths of up to 65 m.

Experience from other areas in the Canadian Shield has shown that active groundwater flow is generally confined to shallow fractured localized systems (Singer and Cheng, 2003). For example, in Manitoba's Lac du Bonnet Batholith, groundwater movement is largely controlled by a fractured zone down to about 200 m depth (Everitt et al., 1996). In deeper regions, hydraulic conductivity tends to decrease as fractures become less common and less interconnected (Stevenson et al. 1996; McMurry et al., 2003).

MOE Water Well Records indicate that no potable water supply wells are known to exploit aquifers at typical repository depths in the Schreiber area or anywhere else in Northern Ontario. Groundwater at such depths is generally saline and very low groundwater recharge at such depths limits the potential yield, even if suitable water quality were to be found. The absence of groundwater resources at repository depth in the Schreiber area would, however, need to be confirmed during subsequent site evaluation stages, if the community remains interested in continuing with the site selection process.

The review of available information did not identify any known groundwater resources at repository depth for the Schreiber area. Experience in similar geological settings suggests that the potential for deep groundwater resources at repository depths is low throughout the Schreiber area. The absence of groundwater resources at repository depth would need to be confirmed during subsequent site evaluation stages, if the community remains interested in continuing with the site selection process.

6.4 Screening Criterion 4: Known Natural Resources

Available land must not contain economically exploitable natural resources as known today, so that the repository site is unlikely to be disturbed by future generations.

As with the assessment of groundwater resources, the need to minimize the risk of future human intrusion requires that the repository be sited in a host rock formation having a low potential for economically exploitable natural resources. Readily-available information on past and potential future occurrence for natural resources such as oil and gas, metallic and non-metallic mineral resources was reviewed in Section 5.

The review indicates that there is no evidence of past or present exploration or development activities associated with oil and gas resources. Given the geological setting (i.e., Canadian Shield), the potential for activities associated with these resources in the area of Schreiber is negligible.

There are currently no operating mines within the Township of Schreiber or its periphery although the area has a long history of mineral exploration and mining. Three abandoned gold mines (Harkness-Hays, Worthington Bay No 1, and North Shore Mines) are located in or immediately adjacent to the Township of Schreiber. The closest currently operating mine is in the Hemlo area, approximately 80 km east of Schreiber.

Current mineral exploration in the Schreiber area is concentrated primarily within the greenstone belt. Limited mineralization has been identified in the granitic intrusions in the area. These include occurrences of gold, fluorite and copper-molybdenum mineralization that are mostly concentrated at the contact with the metavolcanic country rock.

An assessment of overburden heavy mineral data by Morris et al. (2002) identified potential for diamond-bearing kimberlites in the area to the east of Terrace Bay, however, no known kimberlites or lamproites have been identified in the Schreiber area.

Extraction of sand and gravel and quarrying of stone has occurred in the Schreiber area in the past and continues today. However, the risk that these resources pose for future human intrusion is negligible, as quarrying operations are typically limited to very shallow depths. No potential for commercial peat extraction has been identified.

In summary, the potential for economically exploitable natural resources in the Township of Schreiber and its periphery is associated with specific geological units, such as rocks of the greenstone belt. The natural resource potential of the large granitic batholiths in the area is limited, except along their margins.

Based on the review of readily-available information, the Schreiber area contains sufficient lands, free of known economically exploitable natural resources, to accommodate the required repository facilities. The absence of natural resources would need to be confirmed during subsequent site evaluation stages, if the community remains interested in continuing with the site selection process.

6.5 Screening Criterion 5: Unsafe Geological or Hydrogeological Features

Available land must not be located in areas with known geological and hydrogeological characteristics that would prevent the site from being safe, considering the outlined safety factors in Section 6 of the site selection document (NWMO, 2010).

The site should not be located in an area of known geological and hydrogeological features that would make the site unsafe, as per the following five geoscientific safety-related factors identified in the site selection process (NWMO, 2010):

1) Safe containment and isolation of used nuclear fuel. Are the characteristics of the rock at the site appropriate to ensuring the long-term containment and isolation of used nuclear fuel from humans, the environment and surface disturbances?

2) Long-term resilience to future geological processes and climate change. Is the rock formation at the site geologically stable and likely to remain stable over the very long term in a manner that will ensure the repository will not be substantially affected by natural disturbances and events such as earthquakes and climate change?

3) Safe construction, operation and closure of the repository. Are conditions at the site suitable for the safe construction, operation and closure of the repository?

4) Isolation of used fuel from future human activities. Is human intrusion at the site unlikely, for instance, through future exploration or mining?

5) Amenable to site characterization and data interpretation activities. Can the geologic conditions at the site be practically studied and described on dimensions that are important for demonstrating long-term safety?

At this early stage of the site evaluation process, where limited data at repository depth exist, the five safety-related geoscientific factors are assessed using readily-available information, with the objective of identifying any obvious unfavourable hydrogeological and geological conditions that would exclude the Township of Schreiber from further consideration. These factors would be gradually assessed in more detail as the site evaluation process progresses and more site specific data is collected during subsequent evaluation phases, provided the community remains interested in continuing in the site selection process.

As discussed below, the review of readily-available geoscientific information did not identify any obvious geological or hydrogeological characteristics that would exclude the Township of Schreiber from the site selection process at this stage.

Safe Containment and Isolation

The geological and hydrogeological conditions of a suitable site should promote long-term containment and isolation of used nuclear fuel and retard the movement of any potentially released radioactive material. This requires that the repository be located at a sufficient depth, typically around 500 m, in a sufficient rock volume with characteristics that limit groundwater movement. Readily-available information on the local and regional geology and hydrogeology was reviewed in Sections 3 and 4, respectively.

As shown on Figure 3.3, the geology of the Township of Schreiber is dominated by metavolcanic rocks and associated metasedimentary rocks of the Schreiber-Hemlo Greenstone Belt. As discussed in Sections 3.2.1 and 3.2.2, these rocks are heterogeneous and variable in composition. They are arranged in layers of varying thickness. Past tectonic events have deformed these layers, making them difficult to characterize from a stratigraphic point of view. These events created numerous regional folds, faults and smaller scale shear zones within the metavolcanic rocks in the Schreiber area. Although these metavolcanics rocks may have sufficient thickness and lateral extent, they are unlikely to be suitable for hosting a deep geological repository.

About 30% of the Township of Schreiber is underlain by granitic intrusions. These include the Gwynne Mountain Pluton that covers an area of approximately 7.5 km^2 in the southwest, and small parts of the Whitesand Lake Batholith in the northwest and the Terrace Bay Batholith in the southeast corner of the Township. Both the Whitesand Lake Batholith and the Terrace Bay Batholith extend well beyond the Township boundaries to the west and east, respectively. The Crossman Lake Batholith is another granitic intrusion that is located about seven kilometres from the northern boundary of the Township. Limited information is available on the thickness of the granitic intrusions; however, available geophysical data suggests that they may extend to substantial depth (see Section 3.2.1).

The age of these granitic intrusions in not well known. However, lack or weakness of foliation/deformation and the faulting they display on the surface suggests that were emplaced at a later stage in the deformation history of the Schreiber area. The granitic intrusions are cross cut by a number of inferred major faults (Figure 3.3) with an approximate frequency of 2.0 to 4.5 km. Smaller scale faults have also been inferred in the area. The extent to which these faults extend to depth, their frequency of occurrence, and their potential impact on siting the repository would need to be evaluated during subsequent site evaluation stages.

From a hydrogeologic point of view, the review of readily-available information did not reveal the existence of known deep fracture systems or deep aquifers in the Schreiber area (see Section 4.2). The presence of active deep groundwater flow systems in crystalline formations is controlled by the frequency and interconnectivity of fractures at depth. Experience from other areas in the Canadian Shield, particularly for granitic intrusions (plutons and batholiths), indicates that active groundwater flow tends to be generally limited to shallow fractured systems, typically less than 300 m. In deeper rock, fractures are less common and less likely to be interconnected, leading to very slow groundwater movement with residence times that could reach a million years or more (McMurry et al., 2003; Gascoyne, 2000, 2004).

Based on the geological and hydrogeological characteristics described above and available experience from other similar rocks in the Canadian Shield, the granitic intrusions in the Schreiber area warrant further consideration as potentially suitable host rocks. The White Sand Lake, Crossman Lake and Terrace Bay Batholiths seem to occur in sufficient volumes in the Schreiber area. However the portions of these batholiths that are within the Township may not be suitable due to a number of constraints such as topography, water bodies and the potential for mineral resources. The approximately 7.5 km^2 Gwynne Mountain Pluton may have a sufficient volume to host a repository within the Township; however, the suitability of this pluton maybe affected by topography and the potential for mineral resources at its margins with the greenstone belt.

In summary, the review indicates that the Township of Schreiber and its periphery contain areas with no obvious geological and hydrogeological conditions that would preclude safe containment and isolation at repository depth. This would need to be assessed during subsequent site evaluation stages. Other geoscientific characteristics that may have an impact on the containment and isolation functions of a deep geological repository such as the mineralogy of the rock, the geochemical composition of the groundwater and rock porewater, the thermal and geomechanical properties of the rock would also need to be assessed during subsequent site evaluation stages, provided the community remains interested in continuing in the site selection process.

Long-term Stability

A suitable site for hosting a repository is a site that would remain stable over the very long-term in a manner that will ensure that the performance of the repository will not be substantially altered by future geological and climate change processes, such as earthquakes or glaciation. A full assessment of this geoscientific factor requires detailed site specific data that would be typically collected and analyzed through detailed field investigations. The assessment would include understanding how the site has responded to past glaciations and geological processes and would entail a wide range of studies involving disciplines such as seismology, hydrogeology, hydrogeochemistry, paleohydrogeology and climate change.

At this early stage of the site evaluation process, the long-term stability factor is evaluated by assessing whether there is any evidence that would raise concerns about the long-term hydrogeological and geological stability of the Schreiber area. As discussed below, the review of readily-available information did not reveal any obvious characteristics that would raise such concerns.

The Township of Schreiber is located in the Superior Province of the Canadian Shield, where large portions of land have remained tectonically stable for the last 2.5 billion years (Percival and Easton, 2007). As discussed in Sections 3.1 and 3.2, faults and shear zones have been identified in the Schreiber area; however, there is no evidence to suggest that these fault zones have been tectonically active within the past billion years.

The geology of the Schreiber area is typical of many areas of the Canadian Shield, which has been subjected to numerous glacial cycles during the last million years. Glaciation is a significant past perturbation that could occur in the future. However, findings from studies conducted in other areas of the Canadian Shield suggest that deep crystalline formations, particularly the plutonic intrusions, have remained largely unaffected by past perturbations such as glaciation. Findings of a comprehensive paleohydrogeological study of the fractured crystalline rock at the Whiteshell Research Area, located within the Manitoba portion of the Canadian Shield (Gascoyne, 2004) indicated that the evolution of the groundwater flow system was characterized by periods of long-term hydrogeological and hydrogeochemical stability. McMurry et al. (2003) summarized several studies conducted in a number of plutons in the Canadian Shield and in the crystalline basement rocks of Western Ontario. These various studies found that fractures below a depth of several hundred metres in the plutonic rock were typically ancient features. Subsequent geological processes such as plate movement and continental glaciation have typically caused reactivation of existing zones of weakness rather than the formation of large new zones of fractures.

In summary, the review did not identify any obvious geological or hydrogeological conditions that would clearly fail to meet the long-term stability requirement for a potential repository in the Schreiber area. As mentioned above, the long-term stability factor would need to be further assessed through detailed multidisciplinary geoscientific and climate change site investigations.

Potential for Human Intrusion

The site should not be located in areas where the containment and isolation functions of the repository are likely to be disrupted by future human activities such as exploration or mining. Therefore, the repository should not be located within rock formations containing exploitable groundwater resources (aquifers) at repository depth and economically exploitable natural resources and other valuable commodities as known today.

This factor has already been addressed in Sections 6.3 and 6.4, which concluded that the potential for deep groundwater resources at repository depths and known economically exploitable natural resources is low throughout the granitic intrusive rocks in the Schreiber area.

Amenability to Construction and Site Characterization

The characteristics of a suitable site should be favourable for the safe construction, operation, closure and long-term performance of the repository. Aside from the requirement for space discussed in Section 6.1, this requires that the strength of the host rock and in-situ stress at repository depth are such that the repository could be safely excavated, operated and closed without unacceptable rock instabilities, and that the soil cover depth over the host rock should not adversely impact repository construction and site investigation activities. Similarly, the host rock geometry and structure should be predictable and amenable to site characterization and interpretation activities.

From a constructability perspective, limited site specific information is available on the local rock strength characteristics and in-situ stresses for the Schreiber area. However, there is abundant information at other locations of the Canadian Shield that could provide insight into what should be expected for the Schreiber area in general. Available information suggests that crystalline rock formations within the Canadian Shield, particularly within granitic intrusions, generally possess geomechanical characteristics that are good to very good and amenable to the type of excavation activities involved in the development of a deep geological repository for used nuclear fuel (McMurry et al., 2003; Chandler et al., 2004; Arjang and Herget, 1997; Everitt, 1999).

The review of readily-available information on the bedrock geology and Quaternary geology for the Schreiber area (Sections 3.2 and 3.4) did not indicate any obvious conditions which could make the granitic intrusions difficult to characterize, although such conditions may exist in localized areas. As discussed earlier, this may not be the case for the rocks within the greenstone belt, due to their lithological and spatial variability.

The degree to which factors such as geologic variability and overburden thickness might affect the characterization and data interpretation of the granitic intrusions is unknown at this stage and would require further assessment during subsequent site evaluation stages of the site selection process, provided the community remains interested in continuing in the site selection process.

Based on the review of available geological and hydrogeological information, the Schreiber area contains portions of land that do not contain obvious known geological and hydrogeological conditions that would make the area unsuitable for hosting a deep geological repository.

7.0 INITIAL SCREENING FINDINGS

This report presents the results of an initial screening to assess the potential suitability of the Schreiber area against five initial screening criteria using readily-available information. The initial screening focused on the Township of Schreiber and its periphery, which are referred to as the “Schreiber area”. As outlined in NWMO’s site selection process (NWMO, 2010), the five initial screening criteria relate to: having sufficient space to accommodate surface facilities, being outside protected areas and heritage sites, absence of known groundwater resources at repository depth, absence of known natural resources and avoiding known hydrogeologic and geologic conditions that would make an area or site unsuitable for hosting a deep geological repository.

The review of readily-available information and the application of the five initial screening criteria did not identify any obvious conditions that would exclude the Township of Schreiber from further consideration in the NWMO site selection process. The initial screening indicates that the Schreiber area contains portions of lands with geological formations that are potentially suitable for hosting a deep geological repository. Examples of these formations include the Whitesand Lake and Crossman Lake granitic Batholiths at the periphery of the Township. Within the Township, the potential suitability is limited to a small area underlain by the granitic Gwynne Mountain Pluton. The metavolcanic rocks of the greenstone belt that dominate the geology of the Township are likely unsuitable due to their heterogeneity, spatial variability and their potential for natural resources.

It is important to note that at this early stage of the site evaluation process, the intent of the initial screening was not to confirm the suitability of the Schreiber area, but rather to identify whether there are any obvious conditions that would exclude it from the site selection process. Should the community of Schreiber remain interested in continuing with the site selection process, several years of progressively more detailed studies would be required to confirm and demonstrate whether the Schreiber area contains sites that can safely contain and isolate used nuclear fuel.

The process for identifying an informed and willing host community for a deep geological repository for Canada’s used nuclear fuel is designed to ensure, above all, that the site which is selected is safe and secure for people and the environment, now and in the future.

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9.0 REPORT SIGNATURE PAGE

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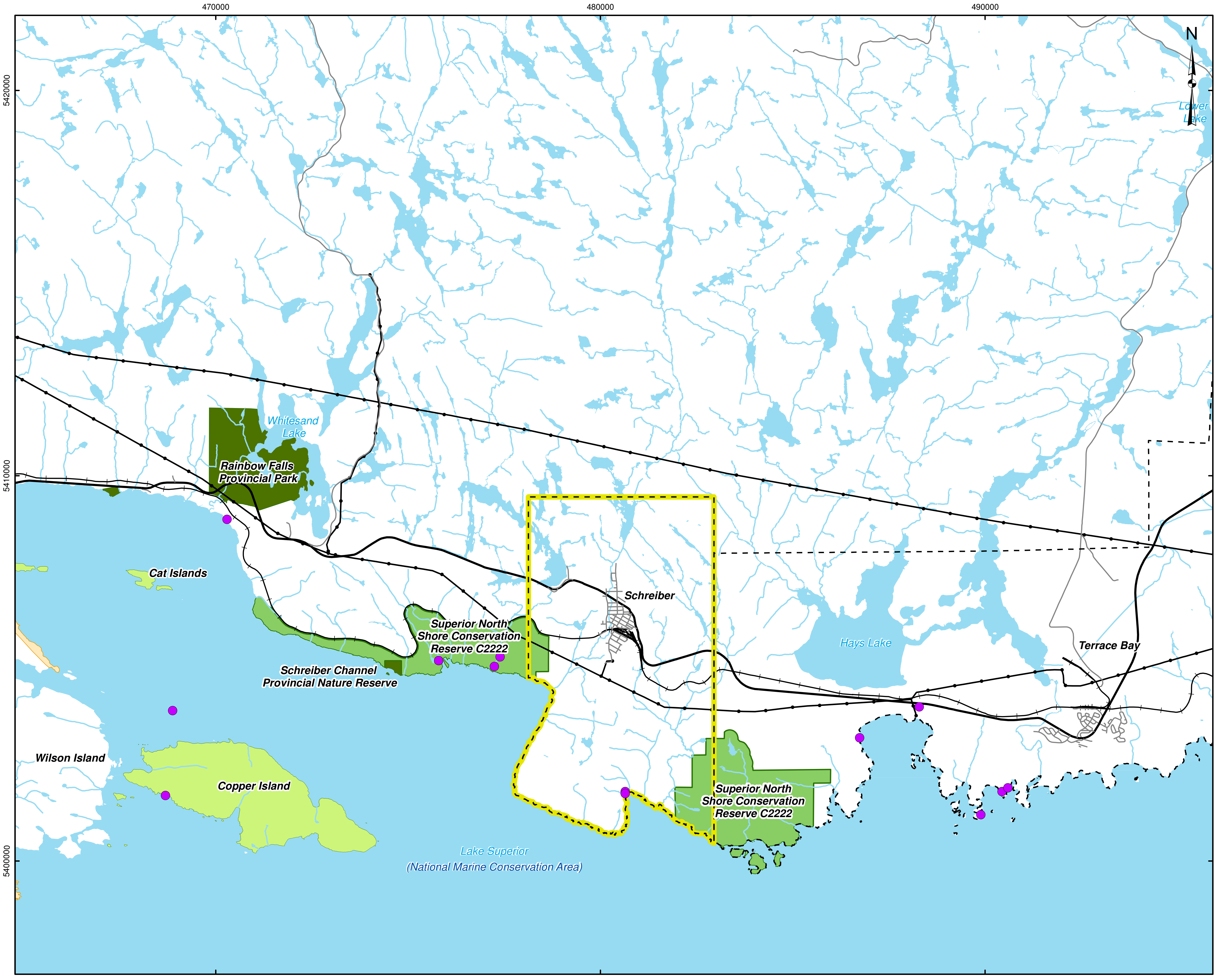
FIGURES



LEGEND

- Township of Schreiber
- Municipal Boundary, Lower Tier
- Main Road
- Local Road
- Railway
- Utility Line
- Watercourse, Permanent
- Watercourse, Intermittent
- Water Area, Permanent
- Registered Archaeological Site
- ANSI, Earth Science
- Recommended Conservation Reserve
- Forest Reserve
- Conservation Reserve
- Provincial Park

REFERENCE

Base Data - MNR NRVIS, obtained 2009, CANMAP v2006.4
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2009
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N

2 1 0 2 4 6
SCALE 1:100,000 KILOMETRES

PROJECT
NWMO Desktop Level Initial Screening

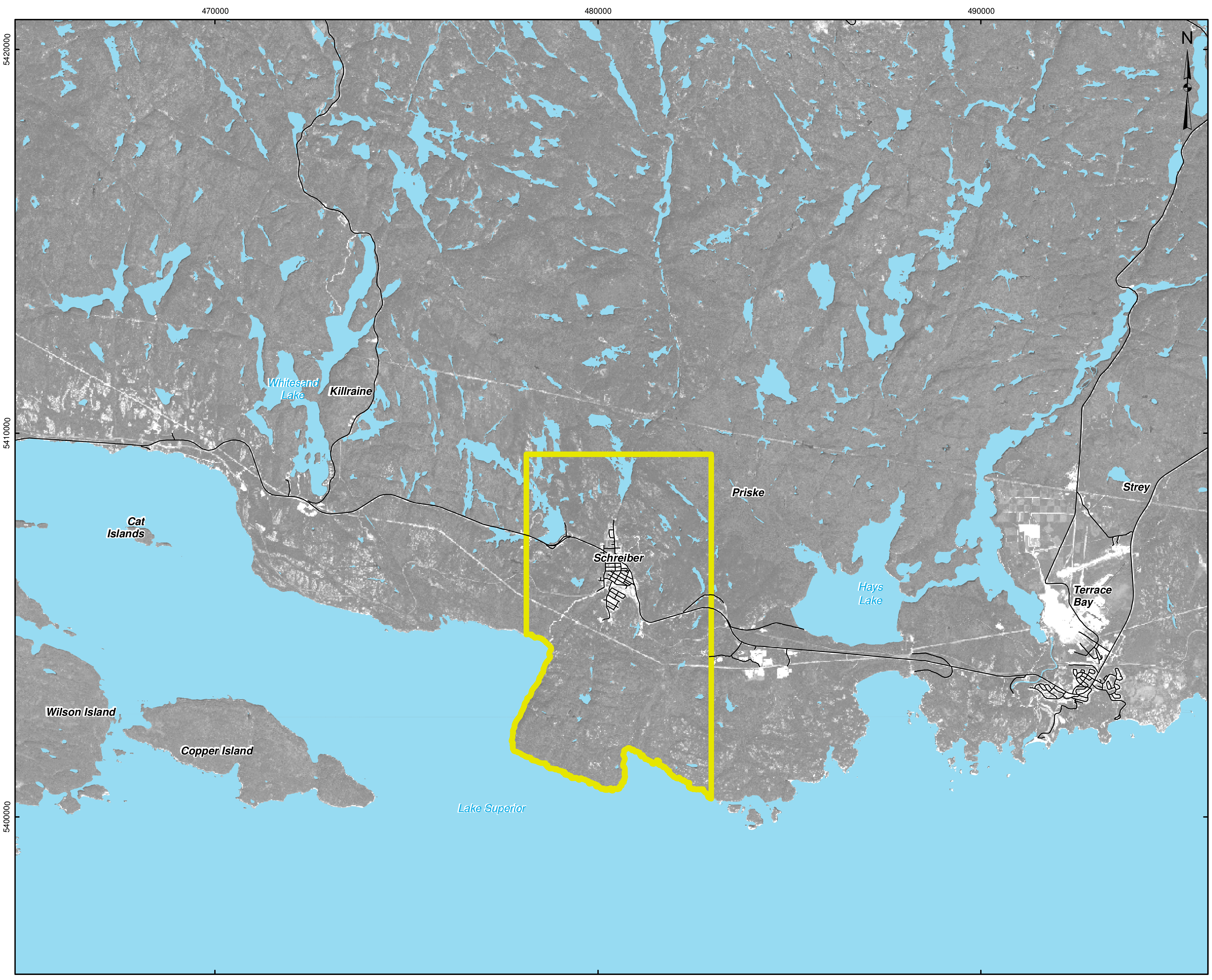
TITLE
Township of Schreiber

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1152-0110			SCALE AS SHOWN	REV. 1.0
DESIGN	PRM	27 Jan. 2011		
GIS	PRM	2 Mar. 2011		
CHECK	CM	2 Mar. 2011		
REVIEW	GS	2 Mar. 2011		

FIGURE: 2.1

G:\Projects\2010\10-1152-0110_NWMO_Initial_Screening\GIS\MXDs\Reporting\phase5000\RegionalArea.mxd



LEGEND

- Township of Schreiber
- Road
- Water Area, Permanent

REFERENCE

Imagery: Spot 5 , Obtained from Geobase (2005, 10 m resolution)
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N

2.5 1.25 0 2.5 5
SCALE 1:100,000 KILOMETRES

PROJECT

NWMO Desktop Level Initial Screening

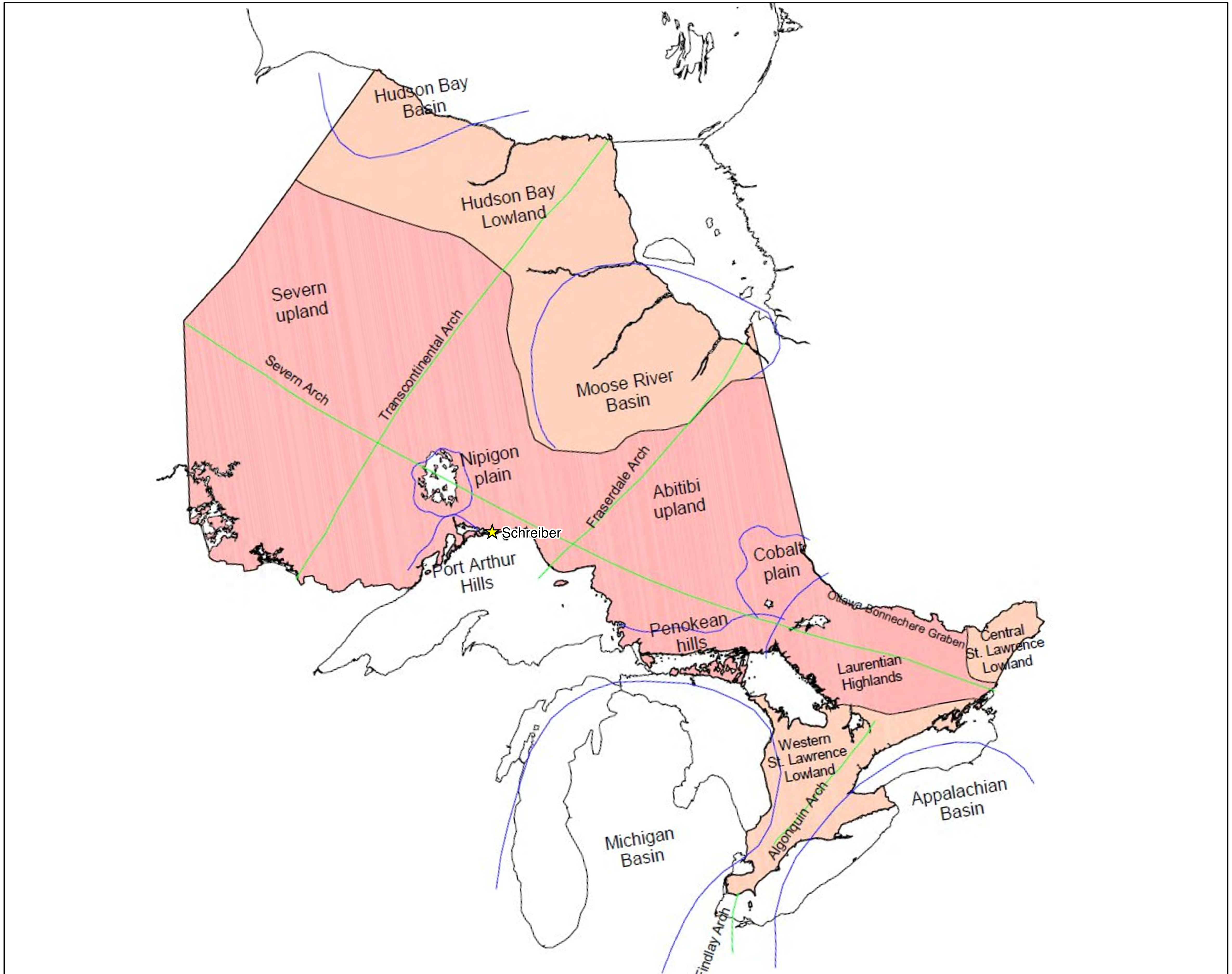
TITLE

Satellite Imagery of the Schreiber Area

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1152-0110			SCALE AS SHOWN	REV. 1.0
DESIGN	PRM	27 Jan. 2011	FIGURE: 2.2	
GIS	PRM	2 Mar. 2011		
CHECK	CM	2 Mar. 2011		
REVIEW	GS	2 Mar. 2011		

G:\Projects\2010\10-1152-0110_NWMO_Initial_Screening\GIS\MXDs\Reporting\phase5000\SatelliteImageryoftheSchreiberArea.mxd



LEGEND

- ☆ Township of Schreiber
- Basin Boundary
- Phanerozic Borderlands
- Precambrian Canadian Shield

REFERENCE

Base Data - ESRI Digital Chart of the World, 2010
Physiography: Physiographic regions in Ontario based on Bostock (1970)
(from Thurston et al. 1991)
Projection:NA

PROJECT

NWMO Desktop Level Initial Screening

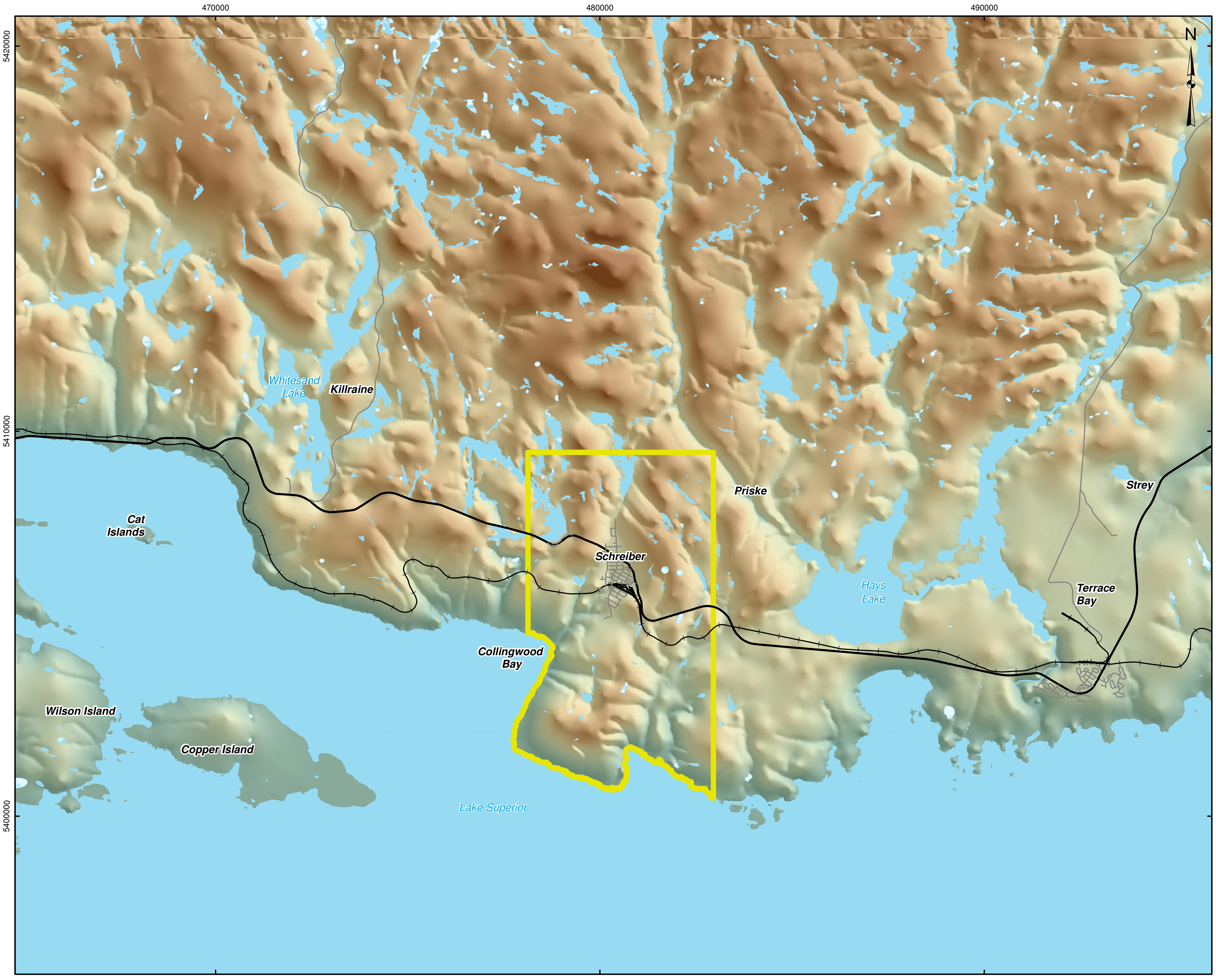
TITLE

Physiographic Regions of Ontario

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1152-0110			SCALE AS SHOWN	REV. 1.0
DESIGN	PB	30 Aug. 2010	**FIGURE: 2.3**	
GIS	PRM	2 Mar. 2011		
CHECK	CM	2 Mar. 2011		
REVIEW	GS	2 Mar. 2011		

G:\Projects\2010\10-1152-0110_NWMO_Initial_Screening\GIS\MXDs\Reporting\phase5000\PhysiographicRegionsofOntario.mxd



LEGEND

- Township of Schreiber
- Main Road
- Local Road
- Railway
- Water Area, Permanent
- Wetland, Permanent

Elevation Model (masl)

590
560
510
460
410
360
310
260
210
160
110
60

REFERENCE

Base Data - MNR NRVIS, obtained 2009, CANMAP v2006.4
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2009
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N

2.5 1.25 0 2.5 5

SCALE 1:100,000 KILOMETRES

PROJECT

NWMO Desktop Level Initial Screening

TITLE

Digital Elevation Model (DEM) of the Schreiber Area

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1152-0110			SCALE AS SHOWN	REV. 1.0
DESIGN	PRM	27 Jan. 2011	**FIGURE: 2.4**	
GIS	PRM	2 Mar. 2011		
CHECK	CM	2 Mar. 2011		
REVIEW	GS	2 Mar. 2011		

G:\Projects\2010\10-1152-0110_NWMO_Initial_Screening\GIS\MXDs\Reporting\phase5000\DigitalElevationModeloftheSchreiberArea.mxd

LEGEND

- Township of Schreiber
- Main Road
- Local Road
- Railway
- Utility Line
- Watercourse, Permanent
- Watercourse, Intermittent
- Water Area, Permanent
- Wetland, Permanent
- Wooded Area
- Surface Water Flow Direction
- Minor Contour (10m)
- Major Contour (50m)
- Subcatchment Boundary

REFERENCE

Base Data - MNR NRVIS, obtained 2009, CANMAP v2006.4
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2009
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N

2.5 1.25 0 2.5 5

SCALE 1:100,000 KILOMETRES

PROJECT

NWMO Desktop Level Initial Screening

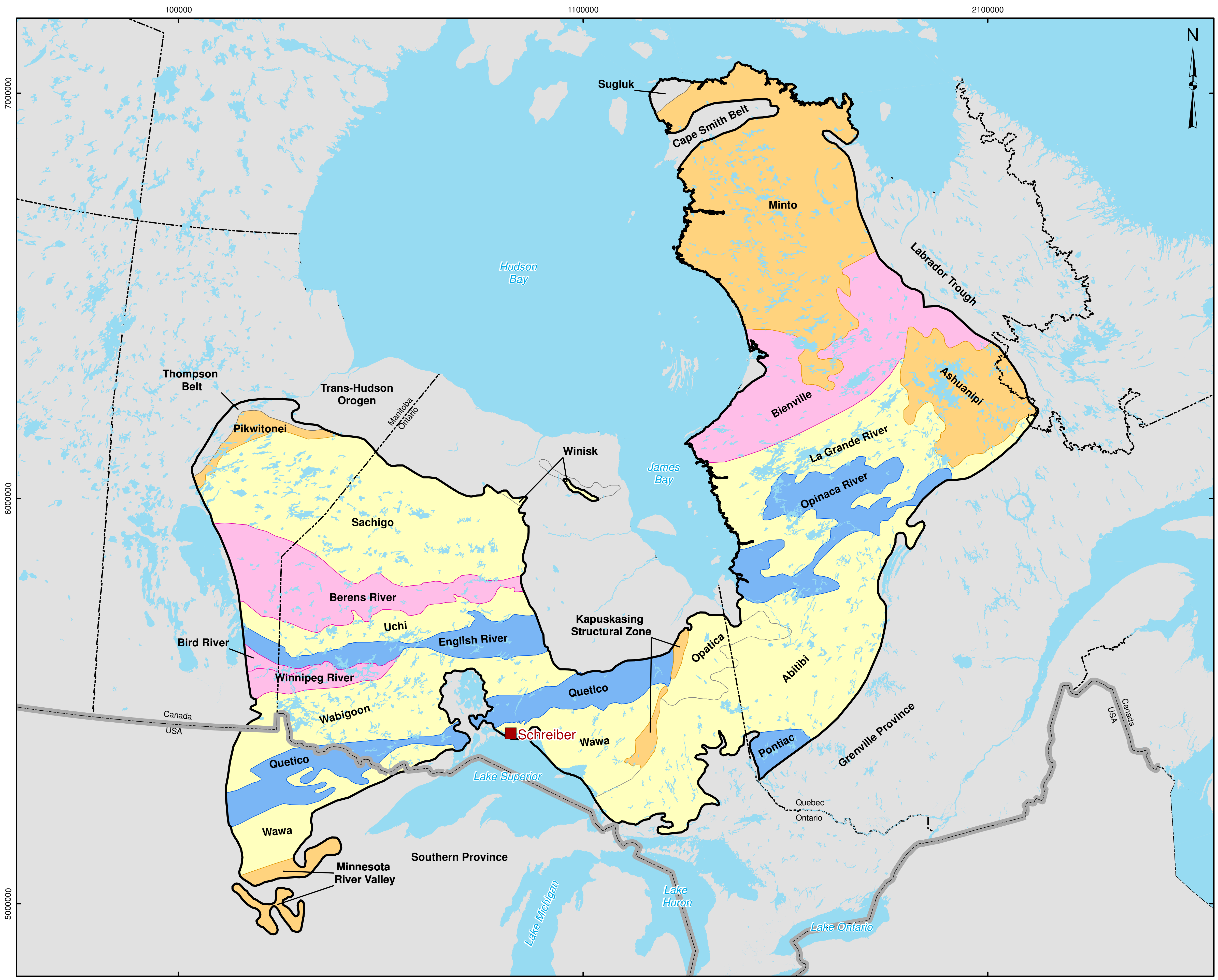
TITLE

Drainage Features of the Schreiber Area

PROJECT NO. 10-1152-0110			SCALE AS SHOWN / REV. 1.0
DESIGN	PRM	27 Jan. 2011	FIGURE: 2.5
GIS	PRM	2 Mar. 2011	
CHECK	CM	2 Mar. 2011	
REVIEW	GS	2 Mar. 2011	

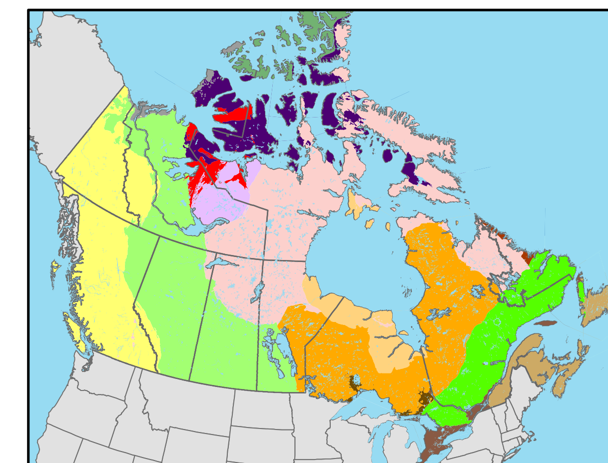
Golder Associates
Mississauga, Ontario

G:\Projects\2010\10-1152-0110_NWMO_Initial_Screening\GIS\MXDs\Reporting\phase5000\DrainageFeaturesoftheSchreiberArea.mxd



LEGEND

- Township of Schreiber
- Provincial Boundary
- International Boundary
- Limit of Exposed Archean Rock



Geological Regions of Canada

Appalachian Orogen	Cordilleran Orogen	Pacific Continental Shelf
Arctic Continental Shelf	Grenville Province	Slave Province
Arctic Platform	Hudson Bay Lowlands	Southern Province
Atlantic Continental Shelf	Innuitian Orogen	St. Lawrence Platform
Bear Province	Interior Platform	Superior Province
Churchill Province	Nain Province	Oceanic crust

REFERENCE

Base Data - MNR NRVIS, obtained 2009, CANMAP v2006.4
Physiographic Regions of Ontario - Thurston, P. C. 1991 Geology of Ontario: Introduction in Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 1, p.26-57
Geology: Geological Map of Canada 1996, Map D1860A
Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2009
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15

200 100 0 200 400

SCALE 1:9,500,000 KILOMETRES

PROJECT

NWMO Desktop Level Initial Screening

TITLE

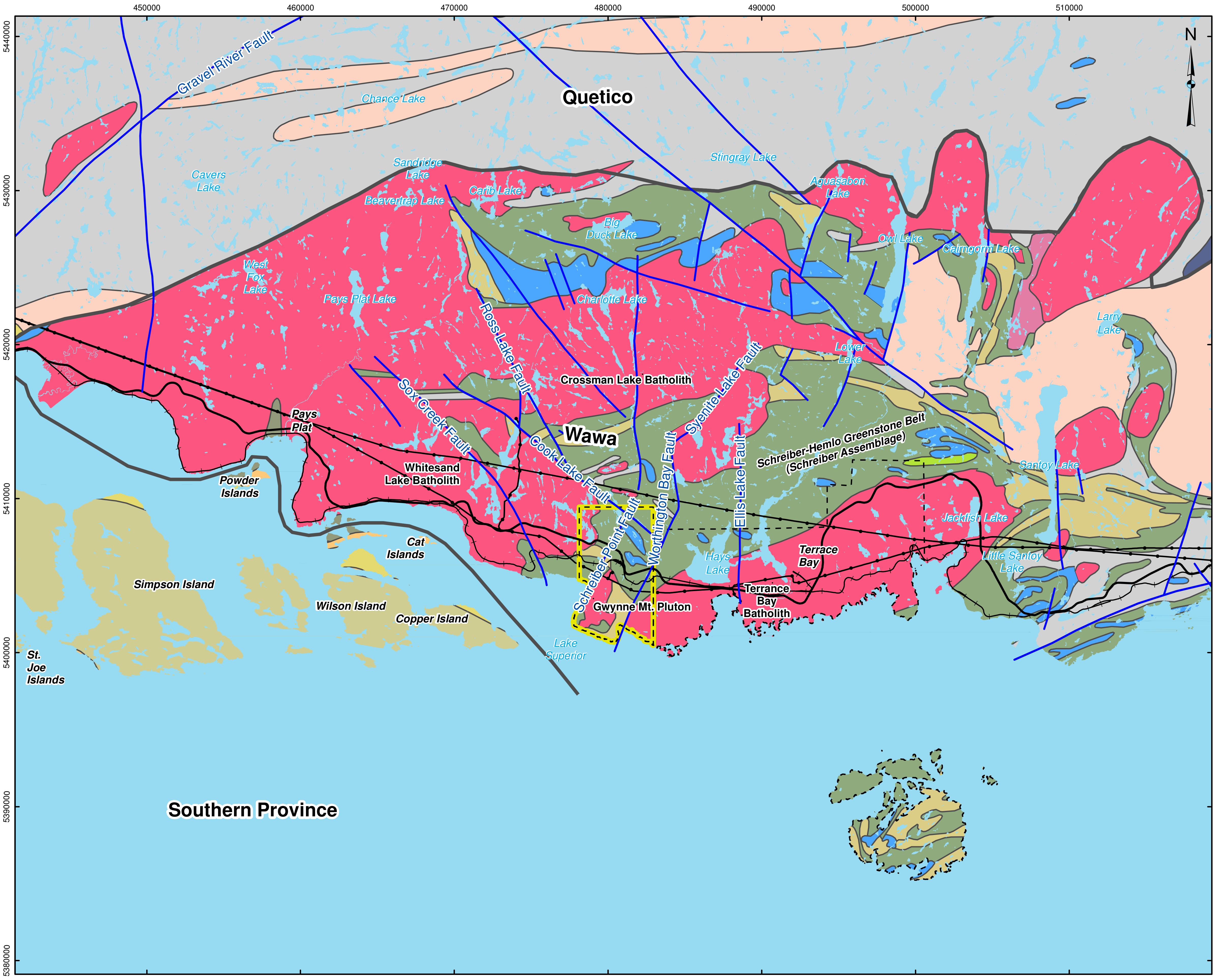
Subdivision of the Superior Province of the Canadian Shield

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1152-0110			SCALE AS SHOWN	REV. 1.0
DESIGN	PB	30 Aug. 2010		
GIS	PB	30 Aug. 2010		
CHECK	JF	30 Aug. 2010		
REVIEW	GS	30 Aug. 2010		

FIGURE: 3.1

G:\Projects\2010\10-1152-0110_NWMO_Initial_Screening\GIS\MXDs\Working\Phase5000\SubdivisionSuperiorProvinceCanadianShield.mxd



LEGEND

- Township of Schreiber
- Municipal Boundary, Lower Tier
- Main Road
- Railway
- Utility Line
- Water Area, Permanent
- Sub-province Boundary (approximate)
- Geological Fault
- Geological Contact
- 34 Mafic and related intrusive rocks (Keweenawan age)
  - 34a Logan and Nipigon sills (1109 Ma): diabase sills
- 32 Osler Gp., Maminse Point Fm., Michipicoten Island Fm.
- 31 Sibley Gp.
- 24 Sedimentary Rocks (Animikie Group): wacke, shale, iron formation, limestone, minor volcanic rocks, conglomerate, taconite, aldal chert, carbonate rocks, argillite-tuff
  - 24a Rove Formation: argillite, shale, wacke, minor volcanic rocks
- 15 Massive granodiorite to granite
- 14-Diorite-monzodiorite-granodiorite suite
- 11 Gneissic tonalite suite
- 10 Mafic and ultramafic rocks
- 8 Migmatized supracrustal rocks
- 7 Metasedimentary rocks
- 6 Felsic to intermediate metavolcanic rocks
  - 6a Dacitic and Andesitic flows, tuffs and breccias
- 5 Mafic to intermediate metavolcanic rocks
- 2 Felsic to intermediate metavolcanic rocks

REFERENCE

Base Data - MNR NRVIS, obtained 2009, CANMAP v2006.4
Physiographic Regions of Ontario - Thurston, P. C. 1991 Geology of Ontario: Introduction in Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 1, p.26-57
Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2009
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N

5 2.5 0 5 10 15

SCALE 1:250,000 KILOMETRES

PROJECT

NWMO Desktop Level Initial Screening

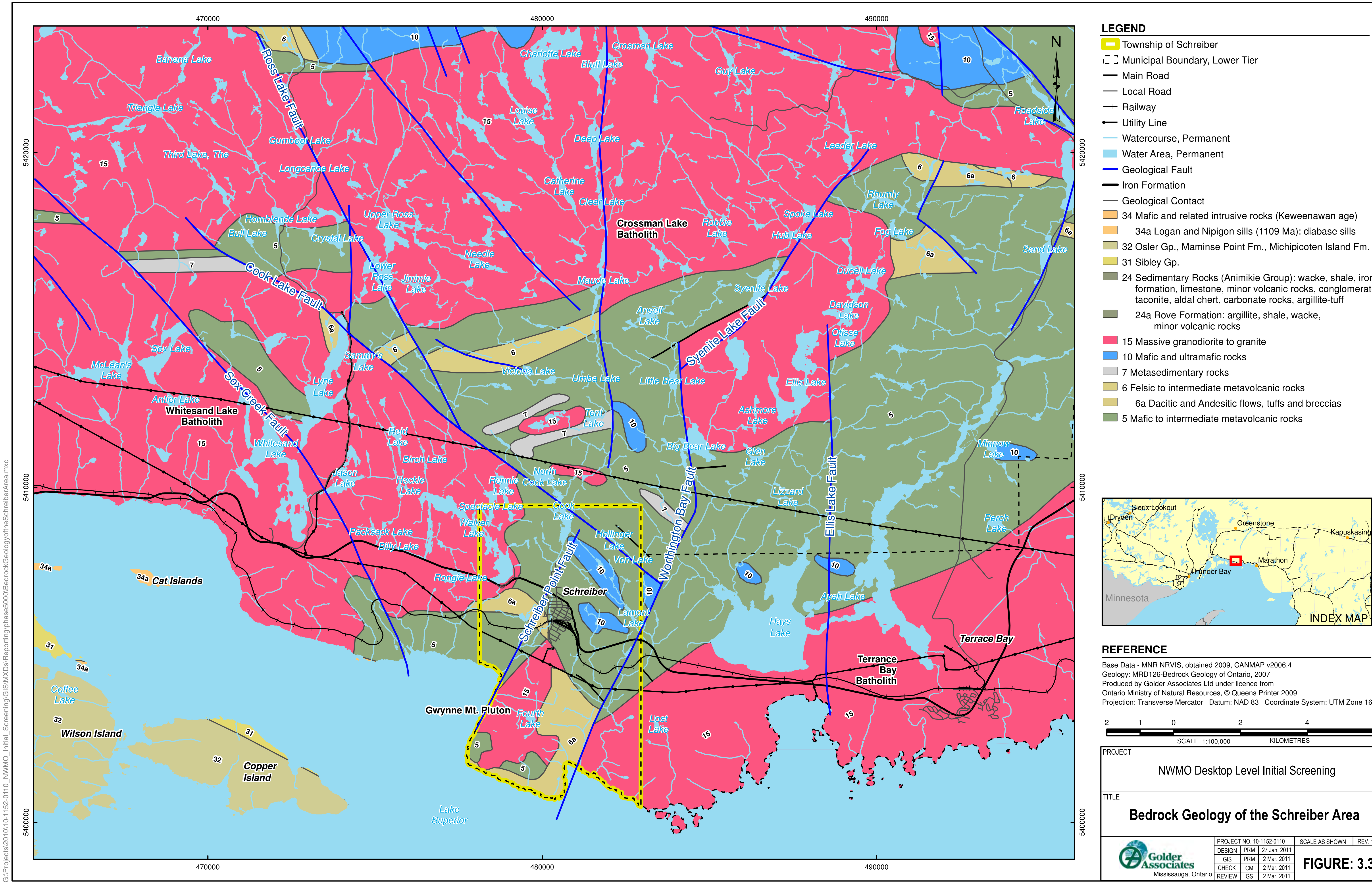
TITLE

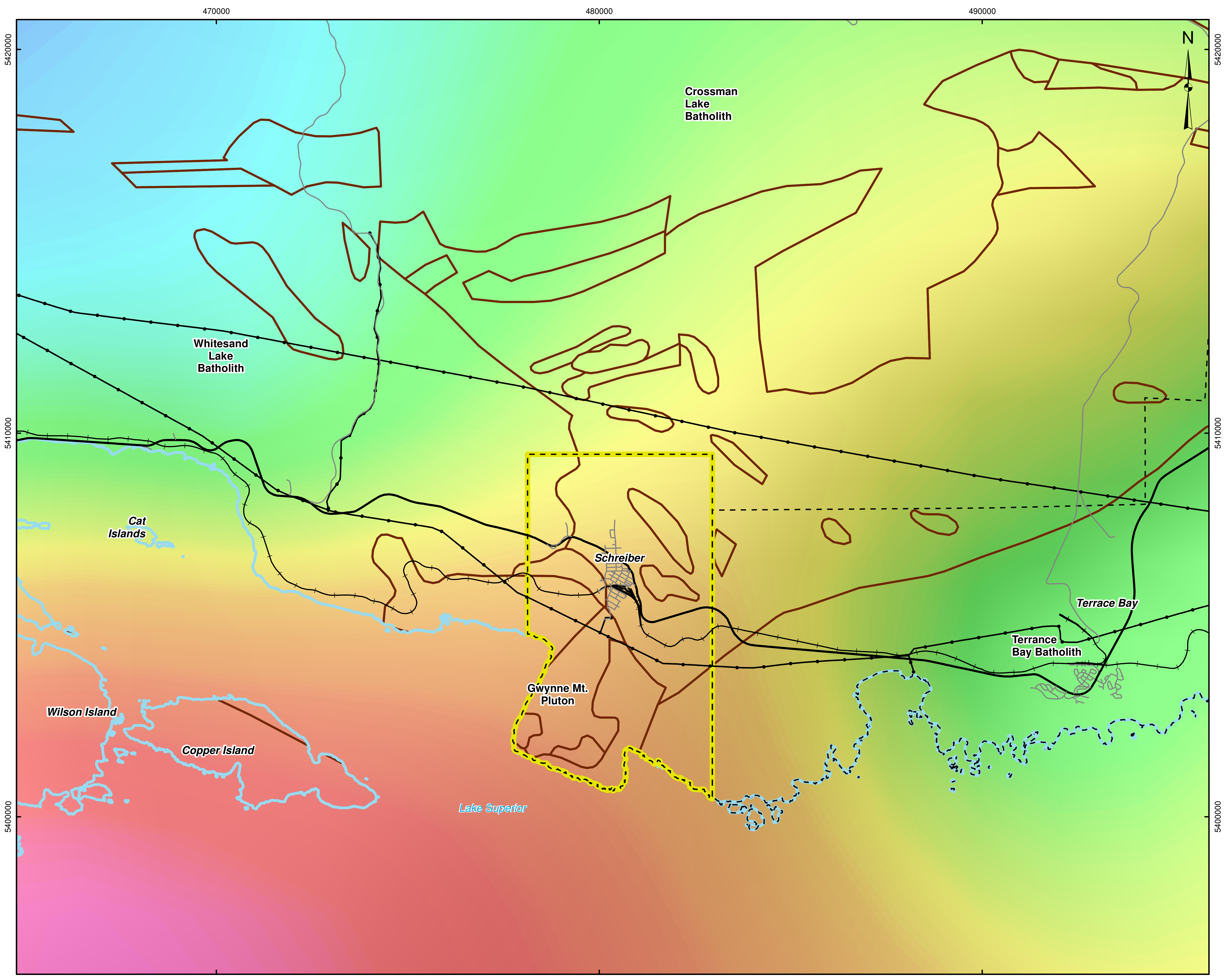
Geology of the East-Central Wawa Subprovince

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1152-0110			SCALE AS SHOWN	REV. 1.0
DESIGN	PRM	27 Jan. 2011		
GIS	PRM	2 Mar. 2011		
CHECK	CM	2 Mar. 2011		
REVIEW	GS	2 Mar. 2011		

FIGURE: 3.2


LEGEND
Township of Schreiber
Municipal Boundary, Lower Tier
Main Road
Local Road
Railway
Utility Line
Watercourse, Permanent
Water Area, Permanent
Geological Fault
Iron Formation
Geological Contact
34 Mafic and related intrusive rocks (Keweenawan age)
34a Logan and Nipigon sills (1109 Ma): diabase sills
32 Osler Gp., Maminse Point Fm., Michipicoten Island Fm.
31 Sibley Gp.
24 Sedimentary Rocks (Animikie Group): wacke, shale, iron formation, limestone, minor volcanic rocks, conglomerate, taconite, aldal chert, carbonate rocks, argillite-tuff
24a Rove Formation: argillite, shale, wacke, minor volcanic rocks
15 Massive granodiorite to granite
10 Mafic and ultramafic rocks
7 Metasedimentary rocks
6 Felsic to intermediate metavolcanic rocks
6a Dacitic and Andesitic flows, tuffs and breccias
5 Mafic to intermediate metavolcanic rocks
N
Sioux Lookout
Dryden
Greenstone
Kapuskasing
Marathon
Thunder Bay
Minnesota
INDEX MAP
REFERENCE
Base Data - MNR NRVIS, obtained 2009, CANMAP v2006.4
Geology: MRD126-Bedrock Geology of Ontario, 2007
Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2009
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N
2 1 0 2 4 6
SCALE 1:100,000 KILOMETRES
PROJECT
NWMO Desktop Level Initial Screening
TITLE
Bedrock Geology of the Schreiber Area
PROJECT NO. 10-1152-0110 | SCALE AS SHOWN | REV. 1.0
DESIGN PRM 27 Jan. 2011
GIS PRM 2 Mar. 2011
CHECK CM 2 Mar. 2011
REVIEW GS 2 Mar. 2011
Golder Associates
Mississauga, Ontario
FIGURE: 3.3
470000
480000
490000
5420000
5410000
5400000
Crossman Lake Batholith
Whitesand Lake Batholith
Terrance Bay Batholith
Gwynne Mt. Pluton
Schreiber
Terrace Bay
Lake Superior
Cat Islands
Wilson Island
Copper Island
Ross Lake Fault
Cook Lake Fault
Sox Creek Fault
Syenite Lake Fault
Worthington Bay Fault
Ellis Lake Fault
Schreiber Point Fault
Banana Lake
Triangle Lake
Third Lake, The
Gumboot Lake
Longcanoe Lake
Hornblende Lake
Bull Lake
Crystal Lake
Upper Ross Lake
Lower Ross Lake
Jimmie Lake
Needle Lake
Charlotte Lake
Crosman Lake
Bluff Lake
Guy Lake
Louise Lake
Deep Lake
Catherine Lake
Clear Lake
Robbie Lake
Spoke Lake
Hub Lake
Leader Lake
Rhumly Lake
Fog Lake
Sand Lake
Roadside Lake
Ducell Lake
Syenite Lake
Davidson Lake
Ottisse Lake
Maude Lake
Ansell Lake
Sox Lake
McLean's Lake
Antler Lake
Sammy's Lake
Lyne Lake
Victoria Lake
Umba Lake
Little Bear Lake
Ellis Lake
Ashmore Lake
Tent Lake
Big Bear Lake
Glen Lake
Minnow Lake
Held Lake
Whitesand Lake
Birch Lake
Jason Lake
Hackle Lake
Rennie Lake
North Cook Lake
Lizzard Lake
Spectacle Lake
Cook Lake
Walker Lake
Packsack Lake
Billy Lake
Hollinger Lake
Von Lake
Perch Lake
Rongie Lake
Lamont Lake
Hays Lake
Ayah Lake
Coffee Lake
Fourth Lake
Lost Lake



LEGEND

- Township of Schreiber
- Municipal Boundary, Lower Tier
- Main Road
- Local Road
- Railway
- Utility Line
- Water Area, Permanent
- Geological Contact

Gravity Anomaly (mGal)

0, -5, -10, -15, -20, -25, -30, -35, -40, -45, -50, -55, -60, -65, -70, -75, -80

REFERENCE

Base Data - MNR NRVIS, obtained 2009, CANMAP v2006.4
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2009
Geophysics: GSC Canada - 2km resolution - Gravity Anomalies, 2010;
Canadian Aeromagnetic Data Base,Airborne Geophysics Section, GSC - Central Canada
Division,Geological Survey of Canada,Earth Sciences Sector,Natural Resources Canada
Geology: MRD126-Bedrock Geology of Ontario, 2007
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N

2 1 0 2 4 6

SCALE 1:100,000 KILOMETRES

PROJECT

NWMO Desktop Level Initial Screening

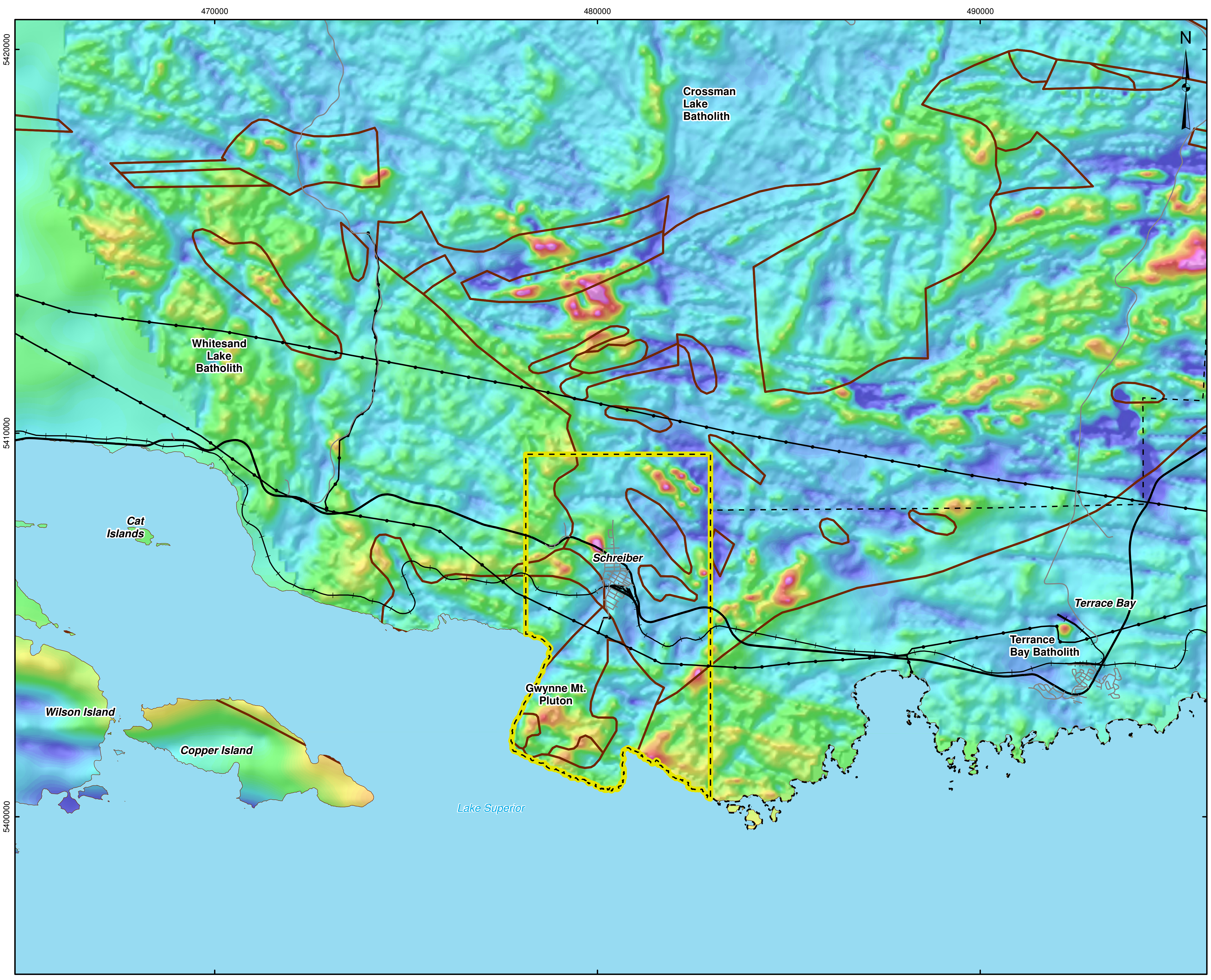
TITLE

Gravity Map of the Schreiber Area

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1152-0110			SCALE AS SHOWN	REV. 1.0
DESIGN	PRM	27 Jan. 2011	**FIGURE: 3.4**	
GIS	PRM	18 Mar. 2011		
CHECK	JF	18 Mar. 2011		
REVIEW	GS	18 Mar. 2011		

G:\Projects\2010\10-1152-0110_NWMO_Initial_Screening\GIS\MXDs\Reporting\phase5000\GravityMapSchreiber.mxd



LEGEND

- Township of Schreiber
- Municipal Boundary, Lower Tier
- Main Road
- Local Road
- Railway
- Utility Line
- Water Area, Permanent
- Geological Contact

Residual Total Magnetic Field (nT)

1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
-200
-300
-400

REFERENCE

Base Data - MNR NRVIS, obtained 2009, CANMAP v2006.4
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2009
Geophysics: GSC Canada - 200m - Magnetic - Residual Total Field, 2008;
Canadian Aeromagnetic Data Base,Airborne Geophysics Section, GSC - Central Canada
Division,Geological Survey of Canada,Earth Sciences Sector,Natural Resources Canada
Geology: MRD126-Bedrock Geology of Ontario, 2007
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N

2 1 0 2 4 6

SCALE 1:100,000 KILOMETRES

PROJECT

NWMO Desktop Level Initial Screening

TITLE

Residual Total Magnetic Field of the Schreiber Area

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1152-0110			SCALE AS SHOWN	REV. 1.0
DESIGN	PRM	27 Jan. 2011	**FIGURE: 3.5**	
GIS	PRM	18 Mar. 2011		
CHECK	JF	18 Mar. 2011		
REVIEW	GS	18 Mar. 2011		

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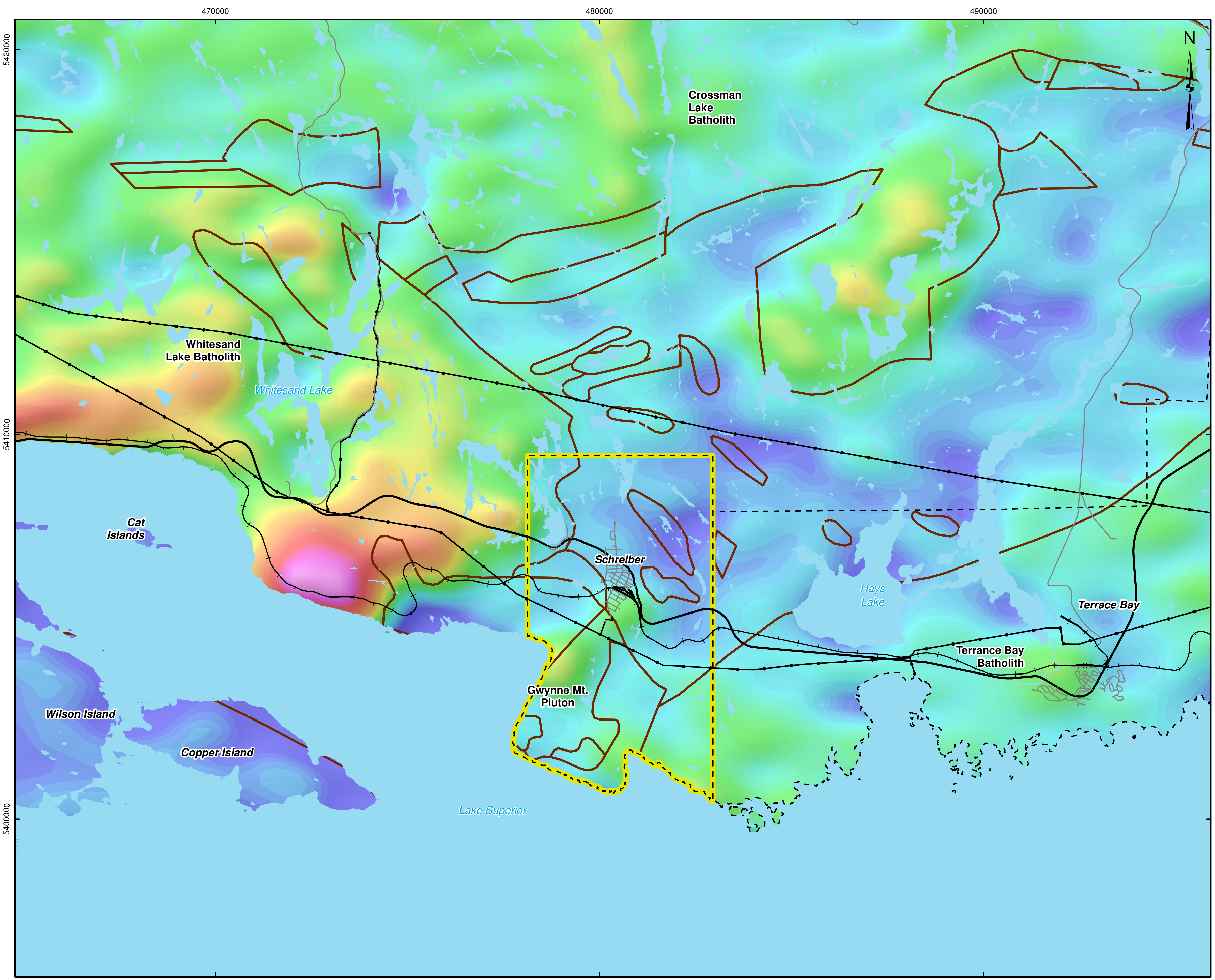


LEGEND

- Township of Schreiber
- Municipal Boundary, Lower Tier
- Main Road
- Local Road
- Railway
- Utility Line
- Water Area, Permanent
- Geological Contact

Equivalent Uranium (ppm)

3
2.75
2.5
2.25
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0

REFERENCE

Base Data - MNR NRVIS, obtained 2009, CANMAP v2006.4
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2009
Radiometrics: GSC Canada - 250m -Equivalent Uranium, 2010;
National Gamma-Ray Spectrometry Program Data Base, Airborne Geophysics Section,GSC -
Central Canada Division, Geological Survey of Canada, Earth Sciences Sector,Natural Resources Canada
Geology: MRD126-Bedrock Geology of Ontario, 2007
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N

2 1 0 2 4 6

SCALE 1:100,000 KILOMETRES

PROJECT

NWMO Desktop Level Initial Screening

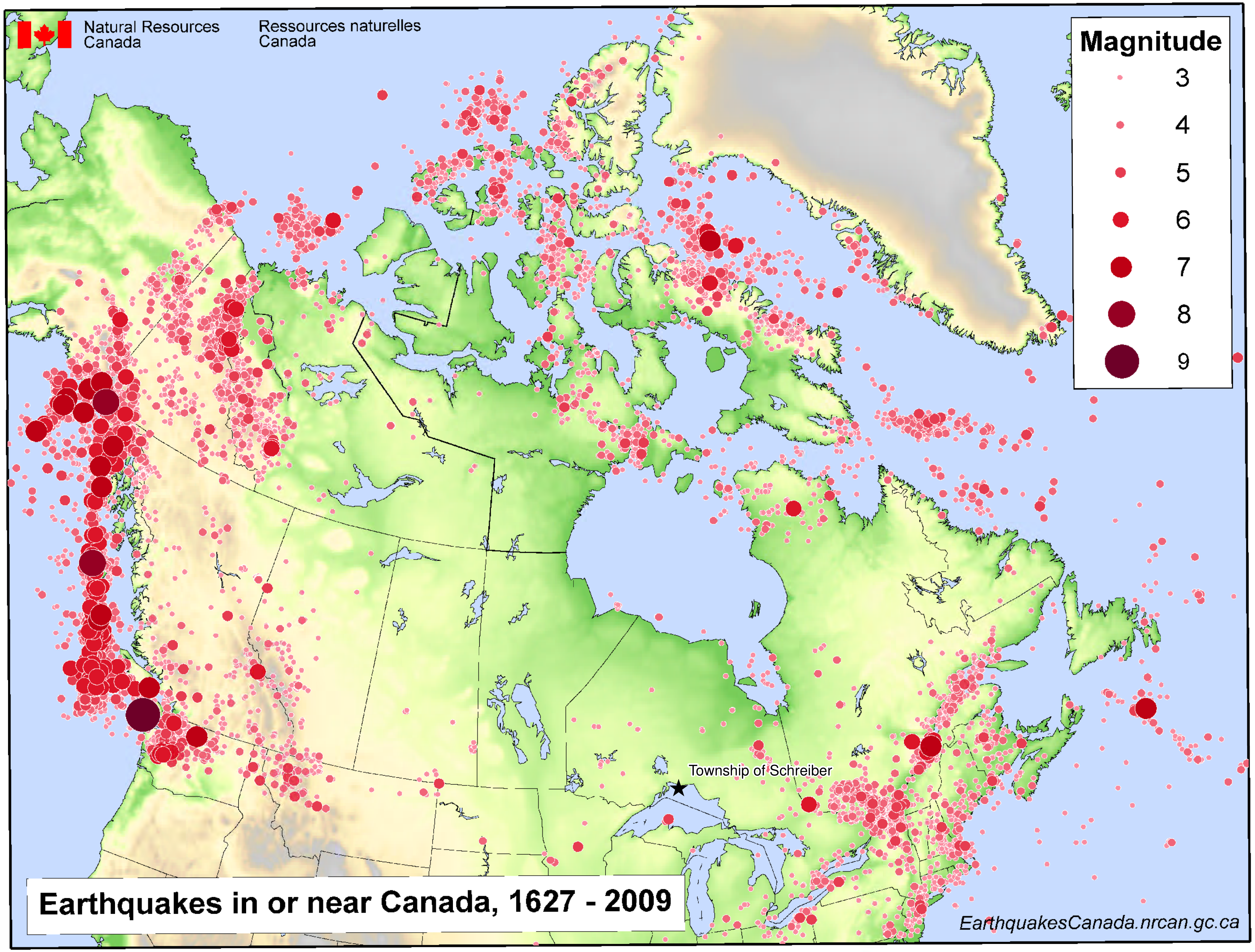
TITLE

Equivalent Uranium of the Schreiber Area

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1152-0110			SCALE AS SHOWN	REV. 1.0
DESIGN	PRM	27 Jan. 2011	**FIGURE: 3.6**	
GIS	PRM	18 Mar. 2011		
CHECK	JF	18 Mar. 2011		
REVIEW	GS	18 Mar. 2011		

G:\Projects\2010\10-1152-0110_NWMO_Initial_Screening\GIS\MXDs\Reporting\phase5000\EquivalentUraniumSchreiber.mxd



LEGEND

★ Township of Schreiber

REFERENCE

Base Data - ESRI Digital Chart of the World,2010
Seismic: NRCAN, Earthquake Map of Canada 1627-2007
Projection:NA

PROJECT

NWMO Desktop Level Initial Screening

TITLE

Earthquakes Map of Canada 1627-2009

Golder Associates, Mississauga, Ontario	PROJECT NO. 10-1152-0110		SCALE AS SHOWN	REV. 1.0
	DESIGN	PB	30 Aug. 2010	**FIGURE: 3.7**
	GIS	PRM	2 Mar. 2011	
	CHECK	JF	2 Mar. 2011	
	REVIEW	GS	2 Mar. 2011	

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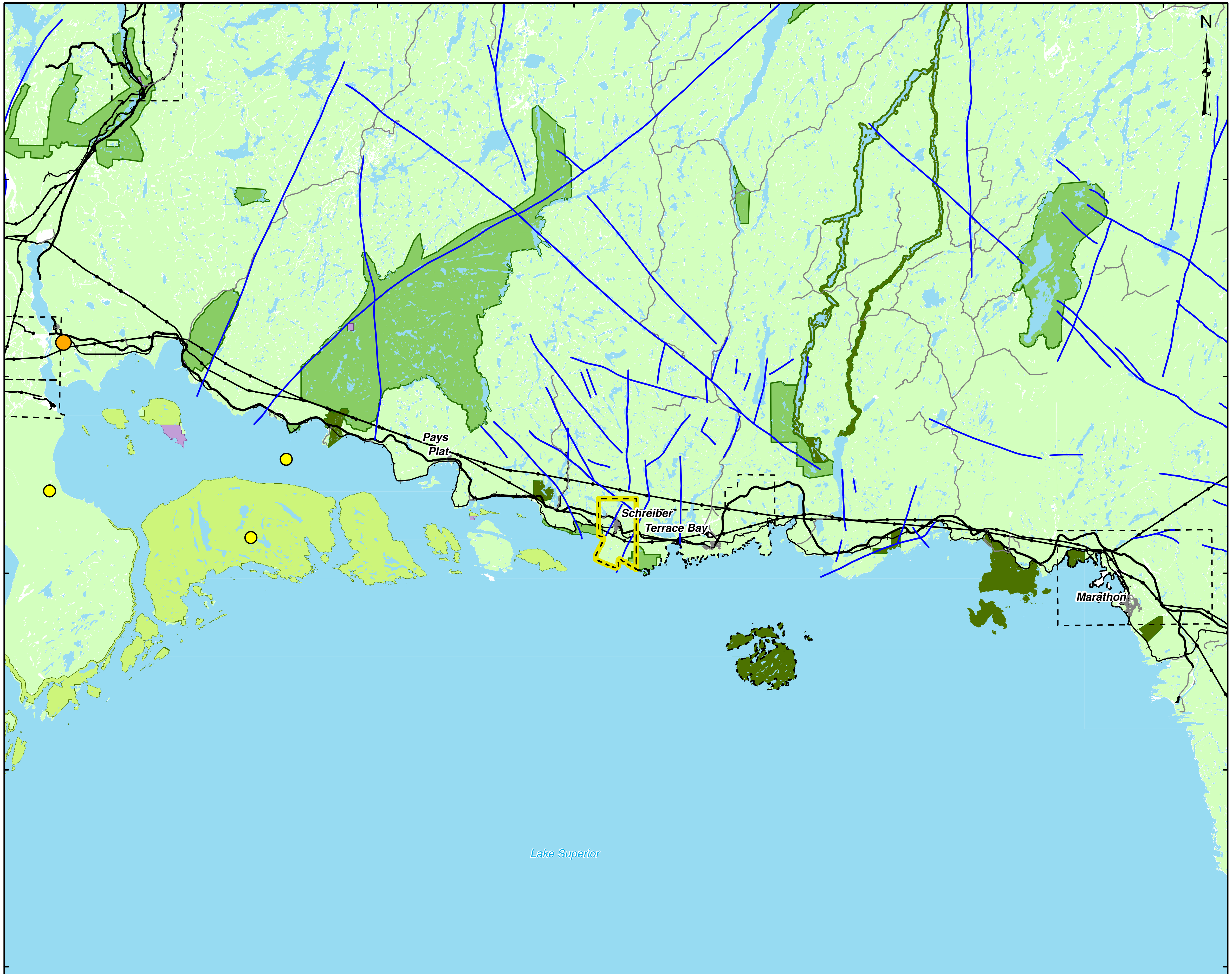


LEGEND

- Township of Schreiber
- Municipal Boundary, Lower Tier
- Main Road
- Local Road
- Railway
- Utility Line
- Water Area, Permanent
- Wooded Area
- Recommended Conservation Reserve
- Forest Reserve
- Conservation Reserve
- Provincial Park
- Geological Fault

Seismic Events (Magnitude)

- < 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- > 3.0

REFERENCE

Base Data - MNR NRVIS, obtained 2009, CANMAP v2006.4
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2009
Seismic:Earthquakes Canada, GSC, Earthquake Search (On-line Bulletin), Sept 2010
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N

10 5 0 10 20 30
SCALE 1:500,000 KILOMETRES

PROJECT

NWMO Desktop Level Initial Screening

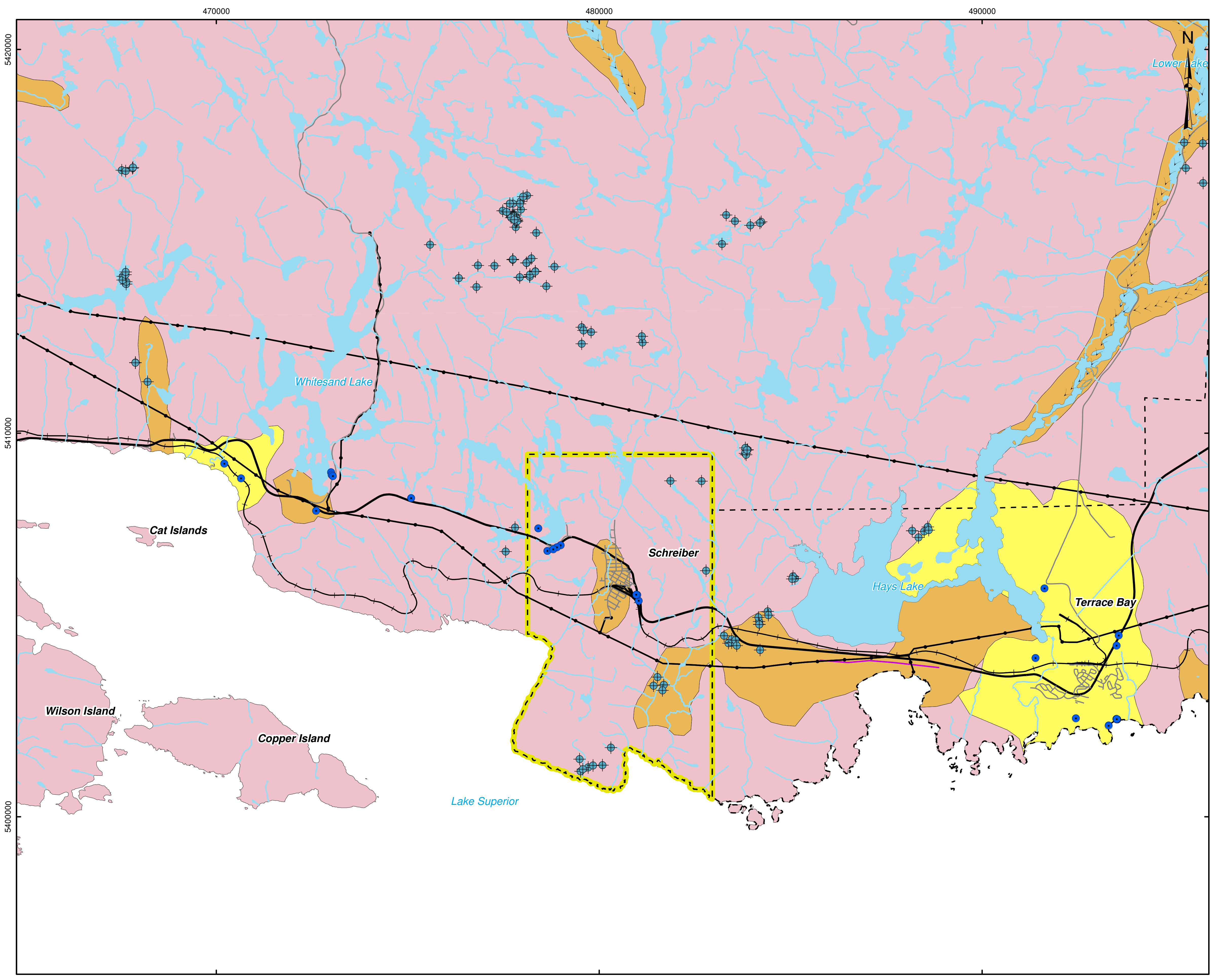
TITLE

Historical Earthquake Records for the Schreiber Area and Surroundings 1985-2010

PROJECT NO. 10-1152-0110			SCALE AS SHOWN	REV. 1.0
DESIGN	PRM	27 Jan. 2011	**FIGURE: 3.8**	
GIS	PRM	2 Mar. 2011		
CHECK	CM	2 Mar. 2011		
REVIEW	GS	2 Mar. 2011		

Golder Associates
Mississauga, Ontario

G:\Projects\2010\10-1152-0110_NWMO_Initial_Screening\GIS\MXDs\Reporting\phase5000\HistoricalEarthQuakeRecordsSchreiberArea1985to2010.mxd



LEGEND

- Township of Schreiber
- Municipal Boundary, Lower Tier
- Main Road
- Local Road
- Railway
- Utility Line
- Watercourse, Permanent
- Water Area, Permanent
- MOE Well Location
- Diamond Drill Hole
- Esker or Area of Eskers; Direction of Flow know or Assumed
- Terrace Escarpment (Abandoned Shore Bluff)
- 1: Bedrock
- 18: Till
- 22: Glaciofluvial Ice
- 23: Glaciofluvial Outwash deposits
- 24: Glaciolacustrine deposits
- 25: Glaciolacustrine deposits
- 28: Fluvial deposits
- 31: Fluvial deposits
- 32: Organic deposits
- 33: Lakes

REFERENCE

Base Data - MNR NRVIS, obtained 2009, CANMAP v2006.4
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2009
Geology: Modified EDS014-Surficial Geology of Ontario 1:1,000,000, 2000
Wells: Ministry of the Environment, 2010
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N

2 1 0 2 4 6
SCALE 1:100,000 KILOMETRES

PROJECT

NWMO Desktop Level Initial Screening

TITLE

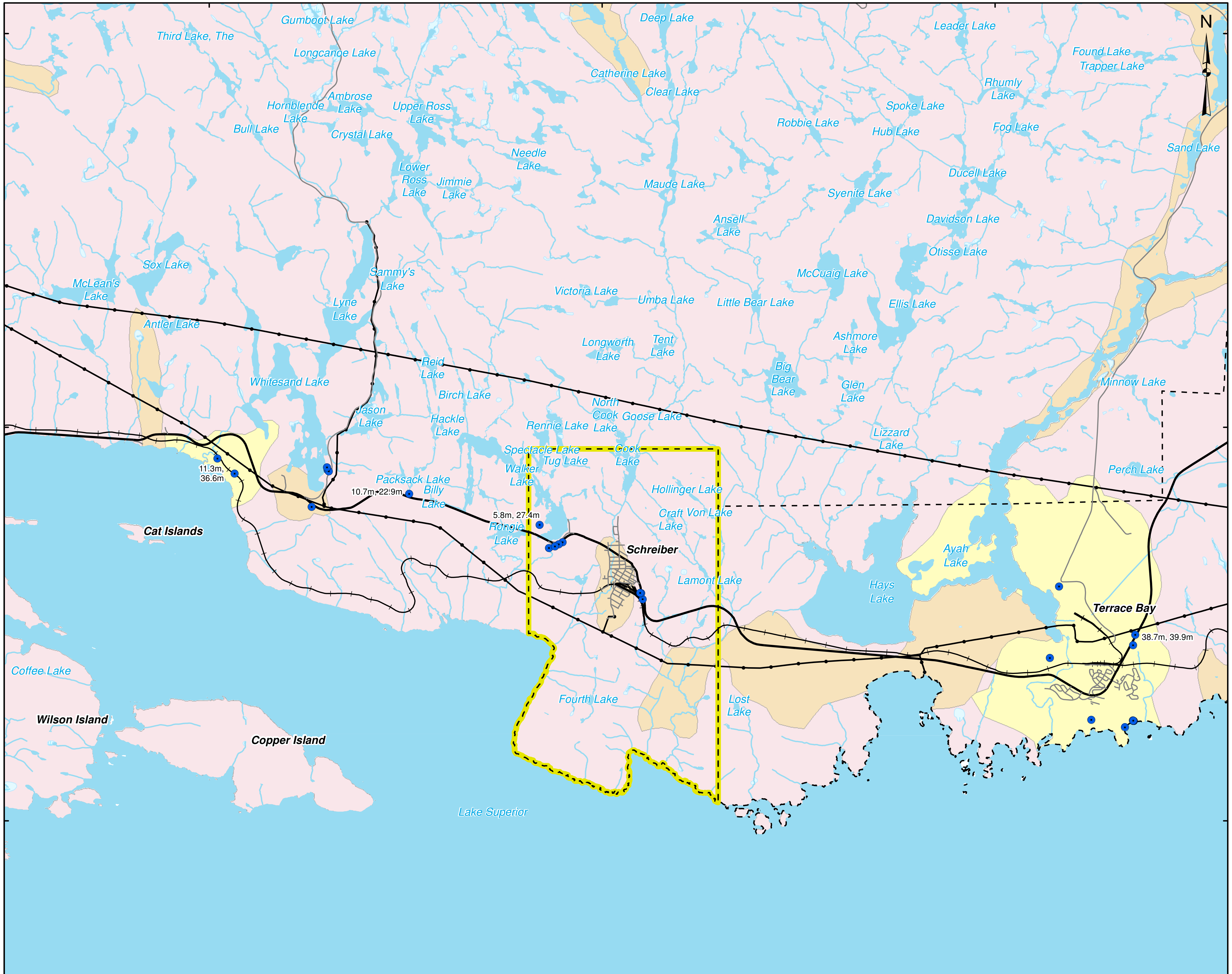
Quaternary Geology of the Schreiber Area

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1152-0110			SCALE AS SHOWN	REV. 1.0
DESIGN	PRM	27 Jan. 2011		
GIS	PRM	18 Mar. 2011		
CHECK	CM	18 Mar. 2011		
REVIEW	GS	18 Mar. 2011		

FIGURE: 3.9

G:\Projects\2010\10-1152-0110_NWMO_Initial_Screening\GIS\MXDs\Reporting\phase5000\QuaternaryGeologySchreiber.mxd



G:\Projects\2010\10-1152-0110_NWMO_Initial_Screening\GIS\MXDs\Reporting\phase5000\WaterWellRecordsoftheSchreiberArea.mxd

LEGEND

- Township of Schreiber
- Municipal Boundary, Lower Tier
- Main Road
- Local Road
- Railway
- Utility Line
- Watercourse, Permanent
- Watercourse, Intermittent
- Water Area, Permanent
- Wetland Area, Permanent
- MOE Well (Depth to Bedrock, Depth to Water)
- 1: Bedrock
- 18: Till
- 22: Glaciofluvial Ice
- 23: Glaciofluvial Outwash deposits
- 24: Glaciolacustrine deposits
- 25: Glaciolacustrine deposits
- 28: Fluvial deposits
- 31: Fluvial deposits
- 32: Organic deposits

REFERENCE

Base Data - MNR NRVIS, obtained 2009, CANMAP v2006.4
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2009
Geology: Modified EDS014-Surficial Geology of Ontario 1:1,000,000, 2000
Wells: Ministry of the Environment, 2010
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N

2 1 0 2 4 6

SCALE 1:100,000 KILOMETRES

PROJECT

NWMO Desktop Level Initial Screening

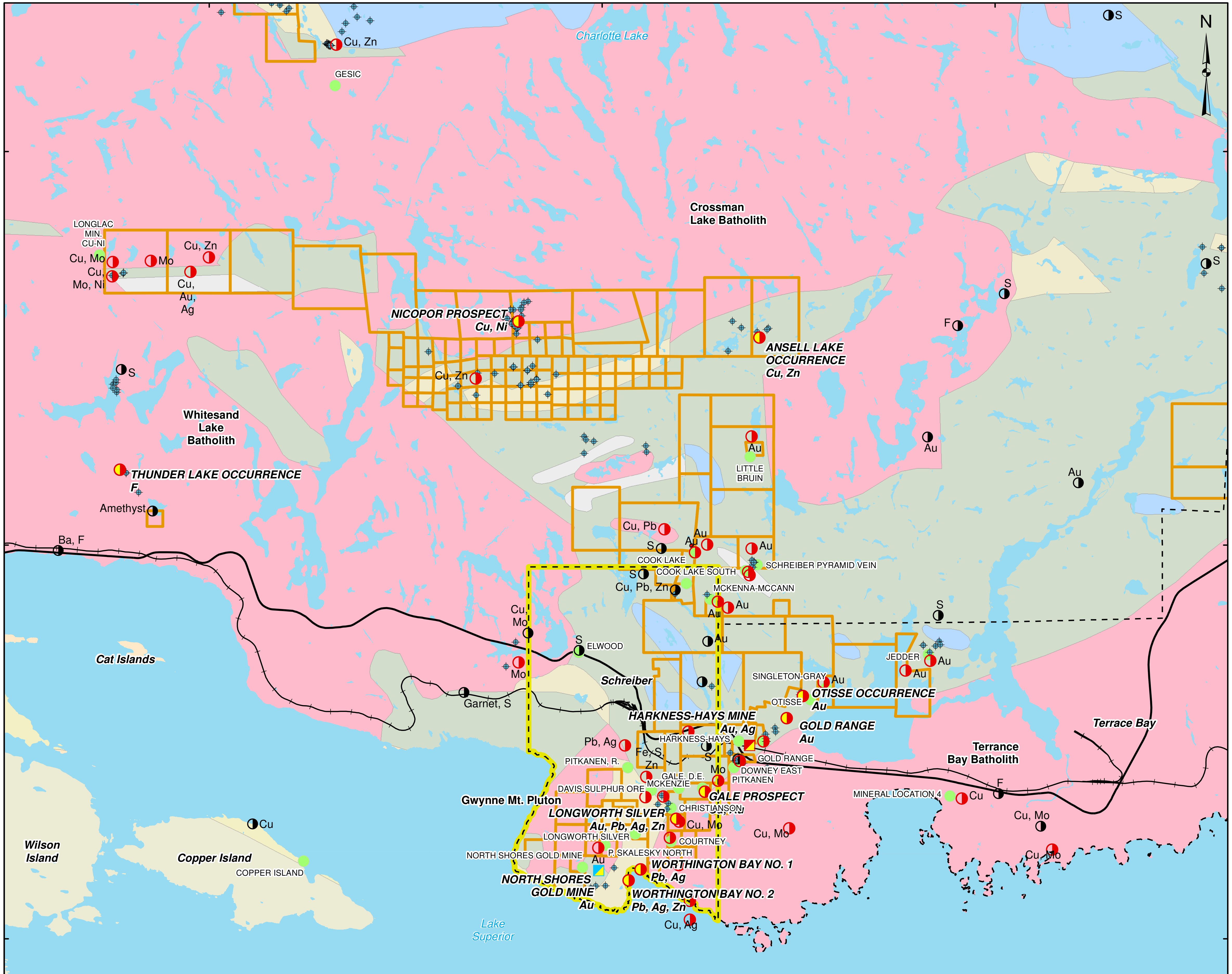
TITLE

Water Well Records of the Schreiber Area

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1152-0110			SCALE AS SHOWN	REV. 1.0
DESIGN	PRM	27 Jan. 2011		
GIS	PRM	18 Mar. 2011		
CHECK	CM	18 Mar. 2011		
REVIEW	GS	18 Mar. 2011		

FIGURE: 4.1



LEGEND

- Township of Schreiber
- Municipal Boundary, Lower Tier
- Main Road
- Railway
- Water Area, Permanent

Mineral Occurence
- Discretionary Occurence
- Occurence
- Past Producing Mine with Reserves
- Past Producing Mine without Reserves

Mineral Occurence Named in Text
- Occurence
- Past Producing Mine with Reserves
- Past Producing Mine without Reserves
- Diamond Drill Hole
- AMIS Site (Abandoned Workings)
- Active Mining Claims
- 34 Mafic and related intrusive rocks (Keweenawan age)
- 34a Logan and Nipigon sills (1109 Ma): diabase sills
- 32 Osler Gp., Maminse Point Fm., Michipicoten Island Fm.
- 31 Sibley Gp.
- 24 Sedimentary Rocks (Animikie Group): wacke, shale, iron formation, limestone, minor volcanic rocks, conglomerate, taconite, aldal chert, carbonate rocks, argillite-tuff
- 24a Rove Formation: argillite, shale, wacke, minor volcanic rocks
- 15 Massive granodiorite to granite
- 11 Gneissic tonalite suite
- 10 Mafic and ultramafic rocks
- 7 Metasedimentary rocks
- 6 Felsic to intermediate metavolcanic rocks
- 6a Dacitic and Andesitic flows, tuffs and breccias
- 5 Mafic to intermediate metavolcanic rocks
- 2 Felsic to intermediate metavolcanic rocks

REFERENCE

Base Data - MNR NRVIS, obtained 2009, CANMAP v2006.4
Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2009
Claims:Ministry of Northern Development, Mines, and Forestry July 2010
AMIS: Ministry of Northern Development, Mines, and Forestry
Mineral Inventory: Mineral Deposit Inventory of Ontario v2, 2004
Geology: MRD126-Bedrock Geology of Ontario, 2007
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N

2 1 0 2 4 6
SCALE 1:100,000 KILOMETRES

PROJECT
NWMO Desktop Level Initial Screening

TITLE
Mining Claims and Mineral Potential in the Schreiber Area

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FIGURE: 5.1

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At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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