



NUCLEAR WASTE MANAGEMENT ORGANIZATION SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Phase 1 Desktop Assessment Environment Report

TOWNSHIP OF HORNEPAYNE, ONTARIO



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PHASE 1 DESKTOP ASSESSMENT

Environment Report Township of Hornepayne, Ontario

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REPORT

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Table of Contents

1.0 INTRODUCTION..... 1

2.0 COMMUNITIES AND INFRASTRUCTURE0

 2.1 Communities.....0

 2.2 Infrastructure.....0

 2.3 Protected Areas 1

 2.3.1 Parks and Reserves..... 1

 2.3.2 Heritage Sites 1

 2.4 Land Use2

3.0 DESCRIPTION OF THE ENVIRONMENT0

 3.1 Physiography.....0

 3.2 Geology0

 3.2.1 Bedrock Geology.....0

 3.2.2 Quaternary Geology.....0

 3.3 Natural Environment 1

 3.3.1 Natural Environment Overview 1

 3.3.2 Natural Areas 1

 3.3.3 Terrestrial Features and Wildlife 1

 3.3.4 Aquatic Features and Fish2

 3.3.5 Endangered, Threatened and Special Concern Species2

 3.3.6 Aboriginal Interests and Traditional Knowledge4

 3.4 Background Environmental Conditions4

 3.4.1 Air Quality4

 3.4.2 Background Radiation.....5

 3.4.3 Soil Quality.....5

 3.4.4 Water Quality6

 3.4.5 Lake Sediment Chemistry6

 3.4.6 Potential Sources of Pollutants6

 3.5 Surface Water Hydrology.....7



3.6	Groundwater and Wells	7
3.6.1	Overburden Aquifers	7
3.6.2	Bedrock Aquifers.....	8
3.7	Climate and Meteorology.....	8
3.7.1	Temperature	8
3.7.2	Precipitation	9
3.7.3	Wind.....	9
3.8	Natural Hazards.....	9
3.8.1	Earthquakes and Seismicity.....	9
3.8.2	Tornadoes and Hurricanes.....	9
3.8.3	Drought and Flooding.....	9
3.8.4	Snow and Ice	10
3.8.5	Forest Fires and Lightning	10
3.8.6	Landslides and Tsunamis	10
4.0	SUMMARY.....	0
5.0	REFERENCES.....	0

TABLES

Table 1: Population Statistics for the Hornepayne Area.....	0
Table 2: Potential Endangered, Threatened and Special Concern Species in the Hornepayne Area.....	3
Table 3: NPRI Regional Sources of Air Emissions.....	5
Table 4: Registered Landfills in the Hornepayne Area	6
Table 5: Water Well Record Summary for the Hornepayne Area.....	7

FIGURES (IN ORDER FOLLOWING TEXT)

- Figure 1: Hornepayne and Surrounding Lands
- Figure 2: Satellite Imagery of the Hornepayne Area
- Figure 3: Hornepayne Area Land Ownership
- Figure 4: Hornepayne – Parks and Protected Lands
- Figure 5: Forest Management Units of the Hornepayne Area
- Figure 6: Digital Elevation Model (DEM) of the Hornepayne Area



Figure 7: Bedrock Geology of the Hornepayne Area

Figure 8: Quaternary Geology of the Hornepayne Area

Figure 9: Hornepayne – Terrestrial Ecology

Figure 10: Hornepayne – Aquatic Ecology

Figure 11: Hornepayne – Background Radiation Levels

Figure 12: Hornepayne Surface Water Drainage and Water Wells

Figure 13: Hornepayne 1971-2000 Temperature Data Summary

Figure 14: Hornepayne 1971-2000 Precipitation Data Summary

Figure 15: Nagagami Annual and Seasonal Wind Rose



ENVIRONMENT REPORT - TOWNSHIP OF HORNEPAYNE, ONTARIO



1.0 INTRODUCTION

The Township of Hornepayne in north-central Ontario is considering hosting a facility to manage Canada's Used Nuclear Fuel through the Nuclear Waste Management Organization's (NWMO) Adaptive Phased Management Site Selection Process (NWMO, 2010). This process is seeking to find a site for a deep geological repository that will provide safe long-term containment and isolation with an informed and willing host community. The process is presently at an early stage.

Part of the process is focussed on determining if there are environmental features that would preclude the potential for a facility to be constructed in the vicinity of Hornepayne. To this end, this report provides a high level description of the environment in the Township of Hornepayne and surrounding area. It is complemented by reports prepared in parallel which characterize the geoscientific conditions and community well-being profile of this area. These reports are summarized, with other information, in an integrated Preliminary Assessment Report.

This report is not an environmental assessment. Its purpose is to provide a high level description of the current human and natural environment based on readily available sources of data. Additional detailed information for specific locations will be sought at subsequent phases of the work.

The area considered here is similar to that used for the Phase I Geoscientific Assessment for Hornepayne. This area is shown on Figure 1, and includes the Township of Hornepayne and surrounding area.



ENVIRONMENT REPORT - TOWNSHIP OF HORNEPAYNE, ONTARIO



2.0 COMMUNITIES AND INFRASTRUCTURE

2.1 Communities

The Township of Hornepayne is approximately 205 km² in size¹, located in north-central Ontario approximately 130 km north of the eastern end of Lake Superior (LIO, 2012). The township is shown on Figure 1 located approximately 340 km east of Thunder Bay, 260 km west of Timmins, and 400 km north of Sault Ste. Marie. Leigh, a railway siding, is located 35 km to the northwest. Figure 2 presents satellite imagery for the area taken in 2006. Table 1 summarizes the total population and population density for the Township of Hornepayne and District of Algoma.

Table 1: Population Statistics for the Hornepayne Area

Political Boundary	Population	Population Density per km ²
Township of Hornepayne	1,050	5.1
District of Algoma	115,870	2.4

Source: 2011 Census of Population (Statistics Canada, 2012)

Figure 1 also shows the geographic boundaries for neighbouring townships within the Hornepayne area. These township boundaries represent former municipal boundaries; the Township of Hornepayne is the only township within the Hornepayne area that currently maintains a municipal government (MMAH, 2009). Land ownership within the Hornepayne area, including areas of Crown land², Crown Reserve³ lands, parks and reserves, and private lands, is shown on Figure 3.

There are a number of Aboriginal communities and organizations in the Hornepayne area including Brunswick House First Nation, Chapleau Cree First Nation, Constance Lake First Nation, Michipicoten First Nation, Missanabie Cree First Nation, Ojibways of the Pic River (Heron Bay) and Pic Mobert First Nation. Métis Councils in the area include Greenstone Métis Council, Superior North Shore Métis Council and Thunder Bay Métis Council as represented by Lakehead/Michipicoten/Nipigon Traditional Territory Consultation Committee and Chapleau Métis Council, Métis Nation of Ontario Timmins Council, Northern Lights Métis Council and Temiskaming Métis Council as represented by Abitibi/Temiskamingue and James Bay Traditional Territory Consultation Committee and the Métis Nation of Ontario.

Further information on Hornepayne and its surrounding communities, including First Nations and Métis communities, is provided in the Community Profile Report for Hornepayne.

2.2 Infrastructure

Figure 1 shows the location of the primary infrastructure corridors in the Hornepayne area. The main transportation route is Highway 631 which passes through the center of the Hornepayne area in a north-south orientation, and through the Township of Hornepayne. The CN main rail line runs east-west through the Hornepayne area and an electrical distribution line runs eastward into Hornepayne from Manitowadge. As

¹ Area calculated using Geographic Information System (GIS) municipal boundaries from the Ministry of Municipal Affairs and Housing (MMAH, 2009).

² Crown land is divided on the Figure into Crown Leased Land, Non-freehold Disposition Public and Unpatented Public Land. Crown Leased land is acquired by MNR for reasons based on ecological sustainability, including ecosystem health, the protection of natural and cultural assets, recreation, and / or the protection of people and property. Non-freehold Dispositions Public are a tenure holding, usually for a set term and a specific purpose (e.g., Lease, Licence of Occupation, Land Use Permit, Beach Management Agreement and Easement), excluding permanent disposition in the form of a patent. Unpatented Public Land is generally land that has never been granted or sold by the Crown to people or organizations for their private use and are under the mandate or management of the MNR.

³ Crown Reserves are Crown lands that have been withdrawn from dispositioning under Section 21 of the Crown Minerals Act.



shown on Figure 1, there is an airport in the Hornepayne area south of Hornepayne and a float plane base west of Hornepayne. There are no pipelines within the Hornepayne area. The Ontario Ministry of the Environment (MOE) identifies four operating landfills within the Hornepayne area, including the Municipal Landfill operated by the Township of Hornepayne. There is one wastewater treatment plant in the Hornepayne area.

2.3 Protected Areas

2.3.1 Parks and Reserves

There are no provincial parks or conservation reserves within the Township of Hornepayne. The only park within the Hornepayne area is the Nagagamisis Provincial Park (Figure 4), covering 425 km² (LIO, 2012); it is classified as a natural environment park (Ontario Parks, 2006). The park is located in the vicinity of Nagagami and Nagagamisis Lakes, approximately 15 km to the north of the Township, and contains the former Nagagami Lake Provincial Nature Reserve which was incorporated into the Park, as well as a Forest Reserve. The park area provides camping, fishing and canoeing along the Nagagami Lake, and Nagagami and Shekak rivers (Ontario Parks, 2006).

2.3.2 Heritage Sites

The cultural heritage screening examined known archaeological and historic sites in the Hornepayne area, using the Ontario Archaeological Sites Database, the Ontario Heritage Trust Database and the National Historic sites Database. There are 21 known archaeological sites in the Hornepayne area (von Bitter, 2012). There are no National or Provincial Historic Sites in the Hornepayne area (Ontario Heritage Trust, 2012; Parks Canada, 2012).

There is one known archaeological site located within the Township of Hornepayne. The site is a pre-contact Aboriginal isolated find (a chert flake), on the south shore of Wicksteed Lake, north of the Township of Hornepayne. Little archaeological research has been undertaken in the southwest Albany River basin. In the early 1970s an archaeological survey of Nagagamisis Provincial Park resulted in the documentation of 15 archaeological sites. Of these sites, all are Late Woodland and/or historic Algonkian with the exception of one historic Euro-Canadian trading post. More recently, a cultural heritage assessment in 2000 - 2001 documented 20 Aboriginal heritage values sites in the Nagagamisis area (HFMI, 2007). Additionally, the cultural heritage assessment in the Nagagamisis area documented more than 30 culturally modified trees that were used by First Nations peoples to mark burial sites, campsites and portages. This is the first large-scale occurrence of these First Nations heritage features to be located in Ontario. The Nagagami Lake area is also the location of five known archaeological sites – three Aboriginal pre-contact sites and two historic Euro-Canadian sites.

Archaeological potential is established by determining the likelihood that archaeological resources may be present on a subject property. In archaeological potential modelling, a distance to water criterion of 300 m is generally employed for primary water courses, including lakeshores, rivers and large creeks, as well as secondary water sources, including swamps and small creeks (Government of Ontario, 2011). The potential for archaeological and historical sites within the Hornepayne area is considered to be high, given the sites already documented and the proximity to primary water courses with known archaeological sites. 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.



2.4 Land Use

Land use described in this section refers to commercial land use such as forestry, mining, trapping and agriculture, but not recreation or Aboriginal spiritual use.

Forestry is a major industry in the area and includes a number of private timber companies currently managing forestry operations, including the Olav Haavaldsrud Timber Company Ltd., operating in this area since 1953. Forest Management Units (FMU) in the vicinity of Hornepayne are presented on Figure 5.

The Township of Hornepayne lies in the Nagagami FMU, which extends in all directions around the Township and is managed by Nagagami Forest Management Ltd. Northwest of Hornepayne, a portion of the Big Pic Forest falls within the Hornepayne area. To the south is a portion of the White River FMU and to the north is the Hearst FMU.

Within heavily forested areas such as the Hornepayne area there is a risk of forest fires. Locations where forest fires occurred in the vicinity of the Hornepayne area between 1976 and 2010, affecting an area of greater than 200 ha, are also shown on Figure 5.

There are currently no producing mines in the Hornepayne area. Few low grade base metal (i.e., iron, copper and copper-nickel) and sulphide occurrences have been discovered in the Hornepayne area. The nearest historically producing mines, including the Willroy Mine, Big Nama Creek Mine and Noranda's Geco Mine, are located in the Manitouwadge area, approximately 50 km to the west of the Township of Hornepayne. Economic base metals in the volcanogenic massive sulphide (VMS) deposits are associated with the Manitouwadge-Hornepayne greenstone belt⁴. Known non-metallic mineral resources within the Hornepayne area include sand and gravel, stone, garnet, diopside and graphite.

Figure 3 shows areas of private land, including large areas of patented land for mining and timber harvesting, within the geographic township boundaries for Derry, Dowsley, Langemark and Alderson townships.

As noted in Section 3.3, other land uses include trapping and fishing.

⁴ A greenstone belt is a zone of volcanic and sedimentary rocks that have undergone metamorphic alteration. The name comes from the green hue imparted by the colour of the dominant minerals within the rocks.



ENVIRONMENT REPORT - TOWNSHIP OF HORNEPAYNE, ONTARIO



3.0 DESCRIPTION OF THE ENVIRONMENT

3.1 Physiography

The Canadian Shield region generally has a low-relief, gently undulating land surface with an elevation of about 150 masl (metres above sea level) in the north and about 450 masl in the south (NRCan, 2011). The Township of Hornepayne lies in the Abitibi Highlands, a broadly rolling surface of Canadian Shield bedrock that occupies most of north-central Ontario and which is either exposed at surface or shallowly covered with Quaternary⁵ glacial deposits or post-glacial organic soils (Thurston, 1991). The land surface is generally rugged with elevations ranging from 483 masl in the southwest, 6 km west of Obakamiga Lake to 263 masl where the Shekak River intersects the northern boundary of the Hornepayne area.

The highest elevations within the Township of Hornepayne occur in the southwest, in the Government Lakes area and also southwest of Wicksteed Lake and along the south side of Marten Lake. The lowest elevations in the Township occur at approximately 300 masl, along the banks of the Jackfish River (tributary to the Shekak River) in the southeast corner of the Township. Topographic highs generally correspond to exposed bedrock while topographic lows are typically areas of thicker overburden. Figure 6 presents the topography of the Hornepayne area as a digital elevation model (DEM).

3.2 Geology

3.2.1 Bedrock Geology

The bedrock geology of the Hornepayne area is shown on Figure 7. Geologically, the municipal boundaries of Township of Hornepayne are situated in the Quetico and Wawa Subprovinces, which is part of the Superior Province of the Canadian Shield – 3 to 2.6 billion year old rocks that form the core of the North American continent. The Township of Hornepayne is almost entirely (about 95%) underlain by the metasedimentary rocks of the Quetico Subprovince. The southern edge of the Township is underlain by an east-west striking belt of metavolcanic rocks, approximately 1 to 2 km wide, within the Wawa Subprovince. These metavolcanic rocks are part of the Manitouwadge-Hornepayne greenstone belt⁶ (Williams et al., 1991), which extends beyond the Township boundaries to the east and west along the border between the two subprovinces.

Two large muscovite-bearing granitic intrusions are located in the northern half of the Hornepayne area, approximately 7 km north of the Township boundaries. South of the Township, the bedrock geology is dominated by the Black-Pic batholith⁷ of the Wawa Subprovince, a vast, regionally-extensive batholith comprised primarily of foliated to gneissic tonalite to granodiorite.

3.2.2 Quaternary Geology

The Quaternary geology of the Hornepayne area is shown on Figure 8. The Quaternary cover in the Hornepayne area is dominated by glacial deposits that accumulated with the progressive retreat of the Laurentide ice sheet during the late Wisconsinan glaciation. Approximately 30% of the area of the Township is covered by Quaternary deposits with the other 70% being bedrock that is either directly exposed or covered by a thin layer of ground moraine (Gartner and McQuay, 1980). Overburden within the Township consists

⁵ Quaternary refers to the last 2.6 million years of Earth's history.

⁶ A greenstone belt is a zone of volcanic and sedimentary rocks that have undergone metamorphic alteration. The name comes from the green hue imparted by the colour of the dominant minerals within the rocks.

⁷ Batholiths are made of multiple masses, or plutons, of igneous rock that have melted and intruded surrounding strata at great depths.



predominately of till, with some glaciofluvial and some glaciolacustrine deposits locally. Approximately 10 km to the north and 20 to 30 km to the east of the Township of Hornepayne, the Quaternary deposits become more extensive. West of the Township of Hornepayne, the bedrock is largely exposed, with till covering small areas near the western boundary. The only significant Quaternary landforms within close proximity of the township include two large esker complexes approximately 5 to 10 km to the south.

3.3 Natural Environment

3.3.1 Natural Environment Overview

The Township of Hornepayne is a central location for the timber industry and popular for its trapping, hunting and fishing resources. The landscape represents an important resource for the Aboriginal communities within the Hornepayne area (Township of Hornepayne, 2007). The forests, wetlands and waters provide substantial habitat for a variety of species such as the bald eagle (*Haliaeetus leucocephalus*) and woodland caribou (*Rangifer tarandus*). The natural environment of the Hornepayne area contains an abundance of plant and animal communities, some of which have special status or designations. The following sections describe the protected natural areas, terrestrial and aquatic ecology and rare species that may be most sensitive to alterations or changes to the landscape.

3.3.2 Natural Areas

Within the Hornepayne area and north of the Township is Nagagamis Provincial Park. There are no known Areas of Natural and Scientific Interest (ANSI), life or earth science sites, Provincially Significant Wetlands (PSWs) or Natural Areas within the Hornepayne area. No Official Plan of the Township of Hornepayne was available from public sources (Township of Hornepayne, 2007).

Wetlands identified in the Land Information Ontario (LIO) natural resources data layers (LIO, 2012) have been depicted on Figure 10. The Hornepayne area contains a total of 35,040 ha (hectares) of wetlands, representing 7% of the land coverage according to the LIO database. Ground investigations are likely to reveal additional wetland areas that have not been identified in the LIO data. If wetlands are to be impacted by a proposed activity, they may require evaluation of significance according to the Ontario Wetland Evaluation System (OWES).

3.3.3 Terrestrial Features and Wildlife

The Hornepayne area lies within the Boreal Forest Region and primarily two FMUs: the Nagagami FMU 390; and the Hearst FMU 601. Small portions of the White River Forest (FMU 060) and the Big Pic Forest (FMU 067) also overlap the edges of the Hornepayne area as depicted on Figure 5 (Forest Branch, 2012). The Nagagami FMU is approximately 448,390 ha of which 99% is managed by Nagagami Forest Management Ltd. as production forest. The FMU is comprised of seven forest units including lowland conifer forest, upland conifer forest, poplar forest, mixed-wood forest, jack pine forest, white birch forest and white and red pine forest (JRML, 2011). The Hearst Forest is approximately 1,200,000 ha, including 82% production forest. Sixty-seven percent of the land base is composed of forest units in which black spruce (*Picea mariana*) is a major component. Other common species are white spruce (*Picea glauca*), jack pine (*Pinus banksiana*), balsam fir (*Abies balsamea*) and trembling aspen (*Populus tremuloides*) (HFMI, 2007). Overall, the Hornepayne area contains 377,475 ha of woodlands, which is 79% of the land coverage according to the LIO data. A number of MNR Forest Research Areas (FRA) are identified within the Hornepayne area (Figure 9).



Portions of Wildlife Management Units (WMU) 22, 21B, 23 and 32 are all found within the Hornepayne area. Trapping of fur bearing species including marten (*Martes americana*), beaver (*Castor canadensis*), mink (*Neovison vison*) and otter (*Lontra canadensis*) has been, and still is, an important employment and commercial activity in the Nagagami Forest. Management of woodland caribou, moose (*Alces alces*) and marten populations are a particular concern to the Ontario Ministry of Natural Resources (MNR) for the Nagagami Forest, and these species as well as black bear (*Ursus americanus*), black-backed woodpecker (*Picoides arcticus*), lynx (*Lynx canadensis*), red-breasted nuthatch (*Sitta canadensis*), barred owl (*Strix varia*), bay-breasted warbler (*Setophaga castanea*) and great gray owl (*Strix nebulosa*) are a management focus in the Hearst Forest (HFMI, 2007). The western portion of the Hornepayne area is part of both continuous and discontinuous woodland caribou habitat as identified in Ontario's Woodland Caribou Conservation Plan (MNR, 2009). Known feeding, wintering and calving sites for moose are also depicted on Figure 9. Concentration and nesting areas for raptors, herons and waterfowl are also considered an important wildlife management concern; known locations are also depicted on Figure 9.

3.3.4 Aquatic Features and Fish

The Hornepayne area is located at the boundary of the Hudson Bay and the Great Lakes-St. Lawrence Drainage Basins. It is located primarily within the Nagagami tertiary watershed, where the terrain cradles wetlands, lakes and rivers that support a diversity of fish and wildlife. Wetlands, including swamps, marshes and peatlands, are often ecologically sensitive. The Hornepayne area lies within Fisheries Management Zone (FMZ) 7 (Fish and Wildlife Service Branch, 2011) for which there is no current fisheries management plan. Fisheries information for the Nagagami Forest portion of this FMZ is limited and mostly derived from data collected by the MNR in the 1970s and 80s (JRML, 2011). The Hearst Forest portion of FMZ 7 contains mostly cool water fisheries on the claybelt and cold water fisheries associated with the eskers (HFMI, 2007). Coldwater fisheries in this area typically support natural brook trout (*Salvelinus fontinalis*) populations and the main sport fish targeted are walleye (*Sander vitreus*), northern pike (*Esox lucius*) and brook trout. The largest aquatic habitat features in the Hornepayne area include the Nagagami and Nagagamisis lakes to the north, the Granitehill and Obakiamiga lakes to the southwest and the Larkin, Kabinakagamisis, Kabinakagami and Cameron lakes to the southeast. These fish populations are managed to maintain and maximize their size and availability to both locals and tourists. Lake sturgeon (*Acipenser fulvescens*) is a species that is classified as threatened in the *Species at Risk Act* (SARA) (Government of Canada, 2012), and can be found within this FMZ. The Hornepayne area has 40,448 ha of area defined as waterbodies by LIO, comprising 8.5% of the area. Fish and fish habitat are managed by the MNR and the Department of Fisheries and Oceans (DFO).

General information is available publicly for each FMZ, but more detailed information must be obtained directly from these agencies for further investigations. Publicly available data for each FMZ may not be consistent for each area. Although there is consistency in the types of data collected by MNR for each area, data deemed sensitive within the FMZ may not be reported or shown on mapping. Field verification will be required to determine the actual fish habitat and use by species across the landscape.

3.3.5 Endangered, Threatened and Special Concern Species

Various data sources were queried for species listed as Endangered (END), Threatened (THR) or Special Concern (SC) either under the Ontario *Endangered Species Act* (ESA), (Government of Ontario, 2007) or the Federal *Species at Risk Act* (SARA) (Government of Canada, 2012). The Royal Ontario Museum range maps (ROM, 2012) provided general areas where species at risk may occur, including those of listed species. The



Ontario Herpetofaunal Summary Data (Oldham and Weller, 2000), Atlas of the Breeding Birds of Ontario (Cadman et al., 2007), Atlas of the Mammals of Ontario (Dobbyn, 1994), the Ontario Odonata Atlas (2005) and the Ontario Butterfly Atlas (Holmes et al., 1991) were also queried for listed species. END, THR or SC species identified from these sources to have a range that overlaps the Hornepayne area are listed in Table 2, although habitat for these species may be confined to specific locations within the area. The Natural Heritage Information Centre (NHIC, 2012) records did not show any END, THR or SC species.

Woodland caribou habitat is described in Section 3.3.3. Although the eastern portion of the Hornepayne area is not considered continuous or discontinuous habitat, it may occur anywhere within the boreal forest which extends throughout the Hornepayne area. The range of eastern cougar (*Puma concolor*) extends to the Hornepayne area, noting that this species is extremely secretive and can cover a very large home range for each individual. Nine END, THR or SC bird species are listed in Table 2, seven of which were identified in the OBBA, and the ROM range maps for short-eared owl (*Asio flammeus*) and golden eagle (*Aquila chrysaetos*) overlap the area although there are no known local records. Bald eagle is reported to occur at many locations in the Hornepayne area. Peregrine falcon (*Falco peregrinus*) (provincially THR, federally SC) and eastern whip-poor-will (*Antrostomus vociferus*) (provincially and federally THR) may be present in the area based on habitat (JRML, 2011). No END, THR or SC amphibian or reptile species are known to occur within the Hornepayne area. One aquatic species (lake sturgeon) and one invertebrate (monarch butterfly) (*Danaus plexippus*) range was reported to overlap with the Hornepayne area, according to ROM (2012). Lake sturgeon has a range that is known to extend into the Hornepayne area with known occurrences in some of the lakes (Kerr, 2002).

In addition to species that are listed on the ESA and SARA, species of conservation concern including those that are considered regionally rare, uncommon or in significant decline would also be considered in the evaluation of wildlife of the area. Many of these species are not tracked in public databases, and therefore a complete list would be obtained as part of the data requests to agencies which would complement the results of field investigations conducted at the site.

With reference to Table 2, there were no species of plants, mosses or lichens were identified as END, THR or SC within the Hornepayne area.

Table 2: Potential Endangered, Threatened and Special Concern Species in the Hornepayne Area

Common Name	Scientific Name	ESA Status ^a	SARA Status (Schedule) ^b	Source ^c
Mammals				
Eastern cougar	<i>Puma concolor</i>	END		ROM
Woodland caribou (Forest-dwelling boreal population)	<i>Rangifer tarandus</i>	THR	THR (1)	ROM
Birds				
Bald eagle	<i>Haliaeetus leucocephalus</i>	SC		OBBA, ROM
Barn swallow	<i>Hirundo rustica</i>	THR		OBBA
Black tern	<i>Chlidonias niger</i>	SC		OBBA, ROM
Canada warbler	<i>Wilsonia Canadensis</i>	SC	THR (1)	OBBA
Common nighthawk	<i>Chordeiles minor</i>	SC	THR (1)	OBBA, ROM



Common Name	Scientific Name	ESAStatus ^a	SARA Status (Schedule) ^b	Source ^c
Golden eagle	<i>Aquila chrysaetos</i>	END		ROM
Olive-sided flycatcher	<i>Contopus cooperi</i>	SC	THR (1)	OBBA
Rusty blackbird	<i>Euphagus carolinus</i>	Not at risk	SC (1)	OBBA, ROM
Short-eared owl	<i>Asio flammeus</i>	SC	SC (3)	ROM
Fish and other aquatic species				
Lake sturgeon (Northwestern Ontario Population)	<i>Acipenser fulvescens</i>	THR		ROM
Invertebrates				
Monarch butterfly	<i>Danaus plexippus</i>	SC	SC(1)	ROM

Notes:

blank: species not assessed; Not at Risk: species assessed to be not at risk; SC: special concern species; THR: threatened species; END: endangered species

^a Status on the Species at Risk of Ontario list of the *Endangered Species Act* (ESA), (Government of Ontario, 2007)

^b Status listed on the federal *Species at Risk Act* (SARA) (Government of Canada, 2012)

^c Data obtained from the Natural Heritage Information Centre (NHIC) (NHIC, 2012), Royal Ontario Museum (ROM) range maps (ROM, 2012), Ontario Herpetofaunal Summary Database (Herp Atlas) (Oldham and Weller, 2000) or Atlas of the Breeding Birds of Ontario (OBBA) (Cadman et al., 2007) or the Ontario Butterfly Atlas (Holmes et al., 1991)

3.3.6 Aboriginal Interests and Traditional Knowledge

Traditional lifestyles, culturally significant wildlife and the extent of sacred and ceremonial locations important to Aboriginal communities are important factors to be considered when identifying potential repository locations for further detailed study.

For this phase of the work, the extent to which such information has been sought is that which can be found in publicly available sources. Known archaeological sites, many of which are Aboriginal, are also noted in Section 2.3.2. Trapline License Areas, which includes a large portion of the Hornepayne area, are shown on Figure 3. Figure 9 presents terrestrial ecology mapping for the area and Figure 10 presents aquatic resource mapping.

It is recognized that this does not fully represent the environmental issues and concerns of Aboriginal communities in the area and that further information and discussion is required before a more complete picture can be developed. Discussions with Aboriginal groups, community members and field investigations would be undertaken in later phases of the work program to further enhance the environmental understanding of specific locations.

3.4 Background Environmental Conditions

3.4.1 Air Quality

Air quality monitors in north-central Ontario indicate that ground-level ozone and particulate matter in the Hornepayne area fall within normal values compared to the national average (EC, 2011a). Table 3 provides a list of industrial facilities that reported air and water emissions through Environment Canada's National Pollutant Release Inventory (NPRI) database (EC, 2012). The list includes nearby sites in Chapleau, Copper Cliff,



Sudbury and Sault Ste. Marie, which have local air emissions. Additional sources that may affect background air quality include rail operations and Highway 631, both of which traverse the Hornepayne area.

Table 3: NPRI Regional Sources of Air Emissions

NPRI ID	Facility Name	City
10397	Tembec - Chapleau Sawmill	Chapleau
11238	First Nickel Inc. - Lockerby Mine	Chelmsford
5928	Safety-Kleen Canada Inc. - Chelmsford Branch	Chelmsford
11227	Fisher Wavy Inc. - Fisher Wavy - Sudbury	Copper Cliff
1465	Vale Canada Limited - Clarabelle Mill	Copper Cliff
10203	Vale Canada Limited - Copper Cliff Mine (North)	Copper Cliff
10204	Vale Canada Limited - Copper Cliff Mine (South)	Copper Cliff
1467	Vale Canada Limited - Copper Cliff Nickel Refinery	Copper Cliff
444	Vale Canada Limited - Copper Cliff Smelter	Copper Cliff
11877	Vale Canada Limited - Ellen Pit	Denison Township
7361	King Packaged Materials Co. - Onaping Falls	Dowling
1236	Xstrata Canada Corporation - Xstrata Nickel Sudbury Smelter	Falconbridge
10144	Union Gas Limited - Hagar LNG Plant	Hagar
11608	FNX Mining Company Inc. - Levack Mine	Levack
11154	FNX Mining Company Inc. - McCreedy West Mine	Levack
10199	Vale Canada Limited - Coleman Mine	Levack
10450	Eacom Timber Corp. - Nairn Centre Sawmill	Nairn Centre
1233	Xstrata Canada Corporation - Sudbury Operations Mines/Mill - Onaping Area	Onaping
11369	Fisher Wavy Inc. - Fisher Wavy - Sault Ste. Marie	Sault Ste. Marie
11466	FNX Mining Company Inc. - Podolsky Mine	Sudbury
11878	Vale Canada Limited - Totten Mine	Worthington

3.4.2 Background Radiation

The source of background radiation in the Hornepayne area is attributed to naturally occurring radioactive materials (NORM), specifically potassium, uranium and thorium-bearing minerals. The background radiation for the Hornepayne area is presented on Figure 11. The dose rate in the Hornepayne area ranges from approximately 10 to 30 nGy/h, with an average of approximately 15 nGy/h. This range of dose rates and average are consistent with regional dose rates for north-central Ontario. NORM minerals are typically elevated in granitic geology and local dose rate highs are attributed to bedrock at or near surface and areas with sparse tree coverage. These highs are consistent with dose rate highs in other areas of north-central Ontario. Additional detailed information is available in the geophysical interpretation report (PGW, 2013).

3.4.3 Soil Quality

There is no specific information on background soil quality in the Hornepayne area available, although soil concentrations would be expected to be consistent with Ontario Typical Background ranges, as noted in Table 1 of Ontario MOE Regulation 153/04 (Government of Ontario, 2004).



3.4.4 Water Quality

The Township of Hornepayne obtains its municipal water supply from Moonlight Lake, which includes a water treatment plant operated by the Ontario Clean Water Agency (Government of Ontario, 2012). Information on municipal drinking water quality was not considered as part of this review, although it is available through a direct request to the Township office.

Surface water hydrology, groundwater and wells are further discussed in Sections 3.5 and 3.6.

3.4.5 Lake Sediment Chemistry

The desktop review did not identify any information related to lake sediment chemistry for the Hornepayne area.

3.4.6 Potential Sources of Pollutants

There are a number of potential sources of pollutants in the Hornepayne area including landfills, transportation corridors, domestic septic systems and local industries.

There are four operating landfill sites within the Hornepayne area: Hornepayne Municipal, an unnamed landfill and two landfills affiliated with the operation of lumber companies, Olav Haavaldsrud Timber Company Ltd. and Kenogami Lake Lumber Ltd. (Table 4); all are shown on Figure 1. All sites are classified as small landfills. As well there are four other small, now closed, landfills within the Hornepayne area (MOE, 2010).

Table 4: Registered Landfills in the Hornepayne Area

Certificate of Approval (C of A) Number	Site Name	Location	Status
6672-57HTDH	Client: The Corporation of the Township of Hornepayne	Part Lot 2-3, Conc 3	Open
		Twp of Hornepayne	
9256-7PKJQH	Haavaldsrud Mill Site	Becker Siding	Open
	Client: Olav Haavaldsrud Timber Company Ltd.	Twp of Haig	
A562101	Client: Ministry of Natural Resources	Lot 27, Conc 1	Closed
		Twp of Hornepayne	
A562102	Hornepayne Municipal	Lot 11, Conc 3	Open
	Client: The Corporation of the Township of Hornepayne	Twp of Hornepayne	
A562103	W. Government Lake	Lot S.W. 1/4 of S. 1/2 of 28, Conc 1	Closed
	Client: Ministry of Natural Resources	Twp of Hornepayne	
A7083901	West Larkin House	Lot 22, Conc 3	Closed
	Client: Ministry of Natural Resources	Twp of Larkin	
A7232901	Client: Kenogami Lake Lumber Limited	Part NW of Lot 1, Conc 10	Open
		Twp of Lessard	
A7407001	Client: Ministry of Natural Resources	Lot 2, Conc 6	Closed
		Twp of Frost	

Source: Ontario Landfills List (MOE, 2010)



Transportation corridors, such as Highway 631, secondary roads, logging roads and rail lines, traverse the Hornepayne area, and are considered to be potential sources of pollution, as a result of salt application for de-icing and mobile air emissions from internal combustion. There is also a potential for chemical releases along transportation routes as a result of spills or accidents. Additionally, the Township of Hornepayne contains a local airport float plane base which is also a potential source of pollution, due to air emissions and potential chemical spills. Local septic systems are a potential source of pollutants, mainly as a result of septic waste and possibly as a result of chemical disposal into the septic system. Industrial operations in the area may be a source of pollutants, due to the potential release of chemicals as a result of spills or improper chemical handling practices. No specific releases of the above-named pollutants into the environment were identified in this review.

3.5 Surface Water Hydrology

The Hornepayne area is located within the drainage area of the Nagagamis River tertiary watershed which has its origin in a series of lakes and creeks to the south of the Hornepayne area that flow in a northeasterly direction; they are joined by the Nagagamis River east of Nagagamis Lake (Figure 12). Lands in the southwest Hornepayne area form part of the White River tertiary watershed which drains to the southwest to Lake Superior. The eastern portion of the Hornepayne area lies within the Upper Kabinakagami River tertiary watershed which drains to the northeast towards James Bay via the Kabinakagami, Missinaibi and Moose Rivers. Given the modest terrain, modest precipitation and relatively small size of catchment areas, no large areas of floodplain are expected to be present.

3.6 Groundwater and Wells

Information concerning groundwater in the Hornepayne area was obtained from the MOE Water Well Record (WWR) database (MOE, 2012). The locations of known water wells are shown on Figure 12. The Township of Hornepayne has historically obtained its municipal water supply from wells sourcing the shallow overburden aquifer. The municipality replaced its groundwater supply with a new system sourcing surface water from Moonlight Lake, located approximately 2.7 km southeast of the Township of Hornepayne. The overburden and shallow bedrock aquifers have historically been the primary source of groundwater and the aquifers continue to be used in areas where municipal water is not provided. The MOE WWR database contained a total of 71 water well records in the Hornepayne area. A summary of these wells is provided in Table 5.

Table 5: Water Well Record Summary for the Hornepayne Area

Water Well Type	Number of Wells	Total Well Depth (m)	Static Water Level (m below surface)	Tested Well Yield (L/min)	Depth to Top of Bedrock (m)
Overburden	38	3 to 29	0.3 to 13.4	0 to 689	N/A
Bedrock	33	11 to 119	0.6 to 8.5	0 to 57	0.6 to 38.4

3.6.1 Overburden Aquifers

There are 38 water well records in the Township of Hornepayne that can be confidently assigned to the overburden aquifer. These wells generally are 3 to 29 m deep and have pumping rates of 0 L/min to 689 L/min. These well yields reflect the purpose of the wells (i.e., private residential supply) and do not necessarily reflect the maximum sustained yield that might be available from the aquifer.



The limited number of well records and their concentration along the main roadways limits the available information regarding the extent and characteristics of the overburden aquifers in the Hornepayne area.

3.6.2 Bedrock Aquifers

No information was found on deep bedrock groundwater conditions in the Hornepayne area at a typical repository depth of approximately 500 m. In the Township of Hornepayne there are 33 well records that can be confidently assigned to the shallow bedrock aquifer. These wells range from 11 to 119 m in depth, with most wells between 20 and 60 m deep. Measured pumping rates in the bedrock wells are variable and range from 0 L/min to 57 L/min, with yields typically between 3 and 5 L/min. These well yields reflect the purpose of the wells (i.e., private residential supply) and do not necessarily reflect the maximum sustained yield that might be available from the 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.

No potable water supply wells are known to exploit aquifers at typical repository depths in the Hornepayne area or anywhere else in northern Ontario. Experience from other areas in the Canadian Shield has shown that active groundwater flow is generally confined to shallow fractured localized systems. In these shallow regions, flow tends to be dependent on the secondary permeability created by fractures. In deeper regions, hydraulic conductivity tends to decrease as fractures become less common and less interconnected. Increased vertical and horizontal stresses at depth tend to close or prevent fractures thereby reducing permeability and resulting in diffusion-dominated groundwater movement.

3.7 Climate and Meteorology

The Hornepayne area has a boreal climate and is characterized by long, cold winters, and short, cool to mild summers. Most precipitation falls between May and October and is associated with continental weather systems moving eastward from the Pacific crossing the prairies into northern Ontario from low pressure systems formed in the American upper Midwest and the Canadian prairies. During the winter, Arctic low pressure areas move southward into the region bringing very cold temperatures and little precipitation. In winter and spring, flow of air masses is dominated by Arctic airstreams. In summer and fall, the Arctic air masses are usually replaced by westerly air currents of Pacific origin. The overall yearly mean temperature is just above zero degrees Celsius.

Climatological information presented in this section is based on meteorological data from Environment Canada's meteorological station located in Hornepayne. It has more than 30 years of continuous data. Parameters that are measured at the Hornepayne station include temperature and precipitation. The nearest Environment Canada's meteorological station that records wind observations is located at Nagagami, approximately 25 km northeast of the Hornepayne area. Thus, the last ten years (2002 - 2011) of wind records from Nagagami meteorological station have been used to assess the local wind conditions.

3.7.1 Temperature

Temperature data was obtained from Environment Canada's 1971-2000 climate normals for the Hornepayne meteorological station (EC, 2011b). Figure 13 presents monthly temperatures for Hornepayne, displaying daily average, maximum and minimum and extreme values over the calendar year.



3.7.2 Precipitation

Figure 14 presents monthly precipitation data obtained from Environment Canada's 1971-2000 climate normals for the Hornepayne meteorological station, including total rainfall, snowfall and all-time extreme values over the calendar year (EC, 2011b).

3.7.3 Wind

Figure 15 presents annual and seasonal wind rose diagrams for data obtained from the Nagagami meteorological station in 2002 to 2011, the nearest meteorological station to the Hornepayne area where wind direction and speed data are collected (EC, 2011b). The wind rose diagrams show a strong general westerly trend with wind directions varying from southwest in the summer and fall to northwest in the winter and spring.

3.8 Natural Hazards

3.8.1 Earthquakes and Seismicity

The Hornepayne area lies within the Canadian Shield, where large parts have remained tectonically stable for the last 2.5 billion years (Percival and Easton, 2007). The Hornepayne area has a low seismic hazard rating (NRCan, 2010). Since 1627, no earthquakes exceeding a magnitude m_N 6 have been known to occur within 1,000 km of the Hornepayne area. According to the National Earthquake Database (NEDB) for the period between 1985 and 2011 (NRCan, 2012) all recorded seismic events in the Hornepayne area had magnitudes m_N ranging from less than 1 to 3.0.

In summary, available literature and recorded seismic events indicate that the Hornepayne area is located within a region of low seismicity.

3.8.2 Tornadoes and Hurricanes

With reference to Figure 15, average monthly wind speeds in the Hornepayne area are inferred to be low, on the order of 10 to 15 km/hr, and rarely exceed 30 km/hr. The Hornepayne area experiences thunderstorms in the summer months and is located in an area with a low tornado frequency (<0.1 tornadoes per year / 10,000 km²), but where there is a potential for F0-F1 tornadoes (Sills et al., 2012). The Hornepayne area is situated too far away from the Atlantic Ocean to be susceptible to hurricanes. The National Building Code of Canada recommends a design 1/50 maximum hourly wind pressure for the Hornepayne area of 0.30 kPa, which is a typical value for Ontario (NRC, 2010).

3.8.3 Drought and Flooding

According to precipitation climate normals for the region (Figure 14), the Hornepayne area experiences on average between 30 and 80 mm of precipitation each month, and is therefore unlikely to experience drought conditions that would affect the viability of local water sources. The single day extreme rainfall and snowfall events on record at the Wawa station (Figure 14) are 44 mm of rain and 101 cm of snow, respectively. In years where there is a high snowpack accumulation, the spring freshet can result in a nominal increase in water levels in local streams and rivers. As noted on Figure 12, the Hornepayne area lies near the headwaters of its watersheds, making size of the upstream catchment areas relatively small. The small catchment size in combination with a moderate terrain makes the risk of flash flooding in the Hornepayne area low. The potential risk of drought or flooding affecting the facility will also depend to some degree on the specific location selected.



3.8.4 Snow and Ice

As noted on Figure 14, the Hornepayne area receives on average about 250 cm of snowfall per year, primarily between the months of October and April. No single month receives an average snowfall greater than 55 cm. There are usually one or two high snowfall events per year, with accumulations of 30 cm or greater, noting that the highest single day snowfall accumulation on record is 101 cm, recorded on March 21, 1972. The National Building Code of Canada recommends a design 1/50 snow load ($S_s + S_r$) for the Hornepayne area of 4.0 kPa, which is a typical value for northern Ontario (NRC, 2010). Local lakes and waterbodies freeze over in the winter months in the Hornepayne area, as average daily temperatures from November to March typically range from -20 to -4°C.

3.8.5 Forest Fires and Lightning

Within heavily forested areas such as the Hornepayne area there is a risk of forest fires. Locations where forest fires have occurred in the vicinity of the Hornepayne area between 1976 and 2010 affecting an area of greater than 200 ha are shown on Figure 5. These forest fires combine to comprise approximately less than 1% of the total Hornepayne area. Forest fires can be initiated by lightning strikes or human activity, particularly if dry conditions are present in the forest understory. As previously noted, thunderstorms do occur in the Hornepayne area and lightning strikes are not uncommon in the summer months.

3.8.6 Landslides and Tsunamis

Moderately steep slopes in the Hornepayne area, where present, are generally comprised of crystalline rock with only a thin veneer of soil cover. The physical nature of these slopes, combined with typically modest precipitation and very low seismicity, results in a low landslide risk for the Hornepayne area. There is no risk of tsunamis in the Hornepayne area, owing to the very low seismicity and a lack of large waterbodies.



ENVIRONMENT REPORT - TOWNSHIP OF HORNEPAYNE, ONTARIO



4.0 SUMMARY

This report provides a high level description of the environment in the Township of Hornepayne and surrounding area.

Situated in the District of Algoma, the Township of Hornepayne is approximately 205 km² in size (LIO, 2012), with a population of 1,050 (Statistics Canada, 2012). The Township of Hornepayne is situated approximately 340 km east of Thunder Bay, 260 km west of Timmins, and 300 km north of Sault Ste. Marie. Hornepayne has a boreal climate and is characterized by long, cold winters, and short, cool to mild summers. Most precipitation falls between May and October from low pressure systems formed in the American upper Midwest and the Canadian prairies. During the winter, Arctic low pressure areas move southward into the region bringing very cold temperatures and little precipitation.

There are a number of Aboriginal communities and organizations in the Hornepayne area including Brunswick House First Nation, Chapleau Cree First Nation, Constance Lake First Nation, Michipicoten First Nation, Missanabie Cree First Nation, Ojibways of the Pic River (Heron Bay) and Pic Moberg First Nation). Métis Councils in the area include Greenstone Métis Council, Superior North Shore Métis Council and Thunder Bay Métis Council as represented by Lakehead/Michipicoten/Nipigon Traditional Territory Consultation Committee and Chapleau Métis Council, Métis Nation of Ontario Timmins Council, Northern Lights Métis Council and Temiskaming Métis Council as represented by Abitibi/Temiskamingue and James Bay Traditional Territory Consultation Committee and the Métis Nation of Ontario.

The Township of Hornepayne lies in the Abitibi Highlands, featuring the broadly rolling surfaces of Canadian Shield bedrock that occupies most of north-central Ontario; either exposed at surface or shallowly covered with Quaternary glacial deposits or post-glacial organic soils. The land surface is generally rugged with an elevation of 483 masl in the southwest part of the Hornepayne area. Lands further to the north and east are less rugged and lower in elevation. Topographic highs generally correspond to exposed bedrock while topographic lows are typically areas of thicker overburden.

The Township of Hornepayne is almost entirely (about 95%) underlain by the metasedimentary rocks of the Quetico Subprovince. The southern edge of the Township is underlain by an east-west striking belt of metavolcanic rocks, part of the Manitouwadge-Hornepayne greenstone belt. Two large muscovite-bearing granitic intrusions are located in the northern half of the Hornepayne area and south of the Township, the bedrock geology is dominated by the Black-Pic batholith, a vast, regionally-extensive batholith comprised primarily of foliated to gneissic tonalite to granodiorite.

Approximately 30% of the area of the Township is covered by Quaternary deposits with the other 70% being bedrock that is either directly exposed or covered by a thin layer of ground moraine (Gartner and McQuay, 1980). The only significant Quaternary landforms within close proximity of the Township include two large esker complexes approximately 5 to 10 km to the south.

There are currently no producing mines in the Hornepayne area. Few low grade base metal (i.e., iron, copper and copper-nickel) and sulphide occurrences have been discovered in the Hornepayne area. The nearest historically producing mines are located in the Manitouwadge area, approximately 50 km to the west of the Township of Hornepayne. Known non-metallic mineral resources within the Hornepayne area include sand and gravel, stone, garnet, diopside and graphite.



The main transportation route through the Hornepayne area is Highway 631 which passes through the center of the Hornepayne area in a north-south orientation, and through the Township of Hornepayne. The CN main rail line runs east-west through the Hornepayne area and an electrical transmission line runs eastward into Hornepayne from Manitouwadge. There is an airport within the Township of Hornepayne, and a float plane base west of Hornepayne. There are no pipelines recorded within the Hornepayne area. The 425 km² Nagagamisis Provincial Park located 15 km north of the Township of Hornepayne is the only provincial park or reserve in the Hornepayne area.

Forestry is a major industry in the area and includes a number of private timber companies currently managing forestry operations, including the Olav Haavaldsrud Timber Company Ltd., operating in this area since 1953. The Hornepayne area lies within the Boreal Forest Region and primarily two Forest Management Units (FMUs): the Nagagami FMU 390; and the Hearst FMU 601.

The region's forests provide habitat for wildlife including game, furbearing mammals and fish. Management of woodland caribou, moose and marten populations and concentration and nesting areas for raptors, herons and waterfowl are a particular concern to the Ministry of Natural Resources (MNR). While the Natural Heritage Information Centre (NHIC, 2012) identified no species observed within the Hornepayne area that are listed as endangered, threatened or special concern either under the Ontario *Endangered Species Act* (Government of Ontario, 2007) or the Federal *Species at Risk Act* (SARA) (Government of Canada, 2012), using other sources and habitat range mapping, 13 endangered, threatened or special concern species were identified to have a range that overlaps the Hornepayne area (ROM, 2012; Oldham and Weller, 2000; Cadman et al., 2007; Holmes et al., 1991). The western portion of the Hornepayne area is part of both continuous and discontinuous woodland caribou (threatened provincially and federally) habitat as identified in Ontario's Woodland Caribou Conservation Plan (MNR, 2009). The ranges for provincially endangered eastern cougar and golden eagle also extend to the region, as does provincially threatened lake sturgeon (northwestern Ontario population).

The Hornepayne area is located within the drainage area of the Nagagami River tertiary watershed which has its origin in a series of lakes and creeks to the south of the Hornepayne area that drain in a northeasterly direction; they are joined by the Nagagamisis River east of Nagagamisis Lake. Lands in the southwest Hornepayne area form part of the White River tertiary watershed which drains to the southwest to Lake Superior. The eastern portion of the Hornepayne area lies within the Upper Kabinakagami River tertiary watershed which drains to the northeast towards James Bay via the Kabinakagami, Missinaibi and Moose Rivers. Fisheries information for the Nagagami Forest area is limited and collected by the MNR in the 1970s and 80s (JRML, 2011). The Hearst Forest area contains mostly cool water fisheries on the claybelt and cold water fisheries associated with the eskers (HFMI, 2007). Coldwater fisheries in this area typically support natural brook trout populations and the main sport fish targeted are walleye, northern pike and trout. The largest aquatic habitat features in the Hornepayne area include the Nagagami and Nagagamisis lakes to the north, the Granitehill and Obakiamiga lakes to the southwest and the Larkin, Kabinakagamis, Kabinakagami and Cameron lakes to the southeast of the Township of Hornepayne. These fish populations are managed to maintain and maximize their size and availability to both locals and tourists. Lake sturgeon is a species that is classified as threatened in the SARA, and can be found within the Hornepayne area.

Water wells in the Hornepayne area obtain water from the overburden or the shallow bedrock. The MOE water well database contains 71 discrete water well records in the Hornepayne area. No potable water supply wells



are known to exploit aquifers at typical repository depths in the Hornepayne area or anywhere else in northern Ontario.

Air, soil and surface water quality within the Hornepayne area are expected to be within the normal range for north-central Ontario. Sources of background radiation in the Hornepayne area are attributed to naturally occurring radioactive materials, specifically potassium, uranium and thorium-bearing minerals. The range of dose rates and average are consistent with regional dose rates for north-central Ontario.

The Ontario Archaeological Sites Database identified 21 known archaeological sites in the Hornepayne area, with one of these found within the Township of Hornepayne. The site identified within the Township of Hornepayne is a pre-contact Aboriginal isolated find (a chert flake). Sites identified in Nagagamisis Provincial Park include 14 Late Woodland and/or historic Algonkian archaeological sites, 20 Aboriginal heritage values sites, 30 culturally modified trees and a historic Euro-Canadian trading post site (von Bitter, 2012; HFMI, 2007). The Nagagami Lake area is also the location of five known archaeological sites – three Aboriginal pre-contact sites and two historic Euro-Canadian sites. The presence of local heritage sites would need to be further confirmed in discussion with the community and Aboriginal peoples in the area.



ENVIRONMENT REPORT - TOWNSHIP OF HORNEPAYNE, ONTARIO



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- von Bitter, R. 2012. Personal Communication on May 29, 2012 re: Archaeological Sites Database. Ministry of Tourism, Culture, and Sport.
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**ENVIRONMENT REPORT - TOWNSHIP OF HORNEPAYNE,
ONTARIO**



Report Signature Page

GOLDER ASSOCIATES LTD.

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Geoscientist

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Senior Geoscientist, Principal

BT/DM/GWS/JLH/wlm/am/wlm

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4005_hornepayne_enviro_14nov2013 cln.docx



ENVIRONMENT REPORT - TOWNSHIP OF HORNEPAYNE, ONTARIO

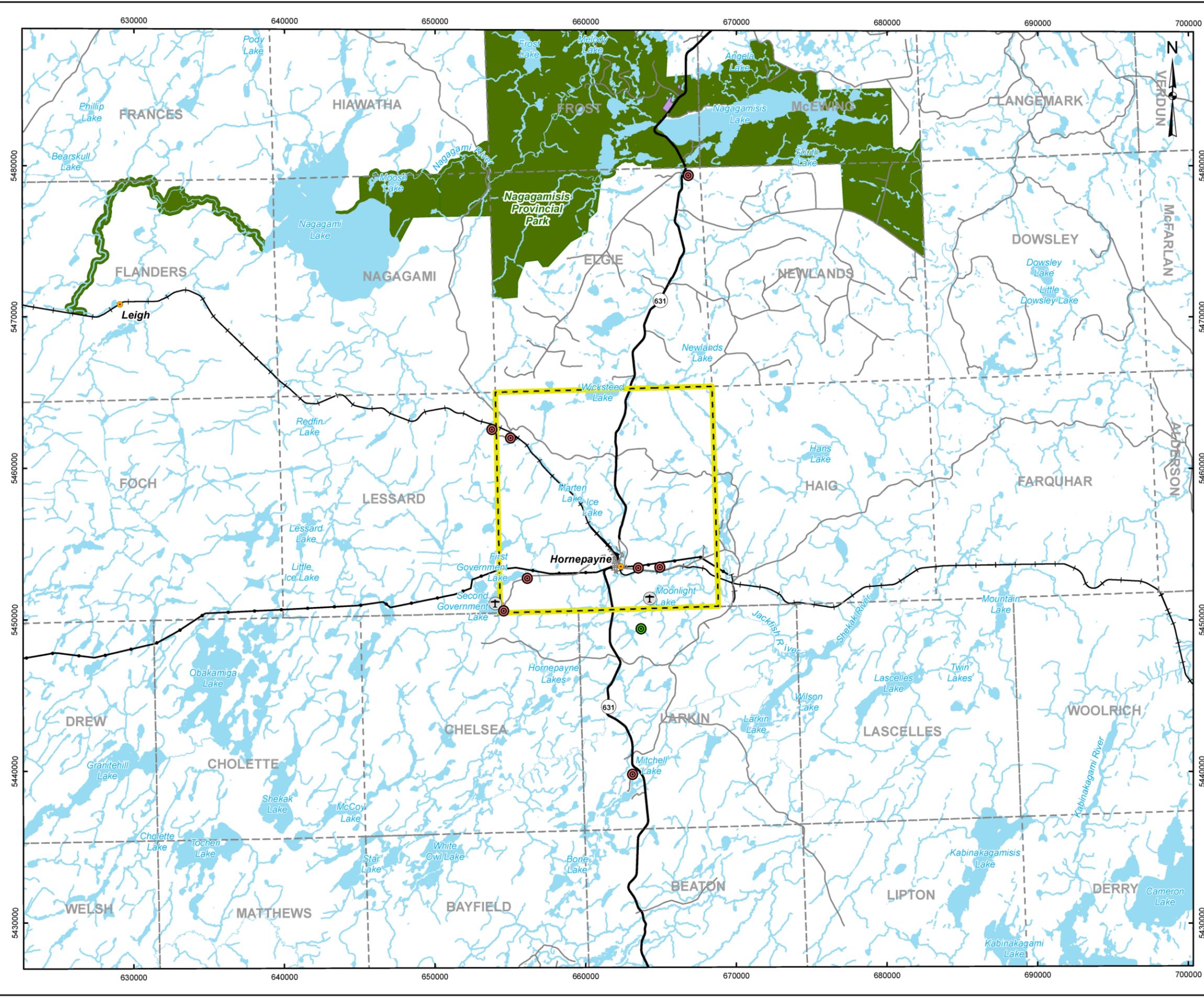


FIGURES



ENVIRONMENT REPORT - TOWNSHIP OF HORNEPAYNE, ONTARIO

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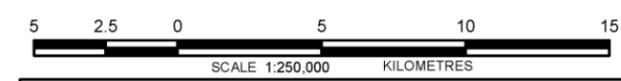
LEGEND

- Community
- ✈ Airport
- ⊙ Domestic Waste Site
- ⊙ Waste Water Treatment Plant
- Main Road
- Local Road
- Railway
- Transmission Line
- Watercourse, Permanent
- Watercourse, Intermittent
- Water Area, Permanent
- Forest Reserve
- Provincial Park
- - - Geographic Township Boundary
- - - Municipal Boundary, Lower Tier
- ▭ Municipal Boundary (Township of Hornepayne)



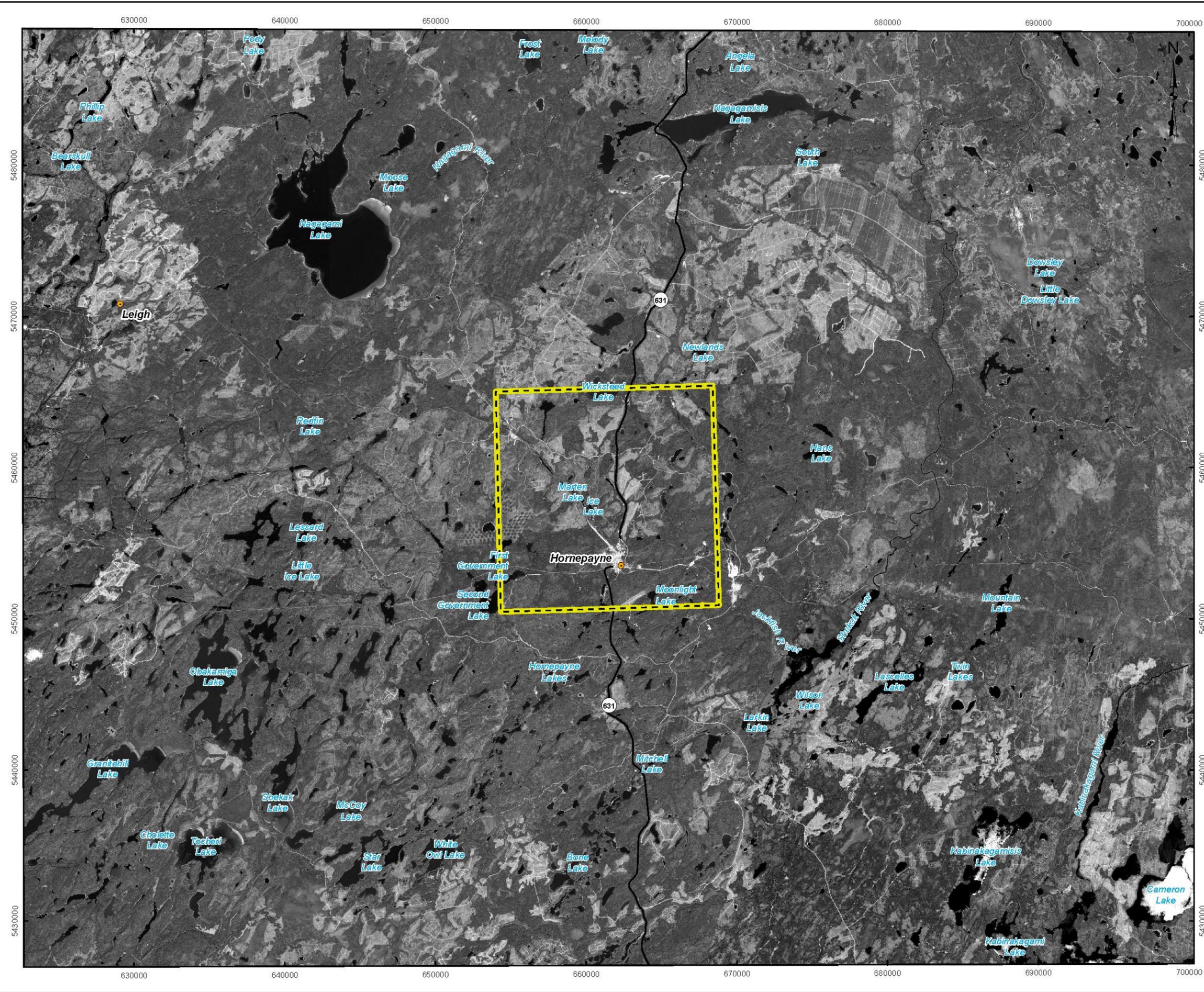
REFERENCE

Base Data - MNR NRVIS, obtained 2009-2012, 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



PROJECT		Environment Report Township of Hornepayne, Ontario	
TITLE		Hornepayne and Surrounding Lands	
 Golder Associates Mississauga, Ontario	PROJECT NO. 12-1152-0026	SCALE AS SHOWN	REV. 0.0
	DESIGN PRM 27 Jan. 2011		
	GIS PM/JB 7 Aug. 2013		
	CHECK JH 7 Aug. 2013		
REVIEW GWS 7 Aug. 2013			FIGURE: 1

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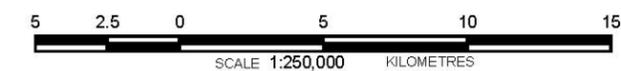
LEGEND

- Community
- Main Road
- Municipal Boundary, Lower Tier
- Municipal Boundary (Township of Hornepayne)



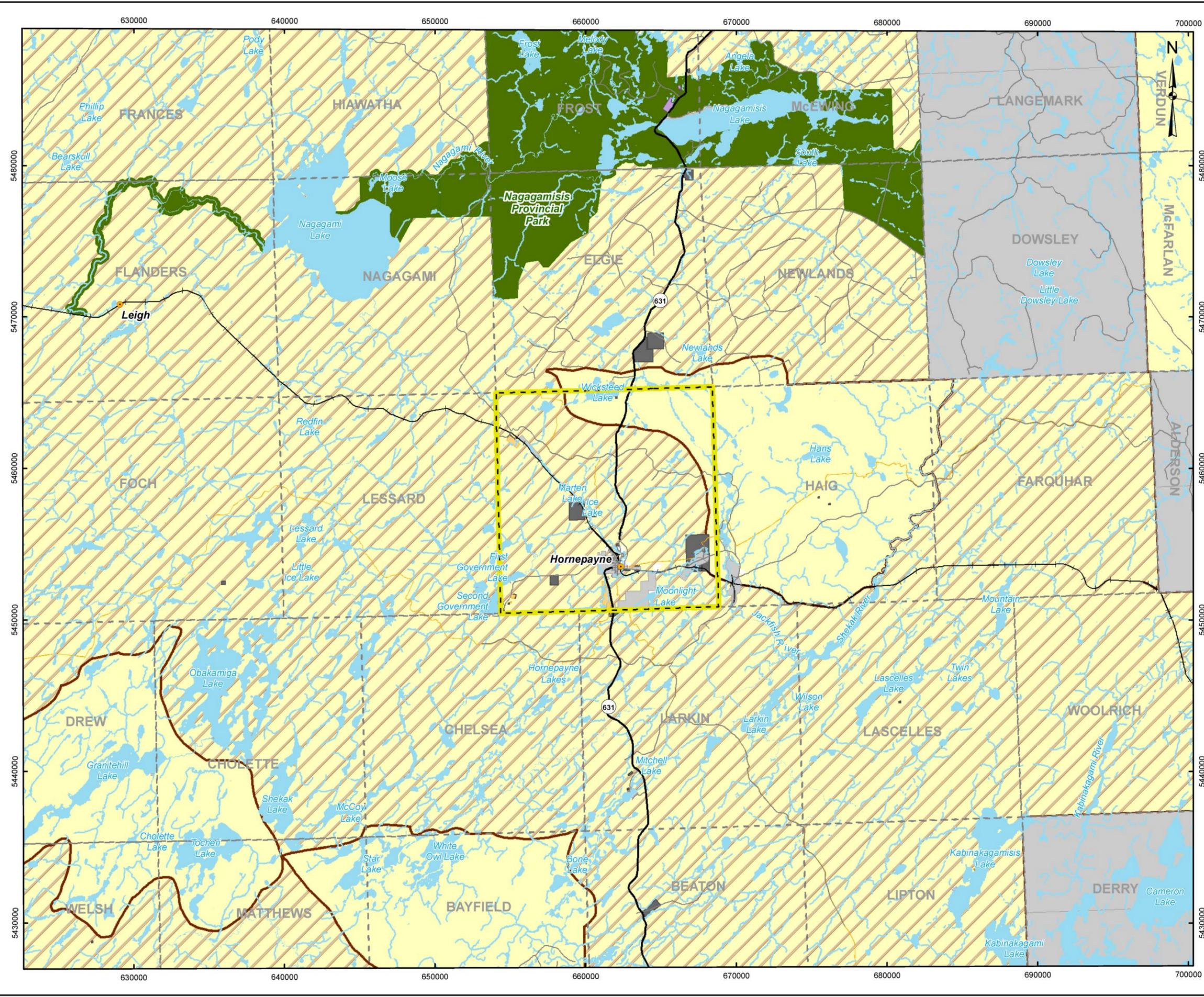
REFERENCE

Base Data - MNR NRVIS, obtained 2009-2012, CANMAP v2006.4
 Imagery: Spot 5, Obtained from Geobase (2006 to 2007, 10 m resolution)
 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



PROJECT		Environment Report Township of Hornepayne, Ontario	
TITLE			
Satellite Imagery of the Hornepayne Area			
 Golder Associates Mississauga, Ontario	PROJECT NO:	12-1152-0026	SCALE AS SHOWN
	DESIGN:	PRM 27 Jan 2011	REV. 3.0
	GIS:	PMJB 7 Aug 2013	FIGURE: 2
	CHECK:	JH 7 Aug 2013	
REVIEW:	GWS 7 Aug 2013		

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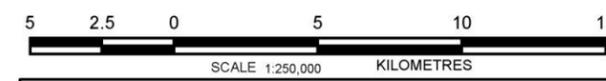
LEGEND

- Community
- Main Road
- Local Road
- Railway
- Watercourse, Permanent
- - - Watercourse, Intermittent
- Water Area, Permanent
- Forest Reserve
- Provincial Park
- Private Land
- Crown Leased Land
- Crown Land - Non-Freehold Dispositions Public
- Crown Land - Unpatented Public Land
- Crown Reserves
- ▭ Regular Registered Trapline Area Boundary
- - - Geographic Township Boundary
- - - Municipal Boundary, Lower Tier
- ▭ Municipal Boundary (Township of Hornepayne)



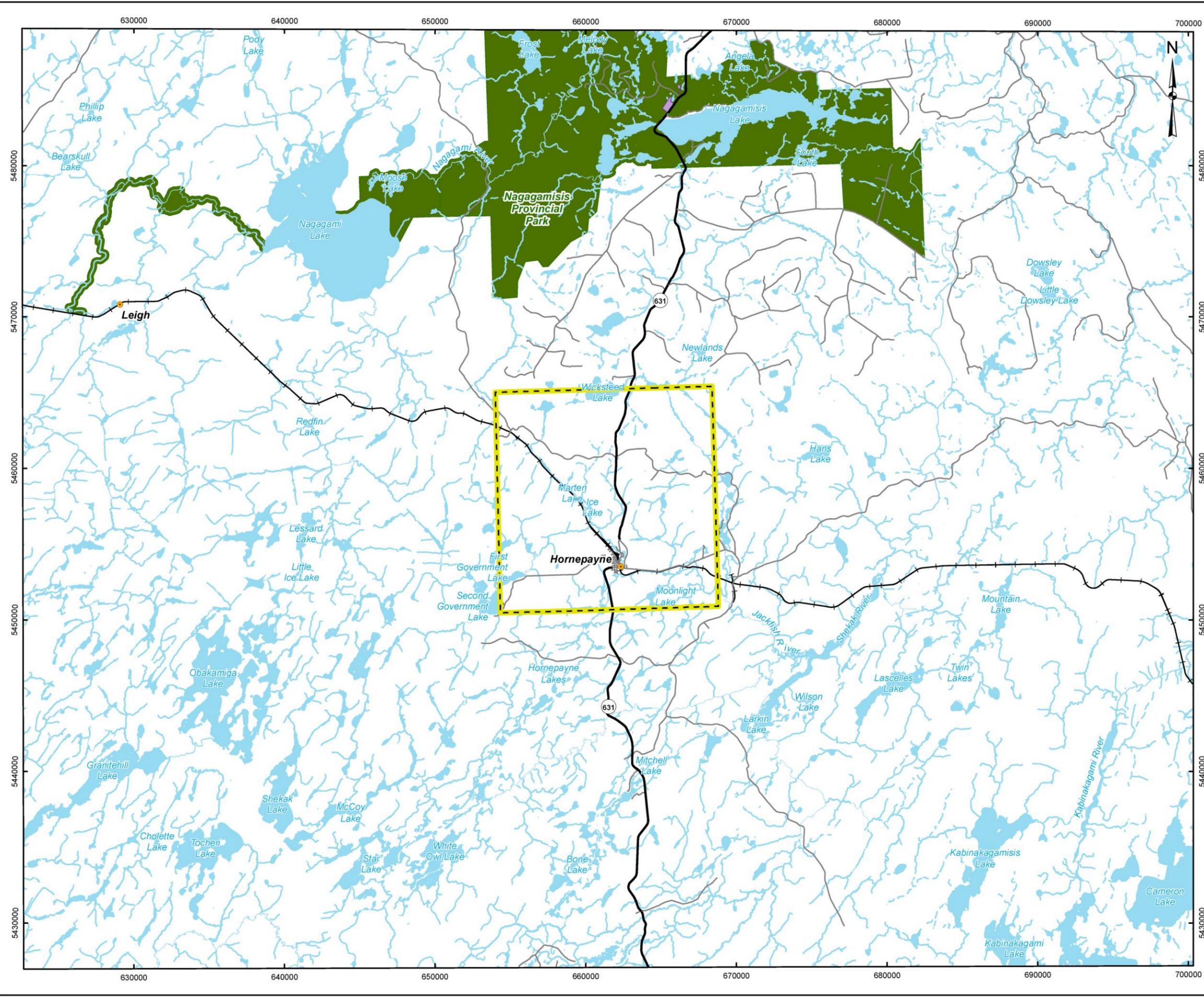
REFERENCE

Base Data - MNR NRVIS, obtained 2009-2012, CANMAP v2006.4
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 Ontario Ministry of Natural Resources, © Queens Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N



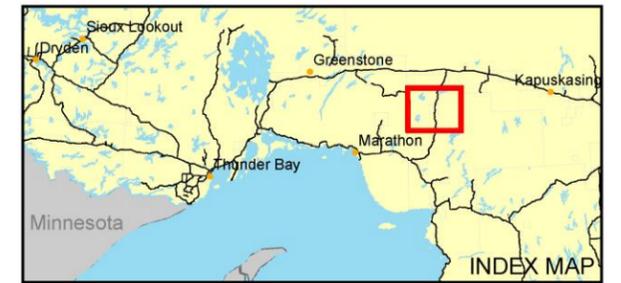
PROJECT		Environment Report Township of Hornepayne, Ontario	
TITLE		Hornepayne Area Land Ownership	
 Golder Associates Mississauga, Ontario	PROJECT NO. 12-1152-0026	SCALE AS SHOWN	REV. 0.0
	DESIGN PRM 27 Jan. 2011	FIGURE: 3	
	GIS PM/JB 7 Aug. 2013		
	CHECK JH 7 Aug. 2013		
REVIEW GWS 7 Aug. 2013			

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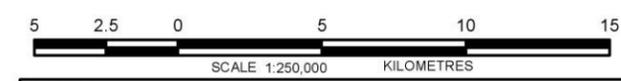
LEGEND

- Community
- Main Road
- Local Road
- + Railway
- Watercourse, Permanent
- Watercourse, Intermittent
- Water Area, Permanent
- Forest Reserve
- Provincial Park
- - - Municipal Boundary, Lower Tier
- ▭ Municipal Boundary (Township of Hornepayne)



REFERENCE

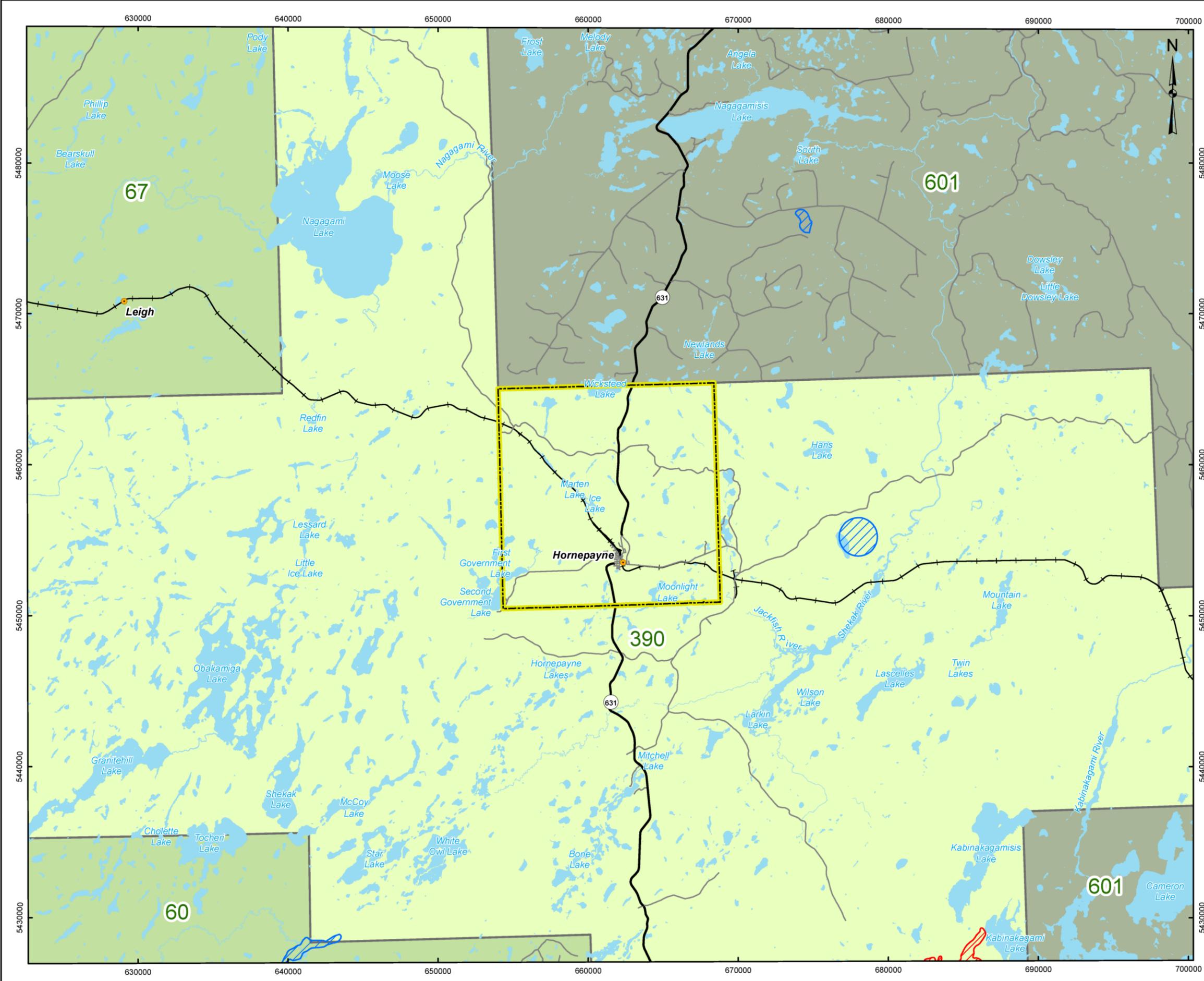
Base Data - MNR NRVIS, obtained 2009-2012, CANMAP v2006.4
 Produced by Golder Associates Ltd under licence from
 Ontario Ministry of Natural Resources, © Queens Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N



PROJECT		Environment Report Township of Hornepayne, Ontario	
TITLE		Hornepayne - Parks and Protected Lands	
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM 27 Jan. 2011	REV. 0.0
	GIS	PM/JB 7 Aug. 2013	
	CHECK	JH 7 Aug. 2013	
	REVIEW	GWS 7 Aug. 2013	

FIGURE: 4

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LEGEND

- Community
 - Main Road
 - - -** Local Road
 - +** Railway
 - Water Area, Permanent
 - Municipal Boundary, Lower Tier
 - Municipal Boundary (Township of Hornepayne)
- Forest Fire Areas (greater than 200 hectares)**
- 1976 - 1980
 - 1981 - 1990
 - 1991 - 2000
 - 2001 - 2010
- Forest Plan Renewal Year**
- 2013
 - 2014
 - 2015
 - 2016
 - 2017

FOREST MANAGEMENT UNITS

- 060 - White River Forest
- 067 - Big Pic Forest
- 390 - Nagagami Forest
- 601 - Hearst Forest



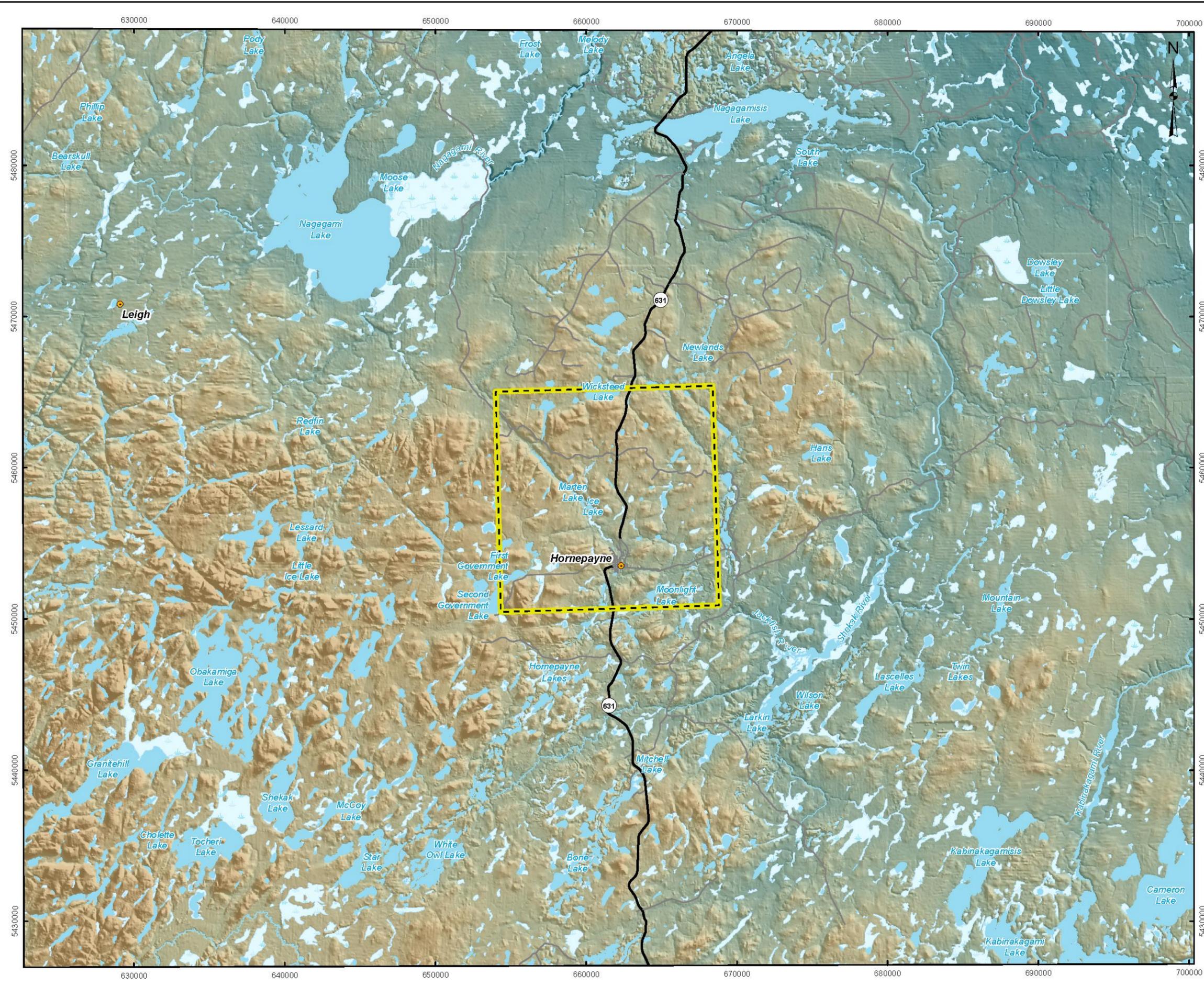
REFERENCE

Base Data - MNR NRVIS, obtained 2009-2012, CANMAP v2006.4
 Forest Management Units & Forest Fire Areas - Canadian Forest Service, 2010.
 Canadian National Fire Database-Agency Fire Data, Natural Resources Canada,
 Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta.
 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



PROJECT			
Environment Report Township of Hornepayne, Ontario			
TITLE			
Forest Management Units of the Hornepayne Area			
	PROJECT NO. 12-1152-0026	SCALE AS SHOWN	REV. 0.0
	DESIGN PRM 27 Jan. 2011		
	GIS PM/JB 7 Aug. 2013		
	CHECK JH 7 Aug. 2013		
REVIEW GWS 7 Aug. 2013			
			FIGURE: 5

G:\Projects\2012\12-1152-0026_NWMO_Phase1_Feasibility\GIS\XDS\Reporting\Env_Safety_Report\Homepayne\HomepayneDigitalElevationModel.mxd

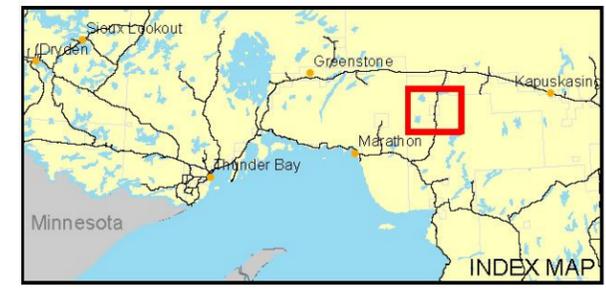


LEGEND

- Community
- Main Road
- Local Road
- Water Area, Permanent
- Wetland, Permanent
- Municipal Boundary, Lower Tier
- Municipal Boundary (Township of Homepayne)

Elevation (masl)

425
400
375
350
325
300
275
250



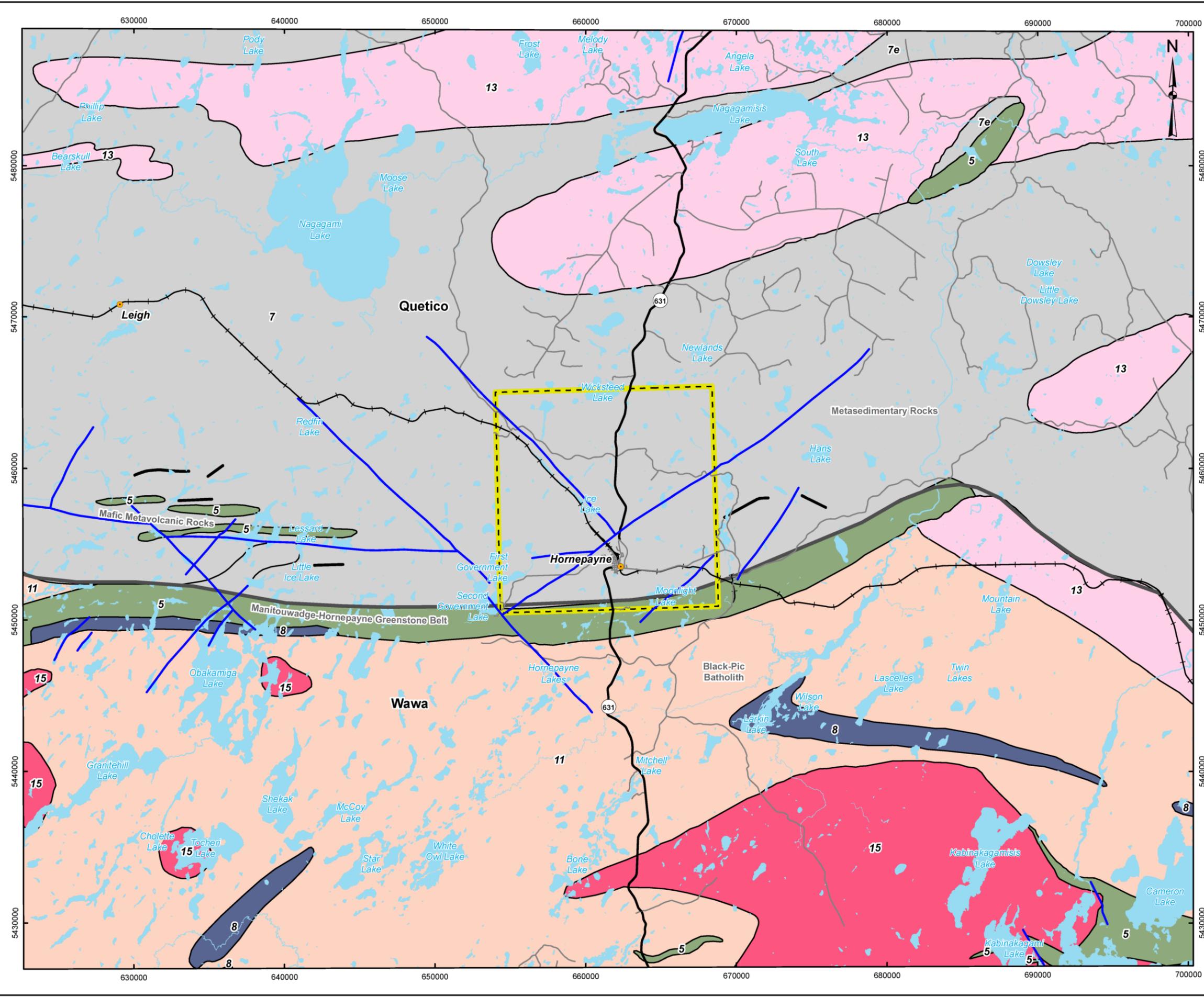
REFERENCE

Base Data - MNR NRVIS, obtained 2009-2012, CANMAP v2006.4
 Digital Elevation Model - CDED slope raster: Geobase.ca (1:50,000)
 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



PROJECT	Environment Report Township of Homepayne, Ontario		
TITLE	Digital Elevation Model (DEM) of the Homepayne Area		
 Golder Associates Mississauga, Ontario	PROJECT NO:	12-1152-0026	SCALE AS SHOWN
	DESIGN:	PRM 27 Jan 2011	REV. 0.0
	GIS:	PM/JB 7 Aug 2013	FIGURE: 6
	CHECK:	JH 7 Aug 2013	
REVIEW:	GWS 7 Aug 2013		

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LEGEND

- Community
- Main Road
- Local Road
- Railway
- Water Area, Permanent
- Geological Fault
- Geological Contact
- Sub-province Boundary (approximate)
- Iron Formation
- 15 Massive granodiorite to granite
- 13 Muscovite-bearing granitic rock
- 11 Gneissic tonalite suite
- 8 Migmatized supracrustal rocks
- 7 Metasedimentary rocks
- 7e Paragneiss and migmatites
- 5 Mafic to intermediate metavolcanic rocks
- Municipal Boundary, Lower Tier
- Municipal Boundary (Township of Hornepayne)



REFERENCE

Base Data - MNR NRVIS, obtained 2009-2012, CANMAP v2006.4
 Geology - MRD126-Bedrock Geology of Ontario, 2011
 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



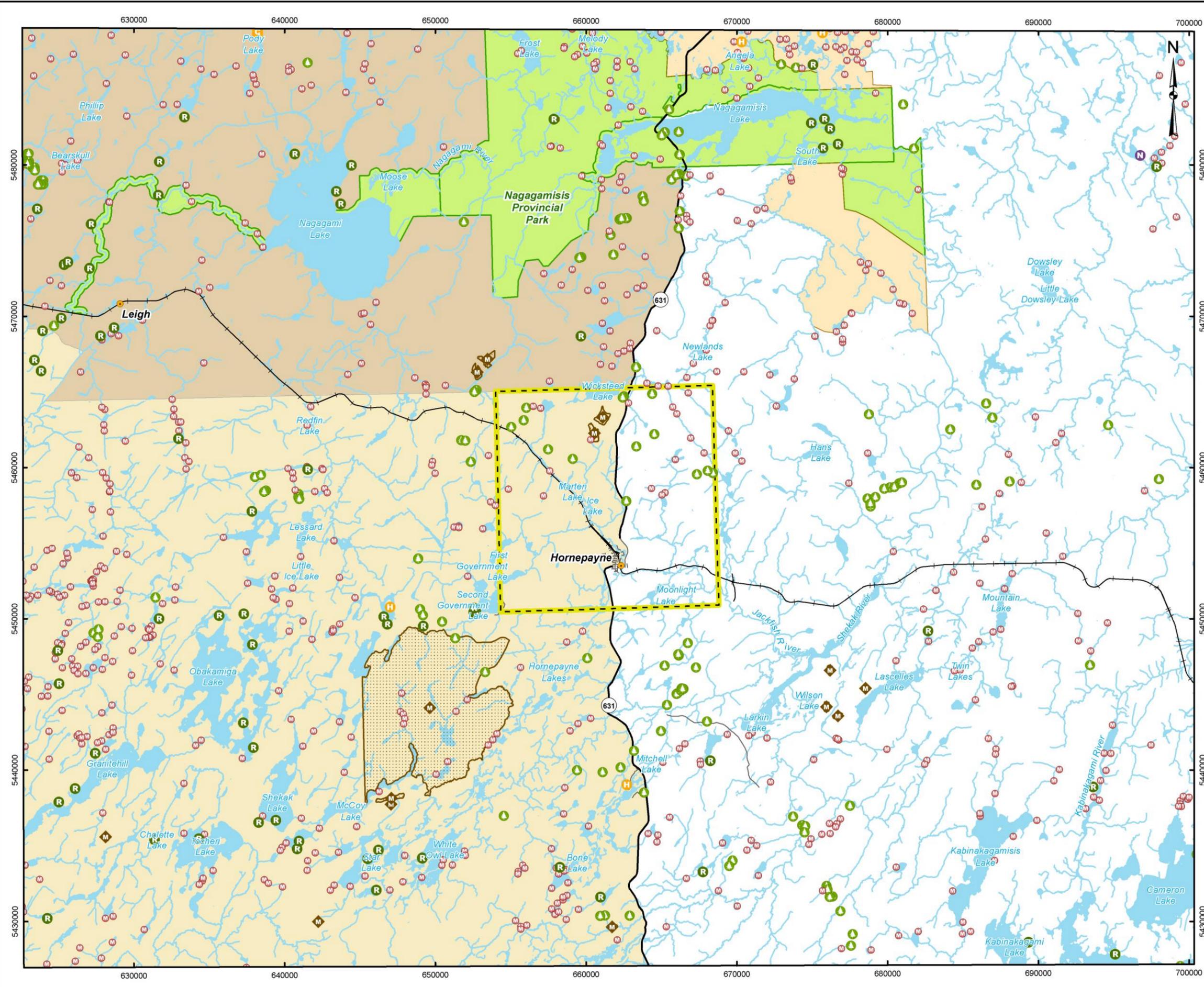
PROJECT
 Environment Report
 Township of Hornepayne, Ontario

TITLE
Bedrock Geology of the Hornepayne Area

PROJECT NO. 12-1152-0026	SCALE AS SHOWN	REV. 2.0
DESIGN PRM 27 Jan. 2011	FIGURE: 7	
GIS PM/JB 26 Jun. 2013		
CHECK JH 26 Jun. 2013		
REVIEW GWS 26 Jun. 2013		

Golder Associates
 Mississauga, Ontario

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LEGEND

- Community
- Main Road
- Local Road
- Railway
- Watercourse
- Water Area, Permanent
- Provincial Park / Reserve
- Enhanced Management Area
- Continuous Caribou Habitat
- Discontinuous Caribou Habitat
- Municipal Boundary
- Municipal Boundary (Township of Hornepayne)

Wildlife and Forestry

- Moose Aquatic Feeding Area
- Forest Research Area
- Forest Research Area

Nesting

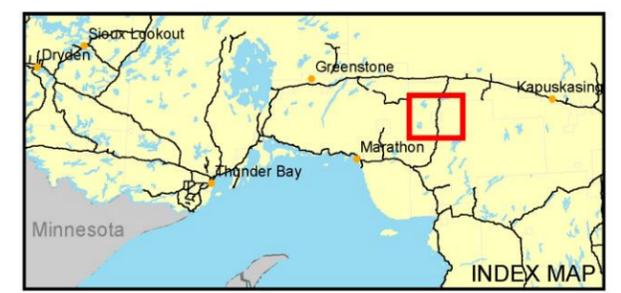
- H Heron
- N Other
- R Raptor

Wintering Area

- M Moose
- Moose

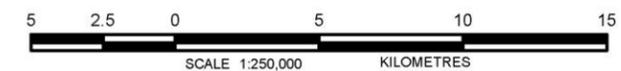
Calving/Fawning Sites

- Caribou Calving Sites

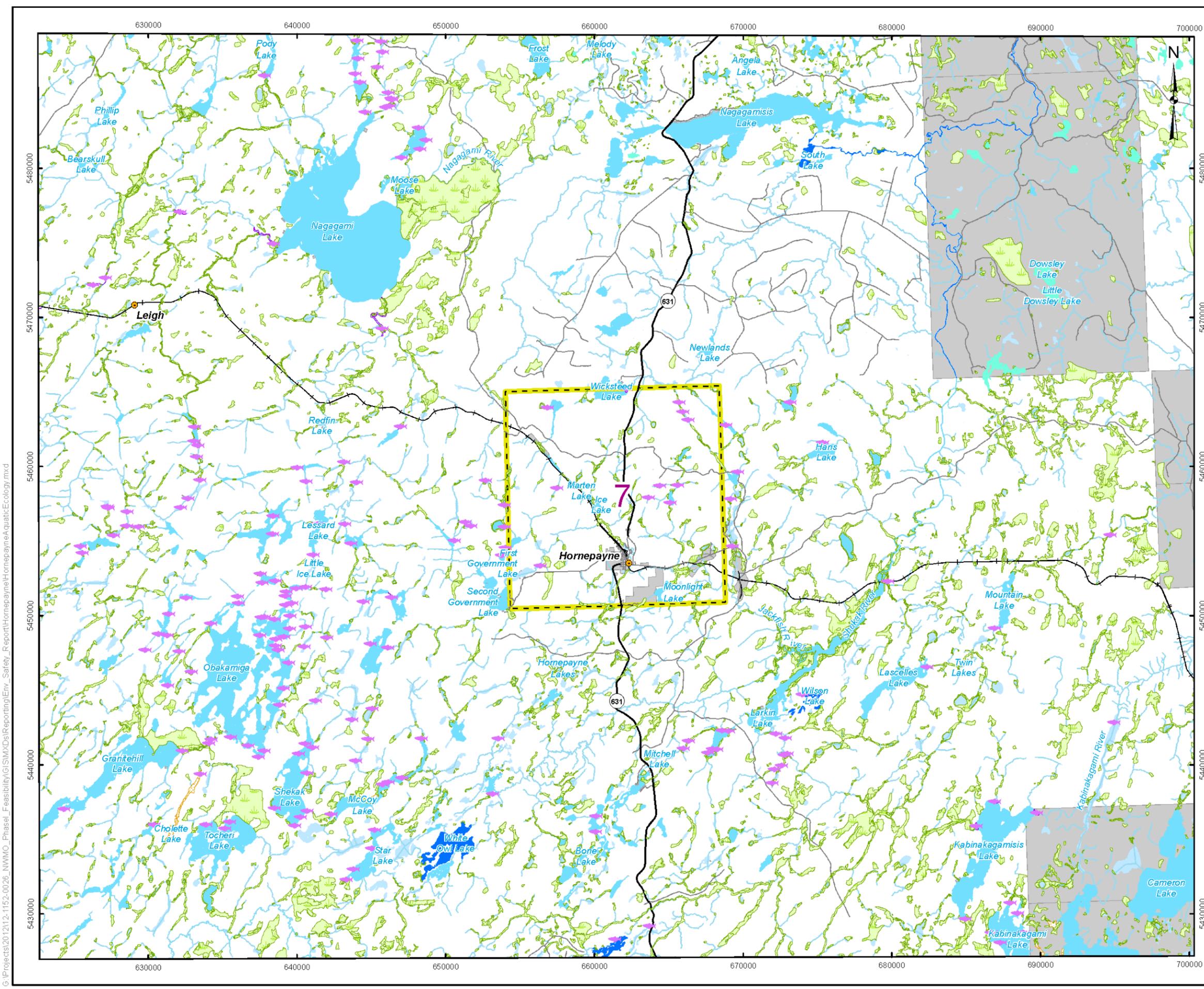


REFERENCE

Base Data - MNR NRVIS, obtained 2009-2012, CANMAP v2006.4
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 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 18N



PROJECT			
Environment Report Township of Hornepayne, Ontario			
TITLE			
Hornepayne - Terrestrial Ecology			
	PROJECT NO: 12-1152-0026	SCALE AS SHOWN	REV. 0.0
DESIGN	PRM	27 Jan. 2011	FIGURE: 9
GIS	PM/IB	7 Aug. 2013	
CHECK	JH	7 Aug. 2013	
REVIEW	GWS	7 Aug. 2013	



LEGEND

- Community
- Main Road
- Local Road
- Railway
- Watercourse
- Private Land
- Fisheries Management Zone (7)
- Municipal Boundary
- Municipal Boundary (Township of Hornepayne)

Fisheries and Wetlands

- Spawning Area
- Spawning Area
- Wild Rice Stand
- Waterbody (unspecified)
- Cold
- Cool
- Warm

Natural Heritage

- Wetland



REFERENCE

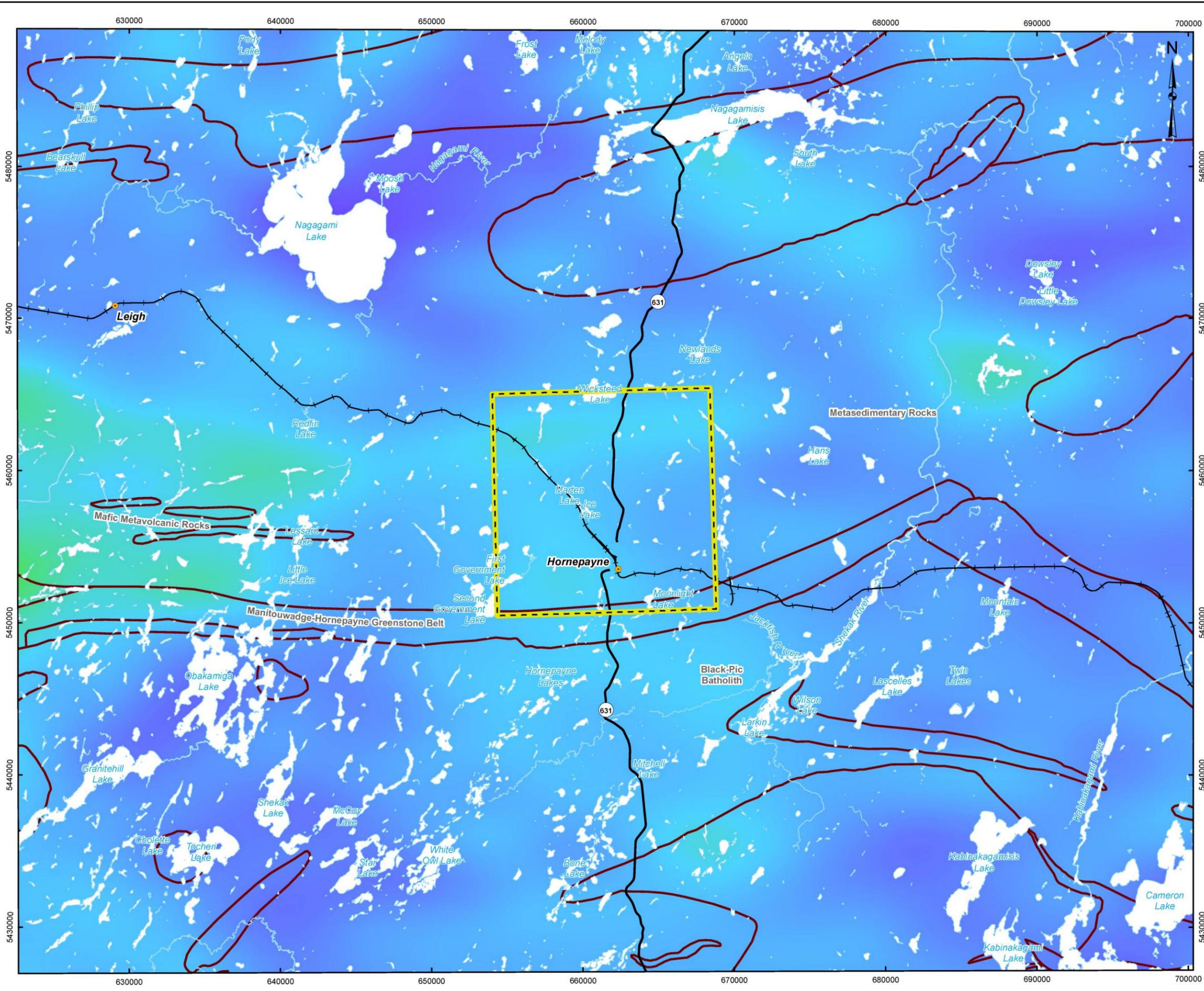
Base Data - MNR NRVIS, obtained 2009-2012, CANMAP v2006.4
 Fisheries and Wetlands Maps - Nagagami Forest and Hearst Forest
 Produced by Golder Associates Ltd under licence from
 Ontario Ministry of Natural Resources, © Queens Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N



PROJECT		Environment Report Township of Hornepayne, Ontario	
TITLE		Hornepayne - Aquatic Ecology	
	PROJECT NO	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM 27 Jan 2011	REV. 0.0
	GIS	PMJB 7 Aug 2013	FIGURE: 10
	CHECK	JH 7 Aug 2013	
REVIEW	GWS 7 Aug 2013		

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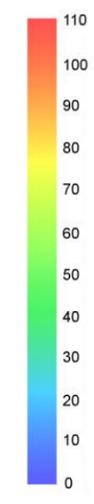
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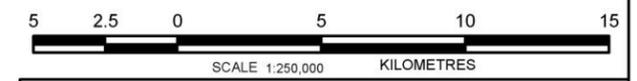
- Community
- Main Road
- +— Railway
- Water Area, Permanent
- Geological Contact
- - - Municipal Boundary, Lower Tier
- ▭ Municipal Boundary (Township of Hornepayne)

Air Absorbed Radiation Levels (nGy/h)



REFERENCE

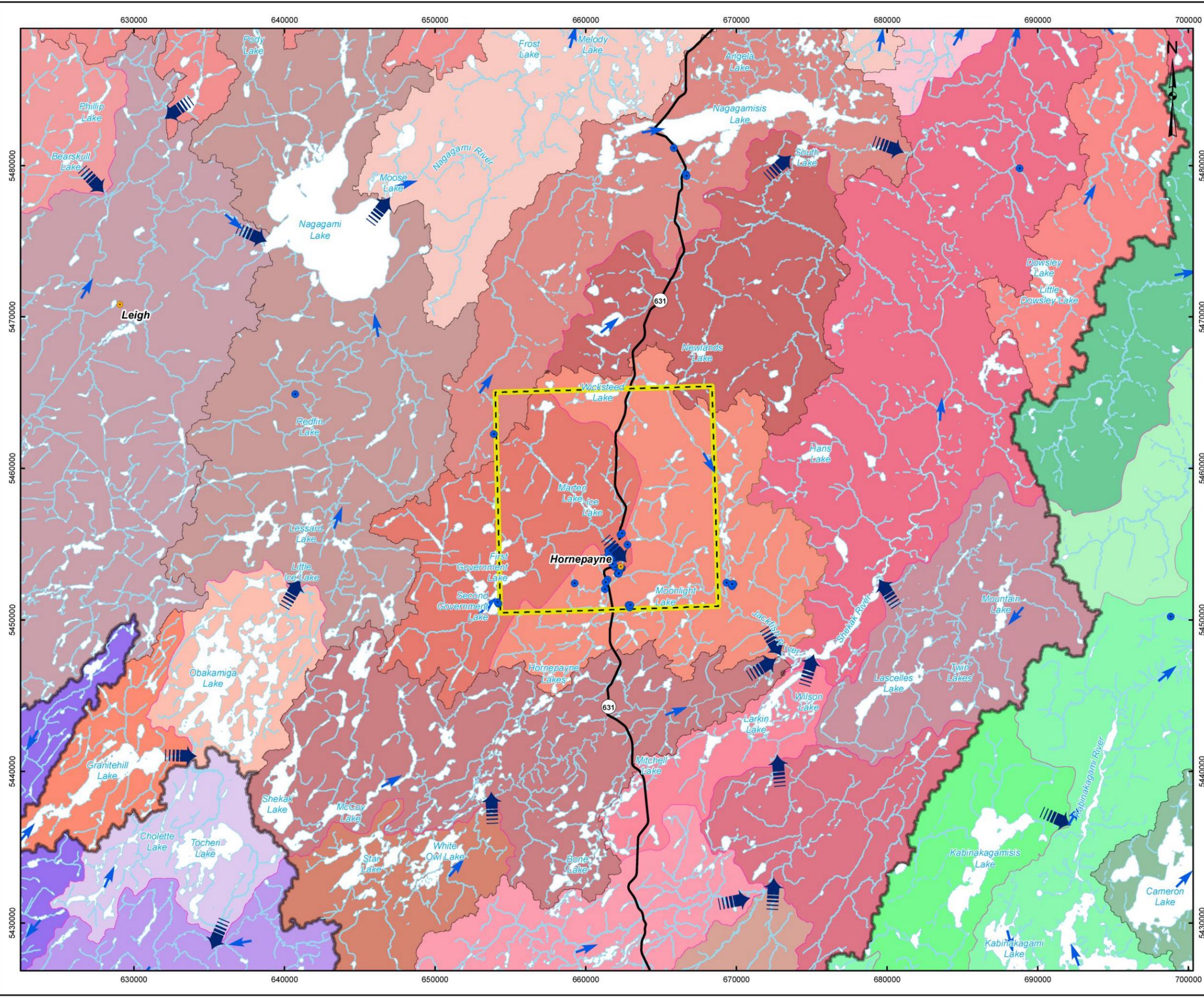
Base Data - MNR NRVIS, obtained 2009-2012, CANMAP v2006.4
 Geology - MRD126-Bedrock Geology of Ontario, 2011
 Geophysics - GSC Canada - 2km resolution - Bouguer Gravity Anomalies, 2010;
 Canadian Aeromagnetic Data Base, Airborne Geophysics Section, GSC - Central Canada Division, Geological Survey of Canada, Earth Sciences Sector, Natural Resources Canada
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 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 16N



PROJECT		Environment Report Township of Hornepayne, Ontario	
TITLE		Hornepayne - Background Radiation Levels	
PROJECT NO. 12-1152-0026		SCALE AS SHOWN	REV. 3.0
DESIGN	PRM	27 Jan. 2011	<p>FIGURE: 11</p>
GIS	PM/JB	7 Aug. 2013	
CHECK	JH	7 Aug. 2013	
REVIEW	GWS	7 Aug. 2013	



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LEGEND

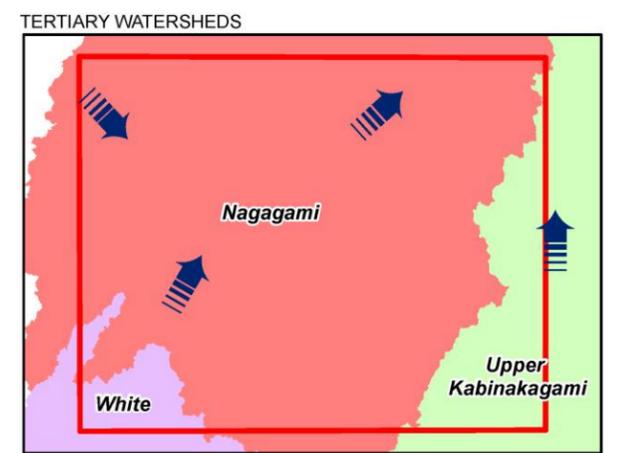
- Community
- MOE Well Location
- Main Road
- Watercourse, Permanent
- Watercourse, Intermittent
- Water Area, Permanent
- ➔ Surface Water Flow Direction
- ▤ Watershed Outflow Point

Drainage Divide

- Delineated by MNR/JDMA
- Delineated by JDMA
- Delineated by MNR

▭ Municipal Boundary, Lower Tier

▭ Municipal Boundary (Township of Hornepayne)



REFERENCE

Base Data - MNR NRVIS, obtained 2009-2012, CANMAP v2006.4
 Wells - Ministry of the Environment, 2010
 Watershed - LIO quaternary watershed (updated by JDMA)
 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

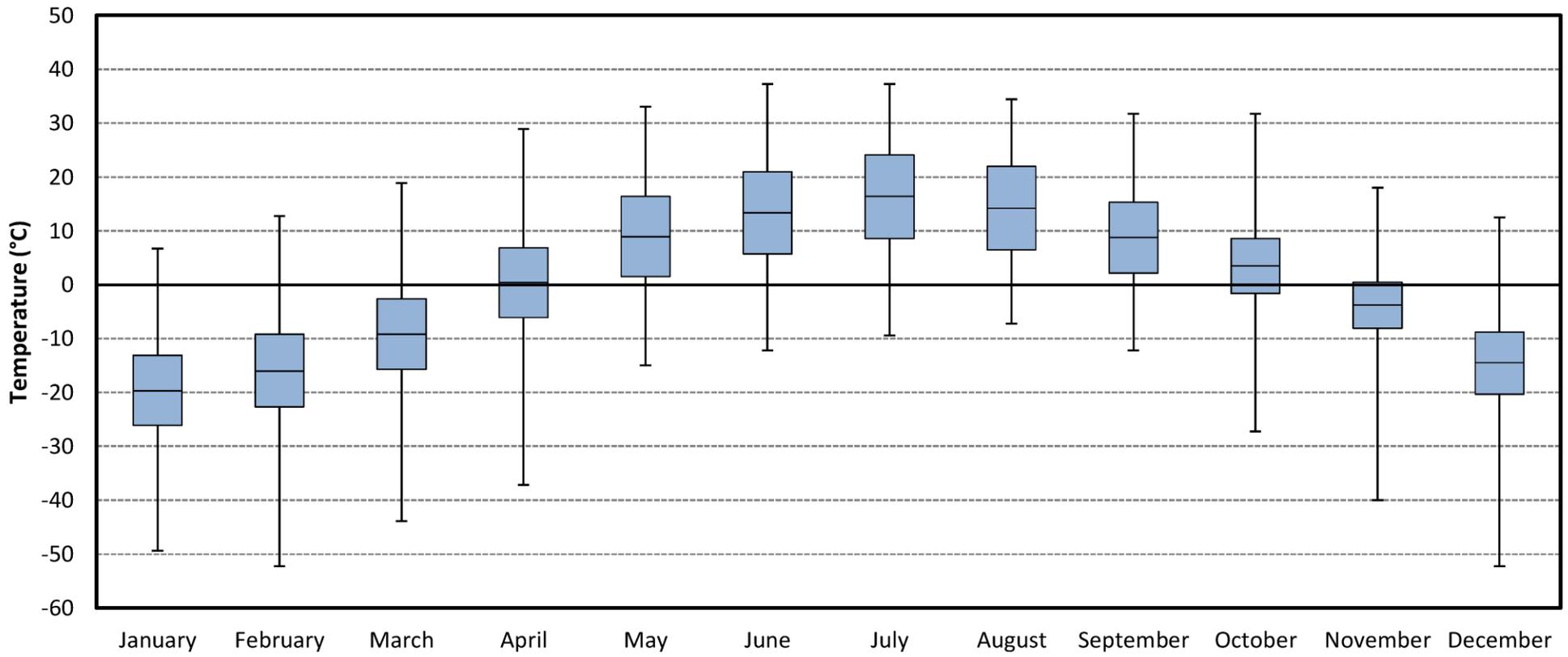
PROJECT

Environment Report
Township of Hornepayne, Ontario

TITLE

**Hornepayne Surface Water Drainage
and Water Wells**

<p>Golder Associates Mississauga, Ontario</p>	PROJECT NO. 12-1152-0026	SCALE AS SHOWN	REV. 2.0
	DESIGN PRM 27 Jan. 2011		
	GIS PM/JB 7 Aug. 2013		
	CHECK JH 7 Aug. 2013		
REVIEW GWS 7 Aug. 2013			FIGURE: 12



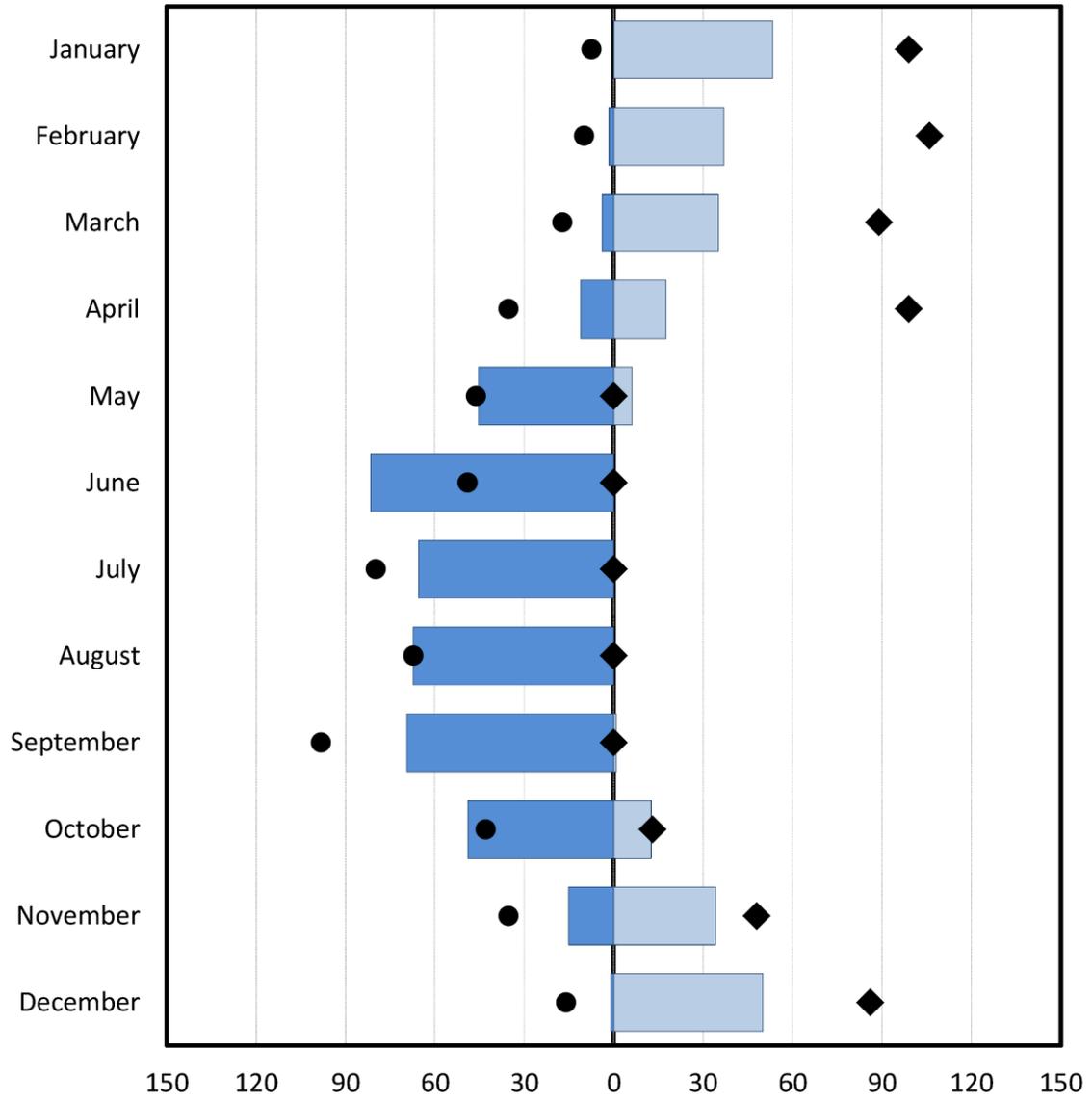
LEGEND

- Extreme Maximum (°C)
- Daily Maximum (°C)
- Daily Average (°C)
- Daily Minimum (°C)
- Extreme Minimum (°C)

DATA SOURCE

Environment Canada

PROJECT		Environment Report Township of Hornepayne, Ontario	
TITLE		Hornepayne 1971-2000 Temperature Data Summary	
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM	28 Mar. 2011
	GIS	PM/JB	7 Aug. 2013
	CHECK	JH	7 Aug. 2013
	REVIEW	GWS	7 Aug. 2013
			FIGURE: 13



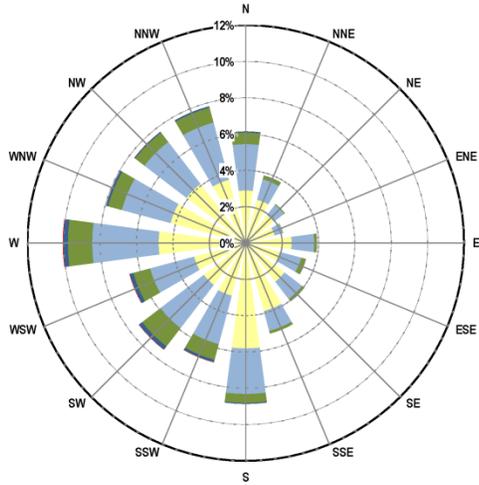
- LEGEND**
- Monthly Rainfall (mm eq.)
 - Monthly Snowfall (mm eq.)
 - Extreme Daily Rainfall (mm eq.)
 - ◆ Extreme Daily Snowfall (mm eq.)

DATA SOURCE
Environment Canada

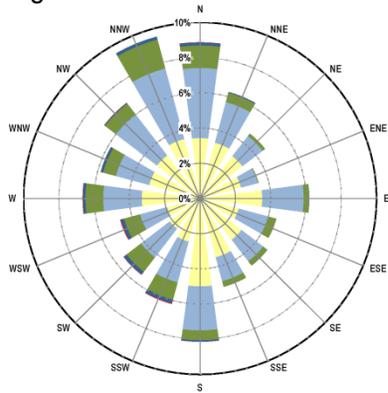
PROJECT		Environment Report Township of Hornepayne, Ontario	
TITLE		Hornepayne 1971-2000 Precipitation Data Summary	
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM 29 Mar. 2012	REV. 0.0
	GIS	PM/JB 7 Aug. 2013	FIGURE: 14
	CHECK	JH 7 Aug. 2013	
REVIEW	GWS 7 Aug. 2013		

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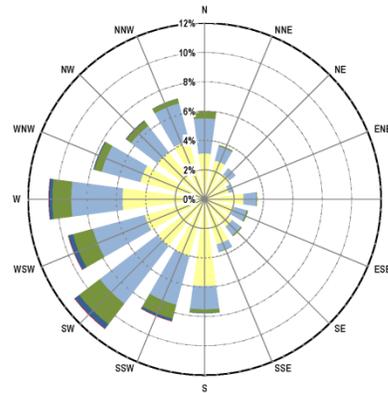
Annual



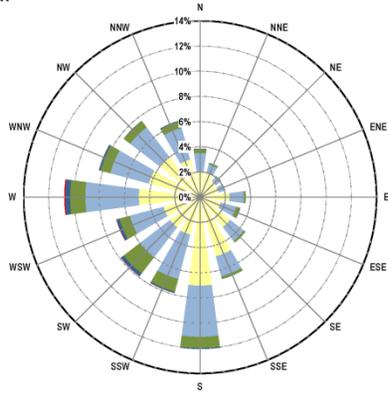
Spring



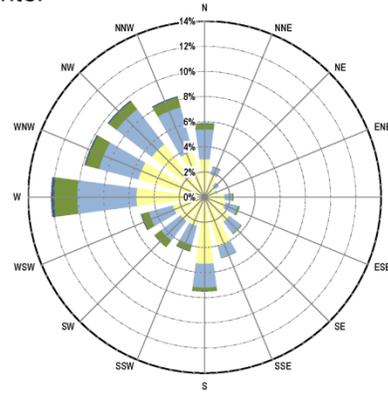
Summer



Fall



Winter



LEGEND

Wind Speed (m/s)

- >9 m/s
- 7 to 9 m/s
- 5 to 7 m/s
- 3 to 5 m/s
- 0.01 to 3 m/s

DATA SOURCE

Environment Canada

PROJECT		Environment Report Township of Hornepayne, Ontario		
TITLE		Nagami Annual and Seasonal Wind Rose January 1, 2002 – December 31, 2011		
 Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN	REV. 1.0
	DESIGN	PRM	5 Apr. 2012	FIGURE: 15
	GIS	PRM	7 Aug. 2013	
	CHECK	JH	7 Aug. 2013	
REVIEW	GWS	7 Aug. 2013		

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. 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 who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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