



NUCLEAR WASTE SOCIÉTÉ DE GESTION
MANAGEMENT DES DÉCHETS
ORGANIZATION NUCLÉAIRES

Phase 1 Desktop Assessment Environment Report

NORTHERN VILLAGE OF PINEHOUSE, SASKATCHEWAN



APM-REP-06144-0058

NOVEMBER 2013

This report has been prepared under contract to the NWMO. The report has been reviewed by the NWMO, but the views and conclusions are those of the authors and do not necessarily represent those of the NWMO.

All copyright and intellectual property rights belong to the NWMO.

For more information, please contact:

Nuclear Waste Management Organization

22 St. Clair Avenue East, Sixth Floor

Toronto, Ontario M4T 2S3 Canada

Tel 416.934.9814

Toll Free 1.866.249.6966

Email contactus@nwmo.ca

www.nwmo.ca



November 2013

PHASE 1 DESKTOP ASSESSMENT

Environment Report Northern Village of Pinehouse, Saskatchewan

Submitted to:

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

REPORT

Report No: 12-1152-0026 (4009)
NWMO Report No: APM-REP-06144-0058
Distribution:

pdf Copy - NWMO
pdf Copy - Golder Associates Ltd.





Table of Contents

1.0 INTRODUCTION.....	1
2.0 COMMUNITIES AND INFRASTRUCTURE	3
2.1 Communities.....	3
2.2 Infrastructure.....	3
2.3 Protected Areas	4
2.3.1 Parks and Reserves.....	4
2.3.2 Heritage Sites	4
2.4 Land Use	4
3.0 DESCRIPTION OF THE ENVIRONMENT	7
3.1 Physiography.....	7
3.2 Geology	7
3.2.1 Bedrock Geology.....	7
3.2.2 Quaternary Geology.....	7
3.3 Natural Environment	8
3.3.1 Natural Environment Overview	8
3.3.2 Natural Areas	8
3.3.3 Terrestrial Features and Wildlife	8
3.3.4 Aquatic Features and Fish	9
3.3.5 Endangered, Threatened and Special Concern Species	10
3.3.6 Aboriginal Interests and Traditional Knowledge	12
3.4 Background Environmental Conditions.....	12
3.4.1 Air Quality	12
3.4.2 Background Radiation.....	12
3.4.3 Soil Quality.....	13
3.4.4 Water Quality	13
3.4.5 Lake Sediment Chemistry	13
3.4.6 Potential Sources of Pollutants	13
3.5 Surface Water Hydrology.....	14



ENVIRONMENT REPORT - NORTHERN VILLAGE OF PINEHOUSE, SASKATCHEWAN

3.6	Groundwater and Wells	14
3.6.1	Overburden Aquifers	14
3.6.2	Bedrock Aquifers.....	14
3.7	Climate and Meteorology.....	15
3.7.1	Temperature	15
3.7.2	Precipitation	15
3.7.3	Wind.....	15
3.8	Natural Hazards.....	16
3.8.1	Earthquakes and Seismicity.....	16
3.8.2	Tornadoes and Hurricanes.....	16
3.8.3	Drought and Flooding.....	16
3.8.4	Snow and Ice	17
3.8.5	Forest Fires and Lightning	17
3.8.6	Landslides and Tsunamis	17
4.0	SUMMARY.....	19
5.0	REFERENCES.....	21

TABLES

Table 1: Population Statistics for the Pinehouse Area	3
Table 2: Potential Endangered, Threatened and Special Concern Species in the Pinehouse Area.....	10
Table 3: NPRI Regional Sources of Air Emissions.....	12
Table 4: Registered Landfills in the Pinehouse Area.....	13
Table 5: Monthly Wind Normals for Buffalo Narrows, Saskatchewan	16

FIGURES (IN ORDER FOLLOWING TEXT)

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



Figure 7: Bedrock Geology of the Pinehouse Area

Figure 8: Quaternary Geology of the Pinehouse Area

Figure 9: Pinehouse – Ecology

Figure 10: Pinehouse – Background Radiation Levels

Figure 11: Pinehouse Surface Water Drainage and Water Wells

Figure 12: Buffalo Narrows 1971-2000 Temperature Data Summary

Figure 13: Buffalo Narrows 1971-2000 Precipitation Data Summary



ENVIRONMENT REPORT - NORTHERN VILLAGE OF PINEHOUSE, SASKATCHEWAN



1.0 INTRODUCTION

The Northern Village of Pinehouse in Saskatchewan 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 Pinehouse. To this end, this report provides a general description of the environment in the Northern Village of Pinehouse and surrounding area. It is complemented by reports prepared in parallel which characterize the geoscientific conditions and community well-being profile of the 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 Pinehouse area considered here is similar to that used for the Phase I Geoscientific Assessment for Pinehouse. This area is shown on Figure 1, and includes the Northern Village of Pinehouse and surrounding area.



ENVIRONMENT REPORT - NORTHERN VILLAGE OF PINEHOUSE, SASKATCHEWAN



2.0 COMMUNITIES AND INFRASTRUCTURE

2.1 Communities

The Northern Village of Pinehouse is located in northern Saskatchewan, on the western shore of Pinehouse Lake (Figure 1). Pinehouse is located 80 km northeast of Beauval, 93 km northwest of La Ronge, and 250 km north of Prince Albert, Saskatchewan. Access to Pinehouse is from the south via Highway 914, which is connected to Highway 165 and Highway 2 leading to the City of Prince Albert. The Northern Village of Pinehouse is approximately 6.8 km² in size (GeoSask, 2012) with a population of 978 (Statistics Canada, 2012). Figure 2 presents satellite imagery for the area taken in 2006.

Table 1 summarizes the total population and population density for the Northern Village of Pinehouse and the census division in which it falls, Census Division No. 18, CDR¹. Census Division No. 18 covers the entirety of northern Saskatchewan, with its southern boundary to the south of Creighton and Beauval.

Table 1: Population Statistics for the Pinehouse Area

Political Boundary	Population	Population Density per km ²
Northern Village of Pinehouse	978	142.9
Division No. 18, CDR	36,557	0.1

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

Land ownership in the Pinehouse area, including areas of Crown land managed by the Saskatchewan Ministry of the Environment, Crown Reserve² areas, recreation sites and private lands, is shown on Figure 3.

There are a number of Aboriginal communities and organizations in the Pinehouse area including Lac La Ronge Indian Band, Birch Narrows First Nation, Buffalo River Dene First Nation, Canoe Lake First Nation, Clearwater River Dene Nation, English River First Nation, Flying Dust First Nation, Makwa Sahgaiehcan First Nation, Ministikwan Lake First Nation (formerly known as Island Lake First Nation) and Waterhen Lake First Nation; all are signatories to Treaty 6, 8 or 10. Métis Locals in the area include Kineepik – Pinehouse #9, Beauval #37, Canoe River #174, Cole Bay #41, Patuanak #82 and Sakitawak – Île-à-la-Crosse #21; all are located within Métis Nation-Saskatchewan Northern Region III.

Further information on Pinehouse and its surrounding communities is provided in the Community Profile Report for Pinehouse.

2.2 Infrastructure

Figure 1 shows the location of the primarily infrastructure corridors in the Pinehouse area. The main transportation routes include access from the south via Highway 914 (gravel road), which is connected to Highway 165 (gravel road) and Highway 2 (paved road) leading to the City of Prince Albert (Figure 1). As well, Highway 910 (gravel road) crosses through the southeast corner of the Pinehouse area. There is one airport in

¹ CDR is defined as census division / division de recensement and is a geographic unit created as equivalent to a census division by Statistics Canada, in cooperation with applicable provinces, for the purpose of disseminating statistical data.

² Crown Reserves are Crown lands that have been withdrawn from dispositioning under Section 21 of the Crown Minerals Act. Note that in Saskatchewan, Crown Reserve lands could also include freehold lands because the person who owns the land/mineral rights may only own those rights for a particular mineral. Therefore the Crown would own the rights for the other minerals that would be found on that land.



the area, as shown on Figure 1. No railways, transmission lines or gas pipelines were identified within the Pinehouse area. There is one operating landfill and a wastewater treatment plant within the Pinehouse area.

2.3 Protected Areas

2.3.1 Parks and Reserves

The Gordon Lake Recreation Site is the only protected area situated partially within the Pinehouse area; it is located 27 km north of the village on the south shore of Gordon Lake. The Gordon Lake recreation site is small, with an area of 3.7 km². Figure 4 shows the location of this protected area.

2.3.2 Heritage Sites

The database for heritage resources maintained by the Saskatchewan Ministry of Tourism, Parks, Culture and Sport (TPCS, 2012) as well as the National Historic Sites Database (Parks Canada, 2012) were consulted to identify previously recorded heritage sites found within the Pinehouse area. Heritage resources include all of Saskatchewan's historic and pre-contact archaeological sites, architecturally significant structures and paleontological resources. Heritage resources are property of the Provincial Crown, and as such, are protected under *The Heritage Property Act* (Government of Saskatchewan, 1980).

The results of the database search indicate that 17 archaeological sites have been recorded within the Pinehouse area. Pre-contact artifact find and scatter sites are the most common, totalling 11; followed by three artifact/feature combination sites; and one pictograph or rock art site. Two heritage resources have insufficient information to be given a site type designation. According to the site database, known heritage resources in the Pinehouse area and the broader region were recorded between 1960 and 1980 as part of various research and assessment projects. The majority of the sites are located on the Churchill River and associated tributaries and lakes. Twenty-three sites were recorded during the Key Lake Road assessment with sites associated with the Churchill and Haultain rivers (Meyer, 1979). The remainder of the sites are found on Besnard and Pinehouse lakes.

As indicated by these heritage resources, the Churchill River and its associated tributaries and lakes were a significant waterway during both pre-contact and historic times. Archaeological evidence indicates that people were occupying the Churchill River as early as 10,000 years ago (Meyer, 1995). During the early fur trade period, explorers and traders began travelling the Churchill River beginning in the late 1770s. This was soon followed by the establishment of fur trade posts by both the English and French beginning in 1775 and continuing through to the 1930s (Russell and Meyer, 1999). Posts were established not only on the Churchill River proper, but also in Lac La Ronge, Lac Île-à-la-Crosse, Lac La Plonge and Pinehouse Lake.

Archaeological potential is established by determining the likelihood that archaeological resources may be present on a subject property. In archaeological potential modelling, a distance criterion of 300 m is generally employed for known archaeological resources, water sources and early Euro-Canadian settlements. The presence of local heritage sites would need to be further confirmed in discussion with the community and Aboriginal peoples in the area.

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.



The Pinehouse area includes parts of three Saskatchewan Crown Forest Areas (Figure 5). The southwestern portion of the Pinehouse area falls within the North West Communities Term Supply License (TSL), the southeastern portion is within the Kitsaki-Zelensky TSL and the northern section is within the Northern Provincial Forest North (Government of Saskatchewan, 2007). The Northern Provincial Forest North has a gross area of 21,196,445 ha (hectares), which makes up 63% of provincial forest in Saskatchewan. This area is designated as non-commercial; therefore, no forestry TSLs have been granted for this area (Government of Saskatchewan, 2007). The North West Communities TSL is a partnership of the communities of Beauval, Buffalo Narrows, Green Lake, Île-à-la-Crosse, La Loche, Patuanak and Pinehouse Lake. North West Communities TSL has a gross area of approximately 770,000 ha, which makes up 6% of provincial commercial forest in Saskatchewan and the Kitsaki-Zelensky TSL includes an area of approximately 595,000 ha or 5% of the commercial forest in Saskatchewan (Government of Saskatchewan, 2007). Commercial forest makes up 37% of total provincial forest (Government of Saskatchewan, 2007).

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

There is no record of metallic mineral production near the Pinehouse area. Past exploration has occurred to the east where occurrences of thorium, uranium, copper and iron have been noted (Delaney, 1993). Some occurrences have undergone limited trenching and drilling exploration (Saskatchewan Energy and Resources, 2010), although there is no information available to indicate if these occurrences have any economic potential. Copper mineralization is primarily associated with metasedimentary rocks, which occur in the Pinehouse area at the north end of Pinehouse Lake. Iron mineralization, in the form of pyrite and pyrrhotite, has been associated with metasedimentary and granitic rocks near Knee Lake and northeast of Besnard Lake. There are currently no producing gold mines near the Pinehouse area; however, there is a gold occurrence approximately 12 km to the southwest of Pinehouse within Canadian Shield gneiss, at a depth of approximately 55 m (Saskatchewan Energy and Resources, 2010). While most of the gold deposits known within Saskatchewan are located in the Canadian Shield, there are no known gold exploration projects currently being undertaken in the Pinehouse area. In the Pinehouse area, uranium mineralization has been identified in the Duddridge Lake area, based on an active mineral claim.

At present, there are no sand and gravel pits, or rock quarries in the Pinehouse area.

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



**ENVIRONMENT REPORT - NORTHERN VILLAGE OF
PINEHOUSE, SASKATCHEWAN**



3.0 DESCRIPTION OF THE ENVIRONMENT

3.1 Physiography

The Pinehouse area is located in the Kazan Upland Physiographic Region of the western Canadian Shield. The Canadian Shield outcrops northeast of Pinehouse Lake, while the Boreal Plain terrain occurs to the southwest. Lakes and ridges in the shield region are generally aligned in a northeast-southwest direction, indicating the direction of past glacial-ice movements. In the shield areas, bedrock and thin moraine veneer are typical. South of the shield, moraine plain and organic plain are more common; these areas tend to have smaller lakes, dendritic drainage patterns and more abundant peatland terrain. The topography of the Pinehouse area is defined by the surficial geology and geomorphology of the region. The organic and moraine plains southwest of Pinehouse have the greatest relief, while numerous lakes and peatlands occur in low-lying areas. For example, surface elevations range from a high of 521 masl on the hill southwest of Snake Rapids to a low of 385 masl in Sandfly Lake.

Figure 6 presents the topography of the Pinehouse area as a digital elevation model (DEM).

3.2 Geology

3.2.1 Bedrock Geology

The bedrock geology of the Pinehouse area is shown on Figure 7. The Northern Village of Pinehouse is located near the unconformity between the Hearne Province of the Precambrian Canadian Shield and the Western Canada Sedimentary Basin. The Northern Village of Pinehouse lies within the Wollaston domain of the Hearne Province. In the southeast corner of the Pinehouse area, the Wollaston domain is separated from the Wathaman batholith³ domain by the Needle Falls shear zone. In the northwest part of the Pinehouse area, the boundary with the Mudjatik domain is marked by a transition in structural style from a linear fold belt to dome-basin fold interference (SGS, 2003; Delaney, 1993; Yeo and Delaney, 2007). Within the Pinehouse region, rocks of the Wollaston and Mudjatik domains are characterized by high metamorphic grades and complex deformation. In the Pinehouse area, Archean felsic gneiss is the main Canadian Shield rock type present.

Approximately 2 km to the south and west of the Northern Village of Pinehouse, Phanerozoic rocks are present in the Western Canada Sedimentary Basin. Five units make up the Phanerozoic outcrops: the Deadwood Formation, Upper and Lower Members of the Meadow Lake Formation, the Winnipegosis Formation and the Lower Cretaceous Mannville Group. The Deadwood Formation consists of granular sandstones, quartz arenites, siltstone shales, argillaceous limestones and shales, and flat-pebble conglomerates (Greggs and Hein, 2000). The Lower Member of the Meadow Lake Formation consists of dolomite with local interbedded mudstone, sandstone and limestone. The Upper Member of the Meadow Lake Formation consists of limestone, dolomite and mudstone. The Winnipegosis Formation is mainly dolomite and limestone. The Lower Cretaceous Mannville Group consists of quartzose sands and poorly consolidated sandstones.

3.2.2 Quaternary Geology

The Quaternary⁴ geology of the Pinehouse area is shown on Figure 8 and is mostly composed of glacial deposits. The main glacial deposits include morainal plains, glaciofluvial plains and glaciolacustrine plains to the

³ Batholiths are made of multiple masses, or plutons, of igneous rock that have melted and intruded surrounding strata at great depths.

⁴ Quaternary refers to the last 2.6 million years of Earth's history.



south. Rock outcrop becomes more prominent to the north of Pinehouse Lake and marshy areas also occur throughout the region. Moraine plains and glaciofluvial plains are primarily sandy with variable silt and clay fractions (Schreiner, 1984a). Thickness of the Quaternary strata is variable and available data for the Pinehouse area with respect to overburden thickness is sparse. It is estimated that its thickness is likely to range from a thin veneer at the north of end of Pinehouse Lake (Schreiner, 1984b) to approximately 20 m in the southern portion of the Pinehouse area.

3.3 Natural Environment

3.3.1 Natural Environment Overview

The Pinehouse area is located in central Saskatchewan and within the boreal forest. It is an important area for many Aboriginal communities. There is limited information about the natural environment of this area available from public data sources. Consultation with the Aboriginal communities in later stages of the Adaptive Phased Management process is likely to provide additional knowledge on the natural environment passed down through generations. The Northern Fur Conservation Block, which covers most of Northern Saskatchewan, is divided into 89 Fur Conservation Areas (FCAs). These are units for trapline management with a restricted number of trappers per FCA. The Pinehouse area is predominantly within FCA N-11⁵, with the southeast corner of the area in N-7 and the northwest in N-16 (Figure 3). The following sections describe the protected natural areas, the terrestrial ecology and aquatic ecology and focus on rare species that may be most sensitive to alterations or changes to the landscape.

3.3.2 Natural Areas

According to the Saskatchewan Representative Areas Network, there are no game preserves, national parks, national wildlife areas, provincial parks, special management areas or wildlife refuges identified within the Pinehouse area (Saskatchewan Ministry of Environment, 2005; GeoSask, 2012). As noted in Section 2.3.1, the Gordon Lake Recreation Site is located within the Pinehouse area. A Migratory Bird Conservation Site (Figure 9) is documented north of Pinehouse, which provides breeding, moulting and staging habitat for numerous migratory birds (SKCDC, 2012). No Official Plan was available in public databases for the Pinehouse area.

Mapping from GeoSask shows that the Pinehouse area contains 30,178 ha of wetlands, which represent approximately 10% of the area (GeoSask, 2012), as shown on Figure 9. Ground investigations and consultation with local experts and First Nations communities are likely to reveal additional wetland areas that have not been identified in the GeoSask data. If wetlands are to be impacted by a proposed activity, they may require evaluation according to the Saskatchewan Wetland Policy.

3.3.3 Terrestrial Features and Wildlife

The Pinehouse area falls within the Saskatchewan Wildlife Management Units 72 and 73 (Figure 9) and is located in the Churchill River Upland and Mid-Boreal Upland Eco-regions. According to mapping from GeoSask, the Pinehouse area contains 190,386ha of woodland, which is approximately 65% of the Pinehouse area (GeoSask, 2012). The Pinehouse area is dominated by a number of major vegetation types that typically characterize the Churchill River and Mid-Boreal uplands. These range from stands dominated by black spruce (*Picea mariana*), jack pine (*Pinus banksiana*) or white spruce (*Picea glauca*), to mixed wood, peatlands and

⁵ The full extent of FCA N-11 extends beyond the boundaries of the Pinehouse area to the north, as shown on Figure 3.



wetlands (Acton et al., 1998). Two additional forest vegetation types found within the Mid-boreal Upland include trembling aspen (*Populus tremuloides*) and mixed black spruce-jack pine (Acton et al., 1998). The understory and ground cover vegetation varies and includes species ranging from feather mosses, sphagnum moss species, lichens, low shrubs such as Labrador tea (*Ledum groenlandicum*) and small cranberry (*Vaccinium oxycoccos*) (Acton et al., 1998). Common shrubs include bearberry (*Arctostaphylos uva-ursi*), dwarf birch (*Betula pumila* L. var. *glandulifera*), low bush-cranberry (*Viburnum edule*), prickly rose (*Rosa acicularis*) and velvet-leaf blueberry (*Vaccinium myrtilloides*) (Acton et al., 1998).

The structural and special variations of the vegetation communities within the Pinehouse area, coupled with the continuity and connectivity of these communities across the Churchill River and Mid-Boreal uplands provides suitable habitat for a variety of mammals and birds. Moose (*Alces alces*), black bear (*Ursus americanus*), and other mammals such as the muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), river otter (*Lontra canadensis*), snowshoe hare (*Lepus americanus*) and gray wolf (*Canis lupus*) are common within the Pinehouse area (Acton et al., 1998). Woodland caribou (*Rangifer tarandus*) are found in moderate numbers within the Pinehouse area, typically in muskeg and semi-open bog habitat (SERM, 2000). The known caribou range is shown on Figure 9.

Bird diversity is considered to be moderate within the Churchill Uplands; however, the Churchill River system contains the second highest concentration of nesting bald eagles (*Haliaeetus leucocephalus*) in North America, surpassed only by Alaska (Acton et al., 1998). Some year round resident birds include: great horned owl (*Bubo virginianus*), common raven (*Corvus corax*), ruffed grouse (*Bonasa umbellus*), great gray owl (*Strix nebulosa*), black-capped chickadee (*Poecile atricapillus*) and red-breasted nuthatch (*Sitta canadensis*) (Acton et al., 1998). In the northern portions of the Mid-Boreal uplands, bird diversity is considered to be low, but increases southward (Acton et al., 1998). Common birds in this eco-region include ruffed grouse, great gray owl, blue jay (*Cyanocitta cristata*), common goldeneye (*Bucephala clangula*) and rose-breasted grosbeak (*Pheucticus ludovicianus*) (Acton et al., 1998).

Amphibians and reptiles common to both the Churchill River and Mid-Boreal uplands include Canadian toad (*Bufo hemiophrys*), wood frog (*Rana sylvatica*) and red-sided garter snake (*Thamnophis sirtalis*). Boreal chorus frog (*Pseudacris maculata*) and northern leopard frog (*Rana pipiens*) also occur in the Mid-Boreal upland (Acton et al., 1998).

3.3.4 Aquatic Features and Fish

The Pinehouse area encompasses numerous named and unnamed waterbodies and watercourses of varying size (Figure 9). According to mapping from GeoSask, the Pinehouse area contains 70,700 ha of aquatic areas, which represent approximately 24% of the surface area (GeoSask, 2012). The Pinehouse area encompasses a number of lakes and rivers that drain into the Churchill River system.

Although existing information on fish and fish habitat features is limited, the Pinehouse area produces fish in quantities that support subsistence, commercial and tourism use (SERM, 2000). Approximately 30 fish species have been documented in the Pinehouse area. Commercial fisheries focus on walleye (*Sander vitreus*), northern pike (*Esox lucius*) and lake whitefish (*Coregonus clupeaformis*), while sport fishing generally focuses on walleye, northern pike and lake trout (*Salvelinus namaycush*) (SERM, 2000).

Walleye spawning has been reported in the Mercer River (Besnard Lake Lodge, 2010). The 2012 Saskatchewan Anglers' Guide (Saskatchewan Ministry of Environment, 2012a) reports the Mercer River as



closed to angling all year between Mercer and Besnard Lakes. Spring spawning habitat is also likely available in the southwest and southeast bays of Pinehouse Lake, and in the downstream sections of Massinahigan, Tippto and Smoothstone rivers, since the fishing regulations identify fishing season opening in these areas after June 21 (Saskatchewan Ministry of Environment, 2012a).

3.3.5 Endangered, Threatened and Special Concern Species

The Saskatchewan Conservation Data Centre (SKCDC) maintains mapping of rare species found within the province (Figure 9). Queries were also made of the Encyclopedia of Saskatchewan (EOS, 2012). All species which are classified as endangered (END), threatened (THR) or special concern (SC) under either the provincial *Wildlife Act*, 1998 (Statutes of Saskatchewan, 1998) or the federal *Species at Risk Act* (SARA) (Government of Canada, 2012) have been listed in Table 2. These species have a home range within the Pinehouse area, but there may not be actual observations in the area and critical habitat for these species may not be present.

Based on a search of the Saskatchewan Conservation Data Centre (SKCDC) database (SKCDC, 2012), no federally listed plant species are currently identified as occurring within the Pinehouse area. Provincially tracked plant species known to occur within the Pinehouse area include western prince’s-pine (*Chimaphila umbellata ssp. Occidentalis*), smooth cinquefoil (*Potentilla pensylvanica var. litoralis*), immaculate lily (*Lilium philadelphicum var. andinum f immaculata*) and pale manna grass (*Torreyochloa pallida var. fernaldii*). Immaculate lily is considered to be extremely rare, pale manna grass is documented as rare and both western prince’s-pine and smooth cinquefoil are considered to be rare to uncommon species. Areas where these plants occur are indicated using green hatching and labelling on Figure 9.

Potential habitat for a number of federally and provincially protected wildlife species can be found in the Pinehouse area, including six bird species. Woodland caribou is a THR species that has known habitat within the Pinehouse area (Figure 9). Also, lake sturgeon (*Acipenser fulvescens*) is listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2010). While lake sturgeon has not been documented in the Pinehouse area, this species is known to occur at other locations in the Churchill River.

In addition to species that are listed on the *Wildlife Act* 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.

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

Common Name	Scientific Name	SKCDC Rank	Wildlife Act Status ^a	SARA Status (Schedule) ^b	Source ^c
Vascular Plants					
Western prince’s-pine	<i>Chimaphila umbellata ssp. Occidentalis</i>	S2S3			SKCDC
Smooth cinquefoil	<i>Potentilla pensylvanica var. litoralis</i>	S2S3			SKCDC
Immaculate lily	<i>Lilium philadelphicum var. andinum f immaclata</i>	S1			SKCDC



ENVIRONMENT REPORT - NORTHERN VILLAGE OF PINEHOUSE, SASKATCHEWAN

Common Name	Scientific Name	SKCDC Rank	Wildlife Act Status ^a	SARA Status (Schedule) ^b	Source ^c
Pale manna grass	<i>Torreyochloa pallid var. fernaldii</i>	S2			SKCDC
Mammals					
Wolverine	<i>Gulo gulo</i>	S3S4		SC	SKCDC, COSEWIC
Woodland caribou	<i>Rangifer tarandus</i>	S3		THR (1)	SKCDC
Birds					
Bald eagle	<i>Haliaeetus leucocephalus</i>	S5B, S4M, S4N			SKCDC
Canada warbler	<i>Cardellina canadensis</i>	S5B		THR (1)	SKBA, COSEWIC
Common nighthawk	<i>Chordeiles minor</i>	S4S5B, S4S5M		THR (1)	SKBA, SKCDC
Olive-sided flycatcher	<i>Contopus cooperi</i>	S4		THR (1)	SKBA, COSEWIC
Peregrine falcon ^e	<i>Falco peregrinus</i>	S1B, S4M, S2N	SC	THR (1)	SKBA
Rusty blackbird	<i>Euphagus carolinus</i>	S4B		SC (1)	SKBA
Red-throated loon ^e	<i>Gavia stellata</i>	S1B			SKCDC
Red knot	<i>Calidris canutus rufa</i>	S2		^d	SKCDC, COSEWIC
Whooping crane ^e	<i>Grus americana</i>	SXB, S1M	END	END (1)	SKCDC
Reptiles and Amphibians					
Northern leopard frog	<i>Rana pipiens</i>	S3		SC (1)	SKCDC, EOS
Fish and other Aquatic Species					
Lake sturgeon	<i>Acipenser fulvescens</i>	S2B		END	COSEWIC

Notes:

S1: Extremely rare; S2: Rare; S3: Rare – uncommon; S4: Common; S5: Very common; A: accidental or casual in the province; B: breeding population in province for a migratory species; N: non-breeding population in province for a migratory species; M: transient population in province for a migratory species; H: historical occurrence without verification in last 20 years; U: status uncertain in province due to limited information; X: believed to be extinct or extirpated; NR

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 Provincial Wild Species at Risk listed under *The Wildlife Act*, (Statutes of Saskatchewan, 1998)

^b Status listed on the federal *Species at Risk Act*; endangered (END), threatened (THR), special concern (SC) (Government of Canada, 2012).

^c Data obtained from the Saskatchewan Conservation Data Centre (SKCDC, 2012), The Encyclopedia of Saskatchewan (EOS, 2012), Saskatchewan Bird Atlas (SKBA) (Saskatchewan Ministry of Environment, 2012b) or COSEWIC Status Reports (COSEWIC, 2010).

^d Currently under consideration for addition to Schedule 1 of SARA (Government of Canada, 2012)

^e Migrant Species only



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.

This phase of the work was limited to desktop studies using publicly available sources. It is recognized that consultation with Pinehouse communities is required before a more complete picture can be developed.

3.4 Background Environmental Conditions

3.4.1 Air Quality

Air quality monitors across the Prairies indicate that regional ground-level ozone and particulate matter 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).

Additional sources that may affect background air quality include traffic along Highways 914 and 910 both of which pass through the Pinehouse area and use of diesel generators in the remote First Nations communities.

Table 3: NPRI Regional Sources of Air Emissions

NPRI ID	Facility Name	City
23186	Richardson Pioneer Ltd. - Marshall	Marshall East
6691	TransGas Limited - Beacon Hill	Pierceland
24207	Cargill Limited - Cargill AgHorizons, Birch Hills, SK	Birch Hills
5381	Eacom Timber Corp. - Big River Sawmill	Big River
23785	TransGas Limited - St. Louis	St. Louis
6510	Vermette Wood Preservers - Vermette Wood Preservers Limited Spruce Home	Spruce Home
3348	AREVA Resources Canada Inc. - Cluff Lake Project	Division No. 18
4866	AREVA Resources Canada Inc. - McClean Lake Operations	Division No. 18
1147	CAMECO - Rabbit Lake Operation	Division No. 18
1148	CAMECO - Key Lake Operation	Division No. 18
1149	CAMECO - McArthur River	Division No. 18
19397	CAMECO - Cigar Lake Operation	Division No. 18
23273	Claude Resources Inc. - Seabee	Saskatoon
17302	NuVista Energy Ltd. - Primrose Comp Station 07-30	N/A
23618	NuVista Energy Ltd. - Primrose Comp Station 05-26	N/A

3.4.2 Background Radiation

The source of background radiation in the Pinehouse area is attributed to naturally occurring radioactive materials (NORM), specifically potassium, uranium and thorium-bearing minerals. The background radiation for the Pinehouse area is presented on Figure 10. The dose rate in the Pinehouse area ranges from approximately 15 to 65 nGy/h, with an average of approximately 38 nGy/h. This range of dose rates and average are consistent with regional dose rates for central Saskatchewan. Dose rate highs are generally related to granitic geology and areas with thin overburden cover. As shown on Figure 10, dose rate highs are generally found in



areas where bedrock is near or at surface and dose rate lows are found where there is thicker overburden or in the Western Canadian Sedimentary Basin.

Additional detailed information is available in the geophysical interpretation report (PGW, 2013).

3.4.3 Soil Quality

There is no specific available information on background soil quality in the Pinehouse area. It would be expected that the soil would have concentrations below guideline limits suggested by the Canadian Council of Ministers of the Environment (CCME, 1999), given that this is an area of largely undisturbed natural forest.

3.4.4 Water Quality

The Northern Village of Pinehouse obtains its potable water source from Pinehouse Lake through Pinehouse Waterworks. As reported by the Government of Saskatchewan through the SaskH₂O website, measured parameters applicable to drinking water quality were in compliance with Saskatchewan Drinking Water Quality Standards and Objectives for the Pinehouse Waterworks (SaskH₂O, 2012), with two noted exceptions. In the most current monitoring, there were two exceedances: trihalomethanes exceeded the standard with a measured value of 105 µg/l, compared to the standard of 100 µg/l (April 2012); and the concentration of manganese was 0.16 mg/l compared with a standard of 0.05 mg/l in June 2010.

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

3.4.5 Lake Sediment Chemistry

This desktop review did not identify any current information related to lake sediment chemistry for the Pinehouse area.

3.4.6 Potential Sources of Pollutants

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

According to SaskH₂O, a website developed by the Government of Saskatchewan to provide information and services related to water, there is one permitted waste disposal ground within the Pinehouse area (Government of Saskatchewan, 2012) (Table 4).

Table 4: Registered Landfills in the Pinehouse Area

OPR ID	Location	Status
52588	Pinehouse, La Ronge Region	Operating

Source: Government of Saskatchewan (2012)

Transportation corridors, such as Highways 914 and 910, secondary roads and logging roads traverse the Pinehouse 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 Pinehouse area contains a local airport which is also a potential source of pollution, due to air emissions, de-icing operations 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 chemical 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 Pinehouse area lies within the Churchill River Drainage Area which flows eastward through the Churchill River, through Saskatchewan and Manitoba, until it drains into Hudson Bay. Most of the Pinehouse area is contained within the Central Churchill tertiary watershed. The northwest corner of the Pinehouse area is contained within the Upper Churchill tertiary watershed.

Watersheds and surface water drainage for the Pinehouse area are shown on Figure 11. The Churchill River Basin is characterized by numerous lakes, joined by rapids and fast-flowing narrows. The Churchill River flows from southwest to northeast, passing through the northern part of the Pinehouse area. All watercourses and lakes within the Pinehouse area drain into the Churchill River system. Major lakes which are part of the Churchill River system include: Knee Lake, Sandy Lake, McDonald Bay, Pinehouse Lake and Sandfly Lake. Given moderately-sized catchment areas and low lying areas along major rivers, there is a potential risk of flooding in the Pinehouse area.

3.6 Groundwater and Wells

Information concerning groundwater in the Pinehouse area was obtained from the Saskatchewan Watershed Authority (SWA) Water Well Record (WWR) database. A search of the SWA WWR database (SWA, 2009) indicated that there no water wells in the area. As previously noted, the Northern Village of Pinehouse obtains its potable water from Pinehouse Lake, a surface water source.

The nearest well to the Pinehouse area is within the Western Canada Sedimentary Basin approximately 30 km south-southwest of the Northern Village of Pinehouse. The well is located on the east side of Highway 914 and is registered to the English River First Nation as a domestic water source. The well was installed on January 10, 1996 to a depth of 22 m.

3.6.1 Overburden Aquifers

There is no available information on the presence, extent or other characteristics of overburden aquifers in the Pinehouse area. In general, the main Quaternary deposits of this region include morainal, glaciofluvial and glaciolacustrine plains, although the thickness of these deposits is unknown. The groundwater table is expected to be shallow in low-lying areas, and it is expected that shallow unconfined groundwater flow generally parallels surface water drainage patterns.

Overburden aquifers in the Pinehouse area are expected to be present in low lying areas where there are potentially substantial thicknesses of coarse grained sediments. However, these areas will be quite localized in extent and are currently not significantly used as a water source. There is little interest in developing these small aquifers as a significant groundwater resource given the abundance of surface water in the area.

3.6.2 Bedrock Aquifers

There are no known shallow or deep bedrock aquifers that are known to be used by the Northern Village of Pinehouse. Surface water sources for domestic use are readily available in the area and form the most widely used source of water supply.



Precambrian rock of the Canadian Shield generally has a low frequency of fractures that are capable of producing sufficient quantities of water for large water supply needs. Any wells drilled into Precambrian rock for water supply purposes are not likely to extend deeper than 100 m. At greater depths, water quality decreases to conditions that preclude its use.

The Precambrian bedrock in the Pinehouse area is not considered to be a significant groundwater resource. There are currently no existing bedrock wells in the area, and the Precambrian rock deeper than 100 m is unlikely to be used for such purposes in the future.

3.7 Climate and Meteorology

The Pinehouse area has a sub-Arctic climate, with long, cold winters and mild summers. The flow of air masses is dominated by mainly Arctic airstreams. The long cold winters and cool summers in the region are attributed to the long distance from a significant body of water to moderate temperatures, combined with its northerly latitude. Despite the overall cool temperature regime, there are periods in the summer season when temperatures can reach greater than 30°C.

Precipitation falls mainly from eastward moving weather fronts from the Arctic and interior regions of the continent. Most precipitation falls between May through September and is associated with continental weather fronts moving from the Pacific crossing the prairies bringing showery weather or scattered thunderstorms. In the spring, fall and winter, the driest time of the year, the area is dominated by Arctic low pressure areas moving southward into the region bringing very cold temperatures and very little overall precipitation.

Climatological information presented in this section is based on meteorological data from Environment Canada's meteorological station located in Buffalo Narrows, Saskatchewan approximately 120 km northwest of the Pinehouse area at a similar elevation, which has more than 30 years of continuous data (EC, 2011b). Parameters that are measured at the Buffalo Narrows station include: temperature, precipitation, wind and relative humidity.

3.7.1 Temperature

Temperature data were obtained from Environment Canada's 1971-2000 climate normals for the Buffalo Narrows meteorological station (EC, 2011b). Figure 12 represents monthly temperatures for the Pinehouse area, displaying daily average, maximum and minimum and extreme values over the calendar year.

3.7.2 Precipitation

Figure 13 presents monthly precipitation data obtained from Environment Canada's 1971-2000 climate normals for the Buffalo Narrows meteorological station (EC, 2011b), including total rainfall, rainfall, snowfall and all-time extreme values over the calendar year.

3.7.3 Wind

Table 5 presents the monthly wind data obtained from Environment Canada's 1971-2000 climate normals for the Buffalo Narrows meteorological station. Average wind speed and direction are average for each month over the calendar year (EC, 2011b). The dominant wind direction is from the west, with winds from the southeast and northwest occasionally dominant during the spring and fall months.



Table 5: Monthly Wind Normals for Buffalo Narrows, Saskatchewan

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Speed (km/h)	12	12	12	13.1	12.7	12.9	12.6	12.3	14.9	15.1	12.9	13	13
Most Prevalent Direction	W	W	W	W	SE	W	W	W	NW	NW	SE	W	W

3.8 Natural Hazards

3.8.1 Earthquakes and Seismicity

The Pinehouse 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 Pinehouse area has a low seismic hazard rating (NRCan, 2010). According to the National Earthquake Database (NEDB) for the period between 1985 and 2011 (NRCan, 2012) there have been no earthquakes in the Pinehouse area. The largest earthquake recorded in Saskatchewan, at a magnitude of 5.5, occurred in 1909 near the USA border (about 750 km from Pinehouse) (NRCan, 2012).

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

3.8.2 Tornadoes and Hurricanes

As noted in Table 5, average monthly wind speeds in the Pinehouse area are low, ranging from 12 to 15 km/hr. The Pinehouse area experiences thunderstorms in the summer months and is located in an area with a low tornado frequency (<0.2 tornadoes per year / 10,000 km²), but where there is a potential for F0-F1 tornadoes (Sills et al., 2012). The Pinehouse area is situated too far away from the Atlantic and Pacific oceans to be susceptible to hurricanes. The National Building Code of Canada recommends a design 1/50 maximum hourly wind pressure for the northern Saskatchewan and Alberta area of 0.35 kPa, which are low to typical values for Saskatchewan and Alberta (NRC, 2010).

3.8.3 Drought and Flooding

According to precipitation climate normals for the region (Figure 13), the Pinehouse area experiences on average between 15 and 75 mm of precipitation each month, and is therefore unlikely to experience drought conditions that would affect the viability of local water sources. The Pinehouse area can experience dry periods in the summer months that may result in an increased forest fire risk.

The single day extreme rainfall and snowfall events on record at the Buffalo Narrows station (Figure 13) are 76 mm of rain and 32 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 11, the Pinehouse area lies within a number of moderately sized watersheds which form a part of the Churchill River Basin. Given moderate sized catchment areas and low lying areas along major rivers, there is a potential risk of flooding in parts of the Pinehouse area. 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 13, the Buffalo Narrows station receives on average about 140 cm of snowfall per year, primarily between the months of October and April. No single month receives an average snowfall greater than 25 cm. The highest single day snowfall accumulation on record is 32 cm, recorded on October 16, 1984. The National Building Code of Canada recommends a design 1/50 snow load ($S_s + S_r$) for the Fort McMurray area of 1.5 kPa, which is assumed to be a similar value for northern Saskatchewan (NRC, 2010). Local lakes and waterbodies freeze over in the winter months in the Pinehouse area, as average daily temperatures from November to March typically range from -18 to -8°C.

3.8.5 Forest Fires and Lightning

Within heavily forested areas such as the Pinehouse area there is a risk of forest fires. Locations where forest fires have occurred in the vicinity of the Pinehouse area between 1976 and 2010 affecting an area of greater than 200 ha are shown on Figure 5. These forest fires combine to comprise less than 1% of the total Pinehouse 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 Pinehouse area and lightning strikes are not uncommon in the summer months.

3.8.6 Landslides and Tsunamis

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



ENVIRONMENT REPORT - NORTHERN VILLAGE OF PINEHOUSE, SASKATCHEWAN



4.0 SUMMARY

This report provides a high level description of the environment in the Northern Village of Pinehouse and surrounding area.

Situated in Division No. 18, the Northern Village of Pinehouse has a population of 978 (Statistics Canada, 2012). The Pinehouse area has a sub-Arctic climate, with long, cold winters and mild summers. Precipitation falls mainly in the summer months (May through September) in the form of locally driven showers and thunderstorms associated with low pressure systems, as well as weather fronts moving from the Pacific into western Canada and moving through the northern Prairies.

There are a number of Aboriginal communities and organizations in the Pinehouse area including Lac La Ronge Indian Band, Birch Narrows First Nation, Buffalo River Dene First Nation, Canoe Lake First Nation, Clearwater River Dene Nation, English River First Nation, Flying Dust First Nation, Makwa Sahgaiehcan First Nation, Ministikwan Lake First Nation (formerly known as Island Lake First Nation) and Waterhen Lake First Nation; all are signatories to Treaty 6, 8 or 10. Métis Locals in the area include Kineepik – Pinehouse #9, Beauval #37, Canoe River #174, Cole Bay #41, Patuanak #82 and Sakitawak – Île-à-la-Crosse #21; all are located within Métis Nation-Saskatchewan Northern Region III.

The Pinehouse area is situated within the Hearne Province of the Precambrian Canadian Shield, with the Western Canada Sedimentary Basin overlying the Canadian Shield rocks in the southernmost portion of the Pinehouse area. The Northern Village of Pinehouse itself lies within the Wollaston domain of the Hearne Province, comprised of Archean gneissic rocks having high metamorphic grades and complex deformation. The Quaternary geology in the Pinehouse area is mostly composed of glacial deposits. The main glacial deposits include morainal plains, glaciofluvial plains and glaciolacustrine plains to the south.

There is no record of metallic mineral production near the Northern Village of Pinehouse. Past exploration has occurred to the east near the Needle Falls Shear Zone where occurrences of thorium, uranium, copper and iron have been noted. In addition, there are currently no producing gold mines near the Pinehouse area; however, there is a gold occurrence located just south of the Phanerozoic unconformity, approximately 12 km to the southwest of Pinehouse. In the Pinehouse area, uranium mineralization has been identified in the Duddridge Lake area as part of a thorium-uranium-copper prospect found in metasedimentary rock based on an active mineral claim.

The main transportation routes through the Pinehouse area include access from the south via Highway 914, which is connected to Highway 165 and Highway 2 leading to the City of Prince Albert. As well, Highway 910 crosses through the southeast corner of the Pinehouse area, to access the Besnard Lake Recreation Site. There is one airport in the area. No railways, transmission lines or gas pipelines were identified within the area.

The Pinehouse area includes parts of three Saskatchewan Crown Forest areas: the North West Communities Term Supply License (TSL) in the southwest, the Kitsaki-Zelensky TSL in the southeast and the Northern Provincial Forest North in the north (Government of Saskatchewan, 2007). Commercial forest makes up 37% of total provincial forest (Government of Saskatchewan, 2007).

The Pinehouse area is dominated by a number of major vegetation types that typically characterize the Churchill River Upland and Mid-Boreal Upland Eco-regions. Provincially tracked plant species known to occur within the Pinehouse area include: western prince's-pine, smooth cinquefoil, immaculate lily and pale manna grass.



Immaculate lily is considered to be extremely rare, pale manna grass is documented as rare and both western prince's-pine and smooth cinquefoil are considered to be rare to uncommon species. Woodland caribou, a federally protected species, are found in moderate numbers within the Pinehouse area, typically in muskeg and semi-open bog habitat (SERM, 2000). Potential habitat for a number of federally and provincially protected wildlife species can be found in the Pinehouse area, including five bird species. Lake sturgeon is listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2010). While lake sturgeon has not been documented in the Pinehouse area, this species is known to occur at other locations in the Churchill River.

The Pinehouse area encompasses a number of lakes and rivers that drain into the Churchill River system, eventually flowing into Hudson Bay. A total of 23 fish species have been documented in the Pinehouse area. Commercial fisheries focus on walleye, northern pike and whitefish; while sport fishing generally focuses on walleye, northern pike and lake trout (SERM, 2000). Spring spawning habitat is also likely available in the southwest and southeast bays of Pinehouse Lake, and in the downstream sections of Massinahigan, Tippo and Smoothstone rivers since the fishing regulations identify fishing season opening in these areas after June 21 (Saskatchewan Ministry of Environment, 2012a).

A search of the Saskatchewan Watershed Authority Water Well Record database (SWA, 2009) indicated that there are no water wells in the area. The Northern Village of Pinehouse obtains its potable water from Pinehouse Lake through Pinehouse Waterworks.

Air, soil and surface water quality within the Pinehouse area are expected to be within the normal range for Saskatchewan. Sources of background radioactivity in the Pinehouse 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 Saskatchewan.

The Saskatchewan Ministry of Tourism, Parks, Culture and Sport identified 28 known archaeological sites in the Pinehouse area. The majority of the sites are located on the Churchill River and associated tributaries and lakes. Precontact artifact find and scatter sites are the most common. The presence of local heritage sites would need to be confirmed in discussion with the community and Aboriginal peoples in the area.



5.0 REFERENCES

- Acton, D.F., G.A. Padbury and C.T. Stushnoff. 1998. The Ecoregions of Saskatchewan. Canadian Plains Research Centre, University of Regina.
- Besnard Lake Lodge. 2010. Besnard Lake Lodge. <http://www.besnardlake.com>. Accessed June 2012.
- Canadian Council of Ministers of the Environment (CCME). 1999. Canadian soil quality guidelines for the protection of environmental and human health: Introduction. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2010. Canadian Wildlife Species at Risk. <http://www.sararegistry.gc.ca>. Accessed June 2012.
- Delaney, G.D. 1993. A Re-examination of the Context of U-Cu, Cu and U Mineralization, Duddridge Lake, Wollaston Domain. In: Summary of Investigations 1993, Saskatchewan Geological Survey, Saskatchewan Energy and Mines, Miscellaneous Report. 93-4.
- Encyclopedia of Saskatchewan (EOS). 2012. Species of Conservation Concern. <http://www.esask.uregina.ca/>. Accessed June 2012.
- Environnement Canada (EC). 2012. National Pollutant Release Inventory. <http://www.ec.gc.ca/inrp-npri/>. Accessed March 2012.
- Environment Canada (EC). 2011a. National and Regional Air Quality, Air and Climate Indicators. <http://www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=4B5631F9-1>. Accessed March 2012.
- Environment Canada (EC). 2011b. National Climate Data and Information Archive . http://climate.weatheroffice.gc.ca/climateData/canada_e.html. Accessed March 2012.
- GeoSask. 2012. Mapping and Land Information for Saskatchewan – various. <https://www.geosask.ca/Portal/> Accessed June 2012.
- Government of Canada. 2012. *Species at Risk Act* (SARA). http://www.sararegistry.gc.ca/default_e.cfm. Accessed March 2012.
- Government of Saskatchewan. 2012. SaskH2O Landfills - Solid Waste Management Facilities List, Interim Data (2012-06-12). <http://www.saskh2o.ca/landfills.asp>. Accessed June 2012.
- Government of Saskatchewan. 2007. Report on Saskatchewan's Provincial Forests. <http://www.er.gov.sk.ca/adx/asp/adxGetMedia.aspx?DocID=10408,5460,2936,Documents&MediaID=26483&Filename=Report+on+Saskatchewan>. Accessed June 2012.
- Government of Saskatchewan. 1980. Chapter H-2.2, *The Heritage Property Act*. Last amended in 2010.
- Greggs, D.H. and F.J. Hein. 2000. The Sedimentology and Structure of the Lower Paleozoic Deadwood Formation of Saskatchewan. In Summary of Investigations 2000, Volume 1, Saskatchewan Geological Survey, Saskatchewan Energy and Mines, Miscellaneous Report 2000-4.1.



- Meyer, D. 1995. Churchill River Archaeology in Saskatchewan: How Much Do We Know? In *The Churchill: A Canadian Heritage River*, Conference Proceedings. P. Jonker (ed.). University Extension Press, University of Saskatchewan, Saskatoon.
- Meyer, D. 1979. Archaeology. In *Key Lake Project Environmental Impact Statement*, Appendix IX. Beak Consultants Ltd., Calgary.
- National Building Code (NRC). 2010. *National Building Code of Canada 2010*, Volume 2. 1245p.
- Natural Resources Canada (NRCan). 2012. Earthquakes Canada Website. URL:<http://earthquakescanada.nrcan.gc.ca>.
- Natural Resources Canada (NRCan). 2010. Seismic Hazard Map, Geological Survey of Canada <http://www.earthquakescanada.nrcan.gc.ca> Accessed April 2013.
- Nuclear Waste Management Organization (NWMO). 2010. *Moving Forward Together: Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel*. May 2010.
- Parks Canada. 2012. National Historic Sites of Canada. <http://www.pc.gc.ca/progs/lhn-nhs/index.aspx>. Accessed June 2012.
- Paterson, Grant and Watson Limited (PGW). 2013. *Processing and Interpretation of Geophysical Data: Phase 1 Desktop Geoscientific Assessment of Potential Suitability*. Northern Village of Pinehouse, Saskatchewan. Prepared for Golder Associates, dated May, 2013.
- Percival, J.A. and R.M. Easton. 2007. *Geology of the Canadian Shield in Ontario: an update*. Ontario Power Generation, Report No. 06819-REP-01200-10158-R00.
- Russell, D. and D. Meyer. 1999. *The History of the Fur Trade ca. 1682 – post 1821; Trading Posts pre-1959 – post 1930*. In: *Atlas of Saskatchewan*. K.I. Fund (ed.) University of Saskatchewan, Saskatoon.
- Saskatchewan Conservation Data Centre (SKCDC). 2012. Sensitive Species website. <http://gisweb1.serm.gov.sk.ca/imf/imf.jsp?config=http://gisweb1.serm.gov.sk.ca/imf/sk/sites/Wildlife/Wildlife.xml>. Accessed June 2012.
- Saskatchewan Energy and Resources. 2010. *Geological Atlas of Saskatchewan*. [http://www.infomaps.gov.sk.ca/wesite/SIR Geological Atlas/viewer.htm](http://www.infomaps.gov.sk.ca/wesite/SIR_Geological_Atlas/viewer.htm). Accessed June 2012.
- Saskatchewan Environment and Resource Management (SERM). 2000. *Pinehouse-Dipper Integrated forest land use plan, background information document (draft)*.
- Saskatchewan Geological Survey (SGS). 2003. *Geology, and Mineral and Petroleum Resources of Saskatchewan*. Saskatchewan Industry and Resources. Miscellaneous Report 2003-7.



- Saskatchewan Ministry of Environment. 2012a. 2012 Saskatchewan Anglers' Guide.
<http://www.environment.gov.sk.ca/adx/asp/adxGetMedia.aspx?DocID=bc022bb7-684b-4547-b064-49526fb40a99&MediaID=56b52705-74d7-46da-9d93-569bf9cecc5f&Filename=2012+Anglers+Guide.pdf&I=English> Accessed June 2012.
- Saskatchewan Ministry of Environment. 2012b. Saskatchewan Bird Atlas.
<http://gisweb1.serm.gov.sk.ca/imf/imf.jsp?site=birds>. Accessed June 2012.
- Saskatchewan Ministry of Environment. 2005. Saskatchewan Representative Areas Network. Progress Report 2005. <http://www.environment.gov.sk.ca/adx/asp/adxGetMedia.aspx?DocID=1574,623,247,94,88,Documents&MediaID=800&Filename=RAN+2005+Progress+Report+WEB.pdf&I=English>. Accessed June 2012.
- Saskatchewan Ministry of Tourism, Parks, Culture and Sport (TPCS). 2012. Heritage Sites. Personal Communication, June 2012.
- Saskatchewan Watershed Authority (SWA). 2009. Water Well Database, May 2009.
- SaskH₂O. 2012. My Drinking Water – Pinehouse Waterworks. <http://www.saskh2o.ca/MyDrinkingWater.asp>
Accessed June 2012.
- Schreiner, B.T. 1984a. Quaternary Geology of the Precambrian Shield, Saskatchewan. Saskatchewan Geological Survey, Saskatchewan Energy and Mines, Report 221.
- Schreiner, B.T. 1984b. Quaternary Geology of the Mudjatik Area (74-B) Saskatchewan. Saskatchewan Geological Survey, Saskatchewan Energy and Mines, Open File Report 84-8, 1:250,000 scale.
- Sills, D., V. Cheng, P. McCarthy, B. Rousseau, J. Waller, L. Elliott, J. Klaassen and H. Auld. 2012. Using tornado, lightning and population data to identify tornado prone areas in Canada. *Preprints, 26th AMS Conference on Severe Local Storms, Nashville, TN, Amer. Meteorol. Soc.*, Paper P59.
- Smith, J.G.E. 1981. "Western Woods Cree." In Handbook of North American Indians. Vol. 6, Subarctic, edited by June Helm, 256-270. Washington, D.C.: Smithsonian Institution.
- Statistics Canada. 2012. Census Profile. Material dated February 10, 2012.
<http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=4718065&Geo2=CD&Code2=4718&Data=Count&SearchText=Pinehouse&SearchType=Begins&SearchPR=01&B1=All&Custom=&TABID=1>. Accessed June 2012.
- Statutes of Saskatchewan. 1998. *The Wildlife Act*, 1998.
<http://www.qp.gov.sk.ca/documents/English/Statutes/Statutes/W13-12.pdf>. Accessed June 8, 2012
- Yeo, G.M. and G. Delaney. 2007. The Wollaston Supergroup, Stratigraphy and Metallogeny of a Paleoproterozoic Wilson Cycle in the Trans-Hudson Orogen, Saskatchewan. In EXTECH IV: Geology and Uranium Exploration TECHNOLOGY of the Proterozoic Athabasca Basin, Saskatchewan and Alberta, C.W. Jefferson and G. Delaney (eds), Geological Survey of Canada Bulletin 588, pp. 89–117.



ENVIRONMENT REPORT - NORTHERN VILLAGE OF PINEHOUSE, SASKATCHEWAN



Report Signature Page

GOLDER ASSOCIATES LTD.

Handwritten signature of Jennifer Hancox in black ink.

Jennifer Hancox, M.Sc., P.Geo.
Geoscientist

Handwritten signature of George Schneider in black ink.

George Schneider, M.Sc., P.Geo.
Senior Geoscientist, Principal

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

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.



ENVIRONMENT REPORT - NORTHERN VILLAGE OF PINEHOUSE, SASKATCHEWAN

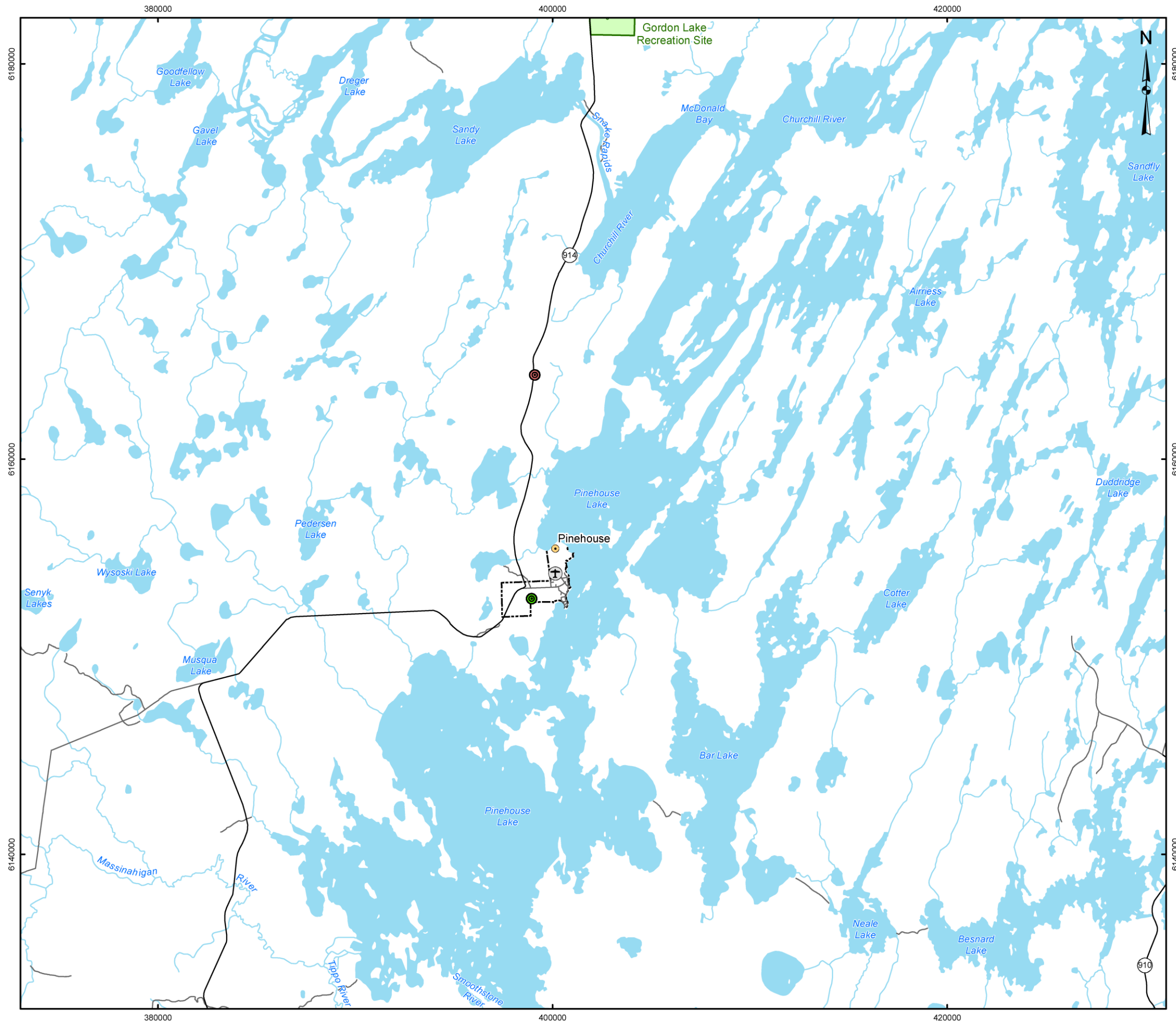


FIGURES



**ENVIRONMENT REPORT - NORTHERN VILLAGE OF
PINEHOUSE, SASKATCHEWAN**

G:\Projects\2012\12-1152-0026_NWMO_Phase1_Feasibility\GIS\MXDs\Reporting\Env_Safety_Report\Pinehouse\PinehouseAndSurroundingLands.mxd



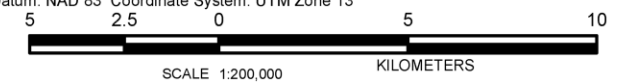
LEGEND

- Community
- Airstrip
- Domestic Waste Site
- Waste Water Treatment Plant
- Main Road
- Local Road
- Watercourse
- Waterbody
- Park and Recreation Area
- Municipal Boundary



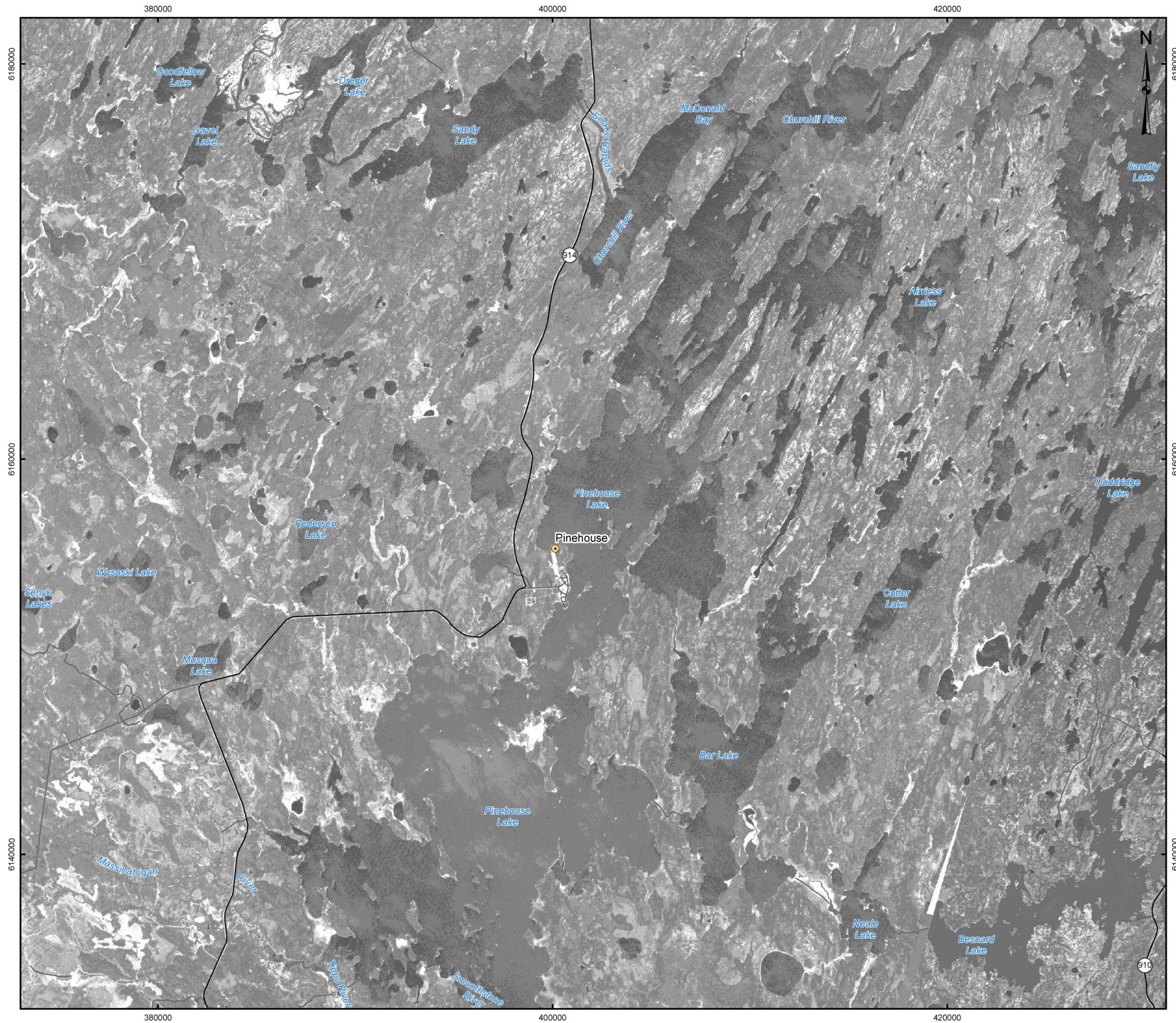
REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
 Administrative Boundaries - Information Services Corporation of Saskatchewan,
 Administrative Boundary Overlays (2012)
 Projection: Universal Transverse Mercator
 Datum: NAD 83 Coordinate System: UTM Zone 13



PROJECT			
Environment Report Northern Village of Pinehouse, Saskatchewan			
TITLE			
Pinehouse and Surrounding Lands			
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM 3 May 2012	REV. 0.0
	GIS	PM/JB 6 Nov 2013	FIGURE: 1
	CHECK	JH 6 Nov 2013	
REVIEW	GWS 6 Nov 2013		

G:\Projects\2012\12-1152-0026_NWMO_Phase1_Feasibility\GISMXD\Reporting\Env_Safety_Report\Pinehouse\PinehouseSatelliteImagery.mxd



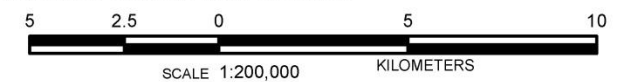
LEGEND


- Community
- Main Road
- Local Road



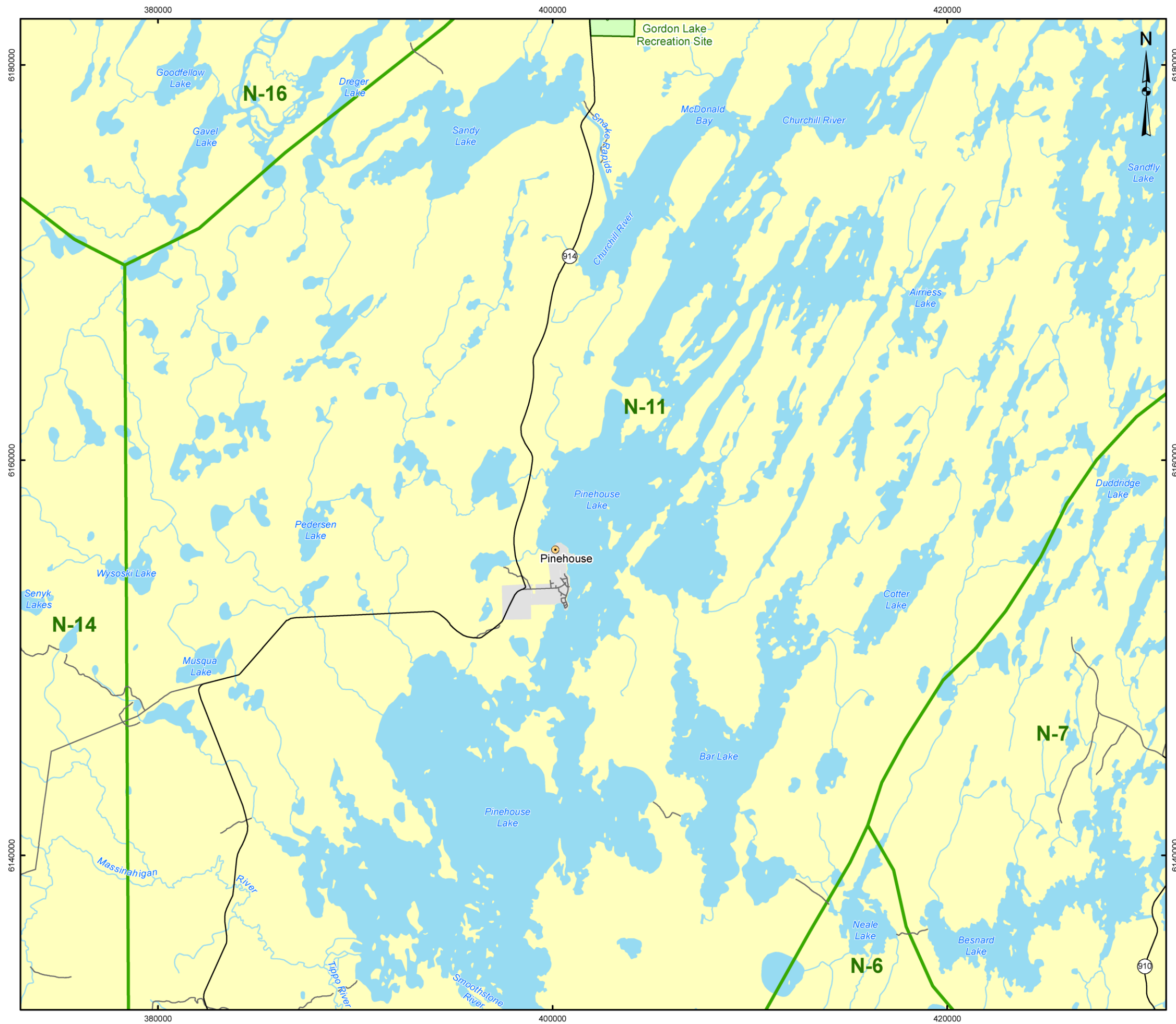
REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
 Administrative Boundaries - Information Services Corporation of Saskatchewan,
 Administrative Boundary Overlays (2012)
 SPOT Imagery Courtesy of GeoBase
 Projection: Universal Transverse Mercator
 Datum: NAD 83 Coordinate System: UTM Zone 13



PROJECT		Environment Report Northern Village of Pinehouse, Saskatchewan	
TITLE		Satellite Imagery in the Pinehouse Area	
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM 3 May 2012	REV. 0.0
	GIS	PM/JB 6 Nov. 2013	FIGURE: 2
	CHECK	JH 6 Nov. 2013	
REVIEW	GWS 6 Nov. 2013		

G:\Projects\2012\12-1152-0026_NWMO_Phase1_Feasibility\GISMXDs\Reporting\Env_Safety_Report\Pinehouse\PinehouseLandOwnership.mxd



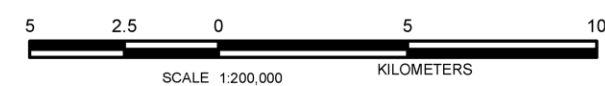
LEGEND

- Community
- Main Road
- Local Road
- Watercourse
- Waterbody
- Crown Land
- Private Land
- Park and Recreation Area
- Fur Conservation Area (N-6, N-7, N-11, N-14, N-16)



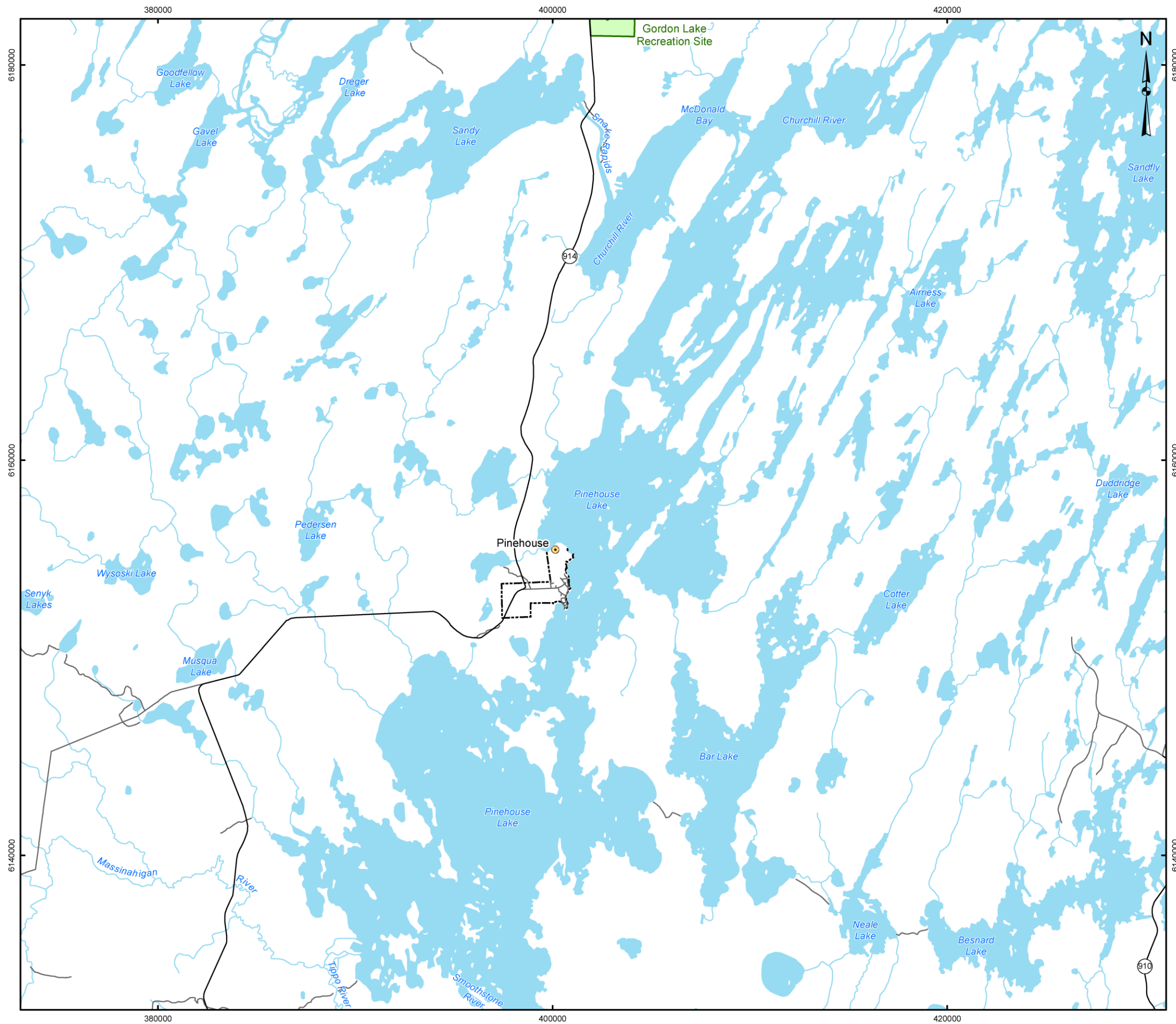
REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
 Administrative Boundaries - Information Services Corporation of Saskatchewan, Administrative Boundary Overlays (2012)
 Cadastral Data - Information Services Corporation of Saskatchewan, 2008
 Fur Conservation Areas - Saskatchewan Environment Administrative Map, Saskatchewan Environment, April 2002
 Projection: Universal Transverse Mercator
 Datum: NAD 83 Coordinate System: UTM Zone 13



PROJECT			
Environment Report Northern Village of Pinehouse, Saskatchewan			
TITLE			
Pinehouse Area Land Ownership			
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM 3 May 2012	REV. 0.0
	GIS	PM/JB 6 Nov 2013	FIGURE: 3
	CHECK	JH 6 Nov 2013	
REVIEW	GWS 6 Nov 2013		

G:\Projects\2012\12-1152-0026_NWMO_Phase1_Feasibility\GIS\MXDs\Reporting\Env_Safety_Report\Pinehouse\PinehouseProtectedLands.mxd



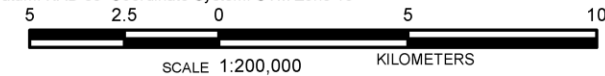
LEGEND

- Community
- Main Road
- Local Road
- Watercourse
- Waterbody
- Park and Recreation Area
- Municipal Boundary



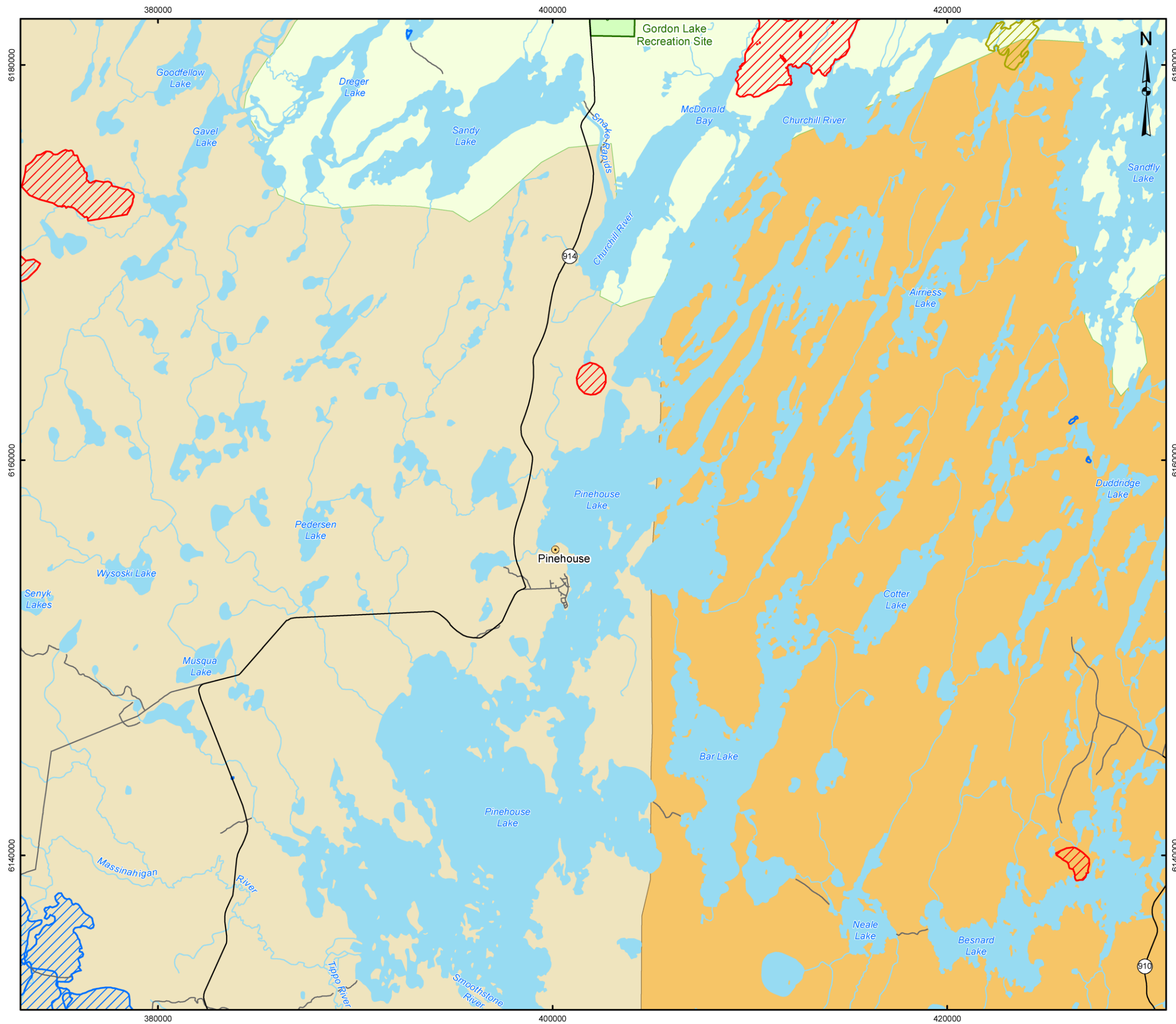
REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
 Administrative Boundaries - Information Services Corporation of Saskatchewan,
 Administrative Boundary Overlays (2012)
 Projection: Universal Transverse Mercator
 Datum: NAD 83 Coordinate System: UTM Zone 13



PROJECT		Environment Report Northern Village of Pinehouse, Saskatchewan	
TITLE		Pinehouse - Parks and Protected Lands	
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM 3 May 2012	REV. 0.0
	GIS	PM/JB 6 Nov. 2013	FIGURE: 4
	CHECK	JH 6 Nov. 2013	
REVIEW	GWS 6 Nov. 2013		

G:\Projects\2012\12-1152-0026_NWMO_Phase1_Feasibility\GIS\MXDs\Reporting\Env_Safety_Report\Pinehouse\PinehouseCrownForestAreas.mxd



- LEGEND**
- Community
 - Main Road
 - Local Road
 - Watercourse
 - Waterbody
 - Park and Recreation Area
 - Forest Fire Areas (greater than 200 hectares)**
 - 1976 - 1980
 - 1981 - 1990
 - 1991 - 2000
 - 2001 - 2010
 - Crown Forest Areas**
 - Kitsaki-Zelensky TSL
 - North West Communities TSL
 - Northern Provincial Forest North



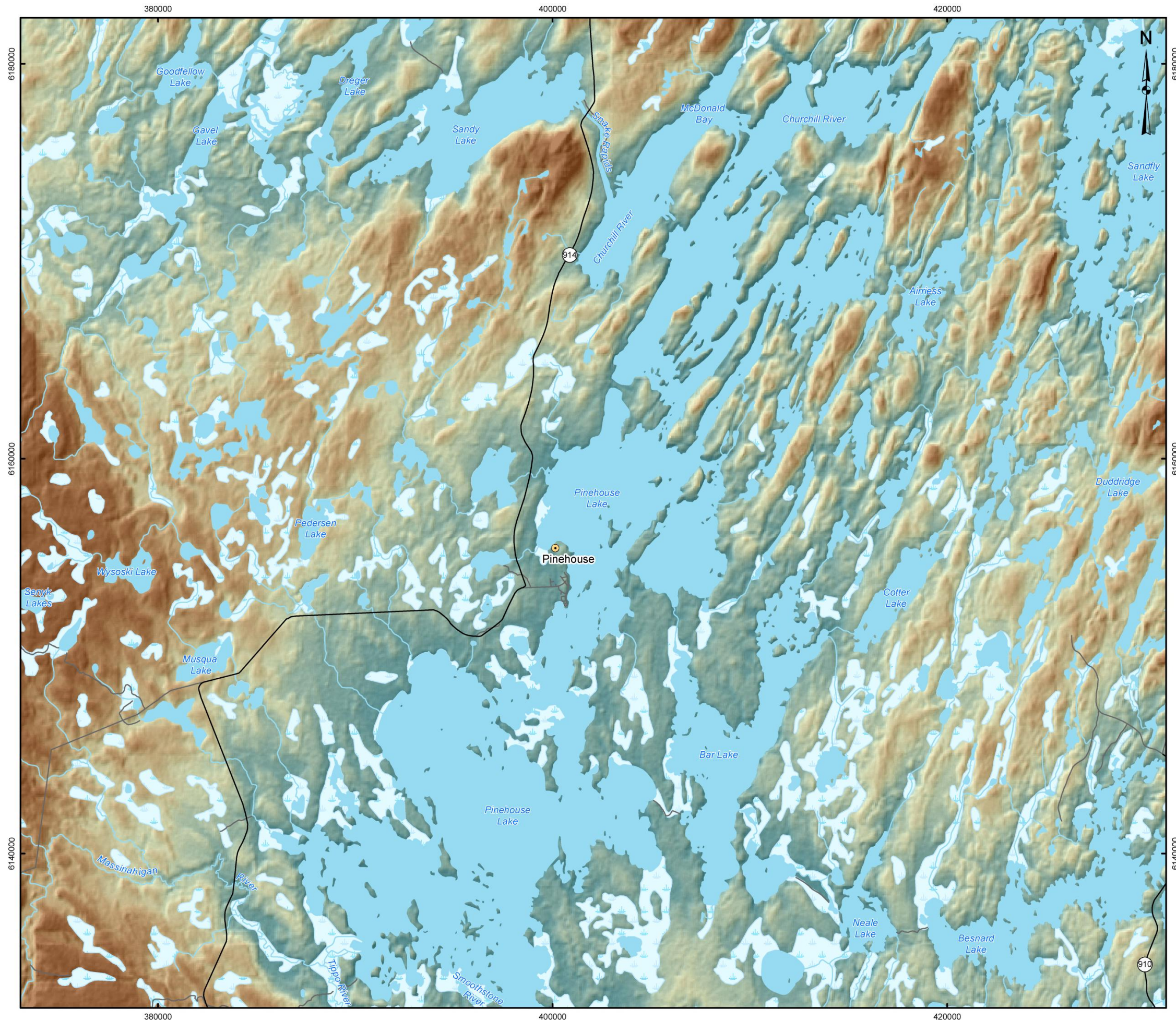
REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
 Administrative Boundaries - Information Services Corporation of Saskatchewan,
 Administrative Boundary Overlays (2012)
 Crown Forest Areas- Saskatchewan Crown Forest Areas, Forest Service, Saskatchewan Environment, 2006
 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.
 Datum: NAD 83 Coordinate System: UTM Zone 13
 Projection: Universal Transverse Mercator
 Datum: NAD 83 Coordinate System: UTM Zone 13



PROJECT			
Environment Report Northern Village of Pinehouse, Saskatchewan			
TITLE			
Pinehouse Crown Forest Areas			
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM 3 May, 2012	REV. 0.0
	GIS	PM/JB 6 Nov. 2013	FIGURE: 5
	CHECK	JH 6 Nov. 2013	
REVIEW	GWS 6 Nov. 2013		

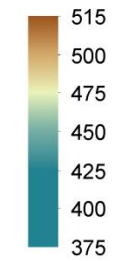
G:\Projects\2012\12-1152-0026_NWMO_Phase1_Feasibility\GIS\MXDs\Reporting\Env_Safety_Report\Pinehouse\PinehouseDigitalElevationModel.mxd



LEGEND

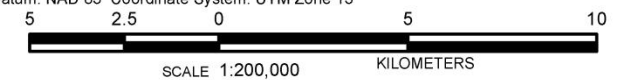
- Community
- Main Road
- Local Road
- Watercourse
- Waterbody
- Wetland

Elevation (masl)



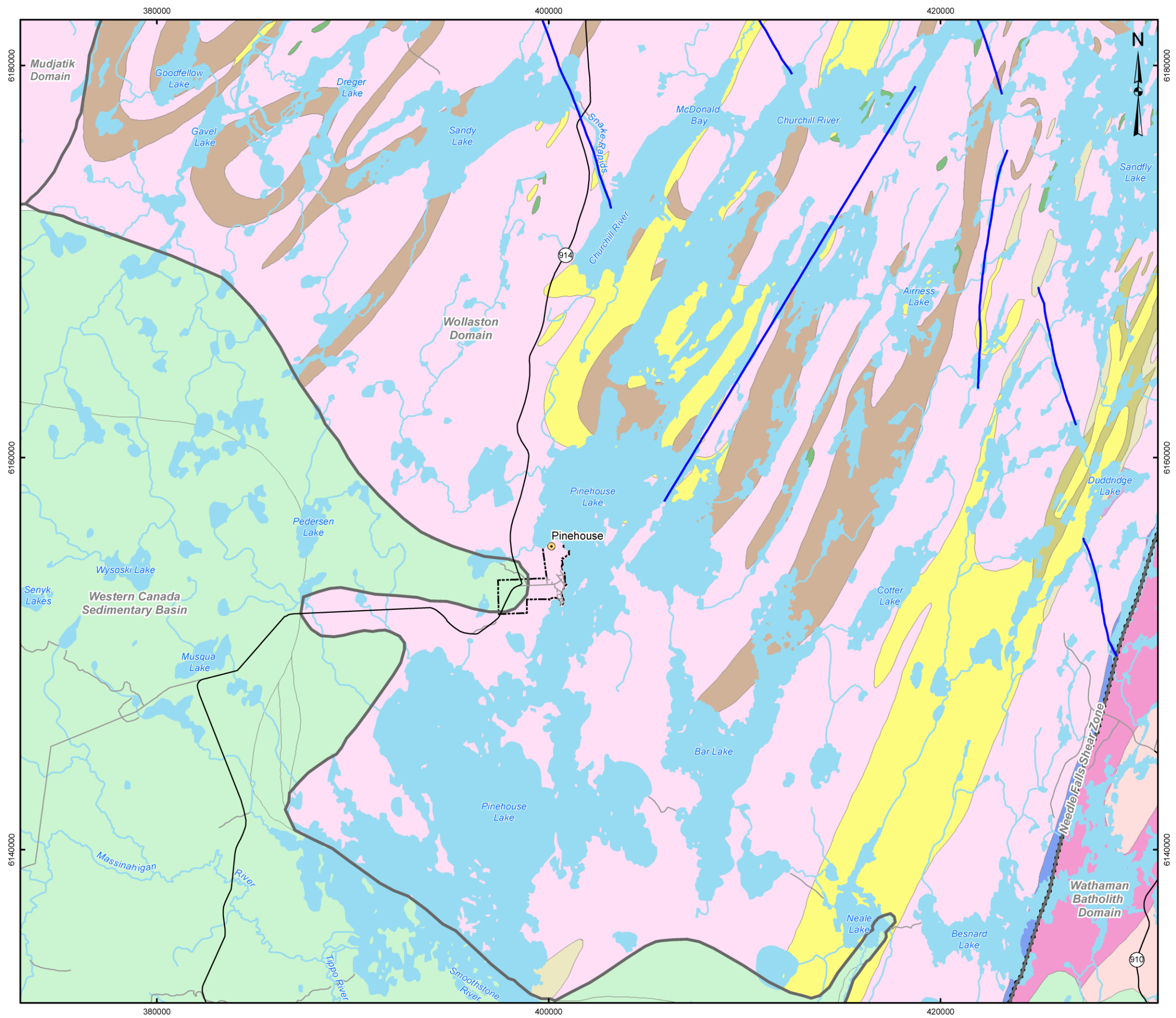
REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
 Administrative Boundaries - Information Services Corporation of Saskatchewan,
 Administrative Boundary Overlays (2012)
 Digital Elevation Model - CDED slope raster: Geobase.ca (1:50,000)
 Projection: Universal Transverse Mercator
 Datum: NAD 83 Coordinate System: UTM Zone 13



PROJECT			
Environment Report Northern Village of Pinehouse, Saskatchewan			
TITLE			
Digital Elevation Model of the Pinehouse Area			
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM 3 May, 2012	REV. 0.0
	GIS	PM/JB 6 Nov. 2013	FIGURE: 6
	CHECK	JH 6 Nov. 2013	
REVIEW	GWS 6 Nov. 2013		

G:\Projects\2012\112-1152-0026_NWMO_Phase1_Feasibility\GIS\MXDs\Reporting\Env_Safety_Report\Pinehouse\PinehouseBedrockGeology.mxd



LEGEND

- Community
- Main Road
- Local Road
- Watercourse
- Waterbody
- Municipal Boundary
- Shear Zone
- Fault
- Domain Boundary

Mudjatik Domain

- Mfn - Felsic Gneiss
- Mpsn - Pelitic, Psammopelitic Gneiss

Wollaston Domain

- Wbd - Diorite
- Wfn - Felsic gneiss
- Wm - Amphibolite
- Wpsn - Pelitic, psammopelitic gneiss
- Wq - Metaquartzite
- Wrn - Psammitic to Meta-Arkosic Gneiss
- Wvn - Biotitic mafic gneiss
- x - Mylonite/cataclastic rocks

Wathaman Batholith

- WBgpx - Augen Gneiss
- WBgp - Megacrystic Granitoid

Western Canadian Sedimentary Basin

- Km - Manville Group



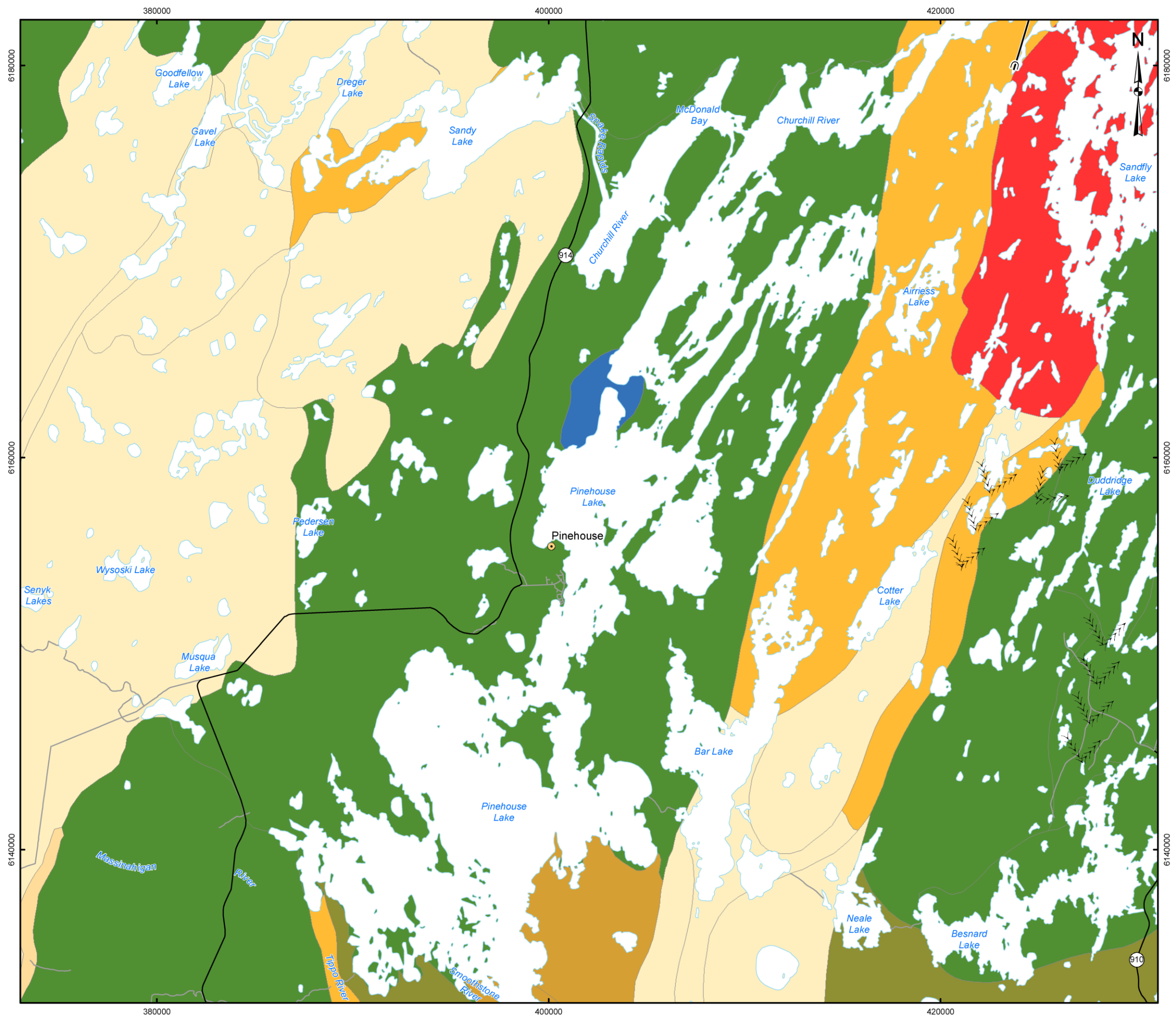
REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
 Admin. Boundaries - Info. Services Corporation of Sask., Administrative Boundary Overlays (2012)
 Bedrock Geology - Saskatchewan Geological Atlas (1:250,000)
 Projection: Universal Transverse Mercator
 Datum: NAD 83 Coordinate System: UTM Zone 13

5 2.5 0 5 10
 SCALE 1:200,000 KILOMETERS

PROJECT			
Environment Report Northern Village of Pinehouse, Saskatchewan			
TITLE			
Bedrock Geology of the Pinehouse Area			
 Saskatoon, Saskatchewan	PROJECT NO. 12-1152-0026		SCALE AS SHOWN
	DESIGN	PRM	8 Jun. 2012
	GIS	PM/JB	6 Nov. 2013
	CHECK	JH	6 Nov. 2013
	REVIEW	GWS	6 Nov. 2013
			FIGURE: 7

G:\Projects\2012\12-1152-0026_NWMO_Phase1_Feasibility\GIS\MXDs\Reporting\Env_Safety_Report\Pinehouse\PinehouseQuaternaryGeology.mxd



LEGEND

- Community
- Main Road
- Local Road
- Waterbody
- Esker
- Striation
- Glaciofluvial
- Glaciofluvial Hummocky
- Glaciofluvial Outwash Plain
- Glaciolacustrine
- Hummocky Moraine
- Morainal Plain
- Organic Plain
- Rock

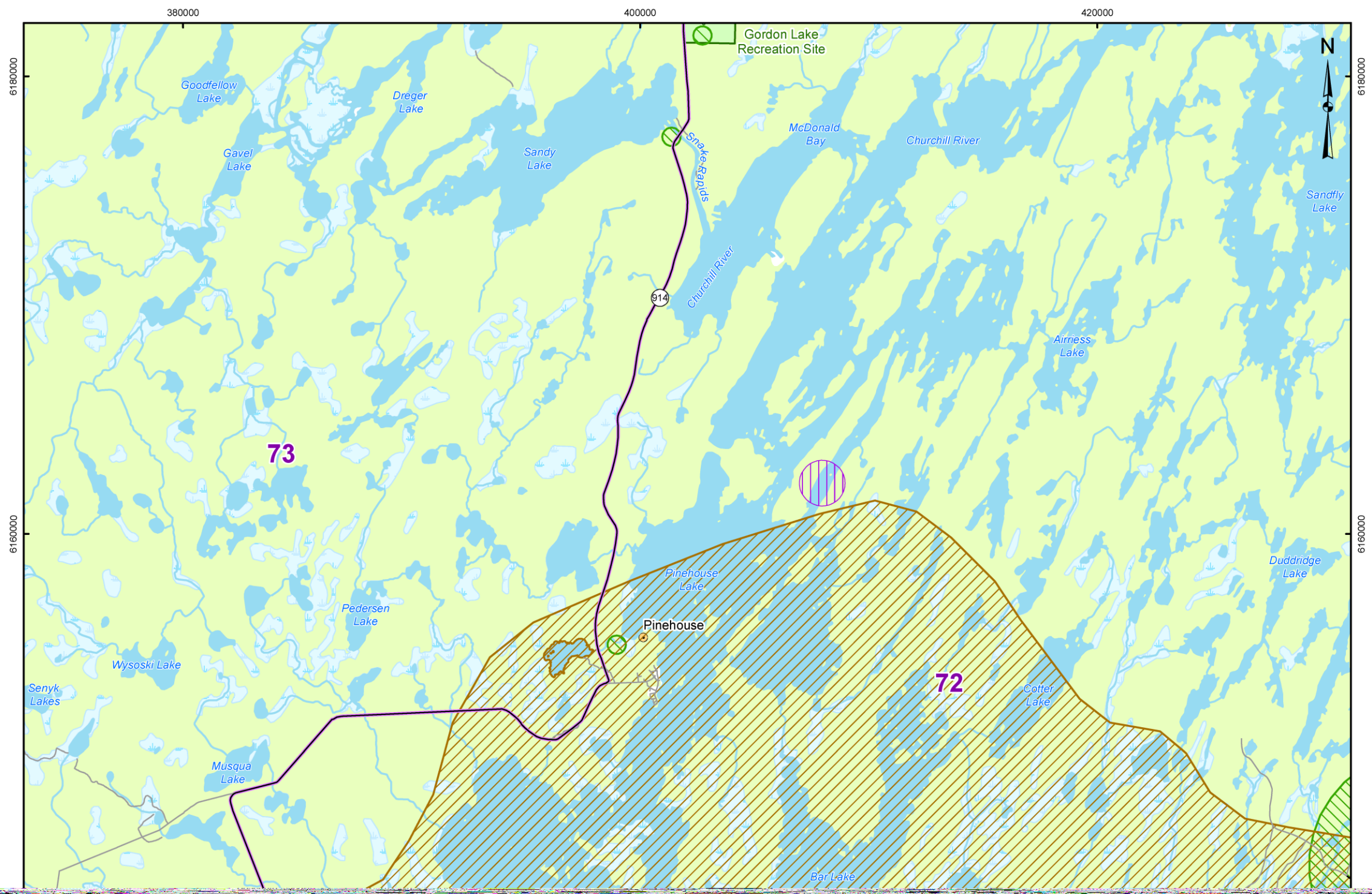


REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
 Administrative Boundaries - Information Services Corporation of Saskatchewan,
 Administrative Boundary Overlays (2012)
 Quaternary Geology - Saskatchewan Geological Atlas (1:250,000)
 Projection: Universal Transverse Mercator
 Datum: NAD 83 Coordinate System: UTM Zone 13



PROJECT		Environment Report Northern Village of Pinehouse, Saskatchewan	
TITLE		Quaternary Geology of The Pinehouse Area	
 Saskatoon, Saskatchewan	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM 19 Jun. 2012	REV. 0.0
	CHECK	JH 6 Nov. 2013	FIGURE: 8
	REVIEW	GWS 6 Nov. 2013	



LEGEND

- Community
- Main Road
- Local Road
- Watercourse
- Waterbody
- Wetland
- Wooded Area
- Park and Recreation Area
- Wildlife Management Zone (72, 73)

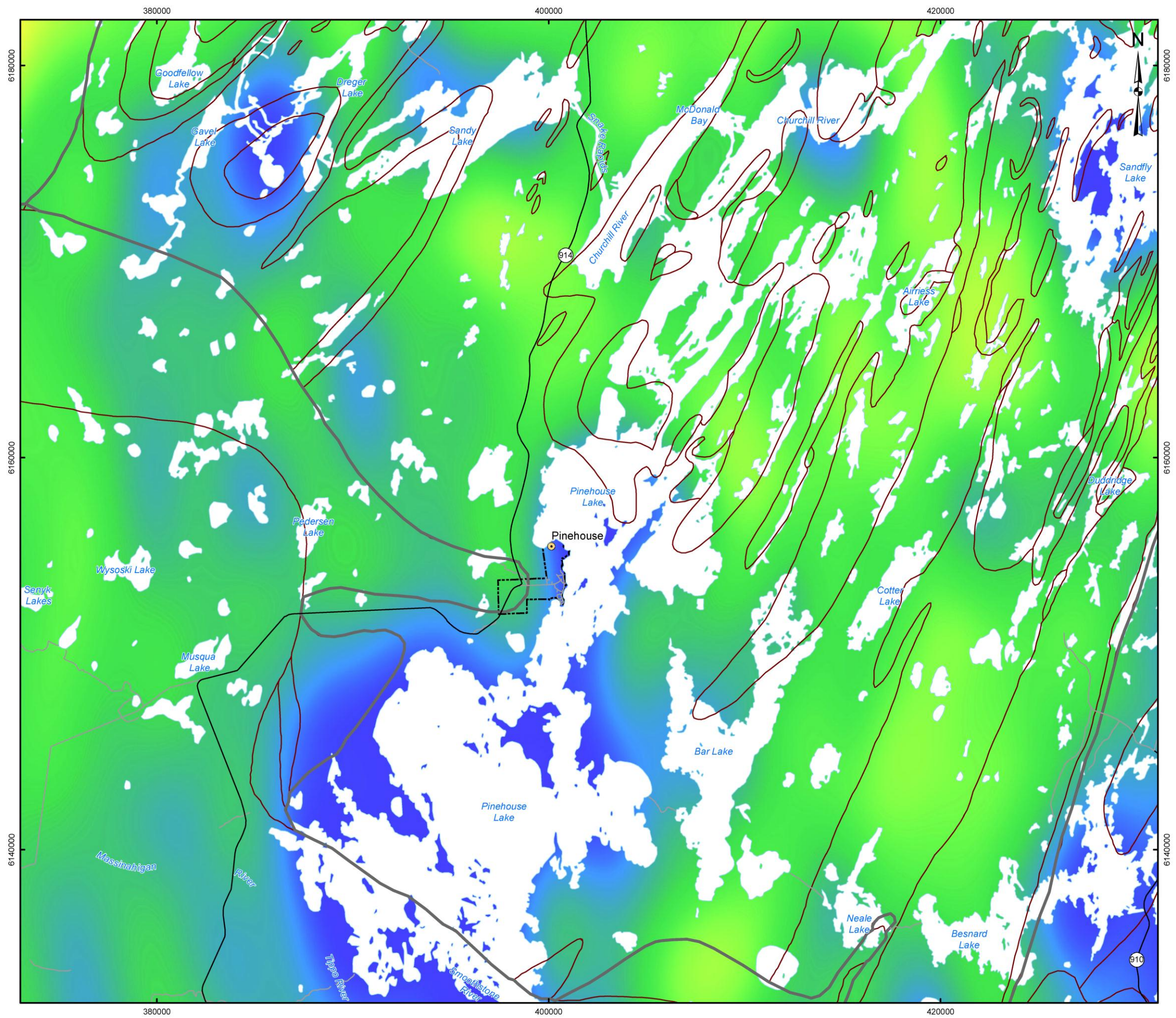
Rare Species Range

- Animal (woodland caribou and red-throated loon)
- Migratory Bird Conservation Site (10382)
- Plant (various)



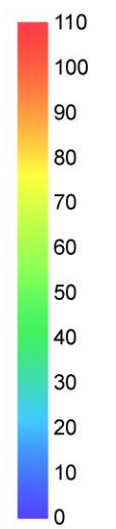
REFERENCE
 Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)

G:\Projects\2012\112-1152-0026_NWMO_Phase1_Feasibility\GIS\MapDocs\Reporting\Env_Safety_Report\Pinehouse\PinehouseBackgroundRadiationLevels.mxd



- LEGEND**
- Community
 - Main Road
 - Local Road
 - Waterbody
 - Geologic Contact
 - Municipal Boundary

Air Absorbed Radiation Levels (nGy/h)

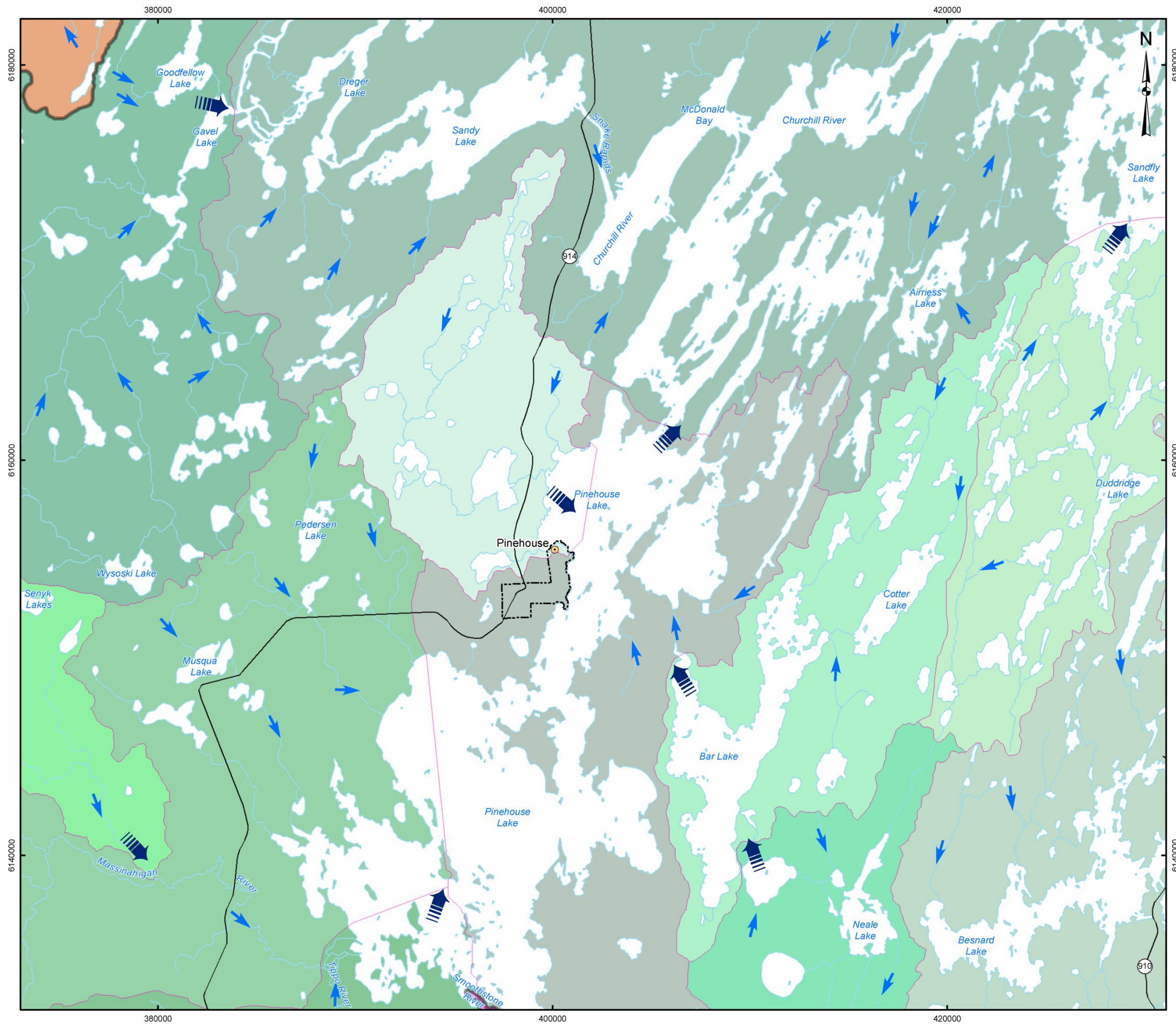


REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
 Administrative Boundaries - Information Services Corporation of Saskatchewan, Administrative Boundary Overlays (2012)
 Bedrock Geology - Saskatchewan Geological Atlas (1:250,000)
 Radiometrics - GSC Canada - 250m -Natural Air Absorbed Dose Rate, 2012;
 National Gamma-Ray Spectrometry Program Data Base, Airborne Geophysics Section, GSC - Central Canada Division, Geological Survey of Canada, Earth Sciences Sector, Natural Resources Canada
 Projection: Universal Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 13

PROJECT			
Environment Report Northern Village of Pinehouse, Saskatchewan			
TITLE			
Pinehouse - Background Radiation Levels			
	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM 20 Jun. 2012	REV. 0.0
	GIS	PM/JB 6 Nov. 2013	FIGURE: 10
	CHECK	JH 6 Nov. 2013	
REVIEW	GWS 6 Nov. 2013		

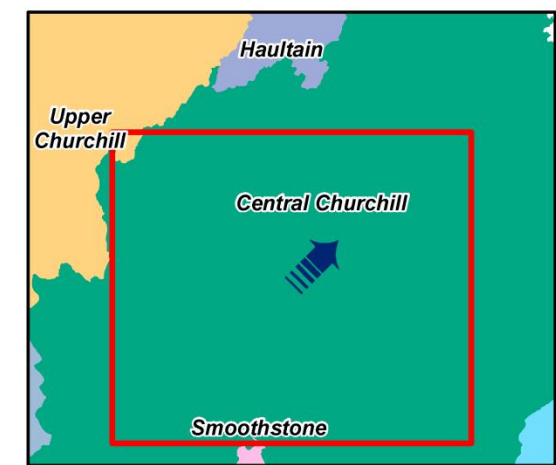
G:\Projects\2012\12-1152-0026_NWMO_Phase1_Feasibility\GIS\MXDs\Reporting\Env_Safety_Report\Pinehouse\PinehouseSurfaceWaterDrainage.mxd



LEGEND

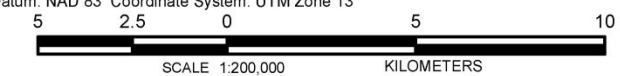
- Community
 - Main Road
 - Watercourse
 - Waterbody
 - Surface Water Flow Direction
 - Watershed Outflow Point
 - Municipal Boundary
- Drainage Divide**
- Delineated by JDMA/PFRA
 - Delineated by JDMA
 - Delineated by PFRA

TERTIARY WATERSHEDS



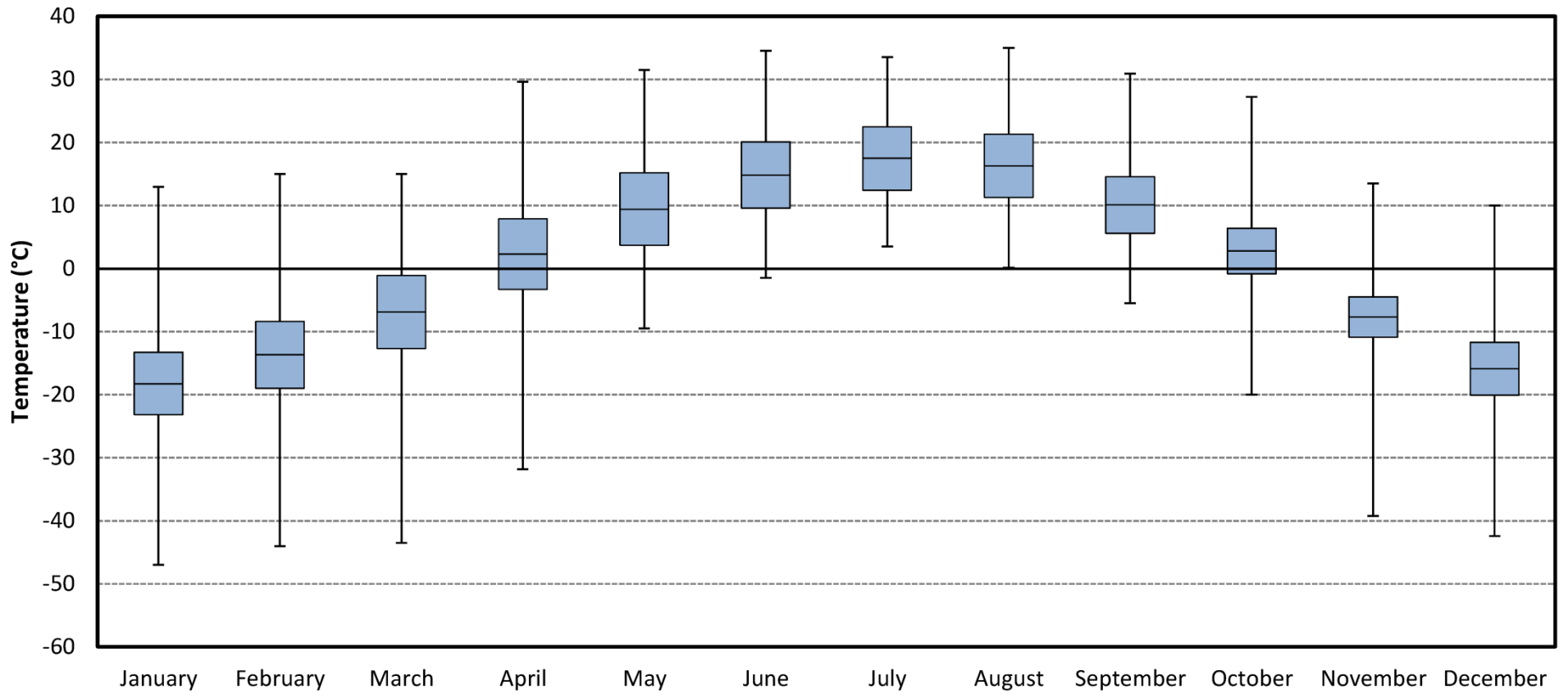
REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
 Administrative Boundaries - Information Services Corporation of Saskatchewan, Administrative Boundary Overlays (2012)
 Catchments - Terrain and Remote Sensing Study, Pinehouse, Saskatchewan (JDMA, 2012)
 Projection: Universal Transverse Mercator
 Datum: NAD 83 Coordinate System: UTM Zone 13








PROJECT			
Environment Report Northern Village of Pinehouse, Saskatchewan			
TITLE			
Pinehouse Surface Water Drainage			
 Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PM 3 May 2012	REV. 0.0
	GIS	PM/JB 6 Nov 2013	
	CHECK	JH 6 Nov 2013	
	REVIEW	GWS 6 Nov 2013	

FIGURE: 11



LEGEND

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

DATA SOURCE

Environment Canada


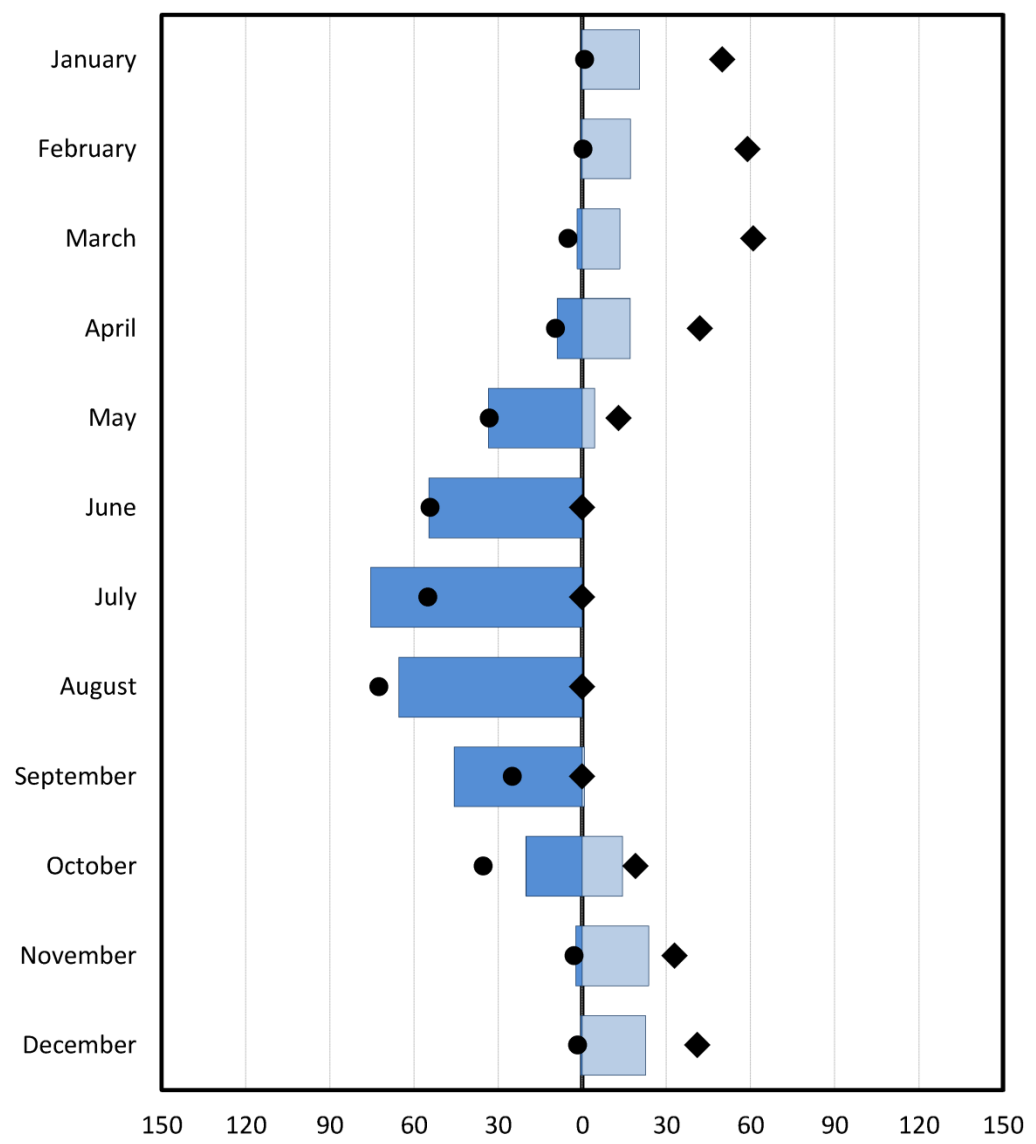
PROJECT		Environment Report Northern Village of Pinehouse, Saskatchewan	
TITLE		Buffalo Narrows 1971-2000 Temperature Data Summary	
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM 7 Jun. 2012	REV. 0.0
	GIS	PM/JB 6 Nov. 2013	
	CHECK	JH 6 Nov. 2013	
	REVIEW	GWS 6 Nov. 2013	

FIGURE: 12

G:\Projects\2012\12-1152-0026_NWMO_Phase1_Feasibility\GIS\IMXD\Reporting\Env_Safety_Report\Pinehouse\BuffaloNarrows\PrecipitationDataSummary.mxd




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 Northern Village of Pinehouse, Saskatchewan	
TITLE			
Buffalo Narrows 1971-2000 Precipitation Data Summary			
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM	7 Jun. 2012
	GIS	PMJB	6 Nov. 2013
	CHECK	JH	6 Nov. 2013
	REVIEW	GWS	6 Nov. 2013
			FIGURE: 13

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.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario, L5N 7K2
Canada
T: +1 (905) 567 4444

