Appendix E

Air Quality Report

Canadian Premium Sand Inc.

Wanipigow Sand Extraction Project Air Dispersion Modelling Report Draft

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Distribution List

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AECOM: 2015-04-13

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AECOM Canada Ltd. APEGA Permit to Practice No.: P10450

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1. Introduction

1.1 Overview

AECOM was retained by the Canadian Premium Sand Inc. ("the Proponent") to conduct an air dispersion model for the Wanipigow Sand Extraction Project ("the Project").

The Proponent is proposing to develop a sand deposit as a source of high-quality silica sand for a variety markets such as oil and gas operations and the glass production industry. The Project is located on the east shore of Lake Winnipeg, Manitoba, approximately 160 km northeast of Winnipeg, within the boundaries of the Incorporated Community of Seymourville. Seymourville, governed by a mayor and council under The Northern Affairs Act, is part of a group of four communities also including Manigotagan, Hollow Water First Nation, and Aghaming (**Figure 1**)

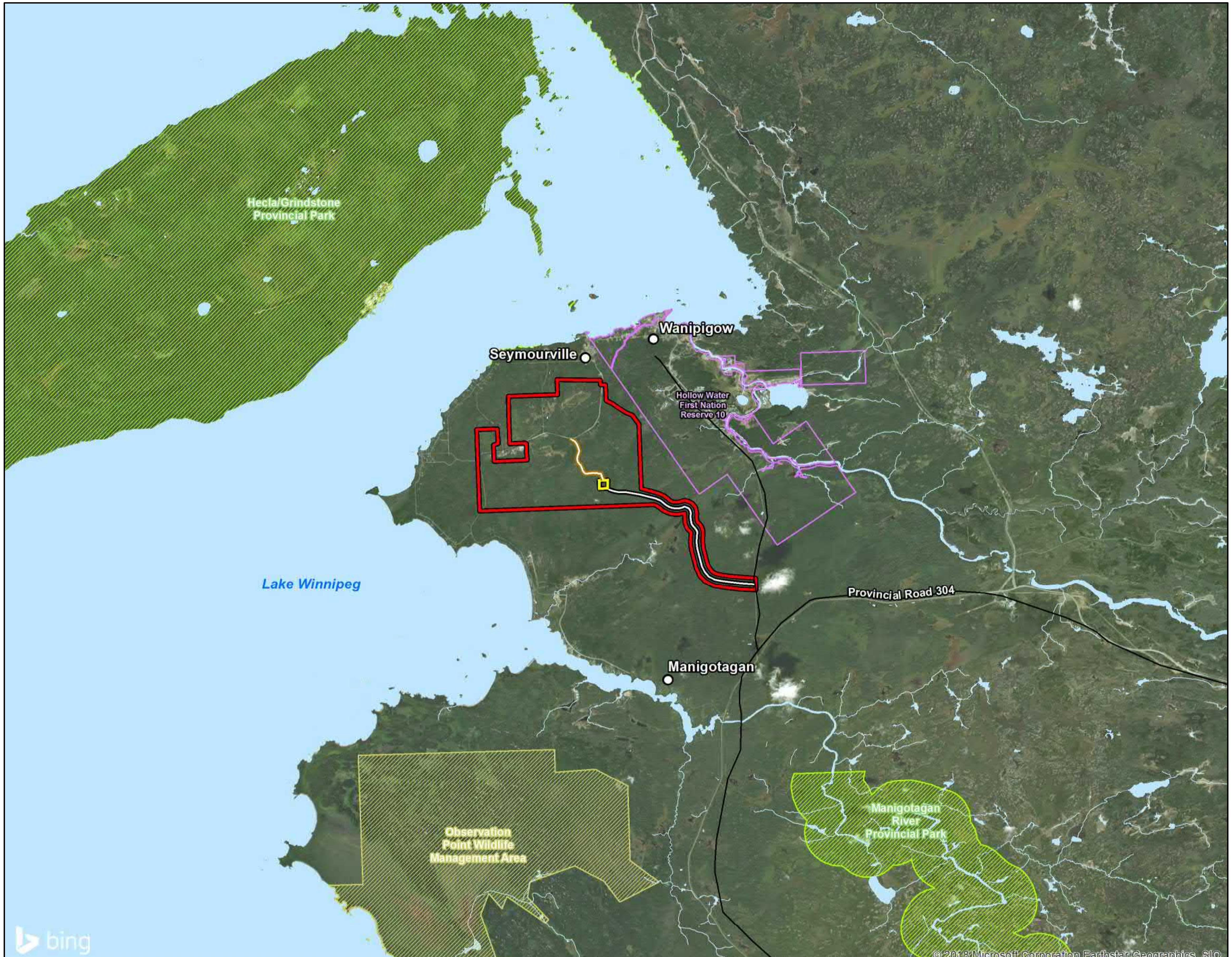
The Project will have an estimated annual production rate of 1 million tonnes of silica sand at full operation that will be processed on-site (washed and dried) and will be trucked to Winnipeg for loading onto rail cars for shipping to markets in Canada and the United States. The anticipated life of the Project will be 54 years. Key components of the Project will include:

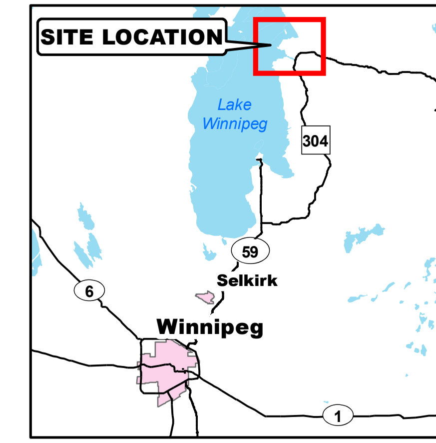
- An active open-pit sand quarry each year of operation, including progressive annual site reclamation of closed quarries;
- Silica sand production process, including a fully enclosed sand wash and dry facility;
- Ancillary facilities, including portable office and storage buildings;
- A main access road approximate 6 km-long; and
- An access road approximately 1.5 km-long for use during Project construction and for emergencies during Project operation.

The Project operations were assessed in accordance with the *Draft Guidelines for Air Quality Dispersion Modelling Manitoba* (MCWS, November 2006) using AERMOD to predict maximum ground-level concentrations, as well as maximum predicted concentrations at selected nearby sensitive receptors, of the following:

- Nitrogen Dioxide (NO_2);
- Carbon Monoxide (CO); and
- Particulate Matter (PM_{10} and $PM_{2.5}$) and,
- Sulfur Dioxide (SO_2).

Model results were compared with the *Manitoba Ambient Air Quality Criteria* (MAAQC, 2005).





Key Map

Project Components

- Plant Location
- Project Site Area Boundary
- Access Road for Project Construction and Emergency Use
- Main Access Road

First Nation

- Hollow Water First Nation Reserve 10

Parks and Protected Areas

- Provincial Park
- Wildlife Management Area

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W E
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1:100,000
NAD 1983 UTM Zone 14N

1 0.5 0 1 2 3 km

Basemap:
Additional Sources:
Ortho-Imagery:

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PROJECT LOCATION
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WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2018-12-13

2. Facility Location

The Project is located on the east shore of Lake Winnipeg, in the Canadian Province of Manitoba, approximately 160 kilometres (km) northeast of the capital city of Winnipeg (**Figure 1**). The deposit is found within the boundaries of the Incorporated Community of Seymourville, governed by a mayor and council under *The Northern Affairs Act*.

Seymourville is one of a group of four communities including Manigotagan, Hollow Water First Nation and Aghaming that are in close proximity (10 km or so) to the Project. The community lies on the southeast boundary of Hollow Water's reserve and is about 70 kilometres by road north of Pine Falls (the nearest service center). The community of Manigotagan is southeast of the Project, situated near the mouth of the Manigotagan River on the east shore of Lake Winnipeg at Provincial Road #304 ("PR #304"). Also, cottage developments can also be found to the northwest, west and southwest of the deposit along the shores of Lake Winnipeg.

Access to the Project (and its markets) is provided by the paved PR #304 and a paved 6 km all-weather road to be sited and built as part of the Project. The Project Site area includes the project footprint which is the area that will encompass the land on which project components are located and immediate surrounding area. The Project Site occurs within quarry lease areas issued to the proponent.

3. Legislation and Policy

The air dispersion model was conducted according to the *Draft Guidelines for Air Quality Dispersion Modelling Manitoba* (MSWS, November 2006), and model results were compared with *Manitoba Ambient Air Quality Criteria* (MAAQC). The assessment was prepared for inclusion with an Industrial Approval Renewal Application.

A summary of the applicable Regulations and Guidelines is shown in **Table 1**, below.

Table 1. Legislation and Policy used for the Air Dispersion Modelling Assessment

Authorization / Guideline	Agency	Rationale
Draft Guidelines for Air Dispersion Modelling in Manitoba	Manitoba Conservation and Water Stewardship	This guideline is a resource that provides consistency in dispersion modelling across all regulatory applications.
Manitoba Ambient Air Quality Criteria (MAAQC)	Manitoba Conservation and Water Stewardship	Manitoba provides a listing of Ambient Air Quality Criteria and Guidelines for various air pollutants.
Alberta Air Quality Modelling Guideline	Alberta Environment and Sustainable Resource Development	This for dispersion modelling provides guidance on appropriate surface characteristics and receptor grids to supplement the Manitoba guidelines.
US EPA AERMOD Implementation Guide	Unites States Environmental Protection Agency	This guideline is a resource that helps with the use of the related modelling modules and programs (AERMOD, AERMAP, AERMET, AERSURFACE, AERSCREEN) and the required additional information

3.1 Air Quality Objectives

The evaluation of ambient air quality typically relies on comparison of modelled concentrations to regulatory standards or objectives. The regulatory standards or objectives are designed by the local, provincial, or federal authority to be conservative and protective of air quality. The MAAQC were used in this assessment.

The applicable air quality Objectives and Guidelines are summarized in **Table 2**, below.

Table 2. Ambient Air Quality Objectives

Compound	Averaging Period	MAAQC[1] (μg/m^3)
Nitrogen Dioxide (NO_2)	1-hour	400
	24-hour	200
	Annual	100
Carbon Monoxide (CO)	1-hour	35,000
	8-hour	15,000
Sulfur Dioxide (SO_2)	1-hour	900
	24-hour	300
	Annual	60
Particulate Matter with a diameter of 2.5 micrometers and less ($PM_{2.5}$)	24-hour	30
Particulate Matter with a diameter of 10 micrometers and less (PM_{10})	24-hour	50

Notes:

[1] *Manitoba Ambient Air Quality Criteria (MCWS, July 2005)*

4. Methodology

The emissions from the Project were assessed based on information provided by the Proponent and supplemented by USEPA AP-42, and engineering estimates. These emissions were then used in the AERMOD dispersion model to assess maximum modelled ground-level concentrations. The Project was assessed in accordance with the *Draft Guidelines for Air Quality Dispersion Modelling in Manitoba* (MCWS, 2006) and the model results were compared to the MAAQC as shown in **Table 2**.

Details on the preparation of the source modeled emissions, stack parameters and the dispersion modelling methodology are discussed further below.

4.1 Dispersion Model

Air dispersion models are important tools that can be used to assess the possible effects of an operation on the air quality at a particular location. These dispersion models mathematically predict the behaviour of emitted plumes by accounting for emission rates, physical characteristics of the release, geometry and location of the sources and buildings as related to receptor locations, terrain effects, meteorology, and atmospheric dispersion.

The air dispersion modelling assessment for the Project was completed using the AERMOD dispersion model (Model Version 18081). AERMOD is specified in the MCWS as a refined model that is suitable for predicting the near-field (within 25 km) dispersion of multiple emission sources. AERMOD determines predicted air quality through air dispersion of emissions using boundary layer turbulence structure and scaling concepts. AERMOD was selected for this application because of its ability to account for:

1. Directional and seasonal variations in land-use;
2. Building induced plume downwash, which can affect the sources plume rise; and
3. Terrain influences.

In addition, AERMET and AERMAP (Model Version 8.9.0), AERMOD's meteorological and terrain pre-processors, were employed to process meteorological data and terrain data inputs for AERMOD. Modelling was conducted in accordance with the 2006 MCWS. Where further guidance was necessary, the AERMOD Implementation Guide (US EPA, 2009) was utilized.

4.1.1 Building Downwash

The AERMOD model includes PRIME (Plume Rise Model Enhancements) algorithms to model the effects of buildings downwash from nearby or adjacent point sources. The building information presented **Table 3** were used as an input for AERMOD PRIME. The building and stack locations are presented in **Figure 2**.

Table 3. Building Information

Building Number	Location (SW Corner or Centre Point)		Height (m)
	(mE)	(mN)	
1	687179.88	5670533.7	6
2	687206.15	5670594.61	6
3	687172.77	5670601.33	6
4	687178.26	5670496.95	6
5	687181.35	5670456.59	6
6	687164.44	5670564.61	6
7	687145.86	5670572.34	6
8	687200.2	5670642.38	6
9	687213.82	5670642.81	6
10	687213.39	5670655.32	6
11	687200.2	5670654.44	6

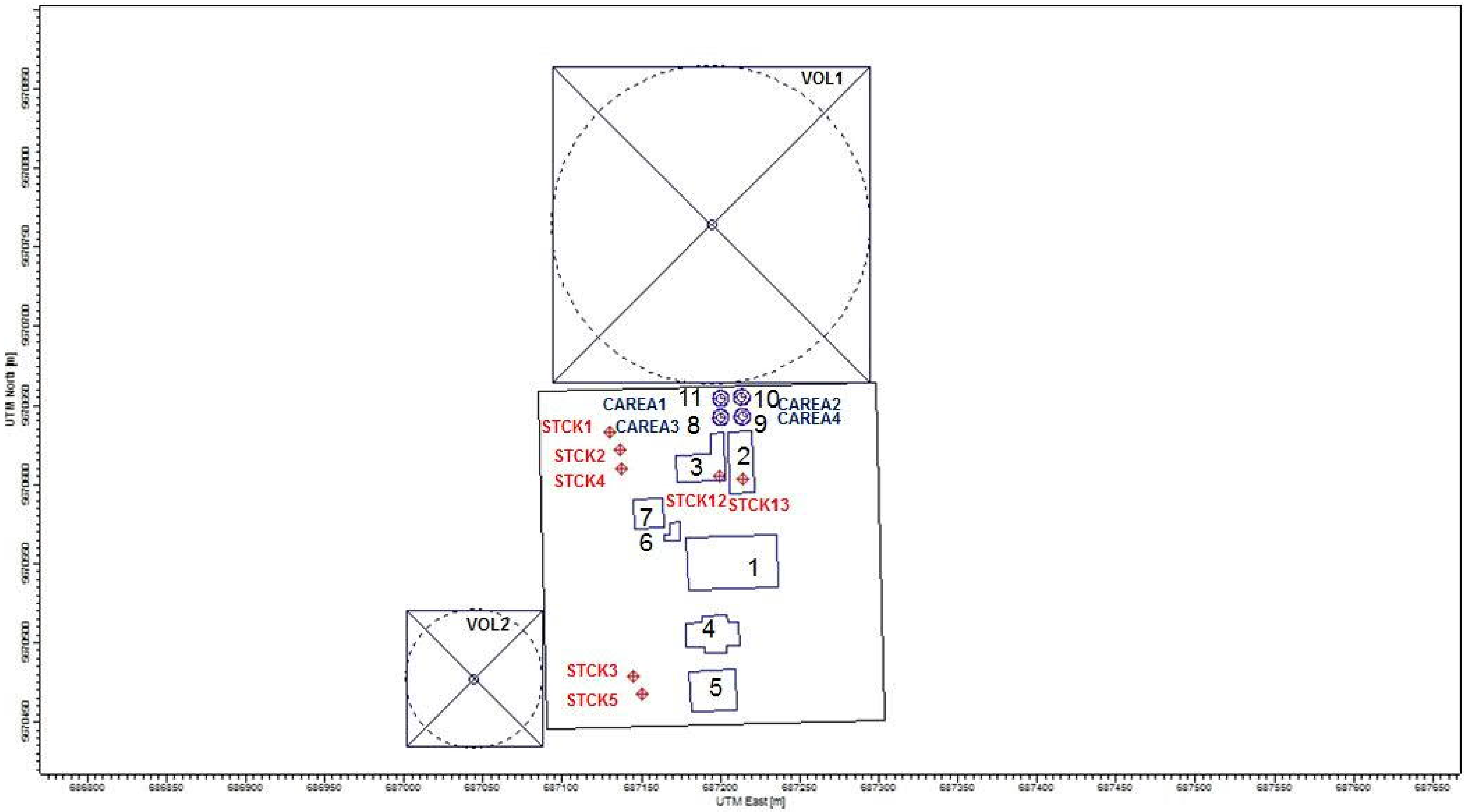


Figure 2. Building Locations

Note: ✦ indicates stack location.

4.2 Boundaries

The following boundaries were used to assess modelled concentrations due to air emissions from the Project and follow guidance in the MCWS. Boundaries for the air quality modelling assessment are categorized in two ways: spatial and temporal. The modelled ground-level concentrations from the Project and comparison with MAAQCs were investigated within these defined boundaries.

4.2.1 Spatial Boundary

The study area for this assessment was the zone of influence of the Project's air emissions, including potential sensitive receptors nearest to the Project. A local study area of 20 km by 20 km surrounding the Project was used for this analysis; the appropriateness of this boundary selection was confirmed by the model outputs which showed that maximum concentrations of were found within a kilometer of the emission sources. Model receptor points are described in **Section 4.5**. All receptors were evaluated at ground-level (i.e. 0 m) elevation.

4.2.2 Temporal Boundary

Temporal boundaries for this assessment were developed in consideration of continuous operations and emissions from the stacks.

The temporal boundary also includes several time-averaging periods in accordance with the time periods outlined for the identified air quality guidelines in **Table 2**.

4.3 Meteorology

Air quality is dependent on the rate of pollutant emissions into the atmosphere and the ability of the atmosphere to disperse the pollutant emissions. The dispersion of air pollutants is affected by local meteorological patterns. The wind direction controls the path that air pollutants follow from the point of emission to the receptors. In addition, wind speeds affect the time taken for pollutants to travel from source to receptor and the distance over which air pollutants travel. As a result, wind speeds also impact the dispersion of air pollutants; therefore, it is important to consider local meteorological patterns when assessing potential air quality effects from an emission source.

AERMET (Model Version 8.9.0) was employed to process meteorological data and terrain data inputs for AERMOD. The hourly surface and upper air meteorological inputs to AERMOD were extracted from Winnipeg James Armstrong International Airport (MB, CA) and International Falls (MN, US), respectively.

AERMET produces surface scalar parameters and vertical profiles of meteorological data that were used as an input for AERMOD. In order to quantify the boundary layer parameters needed by AERMOD, AERMET also requires specification of site-specific land use characteristics including surface roughness (z_o), albedo (r) and Bowen ratio (B_o). These site characteristics are used by AERMET, along with the meteorological data to help characterize the atmospheric boundary layer and dispersion. The boundary layer is quantified by AERMET in calculating parameters such as:

- Sensible heat flux;
- Surface friction velocity;
- Convective velocity scale;
- Vertical potential temperature gradient above the convective mixing height;
- Height of convectively-generated boundary layer;

- Height of mechanically-generated boundary layer; and
- Monin-Obukhov length (m).

These boundary layer parameters are calculated on an hourly basis and are contained in AERMET's surface file. The surface file is read into AERMOD and then these values are used to quantify the atmospheric dispersion.

4.4 Surface Characteristics

The land use surface characteristics surrounding the Project was quantified for the air dispersion model and was based on specific land use surface characteristics provided to AERMET.

The AERMOD Implementation Guide (AIG) (EPA, 2009) (AIG) recommends that the surface characteristics be determined based on digitized land cover data. US EPA has developed a tool called AERMET (EPA 2013) that can be used to determine the site characteristics based on digitized land cover data in accordance with the recommendations from the AIG discussed above.

In the AERMET User's Guide and the Draft Guidelines for Air Quality Dispersion Modelling in Manitoba, the various land use categories are linked to a set of seasonal surface characteristics. As such, AERMET requires specification of the seasonal category for each month of the year. The following four seasonal categories are supported by AERSURFACE, with the applicable months of the year specified for this assessment:

1. Spring when vegetation is emerging or partially green (April-May);
2. Midsummer with lush vegetation (June-September);
3. Autumn when periods of freezing are common, grass is brown and no snow is present (October-November); and
4. Winter with continuous snow on ground and subfreezing temperatures (December-March);

4.4.1 Land-Use and Terrain Characteristics

The calculated albedo, Bowen ratio, and surface roughness values for this specific assessment were based on ArcGIS land use data.

The land use within three (3) km of the Project was analyzed using ArcGIS to determine the surface roughness for the modelling domain. ArcGIS did not have sufficient information for the particular modelling domain. The land use was assumed based on Google Earth imaging. The land use within 3 km of the Project are 50% deciduous forest, 36% coniferous forest, 11% cultivated land, and 3% water. The surface roughness, albedo and Bowen ratios for land use and seasons are default values outlined in the MCWS (2006) and can be seen in **Table 4, Table 5**, **Table** 6 and **Table 7** below.

Table 4. Land Use Factors for Coniferous Forest Category

Season	Surface Roughness[1] (m)	Albedo[1]	Bowen[1]
Spring	1.30	0.12	0.70
Summer	1.30	0.22	0.30
Autumn	1.30	0.12	0.80
Winter	1.30	0.35	1.50

Note: [1] Values from AQMG (AEP, 2013)

Table 5. Land Use Factors for Deciduous Forest

Season	Surface Roughness[1] (m)	Albedo[1]	Bowen[1]
Spring	1.00	0.12	0.70
Summer	1.30	0.12	0.30
Autumn	0.80	0.12	1.00
Winter	0.50	0.50	1.50

Note: [1] Values from AQMG (AEP, 2013)

Table 6. Land Use Factors for Cultivated Land

Season	Surface Roughness[1] (m)	Albedo[1]	Bowen[1]
Spring	0.03	0.14	0.3
Summer	0.20	0.20	0.50
Autumn	0.05	0.18	1.7-
Winter	0.01	0.60	1.50

Note: [1] Values from AQMG (AEP, 2013)

Table 7. Land Use Factors for Water

Season	Surface Roughness[1] (m)	Albedo[1]	Bowen[1]
Spring	0.0001	0.12	0.10
Summer	0.0001	0.10	0.10
Autumn	0.0001	0.14	0.10
Winter	0.0001	0.20	1.50

Note: [1] Values from AQMG (AEP, 2013)

4.5 Receptors

Receptor grids are required to define the locations where the model will predict ground-level concentrations. The receptor grid was designed to ensure that the model captures the maximum modelled concentrations associated with the Project’s emissions. A Cartesian receptor grid was developed to capture the maximum modelled ground-level concentrations associated with the stack emissions. The modelled receptor grid with the following spacing and distances was used, as per the AQMG (AEP, 2013):

- 20-m receptor spacing in the general area of maximum impact and the property boundary;
- 50-m receptor spacing within 0.5 km from the source;
- 250-m receptor spacing within 2 km from the sources of interest;
- 500-m spacing within 5 km from the sources of interest; and
- 1000-m spacing beyond 5 km.

In addition, the AQMG (AEP, 2013) recommends the inclusion of sensitive receptors near the Facility. Receptor points are added to the model in addition to the receptor grid described above so that the model calculates concentrations specific to those locations. Three sensitive receptors were identified in the neighbouring communities; these three sensitive receptors are:

- Nearest Residence
- Aghaming

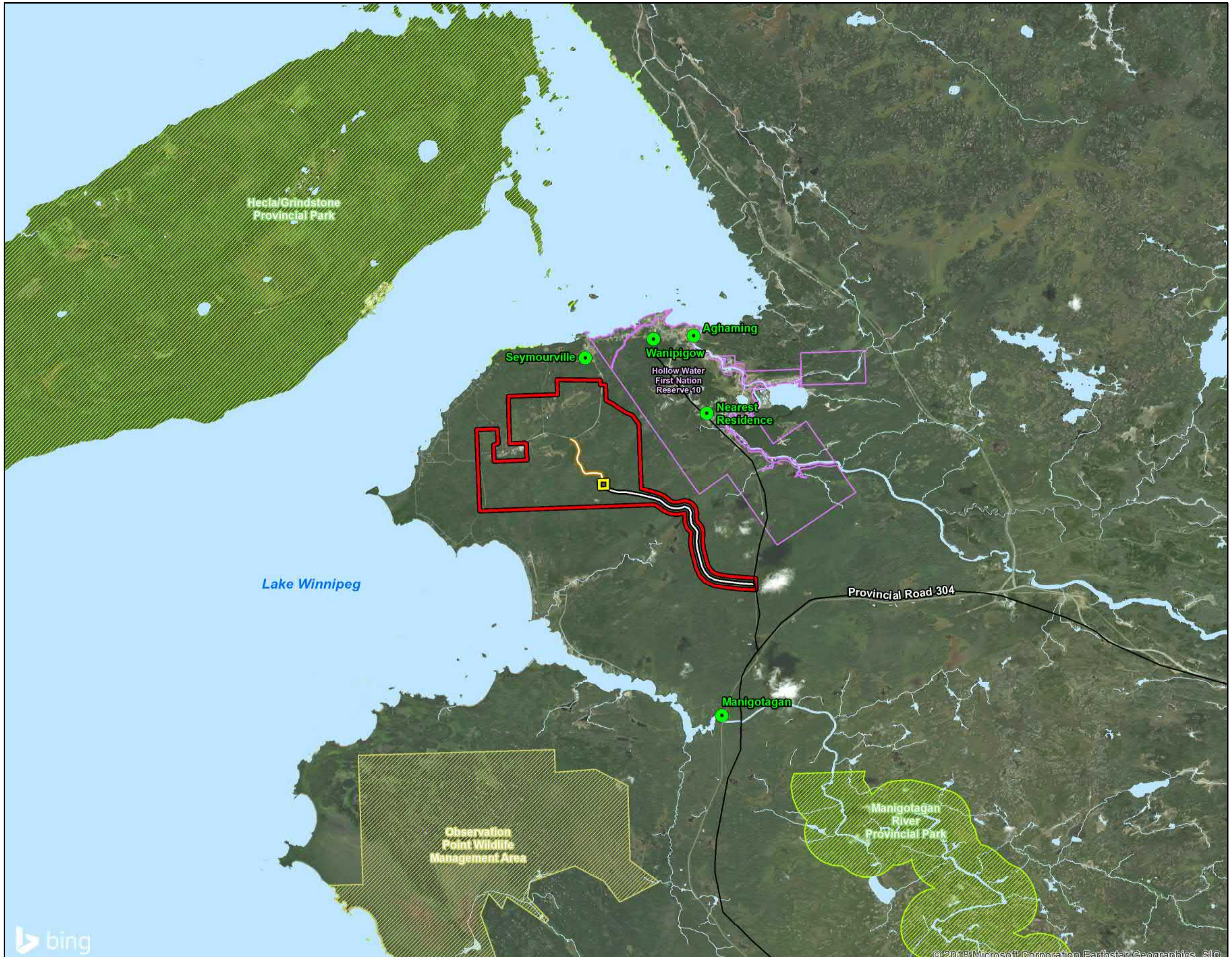
- Manigotagan
- Seymourville and
- Wanipigow

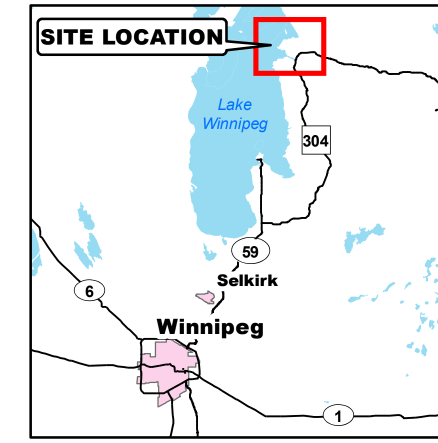
Table 8 and **Figure 3** illustrate the coordinates of the sensitive receptors and their distance from the Project.

Table 8. Sensitive Receptor Details

Sensitive Receptor	Approximate Distance from Facility (m)	UTM co-ordinate (mE)	UTM co-ordinate (mN)
Nearest Residence	3100	689787.00	5672336.00
Aghaming	4300	689457.00	5674288.00
Manigotagan	6500	690170.00	5664746.00
Seymourville	3200	686981.00	5673502.00
Wanipigow	4000	688481.00	5674502.00

For the dispersion modelling assessment, terrain data was based on Canadian Digital Elevation Data (CDED). This data was obtained from Geobase Canada (https://open.canada.ca/data/en/dataset?keywords=GeoBase). The appropriate region was based on the Universal Transverse Mercator (UTM) coordinates. AERMAP is a terrain pre-processor program that prepares the input receptor terrain elevation data file for AERMOD. AERMAP (model version 8.9.0) was run using the 1:50,000 CDED DEM files to assign elevations and critical hill heights to the receptors that were used for the modelling assessment.





Key Map

Sensitive Receptors

Sensitive Receptors

Project Components

Plant Location

Project Site Area Boundary

Access Road for Project Construction and Emergency Use

Main Access Road

First Nation

Hollow Water First Nation Reserve 10

Parks and Protected Areas

Provincial Park

Wildlife Management Area

N
W E
S

1:100,000
NAD 1983 UTM Zone 14N

1 0.5 0 1 2 3 km

Basemap:
Additional Sources:
Ortho-Imagery:

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Figure: 3

SENSITIVE RECEPTORS
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WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2018-12-13

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4.7 Nitrogen Dioxide Modelling

Nitrogen Dioxide (NO_2) dispersion modelling was completed using the total conversion method.

4.8 Baseline/Background Concentrations

Baseline/background air quality includes chemical concentrations from natural sources, existing nearby sources, and unidentified, possibly distant sources.

4.8.1 Background Ambient Air Concentrations Considered in the Air Dispersion Model

As recommended by the MCWS (2006) for a refined modelling analysis, the modelled concentration for each compound was added to its corresponding baseline/background concentration to estimate a "total" modelled concentration that can then be compared to the MAAQC. The MAAQC also specifies statistical forms of the baseline or background ambient air quality that should be used for certain averaging periods.

The baseline/background air quality concentration data obtained from the Winnipeg Ellen St. and Thompson Manitoba monitoring stations used for this analysis was assessed on a basis of the 90th percentile as per the MCWS (2006).

Baseline/background concentrations for the parameters of concern used in the air quality assessment are shown in **Table 9**.

Table 9. Baseline/Background Concentrations

Parameter	Data Source Location	Averaging Period	Objective and/or Guideline[1] ($\mu g/m^3$)	Background ($\mu g/m^3$)
Nitrogen Dioxide (NO_2)	Winnipeg Ellen St., Manitoba	1-hour[2]	400	29.3
		24-hour	200	29.3
		Annual	100	10.9
Carbon Monoxide (CO)[3]	Winnipeg Ellen St., Manitoba	1-hour[2]	35,000	277
		8-hour	15,000	275
Sulfur Dioxide (SO_2)	Winnipeg Ellen St., and Thompson, Manitoba[4]	1-hour[2]	900	23.6
		24-hour	300	23.6
		Annual	60	1.81
Particulate Matter with a diameter of 2.5 micrometers and less ($PM_{2.5}$)	Winnipeg Ellen St., Manitoba	24-hour	30	11.7
Particulate Matter with a diameter of 10 micrometers and less (PM_{10})	Winnipeg Ellen St., Manitoba	24-hour	50	25.6

Notes:

[1] Manitoba Ambient Air Quality Criteria (MCWS, July 2005)

[2] 1-hour values represent the 90th percentile value

[3] Data availability for CO for 2017 was 22.5%, therefor 2016 data was used

[4] Data availability for SO_2 for 2017 was limited from Ellen St. Station; Thompson, Manitoba was used for 2017.

4.9 Modelling Scenarios & Emission Rates

The Project was modelled under one scenario. This scenario is considered “maximum normal” operation or emissions. The sources were conservatively modelled, considering continuous operation to simulate a “worst case” modelled hour of operation.

An “upset” scenario was not modelled, as the units are either on (near full load) or off; an upset condition would correspond with a unit being immediately taken offline.

The assumptions made for the modelling scenario are as follows:

- Activities will occur 24/7.
- One (1) track dozer operating no more than 75% of each hour;
- Two (2) dump trucks, each operating no more than 25% of each hour;
- Fifty four (54) haul trucks, each operating 100% of each hour;
- Two (2) loaders operating no more than 75% of each hour;
- The load factor for the equipment engines was assumed to be 20% on average; and
- Two (2) baghouses, one on the dryer and one on the screen are assumed to have 95% removal efficiency.

The source model input parameters are summarized in **Table 10**, **Table 11**, and **Table 12.**

Table 10. Modelled Source Parameters – Point Sources

Source ID	Source Description	Source parameters				UTM Coordinate		Emission Rates (g/s)				
		Height (m)	Diameter (m)	Temp (K)	Velocity (m/s)	mE	mN	$PM_{2.5}$	PM_{10}	NO_X	SO_2	CO
STCK1	DOZER1	2	0.122	709	50	687130.53	5670632.60	0.0472	0.0472	0.6611	0.0440	0.1431
STCK2	LOADER1	3	0.122	709	50	687136.18	5670622.18	0.0111	0.0111	0.1556	0.0103	0.0337
STCK3	LOADER2	3	0.122	709	50	687144.42	5670478.52	0.0111	0.0111	0.1556	0.0103	0.0337
STCK4	DUMP TRUCK 1	2	0.122	709	50	687137.04	5670609.60	0.0267	0.0267	0.3741	0.0249	0.0810
STCK5	DUMP TRUCK 2	2	0.122	709	50	687150.07	5670468.11	0.0267	0.0267	0.3741	0.0249	0.0810
STCK6	HAUL TRUCK 1KM	2	0.122	AMBIENT	0	690987.41	5668050.13	0.002	0.06	0.00066	0.000007	0.000163
STCK7	HAUL TRUCK 2KM	2	0.122	AMBIENT	0	689986.29	5668171.09	0.002	0.06	0.00066	0.000007	0.000163
STCK8	HAUL TRUCK 3KM	2	0.122	AMBIENT	0	689530.05	5669016.05	0.002	0.06	0.00066	0.000007	0.000163
STCK9	HAUL TRUCK 4KM	2	0.122	AMBIENT	0	689294.65	5669962.52	0.002	0.06	0.00066	0.000007	0.000163
STCK10	HAUL TRUCK 5KM	2	0.122	AMBIENT	0	688436.46	5670179.84	0.002	0.06	0.00066	0.000007	0.000163
STCK11	HAUL TRUCK 6KM	2	0.122	AMBIENT	0	687396.38	5670402.43	0.002	0.06	0.00066	0.000007	0.000163
STCK12	DRYER	6	0.5	AMBIENT	12	687198.91	5670605.29	0.0066	0.007	0.112		
STCK13	SCREEN	6	0.5	AMBIENT	12	687213.95	5670603.85	0.0015	0.0015			

Table 11. Modelled Source Parameters – Volume Sources

Source ID	Source Description	Source Parameters		Emission Rates (g/s)				
		Height (m)	Length of Side (m)	$PM_{2.5}$	PM_{10}	NO_X	SO_2	CO
VOL1	OVERBURDEN	3	200	0.0344	0.227	0	0	0
VOL2	OVERBURDEN EMBANKMENT	5	20.05	0.0793	0.524	0	0	0

Table 12. Modelled Source Parameters – Area Sources

Source ID	Source Description	Source Parameters		Emission Rates (g/s)				
		Height (m)	Diameter (m)	$PM_{2.5}$	PM_{10}	NO_X	SO_2	CO
CAREA1	SILO1	6	5	0.000000374	0.000000374	0	0	0
CAREA2	SILO2	6	5	0.000000374	0.000000374	0	0	0
CAREA3	SILO3	6	5	0.000000374	0.000000374	0	0	0
CAREA4	SILO4	6	5	0.000000374	0.000000374	0	0	0

4.10 Greenhouse Gas (GHG) Emissions

To estimate the annual greenhouse gas emissions from onsite activities, the activities of equipment associated with the Project operation was considered. Equipment includes a dozer, loaders, dump trucks, haul trucks and the rotary dryer. Emission factors for Industrial Engines were taken from AP-42 (Section 3.3). The total emissions per year from each piece of equipment were estimated based on: engine size (hp), load factor, and the emission factors for each pollutant. Once those total yearly emissions were calculated, the Global Warming Potential (GWP) was applied to each pollutant. The GHGs included in the emissions calculation are carbon dioxide (CO_2), methane (CH_4) and Nitrous Oxide (N_2O). The assumptions made for the GHG calculations are as follows:

- Activities will occur 24/7.
- One (1) track dozer operating no more than 75% of each hour;
- Two (2) dump trucks each, each operating no more than 25% of each hour;
- Fifty four (54) haul trucks, each operating 100% of each hour;
- Two (2) loaders operating no more than 75% of each hour; and
- The load factor for the equipment engines was assumed to be 20% on average.

5. Results & Conclusion

AERMOD was executed with emission rates for the Project emissions sources as specified in **Table 10**, **Table 11** and **Table 12** MCWS. Background parameters of concern were monitored by the Winnipeg Ellen St., and Thompson, Manitoba monitoring stations.

The maximum modelled ground-level concentrations resulting from emissions from the Project are shown in **Table 14** and **Table 15**

The model predicted possible exceedances of the MAAQC for particulate matter (PM_{10} and $PM_{2.5}$) that are associated with the project site operations as well as trucking activities. The predicted maximum model output was within the facility boundary, adjacent to operations. Predicted model results at sensitive receptors were between 2x and 5x the MAAQC, as shown in **Table 14** and **Table 15,** below. No drilling, blasting or crushing activities are anticipated to be required for quarry development. Occasional ‘lumps’ of sand may be encountered which will require breaking in the quarry by use of a horizontal shaft breaker. The sand that is extracted from the active quarry has inherent moisture content (i.e. is not ‘dry’). Therefore, dust related to the sand being extracted from the quarry will be minor to negligible with the possible exception of ‘worst-case scenario’ days of extended long, dry, hot weather during non-winter months coupled with high winds.

The model also predicted possible exceedances of the MAAQC for NO_2 associated with the internal combustion by-products of equipment operation. These possible exceedances are limited to an area adjacent to these emission sources, and model predictions of NO_2 concentrations at sensitive receptors are below the MAAQC.

Predicted maximum concentrations of SO_2 and CO were below the associated MAAQC across the modelling domain.

Isopleths (concentration plots) are provided in **Attachment A** for the short-term averaging periods. The locations the maximum modelled ground-level concentrations and the locations of sensitive receptors can also be seen in the figures in **Attachment A**. The intention of the isopleth figures is to provide a graphical depiction of the modelled concentrations, the magnitude of the modelled impacts, and how they vary spatially.

To estimate the annual emissions of greenhouse gasses, emissions of carbon dioxide (CO_2), methane (CH_4) and Nitrous Oxide (N_2O) were estimated from onsite activities associated with the Project operation. Equipment includes the loader, dozer, dump trucks, haul trucks and the rotary dryer. Estimated GHG emissions are summarized in **Table 13.** Overall, the project is estimated to generate 26,526 tonnes of CO_2e annually. For context, the reported emissions in 2017 were 20.9 Mt CO_2e from Manitoba, and 704 Mt CO_2e from Canada.

Table 13. Greenhouse Gas Annual Emissions (CO_2e)

Equipment[2]	Equipment Count	CO_2 (tonnes/year)[1]	CH_4 (tonnes/year)	N_2O (tonnes/year)	CO_2e (tonnes/year)
Dozer	1	586	0.057	0.026	596
Loader	1	46	0.0045	0.00204	46.7
Dump Truck	2	221	0.0215	0.00980	225
Rotary Dryer	1	230	0.28	0.67	436
Haul Trucks	54	24,835	2.41	1.10	25,223
Global Warming Potential[1]	-	1	25	298	-
				Total per Annum	**26,526**

*Note: [1] CO_2e=Total Emission (tonnes/year)*GWP; as such, the rows in the table do not balance.*

Note: [2] List of epage1quipment that will be operating at any one time.

Table 14. Maximum Modelled Concentrations

Compounds	Averaging Period	Objective and/or Guideline (µg/m^3)	Maximum Applicable Model Output (µg/m^3)	Maximum Applicable Model Output + background (µg/m^3)	Maximum Applicable Model Output Location		Background Concentration (µg/m^3)	Date of Maximum Modelled Concentration (year/month/day, hour)
					UTM (mE)	UTM (mN)		
NO_2	1 hr	400	377	406	687085.19	5670658.92	29.3	2015/05/27, 20:00
	24 hr	200	149	178	687085.19	5670658.92	29.3	2013/01/11, 24:00
	Annual	100	23.5	34	687085.19	5670658.92	10.9	—
SO_2	1 hr	900	24.5	48	687085.19	5670658.92	23.6	2015/10/02, 22:00
	24 hr	300	9.46	33	687085.19	5670658.92	23.6	2014/04/24, 24:00
	Annual	60	1.47	3.28	687085.19	5670658.92	1.81	—
CO	1 hr	35000	79.8	357	687085.19	5670658.92	277	2015/10/02, 22:00
	8 hr	15000	52.7	328	687085.19	5670658.92	275	2014/04/24, 16:00
PM_{10}	24 hr	50	160	186	687090.55	5670445.63	25.6	2014/07/17, 24:00
$PM_{2.5}$	24 hr	30	23.3	35	687090.55	5670445.63	11.7	2014/07/17, 24:00

Table 15. Maximum Modelled Concentrations at Sensitive Receptors

Compounds	Averaging Period	Objective and/or Guideline (µg/m^3)	Sensitive Receptor 1 (µg/m^3)	Sensitive Receptor 1 + background (µg/m^3)	Sensitive Receptor 2 (µg/m^3)	Sensitive Receptor 2 + background (µg/m^3)	Sensitive Receptor 3 (µg/m^3)	Sensitive Receptor 3 + background (µg/m^3)	Sensitive Receptor 4 (µg/m^3)	Sensitive Receptor 4 + background (µg/m^3)	Sensitive Receptor 5 (µg/m^3)	Sensitive Receptor 5 + background (µg/m^3)	Background Concentration (µg/m^3)
NO_2	1 hr	400	65.3	94.6	65.0	94.3	12.0	41.3	112	141.3	67.2	96.5	29.3
	24 hr	200	5.3	34.6	6.5	35.8	1.1	30.4	18.7	48.0	6.96	36.3	29.3
	Annual	100	0.273	11.2	0.230	11.1	0.025	10.9	0.98	11.9	0.28	11.2	10.9
SO_2	1 hr	900	3.8	27.4	3.8	27.4	0.79	24.4	6.97	30.6	3.99	27.6	23.6
	24 hr	300	0.31	23.9	0.34	23.9	0.071	23.7	1.11	24.7	0.42	24.0	23.6
	Annual	60	0.0147	1.82	0.0128	1.82	0.00151	1.81	0.06	1.9	0.02	1.83	1.81
CO	1 hr	35000	12.5	290	12.2	289	2.56	280	22.7	300	13.0	290	277
	8 hr	15000	2.85	278	2.61	278	0.63	276	7.05	282	3.10	278	275
PM_{10}	24 hr	50	98.5	124	120	145	238	264	27.63	53.2	26.6	52.2	25.6
$PM_{2.5}$	24 hr	30	33.3	45.0	39.6	51.3	83.7	95.4	4.52	16.2	3.97	15.7	11.7

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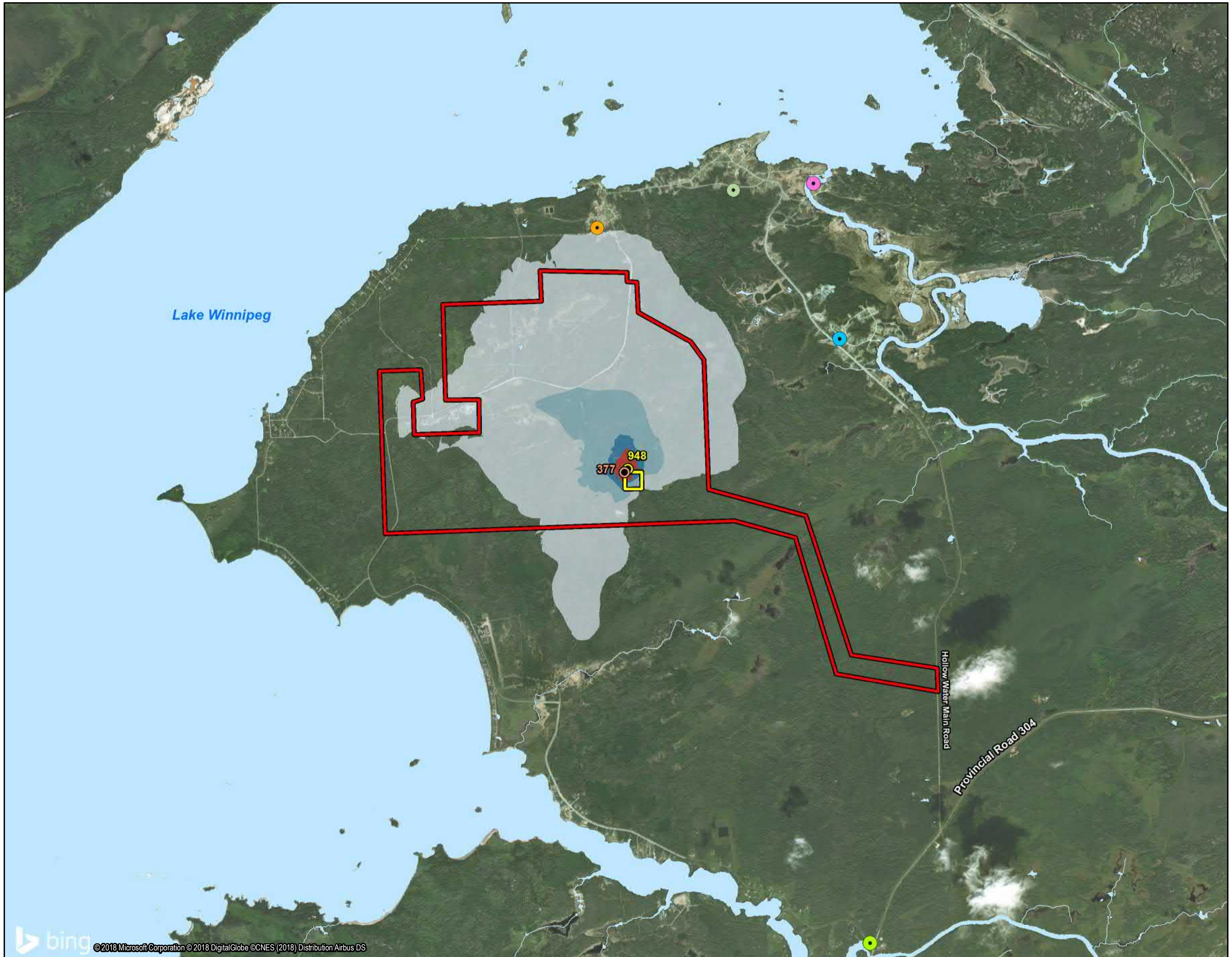
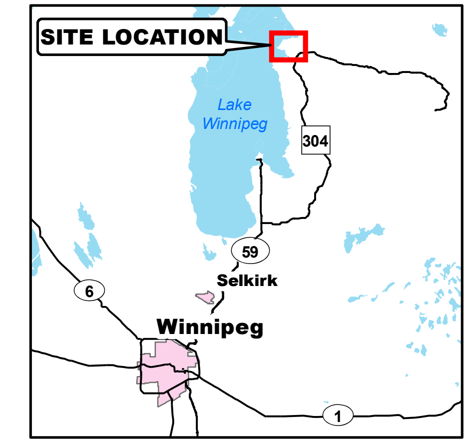
Attachment A

Isopleths





Key Map

Sensitive Receptors

- Aghaming
- Manigotagan
- Nearest Residence
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area Boundary

1 Hour Average NO_2 Concentrations ($\mu g/m^3$)

Ambient Air Quality Limit = 400 $\mu g/m^3$

- 100- 200
- 200 - 300
- 300 - 400
- > 400
- Maximum Concentration ($\mu g/m^3$)
- Maximum Concentration ($\mu g/m^3$) - Outside Facility Boundary

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NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
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Ortho-Imagery:

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Figure: A-1

MAXIMUM 1 HOUR AVERAGE NO_2 CONCENTRATIONS ($\mu g/m^3$)

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WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2018-12-14

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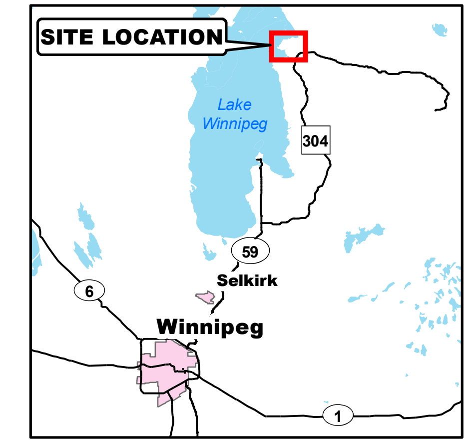

Key Map

Sensitive Receptors

- Aghaming
- Manigotagan
- Nearest Residence
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area Boundary

24 Hour Average NO_2 Concentrations (µg/m^3)

Ambient Air Quality Limit = 200 µg/m^3

- 50 - 100
- 100 - 150
- 150 - 200
- > 200
- Maximum Concentration (µg/m^3)
- Maximum Concentration (µg/m^3) - Outside Facility Boundary

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Basemap:
Additional Sources:
Ortho-Imagery:

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Figure: A-2

MAXIMUM 24 HOUR AVERAGE NO_2 CONCENTRATIONS (µg/m^3)

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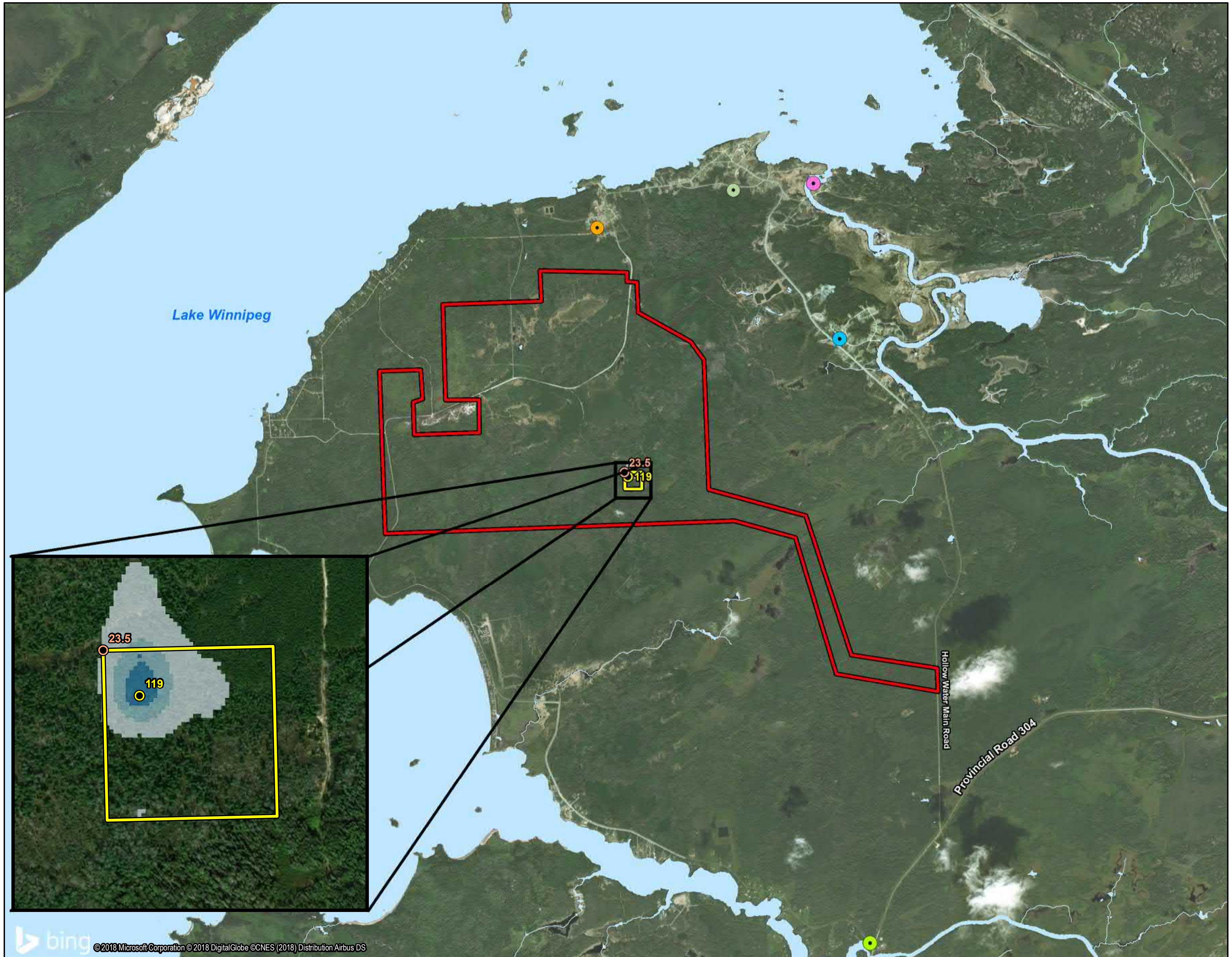

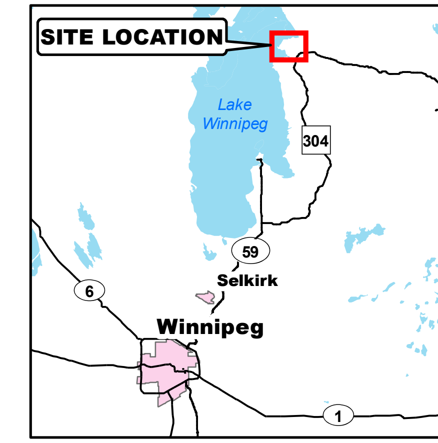

Key Map

Sensitive Receptors

- Aghaming
- Manigotagan
- Nearest Residence
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area Boundary

Annual Average NO_2 Concentrations (µg/m^3)

Ambient Air Quality Limit = 100 µg/m^3

- 25 - 50
- 50 - 75
- 75 - 100
- > 100
- Maximum Concentration (µg/m^3)
- Maximum Concentration (µg/m^3) - Outside Facility Boundary

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Figure: A-3

MAXIMUM ANNUAL AVERAGE NO_2 CONCENTRATIONS (µg/m^3)

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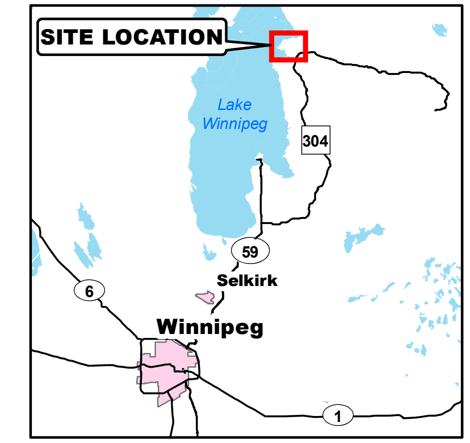

Key Map

Sensitive Receptors
- Aghaming
- Manigotagan
- Nearest Residence
- Seymourville
- Wanipigow

Project Infrastructure
- Facility
- Project Site Area Boundary

1 Hour Average SO_2 Concentrations ($\mu g/m^3$)

Ambient Air Quality Limit = 900 $\mu g/m^3$
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 63.1
- Maximum Concentration ($\mu g/m^3$)
- Maximum Concentration ($\mu g/m^3$) - Outside Facility Boundary

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NAD 1983 UTM Zone 14N

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Ortho-Imagery:

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MAXIMUM 1 HOUR AVERAGE SO_2 CONCENTRATIONS ($\mu g/m^3$)

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Figure: A-4

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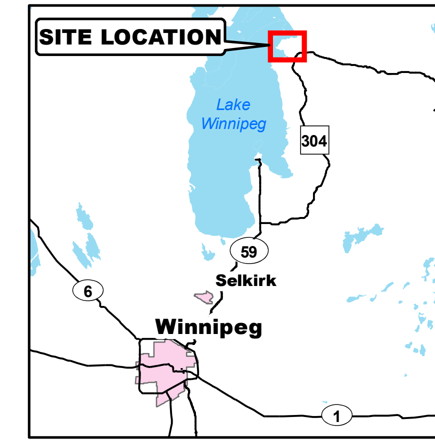

Key Map

Sensitive Receptors
- Aghaming
- Manigotagan
- Nearest Residence
- Seymourville
- Wanipigow

Project Infrastructure
- Facility
- Project Site Area Boundary

24 Hour Average SO_2 Concentrations ($\mu g/m^3$)

Ambient Air Quality Limit = 300 $\mu g/m^3$
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 37.6
- Maximum Concentration ($\mu g/m^3$)
- Maximum Concentration ($\mu g/m^3$) - Outside Facility Boundary

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Basemap:
Additional Sources:
Ortho-Imagery:

MAXIMUM 24 HOUR AVERAGE SO_2 CONCENTRATIONS ($\mu g/m^3$)

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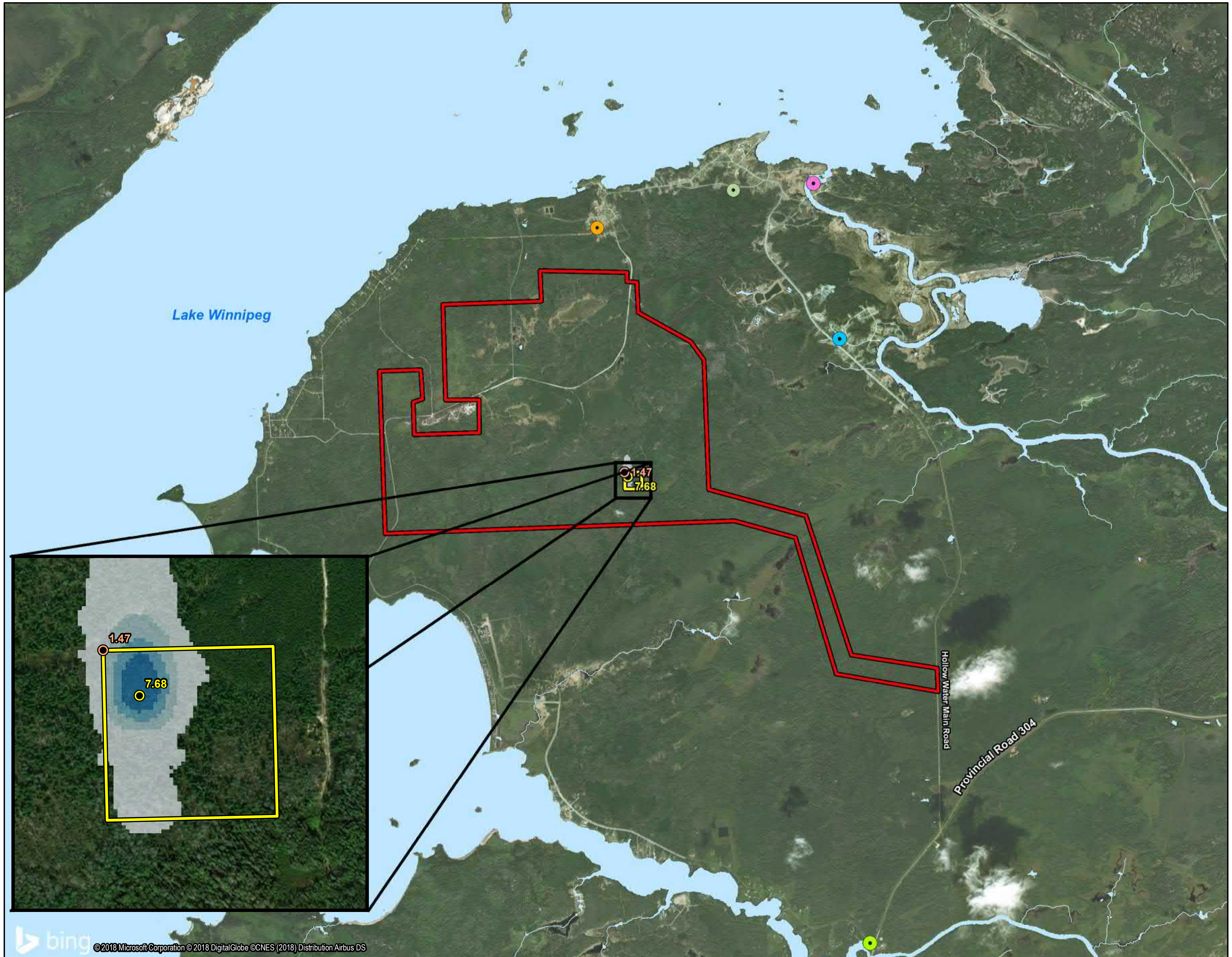

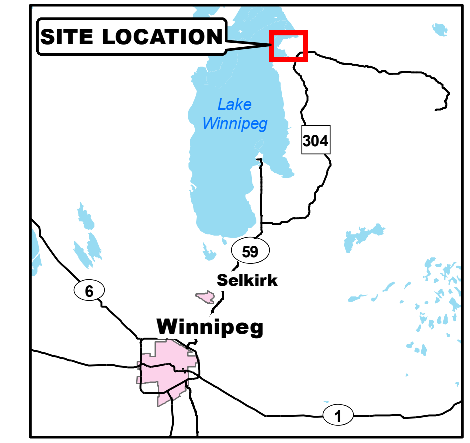

Key Map

Sensitive Receptors

- Aghaming
- Manigotagan
- Nearest Residence
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area Boundary

Annual Average SO_2 Concentrations ($\mu g/m^3$)

Ambient Air Quality Limit = 60 $\mu g/m^3$

- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 7.7
- Maximum Concentration ($\mu g/m^3$)
- Maximum Concentration ($\mu g/m^3$) - Outside Facility Boundary

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Basemap:
Additional Sources:
Ortho-Imagery:

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Figure: A-6

MAXIMUM ANNUAL AVERAGE SO_2 CONCENTRATIONS ($\mu g/m^3$)

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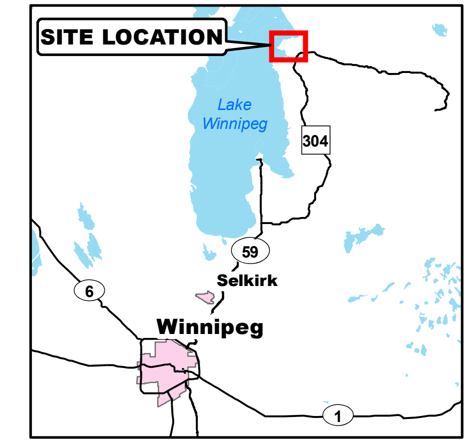

Key Map

Sensitive Receptors

- Aghaming
- Manigotagan
- Nearest Residence
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area Boundary

1 Hour Average CO Concentrations ($\mu g/m^3$)

Ambient Air Quality Limit = 35,000 $\mu g/m^3$

- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 205.2
- Maximum Concentration ($\mu g/m^3$)
- Maximum Concentration ($\mu g/m^3$) - Outside Facility Boundary

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NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
Additional Sources:
Ortho-Imagery:

AECOM

Figure: A-7

MAXIMUM 1 HOUR AVERAGE CO CONCENTRATIONS ($\mu g/m^3$)

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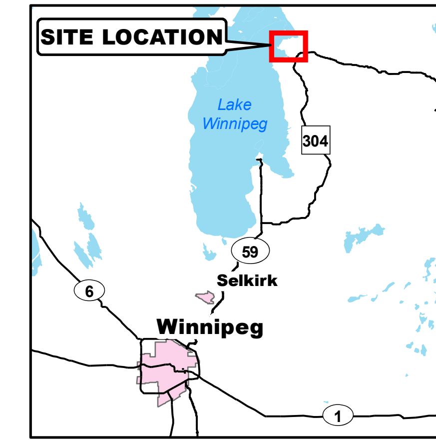

Key Map

Sensitive Receptors
- Aghaming
- Manigotagan
- Nearest Residence
- Seymourville
- Wanipigow

Project Infrastructure
- Facility
- Project Site Area Boundary

8 Hour Average CO Concentrations ($\mu g/m^3$)

Ambient Air Quality Limit = 15,000 $\mu g/m^3$
- 25 - 50
- 50 - 75
- 75 - 100
- 100 - 155.9
- Maximum Concentration ($\mu g/m^3$)
- Maximum Concentration ($\mu g/m^3$) - Outside Facility Boundary

N W E S

1:50,000
NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
Additional Sources:
Ortho-Imagery:

AECOM
Figure: A-8

MAXIMUM 8 HOUR AVERAGE CO CONCENTRATIONS ($\mu g/m^3$)

DRAFT

WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2018-12-14

Last saved by: KNOTTJ (2018-12-14) Last Plotted: Fri Dec 14, 2018
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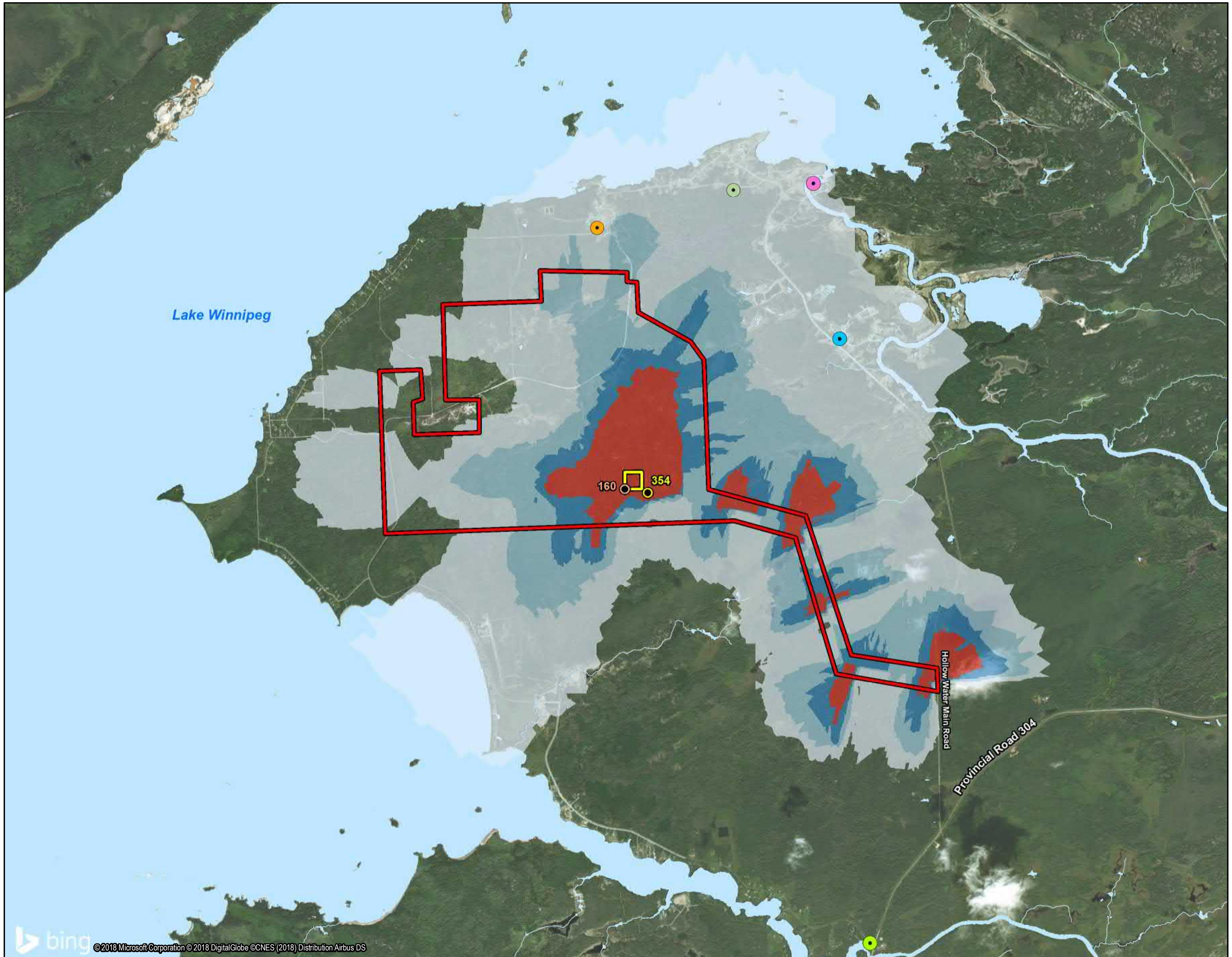
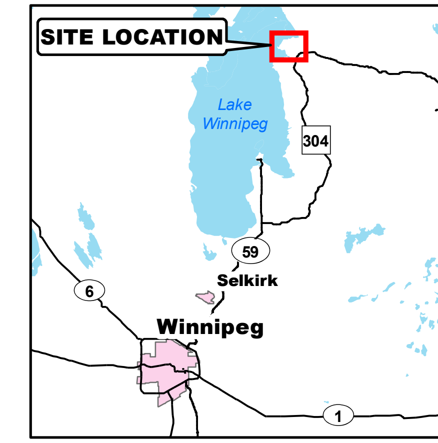
Project Management Initials: Designer: Checked: Approved: ANSI B 279.4mm x 431.8mm





Key Map

Sensitive Receptors

- Aghaming
- Manigotagan
- Nearest Residence
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area Boundary

24 Hour Average PM_{10} Concentrations (µg/m^3)

Ambient Air Quality Limit = 50 µg/m^3

- 12.5 - 25
- 25 - 37.5
- 37.5 - 50
- > 50
- Maximum Concentration (µg/m^3)
- Maximum Concentration (µg/m^3) - Outside Facility Boundary

N W E S

1:50,000
NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
Additional Sources:
Ortho-Imagery:

AECOM

Figure: A-9

MAXIMUM 24 HOUR AVERAGE PM_{10} CONCENTRATIONS (µg/m^3)

DRAFT

WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2018-12-14

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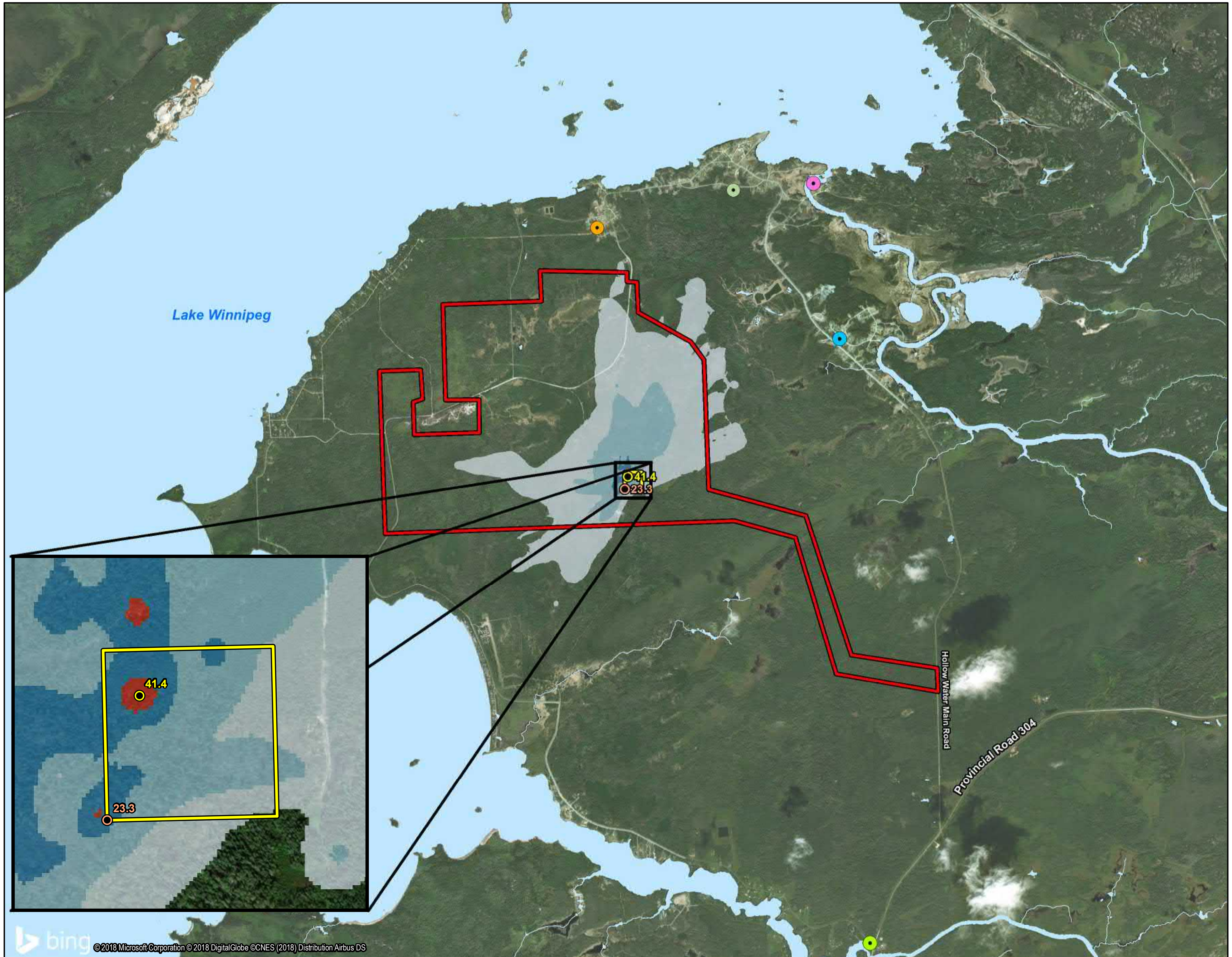

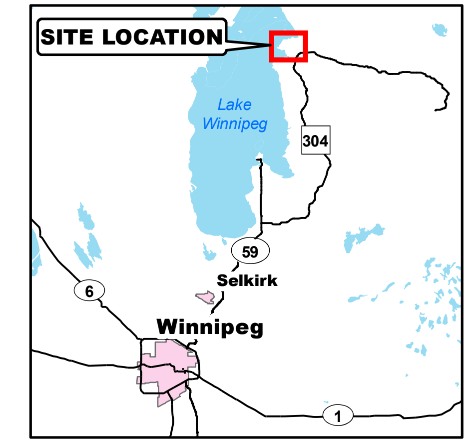

Key Map

Sensitive Receptors

- Aghaming
- Manigotagan
- Nearest Residence
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area Boundary

24 Hour Average $PM_{2.5}$ Concentrations ($\mu g/m^3$)

Ambient Air Quality Limit = 30 $\mu g/m^3$

- 5 - 10
- 10 - 20
- 20 - 30
- > 30
- Maximum Concentration ($\mu g/m^3$)
- Maximum Concentration ($\mu g/m^3$) - Outside Facility Boundary

N E S W

1:50,000
NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
Additional Sources:
Ortho-Imagery:

AECOM

Figure: A-10

MAXIMUM 24 HOUR AVERAGE $PM_{2.5}$ CONCENTRATIONS ($\mu g/m^3$)

DRAFT

WANIPIGOW SAND EXTRACTION PROJECT AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2018-12-14

Last saved by: KNOTTJ (2018-12-14) Last Plotted: Fri Dec 14, 2018 Project Management Initials: Designer: Checked: Approved: ANSI B 279.4mm x 431.8mm
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Appendix F

Noise Impact Assessment Report

Wanipigow Sand Extraction Project

Noise Impact Assessment

Canadian Premium Sand Inc.

Project number: 60588114

December 17, 2018

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("AECOM") for the benefit of the Client ("Client") in accordance with the agreement between AECOM and Client, including the scope of work detailed therein (the "Agreement").

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- represents AECOM's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time..

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Quality information

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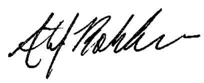			
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Revision History

Revision	Revision date	Details	Authorized	Name	Position
Initial issue	December 17, 2018	Final report	Yes	Atif Bokhari	Acoustic Engineer

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Tables

Glossary

Attenuation	The reduction of sound intensity achieved by various means (e.g. air, humidity, and porous materials) that may be natural or anthropogenic.
Barrier	An obstacle on the propagation path of sound between a source and a receiver. Obstacles may be composed wholly, or by a combination, of berms, walls, or fences; are free of gaps within or below its extents; and of sufficient mass to prevent significant transmission of sound.
Daytime	Defined as the hours from 07:00 to 22:00.
Day-night Sound Level	Describes a receiver's cumulative noise exposure over a 24 hour period, where nighttime events (22:00 to 07:00) are increased by 10 dB to account for humans' greater sensitivity to noise.
Decibel (dB)	The standard unit of measurement for sound levels. Describes the ratio between the sound pressure under consideration and a reference pressure level. Unless otherwise noted, decibel values relate to a reference pressure level of 2×10^{-5} Pascals.
Decibel – "A-Weighted [Network]" (dBA)	A frequency weighting network intended to approximate the response of the healthy human ear to sounds of different frequencies. Overall sound levels calculated or measured using the A-weighting network are indicated by dBA rather than dB.
Energy Equivalent Sound Level – $L_{eq,T}$	The equivalent constant sound level over a specified time period "T" that would have the same sound energy as the actual (i.e. unsteady) time-varying sound over the same period of time.
Frequency	The number of times per second that a sine wave of sound repeats itself. It can be expressed in cycles per second, or Hertz (Hz).
Frequency Weighting	A method used to account for changes in sensitivity as a function of frequency. A, B, and C, are most commonly used to account for different responses to sound pressure levels. Note: The absence of frequency weighting is referred to as linear weighting.
Hertz (Hz)	A unit of frequency, expressed as cycles per second.
Insertion Loss	The sound level reduction provided by a noise barrier or other noise mitigation measure.
International Organisation for Standardisation	An international body that provides scientific standards and guidelines related to various technical subjects and disciplines.

Mitigation	Measures, such as administrative or engineering methods, to reduce, eliminate, or control impacts on the environment.
Night-time	Defined as the hours from 22:00 to 07:00.
Noise Barrier	Same as barrier.
Noise level	Same as sound level.
Octave	The interval for which the upper band frequency is twice the lower band frequency is an octave. For acoustic measurements, octave bands start at a centre frequency of 1,000 Hz and go either up or down from that point at a 2:1 ratio. The next upper centre frequency is 2,000 Hz, followed by 4,000 Hz, etc. The next lower centre frequency is 500 Hz followed by 250 Hz, etc.
Point of Reception (POR) *or* ***Receptor***	A stationary position, at which sound levels are specified, measured or predicted.
Predictable Worst Case Operation	A planned and predictable mode of operation for stationary noise source(s) when the source generates the greatest noise impact at a point of reception, relative to the applicable limit.
Sound	A pressure-wave motion in a medium, such as air or water. The pressure-wave propagates to distant points through rapid oscillatory compression/rarefaction in the medium.
Sound Level	Generally refers to the weighted sound pressure level that may be linear or weighted (e.g., A- or C-weighted) and expressed in decibels.
Sound Level Meter	An instrument used to measure noise and sound levels.
Sound Power Level	The total sound energy radiated by a source per unit time (i.e. rate of acoustical energy radiation) measured in Watts. The acoustic power radiated from a given sound source as related to a reference power level (i.e., typically $1E^{-12}$ watts, or 1 picowatt) and expressed as decibels. A sound power level of 1 watt = 120 decibels relative to a reference level of 1 picowatt.
Sound Pressure	The root-mean-square of the instantaneous sound pressures over a specified time interval "T" in the frequency band of interest.
Sound Pressure Level	Logarithmic ratio of the root mean square sound pressure to a reference sound pressure. The reference sound pressure of the threshold of human hearing (i.e., 20 micropascals) is used.

1. Introduction

Canadian Premium Sand Inc. (CPS) is proposing to develop a high-grade silica sand quarry, processing facility, two access roads and a powerline (the Project) on provincial Crown Land west of Hollow Water First Nation within their Traditional Territory (the Project Area). AECOM was retained by CPS to assess the noise impacts due to the Project operations. This report summarizes the methods, assumptions, technical data and prediction results of the assessment.

The Wanipigow Sand Extraction Project will have a lifespan of 54 years with an initial production rate of one million tonnes per year. The proposed Project will consist of the following key activities and components:

- Overburden and topsoil stripping and stockpiling;
- Quarrying, including sequential site reclamation;
- Fully enclosed sand wash and dry facility;
- Office and storage buildings;
- 6 km long paved main access road;
- 6 km long 115 kV powerline adjacent to the main access road; and
- 1.5 km long construction and emergency use access road.

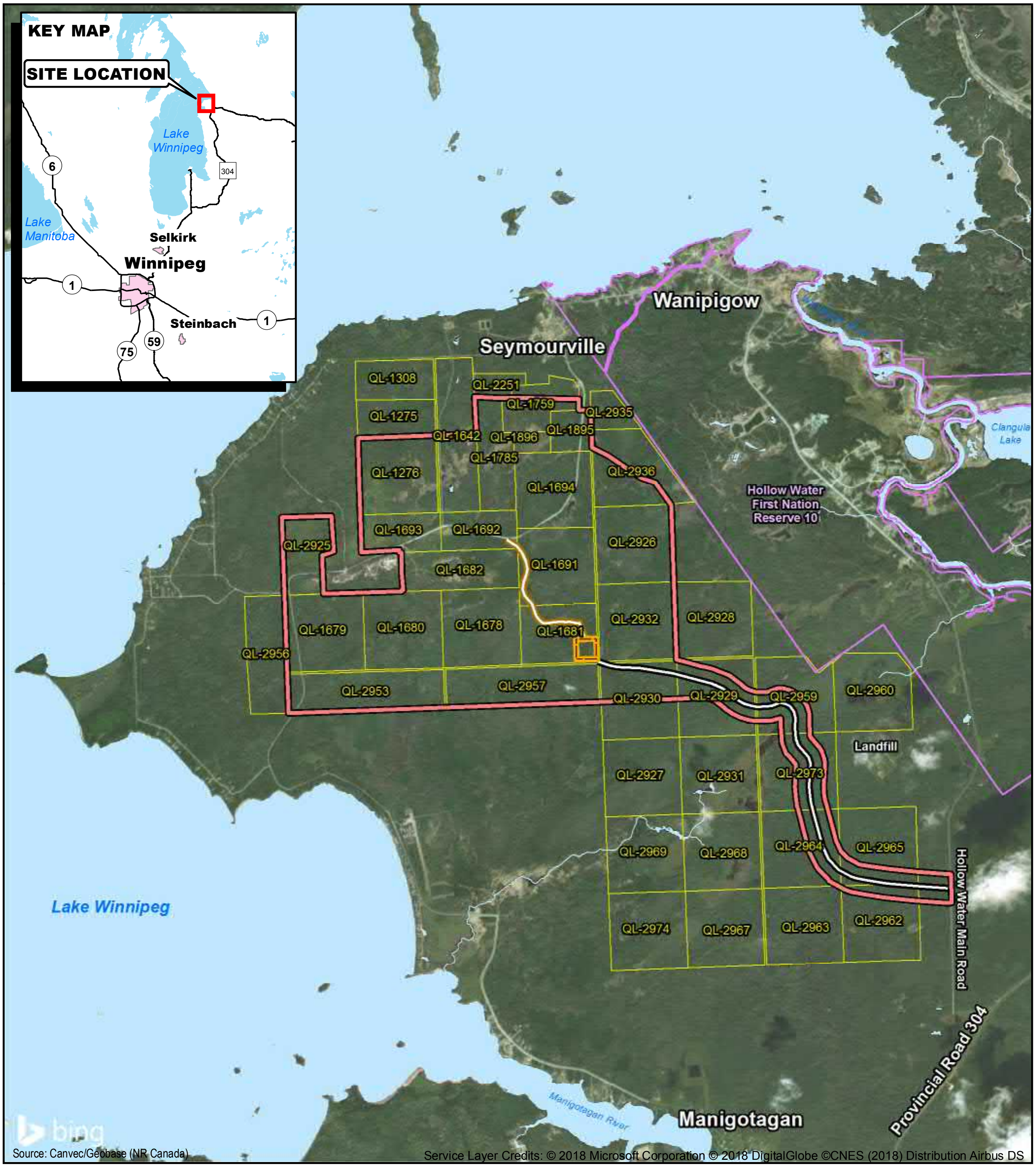
The general production sequence can be summarized as follows:

- Overburden and topsoil material will be stripped and stockpiled along the north side of the quarry area to form a 200 m long, 3 m high berm; these stockpiles will also act as a noise barrier during quarry operations.
- Once the overburden material has been cleared, quarrying of the sand will begin.
- Extracted sand will be transferred to the Wet Plant using enclosed conveyors.
- The 6 km long paved main access road will connect the Project Area to existing roadways.
- Haul trucks will use the 1.5 km long access road to transport “filter cakes” from the Wet Plant to the quarry undergoing reclamation.

Based on the planned equipment use and activities, the Project is not expected to be a source of significant vibration. Therefore a vibration assessment is not required. Correspondingly, the assessment focuses on the noise effects during the predictable worst case operation at the most affected point(s) of reception.

The primary sources of noise associated with the Project operations include delivery trucks, dust collectors, earth-moving equipment (e.g. dump trucks, dozers, grader, excavator, etc.), pumps, and aggregate processing equipment (e.g. stockpilers, scrubbers, hydro separators, dewatering cyclones/screens, conveyors, etc.).

Figure 1-1 provides a scaled area map showing the Project Area. Figure 1-2 illustrates the typical cell that will be developed during the quarrying phase of the Project. Figure 1-3 provides the Wet Plant site layout.



Project Components
- Plant Location
- Project Site Area
- Access Road for Project Construction and Emergency Use
- Main Access Road

Quarry Leases
- Quarry Lease Boundaries

First Nation
- Hollow Water First Nation Reserve 10

600 300 0 600 1,200 m

1:60,000

NAD 1983 UTM Zone 14N

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Project Management Initials: Designer: Checked: Approved:
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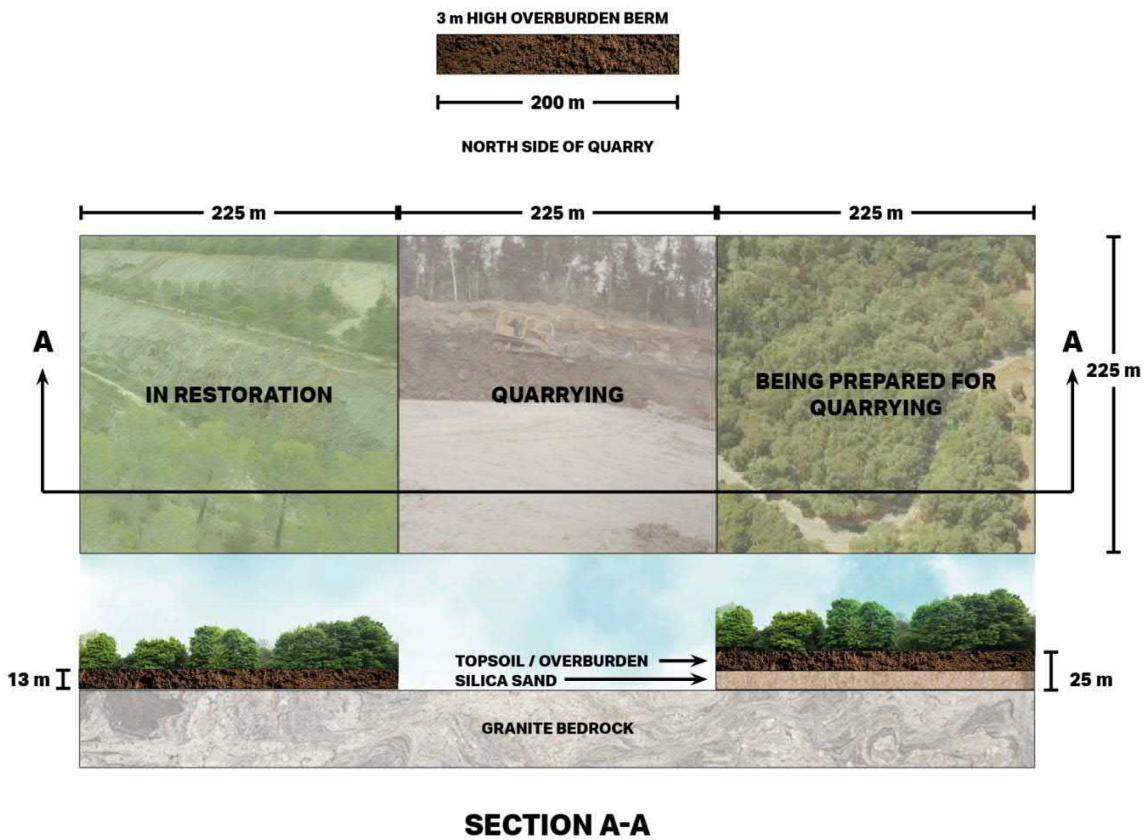
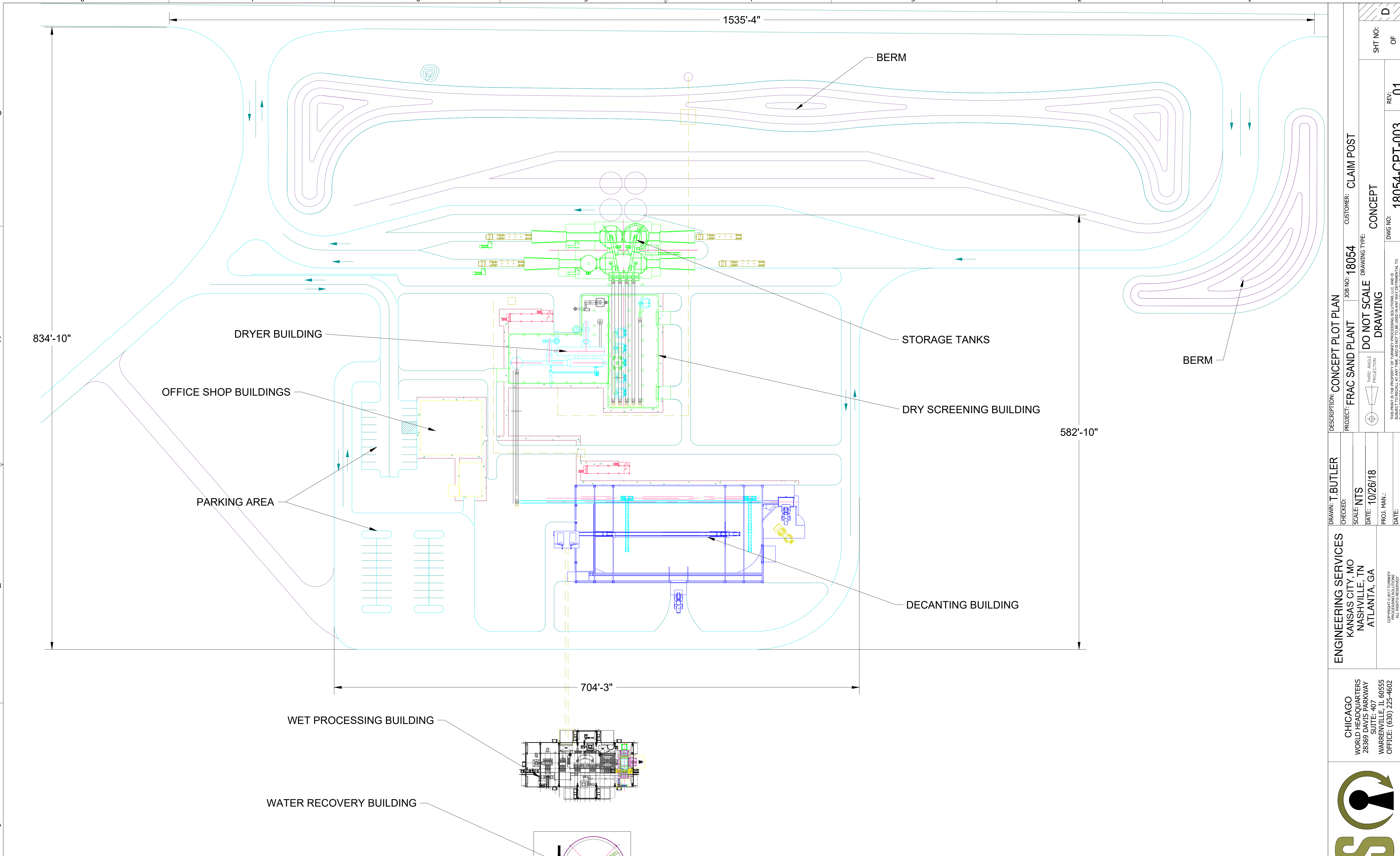
SEYMOURVILLE SAND EXTRACTION PROJECT
CLAIM POST QUARRY LEASES AND PROJECT SITE LOCATION
CLAIM POST RESOURCES INC.

AECOM

Figure: 1-1

Figure 1-2: Typical Project Quarry Cell




1535'-4"
834'-10"
582'-10"
704'-3"
BERM
BERM
STORAGE TANKS
DRYER BUILDING
OFFICE SHOP BUILDINGS
DRY SCREENING BUILDING
PARKING AREA
DECANTING BUILDING
WET PROCESSING BUILDING
WATER RECOVERY BUILDING
DESCRIPTION: CONCEPT PLOT PLAN
PROJECT: FRAC SAND PLANT
CUSTOMER: CLAIM POST
JOB NO: 18054
DRAWING TYPE: CONCEPT
DO NOT SCALE DRAWING
DWG NO: 18054-CPT-003
REV: 01
SHT NO: D
OF
DRAWN: T.BUTLER
CHECKED:
SCALE: NTS
DATE: 10/26/18
PROJ. MAN.:
DATE:
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ATLANTA, GA
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WARRENVILLE, IL 60555
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TPS
TURN-KEY PROCESSING SOLUTIONS

Figure 1-3

2. Regulatory and Policy Framework

The Province of Manitoba Sustainable Development, Environmental Approvals Branch (previously the Manitoba Environmental Assessment and Licensing Branch) has published the Guidelines for Sound Pollution (MEMD, 2000), which provides quantitative limits on noise emissions to the outdoor environment. These sound level limits have been adopted for this noise impact assessment.

The Guidelines for Sound Pollution (the Manitoba Guideline) provides target sound level limits for noise emissions to the outdoor environment at points of reception (PORs). The Manitoba Guideline defines a POR as "any point on the premises of a person where sound originating from other than those premises is received." These target sound level limits are separated by maximum desirable and maximum acceptable sound levels and vary depending on the type of areas including designated residential, commercial and industrial. Table 2-1 presents the Manitoba Guideline sound level objectives for residential areas.

Table 2-1: Manitoba Guideline Sound Level Objectives for Residential Areas – Continuous or Intermittent Sounds

	$L_{eq(24)}$ (dBA)	L_{dn} (dBA)	$L_{eq,(1HR)}$ (day) 07:00 – 22:00 (dBA)	$L_{eq,(1HR)}$ (night) 22:00 – 07:00 (dBA)
a) Maximum Desirable Sound Level	-	55	55	45
b) Maximum Acceptable Sound Level				
i) Summer or year round operations	-	60	60	50
ii) Predominant discrete tone(s) or appreciable impulsive/ impact character	-	55	55	45
iii) Winter operations only or temporary operations	-	65	65	55

The Maximum Desirable Sound Level limits provided above were adopted as the limits for this assessment.

3. Assessment Locations

The nearest points of reception (PORs) were identified based on the planned project activities and were included in the assessment. These locations are representative of the most exposed noise sensitive properties surrounding the Project area. These PORs are summarized in Table 3-1 and Figure 3-1.

Table 3-1: Point of Reception Summary Table

POR ID	Description	UTM Coordinates[1]	
		Easting	Northing
POR_north	Detached dwelling	686766	5673564
POR_northwest	Recreational vehicle (RV) / mobile dwelling	684268	5673129
POR_south	Detached dwelling	685305	5668730
POR_southwest	Detached dwelling	683472	5669156
POR_east	Mobile dwelling	689470	5672602
POR_west	Recreational vehicle (RV) / mobile dwelling	683405	5671395

Notes:
1. Reference UTM Zone 14.

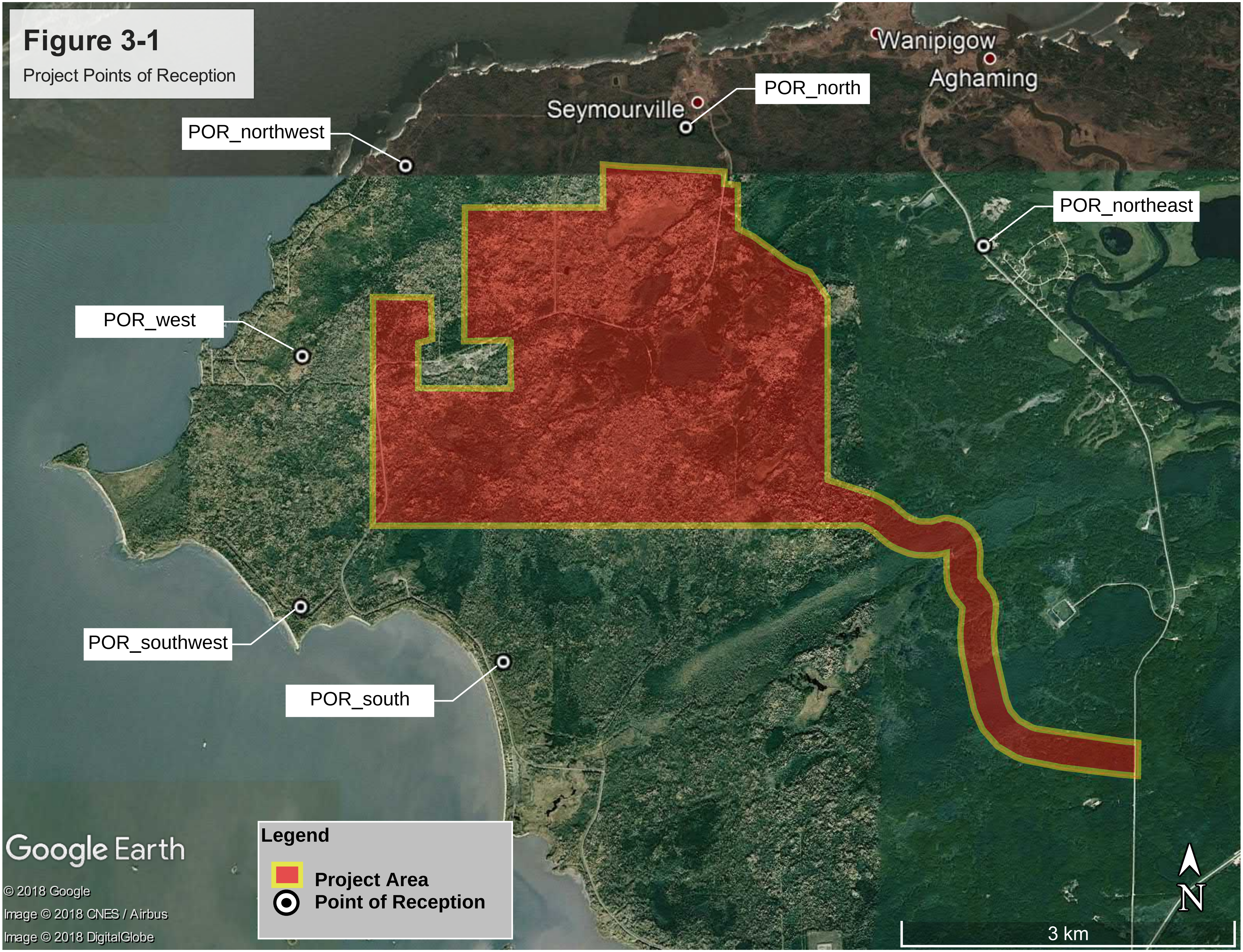
Figure 3-1
Project Points of Reception
Wanipigow
Aghaming
Seymourville
POR_north
POR_northwest
POR_northeast
POR_west
POR_southwest
POR_south
Google Earth
© 2018 Google
Image © 2018 CNES / Airbus
Image © 2018 DigitalGlobe
Legend
Project Area
Point of Reception
N
3 km

4. Modelling and Data Analysis

Sound propagation calculations were conducted in accordance with International Organisation for Standardisation (ISO) publication Standard 9613-2, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation (ISO, 1996).

Sound propagation predictions were performed using Cadna/A modelling software, authored by DataKustik, which implements the ISO prediction algorithms. Sources that emit noise from a stationary position were represented as a point source (e.g. dust collectors, idling trucks). Emission sources that emit noise through building facades were represented as vertical or horizontal area sources. Equipment and activities that emit noise along a defined path (e.g. moving trucks and heavy equipment) were included as line sources in the acoustic model. Table 4-1 summarizes the Cadna/A acoustic modelling parameters.

Table 4-1: Modelling Parameters

Item	Model Parameter	Model Setting
1	Temperature	10°C
2	Relative Humidity	70%
3	Propagation Standard	ISO 9613-2
4	Ground Conditions and Attenuation Factor	Ground Absorption (G): • 1.0 (e.g. porous ground covered by grass, trees or other vegetation) outside of Project Area • 0 (e.g. hard/acoustically reflective ground) within Project Area
5	Receptor Height	1.5 m
6	Topography	Ground contours obtained using Lidar information
7	Foliage Attenuation	None
8	Operating Conditions	All equipment operating during day and night-time periods

4.1 Overburden Stripping and Stockpiling

The equipment and activities anticipated during the overburden stripping and stockpiling phase were identified, and the non-negligible noise sources were included in the acoustic model predictions. The dimensions of the overburden stripping and stockpiling work area were assumed to be relatively small compared to the separation distance to the nearest POR. Accordingly, the noise sources associated with overburden stripping and stockpiling were combined and modelled as a single point source and incorporated the following assumptions:

- Activities will occur 24/7.
- One (1) track dozer operating no more than 75% of each hour;
- One (1) loader operating no more than 75% of each hour;
- Two (2) dump trucks, each operating no more than 25% of each hour;
- One (1) stockpiler operating no more than 50% of each hour;
- Sand will not be extracted from areas outside of the Project Area (particularly, the areas surrounding the new South Access road away from the main Project Area); and
- Sources modelled as a single combined point source operating within Project Area near the closest POR, at a source height of 2 m above grade.

4.2 Quarrying and Wet Plant Processing

The equipment and activities anticipated during the quarrying and processing phase were identified, and the non-negligible noise sources were included in the acoustic model predictions. The noise modelling of the quarrying and processing operations incorporated the following assumptions:

Quarry Sites

- Activities will occur 24/7;
- During the initial stages of quarrying, the north side of the quarry extraction cell will include a 200 m long, 3 m high overburden stockpile/berm;
- One (1) truck per hour will enter/exit the quarry undergoing reclamation to deliver “filter cakes”, and has been modelled as a line source at a source height of 2 m above grade. These trucks will be loaded outdoors and loading will take 5 minutes per truck; the trucks will remain idling for this 5 minute period.
- Sand will be transported to the Wet Plant via a covered conveyor, and have been modelled as a line source at a source height of 2 m above grade;
- Mobile equipment at the quarry will operate as follows:
    - One (1) track dozer operating no more than 75% of each hour;
    - Four (4) pickup-trucks, each operating no more than 50% of each hour;
    - One (1) loader operating no more than 75% of each hour; and
    - One (1) grader operating no more than 75% of each hour.
- Stationary equipment at the quarry will operate as follows:
    - One (1) hopper/feed breaker operating no more than 50% of each hour;
    - One (1) stockpiler operating no more than 50% of each hour;
    - One (1) sump pump operating no more than 50% of each hour; and
    - One (1) truck idling no more than 10% of each hour.
- Mobile sources may operate within an extraction area that is approximately 250 m x 250 m in size, and have been modelled using a corresponding area source at a source height of 2 m above grade; and
- Stationary sources modelled as a single combined point source operating at the centre of the 250 m x 250 m extraction area, at a source height of 2 m above grade.

Wet Plant

- Activities will occur 24/7.
- Noise due to the office HVAC equipment and maintenance building activities will be negligible compared to other noise sources at the Wet Plant.
- One (1) truck per hour will enter/exit the plant site to retrieve “filter cakes” and haul them back to the quarry, and has been modelled as a line source at a source height of 2 m above grade. These trucks will be loaded outdoors and loading will take 5 minutes per truck; trucks will remain idling for this 5 minute period.
- Approximately four (4) trucks per hour will enter and exit the site for transfer of final product (silica sand). These trucks will be loaded indoors and the noise emissions (to the outdoors) during loading will be negligible compared to other noise sources at the Wet Plant.
- Non-negligible outdoor stationary noise sources at the Wet Plant will include a silo dust collector, bucket elevator, and truck loading operations (filter cake loading).
- The following equipment will be located indoors within buildings constructed from 18 ga steel, or thicker:
    - Attrition scrubbers;
    - Pumps;
    - Hydro separators;
    - Dewatering hydro cyclones;
    - Dewatering screens;

- Hydrosizers; and
- Conveyors.

5. Noise Source Summary

Modelled noise source emissions were established using a combination of past measurements of similar equipment and industry-accepted reference sound level data for construction equipment. Table 5-1 summarizes the noise emission sources included in the acoustic modelling.

Table 5-1: Project Noise Sources

Equipment	Sound Power Level (dB) in Octave Band Centre Frequency (Hz)								Overall (dBA)	Quantity per hour	Percent Usage (%)	Notes
	63	125	250	500	1000	2000	4000	8000				
Overburden Stripping and Stockpiling – point sources												
Track dozer	104	113	102	102	109	107	100	94	112	1	75	1,2,6
Wheeled loader	109	109	98	100	96	94	93	85	102	1	75	1,2,6
Dump trucks idling	94	85	76	76	81	77	71	64	84	2	10	1,2
Dump trucks - dumping load	106	102	93	91	93	90	86	78	97	2	5	1,2
Dump trucks - full	110	112	102	100	101	98	94	87	105	2	25	1,2,6
Dump trucks - empty	111	104	104	104	104	109	94	85	112	2	25	1,2,6
Stockpiler	80	89	90	100	101	98	90	79	104	1	50	1,2
Combined noise emissions	**116**	**117**	**108**	**108**	**111**	**112**	**102**	**96**	**116**	-	-	-
Quarrying – mobile sources												
Full haul truck	111	97	89	88	92	87	86	79	96	1	5	1,2,6
Empty haul truck	112	100	96	98	91	86	84	79	98	1	5	1,2,6
Track dozers	104	113	102	102	109	107	100	94	112	1	75	1,2,6
Grader	110	109	105	101	106	100	96	87	108	1	25	1,2,6
4 x 4 pickup trucks	119	117	111	109	106	104	107	99	113	4	50	1,2,6
Wheeled loader	109	109	98	100	96	94	93	85	102	1	75	1,2,6
Combined noise emissions	**118**	**122**	**113**	**112**	**117**	**116**	**109**	**102**	**121**	-	-	-
Quarrying – point sources												
Stockpiler	80	89	90	100	101	98	90	79	104	1	50	1,2
Sump pump	106	108	102	100	101	100	94	88	106	1	50	1,2
Hopper/feed breaker	96	93	87	88	91	87	83	76	94	1	50	1,2
Trucks idling	94	85	76	76	81	77	71	64	84	3	10	1,2
Combined noise emissions	**123**	**122**	**118**	**115**	**114**	**112**	**107**	**101**	**119**	-	-	-
Wet Plant												
Dryer Building Walls and Roof	82	77	66	59	50	44	33	26	82	-	100	2,5
Decanting + Processing Building Walls and Roof	83	77	65	58	50	42	32	25	64	-	100	2,5
Filter cake haul trucks entering site	125	113	109	111	104	99	97	92	111	1	-	1,2,6

Equipment	Sound Power Level (dB) in Octave Band Centre Frequency (Hz)								Overall (dBA)	Quantity per hour	Percent Usage (%)	Notes
	63	125	250	500	1000	2000	4000	8000				
Filter cake haul trucks exiting site	124	110	102	101	105	100	99	92	109	1	-	3,2,6
Idling filter cake haul truck	101	92	83	83	88	84	78	71	91	1	10	1,2
Filter cake haul truck loading	120	112	111	105	104	102	99	90	110	1	10	1,2
Silo dust collector	116	119	115	111	106	102	99	98	113	1	100	1,4
Silo bucket elevator	79	86	89	98	97	90	84	74	100	1	100	1,4
Finished product haul trucks entering site	125	113	109	111	104	99	97	92	111	4	-	3,2,6
Finished product haul trucks exiting site	124	110	102	101	105	100	99	92	109	4	-	3,2,6
Quarry-to-Wet Plant sand conveyor	65	71	69	76	71	62	48	35	75	1	100	3,4,7,8

Notes:

1. Sound power level includes quantity and estimated utilization adjustments.
2. Based on measurement data published in British Standards BS 5228-1: 2009.
3. Single unit sound power level, unadjusted for quantity.
4. Based on past measurement data of similar equipment.
5. Sound power level per square metre.
6. Pass-by sound power level.
7. Sound power level per metre.
8. Based on measurement data published in Proceedings of ACOUSTICS 2004 (Conveyor Noise Specification and Control, Brown, S.C.).

6. Mitigation Measures

Based on the assumptions and equipment noise emissions described in Section 4 and Section 5, no noise mitigation measures are required during the overburden stripping and quarrying phases. The requirement for mitigation measures should be re-examined during detailed design to maintain the Project's compliance with the applicable sound level limits.

7. Results

Table 7-1 presents the acoustic model prediction results at the identified receptors, during the overburden and stripping phase of the Project. Table 7-2 presents the acoustic model prediction results at the identified receptors, during the quarrying and processing phase of the Project. The daytime and nighttime 1-hour, and day-night, equivalent sound levels were predicted and compared to the guideline sound level limits.

Table 7-1: Predicted Noise Levels – Overburden Stripping and Stockpiling

POR ID	Noise Contribution from Project Operation (dBA)			Sound Level Limit (dBA)			Meets Sound Level Limit Criteria? (Y/N)[1]		
	Daytime ($L_{eq,1HR}$)	Nighttime ($L_{eq,1HR}$)	Day-Night Equivalent (L_{dn})	Daytime ($L_{eq,1HR}$)	Nighttime ($L_{eq,1HR}$)	Day-Night Equivalent (L_{dn})	Daytime	Nighttime	Day-Night Equivalent
POR_north	44	44	51	55	45	55	Y	Y	Y
POR_northwest	44	44	50	55	45	55	Y	Y	Y
POR_south	32	32	38	55	45	55	Y	Y	Y
POR_southwest	35	35	41	55	45	55	Y	Y	Y
POR_east	29	29	35	55	45	55	Y	Y	Y
POR_west	40	40	47	55	45	55	Y	Y	Y

Notes:

1. Compliance with the sound level limit is determined by comparing the predicted day-night equivalent sound level with the sound level limit criteria.

Table 7-2: Predicted Noise Levels – Quarrying and Processing

POR ID	Noise Contribution from Project Operation (dBA)			Sound Level Limit (dBA)			Exceeds Sound Level Limit Criteria? (Y/N)[1]		
	Daytime ($L_{eq,1HR}$)	Nighttime ($L_{eq,1HR}$)	Day-Night Equivalent (L_{dn})	Daytime ($L_{eq,1HR}$)	Nighttime ($L_{eq,1HR}$)	Day-Night Equivalent (L_{dn})	Daytime	Nighttime	Day-Night Equivalent
POR_north	45	45	51	55	45	55	Y	Y	Y
POR_northwest	44	44	51	55	45	55	Y	Y	Y
POR_south	37	37	43	55	45	55	Y	Y	Y
POR_southwest	38	38	44	55	45	55	Y	Y	Y
POR_east	32	32	38	55	45	55	Y	Y	Y
POR_west	42	42	48	55	45	55	Y	Y	Y

Notes:

1. Compliance with the sound level limit is determined by comparing the predicted day-night equivalent sound level with the sound level limit criteria.

8. Construction Noise

Construction activities have the potential to generate noise impacts at receptor locations. Noise from construction activities can be controlled in numerous ways, including operational restrictions, source mitigation measures, as well as receptor-based mitigation measures. The following measures may be implemented throughout construction to reduce the noise impacts at sensitive receptors:

- Operate in accordance with local by-laws whenever possible;
- If construction needs to be undertaken outside of the normal daytime hours, local residents shall be informed beforehand of the type of construction planned and the expected duration;
- Keep equipment well-maintained and fitted with efficient muffling devices;
- Idling of equipment will be restricted to the minimum necessary to perform the specified work;
- Ensure vehicles employed continuously on site for extended periods of time (2 to 4 weeks) are fitted with visual warning systems or sound reducing back-up (reversing) alarms;
- Avoid unnecessary revving of engines and switch off equipment when not required (do not idle);
- Minimize drop heights of materials; and

The following additional mitigation measures may be considered and implemented to further reduce noise effects during construction, if required:

- Offset usage of active heavy equipment (schedule non-concurrent use);
- Reroute construction and truck traffic, when possible;
- Co-ordinate ‘noisy’ operations such that they will not occur simultaneously, where possible;
- Where possible, investigate and implement the use of alternative construction equipment or methods to reduce noise emissions from construction. Utilize alternative equipment that generates lower noise levels or optimize silencer/muffler/enclosure performance;
- Line chutes and dumpers to reduce impact noise, where needed;

- Investigate enclosures, noise shrouds or noise curtains around noisy equipment, where needed; and
- Investigate temporary noise barriers/solid construction hoarding on site boundary to screen affected locations, where needed.

9. Summary

Provided that the Project activities and equipment operate within the assumptions described in this assessment, the noise impacts during the overburden stripping and quarrying phases are predicted to meet the Manitoba Guidelines for Sound Pollution limits.

The results of the noise impact assessment incorporate the most recent Project information available for Project operations, as of December 2018. Should changes to any of the Project assumptions occur (e.g. new equipment, facility layout, equipment usage, etc.), the affected Project components and activities should be reassessed to verify that the guidance sound level limits are not exceeded; and develop a revised suite of noise mitigation measures, if necessary.

10. References

ISO (International Organization for Standardization). 1996. Standard 9613-2, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation. Geneva, Switzerland.

ISO (International Organization for Standardization). 2003. Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures. Geneva, Switzerland.

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BSI (British Standards). 2008. Standard 5228-1: 2009, Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise. Great Britain.

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