



Ambient Light Baseline and Predictive Assessment

Springpole Gold Project
First Mining Gold Corp.

ONS2104

Prepared by:
WSP Canada Inc.

October 2024



Ambient Light Baseline and Predictive Assessment Springpole Gold Project

Red Lake District, Northwest Ontario
Project #ONS2104

Prepared for:

First Mining Gold Corp.
Suite 2070, 1188 West Georgia Street
Vancouver, British Columbia, V6E 4A2

Prepared by:

WSP Canada Inc.
6925 Century Avenue, Suite 600
Mississauga, Ontario, L5N 7K2
Canada
T: (905) 567-4444

Copyright

The contents and layout of this report are subject to copyright owned by WSP Canada Inc.

EXECUTIVE SUMMARY

First Mining Gold Corp. proposes to develop, operate and eventually decommission / close an open pit gold and silver mine and ore process plant with supporting facilities known as the Springpole Gold Project (Project). The Project is located in a remote area of northwestern Ontario, approximately 110 kilometres (km) northeast of the Municipality of Red Lake and 145 km north of the Municipality of Sioux Lookout (Figure 1-1).

An environmental assessment pursuant to the *Canadian Environmental Assessment Act, 2012* (SC 2012, c. 19, s. 52) and the *Ontario Environmental Assessment Act* (RSO 1990, c. E.18) is required to be completed for the Project. This report is one of a series of technical support documents prepared by WSP Canada Inc. on behalf of First Mining Gold Corp. to describe the predicted environmental effects of the Project.

This ambient light baseline and predictive assessment demonstrates that the baseline sky glow and light trespass in the study area are consistent with an E1 lighting zone (intrinsically dark, isolated rural area).

The surrounding terrain and forest will block most, if not all, of the direct views of the Project from the points of reception (PORs). Light trespass is not predicted to exceed the maximum recommended for an E1 lighting zone at any of the assessed receptors.

Mitigations incorporated into the lighting strategy, such as downlighting, will reduce light trespass and glare effects on the PORs and will minimize the contribution to sky glow.

TABLE OF CONTENTS

	PAGE
1.0 INTRODUCTION.....	1-1
1.1 Purpose and Objective of the Report	1-1
1.2 Project Overview.....	1-1
2.0 TYPES OF POTENTIAL LIGHT EFFECTS	2-1
2.1 Sky Glow	2-1
2.2 Light Trespass.....	2-1
2.3 Glare	2-1
3.0 POINTS OF RECEPTION	3-1
4.0 AMBIENT LIGHT REFERENCE LEVELS	4-1
4.1 Sky Glow	4-1
4.2 Light Trespass.....	4-1
5.0 METHOD.....	5-1
5.1 Baseline Assessment	5-1
5.1.1 Sky Glow.....	5-1
5.1.2 Light Trespass	5-1
5.1.3 Glare.....	5-2
5.2 Predictive Assessment.....	5-2
5.2.1 Light Attenuation Assessment	5-2
5.2.2 Viewshed Assessment.....	5-2
6.0 RESULTS AND DISCUSSION.....	6-1
6.1 Baseline Assessment	6-1
6.1.1 Sky Glow.....	6-1
6.1.2 Light Trespass	6-1
6.2 Predictive Assessment.....	6-1
6.2.1 Identification of Project Light Sources.....	6-1
6.2.2 Results.....	6-2
7.0 MITIGATION	7-1
7.1 General Considerations	7-1
7.2 Mobile Sources	7-1
7.3 Stationary Sources.....	7-1
8.0 MONITORING	8-1
9.0 SUMMARY OF FINDINGS AND CONCLUSION	9-1
10.0 REFERENCES.....	10-1

LIST OF TABLES

Table 3-1:	Point of Reception Locations.....	3-2
Table 4-1:	International Commission on Illumination Environmental Lighting Zones.....	4-2
Table 4-2:	Sky Glow Reference Levels	4-3
Table 4-3:	International Commission on Illumination Recommendations for Maximum Light Trespass at Points of Reception.....	4-5
Table 6-1:	Baseline Sky Glow and Light Trespass On Site	6-4
Table 6-2:	Baseline Sky Glow at Local Communities Based on Visibly Infrared Imaging Radiometer Suite Data	6-4
Table 6-3:	Light Sources (Stationary and Mobile).....	6-5

LIST OF FIGURES

Figure 1-1:	Project Location	1-3
Figure 3-1:	Points of Reception and Viewshed Analysis	3-3

LIST OF ATTACHMENTS

- Attachment A Predictive Light Assessment Calculations
- Attachment B Composite Sky Glow Data Plots by Location

LIST OF ABBREVIATIONS

°	degree
%	percent
cd	Candela, a measure of light intensity
cd/m ²	candela per square metre
CDF	Co-disposal facility
CIE	Commission Internationale d'Eclairage (International Commission on Illumination), an international body for standards in illumination.
lm	Lumen
lux	Lumen per square metre
K	kelvin
km	kilometre
mag/arcsec ²	magnitudes per square arcsecond
m	metre
POR	Point of reception
Project	Springpole Gold Project
SI	International System of Units
tpd	tonnes per day
TLRU	Traditional Land and Resource Use
UTM	Universal Transverse Mercator
VIIRS	Visibly Infrared Imaging Radiometer Suite

GLOSSARY

Airglow	The upper atmosphere's luminescence is triggered by the absorption of daytime ultraviolet radiation by oxygen molecules, which upon nightfall may undergo further reactions resulting in luminescence, a uniform glowing effect observable globally (EB).
Astronomical twilight	The time of night when sky illumination is so faint that most casual observers would regard the sky as fully dark, with the sun more than 18° below the horizon (United States National Weather Service n.d.).
Aurora borealis	When charged solar particles bombard the atmosphere, transfer energy to the atmospheric gases and force the emission of light that results in glowing light observable in a band near the geomagnetic poles (EB).
Candela (cd)	International System of Units (SI) unit of luminous intensity, approximately equal to the intensity of light emitted by one candle in all directions.
Celestial	Positioned in outer space.
Colour temperature	A numerical value characterizing the colour or light, in units of kelvin (K). Colour temperatures greater than 4,000 K have a cooler blue hue, such as hospital lighting. Lower colour temperatures, such as 2,700 K, have a warmer hue such as candlelight or incandescent lighting.
Cutoff	Blocking of certain directions of light from a source to reduce light spill.
Environmental lighting zones	Classifications of ambient lighting defined by the International Commission on Illumination (CIE).
Glare	The uncomfortable sensation of seeing a light source which is much brighter than its surroundings, measured by its luminance in candela per square metre (cd/m ²).
Illuminance	The density of light that falls upon a surface, measured in units of lumen per square metre (lux), lumen per square foot (lm/ft ²), or footcandles. A light meter measures the density of light that falls upon the surface of its sensor.
Intrinsically dark	A descriptor for landscapes, designated as "E0" by the CIE, that are entirely, or largely, uninterrupted by artificial light (e.g., United Nations Educational, Scientific and Cultural Organization Starlight Reserves, Dark Sky Parks).
Light spill	Light that falls outside of the area intended to be lit.
Light trespass	Unwanted light spill that is perceived by PORs outside of the area intended to be lit.
Line-of-sight	An imaginary line that connects the area of interest to an observer (e.g., POR). Lines-of-sight (or lack thereof) illustrate if there is an obstructed view with examples of obstructions including topography or vegetation between the area of interest and the observer.
Lit centre	The centre of a lighting cluster (e.g., community) where surface radiance is highest.
Luminous flux	The flow of light through space, measured in units of lumen (lm).

Lumen	SI unit of luminous flux emitted by a source.
Luminance	The measure of light that is travelling through, emitted from, or reflected from a given area. Quantified as the intensity of light on a surface in units of cd/m^2 . Luminance is the specific way in which light comes off of a surface.
Luminescence	The emission of light as a result of a chemical reaction.
Lux	SI unit used to measure illuminance.
Nomogram	A graphical representation of several scales lined up such that one can determine the value on one scale from that on another.
Point of reception (POR)	A location with human activity, which includes Indigenous traditional land uses. Locations susceptible to the adverse effects of light pollution. Typically, these are places with nighttime occupancy.
Radiance	Emissions, or flux, of light.
Sky Glow	Brightness of the night sky, most noticeably above urban and industrial areas, in units of magnitudes per square arcsecond ($\text{mag}/\text{arcsec}^2$).
Valued components	Environmental biophysical, socioeconomic or human features that may be impacted by a project.
Viewshed	The geographical area that is visible from a location.
Visibly Infrared Imaging Radiometer Suite (VIIRS)	Satellite instrumentation that provides near real-time radiance imagery of the earth's surface.
Zenith	The point directly above a particular location.
Zenith angle	Part of a sky glow measurement's location; the angle measured from the zenith (e.g., zenith = 0° , horizon = 90°).

1.0 INTRODUCTION

First Mining Gold Corp. proposes to develop, operate and eventually decommission / close an open pit gold and silver mine and ore process plant with supporting facilities known as the Springpole Gold Project (Project). The Project is located in a remote area of northwestern Ontario, approximately 110 kilometres (km) northeast of the Municipality of Red Lake and 145 km north of the Municipality of Sioux Lookout (Figure 1-1).

An environmental assessment pursuant to the *Canadian Environmental Assessment Act*, 2012 (SC 2012, c. 19, s. 52) and the *Ontario Environmental Assessment Act* (RSO 1990, c. E. 18) is required to be completed for the Project. This report is one of a series of technical support documents prepared by WSP Canada Inc. on behalf of First Mining Gold Corp. to describe the predicted environmental effects of the Project.

1.1 Purpose and Objective of the Report

The Impact Assessment Agency of Canada issued *Guidelines for the Preparation of an Environmental Impact Statement* for the Project (Environmental Impact Statement Guidelines; CEA Agency 2018), which specified that the Environmental Impact Statement must present baseline information in sufficient detail to enable the identification of how the Project could affect the valued components and an analysis of those effects. As part of the atmospheric environment per the Environmental Impact Statement Guidelines, the following, related to ambient light, was specified for assessment:

“existing ambient night-time light levels at the project site and at any other areas where project activities could have an effect on light levels. The EIS will describe night-time illumination levels during different weather conditions and seasons.”

This document has been prepared to assess the potential effects of the construction, operations, and decommissioning and closure phases of the Project on light pollution. To evaluate these effects of the Project, this report has been prepared to:

- Establish baseline values for the ambient light conditions (sky glow and light trespass), as supported by a previous baseline report and other publicly available data, prior to the Project construction phase; and
- Provide a predictive assessment of potential light effects from the Project.

An assessment of baseline ambient light conditions and a predictive assessment of light trespass at points of reception (PORs) was conducted for the Project. The objectives of the assessment were to:

- (i) Identify and describe potential for environmental light pollution effects of the Project;
- (ii) Determine how ambient light pollution levels compare to existing scales of sky quality used by the astronomy community;
- (iii) Qualitatively determine the baseline levels of light trespass at PORs;
- (iv) Indicate whether measures are required to mitigate any adverse environmental light effects; and
- (iv) Complete a predictive assessment to determine the change from the current dark (i.e., E1) environment (Section **Error! Reference source not found.**) due to the Project development.

1.2 Project Overview

The Project is proposed to be mined as an open pit. To allow the development and safe operation of the open pit mine, dikes will be established to facilitate safe and controlled dewatering of the open pit basin. Ore from the open pit will be processed in an onsite process plant at approximately 30,000 tonnes per day (tpd). Tailings resulting from the processing of ore will be stored in a co-disposal facility (CDF).

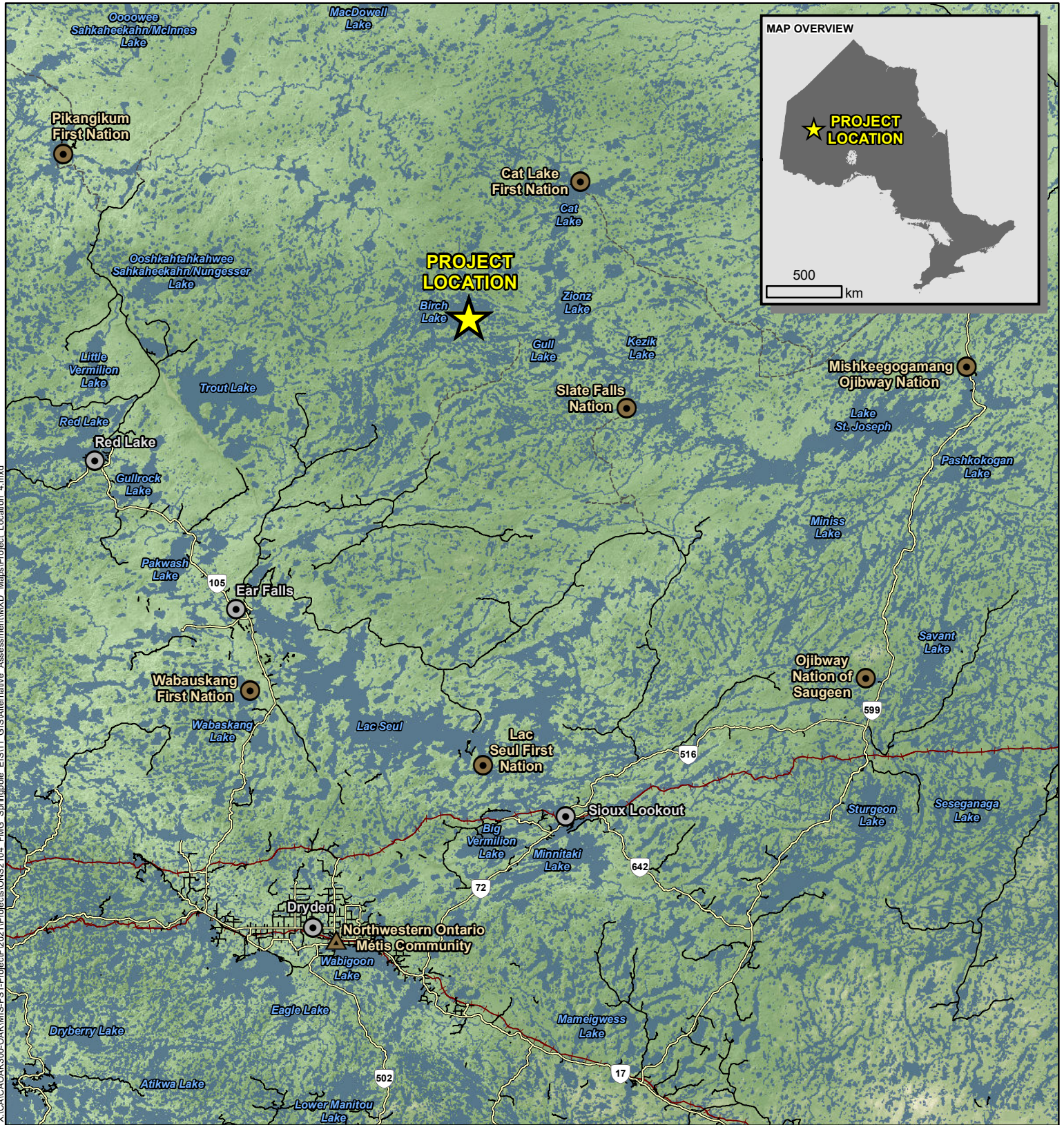
The main components of the Project include:

- Open pit;
- Dikes (west dike and east dike);
- CDF for mine rock and tailings (north cell and south cell);
- Surficial soils stockpile;
- Ore stockpiles;
- Process plant or process plant complex;
- Buildings and supporting infrastructure;
- Water management and treatment facilities;
- Fisher habitat development area;
- Accommodations complex;
- Aggregate operation(s);
- Transmission line; and
- Mine access road and co-located airstrip.

The expected duration of Project phases:

- Construction phase (Years -3 to -1: three years in length);
- Operations phase (Years 1 to 10: ten years in length);
- Decommissioning and closure phase (Years 11 to 15: five years in length); and
- Post-closure phase (Years 16+).

After decommissioning and closure the site will follow a period of environmental monitoring.



X:\CAL\OAK\300-OAK\MIS-FS1-Project\2021\Projects\ONS2104_FMG_Springpole_EIS\11_GIS\Alternative_Assessment\MXD_Maps\Project_Location_4.mxd

LEGEND

- Project Location
- Town
- First Nation Reserve
- Northwestern Ontario Métis Community
- Highway
- Secondary Road
- Resource / Winter Road
- Railway

NOTES:
- Topographic information extracted from LIO, MNRF.



SPRINGPOLE GOLD PROJECT

Project Location

Datum: NAD83
Projection: UTM Zone 18N

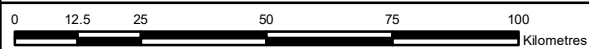


PROJECT N°: ONS2104

FIGURE: 1-1

SCALE: 1:1,500,000

DATE: September 2024



2.0 TYPES OF POTENTIAL LIGHT EFFECTS

The potential effects of introduced artificial lighting are frequently described using three concepts: sky glow, light trespass and glare.

2.1 Sky Glow

Sky glow includes all stray light escaping above the horizontal plane into the atmosphere. The potential effect is readily seen approaching urban areas from the dark countryside at night as a brightening of the natural sky background level. It arises from light being projected above the horizontal plane where it is refracted, or scattered, by air, water molecules and atmospheric aerosols. Sky glow can impede visibility and enjoyment of the stars, hamper astronomical observations and contribute to light trespass. Sky glow may be measured by a sky quality meter in units of magnitudes per square arcsecond (mag/arcsec²).

Nighttime light conditions are also affected by the moon, planets, stars and other celestial bodies, as well as by natural phenomena, such as airglow and the aurora borealis.

Artificial light from satellites, especially those in high density low Earth orbit (e.g., satellite internet constellations) may also contribute to sky glow (Falchi et al. 2016).

2.2 Light Trespass

Light trespass is unwanted light spill that is perceived by PORs outside of the area intended to be lit. An illuminance meter is used to measure light trespass, in units of lumens per square metre (lux).

Discussions of illuminance and light spill must also consider the relative brightness when compared with the existing conditions.

Potential for light trespass effects depend upon the characteristics of the artificial lighting such as height, colour and luminance. The setback or separation distance of the PORs, and other attenuating factors such as local topography, mature trees and other barriers (e.g., buildings, walls and berms), reduce the luminance of light trespass at a receptor.

2.3 Glare

Glare is the often uncomfortable sensation caused by excessive brightness and is often accompanied by a perceived “starring” of the light source. An example of glare is the light from oncoming vehicle headlights on a dark roadway. Where many light sources are sited close together, light clutter may develop where the density and variety of light sources interfere with night vision.

3.0 POINTS OF RECEPTION

For the purposes of this assessment, POR is defined as a location with human activity, which includes consideration of traditional land and resource use (TLRU), that is outside of the Project development area, but within the Viewshed Analysis Study Area (See Section 5.2.2 for further details). The PORs consist of Indigenous points of interest identified through TLRU studies and engagement, and recreational, cabin, lodge and accommodations complex sites identified through a review of the Ministry of Natural Resources and Forestry Land Information Ontario geographic datasets (Government of Ontario 2024) and Engagement and Consultation on the Project. In some cases where a land use covered large areas or for confidentiality reasons, conservative representative points were selected. Traditional land uses in the water were not included as PORs in the assessment of nighttime light levels, as these are typical transient areas with no known overnight use on water. The PORs within the Viewshed Analysis Study Area are depicted in Figure 3-1 **Error! Reference source not found.** and listed in Table 3-1.

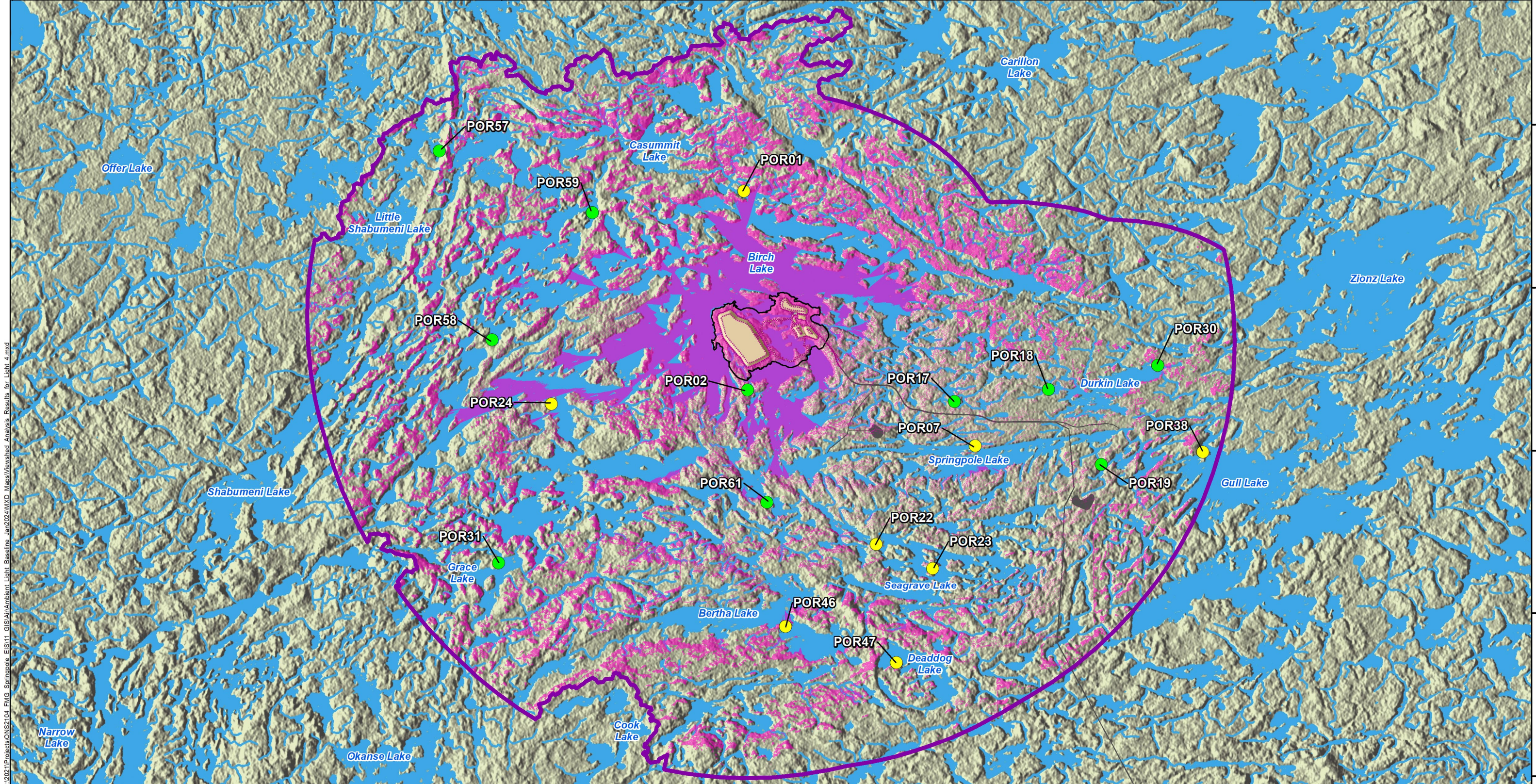
The nearest Indigenous communities to the mine site are Cat Lake First Nation (40 km northeast of the Project) and Slate Falls Nation (45 km southeast of the Project) (Figure 1-1). The nearest municipality is the Municipality of Red Lake, located approximately 110 km southwest of the Project. Due to the distance of these communities, they are not considered to be PORs in the light assessment.

Table 3-1: Point of Reception Locations

Point of Reception	Description	UTM Coordinates (m)	
		Northing	Easting
POR01	Cabin / Lodge / Accommodations Complex	5700737	547907
POR02	TLRU	5690987	548092
POR07	Cabin / Lodge / Accommodations Complex	5688223	559261
POR17	TLRU	5690430	558246
POR18	TLRU	5691012	562850
POR19	TLRU	5687308	565443
POR22	Cabin / Lodge / Accommodations Complex	5683394	554399
POR23	Cabin / Lodge / Accommodations Complex	5682203	557166
POR24	Cabin / Lodge / Accommodations Complex	5690301	538464
POR30	TLRU	5692198	568218
POR31	TLRU	5682483	535868
POR38	Cabin / Lodge / Accommodations Complex	5687920	570436
POR46	Cabin / Lodge / Accommodations Complex	5679342	549951
POR47	Cabin / Lodge / Accommodations Complex	5677581	555391
POR57	TLRU	5702707	532952
POR58	TLRU	5693446	535545
POR59	TLRU	5699690	540466
POR61	TLRU	5685456	549039

Note:
 UTM Coordinates for Zone 15U, NAD-83 datum.

512000 520000 528000 536000 544000 552000 560000 568000 576000 584000



LEGEND

- Springpole Project Development Area (mine site area)
- Project Features outside of Mine Site Area
- Outward Looking Modelled Observer Points (top of mine site features)
- Modelled Mine Site Features (ultimate heights for stockpiles and dams)
- Viewshed Analysis Study Area

Potential Points of Reception (labelled with site ID)

- Cabin/Lodge/Camp
- TLRU

Viewshed Analysis Interpretation Key:

- Solid pink areas indicate ground or water surface visual
- Speckled pink areas indicate forest canopy visual, not ground level visual

NOTES:
 - Topographic information extracted from LIO, MNRF.

Datum: NAD83
 Projection: UTM Zone 15N

FIRST MINING GOLD

SPRINGPOLE GOLD PROJECT

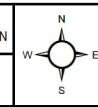
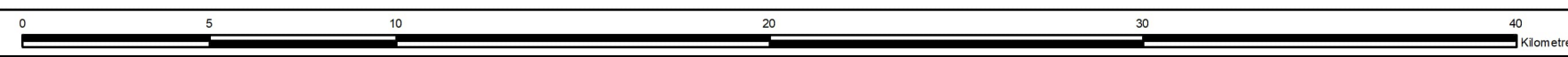
Light Receptors and Viewshed Analysis

PROJECT N°: ONS2104 **FIGURE: 3-1**

SCALE: 1:180,000 DATE: August 2024

P:\2021\Projects\ONS2104_FMG_Springpole_EIS\11_GIS\Air\Ambient_Light_Baseline_Jan2024\MXD_Maps\Viewshed_Analysis_Results_for_Light_4.mxd

570400
569600
568800
568000
567200



4.0 AMBIENT LIGHT REFERENCE LEVELS

In the absence of regulatory criteria for ambient light assessments, published guidelines are presented to support discussions of baseline light conditions and potential effects of introducing artificial lighting.

The CIE identifies five environmental lighting zone classifications (Table 4-1), hereafter referred to as lighting zones; these CIE lighting zones provide a useful framework for describing lighting environments.

4.1 Sky Glow

The unit of measure for sky glow is the mag/arcsec², a measure of the brightness of the sky as perceived by the human eye. A difference of 1 magnitude is defined to be a factor of 100^{1/5} in received photons. Therefore, a sky brightness 5.0 mag/arcsec² fainter corresponds to a reduction in photon arrival rate of a factor of 100 (Unihedron 2021). Values for sky glow after dark range from approximately 22 mag/arcsec² in a rural undeveloped environment, where stars are visually abundant, to approximately 17 mag/arcsec² in an urban environment, where only the brightest stars can be seen.

Illuminance (lux) is used as a secondary measure of sky glow.

Reference levels of sky glow and measured ambient light levels to corresponding scales and appearance of the sky are presented in Table 4-2. The surface brightness and illuminance presented for each lighting zone are intended for illustrative purposes and are not definitive, and not intended to allow for conversion between units and scales. This summary draws from two classification systems used to characterize ambient light conditions.

- The Bortle Scale, introduced in 2001, created nine qualitative classes of sky darkness linked to detailed descriptions of what celestial details were visible with the naked eye or with certain equipment. The ranges of sky quality meter measurements corresponding to each of the nine classes were based on a nomogram (Spoelstra 2002).
- The CIE's "Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations" (2nd Edition) was published in 2017. The maximum values correspond to five lighting zones, E0 to E4. In the 2017 version of the guide, the E1 lighting zone was split into E1 and E0 with E0 lighting zones for areas with especially dark skies such as designated Dark Sky Preserves (e.g., Killarney Provincial Park).

4.2 Light Trespass

The CIE established limits for light trespass which are used in this assessment as reference levels for discussion of potential light effects on receptors. The values represent CIE's recommendations for maximum light trespass at dwellings, or potential dwellings, from artificial lighting installations.

There are limiting values for pre- and post-curfew for each of the five lighting zones that provide an allowance based on the existing levels of lighting in the area. The pre-curfew reference levels are higher values that apply before a curfew hour set by the controlling authority. Pre-curfew limiting values are less restrictive. Post-curfew values generally apply to the hours of 23:00 to 6:00 and are more restrictive such that the spill light at these times will not be obtrusive to the PORs. The CIE recommended limits for pre- and post-curfew are presented in Table 4-3.

Table 4-1: International Commission on Illumination Environmental Lighting Zones

Lighting Zone	Lighting Environment	Examples
E0	Intrinsically dark	UNESCO Starlight Reserves, IDA Dark Sky Parks and major optical observatories
E1	Dark	Relatively uninhabited rural areas
E2	Low district brightness	Sparsely inhabited rural areas
E3	Medium district brightness	Well inhabited rural and urban settlements
E4	High district brightness	Town and city centres, commercial areas

Source: CIE 2017.

Note:

IDA = International Dark-Sky Association; UNESCO = United Nations Educational, Scientific and Cultural Organization.

Table 4-2: Sky Glow Reference Levels

Bortle Class	CIE Lighting Zone	Sky Brightness (mag/arcsec ²)	Illuminance in the Vertical Plane (lux)	Sky Description	Milky Way	Nighttime Conditions
1	E0	>21.90	0	Excellent, truly dark-skies, UNESCO Starlight Reserves	Milky Way shows great detail and light from the Scorpio / Sagittarius region and casts obvious shadows on the ground.	By convention, this is assumed to be the average brightness of a moonless night sky that is completely free of artificial light pollution, i.e., natural background. The Milky Way and abundant stars would be readily visible. The brightness of Jupiter and Venus is annoying to night vision. Ground objects are barely lit, and trees and hills are dark.
2	E1	21.50 to 21.90	0-1	Typical, truly dark skies	Summer Milky Way shows great detail and has veined appearance.	Ground is mostly dark, but objects projecting into the sky are discernible.
3	E2	21.30 to 21.49	1-5	Rural sky	Milky Way still appears complex; dark voids, bright patches and meandering outline are all visible.	Some light pollution evident along the horizon. Ground objects are vaguely apparent. Natural starlit night. Clear rural night sky with no moon.
4		20.15 to 21.29		Rural / suburban transition	Only well above the horizon does the Milky Way reveal any structure. Fine details are lost.	Light pollution domes are obvious in several directions. Sky is noticeably brighter than the terrain. This is typical for a rural area with a medium-sized city not far away.

Table 4-2: Sky Glow Reference Levels

Bortle Class	CIE Lighting Zone	Sky Brightness (mag/arcsec ²)	Illuminance in the Vertical Plane (lux)	Sky Description	Milky Way	Nighttime Conditions
5	E3	19.10 to 20.14	2-10	Suburban sky	Milky Way appears washed out overhead and is lost completely near the horizon.	Light pollution domes are obvious to casual observers. Ground objects are partly lit. This is typical for the outer suburbs of a major city.
6		18.50 to 19.09		Bright, suburban sky	Milky Way only apparent overhead and appears broken as parts are lost to sky glow.	Sky from horizon to 35° glows with grayish color. Ground is well lit. Typical for a suburb with widely spaced single-family homes; also characteristic of twilight where the sun has set but the brightest stars are visible.
7	E4	18.01 to 18.49		Suburban / urban transition	Milky Way is totally invisible or nearly so.	Entire sky background appears washed out, with a grayish or yellow color. Bright suburb or dark urban neighborhood. Also representative of the sky glow directly overhead at a rural site when the Moon is full. The Milky Way is invisible, or nearly so.
8		< 18.00	5-25	City sky	Not visible at all	Entire sky background has an orange glow and it is bright enough to read at night.
9				Inner city sky	Not visible at all	Entire sky background has a bright glow, even at the zenith. Typical near the centre of a major city such as Toronto or Montreal.

Notes:

Table adapted from multiple sources: City of Toronto 2017; IDA 2016; Bortle 2001; CIE 2017; Hänel, A. et al. 2018; Spoelstra 2002; Flanders 2008.

IDA = International Dark Sky Association; UNESCO = United Nations Educational, Scientific and Cultural Organization.

Table 4-3: International Commission on Illumination Recommendations for Maximum Light Trespass at Points of Reception

Light Technical Parameter	Application Conditions	Environmental Lighting Zones				
		E0	E1	E2	E3	E4
Illuminance in the vertical plane	Pre-curfew	N/A	2 lux	5 lux	10 lux	25 lux
	Post-curfew	N/A	< 0.1 lux ⁽¹⁾	1 lux	2 lux	5 lux

Notes:

(1) If the installation is for public (road) lighting then this value may be up to 1 lux.

Limits published in CIE 2017.

N/A = not applicable.

5.0 METHOD

5.1 Baseline Assessment

The baseline, or pre-development, light assessment establishes existing sky glow and light trespass conditions. For the remote Project, and in the absence of anthropogenic light sources, this was accomplished using measurements taken at the Project, publicly available information sources and the light condition classifications published by the International Commission on Illumination (CIE 2017).

Baseline conditions were established through multiple site visits where measurements for light trespass and sky glow were taken with the purpose of: i) classifying the existing condition nighttime light levels; and ii) determining whether this classification conforms to what would be expected given the surroundings. The methods used to establish existing conditions for sky glow, light trespass and glare follow.

5.1.1 Sky Glow

Sky glow measurements proximate to the Project were taken using a Unihedron SQM-LU-DL-V "sky quality meter". The sky quality meter measured the amount of light striking the sensor and converted this into units of mag/arcsec² measuring sky brightness over a prescribed arc. The datalogging feature allowed the sky quality meter to combine vector data from a built-in altitude and azimuth sensor with sky brightness to generate a contour plot of sky brightness (as well as logging the individual readings that make up the plot).

Onsite sky quality measurements were taken throughout the year to reflect seasonal and weather variability, though in general, measurement dates and times are selected to limit variability (e.g., clear skies at the darkest part of night before moonrise, and after the end of astronomical twilight). Nighttime measurements were taken at the exploration camp but as far from camp infrastructure (approximately 400 metres [m]) as safely possible to minimize direct influence from camp lighting.

To supplement the onsite measurements, satellite data from the National Centers for Environmental Information and the National Aeronautics and Space Administration were collected. Visibly Infrared Imaging Radiometer Suites (VIIRS) aboard two joint satellites provide near real-time measurements of radiance from the earth's surface.

The 2015 VIIRS dataset was used to approximate zenith sky brightness (i.e., sky glow) (Stare 2021), which included assumptions of celestial background brightness (Falchi et al. 2016); while there are more recent VIIRS datasets, researchers have only approximated zenith sky brightness with the 2015 dataset. As year-over-year radiance does not typically change considerably (as indicated by a year-over-year review of the imagery), the 2015 sky brightness dataset was used as an indication of sky glow with the 2020 radiance data qualifying this assumption.

5.1.2 Light Trespass

Light trespass measurements proximate to the Project were taken using an Extech EA33 datalogging light meter.

Nighttime measurements were taken at the exploration camp but as far from camp infrastructure (approximately 400 m) as safely possible to minimize direct influence from camp lighting. The sensor was pointed towards the proposed Project for light trespass and towards the zenith to take a secondary measurement of sky glow.

Onsite skyglow measurements were taken throughout the year to reflect seasonal and weather variability, though in general, measurement dates and times are selected to limit variability (e.g., clear skies at the darkest part of night before moonrise).

Light trespass measurements were compared against the CIE recommendations for illuminance (Table 4-3).

5.1.3 Glare

Due to the separation distances between the PORs and the light sources, there is limited potential for glare. The assessment of light trespass will also serve to prevent glare effects; therefore, no specific consideration is given to glare in this assessment.

5.2 Predictive Assessment

A predictive light assessment, considering attenuation by distance and viewshed, was completed to inform the development of the light strategy by identifying whether there are PORs located where there is the potential for trespass.

The assessment considered light sources that would reasonably be required during the construction, operations, and decommissioning and closure phases to allow for safe work to continue following sunset. Light emissions during the construction and decommissioning and closure phases are anticipated to vary according to equipment requirements and are expected to be lower than those during the operations phase. Lighting for mine access road and transmission line construction is not expected to occur at night near PORs and so did not require quantitative assessment.

Both the quantitative light attenuation and viewshed methods are described in the following sections.

5.2.1 Light Attenuation Assessment

To provide a quantitative estimate of illuminance at the PORs, the inverse-square law was employed. The inverse-square law states that the intensity of a physical quantity dilutes with distance as a geometric necessity, and is described by the formula:

$$B_{\text{density of physical quantity at distance "d"}} = \frac{\phi_{\text{flux of the physical quantity}}}{d^2_{\text{distance between source and receptor}}} \quad (\text{Equation 5-1})$$

In the context of light, ϕ is the output (lm) of the light source and B is the illuminance (lux) at the receptor.

For each light source at the Project, the total wattage of lighting was summed based on estimations or manufacturer's specifications, where available. Each source's luminous flux was calculated from wattages to lumens using the luminous efficacy published by the United States Department of Energy (2017) for comparable lighting types. Luminous efficacy considers the sensitivity of the human eye to the wavelength of light produced.

The estimation method conservatively assumes that there are no atmospheric attenuating factors (e.g., aerosols) between sources and receptors.

5.2.2 Viewshed Assessment

For remote areas, light spill is determined by the line-of-sight of Project luminaires in the area, by reviewing the topography of the surrounding terrain, taking the height of land as the limit of light impact, and by considering other attenuating factors (e.g., vegetation). For the Project, line-of-sight was determined with a viewshed analysis that was established using light detection and ranging data. Viewshed modelling was completed using Environmental Systems Research Institute's ArcGIS Desktop Advanced Spatial Analysis Extension and a digital elevation model (WSP 2024) and assumes no diffraction.

6.0 RESULTS AND DISCUSSION

6.1 Baseline Assessment

The baseline light assessment defines existing conditions of sky glow and light trespass prior to the start of construction for the Project, the results of which are summarized in Table 6-1. The existing conditions include limited infrastructure at the Project site with no substantial buildings or lighting.

6.1.1 Sky Glow

There are limited anthropogenic sources near the Project that would cause appreciable sky glow. Based on the sky brightness model of the VIIRS surface radiance data, the communities of Cat Lake First Nation (40 km to the northeast), Slate Falls Nation (45 km to the southeast) and the Municipality of Red Lake (110 km to the southwest), are not bright enough, or near enough, to the Project to cause notable sky glow near the Project.

As a reference and based on VIIRS data, **Error! Reference source not found.** provides the approximate area from the lit centre of the identified communities where sky glow effects may be brighter than an E0 lighting zone (e.g., the surface radiance measured at Red Lake suggests that the darkest lighting zone is not achieved until one is >15 km from the lit centre of the community). Sky brightness models based on the VIIRS surface radiance data do not predict sky glow at the Project brighter than an E0 lighting zone; however, non-zero surface radiance is measured at the Project.

The average brightness was measured at two locations across four different sampling events (the nights of January 25, 2021; August 7, 2021; April 26, 2022; and August 17, 2022) within 400 m of the existing exploration camp. The average brightness across all sampling events was determined to be 21.68 mag/arcsec² in the 0- to 30-° zenith angle; fine particulate matter from nearby wildfires may have had an effect on the measurements for the August 2021 event. The sampling event in August 2022 was omitted from the statistical calculations because of visible aurora borealis and early moonrise. Attachment B, Figures B1 and B2 depict the composite skyglow plots for each measurement location.

Based on the VIIRS data, onsite measurements and visual descriptions of the nighttime conditions, the measured sky brightness is expected to be towards the higher (i.e., darker) end of the E1 lighting zone (21.50 to 21.90 mag/arcsec²).

6.1.2 Light Trespass

No appreciable lighting within the Project development area prior to the construction phase is anticipated. Seasonal measurements taken within 400 m of the existing exploration camp on the sampling dates noted in Section 6.1.1, did not detect illuminance (<0.01 lux) on the vertical plane from the direction of the existing exploration camp; along with the sky glow results, this suggests that the Viewshed Analysis Study Area existing conditions are consistent with an E1 lighting zone (intrinsically dark, isolated rural areas).

6.2 Predictive Assessment

6.2.1 Identification of Project Light Sources

The construction phase (building of mine, access road and transmission line) of the Project and aggregate areas are expected to only occur during day shifts, and therefore, no assessment of nighttime light levels was undertaken.

For the operations phase, the assessment considered the lighting requirements of the mine site. The major site features that require artificial lighting for nighttime activity are summarized in Table 6-3, noting both day and night shifts are projected for the mine site. During nighttime operations, the mine access road is

not expected to have lighting infrastructure due to transient use by predominantly non-industrial vehicles and the transmission line is not expected to have any light sources. Therefore, a nighttime light level assessment was not undertaken.

An inventory of lighting was developed for the purposes of describing expected nighttime illumination levels for the Project; the inventory is based on the anticipated mining fleet and considers lighting requirements at other comparable mining projects in northern Ontario. As a quantitative assessment, sources of light were grouped, the total lighting output of each group estimated (Attachment A, Table A1), and the distance between source groups and PORs determined (Attachment A, Table A2).

6.2.2 Results

A viewshed analysis undertaken for the Project (WSP 2024) was used to identify which PORs (Figure 3-1) are predicted to have full attenuation due to obstructed sight-lines. Based on the viewshed analysis, POR2 and POR17 were the only PORs predicted to have a line-of-sight to the light sources within the Project development area.

For those PORs with line-of-sight, the unattenuated "gross" illuminance was determined, with the following as an example calculation.

Sample Calculation of Illuminance at the POR02 from Lighting at the CDF:

The following equipment, and corresponding lumens for each type of light sources, was considered in the evaluation of illuminance from the CDF:

- Four (4) Magnum MLT3060M mobile floodlights (281,424 lm/mobile unit) with 25 percent (%) of lumens escaping in the horizontal plane;
- Two (2) Caterpillar D10 track dozers (8 x 65-watt high intensity discharge lights x 104 lm per watt = 54,080 lm/dozer) with 50% of vehicles pointed at the POR;
- One (1) Caterpillar D777 truck (8 x 65-watt high intensity discharge lights x 104 lm per watt = 54,080 lm/truck) with 50% of vehicles pointed at the POR;
- Seven (7) Caterpillar 793 haul trucks (8 x 65-watt high intensity discharge lights x 104 lm per watt = 54,080 lm/truck) with 50% of vehicles pointed at the POR; and
- Three (3) light pickup trucks (2 x 55-watt high intensity discharge light x 104 lm per watt = 11,440 lm/truck) with 50% of vehicles pointed at the POR.

$$\begin{aligned}
 \text{Total Lighting Output of CDF Group} &= [(4 \times 281,424 \times 25\%) + (2 \times 54,080 \times 50\%) + (1 \times 54,080 \times 50\%) + (7 \times 54,080 \times 50\%) + (3 \times 11,440 \times 50\%)] \\
 &= 569,984 \text{ lm}
 \end{aligned}$$

It was conservatively assumed that 50% of all vehicle light sources are pointing directly toward the respective PORs, and that any topographical variation between source and receptor would make a negligible difference in the calculation of gross illuminance according to Equation 6-1.

$$\begin{aligned}
 \text{Gross Illuminance}_{\text{at receptor}} (\text{lux}) &= \frac{\text{Total Light Output (lumens)}}{(d_{\text{distance between source and receptor}}(\text{metres}))^2} \\
 &= \frac{569,984 (\text{lumens})}{(2,799 (\text{metres}))^2} \\
 &= 0.07 (\text{lux})
 \end{aligned}$$

This calculation is repeated for each combination of source groupings and receptor, taking into consideration whether each respective POR has line-of-sight to a particular Project component. At each light receptor, the total illuminance, in lux, was determined by summing the contributions from each light grouping. The total illuminance represents a conservative approximation of the unattenuated illuminance for each receptor (Attachment A, Table A3).

Based on this assessment, all PORs had sufficient setback, such that the total illuminance is less than the CIE's maximum vertical illuminance for a receptor in the E1 lighting zone without attenuation or mitigation. As such, light trespass is not predicted to exceed the maximum recommended for an E1 lighting zone at any of the assessed receptors.

Table 6-1: Baseline Sky Glow and Light Trespass On Site

Location	Skyglow (mag/arcsec ²)		Light Trespass (lux)	
	East	West	East	West
Brightest reading	20.89	21.22	<0.01	<0.01
Darkest reading	22.29	23.05	<0.01	<0.01
Average	21.74	21.62	<0.01	<0.01

Notes:

Skyglow readings are from 0-30° zenith angle.
August 2022 event excluded from calculations.

Table 6-2: Baseline Sky Glow at Local Communities Based on Visibly Infrared Imaging Radiometer Suite Data

Location	Estimated Population	Area Surrounding Lit Centre of Community that Corresponds to an Environmental Lighting Zone				
		E0 >21.90 mag/arcsec ²	E1 21.50 to 21.90 mag/arcsec ²	E2 20.15 to 21.49 mag/arcsec ²	E3 18.50 to 20.14 mag/arcsec ²	E4 <18.50 mag/arcsec ²
Project	<100	> 0 km	N/A	N/A	N/A	N/A
Reference Communities						
Cat Lake First Nation	<1,000	> 2.5 km	< 2.5 km	N/A	N/A	N/A
Slate Falls Nation	<1,000	> 2.5 km	< 2.5 km	N/A	N/A	N/A
Municipality of Red Lake	>4,000	> 15 km	7 to 15 km	< 7 km	N/A	N/A

Source: Stare 2021.

Notes:

The mag/arcsec² range for each lighting zone are approximate.
VIIRS data primer (Falchi et al. 2016).
N/A = 2015 VIIRS data do not indicate the community gets this bright.

Table 6-3: Light Sources (Stationary and Mobile)

Site Feature	Source Type
Open pit and onsite haul roads	Mobile floodlight
	Large mining excavator
	Motor grader
	Track dozer
	Blast hole drill
	Loader
	Water truck / sand truck
	Haul truck
	Light vehicle
Process plant and ancillary buildings	Building / pole mount light
	Mobile floodlight
	Track dozer
	Articulated truck
	Ambulance
	Loader
	Haul truck
	Water truck / sand truck
	Light vehicle
	Vacuum truck
Mine access road	Pole mount light
	Light vehicle and bus shuttle
Ore stockpiles	Mobile floodlight
	Haul truck
	Track dozer
	Water truck / sand truck
	Light vehicle
Co-disposal facility	Mobile floodlight
	Track dozer
	Haul truck
	Water truck / sand truck
	Light vehicle

7.0 MITIGATION

While no effects are predicted that require mitigating, good lighting practice to provide site safety and minimize light trespass and sky glow will be implemented for the Project. Best practices are described in Sections 7.1 to 7.3 for all phases of the Project.

7.1 General Considerations

General light mitigation measures for the construction, operations, and decommissioning and closure phases of the Project include:

- Designing the lighting strategy and using adaptive lighting technology to reduce unneeded light;
- Maintaining light sources below the tree line, where feasible, to prevent a direct line-of-sight from a light receptor, thereby maximizing the benefits of natural attenuation; and
- Avoiding high colour temperature lighting (i.e., blue light at 4,000 kelvins [K]) where possible, with preferential use of warmer colour lighting such as yellow and orange.

7.2 Mobile Sources

Mitigation of light effects from mobile sources, such as haul trucks, for the construction, operation and decommissioning and closure phases of the Project, includes the use of natural treed buffers to reduce line-of-sight from a light receptor to a roadway where feasible.

7.3 Stationary Sources

Stationary light sources are to be controlled during all phases of the Project, as detailed in the lighting strategy, and incorporate the following good practice, where it is safe to do so. Mitigation measures include:

- Using higher mounting heights paired with narrower beam lights;
- Reducing the downward aiming angle of the lighting fixture from the vertical plane;
- Locating and orienting the placement of illuminated area / activity where it will have the least effect on PORs, taking advantage of physical features for screening, where there is flexibility to do so;
- Confirming lighting fixtures are correctly located and aimed;
- Selecting light fixtures with appropriate beam classification (spread and projection distance) for the application;
- Avoiding "over" lighting; and
- Fitting light fixture with louvres, baffles, or shields to control light spill:
 - Using smart lighting systems to reduce light use where unneeded;
 - Visual assessing lighting fixtures for evidence of light spill;
 - Using "Full Cutoff" and "Dark Sky" compliant lighting fixtures; and
 - Using warm light colours preferentially over cold lighting colours.

8.0 MONITORING

As light effects are not predicted and best practice measures will be implemented, there is no need for ongoing quantitative monitoring of ambient light at PORs. However, as part of routine monitoring, light sources will be visually assessed for maintenance needs and evidence of light spill.

9.0 SUMMARY OF FINDINGS AND CONCLUSION

Key findings of the Ambient Light Baseline and Predictive Assessment for all phases of the Project follow.

- Baseline sky glow at the PORs is consistent with an intrinsically dark isolated rural E1 lighting zone (21.50 to 21.90 mag/arcsec²).
- The surrounding terrain and forest will block most, if not all, of the direct views of the Project's light sources from the PORs.
- Glare will be addressed through good lighting practices noted in Section 7.0 and regular maintenance inspections.
- Light trespass is not predicted to exceed the maximum recommended for an E1 lighting zone at any of the assessed receptors.
- Although no effects are predicted, mitigations incorporated will further reduce light trespass and glare effects and on sky glow overall and to further minimize nighttime light effects.

10.0 REFERENCES

- Bortle. 2001. Introducing the Bortle Dark-Sky Scale. *Sky & Telescope*, February 2001 Issue.
- Canadian Environmental Assessment Agency (CEA Agency). 2018. Guidelines for the Preparation of an Environmental Impact Statement Pursuant to the *Canadian Environment Assessment Act*, 2012 Springpole Gold Project. First Mining Gold Corp. June 19, 2018. 50 pp.
- City of Toronto. 2017. Best Practices for Effective Lighting. Accessed June 2, 2021. <https://www.toronto.ca/wp-content/uploads/2018/03/8ff6-city-planning-bird-effective-lighting.pdf>.
- Encyclopedia Britannica (EB). Airglow | science. [online]. Accessed June 2, 2021. <https://www.britannica.com/science/airglow>.
- Falchi, F., Cinzano, P., Kyba, C., Elvidge, C., Baugh, K., Portnov, B., Rybnikova, N., Furgoni, R. 2016. The New World Atlas of Artificial Night Sky Brightness. *Journal of Science Advances*, 2(6). June 10, 2016. Accessed August 5, 2021. <https://www.science.org/doi/10.1126/sciadv.1600377>.
- Flanders, T. 2008. *Sky & Telescope*: Rate Your Skyglow. Accessed June 2, 2021. <http://www.skyandtelescope.com/astronomy-resources/rate-your-skyglow/>.
- Government of Ontario. 2024. Ontario GeoHub. Accessed July 25, 2024. <https://geohub.lio.gov.on.ca/>.
- Hänel, A., Posch, T., Ribas, S.J., Aubé, M., Duriscoe, D., Jechow, A., Kollath, Z., Lolkema, D.E., Moore, C., Schmidt, N., Spoelstra, H., Wuchterl, G., Kyba, C.C.M. 2018. Measuring Night Sky Brightness: Methods and Challenges. *Journal of Quantitative Spectroscopy and Radiative Transfer* Volume 205, January 2018:278-290.
- International Commission on Illumination (CIE). 2017. Technical Report: Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installation, 2nd Edition. CIE 150. 2017. ISBN 978-3-902842-48-0.
- International Dark-Sky Association (IDA). 2016. How to Conduct a Sky Quality Survey. Accessed June 2, 2021. <http://darksky.org/idsp/sky-quality-survey>.
- Spoelstra, H. 2002. Night Sky Brightness Comparison Nomogram. Accessed June 9, 2021. <http://www.darkskiesawareness.org/img/sky-brightness-nomogram.gif>.
- Stare. 2021. Light Pollution Map. Accessed July 28, 2021. <https://www.lightpollutionmap.info>.
- Unihedron. 2021. SQM-LU-DL-V User's Manual.
- United States Department of Energy. 2017. Solid-State Lighting 2017 Suggested Research Topics Supplement: Technology and Market Context. US DOE Office of Energy Efficiency & Renewable Energy. 164 pp.
- United States National Weather Service. n.d. Twilight Types. Accessed January 18, 2024. <https://www.weather.gov/lmk/twilight-types#:~:text=Astronomical%20Twilight%3A,urban%20or%20suburban%20light%20pollution>.
- WSP Canada Inc. (WSP). 2024. Visual Aesthetics Baseline Study and Assessment. Springpole Gold Project.

Attachment A

Predictive Light Assessment Calculations

Table A1: Lighting Output by Source Group

Table A2: Horizontal Receptor Distances from Light Groups

Table A3: Unattenuated Illuminance Contribution by Light Group at Receptors

Table A4: Luminous Efficacy

Table A1: Lighting Output by Source Group
Springpole Gold Project - First Mining Gold

Source Type	Proxy Brand/Model	No. of Lights/Source	Assumed Lights Power (watts/light)	Estimated Luminous Efficacy Equivalent	Total Source Type Lighting Power (watts)	Total Source Lighting Output (lumens)	No. of each source per LIGHT GROUP						
							CDF	PIT	PLANT	LGSTK	M/HGSTK	SSTK	ACCESS
Mobile Floodlights	Magnum MLT3060M	—	—	MLT3060M Floodlight Spec.	—	70,356	4	4	5	2	2	1	—
Diesel Drive Shovels	Hitachi EX8000	12	75	LED A19 Lamp (Dimmable, 2700 K)	900	45,000	—	3	—	—	—	—	—
Track Dozer	CAT D10T	8	65	HID (Low-Watt) System	520	27,040	2	2	1	1	1	1	—
Water Truck / Sand Truck	CAT 777	8	65	HID (Low-Watt) System	520	27,040	1	1	1	1	1	1	—
Motor Grader	CAT 16M	8	65	HID (Low-Watt) System	520	54,080	—	1	—	—	—	—	—
Blast Hole Drill	CAT 6420	8	60	LED A19 Lamp (Dimmable, 2700 K)	480	24,000	—	3	—	—	—	—	—
Loader	Komatsu L-1850	12	75	LED A19 Lamp (Dimmable, 2700 K)	900	45,000	—	2	—	—	—	—	—
Haul Truck	CAT 793	8	65	HID (Low-Watt) System	520	27,040	7	7	2	2	2	2	—
Polemount Lights	—	1	100	naturaLED SAL (100W)	100	575	—	—	40	—	—	—	50
Blue Bird School Bus Shuttle	—	2	65	HID (Low-Watt) System	130	6,760	—	—	—	—	—	—	2
Light Pickup Truck	e.g., F150	2	55	HID (Low-Watt) System	110	5,720	3	15	18	1	1	—	2
Water Truck	International 5600i	2	55	HID (Low-Watt) System	110	11,440	—	—	1	—	—	—	—
Vacuum Truck/Dump Truck	Kenworth T370	2	55	HID (Low-Watt) System	110	11,440	—	—	1	—	—	—	—
Ambulance	Medium Conventional	2	55	HID (Low-Watt) System	110	11,440	—	—	1	—	—	—	—
TOTAL (kilolumens)							569	989	620	255	255	179	54

Note: Where specifications were unavailable, lighting was assumed to be based an estimated equivalent number of 65W HID lights. Worst-case assumed to be headlights facing the receptors.

Wattage: Light Energy Input

Lumens: Light output

Lux: Light output per square meter scaled based on the sensitivity of the human eye to various wavelengths

Assumptions:

Process small plant mobile equipment (e.g. manlift, forklifts etc.) are insignificant compared the other equipment

For conservatism, it is assumed that all equipment have been upgraded to low-wattage HID lights

The horizontal spread of the light cone of "Polemount Lights" is assumed, based on proxy spec. sheets, to be limited to 50 metres with a full cut-off fixture. It was assumed that there was a % of lumens escaping in the horizontal plane of:

5%

The horizontal spread of the light cone of "Mobile Floodlight", assumed 30ft mast and 20 degree tilt, based on proxy spec. sheet, to be limited to 250 metres. It was assumed that there was a % of lumens escaping in the horizontal plane of:

25%

The percent of vehicles pointing directly at each point of reception is:

50%

Group Acronyms

CDF - Co-disposal Facility

PIT - Main Open Pit

PLANT - Process Plant Area

LGSTK - Low-Grade Ore Stockpile

M/HG STK - Mid- High-Grade Ore Stockpile

SSTK - Surficial Stockpile

ACCESS - Near-site Access Road



Table A2: Horizontal Receptor Distances from Light Groups
Springpole Gold Project - First Mining Gold

Points of Reception	UTMs, Zone 15U (metres)		Northing	LIGHT GROUP						
				CDF	PIT	PLANT	LGSTK	M/HGSTK	SSTK	ACCESS
	Northing	Easting	Easting	5,693,753	5,693,503	5,694,536	5,694,972	5,693,887	5,693,845	5,693,257
				547,669	549,567	550,702	550,293	550,626	551,131	551,907
				Distance (m)						
POR01	5,700,737	547,907		6,988	7,422	6,802	6,239	7,370	7,609	8,482
POR02	5,690,987	548,092		2,799	2,917	4,406	4,553	3,851	4,172	4,439
POR07	5,688,223	559,261		12,843	11,039	10,635	11,224	10,327	9,885	8,912
POR17	5,690,430	558,246		11,087	9,207	8,589	9,159	8,368	7,892	6,941
POR18	5,691,012	562,850		15,427	13,515	12,649	13,167	12,558	12,057	11,171
POR19	5,687,308	565,443		18,906	17,042	16,418	16,978	16,212	15,734	14,786
POR22	5,683,394	554,399		12,353	11,204	11,739	12,285	11,151	10,950	10,173
POR23	5,682,203	557,166		14,953	13,617	13,924	14,501	13,390	13,113	12,241
POR24	5,690,301	538,464		9,831	11,555	12,950	12,718	12,680	13,153	13,764
POR30	5,692,198	568,218		20,608	18,697	17,671	18,138	17,673	17,166	16,345
POR31	5,682,483	535,868		16,318	17,581	19,113	19,080	18,651	19,028	19,322
POR38	5,687,920	570,436		23,503	21,603	20,814	21,342	20,689	20,194	19,283
POR46	5,679,342	549,951		14,591	14,166	15,213	15,634	14,561	14,551	14,052
POR47	5,677,581	555,391		17,921	16,954	17,592	18,123	16,988	16,813	16,059
POR57	5,702,707	532,952		17,227	18,994	19,540	18,988	19,752	20,224	21,180
POR58	5,693,446	535,545		12,128	14,022	15,196	14,827	15,087	15,591	16,363
POR59	5,699,690	540,466		9,334	11,005	11,460	10,901	11,700	12,162	13,126
POR61	5,685,456	549,039		8,410	8,065	9,231	9,599	8,579	8,646	8,312

Acronyms

POR - Point of Reception

CDF - Co-disposal Facility

PIT - Main Open Pit

ORESP - Ore Stockpiles

PLANT - Process Plant Area

ACCESS - Near-site Access Road



Table A3: Unattenuated Illuminance Contribution by Light Group at Receptors
Springpole Gold Project - First Mining Gold

Points of Reception	ILLUMINANCE (lux)							LINE-OF-SIGHT ¹							TOTAL	LIGHTING ZONE		
	CDF	PIT	PLANT	LGSTK	M/HGSTK	SSTK	ACCESS	CDF	PIT	PLANT	LGSTK	M/HGSTK	SSTK	ACCESS		Background	With Project	Mitigation Needed? ²
POR01	0.01	0.02	0.01	0.01	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00	E1	E1	No
POR02	0.07	0.12	0.03	0.01	0.02	0.01	0.00	Yes	No	No	No	No	No	No	0.07		E1	No
POR07	0.00	0.01	0.01	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00		E1	No
POR17	0.00	0.01	0.01	0.00	0.00	0.00	0.00	Yes	No	Yes	Yes	Yes	Yes	Yes	0.02		E1	No
POR18	0.00	0.01	0.00	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00		E1	No
POR19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00		E1	No
POR22	0.00	0.01	0.00	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00		E1	No
POR23	0.00	0.01	0.00	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00		E1	No
POR24	0.01	0.01	0.00	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00		E1	No
POR30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00		E1	No
POR31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00		E1	No
POR38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00		E1	No
POR46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00		E1	No
POR47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00		E1	No
POR57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00		E1	No
POR58	0.00	0.01	0.00	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00		E1	No
POR59	0.01	0.01	0.00	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00	E1	No	
POR61	0.01	0.02	0.01	0.00	0.00	0.00	0.00	No	No	No	No	No	No	No	0.00	E1	No	

Group Acronyms

- POR - Point of Reception
- CDF - Co-disposal Facility
- PIT - Main Open Pit
- ORESP - Ore Stockpiles
- PLANT - Process Plant Area
- ACCESS - Access Road

Notes

- ¹ Based on April 2024 viewshed analysis
- ² Mitigation may be needed where a CIE Lighting Zone greater than E1 is predicted along with line-of-sight.

Attachment B

Composite Sky Glow Data Plots by Location

Figure B1: Light 1 Sky Plot (excluding August 2022 event)

Figure B2: Light 2 Sky Plot (excluding August 2022 event)

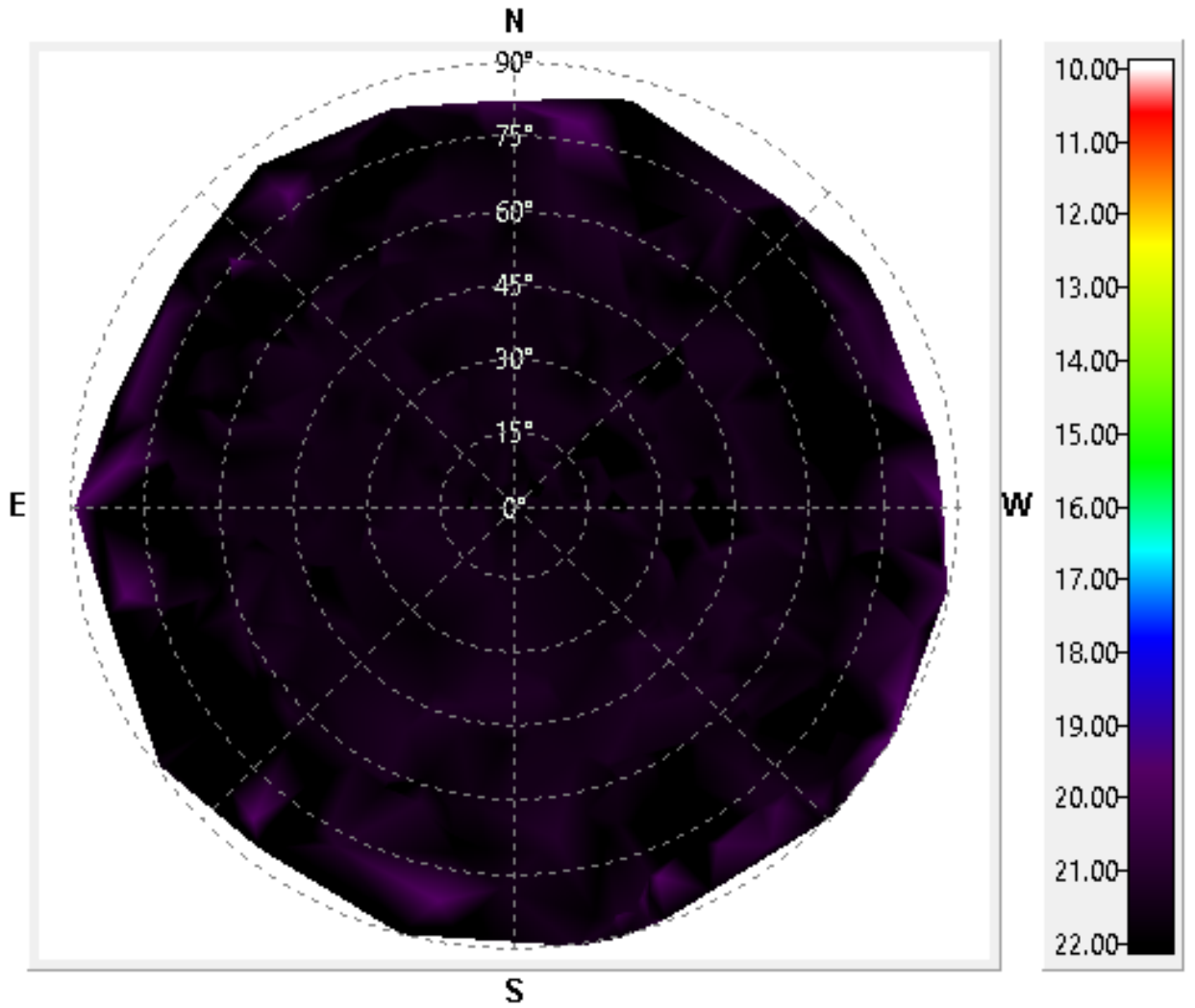


Figure B1: Light 1 Sky Plot (mag/arcsec²)

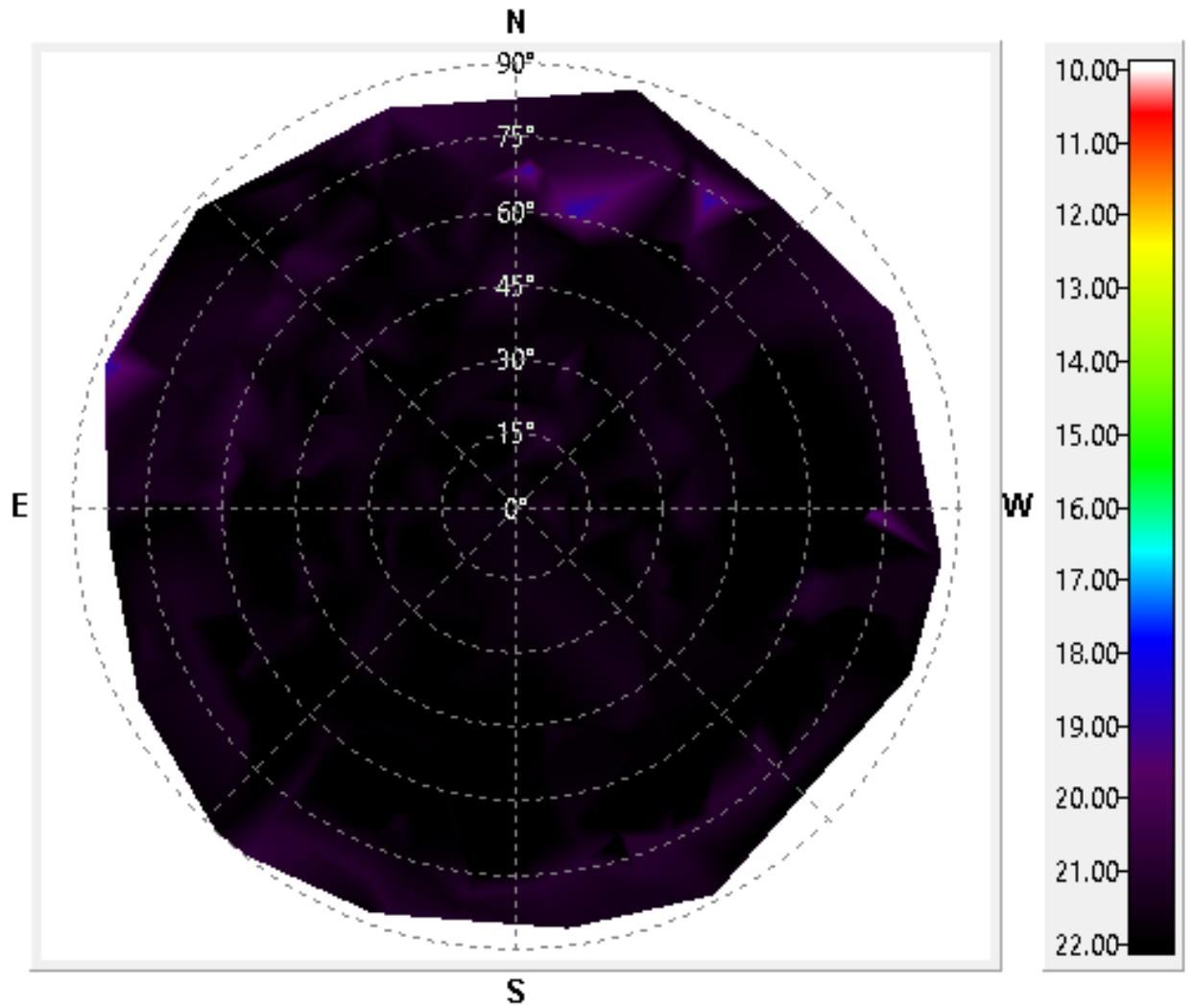


Figure B2: Light 2 Sky Plot (mag/arcsec²)