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# MEADOWBANK MINE

## 2019 WILDLIFE MONITORING SUMMARY REPORT

FINAL

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## APPENDIX G

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### Whale Tail Viewshed Analysis – Roadside Survey Points

## TECHNICAL MEMORANDUM

**DATE** 4 February 2020

**Project No.** 19130696-413-TM-Rev1

**TO** Manon Turmel  
Agnico Eagle Mines Limited

**CC** Michel Groleau, Robin Allard, Carolina Leseigneur Torres, Jen Range

**FROM** Corey De La Mare

**EMAIL** corey\_delamare@golder.com

### WHALE TAIL VIEWSHED ANALYSIS – ROADSIDE SURVEY POINTS (KIVIA-TERRESTRIAL-02)

#### Introduction

During the development and revisions of the Terrestrial Ecosystem Management Plan (TEMP) for the Whale Tail Project and subsequent Expansion Project (the Project), several discussions revolved around caribou detection within and around the mine site and along the Whale Tail Haul Road (Haul Road). A commitment (KivIA-Terrestrial-02) was made by Agnico Eagle during the Expansion Project process as follows: *“AEM shall work through the Terrestrial Advisory Group to update the Terrestrial Ecosystem Management Plan to increase the frequency and efficacy of road monitoring to implement mitigation. The updates will identify appropriate Road survey sites, map these for viewshed, and increase the frequency of Road surveys to cover a greater proportion of each day when long-distance data (generally collared caribou) indicate that migrating caribou may be approaching. The enhanced monitoring will provide a basis for describing the effects of caribou response to traffic which in turn will improve the effectiveness of mitigation”*.

The Haul Road is a 65 km all weather haul road between the existing Meadowbank Operations (i.e., Vault Pit) and Whale Tail Pit. As part of the caribou monitoring component for this haul road, five height of land (HOL) survey locations are used in areas where caribou have been observed based on collar data, presence of caribou trails, caribou sign, and where topographic relief is greatest. Currently, caribou monitoring is achieved through roadside surveys while driving along the Haul Road and informally stopping where necessary for a better vantage point, and through HOL surveys. Viewsheds from HOL surveys have been shown in previous versions of the TEMP (see Appendix A). However, although originally perceived to offer the best vantage points for caribou monitoring during migration periods, the HOL locations have some constraints as follows:

- small sample size of 5 observation points;
- length of time to access, complete the survey and return back to the vehicle is on average an hour or greater because of the distance of these survey points from the road, which limits the number of monitoring surveys that can be completed within a day; and
- health and safety risks related to exposure and physical strain to access the survey points given they are removed from the road and caribou monitoring occurs during spring and fall migration, when extreme winter conditions are common (i.e., cold temperatures, high winds, snow accumulation).

An alternative roadside survey design is being proposed to replace the HOL based surveys. This is largely based on the reasons above and to increase monitoring along the Haul Road so that each survey point can be completed twice per day during periods of peak caribou migration. These roadside surveys will consist of caribou monitoring surveys being completed at fixed roadside survey locations recording observations for 10 minutes, and will be used for the single purpose of informing the location and intensity of mitigation actions and implementing caribou protection measures. This approach may be the most beneficial in terms of achieving maximum monitoring frequency or the appropriate and specific implementation of mitigation. Information on caribou abundance and distribution will also be collected during driving between these roadside survey locations, and HOL surveys may still be considered where they may provide additional coverage of caribou distribution and movement, based on known caribou distribution from maps of collared animals. Selected roadside surveys could be focused on during periods of caribou migration based on the distribution of animals (i.e., limit roadside surveys to those locations that overlap with caribou locations) to inform site-specific mitigation along the Haul Road.

To determine the extent of visibility from these locations, a viewshed analysis was completed within a GIS platform. The results of this memo are intended to validate the distance of visible detection using roadside survey points as one line of information to be considered by Agnico Eagle for the implementation of caribou protection measures.

## Methods

Twelve roadside survey points, in addition to a Height-of-Land (HOL) survey location at the Vault Waste Rock Storage Area (WRSA), were selected based on a set of criteria as follows:

- the roadside survey locations were selected based on an analysis of caribou crossing/observations along the haul road (Commitment #8 – Whale Tail Expansion Technical Meeting; Golder 2019);
- points identified by the KivIA from June 2019 based on ground-based viewsheds (vantage points) (map provided by K. Poole);
- previously identified viewsheds out to 1 km from the centreline of the haul road to understand the viewshed from a truck for scan and drive surveys; and
- locations were fine-tuned based on elevation contours (i.e., highest points along the road in these sections).

The HOL survey location was chosen on top of the Vault WRSA to capitalize on the elevation of the WRSA and vantage point in an area where caribou crossing is frequent. The viewshed analysis shows the area where there is a line of sight based on evaluation from elevations within the landscape, the observer height, and the height of the target, in this case caribou. Visual aids, such as binoculars and spotting scopes, aid the observer to see at the extreme ends of the lines of sight so that caribou can be detected but the line of sight is not changed based on visual aids. The following assumptions were included in this viewshed analysis:

- An observer height of 1.7 m was added to each of the roadside locations.
- A surface offset to simulate the height of caribou was added at 1.5 m.
- The observer height is set as: 1.7 m for the points and the actual road elevations based on the as-built CAD profile.
- Viewshed extended out to a maximum observer sight line of 1 km for the road drive and scan surveys.

- Viewshed extended out to a maximum observer sight line of 4 km for the roadside survey locations.

The viewshed was required for the Regional Study Area; however, the availability of datasets was not consistent for the entire Regional Study Area in terms of data format and data resolution. Consequently, the datasets used and methods for harmonization are as follows:

- Road centerlines: Haul Road centerline and elevations (profile) provided by CAD, all weather road centerline generated semi-automatically using its footprint and linking its northern extremity to the Haul Road.
- Digital Elevation Model (DEM) for the Haul Road survey points used a high resolution DEM (1 m). The DEM was down-sampled to 3 m resolution and merged with CDEM that has a 20 m resolution and then re-sampled back to 3 m resolution, but this is only to keep the 3 m precision where it exists and it does not make the CDEM more precise. Using a merging process avoiding edge effects and creates a smooth transition from one DEM source to the other.
- The high resolution DEM only covers the haul road (approximately 500 m on each side) and a large portion of the Whale Tail Pit and development area.

The viewshed analysis was run on an ESRI ArcGIS platform using the 3D analyst tool – Viewshed. The visibility analysis does not take into account any potential vegetation or any other obstructions (natural/human) that are not part of the bare ground. A viewshed was developed for the existing Haul Road roadside survey locations.

## Results

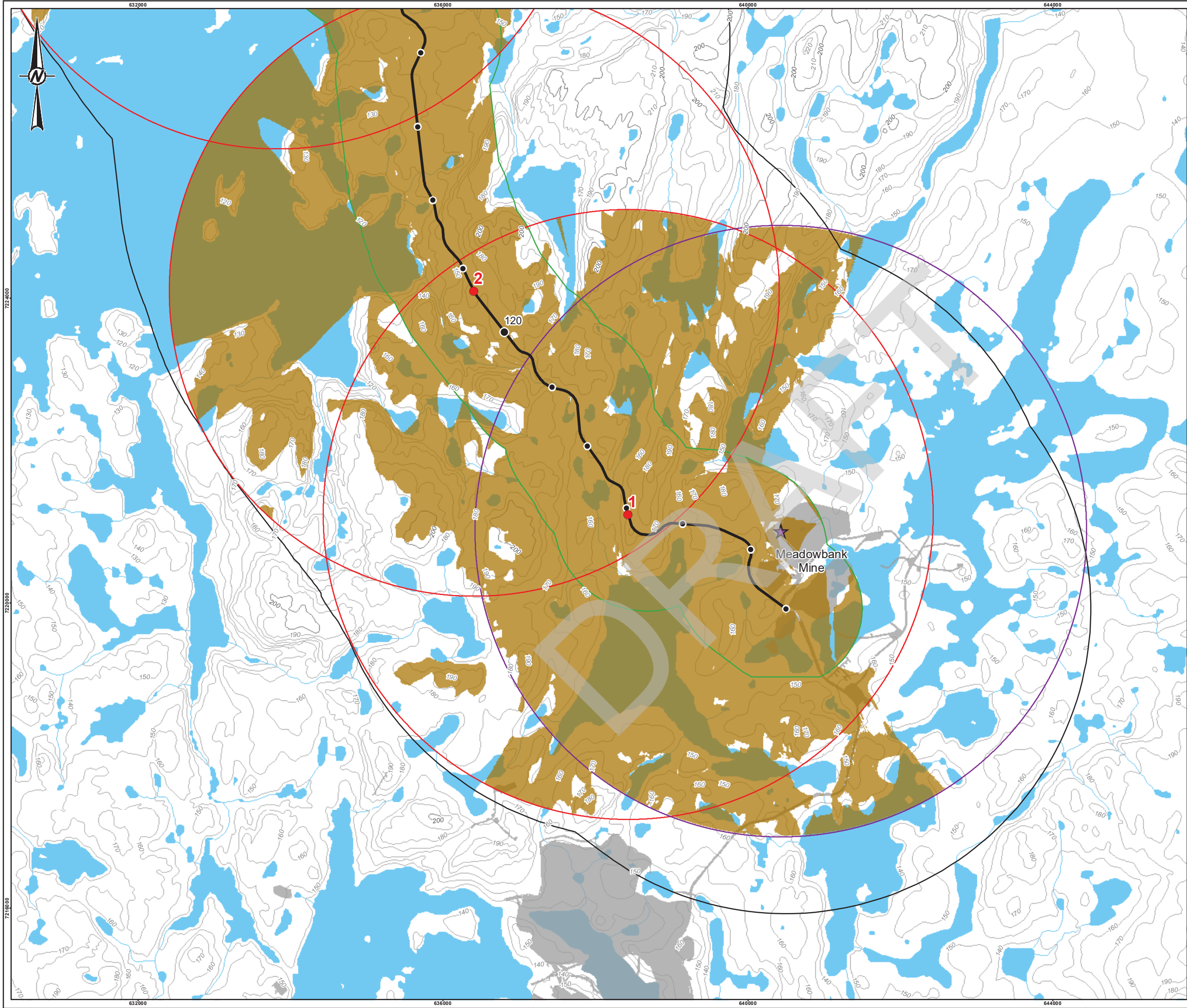
The results of the viewshed analysis can be found in Figures 1A to 1E, which each show the viewshed from the 12 roadside survey locations along the existing Haul Road. Table 1 lists the coordinates for the 12 roadside locations that are numbered in sequential order from south to north. These figures illustrate the theoretical sight lines from the roadside survey points but do not consider the areas that can be viewed from scanning surveys during driving between points where the viewshed will be increased (see Appendix A for the viewshed [1 km on either side of the road] highlighting the HOL survey locations and scanning surveys along the Haul Road). The following are summary statistics of the viewshed analysis:

- total area within 4 km of the Haul Road = 52,709 ha (73% land and 23% water);
- total area within 4 km of the 12 roadside survey locations, the WRSA HOL location and 1 km from the haul road centreline = 44,187 ha or 84% of the total area available within 4 km of the Haul Road (75% land and 25% water), which suggests good coverage from these survey locations;
- total area visible from the roadside survey locations = 24,273 ha or 55% of the available area.

The viewshed analysis is an important component of the overall monitoring program as it provides direction for monitoring locations that best capture caribou movements through the Project area during the spring and fall migration periods. Consequently, the survey locations chosen based on the results of the viewshed analysis will be continually reviewed and updated with the Terrestrial Advisory Group.



PATH: Y:\bunab\CAD-GIS\Client\Agnico\_Eagle\_Mines\_Ltd\Whale\_Tail\09\_PROJECTS\19130696\2200\2220\_1\_VIEWSHED\_HOL\_ROADSIDE\_SURVEY.mxd PRINTED ON: 2025-01-30 AT: 1:07:32 PM



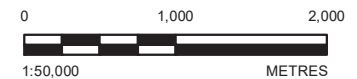
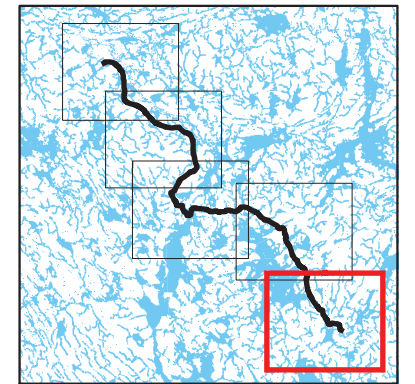
#### LEGEND

- ★ VAULT WRSA SURVEY POINT
- ROADSIDE SURVEY POINT
- KILOMETRE MARKER
- HAUL ROAD
- 4 km BUFFER OF VAULT WRSA SURVEY POINT
- 4 km BUFFER OF ROADSIDE SURVEY POINTS
- 4 km BUFFER OF HAUL ROAD
- 1 km HAUL ROAD VISIBILITY ANALYSIS AREA
- AREA VISIBLE FROM ROADSIDE SURVEY POINT
- INFRASTRUCTURE

#### BASE DATA

- CONTOUR (10 m)
- CONTOUR (100 m)
- WATERCOURSE
- WATERBODY

DRAFT



#### REFERENCE(S)

1. HAUL ROAD AND BASE DEVELOPMENT DATA OBTAINED FROM AEM.
2. CONTOURS, WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

#### CLIENT



AGNICO EAGLE MINES LIMITED:  
MEADOWBANK DIVISION

**AGNICO EAGLE**

#### PROJECT

WHALE TAIL PIT - EXPANSION PROJECT

#### TITLE

VIEWSHED FROM ROADSIDE SURVEY POINTS

#### CONSULTANT

YYYY-MM-DD	2020-01-30
DESIGNED	CDM
PREPARED	JP
REVIEWED	
APPROVED	



PROJECT NO.  
19130696

CONTROL  
2200/2220

REV.  
A

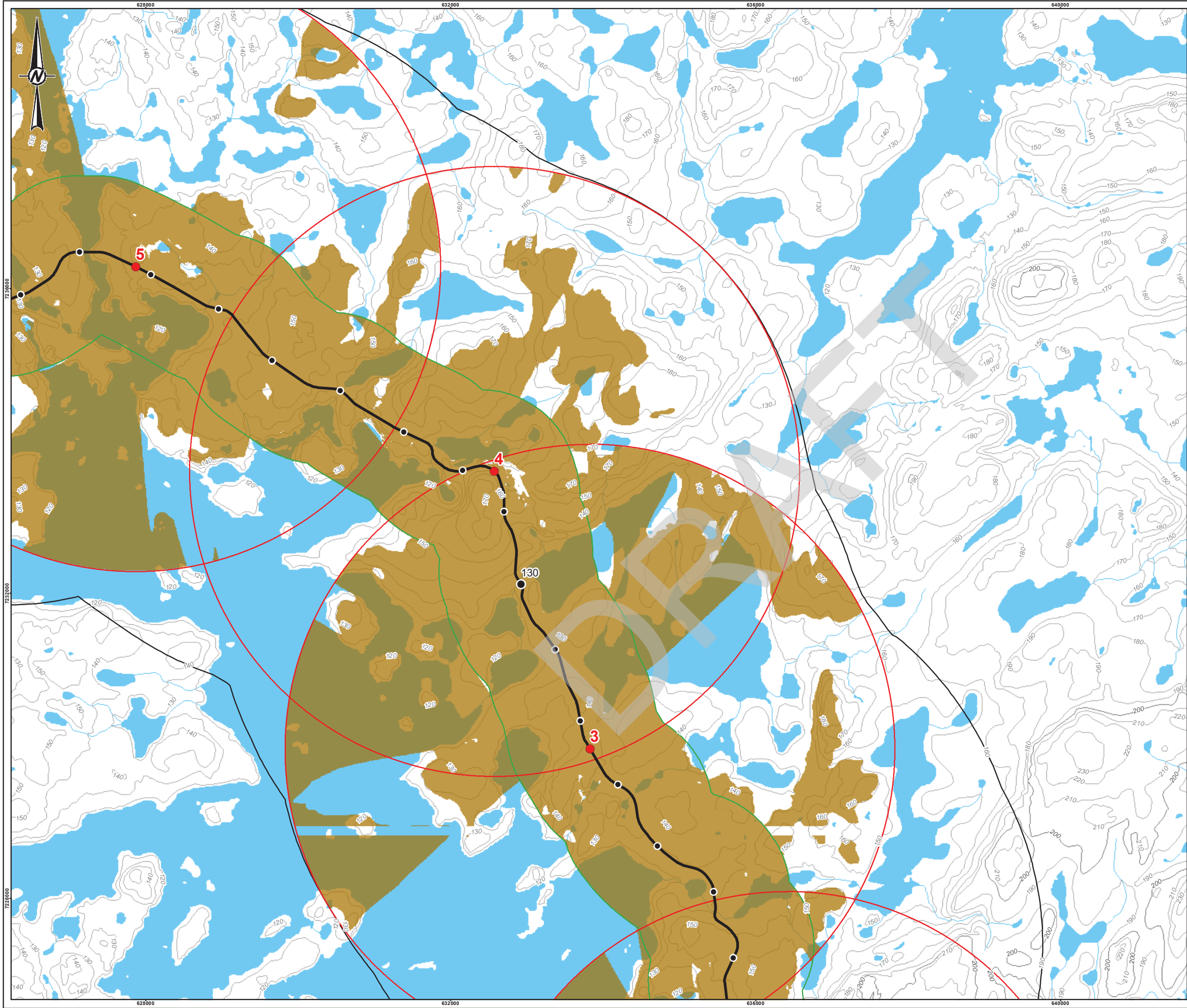
FIGURE  
1A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm



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**LEGEND**

- ROADSIDE SURVEY POINT
- KILOMETRE MARKER
- HAUL ROAD
- 4 km BUFFER OF ROADSIDE SURVEY POINTS
- 4 km BUFFER OF HAUL ROAD
- 1 km HAUL ROAD VISIBILITY ANALYSIS AREA
- AREA VISIBLE FROM ROADSIDE SURVEY POINT
- INFRASTRUCTURE

**BASE DATA**

- CONTOUR (10 m)
- CONTOUR (100 m)
- WATERCOURSE
- WATERBODY

**DRAFT**

0 1,000 2,000  
1:50,000 METRES

**REFERENCE(S)**  
1. HAUL ROAD AND BASE DEVELOPMENT DATA OBTAINED FROM AEM.  
2. CONTOURS, WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.  
DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

CLIENT

**AGNICO EAGLE**

PROJECT  
WHALE TAIL PIT - EXPANSION PROJECT

AGNICO EAGLE MINES LIMITED:  
MEADOWBANK DIVISION

**TITLE**  
VIEWSHED FROM ROADSIDE SURVEY POINTS

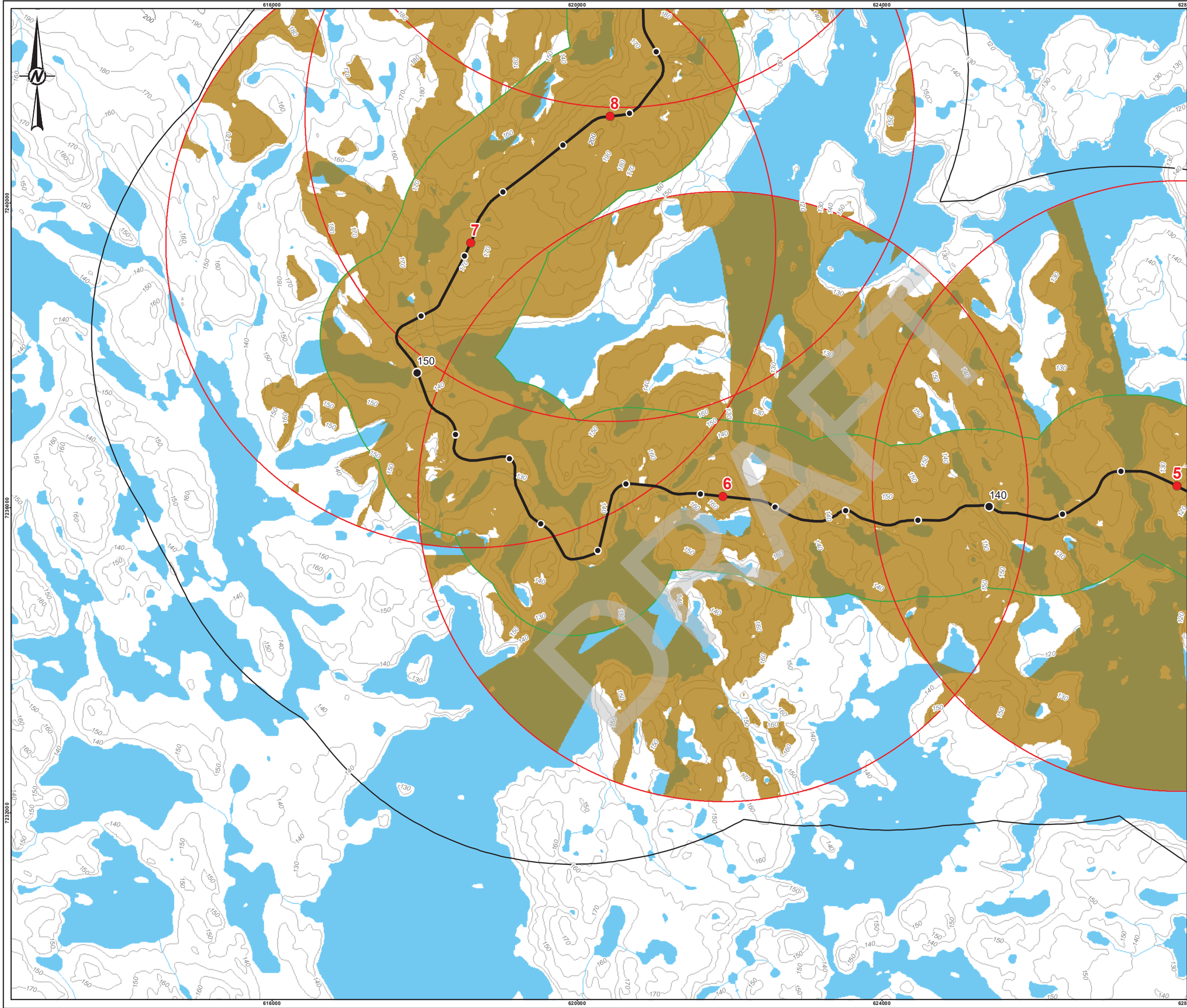
CONSULTANT	YYYY-MM-DD	2020-01-30
	DESIGNED	CDM
	PREPARED	JP
	REVIEWED	
	APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
19130696	2200/2220	A	1B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B 25mm



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**LEGEND**

- ROADSIDE SURVEY POINT
- KILOMETRE MARKER
- HAUL ROAD
- 4 km BUFFER OF ROADSIDE SURVEY POINTS
- 4 km BUFFER OF HAUL ROAD
- 1 km HAUL ROAD VISIBILITY ANALYSIS AREA
- AREA VISIBLE FROM ROADSIDE SURVEY POINT
- INFRASTRUCTURE

**BASE DATA**

- CONTOUR (10 m)
- CONTOUR (100 m)
- WATERCOURSE
- WATERBODY

**DRAFT**

0 1,000 2,000  
1:50,000 METRES

**REFERENCE(S)**  
1. HAUL ROAD AND BASE DEVELOPMENT DATA OBTAINED FROM AEM.  
2. CONTOURS, WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.  
DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

CLIENT

**AGNICO EAGLE**

AGNICO EAGLE MINES LIMITED:  
MEADOWBANK DIVISION

PROJECT

**WHALE TAIL PIT - EXPANSION PROJECT**

TITLE

**VIEWSHED FROM ROADSIDE SURVEY POINTS**

CONSULTANT	YYYY-MM-DD	2020-01-30
	DESIGNED	CDM
	PREPARED	JP
	REVIEWED	
APPROVED		

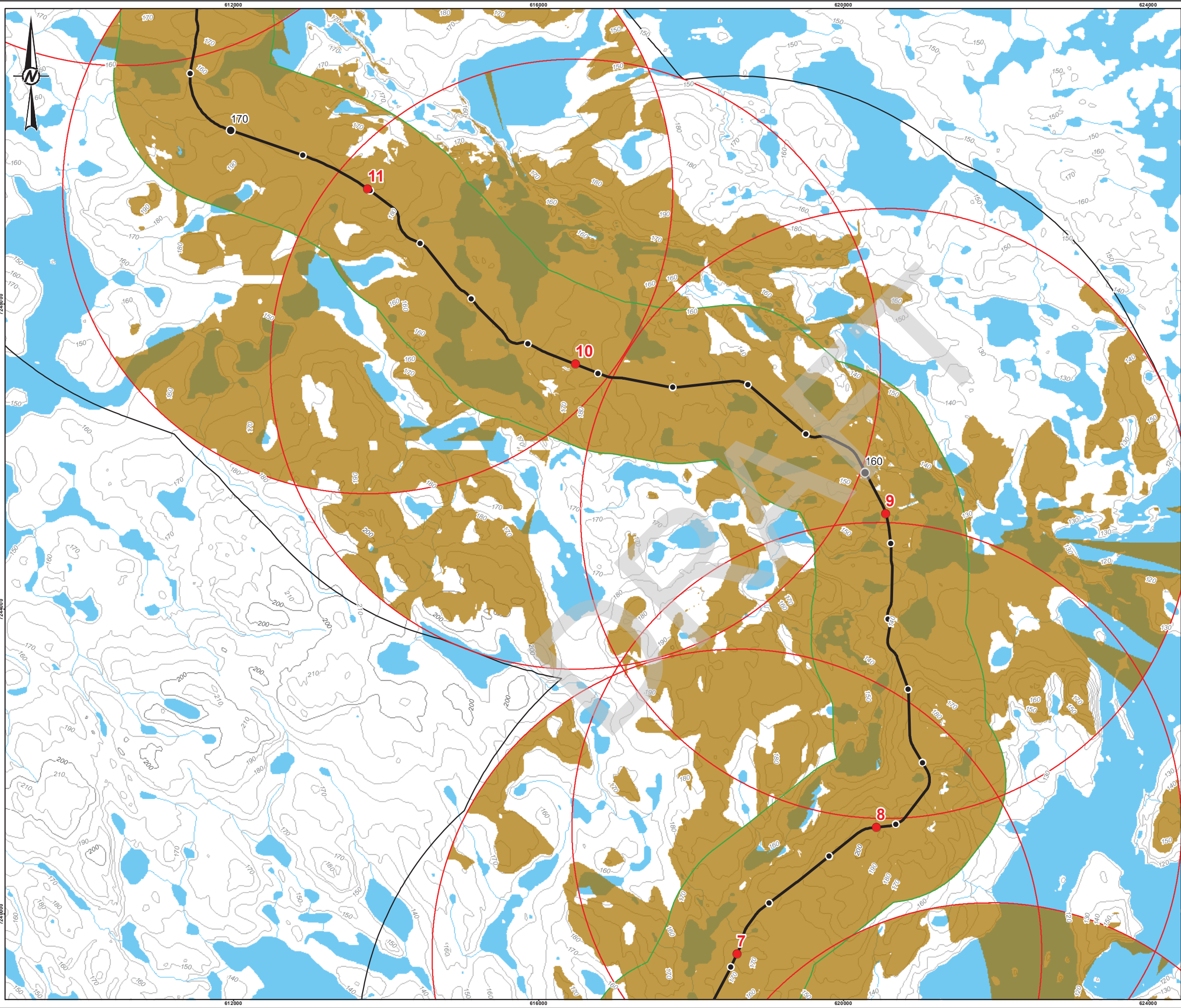
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**LEGEND**

- ROADSIDE SURVEY POINT
- KILOMETRE MARKER
- HAUL ROAD
- 4 km BUFFER OF ROADSIDE SURVEY POINTS
- 4 km BUFFER OF HAUL ROAD
- 1 km HAUL ROAD VISIBILITY ANALYSIS AREA
- AREA VISIBLE FROM ROADSIDE SURVEY POINT
- INFRASTRUCTURE

**BASE DATA**

- CONTOUR (10 m)
- CONTOUR (100 m)
- WATERCOURSE
- WATERBODY

**DRAFT**

0 1,000 2,000  
1:50,000 METRES

**REFERENCE(S)**

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2. CONTOURS, WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.  
DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

CLIENT

**AGNICO EAGLE**

PROJECT

**WHALE TAIL PIT - EXPANSION PROJECT**

**AGNICO EAGLE MINES LIMITED:  
MEADOWBANK DIVISION**

**TITLE**

**VIEWSHED FROM ROADSIDE SURVEY POINTS**

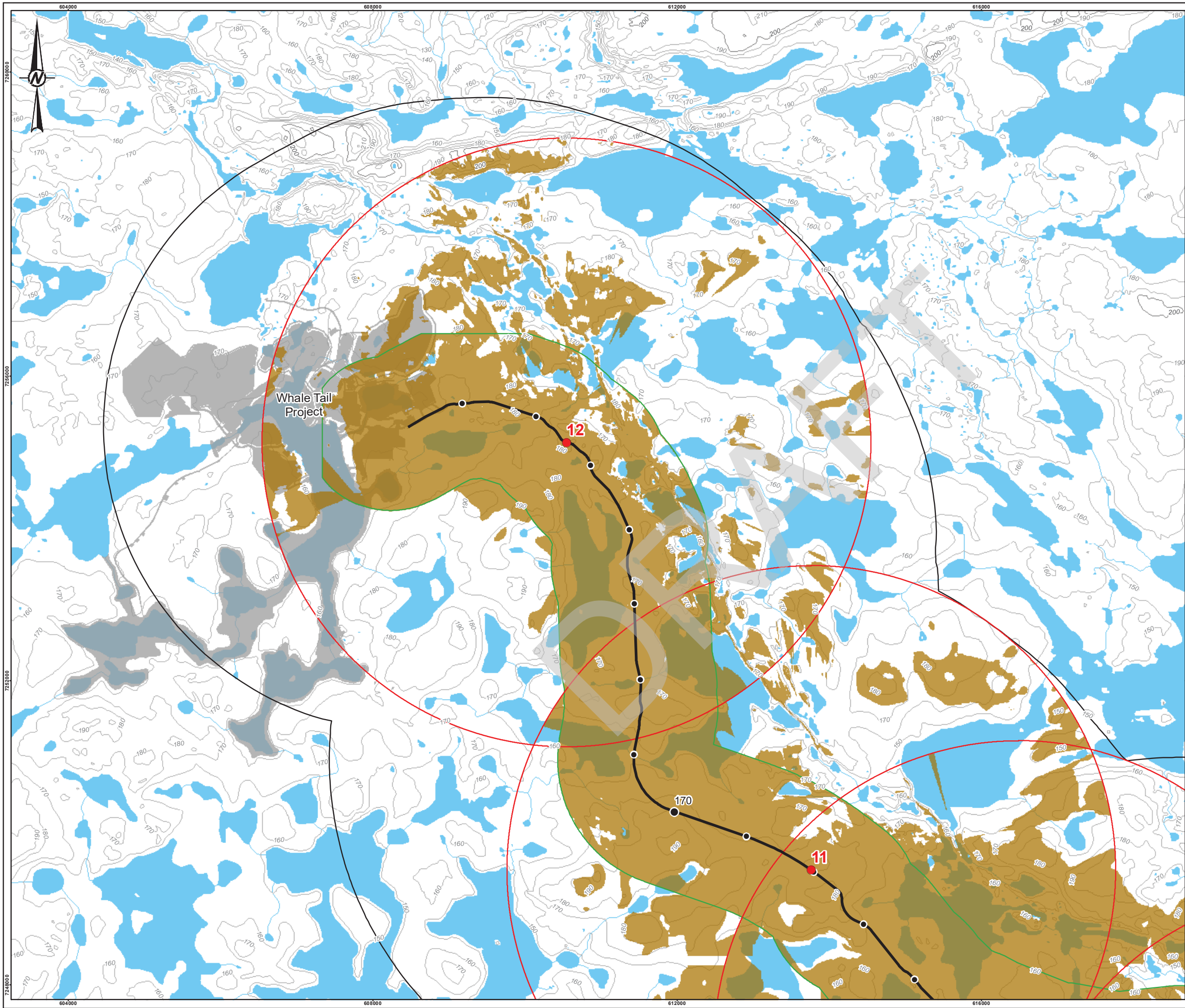
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	DESIGNED	CDM
	PREPARED	JP
	REVIEWED	
	APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B 25mm



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**LEGEND**

- ROADSIDE SURVEY POINT
- KILOMETRE MARKER
- HAUL ROAD
- 4 km BUFFER OF ROADSIDE SURVEY POINTS
- 4 km BUFFER OF HAUL ROAD
- 1 km HAUL ROAD VISIBILITY ANALYSIS AREA
- AREA VISIBLE FROM ROADSIDE SURVEY POINT
- INFRASTRUCTURE

**BASE DATA**

- CONTOUR (10 m)
- CONTOUR (100 m)
- WATERCOURSE
- WATERBODY

**DRAFT**

0 1,000 2,000  
1:50,000 METRES

**REFERENCE(S)**

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2. CONTOURS, WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.  
DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

**CLIENT**

AGNICO EAGLE MINES LIMITED:  
MEADOWBANK DIVISION

**PROJECT**

WHALE TAIL PIT - EXPANSION PROJECT

**TITLE**

VIEWSHED FROM ROADSIDE SURVEY POINTS

CONSULTANT	YYYY-MM-DD	2020-01-30
	DESIGNED	CDM
	PREPARED	JP
	REVIEWED	
	APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
19130696	2200/2220	A	1E

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B 25mm

**Table 1: Roadside Survey Location Coordinates**

Roadside Survey Point	Easting <sup>1</sup>	Northing <sup>1</sup>
1	638429	7221162
2	636407	7224092
3	633827	7229959
4	632575	7233600
5	627867	7236286
6	621911	7236148
7	618602	7239477
8	620433	7241136
9	620553	7245253
10	616483	7247210
11	613760	7249510
12	610545	7255129

<sup>1</sup> UTM Zone 14 NAD83

## Closure

We trust this meets your needs, if you have any questions or concerns, feel free to contact the undersigned.

Regards,

**DRAFT**

Corey De La Mare, P.Biol.  
*Principal, Senior Wildlife Ecologist*

CDM/jr

[https://golderassociates.sharepoint.com/sites/115643/project files/5 technical work/01\\_road\\_point\\_survey\\_analysis/rev1/19130696-413-tm-viewshedanalysis-roadsidesurveypoints-rev1.docx](https://golderassociates.sharepoint.com/sites/115643/project%20files/5%20technical%20work/01_road_point_survey_analysis/rev1/19130696-413-tm-viewshedanalysis-roadsidesurveypoints-rev1.docx)

## Citation

Golder (Golder Associates Ltd.). 2019. Crossing Analysis – Assessment of Effects from the Haul Road to Caribou.  
Prepared by Golder Associates Ltd. for Agnico Eagle: August 26, 2019.



**APPENDIX A**

**2017 Viewshed Analysis  
(submitted with v7 of the TEMP)**