GAHCHO KUÉ PROJECT

ENVIRONMENTAL IMPACT STATEMENT

UPDATED AIR QUALITY ASSESSMENT

September 2012 **11-1365-0012**

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1 INTRODUCTION

The purpose of this report is to provide an update of the air quality assessment for the Gahcho Kué Project (Project), which was presented in the 2010 De Beers Canada Inc. Gahcho Kué Project Environmental Impact Statement (EIS; De Beers 2010, Section 11.4). The update to the EIS air quality assessment is required due to revisions resulting from planned Project changes as described in the updated Project Description in the 2012 EIS Supplement (De Beers 2012a, Section 3), as well as new information related to winter road dust mitigation efficiency derived from a study at De Beers' mining operations in northern Canada (Golder 2012). The updated Application Case and updated Construction Case air quality predictions were compared with the original predictions that were presented in the 2010 EIS. The goals of the updated air quality assessment are to:

- summarize the project updates and new information that influences the air quality predictions;
- refine some of the emissions estimation assumptions to reduce the level of conservatism in the air quality predictions;
- compare the predictions of the updated assessment with the original air quality predictions in the 2010 EIS; and
- provide up-to-date air quality results for the Human Health and Ecological Risk Assessment.

2 AIR QUALITY ASSESSMENT APPROACH

2.1 CHANGES TO AIR QUALITY ASSESSMENT APPROACH

The air quality assessment approach used to estimate the air quality changes due to the updated Project information is, in most part, the same as described in the 2010 EIS (De Beers 2010, Section 11.4). However, some changes were made to the assessment approach in this updated assessment to improve the accuracy of the air quality predictions. These changes are outlined and explained in Table 2-1.

Table 2-1 A Summary of Changes to the Air Quality Assessment Approach in the Updated Air Quality Assessment

Changes in the Updated Assessment	Reasons for Changes	Effects on the Assessment
Background CO (carbon monoxide) concentrations derived from the regional monitoring data were added to the predicted CO concentrations.	A recommendation provided by Government of Northwest Territories (GNWT) during the 1st Round of Information Requests.	Resulted in higher CO predictions when background CO concentrations were added to the air quality model predictions.
The updated Application Case is based on the assessment of three years (Years 1, 5, and 8 of the Project operation) compared to the original Application Case in the 2010 EIS which was based on two years (Years 1 and 5 of the Project operation).	Changes to the Fine Processed Kimberlite Containment (PKC) Facility design and overburden/mine rock/coarse processed kimberlite (PK) production/disposal schedule led to a review of the assessment years.	Resulted in three years (Years 1, 5 and 8) modelled instead of two years (Years 1 and 5) to better understand the local effects associated with different active mine areas at different stages of the Project.
A portion of the particulate matter (PM) emissions from sources within the mine pits was assumed to be retained within the pits due to the depth of the pits rather than being released directly into the atmosphere beyond the pit boundary.	The assumption in the EIS that 100% of the PM, especially larger sized PM (TSP [total suspended particulates]), released from sources within the mine pits will escape from the mine pits is very conservative.	The open pit algorithm for the United States Environmental Protection Agency (U.S. EPA) ISC3 dispersion model was used to determine the escape fraction of PM from the mine pits. Based on this algorithm, it was estimated that 69% of TSP and 95% of PM_{10} and 100% of $PM_{2.5}$ emissions from the pit sources was released into the atmosphere beyond the pit walls and not retained within the pits.
Dioxin/furan emissions from the Project's waste incinerator were assessed based on a waste incinerator operation of 12 hours per day instead of the 24 hours per day in the 2010 EIS.	The waste incinerator at the Project will be a batch operation instead of continuous operation. Therefore, the waste incinerator emissions estimated on a 24 hour per day continuous operation in the 2010 EIS were overly conservative.	The dioxin/furan emissions (not other emissions) assessed in the updated assessment are 50% lower than those presented in the 2010 EIS.

% = percent; PM_{10} = particulate matter of particle diameter less than 10 µm; $PM_{2.5}$ = particulate matter of particle diameter less than 2.5 µm.

2.2 CHANGES TO PROJECT INFORMATION

Project design changes that were considered in this updated air quality assessment are outlined and described in Table 2-2.

Table 2-2 A Summary of Changes in Project Design in the Updated Air Quality Assessment

Changes in the Updated Assessment	Reasons for Changes	Effects on the Assessment
Production and deposition schedules of the overburden, mine rock and coarse PK were updated based on the information presented in the 2012 EIS Supplement (De Beers 2012a).	Updated information was available in the 2012 EIS Supplement (De Beers 2012a).	Updated material production and disposal rates were used in the emission estimation for the updated assessment.
Revised mitigation of the Fine PKC Facility.	Changes in the design for the fine PK disposal affected the layout of the haul roads and processed kimberlite disposal storage piles.	Emissions from road dust and storage pile wind erosion were revised in the updated assessment.

EIS = environmental impact statement; PK = processed kimberlite; PKC = processed kimberlite containment.

Some detailed Project information that was not available during the preparation of the 2010 EIS, has been incorporated into the updated air quality assessment. The changes reflect more refined project information and are outlined and explained in Table 2-3. In the 2010 EIS, an incomplete understanding of the extent to which winter conditions mitigate the road dust emissions at the Project was identified a reason for very conservative winter road dust emission estimates. A road dust study was subsequently conducted at De Beers Snap Lake and Victor mines to quantify the level of natural winter mitigation on road dust (Golder 2012).

Table 2-3 A Summary of New or Updated Data and Assumptions in the Updated Air Quality Assessment

Changes	Reasons for Changes	Effects on the Assessment
Better defined haul road locations and distances.	Road dust emissions are highly dependent on the length of the haul roads. Mine fleet exhaust emissions are allocated based on the layout of the haul roads. More precise information on the haul road distances and layout became available after the completion of the 2010 EIS.	Changes to road dust emissions and allocation of the mine fleet exhaust emissions allocation.

Table 2-3 A Summary of New or Updated Data and Assumptions in the Updated Air Quality Assessment (continued)

Changes	Reasons for Changes	Effects on the Assessment
Mine rock and haul road surface silt content	Road dust emissions are highly dependent on the silt content of the road surface material. No site-specific silt data were available during the preparation of the 2010 EIS; therefore, silt content for crushed limestone (a U.S. EPA default value) was used in the 2010 EIS. Since then, silt content data from samples collected at De Beers Snap Lake Mine located approximately 85 km west of the Project have become available (Golder 2012).	Higher road surface silt content (7.3%) based on samples collected at the Snap Lake Mine was used in the updated assessment. It replaced the previously assumed silt content estimate of 1.6%.
Revised road dust mitigation efficiencies for both the summer and winter seasons	The 2010 EIS was based on a conservative assumption of 0% and 55% road dust mitigation for winter and summer seasons, respectively. This assumption was found to be overly conservative based on a study conducted at the Snap Lake Mine and Victor Mine (Golder 2012).	Winter and summer mitigation on road dust emissions were assumed to be 95% and 70%, respectively, in the updated assessment. This change substantially reduced the overall PM emissions from the Project.
Revised drained lake bed areas	Revised drained lake bed areas based on an updated mine progress plan presented in the 2012 EIS Supplement (De Beers 2012a) that better reflects the actual drained lake areas in the three assessed years of operation (Years 1, 5 and 8).	Potential fugitive PM emissions resulting from wind erosion of the drained lake areas were updated.
Dioxin/furan emissions from the waste incinerators at the Project and De Beers Snap Lake Mine were refined based on actual stack sampling data collected from the Snap Lake incinerator in 2007.	In the 2010 EIS, the incinerators' dioxin/furan emissions were estimated based on U.S. EPA AP-42 emission factors (U.S. EPA 1996). This resulted in an overly conservative estimate of dioxin/furan emissions. Revised dioxin/furan emissions from the incinerators were obtained from the stack sampling data collected at the Snap Lake incinerator, as they provide a measured estimate.	The dioxin/furan emissions derived from the stack sampling data resulted in over a 90% reduction of the incinerator emissions.

EIS = environmental impact statement; U.S. EPA = United States Environmental Protection Agency; PM = particulate matter;% = percent.

3 UPDATED APPLICATION CASE

3.1 UPDATED APPLICATION CASE PROJECT EMISSIONS

Table 3-1 provides a comparison of the Project's maximum annual sulphur dioxide (SO_2), oxides of nitrogen (NO_X), carbon dioxide (CO), fine particulate matter ($PM_{2.5}$) and total suspended particulate (TSP) emissions in the original and updated Application cases. The emissions rates are presented in tonnes per year (t/yr) rather than tonnes per day (t/d) to better reflect the seasonal variations incorporated in the Project emissions. Detailed information on how new information was incorporated into the updated Project emissions is provided in Appendix I.

Some of the updates described in Tables 2-1 to 2-3 resulted in an increase in emissions associated with certain Project activities (e.g., silt content from haul roads from 1.6% to 7.3%); while other changes led in a decrease in emissions (e.g., more pronounced winter mitigation of fugitive dust emissions). As a result, only the Project's particulate matter ($PM_{2.5}$ and TSP) emissions have changed in the updated assessment. The updated Application Case $PM_{2.5}$ emission are higher than those in the original Application Case by 3.84 t/yr or 2.8%; while, the TSP emissions are lower than those in original Application Case by 778.28 t/yr or 30.9%. It is important to note that an increase in emissions does not necessary result in higher predicted concentrations. Other factors such as changes to the allocation of the emissions also influenced the predictions in the updated assessment.

Table 3-1 Comparison of Project Emissions in the Original and Updated Application Cases

Source	Emission Rate [t/y]					
	SO_2			NO_X		
	Original Application Case[(a)]	Updated Application Case	Change	Original Application Case[(a)]	Updated Application Case	Change
Diesel Generators	0.48	0.48	0.00	982.68	982.68	0.00
Auxiliary Boiler	0.03	0.03	0.00	2.62	2.62	0.00
Waste Incinerator	1.41	1.41	0.00	1.38	1.38	0.00
Crushers	—	—	—	—	—	—
Drilling and Blasting	11.69	11.69	0.00	93.55	93.55	0.00
Loading/Unloading	—	—	—	—	—	—
Bulldozing	—	—	—	—	—	—
Grading	—	—	—	—	—	—
Storage Pile Erosion	—	—	—	—	—	—
Conveyors	—	—	—	—	—	—
Minefleet Exhaust	1.25	1.25	0.00	597.82	597.82	0.00
Road Dust	—	—	—	—	—	—
Winter Access Road	0.00	0.00	0.00	0.35	0.35	0.00
Aggregate Plant	—	—	—	—	—	—
Dry Lakebed	—	—	—	—	—	—
Overall Total	14.86	14.86	0.00	1,678.42	1,678.42	0.00

Note: The emission rates presented in the above table have been rounded to two decimal places. Therefore, the totals may not appear to be sum of individual values.

[(a)] De Beers 2010, Section 11.4 .

t/y = tonnes per year; SO_2 = sulphur dioxide; NO_2 = nitrogen dioxide; CO = carbon monoxide; PM = particulate matter; TSP = total suspended particulate.

Table 3-1 Comparison of Project Emissions in the Original and Updated Application Cases (continued)

Source	Emission Rate [t/y]					
	CO			$PM_{2.5}$		
	Original Application Case[(a)]	Updated Application Case	Change	Original Application Case[(a)]	Updated Application Case	Change
Diesel Generators	261.02	261.02	0.00	17.07	17.07	0.00
Auxiliary Boiler	0.66	0.66	0.00	0.05	0.05	0.00
Waste Incinerator	4.38	4.38	0.00	3.07	3.07	0.00
Crushers	—	—	—	3.84	3.84	0.00
Drilling and Blasting	447.35	447.35	0.00	1.15	1.16	0.01
Loading/Unloading	—	—	—	5.85	5.17	-0.67
Bulldozing	—	—	—	0.87	4.74	3.87
Grading	—	—	—	3.53	3.53	0.00
Storage Pile Erosion	—	—	—	8.84	6.27	-2.57
Conveyors	—	—	—	10.34	6.60	-3.74
Minefleet Exhaust	194.19	194.19	0.00	28.30	28.30	0.00
Road Dust	—	—	—	41.19	47.97	6.79
Winter Access Road	0.16	0.16	0.00	0.01	0.01	0.00
Aggregate Plant	—	—	—	6.41	6.41	0.00
Dry Lakebed	—	—	—	3.56	7.26	3.70
Overall Total	907.76	907.76	0.00	134.08	137.92	3.84

Note: The emission rates presented in the above table have been rounded; therefore, the totals may not appear to be sum of individual values.

[(a)] De Beers 2010, Section 11.4.

t/y = tonnes per year; SO_2 = sulphur dioxide; NO_2 = nitrogen dioxide; CO = carbon monoxide; PM = particulate matter; TSP = total suspended particulate.

Table 3-1 Comparison of Project Emissions in the Original and Updated Application Cases (continued)

Source	Emission Rate [t/y]		
	TSP		
	Original Application Case[(a)]	Updated Application Case	Change
Diesel Generators	21.40	21.40	0.00
Auxiliary Boiler	0.43	0.43	0.00
Waste Incinerator	3.07	3.07	0.00
Crushers	10.96	10.96	0.00
Drilling and Blasting	23.50	16.34	-7.16
Loading/Unloading	81.66	61.05	-20.61
Bulldozing	8.32	31.17	22.85
Grading	113.98	89.79	-24.18
Storage Pile Erosion	117.86	83.65	-34.21
Conveyors	28.20	18.00	-10.20
Minefleet Exhaust	29.17	27.98	-1.20
Road Dust	2,013.13	1,350.05	-663.09
Winter Access Road	0.01	0.01	0.00
Aggregate Plant	22.78	22.78	0.00
Dry Lakebed	47.44	96.75	49.31
Overall Total	2,521.92	1,743.64	-778.28

Note: The emission rates presented in the above table have been rounded; therefore, the totals may not appear to be sum of individual values.

(a) De Beers 2010, Section 11.4.

t/y = tonnes per year; SO_2 = sulphur dioxide; NO_2 = nitrogen dioxide; CO = carbon monoxide; TSP = total suspended particulate.

The following sections compare the Baseline Case, the original Application Case and the updated Application Case. Isopleth figures for the updated Application Case predictions are also provided in these sections. Note that isopleth figures are presented only for compounds with predictions above 25% of the applicable Northwest Territories (NWT) air quality standards (GNWT 2011).

A detailed comparison between predictions for Years 1, 5 and 8 in the updated Application Case is provided Appendix II. Predicted concentrations at selected receptors of interest that were used in the Human Health and Ecological Risk Assessment are also provided in Appendix II.

3.2 SO_2 PREDICTIONS

The maximum 1-hour, 24-hour and annual SO_2 predictions in the Baseline Case, the original Application Case and the updated Application Case are summarized in Tables 3-2, 3-3 and 3-4, respectively. Although the updated Application Case SO_2 emissions did not change, the updated Application Case SO_2 predicted concentrations have increased marginally due to relocation of the mine fleet emissions based on latest haul road layout. The predicted concentrations are all substantially below the NWT air quality standards (GNWT 2011). The maximum 24-hour SO_2 predictions relative to the Project are shown graphically in Figure 3-1.

Table 3-2 Maximum 1-Hour SO_2 Concentrations - Comparison of Predicted Baseline Case, Original and Updated Application Cases

Parameters	Baseline Case[(a)]	Original Application Case[(a)]	Updated Application Case
Local Study Area (LSA)			
maximum 1-hour SO_2 [µg/m³]	3.4	67.5	69.1
maximum 1-hour SO_2 (excluding development area) [µg/m³]	3.4	42.9	43.4
occurrences above 1-hour NWT AQS[(b)]	0	0	0
area above 1-hour NWT AQS[(b)] (excluding development area) [ha]	0	0	0
Regional Study Area (RSA)			
maximum 1-hour SO_2 [µg/m³]	24.0	67.5	69.1
maximum 1-hour SO_2 (excluding development area) [µg/m³]	24.0	42.9	43.4
occurrences above 1-hour NWT AQS[(b)]	0	0	0
area above 1-hour NWT AQS[(b)] (excluding development area) [ha]	0	0	0

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for 1-hour SO_2 = 450 µg/m³ (GNWT 2011).

$\mu g/m^3$ = microgram per cubic metre; SO_2 = sulphur dioxide; ha = hectare.

Table 3-3 Maximum 24-Hour SO_2 Concentrations - Comparison of Predicted Baseline Case, Original and Updated Application Cases

Parameters	Baseline Case[(a)]	Original Application Case[(a)]	Updated Application Case
Local Study Area (LSA)			
maximum 24-hour SO_2 [µg/m³]	2.8	49.5	50.5
maximum 24-hour SO_2 (excluding development area) [µg/m³]	2.8	32.9	33.3
occurrences above 24-hour NWT AQS[(b)]	0	0	0
area above 24-hour NWT AQS[(b)] (excluding development area) [ha]	0	0	0
Regional Study Area (RSA)			
maximum 24-hour SO_2 [µg/m³]	8.5	49.5	50.5
maximum 24-hour SO_2 (excluding development area) [µg/m³]	8.5	32.9	33.3
occurrences above 24-hour NWT AQS[(b)]	0	0	0
area above 24-hour NWT AQS[(b)] (excluding development area) [ha]	0	0	0

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for 24-hour SO_2 = 150 µg/m³ (GNWT 2011).

$\mu g/m^3$ = microgram per cubic metre; SO_2 = sulphur dioxide; ha = hectare.

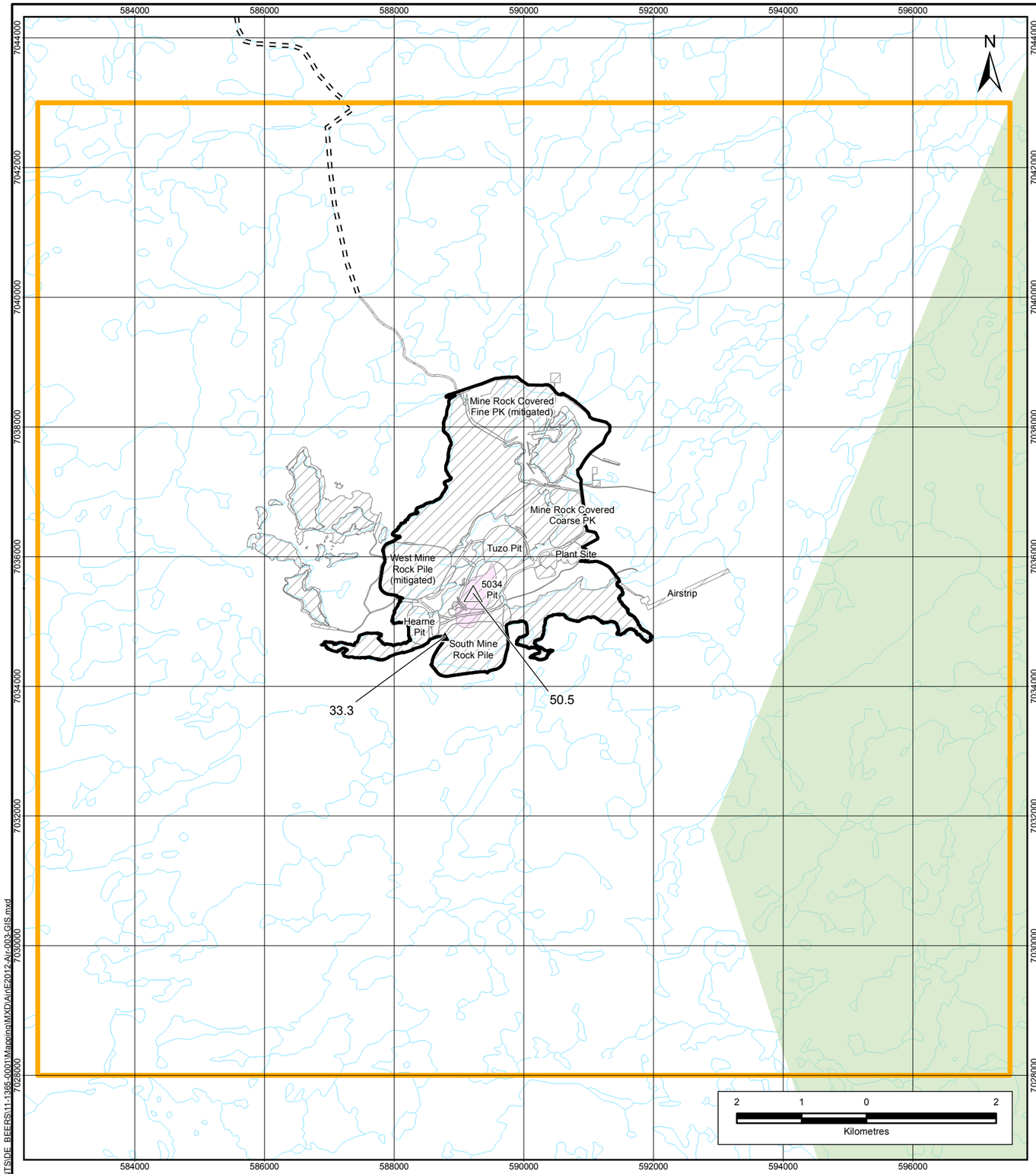
Table 3-4 Maximum Annual SO_2 Concentrations - Comparison of Predicted Baseline Case, Original and Updated Application Cases

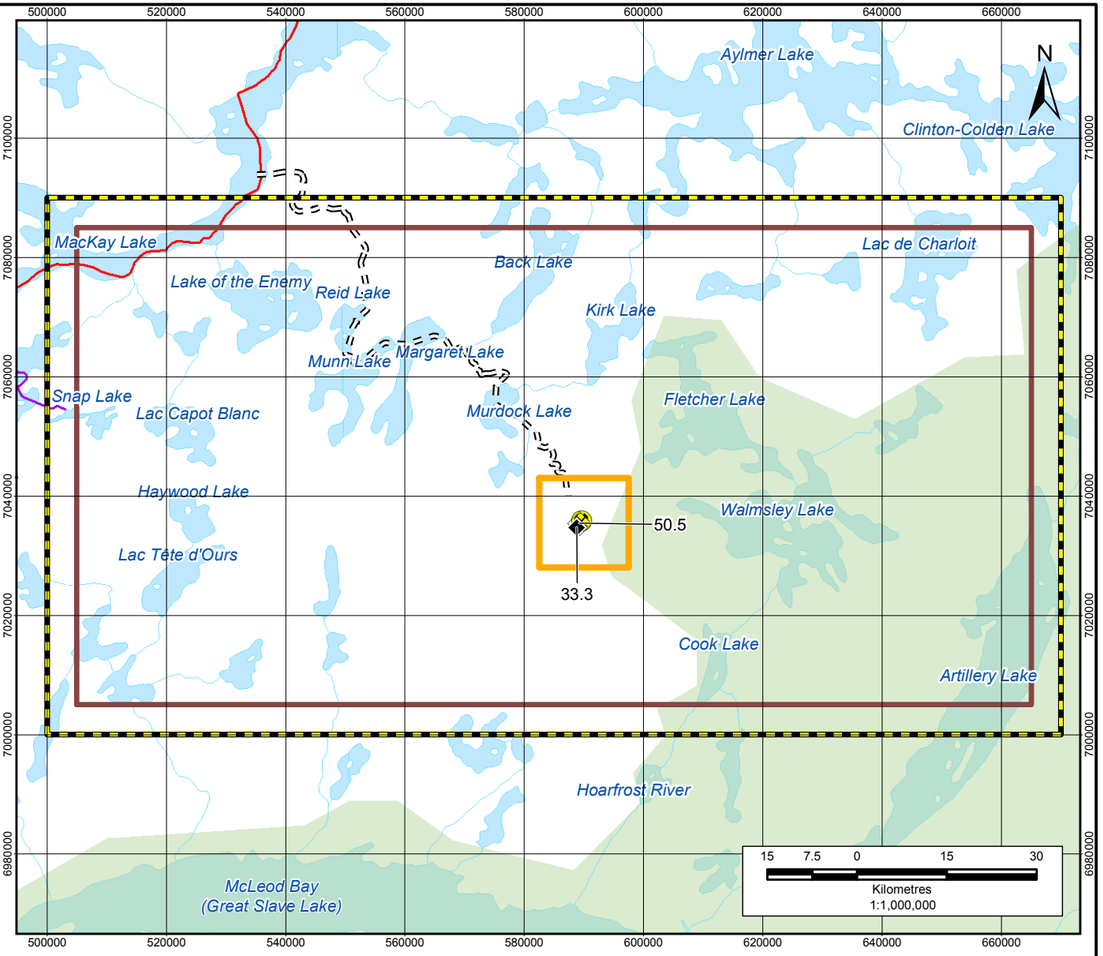
Parameters	Baseline Case[(a)]	Original Application Case[(a)]	Updated Application Case
Local Study Area (LSA)			
maximum annual SO_2 [µg/m³]	2.6	7.3	7.4
maximum annual SO_2 (excluding development area) [µg/m³]	2.6	4.8	4.8
area above annual NWT AQS[(b)] (excluding development area) [ha]	0	0	0
Regional Study Area (RSA)			
maximum annual SO_2 [µg/m³]	3.0	7.3	7.4
maximum annual SO_2 (excluding development area) [µg/m³]	3.0	4.8	4.8
area above annual NWT AQS[(b)] (excluding development area) [ha]	0	0	0

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for annual SO_2 = 30 µg/m³ (GNWT 2011).

$\mu g/m^3$ = microgram per cubic metre; SO_2 = sulphur dioxide; ha = hectare.





LEGEND

- Gahcho Kué Project
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration ($\mu g/m^3$)

- >= 150
- 75 to < 150
- 37.5 to < 75
- 0 to < 37.5

NWT Standard = 150 $\mu g/m^3$
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

GAHCHO KUÉ PROJECT

Maximum 24-hour SO_2 Concentrations - Updated Application Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-003-GIS		DATE: June 11, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	**Figure 3-1**
OFFICE: GOLD-CAL	DRAWN: DC / CHECK: DC	

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3.3 NO_2 PREDICTIONS

Tables 3-5, 3-6 and 3-7 present the comparisons of predicted 1-hour, 24-hour and annual NO_2 concentrations in the Baseline Case, the original Application Case and the updated Application Case. The updated Application Case maximum 1-hour, 24-hour and annual predictions relative to the Project are shown graphically in Figures 3-2, 3-3 and 3-4.

The updated Application Case NO_X emissions did not change from the original Application Case NO_X emissions, but the emissions were distributed differently due to the updated haul road layout.

The updated Application Case NO_2 predictions changed marginally due to the different haul road layout. The updated Application Case predicted 1-hour NO_2 concentrations outside the development area remained below the NWT air quality standards (GNWT 2011). The updated Application Case predicted 24-hour and annual concentrations remained above the respective air quality standards, but the predicted concentrations and the areas exceeding have both decreased marginally. Approximately 1 hectare (ha) outside of the development area is predicted to exceed the 24-hour standard, and less than 1 ha outside of the development area is predicted to exceed the annual standards. These areas are located near the South Mine Rock Pile, Hearne Pit, and the haul roads along the south side of the development area. The relatively high predicted concentrations are a result of the close proximity of haul truck exhaust emission sources to the development area boundary. The predictions at the western edge of the proposed East Arm National Park are well below the NWT air quality standards (GNWT 2011).

Table 3-5 Maximum 1-Hour NO_2 Concentrations - Comparison of Predicted Baseline Case, Original and Updated Application Cases

Parameters	Baseline Case[(a)]	Original Application Case[(a)]	Updated Application Case
Local Study Area (LSA)			
maximum 1-hour NO_2 [µg/m³]	17.9	325.7	361.5
maximum 1-hour NO_2 (excluding development area) [µg/m³]	17.9	314.3	314.8
occurrences above 1-hour NWT AQS [(b)]	0	0	0
area above 1-hour NWT AQS [(b)] (excluding development area) [ha]	0	0	0
Regional Study Area (RSA)			
maximum 1-hour NO_2 [µg/m³]	109.8	325.7	361.5
maximum 1-hour NO_2 (excluding development area) [µg/m³]	109.8	314.3	314.8
occurrences above 1-hour NWT AQS [(b)]	0	0	0
area above 1-hour NWT AQS [(b)] (excluding development area) [ha]	0	0	0

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for 1-hour NO_2 = 400 µg/m³ (GNWT 2011).

$\mu g/m^3$ = microgram per cubic metre; NO_2 = nitrogen dioxide; ha = hectare.

Table 3-6 Maximum 24-Hour NO_2 Concentrations - Comparison of Predicted Baseline Case, Original and Updated Application Cases

Parameters	Baseline Case[(a)]	Original Application Case[(a)]	Updated Application Case
Local Study Area (LSA)			
maximum 24-hour NO_2 [µg/m³]	8.6	258.8	268.5
maximum 24-hour NO_2 (excluding development area) [µg/m³]	8.6	224.8	224.4
occurrences above 24-hour NWT AQS [(b)]	0	2	2
area above 24-hour NWT AQS [(b)] (excluding development area) [ha]	0	9	1
Regional Study Area (RSA)			
maximum 24-hour NO_2 [µg/m³]	81.2	258.8	268.5
maximum 24-hour NO_2 (excluding development area) [µg/m³]	81.2	224.8	224.4
occurrences above 24-hour NWT AQS [(b)]	0	2	2
area above 24-hour NWT AQS [(b)] (excluding development area) [ha]	0	9	1

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for 24-hour NO_2 = 200 µg/m³ (GNWT 2011).

$\mu g/m^3$ = microgram per cubic metre; NO_2 = nitrogen dioxide; ha = hectare.

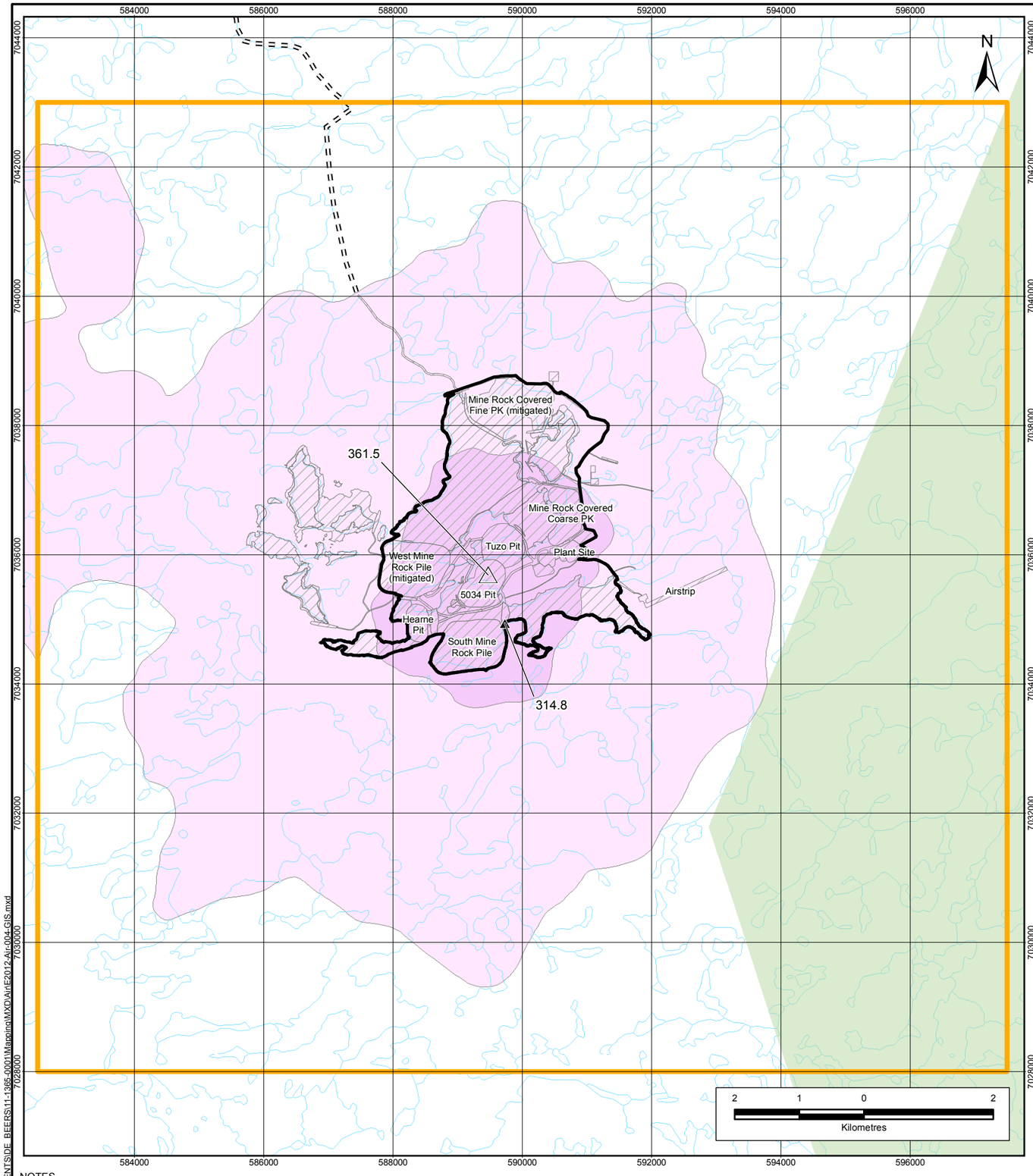
Table 3-7 Maximum Annual NO_2 Concentrations - Comparison of Predicted Baseline Case, Original and Updated Application Cases

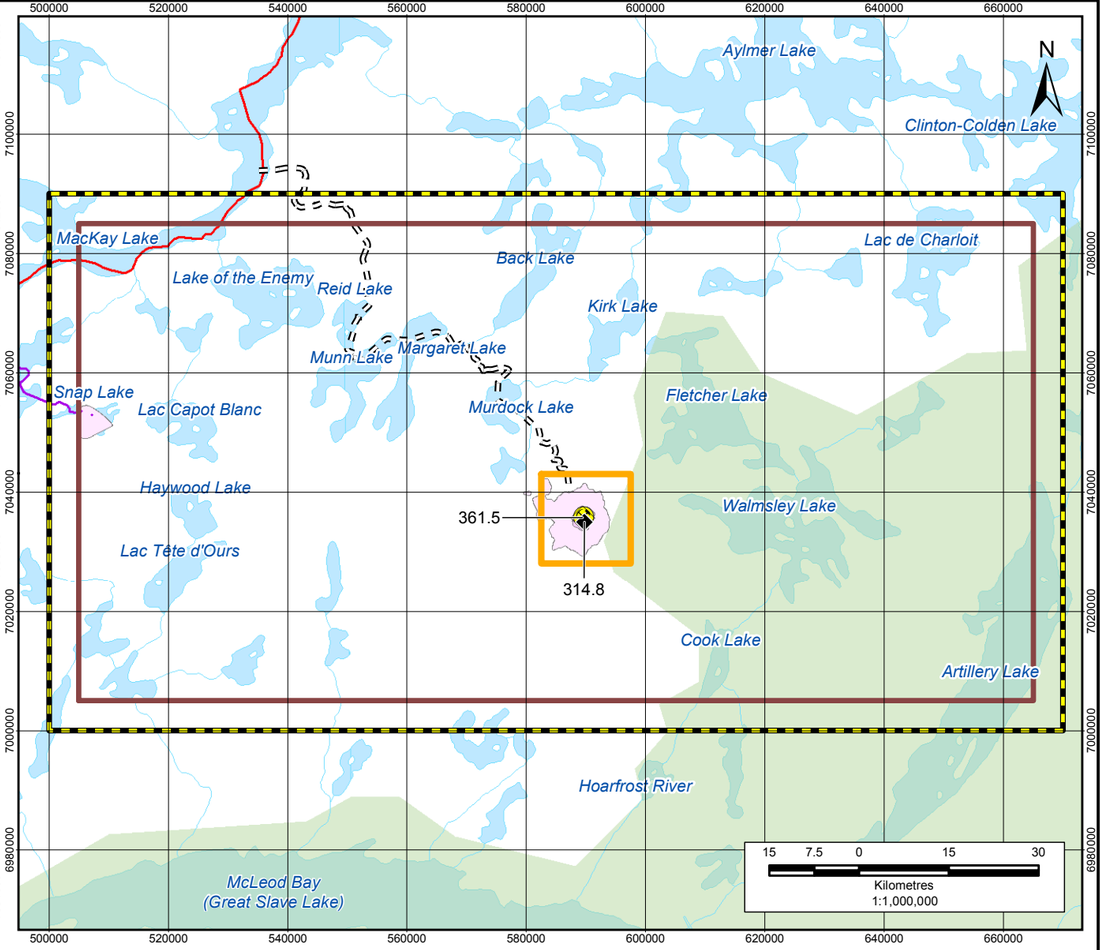
Parameters	Baseline Case[(a)]	Original Application Case[(a)]	Updated Application Case
Local Study Area (LSA)			
maximum annual NO_2 [µg/m³]	5.8	67.7	72.1
maximum annual NO_2 (excluding development area) [µg/m³]	5.8	64.3	62.1
area above annual NWT AQS [(b)] (excluding development area) [ha]	0	1	<1
Regional Study Area (RSA)			
maximum annual NO_2 [µg/m³]	11.9	67.7	72.1
maximum annual NO_2 (excluding development area) [µg/m³]	11.9	64.3	62.1
area above annual NWT AQS [(b)] (excluding development area) [ha]	0	1	<1

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for annual NO_2 = 60 µg/m³ (GNWT 2011).

µg/m^3 = microgram per cubic metre; NO_2 = nitrogen dioxide; ha = hectare.





LEGEND

- Gahcho Kué Project
- Existing Winter Road
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- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
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- Maximum Prediction Within RSA Excluding Development Area
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- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration (µg/m^3)

- >= 400
- 200 to < 400
- 100 to < 200
- 0 to < 100

NWT Standard = 400 µg/m^3
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

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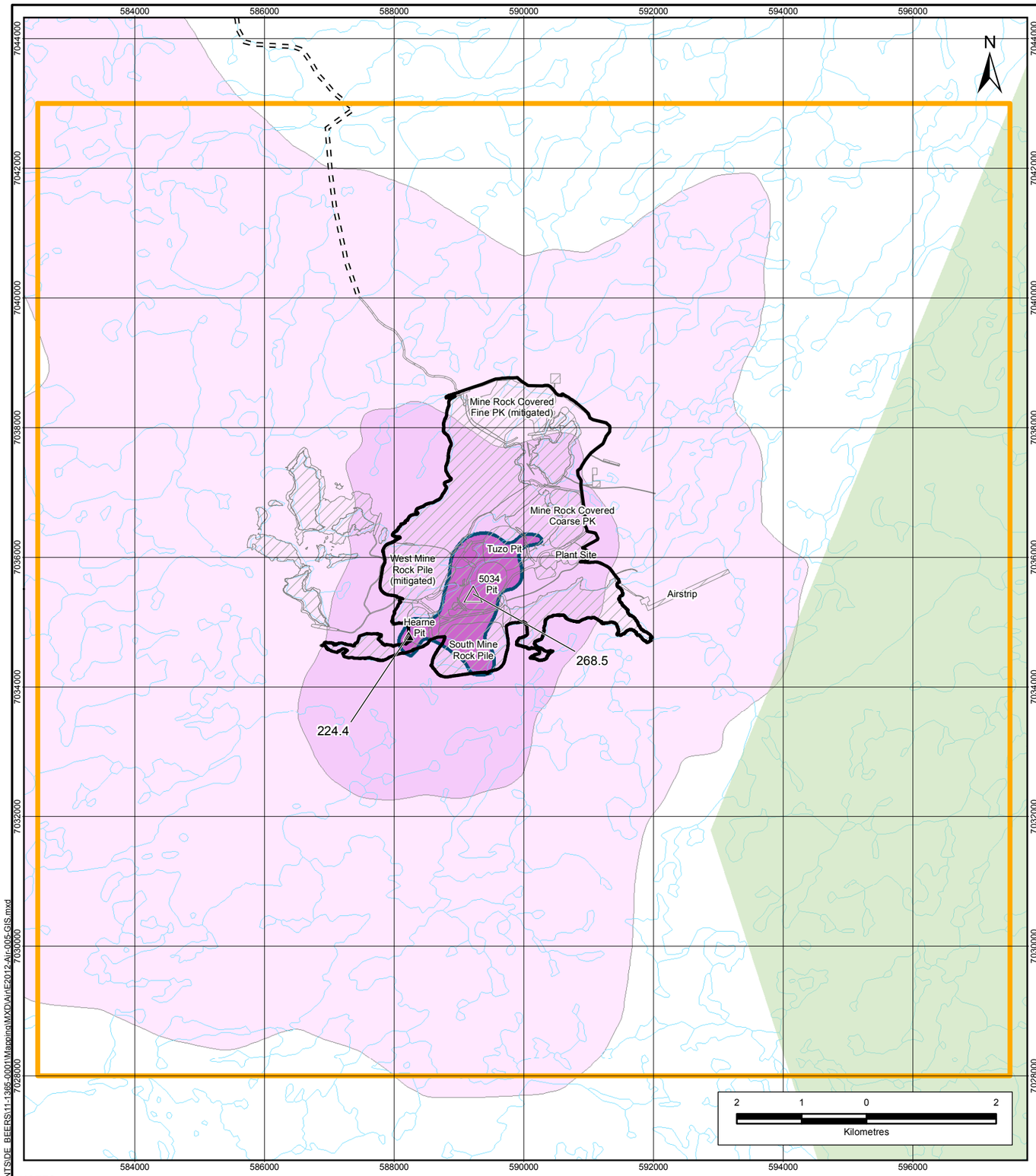
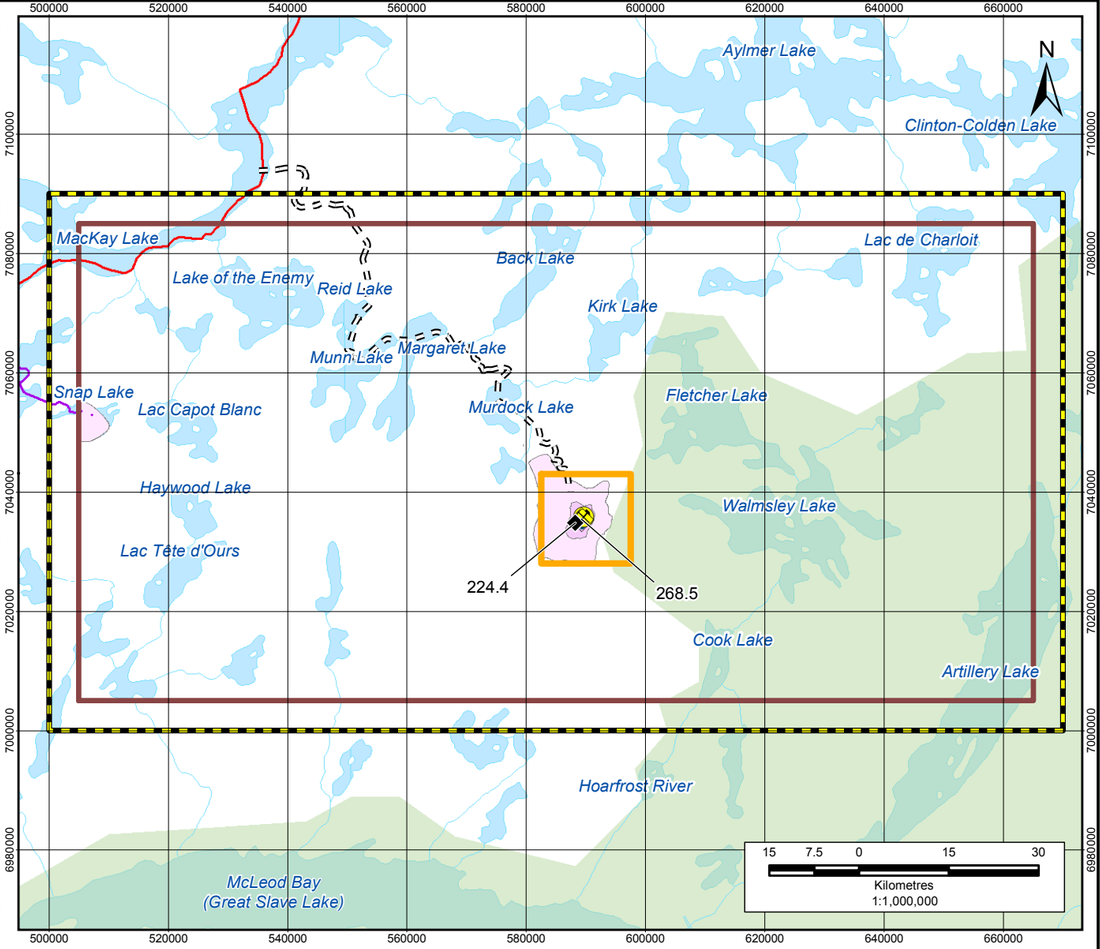
GAHCHO KUÉ PROJECT

Maximum 1-hour NO_2 Concentrations - Updated Application Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-004-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	
OFFICE: GOLD-CAL	DRAWN: DC / CHECK: DC	**Figure 3-2**





LEGEND

- Gahcho Kué Project
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration (µg/m³)

- > = 200
- 100 to < 200
- 50 to < 100
- 0 to < 50

NWT Standard = 200 µg/m³
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

GAHCHO KUÉ PROJECT

Maximum 24-hour NO_2 Concentrations - Updated Application Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-005-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	
OFFICE: GOLD-CAL	DRAWN: DC / CHECK: DC	**Figure 3-3**

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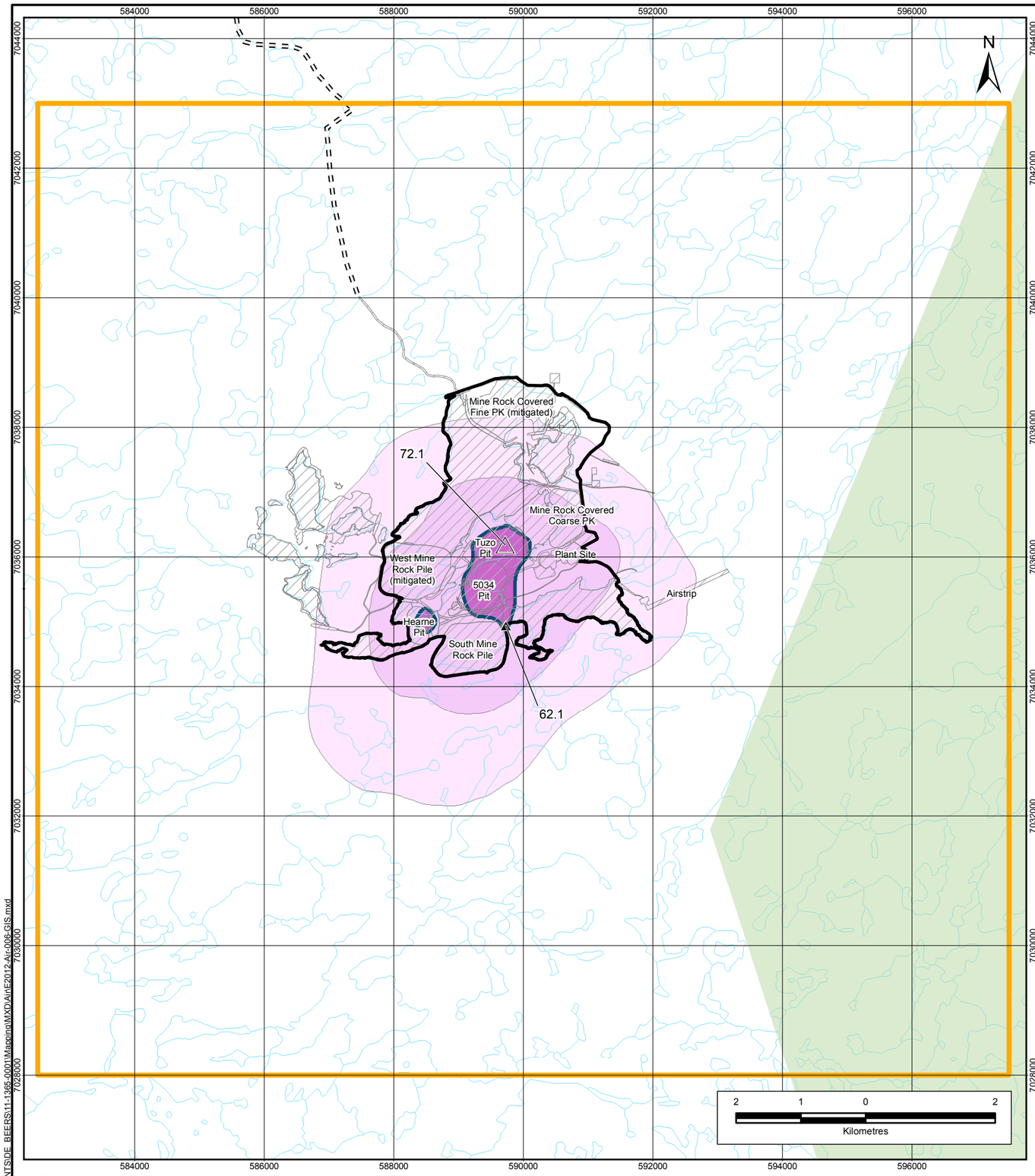

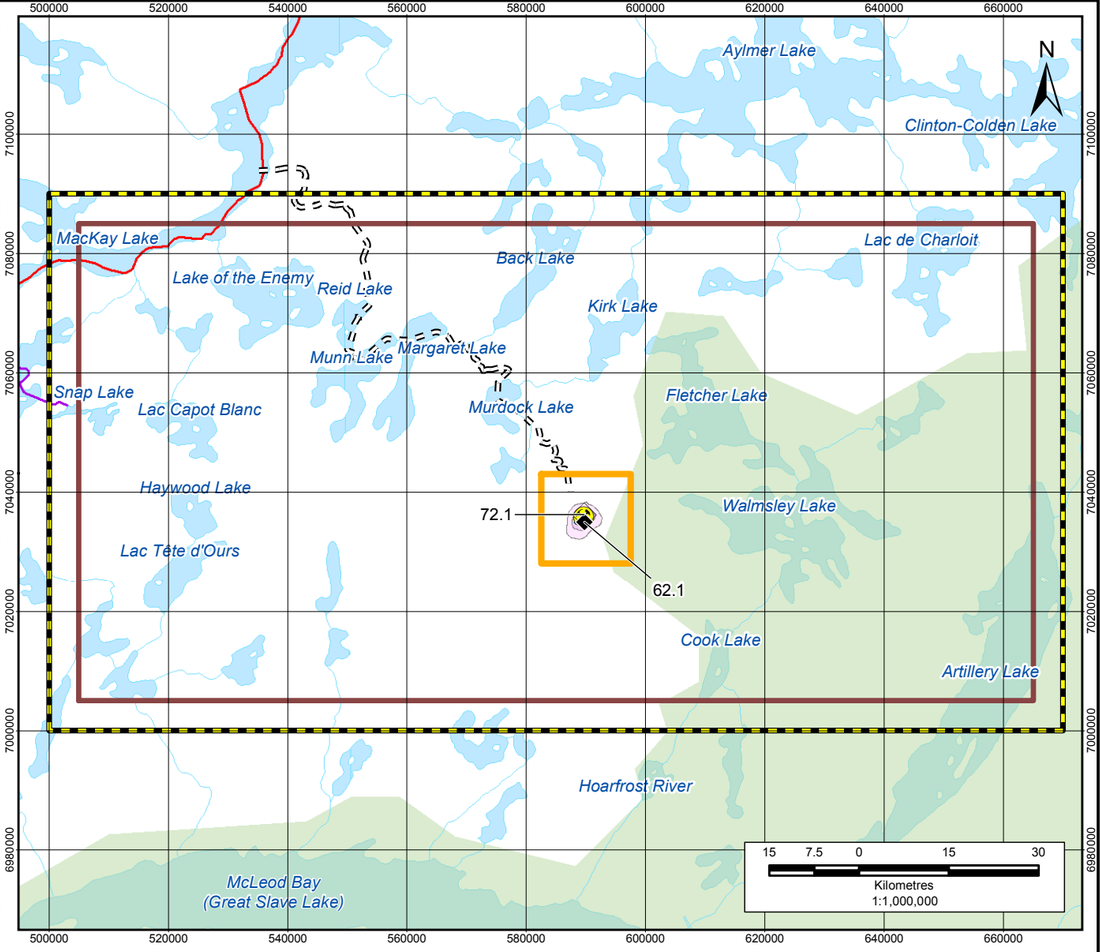

LEGEND

- Gahcho Kué Project
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration (µg/m^3)

- >= 60
- 30 to < 60
- 15 to < 30
- 0 to < 15

NWT Standard = 60 µg/m^3
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

GAHCHO KUÉ PROJECT

Maximum Annual NO_2 Concentrations - Updated Application Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-006-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	
OFFICE: GOLD-CAL	DRAWN: DC / CHECK: DC	**Figure 3-4**

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3.4 CO PREDICTIONS

In the Round 1 Information Request (EC&GNWT_4) for the 2010 EIS, Environment Canada and GNWT indicated that CO monitoring data have been recorded at the SJ_Franklin Station located in Yellowknife since 2003 and background CO concentrations derived these data should be added to the model predictions (De Beers 2012b, EC&GNWT_4). Based on the Environment Canada and GNWTs comment, the SJ_Franklin Station CO data have been used to determine a background concentration to be added to the modelling results.

The same 2006 time range has been used for the CO data set as used for NO_2 and ozone. The CO data collected at the SJ_Franklin Station in 2006 have a median value of 0.1 part per million (ppm) or 116.5 µg/m³. Use of the median value for the background concentration of CO is consistent with NO_2 and ozone, which also used median concentrations calculated in a similar manner. 1-hour CO concentrations measured at the SJ_Franklin station are summarized in Table 3-8. As the SJ_Franklin Station is located in Yellowknife, near to anthropogenic emission sources, the CO background concentration used for the assessment is likely conservative. Actual baseline concentrations near the project are expected to be lower.

Table 3-8 2006 1-Hour CO Concentrations recorded at SJ_Franklin Station in Yellowknife

Month	Concentration [ppm]	
	Median	Maximum
January	0.1	1.7
February	0.1	1.1
March	0.1	0.5
April	0.1	0.4
May	0	0.3
June	0	0.1
July	-	-
August	0.2	0.6
September	0.1	0.7
October	0.1	1.5
November	0.2	2.9
December	0.3	1.2

Source: GNWT ENR-EPD (2006).

- = no data collected or invalid measurement;; ppm = parts per million; CO = carbon monoxide.

Tables 3-9 and 3-10 compare the Baseline Case and Application Case predicted 1-hour and 8-hour CO concentrations with the background concentrations added. The predicted concentrations in both assessment cases are below the NWT air quality standards (GNWT 2011). Figure 3-5 shows the updated Application Case maximum predicted 8-hour CO concentrations relative to the Project.

Table 3-9 Maximum 1-Hour CO Concentrations - Comparison of Predicted Updated Baseline Case, Original and Updated Application Cases

Parameters	Updated Baseline Case[(a)]	Original Application Case[(a)]	Updated Application Case
Local Study Area (LSA)			
maximum 1-hour CO [µg/m³]	120.0	2,884.4	3,239.3
maximum 1-hour CO (excluding development area) [µg/m³]	120.0	1,978.6	2,144.0
occurrences above 1-hour NWT AQS [(b)]	0	0	0
area above 1-hour NWT AQS [(b)] (excluding development area) [ha]	0	0	0
Regional Study Area (RSA)			
maximum 1-hour CO [µg/m³]	275.7	2,884.4	3,239.3
maximum 1-hour CO (excluding development area) [µg/m³]	275.7	1,978.6	2,144.0
occurrences above 1-hour NWT AQS [(b)]	0	0	0
area above 1-hour NWT AQS [(b)] (excluding development area) [ha]	0	0	0

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for 1-hour CO = 15,000 µg/m³ (GNWT 2011).

µg/m^3 = microgram per cubic metre; CO = carbon monoxide; ha = hectare.

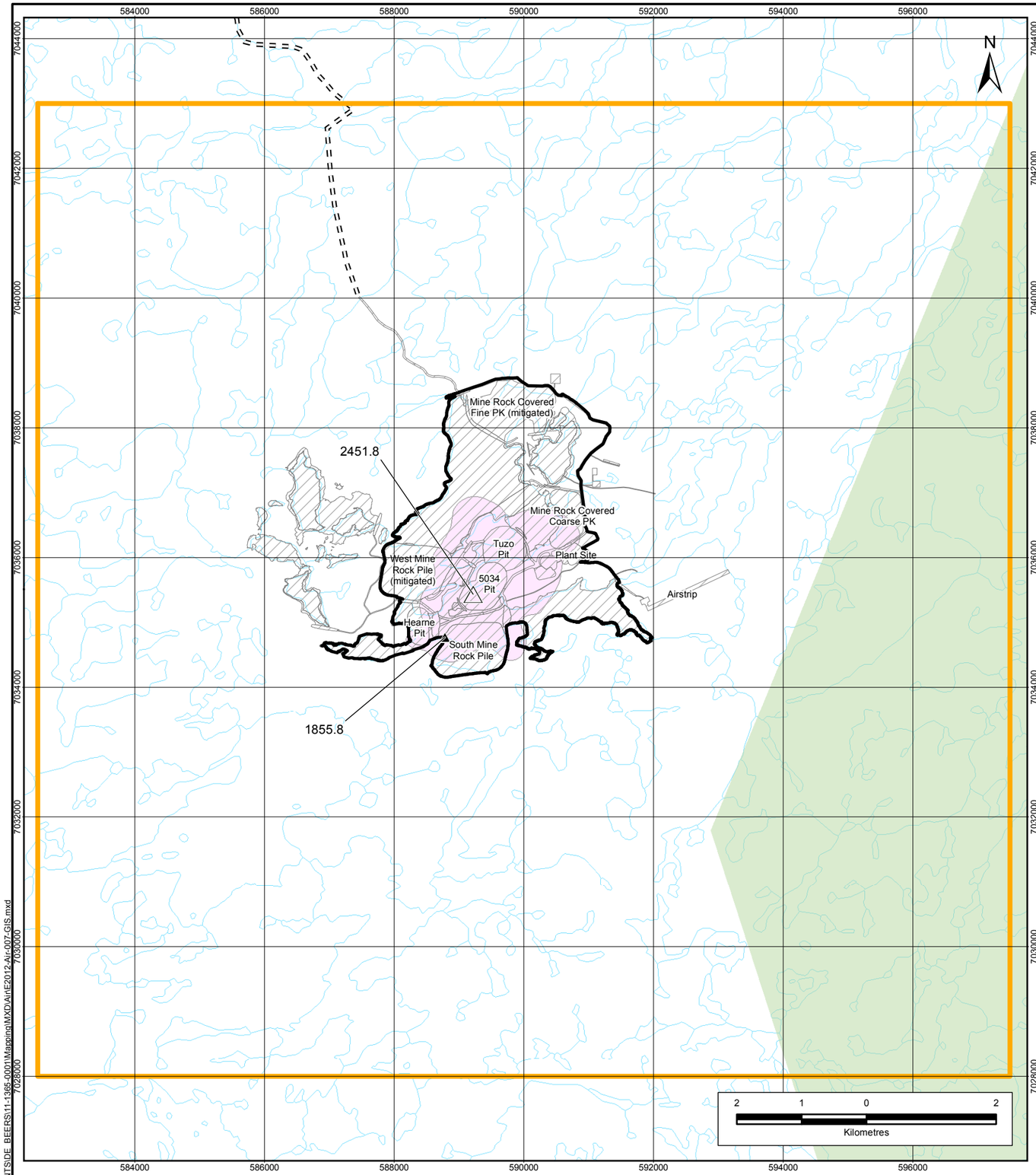
Table 3-10 Maximum 8-Hour CO Concentrations - Comparison of Predicted Updated Baseline Case, Original and Updated Application Cases

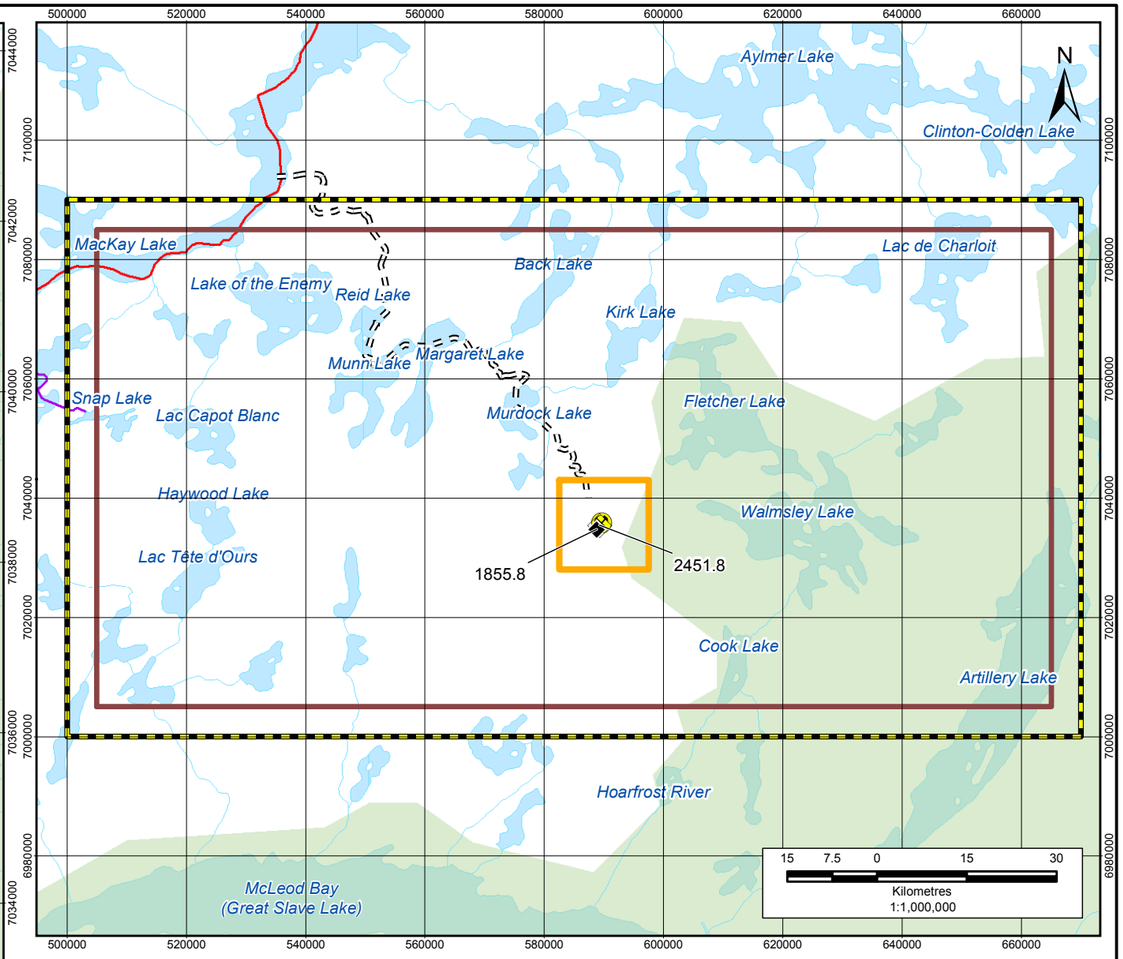
Parameters	Updated Baseline Case[(a)]	Original Application Case[(a)]	Updated Application Case
Local Study Area (LSA)			
maximum 8-hour CO [µg/m³]	118.3	2,170.2	2,451.8
maximum 8-hour CO (excluding development area) [µg/m³]	118.3	1,692.1	1,855.8
occurrences above 8-hour NWT AQS [(b)]	0	0	0
area above 8-hour NWT AQS [(b)] (excluding development area) [ha]	0	0	0
Regional Study Area (RSA)			
maximum 8-hour CO [µg/m³]	200.2	2,170.2	2,451.8
maximum 8-hour CO (excluding development area) [µg/m³]	200.2	1,692.1	1,855.8
occurrences above 8-hour NWT AQS [(b)]	0	0	0
area above 8-hour NWT AQS [(b)] (excluding development area) [ha]	0	0	0

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for 24-hour CO = 6,000 µg/m³ (GNWT 2011).

µg/m^3 = microgram per cubic metre; CO = carbon monoxide; ha = hectare.





LEGEND

- Gahcho Kué Project
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Concentration ($\mu g/m^3$)

- >= 6000
- 3000 to < 6000
- 1500 to < 3000
- 0 to < 1500

NWT Standard = 6000 $\mu g/m^3$
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

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GAHCHO KUÉ PROJECT

Maximum 8-hour CO Concentrations - Updated Application Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-007-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	**Figure 3-5**
OFFICE: GOLD-CAL	DRAWN: DC / CHECK: DC	

3.5 $PM_{2.5}$ PREDICTIONS

Table 3-11 provides a comparison of the Baseline Case, the original Application Case and the updated Application Case predicted maximum 24-hour $PM_{2.5}$ concentrations. The updated Application Case predicted concentrations, as well as the areas outside of the development area and days exceeding NWT air quality standard have all decreased from those predicted for the original Application Case. The primary reason for the decrease in the predictions is the higher mitigation efficiencies assumed for the road dust emissions in the updated Application Case (i.e., 70% and 95% mitigation efficiencies for summer and winter, respectively) compared to the efficiencies assumed in the original Application Case (55% and 0% for summer and winter, respectively). A field study of road dust emissions at the Victor and Snap Lake mines was undertaken in the fall of 2011 and winter of 2012 to provide a better understanding of seasonal road dust emissions (Golder 2012). In the study, measured winter road dust emissions were compared to the unmitigated summer road dust emissions to quantify the level of natural mitigation of winter conditions. Detailed discussion on the assumed seasonal mitigation control efficiencies for the road dust emissions is provided in Appendix I.

Table 3-11 Maximum 24-Hour $PM_{2.5}$ Concentrations - Comparison of Predicted Baseline Case, Original and Updated Application Cases

Parameters	Baseline Case[(a)]	Original Application Case[(a)]	Updated Application Case
Local Study Area (LSA)			
maximum 24-hour $PM_{2.5}$ [µg/m³]	2.2	319.4	267.7
maximum 24-hour $PM_{2.5}$ (excluding development area) [µg/m³]	2.2	228.9	137.7
occurrences above 24-hour NWT AQS[(b)]	0	69	62
area above 24-hour NWT AQS[(b)] (excluding development area) [ha]	0	1,620	865
Regional Study Area (RSA)			
maximum 24-hour $PM_{2.5}$ [µg/m³]	5.5	319.4	267.7
maximum 24-hour $PM_{2.5}$ (excluding development area) [µg/m³]	5.5	228.9	137.7
occurrences above 24-hour NWT AQS[(b)]	0	69	62
area above 24-hour NWT AQS[(b)] (excluding development area) [ha]	0	1,620	865

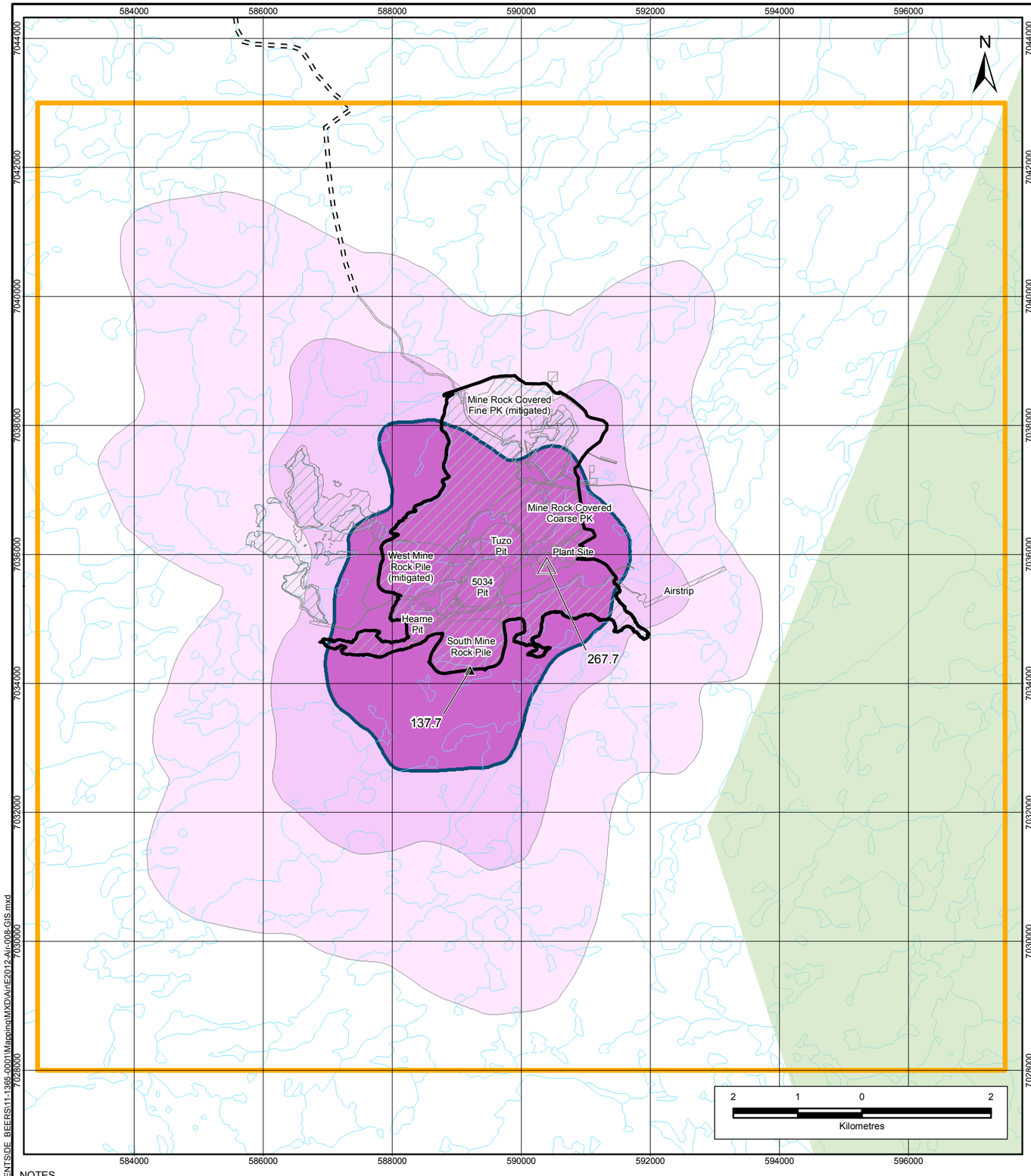
[(a)] De Beers 2010, Section 11.4.

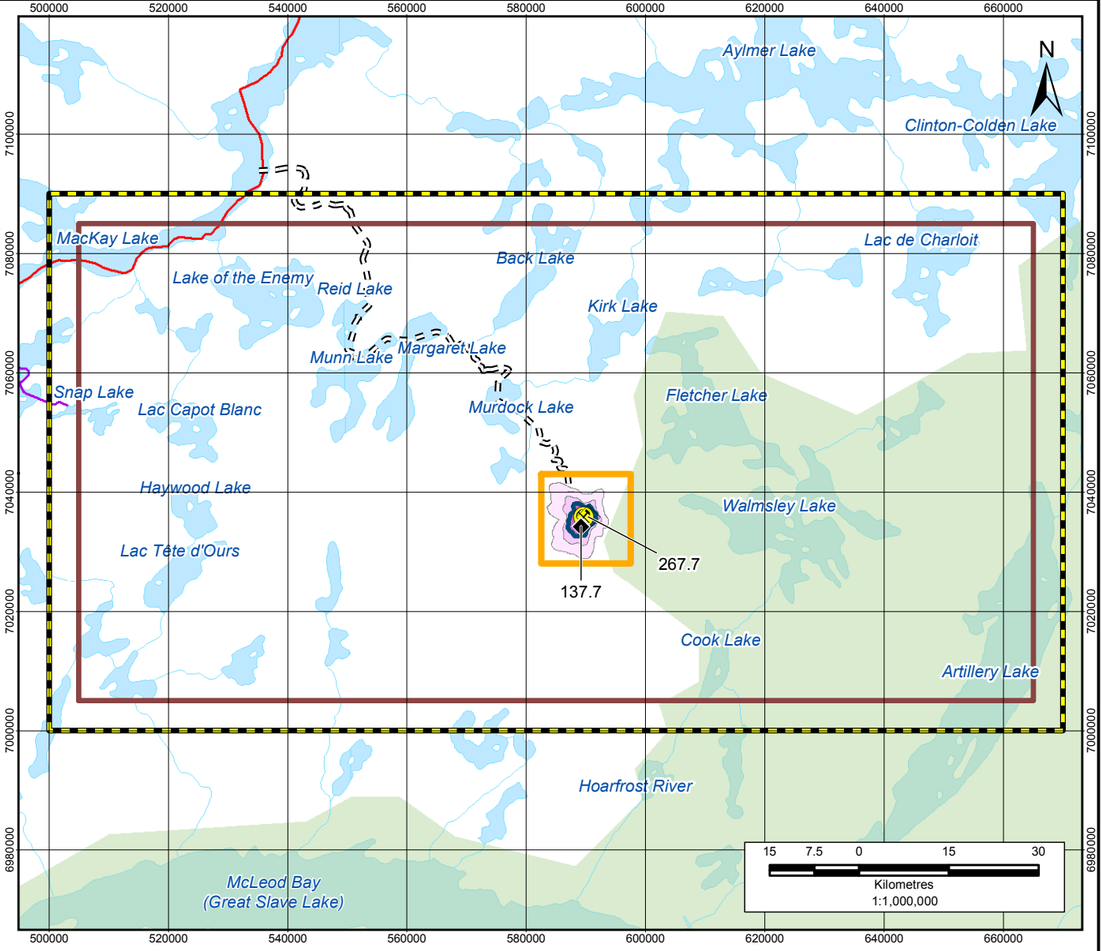
[(b)] NWT Air Quality Standard (AQS) for 24-hour $PM_{2.5}$ = 30 µg/m³ (GNWT 2011).

$\mu g/m^3$ = microgram per cubic metre; PM = particulate matter; ha = hectare.

Figure 3-6 shows the updated Application Case predicted maximum 24-hour $PM_{2.5}$ concentrations relative to the Project. The Application Case predicted maximum 24-hour concentrations outside the development area exceed the NWT air quality standard of 30 µg/m³ for a maximum of 62 days per year, or 17% of a year (GNWT 2011). Predicted maximum $PM_{2.5}$ concentrations are located near the haul roads, which run along the southern, western and eastern boundaries of the development area. More specifically, they are largely a result of fugitive road dust emissions.

Figure 3-7 illustrates the number of days the area surrounding the Project will experience $PM_{2.5}$ concentrations above the NWT air quality standard. The figure shows that predicted $PM_{2.5}$ concentrations in the majority of the area surrounding the Project will exceed the standard between 1 to 14 days per year. Only the area immediately adjacent to the emission sources is predicted to experience more than 14 days of concentrations above the standard. No concentration above the NWT air quality standard is predicted beyond approximately 1.6 km from the development area boundary or inside the proposed East Arm National Park.





LEGEND

- Gahcho Kué Project
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
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- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration (µg/m^3)

- > = 30
- 15 to < 30
- 7.5 to < 15
- 0 to < 7.5

NWT Standard = 30 µg/m^3
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

GAHCHO KUÉ PROJECT

Maximum 24-hour $PM_{2.5}$ Concentrations - Updated Application Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-008-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	**Figure 3-6**
OFFICE: GOLD-CAL	DRAWN: DC / CHECK: DC	

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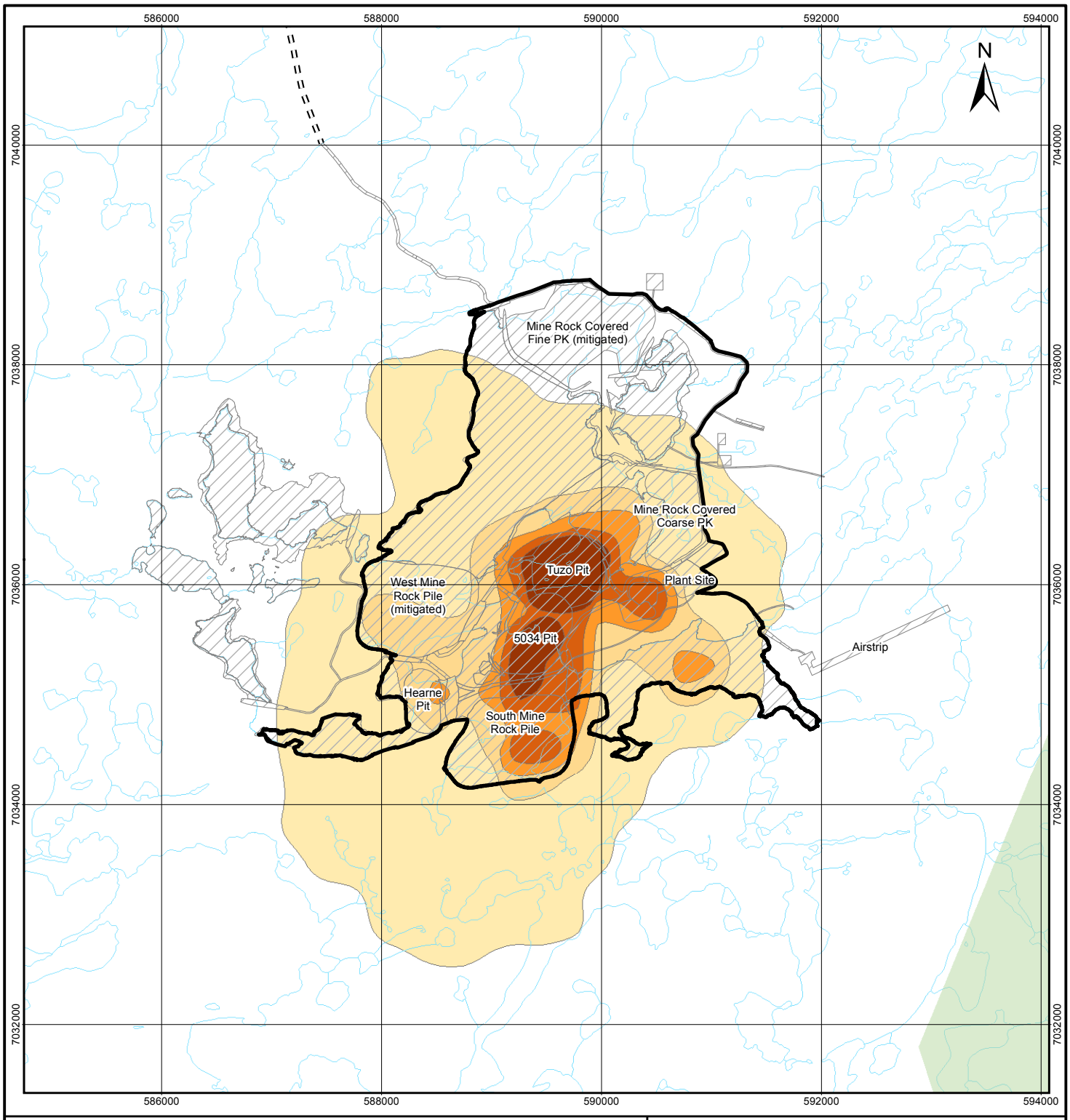

LEGEND

= = Proposed Winter Access Road
Watercourse
Waterbody
Development Area Boundary
Project Footprint
The Study Area for a National Park on the East Arm of Great Slave Lake

Numbers of Days Exceeding Air Quality Standard

> 60
45 to 59
30 to 44
15 to 29
1 to 14

NWT Standard = 30 µg/m^3
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000

GAHCHO KUÉ PROJECT

Number of Days Exceeding 24-hour $PM_{2.5}$ NWT Air Quality Standard

PROJECTION: UTM Zone 12	DATUM: NAD83	
Scale: 1:50,000 500 250 0 500 Metres		DE BEERS CANADA
FILE No: E2012-Air-009-GIS		DATE: June 22, 2012
JOB NO: 11-1365-0001	REVISION NO: 1	
OFFICE: GOLD-CAL	DRAWN: SK	CHECK: DC

Figure 3-7

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3.6 TSP PREDICTIONS

Table 3-12 provides a comparison of the Baseline Case, the original Application Case and the updated Application Case predicted 24-hour TSP concentrations. The updated Application Case predicted maximum concentrations as well as occurrences and areas exceeding the NWT air quality standard (GNWT 2011) have all decreased significantly from those predicted in the original Application Case. However, the predictions are still predicted to exceed the NWT air quality standard of 120 µg/m³ for a maximum of 230 days per year, or 63% of the time. The primary reason for the decrease in the predictions is the higher mitigation efficiencies assumed for the road dust emissions in the updated Application Case, which is partially based on the road dust field study (Golder 2012). Figure 3-8 shows that the area above the standard extends no further than approximately 1.1 km beyond the development area boundary. Predicted maximum concentrations are located near the haul roads along the southern, western and eastern boundary of the development area; and are primarily a result of fugitive road dust emissions.

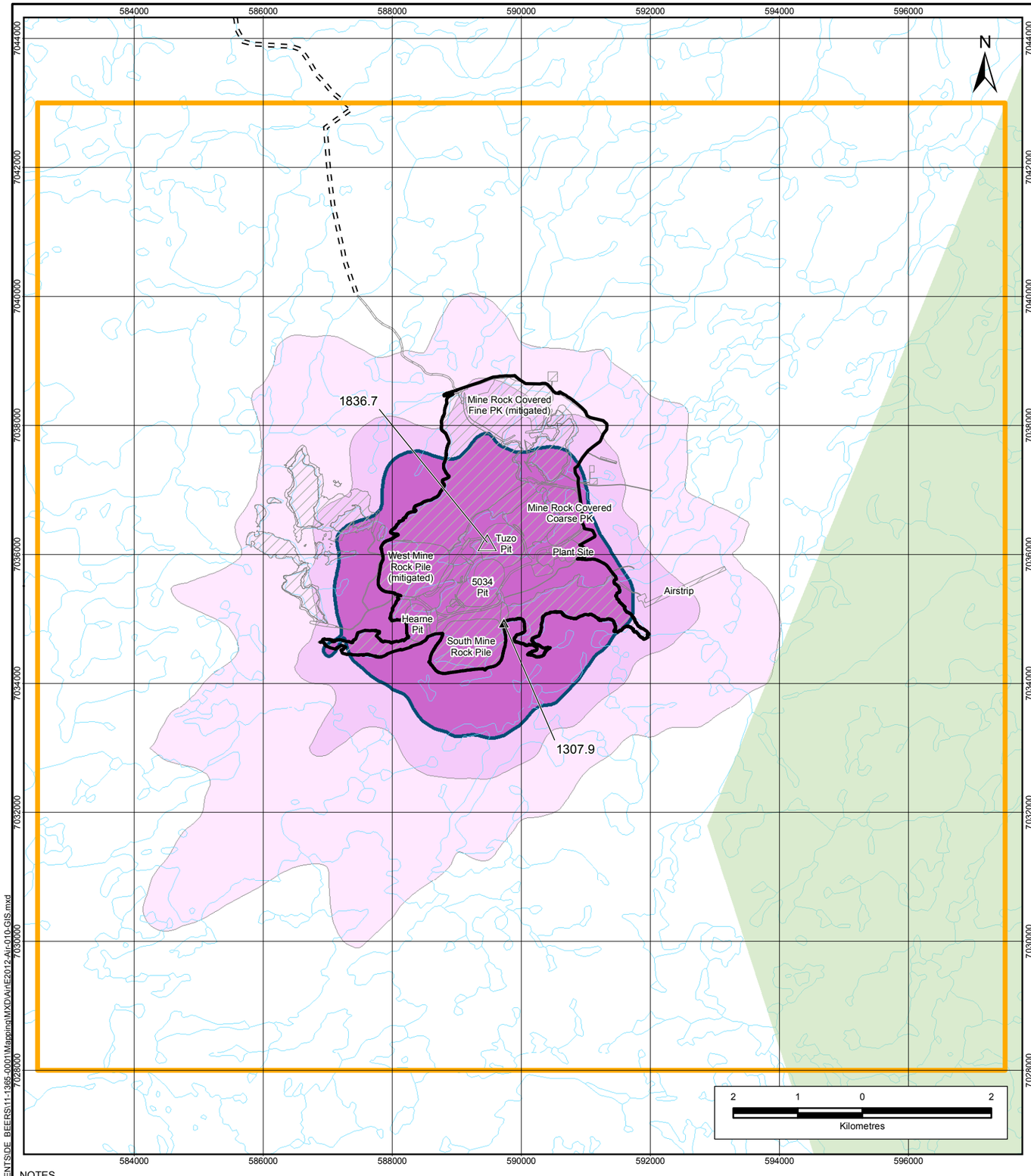
Table 3-12 Maximum 24-Hour TSP Concentrations - Comparison of Predicted Baseline Case, Original and Updated Application Cases

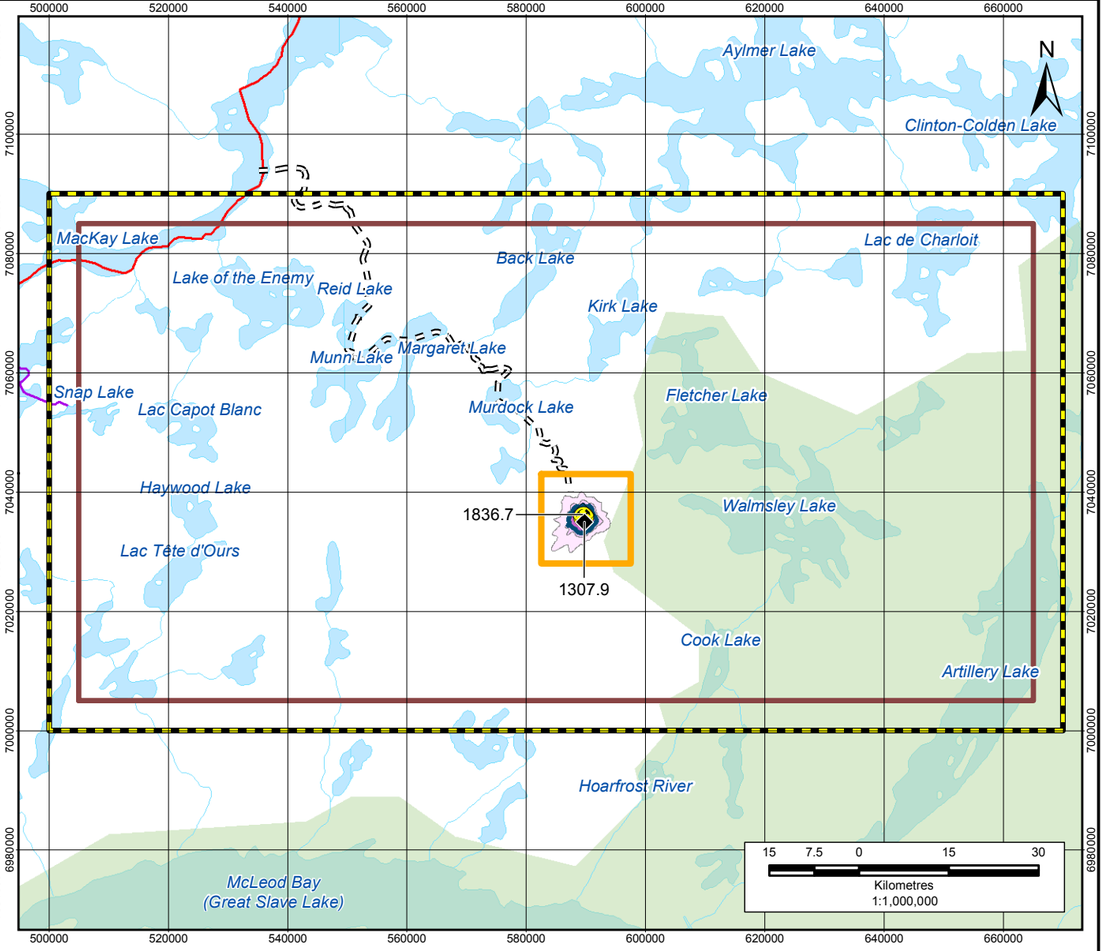
Parameters	Baseline Case[(a)]	Original Application Case[(a)]	Updated Application Case
Local Study Area (LSA)			
maximum 24-hour TSP [µg/m³]	7.1	6,072.8	1,836.7
maximum 24-hour TSP (excluding development area) [µg/m³]	7.1	4,837.6	1,307.9
occurrences above 24-hour NWT AQS[(b)]	0	325	230
area above 24-hour NWT AQS[(b)] (excluding development area) [ha]	0	1,217	648
Regional Study Area (RSA)			
maximum 24-hour TSP [µg/m³]	7.1	6,072.8	1,836.7
maximum 24-hour TSP (excluding development area) [µg/m³]	7.1	4,837.6	1,307.9
occurrences above 24-hour NWT AQS[(b)]	0	325	230
area above 24-hour NWT AQS[(b)] (excluding development area) [ha]	0	1,217	648

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for 24-hour TSP = 120 µg/m³ (GNWT 2011).

µg/m³ = microgram per cubic metre; TSP = total suspended particulate; ha = hectare.





LEGEND

- Gahcho Kué Project
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- Waterbody
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- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration (µg/m³)

- > = 120
- 60 to < 120
- 30 to < 60
- 0 to < 30

NWT Standard = 120 µg/m³
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

GAHCHO KUÉ PROJECT

Maximum 24-hour TSP Concentrations - Updated Application Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-010-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	**Figure 3-8**
OFFICE: GOLD-CAL	DRAWN: DC / CHECK: DC	

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Figure 3-9 shows the number of days the area surrounding the Project is predicted to experience TSP concentrations above the NWT air quality standard (GNWT 2011). The majority of the area with predicted concentrations above the standard is predicted to experience between 1 and 59 days of concentrations above the standard. Only the area adjacent to the emission sources is predicted to experience more than 59 days of concentrations above the standard. No exceedances above the NWT air quality standard are predicted beyond approximately 1.1 km from the development area boundary or inside the proposed East Arm National Park.

Table 3-13 provides a comparison of the Baseline Case, the original Application Case and the updated Application Case predicted maximum annual TSP concentrations. The updated Application Case predicted concentrations and area outside of the development predicted to exceed the NWT air quality standard (GNWT 2011) have both decreased by more than 50% from the original Application Case predictions. Figure 3-10 shows that the expected area above the standard extends no further than approximately 1.1 km beyond the development area boundary and it is not expected inside the proposed East Arm National Park. The maximum concentration predictions are located near the haul roads along the southern and eastern boundary of the development area and are primarily results of fugitive road dust emissions.

Table 3-13 Maximum Annual TSP Concentrations - Comparison of Predicted Baseline Case, Original and Updated Application Cases

Parameters	Baseline Case[(a)]	Original Application Case[(a)]	Updated Application Case
Local Study Area (LSA)			
maximum annual TSP [µg/m³]	7.1	688.7	356.7
maximum annual TSP (excluding development area) [µg/m³]	7.1	604.8	278.1
area above annual NWT AQS[(b)] (excluding development area) [ha]	0	202	64
Regional Study Area (RSA)			
maximum annual TSP [µg/m³]	7.1	688.7	356.7
maximum annual TSP (excluding development area) [µg/m³]	7.1	604.8	278.1
area above annual NWT AQS[(b)] (excluding development area) [ha]	0	202	64

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for annual TSP = 60 µg/m³ (GNWT 2011).

µg/m^3 = microgram per cubic metre; TSP = total suspended particulate; ha = hectare.

Table 3-14 presents the Baseline Case, the original Application Case and the updated Application Case predicted TSP deposition rates overall and outside the development area. The predicted maximum TSP deposition rate outside the development area for the updated Application Case is less than 50% of the value

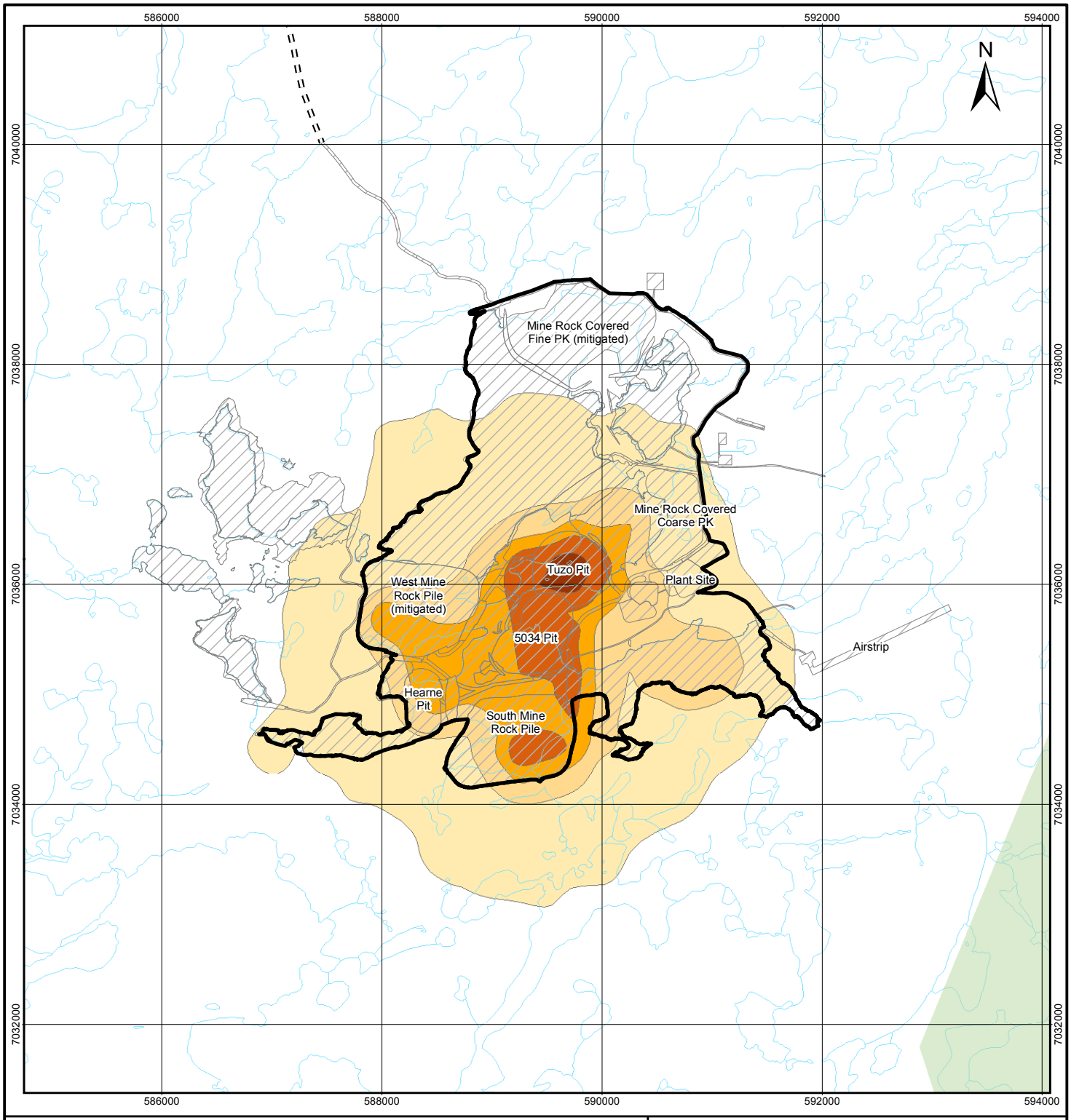
predicted in the original Application Case. Figure 3-11 shows the pattern of annual TSP deposition for the updated Application Case. The areas with the highest deposition are within the Project footprint and specifically associated with the location of the mine pits and the mine rock piles.

Table 3-14 TSP Deposition - Comparison of Predicted Baseline Case, Original and Updated Application Cases

Parameters	Baseline Case[(a)]	Original Application Case[(a)]	Updated Application Case
Local Study Area (LSA)			
TSP deposition [kg/ha/y]	0.0	6,292	3,253
TSP deposition [kg/ha/y] (excluding development area)	0.0	5,520	2,516
Regional Study Area (RSA)			
TSP deposition [kg/ha/y]	4.7	6,292	3,253
TSP deposition [kg/ha/y] (excluding development area)	4.7	5,520	2,516

[(a)] De Beers 2010, Section 11.4.

kg/ha/y = kilogram per hectare per year; TSP = total suspended particulate.



LEGEND

= = Proposed Winter Access Road
Watercourse
Waterbody
Development Area Boundary
Project Footprint
The Study Area for a National Park on the East Arm of Great Slave Lake

Numbers of Days Exceeding Air Quality Standard

- > 240
- 180 to 239
- 120 to 179
- 60 to 119
- 1 to 59
- 0 to <1

NWT Standard = 120 µg/m^3
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000

GAHCHO KUÉ PROJECT

Number of Days Exceeding 24-hour TSP NWT Air Quality Standard

PROJECTION: UTM Zone 12	DATUM: NAD83	
Scale: 1:50,000 500 250 0 500 Metres		DE BEERS CANADA
FILE No: E2012-Air-011-GIS		DATE: July 18, 2012
JOB NO: 11-1365-0001	REVISION NO: 1	
OFFICE: GOLD-CAL	DRAWN: DC / CHECK: DC	**Figure 3-9**

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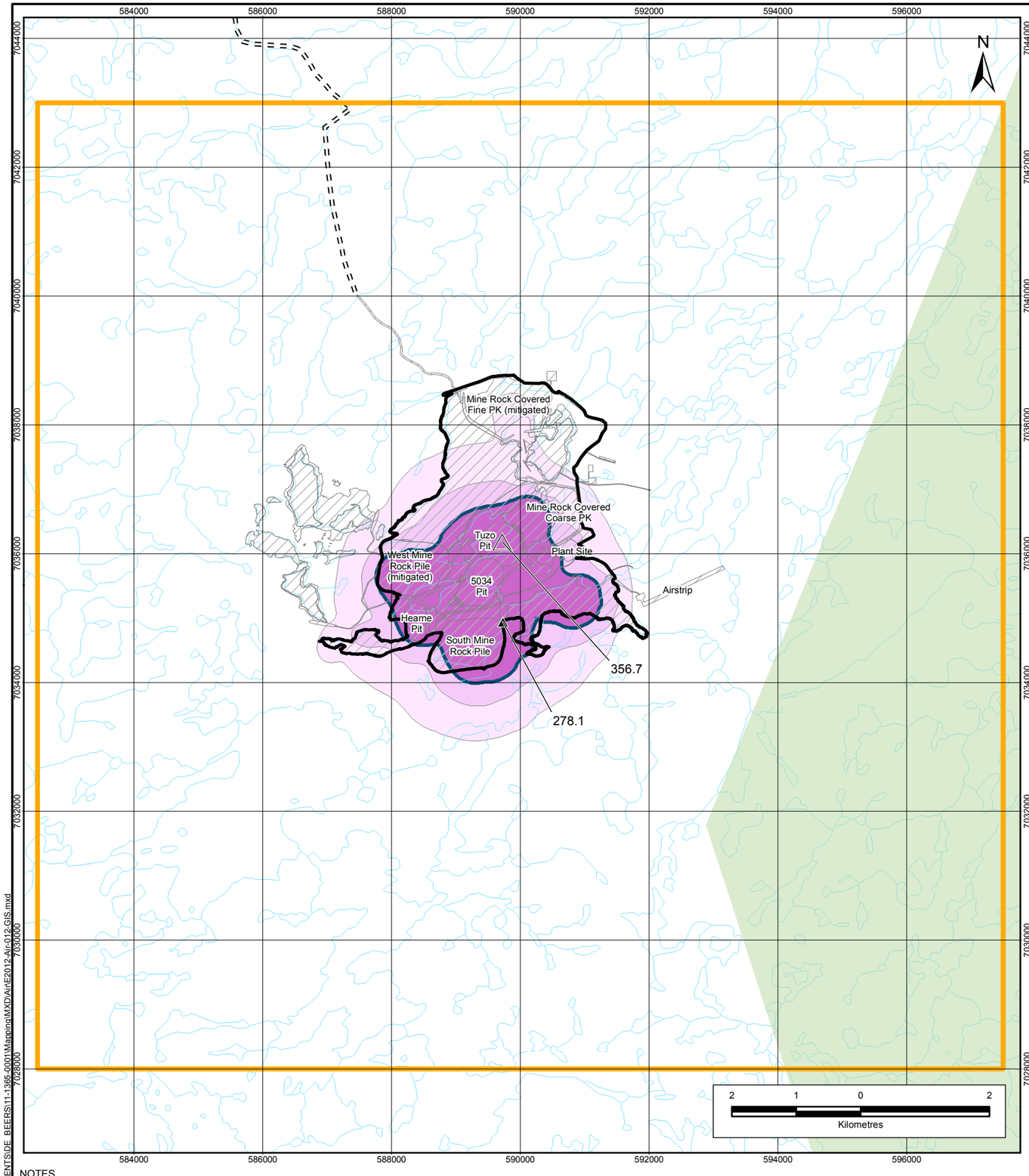

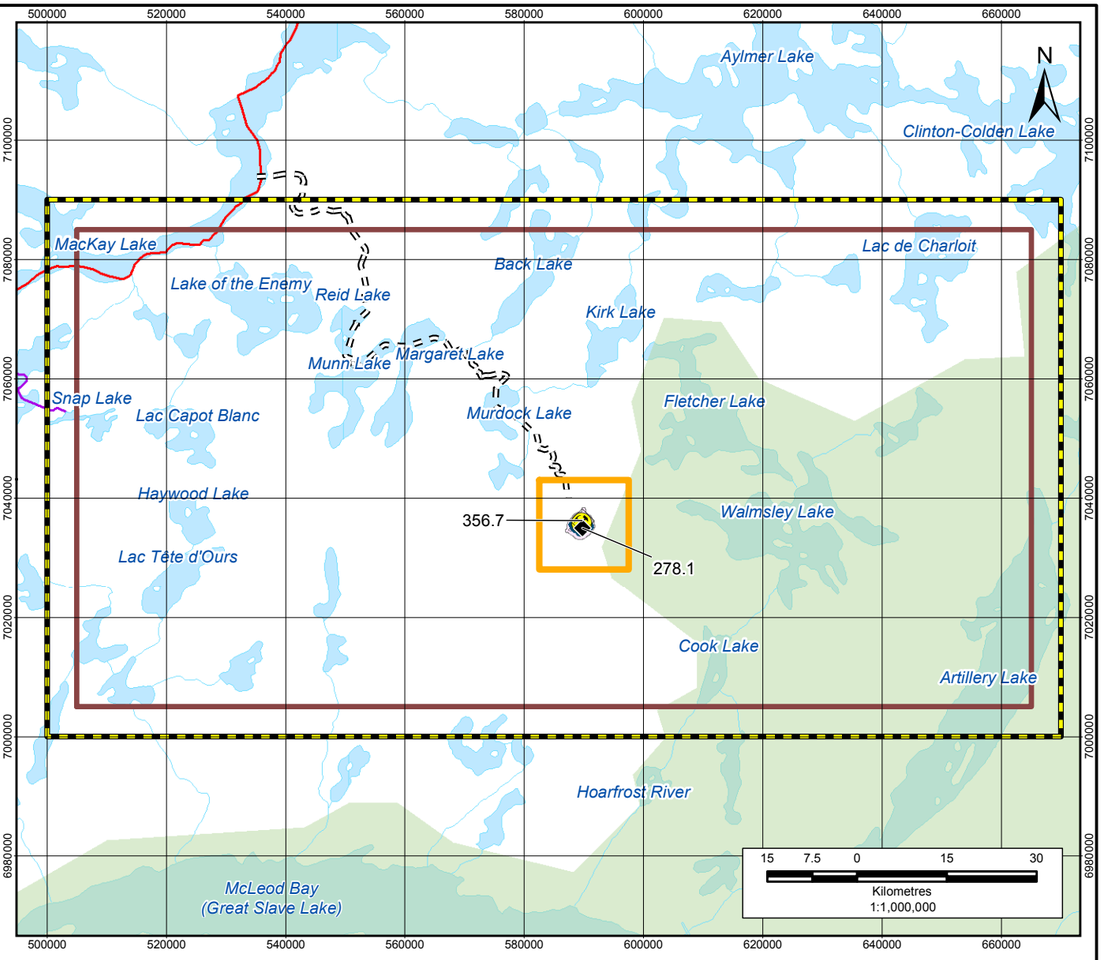

LEGEND

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- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration (µg/m³)

- > = 60
- 30 to < 60
- 15 to < 30
- 0 to < 15

NWT Standard = 60 µg/m³
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

GAHCHO KUÉ PROJECT

Maximum Annual TSP Concentrations - Updated Application Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-012-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	**Figure 3-10**
OFFICE: GOLD-CAL	DRAWN: DC / CHECK: DC	

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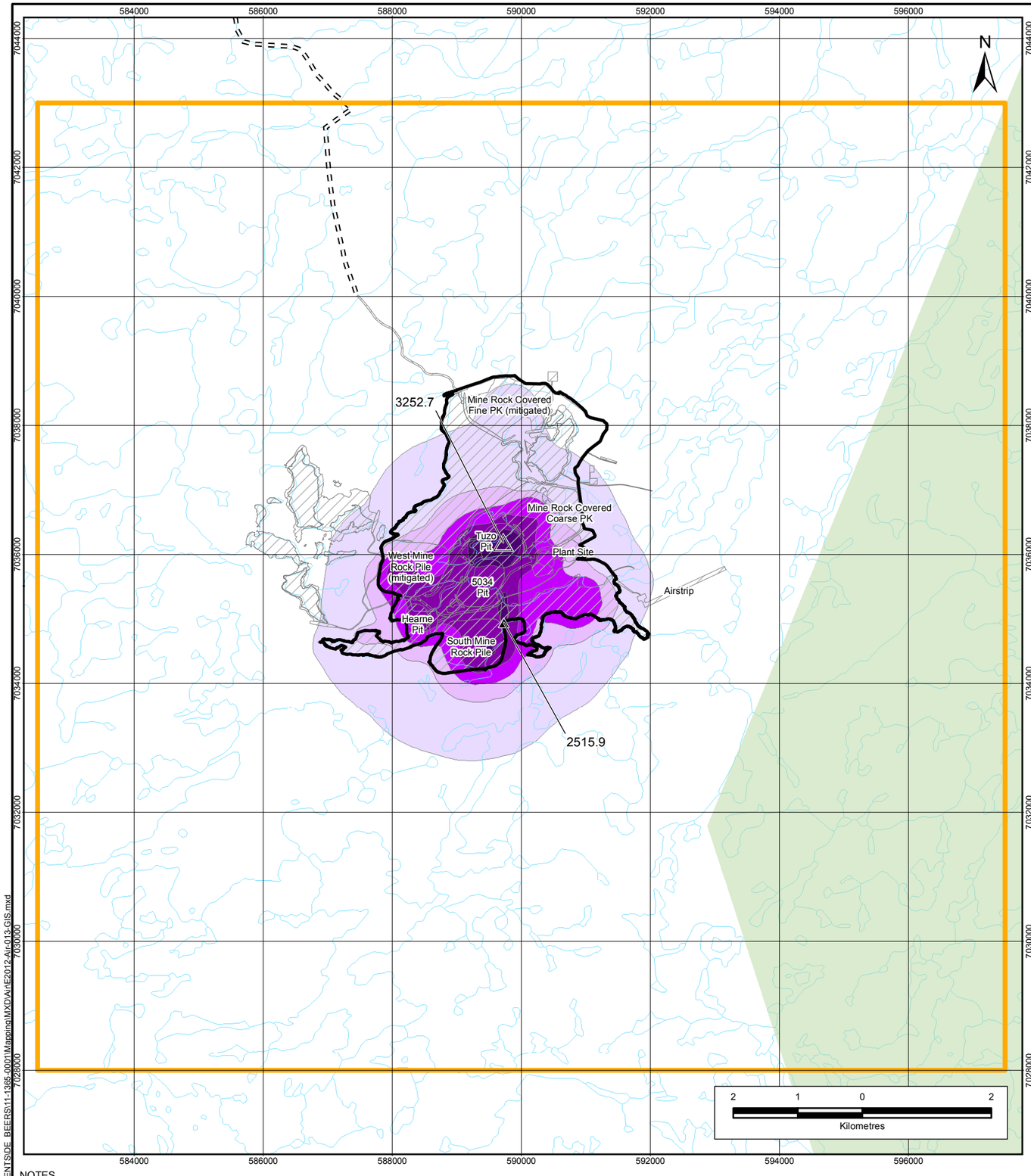

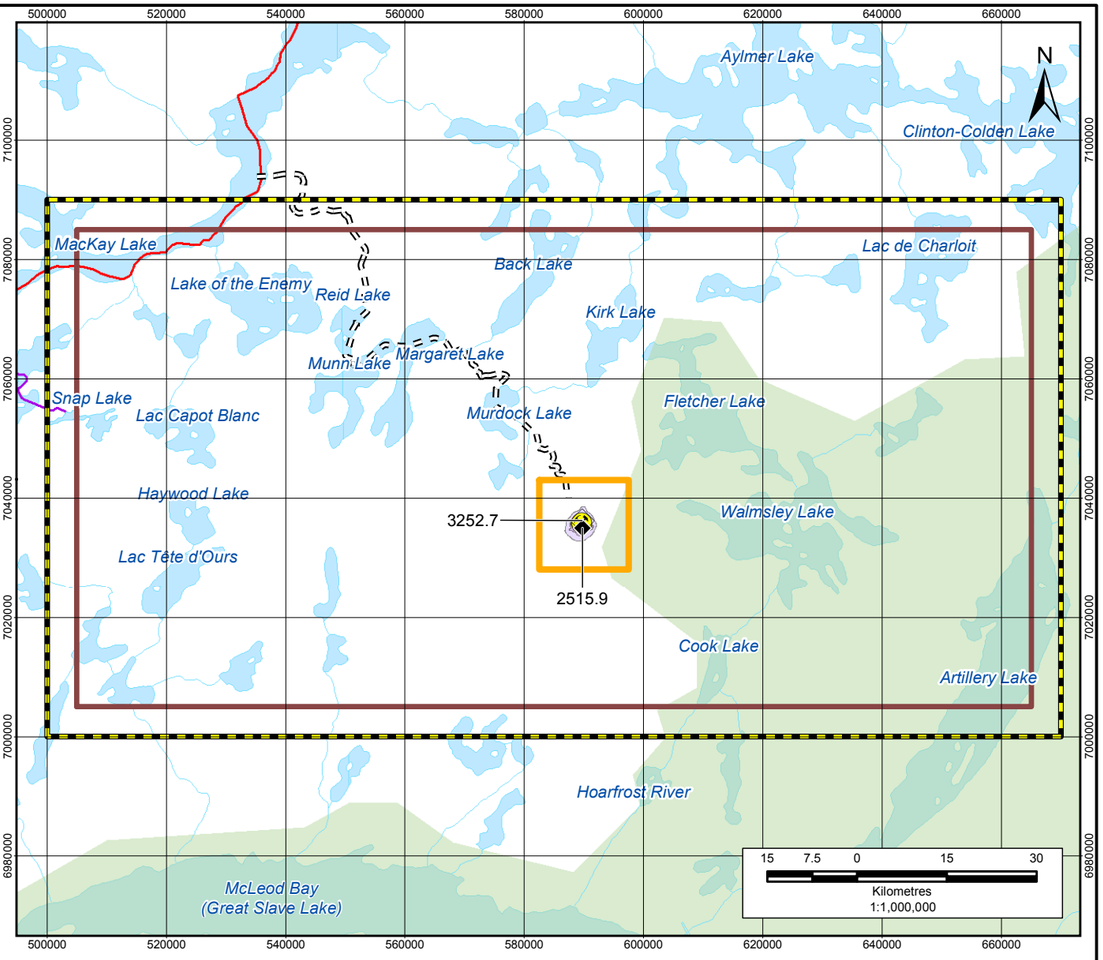

LEGEND

- Gahcho Kué Project
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Deposition (kg/ha/y)

- > = 2000
- 1000 to < 2000
- 500 to < 1000
- 250 to < 500
- 50 to < 250
- 0 to < 50

NOTES

Base data source: National Topographic Base Data (NTDB) 1:50,000.

GAHCHO KUÉ PROJECT

TSP Deposition - Updated Application Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-013-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	**Figure 3-11**
OFFICE: GOLD-CAL	DRAWN: DC / CHECK: DC	

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3.7 POTENTIAL ACID INPUT DEPOSITION

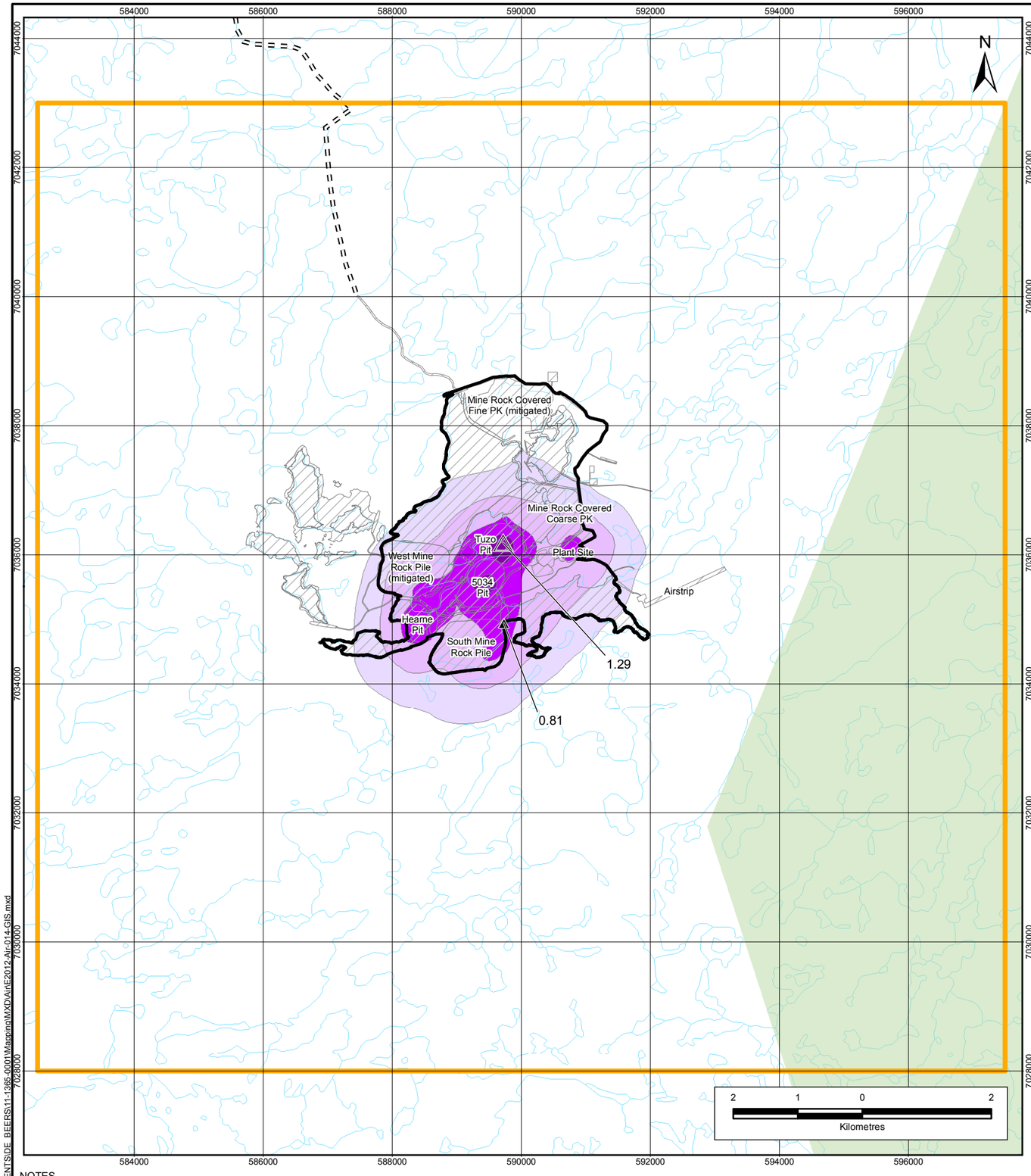
Table 3-15 presents a comparison of the Potential Acid Input (PAI), sulphate and nitrate deposition rates between the Baseline Case, the original Application Case and the updated Application Case. Although the emissions (SO_2, NO_X) that contributed to PAI did not change in the updated Application Case, the allocation of the mine fleet emissions based on the updated haul road layout resulted in a marginal decrease in all predictions outside of the development area in the updated Application Case. The updated Application Case PAI deposition rates relative to the Project are presented graphically in Figure 3-12.

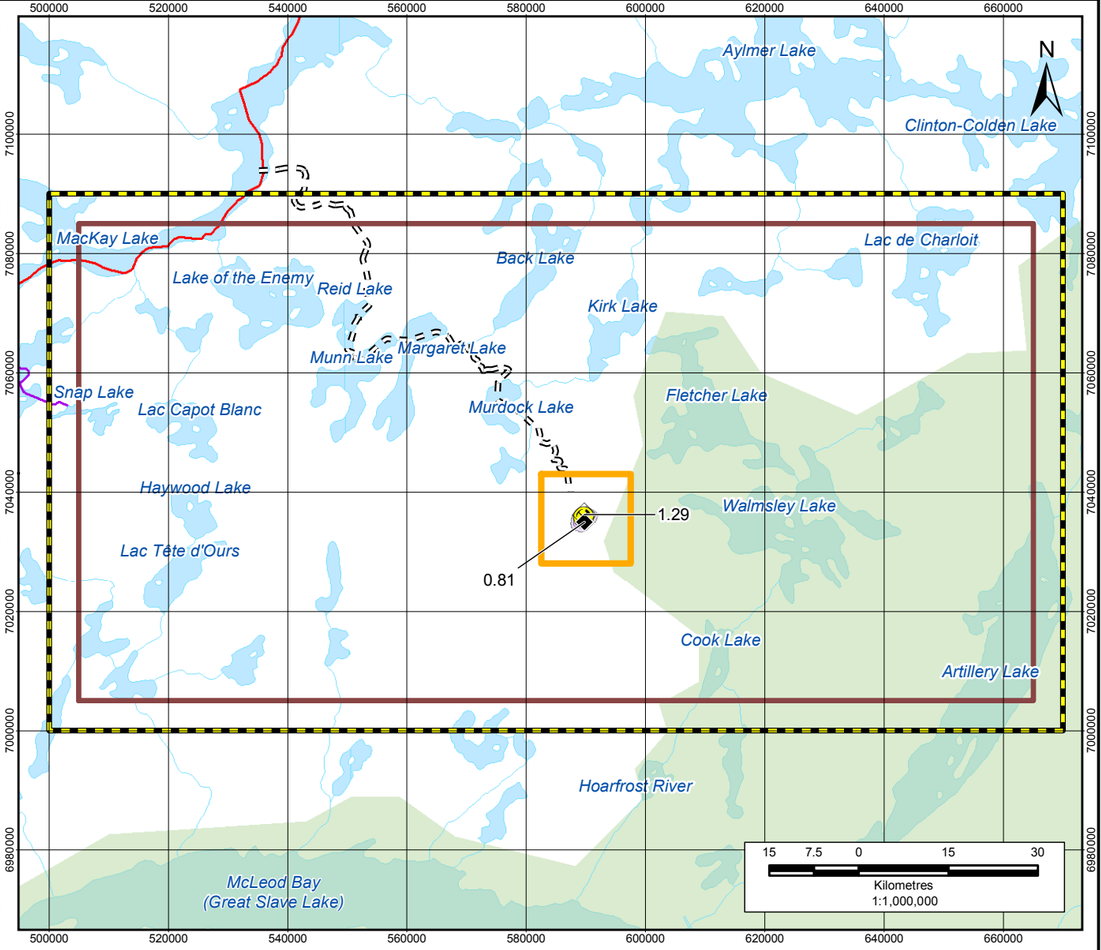
Table 3-15 Potential Acid Input - Comparison of Predicted Baseline Case, Original and Updated Application Cases

Parameter	Baseline Case[(a)]	Original Application Case[(a)]	Updated Application Case
Local Study Area (LSA)			
PAI [keq/ha/y]	0.06	1.16	1.29
PAI (excluding development area) [keq/ha/y]	0.06	0.96	0.81
nitrate (excluding development area) [keq/ha/y]	0.03	0.91	0.76
sulphate (excluding development area) [keq/ha/y]	0.04	0.06	0.06
Regional Study Area (RSA)			
PAI [keq/ha/y]	0.10	1.16	1.29
PAI (excluding development area) [keq/ha/y]	0.10	0.96	0.81
nitrate (excluding development area) [keq/ha/y]	0.06	0.91	0.76
sulphate (excluding development area) [keq/ha/y]	0.04	0.06	0.06

[(a)] De Beers 2010, Section 11.4.

keq/ha/y = kiloequivalent per hectare per year; PAI = potential acid input.





LEGEND

- Gahcho Kué Project
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Deposition (keq/ha/y)

- > = 1
- 0.50 to < 1
- 0.25 to < 0.50
- 0.17 to < 0.25
- 0 to < 0.17

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

GAHCHO KUÉ PROJECT

Potential Acid Input Predictions - Updated Application Case

PROJECTION: UTM Zone 12	DATUM: NAD83	
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-014-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	
OFFICE: GOLD-CAL	DRAWN: DC	CHECK: DC

Figure 3-12

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4 UPDATED CONSTRUCTION CASE

4.1 UPDATED CONSTRUCTION CASE EMISSIONS

The construction of the Project will occur over a period of two years. The construction period will include installation of the Project infrastructure and dewatering part of Kennady Lake before production mining can begin. After the water above the ore bodies has been drained, pre-stripping of the open pits and initial mining will begin.

Sources of emissions during the construction phase of the Project will be similar to emission sources during the operations phase of the Project with the exception of kimberlite ore processing and coarse PK disposal activities. These activities will not commence until the operations phase. The updated Construction Case emissions are summarized in Table 4-1. Overall, the maximum construction emissions are 30% to 70% lower than the operation emissions.

Table 4-1 Project Updated Construction Case Emissions

Source	Emission Rate (t/y)				
	SO_2	NO_X	CO	$PM_{2.5}$	TSP
Diesel Generators	3.14	657.89	182.78	17.51	20.40
Waste Incinerator	1.41	1.38	4.38	3.07	3.07
Drilling and Blasting	7.10	56.80	268.42	0.89	10.23
Loading/Unloading	—	—	—	2.44	28.78
Bulldozing	—	—	—	4.21	27.66
Grading	—	—	—	1.77	49.39
Storage Pile Erosion	—	—	—	3.68	49.01
Minefleet Exhaust	0.61	309.25	101.91	15.17	15.00
Road Dust	—	—	—	5.86	205.93
Aggregate Plant	—	—	—	6.41	22.78
Winter Access Road	0.00	0.59	0.27	0.01	0.01
Dry Lake Bed Fugitives	—	—	—	9.48	126.45
Construction Totals	**12.26**	**1,025.91**	**557.76**	**68.73**	**509.32**

Note: The emission rates presented in the above table have been rounded to three decimal places. Therefore, the totals may not appear to be sum of individual values.

t/y = tonnes per year; SO_2 = sulphur dioxide; NO_2 = nitrogen dioxide; CO = carbon monoxide; PM = particulate matter; TSP = total suspended particulate.

The predicted maximum SO_2, NO_2, CO, $PM_{2.5}$ and TSP concentrations during for the updated Construction Case are presented in the following sections.

4.2 SO_2 PREDICTIONS

Tables 4-2, 4-3 and 4-4 present the original and updated Construction Cases predicted 1-hour, 24-hour and annual SO_2 concentrations. The updated Construction Case predictions are either marginally lower or identical to the original Construction Case predictions. The predicted maximum concentrations outside of the development area remain below the applicable NWT air quality standards (GNWT 2011) for all averaging periods.

Table 4-2 Maximum 1-hour SO_2 Concentrations - Comparison of Predicted Original and Updated Construction Cases

Parameters	Original Construction Case[(a)]	Updated Construction Case
Local Study Area (LSA)		
maximum SO_2 [µg/m³]	42.3	42.7
maximum SO_2 (excluding development area) [µg/m³]	27.0	27.2
occurrences above 1-hour NWT AQS [(b)]	0	0
area above 1-hour NWT AQS (excluding development area) [ha] [(b)]	0	0
Regional Study Area (RSA)		
maximum SO_2 [µg/m³]	42.3	42.7
maximum SO_2 (excluding development area) [µg/m³]	27.0	27.2
occurrences above 1-hour NWT AQS [(b)]	0	0
area above 1-hour NWT AQS (excluding development area) [ha] [(b)]	0	0

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for 1-hour SO_2 = 450 µg/m³ (GNWT 2011).

µg/m^3 = microgram per cubic metre; SO_2 = sulphur dioxide; ha = hectare.

Table 4-3 Maximum 24-hour SO_2 Concentrations - Comparison of Predicted Original and Updated Construction Cases

Parameters	Original Construction Case[(a)]	Updated Construction Case
Local Study Area (LSA)		
maximum SO_2 [µg/m³]	31.2	31.6
maximum SO_2 (excluding development area) [µg/m³]	21.0	21.2
occurrences above 24-hour NWT AQS [(b)]	0	0
area above 24-hour NWT AQS (excluding development area) [ha] [(b)]	0	0
Regional Study Area (RSA)		
maximum SO_2 [µg/m³]	31.2	31.6
maximum SO_2 (excluding development area) [µg/m³]	21.0	21.2
occurrences above 24-hour NWT AQS [(b)]	0	0
area above 24-hour NWT AQS (excluding development area) [ha] [(b)]	0	0

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for 24-hour SO_2 = 150 µg/m³ (GNWT 2011).

µg/m^3 = microgram per cubic metre; SO_2 = sulphur dioxide; ha = hectare.

Table 4-4 Maximum Annual SO_2 Concentrations - Comparison of Predicted Original and Updated Construction Cases

Parameters	Original Construction Case[a]	Updated Construction Case
Local Study Area (LSA)		
maximum SO_2 [µg/m³]	5.5	5.5
maximum SO_2 (excluding development area) [µg/m³]	3.2	3.2
area above annual NWT AQS (excluding development area) [ha] [b]	0	0
Regional Study Area (RSA)		
maximum SO_2 [µg/m³]	5.5	5.5
maximum SO_2 (excluding development area) [µg/m³]	3.2	3.2
area above annual NWT AQS (excluding development area) [ha] [b]	0	0

[a] De Beers 2010, Section 11.4.

[b] NWT Air Quality Standard (AQS) for annual SO_2 = 30 µg/m³ (GNWT 2011).

µg/m^3 = microgram per cubic metre; SO_2 = sulphur dioxide; ha = hectare.

4.3 NO_2 PREDICTIONS

Tables 4-5, 4-6 and 4-7 provide a comparison of the original and updated Construction Cases predicted 1-hour, 24-hour and annual NO_2 concentrations. Overall, the updated Construction Case predictions are higher than the original Construction Case predictions. However, the predicted maximum concentrations outside of the development area are all below the applicable NWT air quality standards (GNWT 2011) for all averaging periods. The predicted maximum 1-hour, 24-hour and annual concentrations relative to the Project are shown graphically in Figures 4-1, 4-2 and 4-3, respectively.

Table 4-5 Maximum 1-hour NO_2 Concentrations - Comparison of Predicted Original and Updated Construction Cases

Parameters	Original Construction Case[a]	Updated Construction Case
Local Study Area (LSA)		
maximum NO_2 [µg/m³]	227.9	252.0
maximum NO_2 (excluding development area) [µg/m³]	207.7	248.2
occurrences above 1-hour NWT AQS [b]	0	0
area above 1-hour NWT AQS (excluding development area) [ha] [b]	0	0
Regional Study Area (RSA)		
maximum NO_2 [µg/m³]	227.9	252.0
maximum NO_2 (excluding development area) [µg/m³]	207.7	248.2
occurrences above 1-hour NWT AQS [b]	0	0
area above 1-hour NWT AQS (excluding development area) [ha] [b]	0	0

[a] De Beers 2010, Section 11.4.

[b] NWT Air Quality Standard (AQS) for 1-hour NO_2 = 400 µg/m³ (GNWT 2011).

µg/m^3 = microgram per cubic metre; NO_2 = nitrogen dioxide; ha = hectare.

Table 4-6 Maximum 24-hour NO_2 Concentrations - Comparison of Predicted Original and Updated Construction Cases

Parameters	Original Construction Case[a]	Updated Construction Case
Local Study Area (LSA)		
maximum NO_2 [µg/m³]	175.8	191.2
maximum NO_2 (excluding development area) [µg/m³]	146.3	153.8
occurrences above 24-hour NWT AQS [b]	0	0
area above 24-hour NWT AQS (excluding development area) [ha] [b]	0	0
Regional Study Area (RSA)		
maximum NO_2 [µg/m³]	175.8	191.2
maximum NO_2 (excluding development area) [µg/m³]	146.3	153.8
occurrences above 24-hour NWT AQS [b]	0	0
area above 24-hour NWT AQS (excluding development area) [ha] [b]	0	0

[a] De Beers 2010, Section 11.4.

[b] NWT Air Quality Standard (AQS) for 24-hour NO_2 = 200 µg/m³ (GNWT 2011).

$\mu g/m^3$ = microgram per cubic metre; NO_2 = nitrogen dioxide; ha = hectare.

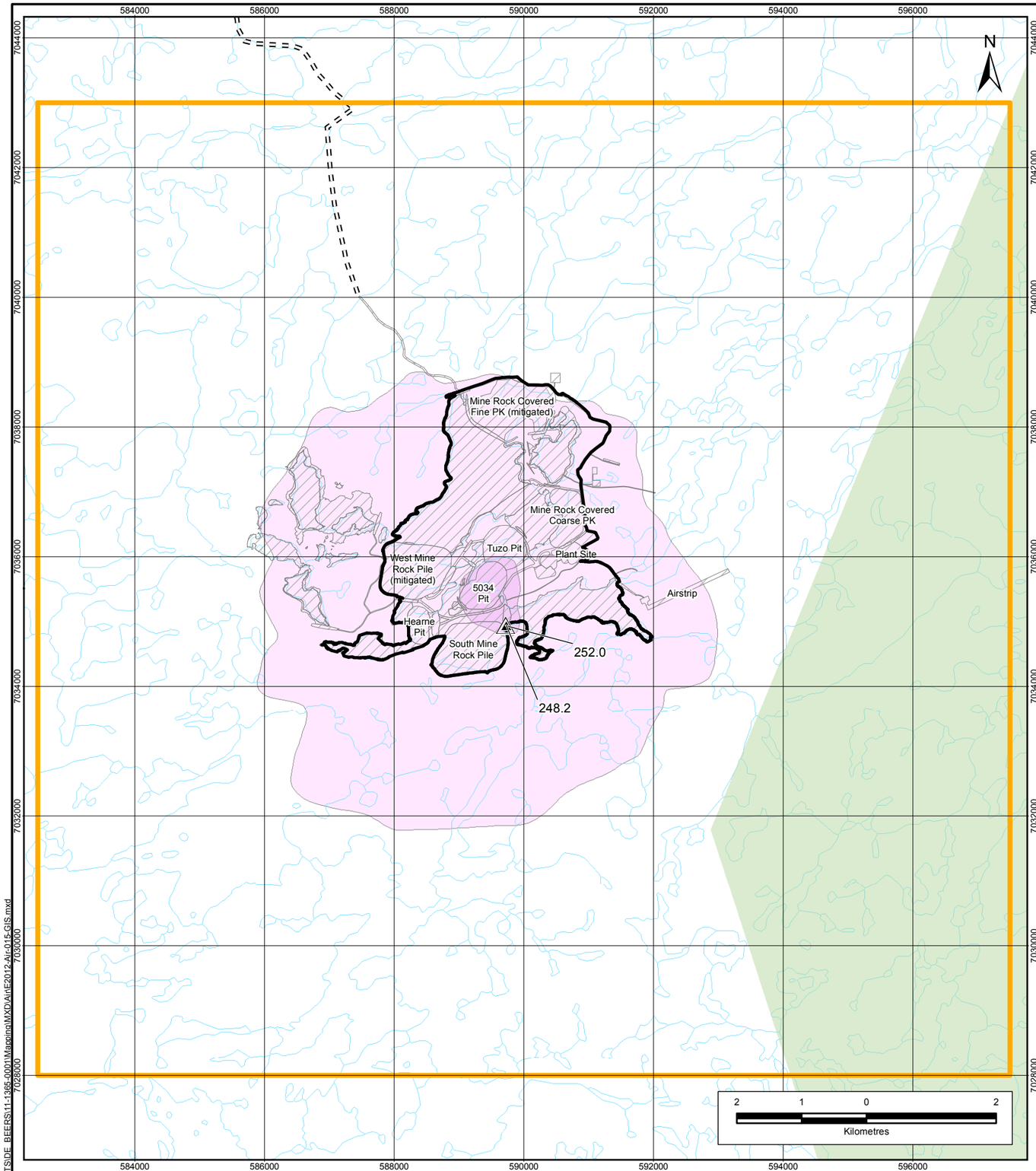
Table 4-7 Maximum Annual NO_2 Concentrations - Comparison of Predicted Original and Updated Construction Cases

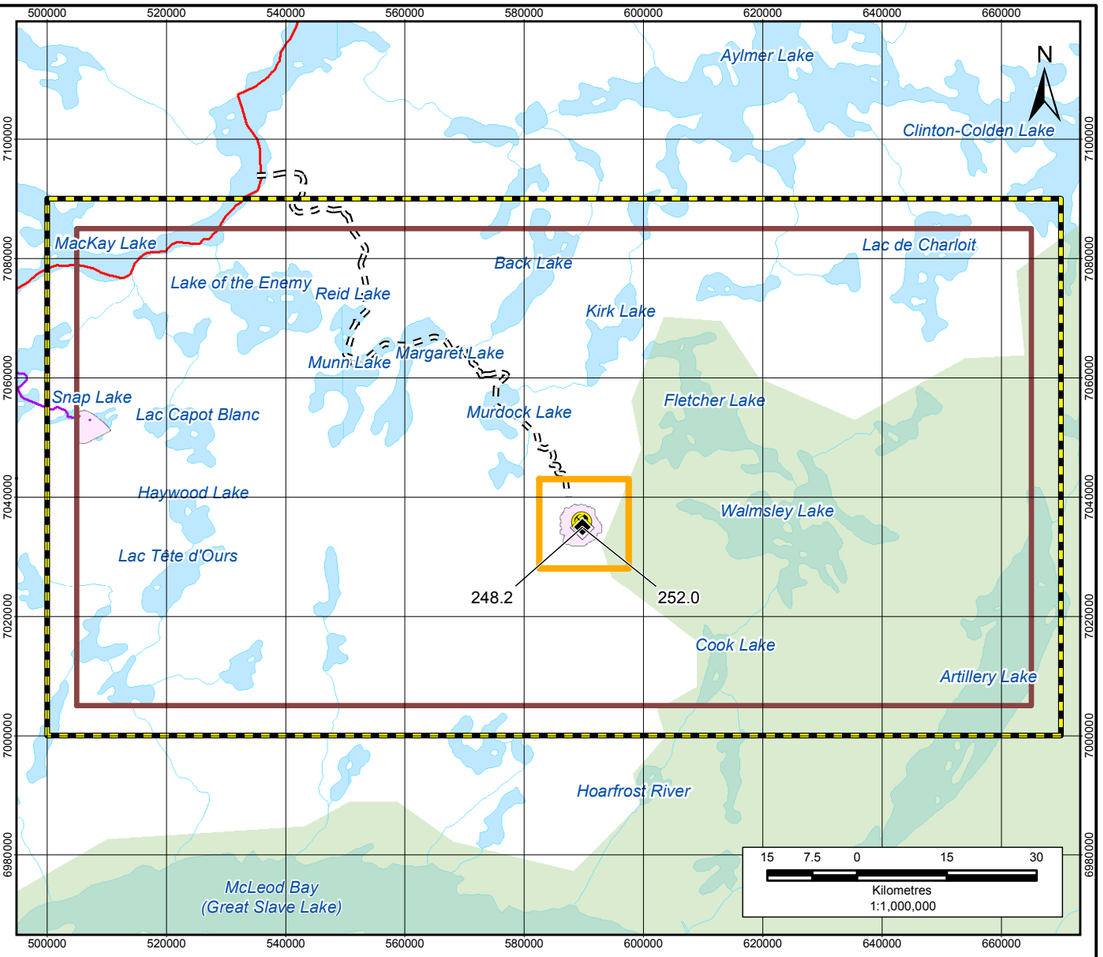
Parameters	Original Construction Case[a]	Updated Construction Case
Local Study Area (LSA)		
maximum NO_2 [µg/m³]	60.3	61.7
maximum NO_2 (excluding development area) [µg/m³]	55.9	56.8
area above NWT AQS (excluding development area) [ha] [b]	0	0
Regional Study Area (RSA)		
maximum NO_2 [µg/m³]	60.3	61.7
maximum NO_2 (excluding development area) [µg/m³]	55.9	56.8
area above annual NWT AQS (excluding development area) [ha] [b]	0	0

[a] De Beers 2010, Section 11.4.

[b] NWT Air Quality Standard (AQS) for annual NO_2 = 60 µg/m³ (GNWT 2011).

$\mu g/m^3$ = microgram per cubic metre; NO_2 = nitrogen dioxide; ha = hectare.





LEGEND

- Gahcho Kué Project
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration ($\mu g/m^3$)

- >= 400
- 200 to < 400
- 100 to < 200
- 0 to < 100

NWT Standard = 400 $\mu g/m^3$
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

GAHCHO KUÉ PROJECT

Maximum 1-hour NO_2 Concentrations - Updated Construction Case

PROJECTION: UTM Zone 12	DATUM: NAD83	
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-015-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	
OFFICE: GOLD-CAL	DRAWN: DC	CHECK: DC

Figure 4-1

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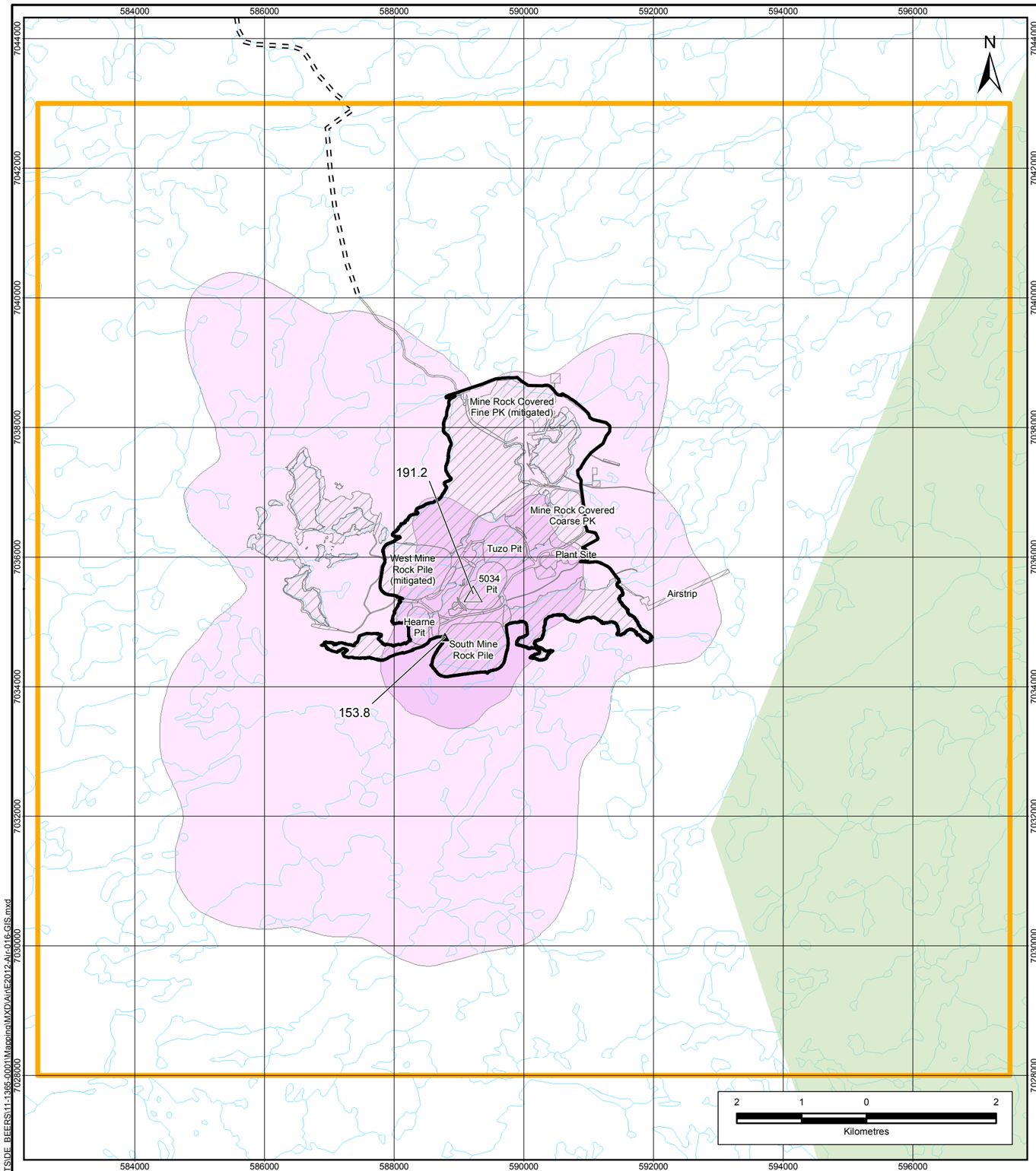

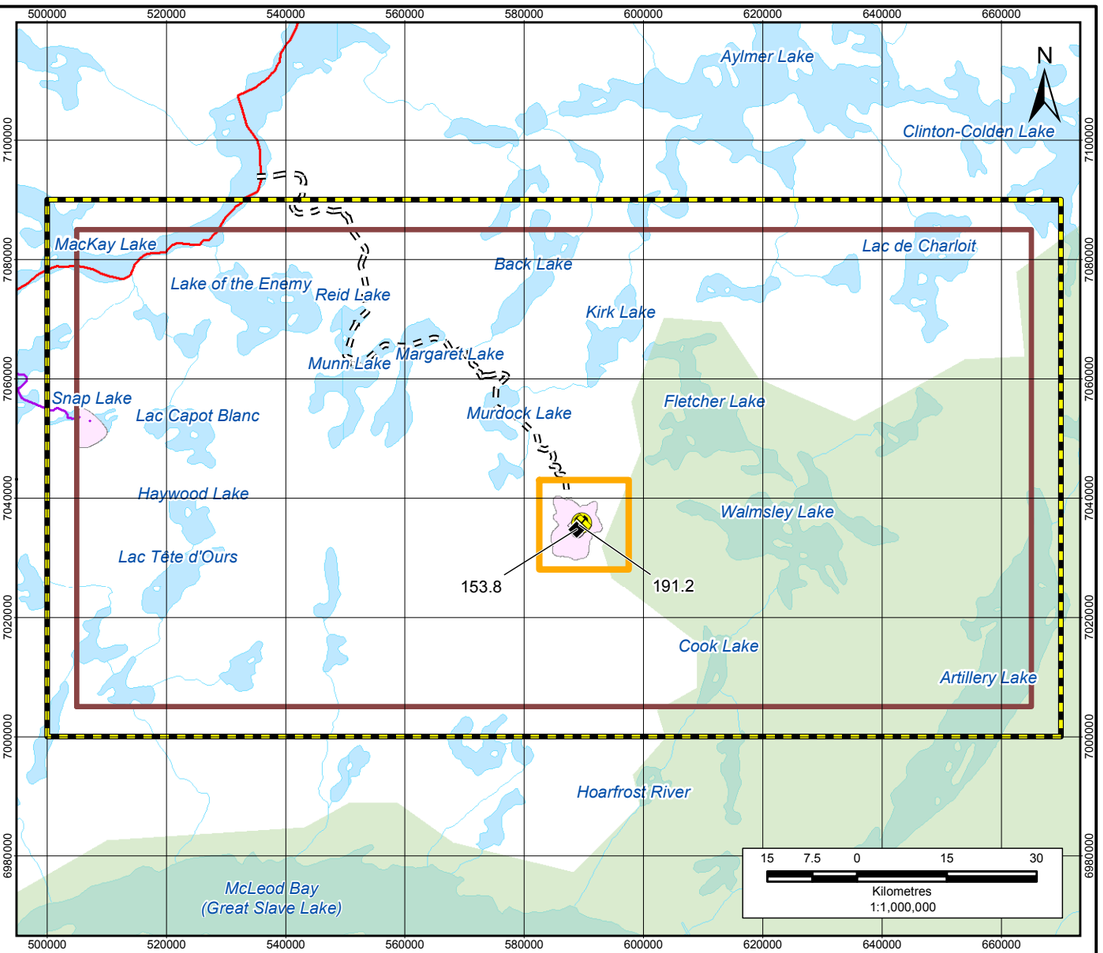

LEGEND

- Gahcho Kué Project
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration ($\mu g/m^3$)

- > = 200
- 100 to < 200
- 50 to < 100
- 0 to < 50

NWT Standard = 200 $\mu g/m^3$
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

GAHCHO KUÉ PROJECT

Maximum 24-hour NO_2 Concentrations - Updated Construction Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-016-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	**Figure 4-2**
OFFICE: GOLD-CAL	DRAWN: DC / CHECK: DC	

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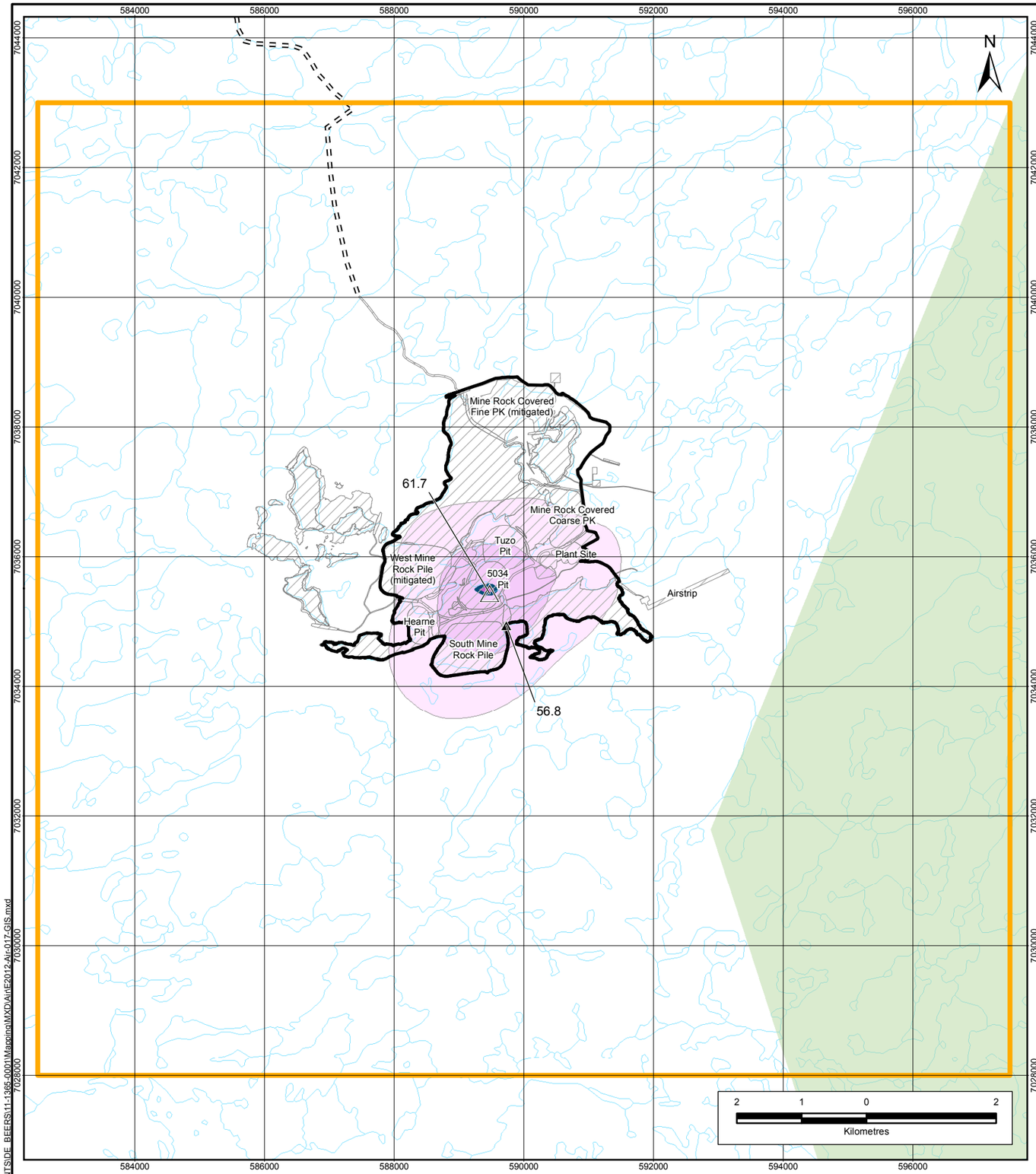

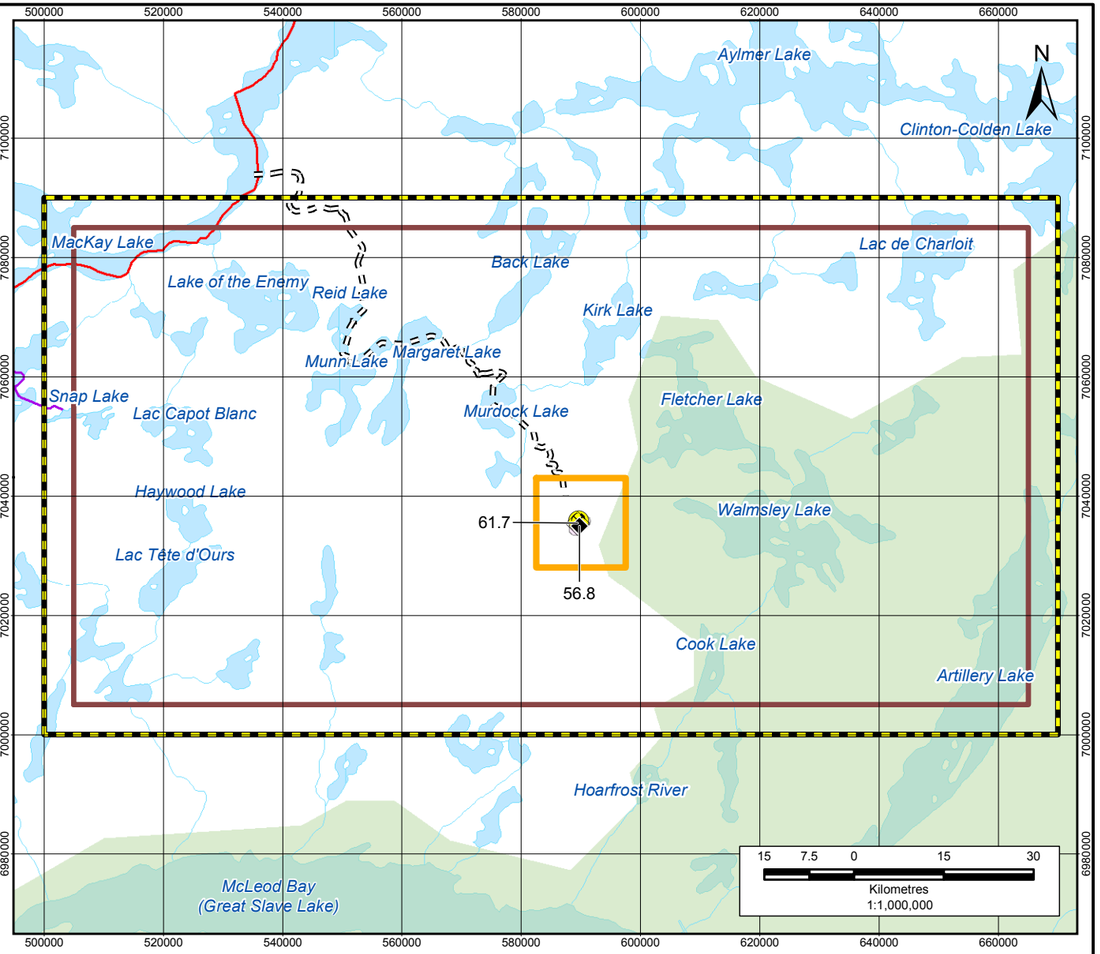

LEGEND

- Gahcho Kué Project
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration ($\mu g/m^3$)

- >= 60
- 30 to < 60
- 15 to < 30
- 0 to < 15

NWT Standard = 60 $\mu g/m^3$
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

GAHCHO KUÉ PROJECT

Maximum Annual NO_2 Concentrations - Updated Construction Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-017-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	**Figure 4-3**
OFFICE: GOLD-CAL	DRAWN: DC / CHECK: DC	

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4.4 CO PREDICTIONS

Tables 4-8 and 4-9 provide a comparison of the original and the updated Construction cases predicted 1-hour and 8-hour CO concentrations. The predicted maximum 8-hour CO predictions relative to the Project are shown in Figure 4-4. As with the CO predictions presented in the updated Application Case (Section 3.4), background CO concentrations have been added to both the original and updated Construction cases in this assessment. The predicted maximum concentrations outside of the development area are all below the applicable NWT air quality standards (GNWT 2011) for both 1-hour and 8-hour averaging periods. The updated Construction Case concentrations are comparable to the original Construction Case concentrations. As the SJ_Franklin Station is located in Yellowknife, near to anthropogenic emission sources, the CO background concentration used for the assessment is likely conservative. Actual baseline concentrations near the Project are expected to be lower.

Table 4-8 Maximum 1-hour CO Concentrations - Comparison of Predicted Original and Updated Construction Cases

Parameters	Original Construction Case[a]	Updated Construction Case
Local Study Area (LSA)		
maximum CO [µg/m³]	1,930.8	1,993.6
maximum CO (excluding development area) [µg/m³]	1,298.4	1,358.2
occurrences above NWT AQS [b]	0	0
area above NWT AQS (excluding development area) [ha] [b]	0	0
Regional Study Area (RSA)		
maximum CO [µg/m³]	1,930.8	1,993.6
maximum CO (excluding development area) [µg/m³]	1,298.4	1,358.2
occurrences above NWT AQS [b]	0	0
area above NWT AQS (excluding development area) [ha] [b]	0	0

[a] De Beers 2010, Section 11.4.

[b] NWT Air Quality Standard (AQS) for 1-hour CO = 15,000 µg/m³ (GNWT 2011).

$\mu g/m^3$ = microgram per cubic metre; CO = carbon monoxide; ha = hectare.

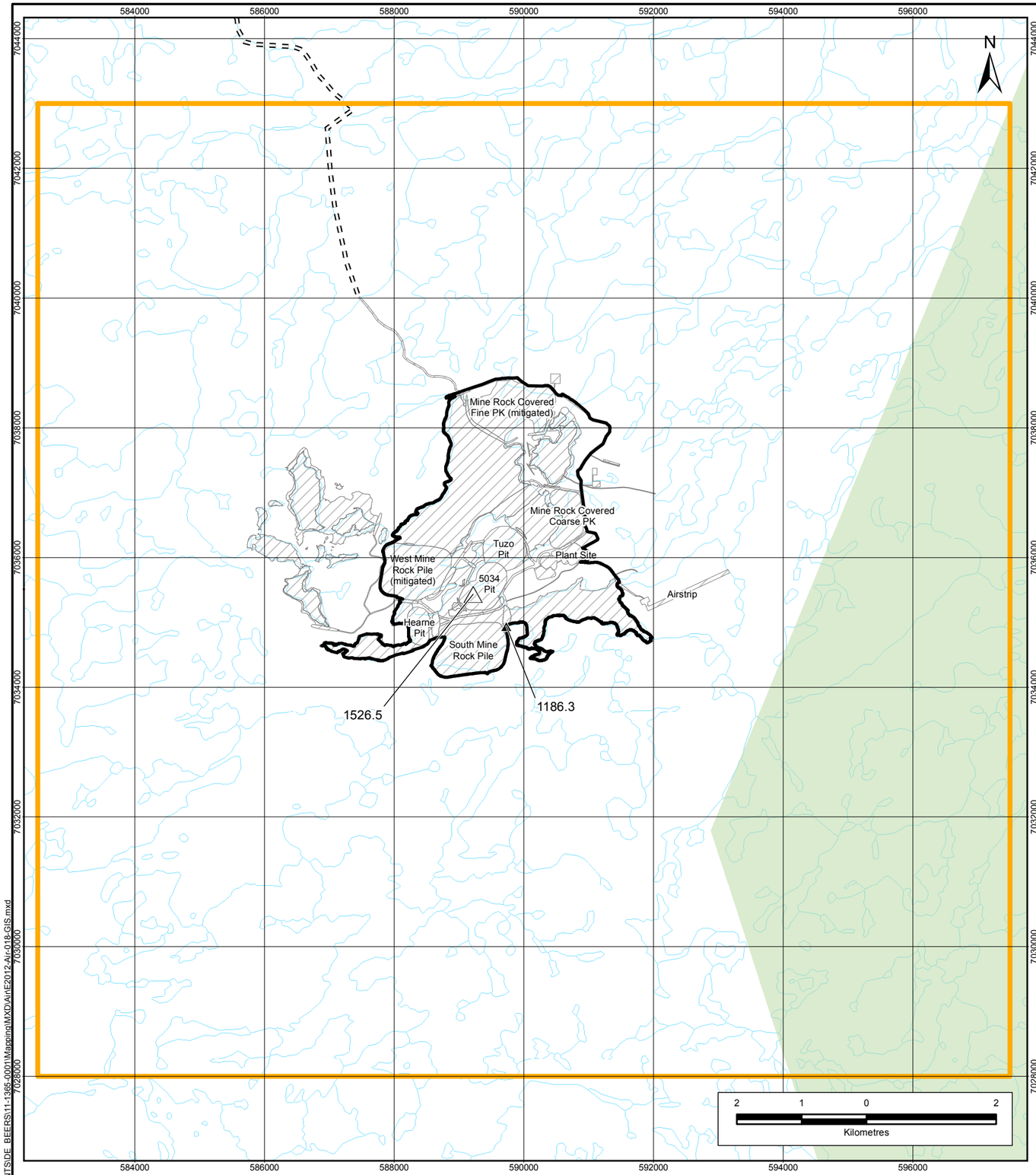
Table 4-9 Maximum 8-hour CO Concentrations - Comparison of Predicted Original and Updated Construction Cases

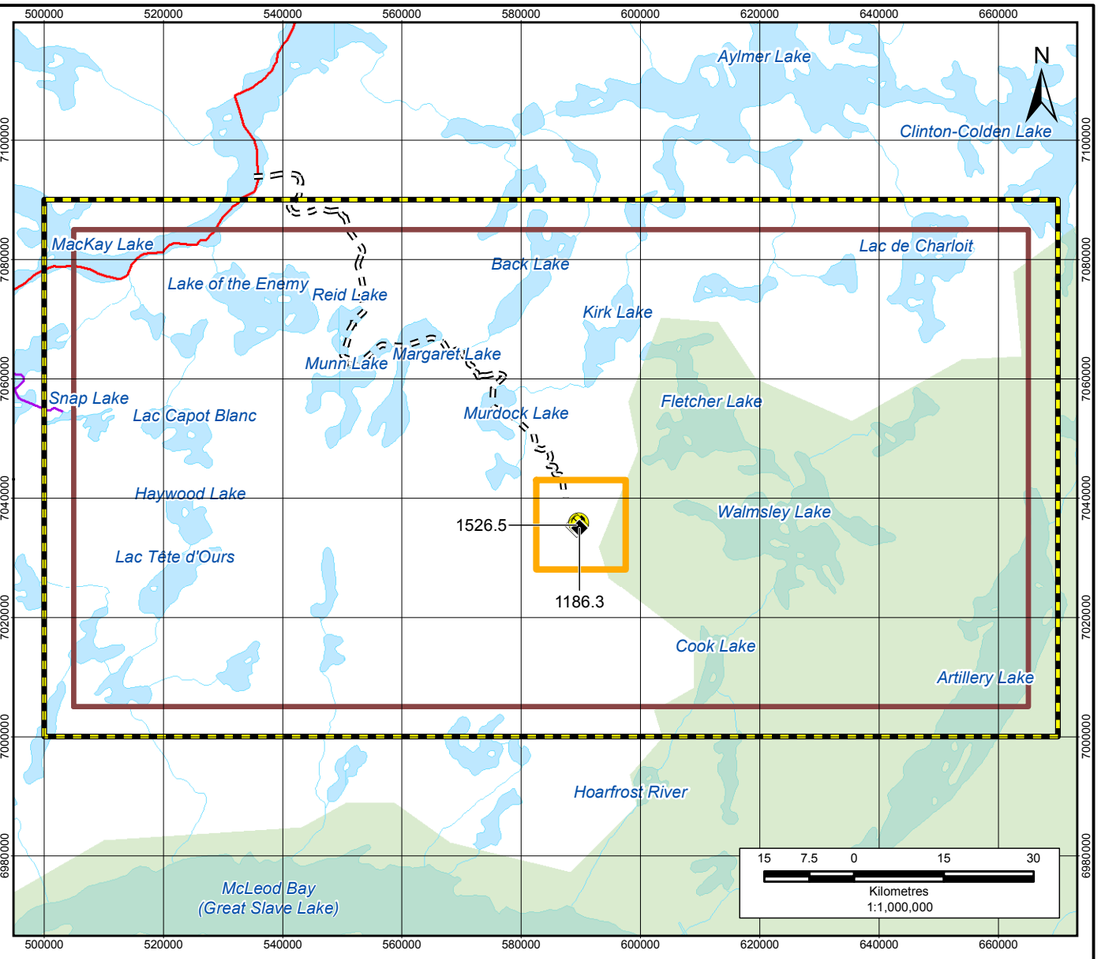
Parameters	Original Construction Case[a]	Updated Construction Case
Local Study Area (LSA)		
maximum CO [µg/m³]	1,472.9	1,526.5
maximum CO (excluding development area) [µg/m³]	1,130.3	1,186.3
occurrences above NWT AQS [b]	0	0
area above NWT AQS (excluding development area) [ha] [b]	0	0
Regional Study Area (RSA)		
maximum CO [µg/m³]	1,472.9	1,526.5
maximum CO (excluding development area) [µg/m³]	1,130.3	1,186.3
occurrences above NWT AQS [b]	0	0
area above NWT AQS (excluding development area) [ha] [b]	0	0

[a] De Beers 2010, Section 11.4.

[b] NWT Air Quality Standard (AQS) for 24-hour CO = 6,000 µg/m³ (GNWT 2011).

$\mu g/m^3$ = microgram per cubic metre; CO = carbon monoxide; ha = hectare.





LEGEND

- Gahcho Kué Project
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration ($\mu g/m^3$)

- >= 6000
- 3000 to < 6000
- 1500 to < 3000
- 0 to < 1500

NWT Standard = 6000 $\mu g/m^3$
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

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GAHCHO KUÉ PROJECT

Maximum 8-hour CO Concentrations - Updated Construction Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-018-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	**Figure 4-4**
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4.5 $PM_{2.5}$ PREDICTIONS

Table 4-10 provides a comparison of the original and the updated Construction Case predicted 24-hour $PM_{2.5}$ concentrations. The updated Construction Case has lower predicted concentrations outside of the development area compared to those in the original Construction Case mainly due to the higher mitigation efficiencies for the road dust emissions derived from the field study (Golder 2012) in the updated Construction Case. The predicted maximum 24-hour concentration outside the development area is 72.7 µg/m³, which is above the NWT air quality standard of 30 µg/m³ (GNWT 2011). The NWT air quality standard is expected to be exceeded for 30 days per year, or 8.2% of the time. The predicted maximum 24-hour concentrations relative to the Project are shown graphically in Figure 4-5. The area outside of the development potentially exceeding the NWT air quality standard has decreased from 293 ha in the original Construction Case to 133 ha in the updated Construction Case.

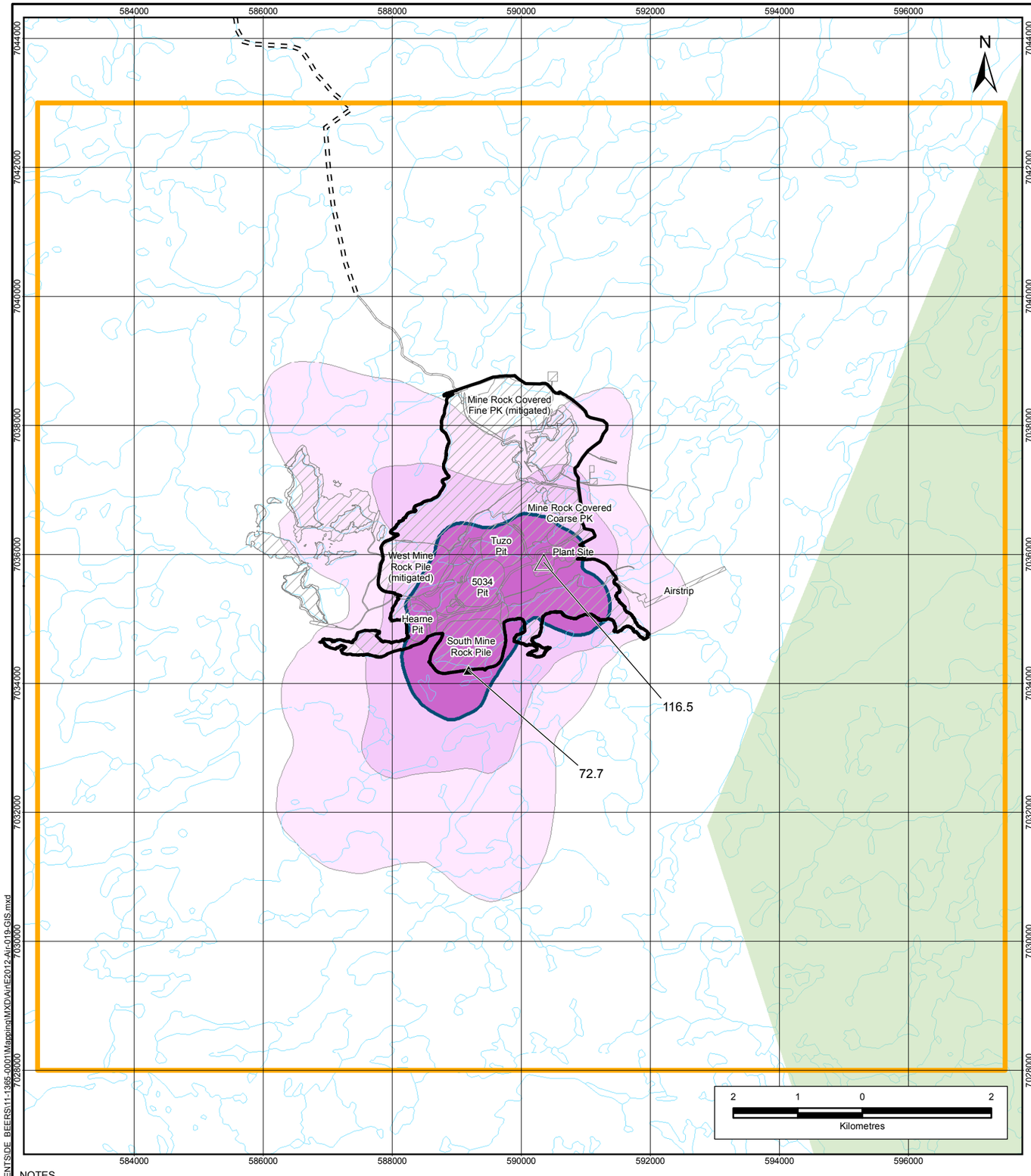
Table 4-10 Maximum 24-hour $PM_{2.5}$ Concentrations - Comparison of Predicted Original and Updated Construction Cases

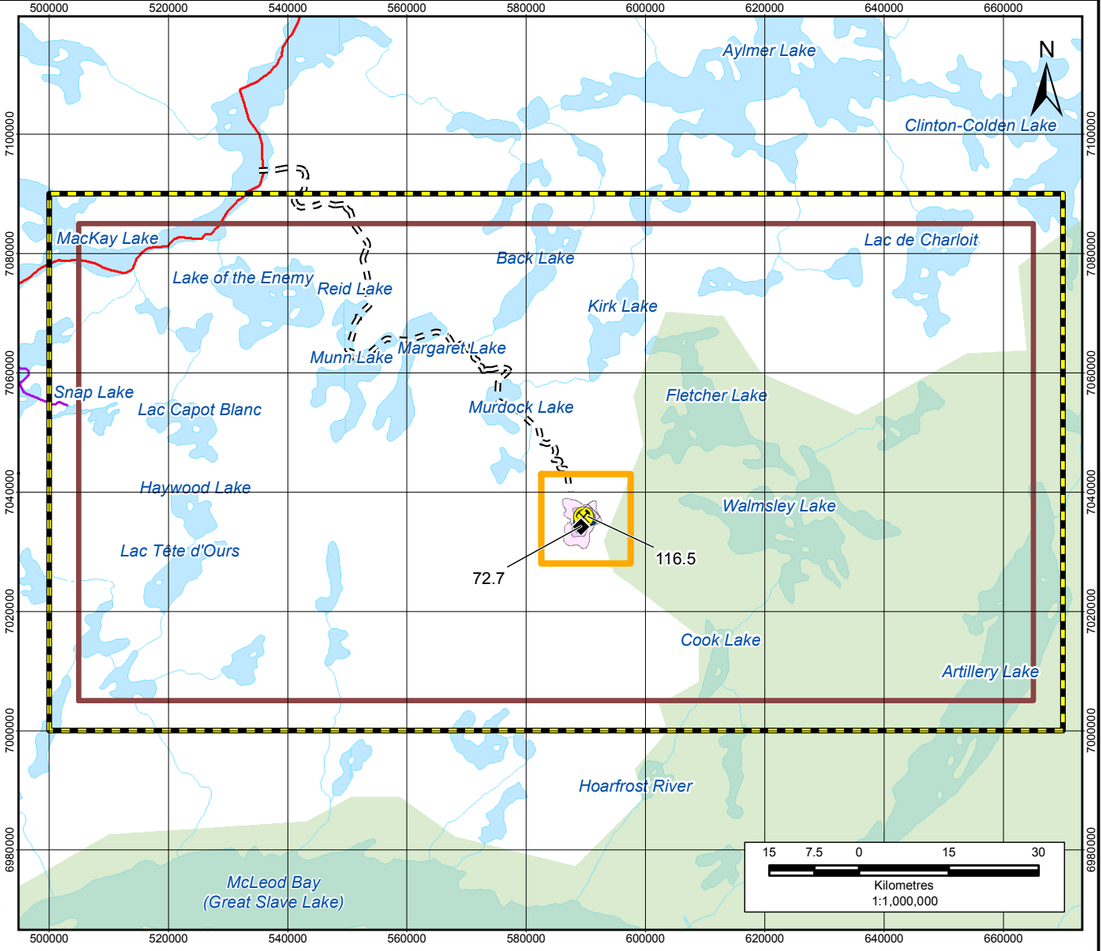
Parameters	Original Construction Case[(a)]	Updated Construction Case
Local Study Area (LSA)		
maximum $PM_{2.5}$ [µg/m³]	118.7	116.5
maximum $PM_{2.5}$ (excluding development area) [µg/m³]	113.1	72.7
occurrences above NWT AQS [(b)]	31	30
area above NWT AQS (excluding development area) [ha] [(b)]	293	133
Regional Study Area (RSA)		
maximum $PM_{2.5}$ [µg/m³]	118.7	116.5
maximum $PM_{2.5}$ (excluding development area) [µg/m³]	113.1	72.7
occurrences above NWT AQS [(b)]	31	30
area above NWT AQS (excluding development area) [ha] [(b)]	293	133

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for 24-hour $PM_{2.5}$ = 30 µg/m³ (GNWT 2011).

$\mu g/m^3$ = microgram per cubic metre; PM = particulate matter; ha = hectare.





LEGEND

- Gahcho Kué Project
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration (µg/m³)

- > = 30
- 15 to < 30
- 7.5 to < 15
- 0 to < 7.5

NWT Standard = 30 µg/m³
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

GAHCHO KUÉ PROJECT

Maximum 24-hour $PM_{2.5}$ Concentrations - Updated Construction Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-019-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	**Figure 4-5**
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4.6 TSP PREDICTIONS

Tables 4-11 and 4-12 provide a comparison of the original and the updated Construction Case predicted 24-hour and annual TSP concentrations. Similar to the $PM_{2.5}$ predictions, the predicted TSP concentrations in the updated Construction Case have decreased substantially, primarily due to the higher road dust mitigation efficiencies derived from the field study (Golder 2012) in the updated assessment. The maximum predicted 24-hour concentrations outside the development area exceed the NWT air quality standard (GNWT 2011) for 149 days per year, or 41% of the time. The predicted maximum 24-hour and annual TSP concentrations relative to the Project are shown graphically in Figures 4-6 and 4-7, respectively. The predicted maximum concentrations outside the development area are associated with fugitive dust emissions from the activities at the South Mine Rock Pile and haul roads along the southern boundary of the development area, as well as the drained Areas 6 and 7.

Table 4-11 Maximum 24-hour TSP Concentrations - Comparison of Predicted Original and Updated Construction Cases

Parameters	Original Construction Case[a]	Updated Construction Case
Local Study Area (LSA)		
maximum TSP [µg/m³]	2,938.7	1,078.4
maximum TSP (excluding development area) [µg/m³]	2,381.5	753.6
occurrences above NWT AQS [b]	252	149
area above NWT AQS (excluding development area) [ha] [b]	392	133
Regional Study Area (RSA)		
maximum TSP [µg/m³]	2,938.7	1,078.4
maximum TSP (excluding development area) [µg/m³]	2,381.5	753.6
occurrences above NWT AQS [b]	252	149
area above NWT AQS (excluding development area) [ha] [b]	392	133

[a] De Beers 2010, Section 11.4.

[b] NWT Air Quality Standard (AQS) for 24-hour TSP = 120 µg/m³ (GNWT 2011).

µg/m^3 = microgram per cubic metre; TSP = total suspended particulate; ha = hectare.

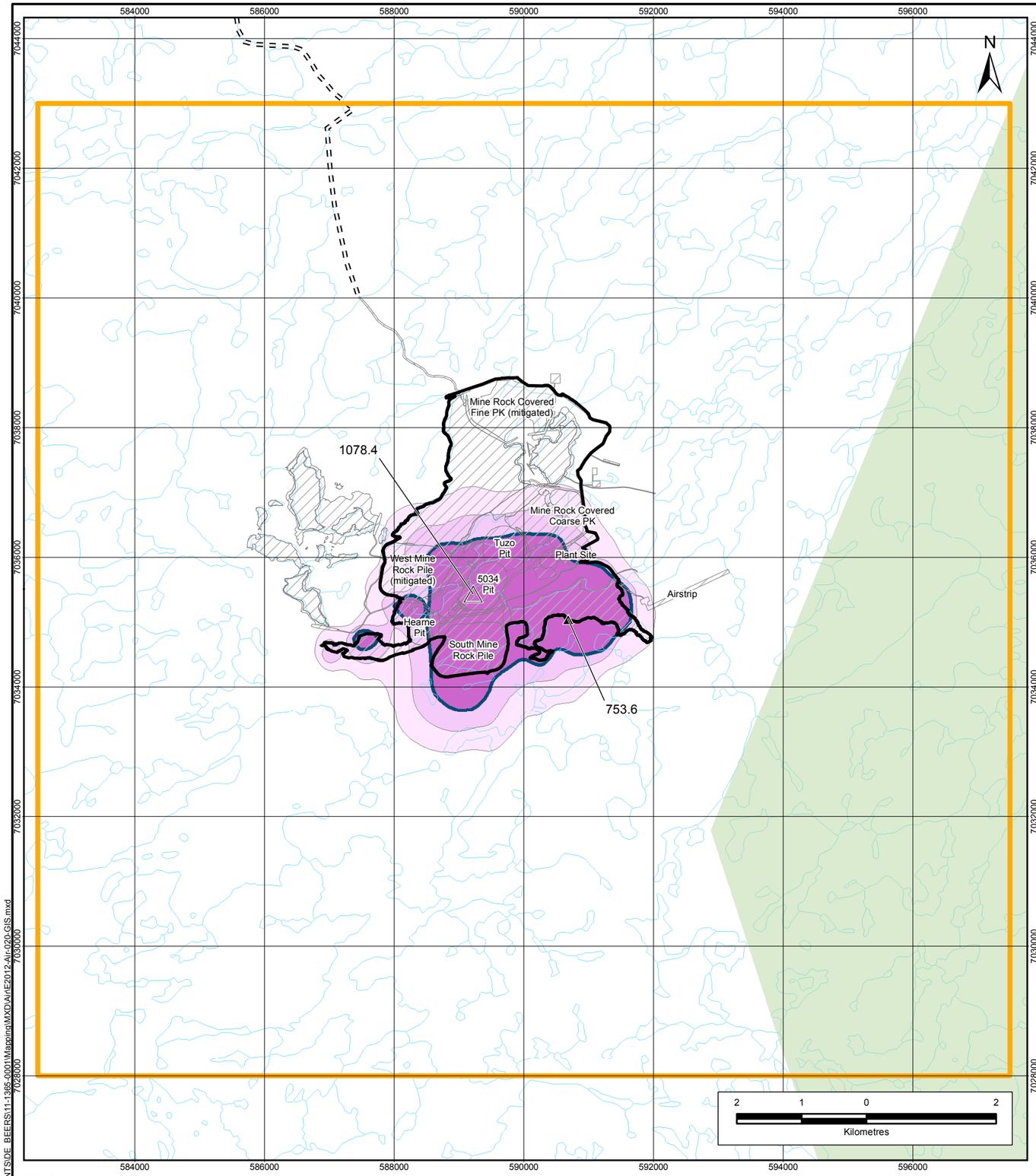
Table 4-12 Maximum Annual TSP Concentrations - Comparison of Predicted Original and Updated Construction Cases

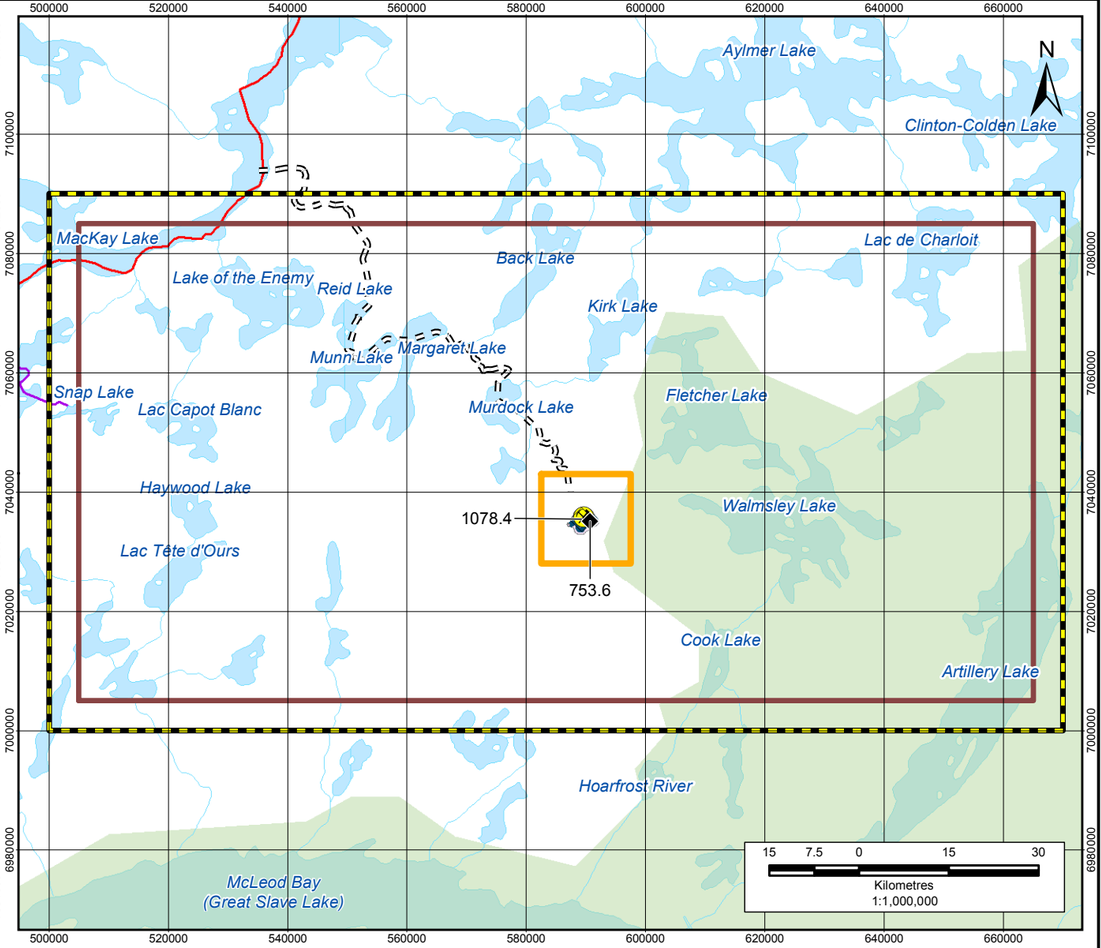
Parameters	Original Construction Case[(a)]	Updated Construction Case
Local Study Area (LSA)		
maximum TSP [µg/m³]	337.6	184.3
maximum TSP (excluding development area) [µg/m³]	295.9	135.1
area above NWT AQS (excluding development area) [ha] [(b)]	40	7
Regional Study Area (RSA)		
maximum TSP [µg/m³]	337.6	184.3
maximum TSP (excluding development area) [µg/m³]	295.9	135.1
area above NWT AQS (excluding development area) [ha] [(b)]	40	7

[(a)] De Beers 2010, Section 11.4.

[(b)] NWT Air Quality Standard (AQS) for annual TSP = 60 µg/m³ (GNWT (2011).

µg/m^3 = microgram per cubic metre; TSP = total suspended particulate; ha = hectare.





LEGEND

- Gahcho Kué Project
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration (µg/m^3)

- > = 120
- 60 to < 120
- 30 to < 60
- 0 to < 30

NWT Standard = 120 µg/m^3
GNWT (2011)

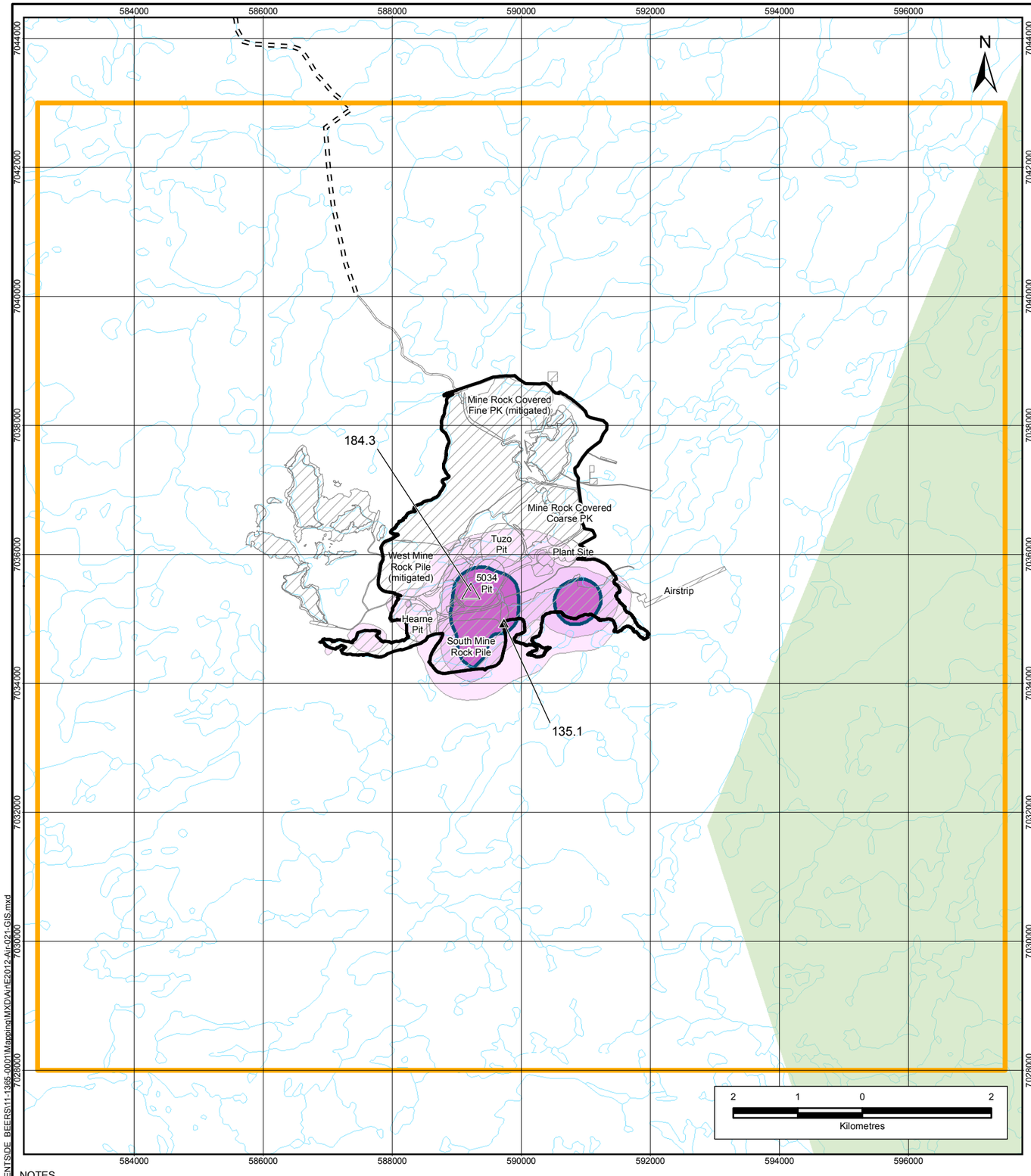
NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

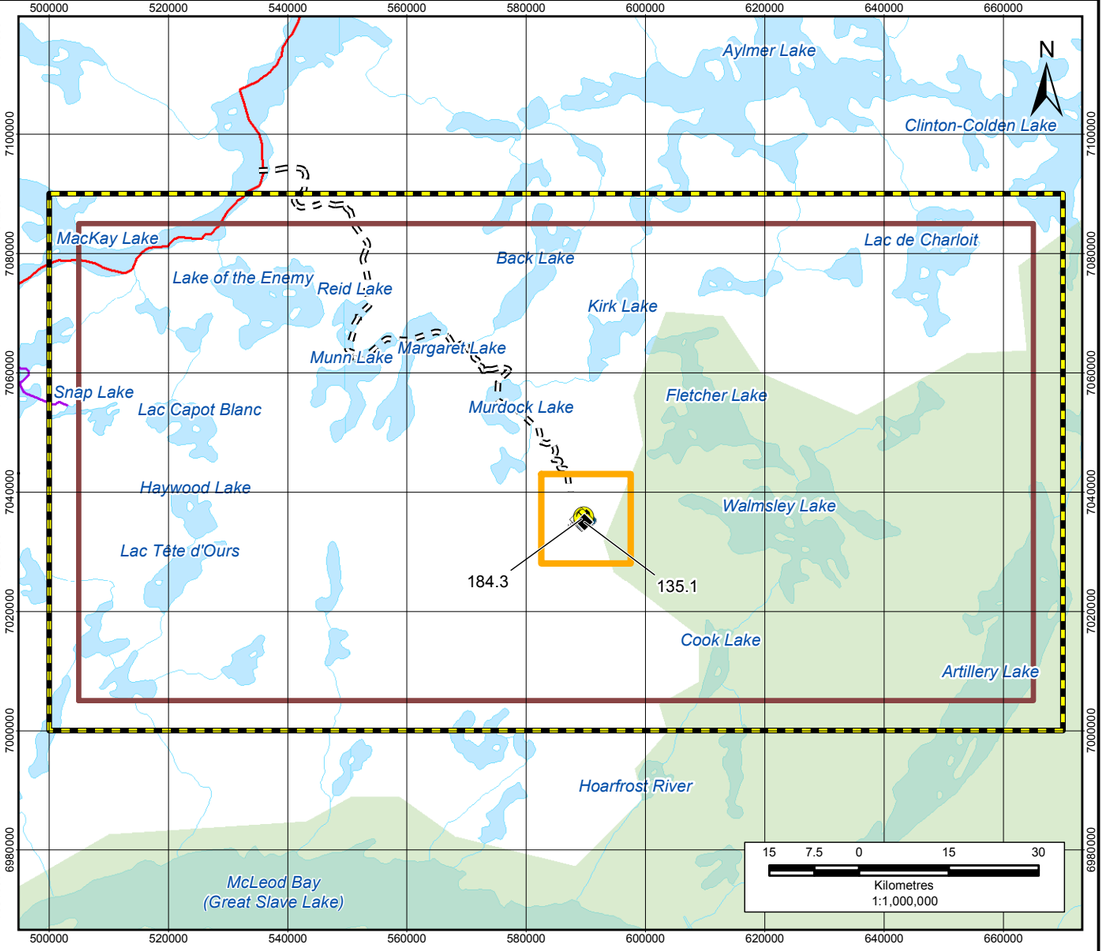
GAHCHO KUÉ PROJECT

Maximum 24-hour TSP Concentrations - Updated Construction Case

PROJECTION: UTM Zone 12	DATUM: NAD83	
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-020-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	
OFFICE: GOLD-CAL	DRAWN: DC	CHECK: DC

Figure 4-6





LEGEND

- Gahcho Kué Project
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Maximum Prediction Within LSA Excluding Development Area
- Maximum Prediction Within LSA
- Maximum Prediction Within RSA
- Maximum Prediction Within RSA Excluding Development Area
- Development Area Boundary
- Local Study Area
- Modelling Domain
- Project Footprint
- Regional Study Area
- The Study Area for a National Park on the East Arm of Great Slave Lake

Concentration (µg/m³)

- > = 60
- 30 to < 60
- 15 to < 30
- 0 to < 15

NWT Standard = 60 µg/m³
GNWT (2011)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:50,000.

GAHCHO KUÉ PROJECT

Maximum Annual TSP Concentrations - Updated Construction Case

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:70,000 (LSA)		
FILE No: E2012-Air-021-GIS		DATE: June 12, 2012
JOB NO: 11-1365-0001	REVISION NO: 0	**Figure 4-7**
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5 AIR QUALITY SUMMARY AND CONCLUSION

5.1 SUMMARY

The results of the updated air quality assessment for the Project are summarized in the following bullets:

- The predicted ground-level concentration and deposition patterns in the updated assessment are similar to those presented in the 2010 EIS.
- The maximum predicted concentrations and deposition rates outside of the development area, in general, have changed only marginally from those predicted in the 2010 EIS.
- The predicted $PM_{2.5}$ and TSP ground-level concentrations and deposition rates have decreased substantially from those in the 2010 EIS as a result of applying more accurate and reasonable seasonal road dust mitigation efficiencies, derived from the field study (Golder 2012).
- Although the predicted $PM_{2.5}$ and TSP concentrations outside of the development area in the updated assessment have decreased from those presented in the 2010 EIS, the predictions are still above the NWT air quality standards (GNWT 2011). The updated assessment did, however, result in substantial decreases in the predicted frequencies and areas of exceedance.
- For compounds that were predicted to be in compliance with the applicable air quality standards in the 2010 EIS, their predictions in the updated assessment remain in compliance with the standards.
- The updated assessment, overall, resulted in more accurate and therefore lower predictions of $PM_{2.5}$ and TSP. The conclusions of the original 2010 EIS remained unchanged.

6 CONCLUSIONS

The updated air quality assessment incorporated the latest Project design information as well as some minor improvements in the assessment approach, assumptions and emission data. The updated assessment found similar SO_2, NO_2, CO and PAI results to those presented in the 2010 EIS, and predicted substantially lower $PM_{2.5}$ and TSP concentrations and deposition rates. Lower predicted $PM_{2.5}$ and TSP concentrations in the updated air quality assessment did, however, remain above the NWT air quality standards (GNWT 2011). The changes in the predictions presented in the updated air quality assessment do not result in any change in the conclusions of the original air quality assessment in the 2010 EIS. Predicted concentrations from this assessment will be used to inform air, water and wildlife monitoring programs.

7 REFERENCES

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Golder (Golder Associates Ltd.). 2012. Determination of Natural Winter Mitigation of Road Dust Emissions from Mining Operations in Northern Canada. Submitted to De Beers Canada Inc.

GNWT ENR-EPD (Government of the Northwest Territories Environment and Natural Resources Environmental Protection Division). 2006. Spreadsheet Data from SJ Franklin Station, SO_2, O_3, NO_2, CO, $PM_{2.5}$, PM_{10}, Conversion factors supplied by John McKay.

GNWT (Government of Northwest Territories). 2011. Guideline for Ambient Air Quality Standards in the Northwest Territories. Department of Environment and Natural Resources. 5 pp.

8 ACRONYMS AND GLOSSARY

8.1 ACRONYMS AND ABBREVIATIONS

AQS	Air Quality Standards
CO	carbon monoxide
De Beers	De Beers Canada Inc.
EIS	environmental impact statement
GNWT	Government of the Northwest Territories
LSA	local study area
NO_2	nitrogen dioxide gas
NO_X	nitrogen oxides
NWT	Northwest Territories
PAI	potential acid input
PM	particulate matter, generally
PM_{10}	particulate matter of particle diameter less than 10 μm
$PM_{2.5}$	particulate matter of particle diameter less than 2.5 μm
PK	processed kimberlite
PKC	processed kimberlite containment
Project	Gahcho Kué Project
RSA	regional study area
SO_2	sulphur dioxide gas
TSP	total suspended particulates
U.S. EPA	United States Environmental Protection Agency

8.2 UNITS OF MEASURE

%	percent
µ	micro - 10^{-6}
µg/m^3	micrograms per cubic metre
µm	micron or micrometre = 10^{-6} m
g	gram
ha	hectare (0.01 km^2)
k	kilo – a thousand - 10^3
keq/ha/y	kilo-equivalent (hydrogen ion equivalent – 1 keq = 1 kmol H^+) per hectare per year. Measure of PAI deposition.
kg	kilogram
kg/ha/y	kilogram per hectare per year
km	kilometre
m	metre
ppm	parts per million
T	tonne = 1,000 kg
t/d	tonnes per day
t/y	tonnes per year
y	year

8.3 GLOSSARY

Ambient air quality objectives	Levels of concentration or deposition of specific chemicals or materials that are established to safeguard the health of ecosystem components (most often sensitive humans or vegetation).
Air quality	A measure of aerial-constituent concentrations in ambient air. Lower concentrations may indicate better air quality.
Anthropogenic	Anthropogenic effects or processes are those that are derived from human activities, as opposed to effects or processes that occur in the natural environment without human influences.
Background	An area (or state of the atmosphere) not influenced by chemicals released from the site under evaluation.
Baseline	A condition which serves as a reference point to which later observations or model results can be correlated.
Carbon monoxide	An odourless, colourless, non-irritating, toxic gas and a product of incomplete combustion of fuel (e.g., gas, diesel).
Dioxins	A variety of chemical compounds that can be described by the chemical formula: $C_4H_4O_2$.
Emission	Release of substances to atmosphere (can be fugitive emission, stack emission, diesel exhaust, mechanical ground disturbance, etc.).
Furans	One of a group of colorless, volatile, heterocyclic organic compounds containing a ring of four carbon atoms and one oxygen atom.
Ground-level concentration	Modelled concentration of a substance in the air near ground level.
Isopleth	A line on a map connecting places sharing the same feature (e.g., ground-level concentrations).
Kimberlite	Igneous rocks that originate deep in the mantle, intrude into the earth's crust and typically form narrow pipe-like deposits that may contain diamonds.
Mitigation	Action(s) taken to reduce negative or harmful effects.
Nitrogen dioxide	One of the component gases of oxides of nitrogen which also includes nitric oxide. In burning natural gas, coal, oil and gasoline, atmospheric nitrogen may combine with molecular oxygen to form nitric oxide, an ingredient in the brown haze observed near large cities. Nitric oxide is converted to nitrogen dioxide in the atmosphere.

Nitric oxide	Nitric oxide gas (NO) is the principal nitrogen oxide (NO_x) constituent in the exhaust from combustion sources (due to the oxidation of fuel nitrogen constituents and the nitrogen in the combustion air). Nitrogen dioxide gas (NO_2) is also produced during combustion; however, in much smaller amounts relative to NO (due to the slow rate of NO to NO_2 oxidation in the presence of oxygen only and without catalysts present). Exhaust containing NO will however completely transform into NO_2 when entering the atmosphere for two reasons: (i) the presence of atmospheric ozone (which is a much stronger NO to NO_2 oxidation driver than oxygen, although the ambient air initially entrained into the exhaust plume may contain insufficient ozone to fully oxidize all NO present), and (ii) the long chemical transformation and reaction time, for NO to NO_2 oxidation, afforded by hours of plume transport time (with ongoing entrainment of ozone-containing ambient air during dispersion).
Overburden	Material overlying a useful mineral deposit.
Potential acid input	A measure of acidification resulting from sulphur and nitrogen deposition to water and soil.
PM_{10}	Airborne particulate matter with a mean diameter less than 10 µm (microns) in diameter. This represents the fraction of airborne particles that can be inhaled into the upper respiratory tract.
$PM_{2.5}$	Airborne particulate matter with a mean diameter less than 2.5 microns (µm) in diameter. This represents the fraction of airborne particles that can be inhaled deeply into the pulmonary tissue.
Processed Kimberlite Containment	Man-made impoundment structure required to contain processed kimberlite slurry. Containment is provided by enclosed dykes made with granite rock and overburden materials, constructed to stringent geotechnical standards.
Sulphur dioxide gas	Bluish in colour and is a product of combustion of sulphur compounds in fuels.
Total Suspended Particulate	Total airborne particulate matter with a mean diameter less than 100 µm in diameter.
Waste incinerator	A combustion chamber that incinerates biological, medical, hazardous chemicals, household waste, etc. and converts them to ashes.