APPENDIX 5C-3

AIR QUALITY MONITORING DURING BULK SAMPLING OPERATIONS 2008, MARY RIVER

FINAL REPORT

AIR QUALITY MONITORING DURING BULK SAMPLING OPERATIONS (2008) BAFFINLAND IRON MINES CORPORATION MARY RIVER, NUNAVUT

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Companion Documents: Noise Monitoring During Bulk Sampling Operations (2008)
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EXECUTIVE SUMMARY

RWDI AIR Inc. (RWDI) was retained by Knight Piésold to conduct an air quality monitoring program at the Mary River mine site during bulk sampling operations undertaken by Baffinland Iron Mines Corporation (Baffinland). The purpose of the monitoring program was to assess the air quality impacts from the activities associated with the bulk sampling. The monitoring results will also assist in understanding air quality impacts from the future construction of the mine and ancillary activities.

Air concentrations of selected air contaminants were measured over 24 hour periods in the surrounding areas of the Mary River mine site over the course of a two week period (April 30 to May 10, 2008). In addition to the 24 hour sampling, passive monitors collected data for a 30 day period starting the first week in May extending to the first week in June.

The monitoring program was designed with consideration for the limited availability of AC power and the potential for harsh weather conditions. Equipment were selected that either required no power (passive monitoring devices) or ran on DC batteries (active monitoring devices).

The passive sampling program involved the collection of SO_2, NO_2, O_3, and dust fall samples simultaneously at the airstrip, crusher, and tote road. Monitoring was conducted at each location for a 32 to 36-day period, however bulk sampling activities were halted after the first week of monitoring, so these results are only partially representative of emissions from the bulk sampling operations. The dust fall samples were analyzed for total dust fall and individual metals.

The active monitoring program involved the measurement of total suspended particulate matter (TSP) and various metal concentrations. Samples were collected simultaneously from six locations using battery-powered PQ100 equipment: the airstrip, the blast pit area, the crusher, the

haul road, the runway (resurfacing activity), and the tote road. At each location two monitors were set up at two distances from the source. Each sample was collected over approximately 24-hours.

The results of the program were compared to indicator thresholds and baseline air quality levels established from the previous baseline ambient monitoring program at Mary River. The ambient air quality criteria selected for the comparison were based on Federal Air Quality Objectives (AQOs), where available, and air quality criteria, objectives and standards from various Canadian provincial jurisdictions.

Although the air quality monitoring program represented only a brief snapshot in time, it coincided with weather conditions and types of activities that were representative of what occurred throughout bulk sampling preparations.

Elevated levels of TSP and silica at various locations were measured in excess of the indicator thresholds. Additional measurements at these locations taken further downwind showed significantly decreased levels, indicating that concentrations in excess of indicator thresholds would be generally limited to areas close to the sources, *i.e*, within about one kilometre.

Measured SO_2 and NO_2 levels were much lower than the indicator thresholds and were fairly consistent with background ambient air quality levels at Mary River. Measured monthly O_3 levels were in excess of the indicator thresholds at all of the locations. O_3 is not directly emitted, but rather results from a series of complex reactions of NO_x and VOCs in the atmosphere. Given that the local sources of NO_x are limited, as indicated in the measured NO_2 concentrations, the high O_3 concentrations, which were somewhat above the levels observed during the baseline program, are likely due regional rather than local factors.

TABLE OF CONTENTS

Page No.

1. INTRODUCTION 1
2. AMBIENT AIR QUALITY CRITERIA 3
3. METHODOLOGY 6
   - 3.1 Sampling Locations 6
   - 3.2 Activities during Sampling Period 7
   - 3.3 Sampling Methods 9
     - 3.3.1 Active Monitoring Program: TSP and Metals 9
     - 3.3.2 Passive Sampling Program (SO_2, NO_2, O_3 and Total Dust Fall 11
   - 3.4 Meteorological Conditions During Sampling Period 12
   - 3.5 Sample Analysis, Instrument Calibrations and Calculations 13
     - 3.5.1 Active Monitoring Program 13
     - 3.5.2 Passive Monitoring Program 13
   - 3.6 Quality Assurance Measures 13
4. RESULTS 14
   - 4.1 TSP Concentrations 14
   - 4.2 Metals Concentrations 15
   - 4.3 SO_2, NO_2 and O_3 Concentrations 17
   - 4.4 Total Dust Fall and Metals 18
5. CONCLUSIONS 20
6. REFERENCES 22

LIST OF TABLES

Table 1: Ambient Air Quality Criteria, Standards and Objectives
Table 2: 24-hour Criteria for Metals
Table 3: Dust Fall Criteria
Table 4: Monitor Locations (UTM Zone 17, NAD83)
Table 5: Activities During Sampling Period
Table 6: Summary of TSP and Metals Sampling Locations Dates
Table 7: Passive Sampling Locations and Dates
Table 8: TSP Concentrations
Table 9: Maximum Concentrations for Selected Metals from Near Locations
Table 10: Maximum Concentrations for Selected Metals from Far Locations
Table 11: SO_2, NO_2 and O_3 Concentrations
Table 12: Total Dust Fall Results
Table 13: Selected Total Metals Results

LIST OF FIGURES

Figure 1: Site Plan Showing Monitoring Locations
Figure 2: TSP Concentrations – Tote Road
Figure 3: TSP Concentrations – Airstrip
Figure 4: TSP Concentrations – Runway Resurface
Figure 5: TSP Concentrations – Crushers
Figure 6: TSP Concentrations – Haul Road
Figure 7: TSP Concentrations – Blast Pit Area
Figure 8: Average SO_2, NO_2, O_3, and Dust Fall Concentrations – Airstrip
Figure 9: Average SO_2, NO_2, O_3, and Dust Fall Concentrations – Crushers
Figure 10: Average SO_2, NO_2, O_3, and Dust Fall Concentrations – Tote Road

LIST OF APPENDICES

Appendix A1: Maximum Concentrations for Metals
Appendix A2: Total Metals Results
Appendix B: Laboratory Results

1. INTRODUCTION

RWDI AIR Inc. (RWDI) was retained by Knight Piésold to conduct an air quality monitoring program at Mary River mine site during the 2008 bulk sampling program undertaken by Baffinland Iron Mines Corporation (Baffinland). The purpose of the monitoring program was to assess the air quality impacts from the various activities related the bulk sampling program. This information will also assist in understanding air quality impacts from the future construction of the mine and from some mine operation activities.

Air concentrations of selected air contaminants were measured over a 24 hour period in the surrounding areas of the Mary River mine site over the course of a two week period (April 30 to May 10, 2008). In addition to the 24 hour sampling, passive monitors collected data for a 30 day period starting the first week in May extending to the first week in June. Air contaminants monitored as part of the program included:

- total suspended particulate (TSP) and metals;
- total particulate (dust fall) and metals deposition;
- sulphur dioxide (SO_2);
- nitrogen dioxide (NO_2); and,
- ozone (O_3).

The selection of air contaminants was the same as those monitored in the baseline air quality report, so that impacts from the preparation and construction activities could be assessed against baseline air quality levels. The selection of air contaminants in the baseline air quality report was made in consultation with Knight Piésold, and took into consideration air contaminants typically associated with mining operations and with the anticipated activities of the BIMC project.

The monitoring program was designed with consideration for the limited availability of AC power and the potential for harsh weather conditions. Equipment was selected that either required no power (passive monitoring devices) or ran on DC batteries (active monitoring

devices). The passive sampling program involved the collection of SO_2, NO_2, O_3, and dust fall, while the active monitoring program involved the measurement of total suspended particulate matter (TSP), and various metal concentrations.

This report provides the details of the monitoring program, the mining activities that occurred during the monitoring period and a summary of the results. The findings are compared to relevant ambient air quality criteria and the baseline air quality levels as established from the previous baseline ambient monitoring program at Mary River.

2. AMBIENT AIR QUALITY CRITERIA

There are currently no regulated air quality criteria specific to Nunavut. The available criteria used to assess impacts from the preparation and construction activities for the bulk sampling program at the BIMC project site included:

- Federal Air Quality Objectives (AQOs) defined under the Canadian Environmental Protection Act (Health Canada 2005);
- Canada-Wide Standards (CWS) established by the Canadian Council of Ministers of the Environment (CCME, 2000); and,
- AQOs from the Northwest Territories and from other provincial jurisdictions (NWT Department of Resources, Wildlife and Economic Development, 2002).

Table 1 identifies and compares the Federal AQOs, the Northwest Territories criteria and the CWS. The criteria refer to different averaging periods to account for potential short-term acute exposures and long-term chronic exposures. Table 2 provides ambient air quality thresholds for metals, which are based on standards for the Province of Ontario, and are generally based on human health effects. Table 3 identifies dust fall criteria for Alberta, BC and Ontario.

Table 1: Ambient Air Quality Criteria, Standards and Objectives

Contaminant	Averaging Time	Federal Air Quality Objectives			Canada Wide Standard	NWT	Indicator Threshold
		Desirable	Acceptable	Tolerable			
TSP ($\mu g/m^3$)	24 hr	-	120	400	-	120	**120**
	Annual	60	70	-	-	60	**60**
SO_2 ($\mu g/m^3$)	1 hr	450	900	-	-	450	**450**
	24 hr	150	300	800	-	150	**150**
	Annual	30	60	-	-	30	**30**
NO_2 ($\mu g/m^3$)	1 hr	-	400	1,000	-	-	**400**
	24 hr	-	200	300	-	-	**200**
	Annual	60	100	-	-	-	**60**
CO ($\mu g/m^3$)	1 hr	15,000	35,000	-	-	-	**15,000**
	8 hr	6,000	15,000	20,000	-	-	**6,000**
O_3 ($\mu g/m^3$)	1 hr	100	160	300	-	-	**100**
	8 hr	-	-	-	127	127	**127**
	24 hr	30	50	-	-	-	**30**
	Annual	-	30	-	-	-	**30**

*Ontario Interim Ambient Air Quality Criterion (AAQC). Ontario Ministry of the Environment, September 2001.

Table 2: 24-hour Criteria for Metals

Parameter	Ontario Air Quality Standards and Criteria (µg/m³)
Ag	1
Al	N/A
As	0.3
B	120
Ba	10
Be	0.01
Bi	N/A
Ca	N/A
Cd	2
Cl	10
Co	0.1
Cr	1.5
Cu	50
Fe	4
Hg	2
K	N/A
Li	20
Mg	120
Mn	2.5
Mo	120
Na	N/A
Ni	2
P	N/A
Pb	2
S	N/A
Sb	25
Se	10
Si	5*
Sn	10
Sr	120
Th	N/A
Ti	120
Tl	N/A
U	N/A
V	2
Zn	120

Notes: * Represents the criterion for silica.

Table 3: Dust Fall Criteria (mg/dm^2/30 days)

Averaging Time	Alberta Residential and Recreation Areas	BC Desirable Level	BC Interim Level	Alberta Commercial and Industrial Areas	Ontario	Indicator Threshold
1 Month	53	53	87	158	70	**53**
Annual	-	-	-	-	46	**46**

In Tables 1 to 3, for contaminants where more than one air quality objective is presented, an indicator threshold was adopted based on the most stringent criterion for preliminary assessment of potential impacts. It should be noted that air quality objectives are typically applied at and beyond the project boundary, whereas the measurement locations for this monitoring program were relatively close to the sources (within 200 m) and within the project boundary. Measured values that exceeded their indicator threshold therefore do not necessarily indicate that the threshold would be exceeded beyond the project boundary. Further assessment would be required to determine whether and to what extent actual impacts may occur.

3. METHODOLOGY

3.1 Sampling Locations

The monitoring locations are shown in Figure 1. Table 4 provides the corresponding UTM coordinates.

Sampling locations were selected to capture contaminant emission from various activities associated with the bulk sampling occurring at the Mary River mine site. At each location two monitors were set up, one closer and one further from the source. The intent of the two monitors at two distances was to give a better indication of how the concentrations varied with distance. The sampling locations included the airstrip, the crusher area, the runway reconstruction, the bulk sample mining area, the haul road from the mining area to the crusher, and the tote road. Only PQ100 sampling occurred at the near locations and the far locations of the haul road and runway (resurface). An effort was made to locate monitors downwind of the air emission sources in order to determine worst-case conditions resulting from the emission sources. Specific monitoring locations were selected based on a review of wind data collected at Mary River. For the various sources, the variation in the distances of the near and far locations from the source was due to practical considerations, notably terrain issues.

Table 4: Monitor Locations (UTM Zone 17, NAD83)

Monitor Location		NAD83 UTM Easting (m)	NAD83 UTM Northing (m)	Comments
Airstrip	Near	557917	7914803	Approx. 80m west of the airstrip
	Far	557753	7914800	Approx. 250m west of the airstrip
Blast Pit Area	Near	563232	7914773	Approx 100m west of the blast location
	Far	563185	7914794	Approx. 200m west of the blast location
Crushers	Near	560700	7913428	Approx. 50m northwest of the border of the crusher area
	Far	560503	7913432	Approx. 250m northwest of the border of the crusher area

Monitor Location		NAD83 UTM Easting (m)	NAD83 UTM Northing (m)	Comments
Haul Road	Near	561733	7913196	Approx. 60m south of Haul Road
	Far	561679	7913175	Approx. 120m south of Haul Road
Runway Resurface	Near	558875	7914156	Approx. 50m southwest of the air runway
	Far	558867	7914147	Approx 70m southwest of the air runway
Tote Road	Near	556818	7915083	Approx. 50m southwest of the Tote Road and KM 98.5
	Far	556767	7915051	Approx. 150m southwest of the Tote Road and KM 98.5

3.2 Activities during Sampling Period

Table 5 summarizes the activities that occurred during the sampling periods. It should be noted that bulk sampling activities were halted after the first week of monitoring, because an early thaw required shifting resources to upgrade the tote road to Milne Inlet. Therefore, results from the 1-month passive monitors are only partially representative of emissions from the bulk sampling operations.

Table 5: Activities During Sampling Period

Activity Area	Activities During Sampling Period
Airstrip	• Airstrip was in use only during daylight hours. • Sampling was started May 1st and ended May 4th. • Flights were as follows, May 1- no flights, May 2 = 10 flights, May 3 = 9 flights, May 4 = 10 flights • Planes generally touched down and took off on the southern half of the airstrip and rarely used the northern section. • There is also a helicopter pad, but is located on the far side of the camp away from the monitoring stations

Activity Area	Activities During Sampling Period
	• There is a local road around the south end of the air strip, which was used by light duty vehicles travelling to the camps and to the various construction areas. • Air monitoring equipment was set up approximately 160 meters from the southwest edge of the airstrip. • The air monitors were strategically located to capture emissions from the activities of the planes from touch downs, taxiing to the loading location, engines revving down, engines starting up, engines revving up, taxiing to the take off location and take off.
Blast Pit Area	• Limited activity during the 24 hour sampling. • Sampling was started May 4th and ended May 7th. • The haul road was slippery in the mornings due to fresh snow overnight, and therefore no access for the haul trucks • 24 hours sampling captured 1 single blast on May 6. • Very limited activity for the 30 day passive monitors, as the camp focus was on repairs to the tote road and not blasting/crushing ore.
Crushers	• 24 hour sampling was conducted May 1 to 4. • The crushers ore throughput on May 1 was 1,640 tonnes. May 2 was 2,891 tonnes, May 3 is was 3, 028 tonnes, and May 4 it was 3,641 tonnes. • Haul trucks are being used to haul ore from the Blast Pit Area to the Crusher and from the Crusher to Milne Inlet via Tote Road
Haul Road	• 24 hour sampling was conducted May 4 to 6. • Attempted to measure air emissions arising from the transport of ore from the blast area to the crushers • Very limited activity due to slippery road conditions in the morning, and increased focus on crushing gravel for tote road and runway repairs
Runway Resurface	• 24 hour sampling was conducted May 6 to 9. • Not in original scope, but monitors were available and samples were taken

Activity Area	Activities During Sampling Period
	• Air monitoring equipment was set up 200m south of the centre of the airstrip • During sample period the crusher was in operation, but switched from crushing ore to esker for runway rebuilding • Hauling of Ore, Esker, and Snow was occurring on road to the north of the airstrip and the Tote Road
Tote Road	• 24 hour sampling was conducted May 7 to 9. • Conditions were mostly damp roads in the morning, with gradual drying over the day. • May 7 had 12 triaxles with pups and 2 triaxles without pups haul ore from Mary River to Milne. • May 8 had 10 triaxles with pups and 5 triaxles without pups haul ore from Mary River to Milne. • Degrading conditions due to warm weather –maintenance has increased, loads are cut back 10%

3.3 Sampling Methods

3.3.1 Active Monitoring Program: TSP and Metals

The remote nature of the study area, lack of line power, and low ambient temperatures were factors that influenced the selection of monitoring methodologies and equipment. The methods selected are in many cases different from the reference methodologies used under normal conditions. The methodologies and equipment selected allowed for easy transportation of equipment and operation from a battery power source.

A battery-powered PQ100 air sampler was used to collect TSP and various metals samples as 110V AC power was not available for operating conventional high-volume samplers. It was also more practical for shipping and deployment than the more conventional 110V AC

based samplers that tend to be larger. While PQ100 samplers do not have accreditation for TSP measurements under the U.S. EPA, they are accredited for PM_{10} measurements and they have been widely accepted by regulatory agencies in a number of jurisdictions for determination of TSP.

Samplers were installed at each of the monitoring locations. A tripod assembly was used to support the sampler. The inlet height of the samplers was approximately two metres above grade. All PQ100 samples were collected on filters at a flow rate of approximately 16.7 litres/min for a duration of approximately 24 hours. Samples were collected for a 3-day period at each location. A number of PQ100 samplers did not collect for the designated 24-hour period due to a faulty pump. Insufficient concentrations were obtained and an analysis could not be completed from these samples. The TSP filters were sent to Alberta Research Council (ARC) for gravimetric and metals analysis. The TSP sampling locations and dates are summarized in Table 6.

Table 6: Summary of TSP and Metals Sampling Locations Dates

Location		Sample No.	Start Date	Stop Date	Sample Duration (hrs)
Airstrip	Near	P6068305	May 1 @ 15:06	May 2 @ 12:27	21.35
		P6068298	May 2 @ 12:39	May 3 @ 9:22	20.72
		P6068296	May 3 @ 9:18	May 4 @ 8:55	23.62
	Far	P6068302	May 1 @ 15:01	May 2 @ 12:36	21.58
		P6068299	May 2 @ 12:39	May 3 @ 9:21	20.70
		P6068297	May 3 @ 9:25	May 4 @ 9:00	23.58
Blast Pit Area	Near	P7034452	May 4 @ 11:41	May 5 @ 9:00	21.32
		P7034468	May 5 @ 8:56	May 6 @ 9:37	24.58
		P7034467	May 6 @ 9:39	May 7 @ 7:57	22.30
	Far	P7034450	May 4 @ 11:36	May 5 @ 8:54	21.30
		P7034469	May 5 @ 8:56	May 6 @ 9:33	24.62
		P7034465	May 6 @ 9:35	May 7 @ 7:58	20.38
Crushers	Near	P6068303	May 1 @ 14:05	May 2 @ 12:00	21.92
		P6068300	May 2 @ 12:04	May 3 @ 8:55	20.85
		P7034447*	May 3 @ 9:00	May 4 @ 8:02	23.03
	Far	P6068304*	May 1 @ 14:00	May 2 @ 0:06	10.10
		P6068301*	May 2 @ 12:02	May 2 @ 21:03	9.02
		P7034446*	May 3 @ 8:55	May 3 @ 20:36	11.68
Haul Road	Near	P7034453	May 4 @ 12:10	May 5 @ 9:19	21.15
		P7034456*	May 5 @ 9:20	May 6 @ 7:20	22.00
		N/A	N/A	N/A	N/A

Location		Sample No.	Start Date	Stop Date	Sample Duration (hrs)
	Far	N/A	N/A	N/A	N/A
		P7034455*	May 5 @ 9:25	May 5 @ 12:03	2.63
		N/A	N/A	N/A	N/A
Runway Resurface	Near	P7034464	May 6 @ 10:18	May 7 @ 8:32	22.23
		P7034458*	May 7 @ 8:32	May 7 @ 19:34	11.03
		P6068281	May 8 @ 9:16	May 9 @ 7:17	22.02
	Far	P7034454*	May 6 @ 10:14	May 6 @ 11:58	1.73
		P7034461*	May 7 @ 8:35	May 7 @ 8:40	0.08
		P6068282*	May 8 @ 9:12	May 8 @ 13:20	4.13
Tote Road	Near	P7034462	May 7 @ 8:59	May 8 @ 9:00	24.02
		P6068283	May 8 @ 9:05	May 9 @ 7:43	22.63
		N/A	N/A	N/A	N/A
	Far	P7034463	May 7 @ 9:03	May 8 @ 8:55	23.87
		P6068284	May 8 @ 8:59	May 9 @ 7:40	22.68
		N/A	N/A	N/A	N/A

Notes: * Sample did not collect for full time
N/A – not applicable

3.3.2 Passive Sampling Program (SO_2, NO_2, O_3 and Total Dust Fall

Sampling for SO_2, NO_2 and O_3 was conducted using passive monitors from Maxxam Analytics Inc. Passive monitors are devices that collect gaseous pollutants through diffusion or permeation onto a specially designed substrate. No power is required for these monitors. This monitoring technique, which was the only practical method of monitoring these contaminants at this site, had the disadvantage of providing only long-term (approximately 1-month) concentrations. It did not provide information on short-term (1-hour or 24-hour) peak concentrations. The monitors were deployed at each location for a 32 to 36-day period. Monitors were supported by a tripod at a height of two metres above grade.

Particulate deposition (dust fall) samples were taken with the passive monitors. These samplers are also passive in nature and require no power. These samplers collect total deposited particulate, including metals. The dust fall samplers were deployed for a 30 to 36-day period. The samples were submitted to ARC for total dust fall and metals analysis.

The passive sampling program involved the collection of SO_2, NO_2, O_3, and dust fall samples simultaneously at the airstrip, crusher, and tote road. Samples using passive monitors and dust fall samplers were collected at the locations and dates shown in Table 7 (locations also shown in Figure 8 to Figure 10). Monitoring was conducted at each location for a 32 to 36-day period, however bulk sampling activities were halted after the first week of monitoring, so these results are only partially representative of emissions from the bulk sampling operations.

Table 7: Passive Sampling Locations and Dates

Location	Type of Sample	Start Date	Stop Date
Airstrip	Passive	May 6	June 10
	Dust Fall	May 6	June 10
Blast Pit Area	Passive	May 5	Not Recovered*
	Dust Fall	May 5	Not Recovered*
Crushers	Passive	May 4	June 10
	Dust Fall	May 4	June 10
Tote Road	Passive	May 8	June 10
	Dust Fall	May 8	June 10

Notes: * At this location the sample tripod fell over due to high winds, and the samples were not recovered.

3.4 Meteorological Conditions During Sampling Period

The location and description of the meteorological measurements are provided in the meteorological report (Draft Baseline Meteorological Assessment for Baffinland Iron Mines Corporation, Submitted by RWDI AIR Inc. November 6, 2007).

The average temperature during the two week active monitoring period was -5°C, with temperatures ranging from -3 °C to -8 °C. Precipitation during the two week program, which consisted only of snow during overnight periods, totalled 23.8 mm. The wind data during the active monitoring program corresponding to the period when maximum concentrations were measured are summarized in Figures 2 through 7.[1]

[1] There are approximately 10 hours of missing wind data for the windrose in Figure 2. The windrose may not be an accurate representation of the wind direction and speed for this sample period.

3.5 Sample Analysis, Instrument Calibrations and Calculations

3.5.1 Active Monitoring Program

TSP filters were sent to Alberta Research Council (ARC) for weighing and metals analysis. The resultant masses were divided by the volume of airflow through the samplers, which was calculated based on the calibration sheets for the PQ100 samplers provided by the supplier. This process yielded 24-hour average TSP and metals concentrations (µg/m³).

3.5.2 Passive Monitoring Program

SO_2, NO_2 and O_3 samples were sent to Maxxam Analytics Inc. for analysis. The results were provided in units of parts per billion (ppb) and were converted to µg/m³ assuming standard conditions of 10 ºC and 101.325 kPa.

Dust fall samples were also collected using dust fall jars. The dust fall samples were sent to ARC for dust and metals analysis. The results were provided as total mass in grams. Dust fall rates were calculated in units of mg/100 cm^2/30 days.

3.6 Quality Assurance Measures

A number of quality assurance measures were implemented during the sampling program to ensure the integrity of the results. These measures included detailed documentation of all field activities, analysis of unexposed samples (blanks), and a number of laboratory related measures including sample handling procedures and instrument calibrations. Chain of custody forms were completed and submitted with the samples to the laboratory.

4. RESULTS

The results of the ambient monitoring program are summarized in Figures 2 to 10 along with coincident wind data. Raw laboratory data can be found in Appendix B.[2]

Although the air quality monitoring program represented only a brief snapshot in time, it coincided with weather conditions and types of activities that were representative of what occurred throughout bulk sampling preparations. It should be noted that bulk sampling activities were halted after the first week of monitoring, so the results of the longer-term (one month) passive sampling program for SO_2, NO_2, O_3, and dust fall are only partially representative of emissions from the bulk sampling operations.

4.1 TSP Concentrations

Table 8 shows the maximum TSP concentrations measured at each monitoring location. The samples were taken over 24-hour time periods and are compared to the 24-hour threshold value. These results are shown in Figures 2 to 7.

[2] See note to Table 7. Samples indicated by Maxxam as "missing" were actually not recovered after the tripod fell over due to high winds.

Table 8: TSP Concentrations

Sampling Location		Maximum TSP Concentrations During Bulk Sampling Preparations (µg/m³)	Range of Maximum Baseline TSP Concentrations (µg/m³)
24-hour Indicator Threshold		***120 µg/m³***	
Airstrip	Near	59	3.0-7.0
	Far	49	
Blast Pit Area	Near	34	
	Far	11	
Crushers	Near	276	
	Far	87	
Haul Road	Near	47	
	Far	Not available*	
Runway Resurface	Near	91	
	Far	Not available*	
Tote Road	Near	68	
	Far	38	

Notes: * – Sampler did not run for an acceptable length of time

The maximum measured 24-hour TSP concentration was 276 µg/m^3, which occurred at the crusher area (Figure 5). This level is above the indicator threshold of 120 µg/m^3. However, the TSP levels at the far station (150m) were lower, at 87 µg/m³, which is below the indicator threshold, only 100 metres further from the crusher.

4.2 Metals Concentrations

Table 9 shows the metal concentrations measured at each of the near monitoring locations. Table 10 shows the metal concentrations measured at each of the far monitoring locations. The samples were taken over a 24-hour time period and are compared to 24-hour threshold values, where available. The table only presents selected metals, the full list of analysis is provided in Appendix A1. The metals selected are those found either to exceed the indicator threshold or to be present in fairly significant quantities (when no indicator threshold is given).

Table 9: Maximum Concentrations for Selected Metals from Near Locations

Parameter	Ontario Metals Criteria (µg/m³)	Airstrip (µg/m³)	Blast Pit Area (µg/m³)	Crushers (µg/m³)	Haul Road (µg/m³)	Runway Resurface (µg/m³)	Tote Road (µg/m³)
Al	***N/A***	3.25	0.664	7.65	1.31	3.94	3.66
Fe	***4***	2.65	9.41*	81.3*	12.4*	3.69	3.05
K	***N/A***	2.01	0.0942	3.93	0.564	3.21	2.42
Mg	***120***	2.09	0.658	4.35	0.704	2.64	2.35
Mn	***2.5***	0.0435	0.0563	0.640	0.0908	0.0668	0.0440
Si	***5***	10.90*	1.57	20.9*	3.05	16.4*	12.1*

Notes: N/A – not applicable
***** – indicates an exceedance of the Ontario Metals Criteria.

Table 10: Maximum Concentrations for Selected Metals from Far Locations

Parameter	Ontario Metals Criteria (µg/m³)	Airstrip (µg/m³)	Blast Pit Area (µg/m³)	Crushers (µg/m³)	Haul Road (µg/m³)	Runway Resurface (µg/m³)	Tote Road (µg/m³)
Al	***N/A***	2.94	0.165	0.696	-	-	1.39
Fe	***4***	2.49	2.60	35.4*	-	-	1.17
K	***N/A***	1.82	0.0871	0.571	-	-	1.02
Mg	***120***	1.80	0.225	0.621	-	-	1.03
Mn	***2.5***	0.0388	12.4*	0.282	-	-	0.0190
Si	***5***	9.62*	0.735	2.23	-	-	4.86

Notes: No values for Haul Road and Runway Resurface as the **s**ampler did not run for an acceptable length of time
N/A – not applicable
***** – indicates an exceedance of the Ontario Metals Criteria.

The results in Tables 9 and 10 are based on limited measurements over a short period of time, but they do provide an indication of the metals concentrations from the activities measured. Where measurements exceeded indicator thresholds, the comparison of results at near and far sampling locations were extrapolated to estimate the approximate extent of these concentrations (*i.e.*, the "zone of influence").

Levels of aluminium, potassium and magnesium were below their respective thresholds for all samples collected. Levels of iron, manganese and silica exceeded their indicator thresholds for some samples. Comparison of near and far measurements in these cases generally showed significant decreases with increasing distance, indicating that concentrations in excess of

indicator thresholds would be generally limited to areas close to the sources, *i.e*, within about 1 km. The principal exception was the runway resurfacing activity, for which a decrease with distance was not discerned from the limited monitoring data.

4.3 SO_2, NO_2 and O_3 Concentrations

Table 11 shows SO_2, NO_2 and O_3 concentrations at each monitoring location for the nominal 30-day averaging period. The concentrations are compared to 24-h and annual threshold indicators. These results are shown in Figures 8 to 10. The area's limited human activity means that ambient concentrations of SO_2 and NO_2 are likely to vary less over time than is typically the case in more populated areas. As a result, their respective 24-h and annual average concentrations will be relatively similar to each other. Therefore, it is possible to make approximate comparisons of the measured 30-day average with 24-h and annual threshold indicators.

Table 11: SO_2, NO_2 and O_3 Concentrations

	Concentrations During Bulk Sampling Preparations (µg/m³)			**Range of Maximum Baseline Concentrations** (µg/m³)		
Monitor Location	**SO_2** 30-day average	**NO_2** 30-day average	**O_3** 30-day average	**SO_2** 30-day average	**NO_2** 30-day average	**O_3** 30-day average
Indicator Threshold	***150 (24-h) 30 (annual)***	***200 (24-h) 60 (annual)***	***30 (24-h) 30 (annual)***	***150 (24-h) 30 (annual)***	***200 (24-h) 60 (annual)***	***30 (24-h) 30 (annual)***
Airstrip	<0.276	1.19	86.6	<0.262-0.262	<0.188-0.188	44.0-52.8
Crushers	<0.276	2.77	86.8			
Tote Road	<0.276	0.79	91.2			

Measured SO_2 and NO_2 levels were much lower than the indicator thresholds and were fairly consistent with background ambient air quality levels at Mary River.

Measured monthly O_3 levels were in excess of the indicator thresholds at all of the locations. O_3 is not directly emitted, but rather results from a series of complex reactions of NO_x and VOCs in the atmosphere. Given that the local sources of NO_x are limited, as indicated in the

measured NO_2 concentrations, the high O_3 concentrations, which were somewhat above the levels observed during the baseline program, are likely due regional rather than local factors. O_3 is considered to be mainly natural variability in regional background levels.

4.4 Total Dust Fall and Metals

Total dust fall results from the one-month monitoring activities at the airstrip, crushers and tote road are presented in Table 12. Selected metals analysis from this sampling are presented in Table 13[3]; the complete analysis is provided in Appendix A2. Total dust fall rates are compared to 30-day dust fall indicators where applicable. There are no applicable indicators for metal deposition. As shown in Table 12, there were no measured dust fall levels that exceeded the indicator threshold of 53 mg/100cm^2/30 days. In general, the highest dust fall levels were associated with silicon, iron, potassium, calcium, magnesium and aluminium. Dust fall levels were noticeably lower in the vicinity of the crushers than at the other sampling locations, due to the fact that the crushers were in operation only during the first week of the 1-month sampling period.

Table 12: Total Dust Fall Results

Location	Maximum Bulk Sampling Dust Fall Results (mg/100cm^2/30days)	Range of Maximum Baseline Dust Fall Results (mg/100cm^2/30days)
1-Month Indicator Threshold	***53 mg/100cm^2/30 days***	
Airstrip	18.5	0.135-0.398
Crushers	5.61	
Tote Road	25.0	

Table 13: Selected Total Metals Results

Parameter	Airstrip (µg/100cm^2/30days)	Crushers (µg/100cm^2/30days)	Tote Road (µg/100cm^2/30days)	Range of Baseline Results (µg/100cm^2/30days)
Ag	0.0094	0.00392	0.076	<0.00057-<0.00272
Al	897	128	1453	<7.62-26.9
As	0.0504	0.0381	2.42	0.00525-0.00977
B	0.95	1.19	1.05	0.149-0.19
Ba	10.0	4.42	8.23	0.191-0.435
Ca	761	449	2020	12.5-25.7

[3] Results from the blast pit area are not presented, as the monitoring equipment fell over due to high winds and the samples were not recovered.

Parameter	Airstrip (µg/100cm^2/30days)	Crushers (µg/100cm^2/30days)	Tote Road (µg/100cm^2/30days)	Range of Baseline Results (µg/100cm^2/30days)
Cd	0.174	0.0565	0.311	<0.00244-0.0308
Cr	2.86	0.497	3.56	<0.153-<0.3
Cu	1.17	0.94	7.26	0.144-0.264
Fe	679	255	774	<11-30.6
K	539	424	271	25-74.4
Li	0.633	0.123	0.338	0.0099-0.0866
Mg	702	164	786	10.9-23.9
Mn	11.7	2.93	10.9	0.899-1.72
Na	236	271	121	20.6-33.3
Ni	3.48	0.645	2.00	<0.0552-<0.162
Pb	0.662	0.260	44.8	<0.0288-<0.114
Si	3086	507	2275	<34.4-<78.1
Sn	0.184	0.568	1.10	<0.016-0.782
Sr	3.73	0.92	3.16	0.0919-2.83
U	0.0723	0.0168	0.0666	0.000737-0.00234
V	1.13	0.162	0.726	0.0255-0.0501
Zn	8.46	26.6	31.3	<0.385-0.708

5. CONCLUSIONS

1. Total suspended particulate (TSP) values were below indicator thresholds at all locations with the exception of the sampling location 50 m from the edge of the crusher area. At the sampling location 200 m from the edge of the crusher area, the maximum measured value was below the indicator threshold, indicating that TSP emissions above the indicator threshold were localized.

2. Metals concentrations from the 24-hour sampling were all below their respective indicator thresholds (where one exists), with the exception of some of the iron and silica measurements and one of the manganese measurements. Generally, the difference in measurements between near and far sampling locations indicated that levels above the indicator threshold were to be found only relatively close to the sources (*i.e.*, within 1 km). The principal exception occurred at the runway resurfacing operations, where no decrease in concentration with distance was observed during the limited sampling period.

3. Long-term (1-month) sampling of SO_2 and NO_2 indicated levels that were much lower than their respective indicator thresholds and were fairly consistent with background ambient air quality levels at Mary River.

4. Long-term (1-month) sampling of O_3 showed results above the indicator threshold at all locations. The O_3 concentrations were somewhat above the levels observed during the baseline program. These concentrations are likely due regional rather than local factors, *i.e.*, they are likely due to long-term transport and are not associated with emission sources at the Mary River site.

5. Long-term (1-month) sampling of dust fall showed a significant increase from the baseline measurements, but all results were lower than the indicator threshold.

6. Metals concentrations from the long-term (1-month) samples showed a significant increase from baseline concentrations, particularly for iron and silica. There are no available metals deposition criteria for comparison with these measured results.

6. REFERENCES

Canadian Council of Ministers of the Environment, 2000. Canada Wide Standards for Particulate Matter (PM) and Ozone. Available at: http://www.ccme.ca/assets/pdf/pmozone_standard_e.pdf

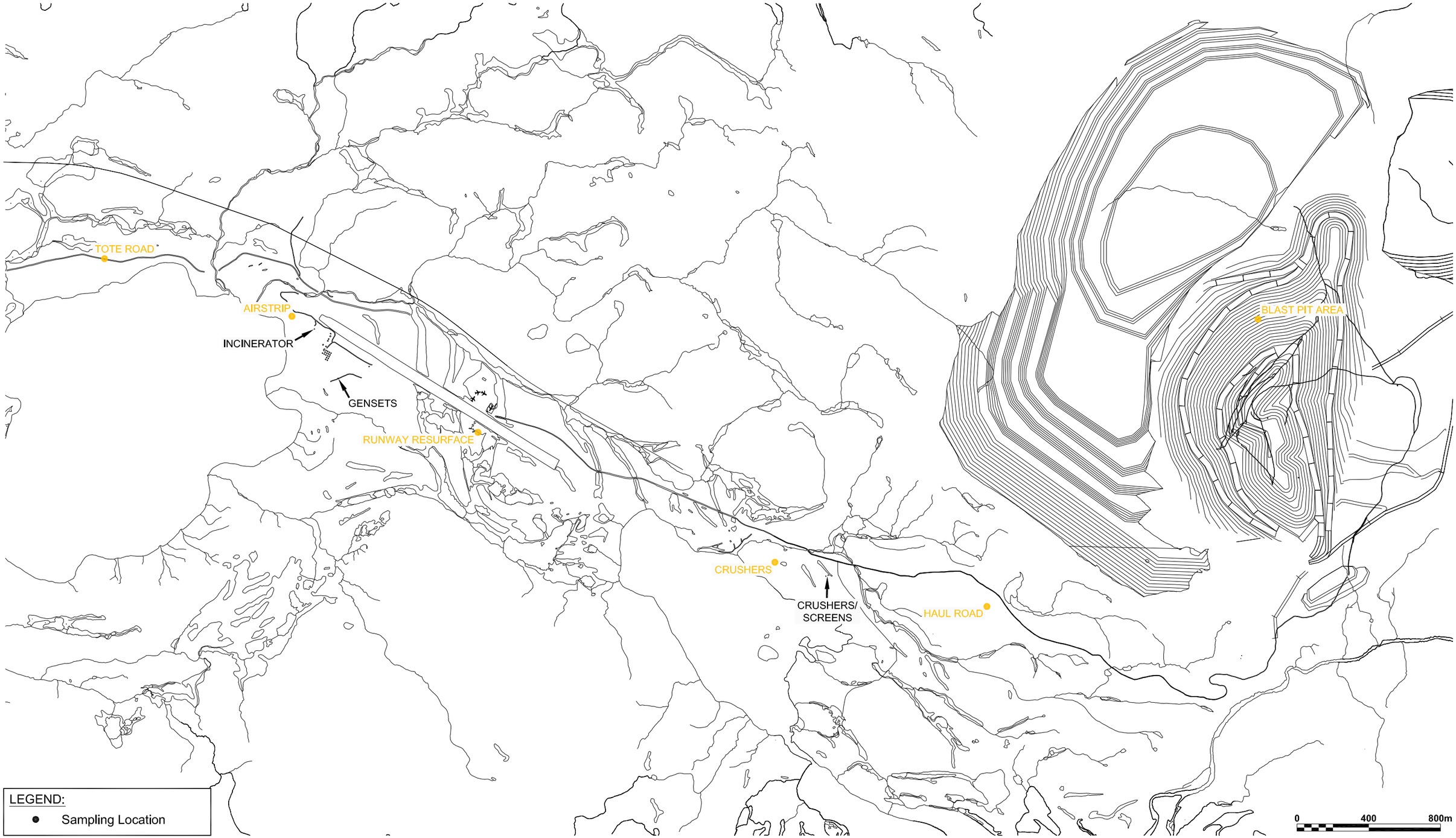
Health Canada, 2005. Environmental and Workplace Health, Regulations Related to Health and Air Quality. Available at http://www.hc-sc.gc.ca/ewh-semt/air/out-ext/reg_e.html

Ontario, Ministry of the Environment, September 2001. Summary of Impingement Standards, Point of Impingement Guidelines and Ambient Air Quality Criteria (AAQC). Available at www.ene.gov.on.ca/envision/air/airquality/standards.htm.

Northwest Territories Department of Resources, Wildlife and Economic Development. December 2002. Guideline for Ambient Air Quality Standards in the Northwest Territories.

U.S. EPA Compendium Method IO-2.3. 2005. Technology Transfer Network and Ambient Monitoring Technology Center. www.epa.gov/ttn/amtic/inorg.html.

FIGURES



Site Plan Showing Sampling Locations

True North

KPL - Mary River AQ Monitoring - Mary River, Nunavut

Project #W07-5226C

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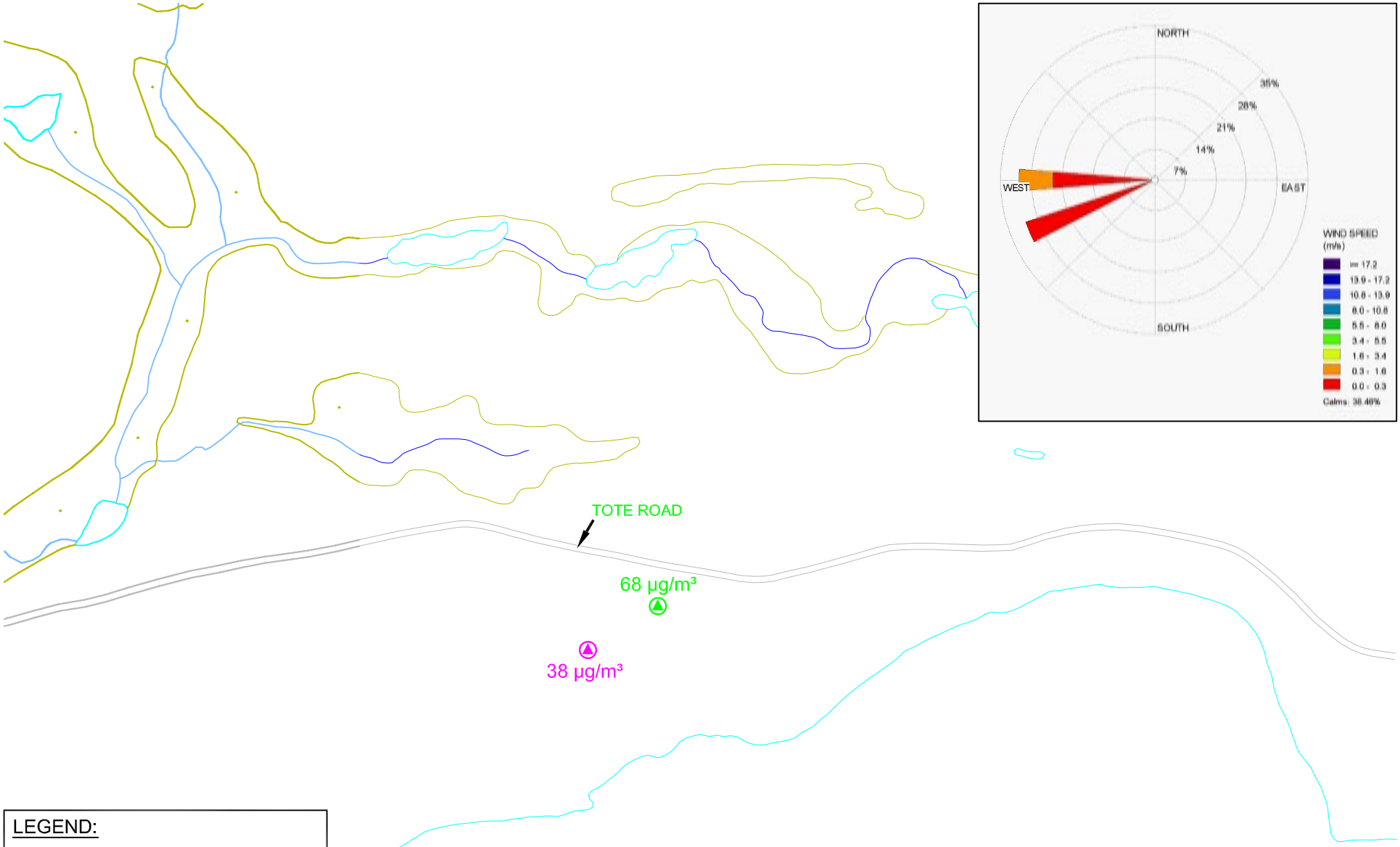
Approx. Scale:	1:20 000		
Date Revised:	Aug. 20, 2008		



Site Plan Showing Sampling Locations and TSP Concentrations - Tote Road
Sampling Period from May 8 to May 9, 2008

KPL - Mary River AQ Monitoring - Mary River, Nunavut

Project #W07-5226C

True North

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Approx. Scale:	1:4000
Date Revised:	Aug. 20, 2008

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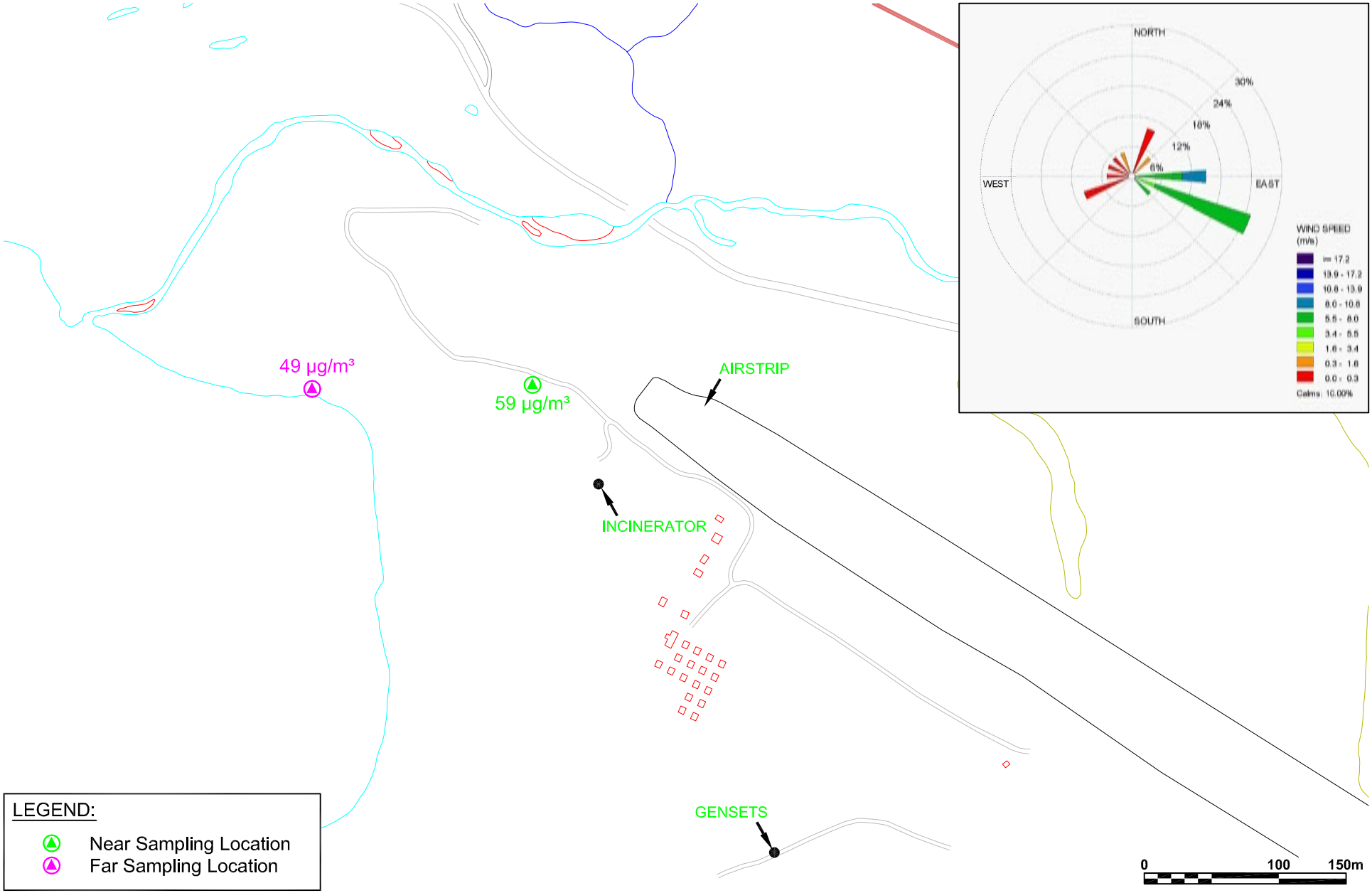

Site Plan Showing Sampling Locations and TSP Concentrations - Airstrip

Sampling Period from May 2 to May 3, 2008

True North

KPL - Mary River AQ Monitoring - Mary River, Nunavut

Project #W07-5226C

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Approx. Scale:	1:4000
Date Revised:	Aug. 20, 2008

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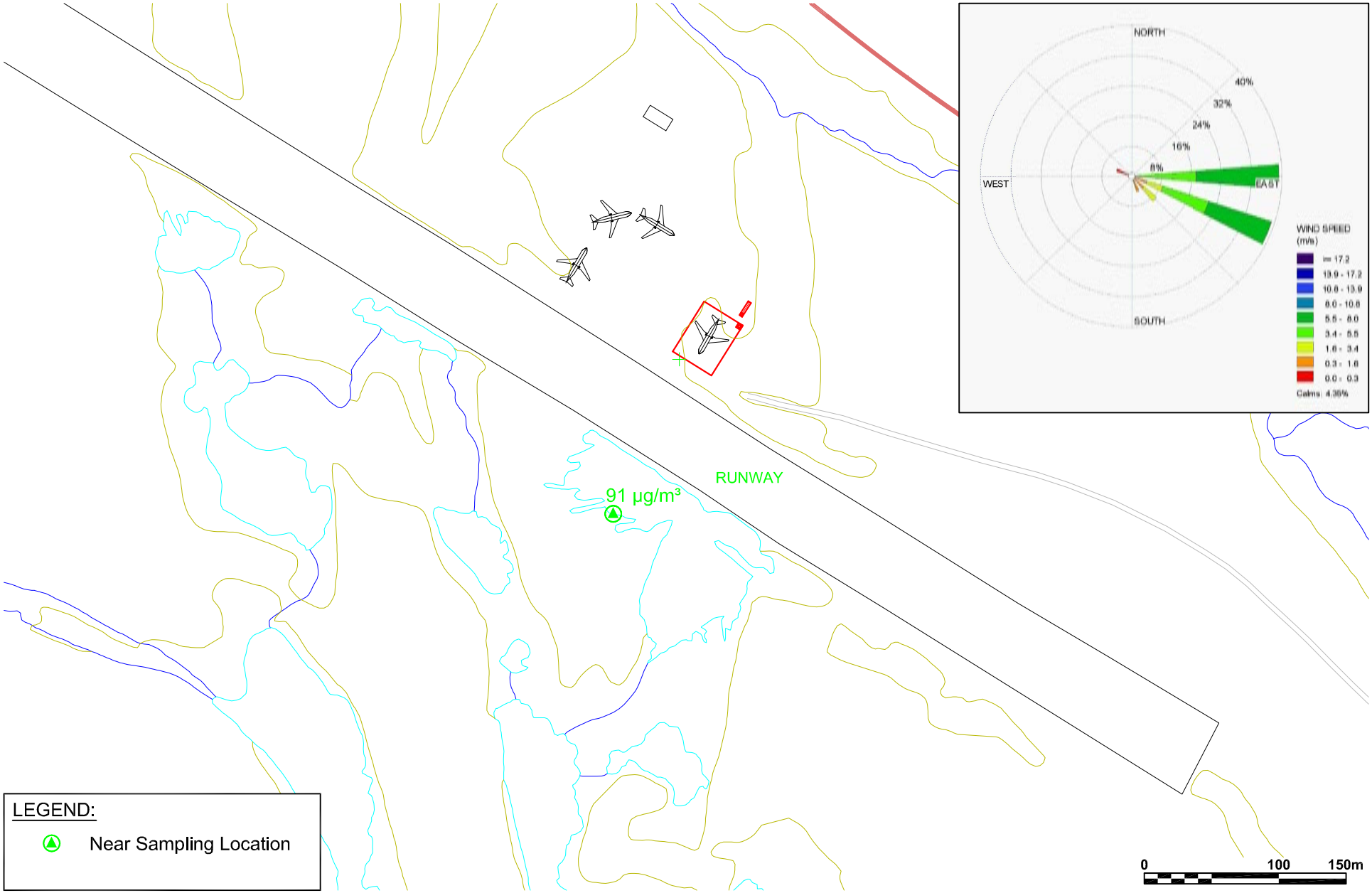

Site Plan Showing Sampling Locations and TSP Concentrations - Runway Resurface

Sampling Period from May 6 to May 7, 2008

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Project #W07-5226C

True North

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Date Revised:	Aug. 20, 2008

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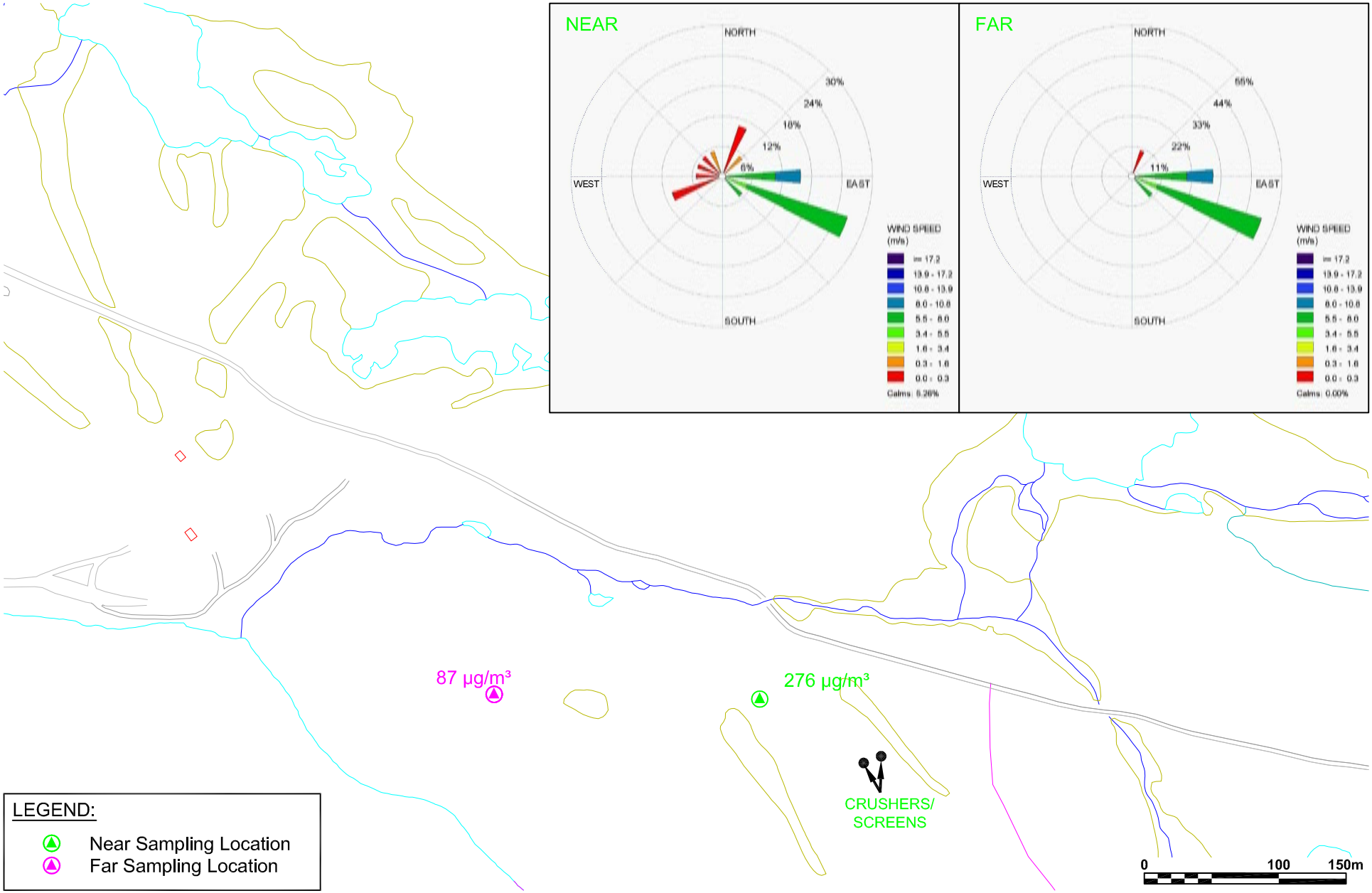

LEGEND:

- Near Sampling Location
- Far Sampling Location

Site Plan Showing Sampling Locations and TSP Concentrations - Crushers

Sampling Period from May 2 to May 3, 2008

True North

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Project #W07-5226C

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Approx. Scale:	1:4000	
Date Revised:	Aug. 20, 2008	

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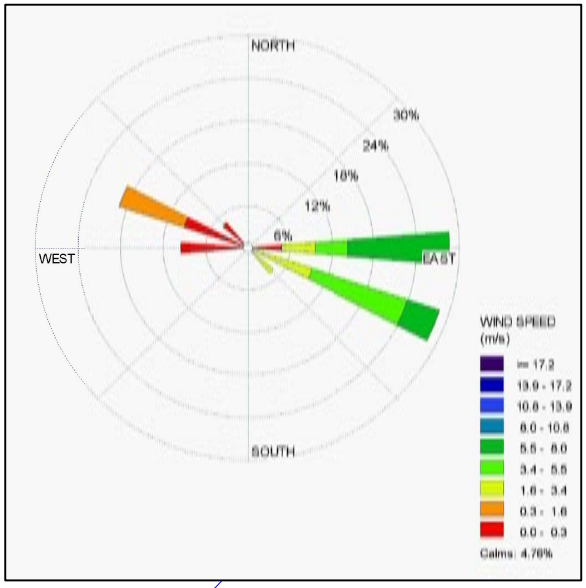

HAUL ROAD

47 µg/m³

LEGEND:

Near Sampling Location

0 100 150m

Site Plan Showing Sampling Locations and TSP Concentrations - Haul Road

Sampling Period from May 4 to May 5, 2008

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True North

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Date Revised: Aug. 20, 2008

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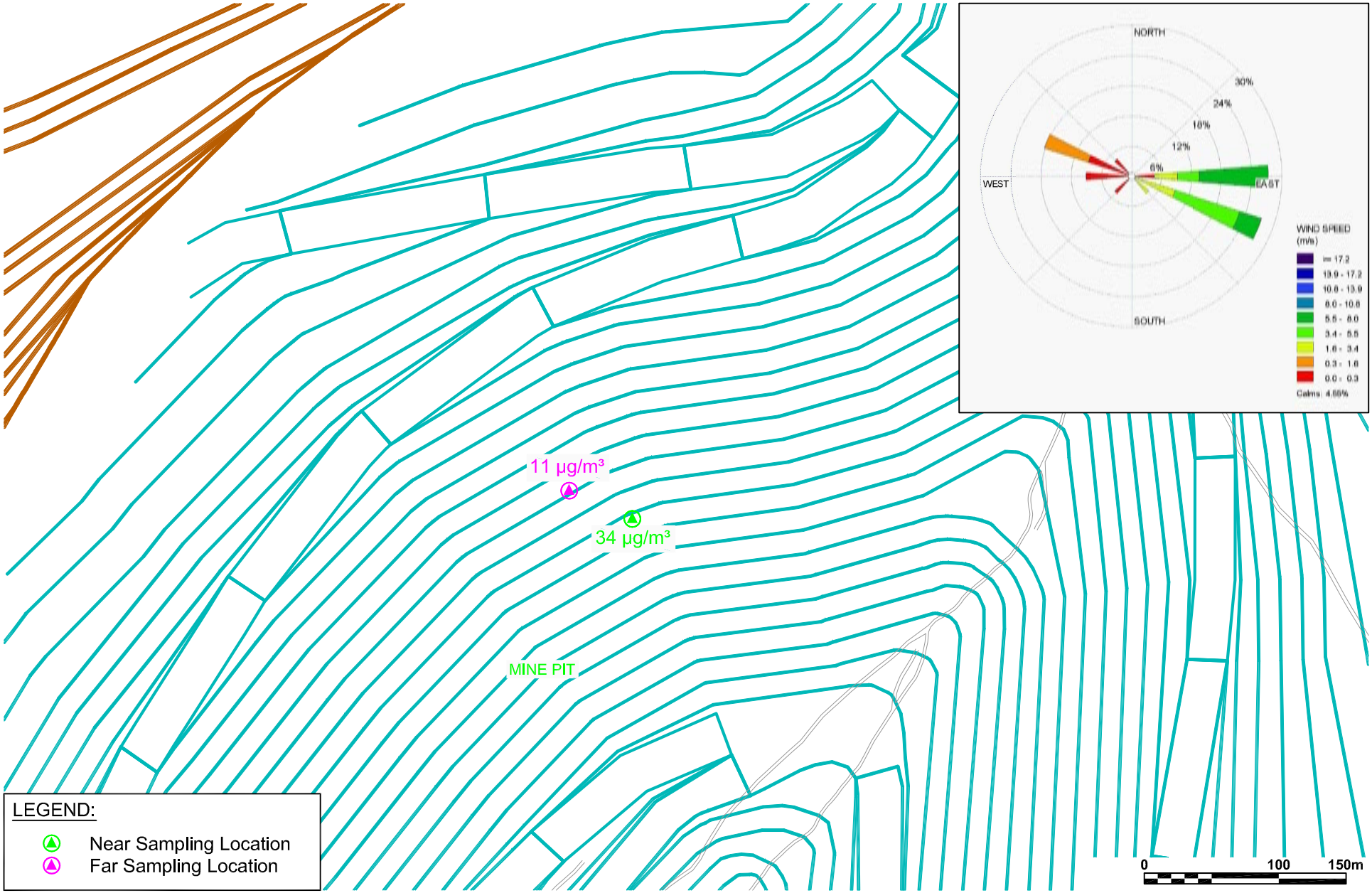

Site Plan Showing Sampling Locations and TSP Concentrations - Blast Pit Area

Sampling Period from May 4 to May 5, 2008

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Project #W07-5226C

True North

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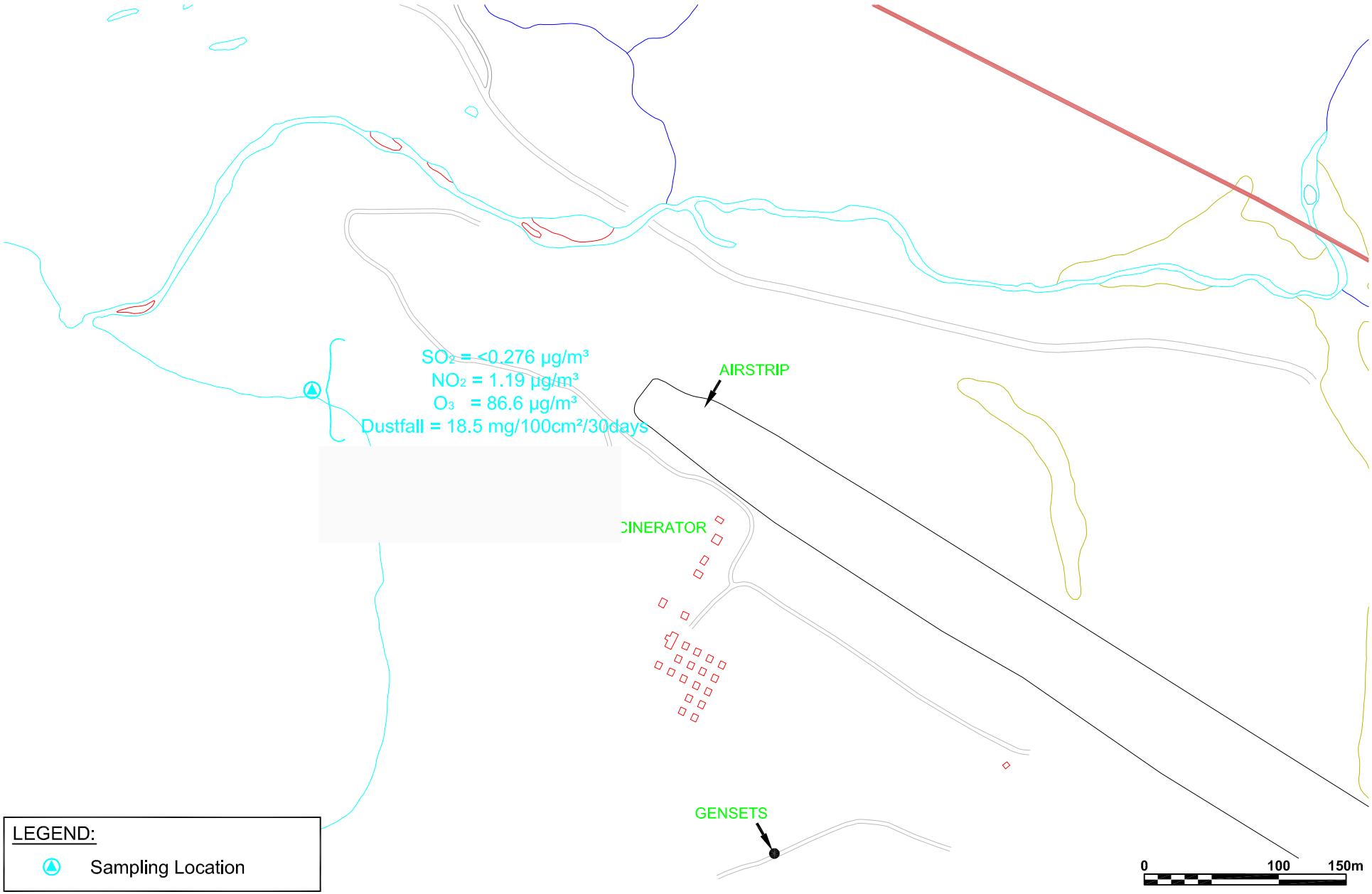
Approx. Scale:	1:4000
Date Revised:	Aug. 20, 2008

RWDI



LEGEND:

Sampling Location

Site Plan Showing Average SO_2, NO_2, O_3 and Dustfall Concentrations - Airstrip

30-Day Sampling Period

True North

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Project #W07-5226C

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Figure: 8

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Date Revised: Aug. 20, 2008

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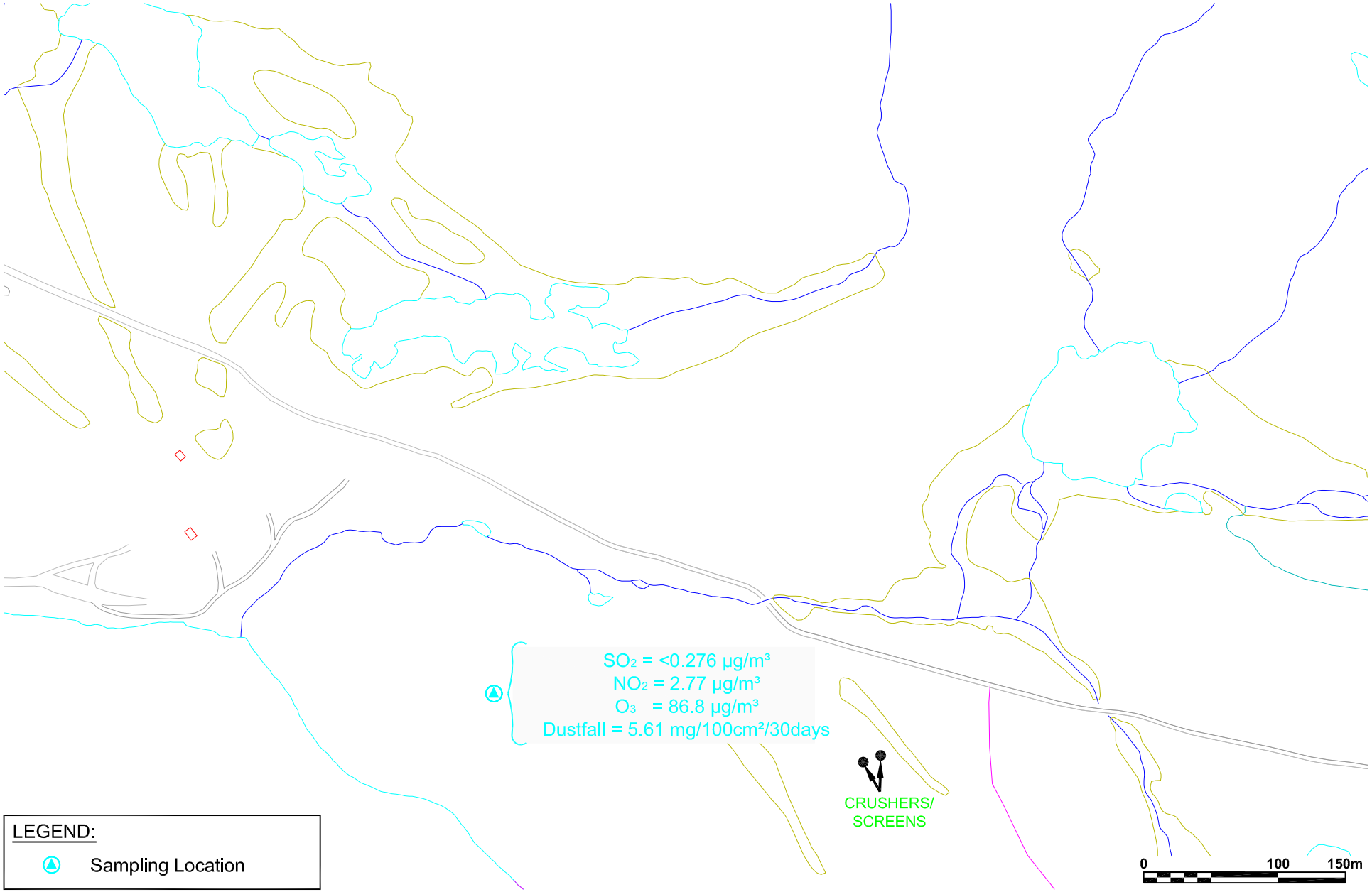

LEGEND:

Sampling Location

Site Plan Showing Average SO_2, NO_2, O_3 and Dustfall Concentrations - Crushers

30-Day Sampling Period

True North

KPL - Mary River AQ Monitoring - Mary River, Nunavut

Project #W07-5226C

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Date Revised:	Aug. 20, 2008	

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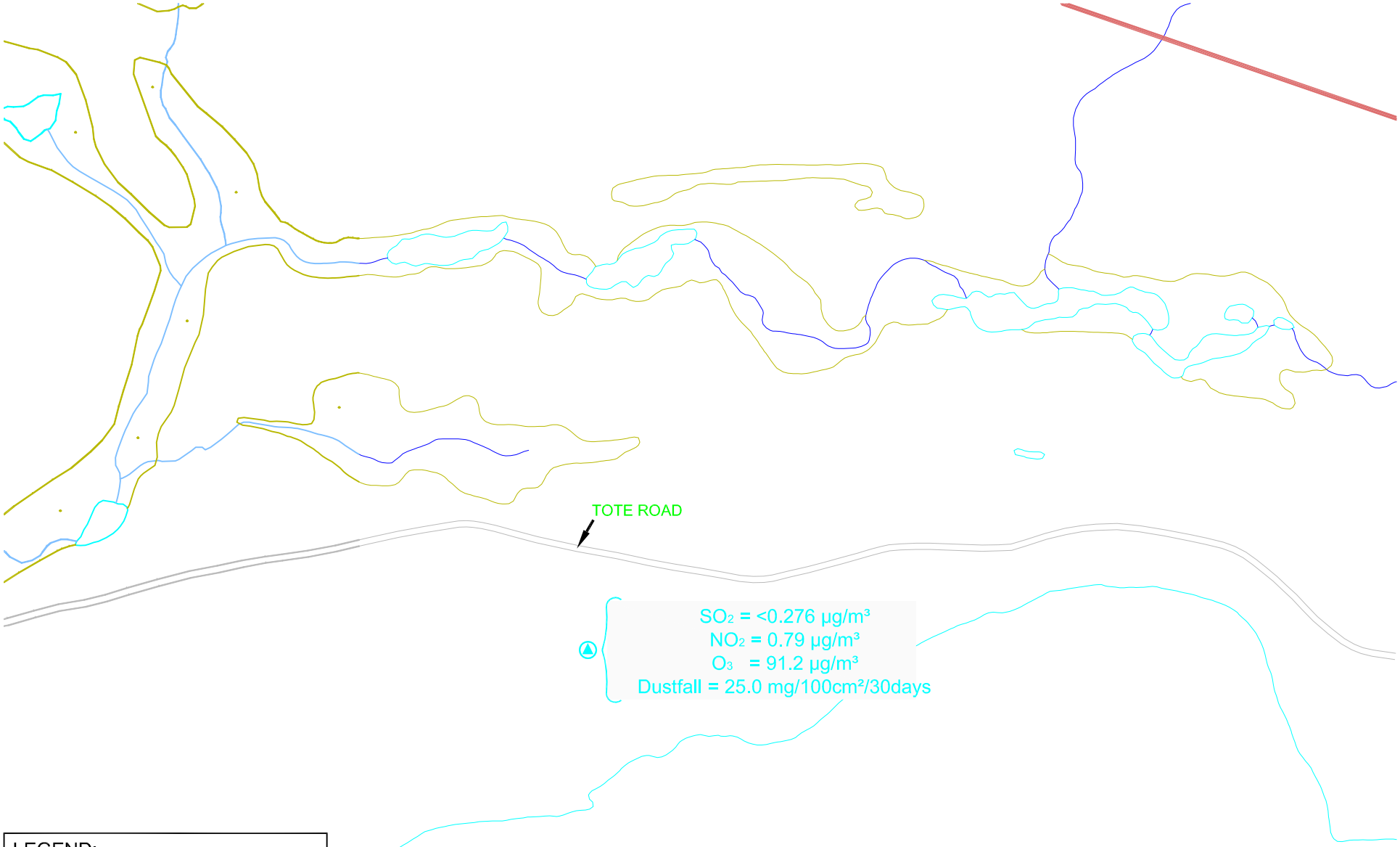

Site Plan Showing Average SO_2, NO_2, O_3 and Dustfall Concentrations - Tote Road

30-Day Sampling Period

True North

KPL - Mary River AQ Monitoring - Mary River, Nunavut

Project #W07-5226C

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Approx. Scale:	1:4000	
Date Revised:	Aug. 20, 2008	

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