Appendix G7

Air Quality and Dustfall Monitoring Report

Report: ***2012 Air Quality and Dustfall Monitoring Report***

Report: ***2012 Preliminary evaluation of dustfall along the Meadowbank AWAR***

MEADOWBANK GOLD PROJECT

2012 Air Quality and Dustfall Monitoring Report

In Accordance with NIRB Project Certificate No.004

Prepared by:
Agnico-Eagle Mines Limited – Meadowbank Division

March, 2013

EXECUTIVE SUMMARY

The 2012 dust and air quality monitoring program at Meadowbank was conducted in support of the Air Quality Monitoring Plan - Addendum (Golder, 2008). The objective of the 2012 program was to measure dustfall, total suspended particulates (TSP), PM10, PM2.5 and NO_2 at four monitoring locations around the Meadowbank site. Locations were established in 2011 in consultation with Environment Canada.

Results obtained for the measured parameters were compared to Government of Nunavut Environmental Standards for Ambient Air Quality (October, 2011), where applicable (TSP, PM2.5, NO_2).

Mass concentrations of suspended particulates (ie TSP, PM10, PM2.5) could not be normalized to standard temperature and pressure (STP) as required for direct comparison to GN standards. However, the values obtained in this monitoring program are expected to be higher than they would be if calculated for STP. With this assumption, GN standards were not exceeded for the applicable measured parameters (TSP, PM2.5, NO_2) at any time point or monitoring location in 2012.

Dustfall results were compared to the Alberta Environment Department's recreational area dustfall guideline for context. This guideline was exceeded at least once at all stations prior to May, 2012. However, the guideline was not exceeded at any site beginning in June 2012, which coincided with increased dust suppression efforts at the mine site.

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1 INTRODUCTION

1.1 OBJECTIVE

Since November, 2011, Agnico-Eagle Mines Ltd. (AEM) has conducted outdoor dust and air quality monitoring at their Meadowbank site, near Baker Lake, Nunavut, as required by NIRB Project Certificate No. 004.

The objective of this program is to monitor ambient air quality around the mine site perimeter, with the goal of mitigating potential environmental effects. The parameters measured in 2012, in accordance with the Project Certificate, were suspended particulates (total, PM10, PM2.5), NO_2 and dustfall (settleable particulate matter). As described in the Air Quality Monitoring Plan - Addendum (Golder, 2008), dustfall was measured approximately monthly and normalized to 30 days; suspended particulates were measured over 24 h on a six day cycle; and NO_2 was measured over approximately one month periods.

1.2 MONITORING LOCATIONS

Monitoring locations were determined in consultation with Environment Canada in 2011. One station was moved in 2012 due to changes in the location of the Vault haul road (see Section 1.2.4). UTM coordinates are provided in Table 1, and locations are shown in relation to minesite features in Figure 1. Note that only the final position of DF-4 is shown on the figure, but coordinates for both locations are provided.

Table 1. UTM coordinates and dates of measurement for the Meadowbank air quality and dustfall monitoring locations.

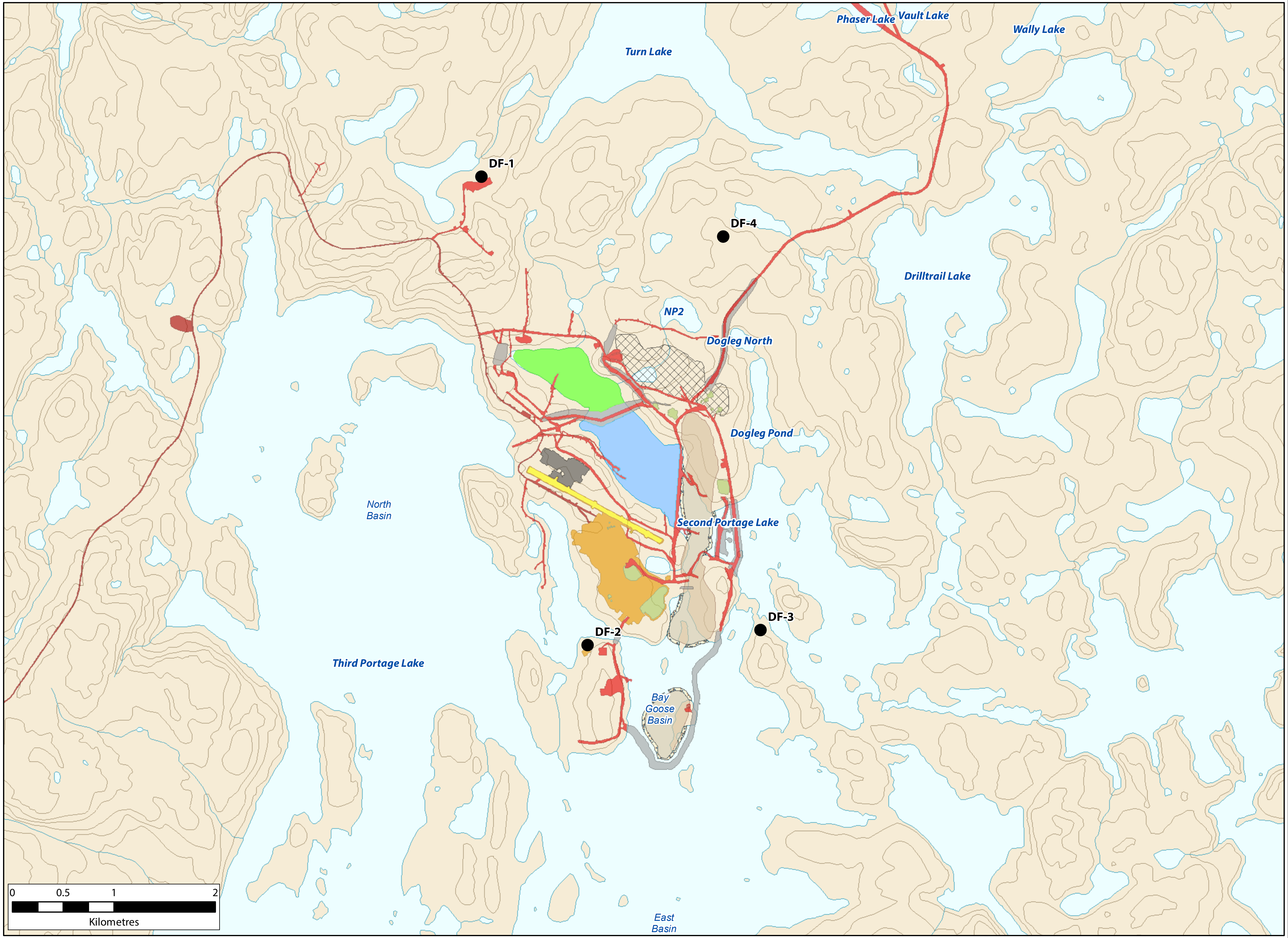
Monitoring Location	Measured Parameters	Easting	Northing
DF-1	TSP, PM10, PM2.5, NO_2, dustfall	636850	7217663
DF-2	TSP, PM10, PM2.5, NO_2, dustfall	637895	7213049
DF-3	Dustfall	639599	7213198
DF-4 (Jan-Feb)	Dustfall	639560	7216715
DF-4 (Mar-Dec)	Dustfall	639233	7217074

1.2.1 DF-1

Station DF-1 is located next to the explosive storage area (emulsion plant), and approximately 500 m north of the all-weather access road. TSP, PM10, PM2.5, NO_2 and dustfall were monitored at this location from April through October 2012, when the unit was removed for calibration.

1.2.2 DF-2

Station DF-2 is located at the northern corner of South Camp Island, near the TCG contractor area. TSP, PM10, PM2.5, NO_2 and dustfall were monitored at this location from April through December 2012.



Legend

- Air Quality & Dust Monitoring Location
- Quarry
- AWAR Quarry
- Dikes
- Portage Attenuation Facility
- Tailings Storage Facility
- Roads
- AWAR
- Stockpiles
- Facility
- Airstrip
- Portage Rock Storage Facility
- Mine Pit Area
- Pit Cap

Air Quality & Dust Monitoring Locations

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PROJECT: DA11-062-03

CLIENT: Agnico-Eagle Mines Ltd., Meadowbank Div.

N
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UTM Zone 14 NAD83

DATE: MARCH 2013

SCALE: 1:35,000

DRAWN BY: LC

CHECKED BY:

FIGURE:

1

1.2.3 DF-3

Station DF-3 is approximately 1,800 m east of the East Dike. Second Portage Lake is to the west and east. Dustfall only was monitored at this location from January through December 2012.

1.2.4 DF-4

Station DF-4 is approximately 1,500 m southwest of the future location of Vault Pit. This monitoring station was installed before the beginning of the construction of the Vault Road. Realignment of the road during construction placed the station within 10 feet of the road. Therefore, AEM re-positioned Station DF-4 approximately 480 m to the north-west on February 29, 2012 to be representative of the originally intended location relative to the road.

Dustfall only was monitored at this location from January through December 2012.

2 REGULATORY STANDARDS

Data collected from the air quality and dustfall monitoring program at Meadowbank were compared to the available Government of Nunavut Environmental Standards for Ambient Air Quality (October, 2011). Standards for the measured parameters are provided in Table 2.

Table 2. Government of Nunavut Environmental Standards for Ambient Air Quality (October, 2011) for the parameters of concern at Meadowbank. All values are for data normalized to standard conditions of 25°C and 101.3 kPa.

Parameter	Time Frame	Standard	
		µg/m^3	ppb
Fine Particulate Matter (PM2.5)	24-h average	30	
Total Suspended Particulate (TSP)	24-h average	120	
	Annual geometric mean	60	
Nitrogen Dioxide (NO_2)	1-h average	400	213
	24-h average	200	106
	Annual arithmetic mean	60	32

No standard is yet available for coarse particulate matter (PM10).

Likewise, no standards for dustfall are available for Nunavut. Results of the dustfall analysis were compared to the Alberta Environment Department recreational area guideline of 0.53mg/cm^2/30d, to provide context.

For all parameters and locations, trends over time were assessed.

3 METHODS

3.1 TSP, PM10, PM2.5

In 2012, AEM field staff sampled suspended particulates (TSP, PM10, PM2.5) at two locations over 24 h every six days, using a Partisol Plus Model 2025 Sequential Air Sampler. Partisol samplers draw in a stream of ambient air at a controlled flow rate through a size-selective inlet and a pre-weighed filter. The exposed filter is then shipped to the laboratory and re-weighed to measure the total accumulated particulates. For comparison to Government of Nunavut Ambient Air Quality Standards (2011), concentrations of particulates must be calculated as

$$C = M/V_{STD}$$

Where: C = mass concentration of particulates (µg/m^3)

M = final mass of filter – initial mass of filter (µg)

V_{STD} = volume of air drawn in during the sampling period, normalized to 25°C and 101.3kPA

(standard temperature and pressure; STP)

The Partisol instrument can calculate and store the V_{STD} value for each filter, but the default is to record the volumetric flow rate (non-STP-normalized), as per the US EPA method. Since the default settings were not adjusted in 2012, mass concentrations of particulates could not be normalized to STP, per the Canadian method. As a result, mass concentrations of suspended particulates were calculated using the volumetric flow rate, as in the US EPA method:

$$C = M/(\text{Flow Rate}_{VOL} \times \text{Time})$$

Where: C = mass concentration of particulates (µg/m^3)

M = final mass of filter – initial mass of filter (µg)

Flow Rate_{VOL} = volumetric flow rate

16.7 L/min for TSP

1.7 L/min for PM10

15 L/min for PM2.5

The US EPA method is expected to be conservative in this case. Since typical temperatures at the Meadowbank site are well below 25°C, the amount of air sampled per filter would be expected to be higher than the calculated volume, resulting in overestimates of particulate concentrations compared to STP-normalized values. Furthermore, the air sampling unit is housed in an insulated container, because winter temperatures inhibit operation. Since the unit's ambient temperature sensor is warmer than actual air temperature for much of the year, intake volumes would be even more inflated. Although results of particulate sampling will be compared to GN standards, these factors will be taken into consideration in assessing results.

3.2 DUSTFALL

Dustfall was collected in open vessels containing a purified liquid matrix over one month periods (approximately) at four locations. Particles are deposited and retained in the liquid, which was then analyzed by an accredited laboratory for total and fixed (non-combustible) dustfall. Calculated dustfall rates were normalized to 30 days (mg/cm^2/30 days).

3.3 NO_2

Concentrations of NO_2 by volume (ppb) were analyzed over one month periods (approximately 30 days) using a passive sampling device provided by Maxxam Analytics. No continuous monitoring was proposed for other gaseous pollutants because of low concentrations predicted in pre-construction dispersion modelling (Cumberland, 2005).

The annual average NO_2 concentration by volume was calculated from the monthly data for comparison against the relevant standard.

3.4 WEATHER DATA

Weather data for the dustfall and air quality monitoring periods was collected using the mine site's permanent weather station. Daily averages for wind speed, wind direction and temperature were available from this station.

3.5 GREENHOUSE GAS EMISSIONS

AEM is required by the Greenhouse Gas Emissions Reporting Program (GHGRP) to track greenhouse gas emissions based on annual fuel consumption, composition and the US EPA's AP-42 emission factors.

4 RESULTS

4.1 TSP, PM10, PM2.5

Sampling dates and 24-h average concentrations of TSP, PM10 and PM2.5 calculated using volumetric flow rate (non-STP normalized) and are provided in Table -Apx 1.

As mentioned previously the 24-h average concentrations of suspended particulates calculated here are expected to be higher than they would be if normalized to STP (see Section 3.1). Despite this, all measured values were below their respective 24-h GN standards, as shown in Figures 2 - 4.

The annual geometric mean concentrations of TSP at DF-1 and DF-2 were 8.04 µg/m^3 and 12.04 µg/m^3, respectively. These estimates are well below the annual GN standard of 60 µg/m^3.

Overall, no clear trends over time or between sampling stations were observed. Several higher concentrations of PM10 were observed near the beginning of the sampling period (April, 2012) at DF-2, but results of this magnitude were not observed again, and these results may have been due to an unidentified sampling error. PM10 values in 2013 will continue to be monitored with specific attention to this time period, to determine whether this is a recurring trend.

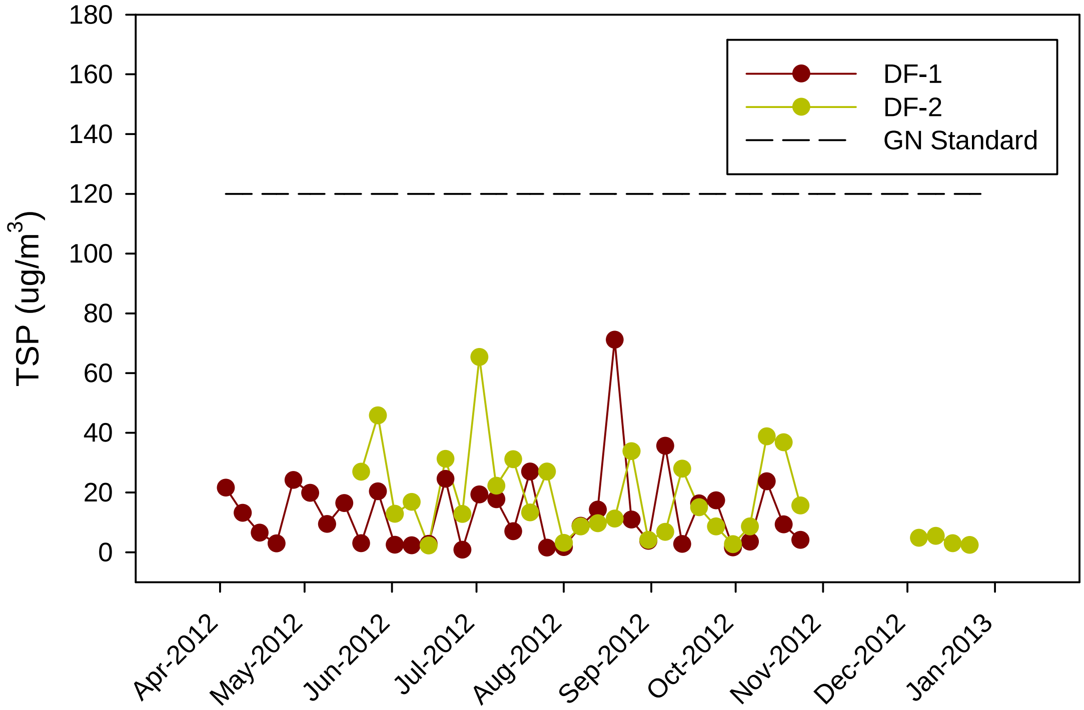

Figure 1. 24-average total suspended particulates (TSP) at Meadowbank DF-1 and DF-2, calculated using volumetric flow rate (non-STP-normalized). Dashed line indicates the 24-hr average GN standard for ambient air quality, normalized to STP conditions.

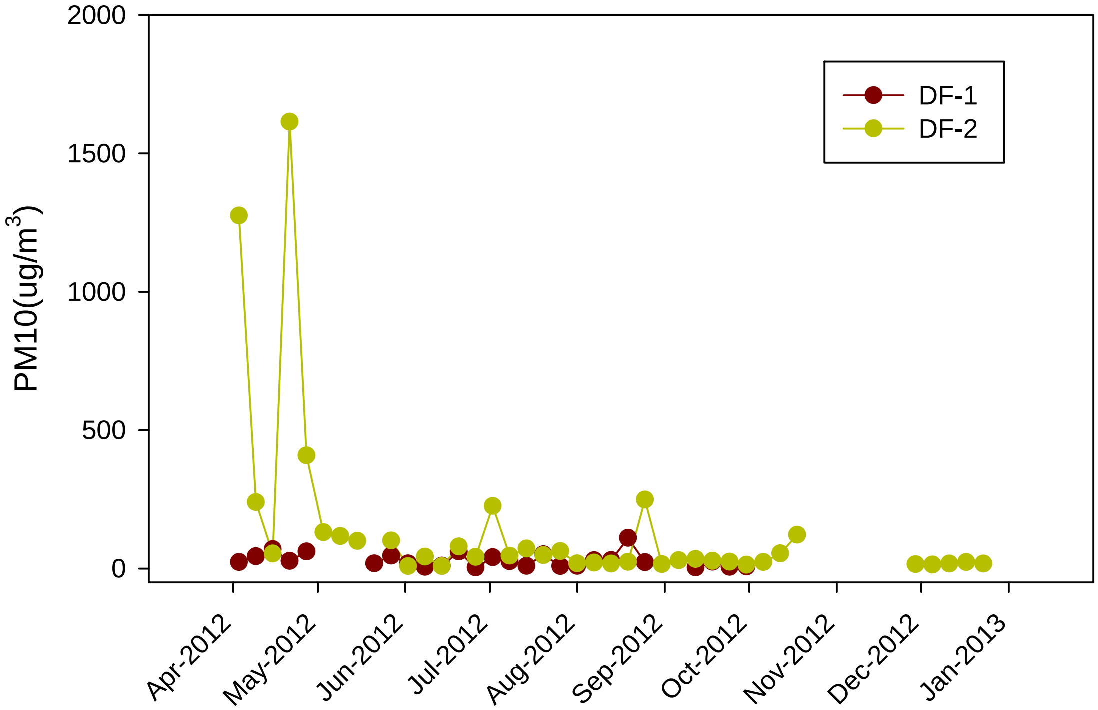

Figure 2. 24-average concentration of airborne particulate matter less than 10 microns (PM10) at Meadowbank DF-1 and DF-2, calculated using volumetric flow rate (non-STP-normalized). There is no GN standard for this parameter.

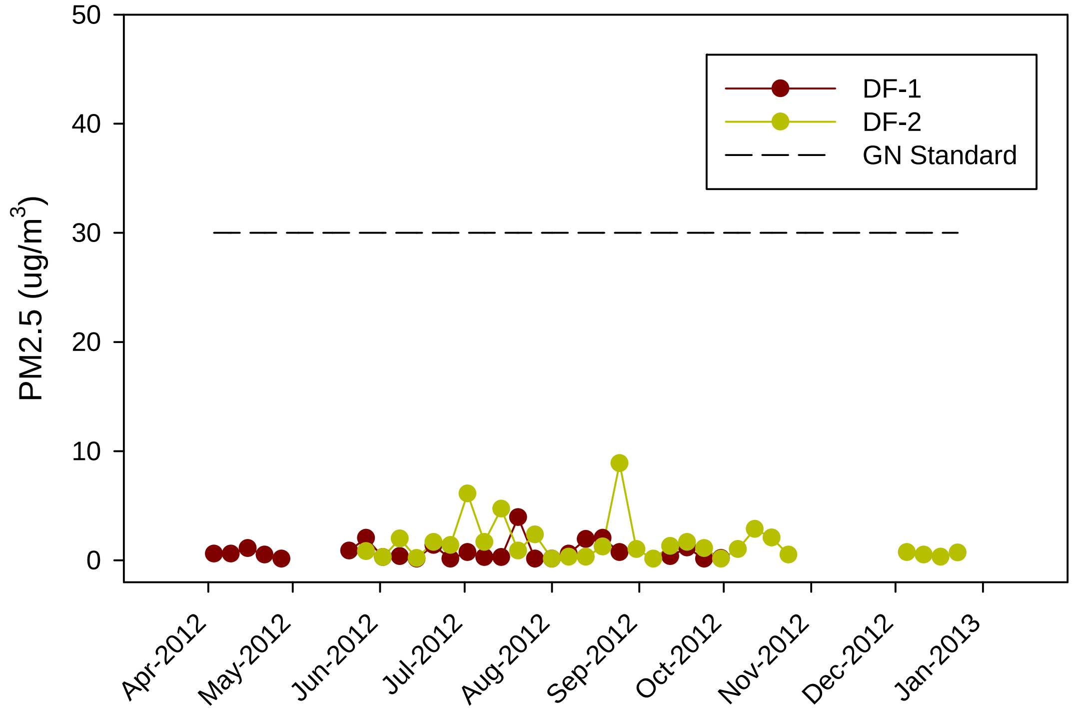

Figure 3. 24-average concentration of airborne particulate matter less than 2.5 microns (PM2.5) at Meadowbank DF-1 and DF-2, calculated using volumetric flow rate (non-STP-normalized). Dashed line indicates the 24-hr average GN standard for ambient air quality, normalized to STP conditions.

4.2 DUSTFALL

Sampling dates and 30-day normalized concentrations of dustfall are provided in Table -Apx 2. One set of samples (November 2012) was lost in shipment.

Results of the 2012 dustfall sampling program (30-day normalized rates of total and fixed dustfall) are provided in Figure 5 and 6. Since samples are referred to by the collection start date, one sample has a 2011 date (collected December 17, 2011 – January 29, 2012). Fixed dustfall formed 80-100% of total dustfall in 67% of samples. To provide context, the Alberta Environment Department's recreational area dustfall guideline of 0.53 mg/cm^2/30 days is indicated.

This guideline was exceeded at DF-1 from January – May, 2012, and at DF-2 in March, 2012. The guideline was slightly exceeded at DF-3 at two time points (February 2012 – 0.661 mg/cm^2/30 days; May 2012 - 0.669 mg/cm^2/30 days), and at DF-4 at two time points (December 2011 6.11 mg/cm^2/30 days; January 2012 – 2.24 mg/cm^2/30 days). Construction of the Vault haul road immediately adjacent to DF-4 in December 2011 appears to have caused the high values at this site in December 2011 and January 2012. This station was moved approximately 480 m to the north-west on February 29, 2012 (see section 1.2.4).

As recommended in the 2011 Air Quality and Dustfall Monitoring Report (AEM, 2012), dust suppression efforts were increased in 2012 in order to reduce dust generation. Beginning in June 2012, calcium chloride was applied as a dust suppressant on the roads around the Meadowbank site. Several applications were made throughout the summer of 2012.

A light oil based dust suppressant was tested on a portion of the airstrip (a major source of dust onsite). The product was effective and will be applied to the airstrip in the spring of 2013. Water was also used daily during summer months as dust suppressant on the airstrip and mine haul roads in 2012. During winter (January to May), it's not possible to apply dust suppressant.

Since June 2012, the recreational area guideline has not been exceeded at any station (including onsite stations, DF-1 and DF-2), at any time point.

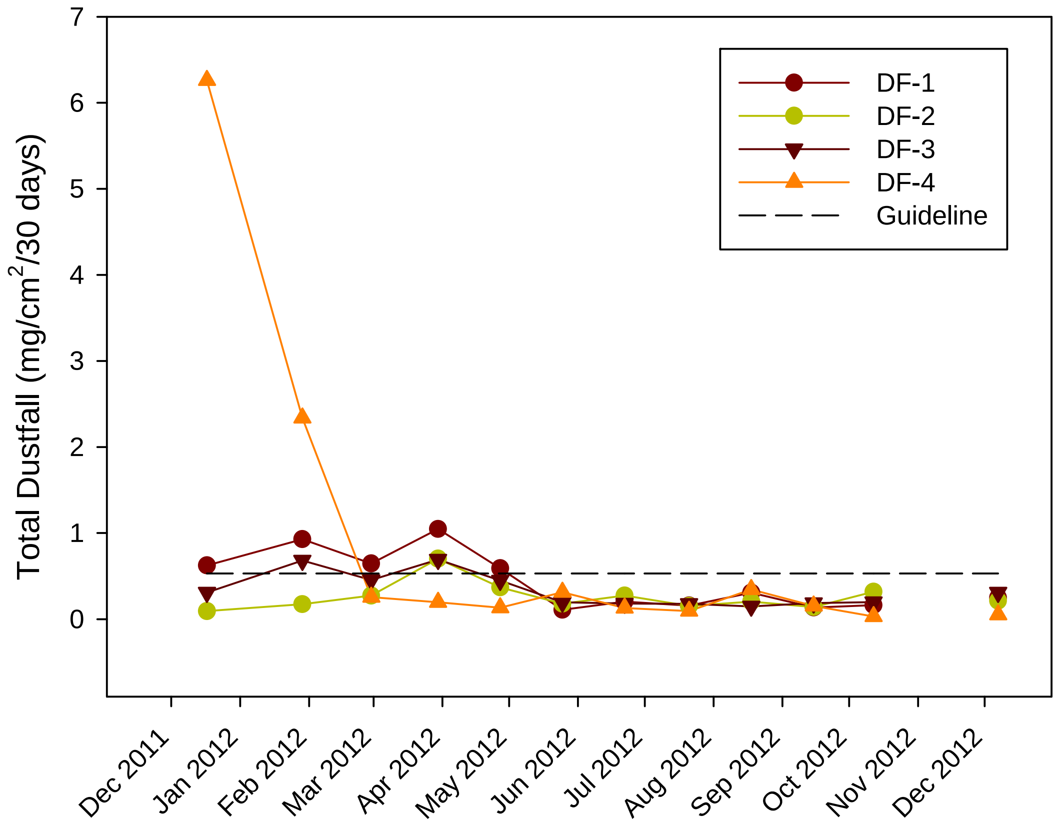

Figure 4. Total 30-day-normalized dustfall at DF-1 – 4 at the Meadowbank site. Points represent start date of sample collection. Dashed line indicates the Alberta Environment Department's recreational area guideline of 0.53 mg/cm^2/30d.

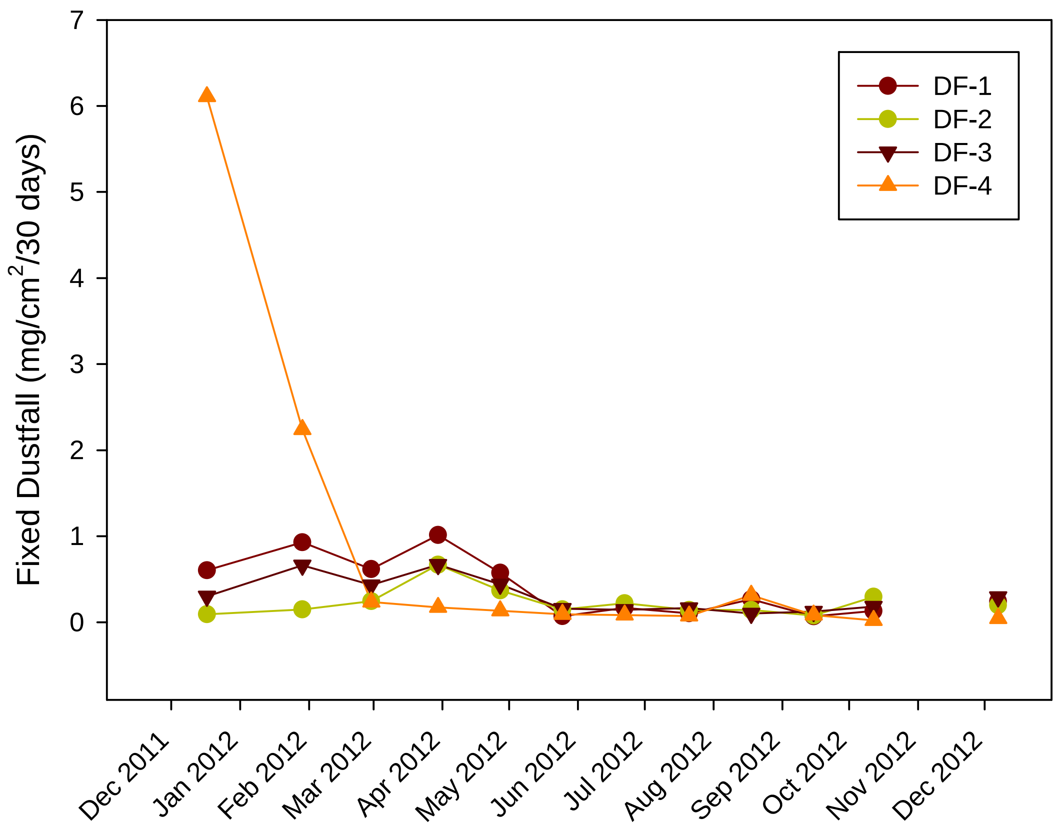

Figure 5. Fixed (non-combustible) 30-day-normalized dustfall at DF-1 – 4 at the Meadowbank site. Points represent start date of sample collection. No guideline specifically for fixed dustfall is available.

4.3 NO_2

Sampling dates and monthly average concentrations of NO_2 are provided in Table -Apx 3. One set of samples (November 2012) was lost in shipment.

Monthly-average NO_2 trends in 2012 are provided in Figure 7. Since samples are referred to by the collection start date, one sample has a 2011 date (collected December 17, 2011 – January 29, 2012). Concentrations of NO_2 vary between 0.1 and 6.8 ppb. At each time point, concentrations are lower at DF-1 than DF-2. This is likely because DF-1 is further from the main camp area and there is generally less vehicular activity in the vicinity. No clear trends towards increasing or decreasing concentrations over time are evident.

Since no monthly standard is available, annual arithmetic mean concentrations were calculated for each station as the average of the monthly values. The annual mean concentrations of NO_2 were 0.78 ppb and 2.86 ppb for DF-1 and DF-2, respectively (December 17, 2011 to December 7, 2012). These are both well below the Government of Nunavut Ambient Air Quality Standard of 32 ppb for the annual average.

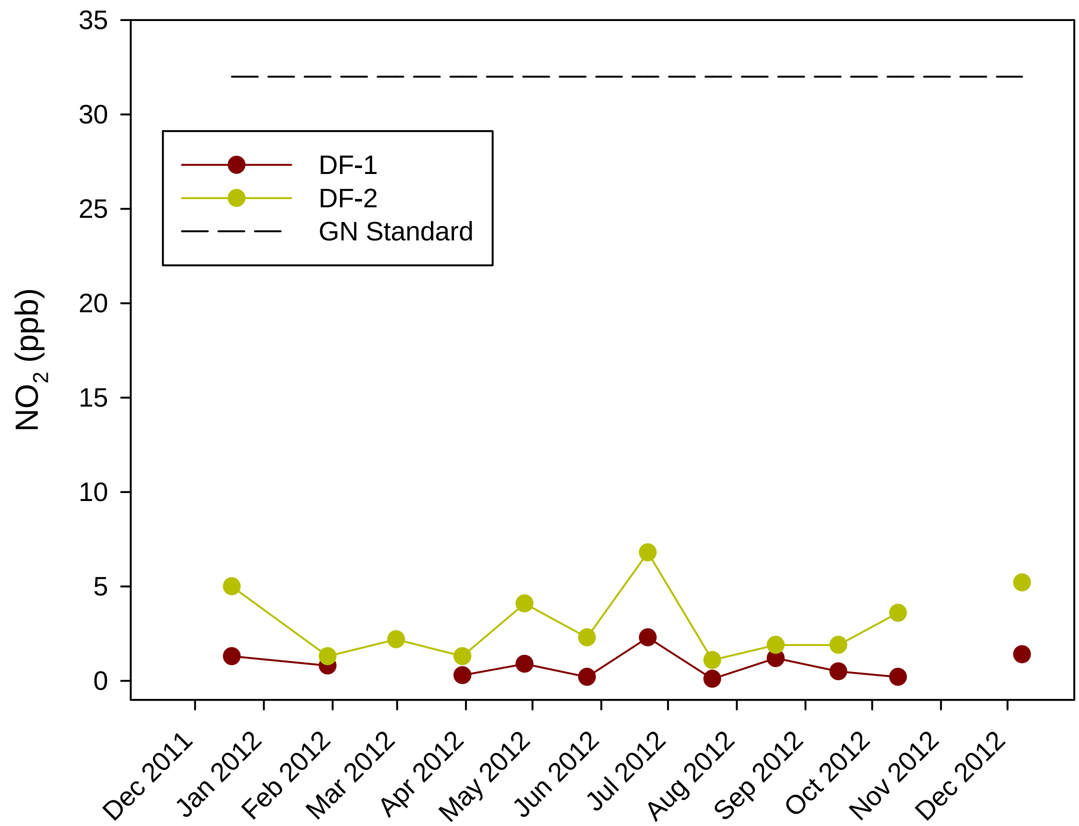

Figure 6. Monthly average concentration of NO_2 at DF-1 and DF-2. Points represent start date of sample collection. Dashed line indicates GN standard for the annual average.

4.4 WEATHER DATA

Daily averages for wind speed, wind direction and temperature are provided in Table -Apx 4.

4.5 GREENHOUSE GAS EMISSIONS

Estimated greenhouse gas emissions for the Meadowbank site in 2012 were 202,201 tonnes CO_2 equivalent. This is an increase of 23% from the 2011 emissions of 164, 618 t CO_2 equivalent. This increase is explained by an increase in production of 28%.

5 QA/QC

QA/QC procedures in 2012 included the use of an accredited lab for sample preparation and analysis, and sample collection by appropriate personnel (trained by a professional air quality specialist). This report was prepared by environmental professionals. AEM's Partisol instruments are sent for calibration yearly.

Procedures in 2013 will include the use of travel blanks as part of sample submissions.

6 SUMMARY

6.1 COMPARISON TO REGULATORY STANDARDS AND GUIDELINES

6.1.1 GN Standards (for TSP, PM2.5, NO_2)

Although concentrations of suspended particulates were not directly comparable to GN standards, the values obtained in this monitoring program are expected to be higher than they would be if calculated for standard conditions (see Section 3.1).

With the above assumption, GN standards for the measured parameters (TSP, PM2.5, NO_2) were not exceeded at any time point or monitoring location in 2012.

6.1.2 Dustfall Guideline

Results of the dustfall collection program were compared to the Alberta Environment Department's recreational area dustfall guideline for reference. This guideline was exceeded from January – May at DF-1, in March at DF-2, in February and May at DF-3, and in December 2011 and January 2012 at DF-4. However, the guideline has not been exceeded at any site since June 2012, when dust suppression efforts were increased. It is not possible to apply dust suppressant in the winter.

6.2 TEMPORAL AND SPATIAL TRENDS

Overall, no trends were evident over the year or between sampling stations for suspended particulates (TSP, PM10 and PM2.5).

Dustfall at all stations decreased in June 2012, likely as a result of an increase in dust suppression efforts. Aside from the high values observed at DF-4 prior to re-location away from the road, no clear trends between sites were observed.

Concentrations of NO_2 were always lower at DF-1 compared to DF-2, likely because DF-1 is more remote. No clear trends over the year were observed.

7 RECOMMENDATIONS

- Professional calibration of the Partisol instruments is recommended on an annual basis.

- The Partisol instrument should be set to record STP-normalized volume such that results can be directly compared with GN standards.
- If possible, the temperature sensor of the Partisol instrument should be maintained at the exterior ambient air temperature, so that internal mass flow calculations and the recorded air volume are accurate.
- The use of travel blanks should be considered as recommended in the monitoring plan.

It is AEM’s intent to implement all recommendations made in this report for the 2013 Air Monitoring Program.

8 REFERENCES

AEM, 2012. 2011 Dust and Air Quality Monitoring Report. Meadowbank Gold Project. Prepared for Nunavut Impact Review Board.

Cumberland Resources Ltd. 2005. Meadowbank Gold Project Air Quality Impact Assessment Report.

Golder Associates Ltd. (Golder) 2008. Technical Memorandum. Addendum Report: Air Quality Monitoring Meadowbank Gold Project. Prepared for Agnico-Eagle Mines Ltd. May 16, 2008.

Appendix A

Data Tables

Table -Apx 1. No sample (NS) is available for certain dates due to contamination of filters, filter jams, or difficulties with instrument set-up. Units at DF-1 were removed from site for calibration on October 27, 2012 (Cal.).

Start	End	TSP (µg/m^3/30 d)		PM10 (µg/m^3/30 d)		PM2.5 (µg/m^3/30 d)	
		DF-1	DF-2	DF-1	DF-2	DF-1	DF-2
3/4/2012	4/4/2012	21.58	NS	22.47	1274.51	0.6	NS
9/4/2012	10/4/2012	13.1	NS	43.3	239.38	0.6	NS
15/4/2012	16/4/2012	6.53	NS	69.44	53.1	1.11	NS
21/4/2012	22/4/2012	2.91	NS	26.96	1613.56	0.51	NS
27/4/2012	28/4/2012	24.16	NS	60.46	408.09	0.14	NS
3/5/2012	4/5/2012	19.84	NS	NS	129.9	NS	NS
9/5/2012	10/5/2012	9.4	NS	NS	116.01	NS	NS
15/5/2012	16/5/2012	16.38	NS	NS	99.26	NS	NS
21/5/2012	22/5/2012	2.95	26.9	17.97	NS	0.88	NS
27/5/2012	28/5/2012	20.33	45.74	45.34	100.08	2.04	0.83
2/6/2012	3/6/2012	2.45	12.81	17.97	8.17	0.28	0.28
8/6/2012	9/6/2012	2.29	16.8	4.9	42.08	0.37	1.99
14/6/2012	15/6/2012	2.74	2.16	9.4	7.76	0.14	0.19
20/6/2012	21/6/2012	24.53	31.19	60.46	78.84	1.39	1.67
26/6/2012	27/6/2012	0.75	12.77	3.27	41.67	0.14	1.39
2/7/2012	3/7/2012	19.29	65.29	39.62	225.49	0.74	6.11
8/7/2012	9/7/2012	17.67	22.21	25.33	45.34	0.28	1.67
14/7/2012	15/7/2012	6.94	31.1	8.99	71.08	0.28	4.72
20/7/2012	21/7/2012	26.99	13.27	50.65	47.39	3.94	0.88
26/7/2012	27/7/2012	1.46	26.99	8.17	62.5	0.14	2.36
1/8/2012	2/8/2012	1.66	3.12	8.58	17.57	0.14	0.14
7/8/2012	8/8/2012	8.82	8.57	28.59	20.42	0.6	0.32
13/8/2012	14/8/2012	14.22	9.65	29.41	17.16	1.94	0.32
19/8/2012	20/8/2012	71.11	11.19	110.29	23.28	2.04	1.25
25/8/2012	26/8/2012	10.85	33.81	21.65	248.37	0.74	8.89
31/8/2012	1/9/2012	3.74	4.03	NS	15.11	NS	1.02
6/9/2012	7/9/2012	35.6	6.78	NS	28.59	NS	0.14
12/9/2012	13/9/2012	2.7	27.94	3.27	33.91	0.37	1.3
18/9/2012	19/9/2012	16.26	14.97	24.1	26.55	1.16	1.67
24/9/2012	25/9/2012	17.3	8.57	4.9	23.69	0.14	1.11
30/9/2012	1/10/2012	1.54	2.66	6.54	13.07	0.19	0.14
6/10/2012	7/10/2012	3.49	8.57	NS	22.47	NS	1.02
12/10/2012	13/10/2012	23.66	38.76	NS	53.51	NS	2.87
18/10/2012	19/10/2012	9.27	36.76	NS	121.32	NS	2.08
24/10/2012	25/10/2012	4.08	15.55	NS	NS	NS	0.51

Start	End	TSP (µg/m³/30 d)		PM10 (µg/m³/30 d)		PM2.5 (µg/m³/30 d)	
		DF-1	DF-2	DF-1	DF-2	DF-1	DF-2
30/10/2012	31/10/2012	Cal.	NS	Cal.	NS	Cal.	NS
11/11/2012	12/11/2012	Cal.	NS	Cal.	NS	Cal.	NS
17/11/2012	18/11/2012	Cal.	NS	Cal.	NS	Cal.	NS
23/11/2012	24/11/2012	Cal.	NS	Cal.	NS	Cal.	NS
29/11/2012	30/11/2012	Cal.	NS	Cal.	14.71	Cal.	NS
5/12/2012	6/12/2012	Cal.	4.78	Cal.	13.48	Cal.	0.74
11/12/2012	12/12/2012	Cal.	5.41	Cal.	17.16	Cal.	0.51
17/12/2012	18/12/2012	Cal.	2.95	Cal.	22.88	Cal.	0.32
23/12/2012	24/12/2012	Cal.	2.37	Cal.	17.16	Cal.	0.69
29/12/2012	30/12/2012	Cal.	NS	Cal.	NS	Cal.	NS

Table -Apx 2. Total and fixed (non-combustible) dustfall at Meadowbank monitoring stations DF-1-4. * One set of samples was lost in transit and re-sent (results pending).

Start	End	**Total** (mg/cm²/30 days)				**Fixed** (mg/cm²/30 days)			
		DF-1	DF-2	DF-3	DF-4	DF-1	DF-2	DF-3	DF-4
17/12/2011	29/01/2012	0.625	0.094	0.310	6.260	0.605	0.094	0.301	6.110
29/01/2012	29/02/2012	0.929	0.174	0.683	2.339	0.929	0.149	0.661	2.240
29/02/2012	30/03/2012	0.647	0.274	0.455	0.257	0.617	0.245	0.433	0.235
30/03/2012	27/04/2012	1.047	0.701	0.693	0.197	1.015	0.669	0.669	0.173
27/04/2012	25/05/2012	0.590	0.370	0.449	0.134	0.575	0.370	0.441	0.134
25/05/2012	22/06/2012	0.110	0.181	0.197	0.314	0.071	0.150	0.157	0.094
22/06/2012	21/07/2012	0.205	0.274	0.182	0.129	0.167	0.220	0.144	0.084
21/07/2012	18/08/2012	0.157	0.153	0.177	0.094	0.105	0.142	0.165	0.073
18/08/2012	15/09/2012	0.307	0.205	0.150	0.346	0.268	0.142	0.102	0.315
15/09/2012	12/10/2012	0.136	0.140	0.186	0.153	0.068	0.078	0.124	0.085
12/10/2012	10/11/2012	0.162	0.319	0.198	0.030	0.132	0.296	0.182	0.023
10/11/2012	07/12/2012	*	*	*	*	*	*	*	*
07/12/2012	12/01/2013	0.25	0.213	0.309	0.05	0.242	0.198	0.294	0.044

Table -Apx 3. Mean concentration of NO_2 at Meadowbank monitoring stations DF-1 and DF-2. * One set of samples lost in transit and re-sent (results pending). ‡ One sampler had a missing cartridge at time of collection.

Start	End	NO_2 (ppb)	
		DF-1	DF-2
17/12/2011	29/01/2012	1.3	5
29/01/2012	29/02/2012	0.8	1.3
29/02/2012	30/03/2012	‡	2.2
30/03/2012	27/04/2012	0.3	1.3
27/04/2012	25/05/2012	0.9	4.1
25/05/2012	22/06/2012	0.2	2.3
22/06/2012	21/07/2012	2.3	6.8
21/07/2012	18/08/2012	0.1	1.1
18/08/2012	15/09/2012	1.2	1.9
15/09/2012	12/10/2012	0.5	1.9
12/10/2012	10/11/2012	0.2	3.6
10/11/2012	07/12/2012	*	*
07/12/2012	12/01/2013	1.4	5.2

Table -Apx 4. Average temperature, wind speed and wind direction for all available dates in 2012 at the Meadowbank site.

Date	Average Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg)
16/01/2012	-34.58	4.838	310.4
17/01/2012	-36.95	6.152	278.4
18/01/2012	-34.23	3.289	239.7
19/01/2012	-35.9	5.125	119.6
20/01/2012	-33.1	5.502	51.95
21/01/2012	-33.07	3.351	83.4
25/01/2012	-24.77	6.485	118.7
26/01/2012	-21.27	6.162	128.1
27/01/2012	-21.32	6.105	125.4
28/01/2012	-21.73	3.534	129.9
29/01/2012	-33.49	7.99	347.3
30/01/2012	-34.88	7.247	346.6
31/01/2012	-30.44	4.024	339.1
02/02/2012	-27.71	2.234	127.8
03/02/2012	-25.13	2.948	155.7
04/02/2012	-17.68	4.167	247.3
05/02/2012	-14.54	7.54	192.9
06/02/2012	-25.85	8.1	344.6
07/02/2012	-24.28	6.146	283.6
08/02/2012	-28.88	12.9	324.3
09/02/2012	-30.33	9.25	340
10/02/2012	-28.77	8.25	334.5
11/02/2012	-19.6	8.3	301.9
12/02/2012	-21.74	2.079	306.9
13/02/2012	-22.96	2.091	134.1
14/02/2012	-17.14	3.445	141.6
15/02/2012	-16.8	3.116	176.5
16/02/2012	-19.1	7.816	329.5
17/02/2012	-22.06	5.261	329
18/02/2012	-26.47	2.847	99.8
19/02/2012	-19.91	5.611	109.1
20/02/2012	-29.94	7.534	342.2
21/02/2012	-33.06	3.21	345.2
22/02/2012	-30.21	3.705	111.6

Date	Average Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg)
23/02/2012	-24.63	6.259	119
24/02/2012	-23.26	3.828	308.8
25/02/2012	-32.47	6.183	334.5
26/02/2012	-35.04	4.723	334.7
27/02/2012	-36.55	3.948	338
28/02/2012	-34.83	1.53	301.6
29/02/2012	-33.44	2.35	209.4
01/03/2012	-34.9	2.109	317.2
02/03/2012	-35.47	7.715	311
03/03/2012	-37.62	5.446	298.1
04/03/2012	-35.27	2.511	188
05/03/2012	-37.34	2.117	13.36
06/03/2012	-36.35	1.968	288.8
07/03/2012	-35.8	2.66	234.3
08/03/2012	-35.18	2.28	178.8
09/03/2012	-35.5	2.013	208.3
10/03/2012	-33.9	3.238	235
11/03/2012	-31.35	3.109	127.6
12/03/2012	-33.94	3.776	341.2
13/03/2012	-30.79	5.314	108.1
14/03/2012	-19.3	9.01	130.6
15/03/2012	-11.1	6.258	92.6
16/03/2012	-20.04	12.91	342.6
17/03/2012	-27.43	3.713	258.6
18/03/2012	-25.1	2.891	45.15
19/03/2012	-29.24	3.526	322.3
20/03/2012	-30.78	4.178	17.07
21/03/2012	-22.67	9.96	67.6
22/03/2012	-20.41	11.23	36.14
23/03/2012	-26.74	7.513	317.5
24/03/2012	-26.73	5.141	294.9
25/03/2012	-25.15	1.86	206.2
26/03/2012	-24.13	3.868	158.6
27/03/2012	-24.4	2.759	303.3
28/03/2012	-25.74	2.43	312.3
29/03/2012	-23.49	2.654	159.8
30/03/2012	-16.08	5.521	162
31/03/2012	-14.96	6.135	128.7

Date	Average Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg)
01/04/2012	-15.13	7.781	116.6
02/04/2012	-15.3	5.951	111.4
03/04/2012	-16.09	4.309	89.6
04/04/2012	-15.31	2.194	90.3
05/04/2012	-14.35	3.771	122.1
06/04/2012	-8.78	5.702	165.1
07/04/2012	-11.64	4.486	23.64
08/04/2012	-8.98	5.669	44.29
09/04/2012	-21.04	7.804	347.3
10/04/2012	-19.39	3.618	329.8
11/04/2012	-16.62	4.864	219.7
12/04/2012	-15.04	5.648	286.6
13/04/2012	-21.47	5.638	311.5
14/04/2012	-23.71	5.282	325
15/04/2012	-24.73	6.003	337.9
16/04/2012	-24.03	5.394	317.6
17/04/2012	-22.59	3.496	328.6
18/04/2012	-22.4	2.79	301.3
19/04/2012	-20.78	2.075	343.5
20/04/2012	-19.68	2.549	279.5
21/04/2012	-17.81	2.302	188.8
22/04/2012	-17.13	3.18	98.4
23/04/2012	-15.45	3.396	72.41
24/04/2012	-15.3	3.185	56.5
25/04/2012	-14.35	2.456	65.17
26/04/2012	-14.6	4.496	345.7
27/04/2012	-18.15	2.837	316.9
28/04/2012	-14.35	2.876	179.1
29/04/2012	-7.62	5.344	135.8
30/04/2012	-2.404	7.173	229.4
01/05/2012	-7.747	6.376	290.4
02/05/2012	-8.5	5.848	345.5
03/05/2012	-13.58	4.493	337.1
04/05/2012	-13.82	4.277	325.1
05/05/2012	-12.56	1.901	282.6
06/05/2012	-7.321	2.151	151.6
07/05/2012	-3.54	2.71	135
08/05/2012	-0.806	4.124	117.1

Date	Average Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg)
09/05/2012	-0.318	3.36	118.6
10/05/2012	-0.699	4.791	135.7
11/05/2012	-2.097	8.7	123.3
12/05/2012	-1.184	5.031	125
13/05/2012	-0.405	5.026	123.1
14/05/2012	-1.797	5.842	17.53
15/05/2012	0.181	5.43	37.26
16/05/2012	0.353	4.083	21.08
17/05/2012	-2.126	4.204	9.17
18/05/2012	-5.63	5.186	352.3
19/05/2012	-5.998	4.294	343
20/05/2012	-4.302	2.346	236.5
21/05/2012	-4.314	4.075	46.6
22/05/2012	-5.17	4.829	359.8
23/05/2012	-5.421	2.496	246.9
24/05/2012	-1.211	6.347	267.8
25/05/2012	-6.309	8.19	2.045
26/05/2012	-6.416	5.009	315.8
20/05/2012	-4.302	2.346	236.5
21/05/2012	-4.314	4.075	46.6
22/05/2012	-5.17	4.829	359.8
23/05/2012	-5.421	2.496	246.9
24/05/2012	-1.211	6.347	267.8
25/05/2012	-6.309	8.19	2.045
26/05/2012	-6.416	5.009	315.8
30/05/2012	-0.393	5.051	239.9
31/05/2012	-0.045	6.051	36.79
01/06/2012	-1.033	6.275	46.53
02/06/2012	0.772	5.533	14.88
03/06/2012	1.57	3.787	285.4
04/06/2012	2.217	3.412	259.8
05/06/2012	4.693	2.612	129.6
06/06/2012	4.82	2.816	200.2
07/06/2012	5.704	4.031	204.7
08/06/2012	2.801	5.537	1.484
09/06/2012	1.583	4.963	339
10/06/2012	1.945	5.258	0.058

Date	Average Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg)
11/06/2012	2.111	5.459	351.3
12/06/2012	2.125	8.49	33.52
13/06/2012	2.606	7.685	348.9
14/06/2012	2.556	10.35	311.5
15/06/2012	2.621	8.09	264.7
16/06/2012	4.066	5.188	306.7
17/06/2012	5.008	3.535	14.51
18/06/2012	3.445	4.297	27.8
19/06/2012	3.619	6.594	343.6
20/06/2012	5.616	3.54	300.6
21/06/2012	8.55	2.479	87.8
22/06/2012	5.536	5.162	284.2
23/06/2012	5.669	6.505	14.99
24/06/2012	6.498	8.57	349.6
25/06/2012	6.445	6.712	327
26/06/2012	6.717	3.604	9.31
27/06/2012	6.518	5.119	336.2
28/06/2012	8.66	3.162	77.61
29/06/2012	9.78	6.125	74.64
30/06/2012	9.11	7.095	43.36
01/07/2012	9.41	4.885	4.646
02/07/2012	11.19	4.972	319.7
03/07/2012	13.3	3.154	38.52
04/07/2012	16.34	2.826	41.95
05/07/2012	16.95	3.114	45.85
06/07/2012	14.45	3.178	168.1
07/07/2012	16.44	3.836	299
08/07/2012	14.98	3.874	348.6
09/07/2012	14.6	2.843	328.6
10/07/2012	15.99	2.076	152.5
11/07/2012	15.97	2.968	133
12/07/2012	15.97	3.29	139.5
13/07/2012	12	5.423	17.09
14/07/2012	11.35	5.386	25.01
15/07/2012	11.29	8.19	6.558
16/07/2012	11.18	7.638	356
17/07/2012	13.99	4.451	14.94
18/07/2012	16.59	2.873	125

Date	Average Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg)
19/07/2012	15.09	4.91	149
20/07/2012	14.65	5.672	155.5
21/07/2012	9.67	5.542	92.2
22/07/2012	10.6	7.463	18.25
23/07/2012	12.39	6.635	0.04
24/07/2012	10.02	7.532	296.9
25/07/2012	8.36	10.11	342
26/07/2012	11.1	3.596	283.6
27/07/2012	8.13	6.492	6.583
28/07/2012	8.48	5.122	62.39
29/07/2012	7.822	4.929	296.6
30/07/2012	7.164	6.582	310.7
31/07/2012	7.546	5.159	3.344
01/08/2012	7.385	6.62	338.9
02/08/2012	8.15	5.149	336.6
03/08/2012	10.29	4.394	13.05
04/08/2012	11.94	3.198	307.4
05/08/2012	16.09	2.715	254.5
06/08/2012	14.55	5.424	78.26
07/08/2012	11.15	6.486	335.6
08/08/2012	12.54	5.232	298.4
09/08/2012	16.1	7.463	253.9
10/08/2012	17.31	4.344	231.4
11/08/2012	18.63	2.63	51.93
12/08/2012	14.3	6.119	11.01
13/08/2012	10.16	4.978	338.1
14/08/2012	8.97	3.865	278.6
15/08/2012	9.38	4.936	265.1
16/08/2012	4.813	5.875	351.4
17/08/2012	4.977	4.64	243.3
18/08/2012	6.295	3.279	240.6
19/08/2012	11.6	3.431	148.7
20/08/2012	12.35	5.658	158.5
21/08/2012	12.66	4.397	208.1
22/08/2012	9.71	4.359	286.1
23/08/2012	9.57	3.731	294
24/08/2012	9.61	5.125	287.1
25/08/2012	9.5	2.685	327.3

Date	Average Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg)
26/08/2012	10.5	3.191	50.96
27/08/2012	10.95	4.76	13.04
28/08/2012	9.55	3.345	52.09
29/08/2012	9.72	4.828	122.8
30/08/2012	9.83	4.5	140.3
31/08/2012	8.47	4.423	178.3
01/09/2012	8.57	4.319	285.8
02/09/2012	9.02	7.163	247.2
03/09/2012	5.183	3.706	39.54
04/09/2012	8.97	4.018	143.2
05/09/2012	7.633	2.721	178.7
06/09/2012	9.37	1.242	273.1
07/09/2012	10.68	5.515	196.4
08/09/2012	8.44	8.88	227.9
09/09/2012	8.12	4.613	318.4
10/09/2012	7.729	2.88	24.06
11/09/2012	7.88	4.786	246.6
12/09/2012	7.444	3.512	140.8
13/09/2012	2.371	7.478	7.094
14/09/2012	4.183	5.103	234.2
15/09/2012	4.494	6.921	285.7
16/09/2012	2.948	9.02	4.101
17/09/2012	1.71	6.888	346
18/09/2012	0.519	6.221	344.6
19/09/2012	0.334	2.795	85.9
20/09/2012	0.706	4.811	101.5
21/09/2012	0.448	3.806	19.31
22/09/2012	0.299	2.867	30.79
23/09/2012	3.164	5.148	180.6
24/09/2012	3.457	9.68	340.7
25/09/2012	0.587	7.557	5.483
26/09/2012	-0.351	3.301	77.36
27/09/2012	2.214	2.978	99.6
28/09/2012	4.266	3.632	211.2
29/09/2012	6.631	5.8	201.3
30/09/2012	6.689	4.483	269.8
01/10/2012	2.69	2.852	351.8
02/10/2012	0.336	5.203	1.407

Date	Average Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg)
03/10/2012	-1.342	7.14	341.2
04/10/2012	-2.622	7.611	293.6
05/10/2012	-1.779	3.792	22.31
06/10/2012	1.009	5.679	240.3
07/10/2012	-1.303	6.491	5.09
08/10/2012	-3.505	4.577	360
09/10/2012	-2.152	1.968	340.5
10/10/2012	-2.319	2.728	236.6
11/10/2012	-3.482	4.668	15.45
12/10/2012	-6.688	5.119	298.4
13/10/2012	-7.394	7.375	279.5
14/10/2012	-6.198	9.81	291.9
15/10/2012	-7.133	6.539	286.6
16/10/2012	-8.68	3.972	69.94
17/10/2012	-7.984	6.644	78.06
18/10/2012	-8.39	2.662	352.4
19/10/2012	-7.82	2.214	49.71
20/10/2012	-5.405	4.448	113
21/10/2012	-3.086	5.07	108.9
22/10/2012	-5.876	5.869	91.6
23/10/2012	-9.56	5.52	72.52
24/10/2012	-11.38	4.288	53.55
25/10/2012	-13.03	2.876	21.02
26/10/2012	-13.55	1.359	345.1
27/10/2012	-11.08	3.985	344.4
28/10/2012	-10.97	10.14	332.8
29/10/2012	-12.6	4.191	313.3
30/10/2012	-11.87	2.821	172.5
31/10/2012	-9.27	7.632	118.8
01/11/2012	-14.09	5.712	276
02/11/2012	-14.61	3.637	304.1
03/11/2012	-16.6	4.251	59.29
04/11/2012	-18.82	3.425	90.3
05/11/2012	-10.48	5.844	179.2
06/11/2012	-12.48	5.814	0.313
07/11/2012	-19.83	4.625	41.25
08/11/2012	-15.65	4.895	34.19
09/11/2012	-17.76	10.59	0.16

Date	Average Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg)
10/11/2012	-20.79	1.472	295.2
11/11/2012	-15.54	4.244	215.7
12/11/2012	-14.22	4.411	219.4
13/11/2012	-16.75	4.311	291.5
14/11/2012	-20.01	7.193	284.8
15/11/2012	-20.57	5.344	188.5
16/11/2012	-23.62	3.231	281.3
17/11/2012	-23.92	0.795	285.2
18/11/2012	-23.44	0.71	320.5
19/11/2012	-24.73	0.71	79.81
20/11/2012	-18.2	7.667	202.5
21/11/2012	-15.87	7.359	212
22/11/2012	-13.27	9.8	150.4
23/11/2012	-18.76	9.91	98.6
24/11/2012	-19.23	5.814	49.95
25/11/2012	-27.19	6.057	69.63
01/12/2012	-37.21	0.71	319.6
02/12/2012	-38.06	0.711	60.33
03/12/2012	-29.84	2.878	317.3
04/12/2012	-30.86	1.057	274.4
05/12/2012	-27.43	1.079	166
06/12/2012	-25.9	2.765	60.68
07/12/2012	-28.67	5.55	352.8
08/12/2012	-29.9	4.533	325
09/12/2012	-29.87	8.45	317
10/12/2012	-27.72	9.09	304.4
11/12/2012	-27.75	5.968	316
12/12/2012	-29.64	3.923	321.1
13/12/2012	-32.74	1.742	319.3
14/12/2012	-34.47	3.516	118
15/12/2012	-27.53	9.08	128.8
16/12/2012	-17	10.5	126.2
17/12/2012	-17.89	4.172	329.7
18/12/2012	-22.73	3.243	127.4
19/12/2012	-23.94	2.488	104.2
20/12/2012	-19.09	2.574	352.7
21/12/2012	-16.56	4.042	357.8
22/12/2012	-17.01	5.7	337

Date	Average Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg)
23/12/2012	-20.09	9.54	345.2
24/12/2012	-24.18	12.3	351.5
25/12/2012	-23.95	12.71	354.5
26/12/2012	-19.11	7.354	0.877
27/12/2012	-16.05	4.703	26.58
28/12/2012	-17.74	5.744	118
29/12/2012	-23.67	3.725	90.6
30/12/2012	-23.69	2.34	349.4
31/12/2012	-20.13	2.346	192.1

TECHNICAL MEMORANDUM

Agnico Eagle Mines Ltd: Meadowbank Division
Baker Lake, Nunavut, X0C 0A0

Date: March 6, 2013
Subject: 2012 Preliminary evaluation of dustfall along the Meadowbank AWAR
From: Ryan VanEngen (Environment Biologist), Kevin Buck (Environment Superintendent) and Leilan Baxter (AEM Consultant)

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1 Introduction

1.1 Background

Since 2009, AEM has maintained a 105 km All Weather Access Road (AWAR) between the hamlet of Baker Lake and the Meadowbank Mine site. In 2012, the hamlet raised concerns about high dust levels along the AWAR near the community (between barge laydown area to Baker Lake Gatehouse). In response, AEM provided calcium chloride to the hamlet for application in 2012. In addition, AEM conducted a preliminary dustfall study along a representative section of the AWAR which augmented regular dustfall monitoring around the mine site. A larger-scale study will be conducted in 2013 to further evaluate the spatial extents of dustfall and potential for impacts to the terrestrial ecosystem.

AEM's NIRB project certificate (Condition 74) states that "Cumberland (now AEM) shall employ environmentally protective techniques to suppress any surface road dust". To date, these techniques have included the enforcement of speed limits along the AWAR, the routine use of water trucks around the mine site where the heaviest year-round traffic occurs and the use of dust suppressants on camp roads.

Detailed modelling of air quality was conducted for the Vault haul road as part of the Meadowbank air quality impact assessment (Cumberland, 2005), because this was expected to be the most frequently used road. The model predicted that the worst case level of air pollution (mainly fugitive dust) will be in the range of, or less than the GN air quality objectives. Evaluation and monitoring of fugitive dust along the AWAR was not required, because much lower traffic volumes were planned for this route.

1.2 Potential Effects of Dustfall

Impacts of dustfall from roadways in the north have been examined in a number of studies; most notably, a series of long-term investigations along Alaska's Dalton Highway, beginning in 1976 (Walker and Everett, 1987; Auerbach et al. 1997; Myers-Smith et al., 2006). It should be noted that no estimations of the duration of road use, or quantity of dust deposition required to induce changes in vegetation were found in the literature to this point. With the exception of one study at the Ekati Diamond Mine (Male and Nol, 2006), the majority of studies have occurred after 10+ years of road use (Male and Nol, 2006 – 4 yr; Auerbach et al., 1997 - 15 yr; Myers-Smith et al. 2006 - 25 yr), and many of these researchers indicate that changes in vegetative cover are likely to become more pronounced over time. While it is likely that significantly more dust is created on this highway than Meadowbank's AWAR, effects would be expected to occur through similar mechanisms if deposition rates were sufficient to impact the surrounding environment. These effects may include earlier snowmelt, change in soil moisture and pH, and reduced moss and lichen cover. Based on the literature reviewed, these potential effects would most likely be confined to within 300 m of the roadway.

AEM's Terrestrial Ecosystem Impact Assessment (TEIA) (Cumberland, 2005) predicted localized "bird habitat degradation and vegetation degradation due to dust and exhaust" near haul roads and the access road due to traffic. The magnitude of the effects was determined to be low which is consistent with the effects of fugitive dust observed at Ekati (Male and Nol, 2006). Further details on potential effects were provided in a Technical Memorandum provided to NIRB from AEM as part of the AEM's responses to the NIRB annual report recommendations, dated December 21, 2012.

1.3 Study Objectives

The overall goals of the Meadowbank dustfall studies (2012, 2013) are to address NIRB recommendations (AEM letter to NIRB dated December 7, 2012), and for development of future mitigative and management actions. The objectives of the study conducted in 2012 were to:

1. Characterize the dustfall gradient in relation to distance from the AWAR
2. Compare rates of dustfall on the minesite with those along the AWAR
3. Develop methods for dustfall sample collection, taking into account recommended standard procedures and practical considerations (collection at ground level compared to 2 m height)
4. Compare rates of dustfall along the AWAR with regulatory guidelines

2 Methods

2.1 Sample Collection and Analysis

Dustfall was collected in open vessels containing a purified liquid matrix provided by an accredited laboratory (Maxxam Analytics). Particles are deposited and retained in the liquid, which was then analyzed by the accredited laboratory for total and fixed (non-combustible) dustfall. For the 2012 study, dustfall canisters were deployed from August 18 – September 15, 2012. Calculated dustfall rates are normalized to 30 days (mg/cm^2/30 days). ASTM (and Ontario MOE) methods suggest collection of the sample at 2-3 m height on a utility pole to prevent re-entrainment of particulates from the ground, and to reduce vandalism. Due to the difficulty of constructing and deploying stands to hold the sample containers in this remote location, the 2012 study compared dustfall at ground level and at 2 m height to assist in the development of future sampling method decisions.

2.2 Sample Locations

The primary objective of the dustfall study was to characterize dust deposition based on proximity to the roadway. To fulfill this objective, samples were collected at 50 m intervals to a distance of 100 or 150 m on either side (west or east) of the AWAR, at two locations (km 76 and km 78). This section of the road is relatively straight with few notable topographical features, which limited confounding factors that alter prevailing winds and prevented micro-climates from influencing dust deposition.

The secondary objective of the study was to compare rates of dustfall on the minesite with those along the AWAR. To address this objective, dustfall samples were collected at two locations on the minesite (DF-1 and DF-2).

Lastly, the study aimed to compare collection at 2 m height (on a constructed wooden stand; the ASTM recommended method) and at ground level, which is more practical for the collection of a large number of samples in remote locations. To fulfill this objective, one of the canisters at 100 m at each AWAR location (km 76, km 78) was duplicated with a canister on a 2 m stand. At the minesite locations (DF-1 and DF-2), three canisters were placed on the ground surrounding one on a stand.

Sample locations are shown in Figure 1 and 2. See Section 4 for a summary of the sample names, height above ground, and distance from road (Table 1).

2.3 Data Analysis

All statistical analyses were performed using SigmaPlot 11 software. Samples collected on the ground at the AWAR sites (km 76, km78) were used to examine the effects of distance from the road (50, 100, 150 m) by one-way ANOVA, and side of the road (east or west) by t-test on total and fixed dustfall. Samples from the two sites were pooled for this analysis. Mean dustfall in samples collected on the ground at each mine site location (DF-1, DF-2) were not significantly different from each other, so were pooled and compared to samples collected on the ground at each distance from the road to compare dustfall onsite with dustfall along the road by one-way ANOVA. In all statistical tests, $\alpha = 0.05$ was used. For AWAR locations, samples collected on the stand were compared qualitatively to the corresponding ground-level sample. For mine site locations, all ground-level samples were collected at approximately the same distance from the stand, so the mean ground-level dustfall was used in the comparison.

2.4 Regulatory Guidelines

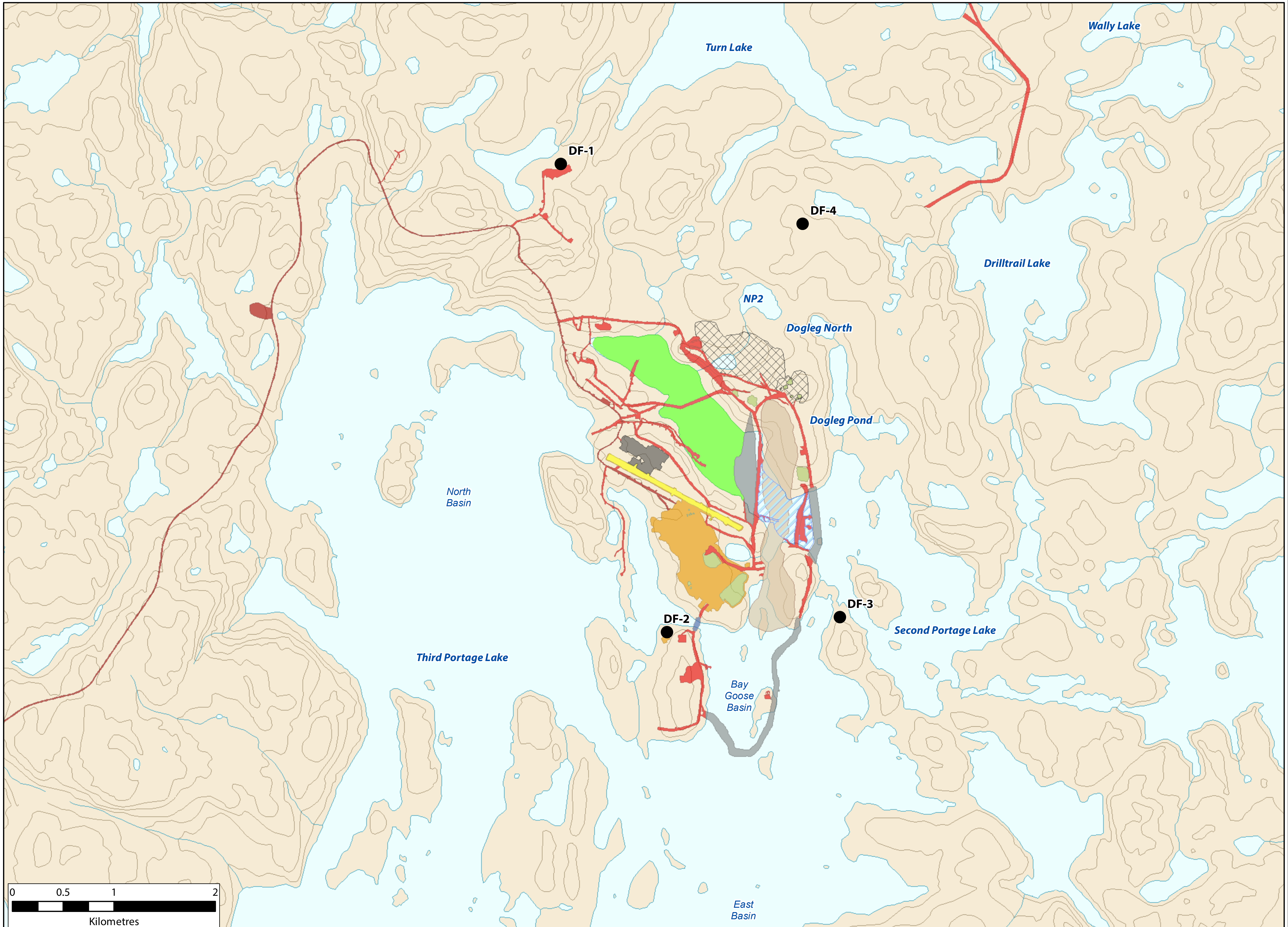
No standards for dustfall are available for Nunavut. Results of the total dustfall analysis were compared to Alberta Environment’s ambient air quality guideline (February, 2013) for recreational areas of 0.53 mg/cm^2/30d, and the commercial/industrial area guideline of 1.58 mg/cm^2/30d. These guidelines were developed in 1975 and the origin of their derivation could not be traced. Further, these values are based on "nuisance", rather than the protection of environmental or human health (Laura Blair, AENV, pers.comm. March 2013). Because of these factors, the guidelines are included to provide context only.

3 Results

Thirty-day normalized rates of total and fixed dustfall for all locations are provided in Table 1. Sample 76B and 78D are the corresponding ground samples for the stands at sites km 76 and km 78, respectively.

Table 1. Sample site characteristics and thirty-day normalized rates of total and fixed dustfall collected from Aug-Sept, 2012 at the Meadowbank sites (DF-1 and DF-2) and all-weather access road sites (km 76 and km 78). Corresponding stand and ground samples for AWAR locations are highlighted in grey and tan. At minesite locations, ground samples were grouped around the stand at equal distances.

Site Name	Sample Name	Ground or Stand	Distance from Road	Side of Road	Total Dustfall (mg/cm^2/30d)	Fixed Dustfall (mg/cm^2/30d)
DF-1	1	Stand	n/a	n/a	0.307	0.268
	1A	Ground	n/a	n/a	0.189	0.150
	1B	Ground	n/a	n/a	0.496	0.457
	1C	Ground	n/a	n/a	0.417	0.362
DF-2	2	Stand	n/a	n/a	0.205	0.142
	2A	Ground	n/a	n/a	0.338	0.291
	2B	Ground	n/a	n/a	0.291	0.244
	2C	Ground	n/a	n/a	0.480	0.441
km 76	76	Stand	100 m	E	0.114	0.090
	76A	Ground	150 m	E	0.556	0.482
	76B	Ground	100 m	E	0.302	0.253
	76C	Ground	50 m	E	1.069	1.029
	76D	Ground	50 m	W	1.029	0.988
	76E	Ground	100 m	W	0.669	0.637
km 78	78	Stand	100 m	W	0.963	0.824
	78A	Ground	100 m	E	0.710	0.580
	78B	Ground	50 m	E	1.469	1.249
	78C	Ground	50 m	W	0.955	0.922
	78D	Ground	100 m	W	0.180	0.163
	78E	Ground	150 m	W	0.449	0.392



Legend

- Air Quality & Dust Monitoring Location

2012 As Built Mine Plan

- South Camp Dike
- Quarry
- AWPAR Quarry
- Dewatered Lake
- Portage Attenuation Facility
- Tailings Storage Facility
- Roads
- AWPAR
- Dikes
- Stockpiles
- Mine Pit Updated Area
- Facility
- Airstrip
- Portage Rock Storage Facility

Air Quality & Dust Monitoring Locations

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PROJECT: DA11-062-03

CLIENT: Agnico-Eagle Mines Ltd., Meadowbank Div.

N W E S
UTM Zone 14 NAD83

DATE: MARCH 2013

SCALE: 1:35,000

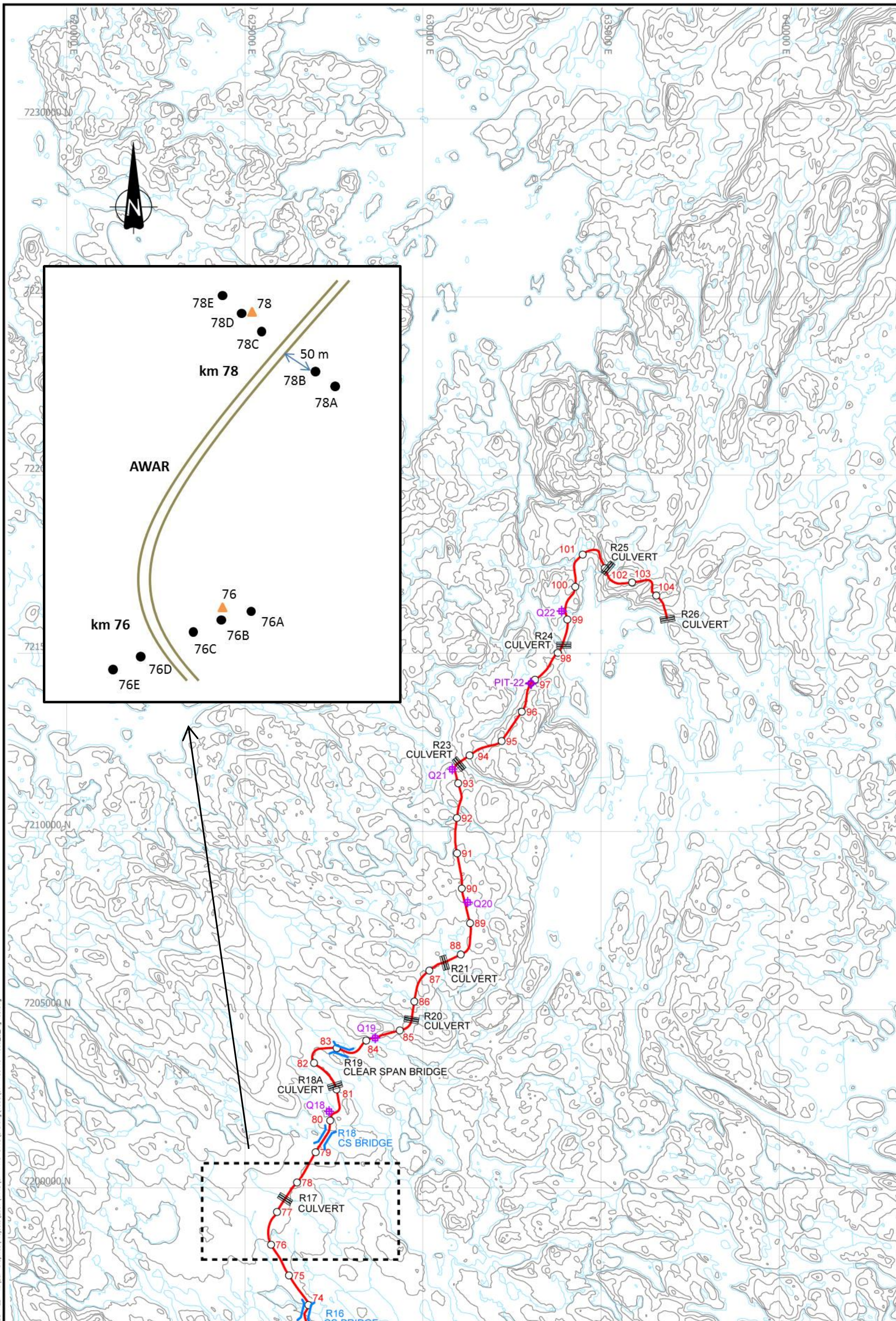
DRAWN BY: LC

CHECKED BY: TF

FIGURE:

1

The information displayed on this map has been compiled from various sources. While every effort has been made to accurately depict the information, this map should not be relied on as being a precise indicator of locations, features, or roads, nor as a guide to navigation. MNR data provided by Queen's Printer of Ontario. Use of the data in any derivative product does not constitute an endorsement by the MNR or the Ontario Government of such products.



LEGEND

- CULVERT
- HADD BRIDGE
- CLEAR-SPAN BRIDGE
- HOOP NETS INSTALLED
- LARVAL DRIFT TRAP
- EXISTING QUARRY
- O10 KILOMETER MARKER

REFERENCES

1) ROAD ALIGNMENT, BRIDGE, CULVERT AND QUARRY LOCATIONS FROM NUNA M&T SERVICES Ltd.
2) BASE DRAWING FROM GOLDER ASSOCIATES Ltd.

PROJECT

AEM **AGNICO-EAGLE MINES LIMITED MEADOWBANK DIVISION**

TITLE

ALL-WEATHER PRIVATE ACCESS ROAD MONITORING LOCATIONS

PROJECT No.			FILE No.	0714130119-1000_B_Fig-03
DESIGN			SCALE AS SHOWN	REV. -
CADD	EA/GG	16MAR08	FIGURE 2	
CHECK				
REVIEW				

AZIMUTH

3.1 Distance from Road

Mean total dustfall was significantly greater at 50 m from the road (1.13 $mg/cm^2/30d$), than at 100 m (0.47 $mg/cm^2/30d$) and 150 m (0.50 $mg/cm^2/30d$), which were not significantly different from each other in the one-way ANOVA analysis. Variability was notably highest at the 100 m location, with a coefficient of variation of 56%, compared to 20% at 50 m, and 14% at 150 m. Variability between the samples at 100 m were not due to the side of the road the sample was taken on (see Section 2.2). Similar trends were seen for fixed dustfall.

3.2 Side of the Road

Mean total dustfall was 0.82 $mg/cm^2/30d$ on the east side, and 0.66 $mg/cm^2/30d$ on the west side of the road. The difference was not statistically significant. No differences were found when groups at each distance from the road were examined individually. Similar results were obtained for fixed dustfall.

3.3 Onsite vs. AWAR Sites

Mean total dustfall onsite was 0.37 $mg/cm^2/30d$, which was significantly less than dustfall at 50 m from the roadway (1.13 $mg/cm^2/30d$). No significant difference was found between dustfall onsite and dustfall at 100 m or 150 m from the road (see Section 3.1 for mean rates). Similar results were obtained for fixed dustfall.

3.4 Height Above Ground

Onsite, mean total dustfall at ground level (0.37 $mg/cm^2/30d$ at DF-1 and DF-2) was greater than at 2 m above ground for DF-1 and DF-2 (0.31 and 0.20 $mg/cm^2/30d$, respectively).

Along the AWAR, stands were placed at the 100 m location, which had the highest variability between samples (see Section 3.1). Total dustfall rates on the two stands were the highest (0.96 $mg/cm^2/30d$ - km 78) and lowest (0.11 $mg/cm^2/30d$ - km 76) rates observed at the 100 m location. Dustfall on the ground at km 76 (76B) was approximately twice as high as dustfall on the stand. However at km 78, dustfall on the ground (78D) was approximately five times lower than dustfall on the stand (see Table 1). Ratios were similar for total and fixed dustfall. No statistical correlations were found between rates of dustfall on stands and those on the ground.

3.5 Comparison to Regulatory Guidelines

No samples collected from onsite locations or from the 150 m locations exceeded the recreational area guideline of 0.53 $mg/cm^2/30d$. At the 100 m location, half of the samples exceeded the recreational guideline, but none exceeded the commercial/industrial guideline of 1.58 $mg/cm^2/30d$. At the 50 m location, all samples exceeded the recreational area guideline, but none exceeded the commercial/industrial guideline.

4 Conclusions

The results of this preliminary study will assist in the development of methods for the study proposed for 2013.

Notably, 30-d rates of dust deposition at 50 m from the Meadowbank AWAR were more than 20 x lower than those reported along Ekati Diamond Mine haul roads in 2003 (extrapolated from 72-h studies; 0.7 g/m^2/day; Male and Nol, 2005). Furthermore, reported dust depositions along Ekati haul roads after application of dust suppressants (extrapolated from 72-h studies; 0.2 g/m^2/day; Male and Nol, 2005) was still more than 4 x higher than observed along Meadowbank's AWAR in this study. Overall, rates of dustfall along the AWAR were within the range of Alberta Environment's ambient air quality guidelines (recreational or industrial).

Side of the road (East or West) results were not significantly different at any distance. However, it is highly probable that in actuality one side receives higher dustfall than the other due to prevailing winds, and the sample size in 2012 was too low to detect a difference. In the 2013 study, data will first be screened based on this variable before pooling for analyses of other variables. Topographical differences will be taken into account as well.

Since dustfall at minesite locations was lower than any sampling position along the AWAR, the 2013 study will primarily focus on locations away from the minesite and at new locations along the Vault Pit haul road.

In this preliminary study, dustfall collection at ground level generally appeared to provide comparable estimates of dustfall to those obtained at 2 m height (and was more conservative in 3 of 4 cases). Based on these results and the reasons described in guidance documents for mounting dust canisters at 2 – 3 m height, this practice appears to be generally conservative, and could be employed in future studies.

Finally, in this study, distance from the road significantly affected recorded rates of dustfall. Since dustfall rates were not significantly different between 100 and 150 m from the road, and these rates were not significantly different from those at the minesite, it is likely that elevated rates of dustfall are confined to < 100 m from the road. This is in agreement with TEIA predictions (Cumberland, 2005) and Male and Nol (2005) who found the most pronounced dustfall rates within 50 m of roads at the Ekati mine site. Despite higher levels of dust deposition at Ekati, Male and Nol (2005) did not find a measurable effect of roads on Lapland longspurs. Similar results were reported in AEM (2012) for the 2011 AWAR Meadowbank breeding bird survey that found higher bird diversity within 150m of the east side compared to the west side of the road and no road related effects on bird abundance (eg. Lapland longspur abundance) or richness (AEM, 2012). The 2013 study will therefore focus on distance from the road and may include a sampling location beyond 150 m, based on evidence in the literature that effects may extend to 300 m from roadways.

As predicted and evaluated in the TEIA (Cumberland, 2005), one potential concern with increased dustfall along the road may be the re-entrainment of contaminants that occur naturally in the rock used for road construction, or in materials used to suppress dust, that may cause effects to receptors such as birds, predatory mammals or ungulates. Concentrations of chromium in Meadowbank area soil have been found to be naturally elevated (above CCME guidelines), and traffic could cause increased deposition on surface soil and vegetation. In 2012, AEM conducted a wildlife screening level risk assessment to quantify risk to identified receptors of concern, which included songbirds, waterfowl, ungulates and small mammals. Concentrations of contaminants examined in the study were not elevated in samples onsite or near site, and no risks to wildlife health through contaminant exposure were identified due to mine activities.

5 References

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