Rio Tinto

2013 – 2014 Environmental Air Quality Monitoring Report – Diavik Diamond Mines (2012) Inc.

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Contents page

Introduction

1. Background

Diavik Diamond Mines (2012) Inc. (DDMI) has been collecting and reporting air quality related data since initial site construction in 2001. In June of 2013 DDMI submitted an Environmental Air Quality Monitoring Plan (EAQMP) to the Environmental Monitoring Advisory Board (EMAB). The EAQMP was developed to address Article 7.2 (a) of the Environmental Agreement (EA). The EAQMP and its results are not part of a Regulatory Instrument but are subject to review by EMAB and the Parties under EA Article 7.5.

1.1 EAQMP Annual Report and Layout

The purpose of this report is to provide a summary of the air quality monitoring and emissions data in relation to the mine's operational activities that can influence annual results. The 2013 – 2014 EAQMP is the first annual report to be produced under this program. The EAQMP annual report summarizes air quality data from the following programs:

- Total Suspended Particulate (TSP) Continuous Monitors
- Dust Fall Monitoring – Aquatic Effects Monitoring Program (AEMP)
- Snow Core Program – AEMP
- Emission Monitoring and Reporting – National Pollutant Release Inventory (NPRI), Environment Canada
- Greenhouse Gas Monitoring and Reporting – Environment Canada

1.2 Context - 2013

The primary sources of fugitive dust were associated with unpaved road and airstrip usage. To supress dust generation, roads were watered during the summer as needed, and EK35 was applied to the airport apron (tarmac) and helipad during the spring. The mine production rate was steady throughout the year and all product obtained was from the underground mine.

There was an increase in construction activity related to the Processed Kimberlite Containment (PKC) Facility between April and September, along with re-mining of the North Country Rock Pile, but as a whole surface activity has decreased compared to previous years.

Fugitive dust generation is expected to be highest during snow-free periods where and when there is site activity. Therefore it is expected that the highest fugitive dust generation and resulting dustfall occurred in areas closest to the mine footprint between April and September.

2. Continuous Total Suspended Particulate Monitoring

2.1 Background

Community interest in the possible effects of dust deposition on wildlife and aquatic effects are the basis for the focus of DDMI's EAQMP on TSP. TSP is the total fraction that deposits on vegetation, snow and water and it is the total fraction that is monitored in the dust gauges and snow cores.

In 2012 an updated air dispersion modelling assessment was undertaken for the entire Mine (Golder, 2012). The modelling results indicated that:

- Annual TSP concentrations are predicted to be lower than the Government of the Northwest Territories Guidelines for Ambient Air Quality Guidelines (2002) for receptors located in the vicinity of the Mine. For two days per year, 24-hr concentrations of TSP are predicted to exceed the air quality criteria;

- Maximum TSP deposition rates are predicted to be higher on the Mine site (222.2 $mg/dm^2/y$) than off-site (4.1 $mg/dm^2/y$) and generally greater than originally predicted. For example 100 $mg/dm^2/y$ was originally predicted adjacent to A154pit (Cirrus Consultants, 1998).

Ambient TSP monitoring in strategic locations can provide additional monitoring information to assist in understanding, tracking and responding to potential dust deposition concerns. Figure 1 shows the location of the two TSP Monitors.

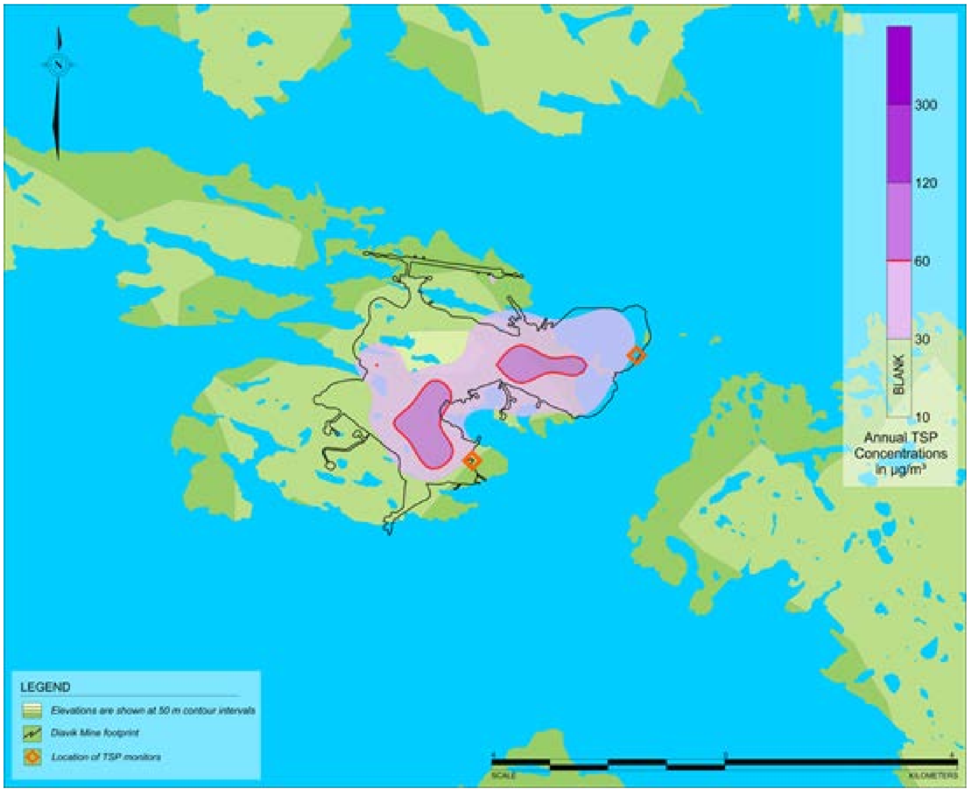

Figure 1: Annual Predicted TSP Concentrations and TSP Monitoring Locations

2.2 Program Overview

2.2.1 Monitoring Methods

TSP monitoring is undertaken using the SHARP 5014i monitor that uses beta attenuation monitoring technology. Ambient air is drawn through a subsonic orifice at a controlled flow rate; continuous mass measurements are conducted and hourly mass concentrations are calculated and stored in the iSeries platform data logging system. The sampling equipment is contained within a climate-controlled shelter to minimize data loss during extreme weather conditions.

2.2.2 Monitoring Locations

Total suspended particulate monitoring is undertaken at two locations, one is near the A154 dike (along the south-east corner of the A154 pit) and the second is within the communications building adjacent to the accommodations complex. The location of the A154 dike monitor was selected based on the proximity to the boundary of the Mine footprint and results of the updated air dispersion modelling assessment. The site near the communications building was selected based on its proximity to the boundary of the Mine footprint and the results of the updated air dispersion modelling assessment.

2.3 Results

TSP results are compared to the Government of the Northwest Territories Department of Environment and Natural Resources (ENR) Guideline for Ambient Air Quality Standards in the Northwest Territories (GNWT, 2011). ENR has developed two standards for TSP:

- 24 Hr Average: 120 µg/m^3
- Annual Arithmetic Mean: 60 µg/m^3

Figures 2 and 3 below compare the 24 Hr Average over the year (May 2013 – April 2014) for both monitoring stations to the GNWT 2011 Standard.

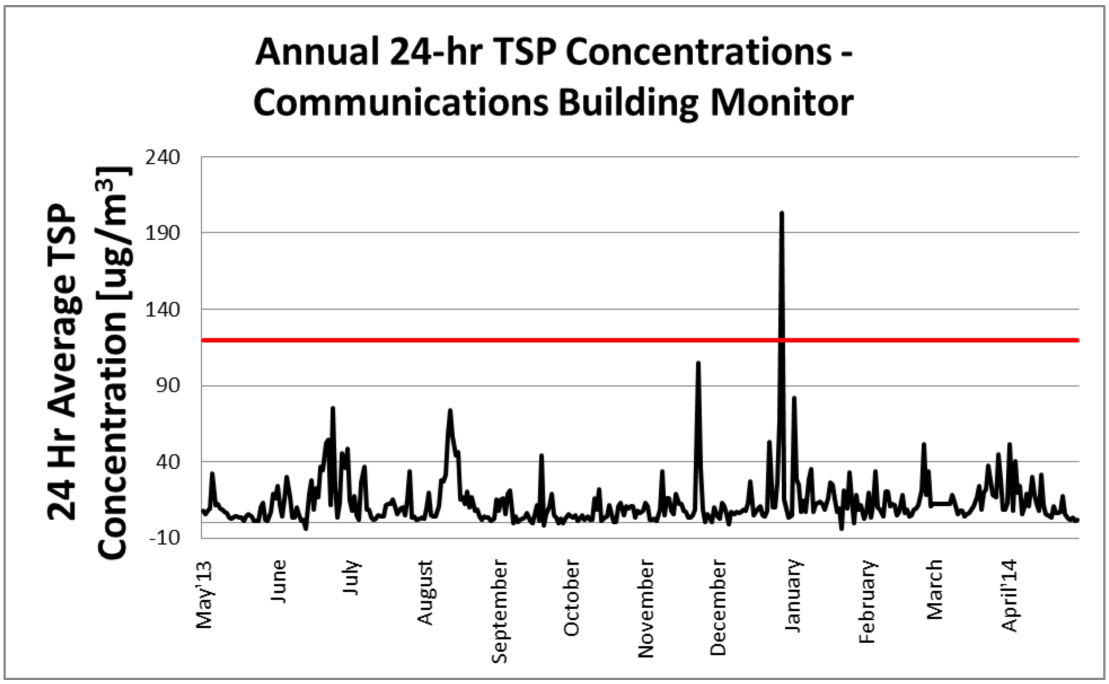

Figure 2: Annual TSP Readings, Communication Buildings

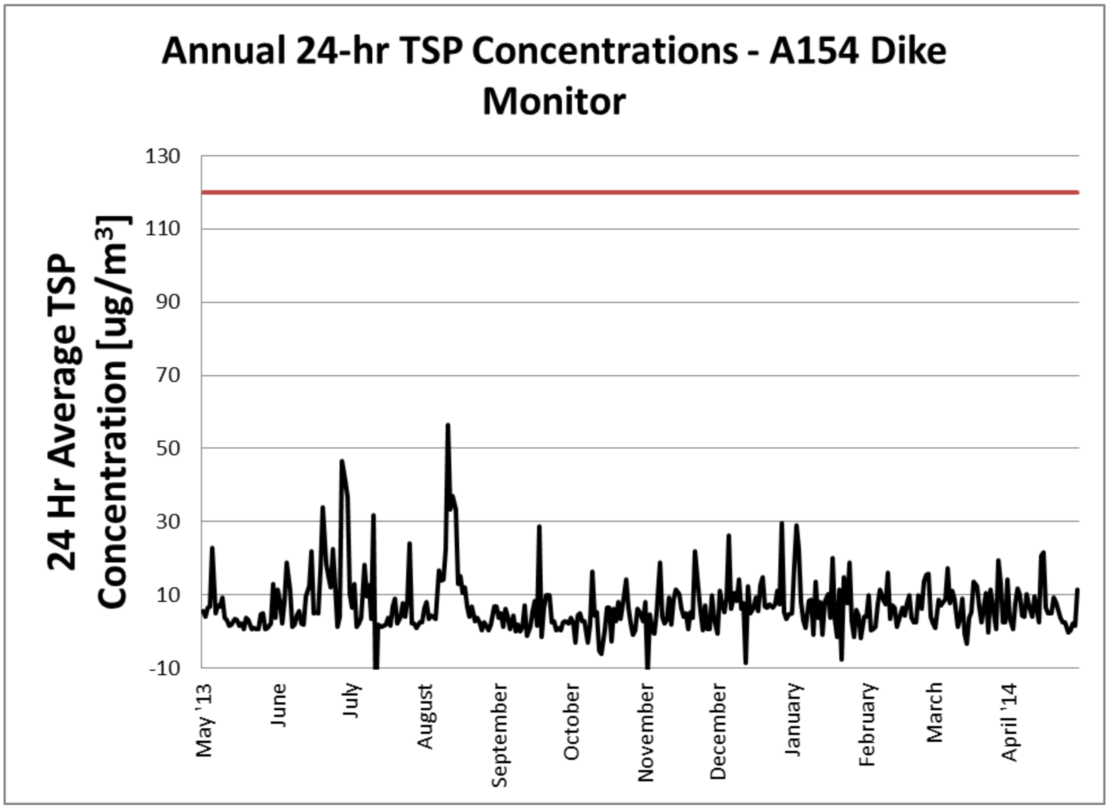

Figure 3: Annual TSP Readings, A154 Dike

The Annual Arithmetic Mean for both stations is listed below:

- Communications Building: **13.41 μg/m^3**
- A154 Dike: **7.01 μg/m^3**

With the exception of one occurance, all data points from both monitors are below the 24 Hr Average and the Annual Arithmetic Mean; this result agrees with the prediction from the 2012 dispersion model. On December 28, 2013 a 24 Hr mean value of 203 μg/m^3 was recorded at the TSP monitor located in the communications building, it is suspected that a build-up of snow was responsible for this reading.

3. Dust Fall Monitoring

3.1 Background

Fugitive dust generated by the Mine Site has the potential to enter Lac de Gras through runoff and fall out onto ice-covered surfaces during winter and the lake during summer. As such, dust fall monitoring and snow core sampling have been included as part of the Aquatic Effects Monitoring Program (AEMP) since 2001.

3.2 Program Overviews

The dust fall monitoring program has been designed and implemented to identify:

- Total particulate (dust) deposition rates at various distances from the Mine to compare the observed deposition rates to original predictions.

The Dust Fall Monitoring Program is detailed in Section 6.2 of Version 3.5 of the AEMP Design Document (Golder, 2014) and uses dust gauges and snow cores to collect samples.

Dust Gauges

Dust gauges are containers used to collect deposited airborne particulates. Each dust gauge consists of a hollow brass cylinder, 52 cm long and 12.7 cm in diameter, surrounded by a fiberglass shield that is the shape of an inverted bell. The shield is placed around the mouth of the gauge to prevent the accumulation of materials that could be carried horizontally by high winds and blowing snow.

Dust collection gauges are located at twelve stations (including two control stations) both on and off site (Figure 3).

Snow Cores

The snow surveys consist of collecting snow core samples to identify the quantity of dust fall during winter and to determine the rate of particulate deposition. Chemical characteristics of the particulate material are determined from a chemical analysis of snow core sub-samples.

A snow core sample is a cylindrical section of snow obtained by drilling into the snowpack with a snow corer. A snow corer is a hollow tube with a cutting apparatus at the bottom end of the drilling barrel that, when inserted into the snowpack, causes a sample to be pushed into the tube. Multiple core samples are collected and compiled at each survey station, dependent upon snow quantity, to ensure a representative snow sample is obtained. Snow samples are collected in annually in April.

Snow core samples are collected along five transects from 27 stations, including three control stations (Figure 1). The snow sampling stations consist of 10 “on land” locations and 17 “on ice” locations. Composite samples collected at “on ice” stations will are sub-sampled for snow water chemistry analysis and dust fall deposition analysis. Samples collected at “on land” stations are analysed solely for dust fall deposition. Snow water chemistry samples associated with each of the three control stations are collected from “on ice” locations immediately adjacent to the control locations to minimize possible contamination associated with soil materials. Snow samples collected during the survey are transported to the on-site environment laboratory where they are analysed for total particulate matter (TPM).

An annual report is completed and appended to the AEMP report as required under Part K Item 10 of Water License W2007L2-0003 issued by the Wek’èezhìi Land and Water Board. The 2013 annual dust report is included as Appendix A.

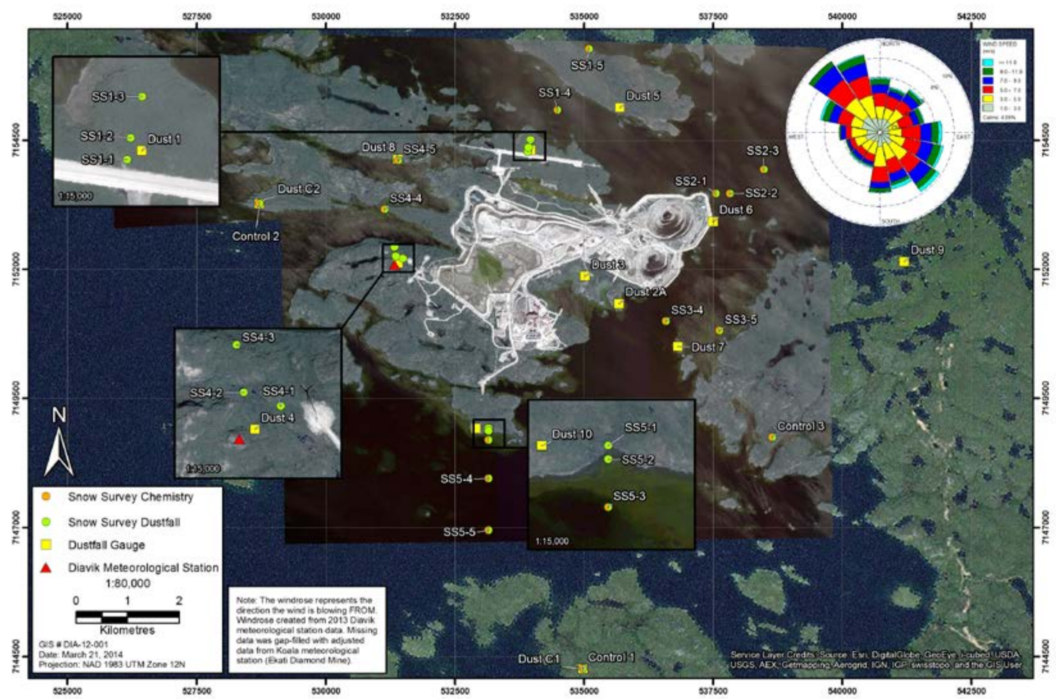

Figure 3: Dust Gauge and Snowcore Locations

3.3 Results

The annualized dustfall rates estimated from the 2013 data ranged from 10 to 1,576 mg/dm^2/yr. Results are presented in Table 2 and illustrated relative to their geographic location from the mine site in Figure 2. In general, dust fall decreases with increased distance from the mine. The detailed 2013 measurements and calculations for each station are included in Appendix A.

Table 1 – 2013 Dust Gauge and Snow Core Results

Zone	Station	Distance from the Mine Footprint (m)	Dustfall (mg/dm^2/yr)
0 – 100 m	Dust 1	75	262
	Dust 3	30	315
	Dust 6	25	175
	SS1-1	30	1,576
	SS4-1	100	174
100 – 250 m	Dust 4	200	122
	SS1-2	115	772
	SS2-1	180	49
	SS4-2	245	52
250 – 1,000 m	Dust 2A	435	155
	Dust 10	670	122
	SS1-3	275	460
	SS1-4	920	178
	SS2-2	445	42
	SS3-4	615	388
	SS4-3	350	168
	SS5-1	665	17
	SS5-2	710	23
	SS5-3	885	18
1,000 – 2,500 m	Dust 5*	1,195	121
	Dust 7	1,155	192
	Dust 8	1,220	95
	Dust 9	3,810	102
	SS1-5	2,180	28

Zone	Station	Distance from the Mine Footprint (m)	Dustfall ($mg/dm^2/yr$)
1,000 – 2,500 m	SS2-3	1,220	44
	SS2-4	2,180	41
	SS3-5	1,325	33
	SS4-4	1,065	42
	SS4-5	1,220	132
	SS5-4	1,635	12
	SS5-5	2,635	10
Control	Dust C1	5,655	49
	Dust C2	3,075	67
	CONTROL 1	5,655	22
	CONTROL 2	3,075	13
	CONTROL 3	3,570	52

*The gauge at Dust 5 was found to be dismantled in September; the sample was compromised and not used.

The mean dustfall rates measured from both dustfall gauges and snow surveys within the 0–100, 101–250, 251–1,000, 1,001–2,500 and Control zones were 500, 249, 157, 71 and 40 mg/dm2/yr, respectively (Table 1). The lowest dustfall recorded was at station SS5-5 (south of the mine on Lac de Gras). Dustfall levels at each snow survey station in 2013 were lower compared to the majority of previous years. The exceptions to this are the stations located closest to the airstrip (SS1-1 to SS1-4), all of which were within the range of results from previous years, but higher than the last two years. The highest levels of dustfall were within 115 m of the airstrip (SS1-1 at 1,576 $mg/dm^2/yr$ and SS1-2 at 772 $mg/dm^2/yr$). The British Columbia Ministry of the Environment Ambient Air Quality Objective (2013) for the mining industry is 621–1,059 $mg/dm^2/y$; however, this is only used for comparison purposes as the Northwest Territories has not adopted a similar objective.

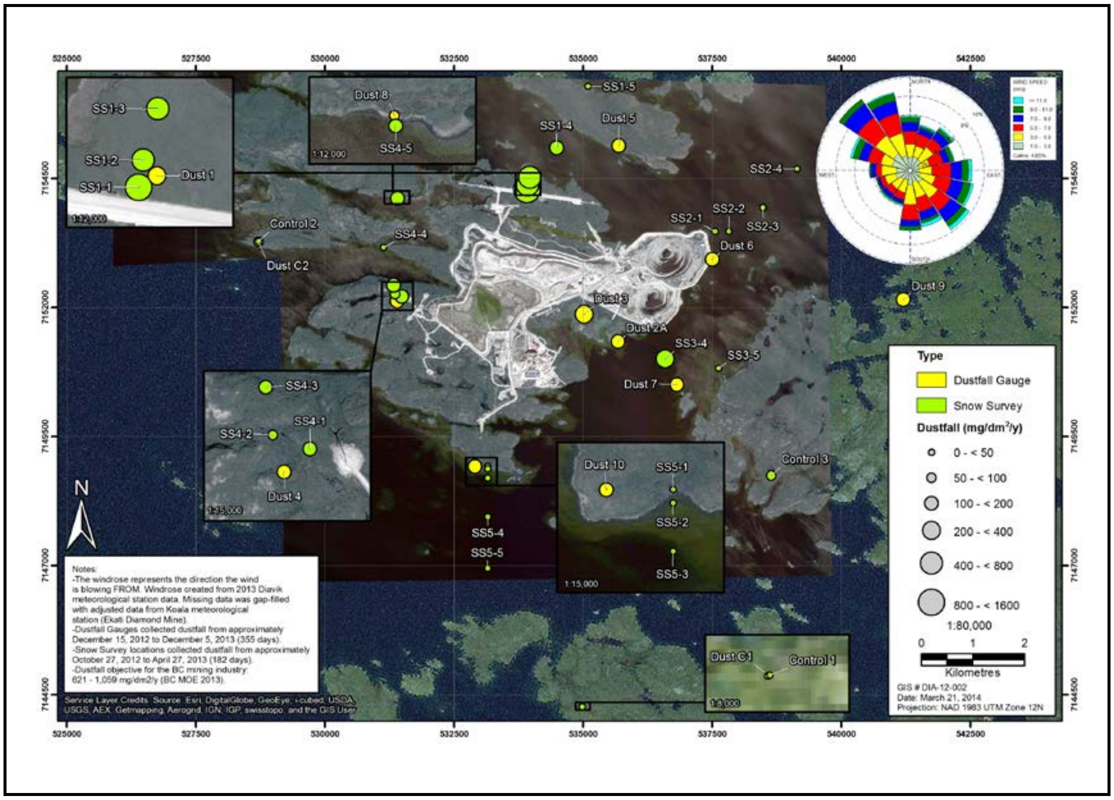

Figure2: 2013 Dust Gauge and Snowcore Results

3.3.1 Snow Chemistry

Similar to findings for dustfall levels, the concentration of metals in the snow core samples decreased as the distance from the mine increased. None of the metal concentrations exceeded the Water License Effluent Quality Criteria as established for effluent discharged from the Mine. Full results are presented in the complete report in Appendix A.

4. National Pollutant Release Inventory

4.1 Program Overview

While there is no regulatory requirement or standard for pollutant release in the Northwest Territories, the National Pollutant Release Inventory (NPRI) is a legislated, publicly accessible inventory used to track the amount of pollutant releases (to air, water and land), disposals and transfers for recycling. The program is administered by Environment Canada and is a requirement of the Canadian Environmental Protect Act, 1999 for owners or operators of facilities that exceed 20,000 employee hours per year and that meet the NPRI reporting requirements published in the Canada Gazette, Part I. NPRI reports are to be submitted prior to June 1 each year.

4.2 Results

NPRI reports for previous years (2001 – 2012) are available on the NPRI website at http://www.ec.gc.ca/inrp-npri/ . NPRI results for the previous year are typically released by Environment Canada in April twenty two months following submission on June 1 of each year. (ie 2013 data was reported by June 1 2014. 2012 data was released by Environment Canada in April of 2014). Table 2 below compares 2012 and 2013 main constituent NPRI results for the Mine.

Table 2 – 2012 and 2013 NPRI Submission

Constituent	2012 (Tonnes)	2013 (Tonnes)
Carbon Monoxide (CO)	669	679
Sulphur Dioxide (SO_2)	3.82	3.25
Oxides of Nitrogen, expressed as NO2 (NOx)	2,274	2,293
Volatile Organic Compounds (VOCs)	58	58
Total Particulate Matter (TPM)	985	451
Particulate Matter ≤ 10 µm (PM_{10})	314	156
Particulate Matter ≤ 2.5 µm ($PM_{2.5}$)	63	46

Table 2 illustrates that CO, SO_2, NOx, and VOCs levels remained similar between 2012 and 2013. These constituents are primarily derived from the combustion of diesel fuel. In 2012 and 2013, 64.6 and 67.0 million litres of diesel were consumed respectively.

Table 2 illustrates that TPM, PM_{10}, and $PM_{2.5}$ levels in 2013 were reduced by half what they were in 2012. This reduction is directly related to the completion of Open Pit mining in September 2012 and a subsequent reduction in the amount of haul truck traffic.

NPRI levels are derived by using emission factor calculations provided by Environment Canada. Known values such as fuel usage, mobile equipment hours, and weather conditions are used to calculate NPRI values.

5. Green House Gas Reporting

5.1 Program Overview

While there is no regulatory requirement or standard for Green House Gas release in the Northwest Territories the Greenhouse Gas Emissions Reporting Program (GHGRP) is Canada's legislated, publicly accessible inventory of facility-reported greenhouse gas (GHG) data and information. The program is administered by Environment Canada and is a requirement of the Canadian Environmental Protect Act, 1999 for owners or operators of facilities that emit the equivalent of 50000 tonnes or more of GHGs in carbon dioxide equivalent units (CO_2 e^-). GHG reports are to be submitted prior to June 1 each year.

5.2 Results

GHG reports for previous years (2001 – 2012) are available on the GHG website at http://www.ec.gc.ca/ges-ghg/ . GHG results for the previous year are typically released by Environment Canada in April twenty two months following submission on June 1 of each year. (ie 2013 data was reported by June 1 2014. 2012 data was released by Environment Canada in April of 2014). Table 3 below compares 2012 and 2013 GHG results for the Mine.

Table 3 – 2012 and 2013 GHGSubmission

Constituent	2012 (Tonnes (CO_2e^-)	2013 (Tonnes (CO_2e^-)
Carbon Dioxide (CO_2)	171,327	175,184
Methane (CH_4)	182	186
Nitrous Oxide (N_2O)	7,077	7,324
Total	178,587	182,696

Table 3 illustrates that CO_2, CH_4, and N_2O levels increased between 2012 and 2013. These constituents are primarily derived from the combustion of diesel fuel. In 2012 and 2013, 64.6 and 67.0 million litres of diesel were consumed respectively which represents a 3.5% increase. Increased diesel consumption in 2013 compared to 2012 is directly linked to advancing the underground operation (ie increased pumping requirements and ventilation requirements). Total CO_2e^- increased by 2.3% during this time.

6. Summary

TSP monitors were installed at Diavik in April 2013. Over the first year of operation, data collected by these monitors accurately reflected the updated model predictions that were completed in 2012. TSP levels were lower than the GNWT Ambient Air Quality Guideline (2011) with the exception of one day (December 28, 2013) which is suspected to be an erroneous data point.

In general, dust fall and its chemical constituents decrease with increasing distance away from the mine site (Figure 2). Because dust gauges continuously collect dust throughout the year, and the snow surveys are only representative of dust fall accumulated over the snow cover period, the reported annual dust fall results from the dust gauges are expected to better estimate annual dust fall compared to snow survey results for similar geographic areas.

NPRI and greenhouse gas emissions remained relatively constant between 2012 and 2013. The amount of particulate matter decreased by 50% as the mine shifted from an open pit operation to a fully underground operation in the fall of 2012.

Diavik will continue to collect and measure air quality parameters moving forward and report the results to the applicable regulators.

7. References

British Columbia Ministry of the Environment. 2013. British Columbia Ambient Air Quality Objectives. Produced by the British Columbia Ministry of the Environment. http://www.bcairquality.ca/reports/pdfs/aqotable.pdf

Cirrus Consultants. 1998. Diavik Diamonds Project. Environmental Effects Report Climate and Air Quality.

Diavik Diamond Mines Inc. 2013. Environmental Air Quality Monitoring Plan. Submitted to the Environmental Monitoring Advisory Board.

Environment Canada. 2014. National Pollutant Release Inventory. http://www.ec.gc.ca/inrp-npri/

Environment Canada. 2014. Greenhouse Gas Emissions Reporting Program. http://www.ec.gc.ca/ges-ghg/

ERM. 2014. Diavik Diamond Mine 2013 Dust Deposition Report. Submitted to Diavik Diamond Mine.

Golder Associates. 2012. Air Dispersion Modelling Assessment. Submitted to Diavik Diamond Mines Inc.

Golder Associates. 2014. Aquatic Effects Monitoring Program Study Design Version 3.5. Submitted to Diavik Diamond Mines Inc.

Government of the Northwest Territories. 2002. Guideline for Ambient Air Quality Standards in the Northwest Territories.

Appendix A – 2013 Dust Deposition Report