

REPORT N° 171-00556-00

AMBIENT AIR QUALITY MONTHLY REPORT

MAY 2017

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MAY 2017

Lafarge Canada Inc.

Project no: 171-00556-00
Date: May 2017

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Project Number: 171-00556-00

June 16, 2017

Janet Brygger
Lafarge Canada Inc.
Highway 1A
Exshaw, AB T0L 2C0

Dear Ms. Brygger,

Subject: Ambient Air Quality Monthly Report – May 2017

The operational uptime for the meteorological systems and all analyzers at the Lagoon station was over 98% in May. There were no contraventions of the 24-hour TSP and PM_{2.5} Alberta Ambient Air Quality Objectives (AAAQOs) in May at the Lagoon monitoring location.

Data collected at all of the GRIMM monitors are considered Industrial Ambient Monitors and are meant for assessing the performance of Lafarge Exshaw's Fugitive Dust Control Best Management Practices – Program. All GRIMM monitors had operational uptime greater than 96%. The Entrance GRIMM monitor exceeded the TSP AAAQO for 7 days while the Berm GRIMM had 10 exceedances of the TSP objective.

I certify that I have reviewed and verified this report and that the information is complete, accurate and representative of the monitoring results, reporting timeframe and the specified analysis, summarization and reporting requirements.

Sincerely,

Tyler Abel, M.Sc.
Group Manager, Air Quality
Environment

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SIGNATURES

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1

INTRODUCTION

This report summarizes the ambient air quality and meteorological data collected at the Lagoon monitoring location and the GRIMM monitors in Exshaw, AB. The station is operated by WSP on behalf of Lafarge Canada Inc. (Lafarge) and is a requirement of Lafarge's Approval 1702-02-04. This report contains data collected between May 1, 2017 and May 31, 2017.

This monthly report was prepared by Byeong Kim, an Air Quality Specialist with WSP, on behalf of Lafarge and was reviewed by Tyler Abel, Manager of Air Quality and Air Quality Specialist at WSP.

2

MAY 2017 REPORT SUMMARY

This summary section provides the pertinent details on data collected and maintenance/calibration activities at each of the monitoring locations. The monitoring results for the stations are described in further detail in their corresponding sections. Maximum hourly concentrations are shown for all particulate matter size fractions, but there are no Alberta Ambient Air Quality Objectives (AAAQO) for 1-hour PM concentrations.

2.1

LAGOON STATION

Table 2-1 Lagoon station data summary

Parameter	Data Completeness (%)	1-Hour Average		24-hour Average	
		Maximum Concentration	Exceedances of AAAQO or AAAQG	Maximum Concentration	Exceedances of AAAQO
NO ₂ (ppb)	100.0	18.4	0	4.7	-
SO ₂ (ppb)	100.0	7.9	0	1.3	0
PM _{2.5} (µg/m ³)	98.8	22.4	-	5.6	0
PM ₁₀ (µg/m ³)	98.0	311.4	-	54.2	-
TSP (µg/m ³)	98.8	484.8	-	77.8	0
Temperature (°C)	99.7	26.3	-	17.7	-
Wind Speed (km/hr) /Direction	99.7	36.5/W	-	29.8/WSW	-
Precipitation (mm)	100.0	6.0	-	17.3	-

Data Quality Notes:

- There were no exceedances of any AAAQOs.

- Instrument errors on May 20th and 21st, resulting in 98.8% operation time for the TSP and PM_{2.5} analyzers. The PM₁₀ analyzer was also down for 15 hours due to instrument error on the same days, resulting in 98% operation time.

Calibration/Maintenance Notes:

- 2 hours of maintenance work resulted in 99.7% operation time for the temperature and wind sensors.

2.2 WEST GRIMM

The GRIMM monitors are Industrial Ambient Monitors meant to aid Lafarge in assessing the performance of their Fugitive Dust Control Best Management Practices – Program (FDCBMP-P). The AAAQO are used as Guidelines to evaluate the performance of the FDCBMP-P.

Table 2-2 West station data summary

Parameter	Data Completeness (%)	1-Hour Average		24-hour Average	
		Maximum Concentration	Exceedances of Guidelines	Maximum Concentration	Exceedances of Guidelines
PM _{2.5} ($\mu\text{g}/\text{m}^3$)	96.5	18.2	-	8.1	0
PM ₁₀ ($\mu\text{g}/\text{m}^3$)	96.5	119.0	-	24.5	-
TSP ($\mu\text{g}/\text{m}^3$)	96.5	219.4	-	50.1	0

Data Quality Notes:

- There were no exceedances of any AAAQOs.

Calibration/Maintenance Notes:

- The West Grimm monitor experienced three periods of instrument error resulting in no values recorded to the GRIMM monitor database in May: from 1pm May 10th to 3am May 11th, from 4am May 18th to 6am May 18th, and from midnight May 20th to 7am May 20th. This instrument error resulted in 96.5% operation time for the month.

2.3

BERM GRIMM

The GRIMM monitors are Industrial Ambient Monitors meant to aid Lafarge in assessing the performance of their FDCBMP-P. The AAAQO are used as Guidelines to evaluate the performance of the FDCBMP-P.

Table 2-3 Berm station data summary

Parameter	Data Completeness (%)	1-Hour Average		24-hour Average	
		Maximum Concentration	Exceedances of Guidelines	Maximum Concentration	Exceedances of Guidelines
PM _{2.5} ($\mu\text{g}/\text{m}^3$)	99.9	65.4	-	11.5	0
PM ₁₀ ($\mu\text{g}/\text{m}^3$)	99.9	366.4	-	74.4	-
TSP ($\mu\text{g}/\text{m}^3$)	99.9	1061.5	-	301.3	10

Data Quality Notes:

- There were 10 exceedances of the 24-hour TSP Guideline.

Calibration/Maintenance Notes:

- The monitor had 99.9% uptime for this month due to a database error at 7am on May 18th.

2.4

ENTRANCE GRIMM

The GRIMM monitors are Industrial Ambient Monitors meant to aid Lafarge in assessing the performance of their FDCBMP-P. The AAAQO are used as Guidelines to evaluate the performance of the FDCBMP-P.

Table 2-4 Entrance station data summary

Parameter	Data Completeness (%)	1-Hour Average		24-hour Average	
		Maximum Concentration	Exceedances of Guidelines	Maximum Concentration	Exceedances of Guidelines
PM _{2.5} ($\mu\text{g}/\text{m}^3$)	99.9	34.3	-	16.4	0
PM ₁₀ ($\mu\text{g}/\text{m}^3$)	99.9	193.3	-	79.7	-
TSP ($\mu\text{g}/\text{m}^3$)	99.9	627.8	-	224.4	7

Data Quality Notes:

- There were 7 exceedance of the 24-hour TSP Guideline.
- The Entrance monitor lost communications with the GRIMM server on May 15th. Raw data stored in the MicroSD card was manually retrieved by the WSP technician.

Calibration/Maintenance Notes:

- The monitor had 99.9% uptime for this month due to maintenance work at 1pm on May 26th.

3 LAGOON STATION

The Lagoon trailer contains NO_x, SO₂, TSP, PM₁₀, and PM_{2.5} analyzers as well as meteorological sensors, and is shown in Figure 3-1. An ambient air quality station has been at this location since 2002, providing a long-term data record for air quality in the Exshaw area.

This section provides a summary of the monitoring activities for the Lagoon ambient air quality station, including: a table of instrumentation (Table 3-1), site visit notes, a wind rose (Figure 3-3) and tables and graphs illustrating the monitoring results for May 2017.

All of the monitors comply with Alberta Environment and Parks Air Monitoring Directive (2016).

Table 3-1 Instrumentation List at the Lagoon Station

Equipment Description	Parameter Measured
MetOne BAM-1020 FRM Continuous Particulate Monitor	PM _{2.5} Concentrations
MetOne BAM-1020 Continuous Particulate Monitor	PM ₁₀ Concentrations
MetOne BAM-1020 Continuous Particulate Monitor	TSP Concentrations
TEI 42C	Oxides of Nitrogen
Teledyne API 102A	Sulphur Dioxide
MetOne 130 Rain/Snow Gauge	Precipitation
MetOne Wind Sensor	Wind Speed
	Wind Direction
MetOne Ambient Temperature Sensor	Ambient Temperature



Figure 3-1 Inlets on the top of WSP's Lagoon monitor

3.1 SITE VISIT NOTES

A summary of site visit notes for each of the monitors is provided in this section.

3.1.1 NO_x MONITORING

The NO_x monitor underwent monthly calibration on May 26th and had 100% uptime.

3.1.2 SO₂ MONITORING

The SO₂ monitor underwent monthly calibration on May 26th and had 100% uptime.

3.1.3 PM MONITORING

All BAM monitors underwent monthly calibration on May 26th, 2017. The TSP and PM_{2.5} analyzers recorded instrument errors on May 20th and 21st, resulting in 98.8% uptime. The PM₁₀ analyzer also experienced 15 hours of instrument error on the same days, resulting in 98% uptime.

3.1.4 METEOROLOGICAL MONITORING

The precipitation sensor had 100% uptime. The other meteorological instruments underwent 2 hours of maintenance work, resulting in 99.7% uptime for the month of May.

3.2 MONITORING RESULTS AND TRENDS

The following wind rose (Figure 3-3) illustrates the frequency of wind speed by wind direction for the month of May 2017. Table 3-2 summarizes the hourly and daily concentrations recorded in May 2017. Figure 3-4 graphically illustrates the time series for hourly concentrations as well as wind speed and

direction, while Figure 3-5 shows daily average concentrations recorded during May 2017 for the pollutants listed in Table 3-2.

Since flooding in 2013, the Municipal District has built up stockpiles of dirt on the far western edge of the wastewater treatment facility. During the summer of 2016, the Municipal District has planted grass seed on these stockpiles in an effort to reduce the amount of fugitive dust generated. Figure 3-2 shows the extent of the grass planted by the MD.



Figure 3-2 Grass planted on the stockpiles near the Lagoon monitor. Photo taken July 12, 2016.

The wind rose (Figure 3-3) indicates that the winds predominantly came from the west. The wind rose for May 2017 follows the general orientation of the valley. As typical of the wind characteristics at the Lagoon site, the westerly winds were much more intense than the easterly winds.

Table 3-2 Summary of May 2017 data at Lagoon

Parameter	Objectives		Station	Exceedances		Monthly Average	1-hour					24-hour		Operational Time (Percent)
	1-hr	24-hr		1-hr	24-hr		Day	Hour	Wind Speed (km/hr)	Wind Direction (degrees)	Maximum Concentration/Meteorological Variable	Day		
NO ₂ (ppb)	159	-	Lagoon	0	-	2.7	18.4	20	0	3.7	56.7	4.7	11	100.0
SO ₂ (ppb)	172	48	Lagoon	0	0	0.6	7.9	14	11	23.0	266.1	1.3	4	100.0
PM _{2.5} (µg/m ³)	-	30	Lagoon	-	0	1.8	22.4	12	1	9.3	73.0	5.6	28	98.8
PM ₁₀ (µg/m ³)	-	-	Lagoon	-	-	20.2	311.4	4	12	34.1	257.1	54.2	4	98.0
TSP (µg/m ³)	-	100	Lagoon	-	0	26.4	484.8	4	12	34.1	257.1	77.8	4	98.8
Temperature (°C)	-	-	Lagoon	-	-	11.1	26.3	30	16	15.3	66.6	17.7	30	99.7
Wind Speed/Direction	-	-	Lagoon	-	-	15.1	36.5/W	3	12	36.5	263.6	29.8/WSW	3	99.7
Precipitation (mm)	-	-	Lagoon	-	-	0.1	6.0					17.3	16	100.0

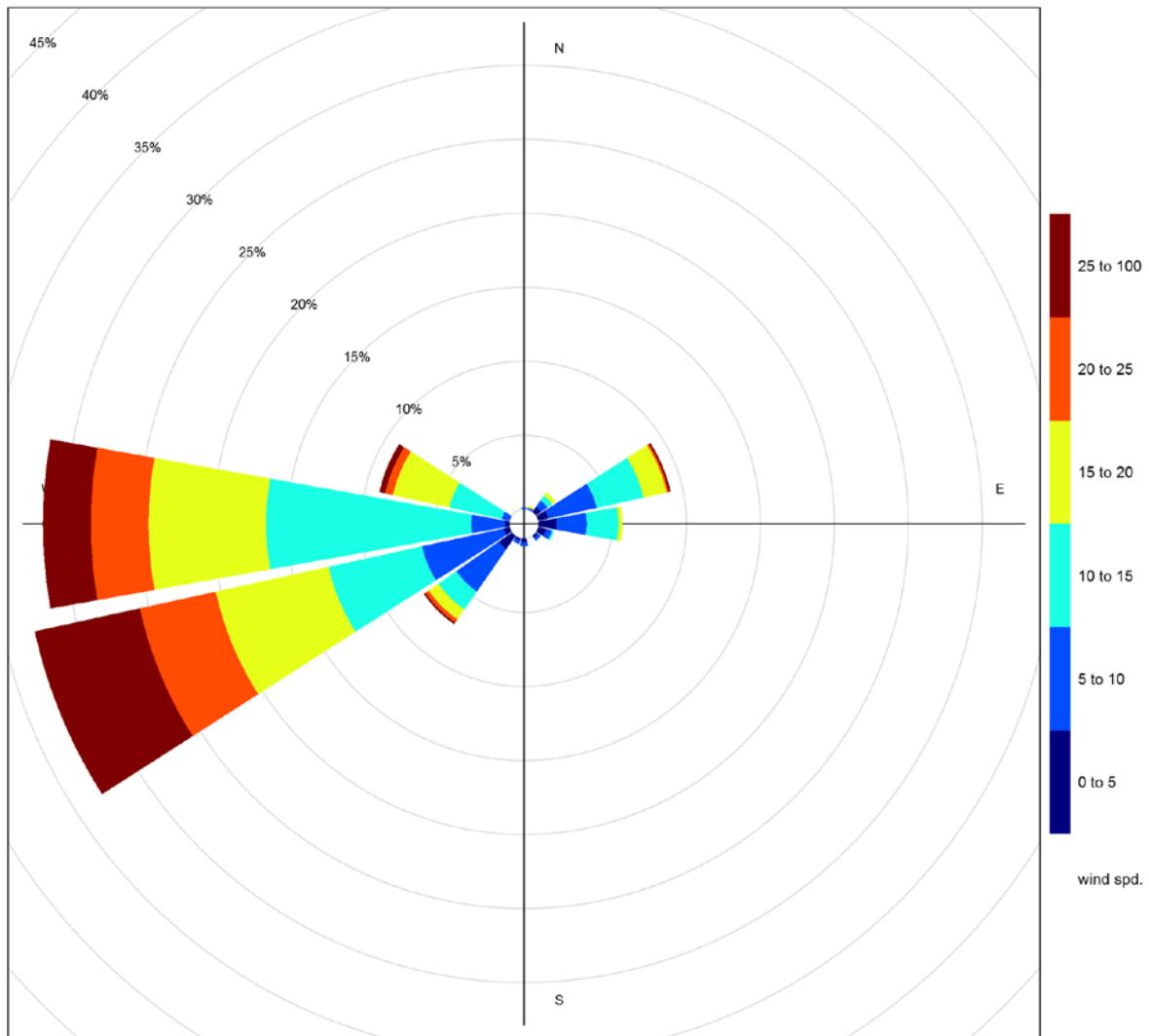


Figure 3-3 May 2017 wind rose from the Lagoon Station

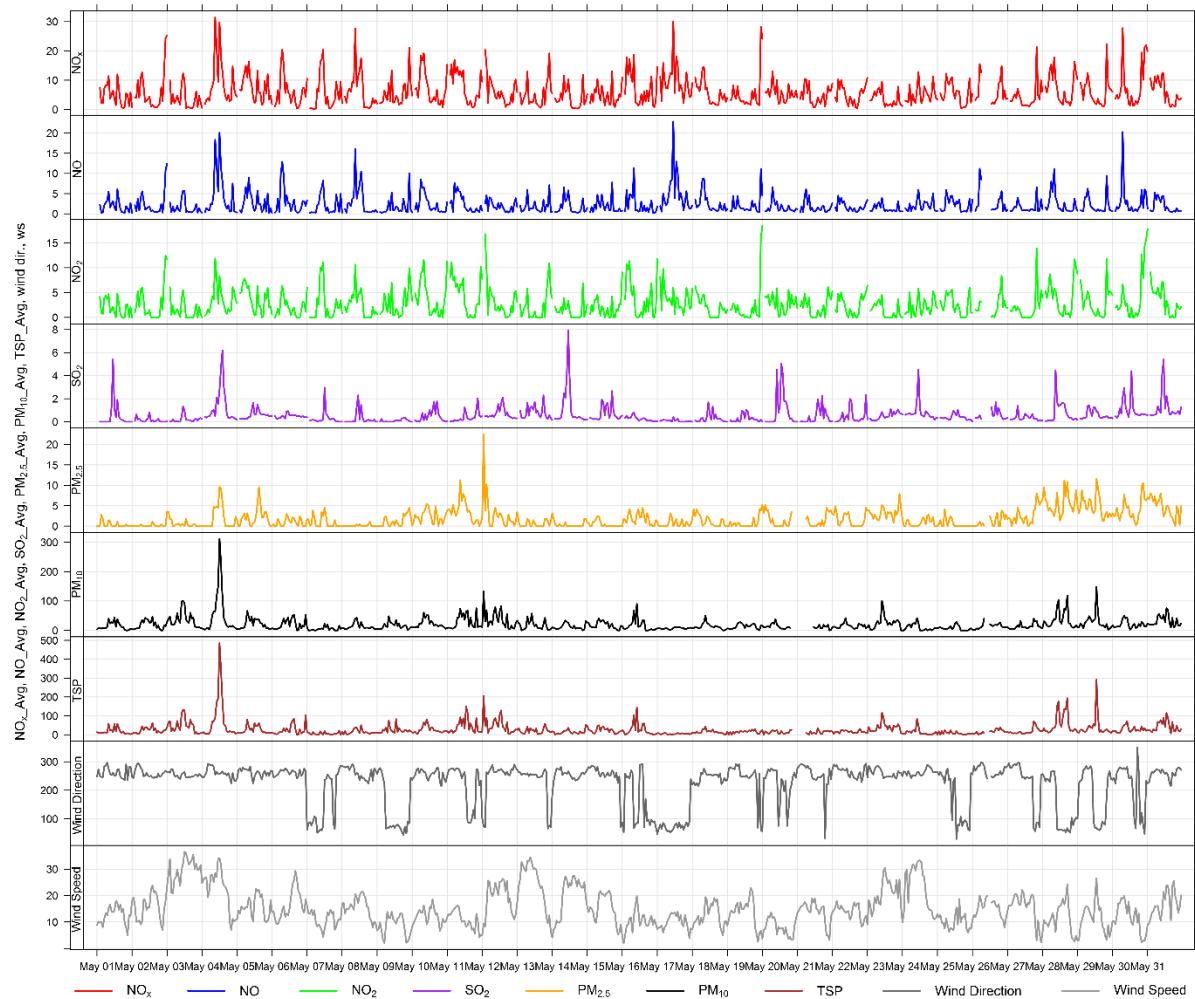


Figure 3-4 1-hour concentrations of NO_x, SO₂, particulate matter, wind direction and wind speed at the Lagoon monitor

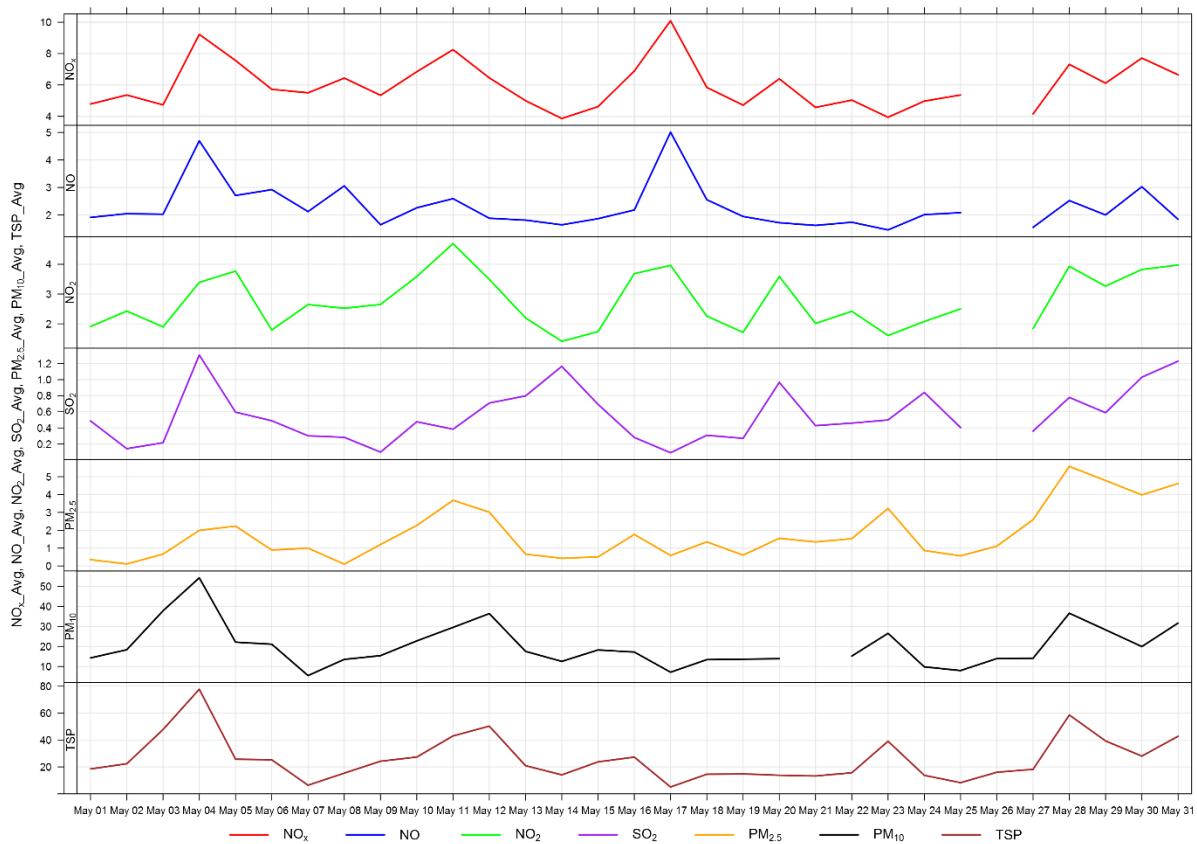


Figure 3-5 24-hour concentrations of NO_x, SO₂, and particulate matter at the Lagoon monitor

Figure 3-6 through Figure 3-8 show the variation in concentrations over various time averaging periods for PM, SO₂ and NO_x. The particulate matter plot in Figure 3-6 shows that PM₁₀ and TSP concentrations tended to rise through the morning before peaking mid-day and decreasing during the afternoon and evening. PM₁₀ and TSP are generally associated with dust from fugitive sources.

Figure 3-7 shows the variation of SO₂ over various time periods. SO₂ concentrations were extremely low in May. Figure 3-8 shows the variation of NO_x, NO and NO₂, with the peak of all three pollutants occurring in the morning between 6 am and noon. This may be indicative of a peak in traffic.

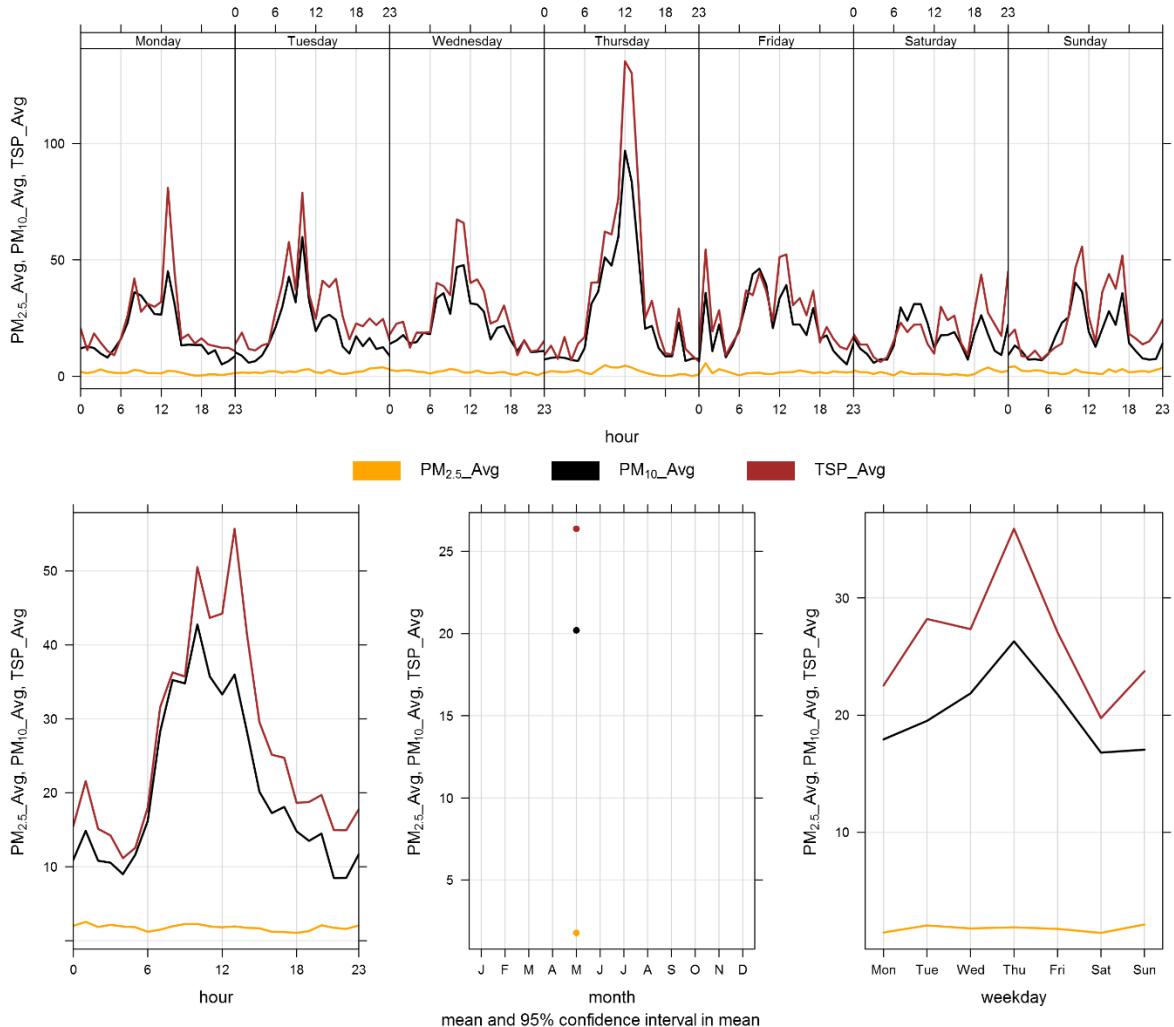


Figure 3-6 Lagoon Monitor particulate matter time variation

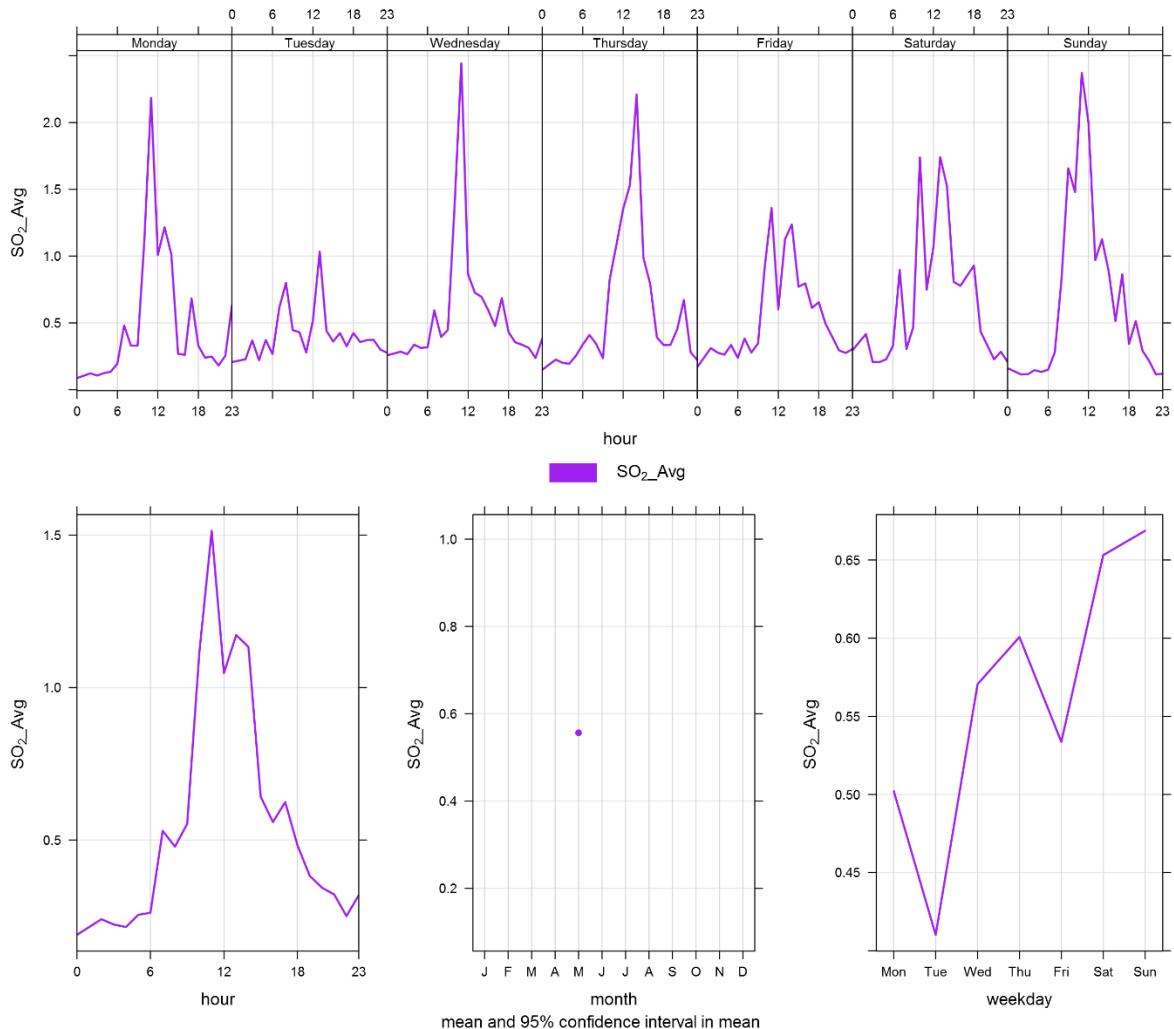


Figure 3-7 Lagoon Monitor SO_2 time variation

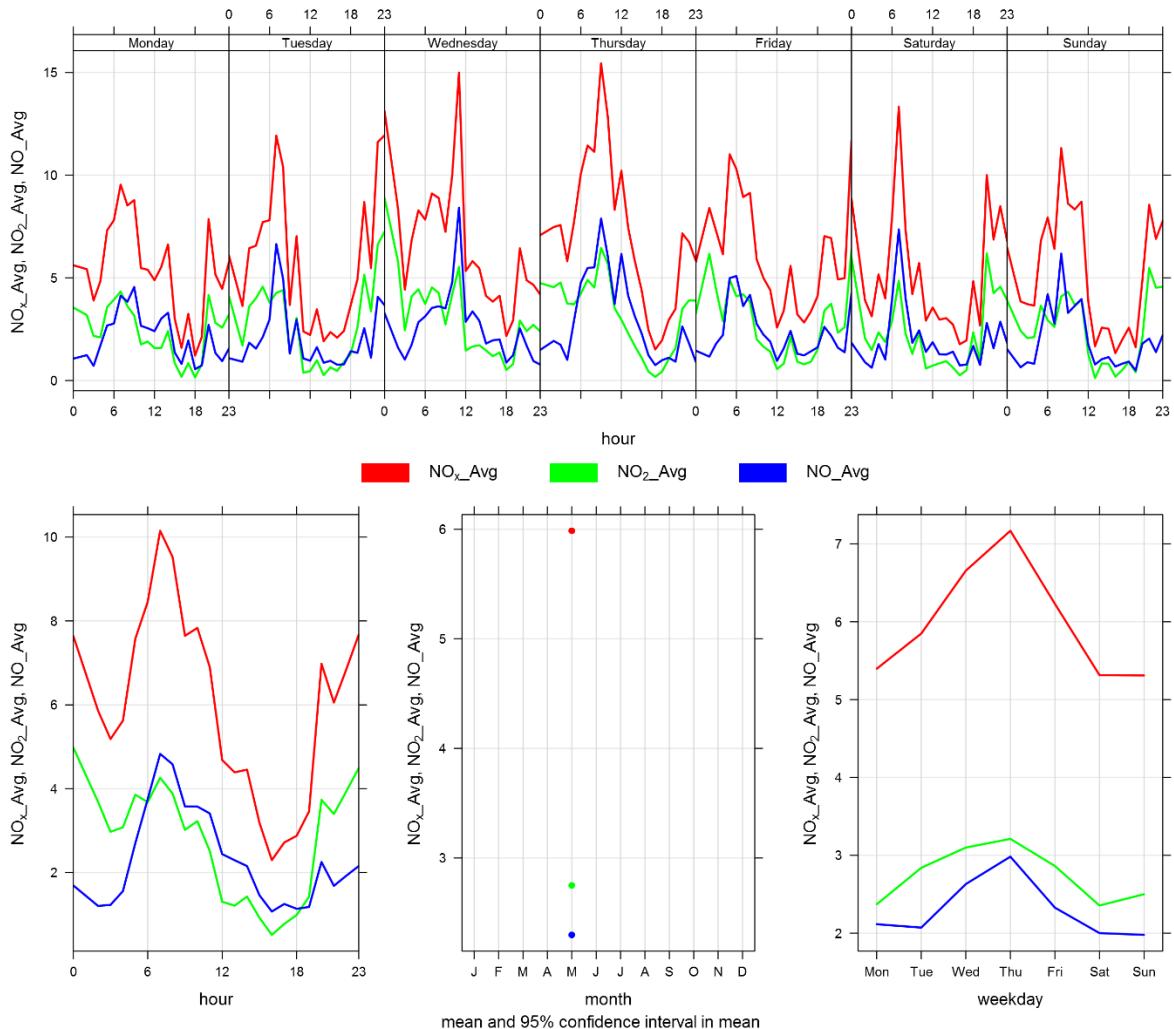


Figure 3-8 Lagoon Monitor NO_x time variation

4 WEST GRIMM

4.1 SITE VISIT NOTES

Table 4-1 indicates the equipment that is installed at the West monitoring location. During the month of May, the West GRIMM had over 96% uptime.

Table 4-1 Equipment at the West monitoring location

Equipment Description	Parameter Measured
GRIMM 365 Continuous Particulate Monitor	PM _{2.5} , PM ₁₀ , TSP Concentrations

4.2 MONITORING RESULTS AND TRENDS

The West GRIMM was installed in its current location in order to monitor “background” PM concentrations since the predominant wind pattern is from west to east in the valley. As indicated in Figure 3-3, the majority of winds came from the west during May. Table 4-2 summarizes the maximum 1-hour and 24-hour concentrations recorded over the course of the month.

Figure 4-1 and Figure 4-2 show the hourly and daily PM_{2.5}, PM₁₀ and TSP concentrations recorded over the month. There were no recorded exceedances of the 24-hour PM_{2.5} (30 µg/m³) or 24-hour TSP Guidelines (100 µg/m³).

Table 4-2 Summary of May 2017 data at the West GRIMM

Parameter	Guideline		Station	Exceedances		Monthly Average	Maximum 1-hour					Maximum 24-hour		Operational Time (Percent)
	1-hr	24-hr		1-hr	24-hr		Maximum Concentration	Day	Hour	Wind Speed (km/hr)	Wind Direction (degrees)	Maximum Concentration	Day	
PM _{2.5} ($\mu\text{g}/\text{m}^3$)	-	30	West	-	0	3.9	18.2	1	12	14.4	249.9	8.1	31	96.5
PM ₁₀ ($\mu\text{g}/\text{m}^3$)	-	-	West	-	-	10.8	119.0	1	12	14.4	249.9	24.5	11	96.5
TSP ($\mu\text{g}/\text{m}^3$)	-	100	West	-	0	23.6	219.4	1	12	14.4	249.9	50.1	31	96.5

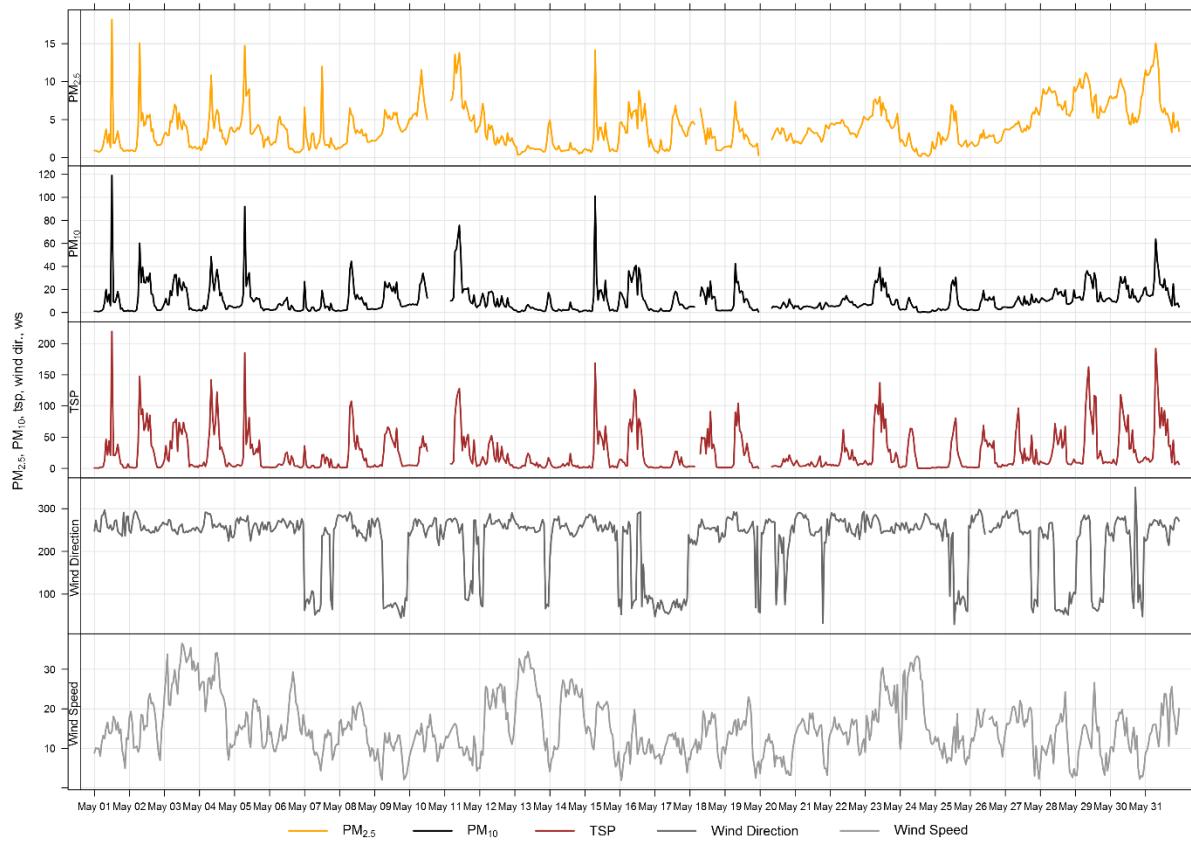


Figure 4-1 1-hour particulate matter concentrations at the West monitor

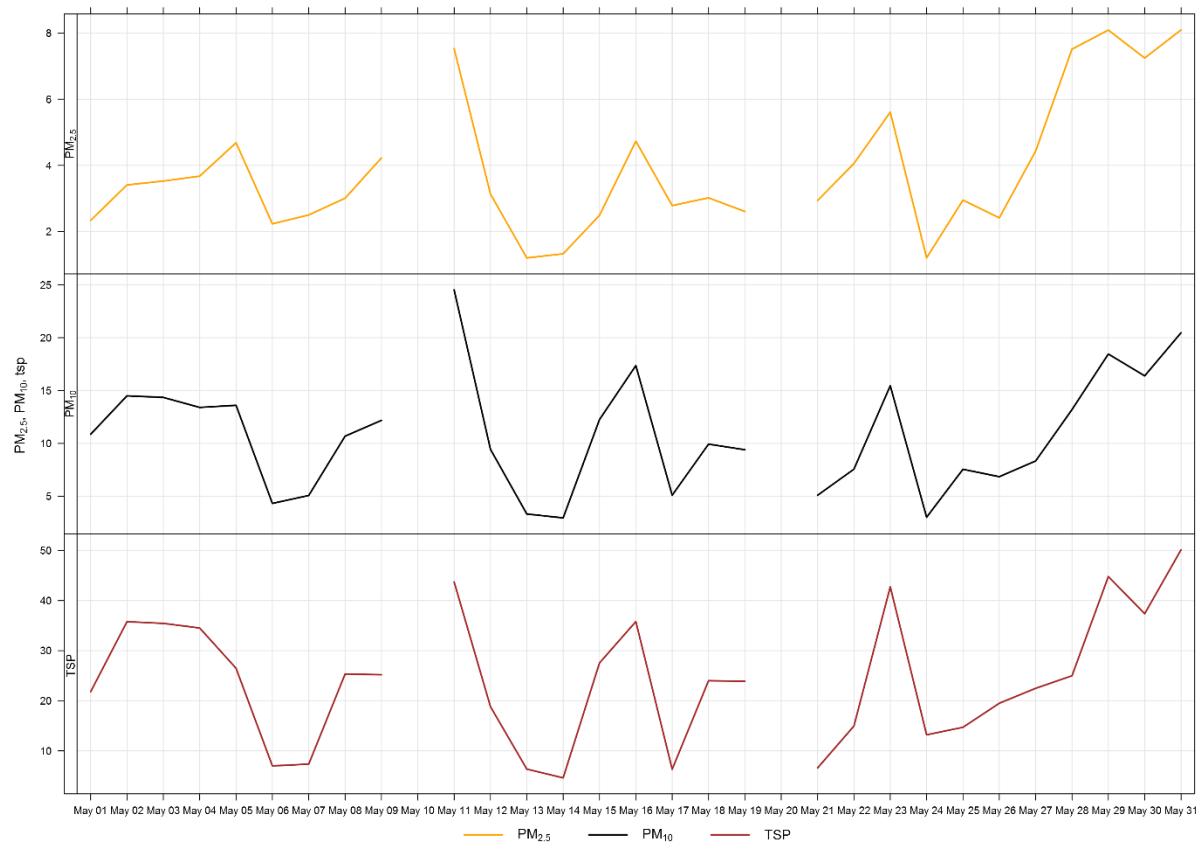


Figure 4-2 24-hour particulate matter concentrations at the West monitor

Figure 4-3 illustrates the hourly PM concentrations recorded at the West monitor, averaged over different time periods. The plot across the top shows the variation of PM over the course of a week, while the bottom three plots show the changes in PM over the course of a day, month and weekday, respectively. Figure 4-3 is based on data collected during May 2017 and indicates a strong relationship between TSP and hours which Lafarge is typically operational. Due to the proximity of the West monitor to the highway, the daily variations in PM may also be a result of higher traffic volume during daylight hours.

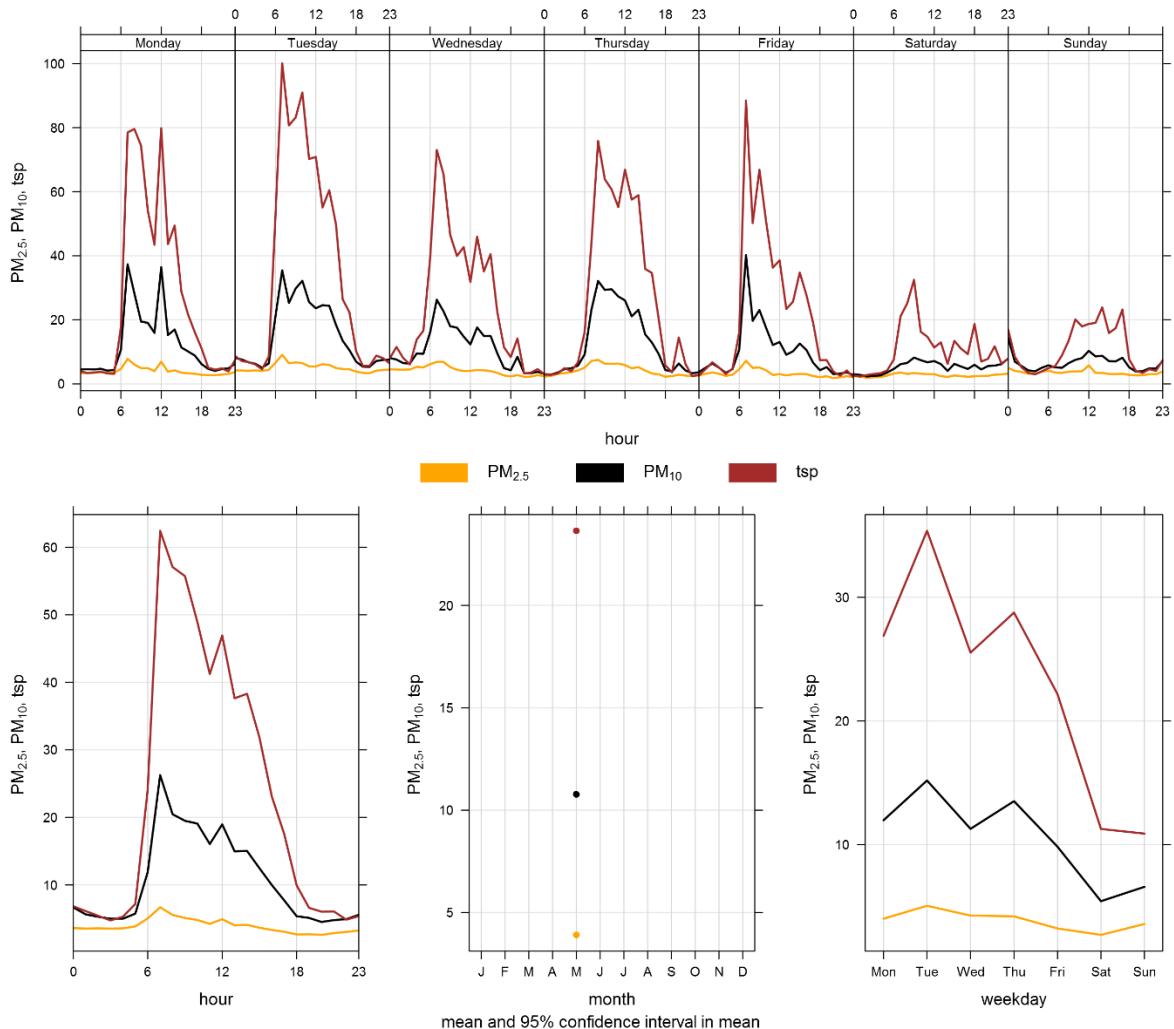


Figure 4-3 West particulate matter time variation

5 BERM GRIMM

5.1 SITE VISIT NOTES

This station was found to be in good operating condition and no repairs were required during the month. During the month of May, the Berm GRIMM had 99.9% uptime.

Table 5-1 Equipment at the Berm monitoring location

Equipment Description	Parameter Measured
GRIMM 365 Continuous Particulate Monitor	PM _{2.5} , PM ₁₀ , TSP Concentrations

5.2 MONITORING RESULTS AND TRENDS

The Berm monitor was placed at its current location as a result of the dispersion modelling conducted for the facility in 2009. Table 5-2 summarizes the maximum 1-hour and 24-hour PM concentrations recorded during the month. The monitor had 99.9% uptime during the month of May due to one hour not being recorded in the GRIMM database on May 18th.

Figure 5-1 and Figure 5-2 show the hourly and daily PM_{2.5}, PM₁₀ and TSP concentrations recorded over the month. Table 5-3 summarizes the recorded exceedances.

During May, there were 10 exceedances of the 24-hour TSP Guideline (100 µg/m³). Historically, the Berm monitor records an average of 8 and 0 exceedances of the 24-hour TSP and PM_{2.5} Guidelines respectively, during the month of May. The largest number of TSP exceedances recorded during May occurred in 2010 and 2012, which had 16 days that exceeded the Guideline. The fewest number of TSP exceedances was recorded during May 2014, which had 2 days that exceeded the Guideline.

It should also be noted that the GRIMM monitors become more conservative in the reported PM concentrations as the size fraction increases. The PM_{2.5} size fraction has been shown to match other regulatory approved PM_{2.5} monitors, but the TSP concentrations recorded by the GRIMM tend to be higher than regulatory approved monitors (Levelton, 2015).

The Berm monitor is located along a ridge at the edge of the Lafarge property and is in an area where on-site trucks drive through site, which can create fugitive dust. Quarry blasting also has the potential to impact short term PM immediately following a blast. High TSP concentrations in the month generally corresponded to the high wind speed events recorded in May.

Table 5-2 Summary of May 2017 data at the Berm GRIMM

Parameter	Guideline		Station	Exceedances		Monthly Average	Maximum 1-hour					Maximum 24-hour		Operational Time (Percent)
	1-hr	24-hr		1-hr	24-hr		Maximum Concentration	Day	Hour	Wind Speed (km/hr)	Wind Direction (degrees)	Maximum Concentration	Day	
PM _{2.5} ($\mu\text{g}/\text{m}^3$)	-	30	Berm	-	0	4.9	65.4	10	14	18.6	260.8	11.5	23	99.9
PM ₁₀ ($\mu\text{g}/\text{m}^3$)	-	-	Berm	-	-	28.2	366.4	10	14	18.6	260.8	74.4	23	99.9
TSP ($\mu\text{g}/\text{m}^3$)	-	100	Berm	-	10	86.7	1061.5	10	14	18.6	260.8	301.3	3	99.9

Table 5-3 Days exceeding the Guideline for TSP at the Berm Monitor

Date	TSP (ug/m ³)	PM _{2.5} (ug/m ³)	Average Wind Direction	Average Wind Speed	Average RH	Root Cause (Provided by Lafarge)
Berm						
5/2/2017	124.3	-	255.7	15.6	40.0	
5/3/2017	301.3	-	253.5	29.8	38.5	high wind event
5/4/2017	245.9	-	262.2	22.7	41.7	high wind event
5/10/2017	132.8	-	257.4	12.2	51.7	
5/12/2017	198.7	-	267.8	19.0	51.6	
5/13/2017	133.2	-	256.3	24.5	41.4	high wind event
5/14/2017	142.0	-	253.0	19.8	39.5	
5/15/2017	147.7	-	262.5	15.3	38.6	
5/23/2017	231.5	-	258.2	20.6	36.0	high wind event
5/31/2017	119.8	-	259.4	16.5	44.9	
Total # of Exceedances	10	0				
Maximum # of Exceedances (May)	16 (2010, 2012)	0 (2010 ~ 2016)				
Average # of Exceedances (May)	8	0				
Minimum # of Exceedances (May)	2 (2014)	0 (2010 ~ 2016)				

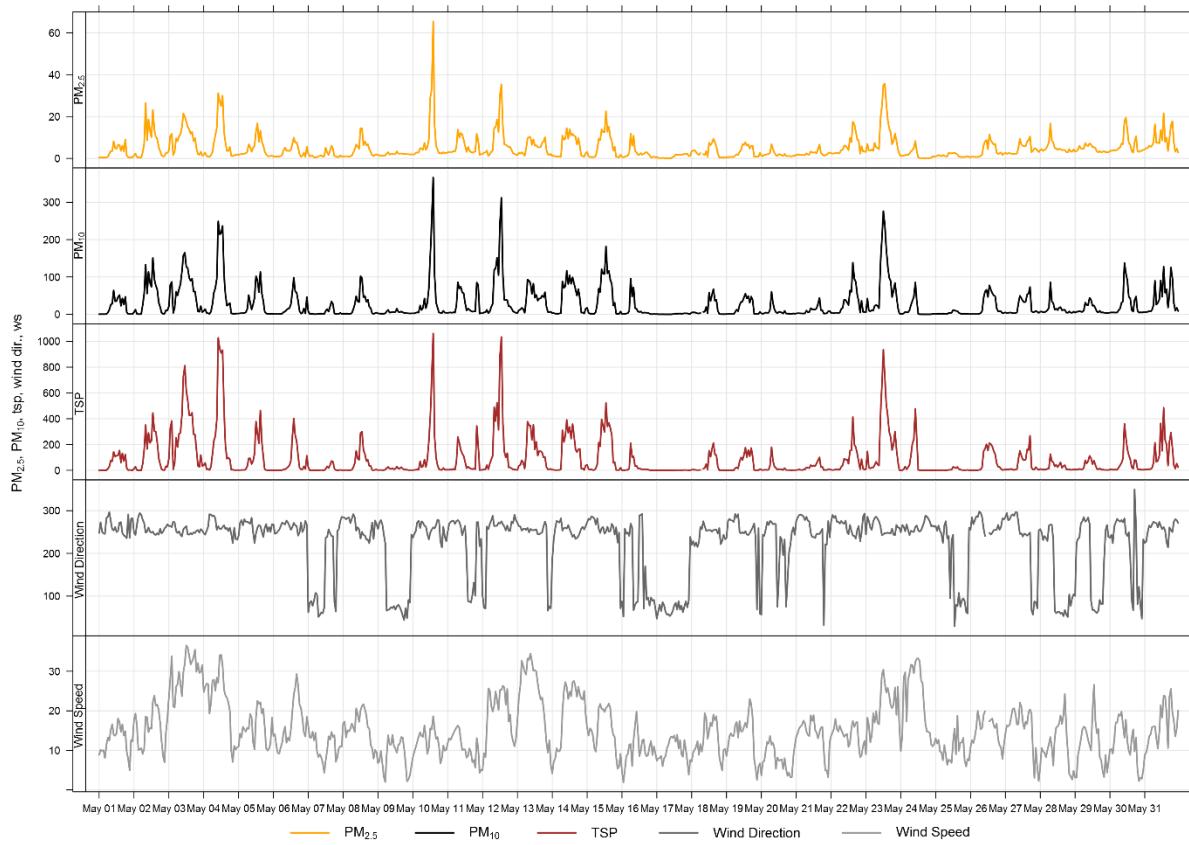


Figure 5-1 1-hour particulate matter concentrations recorded at the Berm monitor

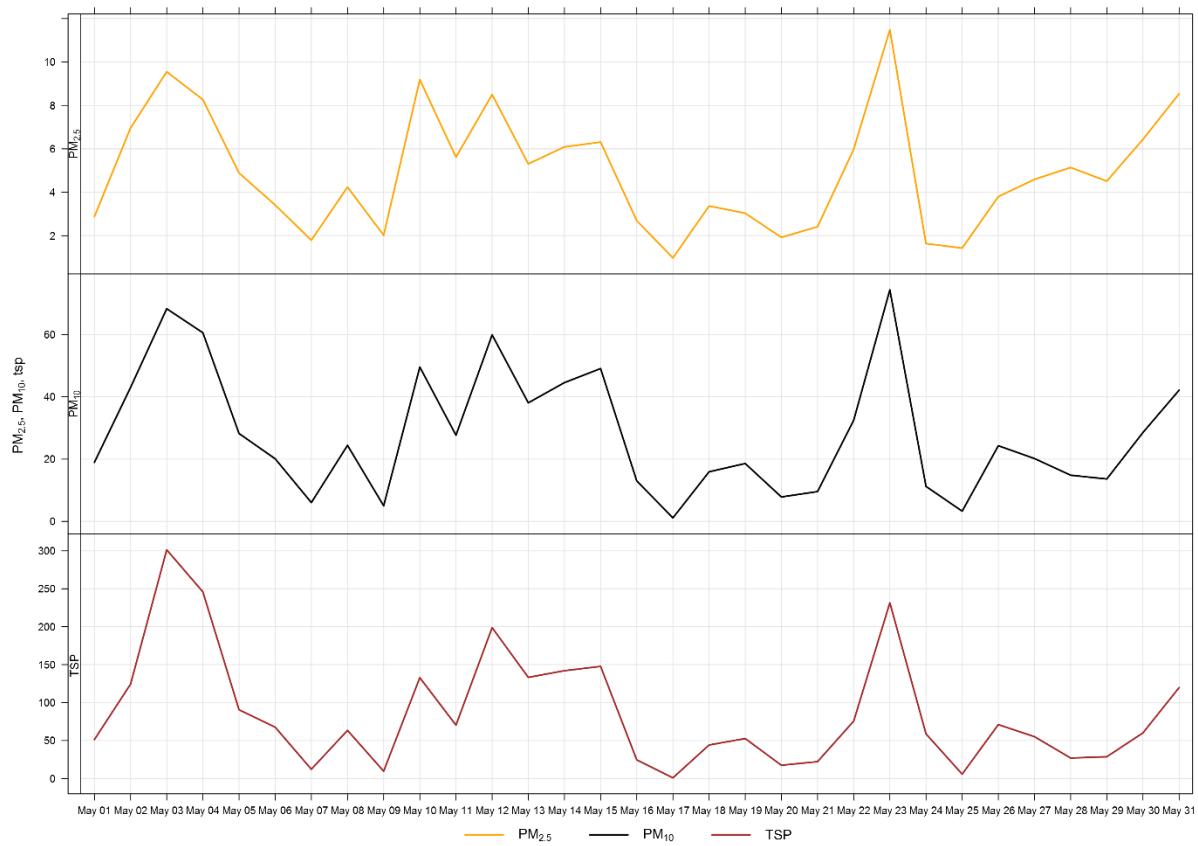


Figure 5-2 24-hour particulate matter concentrations recorded at the Berm monitor

Figure 5-3 shows the wind rose for the 10 days which recorded a TSP exceedance. This wind rose shows that the winds predominantly come from the west and over 25 km/hr.

Figure 5-4 shows the variation of PM recorded at the Berm monitor over various time averaging periods. Similar to the Entrance monitor, the Berm, on average, records elevated PM concentrations during standard operating hours of Lafarge.

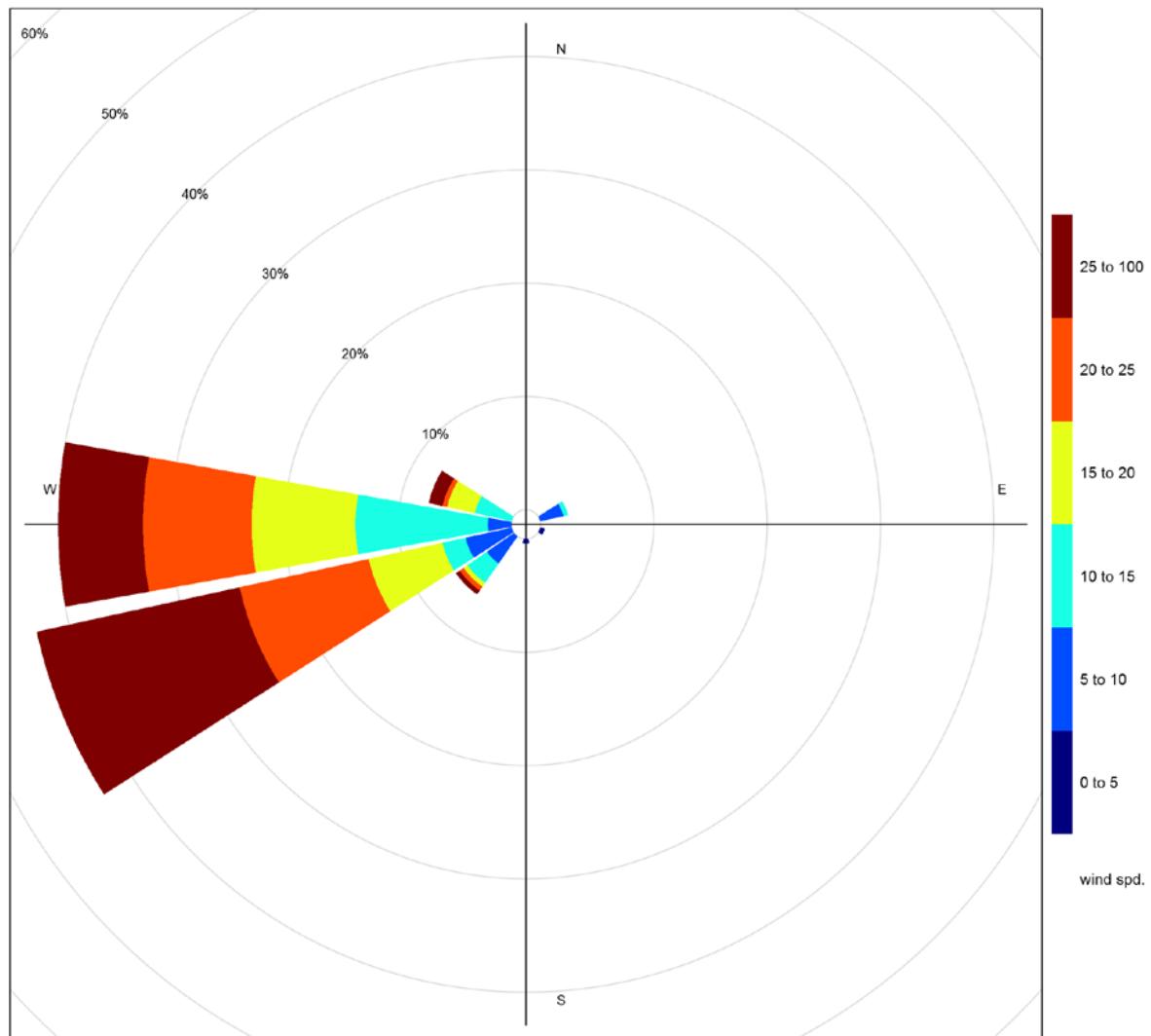


Figure 5-3 Wind rose for TSP exceedance days recorded at the Berm GRIMM

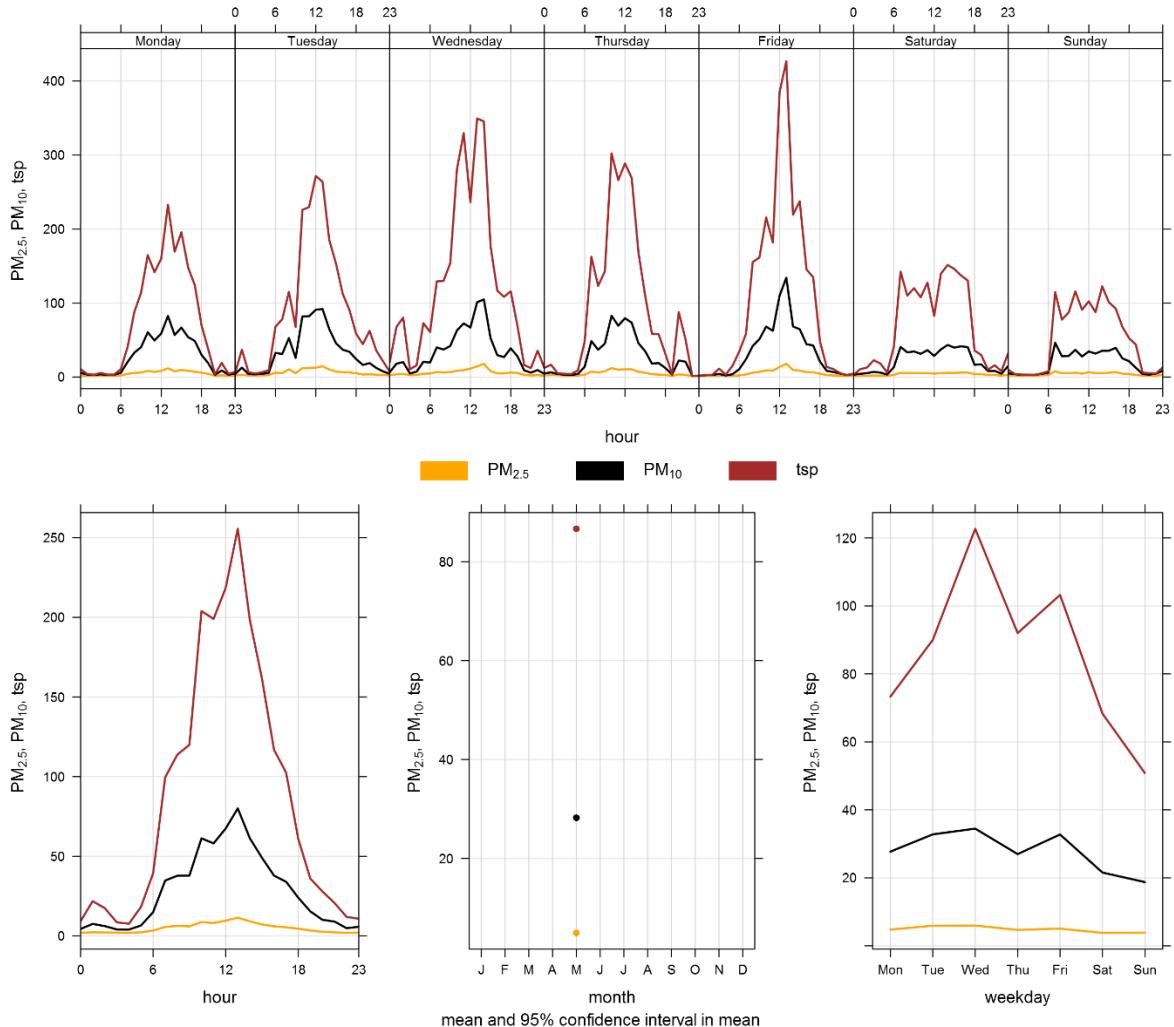


Figure 5-4 Berm particulate matter time variation

6 ENTRANCE GRIMM

6.1 SITE VISIT NOTES

This station was found to be in good operating condition and no repairs were required during the month.

During the month of May, the Entrance GRIMM had 99.9% uptime.

Table 6-1 Equipment at the Entrance monitoring location

Equipment Description	Parameter Measured
GRIMM 365 Continuous Particulate Monitor	PM _{2.5} , PM ₁₀ , TSP Concentrations

6.2 MONITORING RESULTS AND TRENDS

The Entrance monitor was placed at its current location as a result of dispersion modelling conducted in 2009. This area was indicated as being the area where the maximum PM concentrations were expected. Table 6-2 summarizes the maximum 1-hour and 24-hour PM concentrations recorded during the month. The monitor had 99.9% uptime during the month of May due to regular maintenance work conducted on May 26th.

Figure 6-1 and Figure 6-2 show the hourly and daily PM_{2.5}, PM₁₀ and TSP concentrations recorded over the month. Table 6-3 summarizes the recorded exceedances.

During May, there were 7 exceedance of the 24-hour TSP Guideline (100 µg/m³), which is the fewest number of exceedances recorded in May since monitoring began at this location in 2010. Historically, the Entrance monitor records an average of 15 and 0 exceedances of the 24-hour TSP and PM_{2.5} Guidelines respectively, during the month of May. The largest number of TSP exceedances recorded during May occurred in 2014, which had 20 days that exceeded the Guideline. The previous fewest number of TSP exceedances recorded during May occurred in 2015 and 2016, which had 13 days that exceeded the Guideline.

It should also be noted that the GRIMM monitors become more conservative in the reported PM concentrations as the size fraction increases. The PM_{2.5} size fraction has been shown to match other regulatory approved PM_{2.5} monitors, but the TSP concentrations recorded by the GRIMM tend to be higher than regulatory approved monitors (Levelton, 2015).

The Entrance monitor is impacted by fugitive dust from plant activities, and the high wind events described under the Berm monitor section. Trucks also queue nearby the Entrance monitor while waiting to be loaded with material. Additionally, the monitor is closely located to Highway 1A. Traffic, particularly large trucks, can create dust while crossing over the railway tracks. This can all lead to the monitor recording high TSP concentrations, which are typically associated with fugitive dust sources.

Figure 6-3 shows the wind rose for the days which exceeded the TSP Guideline at the Entrance GRIMM. During the exceedance day, winds were predominantly from the west and above 20 km/hr.

Table 6-2 Summary of May 2017 data at the Entrance GRIMM

Parameter	Guideline		Station	Exceedances		Monthly Average	Maximum 1-hour					Maximum 24-hour		Operational Time (Percent)
	1-hr	24-hr		1-hr	24-hr		Maximum Concentration	Day	Hour	Wind Speed (km/hr)	Wind Direction (degrees)	Maximum Concentration	Day	
PM _{2.5} ($\mu\text{g}/\text{m}^3$)	-	30	Entrance	-	0	7.4	34.3	30	9	16.5	272.8	16.4	31	99.9
PM ₁₀ ($\mu\text{g}/\text{m}^3$)	-	-	Entrance	-	-	35.3	193.3	23	12	30.4	244.5	79.7	23	99.9
TSP ($\mu\text{g}/\text{m}^3$)	-	100	Entrance	-	7	78.7	627.8	23	7	19.9	285.8	224.4	23	99.9

Table 6-3 Days exceeding the Guideline for TSP at the Entrance Monitor

Date	TSP (ug/m ³)	PM _{2.5} (ug/m ³)	Average Wind Direction	Average Wind Speed	Average RH	Root Cause (Provided by Lafarge)
Entrance						
5/2/2017	101.1	-	255.7	15.6	40.0	
5/3/2017	139.9	-	253.5	29.8	38.5	high wind event
5/4/2017	126.2	-	262.2	22.7	41.7	high wind event
5/10/2017	103.1	-	257.4	12.2	51.7	
5/11/2017	113.5	-	260.9	10.9	48.4	
5/23/2017	224.4	-	258.2	20.6	36.0	high wind event
5/31/2017	127.8	-	259.4	16.5	44.9	
Total # of Exceedances	7	0				
Maximum # of Exceedances (May)	20 (2014)	1 (2011, 2014, 2016)				
Average # of Exceedances (May)	15	0				
Minimum # of Exceedances (May)	13 (2015, 2016)	0 (2010, 2012, 2013, 2015)				

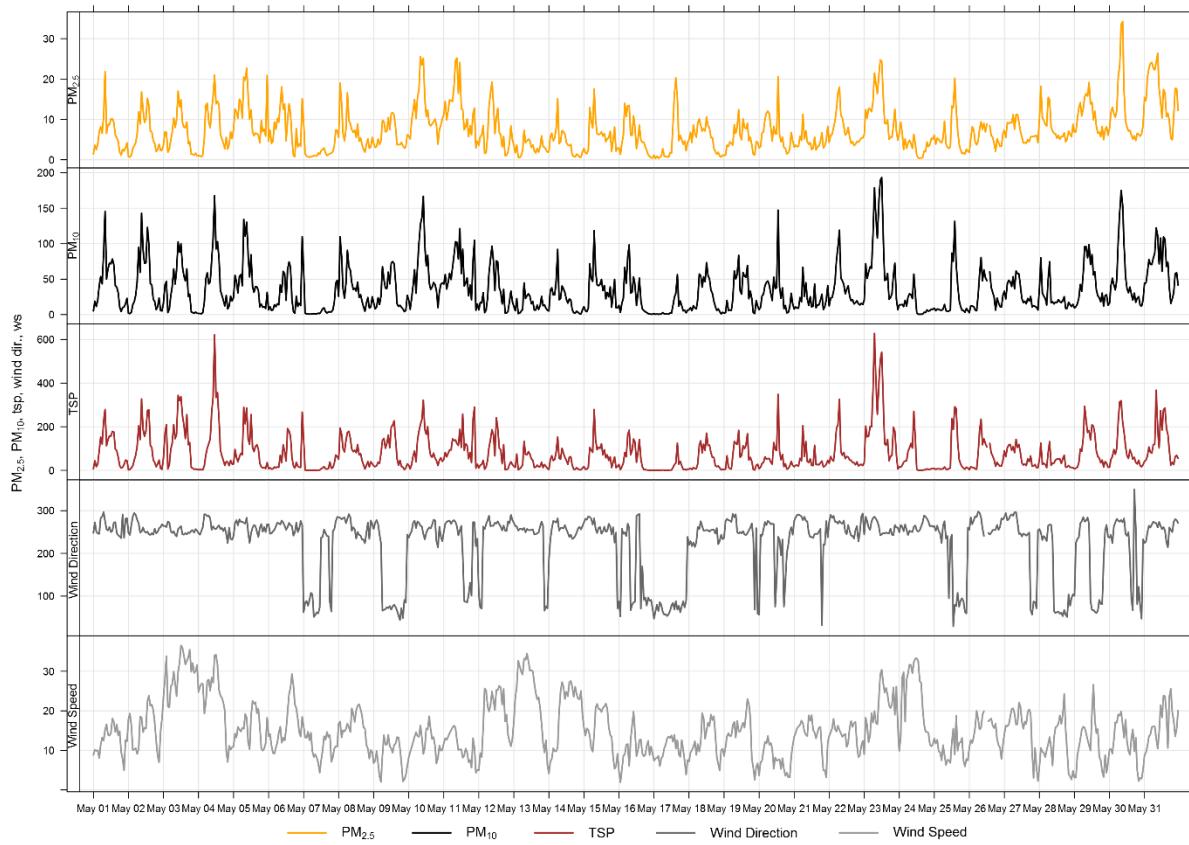


Figure 6-1 1-hour particulate matter concentrations recorded at the Entrance monitor

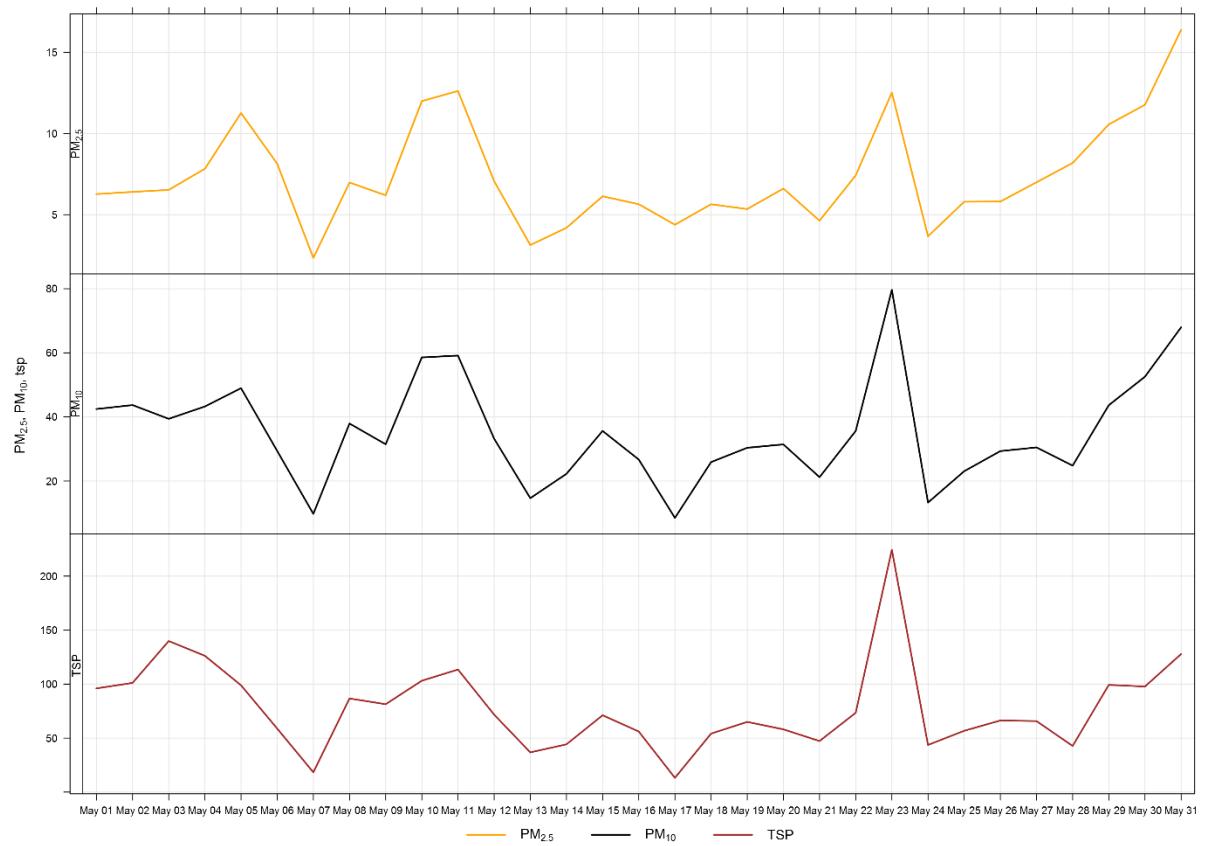


Figure 6-2 24-hour particulate matter concentrations at the Entrance monitor

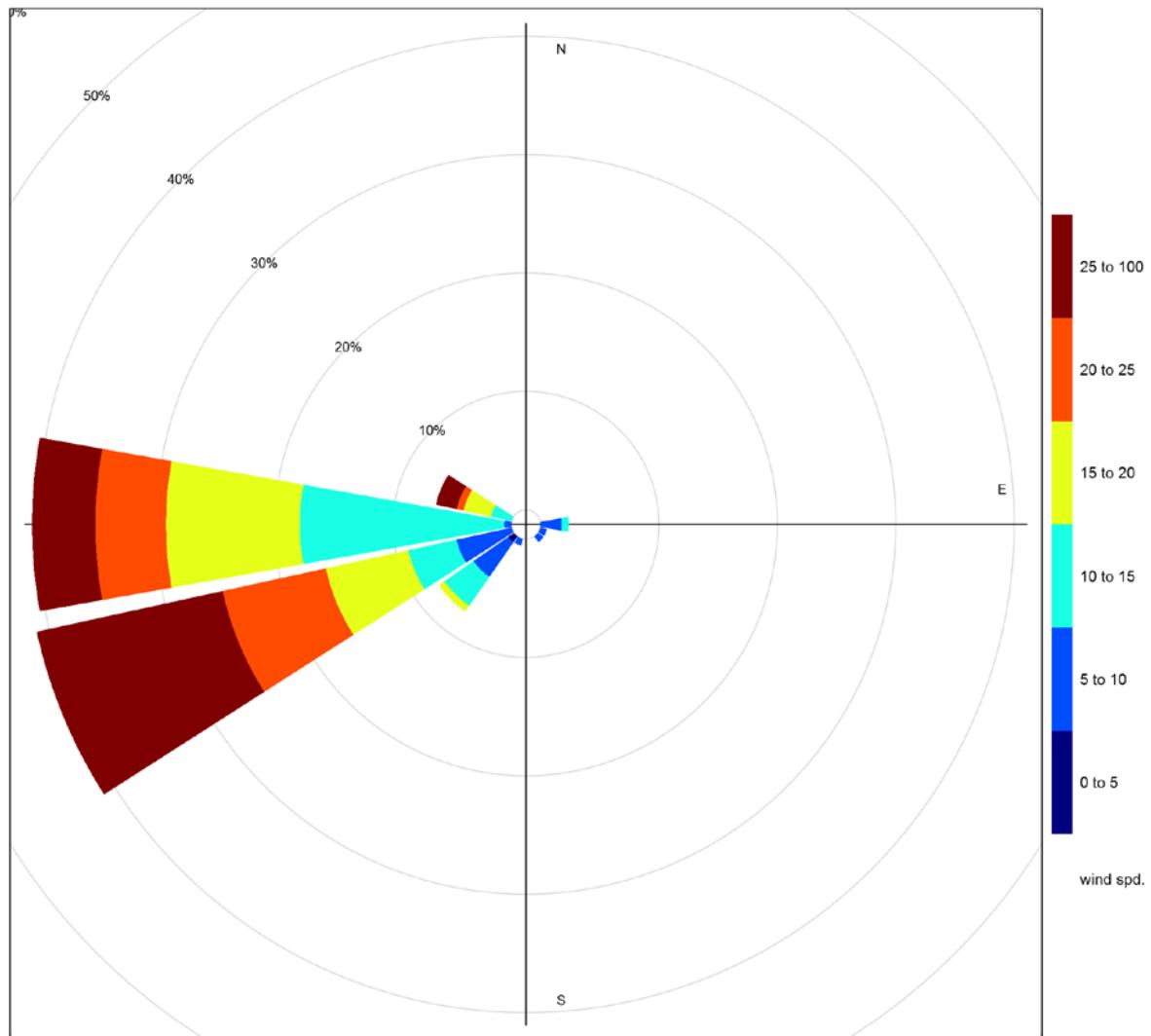


Figure 6-3 Wind rose for TSP exceedance days recorded at the Entrance GRIMM

Figure 6-4 illustrates the hourly PM concentrations recorded at the Entrance monitor, averaged over different time periods. The plot across the top shows the variation of PM over the course of a week, while the bottom three plots show the changes in PM over the course of a day, month and weekday, respectively. Figure 6-4 is based on data collected during May 2017 and indicates a strong weekday (Monday – Friday) diurnal pattern that is typical at this station.

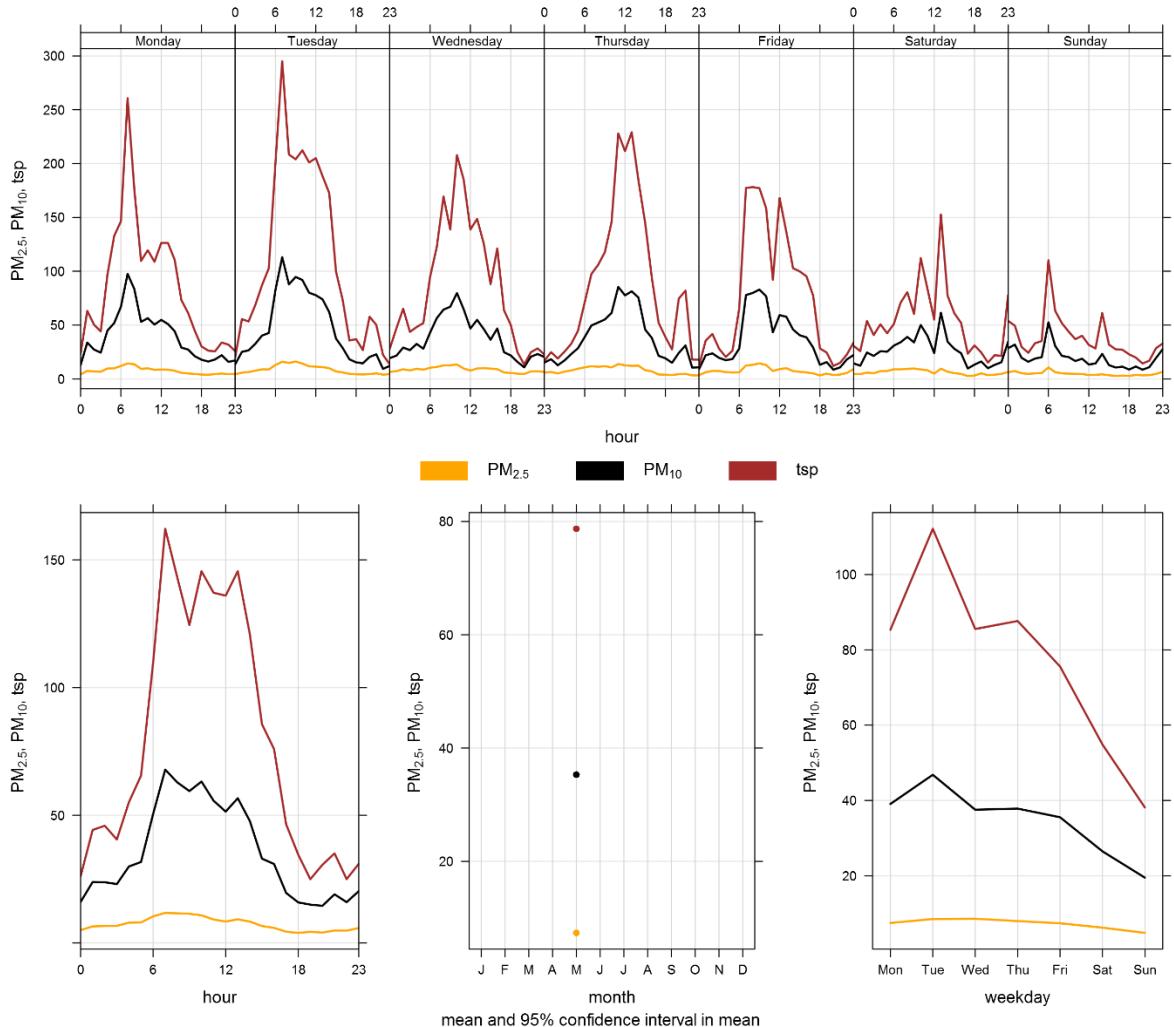


Figure 6-4 Entrance particulate matter time variation

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- Carslaw, D.C. and K. Ropkins, (2012). Openair — an R package for air quality data analysis. Environmental Modelling & Software. Volume 27–28, 52–61.
- Levelton Consultants Ltd. (2015, June 15). Comparison of GRIMM and E-BAM Data. Alberta, Canada.

Appendix A

DATA & CALIBRATION REPORTS



AIR QUALITY MONITORING

MetOne BAM PM₁₀ Calibration

STATION: Lafarge
LOCATION: Exshaw - Lagoon
START TIME (MST): 10:00

OPERATOR: Lenin Flores
DATE: May 26, 2017
END TIME (MST): 12:00

MONITOR INFO / PARAMETER VALUES:

Make/Model	<u>MetOne BAM</u>	Audit Device Model	<u>Delta Cal</u>
Configuration	<u>PM2.5</u>	Audit Device S/N	<u>624</u>
Serial Number	<u>T19087</u>	Certification Date	<u>02-Dec-16</u>

AUDIT / CALIBRATION RESULTS:

	Ambient Temp. (° C)	Ambient Pres. (mmHg)	Leak Check (L/min)	Flow Rate (lpm)	Time settings (hh:mm)
As Found Data	Audit values (I)	13.3	649	0.00	16.7
	MEASURED (AF)	12.1	647	0.20	17.20
Adjusted Data	AF Difference (AF-I)	0.5	-2	0.20	0.50
	MEASURED (M)	13.3	649	0.20	16.70
	Adj Difference (M-I)	0.0	0	0.20	0.00
	LIMITS	± 4.0 °C	5 mm Hg	1.0 L/min	± 1.0 L/min
					±2 min

Sample Head Inspect/Cleaning: Cleaned.

Status of sampling tape: 1/2 roll left

Nozzle Inspection / cleanliness: Inspected and cleaned.

COMMENTS:

Performed self-test, all passed.



AIR QUALITY MONITORING

MetOne BAM PM₁₀ Calibration

STATION: Lafarge
LOCATION: Exshaw - Lagoon
START TIME (MST): 10:00

OPERATOR: Lenin Flores
DATE: May 26, 2017
END TIME (MST): 12:00

MONITOR INFO / PARAMETER VALUES:

Make/Model	MetOne BAM	Audit Device Model	Delta Cal
Configuration	PM10	Audit Device S/N	624
Serial Number	A3315	Certification Date	02-Dec-16

AUDIT / CALIBRATION RESULTS:

	Ambient Temp. (° C)	Ambient Pres. (mmHg)	Leak Check (L/min)	Flow Rate (lpm)	Time settings (hh:mm)
As Found Data	Audit values (I)	12.2	649	0.00	16.7
	MEASURED (AF)	11.3	648	0.20	17.04
Adjusted Data	AF Difference (AF-I)	0.5	-1	0.20	0.34
	MEASURED (M)	12.2	649	0.20	16.70
	Adj Difference (M-I)	0.0	0	0.20	0.00
	LIMITS	± 4.0 °C	5 mm Hg	1.0 L/min	± 1.0 L/min
					±2 min

Sample Head Inspect/Cleaning: Cleaned

Status of sampling tape: Full roll left

Nozzle Inspection / cleanliness: Inspected and cleaned

COMMENTS:

Performed self test, all passed.



MetOne BAM PM₁₀ Calibration

AIR QUALITY MONITORING

STATION: Lafarge
LOCATION: Exshaw - Lagoon
START TIME (MST): 10:00

OPERATOR: Lenin Flores
DATE: May 26, 2017
END TIME (MST): 12:00

MONITOR INFO / PARAMETER VALUES:

Make/Model	MetOne BAM	Audit Device Model	Delta Cal
Configuration	TSP	Audit Device S/N	624
Serial Number	A3589	Certification Date	02-Dec-16

AUDIT / CALIBRATION RESULTS:

	Ambient Temp. (° C)	Ambient Pres. (mmHg)	Leak Check (L/min)	Flow Rate (lpm)	Time settings (hh:mm)
As Found Data	Audit values (I)	11.7	649	0.00	16.7
	MEASURED (AF)	10.7	648	0.50	16.60
Adjusted Data	AF Difference (AF-I)	0.5	-1	0.50	-0.10
	MEASURED (M)	11.7	649	0.50	16.70
	Adj Difference (M-I)	0.0	0	0.50	0.00
	LIMITS	± 4.0 °C	5 mm Hg	1.0 L/min	± 1.0 L/min
					±2 min

Sample Head Inspect/Cleaning: Cleaned

Status of sampling tape: 1/2 roll left

Nozzle Inspection / cleanliness: Inspected and cleaned.

COMMENTS:

Performed self test, all passed.

Calibration Report



Parameter

NO_x-NO-NO₂

Air Monitoring Network

Lafarge - Exshaw

AIR QUALITY MONITORING

Station Information

Calibration Date	April 11, 2017		Previous Calibration	April 11, 2017
Station Number	N/A		Station Location	Exshaw - Lagoon
Reason:	Routine	Installation	Removal	Other:
Start Time (MST)	7:30		End Time (MST)	12:00
Barometric Pressure	651	mmHg	Station Temperature	23.0 Deg C
Calibrator	SABIO 2010		Serial Number	07201211
NO Cal Gas Conc	51.2	ppm	Cal Gas Expiry Date	July 26, 2019
NOx Cal Gas Conc	51.3	ppm	Cal Gas Serial #	EY667

DACS Information

DACS make	Campbell Scientific CR1000	DACS serial No.	67802
Parameter	NO2	NOx	NO
Before	0.992386	0.998137	1.001383
Data Offset	-0.495702	0.580012	0.214291
After	0.998796	1.000550	1.002375
Data Offset	-0.623434	0.323167	0.006392
Channel #	3	1	2
Voltage Range	0 - 5 VDC	0 - 5 VDC	0 - 5 VDC

Analyzer Information

Analyzer make/model	T200	Analyzer serial #	642	
Test Point	before		after	
Concentration range	0 - 500	ppb	0 - 500	ppb
NO Slope	0.991		0.999	
NO Offset	-3.1	mV	-3.1	mV
NOX Slope	0.993		1.002	
NOX Offset	-2.0	mV	-2.0	mV
HVPS	771	V	771	V
Moly Temp	315.9	degC	317.0	degC
O3 Flow	81	ccm	81	ccm
RxCell Press	5.3	inHg	5.6	inHg
Sample press	24.0	inHg	24.0	inHg
Sample flow	450	ccm	441	ccm

Notes: Span adjustment made.

Calibration Report



Parameter **NOx-NO-NO₂**
 Air Monitoring Network **Lafarge - Exshaw**

Station Information

Calibration Date: April 11, 2017 Station Location: Exshaw - Lagoon

Calibration Data

	Dilution flow rate (ccm)	Source gas flow rate (ccm)	Calculated NOx conc (ppb)	Calculated NO conc (ppb)	Calculated NO ₂ conc (ppb)	Indicated NOx conc (ppb)	Indicated NO conc (ppb)	Indicated NO ₂ conc (ppb)	NOx Correction factor	NO Correction factor
zero	5000	0.00	0.0	0.0	0.0	0.2	0.5	-1.1	N/A	N/A
1	5000	40.00	407.1	406.3	0.8	406.9	405.6	0.8	1.0006	1.0019
2	5000	25.00	255.2	254.7	0.5	254.6	254.0	0.1	1.0026	1.0027
3	7000	14.00	102.4	102.2	0.2	101.4	101.3	-0.7	1.0100	1.0085
AFZ	5000	0.00	0.0	0.0	0.0	0.2	0.5	-1.1	0.0000	0.0000
AFS	5000	40.00	407.1	406.3	0.8	400.8	400.5	-0.2	1.0157	1.0146
									Average Correction Factor	1.0044
										1.0044

As Found Concentrations: NO_x= 401.2 NO= 400.2 As Found Percent Change NO_x= -1.5% NO= -1.5%

GPT Calibration Data

Dilution Flow	5000		ccm	Source Gas Flow		40.00		ccm		
O ₃ Setpoint (V)	Indicated NO high point (ppb)	Indicated NO drop conc (ppb)	Calculated NO ₂ conc (ppb)	Indicated NOx conc (ppb)	Indicated NO conc (ppb)	Indicated NO ₂ conc (ppb)	NOx Correction factor	NO Correction factor	NO ₂ Correction factor	Converter Efficiency
0	0.5	0.5	0.0	0.2	0.5	-1.1	N/A	N/A	N/A	N/A
NO point	406.3	406.3	0.0	407.5	406.3	0.7	0.9969	1.0000	N/A	N/A
0.96	406.3	52.1	354.2	407.2	52.1	354.3	0.9978	1.0000	0.9998	100.0%
0.53	406.3	226.8	179.4	408.3	226.8	180.7	0.9950	1.0000	0.9932	100.7%
0.39V	406.3	287.6	118.7	410.1	287.6	121.7	0.9906	1.0000	0.9750	102.6%
							Average Correction Factor	0.9945	1.0000	0.9893
										101.1%

AIC Data

Parameter	Previous calibration				Current calibration			
	NOx	NO ₂	NO	ppb	NOx	NO ₂	NO	ppb
Auto zero	-0.5	1.5	0.0	ppb	1.0	-1.5	0.7	ppb
Auto span	393.8	0.0	392.6	ppb	379.1	0.2	378.1	ppb

Calibration Performed By: Lenin Flores

Calibration Summary



Parameter NO₂
Air Monitoring Network Lafarge - Exshaw

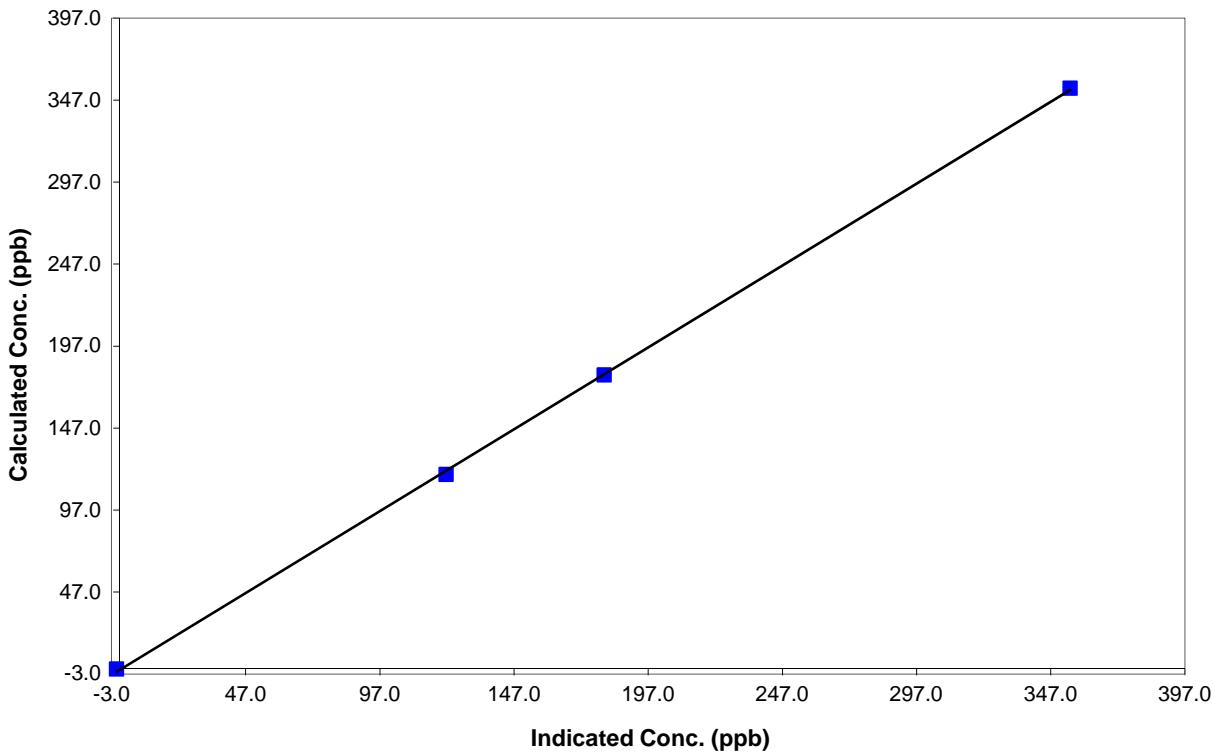
Station Information

Calibration Date	April 11, 2017	Previous Calibration	April 11, 2017
Station Number	N/A	Station Location	Exshaw - Lagoon
Start Time (MST)	7:30	End Time (MST)	12:00
Analyzer make	T200	Analyzer serial #	642

Calibration Data

Calculated conc (ppb) (Cc)	Indicated concentration (ppb) (Ic)	Correction factor (Cc/Ic)	Statistical Evaluation	
0.0	-1.1	N/A		
354.2	354.3	0.9998	Correlation Coefficient	0.999861
179.4	180.7	0.9932	Slope	0.998796
118.7	121.7	0.9750	Intercept	-0.623434

NO₂ Calibration Curve



Calibration Summary



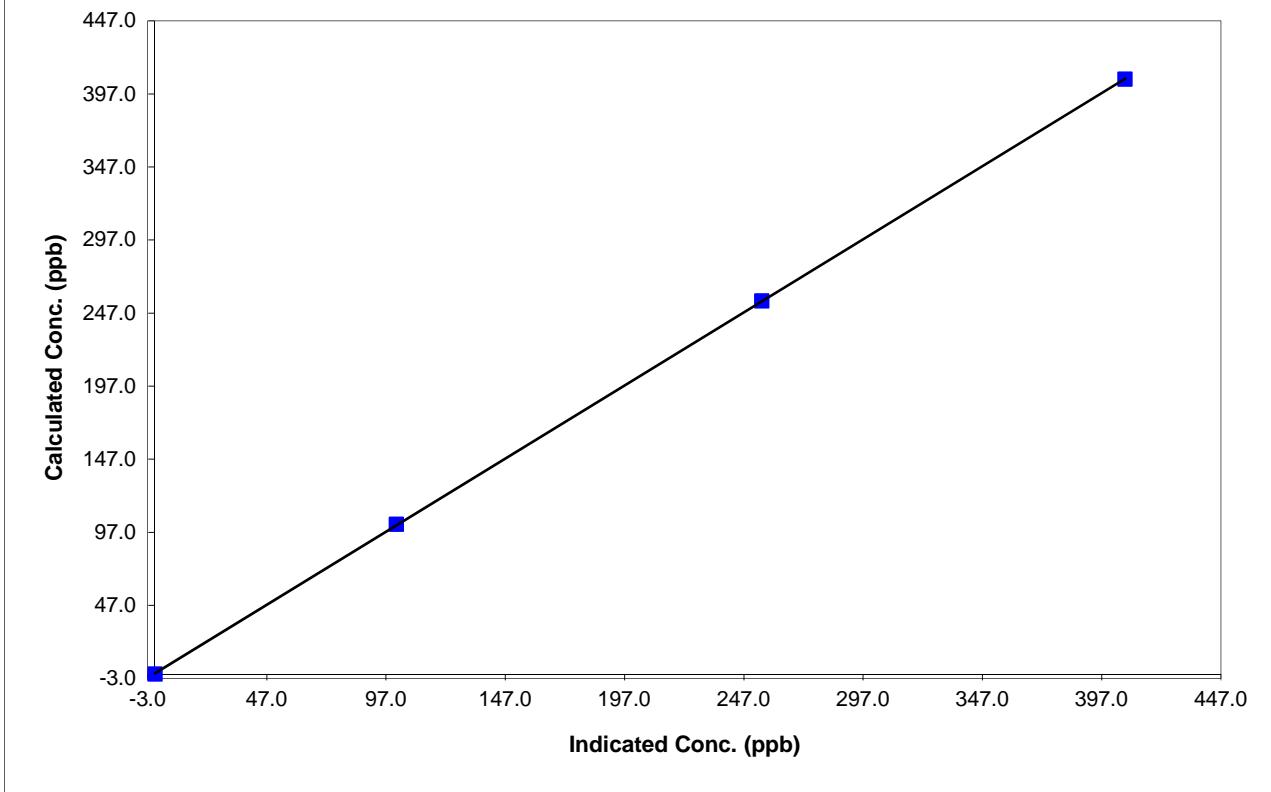
Parameter **NO_x**
 Air Monitoring Network **Lafarge - Exshaw**

Station Information			
Calibration Date	April 11, 2017	Previous Calibration	April 11, 2017
Station Number	N/A	Station Location	Exshaw - Lagoon
Start Time (MST)	7:30	End Time (MST)	12:00
Analyzer make	T200	Analyzer serial #	642

Calibration Data

Calculated conc (ppb) (Cc)	Indicated concentration (ppb) (Ic)	Correction factor (Cc/Ic)	Statistical Evaluation	
0.0	0.2	N/A		
407.1	406.9	1.0006	Correlation Coefficient	0.999991
255.2	254.6	1.0026	Slope	1.000550
102.4	101.4	1.0100	Intercept	0.323167

NOx Calibration Curve



Calibration Summary



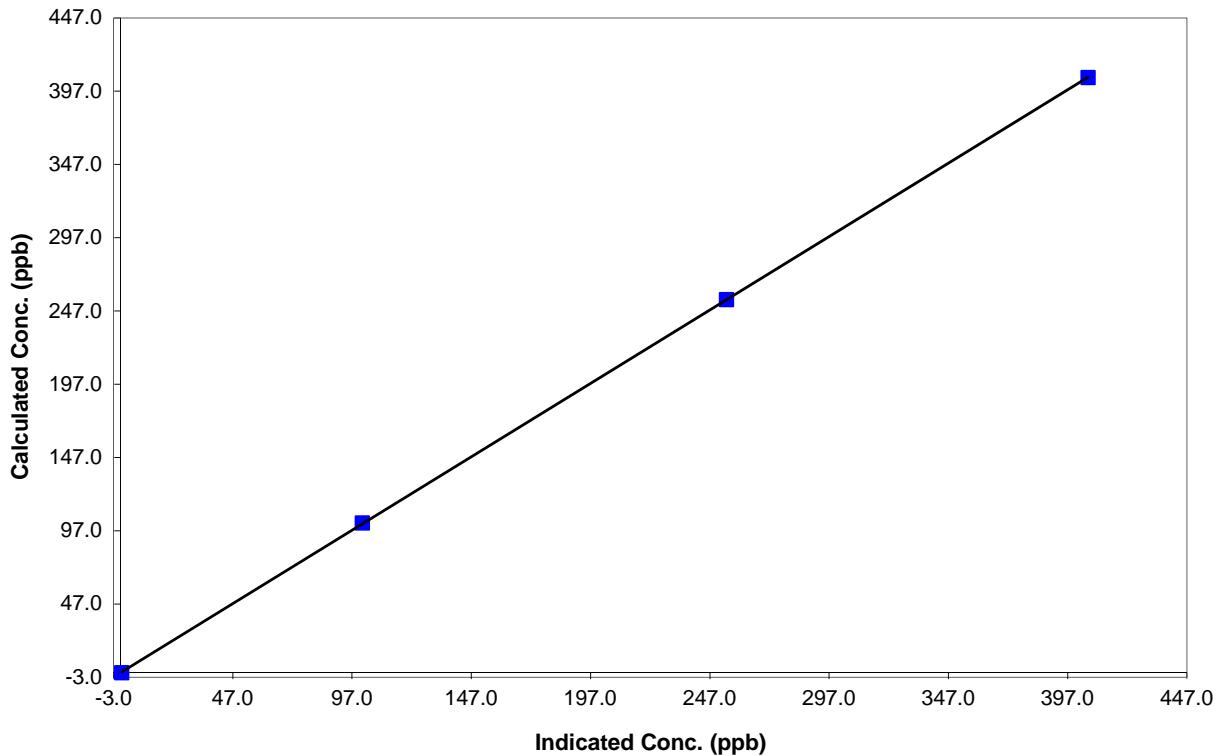
Parameter NO
 Air Monitoring Network Lafarge - Exshaw

Station Information			
Calibration Date	April 11, 2017	Previous Calibration	April 11, 2017
Station Number	N/A	Station Location	Exshaw - Lagoon
Start Time (MST)	7:30	End Time (MST)	12:00
Analyzer make	T200	Analyzer serial #	642

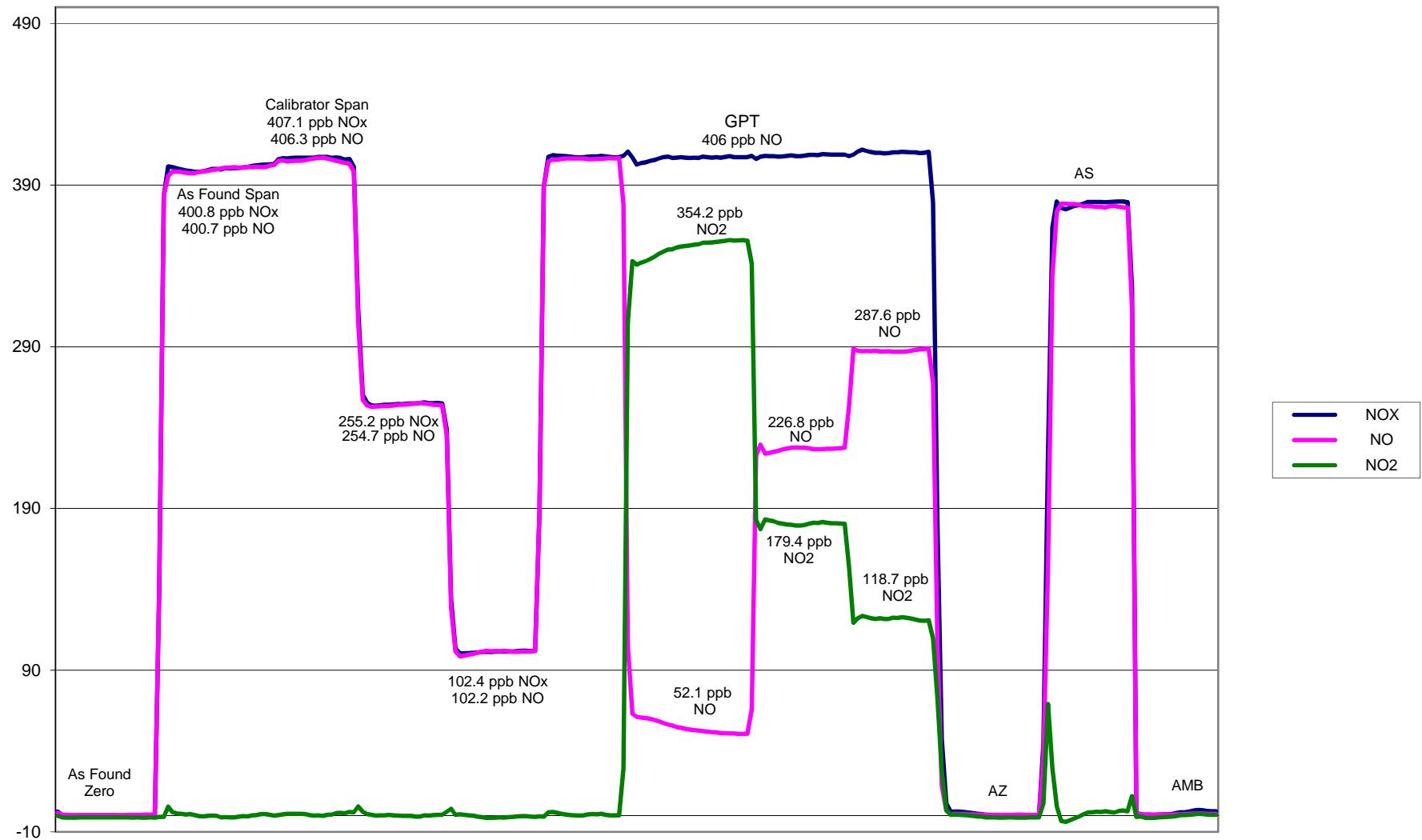
Calibration Data

Calculated conc (ppb) (Cc)	Indicated concentration (ppb) (Ic)	Correction factor (Cc/Ic)	Statistical Evaluation	
0.0	0.5	N/A		
406.3	405.6	1.0019	Correlation Coefficient	0.999993
254.7	254.0	1.0027		
102.2	101.3	1.0085	Slope	1.002375
			Intercept	0.006392

NO Calibration Curve



NOX Calibration



Calibration Report



Parameter SO₂
Air Monitoring Network Lafarge - Exshaw

AIR QUALITY MONITORING

Station Information

Calibration Date	May 26, 2017	Previous Calibration	April 11, 2017
Station Number	N/A	Station Location	Exshaw - Lagoon
Reason:	Routine	Install	Removal
			Other:
Start Time (MST)	7:30	End Time (MST)	12:00
Barometric Pressure	651 mmHg	Station Temperature	23.0 Deg C
Calibrator	SABIO 2010	Serial Number	04090809
Cal Gas Concentration	49.8 ppm	Cal Gas Expiry Date	July 14, 2020
Gas Cert Reference	EY643	DACS serial No.	67802
DACS make	Campbell Scientific CR1000	DACS channel #	4
DACS voltage range	0 - 5 VDC		
	Before		After
DACS Scale High	500	DACS slope	500
DACS Scale Low	0	DACS intercept	0
Calculated slope	0.977601	Calculated slope	0.999652
Calculated intercept	2.737886	Calculated intercept	0.230934

Analyzer make	API Model 102A	Analyzer serial #	393
before		after	
Concentration range	0-500 ppb	0-500	ppb
Slope	0.94	0.951	
Offset	44.8 mV	44.8	mV
Pressure	23.7 in Hg	23.6	in Hg
Sample Flow	496 ccm	493	ccm
UV Lamp	2957.8 mV	2901.8	mV
HVPS	691 V	691	V
PMT Temp	7.6 degC	7.5	degC

Calibration Data

Dilution air flow rate (cc/min)	Source gas flow rate (cc/min)	Calculated concentration (ppm) (Cc)	Indicated concentration (ppm) (Ic)	Correction factor (Cc/Ic)
5000	0.00	0.0	-0.2	N/A
5000	40.00	395.2	395.7	0.9988
5000	25.00	247.8	246.5	1.0050
7000	14.00	99.4	99.7	0.9974
5000	0.00	0.0	-0.2	As found zero
5000	40.00	395.2	389.9	As found span
Average Correction Factor				1.0004

Calculated value of As Found Response: 384.1 ppm Percent Change of As Found: 2.8%

Auto zero	before calibration		after calibration	
	0.0	ppm	0.3	ppm
	394.7	ppm	388.9	ppm

Notes: Span adjustment made.

Calibration Performed By: Lenin Flores

Calibration Summary

Parameter SO₂
Air Monitoring Network Lafarge - Exshaw

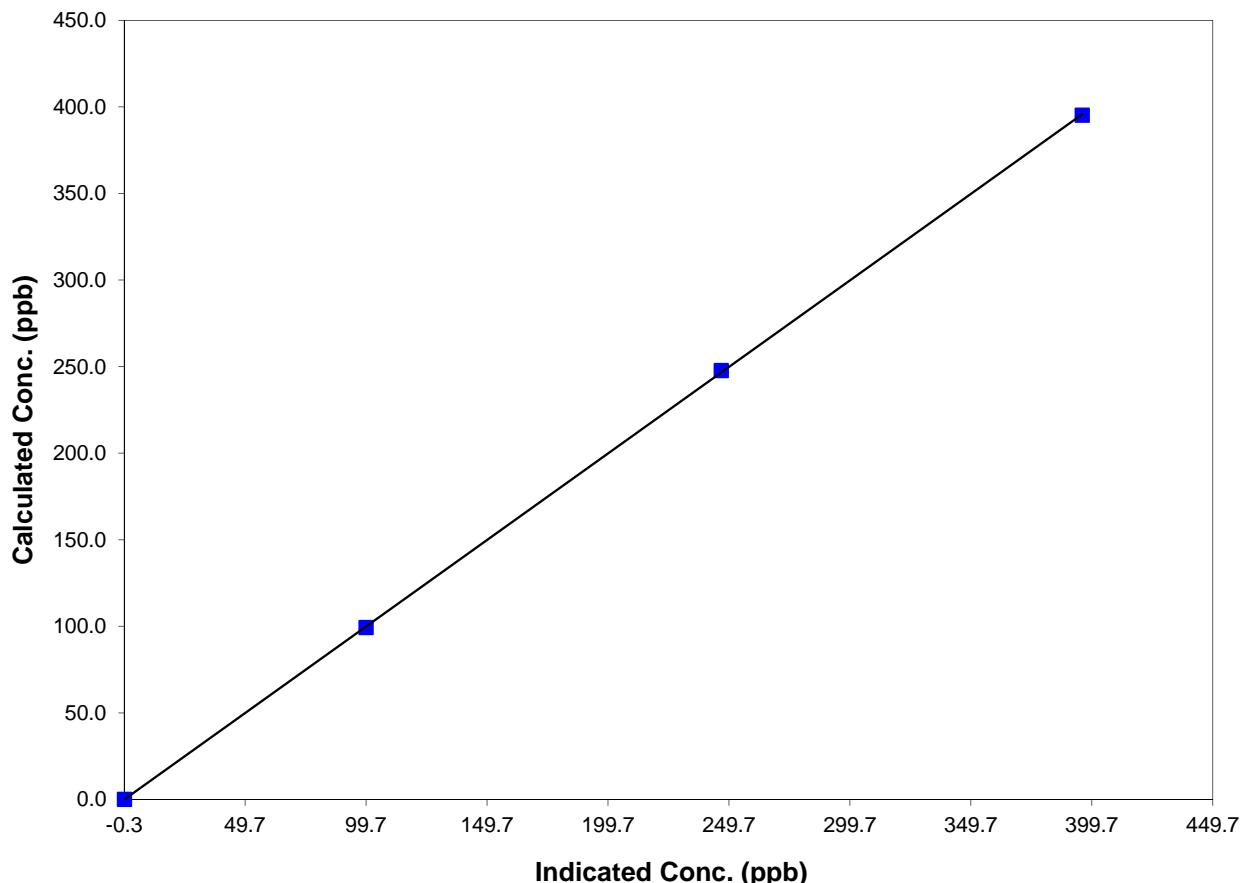


Station Information			
Calibration Date	May 26, 2017	Previous Calibration	April 11, 2017
Station Number	N/A	Station Location	Exshaw - Lagoon
Start Time (MST)	7:30	End Time (MST)	12:00
Analyzer make/model	API Model 102A	Analyzer serial #	393

Calibration Data

Calculated concentration (ppb) (Cc)	Indicated concentration (ppb) (Ic)	Correction factor (Cc/Ic)	Statistical Evaluation	
0.0	-0.2	N/A		
395.2	395.7	0.9988	Correlation Coefficient	0.999981
247.8	246.5	1.0050	Slope	0.999652
99.4	99.7	0.9974	Intercept	0.230934

SO₂ Calibration Curve



SO2 Calibration

