Yara Pilbara Nitrates

EPBC Approval 2008/4546

Baseline Air Quality Monitoring Report

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1 Purpose

The purpose of this report is to inform the Department of the Environment and Energy (DEE) of the findings from the baseline monitoring program carried out as per the requirements of Condition 9 of EPBC Approval 2008/4546 for the Yara Pilbara Nitrates Pty Ltd (YPN) Technical Ammonium Nitrate Plant (TAN Plant). This report is provided in response to Condition 9(d) of the EPBC Approval (Section 3.1).

2 Definitions and Acronyms

Term	Definition	Description and context for this report
AN	Ammonium nitrate	Product from the YPN TAN plant
CSIRO	Commonwealth Scientific & Industrial Research Organisation	Federal government agency for scientific research in Australia
CSIRO passive sampler	Sampler for gaseous substances in ambient air	Sampling devices developed and provided by CSIRO for passively monitoring airborne concentrations of gases
DDG	Dust deposition gauge	Device for sampling of dust which settles from the air column under gravity
DEE	Department of the Environment and Energy	Australian Government department
EPBC	Environment Protection and Biodiversity Conservation	Refers to the Australian Government EPBC Act of 1999
HNO_3	Nitric Acid	Gaseous air pollutant formed in the atmosphere from NOx reactions
HVAS	High volume air sampler	Instrument for sampling of TSP in ambient air with air flow of 1.6 m^3/min or PM_{10} with an air flow of 1.13 m^3/min
L/min	Litres per minute	Air sampling flow rate units for LVAS
LVAS	Low volume air sampler	Instrument for sampling of TSP or PM_{10} in ambient air with air flow rates of 3-5 L/min (0.003-0.005 m^3/min)
m^3/min	Cubic metre per minute	Air sampling flow rate units for HVAS
MicroVol	MicroVol 1100 low volume sampler	LVAS instrument for sampling of TSP, manufactured by Ecotech
MiniVol TAS	MiniVol Tactical Air Sampler	LVAS instrument for sampling of TSP, manufactured by Airmetrics
NH_3	Ammonia	Gaseous air pollutant from natural sources and industrial sources (including YPN TAN plant)
NO	Nitric oxide	Gaseous air pollutant from oxidation of nitrogen containing substances
NO_2	Nitrogen dioxide	Gaseous air pollutant primarily from combustion sources

Term	Definition	Description and context for this report
NOx	Nitrogen oxides	Combination of NO and NO_2, reported as NO_2
Passive sampling	Ambient air sampling for gasous substances involving passive samplers	Sampling technique whereby airborne gaseous pollutants are extracted from the air column onto an adsorbent material via a diffusive mechanism
PM_{10}	Particulate matter (10 micrometre)	Dust particles which are present in ambient air with equivalent aerodynamic diameter of 10 micrometres (µm)
Radiello® passive sampler	Sampler for gaseous substances in ambient air	Sampling devices manufactured by Sigma Aldrich under licence from Fondazione Salvatore Maugeri IRCCS for passively monitoring airborne concentrations of gases
SO_2	Sulfur dioxide	Gaseous air pollutant from oxidcation of sulfur containing substances
SO_3	Sulfur trioxide	Gaseous air pollutant from oxidation of SO_2
SOx	Sulfur oxides	Combination of SO_2 and SO_3, reported as SO_2
TAN Plant	Technical Ammonium Nitrate Plant	Ammonium nitrate plant operated by YPN on the Burrup
TEOM	Tapered element oscillating microbalance	Instrument for continuous measurement of PM_{10} concentrations in ambient air
TSP	Total suspended particulates	Dust particles which are present in ambient air with equivalent aerodynamic diameter of 50 micrometres (µm)
µg	Microgram	One millionth (0.000001) of a gram
$\mu g/m^3$	Microgram per cubic metre	Concentration of air quality data
µm	Micrometre	One millionth (0.000001) of a metre
YPN	Yara Pilbara Nitrates Pty Ltd	Operators of the TAN Plant

3 Scope of Baseline Monitoring Program

3.1 EPBC Approval 2008/4546 Condition 9

Condition 9 of the Approval is reproduced below to inform the scope of the monitoring program.

9. To protect the National Heritage Place, particularly the rock art sites, the person taking the action must undertake an air quality monitoring program. The air quality monitoring program must:

   a) Undertake air quality monitoring at three (3) sites as shown in Attachment 2. These sites being sites previously selected, designed, fenced off and used in the original Western Australian Department of Environment and Conservation (WA DEC)/CSIRO air quality monitoring program.

      - Site 5 - Burrup Road site;
      - Site 6 - Water tanks site; and

- Site 7 - Deep Gorge site

The air quality monitoring must be undertaken for a period of not less than 24 months beginning from the commencement of construction.

The results of this monitoring will be used to establish baseline data on levels of:

- Ammonia (NH_3);
- Nitrogen Oxides (NOx);
- Sulphur Oxides (SOx); and
- Total suspended particulates (TSP), including dust at those rock art sites.

b) Ensure that the monitoring of air quality at rock art sites is undertaken by a suitably qualified person (Air Quality).

A suitably qualified person is defined in the Approval as:

"…a person with at least five (5) years experience in air quality monitoring, including taking air samples and testing those samples to obtain results."

c) Ensure air quality readings during the twenty four (24) months of baseline monitoring are taken at least four (4) times in every 12 months.

d) Ensure that the baseline data established from the air quality monitoring is reported to the Department in writing within 12 months of the completion of construction or following twenty four (24) months of baseline monitoring (which ever finishes last). The report must include a map clearly showing the location of each rock art site being monitored.

e) Ensure air quality monitoring of the rock art monitoring sites (sites 5, 6 and 7) is continued for an additional period of five (5) years, following the establishment of baseline data and once operation has commenced, to record levels of NH3, NOx, SOx and TSP, including dust.

f) Report the results of the five (5) years of monitoring following the establishment of baseline, as per condition 9(e) above, to the Department, in writing, within two (2) months of that year's monitoring having been completed.

Conditions 9(e) and 9(f) apply to future monitoring once operations commence and are not relevant to this report.

3.2 Baseline Monitoring Program

3.2.1 Locations

An aerial photograph showing the locations of the three (3) ambient air quality monitoring stations is shown in Figure 1. Additional monitoring was conducted at two (2) locations on the boundary of the TAN Plant (TRA-1 and TRA-2) as per the Construction Air Quality Management Plan, and those locations are also indicated on the photograph since data from those monitoring stations have been used to inform the baseline data set for the baseline monitoring program.

Figure 1. Locations of Air Quality Monitoring Stations

3.3 Scope of Monitoring Program

Attributes of the monitoring program, including parameters measured, instruments deployed, locations, duration of sampling and laboratories that conducted analyses is contained within Table 1.

Table 1. Baseline Monitoring Scope

Parameter	Instrument	Locations	Sampling Period	Analysis Laboratory
NH_3	CSIRO passive sampler	Sites 5, 6 and 7	Sep 2013 to end May 2016	CSIRO
	Radiello® passive sampler	Sites 5, 6 and 7	Sep 2016 onwards	Leeder Analytical
NO_2	CSIRO passive sampler	Sites 5, 6 and 7	Sep 2013 to end May 2016	CSIRO
	Radiello® passive sampler	Sites 5, 6 and 7	Sep 2016 onwards	Leeder Analytical
SO_2	CSIRO passive sampler	Sites 5, 6 and 7	Sep 2013 to end May 2016	CSIRO
	Radiello® passive sampler	Sites 5, 6 and 7	Sep 2016 to present	Leeder Analytical
HNO_3 *	CSIRO passive sampler	Sites 5, 6 and 7	Sep 2013 to end May 2016	CSIRO
TSP	MiniVol TAS (LVAS)	Site 6	Sep 2013 to Jan 2017	YPN
	Ecotech MicroVol 1100 (LVAS)	Sites 5, 6 and 7 TRA-1	Feb 2017 to present	Compliance Monitoring
	Ecotech HiVol 3000 (HVAS)	TRA-1	Feb 2017 to present	Compliance Monitoring
Dust	Dust deposition gauges	Sites 5, 6 and 7	Sep 2013 to present	YPN and Compliance Monitoring (from February 2017)
PM_{10}	Thermo Fisher 1405 TEOM	TRA-1 and TRA-2	Mar 2013 to present	Continuous analyser
	Ecotech HiVol 3000 (HVAS)	TRA-1	Feb 2017 to present	Compliance Monitoring
	Thermo ADR1500	Sites 5, 6 and 7	Mar 2013 to Dec 2016	Continuous analyser
Wind speed and direction		TRA-1	Mar 2013 to present	Continuous analyser
Rain gauge	ECO200 rain gauge	Sites 5, 6 and 7	Sep 2013 to present	YPN

Parameter	Instrument	Locations	Sampling Period	Analysis Laboratory
Rainwater	ECO200 rainwater sampler	Sites 5, 6 and 7	Mar 2013 to present	CSIRO (March 2013 to May 2016) ALS (May 2016 to present)
Barometric pressure, relative humidity and ambient temperature	Installed with TEOM	TRA-1	Mar 2013 to present	Continuous analysers
* Note that EPBC Condition 9 did not specify monitoring be carried out for HNO_3. That parameter was measured (as NO_3) as part of the baseline study for comparison with historical monitoring conducted by CSIRO.				

In the absence of definitions in EPBC Condition 9, YPN has interpreted the *"including dust"* component of Condition 9(a) to mean monitoring of dust which deposits from the atmosphere to surfaces. As such, monitoring was carried out using dust deposition gauges (DDG). DDGs collect all dust which falls out of the air column over a 30±2 day period to inform risk from dust fall-out on rock art.

Note that some of the parameters listed above are not included in Condition 9(a). In particular, PM_{10} monitoring was conducted at Sites 5, 6 and 7 using ADR 1500 continuous analysers for Western Australian Environmental Protection Authority regulatory purposes. Also, Condition 9(a) only specifies monitoring to be conducted at Sites 5, 6 and 7. Data from monitoring conducted at boundary sites TRA-1 and TRA-2 have been included in this report since the baseline TSP data set has in part, been derived from PM_{10} and wind monitoring conducted at boundary locations and a co-location study conducted at TRA-1. That co-location study has determined the proportion of TSP which is PM_{10}, for application to the TEOM PM_{10} data collected from TRA-1 and TRA-2 during the construction monitoring period (March 2013 to end June 2015), to generate the TSP data set. Further details of the process involved for generation of the baseline TSP data are provided in Section 4.2.2 and the submission YPN made to the DEE on 24 March 2017 (Strategen Environmental 2017).

The results from all measurements and analyses have been collated and reviewed by Strategen Environmental to develop a baseline data set which is fit for purpose. Fit for purpose is defined as provision of data of sufficient quantity and quality as a baseline to facilitate assessment of impacts from operation of the TAN Plant on the rock art. That assessment will be carried out by comparison of the baseline data with operational monitoring data to be acquired over a five (5) year period after commencement of operations (EPBC Conditions 9(e) and 9(f)).

4 Results of Baseline Monitoring

The results from the baseline monitoring program are presented below as descriptive statistics and availability data for individual parameters. All data are presented in the Appendices.

4.1 Gases (NH_3, NO_2, NO_3 and SO_2)

A summary of NH_3, NO_2, NO_3 and SO_2 data availability from the three (3) off-site (rock art) monitoring sites is shown in Table 2. Sampling commenced in September 2013 using samplers provided by the CSIRO. In June 2016, CSIRO advised that they could no longer support the monitoring. YPN then sought an alternative passive sampling technology and the Radiello® samplers were found to be suitable for monitoring of NH_3, NO_2 and SO_2. The first Radiello® samplers were deployed in September 2016.

The samples collected up to end May 2016 involved exposure of CSIRO passive samplers for a period of one month (for each sample), the Radiello® samplers are deployed for two (2) week periods (for each sample). As such, the availability data reflects the numbers of monthly average samples in the period Sept 2013 to May 2016 (for CSIRO samplers) and from September 2016 to mid-February 2017 (for Radiello® samplers). Duplicate Radiello® samplers were deployed at Site 6 for each parameter (thereby providing twice the total number of measurements made at that location for September 2016 to February 2017).

Table 2: Number of NH_3, NO_2, NO_3 and SO_2 Measurements from Sites 5, 6 and 7

12-month period	Number of Measurements											
	Site 5 (Burrup Road)				Site 6 (Water Tanks)				Site 7 (Deep Gorge)			
	NH_3	NO_2	NO_3	SO_2	NH_3	NO_2	NO_3	SO_2	NH_3	NO_2	NO_3	SO_2
Sep 2013 to end Aug 2014	10	10	10	10	10	10	10	10	11	11	11	11
Sep 2014 to end Aug 2015	7	7	7	7	10	10	10	10	10	10	10	10
Sep 2015 to end Aug 2016	7	6	7	7	8	9	7	9	7	7	7	7
Sep 2016 to mid-Feb 2017	11	11	0	11	22	22	0	22	11	11	0	11
Total	**35**	**34**	**24**	**35**	**50**	**51**	**27**	**51**	**39**	**39**	**28**	**39**

The data availability exceeds the requirements of Condition 9, with total of 37 months of monitoring completed for NH_3, NO_2 and SO_2 (24 months for HNO_3) and at least one “reading” carried out at least 4 times per 12-month period.

Descriptive statistics for all samples are summarised in Table 3 for NH_3, Table 4 for NO_2, Table 5 for NO_3 and Table 6 for SO_2. Sampling dates and concentration data are presented in Appendix 1.

Table 3: NH_3 Summary Data (units are µg/m^3)

Statistic	Site 5 (Burrup Road)	Site 6 (Water Tanks)	Site 7 (Deep Gorge)
Minimum	0.00	0.00	0.00
Average	0.44	0.93	0.75
95th percentile	0.94	2.27	1.97
Maximum	1.20	3.97	4.35

Table 4 NO_2 Summary Data (units are µg/m^3)

Statistic	Site 5 (Burrup Road)	Site 6 (Water Tanks)	Site 7 (Deep Gorge)
Minimum	0.38	0.31	0.40
Average	3.60	2.56	2.31
95th percentile	5.40	4.17	3.26
Maximum	6.53	5.27	4.12

Table 5: NO_3 Summary Data (units are µg/m^3)

Statistic	Site 5 (Burrup Road)	Site 6 (Water Tanks)	Site 7 (Deep Gorge)
Minimum	0.28	0.18	0.23
Average	0.80	0.74	0.65
95th percentile	1.50	1.53	1.26
Maximum	1.55	1.81	1.42

Table 6: SO_2 Summary Data (units are µg/m^3)

Statistic	Site 5 (Burrup Road)	Site 6 (Water Tanks)	Site 7 (Deep Gorge)
Minimum	0.13	0.01	0.16
Average	1.39	0.96	0.83
95th percentile	2.52	2.59	1.60
Maximum	3.09	3.50	2.01

These data are obtained from blank corrected concentrations, whereby the levels of these gases present as contaminants in the sampling media and analytical process are subtracted from the measured concentrations. The zero values for minima are a consequence of blank subtraction, and reflect very low ambient concentrations.

These data show the higher concentrations of NO_2 are at Site 5 (Burrup Road), which is in close proximity to other industrial emissions sources, in particular the Pluto gas plant. Higher concentrations of NH_3 are observed from Site 6 (Water Tanks) and Site 7 (Deep Gorge) compared with Site 5 (Burrup Road) which suggests a possible contribution from the Ammonia Plant. Similar maximum concentrations of SO_2 were observed at Sites 5 and 6, whereas a lower maximum concentration was observed at Site 7. However, the average SO_2 concentrations at Sites 6 and 7 were considerably lower than for Site 5. Similar concentrations of NO_3 (as HNO_3) were observed at all sites which most likely reflects the NOx atmospheric chemistry in the area rather than a specific influence from any particular industrial source.

Yara consider that the data obtained from monitoring of NH_3, NO_2, NO_3 and SO_2 are of appropriate quantity and quality to inform baseline air quality for those parameters prior to commencement of TAN Plant operations.

4.2 Total Suspended Particulates (TSP)

4.2.1 Direct and Indirect TSP Measurements at Off-site Locations

Two types of TSP measurements have been made at the off-site locations:

Direct sampling for TSP was carried out at Site 6 (Water Tanks) using a MiniVol TAS instrument and more recently a MicroVol 1100 instrument. Sampling was carried out for 24-hour periods from September 2013 until end January 2017, nominally every six (6) days for the MiniVol.

TSP sampling was conducted at Sites 5, 6 and 7 using a MicroVol instrument from February 2017. Direct TSP sampling was not carried out at Sites 5 and 7 prior to that time. The MicroVol sampling frequency was initially daily for a week, then every third day for a month and currently continues as every six (6) days.

Indirect measurements of TSP were carried out at Sites 5, 6 and 7 using Thermo ADR 1500 instruments fitted with PM_{10} inlets. Estimates of 24-hour average TSP concentrations were made from the 5-minute average PM_{10} data obtained from the stations and the PM_{10}/TSP ratios obtained from a co-location study conducted at the TAN plant boundary monitoring station (see Section 4.2.2 below). Valid data from the ADR instruments were obtained for a 6 week period in August to October 2013.

A summary of TSP data availability from the off-site locations is shown in Table 7.

Table 7: TSP Samples from Off-site Locations

Period	Number of 24-hour average samples

Period	Number of 24-hour average samples					
	Site 5 (Burrup Road)		Site 6 (Water Tanks)		Site 7 (Deep Gorge)	
	TSP calculated from PM_{10}	Direct TSP sampling	TSP calculated from PM_{10}	Direct TSP sampling	TSP calculated from PM_{10}	Direct TSP sampling
Aug 2013 to Aug 2014	40	0	45	26	42	0
Sept 2014 to Aug 2015	0	0	0	14	0	0
Sept 2015 to Aug 2016	0	0	0	19	0	0
Sept 2016 to Mar 2017	0	9	0	23	0	11
Total	**40**	**9**	**45**	**82**	**42**	**11**

The data availability from direct sampling of TSP at Site 6 (Water Tanks) exceeds the requirements from Condition 9, being a minimum of 24 months of monitoring and at least one (1) reading four (4) times each 12 months. PM_{10} monitoring using the ADR 1500 instruments was carried out for a minimum of 24 months, however valid data were only obtained for the indicated 6 week period in 2013 at Sites 5 and 7, which did not meet the monitoring duration and frequency requirements of Condition 9.

Descriptive statistics for all samples are summarised in Table 8. Results from all TSP samples from Sites 5, 6 and 7 are provided in Appendix 2.

Table 8: TSP Summary Data (units are µg/m^3)

Statistic	Site 5 (Burrup Road)		Site 6 (Water Tanks)		Site 7 (Deep Gorge)	
	TSP calculated from PM_{10}	Direct TSP sampling	TSP calculated from PM_{10}	Direct TSP sampling	TSP calculated from PM_{10}	Direct TSP sampling
Minimum	12	8	6	12	1	8
Average	21	19	15	85	28	16
95th percentile	30	29	25	194	38	24
Maximum	40	32	34	1,417	46	26

Overall, considerably higher concentrations were observed over the 42 months direct sampling at Site 6 compared with the recent direct sampling at Sites 5 and 7. This is most likely a reflection of the very heavy rainfall in the area in January and February, which has significantly increased soil moisture and promoted considerable vegetation growth, all of which serves to reduce potential for background dust generation.

The cause of the maximum TSP 24-hour average concentration observed at Site 6 (1,417 µg/m^3) is not known but is more likely to be due to a localised dust emission event than from a very high background. This very high result would be removed from the data set when a comparison of TSP concentrations is made from the operational monitoring program required under Condition 9(e).

The indirect TSP concentrations calculated from PM_{10} monitoring at the three (3) off-site locations show similar distributions, reflecting similar ambient dust influences at the three (3) locations for the six (6) weeks of monitoring in September-October 2013.

4.2.2 TSP Data Derived from Boundary PM_{10} Monitoring

To address the absence of TSP data from Sites 5 and 7 for the 24 months of the monitoring program, the TSP data obtained from monitoring conducted at the three (3) off-site locations is augmented by a baseline TSP data set developed from PM_{10} monitoring carried out at the TAN Plant boundary locations (sites TRA-1 and TRA-2, see Figure 1). This monitoring, carried out as part of the construction monitoring program, has provided PM_{10} data (as 5-minute averages from March 2013 to end June 2015) and wind direction data (also as 5-minute averages).

Baseline TSP concentrations were derived as follows:

1. The 5-minute average PM_{10} data from TRA-1 and TRA-2 were filtered to remove excessively negative values (<-100,000 µg/m^3), indicative of instrument instability due to high variance in relative humidity and/or other instrument issues;
2. The data were also filtered to remove large positive values (>100,000 µg/m^3) which are indicative of potential localised dust emission events and do not describe the background PM_{10} concentrations;
3. The “outlier” filtered data were further filtered by wind direction (as measured at TRA-1) to identify those concentrations which reflect winds from locations not impacted by construction activities. In effect, PM_{10} concentrations which may have been influenced by construction dust emissions were removed from the PM_{10} data set, leaving concentrations which reflect background sources;
4. 24-hour average PM_{10} concentrations were derived from the wind direction filtered data where at least 75% of the 288 daily 5-minute observations were available in a 24-hour period (taken from midnight to midnight).

The wind direction filtered 24-hour average PM_{10} concentration data were then factored by the proportion of TSP which is PM_{10}, to estimate TSP concentrations which reflect background sources. The PM_{10} to TSP ratios were obtained from a co-location study carried out at TRA-1, whereby 19 valid concurrent 24-hour average measurements of TSP and PM_{10} were carried out in February-March 2017 using

high volume TSP and PM_{10} samplers. Details of the results from the co-location study of TSP and PM_{10} measurements are presented in Section 5.

An average PM_{10}/TSP ratio of 0.52 was obtained from the co-location study, to provide TSP concentrations via the following equation:

TSP concentration(24-h average) = TEOM PM_{10} concentration(24-h average) / 0.52

Further details of the process involved in the development of baseline TSP concentrations from PM_{10} data are provided in Strategen 2017.

Data availability for TSP concentrations derived from boundary PM_{10} data are summarised in Table 9.

Table 9: Availability of TSP Data Derived from Boundary PM_{10} Data

Period	Number of 24-hour average samples from TRA-1	Number of 24-hour average samples from TRA-2
Mar 2013 to Feb 2014	86	35
Mar 2014 to Feb 2015	63	32
Mar-June 2015	0	0
Total	**149**	**67**

This TSP data set satisfies the Condition 9 requirement for at least 24 months of monitoring and at readings to be taken at least four (4) times in each 12 months.

Descriptive statistics of the boundary PM_{10} derived TSP data set are shown in Table 10, with all results presented in Appendix 3.

Table 10: Summary of TSP Data Derived from Boundary PM_{10} Data (units are µg/m^3)

Statistic	Boundary derived TSP (24-hour average concentration)
Minimum	4
Average	56
95th percentile	103
Maximum	215

4.2.3 Comparison of Off-site and Boundary Derived TSP Data

A comparison of TSP concentrations measured at Site 6 and TSP derived from boundary and off-site PM_{10} monitoring (at Sites 5, 6 and 7) is illustrated in Figure 2.

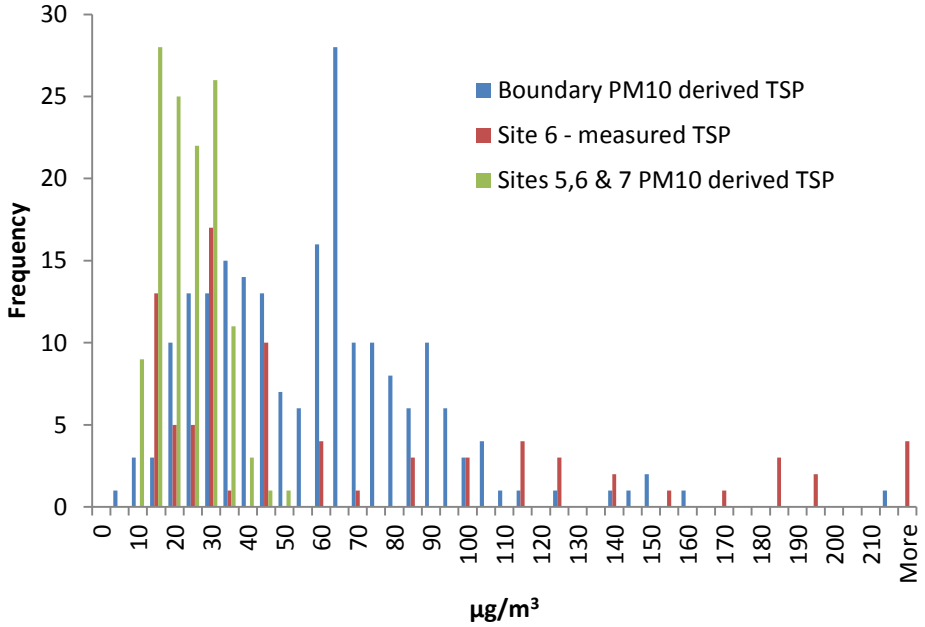

Figure 2. Histogram Showing Boundary and Offsite PM_{10} Derived TSP and Measured TSP Concentrations from Site 6

The histogram shows a greater proportion of higher measured TSP concentrations from Site 6 compared with the boundary PM_{10} derived TSP and off-site PM_{10} derived TSP concentrations. This means the boundary and off-site PM_{10} derived TSP data provides a conservative position for a future comparison of ambient TSP concentrations when the TAN Plant is operating, in that lower baseline concentrations provide greater sensitivity for assessment of risk from TAN Plant TSP emissions.

4.2.4 Conclusions Regarding Baseline TSP Data

YPN consider that the TSP data directly measured from monitoring at the Site 6 (Water Tanks) are of appropriate quality and quantity to inform baseline TSP air quality. That finding will be verified in a co-location study of MiniVol TSP and HVAS TSP samplers, planned for June/July 2017. TSP data derived from off-site PM_{10} measurements are considered informative and will be validated via co-location of ADR1500 PM_{10}, HVAS PM_{10} and HVAS TSP instruments, also planned for June/July 2017.

The absence of data from Sites 5 and 7 for an entire 24 month period has been addressed by consideration of a TSP data set derived from boundary PM_{10} monitoring conducted over a 24 month period (during the baseline monitoring program).

A baseline TSP data set has therefore been compiled comprising of directly measured concentrations from Site 6, more recent directly measured concentrations from Sites 5 and 7, estimates at Sites 5, 6 and 7 based on PM_{10} data and concentrations derived from boundary PM_{10} monitoring.

YPN consider that the combined measured and derived baseline TSP data set is of sufficient quality and quantity to inform baseline TSP air quality for comparison with air quality during future operation of the TAN Plant.

4.3 Dust Deposition

Dust deposition gauges (DDG) were deployed at the three (3) off-site locations from September 2013 until June 2016, with the insoluble fraction of deposited dust analysed. The DDG data availability is summarised in Table 11.

Table 11: Availability of Dust Deposition Data from Off-site Locations

Period	Number of monthly average samples		
	Site 5 (Burrup Road)	**Site 6 (Water Tanks)**	**Site 7 (Deep Gorge)**
Sept 2013 to Aug 2014	9	9	10
Sept 2014 to Aug 2015	6	8	8
Sept 2015 to end June 2016	10	10	10
Total	**25**	**27**	**28**

This dust deposition data set satisfies the Condition 9 requirement for "dust" with more than 24 months of monitoring carried out and readings to be taken at least four (4) times in each 12 months.

Descriptive statistics of the deposition rates for insoluble dust is shown in Table 12. Results from all deposition samples from Sites 5, 6 and 7 are provided in Appendix 4.

Table 12: Dust Deposition (Insoluble Fraction) Summary Data (units are g/m^2/month)

Statistic	**Site 5 (Burrup Road)**	**Site 6 (Water Tanks)**	**Site 7 (Deep Gorge)**
Minimum	0.022	0.000	0.010
Average	0.88	0.84	1.07
95th percentile	1.75	1.86	2.31
Maximum	2.00	2.05	5.03
Annual average of monthly rates	**Site 5 (Burrup Road)**	**Site 6 (Water Tanks)**	**Site 7 (Deep Gorge)**
Sept 2013 to Aug 2014	0.84	0.76	0.86
Sept 2014 to Aug 2015	0.99	0.95	1.33
Sept 2015 to Jun 2016	0.86	0.81	1.04

Similar insoluble dust deposition rates were observed at Sites 5 and 6, whereas Site 7 (Deep Gorge) showed slightly higher rates. The highest observed rate (5.03 g/m^2/month) at Site 7 (Deep Gorge) is an anomalous result that suggests localised sources of dust were evident across the month which combined with background levels of insoluble dust to give this relatively high value.

YPN consider that the baseline dust deposition data set is of sufficient quality and quantity to inform insoluble dust deposition rates for comparison with deposition rates during future operation of the TAN Plant.

5 Co-location Study

As discussed in Section 4.2.2, a co-location study was carried out during the latter stages of the baseline monitoring program to determine PM_{10}/TSP ratios for derivation of TSP concentrations from boundary PM_{10} monitoring (Table 13). The results of the co-location monitoring are presented in this report to provide traceability for the derived TSP data.

Table 13: Airborne Particulate Co-location Study Results (units are µg/m^3)

Date	HVAS TSP	HVAS PM_{10}	PM_{10}/TSP ratio
26-02-17	27.7	11.4	0.41
27-02-17	18.5	10.3	0.56
28-02-17	14.9	8.9	0.60
01-03-17	25.1	10.4	0.42
02-03-17	33.8	15.4	0.46
03-03-17	26.0	12.9	0.50
04-03-17	27.0	14.1	0.52
05-03-17	49.1	20.0	0.41
10-03-17	15.9	6.6	0.42
11-03-17	7.5	1.8	0.65
12-03-17	6.2	2.1	0.34
13-03-17	16.0	8.9	0.56
14-03-17	30.7	14.5	0.47
15-03-17	13.2	8.1	0.61
16-03-17	21.2	15.4	0.73
17-03-17	26.4	16.2	0.61
18-03-17	27.1	14.4	0.53
19-03-17	30.6	15.7	0.51
20-03-17	21.5	11.8	0.55
Minimum	6.2	1.8	0.34
Average	23.1	11.5	0.52
Maximum	49.1	20.0	0.73

Date	HVAS TSP	HVAS PM_{10}	PM_{10}/TSP ratio
Standard deviation	10.0	4.7	0.098

The average PM_{10}/TSP ratio (0.52) has been used to derive TSP concentrations from boundary PM_{10} data. Note that the range and average ratios obtained from the co-location measurements are consistent with the PM_{10}/TSP ratios reported in the NPI Emissions Handbooks (for example, see Table 2 in the NPI Emission Estimate Technique Manual for Mining, version 3.1, January 2012). In particular, a ratio of 0.5 is assigned to PM_{10}/TSP dust emissions from wind erosion events, which along with aerosols from the marine environment are expected to constitute the majority of background airborne particulates in the area.

6 Concluding remarks

A baseline data set has been generated from ambient monitoring conducted at off-site and boundary locations surrounding the YPN TAN Plant, as per the requirements of and in response to Condition 9 of EPBC Approval 2008/4546. The baseline data include measurements of NH_3, NO_2, SO_2, TSP and dust deposition at the three (3) off-site locations (Sites 5, 6 and 7). The duration of TSP measurements at Sites 5 and 7 were less than Condition 9 requirement (24 months monitoring), so additional TSP concentrations were determined at boundary locations from measured PM_{10} concentrations. The boundary TSP data are included in the baseline data set to augment the off-site measurements and provide a robust TSP data set which will facilitate assessment of potential impacts and risks for air emissions from the TAN Plant operations.

7 References

Strategen Environmental 2017. *Technical submission to Department of Environment and Energy. EPBC Approval Condition 9*. Yara Pilbara Technical Ammonium Nitrate Plant. Memo issued to DEE, 7 April 2017. File: YPN16610.01 M008 Rev 0.

Appendix 1 – NO_2, NO_3, SO_2 and NH_3 Data

Site 5 (Burrup Road)

Sampling start date	Sampling end date	NO_2 ($\mu g/m^3$)	NO_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NH_3 ($\mu g/m^3$)
01-Sep-13	01-Oct-13	6.53	0.42	2.44	0.25
01-Oct-13	01-Nov-13	6.50	1.43	2.23	0.66
01-Nov-13	01-Dec-13	4.98	1.27	1.76	0.29
01-Dec-13	29-Dec-13	4.96	1.52	2.36	0.25
29-Dec-13	01-Feb-13	NS	NS	NS	NS
01-Feb-13	01-Mar-14	NS	NS	NS	NS
01-Mar-14	01-Apr-14	4.40	1.22	1.52	0.25
01-Apr-14	01-May-14	4.91	1.55	3.09	0.25
01-May-14	01-Jun-14	5.03	0.64	1.10	0.35
01-Jun-14	01-Jul-14	3.94	0.28	0.31	0.25
01-Jul-14	01-Aug-14	3.67	0.39	0.74	0.98
01-Aug-14	01-Sep-14	4.01	0.50	1.20	0.56
01-Sep-14	01-Oct-14	4.95	0.69	1.75	0.40
01-Oct-14	01-Dec-14	3.38	0.66	1.94	0.15
01-Dec-14	01-Jan-15	3.06	0.42	1.90	0.25
01-Jan-15	01-Feb-15	2.91	0.92	1.66	0.25
01-Feb-15	01-Mar-15	3.09	0.70	1.43	0.25
01-Mar-15	01-Apr-15	NS	NS	NS	NS
01-Apr-15	01-Jun-15	NS	NS	NS	NS
01-Jun-15	01-Jul-15	NS	NS	NS	NS
01-Jul-15	01-Aug-15	4.01	0.36	0.53	1.20
01-Aug-15	01-Sep-15	3.85	0.52	1.29	0.61
01-Sep-15	01-Oct-15	4.13	0.69	1.98	0.68
01-Oct-15	01-Nov-15	4.33	0.66	2.45	0.67
01-Nov-15	02-Dec-15	3.64	0.69	2.30	0.73
02-Dec-15	31-Dec-15	2.84	0.73	2.67	0.80
31-Dec-15	28-Jan-16	NS	0.97	1.76	0.72
28-Jan-16	01-Mar-16	2.92	0.81	2.48	0.25
01-Mar-16	01-Apr-16	3.44	1.09	1.86	0.25
02-May-16	01-Jun-16	0.48	NS	0.25	0.14
02-May-16	01-Jun-16	0.40	NS	0.30	0.09
01-Sep-16	16-Sep-16	4.29	DNV	1.57	0.27
16-Sep-16	01-Oct-16	3.32	DNV	0.45	0.28
01-Oct-16	14-Oct-16	0.38	DNV	0.18	0.00
14-Oct-16	01-Nov-16	4.31	DNV	1.33	0.33
01-Nov-16	15-Nov-16	4.42	DNV	0.79	0.26

Sampling start date	Sampling end date	NO_2 ($\mu g/m^3$)	NO_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NH_3 ($\mu g/m^3$)
15-Nov-16	01-Dec-16	4.60	DNV	0.54	0.27
01-Dec-16	15-Dec-16	3.31	DNV	0.41	0.53
15-Dec-16	30-Dec-16	3.43	DNV	2.31	0.93
30-Dec-16	13-Jan-17	2.43	DNV	0.13	NS
13-Jan-17	30-Jan-17	1.30	DNV	0.17	0.69
30-Jan-17	13-Feb-17	1.51	DNV	0.20	0.67

NS = no sample recovered or analysed
DNV = data not valid

Concentrations from 1 Sep 2013 to 2 May 2016 are nominal monthly averages, thereafter nominal two (2) weekly averages

Site 6 (Water Tanks)

Sampling start date	Sampling end date	NO_2 ($\mu g/m^3$)	NO_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NH_3 ($\mu g/m^3$)
01-Sep-13	01-Oct-13	4.12	1.51	1.79	0.31
06-Oct-13	01-Nov-13	5.27	0.89	1.90	3.97
01-Nov-13	01-Dec-13	3.05	1.81	1.50	0.25
01-Dec-13	29-Dec-13	3.24	1.47	1.95	*0.25*
29-Dec-13	01-Feb-13	NS	NS	NS	NS
01-Feb-13	01-Mar-14	NS	NS	NS	NS
01-Mar-14	01-Apr-14	2.69	1.25	1.48	*0.25*
01-Apr-14	01-May-14	3.60	0.65	1.48	0.72
01-May-14	01-Jun-14	2.74	0.56	0.72	0.28
01-Jun-14	01-Jul-14	1.81	*0.18*	0.34	*0.25*
01-Jul-14	01-Aug-14	2.80	0.38	0.60	1.74
01-Aug-14	01-Sep-14	3.08	0.36	0.78	0.44
01-Sep-14	01-Oct-14	4.33	0.72	1.93	0.57
01-Oct-14	01-Dec-14	2.71	0.65	1.48	0.13
01-Dec-14	01-Jan-15	2.34	0.41	1.10	*0.25*
01-Jan-15	01-Feb-15	2.68	0.74	1.09	*0.25*
01-Feb-15	01-Mar-15	2.96	0.74	1.08	0.86
01-Mar-15	01-Apr-15	2.21	0.41	0.79	0.44
01-Apr-15	01-Jun-15	1.59	0.39	0.53	0.65
01-Jun-15	01-Jul-15	2.46	0.48	0.92	1.29
01-Jul-15	01-Aug-15	1.86	0.37	0.61	1.69
01-Aug-15	01-Sep-15	2.47	0.44	0.93	1.71
01-Sep-15	01-Oct-15	2.52	0.62	1.80	1.54
01-Oct-15	01-Nov-15	3.20	0.58	2.56	2.35
01-Nov-15	02-Dec-15	2.47	0.49	2.61	0.80

Sampling start date	Sampling end date	NO_2 ($\mu g/m^3$)	NO_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NH_3 ($\mu g/m^3$)
02-Dec-15	31-Dec-15	2.64	0.75	3.50	0.86
31-Dec-15	28-Jan-16	2.30	1.54	2.04	1.34
28-Jan-16	01-Mar-16	2.43	0.66	2.84	0.69
01-Mar-16	01-Apr-16	2.58	1.00	2.15	*0.25*
02-May-16	01-Jun-16	0.48	NS	0.25	0.14
02-May-16	01-Jun-16	0.40	NS	0.30	0.09
01-Sep-16	16-Sep-16	3.56	DNV	0.77	1.47
01-Sep-16	16-Sep-16	3.19	DNV	0.65	1.45
16-Sep-16	01-Oct-16	2.25	DNV	0.25	1.45
16-Sep-16	01-Oct-16	2.38	DNV	0.29	1.47
01-Oct-16	14-Oct-16	0.31	DNV	0.37	0.00
01-Oct-16	14-Oct-16	0.31	DNV	0.37	0.00
14-Oct-16	01-Nov-16	2.96	DNV	0.36	0.82
14-Oct-16	01-Nov-16	3.28	DNV	0.77	0.93
01-Nov-16	15-Nov-16	3.77	DNV	0.40	1.46
01-Nov-16	15-Nov-16	3.66	DNV	0.23	1.48
15-Nov-16	01-Dec-16	3.87	DNV	0.86	0.74
15-Nov-16	01-Dec-16	4.21	DNV	0.41	0.71
01-Dec-16	15-Dec-16	2.40	DNV	1.12	1.32
01-Dec-16	15-Dec-16	2.46	DNV	0.15	1.35
15-Dec-16	30-Dec-16	2.85	DNV	0.34	0.67
15-Dec-16	30-Dec-16	2.74	DNV	0.38	0.67
30-Dec-16	13-Jan-17	1.98	DNV	0.07	0.27
30-Dec-16	13-Jan-17	1.98	DNV	0.13	0.27
13-Jan-17	30-Jan-17	1.16	DNV	0.01	1.02
13-Jan-17	30-Jan-17	1.02	DNV	0.03	0.90
30-Jan-17	13-Feb-17	1.51	DNV	0.08	2.27
30-Jan-17	13-Feb-17	1.45	DNV	0.06	2.27

NS = no sample recovered or analysed
DNV = data not valid

Concentrations from 1 Sep 2013 to 2 May 2016 are nominal monthly averages, thereafter nominal two (2) weekly averages

Site 7 (Deep Gorge)

Sampling start date	Sampling end date	NO_2 ($\mu g/m^3$)	NO_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NH_3 ($\mu g/m^3$)
01-Sep-13	01-Oct-13	2.71	0.77	1.60	0.25
01-Oct-13	01-Nov-13	3.52	1.19	1.47	0.81
01-Nov-13	01-Dec-13	2.60	1.16	1.34	0.48
01-Dec-13	29-Dec-13	2.92	0.62	1.41	0.70
29-Dec-13	01-Feb-14	NS	NS	NS	NS
01-Feb-14	01-Mar-14	2.69	0.56	1.28	0.63
01-Mar-14	01-Apr-14	2.69	1.42	1.25	0.25
01-Apr-14	01-May-14	2.57	0.52	1.02	0.25
01-May-14	01-Jun-14	2.51	0.56	0.56	0.25
01-Jun-14	01-Jul-14	1.83	0.23	0.30	0.25
01-Jul-14	01-Aug-14	2.39	0.48	0.37	0.57
01-Aug-14	01-Sep-14	3.18	0.44	0.59	0.45
01-Sep-14	01-Oct-14	2.79	0.72	1.88	0.39
01-Oct-14	01-Dec-14	1.91	0.56	1.39	0.13
01-Dec-14	01-Jan-15	2.06	0.45	1.00	0.25
01-Jan-15	01-Feb-15	2.37	0.40	0.60	0.25
01-Feb-15	01-Mar-15	3.05	0.80	1.14	0.25
01-Mar-15	01-Apr-15	2.18	0.51	1.04	0.25
01-Apr-15	01-Jun-15	1.31	0.42	0.56	0.16
01-Jun-15	01-Jul-15	2.30	0.56	0.51	0.25
01-Jul-15	01-Aug-15	2.09	0.28	0.43	0.40
01-Aug-15	01-Sep-15	2.07	0.48	0.74	0.26
01-Sep-15	01-Oct-15	2.16	0.30	1.02	0.25
01-Oct-15	01-Nov-15	2.01	0.68	1.37	1.53
01-Nov-15	02-Dec-15	1.91	0.66	1.31	2.11
02-Dec-15	31-Dec-15	2.19	0.70	2.01	0.99
31-Dec-15	28-Jan-16	2.27	1.29	1.39	1.66
28-Jan-16	01-Mar-16	2.07	0.78	1.15	4.35
01-Mar-16	01-Apr-16	2.42	0.56	1.39	1.49
02-May-16	01-Jun-16	0.55	NS	0.16	0.00
02-May-16	01-Jun-16	0.48	NS	0.25	0.00
01-Sep-16	16-Sep-16	2.64	DNV	0.53	0.55
16-Sep-16	01-Oct-16	2.25	DNV 0.08	0.33	0.42
01-Oct-16	14-Oct-16	0.40	DNV 0.00	0.28	0.00
14-Oct-16	01-Nov-16	2.83	DNV 0.03	0.59	0.59
01-Nov-16	15-Nov-16	2.37	DNV 0.02	0.33	0.71
15-Nov-16	01-Dec-16	4.12	DNV 0.00	0.29	1.97
01-Dec-16	15-Dec-16	3.26	DNV 0.00	0.22	1.82

Sampling start date	Sampling end date	NO_2 ($\mu g/m^3$)	NO_3 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NH_3 ($\mu g/m^3$)
15-Dec-16	30-Dec-16	3.26	DNV 0.00	0.45	1.53
30-Dec-16	13-Jan-17	2.88	DNV 0.08	0.18	1.44
13-Jan-17	30-Jan-17	1.51	DNV 0.04	0.20	0.67
30-Jan-17	13-Feb-17	1.29	DNV 0.09	0.22	1.09

NS = no sample recovered or analysed
DNV = data not valid

Concentrations from 1 Sep 2013 to 2 May 2016 are nominal monthly averages, thereafter nominal two (2) weekly averages

Appendix 2 – TSP Data from Off-site Locations

MiniVol TSP Sampling (to 29 January 2017) then MicroVol TSP Sampling Thereafter

Date	Site 5 (Burrup Road) µg/m^3	Site 6 (Water Tanks) µg/m^3	Site 7 (Deep Gorge) µg/m^3
12-Sep-13	NS	56	NS
17-Sep-13	NS	42	NS
23-Sep-13	NS	28	NS
29-Sep-13	NS	69	NS
5-Oct-13	NS	42	NS
11-Oct-13	NS	14	NS
17-Oct-13	NS	42	NS
23-Oct-13	NS	139	NS
29-Oct-13	NS	28	NS
4-Nov-13	NS	14	NS
16-Nov-13	NS	83	NS
22-Nov-13	NS	28	NS
28-Nov-13	NS	14	NS
4-Dec-13	NS	28	NS
16-Dec-13	NS	14	NS
28-Dec-13	NS	111	NS
4-Mar-14	NS	181	NS
23-Mar-14	NS	42	NS
28-Mar-14	NS	28	NS
15-Apr-14	NS	14	NS
3-May-14	NS	42	NS
21-May-14	NS	181	NS
27-May-14	NS	28	NS
2-Jun-14	NS	14	NS
8-Jun-14	NS	333	NS
26-Aug-14	NS	111	NS
6-Sep-14	NS	250	NS
31-Nov-14	NS	56	NS
5-Dec-14	NS	125	NS
17-Dec-14	NS	97	NS
29-Dec-14	NS	153	NS
4-Jan-15	NS	28	NS
10-Jan-15	NS	42	NS

Date	Site 5 (Burrup Road) µg/m^3	Site 6 (Water Tanks) µg/m^3	Site 7 (Deep Gorge) µg/m^3
28-Jan-15	NS	28	NS
21-Feb-15	NS	14	NS
4-Apr-15	NS	1417	NS
10-Apr-15	NS	83	NS
28-Apr-15	NS	28	NS
3-Jul-15	NS	14	NS
8-Aug-15	NS	28	NS
9-Sep-15	NS	194	NS
14-Sep-15	NS	28	NS
25-Oct-15	NS	444	NS
24-Jan-15	NS	139	NS
22-Feb-16	NS	97	NS
28-Feb-16	NS	28	NS
4-Mar-16	NS	125	NS
11-Mar-16	NS	42	NS
17-Mar-16	NS	83	NS
29-Mar-16	NS	28	NS
16-Apr-16	NS	42	NS
28-Apr-16	NS	111	NS
4-May-16	NS	14	NS
10-May-16	NS	28	NS
29-May-16	NS	42	NS
4-Jun-16	NS	56	NS
10-Jul-16	NS	14	NS
28-Jul-16	NS	125	NS
8-Aug-16	NS	167	NS
2-Sep-16	NS	42	NS
8-Sep-16	NS	56	NS
14-Sep-16	NS	111	NS
20-Sep-16	NS	28	NS
7-Oct-16	NS	28	NS
30-Nov-16	NS	14	NS
18-Dec-16	NS	181	NS
30-Dec-16	NS	28	NS
5-Jan-17	NS	97	NS
29-Jan-17	NS	194	NS
26-Feb-17	8	24	21
27-Feb-17	18	18	NS

Date	Site 5 (Burrup Road) µg/m^3	Site 6 (Water Tanks) µg/m^3	Site 7 (Deep Gorge) µg/m^3
28-Feb-17	15	15	8
1-Mar-17	20	17	10
2-Mar-17	21	22	21
3-Mar-17	21	NS	NS
4-Mar-17	15	20	NS
5-Mar-17	32	22	15
6-Mar-17	24	21	16
8-Mar-17	NS	21	14
11-Mar-17	NS	12	10
14-Mar-17	NS	32	26
17-Mar-17	NS	17	22
20-Mar-17	NS	19	9

NS = no sample collected or analysed

Concentrations are 24 hour averages

TSP Calculated from ADR 1500 PM_{10} Monitoring

Date	Site 5 (Burrup Road) µg/m^3	Site 6 (Water Tanks) µg/m^3	Site 7 (Deep Gorge) µg/m^3
20-Aug-13	ND	12	30
21-Aug-13	ND	11	32
22-Aug-13	15	9	29
23-Aug-13	14	12	26
24-Aug-13	14	11	27
25-Aug-13	17	14	27
26-Aug-13	18	13	27
27-Aug-13	20	15	26
28-Aug-13	17	12	30
29-Aug-13	24	18	ND
30-Aug-13	ND	7	ND
31-Aug-13	ND	8	ND
01-Sep-13	ND	9	ND
02-Sep-13	23	10	17
03-Sep-13	15	16	29
04-Sep-13	12	12	23
05-Sep-13	14	12	28

Date	Site 5 (Burrup Road) µg/m^3	Site 6 (Water Tanks) µg/m^3	Site 7 (Deep Gorge) µg/m^3
06-Sep-13	19	16	28
07-Sep-13	25	22	33
08-Sep-13	22	17	34
09-Sep-13	22	16	31
10-Sep-13	16	11	27
11-Sep-13	12	6	22
12-Sep-13	20	14	29
13-Sep-13	24	16	30
14-Sep-13	22	15	29
15-Sep-13	17	11	26
16-Sep-13	16	10	25
17-Sep-13	20	13	28
18-Sep-13	17	10	24
19-Sep-13	17	10	25
20-Sep-13	20	14	28
21-Sep-13	16	11	25
22-Sep-13	18	12	27
23-Sep-13	29	22	37
24-Sep-13	24	18	32
25-Sep-13	34	30	43
26-Sep-13	40	34	46
27-Sep-13	28	26	33
28-Sep-13	28	23	35
29-Sep-13	30	25	38
30-Sep-13	22	15	31
01-Oct-13	26	20	34
02-Oct-13	17	14	22
03-Oct-13	24	15	25

ND = no data collected or analysed

Concentrations are 24 hour averages

Appendix 3 – TSP Data Derived from Boundary PM_{10} Monitoring

TRA-1	
Date	**TSP concentration ($\mu g/m^3$, 24-h average)**
9-Mar-13	20
11-Mar-13	23
12-Mar-13	41
13-Mar-13	4
15-Mar-13	8
16-Mar-13	24
19 -Mar-13	29
20-Mar-13	61
25-Mar-13	59
26-Mar-13	86
14-Apr-13	45
18-Apr-13	40
19-Apr-13	63
22-Apr-13	61
6-May-13	35
7-May-13	44
29-May-13	42
11-Jul-13	57
11-Aug-13	67
13-Aug-13	43
15-Aug-13	48
26-Aug-13	46
27-Aug-13	64
28-Aug-13	44
29-Aug-13	64
31-Aug-13	36
1-Sep-13	55
2-Sep-13	47
3-Sep-13	71
7-Sep-13	57
8-Sep-13	66
9-Sep-13	56
10-Sep-13	36
11-Sep-13	41
12-Sep-13	43

TRA-2	
Date	**TSP concentration ($\mu g/m^3$, 24-h average)**
28-Mar-13	59
3-Apr-13	38
5-Apr-13	33
11-Apr-13	19
12-Apr-13	24
11-May-13	32
12-May-13	38
18-May-13	16
19-May-13	16
22-May-13	16
23-May-13	14
24-May-13	20
25-May-13	36
27-May-13	34
31-May-13	20
1-Jun-13	23
2-Jun-13	33
3-Jun-13	25
9-Jun-13	27
23-Jun-13	21
9-Jul-13	24
14-Jul-13	36
19-Jul-13	37
20-Jul-13	28
21-Jul-13	34
22-Jul-13	39
23-Jul-13	41
24-Jul-13	28
25-Jul-13	31
3-Aug-13	30
4-Aug-13	26
22-Aug-13	27
23-Aug-13	25
26-Oct-13	53
10-Jun-14	60

TRA-1	
Date	**TSP concentration ($\mu g/m^3$, 24-h average)**
13-Sep-13	56
14-Sep-13	59
20-Sep-13	73
22-Sep-13	59
23-Sep-13	60
24-Sep-13	60
26-Sep-13	101
30-Sep-13	49
1-Oct-13	44
4-Oct-13	95
6-Oct-13	60
7-Oct-13	100
8-Oct-13	64
9-Oct-13	65
11-Oct-13	62
12-Oct-13	86
18-Oct-13	57
19-Oct-13	77
20-Oct-13	85
29-Oct-13	91
30-Oct-13	87
3-Nov-13	61
4-Nov-13	104
13-Nov-13	87
19-Nov-13	94
20-Nov-13	67
21-Nov-13	49
22-Nov-13	52
23-Nov-13	63
24-Nov-13	76
25-Nov-13	74
26-Nov-13	150
27-Nov-13	64
28-Nov-13	79
29-Nov-13	73
30-Nov-13	64
1-Dec-13	86

TRA-2	
Date	**TSP concentration ($\mu g/m^3$, 24-h average)**
11-Jun-14	32
12-Jun-14	33
13-Jun-14	48
14-Jun-14	36
16-Jun-14	26
17-Jun-14	37
18-Jun-14	25
20-Jun-14	23
23-Jun-14	16
26-Jun-14	215
28-Jun-14	67
1-Jul-14	21
2-Jul-14	22
2-Jul-14	40
4-Jul-14	40
5-Jul-14	41
6-Jul-14	45
6-Jul-14	61
7-Jul-14	61
8-Jul-14	20
9-Jul-14	29
16-Jul-14	16
17-Jul-14	12
18-Jul-14	19
19-Jul-14	19
25-Jul-14	6
26-Jul-14	27
3-Aug-14	34
9-Nov-14	112
15-Nov-14	72

TRA-1	
Date	TSP concentration ($\mu g/m^3$, 24-h average)
2-Dec-13	62
3-Dec-13	80
4-Dec-13	106
5-Dec-13	148
6-Dec-13	81
7-Dec-13	55
8-Dec-13	59
9-Dec-13	90
10-Dec-13	156
25-Jan-14	50
2-Feb-14	22
3-Feb-14	10
29-Mar-14	30
30-Mar-14	29
1-Apr-14	35
2-Apr-14	40
3-Apr-14	44
6-Apr-14	31
7-Apr-14	33
24-Apr-14	54
28-Apr-14	11
23-May-14	31
2-Nov-14	82
3-Nov-14	89
4-Nov-14	141
5-Nov-14	94
6-Nov-14	82
7-Nov-14	64
8-Nov-14	60
11-Nov-14	64
12-Nov-14	67
13-Nov-14	73
18-Nov-14	65
19-Nov-14	61
21-Nov-14	60
22-Nov-14	69
23-Nov-14	77

TRA-2	
Date	TSP concentration ($\mu g/m^3$, 24-h average)

TRA-1	
Date	**TSP concentration ($\mu g/m^3$, 24-h average)**
24-Nov-14	95
25-Nov-14	70
28-Nov-14	63
29-Nov-14	80
30-Nov-14	64
1-Dec-14	73
2-Dec-14	54
3-Dec-14	55
4-Dec-14	58
5-Dec-14	83
6-Dec-14	104
7-Dec-14	139
8-Dec-14	122
9-Dec-14	90
14-Dec-14	87
15-Dec-14	87
16-Dec-14	94
17-Dec-14	72
18-Dec-14	93
19-Dec-14	80
20-Dec-14	56
21-Dec-14	77
22-Dec-14	71
23-Dec-14	61
02-Jan-15	98
03-Jan-15	99
12-Jan-15	61
13-Jan-15	61
17-Jan-15	69
18-Jan-15	64
19-Jan-15	76
22-Jan-15	64
27-Jan-15	67
28-Jan-15	67

TRA-2	
Date	**TSP concentration ($\mu g/m^3$, 24-h average)**

Appendix 4 – Dust Deposition Data (Insoluble Fraction)

Date	Site 5 (Burrup Road) g/m^2/month	Site 6 (Water Tanks) g/m^2/month	Site 7 (Deep Gorge) g/m^2/month
Sep-13	0.077	0.00	0.011
Oct-13	0.093	1.20	1.50
Nov-13	1.58	0.35	1.19
Dec-13	1.71	2.05	0.95
Jan-14	NS	NS	NS
Feb-14	NS	NS	NS
Mar-14	1.42	NS	1.42
Apr-14	0.093	0.47	0.45
May-14	0.033	0.03	0.03
Jun-14	0.022	0.05	0.01
Jul-14	1.57	2.04	1.98
Aug-14	1.76	0.65	1.08
Sep-14	0.56	0.38	0.94
Oct-14	NS	NS	NS
Nov-14	1.68	1.51	2.50
Dec-14	NS	NS	NS
Jan-15	2.00	1.27	5.03
Feb-15	0.84	1.45	1.11
Mar-15	NS	1.29	0.71
Apr-15	NS	NS	NS
May-15	NS	1.35	0.82
Jun-15	NS	0.26	0.12
Jul-15	0.44	0.47	0.35
Aug-15	0.44	0.58	0.43
Sep-15	0.50	0.77	1.18
Oct-15	0.85	0.79	0.77
Nov-15	0.54	1.25	2.03
Dec-15	1.72	0.73	1.87
Jan-16	1.06	1.37	1.19
Feb-16	0.64	0.78	0.74
Mar-16	0.74	0.60	0.01
Apr-16	0.82	0.76	1.70
May-16	0.49	0.58	0.31
Jun-16	1.22	0.42	0.62