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# Ambient air quality report 2017-2018

EPBC 2008/45546

Prepared for  
Yara Pilbara Nitrates  
by Strategen

October 2018



# **Ambient air quality report 2017-2018**

**EPBC 2008/45546**

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Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
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## 1. Introduction

Conditions 9 and 9A of EPBC Approval 2008/4546 (as varied on 12 September 2017) for the Yara Pilbara Nitrates Pty Ltd (YPN) Technical Ammonium Nitrate Plant (TAN Plant) require monitoring of various air quality parameters. Condition 3 of the Approval outlines reporting requirements that include data from the monitoring program conducted under condition 9A. This report is provided in response to Condition 3(a)A of the EPBC Approval.

## 2. Definitions and Acronyms

Table 1: Definitions and Acronyms

Term	Definition	Description and context for this report
TSP	Total suspended particulates	Dust particles which are present in ambient air with equivalent aerodynamic diameter of 50 micrometres ( $\mu\text{m}$ )
EPBC	Environment Protection and Biodiversity Conservation	Refers to the Australian Government EPBC Act of 1999
PM <sub>10</sub>	Particulate matter (10 micrometre)	Dust particles which are present in ambient air with equivalent aerodynamic diameter of 10 micrometres ( $\mu\text{m}$ )
$\mu\text{m}$	Micrometre	One millionth (0.000001) of a metre
YPN	Yara Pilbara Nitrates Pty Ltd	Operators of the TAN Plant
TAN Plant	Technical Ammonium Nitrate Plant	YPN plant on the Burrup for production of ammonium nitrate
NO <sub>2</sub>	Nitrogen dioxide	Gaseous air pollutant from combustion sources
SO <sub>2</sub>	Sulfur dioxide	Gaseous air pollutant from oxidation (combustion) of sulfur containing substances
NO <sub>x</sub>	Nitrogen oxides	Combination of NO and NO <sub>2</sub> , reported as NO <sub>2</sub>
SO <sub>x</sub>	Sulfur oxides	Combination of SO <sub>2</sub> and SO <sub>3</sub> , reported as SO <sub>2</sub>
NH <sub>3</sub>	Ammonia	Gaseous air pollutant from natural sources and industrial sources (including YPN TAN plant)
DDG	Dust deposition gauge	Device for sampling of dust which settles from the air column under gravity
MicroVol	MicroVol 1100 low volume sampler	LVAS instrument for sampling of TSP, manufactured by Ecotech
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
Passive sampling	Ambient air sampling for gaseous substances involving passive samplers	Sampling technique whereby airborne gaseous pollutants are extracted from the air column onto an adsorbent material via a diffusive mechanism
Soluble fraction	Component of deposited dust that is soluble in water	Deposited dust can comprise of aqueous soluble and insoluble materials depending on mechanisms and sources of dust emissions. The soluble fraction is typically derived from marine aerosols
Insoluble fraction	Component of deposited dust that is not soluble in water	Deposited dust can comprise of aqueous soluble and insoluble materials depending on mechanisms and sources of dust emissions. The insoluble fraction is typically derived from crustal materials.

### 3. Scope of Monitoring Program

#### 3.1 Conditions 9 and 9A

Conditions 9 and 9A of EPBC Approval 2008/4546 (as varied 12 September 2017) are 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 **Burrup Rock Art 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<sub>3</sub>);
  - Nitrogen Oxides (NO<sub>x</sub>);
  - Sulphur Oxides (SO<sub>x</sub>); 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)**.
- 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.

Note: Conditions 9 d), e) and f) were revoked. Requirements to publish air quality data are now in condition 14.

**9A.** To protect the values of the **Dampier Archipelago (including Burrup Peninsula) National Heritage Place**, particularly the **rock art sites**, the person taking the action must ensure:

- a) Ongoing air quality monitoring is undertaken within 30 days after this condition comes into effect (the date the relevant variation to conditions notice is signed) and until expiry of the approval.
- b) Air quality monitoring parameters are monitored at the **rock art sites**: Site 5 (Burrup Road), Site 6 (Water tanks site) and Site 7 (Deep Gorge site) as shown in [Attachment 2](#).
- c) Monitoring of air quality at **rock art sites** is undertaken by a **suitably qualified person (Air Quality)**

The air quality monitoring parameters in the table below must be monitored at the frequencies indicated in the table below.

Element of air quality to be monitored	Specific air quality parameter to be sampled	Minimum frequency of monitoring
Ambient air concentration of gases	NH <sub>3</sub> (ammonia)	Continuous monitoring for at least 14 consecutive days, every month
	NO <sub>2</sub> (nitrogen oxide)	
	SO <sub>2</sub> (sulfur oxide)	
Airborne particulate concentration	Total suspended particulates up to 50 µm (TSP)	Every 6 days
Deposited dust	Total dust deposition per month (Insoluble Fraction)	Quarterly
	Total dust deposition per month (Soluble Fraction)	

Conditions 9(a), (b), (c) and (d) refer to baseline monitoring to be conducted for a period of not less than 24 months from commencement of construction and for data from that monitoring to be reported to the Department after completion of construction.

YPN issued a report on the baseline monitoring to the Department on 16 June 2017 in compliance with requirements of Conditions 9(a), (b), (c) and (d) (YPN 2016).

### 3.2 Condition 3 (a)i

Condition 3 (a)i of EPBC Approval 2008/4546 (as varied 12 September 2017) requires (in part) publication of a report that includes “...an analysis of monitoring data required under Condition 9A...”.

This report provides a collation of all data obtained from the monitoring and an analysis of the data as required by the EPBC Approval.

### 3.3 Monitoring period

The most recent amendments to EPBC Approval 2008/4546 came into effect on 12 September 2017. The conditions relevant to the scope and reporting of air quality monitoring program only covered the period 12 September 2017 to 30 June 2018. Notwithstanding the date of the approval, YPN had conducted monitoring of all parameters ahead of the amendment date and is able to report data for the entire period 1 July 2017 to 30 June 2018.

## 4. Air Quality Monitoring Program

### 4.1 Gases (NH<sub>3</sub>, NO<sub>2</sub> and SO<sub>2</sub>)

#### 4.1.1 Results of NH<sub>3</sub>, NO<sub>2</sub> and SO<sub>2</sub> monitoring

YPN continued monitoring of gases (and TSP and deposited particulate matter) after completion of construction of the TAN Plant and generation of the baseline data. That monitoring was conducted as per Condition 9 in EPBC Approval 2008/4546 (dated 14 September 2011) up until 12 September 2017 when the amended approval came into effect. Data are therefore available for reporting of an entire 12 month period (1 July 2017 to 30 June 2018) and includes the months prior to issue of the amended Approval on 12 September 2017.

Results of monitoring are shown in Appendix 1. A total of 23 measurements were made of concentrations for the respective gases at each site in the period 1 July 2017 to 30 June 2018. The July 2017 sampling actually commenced on 30 June 2017 when samplers deployed for the previous fortnight were replaced. The June 2018 sampling actually concluded on 29 June 2018. The “early” commencement and conclusion of sampling in the indicated 12 month period has no material impact on the interpretation of air quality impacts for these gases.

The concentrations for each parameter at the respective sites are illustrated in Figure 1 for NH<sub>3</sub>, Figure 2 for NO<sub>2</sub> and for SO<sub>2</sub>. These data are sorted from lowest to highest concentrations, with a log<sub>2</sub> Y-axis scale utilised for ease of comparison of data across the entire monitoring period.

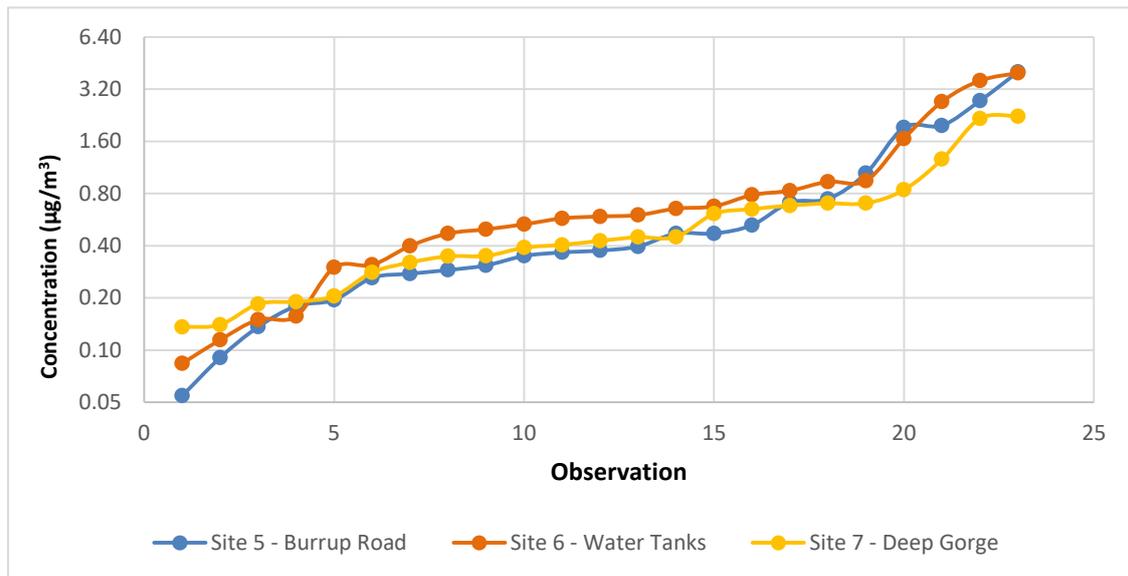


Figure 1: NH<sub>3</sub> concentrations sorted in ascending order for 1 July 2017 to 30 June 2018

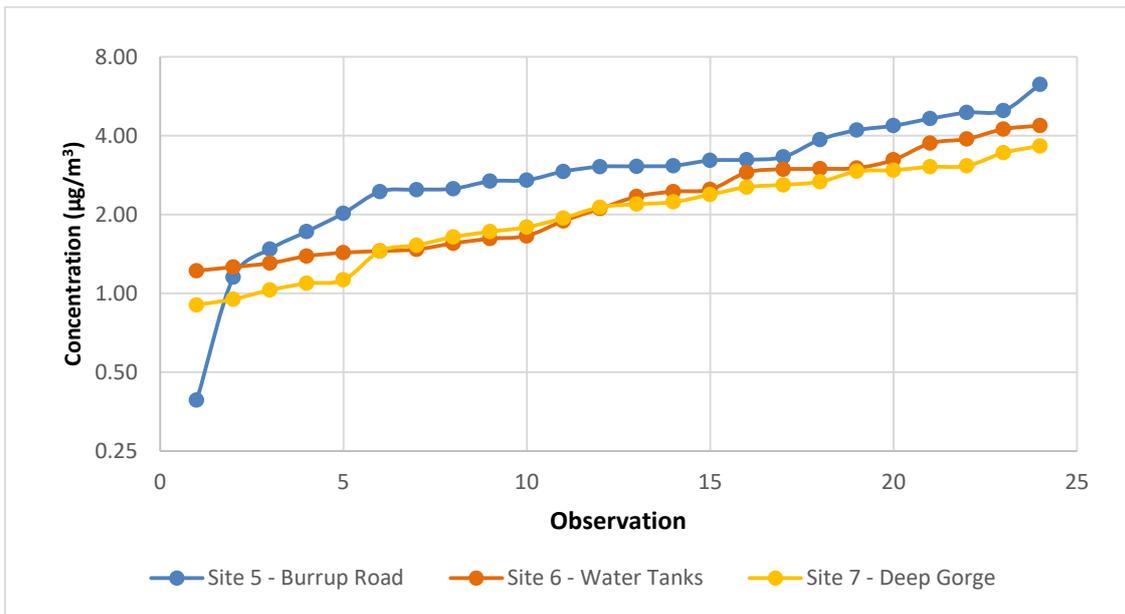


Figure 2: NO<sub>2</sub> concentrations sorted in ascending order for 1 July 2017 to 30 June 2018

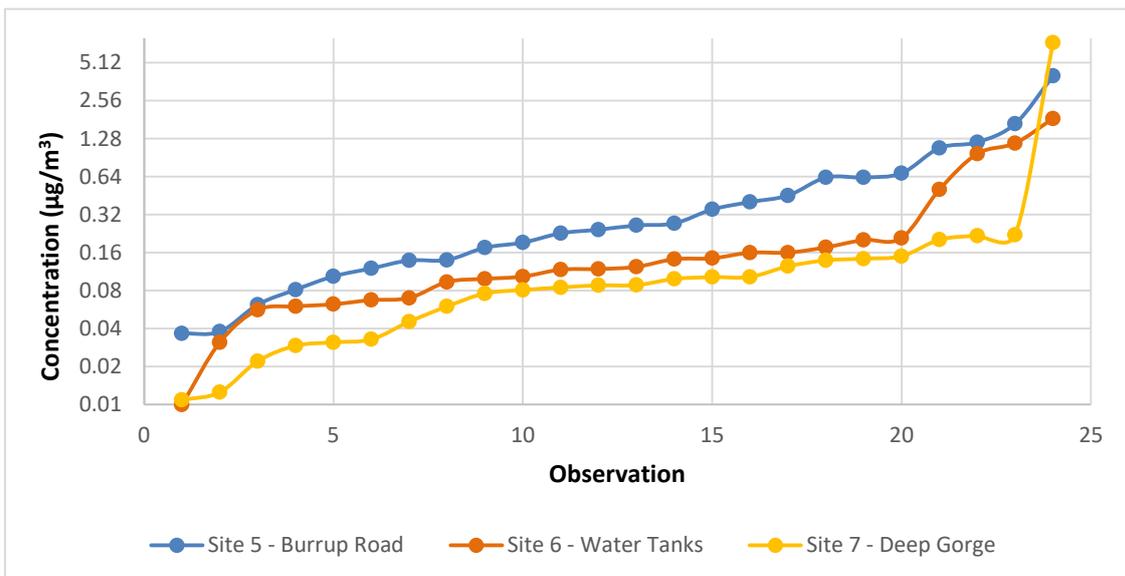


Figure 3: SO<sub>2</sub> concentrations sorted in ascending order for 1 July 2017 to 30 June 2018

#### 4.1.2 Analysis of NH<sub>3</sub>, NO<sub>2</sub> and SO<sub>2</sub> data

The analysis of measured concentrations involved comparison of descriptive statistics for 2017-2018 with those from monitoring conducted in the baseline study (YPN 2016). These statistics are shown in Table 2 for NH<sub>3</sub>, Concentrations are µg/m<sup>3</sup>

Table 3 for NO<sub>2</sub> and Concentrations are µg/m<sup>3</sup>

Table 4 for SO<sub>2</sub>.

Table 2: Descriptive statistics for NH<sub>3</sub> concentrations (2017-2018 and baseline) µg/m<sup>3</sup>

Statistic	Site 5 - Burrup Rd		Site 6 - Water Tanks		Site 7 - Deep Gorge	
	2017-2018	Baseline	2017-2018	Baseline	2017-2018	Baseline
Minimum	0.05	0.00	0.08	0.00	0.14	0.00
Average	0.78	0.44	0.94	0.93	0.61	0.75
Maximum	4.02	1.20	3.96	3.97	2.22	4.35
Standard deviation	0.98	0.34	1.06	0.76	0.56	0.82

Concentrations are µg/m<sup>3</sup>Table 3: Descriptive statistics for NO<sub>2</sub> monitoring (2017-2018 and baseline) µg/m<sup>3</sup>

Statistic	Site 5 - Burrup Rd		Site 6 - Water Tanks		Site 7 - Deep Gorge	
	2017-2018	Baseline	2017-2018	Baseline	2017-2018	Baseline
Minimum	0.39	0.38	1.22	0.31	0.90	0.40
Average	3.11	3.60	2.37	2.56	2.13	2.31
Maximum	6.29	6.53	4.37	5.27	3.66	4.12
Standard deviation	1.34	1.46	1.00	1.04	0.82	0.69

Concentrations are µg/m<sup>3</sup>Table 4: Descriptive statistics for SO<sub>2</sub> monitoring (2017-2018 and baseline)

Statistic	Site 5 - Burrup Rd		Site 6 - Water Tanks		Site 7 - Deep Gorge	
	2017-2018	Baseline	2017-2018	Baseline	2017-2018	Baseline
Minimum	0.04	0.07	0.01	0.00	0.01	0.13
Average	0.55	1.38	0.23	0.95	0.40	0.82
Maximum	4.02	3.09	1.85	3.50	7.40	2.01
Standard deviation	0.85	0.83	0.44	0.84	1.49	0.53

Concentrations are µg/m<sup>3</sup>

The concentrations from 2017-2018 have been compared with the baseline (for each location) via t-tests to determine if differences in the average concentrations are statistically significant. The results are summarised in Table 5.

Table 5: T-test results for comparison of 2017-2018 and baseline NH<sub>3</sub>, NO<sub>2</sub> and SO<sub>2</sub> concentration data

Parameter	Monitoring period	Statistic	Site 5 - Burrup Rd	Site 6 - Water Tanks	Site 7 - Deep Gorge
NH <sub>3</sub>	2017-2018	Average	0.78	0.94	0.61
	baseline	Average	0.44	0.93	0.75
		P value	0.12	0.98	0.44
NO <sub>2</sub>	2017-2018	Average	3.11	2.37	2.13
	baseline	Average	3.60	2.56	2.31
		P value	0.19	0.47	0.38
SO <sub>2</sub>	2017-2018	Average	0.55	0.28	0.40
	baseline	Average	1.38	0.95	0.82
		P value	0.0005	0.00002	0.19

Concentrations are µg/m<sup>3</sup>

Key findings from these data are summarised in Table 6.

Table 6: Analysis of NH<sub>3</sub>, NO<sub>2</sub> and SO<sub>2</sub> concentration data

Parameter	Site	Finding
NH <sub>3</sub>	Burrup Rd	Differences in average concentrations from 2017-2018 and baseline monitoring of these parameters at these sites are not statistically significant
	Water Tanks	
	Deep Gorge	
NO <sub>2</sub>	Burrup Rd	Differences in average concentrations from 2017-2018 and baseline monitoring of these parameters at these sites are not statistically significant
	Water Tanks	
	Deep Gorge	
SO <sub>2</sub>	Burrup Rd	The (lower) average concentration from 2017-2018 monitoring compared with baseline monitoring is statistically significant
	Water Tanks	The (lower) average concentration from 2017-2018 monitoring compared with baseline monitoring is statistically significant
	Deep Gorge	Difference in average concentrations from 2017-2018 and baseline monitoring is not statistically significant

The reasons for the decrease in average SO<sub>2</sub> concentrations at Burrup Rd and Water Tanks sites are not known. YPN is not a significant emitter of SO<sub>2</sub> which suggests reductions in emissions from other industries in the Burrup airshed may have driven the overall reduction in ambient concentrations.

The statistically insignificant differences in average concentrations of NH<sub>3</sub> and NO<sub>2</sub> at all three sites suggests negligible impacts from operation of the TAN plant in 2017-2018.

## 4.2 Total Suspended Particulates

### 4.2.1 Results of TSP monitoring 2017-2018

Results of TSP monitoring at the three sites are shown in Appendix 2. A total of 59 samples were collected at Site 5, 61 samples at Site 6 and 57 samples at Site 7. Some samples were lost at Sites 5 and 7 due to instrument failures. The loss of the small number of samples is of no material significance in respect of characterising the TSP levels over the 12 months of monitoring.

The TSP concentrations at the respective sites are illustrated in Figure 4. These data are sorted from lowest to highest concentrations, with a log<sub>2</sub> Y-axis scale utilised for ease of comparison of data across the entire monitoring period.

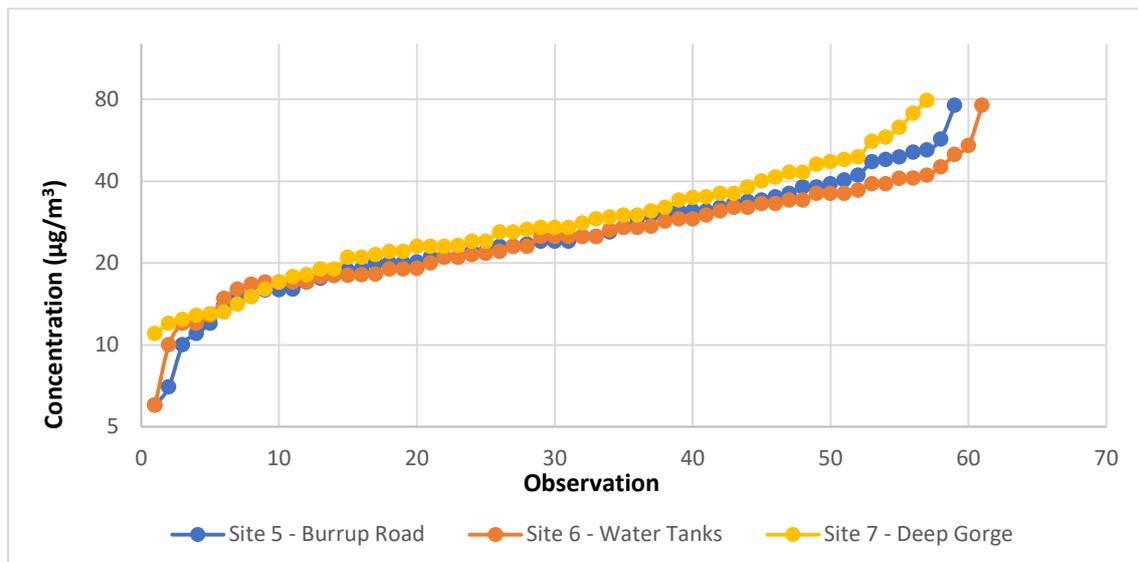


Figure 4: TSP concentrations sorted in ascending order for 1 July 2017 to 30 June 2018

#### 4.2.2 Analysis of TSP data

Descriptive statistics for TSP monitoring at all three sites are shown in Table 7. Data from the baseline study are derived from direct measurements and estimates calculated from measured PM<sub>10</sub> concentrations as described in the baseline report (YPN 2016).

Table 7: Descriptive statistics for TSP monitoring 2017-2018 and baseline – all sites

Statistic	Site 5 - Burrup Rd			Site 6 - Water Tanks			Site 7 - Deep Gorge		
	2017-2018	Baseline (measured)	Baseline (PM <sub>10</sub> derived)	2017-2018	Baseline (measured)	Baseline (PM <sub>10</sub> derived)	2017-2018	Baseline (measured)	Baseline (PM <sub>10</sub> derived)
Minimum	6	8	12	6	12	6	11	8	1
Average	28	19	21	27	84	15	30	16	28
Maximum	76	32	40	76	1417	34	79	26	46
Standard deviation	13	6.6	6.1	12	167	5.9	15	6.1	5.5

Concentrations are µg/m<sup>3</sup>

The measured baseline TSP concentrations at Water Tanks

The concentrations from 2017-2018 have been compared with the measured and PM<sub>10</sub> derived TSP baseline distribution (for each location) via t-tests to determine if differences in the average concentrations are statistically significant. The results are summarised in Table 8.

Table 8: T-test results for comparison of 2017-2018 and baseline NH<sub>3</sub>, NO<sub>2</sub> and SO<sub>2</sub> concentration data

Parameter	Monitoring period	Statistic	Site 5 - Burrup Rd	Site 6 - Water Tanks	Site 7 - Deep Gorge
TSP	2017-2018	Average	28	27	30
	Baseline (measured)	Average	19	84	16
	Baseline (PM <sub>10</sub> derived)	Average	21	15	29
	2017-2018 vs baseline (measured)	P value	0.0090	0.0026	0.0000035
	2017-2018 vs baseline (PM <sub>10</sub> derived)	P value	0.000892	0.0000000008	0.63

Concentrations are µg/m<sup>3</sup>

TSP concentrations are reasonably consistent at the three sites in 2017-2018 (Figure 4) which suggests absence of significant direct impacts from individual sources. The average 2017-2018 concentrations are statistically significantly different from measured baseline concentrations at all three sites and PM<sub>10</sub> derived TSP concentrations at Sites 5 and 6. Relatively high TSP concentrations were measured at Site 6 in the baseline study (compared with 2017-2018 concentrations), which may have reflected impacts from nearby construction activities (such as earthworks) at that location. Those activities have ceased and the levels at Site 6 are aligned with those at the other two sites for 2017-2018 monitoring.

In contrast to the measured TSP concentrations at Site 6 from the baseline study, the TSP data derived from PM<sub>10</sub> measurements also made at that site did not include predictions of higher concentrations. On closer examination, this was attributed to the timing of TSP sampling and PM<sub>10</sub> measurements at that location. More specifically, these parameters were only measured concurrently for a 2 week period in Sept/Oct 2013, with the TSP sampling continuing to end March 2017 (when the baseline study ceased). Relatively low TSP concentrations were measured in that 2 week period.

On average, the TSP concentrations from 2017-2018 are higher at Site 5 compared with the baseline concentrations, lower than baseline concentrations at Site 6 and higher than the measured concentrations from the baseline study at Site 7. These differences for Site 5 and 7 are more likely driven by the relatively small data sets for measured and estimated TSP concentrations. As indicated above, the consistency in TSP concentrations across the three sites for 2017-2018 suggests impacts from individual sources (including the TAN plant) are negligible and the TSP concentrations more likely reflect general background levels at the Burrup.

## 4.3 Dust deposition

### 4.3.1 Results from monitoring of deposited dust for 2017-2018

Results of dust deposition monitoring at the three sites are shown in Table 9.

Table 9: Results of dust deposition monitoring 2017-2018

Date Deployed	Date Collected	Site 5 - Burrup Road		Site 6 - Water Tanks		Site 7 - Deep Gorge	
		Soluble solids	Insoluble solids	Soluble solids	Insoluble solids	Soluble solids	Insoluble solids
		g/m <sup>2</sup> /month					
07-06-17	13-07-17	<0.7	<0.8	<0.7	<0.8	<0.7	<0.8
20-07-17	31-08-17	0.7	<0.8	0.8	<0.8	<0.7	<0.8
31-08-17	29-09-17	<0.7	3.7	<0.7	<0.8	<0.7	1.1
29-09-17	31-10-17	<0.7	<0.8	<0.7	<0.8	<0.7	1.3
31-10-17	30-11-17	<0.7	<0.8	0.8	<0.8	<0.7	1.2
30-11-17	02-01-18	<0.7	<0.8	0.7	<0.8	1.0	0.9
02-01-18	31-01-18	1.9	<0.8	1.6	1.2	1.0	1.2
31-01-18	28-02-18	1.1	<0.8	0.8	0.9	1.7	1.0
28-02-18	29-03-18	0.8	<0.8	1	0.9	<0.7	1.1
29-03-18	27-04-18	<0.7	<0.8	<0.7	<0.8	<0.7	1.0
27-04-18	31-05-18	<0.7	<0.8	<0.7	<0.8	<0.7	<0.8
31-05-18	28-06-18	1.3	<0.8	1.6	<0.8	<2	<0.8

Notes: 1. For logistical reasons, July 2017 sampling commenced on 7 June 2017 and concluded 13 July 2017, and the August 2017 sampling commenced on 20 July 2017 and concluded 31 August 2017. The "early" commencement and conclusion of sampling has no material impact on the interpretation of air quality impacts of deposited materials.

### 4.3.2 Analysis of dust deposition data

A comparison of dust deposition data from 2017-2018 against the baseline study is limited to the insoluble fraction. The soluble fraction was not determined in samples collected for the baseline study, since the EPBC Approval 2008/4546 at the time (dated 14 September 2011) only required measurements of TSP and "dust". The latter requirement was interpreted to mean the insoluble fraction of deposited dust. The amended approval of 12 September 2017 now requires both insoluble and soluble fractions of deposited dust to be monitored.

Dust deposition data from 2017-2018 and the baseline study are shown in Table 10.

Table 10: Descriptive statistics for dust deposition monitoring 2017-2018 and baseline study

Statistic	Burrup Rd (g/m <sup>2</sup> /month)			Water Tanks (g/m <sup>2</sup> /month)			Deep Gorge (g/m <sup>2</sup> /month)		
	2017-2018		Baseline	2017-2018		Baseline	2017-2018		Baseline
	Soluble	Insoluble	Insoluble	Soluble	Insoluble	Insoluble	Soluble	Insoluble	Insoluble
Minimum	0.35	0.40	0.02	0.35	0.40	0.00	0.35	0.40	0.01
Average	0.69	0.68	0.88	0.75	0.55	0.84	0.63	0.87	1.07
95th percentile	1.57	1.89	1.75	1.60	1.04	1.86	1.32	1.25	2.31
Maximum	1.90	3.70	2.00	1.60	1.20	2.05	1.70	1.30	5.03

Notes: 1. Half method detection limit deposition rates for non-detect results were used for calculations of statistics.

Insoluble deposition rates are reasonably consistent at Burrup Rd for 2017-2018 monitoring compared with the baseline data. Rates at Water Tanks and Deep Gorge appear lower in the 2017-2018 monitoring. The reductions may reflect completion of construction of the TAN plant and a reduction in crustal dust emitted during earthworks.

Note that these comparisons reflect the use of non-detect deposition rates of half the detection limits. The actual reductions may be lower or higher depending on the actual deposition rates.

The soluble deposition rates are very consistent across the three sites. This most likely reflects the marine influence on air quality on the Burrup, with sea salt aerosols likely to be a significant contributor to deposited materials.

## 5. Concluding remarks

Monitoring data are reported for all parameters specified in EPBC Approval 2008/4546 of 12 September 2017.

Analysis of data for gases shows the following:

- Average NH<sub>3</sub> and NO<sub>2</sub> concentrations observed at all three monitoring locations in 2017-2018 are not statistically significantly different to those concentrations measured in the baseline study
- Average SO<sub>2</sub> concentrations at Burrup Rd and Water Tanks sites in 2017-2018 are lower than the baseline concentrations, with differences in the averages statistically significant.
- Average NH<sub>3</sub> concentrations were similar at the three monitoring locations in 2017-2018
- Average NO<sub>2</sub> concentrations were similar at Sites 6 and 7 in 2017-2018
- A higher average NO<sub>2</sub> concentration was observed at Site 5 compared with Sites 6 and 7, with the difference statistically significant.
- Overall, there is no evidence to suggest operation of the TAN plant has resulted in materially significant increases in ambient concentrations of the indicated gases over the 12 months of monitoring.

Analysis of TSP data shows the following:

- TSP concentrations are reasonably consistent at the three sites in 2017-2018 which suggests absence of direct impacts from individual sources.
- The 2017-2018 TSP concentrations at Water Tanks site are on average well below the concentrations in the baseline study, which may reflect a reduction in dust emissions from completion of construction activities
- Overall, there is no evidence to suggest operation of the TAN plant has resulted in materially significant increases in ambient concentrations of TSP

Analysis of dust deposition data shows the following:

- Insoluble deposition rates are reasonably consistent at Burrup Rd for 2017-2018 monitoring compared with the baseline data.
- Rates at Water Tanks and Deep Gorge appear lower in the 2017-2018 monitoring.
- The reductions **may** reflect completion of construction of the TAN plant and a reduction in crustal dust emitted during earthworks
- Soluble deposition rates are very consistent across the three sites due to deposition of sea salt aerosols
- Overall, there is no evidence to suggest operation of the TAN plant has resulted in materially significant increases in dust deposition rates

## 6. Reference

YPN (2016). *Yara Pilbara Nitrates, EPBC Approval 2008/4546. Baseline Air Quality Monitoring Report.*  
Document 250-200-EP-PN-0002, issued 16 June 2017.

## **Appendix 1**

**Results from monitoring of gases for 2017-2018**



Site	Date On	Date Off	NH <sub>3</sub> µg/m <sup>3</sup>	NO <sub>2</sub> µg/m <sup>3</sup>	SO <sub>2</sub> µg/m <sup>3</sup>
Site 5 - Burrup Road	30-06-2017	14-07-2017	1.97	4.90	0.24
Site 6 - Water Tanks	30-06-2017	14-07-2017	1.03	2.89	0.18
Site 7 - Deep Gorge	30-06-2017	14-07-2017	0.21	2.19	0.08
Site 5 - Burrup Road	14-07-2017	31-07-2017	0.47	6.29	0.26
Site 6 - Water Tanks	14-07-2017	31-07-2017	1.66	4.26	0.16
Site 7 - Deep Gorge	14-07-2017	31-07-2017	0.45	3.44	0.10
Site 5 - Burrup Road	31-07-2017	14-08-2017	Note 1	3.22	0.08
Site 6 - Water Tanks	31-07-2017	14-08-2017	Note 1	2.28	0.06
Site 7 - Deep Gorge	31-07-2017	14-08-2017	Note 1	1.64	0.01
Site 5 - Burrup Road	09-08-2017	31-08-2017	2.74	Note 1	Note 1
Site 6 - Water Tanks	09-08-2017	31-08-2017	3.72	Note 1	Note 1
Site 7 - Deep Gorge	09-08-2017	31-08-2017	0.65	Note 1	Note 1
Site 5 - Burrup Road	14-08-2017	31-08-2017	Note 1	4.37	0.27
Site 6 - Water Tanks	14-08-2017	31-08-2017	Note 1	3.54	0.12
Site 7 - Deep Gorge	14-08-2017	31-08-2017	Note 1	2.55	0.10
Site 5 - Burrup Road	31-08-2017	14-09-2017	1.05	3.87	0.14
Site 6 - Water Tanks	31-08-2017	14-09-2017	0.63	2.91	0.06
Site 7 - Deep Gorge	31-08-2017	14-09-2017	0.68	2.60	0.20
Site 5 - Burrup Road	14-09-2017	29-09-2017	0.74	4.65	0.18
Site 6 - Water Tanks	14-09-2017	29-09-2017	0.94	4.42	0.07
Site 7 - Deep Gorge	14-09-2017	29-09-2017	0.84	3.66	0.10
Site 5 - Burrup Road	29-09-2017	17-10-2017	0.26	4.20	0.19
Site 6 - Water Tanks	29-09-2017	17-10-2017	0.30	3.21	0.10
Site 7 - Deep Gorge	29-09-2017	17-10-2017	0.28	2.67	0.09
Site 5 - Burrup Road	17-10-2017	31-10-2017	0.29	4.99	0.23
Site 6 - Water Tanks	17-10-2017	31-10-2017	0.32	3.60	0.09
Site 7 - Deep Gorge	17-10-2017	31-10-2017	0.70	3.07	0.03
Site 5 - Burrup Road	31-10-2017	14-11-2017	0.31	3.07	0.10
Site 6 - Water Tanks	31-10-2017	14-11-2017	0.51	3.01	0.53
Site 7 - Deep Gorge	31-10-2017	14-11-2017	0.61	2.95	0.22
Site 5 - Burrup Road	14-11-2017	30-11-2017	0.09	2.45	0.63
Site 6 - Water Tanks	14-11-2017	30-11-2017	0.10	2.55	0.14
Site 7 - Deep Gorge	14-11-2017	30-11-2017	0.14	2.13	0.08
Site 5 - Burrup Road	30-11-2017	14-12-2017	0.18	0.39	4.02
Site 6 - Water Tanks	30-11-2017	14-12-2017	0.19	2.46	0.11
Site 7 - Deep Gorge	30-11-2017	14-12-2017	0.18	2.92	0.05
Site 5 - Burrup Road	14-12-2017	02-01-2018	0.05	2.71	0.63

Site	Date On	Date Off	NH <sub>3</sub> µg/m <sup>3</sup>	NO <sub>2</sub> µg/m <sup>3</sup>	SO <sub>2</sub> µg/m <sup>3</sup>
Site 6 - Water Tanks	14-12-2017	02-01-2018	0.09	3.00	1.18
Site 7 - Deep Gorge	14-12-2017	02-01-2018	0.35	3.04	0.03
Site 5 - Burrup Road	02-01-2018	16-01-2018	0.19	1.15	0.45
Site 6 - Water Tanks	02-01-2018	16-01-2018	0.64	1.71	1.85
Site 7 - Deep Gorge	02-01-2018	16-01-2018	2.17	1.94	0.02
Site 5 - Burrup Road	16-01-2018	31-01-2018	0.28	1.72	1.20
Site 6 - Water Tanks	16-01-2018	31-01-2018	0.30	1.26	0.12
Site 7 - Deep Gorge	16-01-2018	31-01-2018	2.22	0.90	0.08
Site 5 - Burrup Road	31-01-2018	14-02-2018	0.14	1.48	0.04
Site 6 - Water Tanks	31-01-2018	14-02-2018	0.17	1.42	0.97
Site 7 - Deep Gorge	31-01-2018	14-02-2018	0.32	1.13	0.09
Site 5 - Burrup Road	14-02-2018	28-02-2018	0.40	2.02	0.04
Site 6 - Water Tanks	14-02-2018	28-02-2018	0.60	1.45	0.03
Site 7 - Deep Gorge	14-02-2018	28-02-2018	0.70	1.45	0.03
Site 5 - Burrup Road	28-02-2018	15-03-2018	0.37	3.24	0.06
Site 6 - Water Tanks	28-02-2018	15-03-2018	0.53	1.55	0.12
Site 7 - Deep Gorge	28-02-2018	15-03-2018	0.39	1.09	0.01
Site 5 - Burrup Road	15-03-2018	29-03-2018	0.37	2.92	0.68
Site 6 - Water Tanks	15-03-2018	29-03-2018	0.40	1.89	0.20
Site 7 - Deep Gorge	15-03-2018	29-03-2018	0.43	2.38	0.22
Site 5 - Burrup Road	29-03-2018	13-04-2018	0.35	2.49	1.68
Site 6 - Water Tanks	29-03-2018	13-04-2018	0.59	1.47	0.12
Site 7 - Deep Gorge	29-03-2018	13-04-2018	0.35	2.23	0.14
Site 5 - Burrup Road	13-04-2018	27-04-2018	0.53	3.06	0.40
Site 6 - Water Tanks	13-04-2018	27-04-2018	0.78	2.34	0.21
Site 7 - Deep Gorge	13-04-2018	27-04-2018	0.45	1.72	0.12
Site 5 - Burrup Road	27-04-2018	15-05-2018	1.92	3.05	0.35
Site 6 - Water Tanks	27-04-2018	15-05-2018	2.71	1.62	0.16
Site 7 - Deep Gorge	27-04-2018	15-05-2018	0.40	1.53	0.14
Site 5 - Burrup Road	15-05-2018	31-05-2018	0.71	3.32	0.14
Site 6 - Water Tanks	15-05-2018	31-05-2018	3.58	1.43	0.06
Site 7 - Deep Gorge	15-05-2018	31-05-2018	0.19	1.03	0.06
Site 5 - Burrup Road	31-05-2018	15-06-2018	4.02	2.68	0.12
Site 6 - Water Tanks	31-05-2018	15-06-2018	0.83	1.26	0.07
Site 7 - Deep Gorge	31-05-2018	15-06-2018	1.26	1.79	7.40
Site 5 - Burrup Road	15-06-2018	29-06-2018	0.47	2.51	1.08
Site 6 - Water Tanks	15-06-2018	29-06-2018	0.47	1.22	0.01
Site 7 - Deep Gorge	15-06-2018	29-06-2018	0.14	0.95	0.15

Notes: 1. Samplers for NH<sub>3</sub> monitoring were deployed for 3 week period in August 2017 due to delay in supply of new sampler adsorbent tubes. Sampling for NO<sub>2</sub> and SO<sub>2</sub> was not affected, and results for those gases are two-week averages as per all other results from the program

## **Appendix 2**

### **Results from TSP monitoring for 2017-2018**



Sampling Start Date	Site 5 (Burrup Road)	Site 6 (Water Tanks)	Site 7 (Deep Gorge)
	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$
30-06-17	16	27	18
06-07-17	15	Note 1	18
12-07-17	22	17	13
18-07-17	20	19	12
24-07-17	21	Note 1	19
27-07-17	15	Note 1	26
05-08-17	16	19	13
11-08-17	19	15	27
17-08-17	20	18	23
23-08-17	34	28	21
29-08-17	23	18	12
04-09-17	27	21	14
10-09-17	29	22	29
16-09-17	40	41	41
22-09-17	18	26	35
28-09-17	24	21	27
04-10-17	31	32	48
10-10-17	17	54	24
16-10-17	18	23	63
22-10-17	57	50	49
28-10-17	33	33	35
03-11-17	42	36	40
09-11-17	38	36	71
15-11-17	30	34	34
21-11-17	31	39	43
27-11-17	35	39	46
03-12-17	48	30	43
09-12-17	51	31	32
15-12-17	34	37	58
21-12-17	38	34	27
27-12-17	39	41	36
02-01-18	49	27	29
08-01-18	52	45	56
14-01-18	Note 2	33	Note 2
20-01-18	20	27	36
26-01-18	32	36	38
01-02-18	7	10	11
07-02-18	23	25	26
13-02-18	26	29	28
19-02-18	31	42	47

Sampling Start Date	Site 5 (Burrup Road)	Site 6 (Water Tanks)	Site 7 (Deep Gorge)
	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$
25-02-18	22	29	31
03-03-18	Note 3	19	Note 3
09-03-18	24	20	21
15-03-18	36	21	27
21-03-18	23	25	24
27-03-18	47	Note 3	Note 3
02-04-18	16	17	15
08-04-18	76	76	79
14-04-18	20	17	16
20-04-18	14	17	21
26-04-18	24	32	30
02-05-18	21	25	23
08-05-18	25	22	22
14-05-18	25	23	30
20-05-18	21	25	23
26-05-18	10	17	13
01-06-18	30	25	17
07-06-18	6	6	Note 4
13-06-18	11	12	22
19-06-18	19	18	23
25-06-18	12	16	19

- Notes:
1. Sample damaged during recovery and not analysed.
  2. MicroVol instruments failed and were replaced. No samples collected.
  3. Filter from previous start date sampled twice (2 x 24 periods)
  4. Brown strip of dirt observed on filter – appears to have been contaminated during recovery. Sample rejected