NRC

RONPHOS DUST ASSESSMENT 2008

Crushing
Drying
Storage
Transportation
Shipping
Local Community

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20th March to 3 April

2008

[FOR NRC NAURU]

CONTENTS

TABLES

FIGURES

1 INTRODUCTION

Particulate Matter (PM) includes a wide range of sizes and types of particles and will vary in composition from place to place and time to time. Most dust particles are too big to be inhaled but can cause eye, nose and throat irritation and lead to deposition on cars, windows and property.

PM10 is of more concern to human health as the particles can enter the lungs, causing breathing and respiratory problems, with long-term health effects dominated by cardiovascular rather than respiratory problems. (ie asthma) and mortality (deaths brought forward).

Particles can also carry adhered carcinogenic compounds into the lungs. The most vulnerable people are the elderly, the very young and those with existing heart and lung conditions.

For Nauru and Ronphos, material undergoes crushing and drying and shipping 12mm aggregate, the material can be considered as inert phosphate that generates dust. Over the past several years minimal maintenance on the plant has resulted in the deterioration of equipment and supporting infrastructure. The recommencement of higher throughput has resulted in higher dust emissions from the Crushing and Drying facilities called Unit 3.

Located approx 29 meters above sea level, light winds blow from an easterly direction over command ridge towards Aiwo from the tennis court to the North of Unit 3 (N: 0712724 E: 9941102) to the Civic Centre to the South of unit 3 (N: 0712725 E: 9940409)

Elevation of these areas is approximately 7 meters and potentially affects areas approximately 425 x 580 meters.

Nauru is experiencing an unseasonal dry period, resulting in dryer than normal ore. With cool nights and high day temperatures, thermal convention cause periods of warm- hot air to rise. Air streams from the east move over the island moving particle matter and subsequent complaints from the Aiwo area located adjacent and west of the Crushing and Drying facility.

Generally, Phosphate mines generate particles in the air at the range of 0.23 to 11.44 grams per cubic meter of air and the particle size varies from 0.5 to 100um (microns)

A 24 hour trial test on Ronphos's Unit 3 drying plant conveyors estimated 1.5 tons of dust are produced every 24 hours during operations.

Dust emissionare subject to dust control. Hence, Unit 3 Crusher and Dryer's are the primary source of dust generations. There are numerous expensive dust collection/filter systems on the market that reduces dust emissions and containment strategies.

However, there are secondary emissions at Unit 3, for example existing settled dust around the plant, which if removed can reduce air born dust emissions and general housekeeping to improve containment. (see Recommendations)

Approximately 900,000 samples were taken, data in ASC format has been provided separately in a digital readable format. This data is represented in Figure 1, summaries are also provide in Section 4.

Inexpensive dust containment practices, site cleanup and ongoing housekeeping are significant issues in reducing dust.

1.1 SURVEY PURPOSE / OBJECTIVES

The objective is to measure PM10 and Nuisance dust levels at Unit 3 and downstream from the facility in areas potentially affecting workers, the local business and residential community.

Results are tabulated against international standards and guidelines. However, these standards vary from country to country. International Guidelines applied to Nuisance dust also varies from place to place, and is subject to the socio-economic and political situation of the country and affected areas.

1.2 SUMMARY OF FINDINGS

1.2.1 Inhalable Dust Summary

- Chemicals are not added during the process; hence the product is treated as an inert phosphate. (i.e chemically stable, to be verified)
- Key heavy metal of concern is Cadmium. Dust samples have been collected for assessment of cadmium and fluoride levels. The release of cadmium from drying inert phosphate is not yet known.
- "Background" dust levels on Nauru Island are well below PM10 recommended emissions (see Test1 & 2 Fig 1), The recommended standard for allowable dust emissions for inert PM 10 particles is represented in Figure 1 ie. 0.500m/gm.cum

The following are TWA increases from background levels for those samples:

- Cantilever 4 x higher than background
- Unit 3 (a) 29 x higher than background
- Unit 3 (b) 33 x higher than background
- Awio (a) 9 x higher than background
- Awio (b) 2.9 x higher than background
- Awio (c) 7.4 x higher than background
- Awio (d) 1.1x higher than background

(See Figure 1 & 2)

- The area affected by phosphate preparation are primarily the workplace and the Aiwo area immediately below the drying storage bins. An area of approx 250-300m is being affected by airborne dust. The Time Weighted Average (TWA) is used as a health guide. Due to weather conditions and the plant operations, low, high, average and TWA can vary from time to time.
- Sampling is based on a 24hor sampling period
- Dust emissions at the north peripheral area of Unit 3 is high and marginally under the PM10 Emission Standards
- Dust emissions adjacent to the dryer and crusher exceeds PM 10 emission standards

- The remaining sites, in particular, Aiwo District, have not been subjected to recommended PM10 Emission s for TWA (Figure 1 Graph Minimum, Average, Maximum TWA sites 1 to 9)
- PM2.5 ultra fine particles were not measured

1.2.2 Nuisance Dust

- The Aiwo area surveyed exceed emission guidelines for complaints.(Figure 2 TSP Nuisance Dust Results)
- Test Site 8 Aiwo (d) an area most likely to be impacted was surveyed during a wind change, a second set of 24hr readings could expect levels similar to Test 5 Aiwo(a) and Test 6 Aiwo (b)
- Site 2 Cantilever was tested during ship loading when no production at Unit 3 is occurring
- Dust monitoring levels confirm that nuisance complaints are likely when dust emissions exceed the nuisance guidelines.
- Like the weather and the wind, the nuisance/benefit ratio factor is a changing variable that can be minimised with basic plant maintenance and housekeeping procedures and minor containment modifications.

1.2.3 Other Observations

- There seems not to be a chronic health issue, although a health study has not been conducted.
- Security provide roaming visual monitoring in the Aiwo area

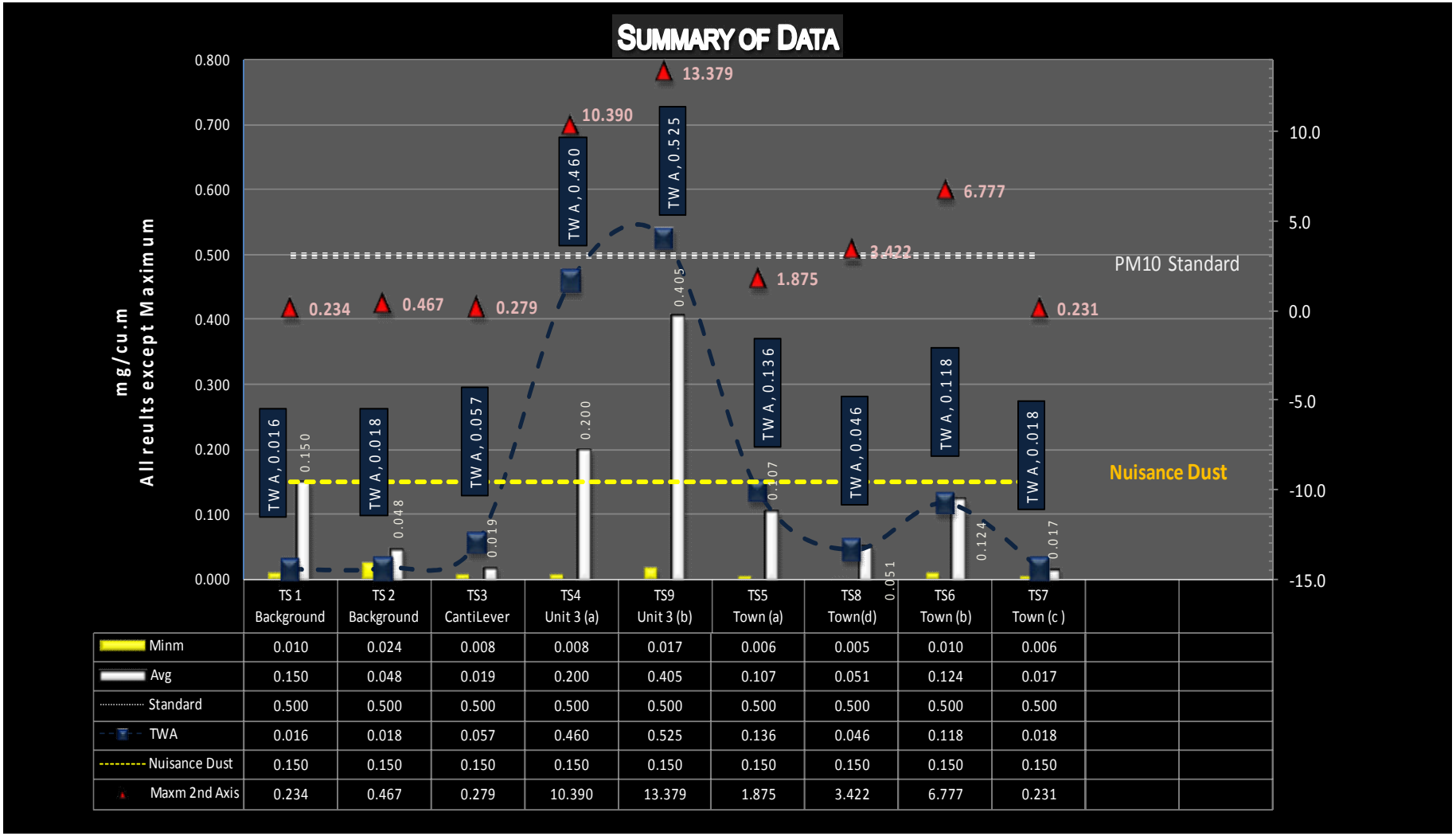
1.2.4 Air Borne - Background Results

- Test sites 1 & 2 provide an indication of "background" dust levels. It is reasonable to use 0.048mg/cu.m as the level of background dust for the Island.
- 4.8% of dust recorded are in the natural environment.
- Based on two sampling locations, the islands TWA (8hrs) of 0.016 mg/cu.m; well below Dust Exposure Standards of 0.500 mg/cu.m
- Dust measurements are every second and an average recorded every 10 seconds. High readings, (spikes) are likely to be a vehicle passing by or a short burst of wind.

1.2.5 Air Borne - Ship Loading Activities

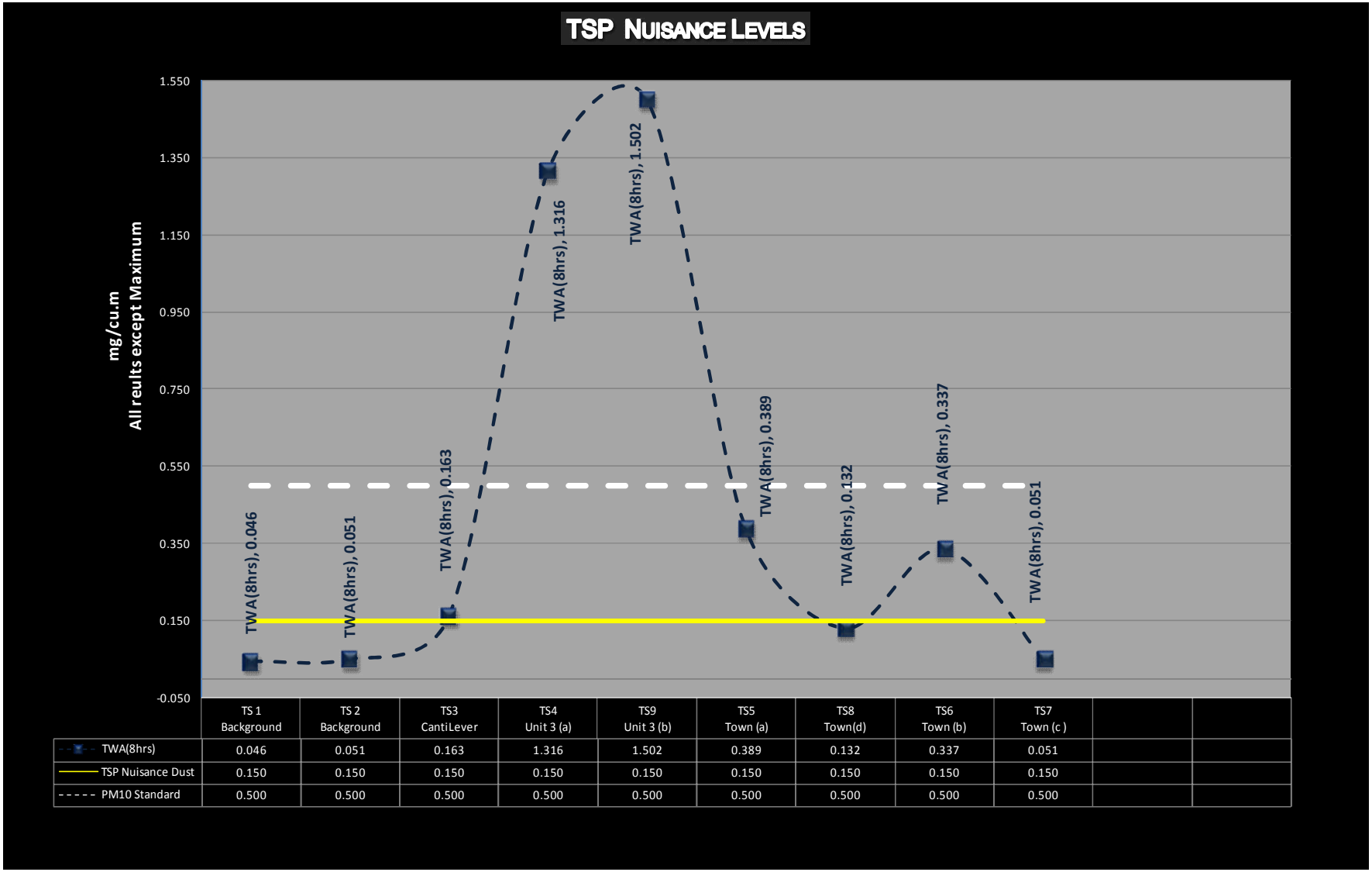
- This is a populated area with human activity such as tennis courts, roads and traffic in close proximity. Shore Bin and Conveyor leakage mostly contribute to emission levels.
- PM10 dust levels are 3 times higher than background, yet well below standard PM10 emission limits.
- The cantilever area has a TWA (8hrs) of 0.057mg/cu.m; below Dust Exposure Standards of 0.500 mg/cu.m

Figure 1 Graph Minimum, Average, Maximum TWA sites 1 to 9



	TS 1 Background	TS 2 Background	TS3 CantiLever	TS4 Unit 3 (a)	TS9 Unit 3 (b)	TS5 Town (a)	TS8 Town(d)	TS6 Town (b)	TS7 Town (c)
Minm	0.010	0.024	0.008	0.008	0.017	0.006	0.005	0.010	0.006
Avg	0.150	0.048	0.019	0.200	0.405	0.107	0.051	0.124	0.017
Standard	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
TWA	0.016	0.018	0.057	0.460	0.525	0.136	0.046	0.118	0.018
Nuisance Dust	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150
Maxm 2nd Axis	0.234	0.467	0.279	10.390	13.379	1.875	3.422	6.777	0.231

Figure 2 TSP Nuisance Dust Results



	TS 1 Background	TS 2 Background	TS3 CantiLever	TS4 Unit 3 (a)	TS9 Unit 3 (b)	TS5 Town (a)	TS8 Town(d)	TS6 Town (b)	TS7 Town (c)		
TWA(8hrs)	0.046	0.051	0.163	1.316	1.502	0.389	0.132	0.337	0.051		
TSP Nuisance Dust	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150		
PM10 Standard	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500		

1.2.6 Air Borne - Unit 3 (a)

Site 4 monitoring was conducted adjacent to the entrance security hut on the west side of the entrance track. This area has excessive dust depositions along the road and the surrounding area.

- The overall 24 average was 0.200mg/cum which is under the 0.500 mg/cu.m emission standard for PM10.
- During the hours of 9.30am and 8.30pm dust levels recorded were above the standard.
- Night levels remained low.
- A 30second event at 10:29:19pm record a high of 10.039mg/cu.m

The peak readings and elevated day readings are a result of :

- excessive dust on the ground being disturbed by wind and traffic
- missing cladding on conveyors and buildings and.
- These conditions resulted in TWA (8hrs) of 0.460 mg/cu.m just below Dust Exposure Standards of 0.500 mg/cu.m

1.2.7 Air Borne – Unit 3 (b)

Site 9 is located between dryer and drying bin with and in close proximity of the crusher and site access road

- This exceeds dust levels for Nuisance and PM 10 emissions
- TWA (8hrs) of 0.525 mg/cu.m above the Dust Exposure Standards of 0.500 mg/cu.m
- Maximum reading of 13.379 mg/cu.m was recorded

1.2.8 Air Borne - Local Residential Area Awio(a)

Sites 5 located in the front yard of the second house on the bitumen road leading to the crusher some 250 m from the crusher.

- This is a populated area with human activity and a main secondary bitumen road.
- PM10 dust levels are 8.5 times higher than background levels, however,
- PM10 dust levels are below PM10 emission standards.
- Awio (a) area has a TWA (8hrs) of 0.136mg/cu.m; below PM10 Dust Emission Exposure Standards of 0.500 mg/cu.m

1.2.9 Air Borne - Local Residential Area Awio(b)

Site 6 is located at the southern end of an (un-grassed) dirt football field and behind in the Unit 3 Drying Shed

- Houses are located in close proximity
- PM10 dust levels are 7.4 times higher than background, similar to Awio(a) , (c) & (d)
- Awio (b) area has a TWA (8hrs) of 0.118mg/cu.m; below PM10 Dust Emission Exposure Standards of 0.500 mg/cu.m

1.2.10 Air Borne - Local Residential Area Awio(c)

Site 7 is located between the Church Hall and a residential house on the western side of the main road

- This is populated, with houses and main road in close proximity.
- PM10 dust levels are 1.1 times higher than background, and
- lower than Awio(a), (b) ,(d) and below PM 10 standard limits.
- Awio (c) area has a TWA (8hrs) of 0.118 mg/cu.m, below PM10 Dust Emission Exposure Standards of 0.500 mg/cu.m.

1.2.11 Air Borne - Local Residential Area Awio(d)

Site 8 is located between behind Aiwo Petrol Station on the main road and behind Unit 3.

- This is populated with business premises and residential houses, main road and feeder road are in close proximity.
- Wind direction at the time of monitoring tended towards NW during the period of monitoring reflecting lower than expected results.
- PM10 dust levels are 1.1 times higher than background, and
- lower than Awio(a), (b) ,(d) and below PM 10 standard limits.
- Awio (d) area has a TWA (8hrs) of 0.o46 mg/cu.m, below PM10 Dust Emission Exposure Standards of 0.500 mg/cu.m.

1.2.12 Chemical Dust Analysis

Ore Samples from pit 372 and 374 and one processed sample contain 1:1 ration of ore from the separate pits. This is to be tested for heavy metals prior to drying. A single sample of dried dust was taken for heavy metal analysis to determine the loss of cadmium and other heavy metals during drying process. This will provide an indication of cadmium / heavy metals released through the dryer stacks during venting of steam. Waiting on assay results.

1.2.13 Water Analysis

- Samples taken from water tanks located in Aiwo area, not yet assayed

2 RECOMMENDATIONS

2.1 SUMMARY

- A cleanup program of deposited dust on the ground within Unit 3's complex will result in lower dust emissions; this is recommended as a priority.
- An ongoing dust maintenance plan is recommended avoid ongoing dust build up, watering of main access road through the plant, and work areas will reduce airborne dust.
- Replacement of missing sheets over buildings and conveyors will reduce emissions significantly
- Any area that does emits dust could be suppressed by mist sprays without coming in contact with the ore, the will aid settling and cleaning within Unit 3 facility
- Extension of stack by 10-12 m to improve venting and dispersion
- A complaints process is recommended

- Review of dust levels after remedial actions are completed is recommend

2.2 SHORE BIN / CONVEYOR

- Replace missing covers on CV
- Replace any missing sheets on Shore Bin and seal off any gaps in dust cover, especially in corners of the building.
- Clean over spill at back of Shore Bin

Figure 3 Photo Shore Bin & Conveyor

Figure 4 Photo Uncovered Conveyor - Shore Bin

Figure 5 Photo Missing Sheeting Shore Bin

Figure 6 Photo Dust & Overflow from Shore Bin

Figure 7 Photo Dust During Loading

Recording of PM10 dust during loading, prevailing winds SW-W minimises land impacts

2.3 CRUSHER / DRYER STORAGE

It has been noted that at the commencement of this survey a 12mm screen was installed which will reduce a percentage of minus 12mm material from entering the crusher circuit.

- Replace missing sheets and Seal Crusher, Dryer and Storage Bins
- Clean up deposited material with loader
- Hand clean remaining areas
- Sliding Doors on Unit 3 Storage Bin and Dryers sheds required
- Install mist sprays in areas that containment is difficult
  Routine water of access road

Figure 8 Photo Deposited Dust South of Crusher

Figure 9 Photo South of Crusher Missing Sheets

Figure 10 Photo Overflows at Crusher, CV #D1

Figure 11 Photo CV D1, & >1.2m deep dust

2.4 ROADS & SURROUND AREAS

Deposited dust from emissions is a significant secondary source of dust build up and impacts on workers and the community. Dust from 0.1 to +1m deep have been deposited within Unit's 3 compound.

This is a significant source of dust emissions. Any vehicle or mobile equipment, combined with light winds will add to emissions. It is recommended that:

- deposited dust be hand shovelled and bagged for sale
- a regular routine dust cleanup program should be implemented.
- dust suppression with water of chemicals should be considered
- As this activity has a cost/benefit component, it may increase revenues whilst reducing dust.

Figure 12 Photo Unit 3 Deposited Dust

Figure 13 Photo Unit 3 Deposited Road

Figure 14 Insufficient Cladding

Figure 15 Access Track

2.5 REDUCTION OF DUST CARRYING STEAM

Commonly known types of industrial dust collectors that can be assessed for suitability include:

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- Inertial separators
- Fabric filters
- Wet scrubbers
- Electrostatic precipitators
- Unit collectors

Initially, an extension of stacks for A & E kiln by 12m will improve dust settling within the stack and emission dispersion will be improved.

Figure 16 Stack Extension

Figure 17 Stack Emissions

2.6 COMMUNITY AWARENESS AND COMMUNICATION

Monitoring complaints through a Community Management Department can be considered as measurement of dust emission impacts. It is recommended that a Complaints Management system be introduced. A suggested format is included in Section 5

3 SCOPE OF WORK

This scope of work covers the measurements of the amount of dust (mg/cu.m) within the particle sizes defined as PM 10

- Ronphos's plant (Unit 3),
- Areas potentially impacted by Unit 3 and
- Background sampling in other areas of Nauru

For areas exceeding 50mg/cu.m further measurements of finer dust (PM2.5) should be made. However, it is not included in the assessment.

In addition water, dust have been collected for analysis

3.1 EQUIPMENT

Dust monitoring is carried out using a DUSTTRAK Aerosol Monitor Model 8520.
Funnel Dust Collection, Water Sampling bottles.

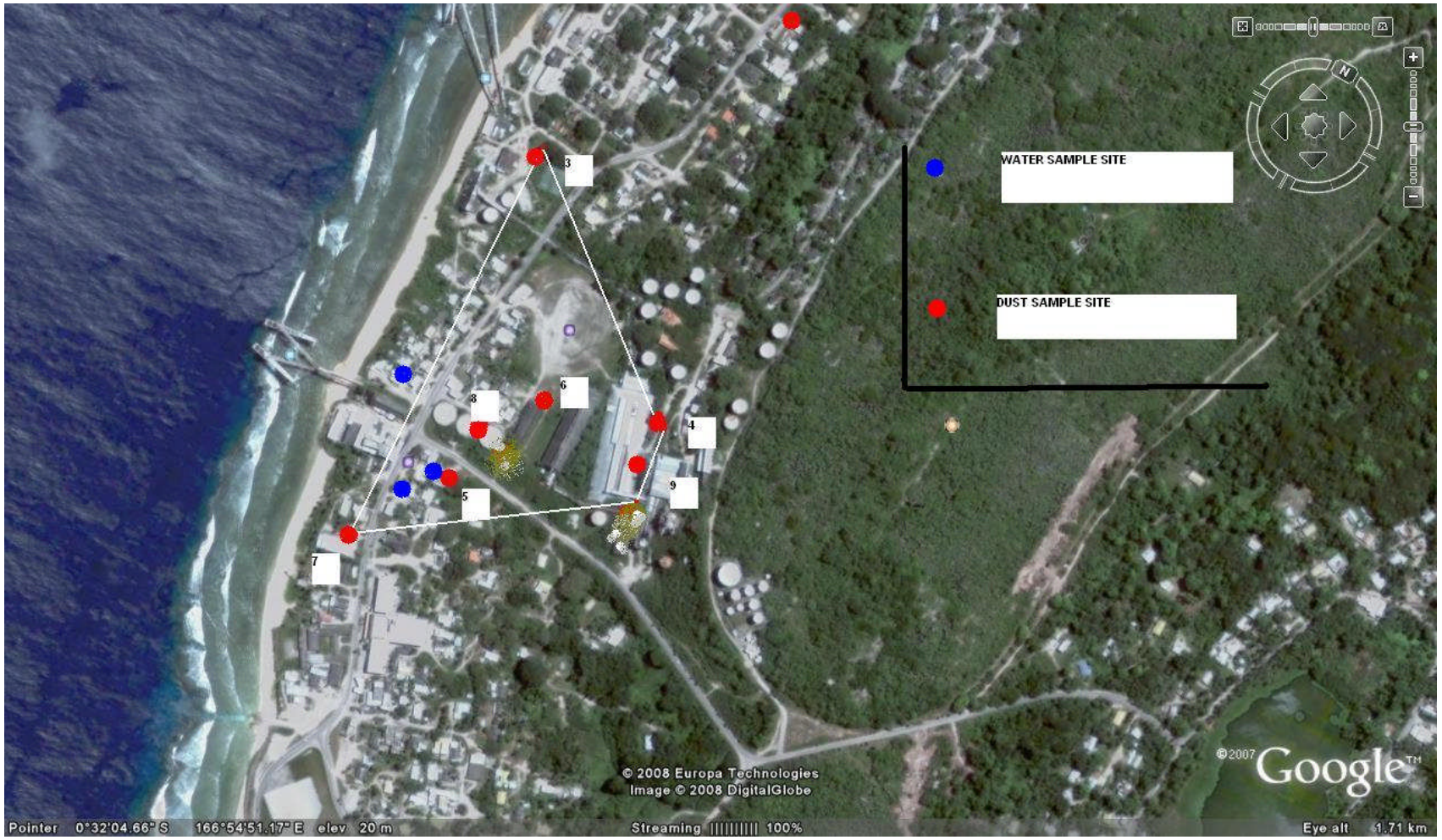
3.2 SAMPLE SITES

Figure 18 General Location Map of Sampling Sites

Table 1 Dust Track Site Details

Nos	Start	Finish	Location	Northing's	Easting's
Test 1	1230 hrs 21/03/08	1230 22/03/08	Approx 600m East of Unit 3 @ House MQ60	713036	9941418
Test 2	1500hrs 22/03/08	1500hrs 23/03/08	NRC Office, car park area	715859	9939091
Test 3	0900hrs 24/03/08	0900hrs 25/03/08	Cantilever, loading facility adjacent to tennis courts	712650	9941079
Test 4	1200hrs 25/03/08	1200hrs 26/03/08	Unit 3 Crusher & dryer Facility	712973	9940833
Test 5	1400 hrs 26/03/08	1400hrs 27/03/08	House 70m east of main road Awio Hotel	712767	9940645
Test 6	1600hrs 27/03/08	1600hrs 28/03/08	Football Oval Behind shop	712811	9940803
Test 7	0900 hrs 29/03/08	0900hrs 30/03/08	Church Hall Opposite Church	712648	9940499
Test 8	1100hrs 31/03/08	1100hrs 1/04/08	South of Dryer Awio	712732	9940733
Test 9	1000hrs 1/04/08	1000hrs 2/03/08	Between Dryer & Storage Bin	712981	9940750

Figure 19 Aiwo Sampling Location Map



3.3 DUST SETTLING SAMPLE SITES

Table 2 Dust Settling Sample Sites

Nos	Start	Finish	Location	Northing's	Easting's
DF 1	1230 hrs 25/03/08	0000hrs xx/04/08	Opposite dryers and Bin storage	712987	9940784
DF 2	1230hrs 25/03/08	0000hrs xx/04/08	Opposite Crusher and CV D1	713018	9940707
DF 3	1300hrs 25/03/08	0000hrs xx/04/08	Adjacent to football oval and behind shop	712757	9940868
DF 4	1500hrs 25/03/08	0000hrs xx/04/08	North side of blacktop road running to Crusher, outside local house	712767	9940638

These are required to collect dust over a 30 day period. Funnel from two sites within the plant have been taken by persons unknown.

Sample for analysis have been sent to ALS in Brisbane

Raw Material	**Sample Nos**
Approx 0.5kg of ore from Pit 372 and 374	(RN1R & RN2R)
Approx 0.5kg of ore crushed & blended from Pit 372 & 374	(RN3R)
Approx 0.5kg of Dust after Drying	(RN4D)

These sample have been taken to confirm that the phosphate is inert after being exposed to drying and high temperatures of 400 deg Celsius.

3.4 WATER SAMPLE SITES

Three samples were taken from water tanks within 100m of Aiwo Hotel.
Samples RN1W and RN2W were taken across the road from the Aiwo Hotel and RN3W was obtain from a tank adjacent and north of the hotel

3.5 SOIL SAMPLE SITES

N/A

4 DUST MONITORING DATA

Each site was monitored for a 24 hour period. 86,400 dust reading are in taken during a 24 hour test period every second and provides a 10 second average reading. Some 2880 data recordings are recorded. Approx. 900,000 measurements were taken in total

4.1 TEST 1 BACKGROUND

TrakPro Version 3.41 ASCII Data File
Model:,Dust Trak Serial Number 23873

Test ID	001
Test Abbreviation	
Start Date:	03/21/2008
Start Time	12:29:29
Duration (dd:hh:mm:ss)	01:00:00:00
Time constant (seconds)	10
Log Interval (mm:ss)	00:30
Number of points	2880

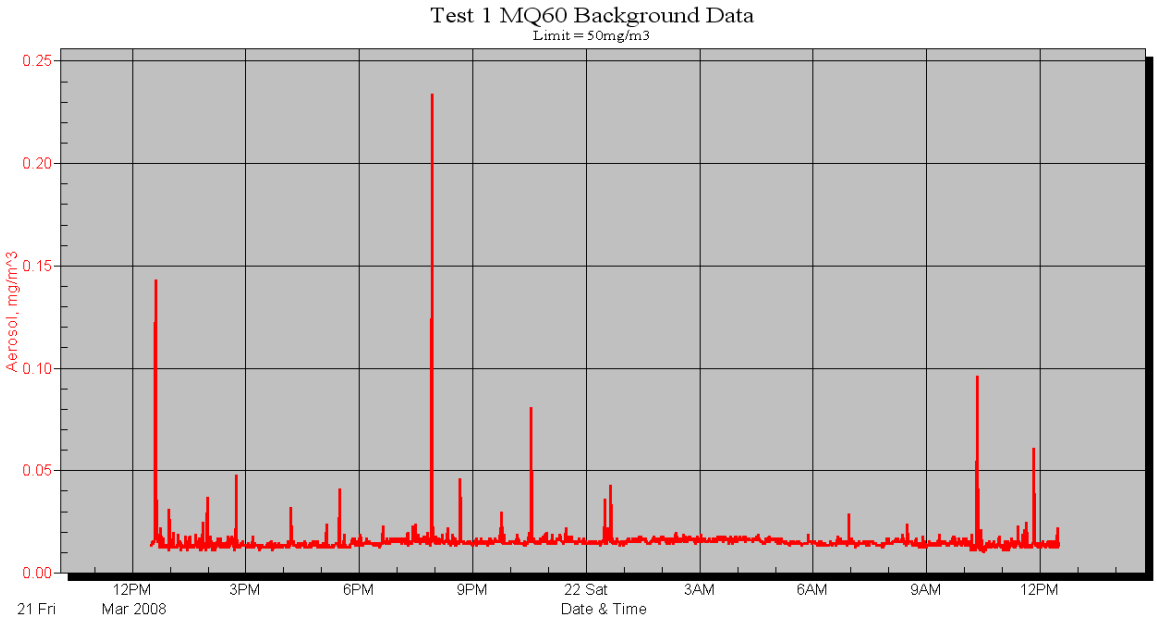
Notes:,

Statistics: Channel: Aerosol
Units: mg/m^3

Average:	**0.015** (max avg 0.500mg/cu.m)
Minimum:	**0.010**
Time of Minimum:	10:29:59
Date of Minimum:	03/22/2008
Maximum:,	**0.234**[1]
Time of Maximum:	19:54:59
Date of Maximum:	03/21/2008
TWA	**0.016(8hrs)**

Calibration,Sensor:,Aerosol
Cal. date,09/21/2007

Figure 20 Test 1 Background Data Graph



See Figure 1

[1] (Note allowable limit 0.50mg/cu.m)

4.2 TEST 2 BACKGROUND

TrakPro Version 3.41

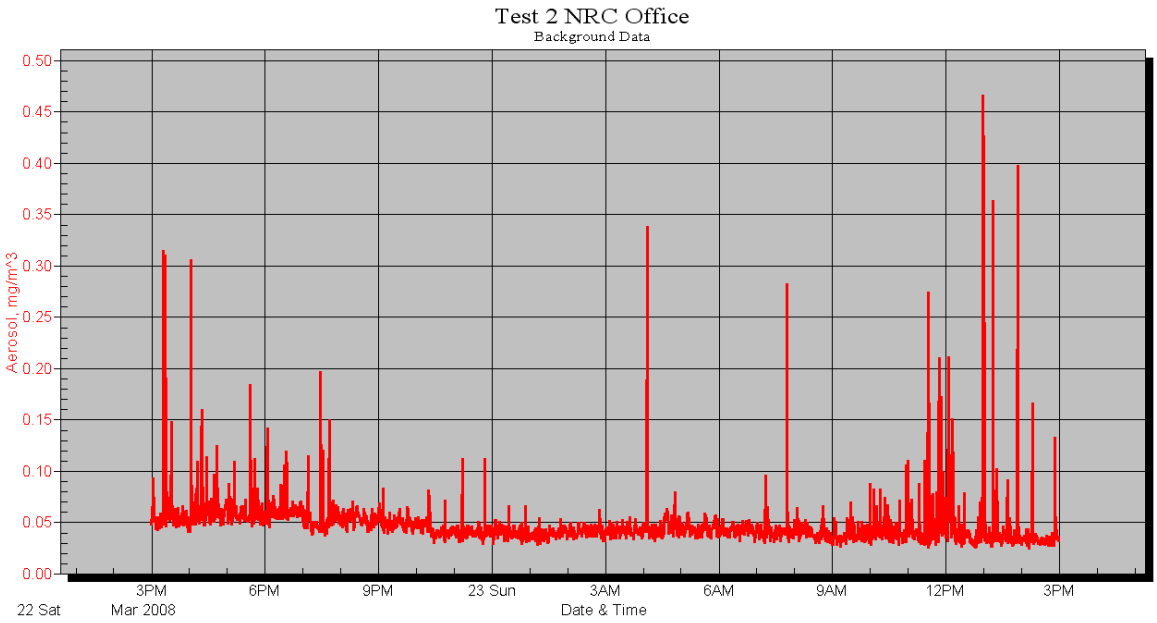
Model:	Dust Trak
Serial Number:	23873
Test ID:,	002
Test Abbreviation:	
Start Date:	03/22/2008
Start Time:	14:58:59
Duration (dd:hh:mm:ss):	01:00:00:00
Time constant (seconds):	10
Log Interval (mm:ss):	00:30
Number of points:	2880
Notes:	Test 2 NRC Office Background data

Statistics,Channel:,Aerosol
Units:,mg/m^3

Average:	**0.048 (max.avg 0.500 mg/cu.m)**
Minimum:	**0.024**
Time of Minimum:	14:11:59
Date of Minimum:	03/23/2008
Maximum:	**0.467**
Time of Maximum:	12:58:29
Date of Maximum:	03/23/2008
TWA	**0.057(8hrs)**

Calibration,Sensor:,Aerosol
Cal. date,09/21/2007

Figure 21 Test 2 Background Data Graph



See Figure 1

4.3 TEST 3 CANTILEVER

TrakPro Version 3.41

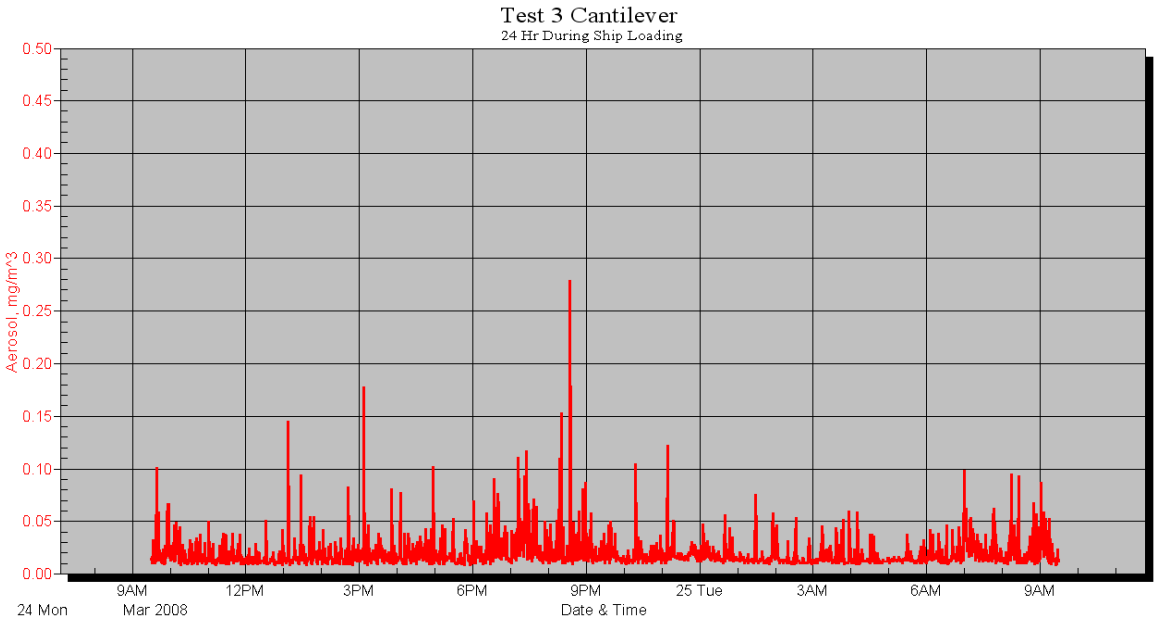
Model:	Dust Trak
Serial Number:	23873
Test ID:	001
Test Abbreviation:	
Start Date:	03/24/2008
Start Time:	09:29:29
Duration (dd:hh:mm:ss):	01:00:00:00
Time constant (seconds):	10
Log Interval (mm:ss):	00:30
Number of points:	2880
Notes:	Test 3Cantilever Area

Statistics,Channel:,Aerosol
Units:,mg/m^3

Average:	**0.019**
Minimum:	**0.008**
Time of Minimum:	10:16:59
Date of Minimum:	03/24/2008
Maximum:	**0.279**
Time of Maximum:	20:33:59
Date of Maximum:	03/24/2008
TWA	**0.018(8hrs)**

Calibration,Sensor:,Aerosol
Cal. date,09/21/2007

Figure 22 Test 3 Cantilever Data Graph



See Figure 1

4.4 TEST 4 UNIT 3 (A)

TrakPro Version 3.41

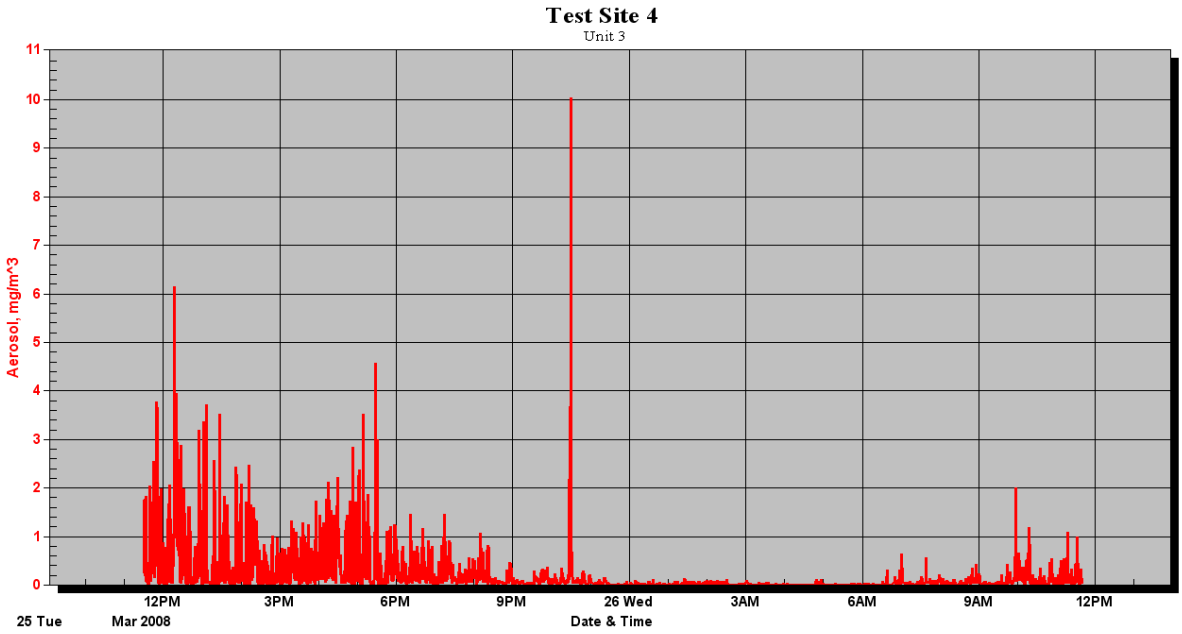
Model:	Dust Trak
Serial Number:	23873
Test ID:	001
Test Abbreviation:	
Start Date:	03/25/2008
Start Time:	11:29:29
Duration (dd:hh:mm:ss):	01:00:10:00
Time constant (seconds):	10
Log Interval (mm:ss):	00:10
Number of points:	8700
Notes:	Test 4 Unit 3 North of facilities

Statistics,Channel:,Aerosol
Units:,mg/m^3

Average:	**0.200**
Minimum:	**0.008**
Time of Minimum:	17:23:19
Date of Minimum:	03/25/2008
Maximum:,	**10.039**
Time of Maximum:	22:29:19
Date of Maximum:	03/25/2008
TWA	**0.460(8hrs)**

Calibration,Sensor:,Aerosol
Cal. date,09/21/2007

Figure 23 Test 4 Unit 3 Opposite Security Data Graph



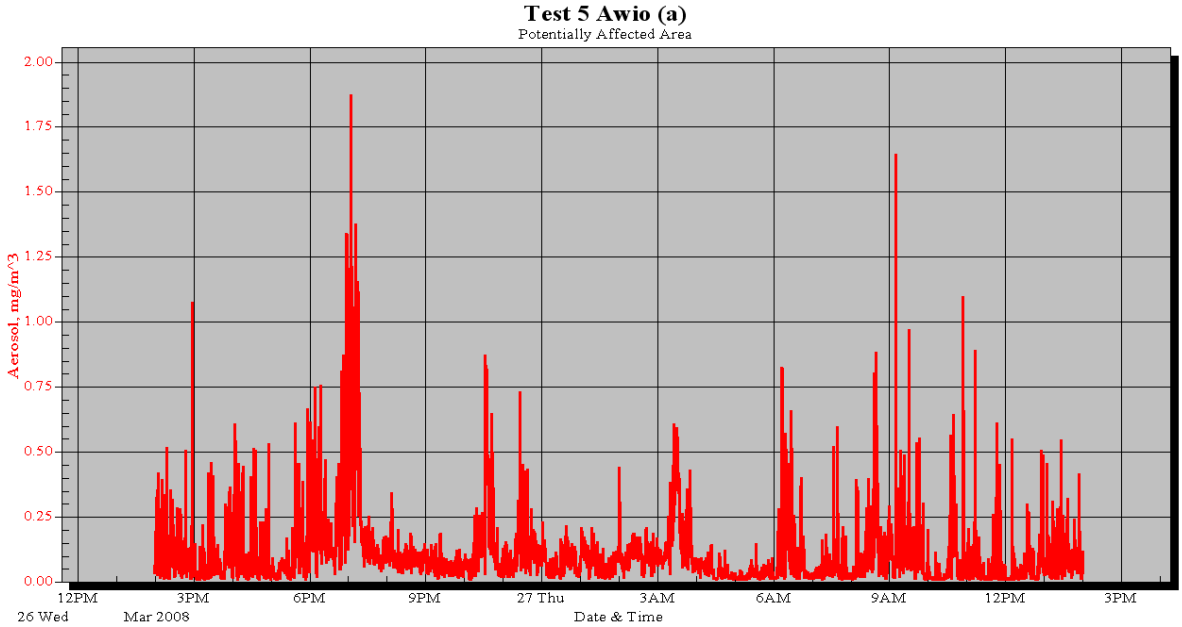
See Figure 1

4.5 TEST 5 T AIWO (A)

TrakPro Version 3.41

Model:	Dust Trak
Serial Number:	23873
Test ID:	001
Test Abbreviation:	Test 5
Start Date:	03/26/2008
Start Time:	13:58:59
Duration (dd:hh:mm:ss):	01:00:01:00
Time constant (seconds):	10
Log Interval (mm:ss):	00:10
Number of points:	8646
Notes:	Test Awio (a)
Statistics,Channel:	Aerosol
Units:	mg/m^3
Average:	**0.107**
Minimum:	**0.006**
Time of Minimum:	17:08:59
Date of Minimum:	03/26/2008
Maximum:	**1.875**
Time of Maximum:	19:03:59
Date of Maximum:	03/26/2008
TWA	**0.136(8hrs)**
Calibration,Sensor:,Aerosol	
Cal. Date	09/21/2007

Figure 24 Test 5 Aiwo (a) Data Graph

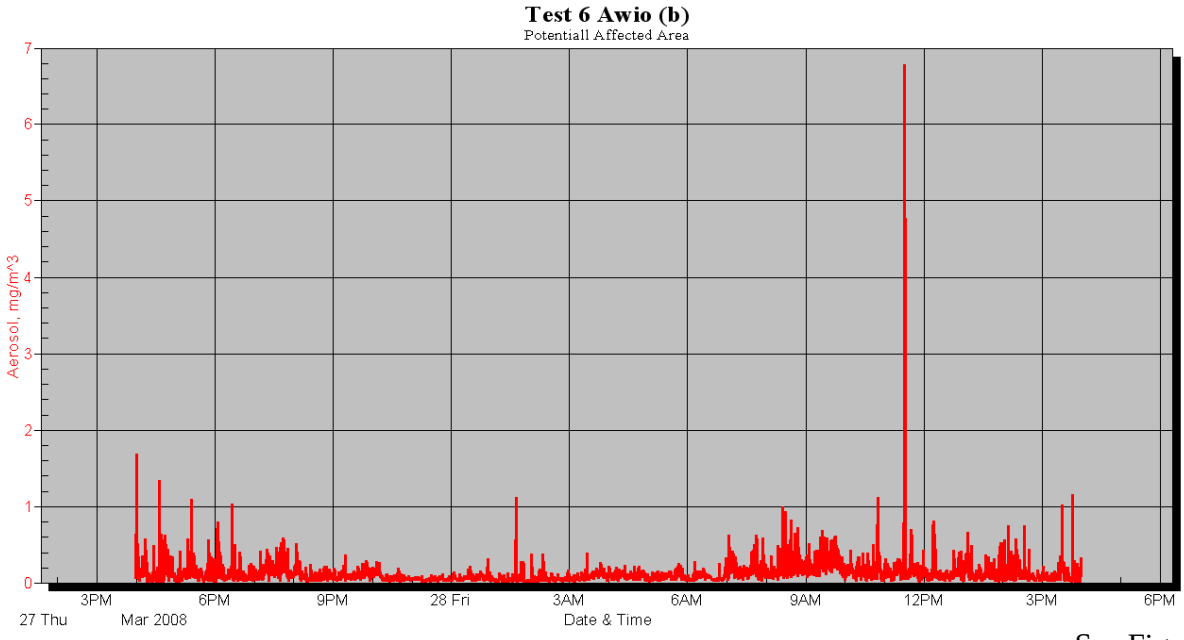


See Figure 1

4.6 TEST 6 AIWO (B)

TrakPro Version 3.41	
Model:	Dust Trak
Serial Number:	23873
Test ID:	001
Test Abbreviation:	
Start Date:	03/27/2008
Start Time:	15:58:59
Duration (dd:hh:mm:ss):	01:00:01:00
Time constant (seconds):	10
Log Interval (mm:ss):	00:10
Number of points:	8646
Notes:	
Statistics,Channel:,Aerosol	
Units:mg/m^3	
Average:	**0.124**
Minimum:	**0.010**
Time of Minimum:	16:32:09
Date of Minimum:	03/27/2008
Maximum:	**6.777**
Time of Maximum:	11:31:09
Date of Maximum:	0/28/2008
Calibration,Sensor:	Aerosol
TWA	**0.118(8hrs)**
Cal. Date	09/21/2007

Figure 25 Test 6 Aiwo (b) Data Graph



See Figure 1

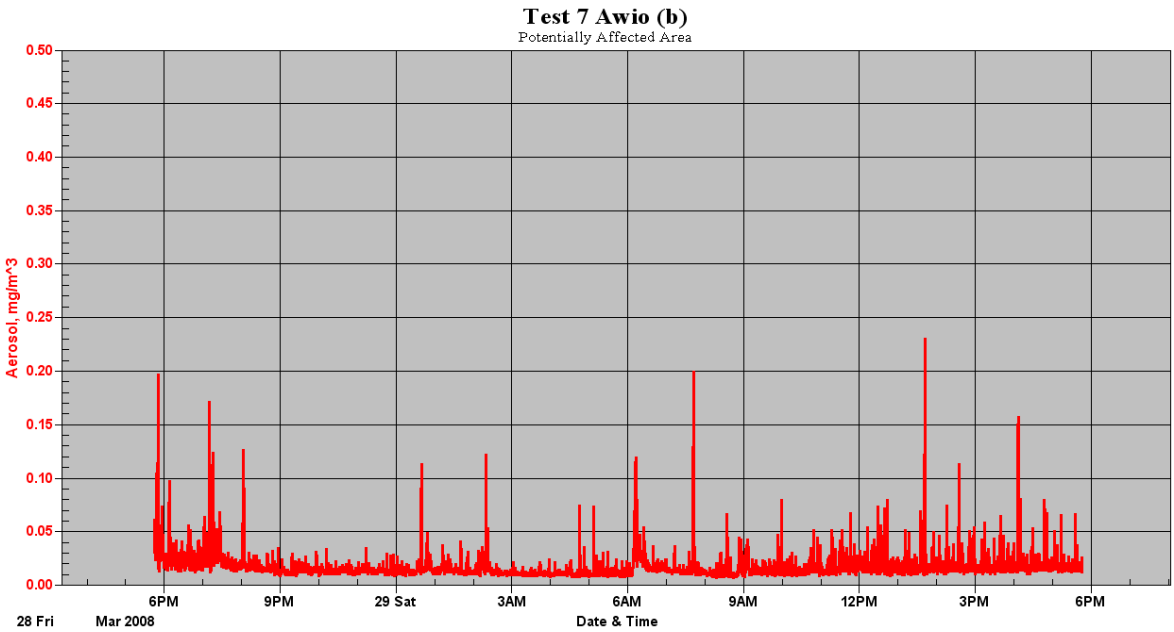
4.7 TEST 7 AIWO (C)

TrakPro Version 3.41
Model:,Dust Trak

Serial Number:,	23873
Test ID:,	001
Test Abbreviation:	Test 7 Awio (b)
Start Date:	03/28/2008
Start Time:	17:44:44
Duration (dd:hh:mm:ss):	01:00:01:00
Time constant (seconds):	10
Log Interval (mm:ss):	00:10
Number of points:	8646
Notes:	Church Hall Awio
Statistics,Channel:	Aerosol
Units:	mg/m^3
Average:	**0.017**
Minimum:	**0.006**
Time of Minimum:	08:17:44
Date of Minimum:	03/29/2008
Maximum:	**0.231**
Time of Maximum:	13:41:14
Date of Maximum:	03/29/2008
TWA	**0.136(8hrs)**

Calibration,Sensor:,Aerosol
Cal. date,09/21/2007

Figure 26 Test 7 Aiwo (c) Data Graph



See Figure 1

4.8 TEST 8 AIWO (D)

TrakPro Version 3.41 ASCII Data File

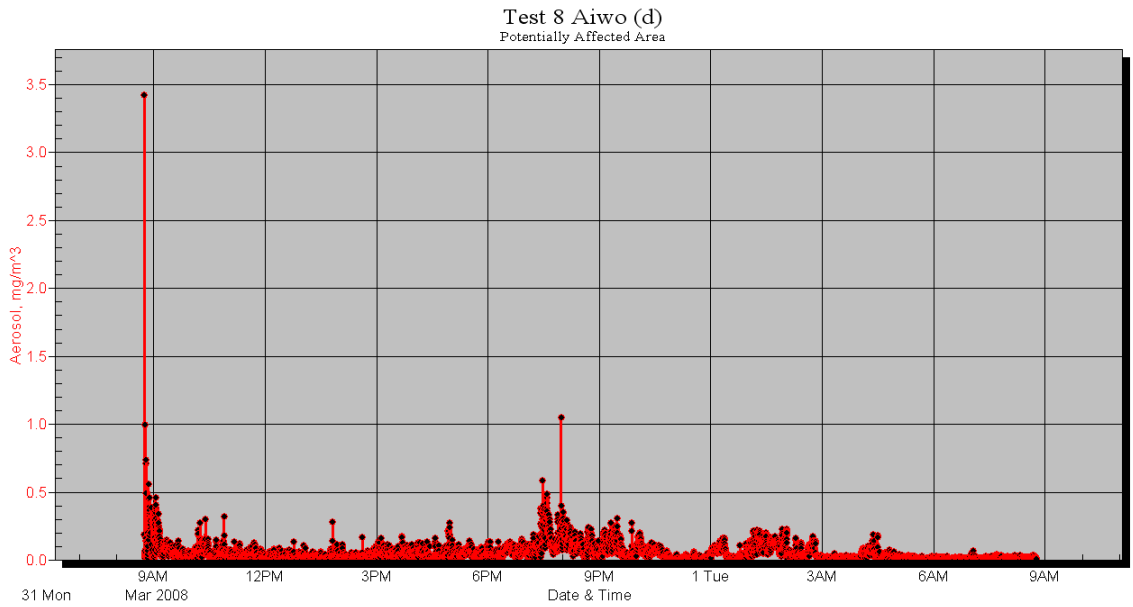
Model:	Dust Trak
Serial Number:	23873
Test ID:	001
Test Abbreviation:	
Start Date:	03/31/2008
Start Time:	08:44:44
Duration (dd:hh:mm:ss):	01:00:01:00
Time constant (seconds):	10
Log Interval (mm:ss):	00:10
Number of points:	8646
Notes:	Test 8 Awio (d) behind petrol station

Statistics,Channel:,Aerosol
Units:,mg/m^3

Average:	0.051
Minimum:	0.005
Time of Minimum:	05:45:34
Date of Minimum:	04/01/2008
Maximum:	**3.422**
Time of Maximum:	08:44:54
Date of Maximum:	03/31/2008
TWA	**0.046(8hrs)**

Calibration,Sensor:,Aerosol
Cal. date,09/21/2007

Figure 27 Test 8 Aiwo (d) Data Graph



See Figure 1

4.9 TEST 9 UNIT3 (B)

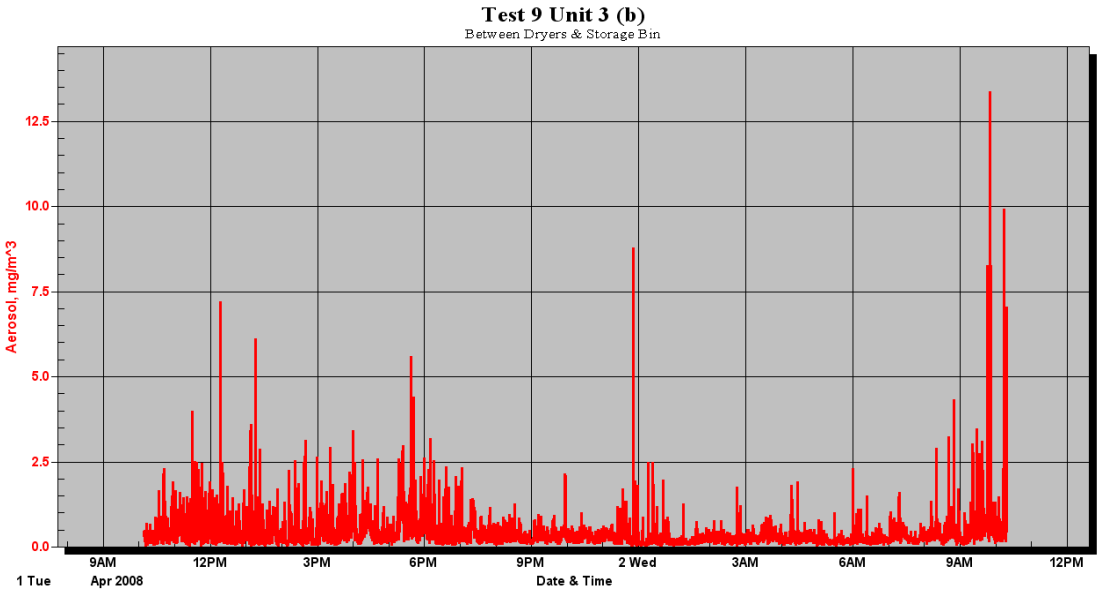
TrakPro Version 3.41 ASCII Data File
Model:,Dust Trak

Serial Number:	23873
Test ID:,	001
Test Abbreviation:	Test 9
Start Date:	04/01/2008
Start Time:	10:08:22
Duration (dd:hh:mm:ss):	01:00:10:30
Time constant (seconds):	10
Log Interval (mm:ss):	00:10
Number of points:	8703
Notes:	Test 9 Unit 3(b)

Statistics,Channel:,Aerosol
Units:,mg/m^3

Average:	**0.405**
Minimum:	**0.017**
Time of Minimum:	13:31:52
Date of Minimum:	04/01/2008
Maximum:	**13.379**
Time of Maximum:	09:51:12
Date of Maximum:	04/02/2008
TWA	**0.525(8hrs)**

Calibration,Sensor:,Aerosol
Cal. date,09/21/2007



See Figure 1

4.10 SETTLED DUST COLLECTION RESULTS

Nuisance factor is subjective and is measured by Total Suspend Solids

Measurement of the amount of dust deposited on a surface tends to focus on either determining the soiling of a surface by a change in its properties or determining the quantity of dust deposited by weight. These techniques are often used to determine nuisance factor in cases of complaints from sensitive receptors.

Example of dust guideline levels

British standard gauge (mg/m2/d)
Complaints possible 150 mg/sq m
Complaints likely 190 mg/sq.m

As there are no Dust Standards in Nauru, **Error! Reference source not found.** is a guide for TSP.

Note:

- TSP values are calculated by applying USEPA factor of 2.86 (i.e. PM10 comprises 35% of TSP) and shown in Table 6
- Complaints usually occur when the TSP is around 0.150 mg/cu.m (150 µg/m³).

Table 3 Aiwo TSP Nuisance Results

Date	Location		PM_{10}	Inferred TSP[2]
			mg/m^3	mg/m^3
29/03/08	Awio (a)	TWA (8h)	0.136	0.389
29/08/07	Awio (b)	TWA (8h)	0.118	0.965
29/08/07	Awio (c)	TWA (8h)	0.051	0.147
29/08/07	Awio (d)	TWA (8h)	0.046	0.376
		Aiwo	Average	0.227

See Figure 2

Table 4 TSP Dust Sizes Guideline[2]

Limit	Impact
120 µg/m³	insensitive areas (e.g. for a quarry in a rural area)
100 µg/m³	moderately sensitive (e.g. large quarry, lifestyle area)
80 µg/m³	sensitive location (e.g. quarry within MUL) 80 mg/m3 is the default and allows for significant deviation from normal operating levels and background ambient TSP levels

[2] WHO (1987)

4.11 WATER SAMPLING RESULTS

Samples collected awaiting results

5 COMPLAINTS PROCESS

5.1 INTRODUCTION

The following commentary is represents a typical generic model for Community Relationship Management; aimed at minimizing negative impacts and can be used to maximizing positive impacts.

A socio-economic assessment would normally be required, to make this model appropriate to Nauru, such a program would need to fall within the social and political structures and "norms" of the country.

The following comments process represents World Bank Guidelines and other Donor Country expectations.

Much of the following is often carried informally, however, international mining expectations require transparent structures with controls, performance targets (KPI) and performance measurement.

Ronphos will need to decide upon the appropriate level of relevance given the uniqueness of the project

5.2 COMPLAINTS PROCESS

A Community Relation Policy will facilitate the expression by stakeholders of questions and concerns regarding its Ronphos operations. It is recommend that the Ronphos encourages engagement, as much as possible, with local communities to ensure interactions are relevant, conflicts are resolved quickly and to the mutual benefit of both parties and in such a way that stakeholders feel positive about their involvement with the Company and its activities.

To meet these objectives, both informal and formal complaint and grievance mechanisms are recommended. Community Relations staff may attempt to answer questions and address issues during formal and informal stakeholder consultations; if they are able to do so. Documentation is not recorded, except to note any key issues. In particular; if a stakeholder raises an issue that requires follow-up; stakeholders contact information and question/issue is documented and addressed by the company's management, according to the complaint process described below.

As complaint registration is a recurring activity, the Community Relations staff would use a Complaint Register Form (see Section 5.9) on which are recorded all complaints received for which no immediate answers are provided. Also a special reception area could be constructed solely for local residents who come to a Ronphos office to register complaints. This is to expeditiously process and address complaints in a very respectful and timely fashion to prevent potential misunderstandings.

These Complaint Forms are submitted to the Community Relations staff for entry into the Complaints Database. Where a written complaint is made, it is also captured the Database. Community workers should be skilled in conflict resolution techniques and fluent in both Local and English languages. Any staff should routinely seek advice and, where appropriate, intervention of traditional authorities to assist in resolving disputes.

Traditional authorities may possess considerable institutional relevance, particularly at the rural level where traditional status may continue to command respect. The Community Relations Department holds regular meetings to discuss, among other things, appropriate responses and approaches to resolving the complaints received during the week. Where it is required that answers to complaints are provided in writing, the Community Relation Officer issues a written letter to that effect.

Where it becomes necessary to have a face-to-face meeting, meetings with the complainants at village/household or Ronphos office or a neutral venue will be undertaken.

A letter or verbal invitation is also issued and / or hand delivered to the complainant. The complaint register procedure outlined above will be one of the repetitive messages in almost all formal and informal consultations.

The purpose of the process is to ensure that complaints from local residents are appropriately addressed and complainants can see the outcome of the issue. All complaints are referred to the on-site manager

Community Relations are responsible for ensuring complainants are provided an explanation of the complaint process and an estimate of when to expect a response. Comments or requests for help are not considered complaints.

Responses to complaints must be initiated within one week of being received. This may be a summary of the process needed to resolve the complaint and when it is likely to be implemented.

This complaint procedure described is designed to accommodate all types of complaints. Complaints that are specific to the compensation process are handled according to the procedure described in this document, Grievance Mechanism.

5.3 CONFLICT RESOLUTION

Mining companies often develop a process that assures stakeholders discussions are of a consultative and collaborative approach to conflict resolution free from coercion and based on informed consent.

In order to ensure the resolution of potential compensation claim and to ensure all discussion are free from coercion and based on informed consent, it is recommended that Ronphos consider a conflict resolution process with the concept that stakeholder groups should elect individuals as their representatives.

The goal being that any Negotiation Committee has to ensure each stakeholder group is fully informed of potential impacts the Project could have on economic, social, cultural, environmental, and/or physical resources.

There may be a variety of stakeholders, people, organizations, and agencies whose behaviour could positively or negatively influence the Project. In the event of a dispute or compensation claim by a group of persons, Ronphos may request the group to elect one or more representatives to participate in resolution process.

Representatives would be elected by acclamation during community gatherings and group meetings.

A list of potential stakeholders identified for the Project and a description of the categories of Project-affected persons should be identified and documented

After selection and presentation of representatives, Ronphos would ask groups to confirm that their representatives were genuine advocates of the views of their members. To do so, it will issue Authorization for Representation Forms, which members of each group signed and submitted to Ronphos

Stakeholder groups will be informed that representatives can be replaced if they were not attending meetings regularly or accurately representing their group. In the case of government agencies, representatives may be appointed from each of the stakeholder agencies involved in the negotiation.

5.4 CONSULTATIVE LIAISON COMMITTEE

A Consultative Liaison Committee (CLC) could be formed with broader stakeholder representation to provide a structured and sustainable consultation mechanism for the life of the Project. The CLC can be extended to cover all communities in the area and should be responsible for addressing all issues that may arise.

5.5 ONGOING PUBLIC CONSULTATION ACTIVITIES

Typical consultation activities include:

- Maintain regular communications with all stakeholders;
- Provide local residents with information on employment and training opportunities;
- Maintain awareness of safety issues around transport;
- Maintain constructive relationships between local residents and company by continuing regular information meetings and informal interactions;
- Identify and respond to new stakeholder issues and concerns by reviewing the complaints file and listening to stakeholders;
- Monitor implementation and effectiveness of mitigation measures such as, community development plan, and other social investment programs;
- Monitor community attitudes toward company and the Project;
- Ensure complaints are addressed according to an established process;

- Ensure gender sensitive and culturally appropriate processes are used in communication and interactions;
- Monitor and evaluate the effectiveness of public involvement techniques (according to the Management System criteria if there is one in place); and
- Employ independent social assessors to evaluate the public consultation and disclosure process, as well as the mining operations, community development plan, and other social investment programs.

Community Relations Department is responsible for implementing procedures and future consultation activities envisioned that covers:

- Project updates;
- Opportunities to discuss / address Community concerns;
- Information about General Project operations;
- Relevant applicable laws related to mining;
- Information on monitoring and management of Project impacts;
- Information on and discussion about Community Investment initiatives.

5.6 COMPLAINT'S PROCESS GUIDE

STEP 1: Receive the complaint, if via letter; put the date of receipt on it. If verbal document complaint and date

STEP 2: Enter the complaint in a Complaint Database

STEP 3: Acknowledge receipt of each complaint in writing to each person. This is done as soon as complaints are received.

STEP 4: Where complaint relates to compensation dispute, withhold payments on all disputed compensation until parties resolve the dispute and notify Ronphos accordingly

STEP 5: File all original complaint letters chronologically by month.

STEP 6: Complaint letters with specific issues are photocopied and forwarded to persons responsible to comment or resolve the case/issue e.g. Maintenance personnel, Legal Department, GM or others as the case may be.

STEP 7: Update the database periodically to indicate those cases that have been resolved; those with or without embargo placed on them; and if applicable those pending at the court

STEP 8: All resolved cases are documented and filed in a separate file.

5.7 INTERNAL GRIEVANCE PROCESS

Ronphos will maintain a grievance mechanism for day to day issues and compensation issues through Community Relations and Finance Department. The public may express concerns and issues at the Project Office in Awio and/or to a Community Relations Officer during normal daily activities.

Informal grievances are treated as complaints and are resolved according to the Complaint Process. Grievances are more serious as they involve potential compensation issues that could result in legal action and are addressed using the formal grievance process, as described below.

5.8 FORMAL GRIEVANCE PROCESS

Formal grievance mechanism addresses actual, measurable concerns relating to the compensation process which is described as follows:

5.8.1 First Mechanism

- First order mechanism is a face-to-face discussion with appropriate Ronphos personnel. Most grievances are heard and resolved in the presence of family members or other "witnesses." Agreement are normally reached or 'proved' without the complainant continuing into another forum.
- Except in complex cases where additional investigation or involvement of third parties is required Ronphos responds to written grievances within 7 days.
- Responses generally include a settlement proposal.
- Ronphos staff will routinely seeks advice and, where appropriate, intervention of traditional authorities to assist in resolving disputes.
- Grievances of a legal nature are forwarded to Ronphos's Legal Department for redress.
- Responses/settlements are coordinated through the on-site management team.

5.8.2 Second Grievance Process

The Consultative Liaison Committee may provide a forum at which individual and community grievances may be raised, discussed, and resolved with Company officials

5.8.3 Third Grievance Process

Nauru citizens and legal entities have access to court recourse in conformance with applicable laws.

Normally the Government, and any owner or other lawful occupier of affected land, in addition to any other right or remedy granted by Law, shall each have the right to refer any disputed matter relating to compensation under a Lease Agreement or under any Law for resolution.

In preference to legal course of action, Ronphos encourages arbitration. Arbitrators can be Persons trained in the common law tradition, a senior Nauru community member but need not be citizens of Nauru. Their decision is normally agreed to be final and binding by the

parties, and needs to be based upon the laws of Nauru and the terms of any pre-existing Agreement. Arbitration shall not be subject to appeal to any court except on the grounds of fraud or dishonesty by the arbitrators, or that they have decided matters beyond the scope of the authority agreed or granted in a legal instrument such as Mining Lease Agreement or Landholder Agreement. Any award made to /or against the lawful occupier or the owner of land shall fully offset any claim asserted by the owner of the affected land against Ronphos. Any award made to an owner of land shall foreclose any claim against on the part of a lawful occupier of that same land.

5.9 FORMS

5.9.1 Complaint Notification Form

Table 5 Third Party Complaint Notification Form

THIRD PARTY : COMPLAINT NOTIFICATION

Employee Name #nos		
Date Compliant Issued / Received		Signed by employee
Date Complaint issued to CR		
Complaint Received by:		
Contact Details of Third Party	**Details of Complaint if Verbal (otherwise send copy of written complaint to CR)**	**Details of Initial response (if verbal)**
CR – Community Relations Mgr		

Table 6 Action Log #Register Dust Emission (Example)

5.9.2 Action L0g #1 Dust from Crushing / Drying		Theme **Dust & Air Quality**		
Issue	Control	Further Planned Actions	Responsibility	Due Date
Dust & Air Quality Impacts **Comment** Likely High emissions will reach international OH&S workplace guideline levels. Emission to the wider community is elevated but within standard guidelines, nuisance dust is an issue to be resolved.	1. Remove all deposited dust around plant 2. Establish routine dust cleanup program 3. Seal of Shore Bin 4. Seal of Shore bin conveyor 5. Seal off Crusher 6. Seal of Crusher CV 7. Improve Seal on Dryer Shed 8. Install sliding door on Dryer shed 9. Install 12mm Screens to Crusher 10. Review Steam Emissions , extend chimney 11. Check Plant dust emissions at Unit #3		1. Plant Mgr 2. Plant Mgr 3. Plant Mgr 4. Plant Mgr 5. Plant Mgr 6. Plant Mgr 7. Plant Mgr 8. Plant Mgr 9. Plant Mgr 10.NRC 11.RONP	12. 30th April 08 13. Ongoing 14. 5th May 08 15. 10th April 08 16. 15thApril 08 17. 20th April 08 18. 30th April 08 19. 10th May 08 20. Completed 21. 30th May08 22. June 08
KPI:	Adherence to Controls Completion of Planned Actions Compliance with Permit Conditions			

Table 7 Action Log Register Complaints (Example)

5.9.3 Action Log # 2 Complaints Process		Theme: **Management**		
Issue	Control	Further Planned Actions	Responsibility	Due Date
Maintain good communication, improve awareness of issues, address potential negative impacts and concerns	1. Complaints process to include protocols: register,, complaint details, actions, responsibilities, feedback, closeout etc 2. Community Relations personnel will make formal quarterly contact with each relevant districts 3. Annual Community presentation and consultation sessions to be held with affected districts 4. Maintain Communication Log 5. Maintain Action Log 6. Ensure ready a Community access to Company 7. Report on Close out issues process. 8.		1. CR 2. CR 3. CR 4. CR 5. CR 6. CR 7. CR 8. CR	1. May 08 2. 1,2,3,4 Qrt 08 3. June 08 4. Ongoing 5. Ongoing 6. Ongoing 7. . 8.
KPI:	Adherence to Controls Completion of Planned Actions			

5.9.4 Reporting Progress & Completion Register

Table 8 Progress& Completion Register

No.	Subject	Task Owner	Follow-up date	Completed
1	Undertake Dust Monitoring	GR		3/04/08
2	Nominate Community Relations personnel			
3	Establish policy, procedures, action plans			
4	Communicate Results of Dust Monitoring			
5	Community Relations personnel will make formal quarterly contact with each relevant districts			
6	Annual Community presentation and consultation sessions to be held with affected districts			
7	Maintain Communication Log			
8	Maintain Action Log			
9	Ensure ready a Community access to Company			
10	Remove all deposited dust around plant			
11	Establish routine dust cleanup program			
12	Seal of Shore Bin			
13	Seal of Shore bin conveyor			
14	Seal off Crusher			
15	Seal of Crusher CV			
16	Improve Seal on Dryer Shed			
17	Install sliding door on Dryer shed			
18	Install 12mm Screens to Crusher			
19	Review Steam Emissions , extend chimney Check Plant dust emissions at Unit #3			
20				

6 MINE DUST OVERVIEW

The following explains the type of dust that is generated from mine sites, the potential risks from mine dust to health and amenity (how pleasant a place is) and the controls the mining operator puts in place to reduce dust emissions.

6.1 DEFINITION OF PM (PARTICULATE MATTER)

Commonly called "dust", scientists and regulators refer to the term “particulate matter” (or PM) to describe the range of particles that exists in the air we breathe.

PM exists naturally in the atmosphere, eg sea-salt spray and pollens from trees and vegetation. PM can be increased due to human activities such as vehicle exhaust, industrial processes, power stations, mining, farming and wood heaters, even smoke from bushfires adds to PM.

Exposure to PM can be associated with health and amenity impacts. The likely risk of these impacts depends on a range of factors including;

- the size: measured in microns
- quantity: measured in milligrams (also referred to in micrograms)
- composition: what is the dust made from
- Recipient: The general health of the persons breathing dust.

6.2 SIZES OF PM (PARTICULATE MATTER)

Just as the size of balls we can see ranges from marbles to footballs, PM can be thought of as microscopic balls of varying sizes.

Instead of measuring PM in centimetres as we do with balls, scientists use micrometres (sometimes called "microns") to measure the diameter of particles. See Table 1

A micrometre is one-millionth of a metre and its symbol is μm.

Table 9 Definition of Dust Size

Types	**Sizes**
Dust exists between when	<.01 – 500 microns
Visible dust occurs when	>50 microns
Nuisance dust occurs when	>20 microns
Inhaled dust occurs when	<10 microns
Respirable dust occurs when	<2.5 microns

For environmental health purposes, particles are initially described by the size inhaled as shown in Table 2:

Table 10 Description of Particle Sizes

Particle size	Description
TSP **Everything**	Total Suspended Particulate Matter (TSP) refers to the total of all particles suspended in the air. Even the largest of these particles is barely half the width of a human hair.
"larger than" PM10 **large**	A subset of TSP, and refers to all particles of size 10 μm in diameter and greater.
PM10 **coarse**	Also a subset of TSP, and includes all particles smaller than 10 μm in diameter (smaller than 1/7th of a hair width). Particles in the size range 2.5 μm to 10 μm in diameter are referred to as **coarse particles** (PM 2.5-10).
PM2.5 **fine**	A subset of both PM10 and TSP categories and refers to all particles less than 2.5μm in diameter. PM2.5 is referred to as *fine particles* and is mainly produced from combustion processes such as vehicle exhaust.

Particles levels in air are measured by the weight (micrograms) of particles per cubic metre of air (µg/m3). One (µg/m3) equals one millionth of a gram in a cubic metre of air. See Fig 3 for Allowable dust Emission Standards

TSP can also be measured as the weight of dust falling on a given area over time ("dust deposition")

6.3 MONITORING METHODS

The following are considered to be best practice methods for dust monitoring:

- Complaint monitoring
- Emission measurement
- Ambient monitoring
  - dust deposition
  - Suspended particulate
  - Other (video monitoring, microscopic examination, "tracer" elements)

6.4 PM (PARTICULATE MATTER) FROM MINING

The vast majority of dust from mining activities consists of coarse particles (around 40 per cent) and particles larger than PM10, generated from natural activities such mechanical disturbance of rock and soil materials by excavators, trucks, bulldozing, blasting, and general vehicles on dirt roads.

Particles are also generated when wind blows over bare ground and different types of stockpiles. These larger particles can have amenity impacts as well as health impacts.

Fine particles from vehicle exhausts and mobile equipment are also produced at mine sites, though they only account for about 5 per cent of the particles emitted during the mining process. Fine particles produced at mine sites are manly from vehicle and mobile equipment exhausts.

6.5 POTENTIAL HEALTH IMPACTS FROM PM

The human body's respiratory system has a number of defence mechanisms to protect against the harmful effects of PM. PM is often trapped in sticky mucus on the walls of the airways and can be removed by cilia, small hair-like objects which line the surface of the airways. This mucus can then be swallowed or coughed up.

Generally, it is thought that fine particles below 2.5 μm in diameter may be of a greater health concern than larger particles as they can reach the air sacs deep in the lungs. However, coarse particles (PM 2.5-10) could also be associated with adverse health effects.

People who may be more susceptible to the health effects of fine and coarse particles are:

- infants, children and adolescents
- elderly
- people with respiratory conditions such as asthma, bronchitis and emphysema
- people with heart disease
- people with diabetes.

If health effects arise from exposure to coarse particles, such as from mining activities, the symptoms are likely to be:

- cough
- wheeze, or worsening of asthma
- increased need for medications (eg: puffers, antibiotics)
- increased breathlessness.

High levels of TSP may also cause coughing, sneezing or sore eyes.

6.6 POTENTIAL AMENITY IMPACTS

Amenity impacts from dust are usually associated with coarse particles and particles larger than PM10. The impact of dust from Ronphos's Unit 3 on local amenity is subject to the distance from the source and climatic conditions such as wind.

Concerns about amenity from mine site dust often relate to "visibility" of dust plumes and dust sources. Visible dust is usually due to short-term episodes of high emissions, as is in this case crushing and drying.

Other amenity impacts include dust depositing on fabrics (such as washing) or on house roofs, and the transport of dust from roofs to water tanks, during rain.

6.7 GOVERNMENT REGULATIONS

In many countries outdoor air quality standards are governed by both State and Federal regulations. International Organisations also provides for air quality standards that are applied in cities and large towns across. Most standards apply to average concentrations across a region.

The standards imposed by the regulatory authorities take into account what we know about health effects on people with asthma, lung conditions, and heart disease. PM standards and criteria are set to control short (daily) and long term (average) levels..

The applicable PM_{10} limits for World Bank are as follows;

- Annual Arithmetic Mean: **100 µg/m^3**
- Maximum 24 hour average: **500 µg/m^3**

The table below summarises the relevant air quality standards and criteria for mines in Australia. These are more favourably comparable to International Standards such as World Bank Standards as shown above

Table 11 Typical Air quality Standards & Criteria for PM (Particulate Matter)

Pollutant	**Averaging Period**	**Concentration Standard**	
		***µ*g/m3**	***m*g/m3**
TSP	Annual	90	0.900
PM10	**1 day (24 hr)**	**50**	**0.500**
	Annual	30	0.300
PM2.5	1 day (24 hr)	25	0.250
	Annual	8	0.080
Dust deposition	Annual (total)	4 grams/m2/month	0.040
	Annual (increase)	2 grams/m2/month	0.020

Sampling of ambient air Particulate Matter (PM_{10}) is normally undertaken at an agreed number of locations at sensitive receptors (eg: habituated areas within the concession but **not** including working areas which are covered under Health & Safety.

6.8 NUISANCE DUST

Nuisance dust is defined as dust with a TWA (Time Weighted Average) of greater than 10mg/cu.m at 2.5microns of respirable air

TWA, is defined as the time-weighted average airborne concentration of a particular substance when calculated over a normal 8-hour work day, for a five-day working week. TWA is a term is used in the specification of Occupational Exposure Limits (OELs)

STEL (Short Term Exposure Limit) is defined as the 15-minute time weighted average exposure which should not be exceeded at any time during a work day even if the eight- hour TWA average is within the TWA exposure standard. Exposures at the STEL should not be longer than 15 minutes and should not be repeated more than four times per day.

There should be at least 60 minutes between successive exposures at the STEL.

TWA and STEL are expressed in either ppm (parts per million) or mg/M3 (Milligrams per cubic metre).

The ppm and mg/M3 are interrelated according to the following formula

$$\text{concentration (in mg/M3)} = \frac{\text{molecular weight X concentration (in ppm)}}{\text{24.4 (molar volume in litres)}}$$

6.9 MINIMISING DUST EMISSIONS FROM MINE SITES

Primary dust control at mine sites is achieved by a combination of water sprays (such as stockpile sprays and road watering) and enclosures (such as covered conveyors).

Dust modelling and prediction is an important part of minimising dust and determining appropriate dust controls and management programs. Many sites use weather stations and real-time dust monitors located between the mine and nearby neighbours to match dust events to activities on the mine site. This information can then be used to adjust processing activities and minimise dust. For example, changing crushing, drying, loading times based on favourable weather conditions.

6.10 AVOIDING MINE DUST

Provided that operations are operated with proper dust controls, it is unlikely that healthy adult residents would suffer any serious health effects from the expected exposure to particulate matter.

- If dust levels are high, keeping windows and doors closed minimises dust.
- People who have asthma or lung conditions should avoid outdoor activities at these time.
- An air-conditioner can reduce PM levels inside, but it is more important to regularly clean the intake filter.
- Residents finding dust levels a nuisance or a health risk can obtain advice by contacting the mine. A mitigating measure and appropriate due process for Ronphos is to have a community complaints process with a Community Consultative Committee where such issues can be raised. Details to be Logged and recorded.
- Residents experiencing the symptoms outlined should see their local doctor.

7 DEFINITIONS

TLV-TWA (Threshold Limit Value-Time Weighted Average): The time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which nearly all

SHORT TERM EXPOSURE LIMIT - Represented as STEL or TLV-STEL, this is the maximum concentration to which workers can be exposed for a short period of time (15 minutes) for only four times throughout the day with at least one hour between exposures. Also the daily TLV-TWA must not be exceeded.

THRESHOLD LIMIT VALUE - Airborne concentrations of substances devised by the ACGIH that represent conditions under which it is believed that nearly all workers may be exposed day after day with no adverse effect. TLV's are advisory exposure guidelines, not legal standards, that are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three different types of TLV's: Time Weighted Average (TLV-TWA), Short Term Exposure Limit (TLV-STEL) and Ceiling (TLV-C).

TIME WEIGHTED AVERAGE - The average time, over a given work period (e.g., 8-hour work day), of a person's exposure to a chemical or an agent. The average is determined by sampling for the contaminant throughout the time period. Represented as TLV-TWA.

PERMISSIBLE EXPOSURE LIMIT (PEL) - PEL may be either a time-weighted-average (TWA) exposure limit (8 hour), a 15-minute short term exposure limit (STEL), or a ceiling (C).

"C" OR CEILING - A description usually seen in connection with ACGIH exposure limits. It refers to the concentration that should not be exceeded, even for an instant. It may be written as TLV-C or Threshold Limit Value-Ceiling.

GRAM (g) - A metric unit of weight. One ounce equals 28.4 grams.

MILLIGRAM (mg) - A unit of weight in the metric system. One thousand milligrams equal one gram.

MILLIGRAMS PER CUBIC METER - Units used to measure air **(mg/m^3)** concentrations of dusts, gases, mists, and fumes. 1 million mg equals one kilogram

MICRON/mg Units used to measure air **($\mu mg/m^3$)** concentrations of dusts, gases, mists, and fumes. 1 billion μmg equals one kilogram

MICRON – units used to measure length, 1 million microns equals a meter

CARCINOGEN - A substance or physical agent that may cause cancer in animals or humans.

DYSPNEA -Shortness of breath; difficult or labored breathing.

HAZARDOUS MATERIAL - Any substance or compound that has the capability of producing adverse effects on the health and safety of humans.

INGESTION - Taking a substance into the body through the mouth, such as food, drink, medicine, or unknowingly as in contaminated hands or cigarettes, etc.

INHALATION - Breathing in of an airborne substance that may be in the form of gases, fumes, mists, vapors, dusts, or aerosols.

PERSONAL PROTECTIVE EQUIPMENT (PPE) - Any devices or clothing worn by the worker to protect against hazards in the environment. Examples are respirators, gloves, and chemical splash goggles.

ppm - Parts (of vapor or gas) per million (parts of air) by volume.

RESPIRATORY HAZARD - A particular concentration of an airborne contaminant that, when it enters the body by way of the respiratory system or by being breathed into the lungs, results in some bodily function impairment.

SENSITIZER - A substance that may cause no reaction in a person during initial exposures, but afterwards, further exposures will cause an allergic response to the substance.

TOXICITY - The potential for a substance to exert a harmful effect on humans or animals and a description of the effect and the conditions or concentrations under which the effect takes place.

CARCINOGEN - A substance capable of causing cancer or cancerous growths in mammals.
- "Known" labels indicate that sufficient information exists which shows a
definite relationship between exposure to a substance and cancer in humans.
- "Probable" labels indicate there is limited evidence in humans andlor sufficient
Evidence in experimental animals. ***c*- -**

MUTAGEN - A substance capable of causing changes in the genetic material of a cell, which

HIGHLY TOXIC - Agents or substances that when inhaled, absorbed or ingested in small amounts
can be transmitted during cell division. can cause death, disablement, or severe illness.
- An unstable substance capable of rapid and violent energy release.
- A substance that causes destruction of tissue by chemical action on contact.
- A substance that on immediate, prolonged,