CITIC PACIFIC MINING

SINO Iron Project

Operational Environmental Management Plan

APPENDIX A

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Appendix A SINO Iron Project, Dust Operational Management Plan, 15 June 2012

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SINO Iron Project

Dust Operational Management Plan

15 June 2012

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Soil Management Procedure	DR017497
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Document approval

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Contents

Executive Summary

The purpose of the operational dust management plan is to ensure that dust generated by the Sino Iron Project (the Project) is managed such that corporate policy, WA legislative requirements and the needs of the local community and environment are met during the Project's operation. Within Western Australia, this typically involves applying best available practices with the aim of "no visible dust" leaving the premise boundary. The term "no-visible dust" is a subjective not scientific measurable.

The Project consists of high wall in-pit mining, primary crushing, wet concentrating using magnetic separation, and a bulk loading facility for the concentrate product. Waste rock dumps and a tailings storage facility (TSF) will be used for the management of the primary wastes from the Project. The concentrate product will be very fine and therefore poses a potential dust risk, in the event that it dries out and becomes exposed, particularly in windy conditions. Good dust management will involve regular reviews of performance based on the ambient monitoring program results and implementing a process of continual improvement.

Table 1, lists the potentially largest dust emissions during full operational activities derived from generic NPI and site activities and where dust management practices can be most beneficial.

Table 2, gives an overview of the potential actions that can be taken to reduce dust and

Table 3, gives an overview of the dust management plan actions

Table 1: Estimates of the potential largest dust emission sources during operational activities

- Mining activities including:
  - removal of overburden;
  - drilling and blasting;
  - loading and unloading of haul trucks; and
  - haul truck movement.
- Material handling at the front (dry) end of the plant.
- Windblown dust from the waste rock dumps, Run of Mine (ROM) stockpiles, TSF and cleared areas.

Table 2: Potential Dust management actions to reduce potential dust emissions

- Maximising efficiency of loads when transporting ore or concentrate (including haul trucks and conveyers).
- Using dust covers on machinery and water suppressants on exposed areas wherever required.
- Minimise open area footprint and rehabilitate or cover (using vegetation, rock, water and/or dust suppressant) exposed areas as soon as practical.
- Implement good housekeeping practices including ensuring that product spills are cleaned up as soon as possible, and water sprays and emissions control equipment is properly maintained.
- Reduce vehicle traffic on unsealed roads and other exposed areas to minimum required.

- Restricting vehicle speeds on unsealed roads.
- Use real time ambient monitoring to respond to elevated emissions associated with the Project.
- Ensuring that the Project's workforce are aware of the importance of appropriate dust management and mechanisms are in place to facilitate prompt reporting and action in the event of elevated dust emissions being observed.

Table 3: Overview of management plan actions

Aspect	Impact	Objective	Target	Control/ Action	Performance Indicator	Responsibility
Emission of dust particles	1. Air Pollution 2. Land degradation	Ensure that environmental values are not adversely impacted by compling with ambient dust concentration guidelines along premise boundary	Daily average PM_{10} guideline of 70 µg/m^3	Monitor average daily PM_{10} along premise boundary. Ensure routine management measures such as sprays etc. are working correctly	Not to exceed the daily guideline on more than ten days from operational activities.	Area Supervisors; and Environmental Manager
		Avoid nuisance dust levels by minimising the probability of short-term dust events leading to exceedances of the daily guideline	Minimise exceedances of the hourly PM_{10} internal trigger. level of 250 µg/m^3	Monitor average hourly PM_{10} dust along plant boundary	Regular review of the internal trigger level. Better operational control leading to fewer exceedances of the daily guidelines.	

Definitions / Acronyms

Term	Meaning
Airborne particles (aerosols)	Airborne particles exist as aerosols, dust, fumes, smoke and mists. These are classified according to their processes of formation.
	• Dust is formed by mechanical subdivision of bulk material. Dust particles are generally solid and irregular in shape and have diameters greater than 1 micrometer (µm).
	• A fume is an aerosol of solid particles formed by condensation of vapours formed at elevated temperatures. The primary particles are generally very small (less than 0.1 µm) and have spherical or characteristic crystalline shapes. Since they may be formed in high concentrations, they often rapidly coagulate, forming aggregate clusters of low overall density.
	• Smoke is formed by condensation of combustion products (including incomplete combustion), generally of organic materials. The particles generally have diameters of less than 0.5 µm.
	• Mist is droplet aerosol formed by mechanical shearing of a bulk liquid (for example, by atomization, nebulisation, bubbling, or spraying). The droplet size can cover a very large range, usually from about 2 µm to greater than 50 µm.
Ambient air	The external air environment, it does not include the air environment inside buildings or structures.
Anthropogenic	Processes or materials that are derived from human activities.
BAM	Beta Attenuation Monitor used for continuous dust concentration measurement.
CPM	CITIC Pacific Mining Management Pty Ltd
DEC	Department of Environment and Conservation.
DEC EAR	DEC Environment Assessment Report
Dust	The generic term used to describe solid airborne particles generated and dispersed into the air by processes such as handling, crushing and grinding of organic or inorganic materials such as rock, ore, metal, coal, wood or grain and stockpiling of materials or are naturally present in the environment (such as pollens, sea salts and smoke).
DMP	Dust Management Plan.
E-BAM	The E-BAM is a portable real-time beta gauge traceable to US-EPA requirements for automated TSP, PM 2.5 and PM 10 measurement.
Equivalent aerodynamic diameter (EAD)	The diameter of a spherical particle with a density of 1 g/cm^3 that would have the same settling velocity as the particle being considered.
EMPgm	Environmental Management Program.
EMS	Environmental Management System.
Fugitive Dust	Particles generated by a wind and/or anthropogenic activities that are not captured and discharged via a stack or vent.
µg/m^3	Microgram per cubic meter referenced to a temperature of 0 degrees Celsius and a pressure of 101.325 kilopascals.
NEPC	National Environment Protection Council.
NEPM	National Environment Protection Measure.
ODMP	Operational Dust Management Plan

PHPA	Port Headland Port Authority have developed their own regional PM_{10} trigger related to iron ore activities. This trigger has been accepted by DEC.
PM_{10}	Refers to particulate matter with an equivalent aerodynamic diameter of up to 10 µm.
$PM_{2.5}$	Refers to particulate matter with an equivalent aerodynamic diameter of up to 2.5 µm.
Quality Assurance/ Quality Control (QA/(QC)	All those planned or systematic actions necessary to provide confidence that a service or data is of the type and quality needed and expected.
Sensitive receptor	Individuals/communities/components of the environment that could be adversely affected by dust emissions, such as dwellings, schools, hospitals, offices, protected wetlands or public recreation areas that exist now and in the future.
Total suspended particles (TSP)	Particles that have an equivalent aerodynamic diameter of less than 50 µm.
Trigger Levels	The "**Warning or Corrective Action**" trigger level is a short term (e.g. hourly) ambient air dust level which if exceeded for three consecutive periods will result in corrective action being taken to identify and reduce dust emissions if the Project is considered the likely primary emission source. The purpose of a trigger level is to provide an internal mechanism for initiative corrective actions and prevent a target level exceedence.

1 Introduction

1.1 Purpose

CITIC Pacific Mining Management Pty Ltd (CPM) is developing an iron ore mining, processing and export facility near Cape Preston approximately 80 km south-west of Karratha (the Sino Iron Project (the Project)). The development of the Project will result in the creation of a large-scale mining, processing and export operation.

The purpose of this Operational Dust Management Plan (ODMP) is to ensure that dust generated by Project activities during the operational phase is managed such that corporate policy, WA legislative requirements and the needs of the local community and environment are met during the operational stage of the Project. This ODMP has been prepared following the guidelines and structure for developing a dust management program (DMP) as described by the Department of Environment and Conservation (DEC) guidance document (DEC, 2008).

1.2 Scope

This ODMP applies to all terrestrial Project activities that may generate dust including mining, beneficiation, stockpiling, reclamation, and the Port bulk loading export phases of operation. All Project personal including operational contractors will operate within this ODMP.

This plan satisfies:

- Commitment 2 of Ministerial Statement 635, which requires an operational environment management programme and a dust management plan to be developed for the Project;
- Part V, *Environment Protection Act 1986* requirements for an operational dust man plan requested under condition of Works Approval WA4482/2008/1, condition 14;
- Align with other statutory operational management plans required by Department of Mines and Petroleum (e.g. TSF operating management plan, TSF operating manuals).

2 Environmental Management Framework

2.1 Project Background

Mining at the Project site will focus on mining iron ore in the form of magnetite at the George Palmer Ore body located at Cape Preston, located approximately 80 km south-west of Karratha in the Pilbara Region of Western Australia. At peak production, mining of ore and waste will be at a rate of around 95Mtpa (consisting of 10.6Mtpa waste and 84.4 Mtpa ore feed).

At its maximum extent the open pit will be 2.5 km long and up to 1 km wide with 12 m benches to a depth of around 220 m. Ore will be mined using conventional blast and haul methods and waste rock will be deposited external to the pit in allocated waste dump areas. Ore will be crushed in-pit using a semi-mobile crushing plant. Crushed ore will be transferred to the concentrator on an inclined conveyor. The concentrator

process is a single stage of open-circuit crushing, two stages of closed-circuit grinding and magnetic separation, concentrate and tailings thickening, concentrate dewatering and tailings disposal.

The concentrator will produce 21.6Mtpa magnetite concentrate, 6Mtpa of magnetite pellets and 57.8Mtpa tailings that will be deposited to a conventional paddock style TSF. The concentrate, as slurry, will be transferred to the port facilities via a 29 km pipeline (partly underground) where it will be dewatered and stockpiled as concentrate. Up to 1 Mt of material can be stored at the port prior to shipping.

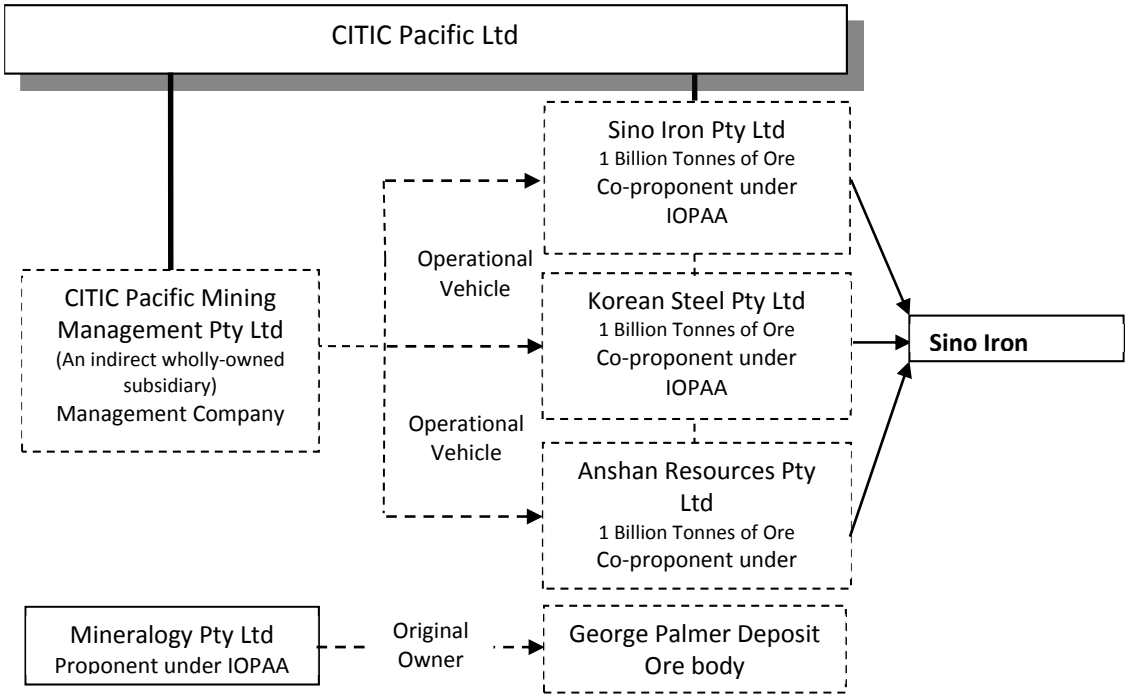
The port facilities will comprise a jetty head, 1.1 km breakwater, conveyor, ship loader, small craft harbour to accommodate two tugs, a pilot boat and a line boat. Other facilities operated by CPM at Cape Preston will include a dewatering plant, pellet plant, 44 GLpa desalination plant, stockyard and laydown areas and various administration buildings and workshops.

Additional infrastructures include a 450 MW natural gas fired power station, access and haul roads, mining workshop, construction, accommodation village 123, and power and water distribution networks.

2.1.1 Iron Ore Processing Agreement Act 2002

The *Iron Ore Processing (Mineralogy Pty Ltd) Agreement Act 2002* (IOPAA) is an agreement between the Western Australian government, Mineralogy and six subsidiary companies. CITIC Pacific Limited purchased the mining rights for the George Palmer Orebody at Cape Preston from Mineralogy in March 2006, thereby becoming a co-proponent to the IOPAA. The mining rights purchased are for 3 billion tonne contained entirely within Mining Leases M08/123, M08/124 and M08/125.

CPM is an Australian company that is wholly owned by CITIC Pacific Limited. CPM was established to manage the development of the George Palmer Deposit, associated processing, and export infrastructure. However, as the owner of the tenements and main proponent of the IOPAA, Mineralogy retains the ultimate liability for the leases. CPM also has access to Mining Leases M08/264 – M08/266 and Mineralogy's General Purposes Leases G08/52-G08/54 and Miscellaneous Lease L08/20. Despite this, CPM is responsible for all aspects of implementation of the Project. The chart below details the ownership structure.



2.1.2 Ministerial Statement 635

As part of the IOPPA agreement with Mineralogy, CPM has also accepted co-responsibility for compliance with the environmental conditions and commitments listed in Ministerial Statement 635 under which Mineralogy are the ultimate proponent.

The Project was approved by the Minister for the Environment under Statement 635 in October 2003 subject to Conditions and Commitments. The timeline of the approvals process is summarised as follows:

2000 (Austeel Pty Ltd) Public Environment Review submitted.

2002 (Austeel Pty Ltd) Supplementary Environment Review.

2003 Ministerial Statement 635.

2004 (Austeel) Section 45C Downstream Iron Ore Processing (DRI and HBI Processing and Port Construction), prepared by Maunsell Pty Ltd.

2008 Section 45C Submission - Support Infrastructure, prepared by Stratagen.

2008 Section 45C Submission - Mine and Processing, prepared by Stratagen.

2009 Section 45C Submission - Pellet Plant relocation, prepared by CPM.

2009 Section 46, Request to change conditions 8 and 7.1(5) of Statement 635, which resulted in their replacement with Ministerial Statement 822.

2.1.3 Part V, Environment Protection Act 1986

A Licence to Operate L8308/2008/1 is issued for the Sino Iron Project for the following prescribed categories; 54 (Sewage Facility), 64 (Class II Landfill) and 73 (Bulk storage of chemicals).The prescribed premise boundary currently defined as Tenements M08/123-

125. In addition to this there are currently five separate Works Approvals applicable to the Sino Iron Project under Part V of the *EP Act 1986*. These permit the construction and commissioning of six prescribed premise activities to occur:

- **W4393/2007/1** (amended May 2011) for Electric Power Generation, prescribed premise category 52 with a capacity of 480 MW on M08/124;
- **W5005/2011/1** (replacing WA4421/2008/4) for a Primary Crushing Facility, prescribed premise category 5 with a capacity of 85.4mtpa on M08/123-125 and a Class III Waste Landfill Facility prescribed premise category 64 with a capacity of 7,500tpa on M08/123.(DEC, 2011);
- **W4447/2008/1** (amended September 2011) Tailings Storage Facility and Concentrator for prescribed premise category 5 with a capacity of 85.4 million tonnes per annum on M08/123-125, G08/54, M08/264-266 (DEC, 2011b);
- **W4482/2008/1** (amended December 2011) Desalination Plant prescribed premise category 54A with a capacity of 44GLpa and Bulk Loading Facility prescribed premise category 58 with a capacity of 192,000 tpd on G08/52 (DEC, 2011c);
- **W4819/2010/1** modification of Camp 123 Wastewater Treatment Plant prescribed premise category 54 with a capacity of 1,000m^3/day and relocation of spray irrigation field to M08/123.

Due to the size of the Sino Iron Project and the DEC's requirement for contiguous premise boundaries, CPM believe that there will need to be three separate Operational Licences to cover all prescribed activities associated with these works approvals.

2.2 Environment Management System Elements

Environmental Management System (EMS) - high level elements include: Environmental Policy, legal requirements, EMS document control, stakeholder communications, compliance/performance/system audits and management review/feedback (P1*).

Environmental Management Program (EMPgm) - being developed in 4 Phases (for 3 Project areas) based on preparation of a construction Environmental Management Program (EMPgm) for each Phase. EMPgm operational elements include: roles and responsibilities, training/induction, internal communications, emergency response, program documentation, inspection and incident reporting, Procedures for overburden storage/land clearing, flora, fauna, weeds, spills, waste, dust, stormwater management, gaseous emissions and risks and hazards (P2).

EMPgm Phases – EMPs applicable to each area are listed below**

Phase 1 EMPgm

(Area 1) Mainland Mine site facilities - pit, waste dumps, TSF, processing plant, power station, infrastructure and support facilities (e.g. accommodation camp)

- Aboriginal Sites Management Plan (P12)
- Vegetation Monitoring Plan (P4)
- Noise Management Plan (M12)
- Greenhouse Gas Emissions Management Plan (M11)
- Preliminary Closure Plan (M16)
- Mesquite Control Plan (P5)
- Surface Water Management Plan (P8)
- Pit Dewatering and Vegetation Monitoring Plan (M6)
- Recreational Use Management Plan (M13)
- Groundwater Management Plan (P9)

COMMENCED

Phase 2 EMPgm

(Area 2) Cape Preston Port's terrestrial facilities - service corridor to the Port, stockyard, desalination plant, and support facilities (e.g. port administration office)

- Aboriginal Sites Management Plan (P12)
- Vegetation Monitoring Plan (P4)
- Noise Management Plan (M12)
- Greenhouse Gas Emissions Management Plan (M11)
- Preliminary Closure Plan (M16)
- Mesquite Control Plan (P5)
- Recreational Use Management Plan (M13)

COMMENCED

Phase 3 EMPgm

(Area 3) Marine Port's causeway, tug/barge harbour, jetty, wastewater intake and brine outfall

- Wastewater Outfall Management Plan (M8) *(no longer required)*
- Conservation Estate Management Plan (M15)
- Fauna Management Plan (P6)
- Marine Management Plan (M7)
- Port EMP (M9)

COMMENCED

Phase 4 EMPgm

(Area 3) Marine Port's channel

- Update Marine Management Plan (M7) to address dredging

PENDING COMMITMENT TO DEEP WATER PORT

Notes

***** Requirements of Statement 635
P1 = Commitment 1; M12 = Condition 12
****** EMPs are supported by the high level elements of the EMPgm and EMS. An EMP may apply to more than one area and includes: environmental objectives and targets, management actions, monitoring regime, performance indicators, corrective and preventative actions, and contingency actions.

2.3 Applicable Policy and Guidelines

2.3.1 Dust

Dust is defined as particles that can remain suspended in the air by turbulence for a length of time. Dust can consist of a range of matter including crustal material, pollens, sea salts and smoke from combustion products. Dust or particulate matter is commonly defined by the size of the particles as follows:

- TSP (total suspended particulate), which is all particulate matter with an equivalent aerodynamic particle diameter below 50 µm diameter;
- PM_{10}, particulate matter below 10 µm in equivalent aerodynamic diameter; and
- $PM_{2.5}$, particulate matter below 2.5 µm in equivalent aerodynamic diameter.

TSP contains both the PM_{10} and $PM_{2.5}$ fractions and is normally associated with nuisance impacts such as dust fallout. PM_{10} and $PM_{2.5}$ are generally associated with the potential for health impacts as particles below these sizes may enter the lungs.

2.3.2 National Environment Protection Measure

The National Environment Protection Council (NEPC) has produced national ambient air quality standards for the protection of human health relevant to particulates. These include the National Environment Protection (Ambient Air Quality) Measure (Air NEPM) (NEPC, 1998), which sets national air quality standards for the criteria pollutants including particulate (as PM_{10}), and the Variation to the National Environment Protection (Ambient Air Quality) Measure (NEPC, 2003) which sets an advisory reporting standard for $PM_{2.5}$.

The Air NEPM sets a standard for PM_{10} of 50 µg/m^3 (24-hour average) with a maximum of five allowable exceedences per year. The NEPM standards have been derived from health studies in major urban centres where the particulate matter primarily consisted of combustion products from vehicles, industry and smoke from various burning activities. The Western Australian State Government has adopted the NEPM standards for ambient air quality as part of the Draft State Environmental (Ambient Air) Policy 2009 (EPA, 2009).

2.3.3 Port Hedland Air Quality and Noise Management Plan - Interim Air Quality Guideline

The Port Hedland Air Quality and Noise Management Plan (DSD, 2010) (the Plan) is a strategy for future land use in Port Hedland developed by a taskforce established by the Western Australian State Government. The Plan sets goals and allocates responsibilities for managing the impact of dust and noise on people and property, and for monitoring and managing dust and noise levels in the Port Hedland region.

The taskforce, which is chaired by the Department of State Development (DSD) and reports to the Premier, includes representatives of local industry. The taskforce developed the plan to monitor and assess air quality in a situation where the NEPC NEPM PM_{10} standard was regularly exceeded. The plan recognises that the national standard for PM_{10} was designed for an urban setting and was not intended for regulating dust from mining activities.

The taskforce investigated the potential health effects from inhalation exposure to particulate matter rich in crustal materials, (in particular iron oxides) and assessed the relevance of the Air NEPM PM_{10} guideline for Port Hedland. To determine acceptable levels of particulate matter or dust in Port Hedland, the review summarised over 500 epidemiological and toxicological studies on the health effects of particulate matter, assessed what type of monitoring was appropriate and identified suitable methods of measuring particulate matter.

The study concluded that a departure from the Air NEPM for particulate matter might be justified on compositional grounds because dust in Port Hedland is largely composed of coarse particles rich in iron oxides (93%) generated by mining related activities. In contrast, dust found in urban centres is largely composed of fine and ultra fine particles rich in combustion products. They recommended increases to the guideline concentration from 50 $\mu g/m^3$ to 70 $\mu g/m^3$ and an increase in the number of allowable exceedances from five to ten per year.

The taskforce recommended a precautionary approach that involved reducing dust concentrations over time and implementing strategies to monitor and assess air quality in Port Hedland. In particular, the Taskforce has set a short-term goal that at the end of five years to have less than ten exceedances per year of its interim 70 $\mu g/m^3$ guideline at the Hospital monitoring site (DSD, 2010).

3 Project Phases

Due to the size and complexity of the Project, environmental management has been divided into three phases to reflect the different aspects and impacts that occur during construction, commissioning and operations. Ministerial Statement 635, Schedule 2, commitments 1 and 2 specifically require separate construction and operational phase EMS and EMPgm.

Table: Summary of Commitment 1 and 2 from MS 635, Schedule 2.

#	Objective	Action
1	To manage the relevant environmental factors and to fulfil the requirements of the conditions and procedures in the Ministerial Statement	Prepare and implement and EMS for the project, to include: • an environmental policy and corporate commitment to the EMS; • Planning to meet environmental requirements • Specification and implementation of actions to meet environmental requirements • Measurement and evaluation of environmental performance • Review and improvement of environmental outcomes
2	To manage the potential impacts of the construction and operations phases of the project.	The EMP will contain plans, guidelines and procedures to manage environmental issues associated with construction and operation of the project including: • flora and fauna monitoring and management plans • overburden storage • pit dewatering and vegetation monitoring plan • marine management plan

		• spill contingency plan • surface water (including floor) management • groundwater management • dust and noise • gaseous emissions • greenhouse gas emissions plan • risk and hazards management plan • Aboriginal sties management plan • decommissioning and closure plan

The Construction EMPgm (CPM, 2010) was categorised by activities associated with three different areas of the Project:

1. Mainland terrestrial;
2. Cape Preston terrestrial; and
3. Marine Port construction.

Under the Construction EMS, fourteen environmental management plans were developed to cover activities specific to the construction phase of the Project. These construction phase plans have all been approved by the Minister of the Environment. In addition to the Part IV requirements, the DEC had expectations that emissions during commissioning would differ from those during construction or operations. Although CPM believes that these emissions will be no greater during commissioning, it agreed to amendments within the Works Approvals for submission of specific Environmental Commissioning Plans. Therefore, there are three area specific Environmental Commissioning Plans respectively for:

- ❑ Primary Crusher (WA5055, condition 3);
- ❑ Concentrator and TSF (WA4447, condition 3); and
- ❑ Desalination Plant (WA4482, condition 4).

Each of these plans have been submitted to the DEC for approval under Part V of the *EP Act 1986* and are applicable to the commissioning phase only.

The Operational Environment Management System (EMS) and Environment Management Programme (EMPgm) are currently developed. CPM has engaged Graham Brown and Associates to assist with refining the framework for the operational EMS. This Dust Management Plan will form part of the operational EMPgm.

4 Environment Baseline

The Project is located approximately 80 km south-west of Karratha and lies within the Mardie Station pastoral lease, an active pastoral station producing beef cattle. Mardie Station is owned and operated by Pastoral Management Pty Ltd (PMPL), a subsidiary of CITIC Pacific Limited, CPM's parent company. Cape Preston is located approximately 18 km to the north of the TSF and the North West Coastal Highway passes approximately 5 km to the south east of the Project region at its closest point.

A site overview is provided as **Figure 1.** and shows the locations of the main components of the Project and the existing meteorological and PM_{10} dust monitoring sites.

4.1 Climate

The Pilbara region is characterised by a hot arid climate. **Table 4** presents key climatic characteristics for Mardie Station Homestead (BOM, 2011) which is located approximately 20 km south-west of the Project Area. Mardie Station Homestead has daily maximum temperatures ranging from 28°C to 38°C, daily minimum temperatures ranging from 12°C to 25°C and an annual rainfall of about 270 mm. The morning (9am; **Figure 1**) and afternoon (3pm; **Figure 2**) wind roses, highlights the land-sea breeze influence. Winds change from the south east in the morning, to stronger winds from the north-west in the afternoon.

Occasional heavy rainfall events occur because of cyclonic activity. The Pilbara coast experiences more cyclones than any other part of Australia. On average about five tropical cyclones occur during each tropical cyclone season over the warm ocean waters off the northwest coast between 105 and 125°E. On average about two cyclones cross the coast, one of which is severe. Since 1910 there have been 48 cyclones that have been associated with damaging wind gusts (category four or five) in the Karratha, Dampier and Roebourne region (BOM, 2011); an average of about one every two years. About half of these cyclones have an impact equivalent to a category five cyclone with very destructive wind gusts in excess of 270 km/h. Along the central Pilbara coast, the cyclone season runs from mid December to April, peaking in February and March. Apart from the high winds, flooding and storm surges are other potential high risk factors.

Operations should be mindful of the low rainfall seasons and stronger afternoon wind speeds where dust mitigation procedures are likely to be important.

Table 4: Climatic statistics for Mardie Station Homestead (1981 to 2010) (Source BOM website)

Statistic Element	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Highest temperature (°C)	49	51	47	44	41	35	34	38	41	46	47	49	51
Mean maximum temperature (°C)	38	37	38	36	32	28	28	30	32	35	36	38	34
Mean minimum temperature (°C)	25	25	24	21	17	14	12	12	14	17	20	23	19
Lowest temperature (°C)	16	17	13	10	8	4	3	4	6	8	13	15	3
Highest rainfall (mm)	249	675	330	211	212	275	151	117	64	24	32	171	857
Mean rainfall (mm)	38	61	50	20	37	37	13	7	1	1	1	8	275
Mean rain days	2	3	2.3	1.1	2	2.1	1.2	0.8	0.2	0.1	0.2	0.5	16
Maximum wind gust speed (km/h)	108	260	180	211	76	81	76	71	68	76	82	174	260
Mean 9am wind speed (km/h)	14	13	13	13	14	14	13	14	16	17	16	15	14
Mean 3pm wind speed (km/h)	28	25	24	21	18	17	18	21	25	29	30	29	24

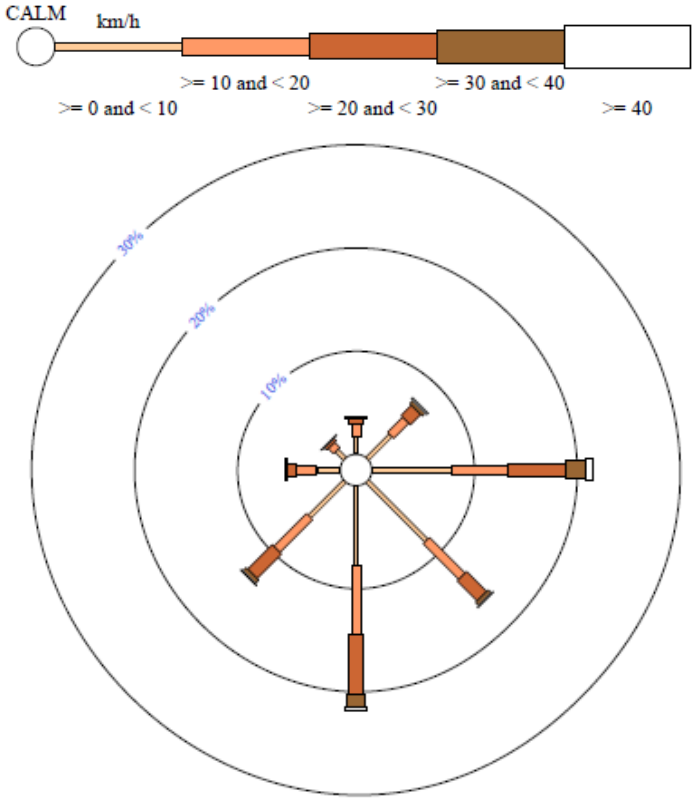


Figure 1: Mardie, 9am wind rose (8% calms) (Source BOM website; 1981 to 2010)

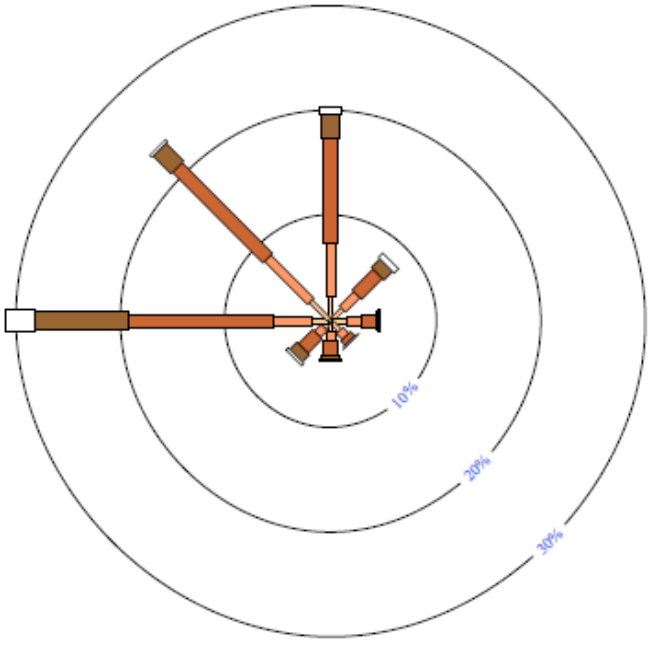


Figure 2: Mardie, 3pm wind rose (1% calms) (Source BOM website; 1981 to 2010)

4.2 Topography

The south-eastern side of the Project is dominated by two ridges running north to south (see **Figure 2**). The western series of ridges comprise the Northern, George Palmer and Southern ore bodies. To the west of the ore bodies lie the Du Boulay Creek and then the Fortescue River floodplain. The Edward and Du Boulay Creeks flow in a north-westerly direction through the Project Area with the Du Boulay Creek extending up the western side of the ore body, parallel to the Fortescue River. Edward Creek is a tributary to Du Boulay Creek, which discharges into the ocean adjacent to the mouth of the Fortescue River.

4.3 Vegetation

The vegetation of the Cape Preston area has been mapped and is described as clayey plains with low hills and slopes and is predominantly part of the Horseflats, Rocklea and Paraburdoo Land Systems (Astron, 2011). There are mangrove regions at the mouth of rivers and at Cape Preston (refer to pink shaded regions on **Figure 2**, Refer to Appendix A).

4.4 Soils

In most areas of the Project, and particularly on the upper slopes, the soil surface is weathered sheets of gravels and stones. Topsoil is generally thin (2-10 cm), easily broken, and with a gravel content typically more than 50%. The subsoil conditions comprise a layer approximately 2 m thick of gravelly sandy clay/gravelly clayey sand overlying basalt/shale/chert bedrock.

Due to the high gravel content, soil materials occupy a small volume of the profile matrix, with little potential for the development of soil structure. The texture of the finer soil fraction ranges from a sandy clay loam to clay loam in the shallow upper soils, and a clay loam to clay texture on the lower slopes and flats areas. The soils have low nutrient status, are neutral to slightly alkaline and generally have low salinity levels. Roots are abundant in the upper part of the soil profile and explore subsoil materials and underlying fractured rock. The high gravel content of the soil will reduce natural wind-blown dust from cleared and surrounding areas.

5 Operational Activities

5.1 Environment Management Aspect and Impact

Construction of the Project commenced in early 2008 with preliminary mining operations, including clearing and pre-stripping. Stockpiling of mine waste and ore from the pit is continuing on-site with processing of the ore scheduled to commence towards the end of 2012. **Figure 3** is a schematic diagram of the Project and shows the following activities that are explained further according to their area and facility:

- Ore processing consist of in-pit crushing and primary grinding at the primary crushing facility (PCF).
- Grinding and magnetic separation during the concentration stage (wet processes).

- Tailings directed to the tailings storage facility (TSF) for final disposal whilst the ore is pumped as slurry to the bulk loading facility (BLF).
- The BLF consists of a dewatering facility, stockpile facility and ship loading facilities. A pellet plant is scheduled for later operations and is not included in this ODMP.

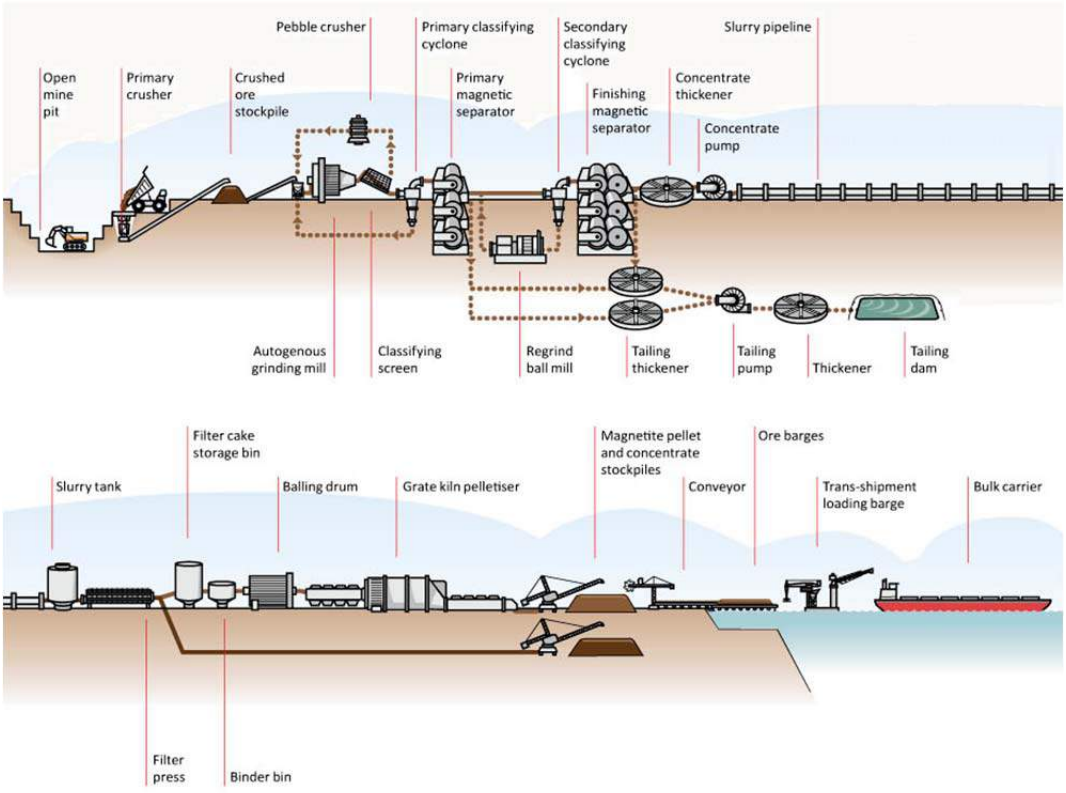


Figure 3: Schematic of the Project's mining and beneficiation operations

5.1.1 Mining

Ore is mined using conventional blast and haul method with waste rock materials deposited external to the pit in allocated waste dump areas. The mining fleet currently consists of 4 excavators and 18 haul trucks, increasing up to 6 excavators and 30 haul trucks within two years of operating. Mining production is anticipated to commence at 12Mtpa ramping to 95Mtpa over five years.

5.1.2 In-pit primary crushing

The PCF consists of four crushing units (located inside the pit), crushed ore stockpile, associated conveyors, and transfer stations. Each crusher has a design throughput of 4,250 tonnes per hour, with a combined annual process capability of up to 85.4 million tonnes (with 77 Mtpa being the nominal throughput). The PCF's primary function is to break down the mined magnetite ore from heavy rock to smaller sized pebbles (>250mm to <1200mm). The crushed ore is transported to the coarse ore stockpile by belt conveyors and tripper assemblies. Two pairs of two sequential overland conveyors (i.e. four conveyors) are used for overland transport. The design capacity of each conveyor is approximately 13,000 tonnes per hour and the conveyor length is 1.6 km. There is adequate management (including covers and wet type de-dusters), monitoring

and contingencies in place at the overland conveyors to ensure that dust emissions from these are appropriately managed.

As the pit is extended, the crushers will be relocated to locations that are more efficient in terms of material movement and the conveyors extended. The covered coarse ore stockpile has a design capacity of approximately 1 Mt. The crushed ore is reclaimed from the stockpile using a tunnel reclaim system and includes an automatic dust suppressant water spray system.

The reclaimed ore is ground further prior to the primary magnetic separator as part of the concentrator plant. The crushed ore is sent to the pebble crusher then onto the autogenously grinding mill and ball mill.

The DEC Environment Assessment Report (DEC EAR) assessed dust emissions from the PCA as having a significance level of 1 indicating that licence conditions were not required (DEC 2008)

5.1.3 Concentrator Process Plant

The concentrator plant is a two stage grinding process followed by magnetic separation where the ore is separated from waste material and sent to the thickeners before being piped to the Port. During operations, dust emissions from the Process Plant will be minimal, as it will operate as a 'wet process' with large volumes of water required throughout the concentrating, thickening, filtration and dewatering process (CITIC Pacific Mining 2008). The DEC EAR assessed dust emissions from the concentrator as having a significance level of 1.

5.1.4 Tailing Storage Facility – Stage 1

The waste residue from the concentrator plant is dewatered and thickened before being pumped to the TSF. The TSF is defined as a "side hill storage" design. Tailings thickened to 64% solids are stacked from the ridge on the eastern side of the proposed tailings impoundment area. Dust may potentially lift off from dry wall faces, the base of the TSF, and the dried tailings surface during operation.

As Stage 1 of the Tailings Storage Facility (TSF) has a footprint of 330 ha, it is risk ranked by the Department of Mines and Petroleum (DMP) as Category 1 High hazard. The DEC also assessed dust from the TSF with a significance level of 5 during operations. When the socio-political concerns were considered, the overall environmental risk from dust emissions was determined to be a "B" or medium – high risk (DEC, 2011b).

5.1.5 Cape Stockyards and Material Handing

The Stockyard and Material Handling Facility is located at the Cape and is shown schematically as part of **Figure 3**. Slurry is received from the concentrator plant and passes through a dewatering and filter press facility as the final step in producing up to 27.6 Mtpa of ore concentrate. The concentrate is stored in the stockyard in stockpiles within an area of 16 ha. The concentrate is deposited to the stockpiles using 4,000 t/h rail mounted rocker stackers. The concentrate is then reclaimed from the stockpiles by the same 8,000 t/h rail mounted bucket wheel reclaimer and transferred to the conveyor, which transports the concentrate to the barge loading facility.

The DEC EAR assessed dust emissions from the Stockyards and Bulk Loading Facility as having a significance level of 3 during operations as a consequence of potential impact to vegetation and marine life from sediment deposition.

5.1.6 Bulk Barge Loading Facility

A rail mounted non-slewing barge loader capable of loading at an average rate of 8,000 tph is installed on the breakwater. The fixed transverse boom of the barge loader conveyor is sized to cover the barge design width from the side of the loading berth. The barge loading-berth (340 m in length) allows two barges to be berthed simultaneously. The barge loader is able to travel the full length of the berth. Each barge will have a capacity of around 16,000 t of concentrate. The barges are moved using tugboats. At peak operations there will be up to four barges operating at once, the barges are capable of transporting approximately 75,000 t of ore per day. In the event of unsafe weather conditions, the barges will return to anchor in the port, and will continue operations once the weather reverts to safe operational conditions.

The DEC EAR assessed dust emissions from the Stockyards and Bulk Loading Facility as having a significance level of 3 during operations as a consequence of potential impact to marine life from sediment deposition.

5.2 Site Dust Risk Assessment

Emission estimates were derived from the NPI manuals for blasting (NPI, 2008), mining (NPI, 2011) and the review of mining dust emissions by SKM (SKM, 2005). These generic emission estimates are generally considered to be conservative and require site-specific data to improve accuracy. These results are based on generic emission factors and do not represent actual emissions to the environment. It should also be noted that these estimates assume inputs from full production, which will not be achieved for many years post operations. They are useful in that they provide “order of magnitude estimates” enabling the source strengths to be ranked against each other and prioritised in terms of potential dust mitigation measures.

Estimations of PM_{10} emissions for all sources used the approaches discussed in Appendix A and the results are summarised in Figure 9. These results highlight that most of the potential major sources of PM_{10} dust are likely to arise from:

- loading and unloading the haul trucks;
- travelling on the haul roads within the mine pit; and
- wind-blown losses from the stockpiles and open areas (pit and TSF).

Management of these areas will therefore result in significant reductions in the potential dust emissions from the Project.

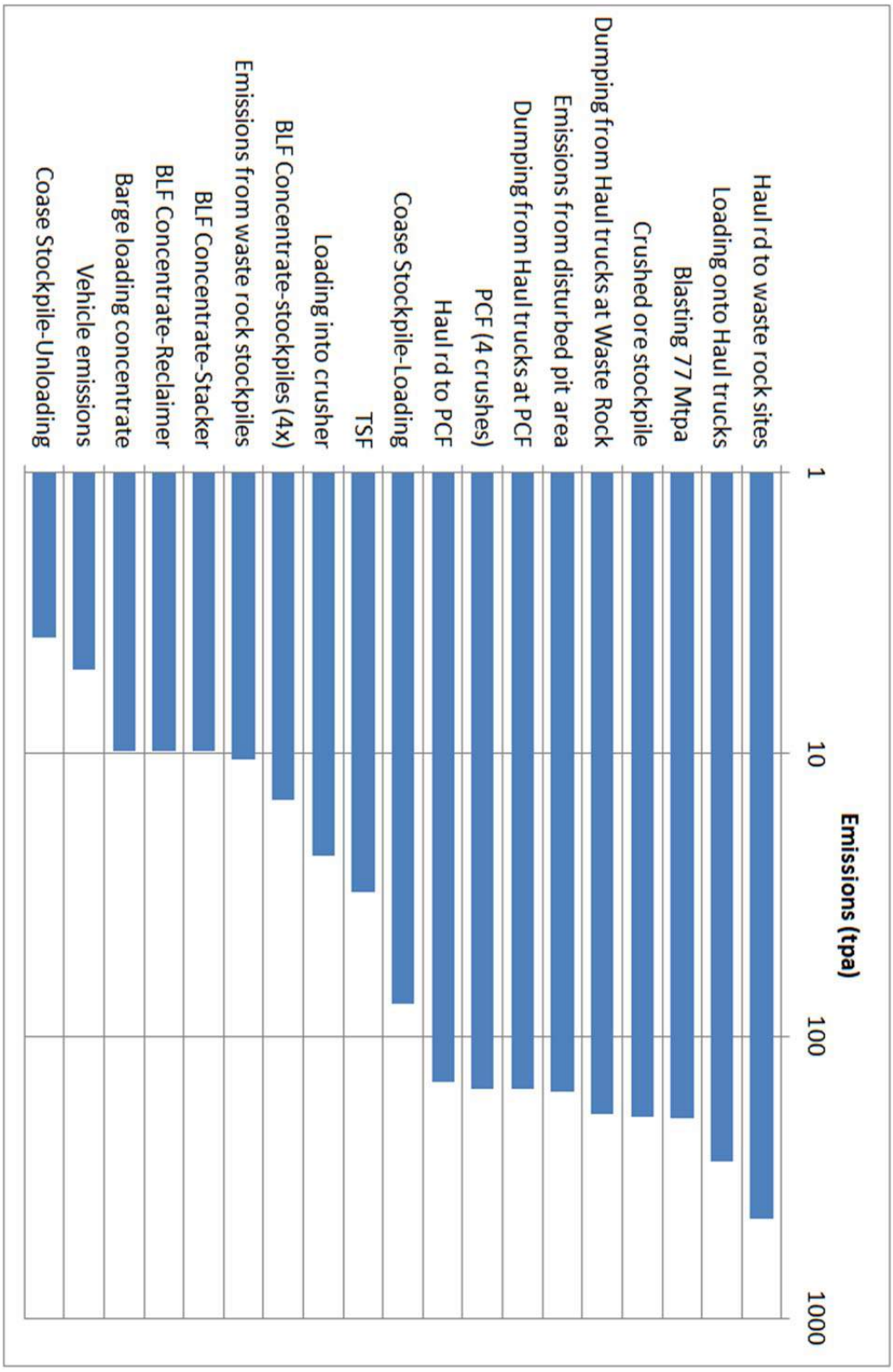


Figure 4: Estimated PM_{10} emissions (tpa)

5.3 Objective and Targets

CPM's over-arching objectives for dust management for the Project are outlined within the Operational Environment Management System. These are:

- ❑ Ensure that environmental values are not adversely affected (e.g. vegetation smothering) by minimising dust emissions by ensuring ambient guidelines are met;
- ❑ Ensure that nuisance dust levels are not experienced by neighbouring land users;

The specific targets and performance indicator for each objective are given in **Table 5** below.

Table 5: Operational Dust Objectives and Targets

Objective	Target	Control/ Action	Performance Indicator
Ensure that environmental values are not adversely impacted by complying with ambient dust concentration guidelines along premise boundary	Daily average PM_{10} guideline of 70 µg/m^3	Monitor average daily PM_{10} along premise boundary. Ensure routine management measures such as sprays etc. are working correctly	Not to exceed the daily guideline on more than ten days from operational activities.
Avoid nuisance dust levels by minimising the probability of short-term dust events leading to exceedances of the daily guideline	Minimise exceedances of the hourly PM_{10} internal trigger. level of 250 µg/m^3	Monitor average hourly PM_{10} dust along plant boundary	Regular review of the internal trigger level. Better operational control leading to fewer exceedances of the daily guidelines.

5.4 Management Actions and Control Measures

Best practice measures have been detailed in the BLF modelling study (PAE, 2008) and in more detail in the Federal Government's Department of Resources, Energy and Tourism document "Best Practice Environmental Management in Mining: Dust Control" (RET, 1998). CPM will implement realistic measures to minimise the generation of fugitive dust over the life of the Project.

The management actions and control measures that will minimise dust emissions from within the different areas of the Project during operations are summarised in the sections below.

5.4.1 Mine Pit

Sources of dust within the mine pit are associated with the following activities:

- drill and blasting;
- loading and unloading the haul trucks;

- vehicles travelling on haul roads; and
- wind-blown losses from stockpiles and open areas.

Management and control actions to minimise dust emissions from these activities are summarised in Table 6 below.

Table 6: Mine Pit Management Actions and Control Measures

Reference #	Action or Control Measure	Role / Responsibility
3934	• Unsealed haul roads within mining operations will be treated with dust suppression.	Mining Manger
3935	• Optimise load efficiency of haul trucks by not over or under-loaded to minimise spillage.	Mining Manager
3936	• Ensure that vehicles keep to the speed limits and drive within clearly demarcated areas.	Mining Manager/ All Mining Staff
3937	• Minimise tramming distance of heavy vehicles.	Mining Manager / Mining Engineers
3938	• Access tracks that have been identified as having low or no vehicle usage will be rehabilitated or have dust suppressant applied to reduce the risk of dust liftoff.	Mining Manager / Environment Manager
3938	• Use crushed waste rock on sandy sections of the active mine roads to minimise emissions.	Mining Manager

5.4.2 Waste Rock Dump and Stockpiles

Material handling, transfer and stockpiling of topsoil, overburden and waste rock by earth moving equipment is one of the largest dust emission sources for the Project. Dust is generated from the activities of:

- excavation by front-end loaders;
- loading and unloading of haul-trucks;
- construction of stockpile landforms; and
- erosion of stockpiled landforms.

Management and control measures to minimise dust emissions from these activities are summarised in Table 7 below.

Table 7: Waste Rock Dump and Stockpile Management Actions and Control Measures

Reference #	Action or Control Measure	Role / Responsibility
3940	• Apply water to the working face before excavation and continue during excavation as required.	Mining Manager
3941	• Limit the tipping distance between	Mining Manager

3942	excavator and receptacle to minimise volume exposed to wind action. • Commencing rehabilitation of waste rock dumps as soon as final landform has been reached	Mining Manager

5.4.3 Primary Crusher Area

Sources of dust within the Primary Crushing Area are associated with the following activities:

- Crushing; and
- Conveying and transfer.

Management and control measures to minimise dust emissions from these activities are summarised in **Table 8** below:

Table 8: Primary Crushing Area Management Actions and Control Measures

Reference #	Action or Control Measure	Role / Responsibility
3943	• Locating crusher units within the mine-pit (approximately 40m below natural ground level) to reduce the influence of wind movements on fugitive dust emission.	Project Engineer / Mining Manager
3944	• Maintenance of the Fog, Mist and Deluge system on the Crusher dump pockets and discharge conveyors.	Manager Operational Services
3945	• Overland conveyors to be fully enclosed.	Manager Operational Services
3946	• Partial enclosure of the coarse ore stockpile with the solid roof and half walls maintained.	Manager Operational Services
3947	• Eighteen dust collectors mounted on the roof of the stockpile enclosure to be maintained in accordance with manufacturer requirements.	Manager Operational Services
3948	• Use of fourteen water cannons located around the periphery of the exposed regions of the coarse ore stockpile.	Manager Operational Services

5.4.4 Concentrator Process Plant

Actions and controls to mitigate emissions from the concentrator are included in **Table 9** below.

Table 9: Concentrator Process Plant Management Actions and Control Measures

Reference #	Action or Control Measure	Role / Responsibility
3949	• Use of water sprays and fogging systems on conveyor transfer points for the apron and mill feed conveyors;	Process Plant Manager
3950	• Routine maintenance of the enclosed primary grinding process;	Process Plant Manager

5.4.5 TSF Stage 1

Control measures to minimise dust are documented in the TSF Operating Manual (Golders 2011), which has been drafted in accordance to the DMP Guidelines on the Development of an Operating Manual for Tailings Storage (DMP, 1998). These measures are outlined in **Table 10** below.

Table 10 TSF Management Actions and Control Measures

Reference #	Action or Control Measure	Role / Responsibility
3951	• Rotating the discharge points to keep the tailing surface wetted to inhibit dust generation;	TSF Operating Manager
3952	• Preventing the channelization of the tailings during placement;	TSF Operators
3953	• Use of a polyacrylamide flocculant to assist with improving the bond properties between particles and thereby facilitate crusting;	Process Plant Manager
3954	• Daily visual assessments of the tailings beach for signs of drying and dust generation;	TSF Operator
3955	• Managing the deposition of tailings before any planned plant stoppage, so that the tailings will remain moist over the stoppage period	TSF Operating Manager
3956	• Placement of a progressive cover of waste rock over dry tailings; and	TSF Operating Manager / Environment Manager
3957	• Ensuring once tailings are dry and have crusted that no mechanical disturbances or vehicles are tracked upon when dry	TSF Operating Manager

5.4.6 Cape Stockpiling and Material Handling

Design and engineering controls measures to minimise dust generation from the Cape Stockpile and Material Handling facility are outlined in **Table 11**.

Table 11: Control Actions: Stockpiles

Reference #	Control Measure	Role / Responsibility

3958	• Stockpile orientation north-south perpendicular to prevailing westerly wind	Manager Operational Services
3959	• Minimising the height and volumes of the stockpiles;	Manager Operational Services
3960	• Stacking and reclaiming predominantly on the downwind side of the stockpile.	Manager Operational Services
3961	• Reduce disturbance on stockpiles by preferentially leaving the first two stockpiles (coated) and stacking and reclaiming the two downwind stockpiles	Manager Operational Services
3962	• Dust suppression is installed with water sprays installed at stackers.	Manager Operational Services
3963	• Enclosed conveyors at transfer points.	Manager Operational Services
3964	• Use of primary and secondary scrapers and return belt V plough on stackers	Manager Operational Services
3965	• Use of a crusting agent applied to the stockpiles.	Manager Operational Services
3966	• Ensure that good housekeeping practices are maintained, e.g. cleaning up spilt concentrate as soon as possible.	Manager Operational Services
3967	• Regular cleaning and maintenance of belt scrapers and water suppression system.	Manager Operational Services

5.4.7 Barge Loading Facility

Design and engineering controls measures to minimise dust generation from the barge loading facility are outlined in **Table 12**.

Table 12: Barge Loading Management Actions and Control Measures

Reference #	Control Measure	Role / Responsibility
3968	• Water suppression on the stackers and reclaimer.	Manager Operational Services
3968; 3963	• Enclosed conveyor at transfer points.	
3969	• Use of primary and secondary scrapers and return belt V plough on reclaimer;	
3970	• Alarms for belt misalignment, slippage & hopper blockage	
3971	• An enclosed headbox, dust curtain at entrance and rubber skirt were observed on the barge loading facility ; and	
3972	• Mechanical luffing capability on the barge loader	

5.4.8 Open Areas General

Exposed areas not bound by vegetation or covered have the potential to dry out and can create high dust emissions even under moderate winds (>20km/hr). If left untreated, open cleared areas can be a significant dust emission source particularly if disturbance is ongoing. Cleared or exposed open areas in the pit, TSF and stockpiles are all susceptible to wind erosion. Adopting the following techniques in **Table 13** will minimise dust emissions from open areas:

Table 13: Control Actions: Open areas

Reference #	Control Measure	Role / Responsibility
3973 3974 3975	• Minimise the footprint of non-operational open areas. • Progressively revegetate or cover open areas once they are no longer required. • Being vigilant with preventative measures (housekeeping; use of water sprays) during the drier summer between 12 and 3 pm when the winds are typically the strongest.	Environment Manager

5.5 Monitoring & Performance Indicator

The effectiveness of the ODMP will be reviewed annually by the Environmental Manager against the following indicators:

- ❑ Number of exceedances of the hourly internal trigger PM_{10} level of 250 µg/m^3
- ❑ Number of exceedances of daily average PM_{10} guideline of 70 µg/m^3
- ❑ Review results annually and look at developing a reduction in the number of exceedances recorded per year.
- ❑ The results of monitoring and potential impacts on vegetation adjacent to cleared areas, haul roads, access tracks and the mine.
- ❑ The number of internal and external complaints and incident reports received and their resolution.

5.6 Contingency Action

The PM_{10} data measured by the continuous monitors is compared to the guideline of 70 µg/m^3 for a 24-hour averaging period. Any 24-hour PM_{10} concentration in excess of this guideline is reported as an internal incident and investigated. This mechanism is used for identifying if operations is the source, what proportion it is contributing above background levels and where the potential exists for additional dust control measures, so that future emissions from the identified source(s) can be minimised.

In the event that dust levels continue to be above the daily guideline, or visible dust is seen crossing the site boundary, CPM's actions may include the following action steps:

- ❑ undertake an investigation to determine if the Project was a significant contributor to the ambient concentrations and if so, the contributing factors;

- evaluate the effectiveness of any control measures;
- evaluate the suitability of the internal triggers if exceedances of the daily standard are occurring regularly; and
- evaluate the need for different or improved control measures.
- Trials of using agglomerate and / or binding products within TSF, Cape Stockpiles and material on transit in barges.

Contingency actions can also be set if the controls do not adequately improve the air quality following an incident. This will necessitate a review of the trigger levels and potentially evaluation of control measures.

6 Reporting

Due to the remoteness of the site, the primary stakeholders are government organisations, the Project's owners, staff and contractors. The Port facility is designed for multiple use and additional users will be included in the consultation process as they use the facilities in the future. The induction program for site personal (staff and contractors) will highlight the importance of dust management and that its successful management is everyone's responsibility.

6.1 Roles and Responsibilities

6.1.1 Staff and Contractors

All Staff and Contractors have a responsibility to undertake their work in a manner to reduce and manage dust emissions and comply with all prescribed dust management procedures. They should take all reasonable precautions to minimise dust emissions (such as staying to speed limits, restricting activities that could cause dust during high wind events, and using mitigation measures such as water sprays where required). All incidents of visible dust emissions crossing the site boundary will be reported to the environmental department.

6.1.2 Environmental Department

The Environment Department will be responsible for:

- the management and review of the ODMP including trigger levels;
- the operation and maintenance of the ambient monitoring programs;
- the content of the induction program with regards to the ODMP;
- investigating any exceedance of the PM_{10} internal reporting target and compliance with the relevant approvals; and
- provision of advice on dust management including controls such as binders, chemical suppressants or water foggers.

6.2 Ambient Dust Monitoring

Appendix B includes a summary of the Ambient Dust Monitoring conducted during the construction phase. The analysis of these results led to the following conclusions:

- The existing site locations and equipment should be retained.

- ❑ Ambient PM_{10} monitoring should focus on the site boundary.
- ❑ Utilise a daily guideline of 70 µg/m^3 for PM_{10} concentrations in accordance with the dust guidelines developed for Port Hedland.
- ❑ Use an hourly trigger, initially set at 250 µg/m^3 (based on an analysis of the construction monitoring data) to assist with operational management of dust events.
- ❑ No long-term measurable vegetation impacts were noted during the construction period.

6.3 Internal Report

Table 14: Internal reporting

Report	By When	Action	Role/Responsibility
Internal hourly PM_{10} trigger exceeded	Within 3 hours	• Investigation to determine cause. • Remedial actions if appropriate (e.g. turn on sprayers)	Environmental Manager
Daily PM_{10} guideline exceeded	Investigation within 24 hours and report within one week of incident	• Investigation to determine cause. • Review hourly triggers. • Initiate remedial actions	
Annual review of internal triggers and performanc e evaluation	Annually	• Evaluation of performance against guideline and maximum number of exceedances target to reflect continuous improvement.	

The ODMP will be reviewed annually and include consultation with site personal concerning the practicality of the ODMP and to seek suggestions for improved dust management practices. Communication between site operators and the environmental group will facilitate new ideas and ensure a policy of continual improvement in managing and mitigating dust levels.

The annual review of the ODMP will also look at opportunities for continuous improvement. The ODMP may also be modified at any time should there be a need to do so as a result of the monitoring program or changes to the Project.

6.4 Incident Reports

The internal procedure described in "Reporting Exceedences of the Internal Dust Standard" (CPM, 2011) provides guidance on internal dust reporting. The following additional information should be included in that document:

An investigation of all exceedances of the internal 70 µg/m^3 daily guideline should be undertaken. As a minimum, this will include:

- ❑ Hourly meteorological and PM_{10} data;
- ❑ Instrument operational data including status flags;

- Project operating conditions;
- Assessment of the monitoring data to review its validity and to identify potential emission sources associated with the incident;
- Identification of potential remedial actions that could be implemented to minimise the risk of a reoccurrence including a review of the trigger and warning levels if the exceedance was attributable to the Project;
- Documentation of the investigation;
- Feedback to site management and operational personnel; and
- Complete all internal incident investigations within one week of the monitored incident.

6.5 Annual Statutory Reports

Annual reports to OEPA will include a summary of the ambient monitoring program including the number of exceedances of the daily PM_{10} guidelines together with a summation of the incident reports for each incident.

7 References

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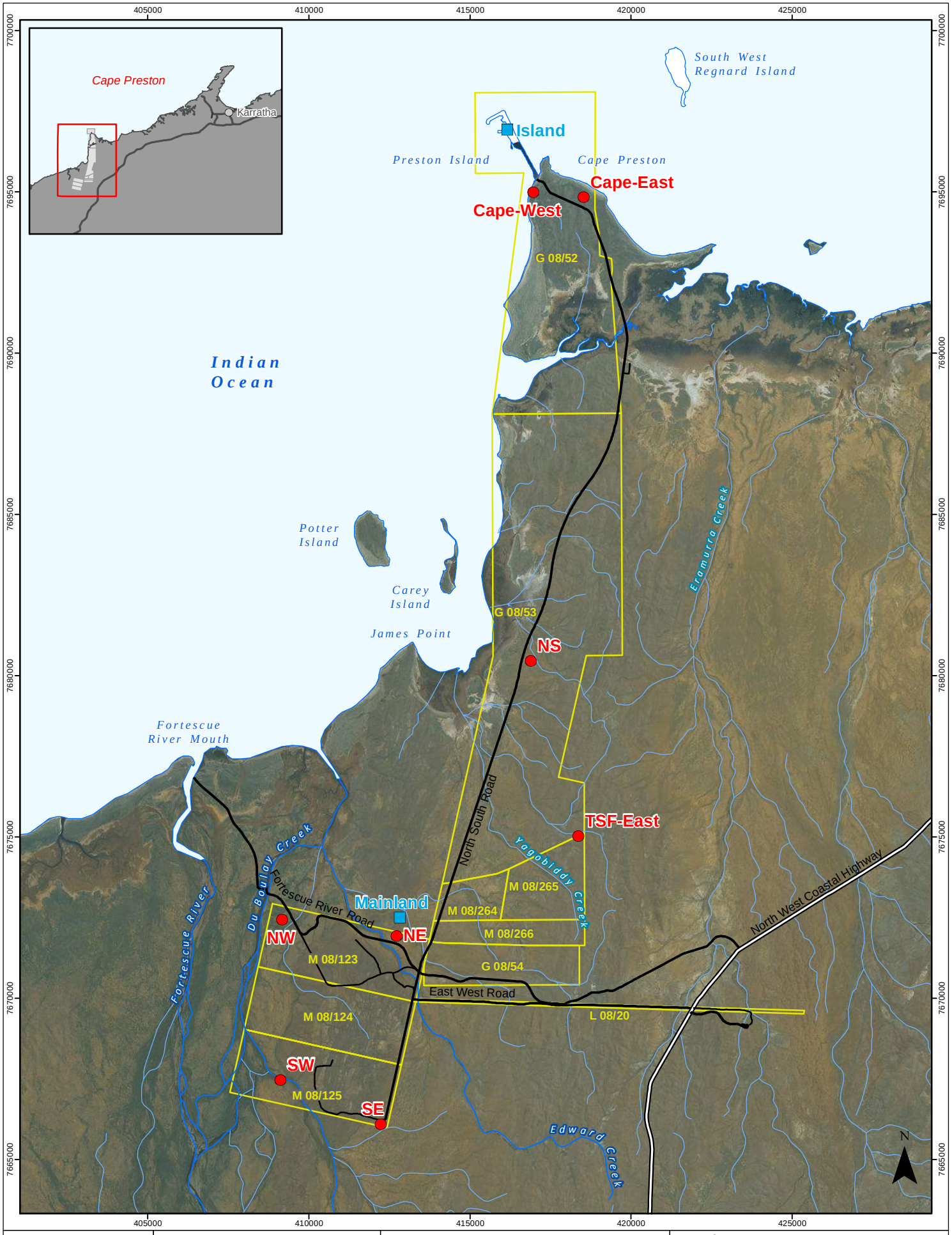
Appendix A – Figures



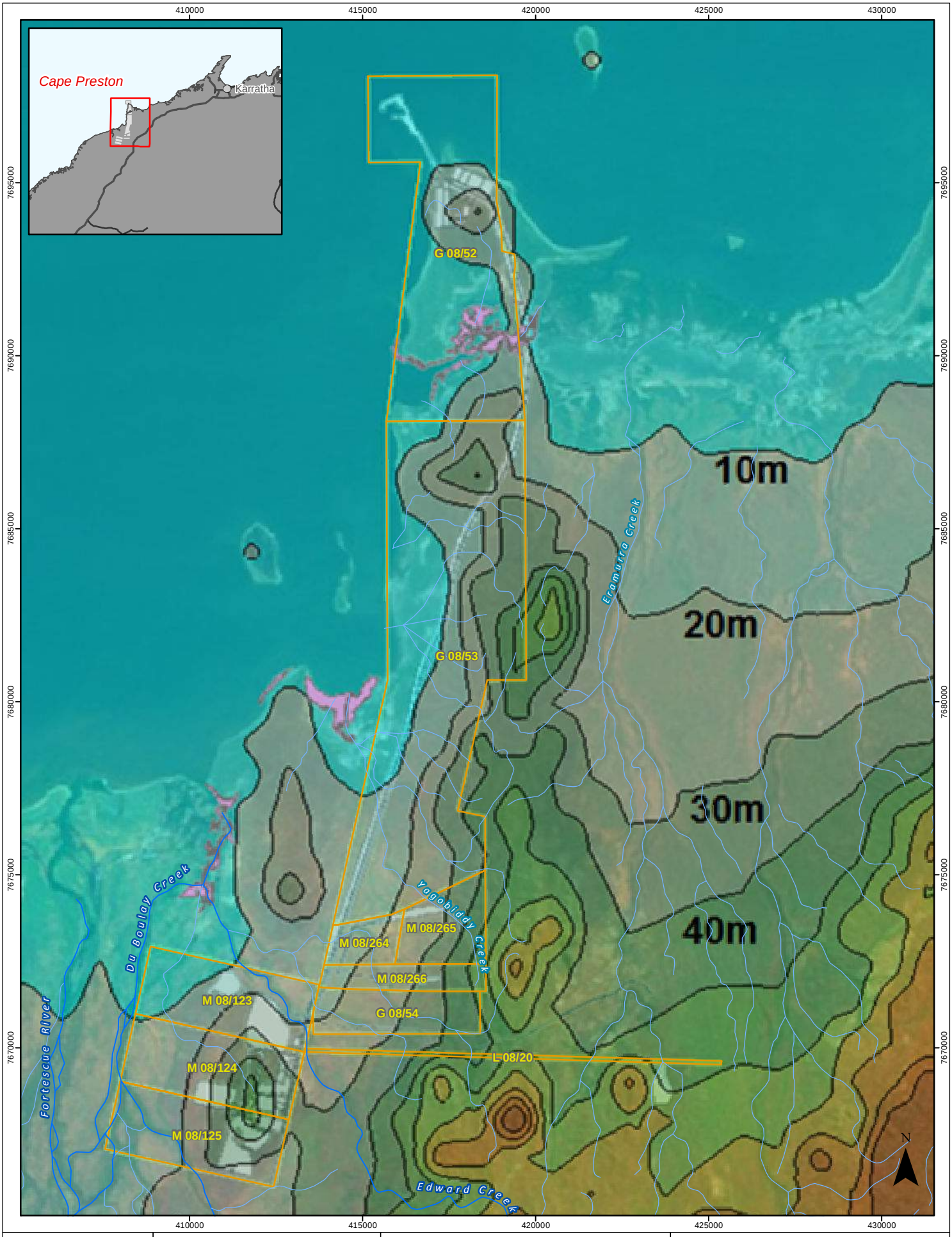
ENVIRON

SINO IRON PROJECT

FIGURE 1

Sino Iron Project Overview
with Current Monitoring Stations

Department:	ENV	Date:	23/04/2012
Sheet Size:	A4	Status:	Final
Drawn by CF	Requested by KG	Internal Reference 2721_01_2012	



ENVIRON

SINO IRON PROJECT

FIGURE 2
Topography of Project Area

with Mangroves Community

0 1 2 3 4 5 6
Kilometres
1:140,000

Datum: GDA94
Projection: MGA Zone 50

Department:	ENV	Date:	15/05/2012
Sheet Size:	A4	Status:	Final
Drawn by: CF	Requested by: KG	Internal Reference: 2723_02_2012	

Legend

- Project Tenement Boundaries
- Major River
- Minor Creek
- Mangrove Areas
- 10m contours

Appendix B– Site Dust Risk Estimations

Blasting

NPI uses two estimation methods (NPI, 2008) to determine emissions from blasting:

$$TSP(kg) = 3.44\ x\ Area(m^2)^{0.8} \quad / \quad (Moisture(\%)^{1.9} * Depth(m)^{1.8}) \quad \textbf{Equation 1}$$

Or the simpler equation (NPI, 2011)

$$TSP(kg) = 0.00022\ x\ Area(m^2)^{1.5} \quad \textbf{Equation 2}$$

PM_{10} is given as 52% of TSP for both equations. **Equation 2** was used in the absence of pit moisture and percentages, as it is the current NPI approach.

Material Handling

Material handling emissions are estimated using a generic NPI factor for all handling operations including: transferring, and conveying, stacking and reclaiming. For moist ores (moisture content greater than 4%), the default TSP emission rate is 0.05 kg/t and PM_{10} is 40% of TSP. The NPI suggests a wind-speed dependant formula of:

$$TSP\ \left(\frac{kg}{t}\right) = 0.74\ x\ 0.0016\ \left(\frac{Wind\ Speed(m/s)}{2.2}\right)^{1.3} \left(\frac{Moisture(\%)}{2}\right)^{-1.4} \quad \textbf{Equation 3}$$

(Note: In this equation, NPI recommends a 47% PM_{10}/TSP ratio)

Primary Crushing

For moist ores the default TSP emission rate for primary crushing is 0.01 kg/t and PM_{10} is 40% of TSP.

Wind Blown Dust

The NPI manual suggests a fixed emission rate of 0.4 kg/ha/hr with a 50% PM_{10} to TSP ratio for open disturbed areas. In contrast the US EPA suggests a wind dependant equation of 1.8u(m/s) kg/ha/hr that can result in much higher emission rates.

Golder studied the impact of cyclonic activity on the TSF using wind tunnel studies (Golder, 2009). Their tests were for a total duration of five minutes and the area of the simulated TSF was 0.04 m2. Literature indicates that most erodible material is released during the initial wind gust, therefore the five-minute tests could be considered as being applicable for an hour. Using these results ENVIRON derived a two point power curve of emissions for disturbed TSF conditions based on the Golder report data, which yielded the following equation:

$$\mathbf{E\ (kg/ha\ /hr)} = \frac{1}{3}\ (\mathbf{u - 5.5(m/s)})^{2.7} \quad \textbf{Equation 4}$$

Using the meteorology from the Mainland monitoring site returned an annual average = 1.4 kg/ha/hr. Although this was derived by extrapolating from cyclonic conditions, the values are comparable to other methodologies. This was higher than the default of 0.4 kg/ha/hr but comparable to two other US EPA wind derived methods (E=1.8u =2.36 kg/ha/hr) and ($E=52(u-u^*)^2+25(u-u^*) = 2.7$ kg/ha/hr) and the NPI mining manual for active stockpiles (5.57 kg/ha/hr using the parameters in the PAE report (PAE, 2008).

The conservative NPI active stockpile equation with the PAE factors (5.57 kg/ka/hr) was used to estimate maximum emissions expected from stockpiles.

Wheel Generated Dust from Unpaved Roads

Although the NPI manual has a formula based on silt, moisture and weight of the vehicles these parameters are not fully quantified and generic factors of 4.08 (TSP) and 1.24 (PM_{10}) kg/VKT were used instead (NPI, 2011).

Vehicle Exhaust Emissions

Vehicles are not likely to be considered as a significant source, and their emissions were conservatively estimated by using a default PM_{10} emission rate of 3 kg/kl with a consumption rate of 1 km/l (based on mostly heavy vehicle used).

Appendix C– Ambient Dust Monitoring

Overview of the ODMP monitoring program

Ambient dust monitoring is an integral component of the successful management of dust emissions and demonstrating compliance with the ODMP objectives. Timely intervention based on real time data can reduce the severity of the potential impacts associated with dust emissions. The Project Area is sparsely populated and there are limited sensitive receptors within the area. The only populated location is the Project's accommodation village (Eramurra) (located approximately 10 km west of the site).

While the construction dust management plan referenced the NEPM daily standard of 50 µg/m^3, the Port Hedland interim guideline of 70 µg/m^3 is considered more appropriate for the Project. The DEC also use the unquantifiable and generally impractical guidance of "no visible dust" crossing the Project's boundary. The ambient air quality monitoring network, installed during the construction phase, will be continued as part of the ODMP to monitor compliance with the ambient PM_{10} guideline and provide real time data to identify areas where additional dust mitigation measure may be required.

Potential dust impacts on vegetation also need to be managed, particularly on the mangrove communities. The EPA has guidelines (DEC, 2001) relating to mangroves in the Pilbara region (with specific reference to Cape Preston). The project was assessed by the EPA against the specific objectives of this guideline and no further issues from dust settlement have been identified. The annual vegetation-monitoring program undertaken under MS635 that was started during the Project's construction has shown that the impacts of dust deposition from Project activities are small over the Project Area. While deposition onto vegetation does occur, it is typically washed off by rain.

Performance criteria and monitoring methods

Results of the vegetation surveys indicated that no observable long-term measurable impacts to vegetation have occurred. Bitumisation of some roads has reduced the need for many of the previous vegetation sites and the low impact previously monitored, justifies a reduction of the vegetation-monitoring grid to a few selected sites. Placing deposition gauges at some (about 3 to 4) of these vegetation-monitoring sites in the port area will quantify and characterise the dust. This will enable baseline data prior to other exporters using the port. It is recommended that the requirement for visual vegetation monitoring and deposition gauges are reassessed after about six months of operation (including a dry season) to determine impact levels and that the program be discontinued if impacts are not significant.

Eight continuous E-BAM monitors have been utilised during the construction phase and these are strategically located at the edge of the prescribed premise boundaries and near potentially high impact sources. Following a review of the dust during the construction phase, it is recommended that they be kept at their current locations (refer to **Figure 1**). Operational conditions such as high temperatures during the day together with high humidity has in the past given rise to problems such as blockages and signal instability. It is vital that good QA/QC procedures are maintained to ensure the accuracy and reliability of the data. This includes:

- Regular calibration of the instruments in accordance with the manufacturer's recommendations.
- Monthly review of data to identify data that are:
  - Out of range (either below the minimum or above the maximum); and
  - Associated with periods where there is no change to data for three or more consecutive readings above a threshold.

Detailed guidance on on-line air quality data verification and validation can be obtained from the US EPA website (USEPA, 2002).