# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXECUTIVE SUMMARY</td>
<td>3</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>5</td>
</tr>
<tr>
<td>1.1 PURPOSE OF THE GUIDELINES</td>
<td>5</td>
</tr>
<tr>
<td>1.1.1 Benefits of Leading Practice</td>
<td>6</td>
</tr>
<tr>
<td>1.1.2 Applicability of Guidance</td>
<td>6</td>
</tr>
<tr>
<td>PORT HEDLAND AIR QUALITY OBJECTIVES</td>
<td>7</td>
</tr>
<tr>
<td>2.1 OVERVIEW</td>
<td>7</td>
</tr>
<tr>
<td>2.2 DUST AND PARTICULATES</td>
<td>7</td>
</tr>
<tr>
<td>2.3 CRITERIA FOR ASSESSING PARTICULATE 10 MICRON IN AERODYNAMIC DIAMETER (PM_{10})</td>
<td>7</td>
</tr>
<tr>
<td>LEADING PRACTICE REVIEW</td>
<td>8</td>
</tr>
<tr>
<td>3.1 FROM BULK MATERIAL TO DUST</td>
<td>8</td>
</tr>
<tr>
<td>3.2 KEY EMISSION SOURCES</td>
<td>8</td>
</tr>
<tr>
<td>3.2.1 Wind Erosion</td>
<td>9</td>
</tr>
<tr>
<td>3.2.2 Material Handling</td>
<td>9</td>
</tr>
<tr>
<td>3.2.3 Vehicular Movement</td>
<td>9</td>
</tr>
<tr>
<td>3.3 EXISTING DUST MANAGEMENT PRACTICES IN THE PILBARA</td>
<td>9</td>
</tr>
<tr>
<td>3.4 LEADING PRACTICE - DUST MANAGEMENT</td>
<td>10</td>
</tr>
<tr>
<td>3.4.1 International Leading Practice</td>
<td>10</td>
</tr>
<tr>
<td>3.4.1.1 European Union</td>
<td>10</td>
</tr>
<tr>
<td>3.4.1.2 International Finance Corporation, World Bank Group</td>
<td>11</td>
</tr>
<tr>
<td>3.4.1.3 Canada</td>
<td>12</td>
</tr>
<tr>
<td>3.4.1.4 United Kingdom</td>
<td>13</td>
</tr>
<tr>
<td>3.4.1.5 United States of America</td>
<td>14</td>
</tr>
<tr>
<td>3.4.2 AUSTRALIAN REGULATORY GUIDANCE</td>
<td>15</td>
</tr>
<tr>
<td>3.5 ASSESSMENT OF DUST MITIGATION TECHNIQUES (SKM 2010)</td>
<td>18</td>
</tr>
<tr>
<td>3.6 BENCHMARKING LEADING PRACTICE DUST MANAGEMENT</td>
<td>19</td>
</tr>
<tr>
<td>LEADING PRACTICE GUIDELINES</td>
<td>20</td>
</tr>
<tr>
<td>4.1 DUST MITIGATION</td>
<td>20</td>
</tr>
<tr>
<td>4.1.1 Key Mitigation Measures</td>
<td>20</td>
</tr>
<tr>
<td>4.1.2 Additional Mitigation</td>
<td>20</td>
</tr>
<tr>
<td>4.1.3 Time Frame</td>
<td>21</td>
</tr>
<tr>
<td>4.2 MODELING</td>
<td>21</td>
</tr>
<tr>
<td>4.3 MONITORING</td>
<td>22</td>
</tr>
<tr>
<td>4.4 STAKEHOLDER ENGAGEMENT</td>
<td>23</td>
</tr>
<tr>
<td>4.5 MANAGEMENT</td>
<td>23</td>
</tr>
<tr>
<td>4.5.1 Complaints Management</td>
<td>23</td>
</tr>
<tr>
<td>4.5.2 Responsibilities and Reporting</td>
<td>23</td>
</tr>
<tr>
<td>4.6 REVIEWS</td>
<td>24</td>
</tr>
<tr>
<td>4.6.1 Operators</td>
<td>24</td>
</tr>
<tr>
<td>4.6.2 Leading practice guidelines</td>
<td>24</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>25</td>
</tr>
<tr>
<td>APPENDIX A – BENCHMARKING FRAMEWORK</td>
<td>28</td>
</tr>
</tbody>
</table>
EXECUTIVE SUMMARY

Port Hedland is the largest export ports, by tonnage, in Australia. In the 2010-11 financial year just under 200 million tonnes (Mt) were exported. When the approved expansions of existing facilities and new facilities in the region is taken into account, this is expected to increase to approximately 886 Mt per year (Mt/a). The majority of the commodities passing through the port is the export of iron ore. Other commodities leaving the port include manganese ore, chromite ore, copper concentrate, salt, scrap metal, and livestock. The port also imports a variety of commodities including oil and fuel, sulphuric acid, containers, break bulk and general cargos.

Due to the close proximity of these export facilities to the town of Port Hedland, particulate emissions and their associated impacts are an important issue for the community and government.

To assist in addressing the issues surrounding particulate concentrations within Port Hedland, the Government of Western Australia established a taskforce with the objective of providing effective dust management strategies within Port Hedland. The Taskforce reported in March 2010 with the release of the Port Hedland Air Quality and Noise Management Plan report.

One of the objectives in this report was the development of best (or leading) practice guidelines for the management of dust impacts associated with the activities and operations taking place within the region controlled by Pilbara Ports Authority (PPA).

These Guidelines set out findings based on a review of national and international best practice. It describes what is broadly considered to constitute leading practice for dust management in bulk materials handling processes. For site specific application, the approach typically needs to take into account a range of factors including local conditions and circumstances, available knowledge and technology, operational and maintenance aspects, safety and financial considerations.

A review of international and local leading practice dust management highlighted the following broad key mitigation measures:

- Suppression (water or chemical)
- Extraction
- Barriers/wind breaks
- Enclosure
- Moisture content control
- Consideration of meteorology
- Sealing surfaces

Modelling conducted by SKM (2010) identified that the following key dust mitigation techniques are effective measures to lower dust emissions from bulk handling operations:
• All ore brought into, stockpiled and loaded through the Port of Port Hedland is at, or above, the Dust Extinction Moisture (DEM) for that particular ore type.
• Major transfer stations or transfer stations located adjacent to ship loaders are fully enclosed with extraction (either wet or dry).
• All transfer stations are fitted with a fogging system.
• All trafficable areas are sealed and regularly cleaned and maintained (including traffic management).
• A meteorological forecast system in place to predict adverse weather conditions and allow for early action for dust management.
• All ship loader booms are fitted with sprays at the loading chute.
• Water cannons are used on all stockpile areas to maintain the Dust Extinction Moisture (DEM) of the product and prevent dust emissions associated with wind erosion.
• All stackers are the luffing/slewing type to reduce drop height and are fitted with water sprays on the boom.
• Car dumpers are fully enclosed and fitted with dust extraction (wet or dry).

These techniques are consistent with identified international and local leading practice recommendations.

It is the recommendation of this report that these techniques be evaluated as key mitigation measures for application to bulk material handling operations in Port Hedland.

Further to these key mitigation measures, all operators should address the following points in detail within their dust management plans:

• Monitoring commitments and plans
• Details of dust modelling
• Stakeholder engagement
• Complaints management
• Clearly identified roles and responsibilities for dust management plan execution
• Ongoing review and revisions of dust management plan.
INTRODUCTION
Port Hedland is the largest export ports, by tonnage, in Australia. In the 2010-11 financial year just under 200 million tonnes (Mt) were exported. When the approved expansions of existing facilities and new facilities in the region is taken into account, this is expected to increase to approximately 886 Mt per year (Mt/a). Due to the close proximity of these export facilities to the town of Port Hedland, particulate emissions and their associated impacts are an important issue for the community and government.

To assist in addressing the issues surrounding particulate concentrations within Port Hedland, the Government of Western Australia established a taskforce with the objective of providing effective dust management strategies within Port Hedland. The taskforce, comprising representatives from local and state government and key industrial operators, achieved this objective in March 2010 with the release of the Port Hedland Air Quality and Noise Management Plan (DSD 2010) report.

One of the objectives in this report was the development of leading practice guidelines for the management of dust impacts associated with the activities and operations taking place within the region controlled by Port Hedland Port Authority (PPA).

1.1 PURPOSE OF THE GUIDELINES
The Western Australia Environmental Protection Authority (WA EPA) requires that ‘all reasonable and practicable means should be taken to minimise the generation of waste and its discharge into the environment’ (WA EPA 2008). For new proposals the WA EPA requires an assessment of the best available technologies for minimising the discharge of waste for the processes and justification for the adopted technology.

In early 2009, the WA EPA stated that a coordinated government and industry approach is required in order to address the current dust levels and associated emerging health concerns in Port Hedland (WA EPA 2009).

A key objective of the Port Hedland Air Quality and Noise Management Plan (DSD 2010) report is to set out a strategic framework for the ongoing management of air quality, including dust levels, in the Port Hedland area. It summarises:

- key issues facing the port
- environmental, health and planning studies
- current industry management initiatives
- future plans
- recommendations and summary actions

INTRODUCTION
Port Hedland is the largest export ports, by tonnage, in Australia. In the 2010-11 financial year just under 200 million tonnes (Mt) were exported. When the approved expansions of existing facilities and new facilities in the region is taken into account, this is expected to increase to approximately 886 Mt per year (Mt/a). Due to the close proximity of these export facilities to the town of Port Hedland, particulate emissions and their associated impacts are an important issue for the community and government.

To assist in addressing the issues surrounding particulate concentrations within Port Hedland, the Government of Western Australia established a taskforce with the objective of providing effective dust management strategies within Port Hedland. The taskforce, comprising representatives from local and state government and key industrial operators, achieved this objective in March 2010 with the release of the Port Hedland Air Quality and Noise Management Plan (DSD 2010) report.

One of the objectives in this report was the development of leading practice guidelines for the management of dust impacts associated with the activities and operations taking place within the region controlled by Port Hedland Port Authority (PPA).

1.1 PURPOSE OF THE GUIDELINES
The Western Australia Environmental Protection Authority (WA EPA) requires that ‘all reasonable and practicable means should be taken to minimise the generation of waste and its discharge into the environment’ (WA EPA 2008). For new proposals the WA EPA requires an assessment of the best available technologies for minimising the discharge of waste for the processes and justification for the adopted technology.

In early 2009, the WA EPA stated that a coordinated government and industry approach is required in order to address the current dust levels and associated emerging health concerns in Port Hedland (WA EPA 2009).

A key objective of the Port Hedland Air Quality and Noise Management Plan (DSD 2010) report is to set out a strategic framework for the ongoing management of air quality, including dust levels, in the Port Hedland area. It summarises:

- key issues facing the port
- environmental, health and planning studies
- current industry management initiatives
- future plans
- recommendations and summary actions
The report sets out several approaches for the management of air quality. In particular, it contains an action to develop and implement leading practice guidelines for the management of airborne dust.

Operational dust emissions from local sources are recognised as the main source of airborne dust loadings across the town (DSD 2010). The purpose of this guidance is therefore to outline a leading practice approach for the coordinated management of operational dust emissions in Port Hedland, focusing predominantly on bulk materials handling activities.

1.1.1. Benefits of Leading Practice

As an approach or concept, leading practice is about identifying and implementing the best way of doing things for a given site. It considers the latest and most appropriate outcomes for both the short and long term. As new challenges emerge and new solutions are developed or better solutions are devised for existing issues, it is important that leading practice be flexible and innovative in developing solutions that match site specific requirements. Leading practice includes consideration of approach and attitude, as well as the set of practices and technologies (DRET 2009).

For site specific application, the approach typically needs to take into account a range of factors including local conditions and circumstances, available knowledge and technology, operational and maintenance aspects, safety and financial considerations, and the specific bulk material being handled and its characteristics.

Wherever possible, the guidelines set out leading practice dust management in the context of Port Hedland. By co-ordinating the dust management practices (for example, monitoring) of the various bulk materials handling operators in Port Hedland, there is an opportunity to fine tune the approach and achieve more effective long term dust management across the Port Hedland area.

These guidelines also set out a framework for demonstrating and tracking the progress towards achieving, and demonstrating, leading practice. This benchmarking approach supports the comparison of mitigation measures across the operations, as well as highlighting what type of improvement may be needed, and where the improvement are best applied (see Section 3.6).

1.1.2. Applicability of Guidance

These guidelines are to apply to the operational bulk materials handling activities in Port Hedland. All operators in Port Hedland are encouraged to review their current dust management practices against the approaches set out in these guidelines. The initial timelines for operators to complete the reviews are outlined in DSD 2010. Regular review is
also encouraged to ensure leading practices continue to be adopted in future.

PORT HEDLAND AIR QUALITY OBJECTIVES

2.1 OVERVIEW
This section details environmental air quality objectives (criteria) relevant to ambient dust levels in Port Hedland. Dispersion modeling predictions or ambient monitoring concentrations is compared to the criteria as part of the assessment to determine if dust levels may be considered harmful to human health and/or the environment.

2.2 DUST AND PARTICULATES
Consistent with the Port Hedland Taskforce Report, in these guidelines, the term ‘Port Hedland dust’ will mean dust characteristic of the area. Port Hedland dust is a mixture of particles mainly from rocks and minerals. The presence of iron oxide particles (93%) is dominant with smaller amounts of sodium, magnesium, aluminium, calcium, manganese, chromium and copper. It is a combination of both crustal and man-made dust derived from mining, crushing and transporting activities.

Dust is a common component of air-borne particulate matter (PM). Two key features characterise particulate matter – particle size and particle composition. Size and composition vary with location and the process or activity releasing the particles (DSD 2010).

The particulate of concern (PM\(_{10}\)) refers to particulate with an aerodynamic diameter of 10 microns (\(\mu\)m) or smaller. Particulate within this size range are capable of entering the respiratory system (WHO 2000). The health effect of particulate in the PM\(_{10}\) range is mainly the exacerbation of respiratory problems, with the elderly, people with existing respiratory and/or cardiovascular problems and children being the most susceptible (US EPA 2010).

2.3 CRITERIA FOR ASSESSING PARTICULATE 10 MICRON IN AERODYNAMIC DIAMETER (PM\(_{10}\))
The Port Hedland Air Quality and Noise Management Plan (DSD 2010) establishes a criterion for PM\(_{10}\) concentration levels in Port Hedland. This is presented in Table Error! No text of specified style in document.-1. Table Error! No text of specified style in document.-1: Port Hedland Dust Taskforce recommended criterion for PM\(_{10}\).
The PHDTF criterion is an interim value, established as a guideline until further health research and particulate data collection is undertaken (nominally within 3 to 5 years of the dust management plan date of issue). The criterion target is assessed at receptors east of Taplin St, but it is expected significant reductions to existing dust levels west of Taplin St (as far as McKay St) will be achieved in that time frame.

LEADING PRACTICE REVIEW

This section outlines the key information sources that have been considered when determining leading practices. It summarises the key considerations relating to the nature and behaviour (tendency to dust) of the bulk materials handled through the port, the activities leading the creation of dust (emission sources) and the practices adopted to manage the emission and or its source.

3.1 FROM BULK MATERIAL TO DUST

The nature or characteristics of the bulk material being handled need to be understood to determine if the material will present a dust issue. Understanding the key characteristics of the material is necessary prior to further consideration of emission sources and management practices. The four key characteristics that need to be understood are:

- Material (or mineral) characteristics of the bulk material, and hence the dust. This includes understanding the likely chemical composition of the material, its stability and other features of its base structure.
- Moisture characteristics including hydrophobicity. DEM needs to be known, as well as any specific characteristics such as hydrophobicity which would mean practices relying on water application would be ineffective. Both the DEM and the hydrophobicity can be determined through test work.
- Particle size distribution – generally the finer the particle size the more “dusty” the behaviour of the material. Once finer grains are lifted they tend to become airborne more easily and stay airborne for longer, giving the potential to move further from the source (DRET 2009).

3.2 KEY EMISSION SOURCES

There are typically three main categories of dust emission sources from bulk material handling operations: wind erosion, materials handling and vehicle
movements (DRET 2011). These sources and the relevant dust generation mechanisms are outlined below.

3.2.1. Wind Erosion

Wind-generated dust occurs when wind speed exceeds the erosion threshold velocity of the underlying surface. Under these conditions, large particles are dislodged by shear forces and bounce and creep across the surface. These particles, by their bouncing, skipping motion, can dislodge smaller particles, which then remain suspended in the air. The surface impacts also re-arrange the surface exposing new particles that may contribute further to this process (Lu 1999). The amount of dust generated is therefore dependent on the wind speed. Below the wind speed threshold (normally in the range of 5 m/s), little to no dust is generated, whilst above the threshold, dust generation increases with the cube of the wind speed (Shao et al. 1996).

3.2.2. Material Handling

Mechanical material handling processes generating dust include movement such as screening operations, dropping operations such as conveyor transfer points and ship loading, stacking and reclaiming. The amount of dust generated from these processes is usually not primarily dependent on the wind speed. The highest dust levels occur downwind under light wind conditions where dust plumes are relatively undispersed.

3.2.3. Vehicular Movement

Wheel generated dust occurs when the road surface is pulverised by the passage of vehicles and loosened particulate matter is uplifted by the turbulent air behind the vehicle (Williams, Shukla & Ross 2008). Heavy vehicles and high speeds will produce higher emissions than light vehicles and low speeds. This effect is enhanced when vehicles are travelling over roads with heavy particulate loading, usually around areas where unsealed roads intersect sealed roads.

3.3 EXISTING DUST MANAGEMENT PRACTICES IN THE PILBARA

Operations exporting bulk materials from Port Hedland are required to manage their dust emissions to mitigate their impact on the town. Dust management plans, as part of overall environmental management systems, form the basis for operations in the region to effectively monitor, respond to, and manage their dust emissions. The execution of dust management plans are typically required under ministerial conditions applied to many operators in the region.

Operational dust management plans for individual operators in the Pilbara region typically include the following management elements:

- Definition of operational accountabilities and responsibilities
• Dust monitoring
• Dust modelling (including verification) to better understand sources, controls and impacts
• Reducing cleared open areas
• Revegetating unused cleared areas
• Dust suppression (water trucks)
• High traffic routes sealed with bitumen
• Moisture content of bulk materials increased
• Enclosure of high dust plant (car dumpers, major transfer stations)
• Dust extraction
• Water sprays
• Fogging systems
• Belt washers and scrapers
• Water cannons on stockpiles
• Management of vehicle speeds on unsealed areas
• Education of site personnel on reducing dust
• General site housekeeping
• Community information and engagement
• Ongoing review of available dust abatement practices and technologies.

3.4 LEADING PRACTICE - DUST MANAGEMENT
The following sections discuss dust management practices which are regarded as the most effective either internationally and locally.

3.4.1. International Leading Practice
Air quality is a globally recognised environmental and health issue, and dust is a significant contributor to reduced air quality around the world. Dust control and management techniques are implemented in numerous countries by many different industries to comply with relevant air quality guidelines and legislation. This section will outline the techniques adopted as leading practice dust control in Europe, the United Kingdom and America.

3.4.1.1. European Union
Integrated Pollution Prevention and Control (IPPC) is a directive of the European Union (EU) founded to organise the exchange of information and produce Best Available Techniques (BAT) reference documents (IPPC 2006). BAT represents technology, processes and operations that prevent impacts to the environment, or if this is not practicable, to mitigate as best and reasonably possible. Member States are required to take into
account BAT when determining air quality management techniques both generally and in specific cases. EU air quality objectives and BAT for various industries have been implemented or incorporated into legislation and guidelines by Member States. The following techniques are recognised by the EU as the best available for dust control and management in the mineral extraction, processing and handling sector (IPPC 2009):

- The use of wet suppression, temporary seeding, and minimisation of stockpiles to reduce dust emissions.
- Enclosed offloading points for dusty materials with extraction to bag filter.
- Enclosure storage to eliminate windblown dust.
- Enclosure of high dust generating plant.
- Covered transport where appropriate.

Recognised BAT for the reduction of emissions from the storage of bulk or dangerous materials (IPPC 2006) which are relevant to port bulk material handling operations include:

- Moistening the surface of stockpiles using water or durable dust binding substances.
- Covering stockpiles with tarpaulins.
- Applying protective plantings or windbreak fences.
- Minimising the size of stockpiles.
- Considering prevailing winds when developing storage areas.

The IPPC Directive also recommends that the timing of work with the potential to create dust emissions should avoid dry and windy conditions where possible.

3.4.1.2. International Finance Corporation, World Bank Group

The Environmental, Health, and Safety (EHS) Guidelines – Ports, Harbors and Terminals (IFC 2007) are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. These industry sector EHS guidelines are designed to be used together with the General EHS Guidelines document, which provides guidance to users on common EHS issues potentially applicable to all
industry sectors. The guidelines for Ports, Harbours and Terminals (2007) state that dry bulk materials storage and handling facilities should be designed to minimise or control dust emissions, including:

- Installing dust suppression mechanisms (e.g. Water spray or covered storage areas).
- Using telescoping chutes to eliminate the need for slingers.
- Using vacuum collectors at dust generating activities.
- Using slurry transport, pneumatic or continuous screw conveyors, and covering other types of conveyors.
- Minimising free fall of materials.
- Minimising dry cargo pile heights and containing piles with perimeter walls.
- Removing materials from the bottom of piles to minimise dust re-suspension.
- Ensuring hatches are covered when materials handling is not being conducted.
- Covering transport vehicles.
- Regularly sweeping docks and handling areas, trucks, rail storage areas, and paved roadway surfaces.

3.4.1.3. Canada
The Great Lakes Maritime Research Institute published the Manual of Best Management practices For Port Operations and Model Environmental Management System (GLMRI 2009). This document outlines preventative measures for ports seeking to implement operational controls to reduce the actual or potential impact of activities at the port, specifically addressing dust generation and dispersion associated with dry bulk storage and handling of materials. Practices relevant to operations at Port Hedland include the following:

- Using enclosed conveyors or chutes and telescoping arm loaders to reduce spillage and dust.
- Minimise the distance between the working face and trucks/trains being loaded to reduce the area that has to be swept/cleaned.
- Suspending unloading and handling operations during unfavourable weather conditions.
- Spraying a light mist during handling operations.
• Maintaining pile size/volume consistent with customer demand, transportation schedules and materials cost to reduce the amount of material exposed to weather conditions.

• Using dust suppression, bag house, screw conveyors and vacuum collecting equipment when handling fine, granular or powdery material.

• Regularly inspecting dry bulk storage piles, facilities and handling equipment to ensure proper operation is maintained.

• Scheduling regular mechanised sweeping of bulk storage and access areas.

• Washdown or spray the underside and tyres of trucks transporting dry bulk materials to public roads.

3.4.1.4. United Kingdom

The UK Minerals Policy Statement 2: Controlling and Mitigating the Environmental Effects of Mineral Extraction in England (ODPM 2005) outlines what is considered good practice in the control and mitigation of dust at mineral and related workings. The description of good practice focuses around dust assessments, site layout, methods of working and site management. Practices relevant to operations at Port Hedland include the following:

• The recommendation that a dust assessment study is undertaken for all new and extended operations to identify likely causes of dust and make recommendations for mitigation measures.

• Using results of the dust assessment when designing sites.

• Locating dust generating activities away from sensitive land uses and receptors, in areas where prevailing winds will blow dust away from sensitive areas, or in areas where maximum protection can be obtained from topography, vegetation or other features.

• Undertaking dust generating activities during favourable weather conditions.

• Spray exposed surfaces of stockpiles to maintain surface moisture.

• Use dust extraction equipment such as filters where possible.

• Store material in an enclosed space where possible.
• Screen material to remove dusty fractions prior to external storage.

• Specification of a site or organisation policy on dust and environmental matters.

• Education of site personnel in working practices and controls.

The UK also has several guidelines for the control of dust emissions from construction and development activities. The UK Development Control Guidelines (Environmental Protection UK 2010) and the best practice dust control guidelines for construction and demolition in London (Greater London Authority 2006) recognise the following methods as leading practice for the control of dust arising from the construction industry which could also be applicable to Port operations.

• Air quality assessments / air quality impact evaluations are required where a development is anticipated to give rise to significant changes in air quality and must be conducted before work activities begin on site.

• Air quality risk assessments can be used to define potential risks to air quality and determine best practice measures for mitigation.

• During site planning, machinery and dust causing activities should be located away from sensitive receptors.

• Stockpile location should also consider prevailing winds.

• Use water as a dust suppressant.

• Early implementation of paved haul routes.

• Keep stockpiles to a minimum size and for the shortest possible time.

• Erect solid barriers around the site boundary.

• Cover, seed or fence stockpiles to prevent erosion.

3.4.1.5. United States of America

The United States Environmental Protection Agency (US EPA) guidance on leading practice management of dust emissions is found in the Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures (US EPA 1992). This document is designed to provide technical information on reasonable and best available dust control measures. Though dated, the document nonetheless provides emissions management guidance relevant to Port Hedland. For roads the US EPA recommends:
- Vacuum sweeping (sealed only).
- Water flushing with sweeping after (sealed only).
- Cover haul truck loads.
- Wet down hauled material.
- Focus cleaning on unsealed/sealed road connections.
- Pave/treat parking areas, driveways and road shoulders.
- Limit traffic on unsealed surfaces.
- Curbing, gutters and adequate drainage for surface water.
- Speed controls.

The guidelines advise against frequent watering of unpaved roads, and repeatedly advise rapid clean-up of spills due to tracking of mud and dirt to clean areas, which can account for a substantial percentage of road particulate loading. Curbing also has the effect of preventing unauthorised traffic into unsealed areas, though road markings and caution signs may also do this at less expense. For stockpiling and bulk material handling the US EPA recommends:

- Drop height reduction.
- Wind shields/sheltering/enclosures.
- Increase product moisture.
- Water suppression.
- Chemical stabilisation.
- Wet suppression systems (foam or liquid sprays).

Physical stabilisation (less erodible material stacked on top, vegetation) while able to reduce dust emissions, are not considered practical for active stockpiles. For large stockpiles the use of porous wind barriers (fences, tree, etc.) is advised with an optimal porosity of 50%. For general dust management, the USEPA also recommends:

- Increasing surface roughness of unsealed areas (e.g. using a coarse material like lump product).
- Vegetation (live or mulch) cover maintained (in preference to the above).

### 3.4.2. AUSTRALIAN REGULATORY GUIDANCE

The Leading Practice Sustainable Development Program is an initiative by the Australian government and mining industry. The program aims to provide information and case studies to support industry in pursuing a
more sustainable operating basis (DRET 2011). The program has delivered a series of 14 handbooks including one addressing Airborne Contaminants, Noise and Vibration (DRET 2009). The handbook addresses issues related to emissions of particles and uses a risk based hierarchy of controls. The approach and actions are of relevance to the bulk handling operations considered here.

The DRET guidance for process plants and any materials-handling plant is:

- **Process or material handling plant:**
  - Raw material stream to be at the DEM point prior to separation (sizing), prior to tipping or any action involving the free falling of the material, and prior to conveying.
  - Enclosed transfer points, including hood and spoon chutes and cascade rock box chutes.
  - Enclosed operating equipment.
  - Seals on all enclosures are to be designed to the specific application, as well as practical and maintainable.
  - Minimise the open space at the entrance point where a raw material stream enters a transfer hood or chute.
  - Use an appropriate chemical (that incorporates a wetting agent) to bind ultra-fine particles without detrimentally impacting the raw material itself, such as a wetting agent.
  - Wind barriers over conveyor structures.
  - Belt cleaning stations along the length of the conveyor.

- **Roads:**
  - Road surfacing a suitable “wearing course”.
  - Treated road surfaces (spray on application and reapplication) with a chemical palliative, in conjunction with regular sweeping.
  - Control vehicle speed generally to 40 kilometres per hour or less.
  - All open areas not needed for vehicle access or construction should be isolated and sprayed with a hydro mulch chemical or chemical veneer.

- **Stockpiles and stockyards:**
  - Stackers should have sprays installed onto the boom. Sprays should be directed into the falling material stream and only used when necessary.
  - Misting sprays should be installed and directed to form a curtain around the falling material stream.
o Use of low-volume misting nozzles directed along the raw material stream.
o Use of water addition nozzles in conjunction with the low volume misting nozzles where the raw material is not at DEM.
o All nozzles on stackers to have both automatic and local control valves.
o Mobile reclaimers - bucket wheel reclaimers to be fitted with two sets of nozzles (one set to spray the face of the stockpile immediately ahead of and behind the cutting wheel, and the second set to spray into the raw material stream as it cascades out of the buckets into the transfer chute and onto the boom conveyor
o Drum reclaimers to be fitted with sprays directed at the material falling down the face of the stockpile.
o Design and use static reclaim systems (i.e. reclaim tunnel) where possible. Misting sprays to be fitted and sprays directed into the falling raw material stream.
o Use water cannons to deliver water to stockpile surface.
o Use water trucks (fitted with nozzles) to access areas where water cannons cannot be deployed or do not reach the stockpile.
o Spray pattern height on material stockpile to be just over the top of the stockpile
o Locate water cannons as close to the stockpile as possible.
o Spray stockpiles immediately prior to strong wind events.
o Use a chemical or chemical veneer on stockpiles.

The program also advocates effective particle emissions management requires a coordinated, site-wide system that is automated and makes use of weather prediction data, local weather station data, scheduling of raw material movements and handling, raw material characteristics, moisture information from analysers and samples, and real time particle monitors. For larger operations, the systems should be linked together to create a whole of site particle emissions management system.

The WA EPA has issued the guidance statement: Prevention of Air Quality Impacts from Land Development Sites (WA EPA 2000). While not specific to bulk material handling, the guidance does discuss mitigation techniques for disturbed ground which are applicable to Port Hedland operations. These techniques include:

- Wind fencing.
- Water to damp down areas.
- Hydro mulching.
• Chemical stabilisation.
• Chipped vegetation.

The DEC (2008) as part of their draft guidelines for developing a dust management plan advises any monitoring program should:

• Have a clearly defined purpose.
• Identify relevant criteria and monitoring methodologies.
• Locate a suitable number of sites.
• Establish quality control protocol.

Environmental Protection Authority Victoria (EPA Victoria) offers guidance on monitoring for mining and extractive industries (EPA Victoria 2007). For regions like Port Hedland, where emission sources are close to residential areas, the following would be relevant:

• Monitoring should be conducted at least one year prior to any air quality assessment for a proposed development if monitoring data is unavailable for the region of interest.
• Daily monitoring should then be ongoing for the life of the project to validate modelling assessments, and for reactive management purposes.
• Hourly trigger levels indicate to the site operators that additional mitigation (e.g. suppression, slowdowns, etc.) need to be employed to prevent excessive off-site dust impact.

3.5 ASSESSMENT OF DUST MITIGATION TECHNIQUES (SKM 2010)

In February 2010, the PPA commissioned SKM to conduct modelling to determine the efficacy of dust control techniques for minimising air quality impacts on sensitive receptors in the Port Hedland region due to potential new iron ore export facilities. Modelling identified the following key mitigation measures that all operators exporting through Port Hedland should adhere to:

• All ore brought into, stockpiled and loaded through the Port of Port Hedland is at, or above, the Dust Extinction Moisture (DEM) for that particular ore type.
• Major transfer stations or transfer stations located adjacent to ship loaders are fully enclosed with extraction (either wet or dry).
• All transfer stations are to have a fogging system installed.
• All trafficable areas are sealed and regularly cleaned and maintained (including traffic management).
• A meteorological forecast system to predict adverse weather conditions and allow for early action for dust management.
• All ship loader booms are fitted with sprays at the loading chute.
• Water cannons used on all stockpile areas to maintain the Dust Extinction Moisture (DEM) of the product and prevent dust emissions associated with wind erosion.
• All stackers should be of the luffing/slewing type to reduce drop height and be fitted with water sprays on the boom.
• Car dumpers should be fully enclosed and fitted with dust extraction (wet or dry).

3.6 BENCHMARKING LEADING PRACTICE DUST MANAGEMENT

A benchmarking approach is adopted in these guidelines to assist operators in demonstrating and tracking progress towards achieving leading practice. The benchmarking process takes into account comparisons of management and mitigation measures across the operations, as well as considering the practices interstate and internationally. The benchmark process also highlights the areas where improvements may be needed or can be achieved, as well as considering where the improvement is best applied.

The base information considered in the benchmarking process follows a generic hierarchy of considerations around the concept of ‘risk’ i.e. the risk of dust being generated. This approach relies on the operator understanding the basic characteristics and likely behaviour of the bulk material being handled (see Section 3).

The considerations are:

• Control or mitigate the dust at source where the intention is to minimise or eliminate the dust emission, and is achieved through:
  • Moisture control
  • Engineering design
  • Equipment
  • Practices
• Control or mitigate the dust dispersion pathway, and is achieved through:
  • Engineering design
  • Design and implementation of standard procedures
  • Measurement, monitoring and reporting
• Control at or mitigate dust at receiver, achieved through:
  • Engineering design
  • Equipment
  • Practices such as administrative procedures or systems, including community liaison for complaints, clean up practices

Generic benchmark information supporting these guidelines is provided in Appendix A. The framework is presented in a format where emission sources
are considered individually, accounting for variation in operations, both in terms of materials handled and scale of operations.

LEADING PRACTICE GUIDELINES
The leading practice guidelines are presented in this section. The guidelines are based on a review of local, interstate and international practices. As leading practice guidelines they represent a set of practices and technologies that are readily available and technically achievable. Their application to an operation must be considered on a case by case basis allowing for the dust management or mitigation practice to match the site specific conditions or needs. The benchmarking framework supports the consistent consideration of the practices and technologies, and allows for the ongoing consideration and development of new or better solutions in time.

4.1 DUST MITIGATION

4.1.1. Key Mitigation Measures
The dust mitigation techniques described in Section 3.4 are consistent with international and local best practice for dust mitigation (Section 3.3) with the broad key mitigation measures including:

- Suppression (water or chemical).
- Extraction.
- Barriers/wind breaks.
- Enclosure.
- Moisture content control.
- Consideration of meteorology.
- Sealing surfaces.

As the mitigation techniques listed in Section 3.4 are predicted to have the most effect on Port Hedland sources, it is the recommendation of this report that these be evaluated as key mitigation measures for application to bulk material handling operations in Port Hedland.

It is noted that several of these key mitigation measures are already practiced by operators in Port Hedland. Furthermore the Port Hedland Air Quality and Noise Management Plan recognises that new developments in the region are employing world best practicing engineering solutions (DSD 2010), such as those listed above.

4.1.2. Additional Mitigation
In addition to the key dust mitigation measures described above, proponents should also consider the following controls to further reduce their dust impact as part of future-proofing their operations, or if operations are considered high risk (such as close to the West-end of
Port Hedland, or if bulk materials handled by operator are predominantly fines or ultra-fines product):

- Shielding conveyors and installing belt launders.
- Use of chemical product (surfactant) to coat stockpiles and open areas.
- Reactive boundary monitors.
- 20m high wind fence along stockpile length (upwind) and/or a 20m high environmental berm along stockpile length (downwind).
- Fully enclose stockpiles.
- Education and training of workers to report and minimise their dust impact

4.1.3. Time Frame
For new operators, it is expected these key mitigation measures would be required to obtain approval for construction and to be fully operational before the export of bulk materials begin. This requirement would also extend to existing operations that undergo expansions to add new stockyards or plant.

For existing operations not undertaking expansions, the Port Hedland Air Quality and Noise Management Plan (DSD 2010) stipulates ongoing implementation of dust mitigation measures, but does not specify a timeframe for executing the recommendations of leading practice guidelines. The implementation of key mitigation measures would vary from operation to operation, depending on what measures are already in place.

4.2 MODELING
Dust dispersion modelling for capacity expansion projects should be undertaken as part of the planning approvals process. The outcomes of modelling assist operators in understanding relative source contributions and accordingly, the priorities for application of mitigation techniques. Furthermore, modelling assists operators in locating monitoring stations in optimal locations (Section 4.3).

As well as the initial modelling of a planned development, operators should commit to undertaking regular model verification (every two to three years). This involves using monitoring, operation and product data in conjunction with dust sampling of on-site sources to confirm the assumptions used in the site dust model.

The information provided by this process will allow operators to confirm their model is representative of operations (or highlight changes required in the model). As model results are used to determine contribution of a facility to the local air shed, having up to date model information is critical for regional dust
management. Furthermore model verification allows operators to demonstrate the effectiveness of emissions management and allows specific targets to be identified for further dust management.

Modelling should adhere to the guidelines stipulated in the DEC’s *Air Quality Modelling Guidance Notes* (DoE 2006).

### 4.3 MONITORING

As well as evaluating the above mitigation measures, all operations should commit to implementing ambient air monitoring programmes as part of their dust management plans. All operations should clearly identify in their dust management plans how they are establishing a dust monitoring program and address the key requirements in detailed in Section 3.4.2. The design of the monitoring program should be consistent with the design specifications for the ambient air monitoring network and industry fence-line monitoring programs as detailed in DSD (2010).

Monitoring should be targeted to meet defined objectives. For all operators this will typically be to measure compliance with the objective described in Section 0 and to allow for reactive management response to high dust events. There may be other objectives operators may wish to achieve depending on the nature of their operations, such as characterising emission rates from certain site activities, or monitoring of non-particulate pollutants (NO$_X$, SO$_2$). Clearly defining monitoring objectives will allow operators to better understand their monitoring needs.

Specific requirements of a monitoring network should be further defined through investigating the existing environment (meteorology, existing pollution levels), reviewing the outcomes of pollutant modelling specific to the operator's facility, and checking for locations where adequate infrastructure to support monitoring exists. This will allow operators to best determine key monitoring locations and other monitoring sites of interest (placing a monitor where there is no predicted dust impact, or limited access to power will be of low value to most operations).

All operations should have boundary monitors capable of providing immediate feedback to operations to allow high dust events to be identified and mitigated rapidly. Boundary monitoring will also allow individual operators to determine their contribution to high dust events at sensitive receptor locations off-site. Monitoring equipment for this purpose does not necessarily have to be same equipment as monitoring for compliance, but should be able to provide a reasonable and immediate indication of when dust levels are approaching critical levels.

Further to boundary monitoring, monitoring is also required at key sensitive receptor locations across the Port Hedland region. Currently BHP Billiton Iron Ore and Fortescue Metals Group operate off-site monitors in Port Hedland (DSD 2010). Future operations should either link into and contribute to
established monitoring sites in the region, or establish their own stations. For compliance purposes, all off-site monitoring equipment must meet the requirements contained in AS/NZS3580.1.1:2007 as well as other Australian standards relevant to the type of monitor installed.

Quality assurance and control procedures should also be documented as part of all operators’ dust monitoring plans. This includes detailing what Australian Standards (or equivalent) that sampling and analysis is completed under.

Specific guidance on approved monitoring methods for boundary and compliance monitoring is provided in the DEC Draft – A guideline for the development and implementation of a dust management program (DEC 2008). This includes determining performance criteria for demonstrating compliance, as well as trigger levels for initiating corrective action (dust suppression).

4.4 STAKEHOLDER ENGAGEMENT
The DEC has identified that engagement with the community early in a proposed development may reduce resistance, capture alternate perspectives that may be otherwise missed and establish/maintain positive relations between the developer and the community through a commitment to transparency and accountability (DEC 2006).

To this end, draft dust management plans of all operators in the Port Hedland region should be made available to the public for consideration and comment before being finalised. Details of all parties involved in developing the plan should also be included.

4.5 MANAGEMENT

4.5.1. Complaints Management
Operators should have a clearly defined process for community liaison. The dust management plan should clearly outline how complaints will be addressed, covering (as a minimum) the following points in detail:

- Receipt of complaint (logging time, location, nature of complaint and actions taken).
- Timeframe allowed for feedback to the complainant/s.
- Sample complaint form template.
- Maintaining a complaint registry.
- Reporting of complaints to the community.

4.5.2. Responsibilities and Reporting
Individual operations should have a nominated representative(s), or role, responsible for the implementation of the dust management plan as a whole. Specific components of the plan should also have nominated
persons/roles/departments responsible for ensuring implementation and compliance with the commitments in the plan.

Individual operations in Port Hedland should report no less than annually to any identified relevant bodies, detailing their compliance with the key mitigation measures and monitoring commitments.

Operators should also be prepared to all times to present monitoring data/results to the DEC or other relevant body (e.g. the Port Hedland Industries Council) upon request.

4.6 REVIEWS

4.6.1. Operators

Reviews of operational dust management plans should be undertaken as a minimum every 5 years after issue, and ideally every year or after a model verification study. This will allow operators to capture changes to site such as new dust mitigation management techniques, changes to site operations, major emission sources in need of attention, and other information that details and/or improves the management of dust emissions from site. It will also allow operators to maintain consistency with updates to these guidelines.

4.6.2. Leading practice guidelines

These guidelines should also be reviewed and revised as a minimum every 5 years to capture changes to leading practice mitigation techniques, any updates to regulatory guidance, updates to the Port Hedland Air Quality and Noise Management Plan, and the outcomes of any health and environmental studies conducted across the region.
REFERENCES


Lu, Hua (1999). An Integrated Wind Erosion Modelling System with Emphasis on Dust Emission and Transport. School of Mathematics, the University of New South Wales, Sydney, Australia.


APPENDIX A – BENCHMARKING FRAMEWORK

A1. BENCHMARKING FRAMEWORK
This section describes a generic and consistent process that can be used to benchmark the dust management actions adopted at the port. This process looks at dust generation sources and mitigation strategies, specifically on bulk materials handling and storage at port facilities, and defines what is meant by leading practice and identifies the extent to which leading practice has been implemented.

A2. BENCHMARK PROCESS
The benchmark process follows three key steps:

- Step 1 - Identify activities (leading to generation of dust).
- Step 2 - Rank relevant operation activities according to importance (i.e. place list in order of the amount of dust produced per activity highest to lowest) (paretto charts generated from emission estimate and dispersion modelling activities).
- Step 3 - For each activity, further breakdown into actions or main causes of dust generation, and rank again, based on the amount of dust, and the amount of influence this item has on the total dust generated by the site.

For the purposes of these leading practice guidelines, the following activities are considered to be the main activities leading to the generation of dust and should be considered in Step 1:

- Unloading
- Stacking
- Stockpiles
- Reclaiming
- Conveyors and transfers
- Ship loading

Supporting activities considered to be leading practices are:

- Air quality monitoring
- General measures

Emission estimation techniques and presentation of results in the form of paretto charts will assist in determining the relevant ranking of each activity in Step 2. While the activities considered may be relevant to all operations, it should be anticipated that the relative ranking of each will differ across the sites depending on site specific considerations, from material handled, location and other considerations.
A series of benchmark tables are provided for Step 3, supporting a consistent approach to demonstrating progress towards and achieving leading practice. These tables should be used on a site by site basis.

**BENCHMARKING – UNLOADING (EXAMPLE ONLY)**

<table>
<thead>
<tr>
<th>ACTIVITY/MANAGEMENT APPROACH</th>
<th>LEADING PRACTICE EXAMPLE</th>
<th>WHAT IS IMPLEMENTED AT SITE</th>
<th>IS SITE EQUIVALENT TO GOOD PRACTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture control</td>
<td>Moisture control of raw material to DEM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering design</td>
<td>Exposure to wind minimised</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conveyors</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hoppers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bottom or top unload</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Car dumpers fully enclosed and fitted with dust extraction (wet or dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>Dust collection systems installed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practices</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### BENCHMARKING – STACKING (EXAMPLE ONLY)

<table>
<thead>
<tr>
<th>ACTIVITY/MANAGEMENT APPROACH</th>
<th>LEADING PRACTICE EXAMPLE</th>
<th>WHAT IS IMPLEMENTED AT SITE</th>
<th>IS SITE EQUIVALENT TO GOOD PRACTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture control</td>
<td>Moisture control of raw material</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering design</td>
<td>Drop height (minimise)</td>
<td>Stockpile formation, design, size</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>Water spray method on stockpiles</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Luffing/slewing type stackers to reduce drop height</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Luffing/slewing type stackers fitted with water sprays on the boom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practices</td>
<td>Automation and application of wetting agent relative to current weather measurements and forecast</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Application of surface treatments to bind loose fine surface material under adverse weather conditions e.g. water trucks</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## BENCHMARKING – STOCKPILES (EXAMPLE ONLY)

<table>
<thead>
<tr>
<th>ACTIVITY/MANAGEMENT APPROACH</th>
<th>LEADING PRACTICE EXAMPLE</th>
<th>WHAT IS IMPLEMENTED AT SITE</th>
<th>IS SITE EQUIVALENT TO GOOD PRACTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture control</td>
<td>Moisture control of raw material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering design</td>
<td>Shielding stockpiles from prevailing winds – wind fences or berms</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orientation of stockpiles (long direction and perpendicular to prevailing wind)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enclosed stockpiles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>Water cannons used on all stockpile areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practices</td>
<td>Automation of and application of wetting agent/surface wetting relative to current weather measurements and forecast</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Application of surface treatments to bind loose fine surface material under adverse weather conditions e.g. water trucks</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**BENCHMARKING – RECLAIMING (EXAMPLE ONLY)**

<table>
<thead>
<tr>
<th>ACTIVITY/MANAGEMENT APPROACH</th>
<th>LEADING PRACTICE EXAMPLE</th>
<th>WHAT IS IMPLEMENTED AT SITE</th>
<th>IS SITE EQUIVALENT TO GOOD PRACTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moisture control</strong></td>
<td>Moisture control of raw material at Stockpile</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use of wetting agents on stockpile</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Engineering design</strong></td>
<td>Shielding in use on equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stockpile traversing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Distance and speed travelled by vehicles over stockpiles and empty stockyards</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sealed road v’s unsealed roads</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td>Disturbance of the stockpile can be minimised by the method of reclaiming e.g. bucket wheel, dozers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mechanical preparation of the stockpile for reclaiming and Reclaiming</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Design of bucket system</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use of dozers</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Practices</strong></td>
<td>Clean up of spills</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### BENCHMARKING – CONVEYORS AND TRANSFERS (EXAMPLE ONLY)

<table>
<thead>
<tr>
<th>ACTIVITY/MANAGEMENT APPROACH</th>
<th>LEADING PRACTICE EXAMPLE</th>
<th>WHAT IS IMPLEMENTED AT SITE</th>
<th>IS SITE EQUIVALENT TO GOOD PRACTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moisture control</strong></td>
<td>Moisture control of raw material - Water application (up to the DEM) i.e. surface treatment at each point of disturbance and on each exposed conveyor</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Engineering design</strong></td>
<td>Wind shielding of conveyors</td>
<td>Belt lauders</td>
<td></td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td>Integrated control systems to prevent overloading of conveyors to prevent spills</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Practices</strong></td>
<td>Belt washing stations</td>
<td>Cleanup of spills including under conveyors</td>
<td>Wetting agent application</td>
</tr>
</tbody>
</table>
## BENCHMARKING – SHIP LOADING (EXAMPLE ONLY)

<table>
<thead>
<tr>
<th>ACTIVITY/MANAGEMENT APPROACH</th>
<th>LEADING PRACTICE EXAMPLE</th>
<th>WHAT IS IMPLEMENTED AT SITE</th>
<th>IS SITE EQUIVALENT TO GOOD PRACTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture control</td>
<td>Fogging at point of loading</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>Ship loading booms</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>are fitted with sprays</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>at the loading chute</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practices</td>
<td>Automation of and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>application of wetting</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>agent/surface wetting</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>relative to current</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>weather</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>measurements and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>forecast</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Application of surface</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>treatments to bind</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>loose fine surface</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>material under</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>adverse weather</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>conditions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>