## Appendix X: Desktop Air Quality Study to Determine Monitoring Locations

# West Pilbara Project

## Subject: Proposed monitoring equipment and locations

Date: 22 June 2021

Sarah,

Please find attached a brief report outlining the potential ambient air monitoring requirements for the proposed West Pilbara project, in the vicinity of the Port of Ashburton. The report covers the following:

- Types of ambient monitors available (regulatory and non-regulatory)
- Siting requirements for air quality monitoring
- An analysis of the meteorology from the Bureau of Meteorology from the Onslow airport
- Receptors in the region along with recommendations on if there is the potential that they could be impacted from the proposed operations and the type of monitoring required (if any).

Ambient monitoring is proposed principally to establish the baseline air quality, in the vicinity of key sensitive receptors, prior to the construction of the Ashburton Infrastructure Project (AIP). Taking into account the likely emission sources associated with the AIP, the type of ore to be handled through the Port of Ashburton, and on the assumption that the most sensitive receptors are community members, the continuous monitoring of particles (as $PM_{10}$) to establish the existing background air quality aligns with the relevant considerations for environmental impact assessment for the Air Quality Factor (EPA, 2020).

If you have any questions please do not hesitate to contact me.

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# 1 Introduction

Mineral Resources Limited (MRL) is undertaking planning for iron ore mining and export developments in the West Pilbara region of Western Australia. The proposed Ashburton Infrastructure Project (AIP) will support this development, and involves a new private haul road connecting an open cut mining area to landside facilities at the Port of Ashburton, and export via marine facilities at the Port.

The Ashburton Haul Road will be a fully sealed private road commencing at the boundary of the approved Buckland mine (Bungaroo South) (MS906 and MS1147), about 45 kilometres (km) southwest of Pannawonica, and continuing for about 150 km westward towards Onslow. The Port Facilities will be located at the Port of Ashburton, about 12km southwest of the Onslow township, and will include a storage shed, covered conveyors, a new jetty with a ship loader and marine transhipping and dredge spoil deposition.

In regard to the potential air quality impacts from the proposed port operations, MRL contracted Environmental Technologies & Analytics (ETA) to provide advice on establishing an air quality monitoring network. This brief report outlines the processes undertaken to evaluate potential monitoring equipment and locations including:

- Providing advice on monitoring equipment.
- Undertaking an analysis of meteorological data available in the region.
- Advising on appropriate locations for installation of up to three continuous air quality (particulate) monitors to establish baseline air quality.

This memorandum outlines the steps taken to address the requirements of the scope of work and the overall recommendations regarding monitoring locations and equipment for the proposed port facilities.

Note that the haul road has been excluded from this assessment for the following reasons:

- Haul road will be sealed – noting that the National Pollutant Inventory (NPI) Emission Estimation Technique Manual for Mining Ver 3.1 (EETM for Mining) allows for 100% reduction from sealed or salt-encrusted roads.
- Loads will be covered ensuring negating potential emissions from the load.
- There are no requirements for ambient monitoring within the Port Hedland airshed along the haulage route to the Pilbara Port Authority (PPA) Utah Point facility.

The EPA's Environmental Factor Guideline (EPA, 2020) sets out the key considerations for air quality as part of the environmental impact assessment process. The EPA "*…recognises that maintaining good air quality and minimising emissions protects human health and amenity, as well the broader environment*." In addition to emissions characterisation and modelling, the EPA may consider "whether existing background air quality, including natural variations, has been established through monitoring and accepted proxy data". ETA has used this context as the basis for reviewing the potential monitoring needs for the AIP, prior to construction. Taking into account the likely emission sources associated with the AIP, the type of ore to be handled through the Port of Ashburton, and on the assumption that the most sensitive receptors are community members, the continuous monitoring of particles (as $PM_{10}$) to establish the existing background air quality, pre-construction, aligns with the key considerations for environmental impact assessment for the Air Quality Factor (EPA, 2020[1]).

[1] EPA (2020). Environmental Factor Guideline – Air Quality. Environmental Protection Authority, Western Australia, April 2020.

# 2 Monitors

The following sections briefly outline some of the ambient particulate monitors that are available, their applicability for the Onslow region and criteria for siting of the equipment.

## 2.1 Regulatory Monitors

A regulatory monitor is defined as a monitor that has been approved by the United States Environmental Protection Agency (US EPA) and has been published in their List of Designated Reference and Equivalent Methods. Within Australia a regulatory monitor will also have an applicable standard published by Standards Australia. For air quality monitoring there are three main types of approved, or regulatory, monitors:

- High Volume Air Samplers (HVAS): HVAS are an approved gravimetric method to determine the ambient concentration of particulates and the Australian Standard is AS/NZS 3580.9.6:2015 (for $PM_{10}$). The operating principle of the HVAS is very simplistic with ambient air being drawn at a known rate through a filter paper on which the particulates collect. This filter is removed and weighed after a set period of time (nominally 24-hours). The concentration is determined by the weight of the particulates on the paper, the average flow rate and the sample duration.
  - Advantages:
    - Low capital cost for establishing monitor.
    - Filter paper can be analysed for metals or other pollutants.
  - Disadvantages:
    - Requires 240v power.
    - Labour intensive as the filter papers are required to be changed after each sampling period.
    - Actual monitoring results are not normally available until two days after the sampling period (laboratory dependent) so there is a delay in determining excursions above the regulatory criteria.
- Tapered Element Oscillating Microbalance (TEOM): TEOMs are an approved method to determine the ambient concentration of particulates ($PM_{10}$, or $PM_{2.5}$) on a real time basis (AS/NZS 3580.9.8:2008 for $PM_{10}$) The operating principle of these instruments is more complex than that for the HVAS in that ambient air is drawn at a known rate through a size selective inlet then into an isokinetic splitter which separates the stream into a main and by-pass flow. The main flow is passed through a sample filter that is attached to a hollow tapered element. By measuring the frequency that the hollow element oscillates it is possible to determine the mass of the accumulating particulates. This mass is then converted into a mass concentration through using the flow rate.
  - Advantages:
    - Real-time data
    - Sub-hourly data
    - Wind speed/direction sensors allow for apportionment of dust
  - Disadvantages:
    - Requires 240v power.
    - Unit is required to be contained within an air-conditioned enclosure
    - High initial capital cost
    - Issues with change in moisture (negative readings)
    - No subsequent analysis possible for what was in the particulate (ie metals or other pollutants)

- Beta Attenuation Monitor (BAM): BAMs are an approved method to determine the ambient concentration of particulates ($PM_{10}$,) on a real time basis (AS/NZS 3580.9.11:2016 for $PM_{10}$). The theory behind these monitors is that beta rays, derived from the decay of a radioactive source such as Carbon 14, either lose energy or are absorbed when they interact with matter (AS 2008). The mass concentration is determined by using the volumetric flow and the change in beta attenuation over time.
    - Advantages:
        - Real-time data
        - Hourly data
        - Wind speed/direction sensors allow for apportionment of dust
    - Disadvantages:
        - Requires 240v power – noting that some units can be configured for solar panels/batteries.
        - High initial capital cost
        - No subsequent analysis possible for what was in the particulate (ie metals or other pollutants)

The recommendation from ETA, based on the previous information, is that is advisable to utilise a BAM for real time monitoring. Although these monitors do have a higher initial capital cost than the HVAS, they are less labour intensive and provide real time, hourly monitoring data. The BAM is also preferable over a TEOM due to the relatively high humidity of the coastal Pilbara region.

An example of a BAM unit, fitted with solar panels and wind speed/direction sensors, is presented in Figure 1. This unit forms part of the Port Hedland Industries Council (PHIC) monitoring network in Port Hedland.

**Figure 1: Solar powered BAM unit with wind speed/direction at 3m**

## 2.2 Nephelometer

In locations, or situations, that require ambient monitoring, but not for regulatory purposes, then a type of monitor called 'nephelometers' can be used. A nephelometer uses light scattering to count the particles which are then converted into a mass concentration. By installing the appropriate inlet these monitors can be configured to monitor for either the $PM_{10}$ or $PM_{2.5}$ size fractions. Examples of which include the recommended ambient monitors Met-One ES-642 and E-Sampler. The conversion is based on Arizona road dust and if a more representative concentration is required then a correction factor, commonly stated as a k-factor, is required. This can be determined by co-locating the monitor adjacent to a regulatory monitor for a period of time, determining the difference in the readings, and calculating the required correction factor.

- Advantages:
  - Real-time data
  - Wind speed/direction sensors allow for apportionment of dust
  - Can operate with 12v power supplied by solar panels and a battery.
  - Lower initial capital cost compared to a BAM or TEOM.
- Disadvantages:
  - Not a regulatory monitor

## 2.3 Siting Requirements

When siting a monitor it is important that the requirements outlined in AS/NZS 3580.1.1:2016 (Method for sampling and analysis of ambient air – Guide to siting air monitoring equipment) be referenced and followed as reasonably possible. Some of the requirements, for particulates, include:

- Will the airflow in the vicinity of the sampling inlet be free from restrictions?
- The sampling inlet should have a clear sky angle of 120$^{\circ}$.
- The surrounding area should be clear of objects which may alter concentrations by adsorption or absorption. Examples include some building surfaces or vegetation.
- The surrounding area should be free from physical interference which may produce atypical results. Examples include measuring particulates near incinerators (commercial or domestic).
- The surrounding area should be free from sources of extraneous emissions, such as unsealed roads, although this may not be practicable for this project.
- The site needs to be secure (minimised potential for vandalism or theft).
- Avoid sites prone to natural disasters (including wildfires and flooding).
- Does the site have sufficient, and reliable, communication services to support the reliable telemetry of data?

# 3 Meteorology

For this assessment 10 years of meteorology from the Bureau of Meteorology (BoM) Onslow Automatic Weather Station (AWS) was analysed. As the aim of the project is to determine potential monitoring locations, in relation to the proposed AIP and sensitive receptors in the Onslow region, the primary focus of the analysis concerns the wind direction, and to a lesser extent, the wind speed.

The annual wind rose for 2011 to 2020 for data from the BoM AWS at the Onslow Airport is presented in Figure 2. From this figure the following can be surmised:

- There are two dominant wind directions:
  - A defined west-north-west direction which also has a high frequency of wind speeds above 8 metres per second (m/s)
  - From a south to south-easterly direction with a high frequency of wind speeds in the 4 – 8 m/s range.
- The average wind speed is 5.5 m/s with calm winds (below the stall speed of the anemometer) occurring for only 0.2% of the time.
- Wind speeds below 2 m/s can occur from all directions, though there is a slight increase from the west south westerly.

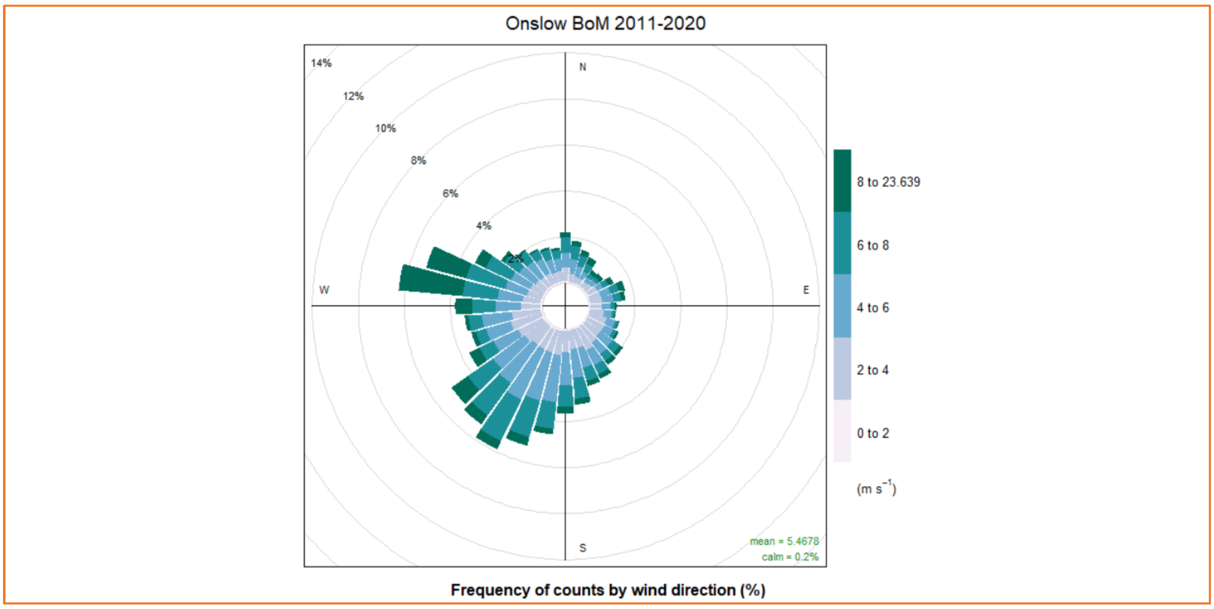


**Figure 2: Annual wind rose for Onslow Airport (2011-2020)**

The annual wind roses, for each year from 2011 to 2020, are presented in Figure 3. The individual annual wind roses generally follow, allowing for some interannual variation, a similar trend to that outlined for the overall wind rose (Figure 2) with the following exceptions:

- 2011 and 2012 have a lower frequency of winds from the west-north-west direction
- Both 2011 and 2012 have a noticeable peak in the wind direction from both the north and an east north easterly direction. A potential cause of this variation could be due to instrument replacement however

as the wind speed/direction sensors were last replaced in 2009 (BoM2021b) this is unlikely to be the cause.

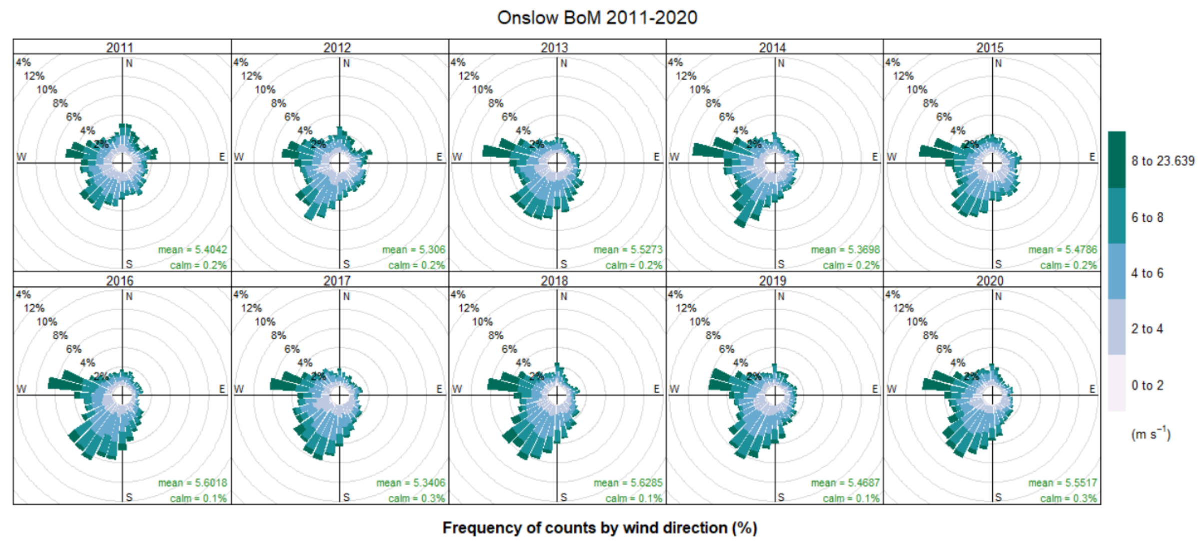


**Figure 3: Annual wind roses for Onslow Airport (2011-2020)**

The wind roses for the period 2011 – 2020, by season and daytime/night time, are presented in Figure 4. From the information contained within this figure the following can be surmised:

- The daytime, during spring and summer, is dominated by strong winds from the west-north-west direction.
- The night time during spring is dominated by winds from the south through to the west with a dominate south westerly component, while during summer nights the wind direction has a more westerly component.
- The autumn and winter daytimes are transitional periods with the wind derived from just about all directions, though there is a noticeable gap in the winds from the south through to the west.
- The wind direction during the night in autumn and winter is primarily from the south to south east.
- The spring and summer periods have a high percentage of wind speeds above 6 m/s – which is important as wind erosion typically starts to occur at this speed.
- The wind speeds during the autumn and winter periods are calmer with speeds rarely exceeding 8 /ms and with a higher percentage of winds below 2 m/s, especially during the night

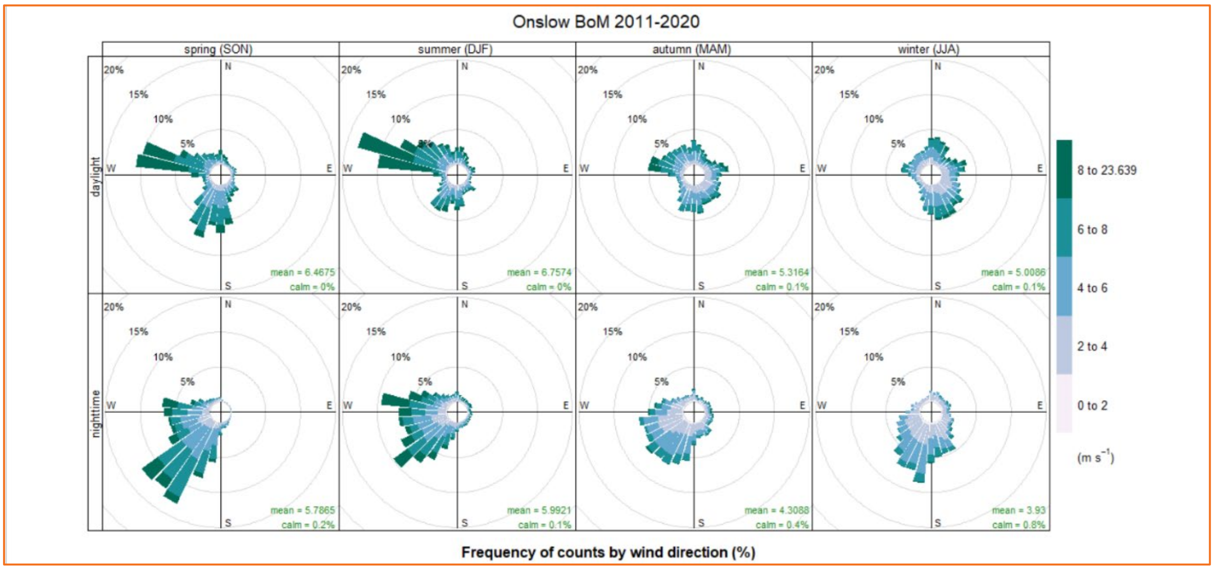


**Figure 4: Seasonal wind roses (divided into day time/night time)**

# 4 Regional Receptors

The location of the proposed AIP within the Port of Ashburton is presented in Figure 5 along with potential receptors in the region. These receptors include:

- Township of Onslow located approximately 12km to the northeast.
- BHP Macedon Gas located approximately 6km to the southwest.
- Chevron Wheatstone located immediately to the west.
- Onslow Salt – evaporation ponds (3km to the southeast) and stockpiles and export facilities (10km to the northeast).
- Accommodation village located approximately 10km to the south.

Of these potential receptors the Township of Onslow is the only 'sensitive receptor' in the region, in that it contains residences, schools and recreation areas. Although the other designated potential receptors are not classified as 'sensitive' there will still be a requirement to minimise the impact on these operations for the following potential reasons:

- Increased dust intake to the gas turbines at either the Chevron Wheatstone or BHP Macedon facilities may reduce their efficiencies, or at least the perception of a reduction.
- Dust deposition onto the salt evaporation pans may result in a reduction in quality of the product.
- Dust deposition at the accommodation village may be apportioned solely to the operations of the AIP, including haulage.

To determine potential monitoring locations this assessment takes into account the receptor (and receptor type), its location in relation to the AIP and the prevailing wind direction:

- Onslow: Due to its location any potential impact would occur during south westerly winds which occur primarily during the night throughout the year, though the spring and summer months have a higher frequency of strong winds. These conditions are more conducive for wind erosion events which may result in higher particulate emissions that could potentially travel further. However given the relatively large distance between the proposed operations and Onslow (≈12km) there is a low probability of any adverse impacts.
  As Onslow is the primary sensitive receptor in the region it is recommended that a regulatory monitor, preferably a BAM monitor, be located at a suitable location within the town. The monitor should be located, as far as practical, to the requirements listed in AS/NZS 3580.1.1:2016 (Section 2.3).
- BHP Macedon: From Figure 5 it can be seen that this facility is located 6 km to the south west of the proposed West Pilbara project and given the prevailing wind conditions (Figure 4) it is highly unlikely that this facility will be impacted.
  No monitoring is recommended for this receptor.
- Chevron Wheatstone: The location of the gas turbines and gas processing trains in relation to the proposed West Pilbara project are presented Figure 6. In respect to the West Pilbara project, Train 1 within the Wheatstone facility is approximately 1.5 km to the south west, and the gas turbines are approximately 2.1 km to the south west. Based on the seasonal wind roses (Figure 4) the primary time that north easterly winds occur, which could direct potential emissions towards the Wheatstone operations, is during the daytime between June and August.
  It is recommended that monitoring be undertaken to determine potential impacts on this operation, though consideration should be given to campaign monitoring during the autumn/winter period only. This monitoring can be undertaken with a non-regulatory monitor. The actual location of the monitor will need to be determined based on the requirements outlined in AS/NZS 3580.1.1:2016 and land

access conditions. The general recommendation would be to locate this monitor half between the source and receptor. If this is not possible then the monitor could potentially be located along the boundary of the proposed AIP.

- Onslow Salt: The evaporation ponds are located approximately 3.5 km to the south east of the proposed West Pilbara project (Figure 6). Given that the prevailing wind direction during the daytime in spring and summer is from the west-north-west direction, and that there is a high percentage of winds above 6 m/s which are conducive to wind erosion, then there is the potential that these operations could be impacted.
  It is recommended that monitoring be undertaken to determine potential impacts on these salt evaporation ponds. This monitoring can be undertaken with a non-regulatory monitor to assist in determining potential impacts. The actual location of the monitor will need to be determined based on the requirements outlined in AS/NZS 3580.1.1:2016 and land access conditions. The general recommendation would be to locate this monitor halfway between the source and receptor. If this is not possible then the monitor could potentially be located along the boundary of the proposed AIP.
- Accommodation Village: As this receptor is located approximately 10km to the south of the AIP, and that there are minimal northerly winds (Figure 4) the potential of impacting this receptor is very low. No monitoring is recommended for this receptor.


Figure 5: Potential receptors within the region around the proposed AIP

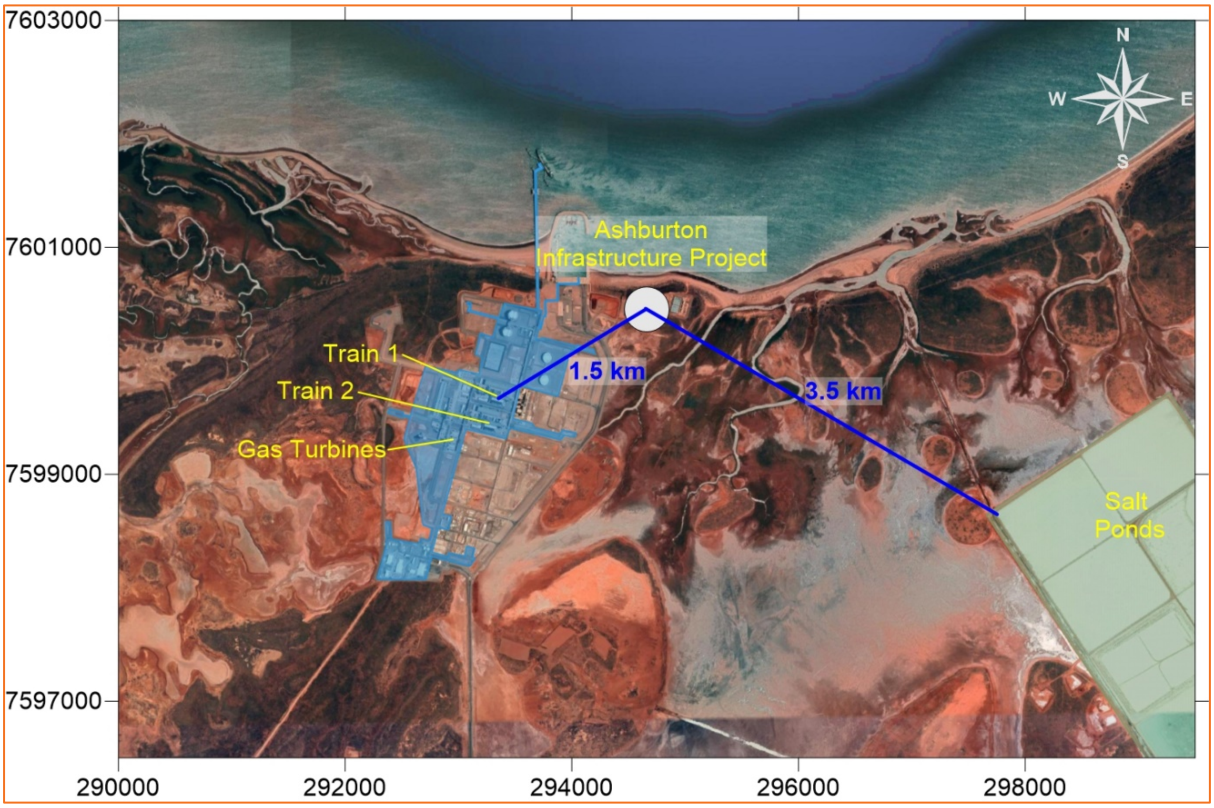


**Figure 6: Potential receptors immediately surrounding the proposed AIP**

# 5 Conclusions

To assist in determining potential monitoring locations an analysis was undertaken using 10 years of meteorological data from BoM Onslow airport AWS. Using this data the following was determined:

- There are two dominant wind directions:
  - A defined west-north-west direction which also has a high frequency of wind speeds above 8 m/s
  - From a south to south-easterly direction with a high frequency of wind speeds in the 4 – 8 m/s range.
- The average wind speed is 5.5 m/s with calm winds (below the stall speed of the anemometer) occurring for only 0.2% of the time.
- Wind speeds below 2 m/s can occur from all directions, though there is a slight increase from the west south westerly direction.

The meteorological data, primarily the wind speed and direction, was further analysed to determine seasonal and diurnal (day and night time) trends. This analysis determined that:

- The daytime, during spring and summer, is dominated by strong winds from the west-north-west direction.
- The night time during spring is dominated by winds from the south through to the west with a dominant south westerly component, while during summer nights the wind direction has a more westerly component.
- The autumn and winter daytimes are transitional periods with the wind derived from just about all directions, though there is a noticeable gap in the winds from the south through to the west.
- The wind direction during the night in autumn and winter is primarily from the south to south east.
- The spring and summer periods have a high percentage of wind speeds above 6 m/s – which is important as wind erosion typically starts to occur at this speed.
- The wind speeds during the autumn and winter periods are calmer with speeds rarely exceeding 8 m/s and with a higher percentage of winds below 2 m/s, especially during the night.

A series of potential receptors in the region were identified and using the analysis of the wind speed/direction and the distance from the proposed West Pilbara project, a series of recommendations were made in regard to monitoring requirements:

- Onslow: As this is the primary sensitive receptor in the region it is recommended that a regulatory monitor, preferably a BAM monitor, be located at a suitable location within the town. The monitor should be located, as far as reasonably possible, to the requirements listed in AS/NZS 3580.1.1:2016 (Section 2.3).
- BHP Macedon: No monitoring is recommended for this receptor.
- Chevron Wheatstone: It is recommended that monitoring be undertaken to determine potential impacts on this operation, though consideration should be given to campaign monitoring during the autumn/winter period only. This monitoring can be undertaken with a non-regulatory monitor.
- Onslow Salt: It is recommended that monitoring be undertaken to determine potential impacts on the salt evaporation ponds. This monitoring can be undertaken with a non-regulatory monitor to assist in determining potential impacts.
- Accommodation Village: No monitoring is recommended for this receptor.

The general recommendation for the locations of the non-regulatory monitors would be to locate them half between the source and receptor. If this is not possible then the monitors could potentially be placed along the boundary of the proposed AIP, forming part of a boundary monitoring system. All monitoring locations, and the siting of the monitor in situ. will need to be determined based on the requirements outlined in AS/NZS 3580.1.1:2016.

# 6 References

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