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REPORT 20-1873-R4

Revision 0

Northern Pipeline Interconnector - Stage 2
Air Quality Impact Assessment

PREPARED FOR

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Northern Pipeline Interconnector - Stage 2

Air Quality Impact Assessment

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EXECUTIVE SUMMARY

The Stage 2 of Northern Pipeline Interconnector (NPI) project involves the construction of approximately 48 km of reverse-flow pipeline extending from NPI Stage 1 Landers Shute Water Treatment Plant at Eudlo to the Noosa Water Treatment Plant near Cooroy on the Sunshine Coast. The completed reverse-flow NPI, including Stage 1 and Stage 2, will supply a target volume of 65 ML a day of potable fresh water to existing storage facilities at Elimbah and Morayfield for distribution to the greater Brisbane region.

The current study has been requested by LinkWater for the purpose of updating the initial assessment (Heggies Report 20-1873R2 dated 27/02/08), in particular the ambient air quality, as a result of changes in pipeline alignment. The current assessment is intended to support the Supplementary Environmental Impact Statement (SEIS) which has recently been released to those who made submissions to the full EIS.

Air pollutants relating to the proposed pipeline project that will potentially affect air quality are related primarily to construction activities. Emissions will mainly be in the form of dust raised by mechanical operations, transport activities and wind. Small quantities of gaseous pollutants will be emitted from internal combustion engines in construction equipment, but ambient concentrations of these substances should be low compared to relevant guidelines.

Based on the comparison of predicted modelling results with the relevant project air quality goals, minimal impact from particulate matter emissions are expected to be associated with works conducted along the pipeline.

The table below presents the greatest distance that an exceedance of relevant air quality goal occurs for standard construction operations and blasting operations (i.e. without mitigation measures).

Air Quality parameter	Project Goal	Distance of Exceedance of Project Goal	
		Standard Operations	**Blasting Operations**
PM_{10} 24-hour Average	50 µg/m^3	25 m to 30 m	140 m to 150 m
PM_{10} Annual Average	30 µg/m^3	10 m to 15 m	50 m to 55 m
TSP Annual Average	90 µg/m^3	20 m to 25 m	5 m to 10 m
Monthly Average Dust Deposition	2 g/m^2/month *	55 m to 60 m	55 m to 60 m

* Incremental impact of project (i.e. excluding background)

Based on this modelling outcome, if any blasting work needs to be conducted within 140 m of a residential property, appropriate additional dust mitigation measures (e.g. optimising blasting conditions to minimise dust generation and avoiding blasting during unfavourable wind conditions) should be implemented to ensure that air quality impacts are appropriately managed.

Standard maintenance procedures, normal operational inspections and appropriate siting should be adequate to ensure that combustion products are not an issue for residents during construction.

The generation and impact of construction dust emissions will be minimised by use of appropriate management techniques, in particular the minimisation of cleared areas and the use of watering to bind the surface layer.

EXECUTIVE SUMMARY

It should be noted that the above analysis assumes that activities are undertaken at a constant rate and long-term emission factors are used for estimation of sources such as wind-blown dust. The onus will be on operators to ensure that such controls are applied appropriately and that attention is paid to the prevailing meteorology if activities are undertaken upwind of and in close proximity to sensitive receptors (residences, schools, hospitals and businesses etc).

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1 INTRODUCTION

The Stage 2 of Northern Pipeline Interconnector (NPI) project involves the construction of approximately 48 km of reverse-flow pipeline extending from NPI Stage 1 Landers Shute Water Treatment Plant at Eudlo to the Noosa Water Treatment Plant near Cooroy on the Sunshine Coast. Approximate alignment of the NPI is presented in **Figure 1**. The completed reverse-flow NPI, including Stage 1 and Stage 2, will supply a target volume of 65 ML a day of potable fresh water to existing storage facilities at Elimbah and Morayfield for distribution to the greater Brisbane region.

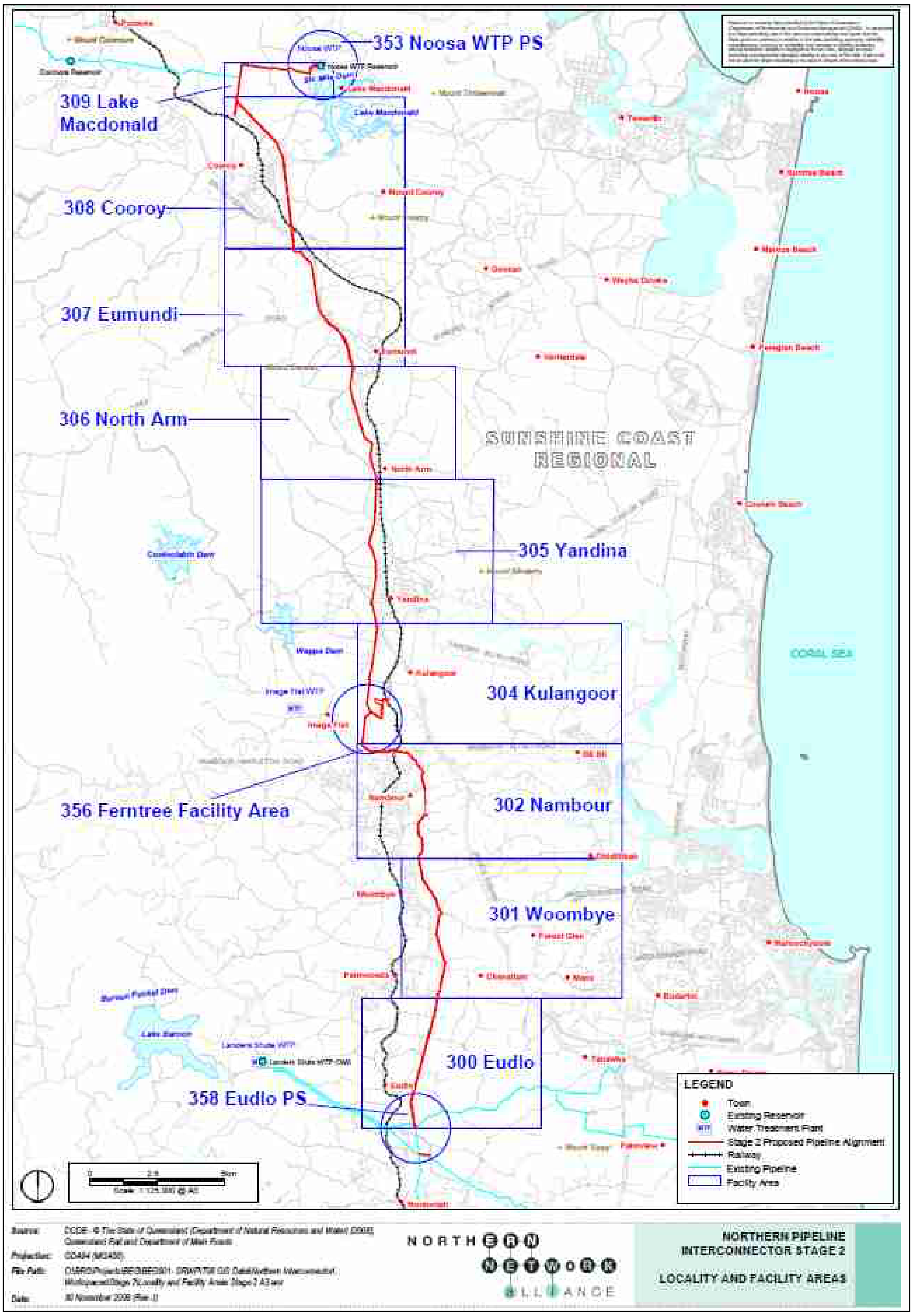
Design of the NPI Stage 2 is being performed by the Northern Network Alliance (NNA) for LinkWater Projects, the State Government's special purpose vehicle for the design and construction of water infrastructure. On 17 January 2009, the NPI Stage 2 released its Environmental Impact Statement (EIS) which was available for public comment until 9 March 2009. The EIS investigated the potential benefits and impacts of the NPI Stage 2 during construction and operation.

The current study has been requested by NNA for the purpose of updating the initial assessment (Heggies Report 20-1873R2 dated 27/02/08), in particular the ambient air quality assessment, as a result of changes in pipeline alignment. The current assessment is intended to support the Supplementary Environmental Impact Statement (SEIS) which has recently been released to those who made submissions to the full EIS.

This document assesses the potential air quality impacts from construction and operation of NPI Stage 2. The principal issues in relation to dust are expected during the construction phase of the works.

The environmental controls described in this document are designed to minimise the potential noise and vibration impacts of the project on nearby residences, businesses, schools, places of worship and other sensitive receptors. Mitigation measures are discussed (where necessary) to assist in minimising significant impacts to sensitive receptors.

Figure 1 Approximate Alignment of the Northern Pipeline Interconnector



2 PROJECT DESCRIPTION

The Northern Pipeline Interconnector (NPI) is a drought contingency project that will provide a bulk fresh water supply of up to 65 ML/d between the Sunshine Coast and Brisbane. Stage 2 of the NPI will link Noosa Water Treatment Plant (WTP) with the first stage of the pipeline from the Landers Shute WTP main line at Eudlo.

Since the release of the EIS on 17 January 2009, several changes have been made to the nature and operation of certain facilities, and to the alignment in certain locations. These changes are summarised as follows:

- Stages 1 and 2 of the NPI will now operate as a reverse flow pipeline with the capability to transport water in both southern and northern directions. These works will include both the construction of new facilities and the augmentation of existing facilities.
- The location of the Ferntree Facility Area and pipeline corridor have been finalised following assessment of the Ferntree Special Investigation Area.
- Minor route refinements have been made to the pipeline corridor alignment following further assessments.

3 TECHNICAL INFORMATION

3.1 Air Quality

Dust and particulate emissions associated with construction and earthworks have the potential to adversely impact on amenity and human health. Health impacts depend on particulate size. The term “particulate matter” refers to a category of airborne particles typically less than 50 microns (µm) in diameter and ranging down to 0.1 µm in size. Particles less than 10 µm and 2.5 µm are referred to as PM_{10} and $PM_{2.5}$ respectively.

Emissions of PM_{10} and $PM_{2.5}$ are considered important in terms of impact due to their ability to penetrate to varying degrees into the respiratory system. Because of their smaller particle size, particles in the $PM_{2.5}$ category tend to be less readily trapped in the upper respiratory tract and can more readily penetrate into the lungs. The respiratory system of healthy individuals generally can effectively deal with increased dust levels via a range of response mechanisms. However, recent studies suggest that the long-term exposure of sensitive individuals to high levels of PM_{10} and $PM_{2.5}$ can give rise to potential adverse health impacts including increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

Earthmoving activities and wind erosion of disturbed areas, including construction sites, give rise to dust emissions that are predominantly in the coarser fraction of the particle size range (i.e. larger than PM_{10}). The impacts associated with coarser dust fractions are frequently more significant in terms of nuisance and amenity rather than health. Both fine and coarse particles give rise to nuisance impacts, such as soiling of surfaces, and the creation of deposits in rainwater tanks, swimming pools, cars and other such undesirable effects.

Nitrogen dioxide (NO_2) is formed in the atmosphere from the oxidation of nitric oxide (NO), a colourless, odourless gas with no significant human health impact that is formed during the combustion of fossil fuels (e.g. combustion of diesel in trucks and other mobile or fixed machinery). Nitrogen dioxide, on the other hand, has significant health and environmental impacts. The oxidation of NO to NO_2 is compounded in the presence of ozone.

4 APPLICABLE AIR QUALITY CRITERIA

State air quality guidelines formulated by the Queensland Department of Environment and Resource Management (DERM) are published in the *Environmental Protection (Air) Policy 2008* (Qld Government, 2008) (hereafter, "the EPP (Air)"). Relevant air quality goals, as prescribed within Schedule 1 of the EPP (Air) are summarised in **Table 1**. The 24 hour guideline set for PM_{10} of 50 µg/m^3 is the same as the Condition specified for the project by the State Government for measured PM_{10} concentrations at any sensitive or commercial place downwind of the site.

In addition to the goals listed in **Table 1**, the potential nuisance impacts from project-related emissions also need to be considered, particularly in relation to dust deposition. While there is no specific criterion established in the EPP (Air) for dust deposition, the New South Wales Department of Environment, Climate Change and Water (NSW DECCW) sets dust deposition limits in the 2005 *Approved Methods for the Modelling and Assessment of Air Pollutants* as a maximum total dust deposition rate of 4 g/m^2/month, with a maximum incremental increase of 2 g/m^2/month. It is noted that one of the Conditions set by the State Government for the project is that measured dust deposition levels at any sensitive receptor must not exceed 120 mg/m^2/day, which is equivalent to 4 g/m^2/month. As this modelling assessment does not include background dust deposition levels, the guideline for incremental impact of 2 g/m^2/month (or 60 mg/m^2/day) has been used.

The NSW DECCW limit for annual average PM_{10} is 30 µg/m^3.

In June 1998, the National Environment Protection Council of Environment Ministers agreed to set uniform standards for ambient air quality to apply to all States and Territories. These standards are contained in the National Environment Protection Measure (NEPM) for ambient air quality.

The NEPM standards for pollutants relevant to this assessment are summarised in **Table 2**. The NEPM also provides advisory reporting standards of 25 µg/m^3 (24 hour average) and 8 µg/m^3 (annual average) for particulate matter less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$).

Table 1 Relevant Queensland Air Quality Indicators and Compliance Goals

Pollutant	Averaging Period	Goal	Maximum Allowable exceedances
Carbon Monoxide (CO)	8 hours	9 ppm (11 mg/m^3)	1 day a year
Nitrogen dioxide (NO_2)	1 hour	0.12 ppm (250 µg/m^3)	1 day a year
	Annual	0.03 ppm (62 µg/m^3)	none
Particulate matter <10 µm (PM_{10})	24 hours	50 µg/m^3	5 days a year
Total Suspended Particulate (TSP)	Annual	90 µg/m^3	none

Note 1 Source: Queensland Department of Environment and Resource Management, EPP (Air) 2008.
Note 2 Gravimetric concentrations expressed at 1 atmosphere pressure, 0°C

Table 2 National Environment Protection Measure (NEPM) Ambient Air Quality Goals

Pollutant	Averaging Period	Goal	Maximum Allowable exceedances
Carbon Monoxide (CO)	8 Hour	9.0 ppm (11 mg/m^3)	1 day a year
Nitrogen dioxide (NO_2)	1 Hour Annual	0.12 ppm (246 µg/m^3) 0.03 ppm (62 µg/m^3)	1 day a year none
Particulate matter <10 µm (PM_{10})	24 Hours	50 µg/m^3	5 days a year

Note 1 Source: National Environment Protection Council 1998.

Note 2 Gravimetric concentrations expressed at 1 atmosphere pressure, 0°C

As shown by the tables above, The EPP (Air) has adopted the NEPM standards for CO, NO_2 and PM_{10}, However it should be noted that the NEPM standards were intended to apply only to performance monitoring stations that satisfy the criteria for siting incorporated into the NEPM. The siting criteria stipulates that performance monitoring stations should be located in a manner such that they contribute to obtaining a representative measure of air quality likely to be experienced by the general population in a region. Therefore, the NEPM standards were not intended to be used in areas impacted by local pollutant sources, such as in the vicinity of major roads or industrial sources.

5 EXISTING AIR QUALITY ENVIRONMENT

5.1 Introduction

The existing air quality environment along the pipeline route is influenced by regional air pollutant sources (mainly transport and industry related), with minor contributions from local traffic, construction, commercial/industrial sources and rural/cropping activities.

Variations in local air quality will occur due to the proximity of sources such as major roads, regional events such as bushfires and dust storms and variations of meteorological conditions such as wind speed, wind direction and atmospheric stability.

5.2 Air Quality Monitoring

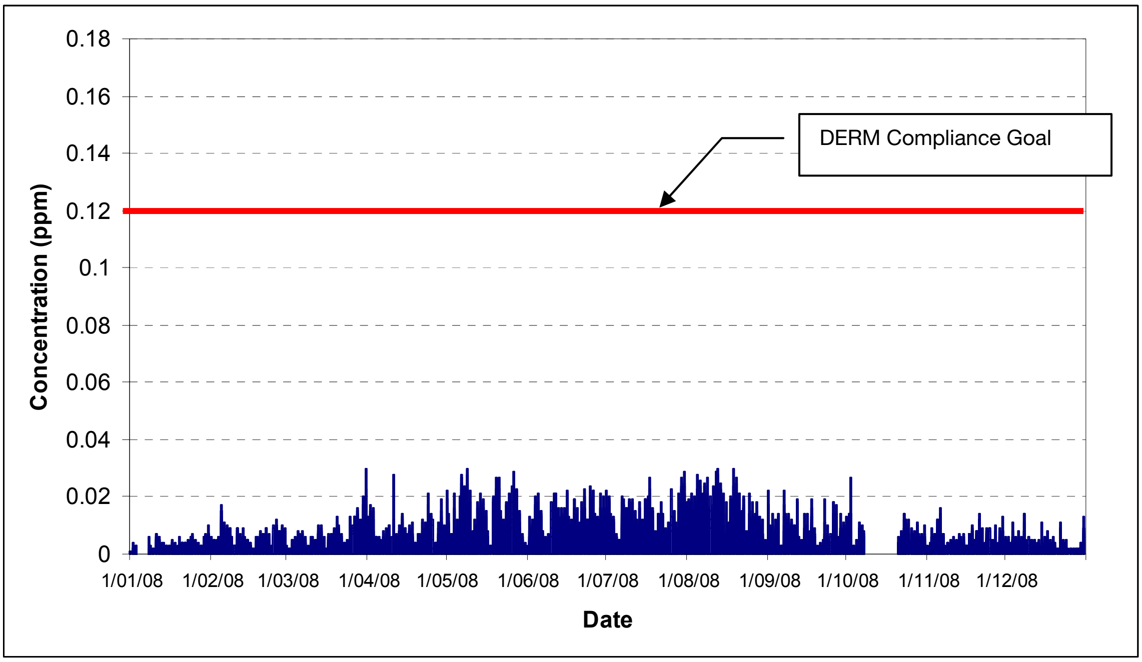
Measurements of existing meteorological parameters and air quality have been made in the general vicinity of the pipeline over a period of some years by DERM.

DERM maintains an air quality monitoring station at Mountain Creek, approximately 13 km east-northeast of the Eudlo end of the proposed pipeline project. It is located at the Mountain Creek State Primary School, and was established in July 2001 to measure local meteorology and concentrations of ozone (O_3), oxides of nitrogen (NO_x - nitrogen dioxide (NO_2) plus nitrogen monoxide (NO)) and PM_{10}. The latter two parameters are considered to be relevant to the current assessment of construction air quality impacts.

5.2.1 Nitrogen Dioxide

Figure 2 summarises the Mountain Creek 1-hour average Nitrogen Dioxide (NO_2) ambient monitoring data for one full year of validated and representative data (calendar year 2008). As shown in **Figure 2**, the 1-hour average NO_2 concentration did not exceed the DERM compliance goal (0.12 ppm) throughout 2008. The maximum of the dataset, 0.03 ppm, was recorded on four days (31 March 2008, 9 April 2008, 13 August 2008 and 19 August 2008). The annual average NO_2 concentration was recorded as 0.0031 ppm which is well below the relevant EPP (Air) goal of 0.03 ppm.

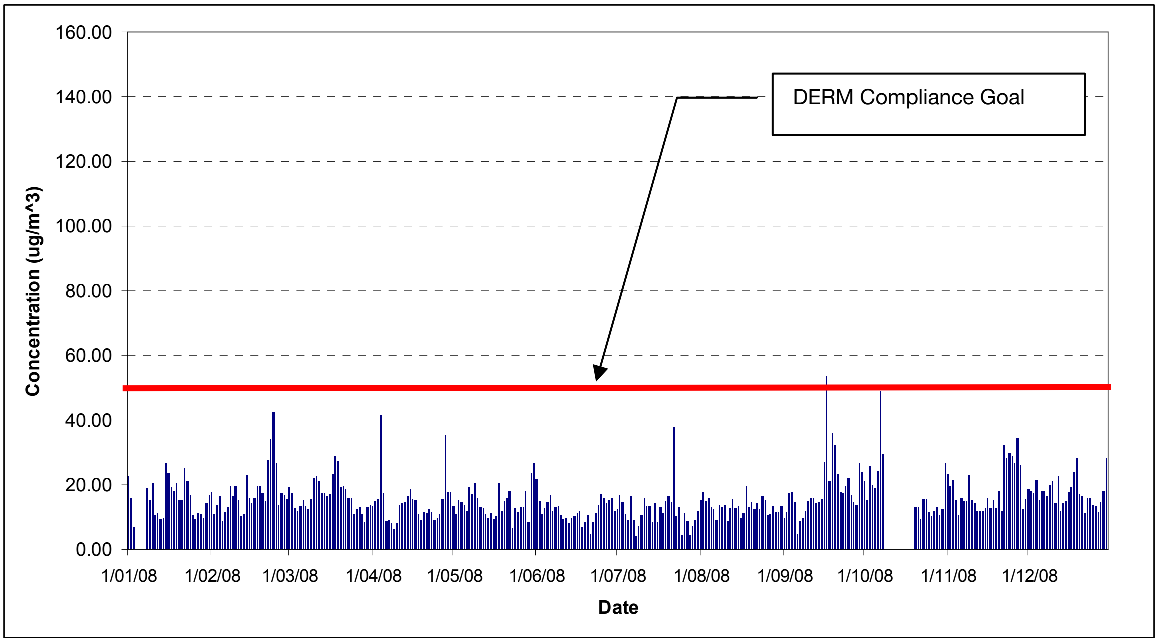
Figure 2 Mountain Creek Ambient 1-hour Average NO_2 Concentrations (ppm) – 2008



5.2.2 PM_{10}

PM_{10} is measured continuously at the Mountain Creek monitoring site using a tapered element oscillating microbalance (TEOM) monitor. **Figure 3** summarises the Mountain Creek 24-hour average PM_{10} ambient monitoring data for one full year of validated and representative data (calendar year 2008).

Figure 3 Mountain Creek Ambient 24-hour Average PM_{10} Concentrations (µg/m³) – 2008



As shown in **Figure 3**, PM_{10} concentrations exceeded the DERM compliance goal of 50 µg/m^3 for one 24-hour period throughout 2008. The maximum of the dataset, 53.3 µg/m^3, was recorded on 17 September 2008. A maximum number of 5 exceedences of 50 µg/m^3 are allowed for any year as per DERM guideline. The annual average PM_{10} concentration at Mountain Creek was 15.75 µg/m^3. This also satisfies the EPP (Air) goal of 30 µg/m^3.

The 75th percentile of the 24-hour average PM_{10} concentrations monitored at Mountain Creek of 17.7 µg/m^3 has been used as a representative PM_{10} background concentration in this assessment, as use of the maximum would be overly conservative. There is no guidance in the EPP (Air) on methodologies to be used to account for background concentrations in modelling assessments. The State Environment Protection Policy (Air Quality Management) gazetted by the EPA of Victoria in 2001 requires the use of the 70th percentile.

The annual average PM_{10} concentration of 15.7 µg/m^3 measured at Mountain Creek has been used as a representative background concentration for estimating cumulative annual average PM_{10} concentrations in the assessment.

In regions where road traffic is not the dominant particulate source, such as rural areas, the PM_{10} sub-set is typically approximately 50% of total suspended particulates (TSP) in the ambient air (US EPA, 2001). In the absence of monitoring data for TSP, the annual average TSP concentration for the region has therefore been estimated by multiplying the annual average PM_{10} concentration of 15.7 µg/m^3 by a factor of two. This gives a background TSP concentration of 31.5 µg/m^3.

The background monitoring data presented above indicates that there is capacity within the regional airshed for additional atmospheric emissions to occur without compromising DERM air quality goals.

5.3 Dispersion Meteorology

The dispersion model chosen for this assessment requires as input - air temperature, wind direction and wind speed in addition to mixing height and stability class. The dataset was generated synthetically through the use of The Air Pollution Model (hereafter, "TAPM"). TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), is a prognostic model which may be used to predict three-dimensional meteorological data, with no local data inputs required.

The model predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations.

Additionally, the TAPM model may assimilate actual local wind observations so that they can optionally be included in a model solution. The wind speed and direction observations are used to realign the predicted solution towards the observation values. Thus, direct measurements for 2008 of hourly average wind speed, wind direction and temperature, obtained at the nearby meteorological stations (see **Table 3**) have been used to create a meteorological input file suitable for modelling purposes. Parameters not recorded by these weather stations but required by the meteorological input file (i.e. atmospheric stability class, mixing height and the standard deviation of wind direction – or sigma theta) were synthetically generated using TAPM.

Table 3 Meteorological Stations Included in TAPM

Station Name	Data Assimilated in TAPM	Latitude	Longitude	Source
Nambour DPI Hillside	Hourly wind speed and wind direction	-26.644	152.938	BOM
Mountain Creek	Hourly wind speed and wind direction	-26.690	153.103	DERM

5.3.1 Wind Regime

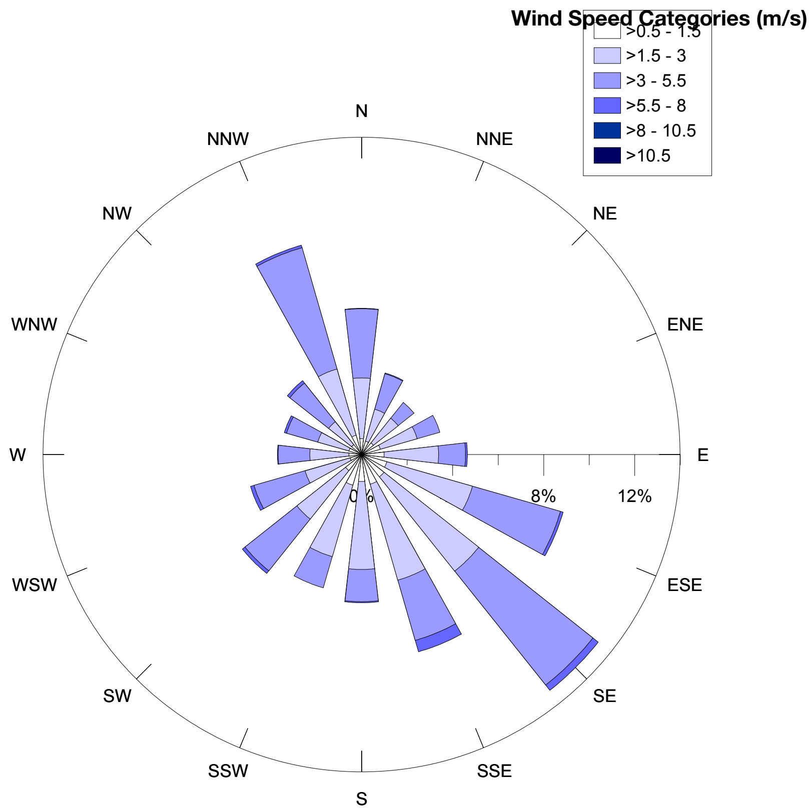
Wind roses for the TAPM-generated meteorology of the Project region can be observed in **Figure 4** (based on a nominal location at the centre of the project area). Presented in a circular format, a wind rose shows the frequency of winds blowing from particular directions. The length of each "spoke" relates to the percentage of time that the wind blows from that particular direction. Each spoke is also broken down into discrete categories (differentiated by various shades of blue) that show the percentage of time that winds blow from a particular direction *and* at certain wind speed ranges.

The annual wind rose indicates that winds tend to be experienced from the southeastern and north-northwestern quadrants and are typically light to moderate, having an average wind speed of between 1.5 m/s and 8 m/s.

The seasonal variation in wind behaviour at the Project Site is also presented in **Appendix A**. The seasonal wind roses indicate the following.

- In summer, light to moderate winds occur from the southeast and north-northwest.
- In autumn, light to moderate winds are prevalent from the southeast.
- In winter, light winds, being those from 1.5 m/s to 5.5 m/s, are mostly experienced from the southwest.
- In spring, light to moderate winds are experienced from the north-northwest.

Figure 4 TAPM Predicted Wind Rose Representative of Project Site – 2008



5.3.2 Atmospheric Stability

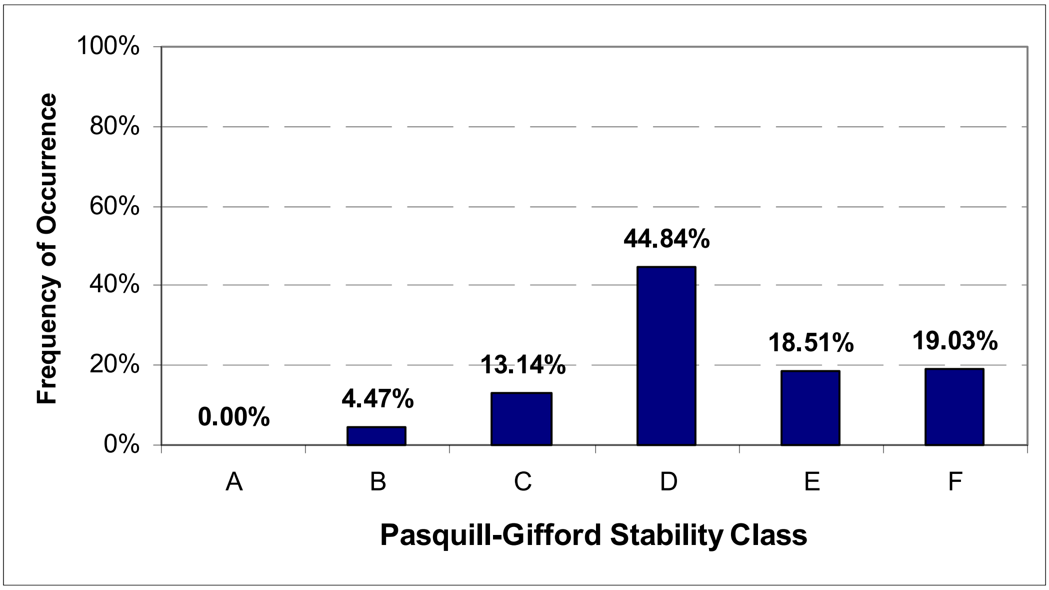
Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion (i.e. for parcels of air to rise or sink in the atmosphere). The Pasquill-Turner assignment scheme identifies six Stability Classes, “A” to “F”, to categorise the degree of atmospheric stability. These classes indicate the mechanical mixing characteristics of the prevailing meteorological conditions and are used as input into various air dispersion models (**Table 4**). Under stable conditions there is little vertical mixing in the atmosphere, which means that the dispersion of air pollutants is limited and elevated ground level concentrations can occur some distance from the source. Unstable conditions result in rapid dispersion of pollutants and are normally associated with improved air quality, although emissions from tall stacks are returned more readily to ground level, potentially leading to higher ground level concentrations.

Table 4 Description of atmospheric stability

Atmospheric Stability Class	Category	Description
A	Very unstable	Low wind, clear skies, hot daytime conditions
B	Unstable	Clear skies, daytime conditions
C	Moderately unstable	Moderate wind, slightly overcast daytime conditions
D	Neutral	High winds or cloudy days and nights
E	Stable	Moderate wind, slightly overcast night-time conditions
F	Very stable	Low winds, clear skies, cold night-time conditions

The frequency of each stability class at the project site (based on a nominal location at the centre of the project area), as predicted by TAPM, is presented in **Figure 5**. The seasonal stability class distributions for Project Site are included in **Appendix B**. The results indicate a high frequency of conditions typical to Stability Class "D". Stability Class "D" is indicative of neutral conditions, conducive to a moderate level of pollutant dispersion due to mechanical mixing.

Figure 5 TAPM-Predicted Annual Stability Class Distributions for Project Site, 2008



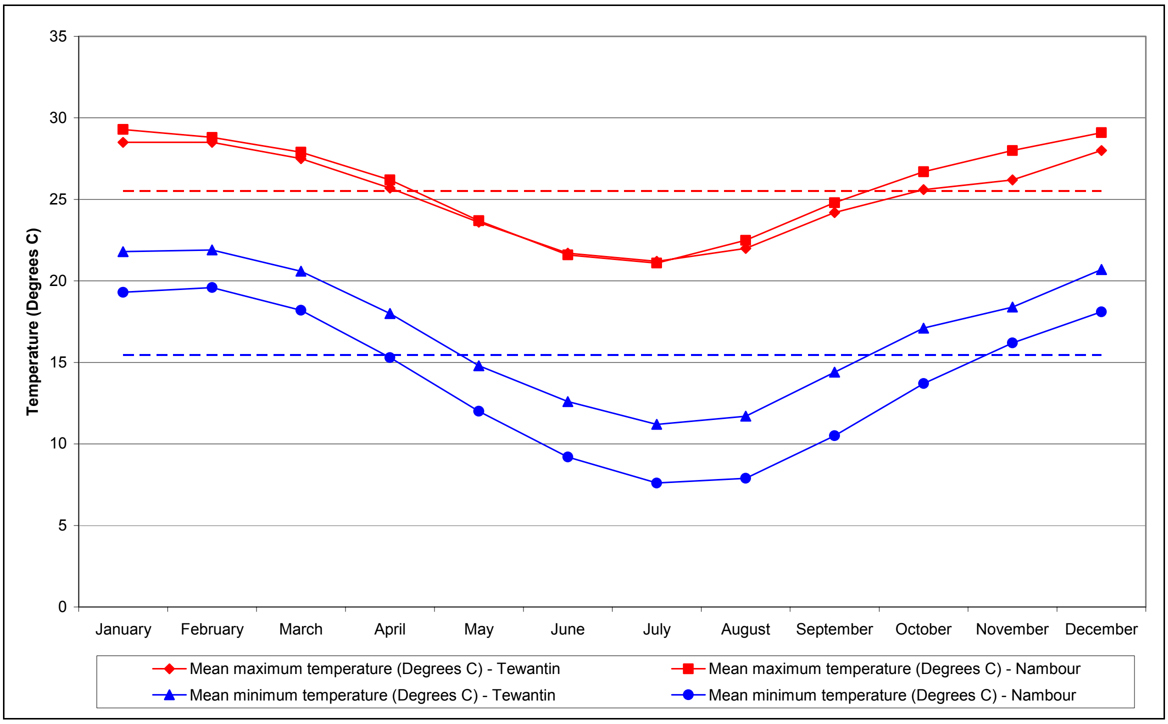
5.4 Regional Climate Averages

Long term climatic averages have been obtained from the Tewantin and Nambour AWSs in order to illustrate the common trends in regional climate.

5.4.1 Air Temperature

The monthly fluctuations in mean daily minimum and mean daily maximum temperatures at Tewantin (1996 – 2009) and Nambour (1953 – 2007) are shown in **Figure 6**.

Figure 6 Monthly Temperature Averages at Tewantin and Nambour

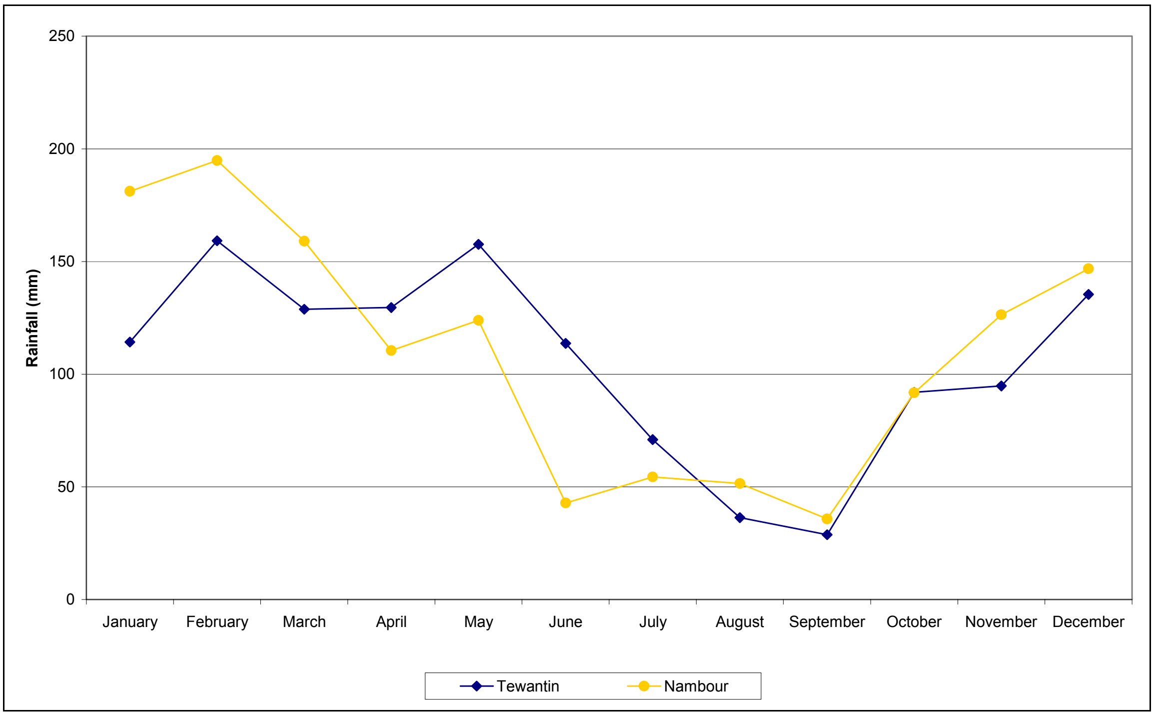


It can be seen from **Figure 6** that the temperature for the Project region may be described as mild to warm overall, based on historic data from the Tewantin and Nambour BoM stations. Average air temperatures during the day tend to vary between 21.1°C – 22.5°C in winter and 28.0°C – 29.3°C in summer. Average air temperatures during the night tend to be cool to mild, varying from 7.6°C – 12.6°C in winter to 21.1°C – 22.5°C in summer.

5.4.2 Rainfall

A graph displaying the median (5th decile) monthly rainfall at both the Tewantin (1996 – 2009) and Nambour (1952 – 2007) AWS is shown in **Figure 7**.

Figure 7 Median (5th decile) Monthly Rainfall Measurements, Tewantin and Nambour



The rainfall experienced at both Tewantin and Nambour can be described as moderate, with the area receiving, on average, between 1,260 mm and 1,320 mm per annum. It can be seen that rainfall is significantly lower between mid-winter to mid-spring than at any other time of the year.

Rainfall has a significant effect on the way in which particles behave in the atmosphere, and hence the way in which pollution is dispersed. When rainfall occurs, particulate matter is flushed out of the atmosphere quickly, thus reducing potential nuisance impacts, as well as those on health and visibility. Rainfall is also a determining factor in the amount of wind erosion occurring from exposed surfaces. From the data presented in **Figure 7**, it could be expected that the potential for wind erosion of dry surfaces is greater between July and September due to the lower expected rainfall.

6 POTENTIAL AIR QUALITY IMPACTS

6.1 Construction Air Quality Impacts

Construction air quality impacts will, in the most part, arise during clearing and earthmoving operations. The main impact is expected to be dust raised by direct mechanical action (e.g. digging, dozing, grading), by moving vehicles (e.g. spoil trucks) or wind. Very small quantities of gaseous air pollutants will be emitted from internal combustion engines of construction equipment.

Air pollutants associated with the project are mostly emitted during construction in the form of particulates, with minor contributions of carbon monoxide (CO) and nitrogen oxides (NOx) associated with fuel combustion from vehicles and plant.

During dry conditions, on-site construction activities have the potential to generate dust. The following activities are those identified as a specific potential source of dust generation as a result of construction works:

- Vegetation clearing.
- Earthmoving activities and excavation including construction of batters and stabilisation of earthworks.
- Movement of vehicles and construction machinery, both within and outside the construction site.
- Transport of construction materials, fill, rubble and waste.
- Stockpiling of materials.
- Build-up of material around erosion and sedimentation controls.
- Blasting in hard rock areas (if necessary) – see below.

Most of these activities will occur for a limited period at any location along the pipeline route. Construction activities will generally be of a low intensity. Earthworks over most of the pipeline length will be restricted primarily to trenching and filling activities. Equipment to be used on site will include excavators, cranes, tip trucks, backhoes, generators and compressors. Access to the pipeline will be via sealed and unsealed roads.

Micro Tunnelling

It is noted that longer term worksites may be required for micro tunnelling works depending on the selected alignment of the pipeline. From the proposed route options provided for the Project, micro tunnelling may be required at the following locations:

- at a number of crossings of the Bruce Highway;
- in regions of significant topography, in particular to the between Panorama Drive and Petrie Creek Road (east of Nambour) and east of Image Flat Road (northwest of Nambour); and
- where existing rail infrastructure is encountered, including at Duhs Road (north of Nambour) and between the Bruce Highway and Nambour North Connection Road (south of Yandina).

It should be noted that, however, as the micro tunnelling process is a completely underground activity, no significant air quality impacts are anticipated associated with such works. Extracted materials from the tunnelling process will be stockpiled at the tunnel portals, creating a potential source of emissions through wind erosion of particulate matter. Consequently, the modelling conducted for standard operations (**Section 7.3**) can also be applied to sections of micro tunnelling.

Blasting Works

Blasting of areas of hard-rock may be required adjacent to the Bruce Highway north of Eumundi-Kenilworth Road. In order to assess the potential impact on the area surrounding these blasting operations, a separate modelling scenario incorporating both standard and blasting-related activities has been developed for this assessment.

Construction activities will generally be of a low intensity. Earthworks over most of the pipeline length will be restricted primarily to trenching and filling activities. Equipment to be used on site will include excavators, cranes, tip trucks, backhoes, generators and compressors. Access to the pipeline will be by sealed and unsealed roads.

6.2 Operational Air Quality Impacts

During operation, potential air quality impacts from pipeline-related activities will be minimal, mainly relating to maintenance activities. Pumping will be undertaken by high-capacity, electrically operated pumps with no direct air emissions.

7 ATMOSPHERIC DISPERSION MODELLING

The impact of emissions from the Project was assessed using the Ausplume computer dispersion model developed by the Victorian EPA. This assessment involved earthwork activities being undertaken during construction of the pipeline.

7.1 Modelling Assumptions

The following assumptions have been made in the course of this modelling assessment:

- Hours of construction are assumed to be 7am to 6pm, or 11 operational hours, for all plant and equipment.
- Work is anticipated to be conducted within a corridor 30 m wide and 150 m long. Total area of disturbance at any one time is assumed to be 4500 m^2.
- It is assumed that there will be 30 haulage trucks servicing the site per day, removing excavated materials. Each truck is assumed to have a load capacity of 10 t. The daily throughput of excavated material is therefore assumed to be 300 t per day.
- A grader is to be employed and is assumed to operate at an average speed of 5 km/hour, accounting for stopping and starting associated with this process. Movement of the grader has been represented as a series of three volume sources with a spacing of 12.5 m.
- An unsealed haul route has been simulated, with a nominal length of 100 m extending out from the centre of the work site. Movement of haul trucks along this route represented by 4 volume sources with a spacing of 25 m.
- The movement of small private vehicles about the site has not been included in the modelling, as the associated particulate emissions are not anticipated to be significant.
- The emission rate for excavator operation accounts for the excavation of materials and loading of haul trucks. These two processes are assumed to occur in succession.
- An emission reduction factor of 50% associated with water spraying along the unsealed haul route has been applied.
- A representative surface roughness of 0.4 m was selected within the modelling, being representative of rolling rural conditions and areas with low vegetation. Irwin rural wind profile exponents were used.

- Background particulate environment has been established with reference to the data presented in **Section 4.2**.
- For the blasting scenario, the first four hours of an operational day are assumed to be drilling. Drilling is followed by one hour of blasting. Standard construction activities from the original scenario are maintained throughout the operational day.
- One blast is assumed per day. A blast area of 125 m is assumed.

7.2 Emission Rates

The emission rates used in the modelling assessment have been listed in **Table 5.** These emission rates have been calculated using assumptions detailed above and the relevant emission factor formulae listed in the National Pollutant Inventory document, *Emission Estimation Technique Manual for Mining, Version 2.3*, (Environment Australia, 2001) and USEPA AP-42 documents *13.2.2 Unpaved Roads* (USEPA, 2003) and *13.2.5 Industrial Wind Erosion* (USEPA, 2006).

Table 5 Estimated Particulate Emission Rates for "Worst Case" Construction Scenario

Source	Pollutant Emission Rate (mg/s)	
	PM_{10}	Total Suspended Particulate (TSP)
Wind erosion	0.023[1] (wind speeds 5.1-8.2 m/s) 0.46[1] (wind speeds 8.2-10.8 m/s)	0.059[1] (wind speeds 5.1-8.2 m/s) 1.16[1] (wind speeds 8.2-10.8 m/s)
Grading	2.95	6.60
Excavation/ loading	0.87	1.84
Truck movements	11.81	43.7
Drilling	344.44	655.56
Blasting	720.97	1386.48

Note 1 Emission rate is expressed as a flux in units of $mg/s/m^2$ as wind erosion has been modelled as area source.

7.3 Modelling Assessment

7.3.1 Emission Assessment – Standard Operations

The results of the modelling for incremental PM_{10} (24-hour and annual average) increase attributable to the project and cumulative impacts for standard construction operations are illustrated in **Figure 8, Figure 9, Figure 10** and **Figure 11** below. As discussed above, the modelling assumed that construction work would take place within a 150 m by 30 m area which would move progressively along the pipeline route. These contour plots therefore represent the maximum predicted impact from construction activities and provide an indicative "footprint" that could be applied to any given work site (excluding where blasting is to occur) along the route of the pipeline. The area source used in the model to represent the dust sources is shown in the figures as a blue rectangle, while the ground level pollutant concentrations (in $\mu g/m^3$) predicted by the model are shown as black contour lines. Areas of highest concentration are shaded green.

Figure 8 Predicted Worst-Case Incremental 24-hour Average PM_{10} (µg/m³) – Standard Operations

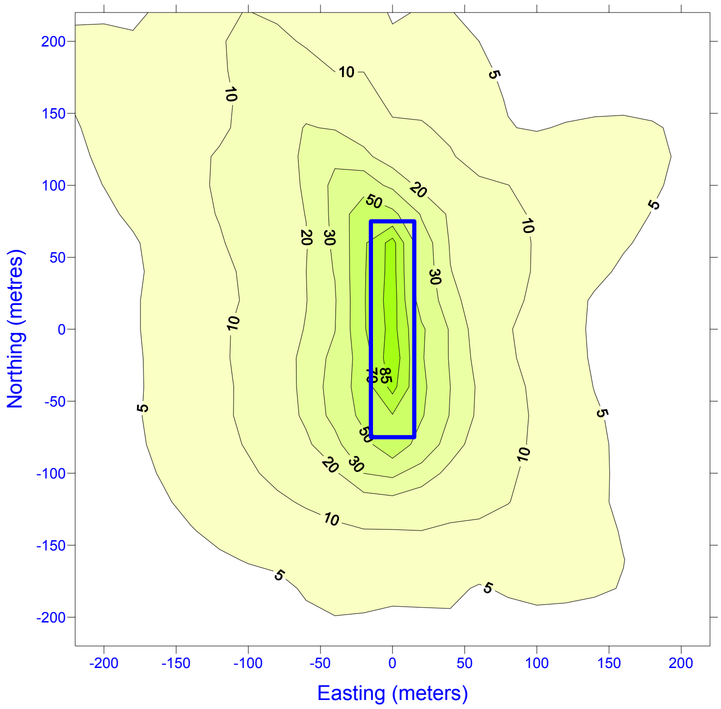
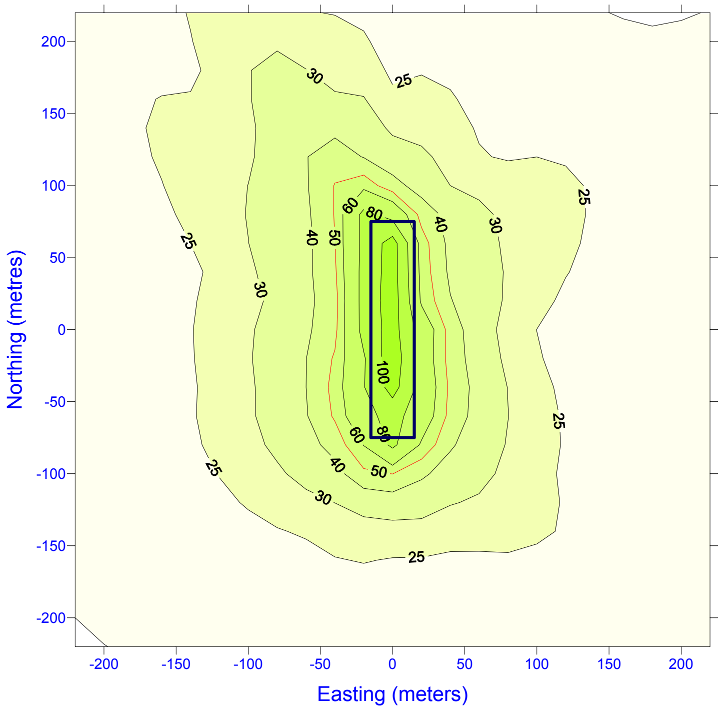


Figure 9 Predicted Worst-Case Cumulative 24-hour Average PM_{10} (µg/m³) – Standard Operations



Note 1 DERM Compliance Goal is 50 µg/m³ at a Sensitive Receptor.

Note 2 Assumed background level of 17.7 µg/m³ for 24-hour average PM_{10} concentration.

Figure 10 Predicted Incremental Annual Average PM_{10} ($\mu g/m^3$) – Standard Operations

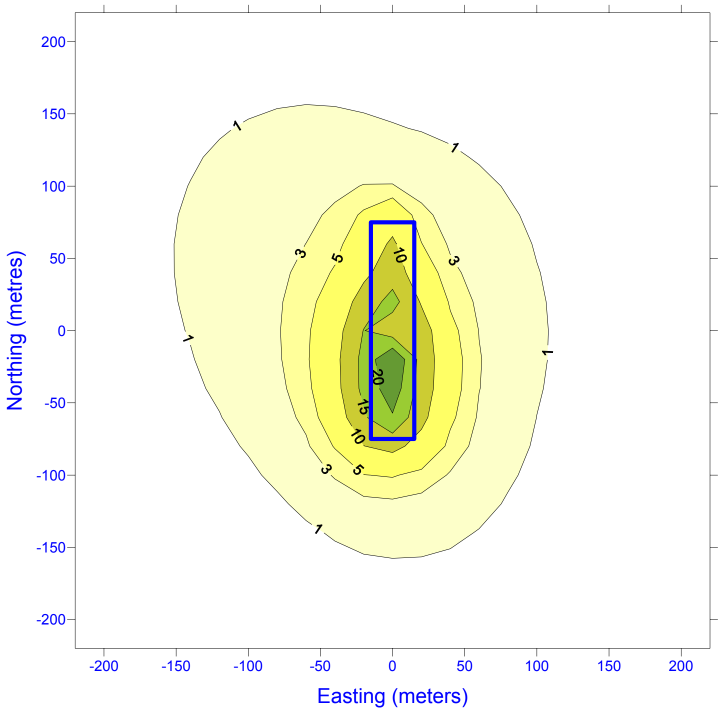
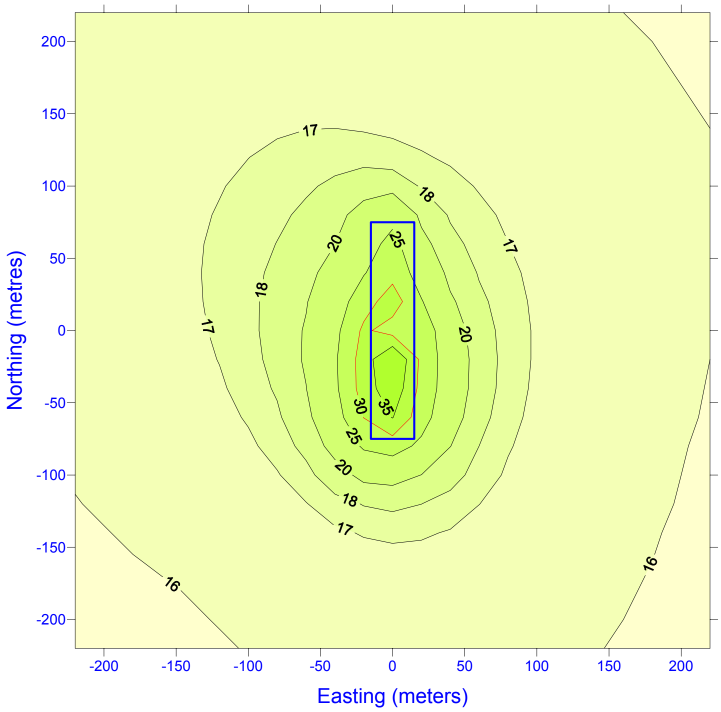


Figure 11 Predicted Cumulative Annual Average PM_{10} ($\mu g/m^3$) – Standard Operations

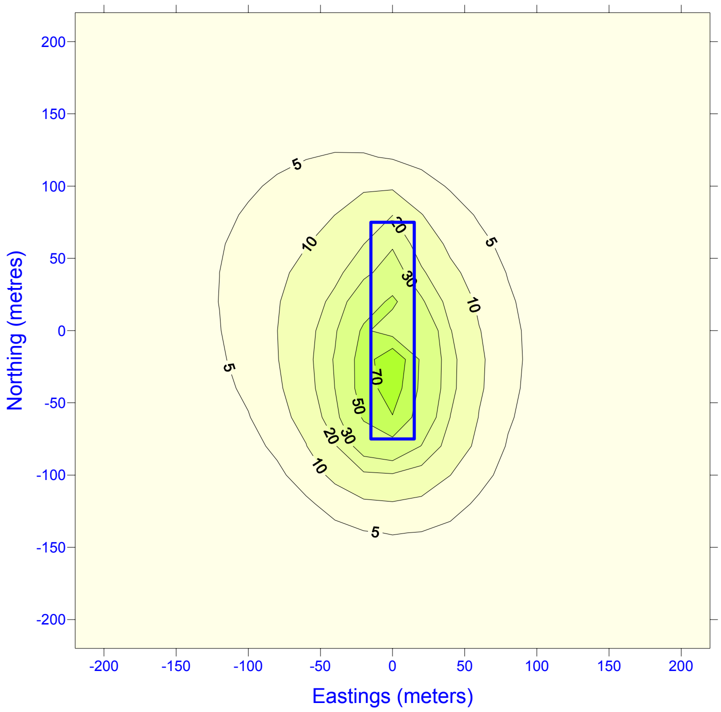


Note 1 NSW DECC Compliance Goal is 30 $\mu g/m^3$ at a Sensitive Receptor.

Note 2 Assumed background level of 15.7 $\mu g/m^3$ for annual average PM_{10} concentration.

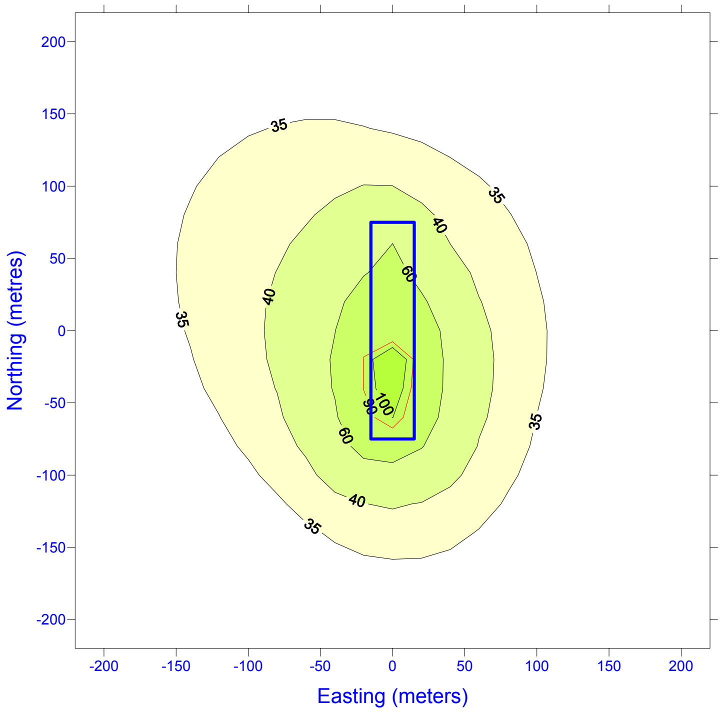
The results of the modelling for incremental TSP (annual average) increase attributable to the project and cumulative impacts for standard construction operations are illustrated in **Figure 12** and **Figure 13** below. These contour plots present the maximum predicted impact from construction activities and provide an indicative "footprint" that could be applied to any given work site, excluding where blasting is to occur, along the route of the pipeline.

Figure 12 Predicted Incremental Annual Average TSP (µg/m³) – Standard Operations



The results of the modelling for incremental monthly average dust deposition increase attributable to the project for standard construction operations are illustrated in **Figure 14**. These contour plots present the maximum predicted impact from construction activities and provide an indicative "footprint" that could be applied to any given work site, excluding where blasting is to occur, along the route of the pipeline.

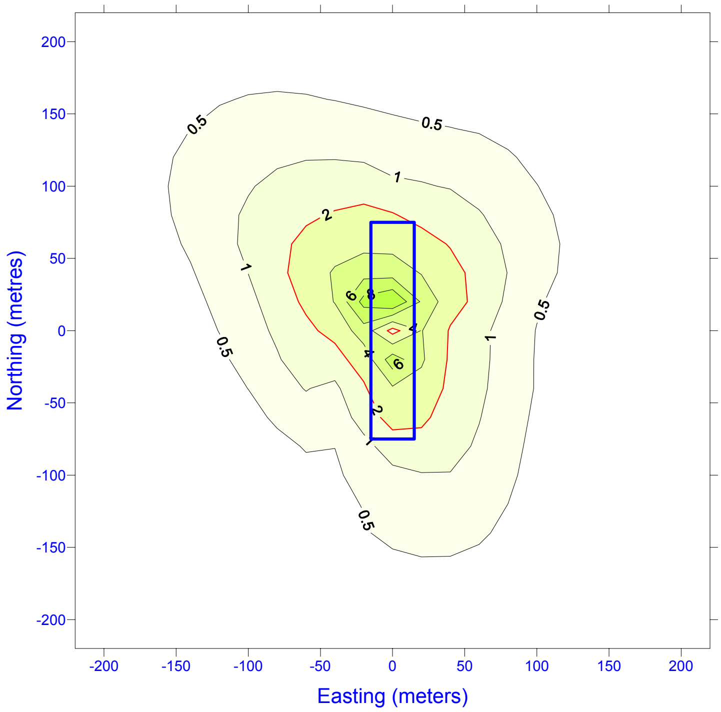
Figure 13 Predicted Cumulative Annual Average TSP (µg/m³) – Standard Operations



Note 1 DERM Compliance Goal is 90 µg/m³ at a Sensitive Receptor.

Note 2 Assumed background level of 31.5 µg/m³ for annual average TSP concentration.

Figure 14 Predicted Incremental Monthly Average Dust Deposition (g/m²/month/month) – Standard Operations



Note 1 DERM Compliance Goal is an incremental increase of 2 g/m²/month at a Sensitive Receptor.

7.3.2 Emission Assessment – Blasting Operations

The results of the modelling for incremental PM_{10} (24-hour and annual average) increase attributable to blasting construction operations and cumulative impacts (incremental impacts due to blasting operations plus background) for blasting construction operations are illustrated in **Figure 15, Figure 16, Figure 17,** and **Figure 18** below. These contour plots present the maximum predicted impact from construction activities and provide an indicative "footprint" that could be applied to worksites where blasting of hard-rock is required (i.e. Adjacent to the Bruce Highway north of Eumundi-Kenilworth Road).

Figure 15 Predicted Worst-Case Incremental 24-hour Average PM_{10} (µg/m³) – Blasting Operations

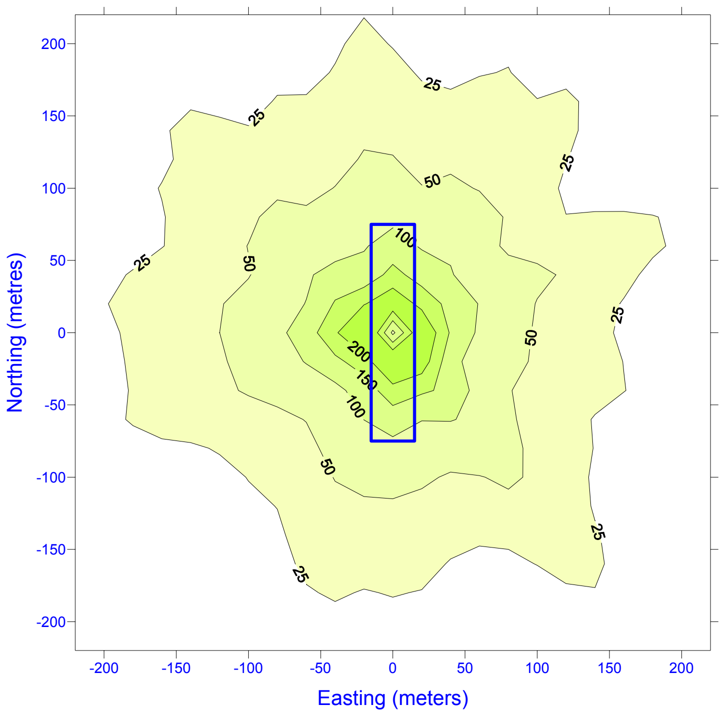
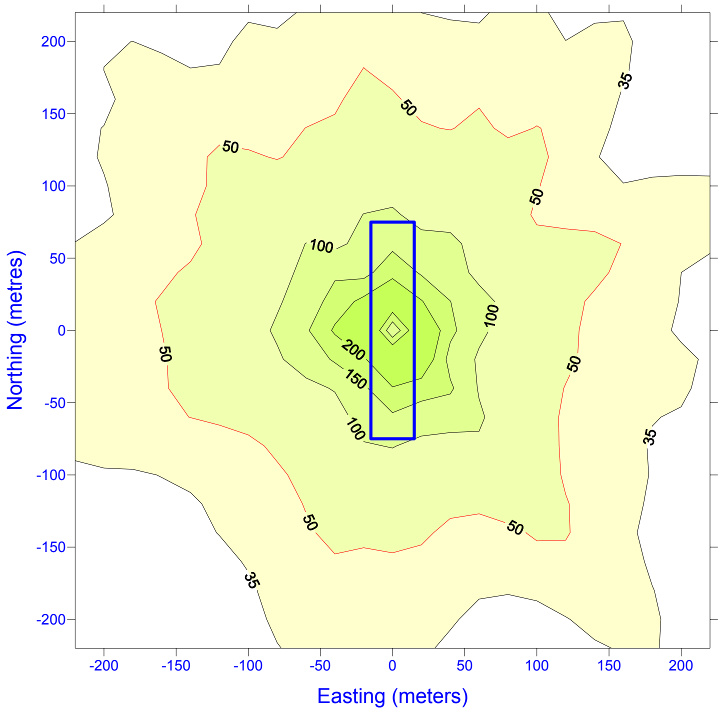


Figure 16 Predicted Worst-Case Cumulative 24-hour Average PM_{10} (µg/m³) – Blasting Operations



Note 1 DERM Compliance Goal is 50 µg/m³ at a Sensitive Receptor.

Note 2 Assumed background level of 17.7µg/m³ for 24-hour average PM_{10} concentration.

Figure 17 Predicted Incremental Annual Average PM_{10} (µg/m³) – Blasting Operations

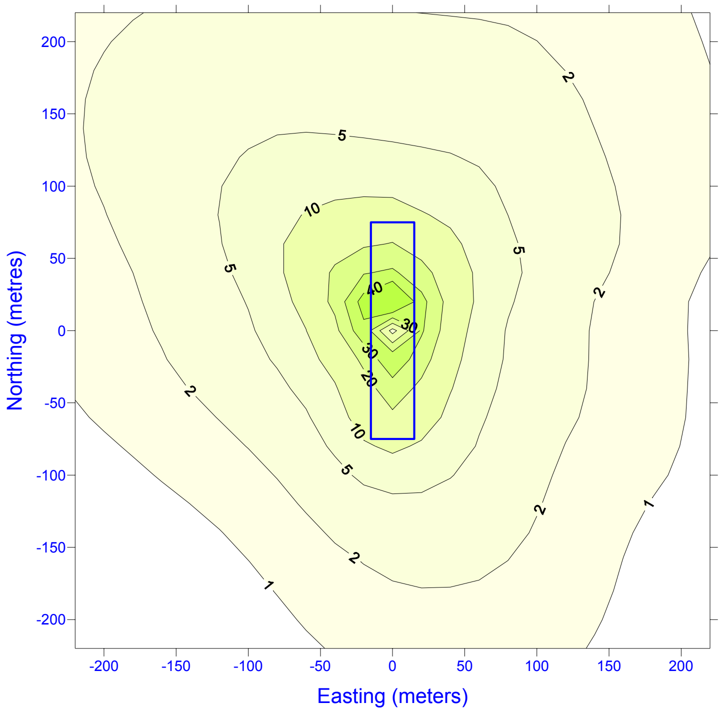
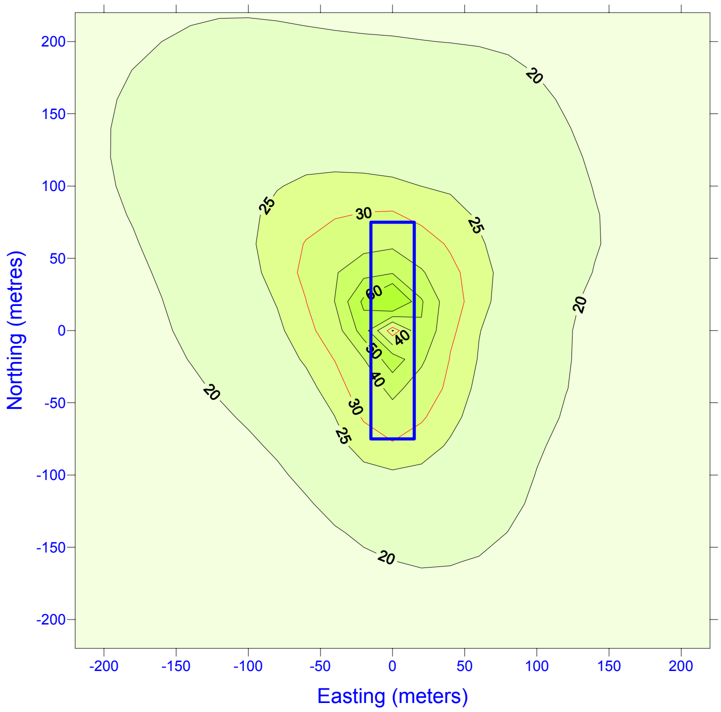


Figure 18 Predicted Cumulative Annual Average PM_{10} (µg/m³) – Blasting Operations



Note 1 NSW DECC Compliance Goal is 30 µg/m³ at a Sensitive Receptor.

Note 2 Assumed background level of 15.75 µg/m³ for annual average PM_{10} concentration.

The results of the modelling for incremental TSP (annual average) increase attributable to blasting construction operations and cumulative impacts (incremental impacts due to blasting operations plus background) for blasting construction operations are illustrated in **Figure 19** and **Figure 20** below. These contour plots present the maximum predicted impact from construction activities and provide an indicative "footprint" that could be applied to worksites where blasting of hard-rock is required (i.e. Adjacent to the Bruce Highway north of Eumundi-Kenilworth Road).

The results of the modelling for incremental monthly average dust deposition increase attributable to blasting construction operations are illustrated in **Figure 21**. These contour plots present the maximum predicted impact from construction activities and provide an indicative "footprint" that could be applied to worksites where blasting of hard-rock is required (i.e. Adjacent to the Bruce Highway north of Eumundi-Kenilworth Road).

Figure 19 Predicted Incremental Annual Average TSP (µg/m³) – Blasting Operations

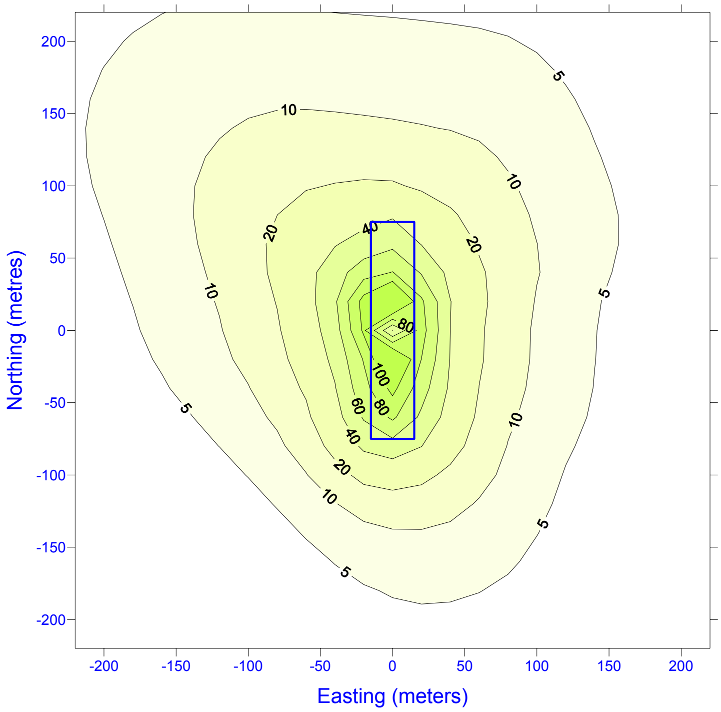
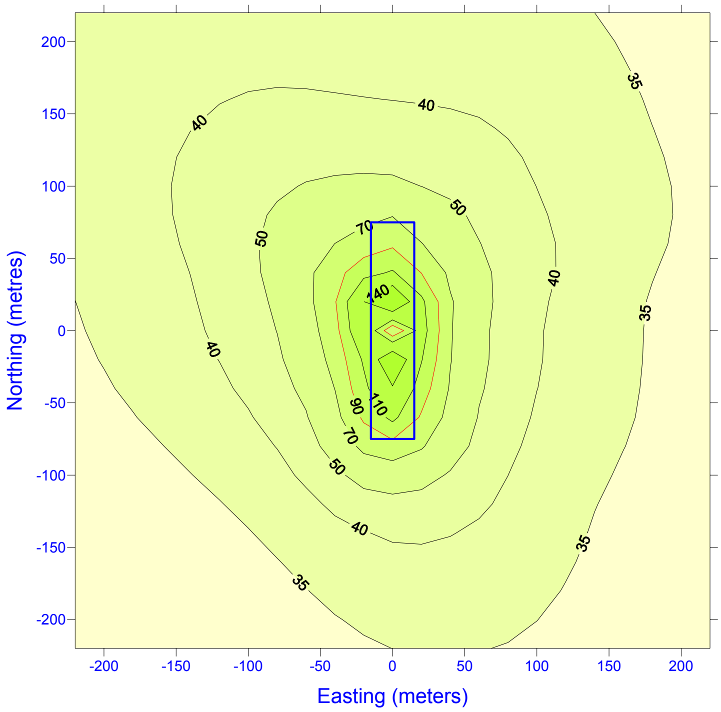


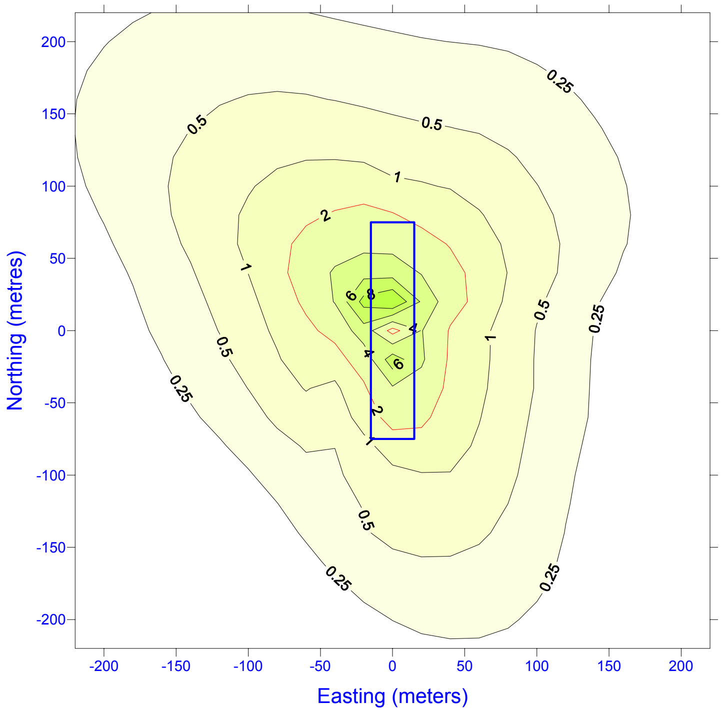
Figure 20 Predicted Cumulative Annual Average TSP (µg/m³) – Blasting Operations



Note 1 DERM Compliance Goal is 90 µg/m³ at a Sensitive Receptor

Note 2 Assumed background level of 131.5 µg/m³ for annual average TSP concentration.

Figure 21 Predicted Incremental Monthly Average Dust Deposition (g/m²/month) – Blasting Operations



Note 1 DERM Compliance Goal is an incremental increase of 2 g/m²/month at a Sensitive Receptor

7.4 Emission Assessment Conclusions

It can be seen from examination of the figures presented in **Section 7.3**, and comparison with the relevant project air quality goals, that minimal impact from particulate matter emissions are expected to be associated with works conducted along the pipeline.

Based on the result contours, **Table 6** presents the greatest distance that an exceedance of the relevant air quality goal occurs for standard construction operations and blasting operations.

Table 6 Emission Assessment Summary

Air Quality parameter	Project Goal	Distance of Exceedance of Project Goal	
		Standard Operations	Blasting Operations
PM_{10} 24-hour Average	50 µg/m^3	25 m to 30 m	140 m to 150 m
PM_{10} Annual Average	30 µg/m^3	10 m to 15 m	50 m to 55 m
TSP Annual Average	90 µg/m^3	20 m to 25 m	5 m to 10 m
Monthly Average Dust Deposition	2 g/m^2/month	55 m to 60 m	55 m to 60 m

Based on this modelling outcome, if any blasting work needs to be conducted within 140 m of a residential property, appropriate additional dust mitigation measures (e.g. optimising blasting conditions to minimise dust generation and avoiding blasting during unfavourable wind conditions) should be implemented to ensure that air quality impacts are appropriately managed.

It should be noted that the above analysis assumes that activities are undertaken at a constant rate and long-term emission factors have been used for estimation of sources such as wind-blown dust. The onus will be on operators to ensure that dust emission controls are applied appropriately and that attention is paid to the prevailing meteorology if activities are undertaken upwind of and in close proximity to sensitive receptors (residences, schools, hospitals and businesses etc.).

Impacts of air pollutants associated with fuel combustion (principally PM_{10}, NO_2, CO and unburnt hydrocarbons) would be expected to be minor. It is noted that the anticipated rate of truck movements is of the order of 30 haulage trucks servicing the site per day. Previous atmospheric dispersion modelling projects conducted by Heggies indicate that adverse air quality impacts associated with emissions from truck movements of this magnitude would be easily contained within the worksite boundaries. As such, no adverse air quality impacts from this source are anticipated at the nearest sensitive receptors. This is supported by ambient air quality monitoring (refer **Section 5.2**) which suggests that there is a capacity within the regional air shed for additional atmospheric emissions to occur without compromising air quality goals. Mobile equipment should be tuned and maintained in accordance with manufacturers' specifications to minimise emissions.

7.5 Greenhouse Gas Emissions

It is noted that operations relating to the construction and operation of the project have the potential to generate greenhouse gas emissions. Sources of greenhouse gases would be the combustion of diesel and other automotive fuel types for the construction phase and consumption of externally sourced electricity for the operational phase.

As the project is currently in planning phase, specific details relating to the amount of diesel fuel and electricity required for the construction and operational phases of the project respectively are yet to be finalised. It is recommended that once these figures are known, the greenhouse gas emissions for each phase are calculated in accordance with the relevant Australian Greenhouse Office methodologies.

It should be noted that the most significant project-related source of greenhouse gas emissions would likely be related to consumption of electricity during the operational phase. To that end, it is noted that a number of alternative energy sources are being considered for implementation with the project.

8 MITIGATION MEASURES AND SAFEGUARDS

8.1 Construction

Air quality management controls are recommended during construction to:

- Assist in ensuring that standards of air quality during the construction works comply with legislative guidelines, conditions of approval and other relevant Authority conditions; and
- Ensure that construction activities that have the potential to generate dust emissions, odours and gaseous emissions are controlled to avoid degradation of air quality, nuisance to adjoining properties, impacts on neighbouring amenity and health, and community complaints.

Recommended construction control measures include:

- The size of areas that require clearing should be kept a minimum, as much as practicable.
- Cleared areas should be revegetated as soon as practicable.
- Cleared vegetation should be chipped/mulched and used on cleared areas to minimise wind-generated dust.
- Temporary unsealed access roads and open areas should be watered when necessary to reduce dust generation.
- Wind breaks of earth banks and other temporary screens should be considered to reduce the capacity of the wind to raise dust from open areas.
- Ensure that the entire vehicle fleet (trucks, excavators, etc) is regularly serviced and maintained to minimise emissions.
- Truck wheel washes or other dust removal devices should be installed where necessary to minimise transport of dirt/dust offsite.
- All truck loads should be covered.
- Vehicle speeds on unsealed roads should be reduced when visible dust generation is noted.
- Construction activities upwind of and close to residences should cease or appropriate control measures be applied during periods of high wind.
- Stockpiles and exposed areas should be regularly watered.
- Construction equipment powered by internal combustion engines should be sited as far as practicable downwind from residences (see wind roses – **Appendix A**).
- Use of odorous chemicals and dusty or odour-generating construction or maintenance activities should be situated downwind of residences where possible.

8.2 Operational

Regular inspection of the project area should be undertaken to ensure that air pollutant emissions are minimised. This should include:

- Periodic inspection of cleared/rehabilitated areas to ensure that vehicle and wind-generated dust emissions are minimal.
- Maintenance any on-site equipment and pipeline maintenance equipment so that air pollutant emissions are minimised.

9 CONCLUSION

Heggies has been commissioned by NNA to update the air quality impact assessment associated with the construction and operation of Northern Pipeline Interconnector Stage 2 project.

Air pollutants relating to the proposed pipeline project that will potentially affect air quality are related primarily to construction activities. Emissions will mainly be in the form of dust raised by mechanical operations, transport activities and wind. Small quantities of gaseous pollutants will be emitted from internal combustion engines in construction equipment, but ambient concentrations of these substances should be low compared to relevant guidelines. Standard maintenance procedures, normal operational inspections and appropriate siting should be adequate to ensure that combustion products are not an issue for residents during construction.

The generation and impact of construction dust emissions will be minimised by use of appropriate management techniques, in particular the minimisation of cleared areas and the use of watering to bind the surface layer.

Air pollutant emissions during pipeline operation will be very low, mainly relating to maintenance activities. Inspections should be carried out on a regular basis to ensure that dust and odour emissions from sources along the pipeline corridor are minimal. Equipment used on the site will be appropriately operated and maintained to ensure that air pollutant emissions are minimised.

Dispersion modelling of particulate emissions estimated for the construction phase (standard operations only, i.e. no blasting) indicates that all relevant air quality guidelines should be complied with at distances beyond 60 m of the active work area. However, if any blasting work needs to be conducted within 140 m of a residential property, appropriate additional dust mitigation measures should be implemented to ensure that air quality impacts are appropriately managed.

10 REFERENCES

The following documents and resources have been used in the production of this report:

- Bureau of Meteorology, Historic Climate Data for Nambour and Tewantin AWS.
- Bureau of Meteorology, Hourly Weather Observations for 2008 from Nambour and Tewantin AWS.
- National Environment Protection Council (1998), National Environment Protection (Ambient Air Quality) Measure.
- NSW Department of Environment and Climate Change (2005), Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales.
- Queensland Department of Resource Management, Hourly monitoring data for NO_2 and PM_{10} from Mountain Creek Monitoring Station.
- Queensland Department of Resource Management, Environmental Protection (Air) Policy 2008.
- US Environmental Protection Agency (1998), Miscellaneous Sources, Unpaved Roads – Background Documentation, AP-42: Compilation of Air Pollutant Emission Factors, Fifth Edition. Chapter 13.2.2.
- US EPA (2003) Compilation of Air Pollutant Emission Factors AP-42 - Chapter 13.2.2 Unpaved Roads.
- US EPA (2006) Compilation of Air Pollutant Emission Factors AP-42 (Chapter 13, Section 13.2.5 Industrial Wind Erosion).

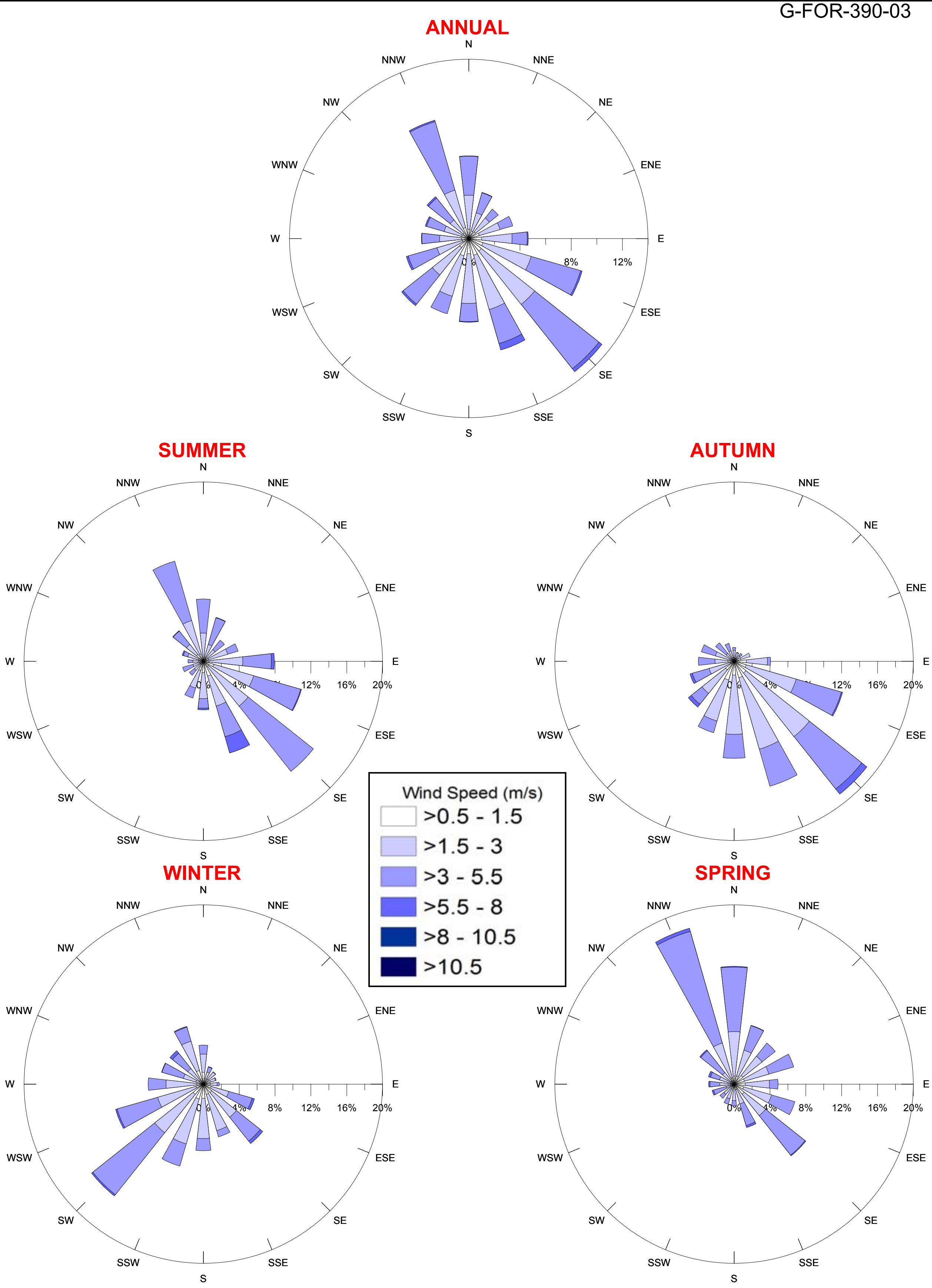
11 GLOSSARY OF TERMS, SYMBOLS AND ACRONYMS

AHD	Australian Height Datum
AWS	Automatic Weather Station
BoM	Bureau of Meteorology
CO	Carbon Monoxide
DERM	Department of Environment and Resource Management
EPP (AIR)	Environmental Protection (Air) Policy 2008
Heggies	Heggies Pty Ltd
HVAS	High Volume Air Sampler
mg	Milligram (g x 10^{-3})
µg	Microgram (g x 10^{-6})
m^3	Cubic meter
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NO_2	Nitrogen Dioxide
NO_X	Oxides of Nitrogen
NPI	Northern Pipeline Interconnector
Project	Northern Pipeline Interconnector project
PM_{10}	Particulate matter less than 10microns in aerodynamic diameter
pphm	Parts per hundred million
ppm	Parts per million
TAPM	“The Air Pollution Model”
TEOM	Tapered Element Oscillating Microbalance
TVOC	Total Volatile Organic Compounds
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds

Appendix A

Report 20-1873-R4

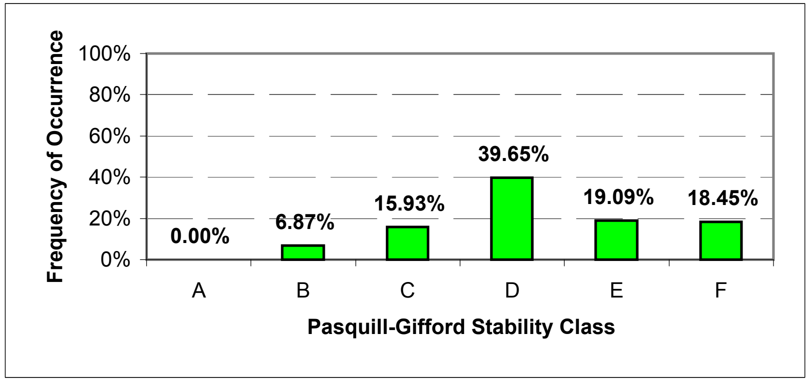
Annual and Seasonal Wind Rose –TAPM 2008



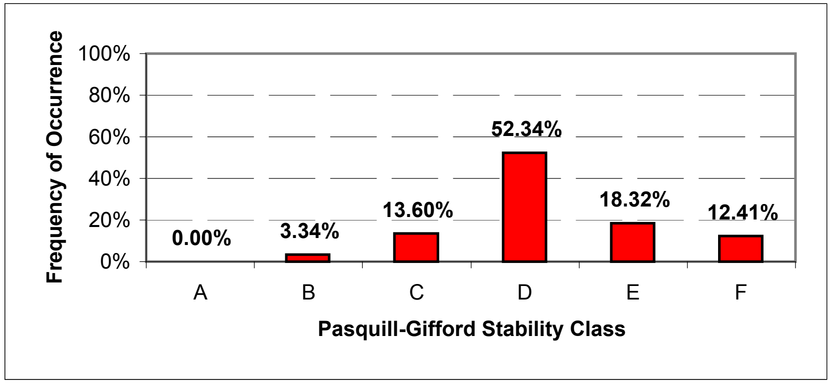
Heggies Australia Pty Ltd Consulting Engineers Level , 240 Waterworks Road Ashgrove QLD 4060 Australia Telephone +617 3858 4800 Facsimile +617 38584801 Email Brisbane@heggies.com.au	Designed by	Checked by	Approved by - date	Filename	Dated
	BB	SF	17-10-09	20-1873	17-10-09
	Appendix D: SEASONAL WINDROSE TAPM 2008				

Appendix B

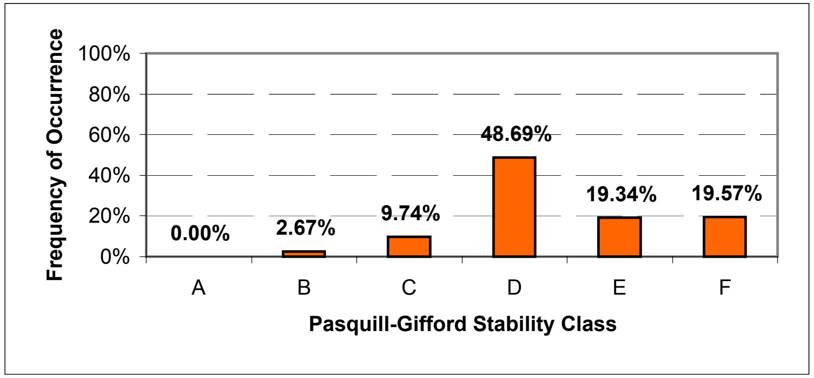
Seasonal Stability Class –TAPM 2008



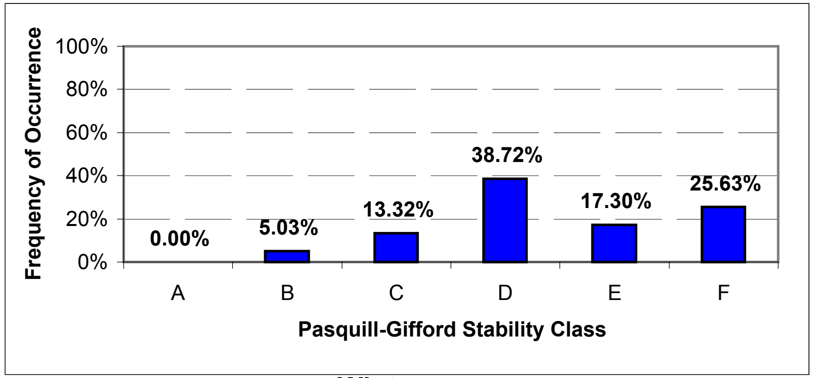
Spring



Summer



Autumn



Winter

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TAPM Predicted Seasonal Stability Classes Project Site 2008