Appendix H

Air quality impact assessment (GHD)

CLIENTS | PEOPLE | PERFORMANCE

Orange City Council

Macquarie River to Orange Pipeline Project

Air Quality Impact Assessment

July 2012

Revision 1

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

1. Introduction 1
   - 1.1 Purpose of this report 1
   - 1.2 Project overview 1
   - 1.3 The location of the project 2
   - 1.4 Scope and structure of report 2
2. Existing environment 3
   - 2.1 Ambient air quality 3
   - 2.2 Sensitive receivers 4
   - 2.3 Local meteorology 5
   - 2.4 Naturally occurring asbestos 8
3. Emissions inventory 9
   - 3.1 Description of construction activities 9
   - 3.2 Construction equipment 9
   - 3.3 Description of proposed maintenance operations 10
   - 3.4 Sources of dust emissions 10
   - 3.5 Vehicle and other exhaust emissions 11
   - 3.6 Adopted dust emission rates 11
4. Assessment criteria 14
5. Predicted impacts 15
   - 5.1 Dispersion modelling methodology 15
   - 5.2 The model 15
   - 5.3 Source characterisation 15
   - 5.4 Model configuration 16
   - 5.5 Predicted results 16
6. Dust mitigation 20
7. Conclusions 21
8. Limitations 22

Table Index

Table 3-1	Dust emissions inventory	13
Table 4-1	Assessment criteria for PM_{10} and TSP	14
Table 5-1	Wind erosion dust emission rates	16

Figure Index

Figure 2-1	PM_{10} daily averages 01 January 2012 to 01 January 2011 Bathurst airport	4
Figure 2-2	Monthly averages of maximum and minimum temperature at Orange Airport AWS	6
Figure 2-3	Monthly rainfall averages at Orange Airport AWS	6
Figure 2-4	Annual wind rose – Orange Airport 2010	7
Figure 2-5	Seasonal wind roses – Orange Airport 2010	8
Figure 5-1	Predicted dust impact contours – Indicative pipeline construction – Level 1 Haul Road watering	18
Figure 5-2	Predicted Dust Impact Contours – Indicative Pipeline Construction – Level 2 haul Road Watering	19

Appendices

A Pipeline Location

B Ausplume Output File

1. Introduction

1.1 Purpose of this report

Orange City Council proposes to undertake the Macquarie River to Orange pipeline project (referred to in this report as 'the project'). This report has been prepared to provide an assessment of the air quality impacts of the project as an input to the environmental assessment. The environmental assessment is being prepared in accordance with the requirements of Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

The environmental assessment addresses the requirements of the Director-General of the NSW Department of Planning and Infrastructure (the Director-General's Requirements) dated 24 March 2011. It is noted that the Director-General's Requirements did not specifically require an assessment of air quality impacts. This air quality study has been completed on request of Orange City Council.

As identified in the Preliminary Environmental Assessment (PEA) for the project[1], the primary emissions to air are likely to be dust emissions during construction works. Air quality impacts during the operation phase of the project are expected to be minimal and primarily be caused by limited maintenance activities.

1.2 Project overview

The project involves the construction and operation of infrastructure required to transfer approximately 12 ML/day of water a distance of approximately 37 km from the Macquarie River to the Suma Park Dam at Orange.

The infrastructure required to transfer the water includes intake and pump stations, an underground pipeline (approximately 37 km in length), an outlet structure, and ancillary infrastructure (power supply).

In summary, the project would involve construction and operation of the following infrastructure:

- 36 km of 375 mm diameter water rising main between the Macquarie River and Suma Park Dam.
- An offtake structure located at the upper Macquarie River.
- Two booster pump stations along the pipeline corridor.
- Power supply to pumps and other infrastructure.
- Telemetry controls to enable remote operation of the infrastructure including pumps and valves etc.
- An inlet structure at the Suma Park Dam.

[1] GHD Pty Ltd. Orange City Council, Orange Drought relief Connection preliminary Environmental Assessment, March 2011.

1.3 The location of the project

The proposed offtake point would be located north of Long Point on the upper Macquarie River.

The pipeline corridor is shown in Appendix A. The majority of the pipeline corridor is located in a rural area and includes road reserves such as Ophir Rd and Long Point Rd. In some areas the pipeline would need to cross private land. It is proposed that the majority of the pipeline would be underground and would not impact on farming or other land uses.

The majority of the pipeline would be located in the Cabonne local government area (LGA).

The pipeline would discharge to the inlet structure, located at the north of the Suma Park Dam.

1.4 Scope and structure of report

1.4.1 Scope of report

The following scope of work was undertaken as part of the air quality impact assessment:

- A gap analysis on available information and identify strategies to overcome any shortfall (if any).
- A definition of the climatic features of the area along the pipeline corridor.
- Describe the existing ambient air quality conditions near the pipeline corridor.
- Identify potential sources of air emissions associated with the pipeline construction in order to generate a dust emissions inventory.
- Assess the potential for dust generation associated with the pipeline construction, as well as its impact on the local residents using the Approved Modelling Methods for Air Quality Assessments in New South Wales (DEC 2005).
- Discuss any potential health impacts on the local community from the pipeline construction.
- Identify and discuss operational air quality impacts.
- Identify control measures required to minimise and/or control air emissions for the pipeline construction.

1.4.2 Structure of the report

Section 2 of this report explains the existing environment in the area of which the project is set. The report then goes on to discuss the primary sources of emissions to air (Section 3) and outline the target air quality criteria for projects in NSW (Section 4). The predicted impacts on air quality are discussed in Section 5, along with recommendations to reduce air quality impacts in Section 6.

2. Existing environment

2.1 Ambient air quality

National State of the Environment reporting[2] states: “In rural and regional Australia, levels of most pollutants are well below actual or proposed standards”. Outside urban areas, dust and other fine particulate matter is the greatest threat to ambient air quality. Construction of the pipeline may create dust but other pollutant issues will be localised.

At the time of this assessment there was no site specific ambient air quality information available for the proposed project site. The nearest ambient air quality monitoring station is located at Bathurst Airport, approximately 60 km west of the site. This monitoring station is operated by the New South Wales Government Office of Environment and Heritage (OEH). Despite the distance between these two locations, the ambient air quality at Bathurst Airport was considered to be a reasonable representation of the ambient quality at the project site with both Bathurst and Orange being in the Central Tablelands.

Ambient dust levels for Bathurst Airport were obtained from the OEH Air Quality Data website[3] for the year 2010. The ambient PM_{10} 24-hour measured at Bathurst Airport during 2010 is summarised in Figure 2-1. The maximum and average 24-hour concentrations over the year were 43 $\mu g/m^3$ and 9 $\mu g/m^3$ respectively (NSW criteria 50 $\mu g/m^3$). The annual average is 16 $\mu g/m^3$ (NSW criteria 30 $\mu g/m^3$). Based on the above data and due to the small population density and distance from major airsheds (containing urbanised or industrial concentrated air pollution sources) a concentration level of 20 $\mu g/m^3$ has been adopted as a conservative estimate of the ambient dust levels in the project area at any one time.

[2] [2] SoE 2006. Australia State of the Environment 2006, *Independent report to the Australian Government Minister for the Environment and Heritage*, Beeton RJS (Bob), Buckley Kristal I, Jones Gary J, Morgan Denise, Reichelt Russell E, Trewin Dennis (2006 Australian State of the Environment Committee), 2006. http://www.environment.gov.au/soe/2006/publications/report/atmosphere-2.html#ambient

[3] http://www.environment.nsw.gov.au/aqms/index.htm

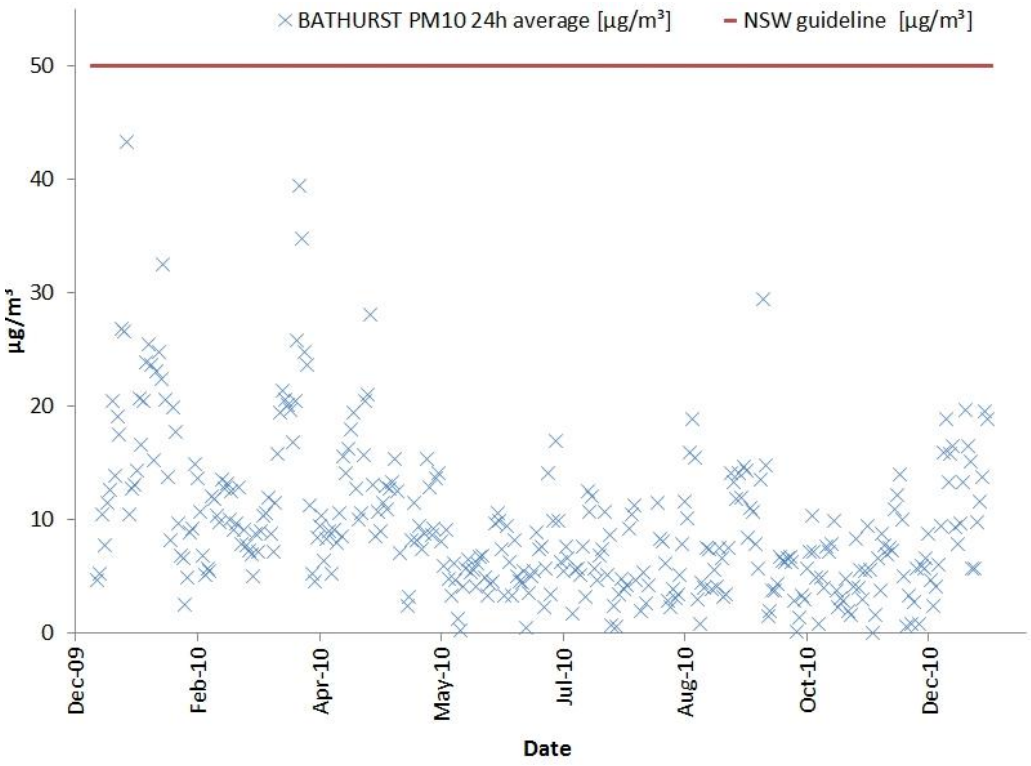


Figure 2-1 PM_{10} daily averages 01 January 2012 to 01 January 2011 Bathurst airport

2.2 Sensitive receivers

Residential premises, schools, sports grounds, medical clinics, hospitals, wetlands and some flora are considered to be sensitive locations in regards to health and amenity impacts due to dust.

The landscape along the pipeline alignment is predominantly agricultural with rural and isolated residential properties. The proposed pipeline alignment is generally located more than 100 m from residential dwellings, however will pass within 50 m of dwellings in areas such as Oakey Lane and along Ophir Road.

Apart from the construction of the pump stations and any lay down areas, the emission sources will not be static but will migrate along the pipeline alignment during the construction period. Hence, any given receptor near the pipeline will only be in the vicinity of construction emissions for a short time (typically in the order of just a few days, although in the order of a limited number of weeks between land clearing and final rehabilitation).

With regards to dust impacts, it is not expected that the proximity or density of sensitive receivers within the pipeline corridor will be a major factor in defining the alignment, as:

- Construction operations will only be proximate for a relatively short amount of time.
- The civil works at the pumps stations and RWTP are of a small scale with significant buffer to sensitive receivers.
- Appropriate management measures, as simple as watering access tracks, can effectively mitigate the impacts of dust generated during construction.

2.3 Local meteorology

The transport and dispersion of air emissions from the project site will be influenced by the rain and wind climate experienced at the site. Meteorological records from the Bureau of Meteorology's (BOM) Automatic Weather Station (AWS) at Orange Airport were used to characterise the transport and dispersion of emissions from the construction area along the pipeline corridor.

The regional climate is discussed below with a particular focus on the typical distribution of wind speed and wind direction which may highlight key issues in regard to construction dust dispersion from source to receptor impacts.

According to the BOM[4] the major classification of the climate in this region is "temperate", characterised by:

- Average temperatures of approximately 18º C, in the summer months (December to February).
- Average temperatures of approximately 6º C, in the coldest months (June to August).
- Relatively uniform rainfall throughout the year with the driest months of the year still receiving, on average, greater than 35 mm of rainfall.

The above characteristics are illustrated in Figure 2-2 and Figure 2-3.

[4] Bureau of |Meteorology 2011, Australia Climate of our Continent, Commonwealth of Australia, http://www.bom.gov.au/lam/climate/levelthree/ausclim/zones.htm#one

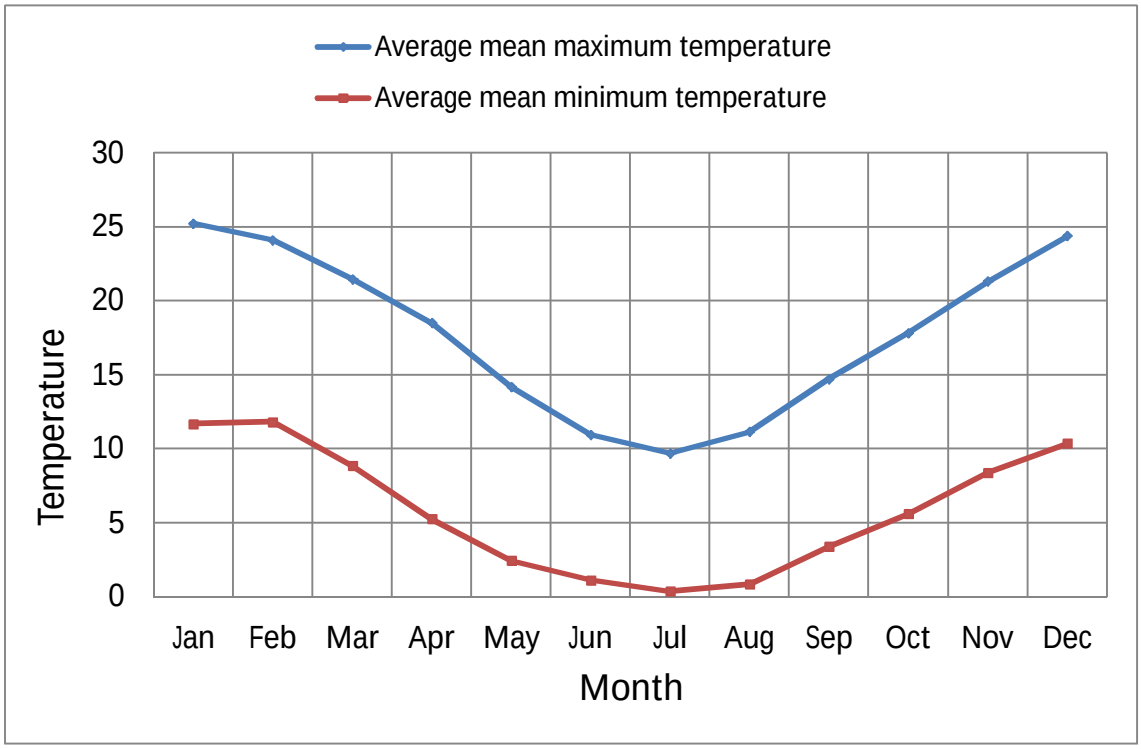


Figure 2-2 Monthly averages of maximum and minimum temperature at Orange Airport AWS

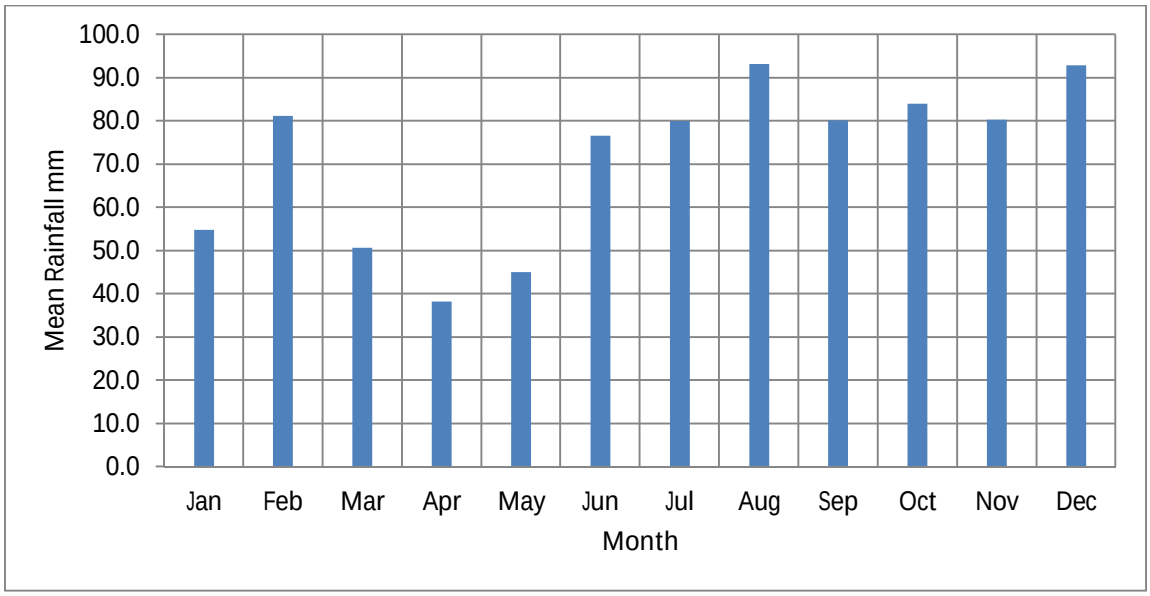


Figure 2-3 Monthly rainfall averages at Orange Airport AWS

2.3.1 Dispersion meteorology

Typical temperate conditions for wind over the project site can be seen in the climate data for Orange. The average wind speed for Orange Airport in 2010 was 4.34 m/s. The average wind speeds across the four seasons are reasonably consistent.

The annual wind rose for Orange Airport is shown in Figure 2-4. Seasonal wind roses are shown in Figure 2-5. Predominant wind directions are from the north-northwest, west-southwest and east-northeast. This data was processed into a format for use with atmospheric dispersion modelling.

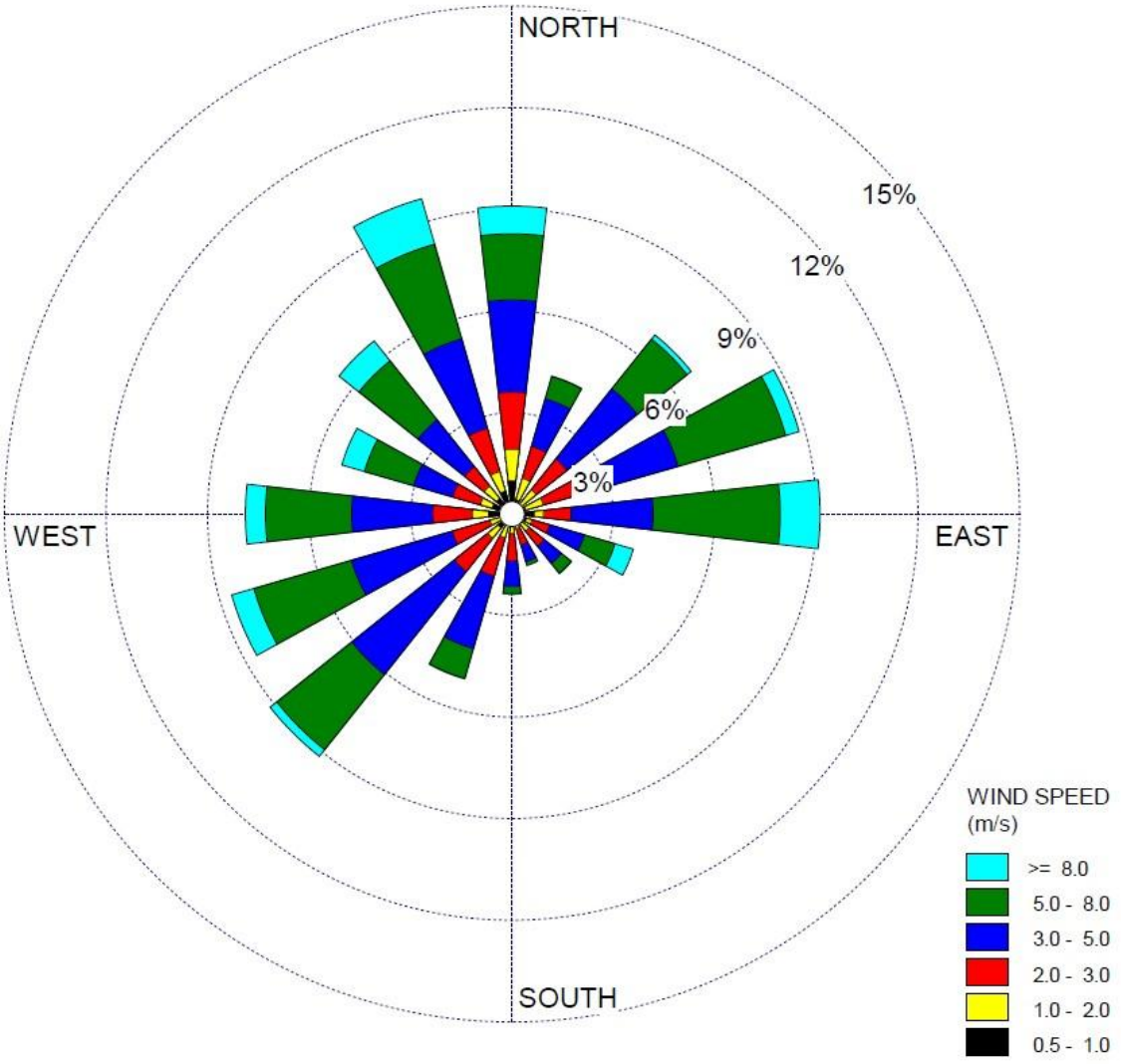


Figure 2-4 Annual wind rose – Orange Airport 2010

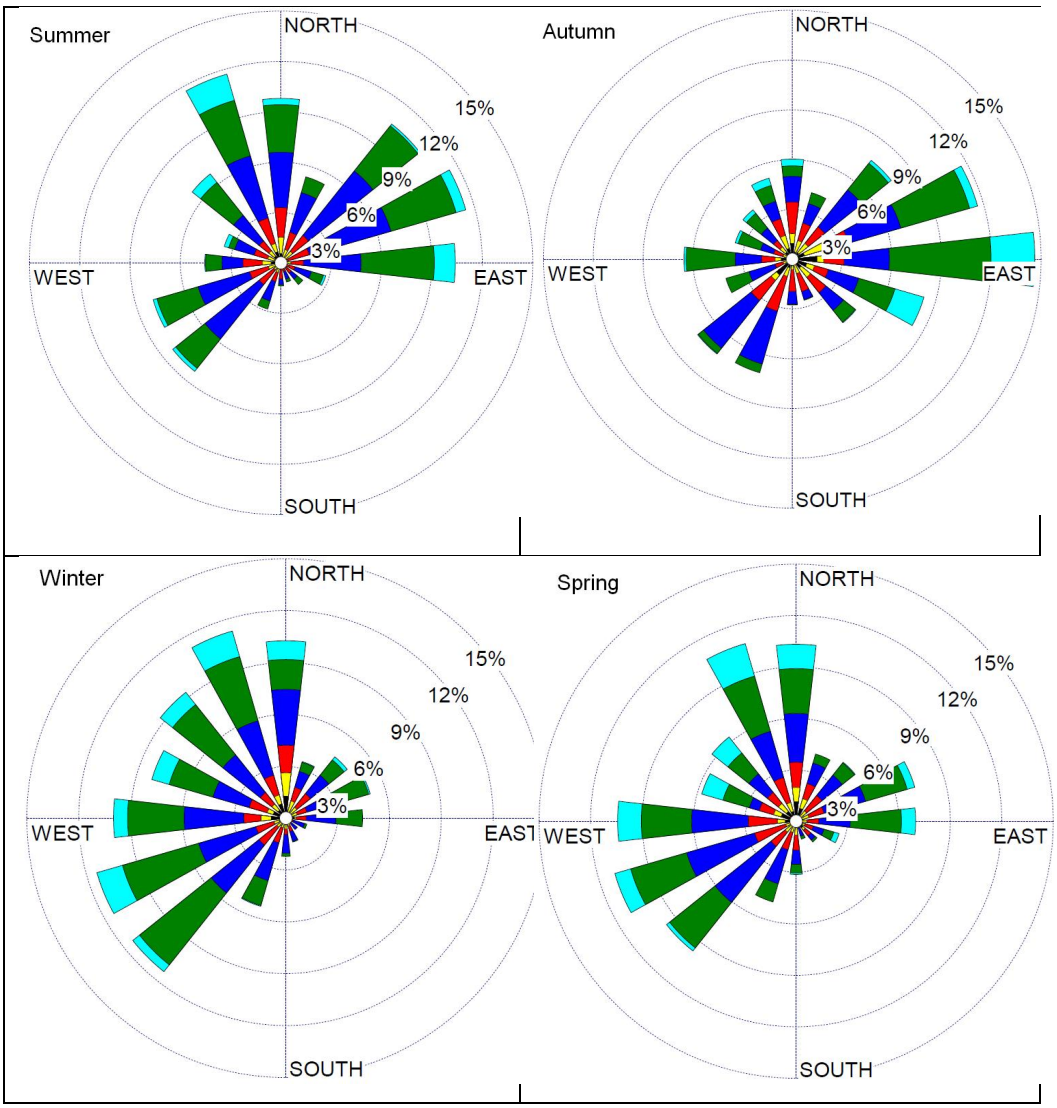


Figure 2-5 Seasonal wind roses – Orange Airport 2010

2.4 Naturally occurring asbestos

The preliminary contamination investigation report completed for the project[5] has identified Naturally Occurring Asbestos (NOA) at sections of the pipeline corridor. NOA was observed on the soil surface between pipeline chainages 34680 and 34750. NOA is also expected to occur in the subsoil between chainages 34600 and 34950.

[5] Envirowest Consulting Pty Ltd, Preliminary contamination investigation, Orange Drought Relief Connection Pipeline. Prepared for GHD Pty Ltd, 23 December 2011.

3. Emissions inventory

3.1 Description of construction activities

Pipeline construction activities will be limited to a 37 km long construction footprint, between 4 to 20 m wide. The area that would be directly impacted upon by construction activities would range in width, depending on a range of factors considered that include occurrences of critical habitats for endangered species and communities, vegetation sensitivity and quality, constructability, construction management and safety considerations, land form, slopes and anticipated sub-soil structures. The construction corridor would typically include a trenching zone of five metres, an excavator working zone of five metres, and a 10 metre vehicle access and stockpiling zone. An easement parallel to the pipeline will also be maintained for future maintenance. The trench may be up to 1.2 to 2 m deep and 1 m wide, suitable for a nominal 375 mm diameter pipe.

A hydraulic rock breaker, mounted on an excavator, would be used to excavate rock where required. Sand or crushed rock would be used as bedding material at the bottom of the trench, and surrounding the pipe. Excavated material would be stockpiled and re-used as far as possible as backfill above the pipe. Any excess cut material would be removed from the construction site by a single haul truck and transported to an approved stockpile location. *In situ* ground boring operations may also be required in some sections of pipeline construction. Boring would be undertaken using horizontal directional drilling (HDD).

Once a section of the pipeline has been laid, the area of disturbed soil would be levelled, cultivated and seeded – or treated as per landowner requirements. For any given segment of the pipeline alignment, the trench will only be 'open' for approximately one day; it may take up to a few days to a month from the time of initial clearing to pipe laying and final reinstatement. It is estimated at this stage that the total time for pipeline construction would be around 6 - 12 months.

A pump station and offtake structure would be constructed at the Upper Macquarie River as well as two booster pump stations along the pipeline corridor. An inlet structure is also required to be constructed at the Suma Park Dam.

3.2 Construction equipment

Typical construction and administrative vehicles associated with the pipeline construction are expected to comprise:

- Excavators.
- 'Franna' crane.
- Water carts.
- HDD machine and HDD truck.
- Tipper dump truck.
- Grader.

Six construction teams (three for the pipeline and one each for the pump stations, break tanks and power supply) will operate six days per week with operating hours between 7:00 am to 6:00 pm on weekdays and 8:00 am to 1:00 pm on Saturday. It is expected that the pipe will be laid at a rate of 150 - 400 m per day. On this basis, an individual locality along the pipeline alignment could expect to have a construction team nearby for less than one week. The pipeline laying process is expected to take 12 months.

3.3 Description of proposed maintenance operations

After construction of the pipeline, testing would take place before commissioning. Subsequent to testing and commissioning, it is not expected that routine maintenance would be required for many years. Maintenance crews may need to traverse unsealed access roads and the easement but this is expected to be so infrequent that it can be ignored for a dust impact assessment.

3.4 Sources of dust emissions

This assessment focuses on the air quality impacts associated with dust, as it is expected that dust (total suspended particles (TSP)) and fine particulate matter less than 10 microns in equivalent aerodynamic diameter (PM_{10}) will be the primary emission to air generated during the construction and ongoing maintenance of the pipeline.

The individual processes that generate significant amounts of particulate matter (dust) were identified to be:

- Mechanical disturbance: dust emissions brought about by the operation of construction and maintenance vehicles and equipment.
- Wind erosion: dust emissions from exposed, disturbed soil surfaces under high wind speeds during construction.

The potential for exposure to dust emissions is dependent on the intensity of construction and maintenance operations (i.e. the amount of dust generated) and the duration and frequency of the operations in any given locality. For this reason it is necessary to define the expected construction process and any plans for ongoing maintenance, including:

- Details of project sequencing and timelines.
- Vehicle and plant type.
- Movement patterns and shift timing.

Dust emission sources to consider are:

- Excavation of the trench.
- Handling and localised stockpiling of topsoil, and spoil.
- Pneumatic rock-breaking, where required.
- Removal and transport from site of spoil and rock.

- Delivery to site and infill of bedding and fill material.
- Levelling and rehabilitation of disturbed soil surfaces.
- Passage of construction and administrative vehicles over unsealed sections of road or localised unconsolidated soil surfaces.
- Wind erosion of exposed unstable soil surfaces and localised stockpiles.

3.5 Vehicle and other exhaust emissions

Vehicle exhaust emissions during the construction phase have the potential to impact on air quality; however the impact is likely to be negligible given the limited amount of equipment, distance to receptors and the short-term construction period at any one location.

All construction and administrative vehicles are expected to be maintained in a serviceable condition such that exhaust emissions are reduced to manufacturer specified levels.

3.6 Adopted dust emission rates

An emissions inventory for the identified dust sources was derived based upon wind erosion and mechanically induced sources of dust. The derived emissions rates are characterised using emissions factors published in the National pollutant Inventory (NPI) Emission Estimation Technique Manual (EETM) for Mining V 3.0, June 2011.

In all cases the reasonable worst-case scenario was used for calculating dust emission rates so that real life dust emissions are unlikely to exceed those predicted by the model. Default silt content of 10% and moisture content of 2% were assumed.

The worst case modelling was taken to be concurrent emissions from the following operations:

- Construction activities occurring from 7.00 am to 6.00 pm on every day.
- An excavator in continuous operation.
- A grader in continuous operation.
- A haul truck in continuous operation.
- A 4WD administration vehicle in continuous operation.
- Exposed surface area of 500 m x 20 m.

The following assumptions were made in calculating the emission rates for construction activities:

- *Excavator* – the excavator was used in digging the trench and occasionally loading the hall truck with a total soil movement rate of 50 tonnes per hour.
- *Grader* – the grader was modelled as an individual source of wheel-generated dust calculated using the default emission factor. The maximum length of the site was taken as 500 metres, and the grader was modelled as traversing this distance four times an hour.
- *Haul truck* – a haul truck was assumed to traverse the site four times an hour making the total distance travelled 2 km. In reality the truck is unlikely to travel this much although two return trips in any given construction hour is possible.

- *4WD* – a 4WD (site supervisor and general non – haul activity) was also modelled traversing the site four times per hour at the site speed limit of 15 km per hour.
- *Wind Erosion* – Wind erosion was modelled as acting over an exposed surface area of 500 m x 20 m. Stockpiles were included in the calculation of exposed areas. Wind erosion was modelled to occur only during periods of high wind speed. Wind speed profiles were derived from the Orange Airport meteorological data file produced by GHD using BOM data (refer to Section 2.3).

Table 3-1 summarises the NPI emission factors and calculated emission rates for each item of equipment and activity within the construction area. The default emission rates used to derive the values in Table 3-1 assume dry conditions; however a water cart is proposed to be used to mitigate dust generation. Water use at the rate of 2.0 l/hour/m^2 on haul roads can reduce emissions from the haul truck, grader and 4WD by 50%. Therefore, with consideration to the NPI, a 50% control factor has been applied to these sources. As wind erosion occurs continuously throughout the day, no watering mitigation was considered for exposed surfaces.

Table 3-1 Dust emissions inventory

Location	Equipment	TSP Emission Factor	PM_{10} Emission Factor	Units	Assumptions	TSP Emission Rate (kg/hr)	PM_{10} Emission rate (kg/hr)
Work Area	Excavator	0.025	0.012	kg/t	• Soil movement rate = 50 tonnes /hr.	1.25	0.6
Work Area	Grader	0.19	0.085	kg/VKT [1]	• Traverses 2 km/hr. • 50% control factor for watering	0.19	0.085
Haul roads	Haul Truck	4.08	1.24	kg/VKT	• 1 haul truck • Traverses 2 km/hr. • 50% control factor for Level 1 watering (2 litres/m^2/hr)	4.08	1.24
Haul roads	4WD	0.94	0.33	kg/VKT	• 1 4WD carries out 4 movements @ 500 m per hour • 50% control factor for watering	0.94	0.33
Erosion	Exposed Areas	0.4	0.2	kg/Ha/hr.	• Exposed surface area 500 m x 20 m = 10,000 m^2 = 1 Ha	0.4	0.2

1. VKT – Vehicle Kilometres Travelled

4. Assessment criteria

Generally, construction activities of this nature are similar to farming activity and are not directly regulated or controlled. It is usually the role of a local government to control nuisance dust from construction (residential development for example) activity. However, NSW guidelines set out applicable dust mitigation and management measures and can be used in this project as a guide for best practice to minimise off-site impact.

Dust impact assessment criteria for PM_{10} and TSP are prescribed within the *Approved methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DECC, August 2005). These criteria are based on a 24-hour average (PM_{10}) or annual average (PM_{10} and TSP), and are required to be met at the nearest or likely future off-site sensitive receptor. These levels are provided as cumulative dust impacts, where the predicted incremental impact from the project is added to the adopted background dust levels.

As the pipeline construction will be transient in nature and will only expose individual receptors for a short period of time (likely to be in the order of a few days), the annual average criteria are not appropriate for this assessment. Similarly, the dust deposition criteria are derived from the monthly average over 12 months. Therefore, only the PM_{10} 24-hour criteria will be used for this assessment.

Table 4-1 summarises the *Approved Methods* air quality goals.

Table 4-1 Assessment criteria for PM_{10} and TSP

Pollutant	Averaging Period	Criteria
PM_{10}	24 hours	50 μg/m^3
	Annual	30 μg/m^3
TSP	Annual	90 μg/m^3
Dust deposition	Annual	2 g/m^2/month* 4 g/m^2/month **

**Maximum increase in deposited dust level*

***Maximum total deposited dust level*

The *Approved Methods* also provides an impact assessment criterion for asbestos of 0.18 mg/m^3, based on a 1-hour averaging period. However, a quantitative assessment of impacts from NOA has not been undertaken as part of this assessment.

5. Predicted impacts

5.1 Dispersion modelling methodology

Atmospheric dispersion modelling has been undertaken in order to identify the worst case conditions and to give an indication of the radius of influence from construction activities to potential sensitive receptors.

The model results are presented as contours of predicted ground level particulate concentration. These results were used to determine the maximum predicted construction activity impact on the surrounding residences as an indicative “foot-print” that can be moved along the pipeline alignment as construction proceeds.

Dispersion modelling of emissions to air requires the selection of an appropriate model. Further inputs required for the model include:

- Site representative meteorological data for a period not less than one year. The data used for this assessment is discussed in Section 2.3.
- Source characterisation, which includes dust emission sources, an emission rate inventory and source geometry.
- Model configuration, in which various model settings are selected to best characterise the physical processes specific to the site and make the best use of the available data.

5.2 The model

Ausplume version 6.0 is a regulatory approved dispersion model[6] and was used in this assessment.

5.3 Source characterisation

The dust emission sources considered for this assessment are detailed below.

5.3.1 Mobile and fixed plant

Processing and mobile equipment, such as the excavator, grader, haul truck and 4WD have been modelled as individual ‘volume’ sources using the corresponding emission rates and characteristics presented in Table 3-1.

5.3.2 Wind erosion

Wind erosion was modelled as an area source over an exposed surface are of 500 m x 20 m. The dust emission rates associated with wind erosion are shown in Table 3-1. Dust emission rates were set for each wind speed category proportional to the wind speed cubed as shown in Table 5-1.

[6] AUSPLUME - air modelling software for industry, http://www.epa.vic.gov.au/air/epa/ausplume-pub391.asp

Table 5-1 Wind erosion dust emission rates

Wind Speed Category (m/s)	Specific TSP Emission Rate ($kg/hr/m^2$)	Specific PM_{10} Emission Rate ($kg/hr/m^2$)
> 10.80	0.00024	0.00012
8.24 > 10.80	0.00012	0.00006
5.15 > 8.23	0.000041	0.000021
3.10 > 5.14	0.000010	0.000005
1.55 > 3.09	0.0000021	0.0000011
0 > 1.54	0	0

5.4 Model configuration

The key components of the Ausplume model configuration used in this assessment are:

- Ground level concentrations (GLC) were predicted over a 1 km x 1 km receptor grid, with a grid resolution of 50 m.
- As a conservative measure, dry depletion was not selected for PM_{10} model runs.

Further detail concerning the Ausplume configuration can be found in the sample Ausplume output file in Appendix B.

5.5 Predicted results

The mechanical operation of handling spoil is a source of dust emissions. Dust generation behind vehicles also results in a dust plume with initial dimensions approximately equal to twice the vehicle height and vehicle width. Light winds disperse the dusty material downwind but with greater concentrations than with stronger winds.

The results of the screening dispersion modelling based on meteorological data recorded in Orange during 2010 are shown in Figure 5-1 and Figure 5-2. Note that a nominal pipeline alignment of north-to-south was assumed (these are more frequent than east-to-west alignments). The construction area and equipment are represented by the shaded area. The Approved Methods criteria for PM_{10} is 50 $\mu g/m^3$ (24-hour average) but an allowance for a background concentration of around 20 $\mu g/m^3$ is required; hence, the 30 $\mu g/m^3$ contour line is the maximum allowed incremental impact. Figure 5-1 indicates that dust impacts can exceed the criteria at up to 240 m from the activity when worst-case conditions and all activities are concurrent (with Level 1 haul road watering of 2 litres/m^2/hr). Figure 5-2 shows the predicted dust impacts assuming Level 2 haul road watering (>2 litres/m^2/hr). With increased haul road watering, dust impacts from haul trucks are reduced and the foot print of the impacted area is reduced to approximately 100 - 150 m from the construction area. Without the haul truck movements (not shown), the impact footprint reduces to less than 80 m.

Exposure to airborne asbestos fibres (generated from the disturbance of NOA) is directly related to the exposure levels of airborne dust and the concentration of asbestos within the soil and rock. A quantitative prediction of impacts from NOA cannot be made without this information. NOA has been identified between chainages 34600 and 34950. It is noted that the only potentially sensitive receptor is this area is the Orange Resource Recovery Centre, which at the closest point is located approximately 50 m from chainage 34750. There are no residential receptors located immediately surrounding the corridor where NOA asbestos has been identified. However, particular attention to dust control and work methods is required in this area and all visible dust plumes should be contained to within the pipeline corridor.

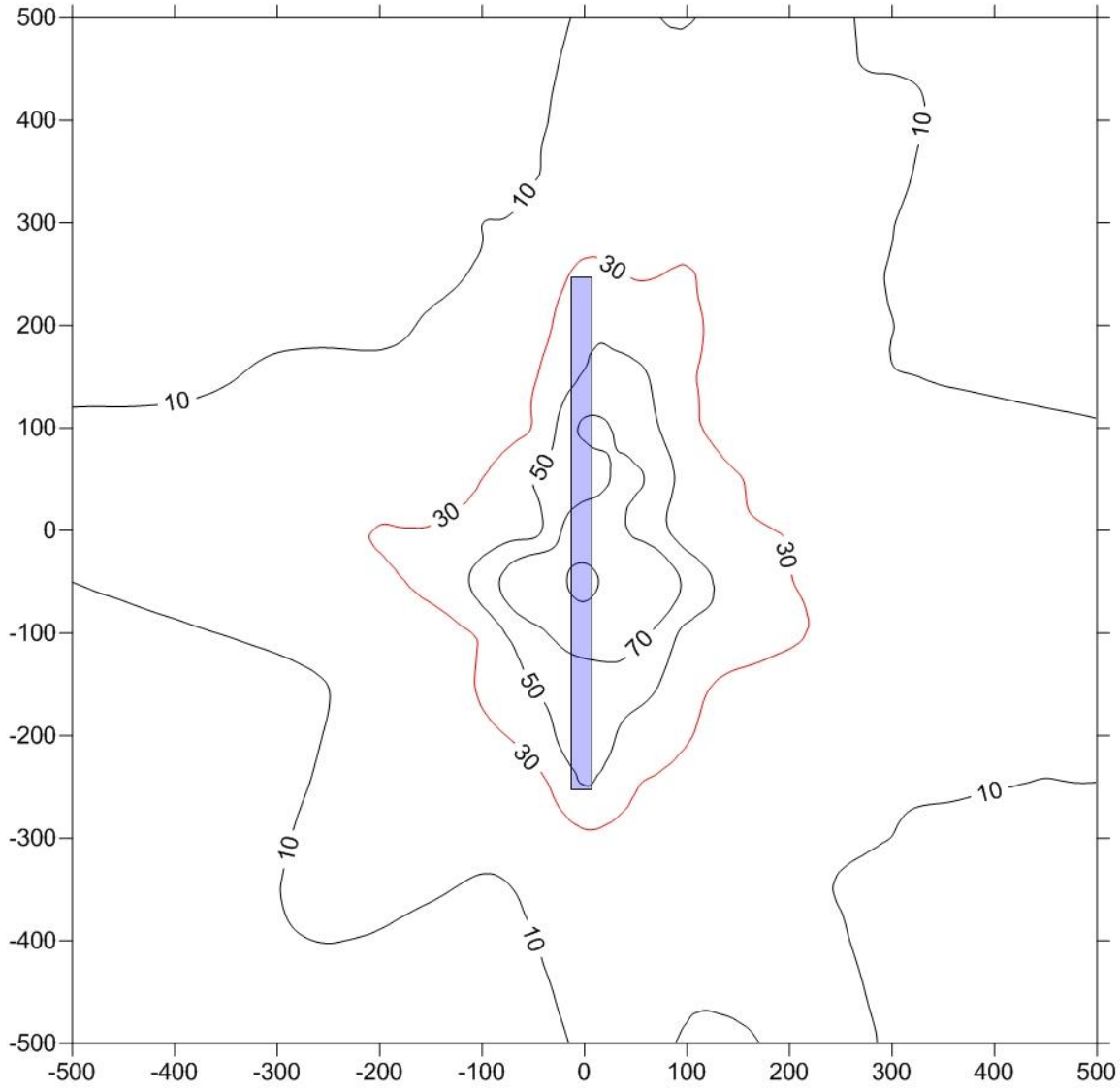


Figure 5-1 Predicted dust impact contours – Indicative pipeline construction – Level 1 Haul Road watering

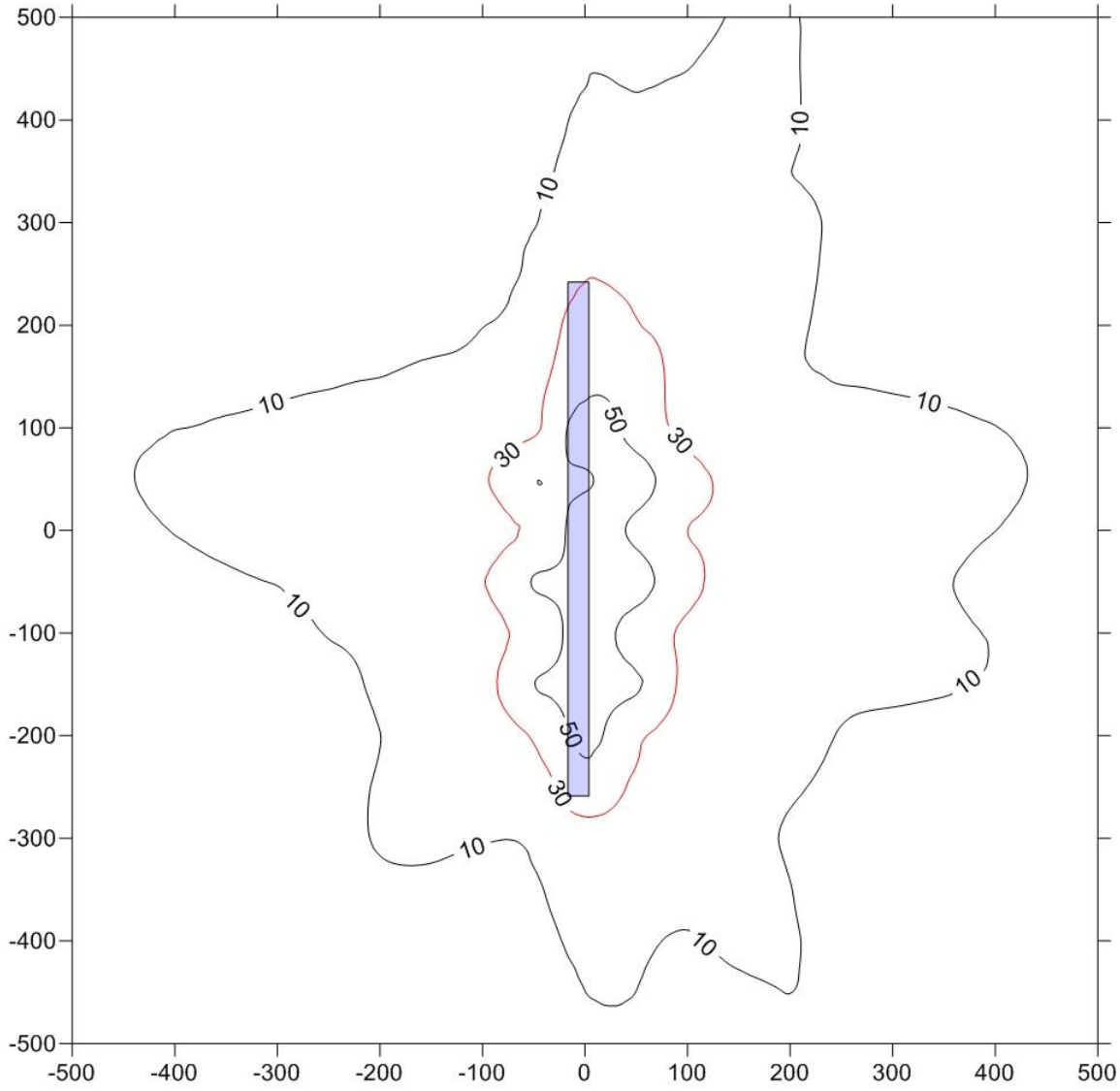


Figure 5-2 Predicted Dust Impact Contours – Indicative Pipeline Construction – Level 2 haul Road Watering

6. Dust mitigation

The scale of the civil works for pump stations and booster pump stations present no likely risks that applicable air quality standards will be exceeded. The work will have minimal impact resulting in no overall net effect. There is therefore no need for management mitigation measures for air quality control for these aspects of the project.

For the pipeline construction, it is recommended that some of the dust control measures outlined below be adopted during construction for sections of the pipeline corridor which fall within close range of sensitive receptors (within 240 m) or during dry conditions when visible dust plumes are moving off-site towards sensitive receptors. Particular attention to dust control measures is required for construction activities between chainages 34600 and 34950, where NOA has been identified to exist in the soil. At other times, normal construction control measures will minimise off-site dust impact to an acceptable level.

Recommendations for measures to minimise air quality impacts are as follows:

- All construction and maintenance equipment/vehicles are to be operated and maintained to manufacturer's specifications in order to minimise exhaust emissions.
- Vehicular speeds be limited to 15 km/hr on areas of unconsolidated/ unsealed soil associated with the project.
- Limit cleared areas of land and clear only when necessary to reduce fugitive dust emissions.
- Aim to minimise the size of storage piles where possible.
- Excavating operations conducted in areas of low moisture content material should be suspended during high wind speed events or water sprays should be used.
- All haulage vehicles are to have their loads covered while transporting material to and from work areas.
- Prompt mitigation of visible dust emissions, which may involve a combination of
  - Stabilisation of surface silt content through the application of water sprays.
  - Control of mechanically induced dust emissions by temporarily suspending activity or reducing the intensity of operations, including speed limits.
- Implementing Level 2 (>2 litres/m^2/hr) haul road watering when sensitive receptors are located within 240 m of construction works. Figure 5-1 indicates that with increased watering on haul roads, the impacted area reduces to approximately 100 - 150 m from the construction works (under worst case conditions).

Procedures for work undertaken in areas of NOA are detailed in the Orange City Council Planning Procedures for Naturally Occurring Asbestos[7]. The recommendations and work method requirements of this document should be adhered to when work is conducted within areas where NOA has been identified.

[7] Noal Arnold & Associates Pty Ltd, Naturally Occuring Asbestos Planning Procedures, Orange City Council, Orange City, NSW. Prepared January 2006 for Orange City Council. www.orange.nsw.gov.au

7. Conclusions

With regard to the limitations outlined in Section 8, the following conclusions can be drawn from this air quality impact assessment:

- The major sources of dust emissions related to construction and maintenance of The Macquarie River to Orange pipeline project have been identified.
- The wind climate within the study area has been characterised and wind roses showing the prevailing wind directions will assist with the management of wind-blown dust from construction areas.
- Sensitive receivers (isolated residential dwellings) with potential exposure to the pipeline construction activities have been identified as being typically within 80 m from the pipeline corridor. Under worst-case conditions and with a haul truck continuously operating on an unsealed road the dust impact foot-print has the potential to expand to 240 m.
- Appropriate dust management and mitigation measures have been identified with typical control activity applying at all times (for example, watering of access/haul tracks) and additional control (proactive measures to reduce emissions) when a residential dwelling is within 240 m downwind of dust-generating activity. Increased watering during haul road activities can reduce the potentially impacted footprint to within 100 - 150 m of the construction works.
- Exposure to airborne asbestos fibres (generated from the disturbance of NOA) is directly related to the exposure levels of airborne dust and the concentration of asbestos within the soil and rock. Therefore, particular attention to dust control and work methods is required when construction work is between chainages 34600 and 34950, where NOA has been identified. In this area, visible dust plumes should be contained to within the pipeline corridor.
- Based on the findings of the assessment, it is expected that the generation of dust emissions due to construction of the Orange Drought Relief Pipeline can effectively be mitigated by implementation of a dust management plan.

8. Limitations

This Air Quality Impact Assessment report for the proposed Drought Relief Pipeline, near Orange, NSW ("Report"):

- Has been prepared by GHD Pty Ltd ("GHD") for Orange City Council.
- May only be used and relied on by Orange City Council.
- Must not be copied to, used by, or relied on by any person other than Orange City Council without the prior written consent of GHD.
- May only be used for the purpose of the prescribed scope of work stated in Section 1.4 (and must not be used for any other purpose).

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than Orange City Council arising from or in connection with this Report.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report:

- Were limited to those specifically detailed in Section 1.4 of this Report.
- Were based on the assumptions made in Sections 3 and 5.

It is not the intention of the assessment to cover every element of the air environment, but rather to conduct the assessment with consideration to the prescribed work scope.

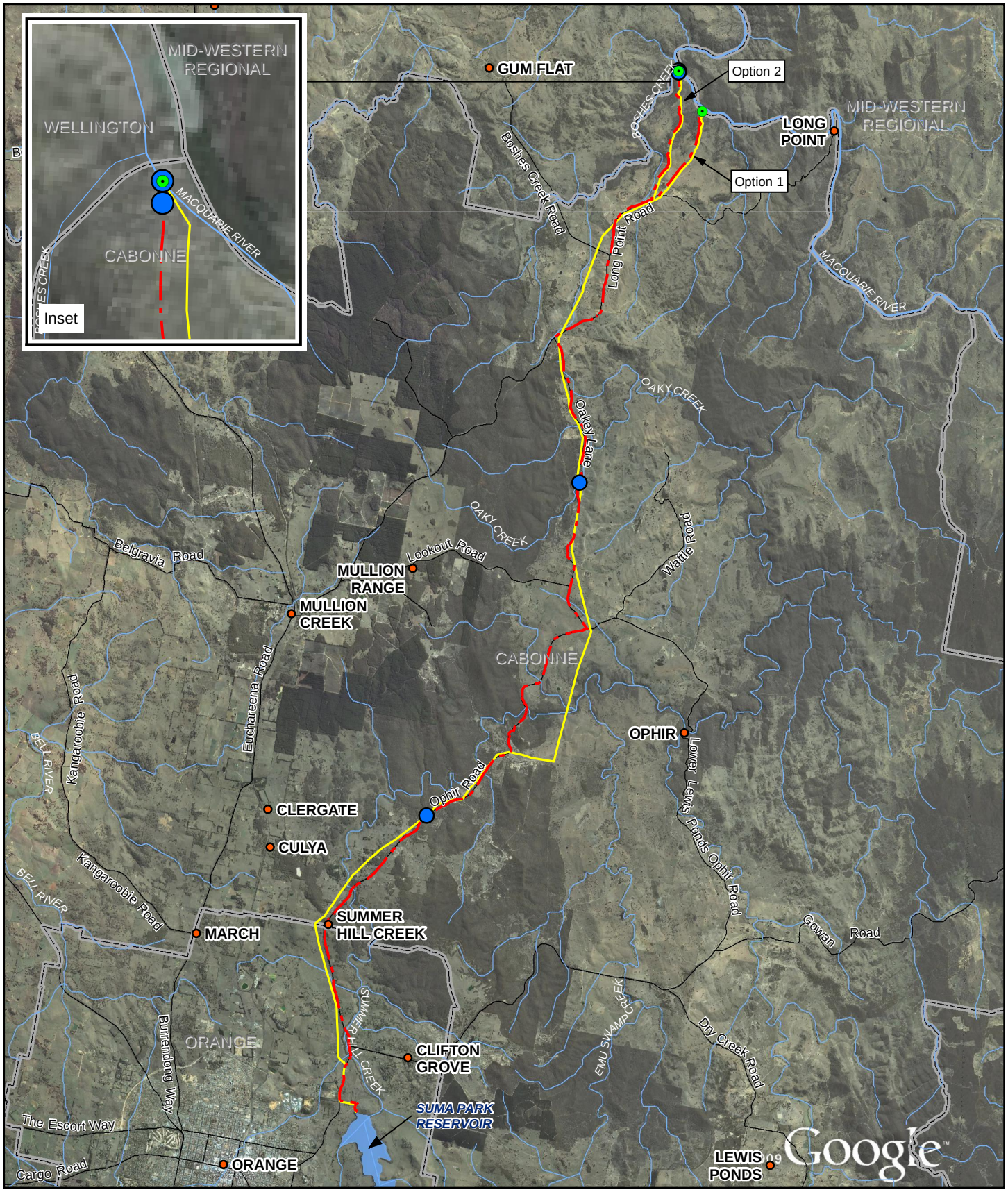
The findings of this report represent the findings apparent at the date and time of the assessment. It is the nature of environmental assessments that all variations in environmental conditions cannot be accessed and all uncertainty concerning the conditions of the ambient noise environment cannot be eliminated. Professional judgement must be exercised in the investigation and interpretation of observations.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report.

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Appendix A

Pipeline Location



LEGEND

- Place Names
- Off-Take Locations
- Pump Stations
- Watercourse
- Macquarie River
- Roads
- Water pipeline
- PowerEasement Option
- LGA Boundary
- Reservoir

1:150,000(at A4)

0 5501,100 2,200 3,300 4,400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD

CLIENTS | PEOPLE | PERFORMANCE

Orange City Council
EPBC Referral

Orange Drought Relief Pipeline
Locality Plan

Job Number	21-20541
Revision	A
Date	21 SEP 2011

Figure 1

G:\21\20541\GIS\Maps\Deliverables\2120541_001_Locality_20110916_A.mxd
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: Geoscience Australia: 250k Topographic Data Series 3 - 2006; Google: Imagery - 2011. Created by: fmackay, tmorton, TMorton

Appendix B

Ausplume Output File

Orange pipeline - construction dust

Concentration or deposition	Concentration
Emission rate units	kg/hour
Concentration units	microgram/m3
Units conversion factor	2.78E+05
Constant background concentration	0.00E+00
Terrain effects	None
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	No
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.300 m
Use the convective PDF algorithm?	No

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Pasquill-Gifford
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Briggs Rural
Vertical dispersion curves for sources >100m high	Briggs Rural
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.400m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes
Stack-tip downwash included?	Yes
Building downwash algorithm:	PRIME method.
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	No

and in the absence of boundary-layer potential temperature gradients given by the hourly met. file, a value from the following table (in K/m) is used:

Wind Speed Category	Stability Class A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES
24 hours

1

Orange pipeline - construction dust

SOURCE CHARACTERISTICS

INTEGRATED AREA SOURCE: WIND

X0(m)	Y0(m)	Ground El	Length X	Length Y	Or. Angle	Ver. spread	Height
-10	-250	0m	20m	500m	0deg	1m	0m

Emission rates by stability and wind speed, in kg/hour per square metre:

Wind speeds (m/s):	< 1.5	1.5_ 3.1	3.1_ 5.1	5.1_ 8.2	8.2_10.8	>10.8
Stability A:	0.00E+00	1.10E-06	5.00E-06	2.10E-05	6.00E-05	1.20E-04
Stability B:	0.00E+00	1.10E-06	5.00E-06	2.10E-05	6.00E-05	1.20E-04
Stability C:	0.00E+00	1.10E-06	5.00E-06	2.10E-05	6.00E-05	1.20E-04
Stability D:	0.00E+00	1.10E-06	5.00E-06	2.10E-05	6.00E-05	1.20E-04
Stability E:	0.00E+00	1.10E-06	5.00E-06	2.10E-05	6.00E-05	1.20E-04
Stability F:	0.00E+00	1.10E-06	5.00E-06	2.10E-05	6.00E-05	1.20E-04

No gravitational settling or scavenging.

VOLUME SOURCE: GRADER

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
0	150	0m	0m	5m	2m

Emission rates by hour of day in kg/hour:

1	0.00E+00	2	0.00E+00	3	0.00E+00	4	0.00E+00
5	0.00E+00	6	0.00E+00	7	0.00E+00	8	8.50E-02
9	8.50E-02	10	8.50E-02	11	8.50E-02	12	8.50E-02
13	8.50E-02	14	8.50E-02	15	8.50E-02	16	8.50E-02
17	8.50E-02	18	0.00E+00	19	0.00E+00	20	0.00E+00
21	0.00E+00	22	0.00E+00	23	0.00E+00	24	0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: EXC

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
0	50	0m	0m	10m	5m

Emission rates by hour of day in kg/hour:

1	0.00E+00	2	0.00E+00	3	0.00E+00	4	0.00E+00
5	0.00E+00	6	0.00E+00	7	0.00E+00	8	1.20E+00
9	1.20E+00	10	1.20E+00	11	1.20E+00	12	1.20E+00
13	1.20E+00	14	1.20E+00	15	1.20E+00	16	1.20E+00
17	1.20E+00	18	0.00E+00	19	0.00E+00	20	0.00E+00
21	0.00E+00	22	0.00E+00	23	0.00E+00	24	0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: TRUCK

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
0	-50	0m	0m	10m	5m

Emission rates by hour of day in kg/hour:

1	0.00E+00	2	0.00E+00	3	0.00E+00	4	0.00E+00
5	0.00E+00	6	0.00E+00	7	0.00E+00	8	1.24E+00
9	1.24E+00	10	1.24E+00	11	1.24E+00	12	1.24E+00
13	1.24E+00	14	1.24E+00	15	1.24E+00	16	1.24E+00
17	1.24E+00	18	0.00E+00	19	0.00E+00	20	0.00E+00
21	0.00E+00	22	0.00E+00	23	0.00E+00	24	0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: 4WD

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
0	-150	0m	0m	5m	3m

Emission rates by hour of day in kg/hour:

1	0.00E+00	2	0.00E+00	3	0.00E+00	4	0.00E+00
5	0.00E+00	6	0.00E+00	7	0.00E+00	8	3.30E-01
9	3.30E-01	10	3.30E-01	11	3.30E-01	12	3.30E-01
13	3.30E-01	14	3.30E-01	15	3.30E-01	16	3.30E-01
17	3.30E-01	18	0.00E+00	19	0.00E+00	20	0.00E+00
21	0.00E+00	22	0.00E+00	23	0.00E+00	24	0.00E+00

No gravitational settling or scavenging.

1

Orange pipeline - construction dust

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):

-500.m	-450.m	-400.m	-350.m	-300.m	-250.m	-200.m
-150.m	-100.m	-50.m	0.m	50.m	100.m	150.m
200.m	250.m	300.m	350.m	400.m	450.m	500.m

and these y-values (or northings):

-500.m	-450.m	-400.m	-350.m	-300.m	-250.m	-200.m
-150.m	-100.m	-50.m	0.m	50.m	100.m	150.m
200.m	250.m	300.m	350.m	400.m	450.m	500.m

METEOROLOGICAL DATA : Orange Airport 2010

GHD

Level 3 GHD Tower 24 Honeysuckle Drive Newcastle NSW 2300
PO Box 5403 Hunter Region Mail Centre NSW 2310
T: (02) 4979 9999 F: (02) 4979 9988 E: ntlmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	T Gribble	B Cook		V Chavand		27/06/12
1	T Gribble	B Cook		A Raleigh		23/07/12