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Midal Cables International Pty Limited

Report on Tomago Cable Manufacturing Plant

Air Quality Impact Assessment

February 2012

Revision 3



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Glossary

Term	Definition
CO	Carbon monoxide
GLC	Ground Level Concentration
NO _x	Oxides of Nitrogen
NO	Nitrogen oxide
NO ₂	Nitrogen dioxide
OEH	NSW Government Office of Environment and Heritage [formerly the Department of Environment, Climate Change and Water (DECCW)]
PM ₁₀	The fraction of suspended particles with an aerodynamic diameter less than 10 µm is referred to as PM ₁₀ .
SO ₂	Sulfur dioxide
TSP	The term total suspended particulate (TSP) matter refers to airborne particles typically less up to 50 – 80 microns (µm) in aerodynamic diameter.
VOC's	Volatile Organic Compounds



1. Introduction

1.1 Overview

Midal Cables International Pty Ltd (Midal) proposes to construct an aluminium rod and conductor manufacturing facility on a 2.8 ha parcel of land adjacent to the Tomago Aluminium Smelter at Tomago in Port Stephens, NSW. This is referred to as 'the project' for the purposes of this report. The project will be located adjacent to the existing Tomago Aluminium Company (TAC) Smelter.

This air quality impact assessment forms part of an Environmental Assessment for the project.

1.2 Project Description

The project will produce aluminium rods and conductor from molten aluminium sourced from the aluminium smelter, which would be delivered in crucible trucks. The primary production process will involve natural gas fired holding furnaces, tilting furnaces, casting machines, rolling mills, wire coilers, ovens and packaging units. Secondary processes include wire drawing, wire stranding, packing and cooling. The facility will process 50,000 tonnes of aluminium per year.

The following buildings and structures are proposed:

- ▶ Casting and Coil Storage Shed of approximately 35 m wide by 98 m.
- ▶ Wire Drawing and Stranding Shed of approximately 46 m wide by 124 m long.
- ▶ Administration Building.
- ▶ Workshop and Stores Building.
- ▶ Compressor House.
- ▶ Electrical Substation/MCC.
- ▶ In ground storage tanks.
- ▶ General earthworks will include building and infrastructure works, such as:
 - ▶ Site preparation and levelling.
 - ▶ Construction of access roads and infrastructure, including a haul road from Tomago Aluminium to the north of the Midal site.
 - ▶ Construction of site buildings.
 - ▶ Construction of car parking areas.

1.3 Scope of Works

The scope of work undertaken by GHD for the assessment of air quality emissions from the project is outlined below:

- ▶ Initial review of available project information to gain an understanding of local site features and the operational parameters for the project.



- ▶ Review of available ambient air quality monitoring data to gain an understanding of existing background air quality in the study area.
- ▶ Synthesise a site-representative meteorological data file with which to use as model input for conducting atmospheric dispersion modelling.
- ▶ Compilation of an air emission inventory for all significant point source air discharges associated with the operations of facility with which to:
 - Define the mass emission rates and source release parameters for conducting atmospheric dispersion modelling.
 - Conduct a comparison against emission limits for each applicable air pollutant, as specified in the Protection of the Environment Operations (Clean Air) Regulations 2002.
- ▶ Air quality impacts during construction works were qualitatively assessed.
- ▶ Dispersion modelling was conducted using a regulatory approved atmospheric dispersion model to predict the maximum incremental impact at the nearest sensitive receptors. The potential for cumulative air quality impacts with the addition of the adopted background air quality was also assessed.
- ▶ Recommend in-principle measures for managing air emissions with consideration to technical guidelines.

The abovementioned scope of work has been conducted with consideration to the NSW Office of Environment and Heritage (OEH) *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, August 2005 (*Approved Methods*). The assessment is subject to the limitations discussed in Section 9.



2. Existing Environment

2.1 Study Area

The site of the project is on industrial land within the Tomago Industrial Area, approximately 6 km from the Port of Newcastle and immediately adjacent to the Tomago Smelter. This land comprises lots 5 and 6 in DP 270328 and has an area of approximately 2.8 ha.

The site has been subject to previous industrial usage as a manufacturing facility and parts of the site have been used for sand mining activities. The existing building on the site, located in the southern half of the site, will be demolished as part of the construction activities.

Access to the south of the site is provided by a sealed road off School Drive and the existing gravel road leading up to the current building will be reformed and sealed as part of the project. The haul road will be constructed from the smelter and enter the site on its northern boundary. This haul road will be constructed on land owned by the TAC but maintained by Midal. The existing industrial buildings to the west are similar in size to those proposed on the Midal site.

The site is generally flat with a slight incline in the northern edge towards the northern boundary. Grass and occasional small trees and shrubs exist across the site with a majority of the trees located along the northern boundary.

The site lies within the industrial buffer area surrounding the TAC smelter.

2.2 Sensitive Receptors

Sensitive receptors in the vicinity of the site include residential dwellings located along School Drive, Tomago Road and Graham Road. The nearest residential dwelling is located approximately 230 metres south and southeast of the site.

A number of commercial and industrial facilities also surround the site. The sensitive receptors identified for the purpose of this assessment are detailed in Table 2-1. These identified receptors have been chosen to represent the locations with the greatest potential for adverse impacts, as well as showing the effects of dispersion of air pollution over varying distances from the site. A map of the identified receptors is shown in Figure 1.

Table 2-1 Identified Sensitive Receptors

Receptor	Receptor Type	Description	Coordinates (Easting, Northing)
R1	Residence	5 Graham Drive. 1800 metres east-northeast of the site	E 382724, N 6367829
R2	Residence	41 School Drive. 250 metres east of the site	E 381369, N 6367140
R3	Residence	29 School Drive. 230 metres south of the site	E 381199, N 6366860

Receptor	Receptor Type	Description	Coordinates (Easting, Northing)
R4	Residence	423 Tomago Road. TAC monitoring station. 350 metres south-southeast of the site	E 381338, N 6366782
R5	Residence	Tomago Detention Centre, 590 Tomago Road. 1100 metres west-southwest of the site	E 379977, N 6366683

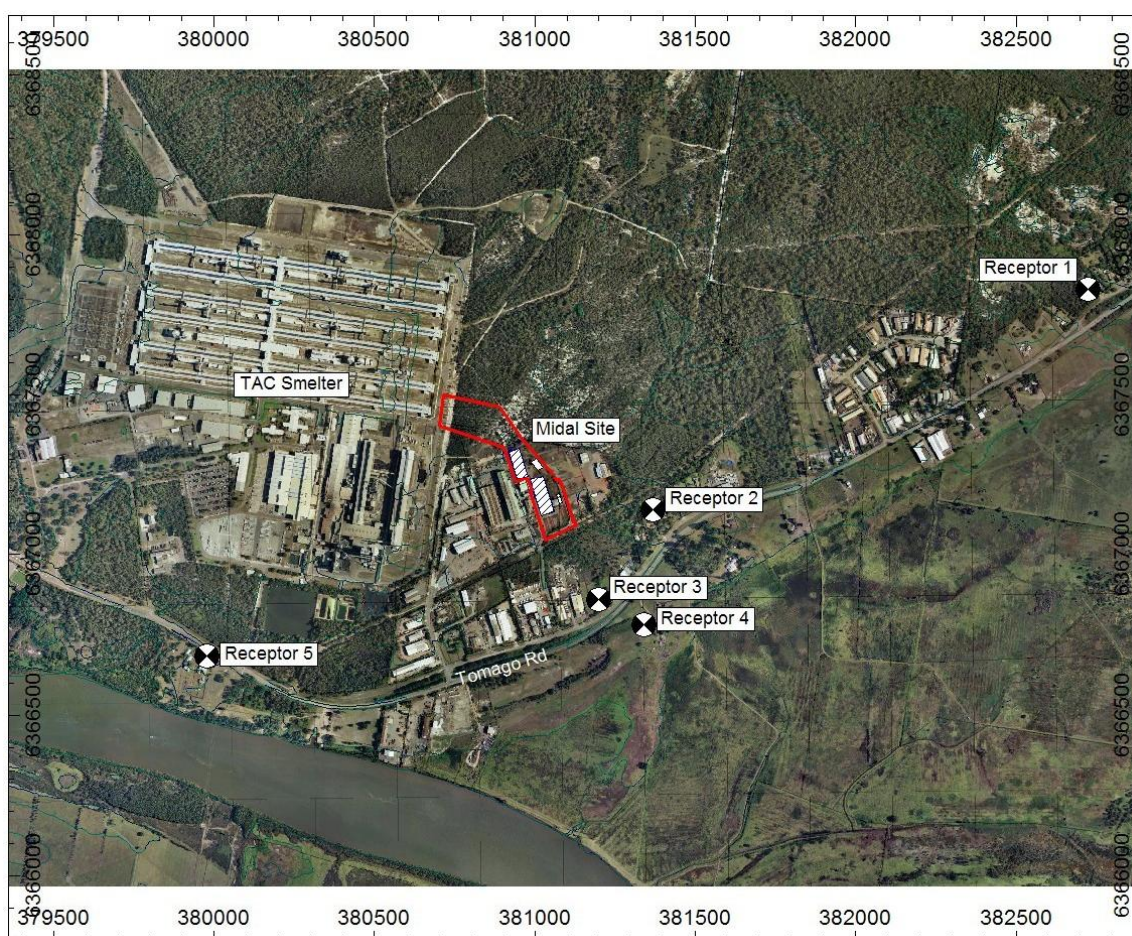


Figure 1 Location of the Midal Site and nearest Sensitive Receptors



2.3 Ambient Air Quality

Air quality standards and goals are provided as cumulative values which are made up of the project as well as background concentration levels of pollutants. Therefore, to assess impacts against the relevant air quality standards and goals (see Section 3) it is necessary to have information on existing air quality pollution levels in the area.

As outlined in the Newcastle State of the Environment report (Newcastle City Council, 2009), air quality in the Newcastle local government area meets the standard set in the National Environment Protection Measure (NEPM) for ambient air quality. The state of the environment report also identifies that industrial, domestic and transportation sources are all significant contributors to adverse air quality in Newcastle and the surrounding areas.

The National Pollutant Inventory (NPI) holds a database of facilities and emissions to air in the Newcastle and Tomago region. A search of the National Pollutant Inventory for a 5 kilometre radius around the site indicated that there are five reporting facilities in the area resulting in the emission of various substances including Volatile Organic Compounds (VOC's), particulate matter (dust), carbon monoxide (CO), sulfur dioxides (SO₂), oxides of nitrogen (NO_x) and hydrogen fluoride (HF).

The largest single source of pollutants near the site is the TAC Smelter, which produces over 530,000 tonnes of aluminium product per year. Typically, aluminium smelters have significant fluoride and sulfur dioxide emissions¹. An environmental buffer zone has been developed for the smelter which identifies a special environmental management zone where ambient levels of pollutants may be above OEH guideline values. The buffer zone boundaries lie at a radius of approximately 2 km to 4 km from the centre of the smelter². The site and many sensitive receptors lie within this buffer zone. Residential properties within the buffer zone have still been included in this assessment.

Other industries and potential sources of impacts to local air quality in the area include chemical manufacturing facilities, such as Omega Chemicals and Minmet Operations Tomago as well as Hunter Galvanising. Motor vehicles on the surrounding road network also contribute to the ambient levels of particulate matter.

To obtain a better understanding of the existing air quality in the area surrounding the site, a variety of ambient air monitoring data has been referenced. As discussed in Section 4, the expected emissions to air during the proposed cable plant operations include CO, NO_x, SO₂, particulate matter and VOCs. Ambient air monitoring data for these pollutants has been sourced from the NSW OEH ambient air monitoring database and also from compliance monitoring by TAC.

2.3.1 NSW OEH Monitoring

The NSW OEH operates an ambient air quality monitoring station at Lawson Avenue, Beresfield. The Beresfield monitoring station is located approximately 6 km northwest of the Tomago site and collects data for ambient PM₁₀, NO₂, and SO₂ which are relevant to this study.

¹ Tomago Aluminium Company Annual Environment Reports for 2009 and 2010.

² NSW Government Planning Assessment Report, Tomago Aluminium Smelter Section 96(2) Modification – Proposed Increase in Production Rate.

Figure 2 and Figure 3 display the 1-hour maximum NO₂ and SO₂ concentrations at Beresfield throughout 2009 and 2010. There were no exceedances of the NO₂ or SO₂ 1-hour OEH criteria throughout this time period.

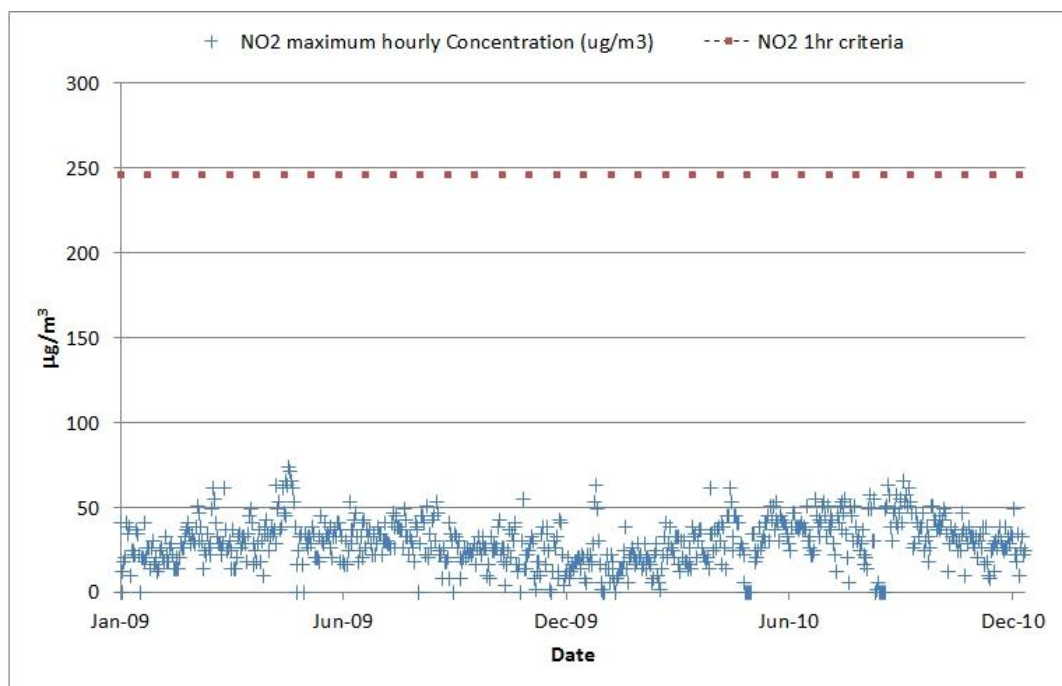


Figure 2 Beresfield 1-hour maximum NO₂ ambient air data

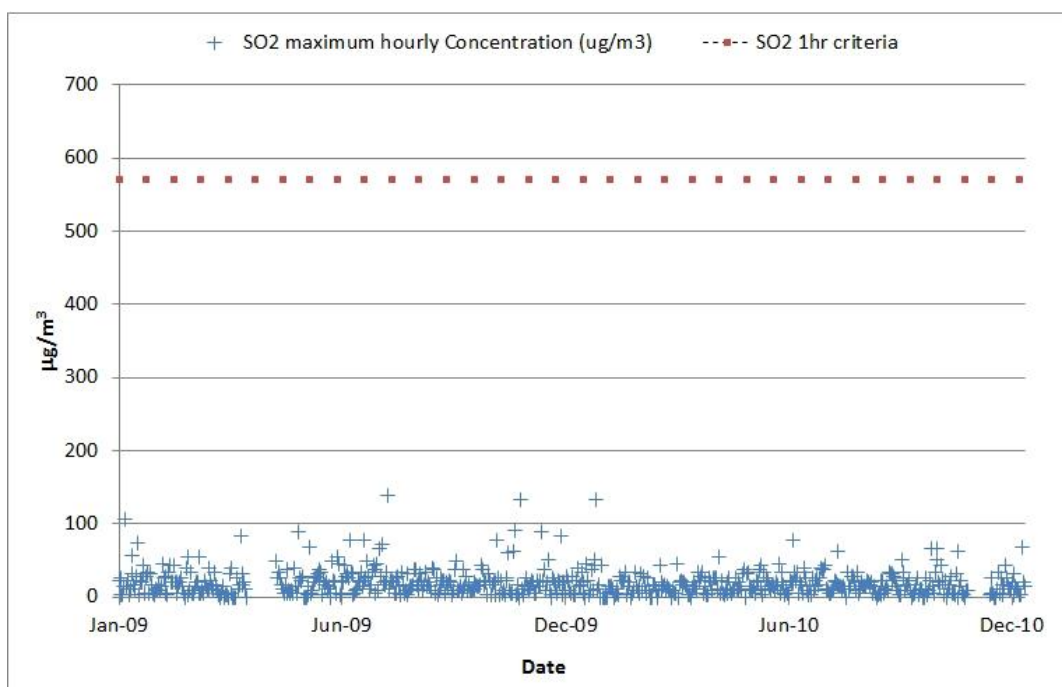


Figure 3 Beresfield 1-hour maximum SO₂ ambient air data

Figure 4 presents the 24-hour average PM₁₀ concentrations for Beresfield during 2009 and 2010. The data is presented without anomalous concentration levels likely to be caused during events such as bushfires or dust storms (e.g. September 2009 recorded a 24-hour PM₁₀ concentration of 1999 µg/m³) to provide more representative ambient PM₁₀ levels. Excluding anomalous data, the highest 24-hour average concentration is 41 µg/m³ and the annual average is 22 µg/m³.

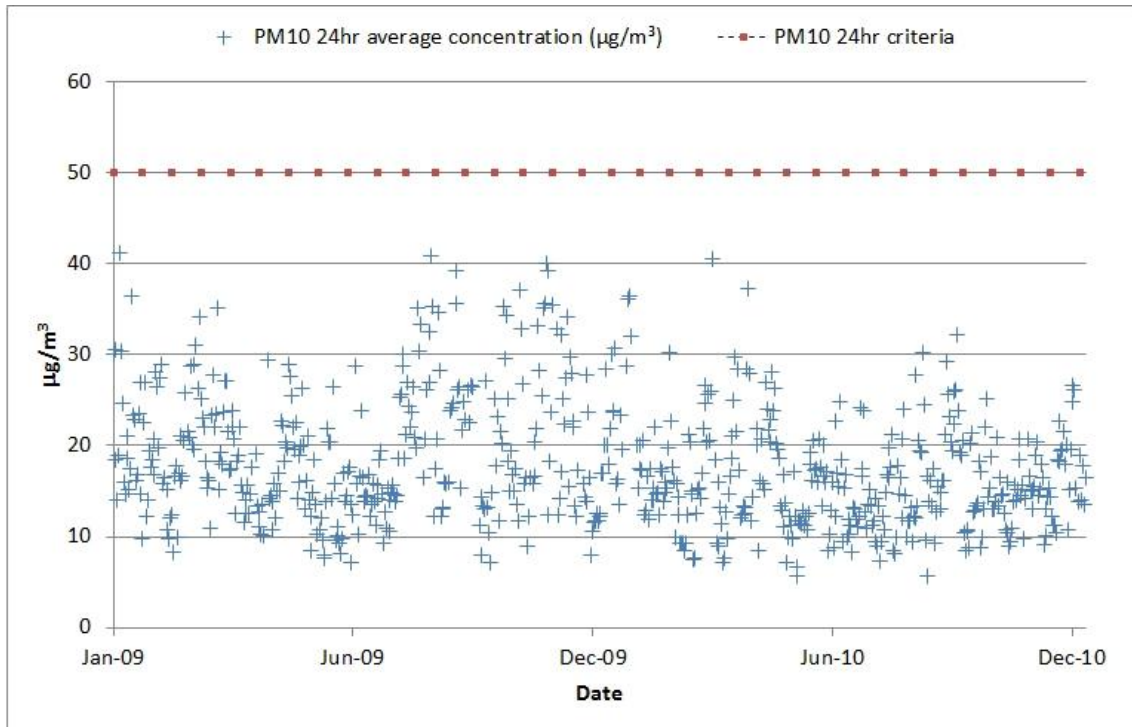


Figure 4 Beresfield 24-hour average PM₁₀ ambient air data (anomalies removed)

2.3.2 Tomago Aluminium Company (TAC) Air Monitoring

Ambient concentrations of fluoride and sulfur dioxide are industry monitored by TAC in the area surrounding the smelter.

TAC operates 8 sites for the monitoring of fluoride (see Appendix A for locations) and results are compared to the ANZECC guidelines in the *Approved Methods* (refer to Table 3-1). Generally, the levels of fluoride have been found to comply with the recommended guidelines; however two of the monitoring sites (site 84 and 181) have recorded short-term fluoride concentration levels that exceeded the ANZECC guidelines. Both of these sites are located well inside the industrial buffer zone around TAC, which was established in recognition that some locations would exhibit fluoride levels in excess of the guidelines. Fluoride emissions are associated with the aluminium smelting process and are not expected to be an emission from the cable manufacturing plant.

Monitoring for SO₂ is undertaken in the vicinity of the smelter by TAC. SO₂ monitoring was undertaken at two sites during 2009 and, since then, monitoring has commenced at a further three sites. The most applicable sites for this assessment are 41 School Drive and 'Tomago Farm', Tomago. A location map of the monitoring sites is shown in Appendix A.

Monitoring results indicated that the 1-hour and 24-hour SO₂ concentration criteria are exceeded on a number of occasions. Analysis of weather conditions indicate that these non-compliances occurred during periods of persistent west and north-west winds.

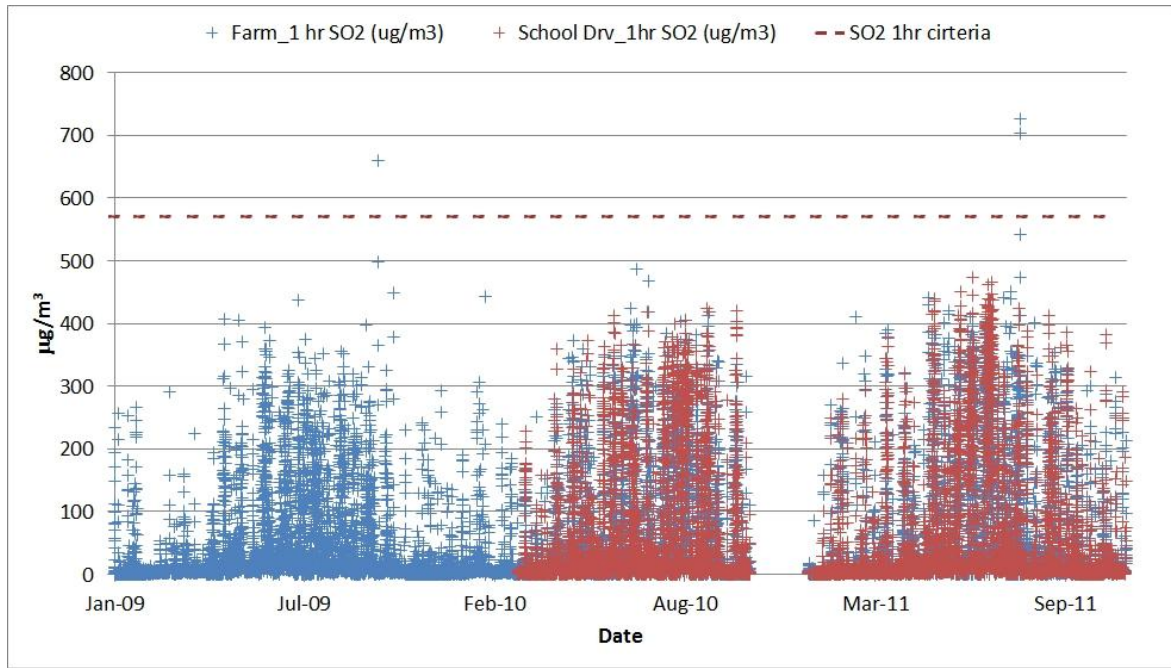


Figure 5 TAC 1-hour SO₂ Concentration Levels 2009 – 2011

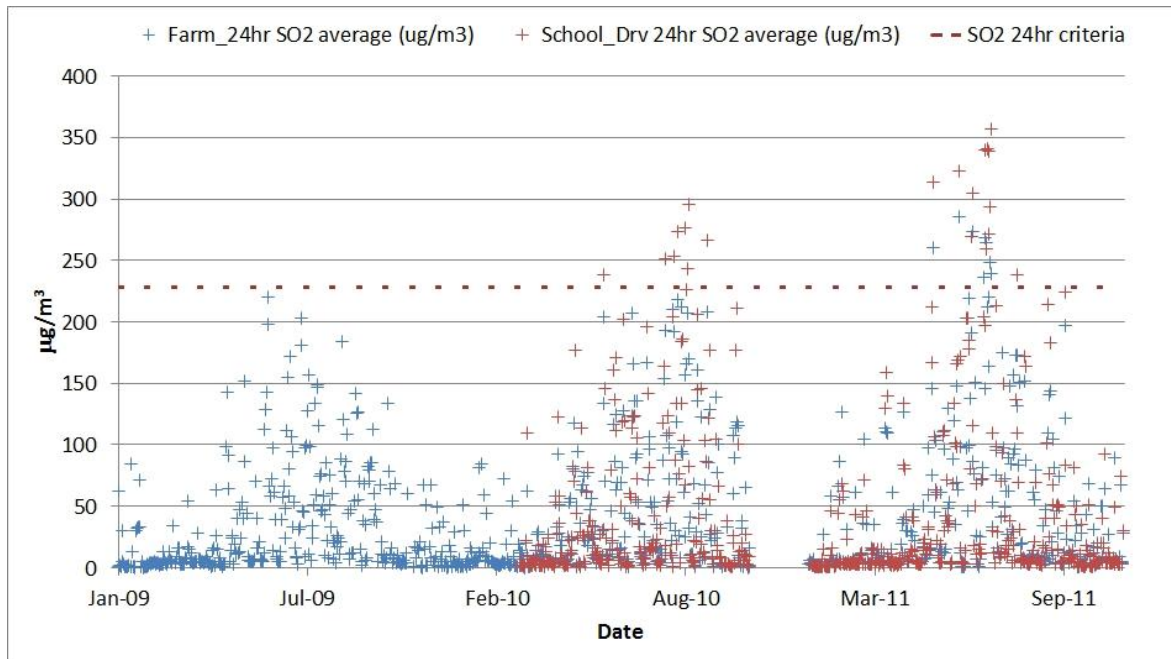


Figure 6 TAC 24-hour Average SO₂ Concentration Levels 2009 – 2011

2.4 Local Meteorology

Site representative meteorological data is required to determine the potential direction and extent of off-site impact of ground level emissions generated by construction, development and operation of the project.

In order to perform dispersion modelling hourly data including wind speed, wind direction, temperature and atmospheric stability is required.

2.4.1 Choice of Meteorological Data Set

The chosen data set was a synthesised data set centred at Tomago for the calendar year 1986. This dataset was produced by GHD based on instrument measured data and is considered to remain representative of meteorological conditions in the study area.

The Tomago data was validated against meteorological data obtained from the TAC automatic weather station, located within 1 km from the site. Three years' worth of TAC data was obtained, with the most complete year being 2008.

Figure 7 shows an annual wind rose of each of the data sets. The TAC measured data is shown to include more occurrences of lower wind speeds, however the data is seen to compare well. It was considered that the use of the Tomago data set is acceptable for this project.

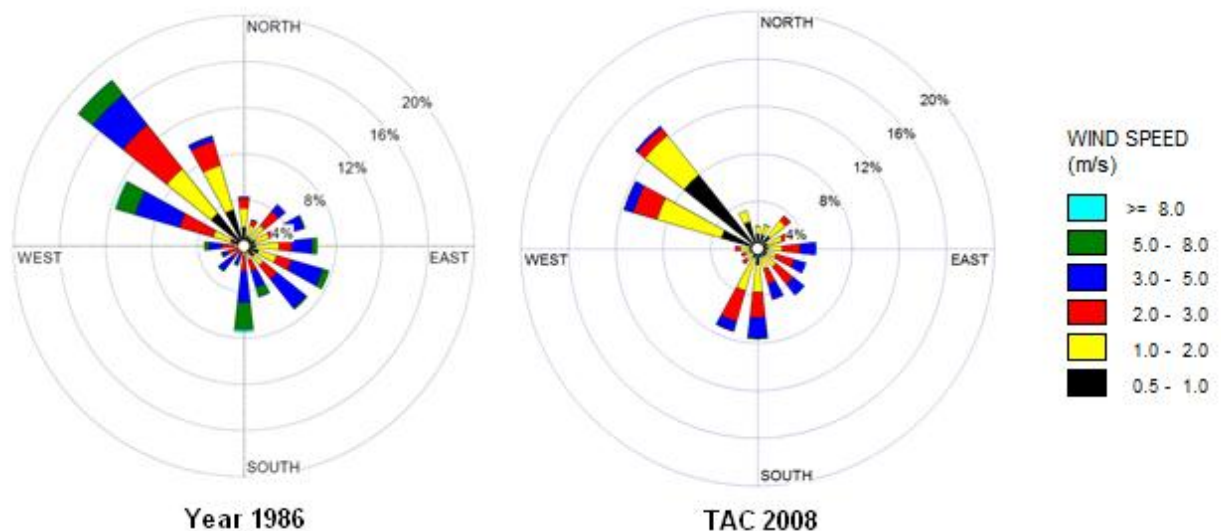


Figure 7 GHD Year 1986 and TAC 2008 Annual Wind Roses

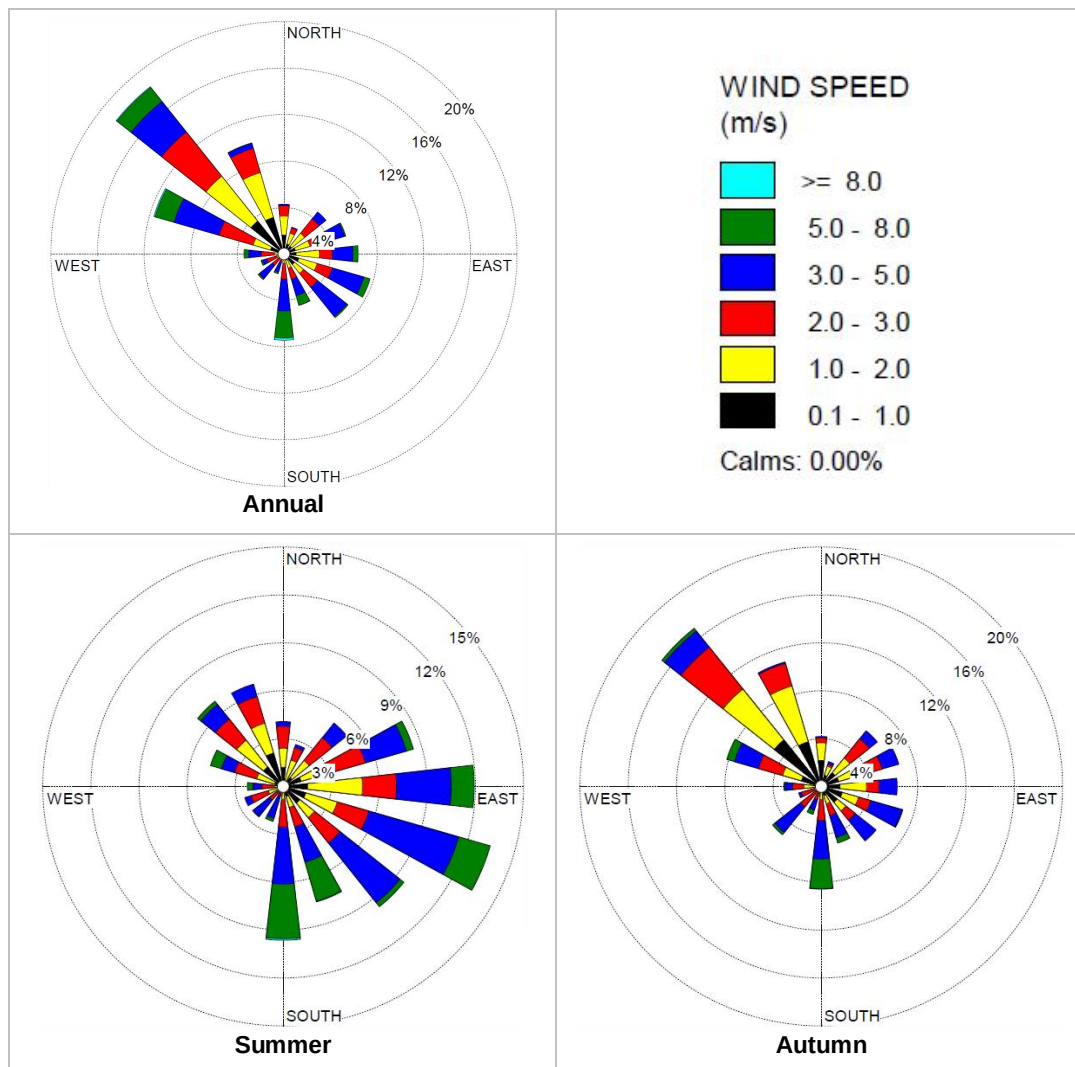
2.4.2 Wind Climate

Figure 8 shows the annual wind rose for Tomago which indicates that the prevailing wind is from the northwest quadrant. Winds from the northwest comprise 18% of annual winds, followed in frequency by winds from the west-northwest (12% of annual winds) and north-northwest (10% of annual winds). This pattern reflects the westerly synoptic flow experienced at mid-latitudes, especially for months near the time of the winter solstice, and the Hunter Valley having a northwest-southeast orientation.

The incidence of light winds, which are related to poor emission dispersion is also highest from the northwest quadrant. Winds from the northwest comprise approximately 20% of total winds in the 0.1 – 2.0 m/s range.

There is a clear distinction in incident wind direction between the winter and summer seasons at the site. This is reflective of increased temperatures during summer inducing a sea breeze from the south-eastern quadrant and easterly component synoptic flows as the sub-tropical ridge migrates south of the Australian continent during the peak of summer.

During the spring and autumn months the sea breeze is present, but is less frequent. The prevailing wind remains from the northwest with an increase in winds from the south-eastern quadrant as compared to winter.



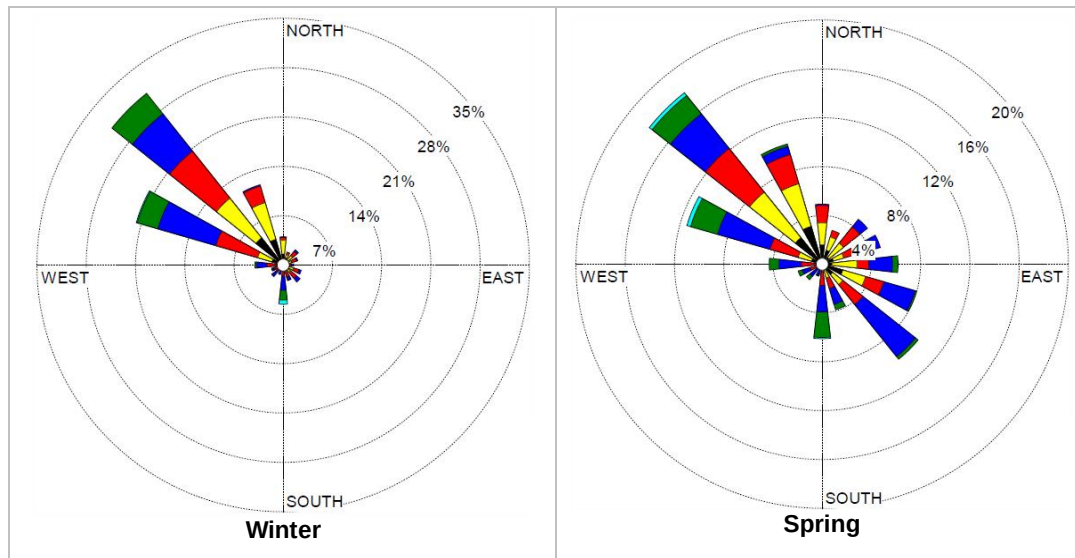


Figure 8 Annual and Seasonal Wind Rose Charts – Tomago NSW

2.4.3 Pattern of Atmospheric Stability

Atmospheric stability dictates how effectively a plume will disperse. The Pasquill-Gifford scale of atmospheric stability consists of six stability classes. A, B and C represent, strongly, moderately and slightly unstable atmospheres respectively. Under such conditions the dispersion of ground level emissions is efficient due to convective and turbulent vertical mixing.

Category D classifies a neutral atmosphere and E and F slightly and moderately stable atmospheres respectively. Stable conditions persist at night, with clear skies and weak gradient winds. Such conditions are often coupled with ground based temperature inversions, sometimes with fog. In a stable atmosphere (categories E and F), dispersion is poorest for ground level and near ground sources as vertical mixing of air is suppressed. This can result in a downwind plume, which is detectable to a greater distance compared to similar emissions under unstable conditions. For near ground sources, it is commonly stable conditions that result in maximum off-site impact, while for an elevated point source such as a stack, it is typically unstable conditions that cause maximum ground level impact.

The frequency of occurrence of each stability class is displayed in Figure 9. The annual and seasonal stability roses for the data set are displayed in Figure 10. The following features are portrayed:

- ▶ Stability class D (neutral) is the most frequently experienced atmospheric condition, present 32% of the time.
- ▶ Stable classes E and F combined comprise approximately 33% of atmospheric conditions.
- ▶ The highest incidence of E and F conditions are seen from the northwest quadrant.

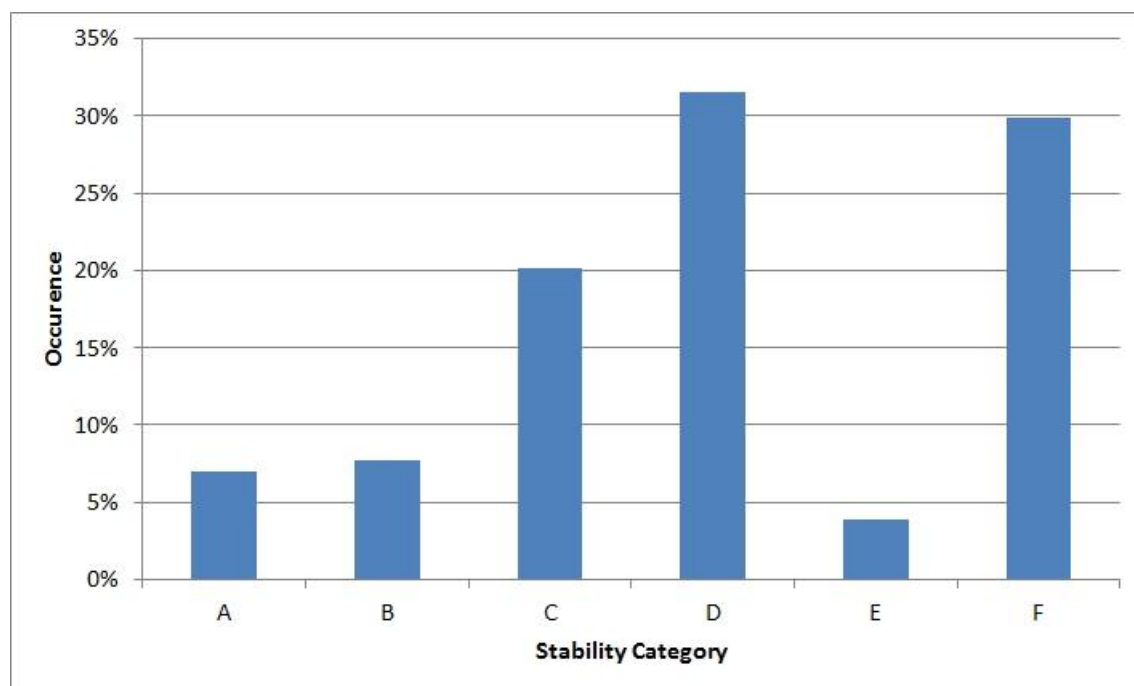


Figure 9 Stability Class Frequency – Tomago NSW

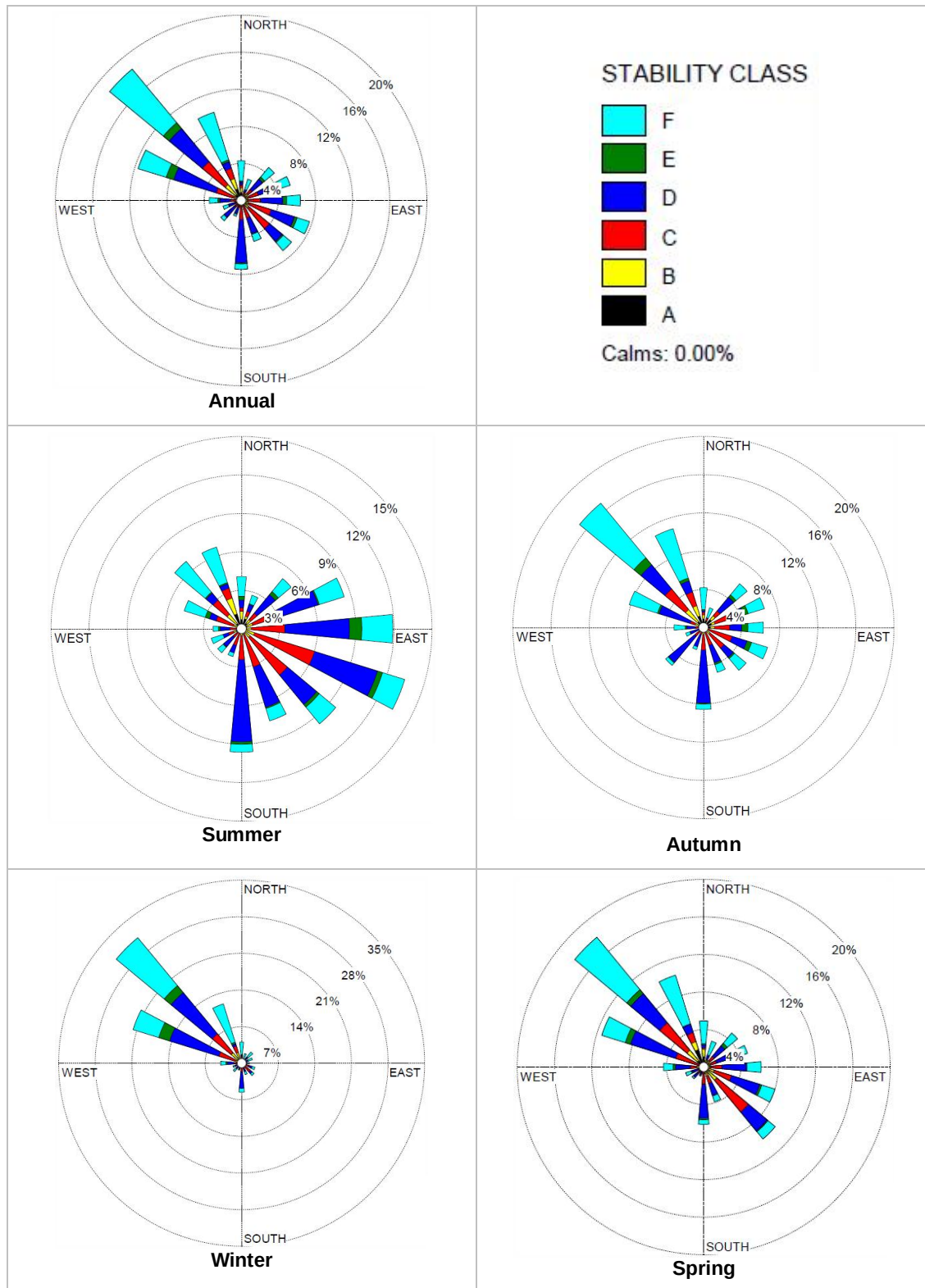


Figure 10 Annual and Seasonal Stability Roses – Tomago NSW



3. Air Quality Assessment Criteria

Air quality impact assessment criteria are prescribed within the NSW *Approved Methods*. The *Approved Methods* largely adopt the air pollution standards set by the National Environment Protection Council (NEPC) for ambient air quality.

To ensure the environmental outcomes are achieved, emissions from a premise must be assessed against the criteria given in Table 3-1. The impacts of each pollutant must be combined with the existing background level before comparison against the relevant impact assessment criteria.

Table 3-1 Assessment Criteria for Air Quality

Pollutant	Averaging Period	Concentration		Source
		pphm ⁽¹⁾	µg/m ³	
Sulfur dioxide (SO ₂)	10 minutes	25	712	NHMRC (1996)
	1 hour	20	570	NEPC (1998)
	24 hours	8	228	NEPC (1998)
	Annual	2	60	NEPC (1998)
Nitrogen dioxide (NO ₂)	1 hour	12	246	NEPC (1998)
	Annual	3	62	NEPC (1998)
Ozone (O ₃)	1 hour	10	214	NEPC (1998)
	4 hour	8	171	NEPC (1998)
Lead (Pb)	Annual	-	0.5	NEPC (1998)
PM ₁₀	24 hours	-	50	NEPC (1998)
	Annual	-	30	EPA (1998)
TSP	Annual	-	90	NHMRC (1996)
		g/m ² /month ⁽²⁾	g/m ² /month	
Deposited dust	Annual	2	4	NERDDC (1998)
		ppm	mg/m ³	
Carbon monoxide (CO)	15 minutes	87	100	WHO (2000)
	1 hour	25	30	WHO (2000)
	8 hours	9	10	NEPC (1998)
		µg/m ³ ⁽³⁾	µg/m ³ ⁽⁴⁾	



Pollutant	Averaging Period	Concentration		Source
		pphm ⁽¹⁾	µg/m ³	
Hydrogen fluoride (HF)	90 days	0.5	0.25	ANZECC (1990)
	30 days	0.84	0.4	ANZECC (1990)
	7 days	1.7	0.8	ANZECC (1990)
	24 hours	2.9	1.5	ANZECC (1990)
		ppm ⁽⁶⁾	µg/m ³ (7)	
Polycyclic aromatic hydrocarbons (as benzo[a]pyrene) ⁽⁵⁾	1 hour	NA	0.4	Victorian Government Gazette 2001
Benzene	1 hour	0.009	29	Victorian Government Gazette 2001 (health)
Toluene	1 hour	0.09	0.36	Victorian Government Gazette 2001 (odour)
Ethylbenzene	1 hour	1.8	8000	Victorian Government Gazette 2001 (health)
Xylenes	1 hour	0.04	0.19	Victorian Government Gazette 2001 (odour)

(1) Parts per hundred million (pphm).

(2) Maximum Increment. Maximum cumulative impact of 4 g/m²/month.

(3) General land use, which includes all areas other than specialised land use.

(4) Specialised land use, which includes all areas with vegetation sensitive to fluoride.

(5) PAHs should be assessed as toxic equivalents of benzo(a)pyrene.

(6) For toxicants units are ppm.

(7) For toxicants units are µg/m³.



4. Emissions Inventory

The emissions inventory for the site is focused on emission sources during the process operations, such as holding of molten aluminium, rolling, wire drawing and wire stranding as well as emissions from the combustion of natural gas used to power the furnaces and ovens.

Molten aluminium product will be supplied to the Midal facility in crucibles via a haul road linking the site to the adjacent TAC smelter. Fluoride and silicate emissions from aluminium manufacturing typically occur during the reduction process which will occur solely within the neighbouring smelter. Therefore, fluoride and silicate emissions from the cable manufacturing plant have been assumed to be negligible for the purpose of this assessment.

4.1 Reporting Thresholds

The National Pollutant Inventory (NPI) Emission Estimation Technique Manuals for *Aluminium Smelting* and *Combustion in Boilers* provides threshold limits for fuel usage, over which all emissions from fuel combustion must be reported. The project is expected to use approximately 8,900 tonnes of gas per year. This exceeds the trigger level for Natural Gas usage of 2,000 tonnes per year. Therefore, reporting of all emissions from natural gas combustion is required.

The NPI provides advice and recommended emission rates for the combustion of natural gas in furnaces (Section 4.3). However, the emission factors presented in these Manuals do not account for the metal fume or PM₁₀ emissions associated with this process. There is no published data available on emissions of metal fume from furnaces. The NPI states that 'These emissions would need to be characterised on a site by site basis'.

4.2 Metal Flume Emissions

Midal currently operates a cable manufacturing plant in Bahrain. The project will be identical to the Bahrain facility in design and operations, except where the Bahrain facility houses five rolling mills (units), the project will have one.

Appendix B shows the site layout and manufacturing flow diagrams for the project. Based on emission testing completed at the Bahrain facility, metal fume emissions will occur from the Holding Furnaces, Tilting Furnaces, ageing oven and rolling mill. Extraction flues will be located directly above each of these emission sources and emit the gas through a short stub stack in the roof of the main buildings. Site visits by GHD to the Bahrain facility and design details indicate that all flume emissions would be captured through these flues and that fugitive emissions within the buildings would be negligible.

The emission release parameters, provided by Midal, are shown in Table 4-1 for all stacks. Release parameters have been calculated based on design flow rates and flue diameters for the project. A separate stack was modelled for each production process (two holding furnaces, two tilting furnaces, ageing oven and rolling mill), with six stacks in total. Each stack was modelled directly above the emission source within the building. All stacks have been modelled as wake affected sources.



Table 4-1 Stack Release Parameters⁽¹⁾

Stack source	Source Release Height ⁽²⁾ (m)	Exit Gas Temperature ⁽³⁾ (°C)	Exit Stack Diameter (m)	Exit Exhaust Velocity (m/s)	Actual Flow rate (Am ³ /s)	Normalised Flow rate (Nm ³ /s) ⁽⁴⁾
Hold furnaces	13	150	1.06	3.85	3.38	2.18
Tilt furnaces	13	150	0.5	5.14	1.01	0.65
Heat ageing oven	13	150	0.4	0.32	0.04	0.03
Rolling mill	13	150	0.5	0.2	0.04	0.03

- (1) Parameters are for the combined flue exhaust of the metal flume and natural gas emissions.
- (2) Building heights were assumed to be 8 metres. Stack tip was assumed to be 5 metres above building height.
- (3) An exhaust exit temperature range of 150 – 200 degrees Celsius was supplied for each stack. Conservatively, a temperature of 150 °C was used in modelling.
- (4) Normalised air flow rate based on gas temperature of 150 °C. Flow rate was normalised to 0 °C as required by the Approved Methods.

Stack emission testing reports were supplied to GHD by Midal for emission testing at the Bahrain facility on each emission source within each operating unit. Emission testing reports are provided in Appendix C. Since the emission testing reports were supplied per operating unit, the emissions could be directly transferable to the one operating unit for the project.

Pollutant concentrations (mg/m³) emitted out of each stack was provided to GHD based on two rounds of emission testing^{3,4} at the Bahrain facility. Emission testing was completed by the Al Khalida Group and by the University of Bahrain, who undertake testing in accordance with British and International Standards.

The results of the emission monitoring are displayed below in Table 4-2. Where more than one concentration level was provided for the same source, the range of concentrations has been provided. Since the stack testing reports provide a direct comparison to the Environmental Protection Committee (EPC) limits (which are provided on a normalised basis), it has been assumed that supplied concentrations have been normalised to 0 °C. Emission measurements have been supplied for normal operations as well as during furnace de-gassing operations. It is understood that de-gassing of furnaces will occur for approximately 10 minutes every 3 hours.

No testing reports have been provided for emissions from the Holding Furnace during de-gassing operations. Therefore, estimates of de-gassing emissions from the Holding Furnaces have been made by scaling up the 'normal' concentration levels using the relationship between normal and de-gassing emissions of the Tilt Furnace.

³ Magnum Industrial Laboratories, Al Khalida Group. Air Monitoring Analysis Midal Cables Ltd, Kingdom of Bahrain, February 2006.

⁴ Environment Research Centre, University of Bahrain. Air Pollutants, Midal Cables, October 2003.

Table 4-2 Range of In-Stack Concentration Data Supplied by Midal

Activity	Source	In-Stack Concentration				
		CO	NO _x	SO ₂	PM ₁₀ ⁽¹⁾	VOC ⁽²⁾
		mg/m ³	mg/m ³	mg/m ³	mg/m ³	mg/m ³
Normal operations	Holding furnaces	2 - 10	2 - 6	2 - 6.1	0.6 - 4.9	0 - 2.9
Normal operations	Tilting furnaces	6 - 71	5 - 5.9 ⁽³⁾	4 - 16	3.39 – 4.5	0 - 4.3
Normal operations	Ovens	0 - 12.5	0 - 12.3 ⁽³⁾	0 - 8.3	1.59 - 4.9	0
Normal operations	Rolling mill	0 - 2	0	0	0 - 3	0 - 22.8
De-gassing	Holding Furnace ⁽⁴⁾	11.4	9.1	7.7	17	0 - 4.7
De-gassing	Tilting Furnace	11.5 – 81	4 - 8.9	9.1 - 20	3.7 – 15.6	0 - 7.1

- (1) The supplied concentration levels for particulate matter have been assumed to be for PM₁₀. GHD note that the Magnum Industrial Laboratories indicate a particulate matter size fraction of 0.45 microns. The measured concentration levels however are consistent with the Bahrain University measurements which were for total particulate matter.
- (2) Where VOC concentration levels have been provided as parts per million, the molecular weight of propane has been adopted to convert the concentration to mg/m³. Propane is typically adopted in this instance as it is how VOC's are regulated through the Clean Air Regulation 2010.
- (3) Where concentrations have been provided for NO and NO₂, NO_x concentrations have been calculated using the formula: NO_x = NO₂ + NO*(46/30) as advised by the NSW EPA (Jan 2012).
- (4) Holding Furnace de-gassing concentration levels have been calculated based on the relationship between normal and de-gassing concentrations provided for the Tilting Furnace. i.e. HF_{de-gassing} = HF_{normal} × (TF_{de-gassing}/TF_{normal}).

The mass emission rates for each source were then calculated based on the concentration levels presented in Table 4-2 and the normalised flow rates through each flue. To represent worst-case emissions, the highest value in the range of in-stack concentration levels has been used in calculating the mass emission rates. Table 4-3 displays these maximum mass emission rates for each stack.

Table 4-3 Normalised Mass Emission Rates – Metal Fume

Activity	Source	Pollutants – Mass Emission Rates (kg/hr)				
		CO	NO _x	SO ₂	PM ₁₀	VOC
Normal operations	Holding furnaces	0.08	0.05	0.05	0.04	0.02
Normal operations	Tilting furnaces	0.17	0.01	0.04	0.01	0.01



Normal operations	Ovens	0.001	0.001	0.001	0.0005	0
Normal operations	Rolling mill	0.0002	0	0	0.0003	0.002
De-gassing	Holding Furnace	0.09	0.07	0.06	0.13	0.04
De-gassing	Titling Furnace	0.19	0.02	0.05	0.04	0.02

4.3 Emissions from Natural Gas Combustion

Emission rate data for the combustion of natural gas fuel has been sourced from the NPI Emission estimation technique manual for *Combustion in Boilers*, Version 3.3 September 2010. Natural gas will be used to fuel the holding furnaces, tilting furnaces and heat ageing ovens. Based on the proposed design, emissions from the combustion of natural gas will be extracted through the same flues as the emissions from the manufacturing processes.

The rate of natural gas energy consumption will be approximately 1330 Gj/day to power the furnaces and heating ovens.

Table 4-4 presents the NPI emission factors as well as adopted emission rates for natural gas consumption based on an annual production capacity of 50,000 tonnes of molten aluminium. The combustion rate of natural gas was assumed to be constant, occurring 24 hours per day every day of the year, equating to 55.4 Gj/hr.

Table 4-4 Total Natural Gas Consumption Emissions (Source: NPI)

Natural Gas Emissions	Emission Factor (kg/Gj) ⁽¹⁾	Total Emissions (kg/hour) ⁽²⁾
Carbon monoxide	4.77E-02	2.64
Oxides of Nitrogen	3.69E-02	2.04
Particulate matter ≤10.0 µm	3.60E-03	1.99E-01
Polycyclic aromatic hydrocarbons	3.11E-07	1.72E-05
Sulfur dioxide	5.37E-04	2.97E-02
Total volatile organic compounds (Total VOC)	2.68E-03	1.48E-01

(1) Number displayed in scientific notation. E.g. 4.77E-2 is equal to 0.0477.

(2) Consumption rate of natural gas is 1330 Gj/day

Natural gas burners are used for the Holding Furnaces, Tilting Furnaces and ageing oven. The Rolling mills are powered by electricity and therefore do not have any emissions from natural gas combustion associated with them.

The breakdown of natural gas use and emissions is shown below in Table 4-5.

Table 4-5 Breakdown of Natural Gas Emissions

Item	Gas Mj/hr	% of Gas Use	kg/hr				
			CO	NO _x	SO ₂	PM ₁₀	VOCs
Hold Furnaces	42478.5	76.6	2.03	1.57	0.02	0.15	0.11
Tilt Furnaces	12671.5	22.9	0.60	0.47	0.007	0.05	0.03
Oven	251.2	0.5	0.01	0.009	0.0001	0.0009	0.0007

4.4 Total Operational Emissions

The total mass emission rates for metal fume and natural gas emissions are summarised below in Table 4-6. These mass emission rates represent the worst-case emissions from the plant, based on the highest in-stack concentrations provided in the test reports from the Bahrain facility. These mass emission rates have been used as input to the plume dispersion model.

Table 4-6 Normalised Mass Emission Rates – Metal Fume plus Natural Gas

Activity	Source	Pollutants – Mass Emission Rates				
		CO	NO _x	SO ₂	PM ₁₀	VOC
		kg/hr	kg/hr	kg/hr	kg/hr	kg/hr
Normal operations	Holding furnaces	2.10	1.61	0.07	0.19	0.14
Normal operations	Tilting furnaces	0.77	0.48	0.04	0.06	0.04
Normal operations	Ovens	0.01	0.01	0.0009	0.001	0.0007
Normal operations	Rolling mill	0.0002	0	0	0.0003	0.002
De-gassing	Holding Furnace	2.12	1.64	0.08	0.29	0.15
De-gassing	Titling Furnace	0.79	0.49	0.05	0.08	0.05

Particulate matter emissions from vehicle movements within the site should be negligible compared to both the stack emissions and the (paved road) emission source of the nearby Tomago Road. Emissions from vehicle exhausts should also be negligible given the limited number of movements and separation distance to the nearest receptors. Fugitive vehicle emissions have not been considered in the dispersion modelling and assessment of impacts but a discussion on this aspect is included as Appendix D.



5. Dispersion Modelling Methodology

Atmospheric dispersion modelling was conducted to predict the maximum ground level concentrations (GLCs) resulting from emissions to air from the project. The predicted ground level concentrations were then assessed against the relevant criteria.

Dispersion modelling of emissions to air requires the selection of an appropriate model and then the selection of three general types of input. These are:

- ▶ Hourly site-specific or site representative meteorological data for a period of not less than one year. The meteorological data file used in this assessment is discussed in Section 2.4.
- ▶ Source characterisation (inclusive of emission rate inventory – see section 4, and source geometry).
- ▶ Model configuration – in which the various model settings are selected to best characterise the physical processes specific to this site and to make best use of the available emissions and meteorological data.

The source characterisation and model configuration are detailed below under relevant section headings.

5.1 The Model

AUSPLUME Version 6.0 is an approved dispersion model in NSW (section 2.4.2 of the *Approved Methods*) and was used in this assessment. AUSPLUME is a steady-state Gaussian plume model that can be used to predict off-site pollutant concentrations for a wide variety of sources and this site involves near-field impacts in terrain that is not complex.

5.1.1 Model Configuration

Key components of the AUSPLUME model configuration used in this assessment are:

- ▶ GLCs were predicted over a 4 km by 4 km receptor grid, with a grid resolution of 50 m.
- ▶ The effect of terrain on plume dispersion was considered to be negligible, given the site is relatively flat, and was therefore not included.
- ▶ The depletion option was not selected for PM₁₀ concentration model runs (this is a conservative approach and will result in a slight over-estimate of PM₁₀ concentration).
- ▶ Irwin's 'Rural' wind profile exponents were used.
- ▶ Horizontal dispersion was parameterised according to equations for the Pasquill-Gifford curves.
- ▶ A roughness height of 0.2 m ('Flat Rural') was used to represent the land features that surround the site.

The model results are discussed in Section 6.

Further detail on the AUSPLUME configuration can be found in the AUSPLUME output files attached in Appendix E.



5.1.2 Source Characterisation

Section 4 provides details on the emission inventory used for the model.

The site layout, buildings and most indicative stack dimensions were provided and used for model input into AUSPLUME.

Discharge parameters for emissions to air from modelled sources have been detailed in Section 4 of this report.

At full capacity, emissions from the various sources were assumed to be constant, emitting 24 hours per day, every day of the year.



6. Impact Assessment

6.1 Construction

Construction activities are expected to consist of the following:

- ▶ Site works, comprising:
 - General earthworks for fill and site preparation.
 - Civil infrastructure works (road works, water and stormwater infrastructure, electrical infrastructure).
- ▶ Construction of the cable manufacturing plant, comprising:
 - The plant buildings and installation of equipment.
 - Ancillary infrastructure and facilities.

The types of emissions to air during the construction process will primarily consist of:

- ▶ Dust emissions from both the mechanical disturbance and wind erosion of crustal material.
- ▶ Vehicle and other exhaust emissions from the range of motor vehicle types required for the project.

Activities that have been identified as possible sources of emissions to air of dust will be:

- ▶ Clearance of vegetation, rock and soil material.
- ▶ Pneumatic rock-breaking, if required.
- ▶ Loading and dumping of cleared material.
- ▶ Leveling and grading of disturbed soil surfaces.
- ▶ Passage of construction and administrative vehicles over unsealed sections of road or localised unconsolidated soil surfaces.
- ▶ Haul truck movements for the delivery and installation of plant items.
- ▶ Wind erosion of all unstable/uncovered stockpiles and other surfaces.

The transport and dispersion of the dust emissions during the site preparation will be influenced by prevailing wind that will alter both diurnally and seasonally.

Vehicle exhaust emissions during the project have the potential to impact on air quality; however the impact is likely to be negligible given the short time period and limited number of vehicles.

Given the nature of the construction activities, the application of standard mitigation measures to reduce dust generation is expected to provide adequate protection to nearby residences. Mitigation measures to reduce impacts during construction activities are discussed in Section 7.1.



6.2 Operation

A Level 2 impact assessment, with consideration to the NSW *Approved Methods* was undertaken for the project. The sections below assess the predicted GLCs against the adopted air quality goals for the individual pollutants assessed in this report.

Air quality impacts from the project have been predicted for normal operations ('normal') and de-gassing operations ('de-gassing'). Due to model limitations and for conservatism, de-gassing emissions have assumed to occur continuously for the 'de-gassing' model run. This is highly conservative given that de-gassing operations are expected to occur for approximately 10 minutes every 3 hours.

Typical background concentration levels of NO₂, SO₂ and PM₁₀ were added to the predicted incremental impacts before comparison with the adopted criteria. There was no background air quality data available for CO.

6.2.1 Carbon Monoxide (CO)

Predicted off-site CO concentrations from the cable manufacturing plant emissions were assessed against OEH criteria, and the results are given in Table 6-1.

Predicted 15-minute, 1-hour and 8-hour average incremental impacts of CO were found to be at least an order of magnitude below the OEH criteria at all nearby sensitive receptors. It is therefore considered that the CO levels generated by the project will not impact on the local amenity.

With negligible incremental impact, it is also considered that the cumulative impact (incremental plus background) will comply with OEH criteria.

Table 6-1 Impact Assessment Criteria and Predicted Concentration Levels of Carbon Monoxide (CO) (with percentage of assessment criterion)

Receptor	Averaging Period	Criterion (mg/m ³)	Maximum Predicted Concentration (mg/m ³)	
			Normal	De-gassing
R1	15 minutes	100	0.08 (<0.1%)	0.08 (<0.1%)
	1 hour	30	0.06 (<0.1%)	0.06 (<0.1%)
	8 hour	10	0.01 (<0.1%)	0.01 (<0.1%)
R2	15 minutes	100	0.19 (<0.1%)	0.19 (<0.1%)
	1 hour	30	0.17 (0.6%)	0.17 (0.6%)
	8 hour	10	0.11 (1.1%)	0.11 (1.1%)
R3	15 minutes	100	0.18 (<0.1%)	0.18 (<0.1%)
	1 hour	30	0.16 (0.5%)	0.16 (0.5%)
	8 hour	10	0.11 (1.1%)	0.11 (1.1%)

Receptor	Averaging Period	Criterion (mg/m ³)	Maximum Predicted Concentration (mg/m ³)	
			Normal	De-gassing
R4	15 minutes	100	0.15 (<0.1%)	0.15 (<0.1%)
	1 hour	30	0.13 (<0.1%)	0.13 (<0.1%)
	8 hour	10	0.07 (1.1%)	0.07 (1.1%)
R5	15 minutes	100	0.12 (<0.1%)	0.12 (<0.1%)
	1 hour	30	0.10 (<0.1%)	0.10 (<0.1%)
	8 hour	10	0.02 (<0.1%)	0.02 (<0.1%)

6.2.2 Nitrogen Dioxide (NO₂)

The testing reports provided from the Bahrain facility note mixtures of NO, NO₂ and NO_x emissions from some sources. Where NO and NO₂ concentrations were provided, both were included in the total NO₂ assessment. The OEH outlines various methods for assessing the oxidation of NO to NO₂ in the atmosphere. As a conservative measure it was assumed 100% conversion of NO_x to NO₂.

Table 6-2 shows the predicted incremental NO₂ concentrations for 1-hour average and annual average periods at each of the identified receptors. De-gassing operations have been included in the annual average predictions.

Table 6-2 Maximum Predicted NO₂ GLCs (µg/m³) (with percentage of assessment criterion)

Receptor	Averaging Period	Incremental Impact		Adopted Background	Highest Cumulative Impact	Criterion
		Normal	De-gassing			
R1	1 hour	32 (13%)	33 (13%)	74 ⁽¹⁾	107 (43%)	246
	Annual	-	<1 (2%)	2 ⁽²⁾	<3 (5%)	62
R2	1 hour	99 (40%)	100 (41%)	74	174 (71%)	246
	Annual	-	5 (8%)	2	7 (11%)	62
R3	1 hour	98 (40%)	100 (41%)	74	174 (71%)	246
	Annual	-	5 (8%)	2	7 (11%)	62

Receptor	Averaging Period	Incremental Impact		Adopted Background	Highest Cumulative Impact	Criterion
		Normal	De-gassing			
R4	1 hour	83 (34%)	84 (34%)	74	158 (64%)	246
	Annual	-	4 (6%)	2	6 (10%)	62
R5	1 hour	55 (22%)	56 (23%)	74	130 (53%)	246
	Annual	-	<1 (2%)	2	<3 (5%)	62

(1) Taken as the maximum 1-hour concentration throughout 2009 and 2010 at Beresfield.

(2) The annual average throughout 2009 and 2010 – based on 24 hour average levels.

Predicted 1-hour and annual average cumulative impacts of NO₂ were found to be less than the OEH assessment criteria at all nearby sensitive receptors. It is therefore considered that the NO₂ levels generated by the project will not impact on the local amenity.

The maximum predicted GLCs were highest at Receptors 2 and 3, where predicted incremental concentrations were approximately 41% of the OEH 1-hour criterion. When this increment is combined with the adopted background level the resultant impact is approximately 71% of the impact assessment criterion.

Note that these results are based on conservative assumptions with highest hourly background concentration level adopted and 100% conversion of NO_x to NO₂ assumed for the tilting furnaces and natural gas combustion.

A contour plot for maximum 1-hour NO₂ concentration levels is shown in Appendix F.

GHD note that the neighbouring TAC smelter contains a significant source of NO_x emissions in the bake ovens. The adopted background levels taken from the Beresfield station do not account for this emission source as the ambient monitoring site is more than 5 km distance from the source. No other ambient air monitoring data was available for NO_x in the area as TAC are only required to perform fluoride and SO₂ monitoring for licence compliance purposes. Air quality assessments from the TAC smelter do not generally identify NO_x as a significant emission and have not identified any exceedances of the OEH criterion. Therefore, given that the highest incremental impact from the project is 41% of the 1-hour criterion, it is unlikely that additional (if any) cumulative impacts will occur.

6.2.3 Sulfur Dioxide (SO₂)

Predicted incremental SO₂ concentration levels at the nearest sensitive receptors from the project are shown below in Table 6-3. De-gassing operations have been included in the annual average predictions.

Table 6-3 Maximum Predicted SO₂ GLCs from the Project (µg/m³) (with percentage of assessment criterion)

Receptor	Averaging Period	Incremental Impact		Criterion
		Normal	De-gassing	
R1	10 minute	3.8 (0.5%)	4.5 (0.6%)	712
	1 hour	2.8 (0.5%)	3.3 (0.6%)	570
	24 hour	0.2 (0.1%)	0.2 (0.1%)	228
	Annual	-	<0.1 (0.2%)	60
R2	10 minute	8.3 (1.2%)	9.8 (1.4%)	712
	1 hour	7.3 (1.3%)	8.7 (1.5%)	570
	24 hour	2.0 (0.9%)	2.4 (1%)	228
	Annual	-	0.3 (0.5%)	60
R3	10 minute	7.8 (1.1%)	9.3 (1.3%)	712
	1 hour	6.7 (1.2%)	8.0 (1.4%)	570
	24 hour	2.1 (0.9%)	2.5 (1.1%)	228
	Annual	-	0.4 (0.7%)	60
R4	10 minute	6.6 (0.9%)	7.9 (1.1%)	712
	1 hour	5.5 (1%)	6.5 (1.1%)	570
	24 hour	1.3 (0.6%)	1.6 (0.7%)	228
	Annual	-	0.4 (0.7%)	60
R5	10 minute	5.4 (0.8%)	6.5 (0.9%)	712
	1 hour	4.2 (0.7%)	5.0 (0.9%)	570
	24 hour	0.5 (0.2%)	0.5 (0.2%)	228
	Annual	-	<0.1 (0.2%)	60

The maximum predicted GLCs of SO₂ from the project alone are well below the OEHL impact assessment criteria, with the maximum 1-hour average concentration level during de-gassing operations being less than 2% of the OEHL criterion. Daily (24-hour) and annual average incremental impacts are also shown to be a fraction of the OEHL criteria. Section 6.2.4 discusses cumulative SO₂ impacts.

A contour plot for maximum 1-hour SO₂ concentration levels is shown in Appendix F.



6.2.4 Cumulative SO₂ Emissions

The maximum incremental 1-hour SO₂ impact from the project was predicted to be less than 2% of the OEH criteria. In order to assess the cumulative impacts of SO₂ emissions, the predicted incremental impacts were added to the corresponding measured background concentration from the most representative monitoring location. The assessment of cumulative impacts is made to determine if the operation of the project would result in any additional exceedances of the SO₂ assessment criteria.

The cumulative impact assessment has been undertaken for the most impacted sensitive receptor over a 1-hour averaging period, being Receptor 2. Table 6-4 shows the ten highest measured 1-hour SO₂ concentrations with the corresponding predicted incremental impact for the project. Measured SO₂ concentrations have been taken from the highest readings at the School Drive and Tomago Farm monitoring stations throughout the time period of January 2009 to September 2011. Both these stations are located within the vicinity of Receptor 2.

Incremental impacts from the project were predicted using meteorological data files generated from the TAC weather station data corresponding to the day and time of the highest background SO₂ measurements.

The location of the existing TAC smelter and the project relative to Receptor 2 means that maximum impact from each facility may occur under similar weather conditions. That is, relative to Receptor 2, both sources are aligned in the same direction. Maximum impact at Receptor 2 from each of the two sources (TAC smelter and project) was found to occur under northwest and west-northwest winds.

Table 6-4 1-hour SO₂ Impact and Background – Receptor 2

Date, Hour	SO ₂ 1-hour average (µg/m ³)			OEH Criteria
	Highest Background	Predicted Increment	Total	
12/08/2011, 5:00	725	0.3	725.3	570
12/08/2011, 3:00	703	2.5	705.5	570
5/10/2009, 22:00	659	3.5	662.5	570
12/08/2011, 4:00	542	0	542	570
5/10/2009, 21:00	498	0	498	570
4/07/2010, 8:00	486	0.04	486	570
23/06/2011, 1:00	473	2.1	475.1	570
12/08/2011, 6:00	473	0.7	473.7	570
17/07/2010, 10:00	467	0.2	467.2	570
13/07/2011, 7:00	465	0.01	465	570

The results of Table 6-4 indicate that the addition of the incremental impact from the project does not cause additional exceedances of the OEH 1-hour average SO₂ criteria. This methodology is consistent with the Approved Methods guidance in dealing with elevated background concentrations (section 5.1.3, *Approved Methods*) for when existing ambient concentrations already exceed the impact assessment criterion.

The maximum predicted 24-hour SO₂ impact from the project was predicted to be approximately 1% of the OEH criteria. TAC SO₂ monitoring results from the School Drive and Tomago Farm stations indicated that there were 8 days in 2010 and 19 days in 2011 where the 24-hour SO₂ concentration was higher than the OEH criteria of 228 µg/m³. The next highest background concentration levels were 226.3 µg/m³ on 25/08/2010 and 224.6 µg/m³ on 30/09/2011, both at School Drive. These concentration levels were found to occur under consistent light winds from the west-northwest, which are the same weather conditions that were found to cause the maximum predicted incremental concentration of 2.5 µg/m³ from the project. Therefore, the addition of these levels (226.3 + 2.5 = 228.8 µg/m³) would cause one additional exceedance of the 24-hour SO₂ criterion. Note that at 0.8 µg/m³, the exceedance is marginal with the overwhelming contribution from the TAC smelter. Figure 11 shows the incremental contribution graphically against the 25 highest background SO₂ levels recorded at the Tomago Farm and School Drive monitoring stations during 2011 so far. It can be seen that the incremental impact from the project is insignificant compared to the existing measured levels. Based on the 2011 SO₂ monitoring data and the maximum predicted incremental impact, there would not be an additional exceedance of the 24-hour criterion.

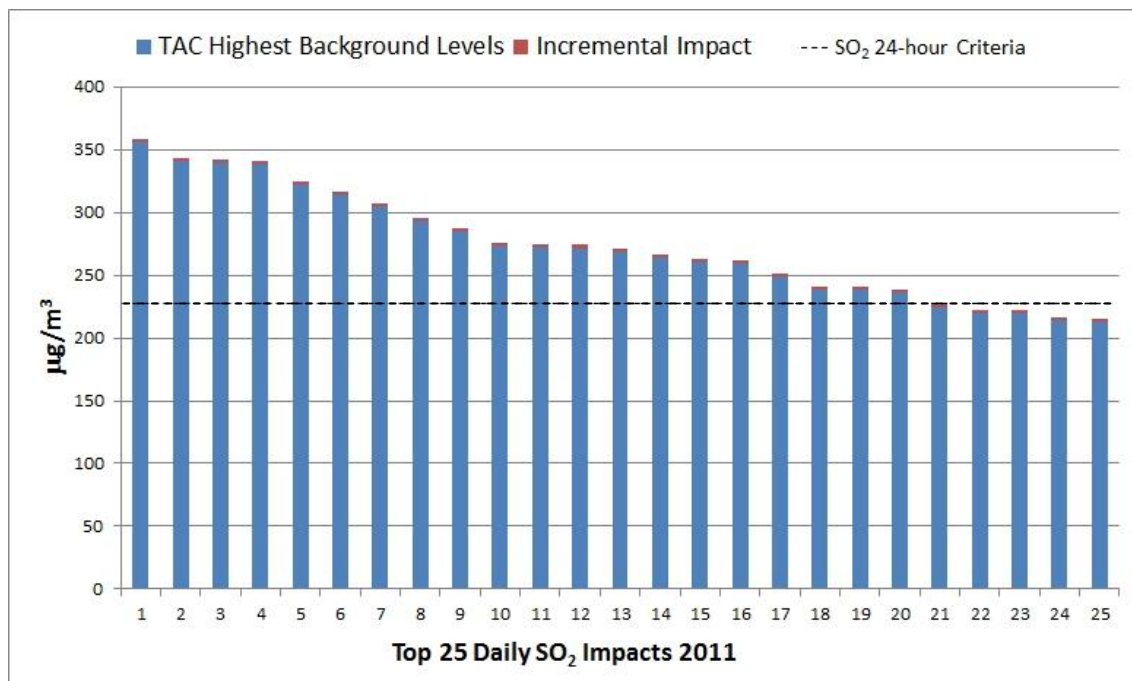


Figure 11 24-hour Cumulative SO₂ Impacts, 2011

Therefore, if the measured background level is very close to the criterion, it is possible that an additional exceedance of the 24-hour SO₂ criterion may occur from the operations of the project. However, this conclusion should be viewed in context. The maximum incremental contribution



from the project, over a 24-hour period is approximately 1% of the OEH criterion. The remaining background concentration levels are primarily made up of emissions from the neighbouring TAC smelter. Therefore, the incremental impact from the project is considered to be very minor.

An alternative to the above approach is the methodology of the Victorian State Environment Protection Policy (Air Quality Management) or 'SEPP (AQM)' that recommends a way of determining an ambient background air quality concentration level separate to location specific fixed-site monitoring. The SEPP AQM recommends adopting the 70th percentile of measured ambient levels as the background concentration level for averaging times greater than 1-hour. Based on TAC supplied SO₂ monitoring data, this approach would yield a 24-hour SO₂ background (or ambient) concentration level of approximately 40 µg/m³. The addition of the predicted incremental impact would then result in a cumulative impact well below the OEH criterion. It is acknowledged that this approach is generally not taken for air quality assessments in NSW, however, it has been included to demonstrate the conservatism of the *Approved Methods* assessment approach.

6.2.5 VOC's

VOC emissions from the project are primarily produced from the combustion of natural gas, with a small proportion from the metal fume.

As the breakdown of VOC's within the metal fume was unknown, propane was adopted as a surrogate for conversion from ppm to mg/m³. The total VOC's were then used as input to the dispersion model.

The United States Environment Protection Agency's SPECIATE Version 3.2⁵ model identifies the VOC speciation for combustion of natural gas.

Table 6-5 shows the breakdown of VOC's from combustion of natural gas and the OEH criteria for each species. Table 6-6 displays the predicted 1-hour incremental concentration levels for total VOC's at the identified receptors. For conservatism, VOC concentrations have been predicted using emission factors during de-gassing operations.

Table 6-5 Total VOC Breakdown from Natural Gas Combustion

Species	Weight Per cent	OEH Criteria 1-hour (mg/m ³)
Benzene	4	0.029
Cyclohexane	1	0.26
Formaldehyde	8	0.02
N-pentane	6	33
Toluene	2	0.36

Note: The OEH does not provide recommended criteria for the remaining species in the breakdown of total VOC emissions. Therefore these were not included in this assessment.

⁵ www.epa.gov/ttn/chief/software/speciate

Table 6-6 Maximum Predicted 1-hour VOC Impact

Receptor	Predicted 1-hour Incremental Impact (mg/m ³)	
	Normal	De-gassing
R1	0.003	0.003
R2	0.009	0.010
R3	0.009	0.011
R4	0.007	0.008
R5	0.005	0.005

If all of this combined VOC emission is modelled as benzene, it can be conservatively compared to the assessment criterion. Predicted model results indicated a maximum 1-hour average concentration level of total VOC's at Receptor 3 (the most affected receptor) to be 0.011 mg/m³. This value is approximately half or less of any of the OEH criteria listed in Table 6-5, suggesting compliance of all VOC species. So even if all the VOC were benzene, for example, the predicted incremental impact is below the design criterion. Therefore, it is considered that the levels of VOC emissions generated by the project will not impact on the local environment.

6.2.6 Particulate Matter Impact (PM₁₀)

Table 6-7 shows the predicted incremental impact for 24-hour average and annual average PM₁₀ at each of the identified receptors. PM₁₀ emissions from the project were then added to the adopted background levels and assessed against OEH criteria. De-gassing operations have been included in the annual average predictions.

Table 6-7 Maximum Predicted PM₁₀ GLCs (with percentage of assessment criterion)

Receptor	Averaging Period	Incremental Impact (µg/m ³)		Adopted Background (µg/m ³)	Cumulative Impact (µg/m ³)	Criterion (µg/m ³)
		Normal	De-gassing			
R1	24 hour	0.2 (0.4%)	0.3 (0.6%)	41	41.3 (83%)	50
	Annual	-	<0.1 (0.3%)	22	22.1 (74%)	30
R2	24 hour	3.6 (7.2%)	5.4 (10.7%)	41	46.4 (93%)	50
	Annual	-	0.6 (2.0%)	22	22.6 (75%)	30

Receptor	Averaging Period	Incremental Impact ($\mu\text{g}/\text{m}^3$)		Adopted Background ($\mu\text{g}/\text{m}^3$)	Cumulative Impact ($\mu\text{g}/\text{m}^3$)	Criterion ($\mu\text{g}/\text{m}^3$)
		Normal	De-gassing			
R3	24 hour	3.2 (6.4%)	4.7 (9.4%)	41	45.7 (91%)	50
	Annual	-	1.0 (3.3%)	22	23.0 (77%)	30
R4	24 hour	2.2 (4.5%)	3.3 (6.7%)	41	44.3 (89%)	50
	Annual	-	0.8 (2.7%)	22	22.8 (76%)	30
R5	24 hour	0.6 (1.3%)	1.0 (1.9%)	41	42.0 (84%)	50
	Annual	-	<0.1 (0.3%)	22	22.1 (74%)	30

Predicted concentration levels show the maximum 24-hour average PM_{10} incremental impact at the highest impacted sensitive receptor to be approximately 11% of the OEHL criteria. The maximum predicted GLCs of PM_{10} indicate that the cumulative impact (incremental plus background) will comply with OEHL criteria at all of the identified receptors over all time intervals.

A contour plot for maximum 24-hour PM_{10} concentration levels is shown in Appendix F.

6.2.7 Odorous Emissions

The process of aluminium smelting removes oxides and impurities from the metal. Therefore, molten aluminium arriving at the manufacturing plant will have minimal levels of impurities, including sulphur compounds, and corresponding odorous emissions. Additionally, any odour from the molten material will be several orders of magnitude lower than the neighbouring smelter.

Section 4 of this report outlines the expected air emissions from the project as NO_x , SO_2 , CO, VOC's and PM_{10} . Table 7.4a of the NSW *Approved Methods* lists impacts assessment criteria for individual odorous air pollutants. Of the expected emissions, individual species of VOC's are the only pollutants listed in the *Approved Methods* as odorous. As shown in Section 6.2.5, the concentration levels of individual VOC's are expected to be well below the assessment criteria. Therefore, odour is not considered to be an issue with products of combustion coming from gas fuelled power plant or from the metal fume emissions.

Based on the above findings, the impact of odorous emissions from the project is expected to be negligible.

6.3 Protection of the Environment Operations (Clean Air) Regulation 2010

In-stack pollutant concentrations have been assessed against the OEHS Protection of the Environment Operations (Clean Air) Regulation 2010. Part 5 of the regulation applies to industries and deals with emission of air impurities from activities and plant. In particular, the Regulation:

- ▶ Sets maximum limits on emissions from activities and plant for a number of substances, including oxides of nitrogen, smoke, solid particles, chlorine, dioxins, furans and heavy metals.
- ▶ Imposes operational requirements for certain afterburners, flares, vapour recovery units and other treatment plant.
- ▶ Deals with the transport and storage of volatile organic liquids.
- ▶ Restricts the use of high sulfur liquid fuel.

Since operations would commence after September 2005, under the Clean Air Regulation, the project is classified as Group 6.

In-stack concentration levels for metal fume emissions were supplied to GHD by Midal. These were then added to the calculated emissions from natural gas combustion to give total in-stack concentration levels. All concentration levels have been converted to a normalised basis, using a temperature conversion to a standardised 0°C. Stack release parameters and pollutant concentrations have been discussed in Section 4.

There is no Group 6 emission limit for SO₂ for general activities or plant. The only SO₂ limit in the Clean Air Regulations applies to the manufacture of sulphuric acid exclusively. Therefore, SO₂ emissions have been excluded from the assessment against the Clean Air Regulations.

Table 6-8 presents a summary of the predicted stack concentration levels and the Clean Air Regulation criteria.

Table 6-8 Clean Air Regulation 2010 – Predicted Concentrations

Emission Source	In-stack Concentration (mg/m ³)		
	Solid particles (total) ⁽²⁾	NO ₂	VOC ⁽³⁾ (n-propane)
Holding furnace - normal	24	205	17
Holding furnace – de-gassing	36	208	19
Tilting furnace - normal	24	205	19
Tilting furnace – de-gassing	35	208	22
Gas Oven	15	112	7
Rolling Mill	3	0	23
POEO Limits (mg/m³)⁽¹⁾	50	300	40



- (1) Concentration goals from Schedule 3: Standards of concentration for scheduled premises - activities and plant for specific purposes.
- (2) Based on PM₁₀ emission rate only.
- (3) Based on total VOC's.

The results shown in Table 6-8 indicate that all emissions are well below the assessment criteria.

Due to emissions from the burning of natural gas outweighing emissions from metal fume, the de-gassing operations do not significantly increase total in-stack concentrations.



7. Mitigation measures

7.1 General Construction Dust Mitigation Measures

While general construction operations are not expected to cause adverse air quality impacts, the following mitigation measures would be implemented to reduce fugitive dust emissions:

- ▶ Water material prior to it being loaded for haulage, where appropriate.
- ▶ Aim to minimise the size of storage piles where possible.
- ▶ Limit cleared areas of land and clear only when necessary.
- ▶ Control on-site traffic by designating specific routes for haulage and access and limiting vehicle speeds to below 25 km/hr.
- ▶ All trucks hauling material would be covered before exiting the site and would maintain a reasonable amount of vertical space between the top of the load and top of the trailer.
- ▶ Excavating operations conducted in areas of low moisture content material would be suspended during high wind speed events or water sprays would be used.

7.2 Operation

Off-site impacts are expected to comply with OEH emission criteria at all identified receptors. Additionally, the emission limits provided in the Clean Air Regulations (2010) are also met.

Worst-case emissions have been assumed throughout this assessment, based on emission testing reports provided for an identical processing facility, albeit on a larger scale, in Bahrain. It has been assumed that the Bahrain facility was equipped with reasonably available technology and is operated in a proper and efficient way. This is indicated in the emission testing reports which show that the limits of the Environment Protection Committee (EPC) are comfortably met. This reflects a plant which is run efficiently and with good environmental practices. It is expected that the project would utilise more modern reasonably available technology and also be operated in a proper and efficient way, which would ensure that the plant will meet the Regulation limits.

The project would be issued with an Environmental Protection Licence (EPL) which would likely require monitoring of emissions from the site on a regular basis. Stack testing monitoring may initially be required once or twice per year. If it is demonstrated that the plant is always under the EPL limits, the monitoring requirements may be reduced or ceased after a few years.

8. Conclusions

The impacts of emissions to air from the project have been assessed through atmospheric dispersion modelling. The following conclusions were made.

- ▶ The site is located within the existing industrial buffer zone set for the neighbouring TAC smelter. The smelter produces over 530,000 tonnes of aluminium product per year. Comparatively smaller, the project will have a throughput of approximately 50,000 tonnes of molten aluminium per year.
- ▶ Primary emissions from the project result from metal plumes from molten aluminium and the combustion of natural gas (NO₂, SO₂, CO, PM₁₀ and VOCs).
- ▶ Principal sources of emissions were the holding furnace and tilt furnace flues.
- ▶ Light, stable winds are most frequent from the west-northwest and northwest, indicating that the direction of poor dispersion will be to the east-southeast and southeast of the site. Some of the nearest sensitive receptors are located in this direction. Maximum concentration levels at the Receptors 2 and 3 (the most impacted receptors) were caused during light, stable flows from the northwest.
- ▶ The maximum predicted 15-minute, 1-hour and 8-hour average incremental impacts of CO were found to be considerably less than the OEH criteria at all nearby sensitive receptors.
- ▶ The maximum predicted 1-hour and annual average cumulative impacts of NO₂ were found to be less than the OEH assessment criteria at all nearby sensitive receptors. It is therefore considered that the NO₂ levels generated by the project will not impact on the local amenity.
- ▶ The predicted incremental concentration levels of SO₂ at the most sensitive receptors were significantly below the OEH criteria. The highest predicted 1-hour average incremental SO₂ concentration level was less than 2% of the criterion, while the 24-hour incremental concentration level was predicted to be 1% of the criterion.
- ▶ TAC conducts SO₂ monitoring at a number of locations surrounding the site. Monitoring results indicated that the background SO₂ concentration levels are generally high and have exceeded the 1-hour and 24-hour average criteria on a number of occasions throughout 2009, 2010 and 2011. Therefore, a cumulative impact assessment was undertaken which indicated that, although the incremental impacts are very minor, there is potential for an additional exceedance of the 24-hour SO₂ criterion (based on the assessment approach outlined in the *Approved Methods*). There is not expected to be any additional exceedances of the 1-hour SO₂ criterion with the operations of the project.
- ▶ Predicted results for concentration levels of VOC's suggest compliance of all VOC species over all averaging time periods.
- ▶ Predicted results show the maximum 24-hour average PM₁₀ incremental concentration levels to be approximately 11% of the OEH criteria. The maximum predicted GLCs of PM₁₀ indicate that the cumulative impact will comply with OEH criteria at all of the identified receptors over all time intervals.



- ▶ Odorous emissions from the construction and operation of the project are expected to be negligible.
- ▶ In-stack concentration levels for each of the stacks indicate that the goals recommended in the Clean Air Regulation (2010) will be met.



9. Limitations

This “Report for Tomago Cable Manufacturing Plant – Air Quality Impact Assessment”:

1. Has been prepared by “GHD Australia Pty Ltd” for Midal Cable International Pty Ltd.
2. May only be used and relied on by Midal Cable International Pty Ltd.
3. Must not be copied to, used by, or relied on by any person other than Midal Cable International Pty Ltd without the prior written consent of GHD.
4. May only be used for the purpose of Air Quality Impact Assessment (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 Midal Cable International Pty Ltd 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:

- ▶ The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report.
- ▶ Relied on client supplied data which was not independently verified.

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.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation.



10. References

Legislation

- ▶ NSW Office of Environment and Heritage (OEH) Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, August 2005.
- ▶ OEH Protection of the Environment Operations (Clean Air) Regulation 2010.

Reports

- ▶ Newcastle State of the Environment report, Newcastle City Council, 2009.
- ▶ The National Pollutant Inventory (NPI) Emission estimation technique manual for Combustion in Boilers, Version 3.3 September 2010.
- ▶ The National Pollutant Inventory (NPI) Emission Estimation Technique Manuals for Aluminium Smelting, March 1999.
- ▶ NSW Government Planning Assessment Report, Tomago Aluminium Smelter, Section 96(2) Modification – Proposed Increase in Production Rate, 2009.
- ▶ Magnum Industrial Laboratories, Air Pollutant Analysis, Bahrain Cable Manufacturing Plant, January 2005.

Website Information

NSW Government Office of Environment and Heritage (OEH) Air Quality Monitoring Reports, Ambient air data accessed from <http://www.environment.nsw.gov.au/AQMS/search.htm> (accessed 12/12/2011)



Appendix A

TAC Air Quality Monitoring Stations

Fluoride and Sulfur dioxide

Ambient Air Monitoring Sites

(F) – Fluoride monitoring
SO₂ – Sulphur dioxide monitoring



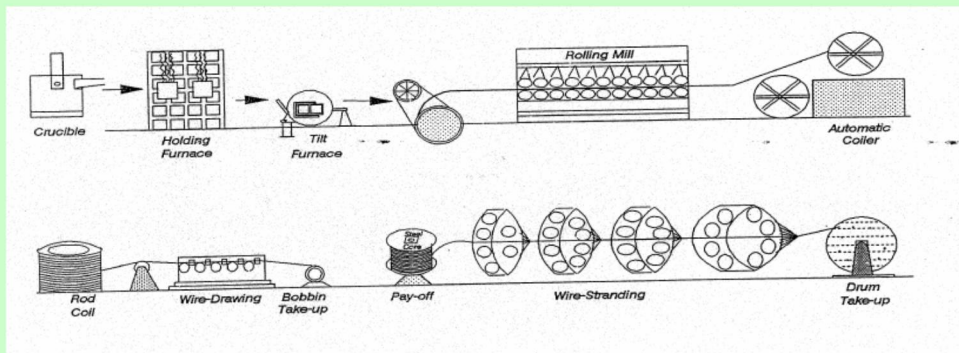


Appendix B

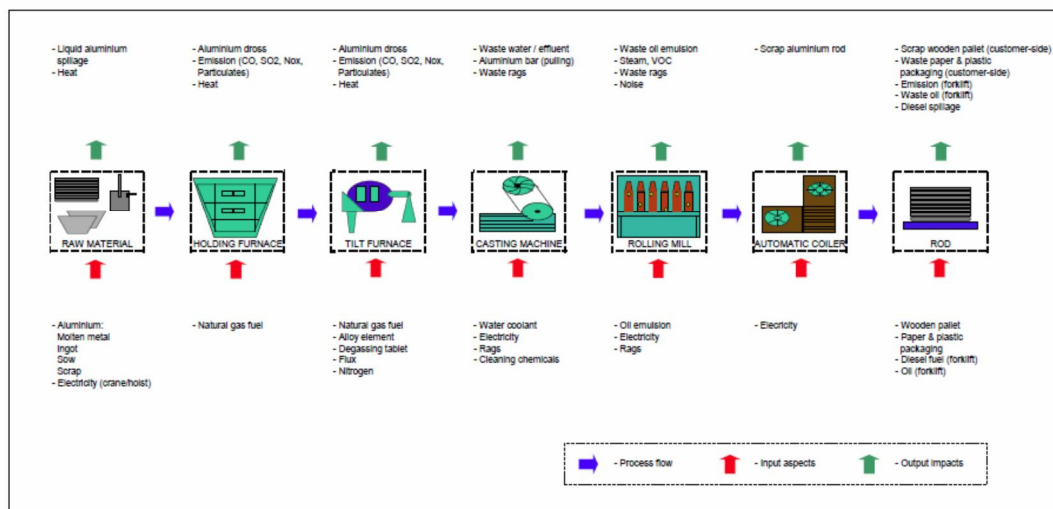
Manufacturing Diagrams

Cable Manufacturing

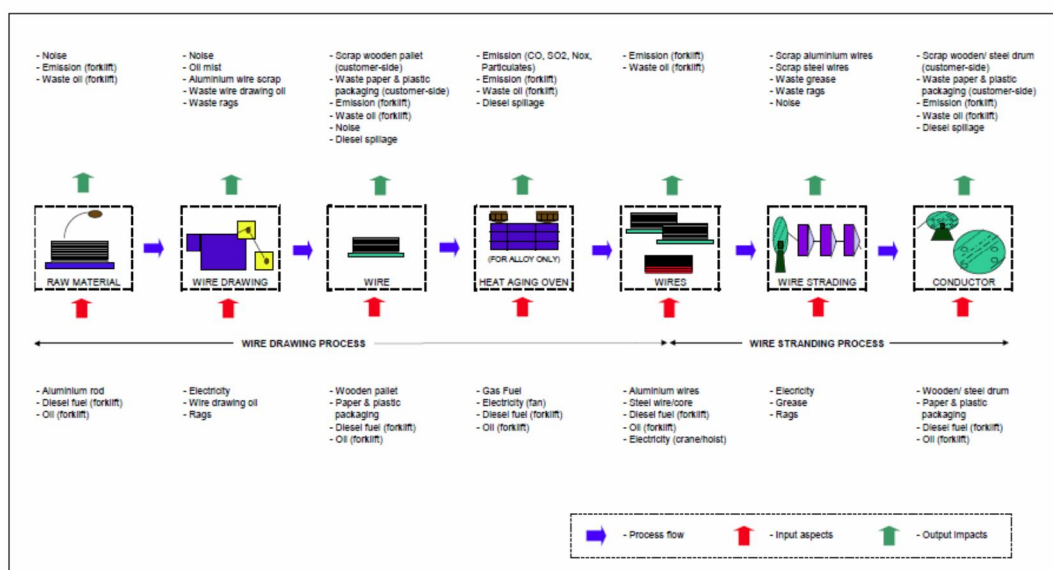
ALUMINIUM ROD AND CONDUCTOR MANUFACTURING FLOW



CASTING AND ROLLING PROCESS



WIRE DRAWING AND WIRE STRANDING PROCESSES





Appendix C

Emission Testing Reports

JANUARY- 9TH , 2005**AIR POLLUTION ANALYSIS**

CLIENT:- MIDAL CABLE LTD P.O.BOX: 5838 KINGDOM OF BAHRAIN	MIL JOB NO: JAN 009-F
	MIL REPORT NO.: MIL/RPT/0079/CH-01/05
	MONITORING COMPLETED: DATED: JANUARY- 6 TH ,2005

JOB DESCRIPTION: Following are the Air Sample Analysis Results which are Monitored in Rolling Mill -1

Sc.No	PARAMETERS	CONCENTRATION		EPC LIMITS
		Mg/m ³	PPM	
01	Particulate matter (0.45 μ)	1.81	---	50
02	Carbon-monoxide (CO)	Traces	<1.0	400
03	Sulphur-di-oxide (SO ₂)	Traces	<1.0	500
04	Nitrous Fumes (NO)	Traces	<1.0	400
05	Nitrogen-di-oxide (NO ₂)	Traces	<1.0	400
06	Volatile (O) Compound	Traces	<1.0	20

NOTE: All the parameters are under the limits of Environmental Protection Committee.


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AIR MONITORING ANALYSIS

<u>CLIENT:-</u>	MIL JOB NO: FEB-033-F
MIDAL CABLES LTD	MIL REPORT NO: MIL/RPT/0631/LC-02/06
KINGDOM OF BAHRAIN	MONITORING COMPLETED DATE: 27 th February-06

JOB DESCRIPTION: Following are the Air Sample Analysis Results
 Monitored at the Rolling Mill No.3

Se.No	PARAMETERS	CONCENTRATION		EPC LIMITS
		Mg/m ³	PPM	
01	Particulate matter (0.45 μ)	1.53	---	50
02	Carbon-monoxide (CO)	Traces	<1.0	400
03	Sulphur-di-oxide (SO ₂)	Traces	<1.0	500
04	Nitrogen Oxide(No _x)	Traces	<1.0	400
05	Volatile (O) Compound	Traces	<1.0	20

NOTE: All the parameters are under the limits of Environmental Protection Committee.

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JANUARY- 9TH , 2005**AIR POLLUTION ANALYSIS**

CLIENT:- MIDAL CABLE LTD P.O.BOX: 5838 KINGDOM OF BAHRAIN	MIL JOB NO: JAN 009-B
	MIL REPORT NO.: MIL/RPT/0075/CH-01/05
	MONITORING COMPLETED: DATED: JANUARY- 6 TH ,2005

JOB DESCRIPTION: Following are the Air Sample Analysis Results which are Monitored in Tilting Furnace-2 during degassing operations.

Sc.No	PARAMETERS	CONCENTRATION		EPC LIMITS
		Mg/m ³	PPM	
01	Particulate matter (0.45 μ)	15.60	---	50
02	Carbon-monoxide (CO)	11.50	2.3	400
03	Sulphur-di-oxide (SO ₂)	9.07	3.4	500
04	Nitrous Fumes (NO)	3.64	1.9	400
05	Nitrogen-di-oxide (NO ₂)	2.49	1.3	400
06	Volatile (O) Compound	7.07	2.1	20

NOTE: All the parameters are under the limits of Environmental Protection Committee.

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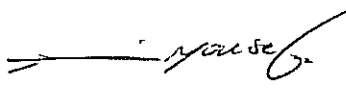
28TH FEBRUARY-06**AIR MONITORING ANALYSIS**

<u>CLIENT:-</u>	MIL JOB NO: FEB-033-C
MIDAL CABLES LTD	MIL REPORT NO: MIL/RPT/0629/LC-02/06
KINGDOM OF BAHRAIN	MONITORING COMPLETED DATE: 27 th February-06

JOB DESCRIPTION: Following are the Air Sample Analysis Results
 Monitored at the stack of Tilting Furnace No.3 during
 Degassing Operation Condition.

Se.No	PARAMETERS	CONCENTRATION		EPC LIMITS
		Mg/m ³	PPM	
01	Particulate matter (0.45 μ)	6.9	---	50
02	Carbon-monoxide (CO)	15.0	3.0	100
03	Sulphur-di-oxide (SO ₂)	13.35	5.0	500
04	Nitrogen Oxide(No _x)	8.93	4.6	400
05	Volatile (O) Compound	Traces	<1.0	20

NOTE: All the parameters are under the limits of Environmental Protection Committee.

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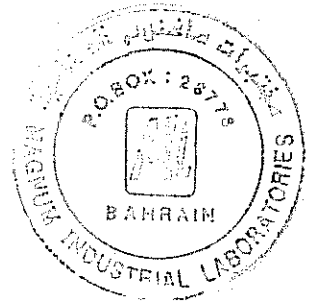
JANUARY- 9TH, 2005**AIR POLLUTION ANALYSIS**

CLIENT:- MIDAL CABLE LTD P.O.BOX: 5838 KINGDOM OF BAHRAIN	MIL JOB NO: JAN 009-A
	MIL REPORT NO.: MIL/RPT/0074/CH-01/05
	MONITORING COMPLETED: DATED: JANUARY- 6 TH , 2005

JOB DESCRIPTION: Following are the Air Sample Analysis Results which are Monitored at the stack of Holding Furnace-No.3

Se.No	PARAMETERS	CONCENTRATION		EPC LIMITS
		Mg/m ³	PPM	
01	Particulate matter (0.45 μ)	3.90	---	50
02	Carbon-monoxide (CO)	10.0	2.0	400
03	Sulphur-di-oxide (SO ₂)	6.14	2.3	500
04	Nitrous Fumes (NO)	2.03	1.2	400
05	Nitrogen-di-oxide (NO ₂)	2.88	1.5	400
06	Volatile (O) Compound	Traces	<1.0	20

NOTE: All the parameters are under the limits of Environmental Protection Committee.

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JANUARY- 9TH, 2005**AIR POLLUTION ANALYSIS**

CLIENT:- MIDAL CABLE LTD P.O.BOX: 5838 KINGDOM OF BAHRAIN	MIL JOB NO: JAN 009-C
	MIL REPORT NO.: MIL/RPT/0076/CH-01/05
	MONITORING COMPLETED: DATED: JANUARY- 6 TH , 2005

JOB DESCRIPTION: Following are the Air Sample Analysis Results which are Monitored in Tilting Furnace-2 under normal operations.

Se.No	PARAMETERS	CONCENTRATION		EPC LIMITS
		Mg/m ³	PPM	
01	Particulate matter (0.45 μ)	3.39	---	50
02	Carbon-monoxide (CO)	6.00	1.2	400
03	Sulphur-di-oxide (SO ₂)	4.00	1.5	500
04	Nitrous Fumes (NO)	2.60	1.4	400
05	Nitrogen-di-oxide (NO ₂)	1.92	1.0	400
06	Volatile (O) Compound	Traces	<1.0	20

NOTE: All the parameters are under the limits of Environmental Protection Committee.



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**AIR MONITORING ANALYSIS**

<u>CLIENT:-</u>	MIL JOB NO: FEB-033-A
MIDAL CABLES LTD	MIL REPORT NO: MIL/RPT/0626/LC-02/06
KINGDOM OF BAHRAIN	MONITORING COMPLETED DATE: 27 th February-06

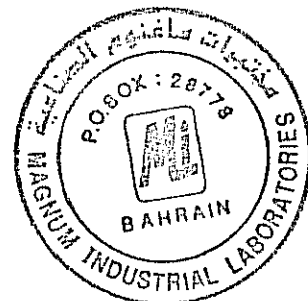
JOB DESCRIPTION: Following are the Air Sample Analysis Results
Monitored at the stack of Holding Furnace-No.2

Se.No	PARAMETERS	CONCENTRATION		EPC LIMITS
		Mg/m ³	PPM	
01	Particulate matter (0.45 μ)	4.90	---	50
02	Carbon-monoxide (CO)	2.30	2.3	400
03	Sulphur-di-oxide (SO ₂)	6.14	3.0	500
04	Nitrogen Oxide(No _x)	2.03	5.4	400
05	Volatile (O) Compound	Traces	<1.0	20

NOTE: All the parameters are under the limits of Environmental Protection Committee.

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AIR MONITORING ANALYSIS

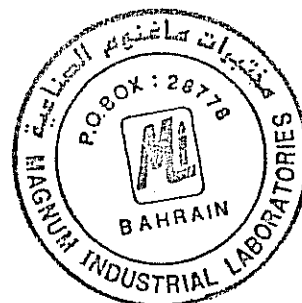
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MIDAL CABLES LTD	MIL REPORT NO: MIL/RPT/0628/LC-02/06
KINGDOM OF BAHRAIN	MONITORING COMPLETED DATE: 27 th February-06

JOB DESCRIPTION: Following are the Air Sample Analysis Results
 Monitored at the stack of Tilting Furnace No.3 during
 Normal Operating Condition

Se.No	PARAMETERS	CONCENTRATION		EPC LIMITS
		Mg/m ³	PPM	
01	Particulate matter (0.45 μ)	4.50	---	50
02	Carbon-monoxide (CO)	7.50	1.5	400
03	Sulphur-di-oxide (SO ₂)	10.68	4.0	500
04	Nitrogen Oxide(NO _x)	5.56	2.9	400
05	Volatile (O) Compound	Traces	<1.0	20

NOTE: All the parameters are under the limits of Environmental Protection Committee.

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**AIR POLLUTION ANALYSIS**

CLIENT:- MIDAL CABLE LTD P.O.BOX: 5838 KINGDOM OF BAHRAIN	MIL JOB NO: JAN 009-E
	MIL REPORT NO.: MIL/RPT/0078/CH-01/05
	MONITORING COMPLETED: DATED: JANUARY- 6 TH ,2005

JOB DESCRIPTION: Following are the Air Sample Analysis Results which are Monitored in Oven No.7 (Gas Fired)

Sc.No	PARAMETERS	CONCENTRATION		EPC LIMITS
		Mg/m ³	PPM	
01	Particulate matter (0.45 μ)	4.90	---	50
02	Carbon-monoxide (CO)	12.50	2.5	400
03	Sulphur-di-oxide (SO ₂)	8.27	3.1	500
04	Nitrous Fumes (NO)	4.41	2.3	400
05	Nitrogen-di-oxide (NO ₂)	5.56	2.9	400
06	Volatile (O) Compound	Traces	<1.0	20

NOTE: All the parameters are under the limits of Environmental Protection Committee.

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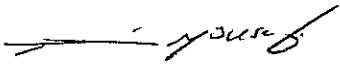
28TH FEBRUARY-06**AIR MONITORING ANALYSIS**

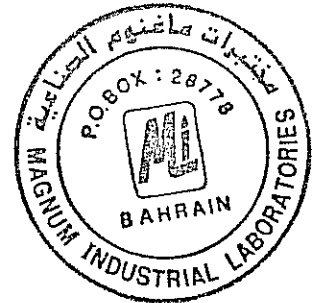
<u>CLIENT:-</u>	MIL JOB NO: FEB-033-E
MIDAL CABLES LTD	MIL REPORT NO: MIL/RPT/0630/LC-02/06
KINGDOM OF BAHRAIN	MONITORING COMPLETED DATE: 27 th February-06

JOB DESCRIPTION: Following are the Air Sample Analysis Results
 Monitored at the Oven No:8 (Gas Fired)

Se.No	PARAMETERS	CONCENTRATION		EPC LIMITS
		Mg/m ³	PPM	
01	Particulate matter (0.45 µ)	1.59	---	50
02	Carbon-monoxide (CO)	Traces	<1.0	400
03	Sulphur-di-oxide (SO ₂)	Traces	<1.0	500
04	Nitrogen Oxide(No _x)	Traces	<1.0	400
05	Volatile (O) Compound	Traces	<1.0	20

NOTE: All the parameters are under the limits of Environmental Protection Committee.

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 MANAGER INDUSTRIAL LABORATORIES.





Ref: ENRC/ 114/ 2002/ UOB

Date: December 13th, 2003

Eng. A.Redha Al-Mosawi
Head of Quality & Environmental Management
QEM System Dept.
Midal Cables Ltd
P. O. Box 5939
Kingdom of Bahrain

Subject: AIR & WATER POLLUTION EMISSION – MONITORING SYSTEM

Dear Eng. Al-Mosawi,

Please find attached the analysis results of your order number 26775/17-09-2003. Please note that water and air flows of degasifier will be tested on December 14th, 2003.

Sincerely yours,

Mohammed Al-Sheriadeh
Mohammed

Dr. MohanNed S. Al-Sheriadeh
Director of Environmental Research Centre

MSS/HMQ

Environment Research Centre
University of Bahrain



Data Sheet

Place: Midal Cables

Analyzed by: Environment Research Centre/ University of Bahrain

Sampling Date: October 12th, 2003

A. AIR POLLUTANTS

Stack			CO mg/m ³	NO _x mg/m ³	SO ₂ mg/m ³	Particulate Matter mg/m ³	VOC ppm
a.	Normal operation in Furnaces	1. Holding Furnace # 1	2	6	2	0.6	2
		2. Titling Furnace # 1	71	5	16	3.5	3
b.	Degassing operation in Furnaces	1. Output of Titling Furnace # 1	81	4	20	3.7	ND
c.	Normal operation in ovens	1. Oven 4	0	0	1	3.2	ND
d.	Normal operation in rolling mills	Rolling Mill # 1	2	0	0	3.0	16
Environmental Affairs Average			100	100	500	50	20

- Reference Oxygen 15%
- ND = Not Detected.

Environment Research Centre
University of Bahrain



Data Sheet

Place: Midal Cables

Analyzed by: Environment Research Centre/ University of Bahrain

Sampling Date: November 2003

B. Reject Water		
Parameter	Unit	Value
B. 1 Physical		
pH@25°C		6.63
EC	µs/cm	30,000
TDS	mg/l	18090
Total Suspended Solids	mg/l	25
B. 2 Inorganic Chemicals		
Nitrate (NO ₃ -N)	mg/l	0.015
Nitrite (NO ₂ -N)	mg/l	0.004
Sulfide as H ₂ S in water	mg/l	ND
Phosphate (PO ₄)	mg/l	0.02
B. 3 Organic Pollutants		
Total Nitrogen-N	mg/l	0.05

ND = Not Detected



Appendix D

Haul Road Emissions



Haul Road Emissions

The molten aluminium will be transported from the neighbouring TAC smelter to the project site via an internal haul road of approximately 250 metres linking the two sites. This haul road will be sealed. Based on the throughput of the plant, there will be up to 20 truck movements⁶ per day along this haul route. The crucible trucks will travel at 10 – 20 km/hr. Therefore, it has been assumed that on average there will be two truck movements per hour (one full truck and crucible and one returning empty), equating to a total of 500 metres travelled per hour (or 0.5 km).

Particulate emissions occur whenever vehicles travel over a paved surface such as a haul road or parking lot. Particulate emissions from paved roads are due to direct emissions from vehicles in the form of exhaust, brake wear and tire wear emissions and re-suspension of loose material on the road surface. The re-suspended particulate emissions from paved roads originate from the loose material present on the surface (i.e. the surface loading).

The United States Environment Protection Agency (US EPA) outlines emission factors in AP 42 Chapter 13: Miscellaneous sources – Paved Roads. The quantity of particulate emissions from re-suspension of loose material on the road surface due to vehicle travel on a dry paved road may be estimated using the following equation:

$$E \text{ (g/VKT)} = k \text{ (SL)}^{0.91} \times \text{(W)}^{1.02} \quad \text{Equation (1)}$$

Where;

E = particulate emission factor

VKT = vehicle kilometres travelled

K = particle size multiplier (provided as 0.62 for PM₁₀)

SL = road surface silt loading (provided as a range of 0.09 – 79 g/m² for Iron and steel industries, with a mean of 9.7)

W = average weight (US tons) of the vehicles. Each crucible will be approximately 7 tonnes. An average crucible truck weight of 20 tonnes has been assumed. 20 tonnes = 22 US tons.

The above equation and assumptions yield an E value of 114.7 g/VKT. Based on a VKT of 0.5 per hour, the particulate emission rate for the haul road is 0.057 kg/hr. This assumes a fixed silt loading with no variation during wet or dry conditions in Newcastle.

Particulate emissions from haul roads would need to be considered in the modelling as a volume source, taking up the approximate size and shape of the wake behind the haul truck as it passes by and spread across the entire driven route. This already dispersed particulate source would be further diluted by the modelling dispersion as it is blown to the site boundary.

This emission rate is five times lower than de-gassing operations from the Holding Furnace and more than three times lower than normal operations from the Holding Furnace.

⁶ Refer to GHD Noise Impact Assessment Report and Environmental Assessment for the project.



Appendix E

Ausplume Output Files



1

Midal Cable plant Tomago. CO emissions. maximum emissions

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	0.200m
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

1 hour
8 hours

1

Midal Cable plant Tomago. CO emissions. Feb 2012 emissions

SOURCE CHARACTERISTICS



STACK SOURCE: HF1

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed								
380924	6367321	0m	13m	1.06m	150C	3.8m/s								
Effective building dimensions (in metres)														
Flow direction			10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width			74	84	92	97	99	98	94	96	98	98	94	88
Effective building height			8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length			97	94	88	78	67	53	38	47	61	74	84	92
Along-flow distance from stack			-81	-74	-64	-52	-39	-25	-10	-7	-7	-7	-7	-7
Across-flow distance from stack			-30	-35	-39	-42	-44	-44	-43	-40	-37	-33	-27	-20
Flow direction			130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width			79	67	53	38	47	61	74	84	92	97	99	98
Effective building height			8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length			97	99	98	94	96	98	98	94	88	79	67	53
Along-flow distance from stack			-7	-6	-5	-4	-7	-12	-17	-20	-24	-26	-28	-29
Across-flow distance from stack			-13	-6	2	9	17	24	30	35	39	42	44	44
Flow direction			250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width			94	96	98	98	94	88	78	67	53	38	47	61
Effective building height			8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length			38	47	61	74	84	92	97	99	98	94	96	98
Along-flow distance from stack			-29	-40	-54	-66	-77	-85	-90	-93	-93	-90	-89	-86
Across-flow distance from stack			43	40	37	32	27	20	14	6	-2	-9	-17	-24

(Constant) emission rate = 2.10E+00 kg/hour
No gravitational settling or scavenging.

STACK SOURCE: TF1

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed								
380932	6367305	0m	13m	0.50m	150C	5.1m/s								
Effective building dimensions (in metres)														
Flow direction			10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width			74	84	92	97	99	98	94	96	98	98	94	88
Effective building height			8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length			97	94	88	78	67	53	38	47	61	74	84	92
Along-flow distance from stack			-67	-62	-54	-45	-35	-24	-12	-12	-15	-18	-20	-22
Across-flow distance from stack			-19	-22	-24	-26	-26	-26	-25	-23	-21	-18	-15	-10
Flow direction			130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width			79	67	53	38	47	61	74	84	92	97	99	98
Effective building height			8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length			97	99	98	94	96	98	98	94	88	79	67	53
Along-flow distance from stack			-23	-24	-23	-22	-25	-28	-31	-33	-34	-33	-32	-30
Across-flow distance from stack			-6	-2	3	7	12	16	19	22	24	25	26	26
Flow direction			250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width			94	96	98	98	94	88	78	67	53	38	47	61
Effective building height			8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length			38	47	61	74	84	92	97	99	98	94	96	98
Along-flow distance from stack			-27	-35	-46	-56	-64	-70	-74	-76	-75	-72	-71	-70
Across-flow distance from stack			25	23	21	18	14	11	6	2	-3	-7	-12	-16

(Constant) emission rate = 7.71E-01 kg/hour
No gravitational settling or scavenging.

STACK SOURCE: HO

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed										
381038	6367192	0m	13m	0.40m	150C	0.3m/s										
Effective building dimensions (in metres)																
Flow direction			10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°		



Effective building width	93	106	116	123	125	124	120	123	125	124	119	111
Effective building height	8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length	124	120	111	99	85	67	48	59	77	93	106	116
Along-flow distance from stack	-73	-74	-71	-67	-61	-52	-42	-47	-55	-61	-66	-68
Across-flow distance from stack	15	13	10	7	4	1	-2	-6	-9	-11	-14	-16
Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	99	84	67	48	59	77	93	106	116	123	126	124
Effective building height	8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length	123	126	124	120	122	125	124	119	111	99	84	67
Along-flow distance from stack	-69	-67	-63	-58	-56	-54	-51	-46	-40	-33	-24	-15
Across-flow distance from stack	-17	-18	-19	-19	-18	-17	-15	-13	-10	-7	-4	-1
Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	120	123	125	124	119	111	99	84	67	47	59	77
Effective building height	8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length	48	59	77	93	106	116	123	126	124	120	122	125
Along-flow distance from stack	-5	-12	-22	-32	-41	-48	-54	-59	-61	-62	-67	-71
Across-flow distance from stack	2	6	9	12	14	16	17	18	19	18	18	17

(Constant) emission rate = 1.31E-02 kg/hour
No gravitational settling or scavenging.

STACK SOURCE: HF2

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter				Temperature	Speed					
380933	6367323	0m	13m	1.06m				150C	3.8m/s					
Effective building dimensions (in metres)														
Flow direction			10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width			74	84	92	97	99	98	94	96	98	98	94	88
Effective building height			8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length			97	94	88	78	67	53	38	47	61	74	84	92
Along-flow distance from stack			-85	-79	-71	-60	-47	-34	-19	-16	-16	-16	-15	-14
Across-flow distance from stack			-21	-27	-32	-36	-39	-41	-42	-41	-39	-36	-32	-26
Flow direction			130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width			79	67	53	38	47	61	74	84	92	97	99	98
Effective building height			8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length			97	99	98	94	96	98	98	94	88	79	67	53
Along-flow distance from stack			-12	-10	-8	-6	-7	-10	-13	-16	-18	-19	-20	-20
Across-flow distance from stack			-21	-14	-7	0	7	15	21	27	32	36	39	41
Flow direction			250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width			94	96	98	98	94	88	78	67	53	38	47	61
Effective building height			8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length			38	47	61	74	84	92	97	99	98	94	96	98
Along-flow distance from stack			-19	-31	-45	-58	-69	-78	-85	-89	-90	-89	-89	-88
Across-flow distance from stack			42	41	39	36	32	27	21	14	7	0	-8	-15

(Constant) emission rate = 2.10E+00 kg/hour
No gravitational settling or scavenging.

STACK SOURCE: TF2

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed								
380939	6367306	0m	13m	0.50m	150C	5.1m/s								
Effective building dimensions (in metres)														
Flow direction			10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width			74	84	92	97	99	98	94	96	98	98	94	88
Effective building height			8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length			97	94	88	78	67	53	38	47	61	74	84	92
Along-flow distance from stack			-69	-65	-59	-51	-41	-30	-19	-19	-22	-25	-27	-28
Across-flow distance from stack			-12	-16	-18	-21	-23	-24	-24	-23	-22	-20	-18	-15
Flow direction			130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width			79	67	53	38	47	61	74	84	92	97	99	98
Effective building height			8	8	8	8	8	8	8	8	8	8	8	8



Along-flow building length	97	99	98	94	96	98	98	94	88	79	67	53
Along-flow distance from stack	-28	-27	-26	-24	-25	-27	-29	-29	-29	-28	-26	-23
Across-flow distance from stack	-12	-8	-4	0	5	9	12	16	18	21	23	24

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	94	96	98	98	94	88	78	67	53	38	47	61
Effective building height	8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length	38	47	61	74	84	92	97	99	98	94	96	98
Along-flow distance from stack	-20	-28	-39	-49	-58	-64	-69	-72	-73	-71	-71	-71
Across-flow distance from stack	24	23	22	20	18	15	12	8	4	0	-5	-9

(Constant) emission rate = 7.71E-01 kg/hour
No gravitational settling or scavenging.

STACK SOURCE: RM

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed							
381017	6367157	0m	13m	0.50m	150C	0.2m/s							
Effective building dimensions (in metres)													
Flow direction		10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width		93	106	116	123	125	124	120	123	125	124	119	111
Effective building height		8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length		124	120	111	99	85	67	48	59	77	93	106	116
Along-flow distance from stack		-35	-34	-30	-27	-22	-16	-11	-20	-34	-47	-58	-68
Across-flow distance from stack		0	5	9	14	18	21	24	25	27	27	27	25
Flow direction		130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width		99	84	67	48	59	77	93	106	116	123	126	124
Effective building height		8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length		123	126	124	120	122	125	124	119	111	99	84	67
Along-flow distance from stack		-75	-81	-83	-83	-87	-89	-89	-86	-81	-73	-63	-51
Across-flow distance from stack		24	21	17	13	9	5	0	-5	-9	-14	-17	-21
Flow direction		250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width		120	123	125	124	119	111	99	84	67	47	59	77
Effective building height		8	8	8	8	8	8	8	8	8	8	8	8
Along-flow building length		48	59	77	93	106	116	123	126	124	120	122	125
Along-flow distance from stack		-37	-38	-43	-46	-48	-49	-48	-45	-42	-37	-36	-36
Across-flow distance from stack		-23	-25	-27	-27	-27	-25	-23	-21	-17	-13	-9	-5

(Constant) emission rate = 2.90E-04 kg/hour
No gravitational settling or scavenging.

1

Midal Cable plant Tomago. CO emissions. Feb 2012 emissions

RECEPTOR LOCATIONS

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

379000.m 379050.m 379100.m 379150.m 379200.m 379250.m 379300.m
379350.m 379400.m 379450.m 379500.m 379550.m 379600.m 379650.m
379700.m 379750.m 379800.m 379850.m 379900.m 379950.m 380000.m
380050.m 380100.m 380150.m 380200.m 380250.m 380300.m 380350.m
380400.m 380450.m 380500.m 380550.m 380600.m 380650.m 380700.m
380750.m 380800.m 380850.m 380900.m 380950.m 381000.m 381050.m
381100.m 381150.m 381200.m 381250.m 381300.m 381350.m 381400.m
381450.m 381500.m 381550.m 381600.m 381650.m 381700.m 381750.m
381800.m 381850.m 381900.m 381950.m 382000.m 382050.m 382100.m
382150.m 382200.m 382250.m 382300.m 382350.m 382400.m 382450.m
382500.m 382550.m 382600.m 382650.m 382700.m 382750.m 382800.m
382850.m 382900.m 382950.m 383000.m 383050.m 383100.m 383150.m
383200.m 383250.m 383300.m 383350.m 383400.m 383450.m 383500.m
383550.m 383600.m 383650.m 383700.m 383750.m 383800.m 383850.m
383900.m 383950.m 384000.m

and these y-values (or northings):



6365000.m 6365050.m 6365100.m 6365150.m 6365200.m 6365250.m 6365300.m
6365350.m 6365400.m 6365450.m 6365500.m 6365550.m 6365600.m 6365650.m
6365700.m 6365750.m 6365800.m 6365850.m 6365900.m 6365950.m 6366000.m
6366050.m 6366100.m 6366150.m 6366200.m 6366250.m 6366300.m 6366350.m
6366400.m 6366450.m 6366500.m 6366550.m 6366600.m 6366650.m 6366700.m
6366750.m 6366800.m 6366850.m 6366900.m 6366950.m 6367000.m 6367050.m
6367100.m 6367150.m 6367200.m 6367250.m 6367300.m 6367350.m 6367400.m
6367450.m 6367500.m 6367550.m 6367600.m 6367650.m 6367700.m 6367750.m
6367800.m 6367850.m 6367900.m 6367950.m 6368000.m 6368050.m 6368100.m
6368150.m 6368200.m 6368250.m 6368300.m 6368350.m 6368400.m 6368450.m
6368500.m 6368550.m 6368600.m 6368650.m 6368700.m 6368750.m 6368800.m
6368850.m 6368900.m 6368950.m 6369000.m 6369050.m 6369100.m 6369150.m
6369200.m 6369250.m 6369300.m 6369350.m 6369400.m 6369450.m 6369500.m
6369550.m 6369600.m 6369650.m 6369700.m 6369750.m 6369800.m 6369850.m
6369900.m 6369950.m 6370000.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	382724	6367829	0.0	0.0	4	381338	6366782	0.0	0.0
2	381369	6367140	0.0	0.0	5	379977	6366683	0.0	0.0
3	381199	6366860	0.0	0.0					

METEOROLOGICAL DATA : " Tomago AUSPLUME file, z0 = 0.03m"



Appendix F

Predicted Concentration Contours

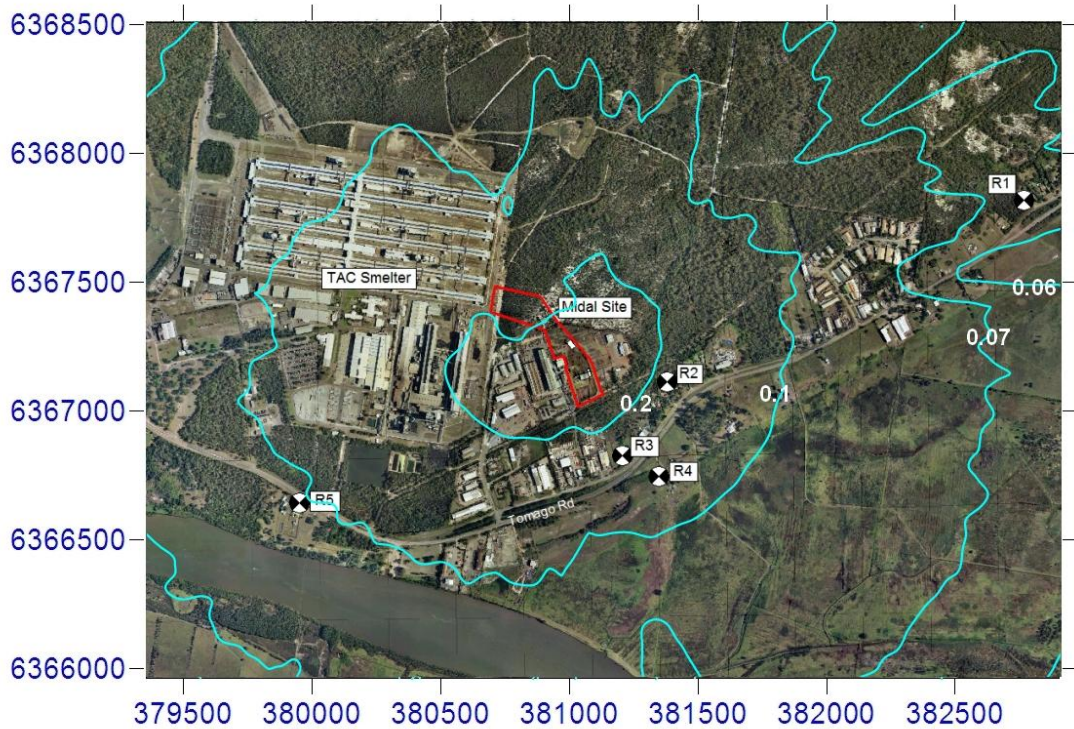


Figure A – CO 1-hour concentration contours (mg/m^3)

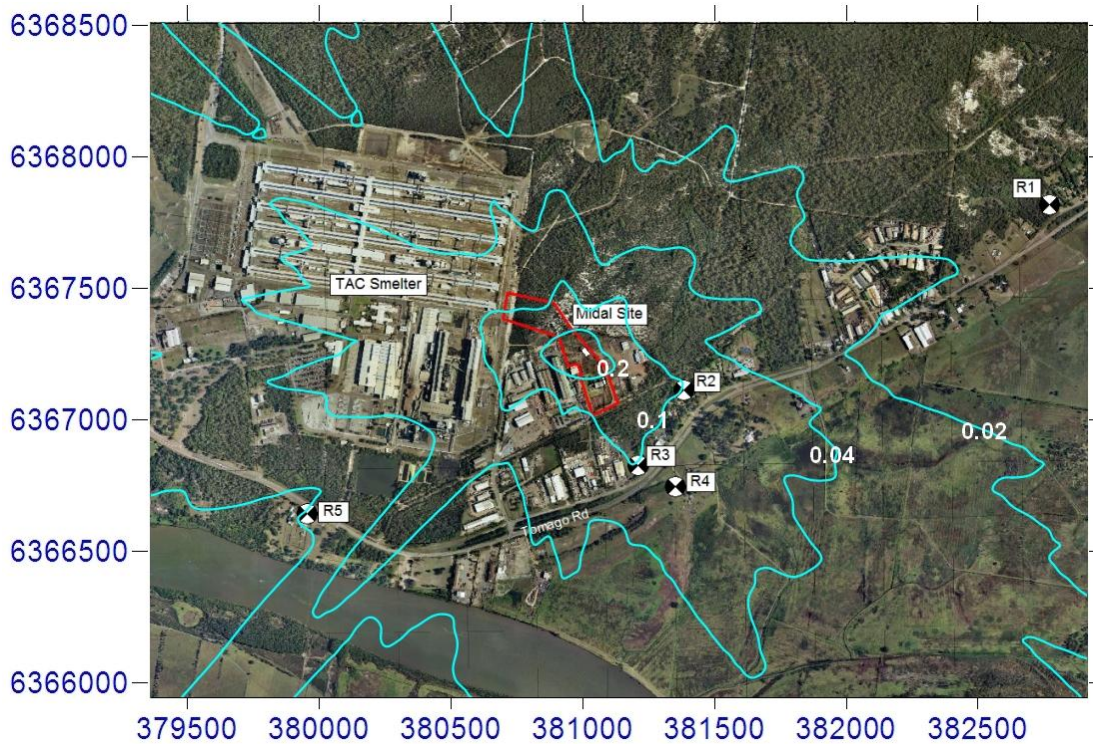


Figure B – CO 8-hour concentration contours (mg/m^3)

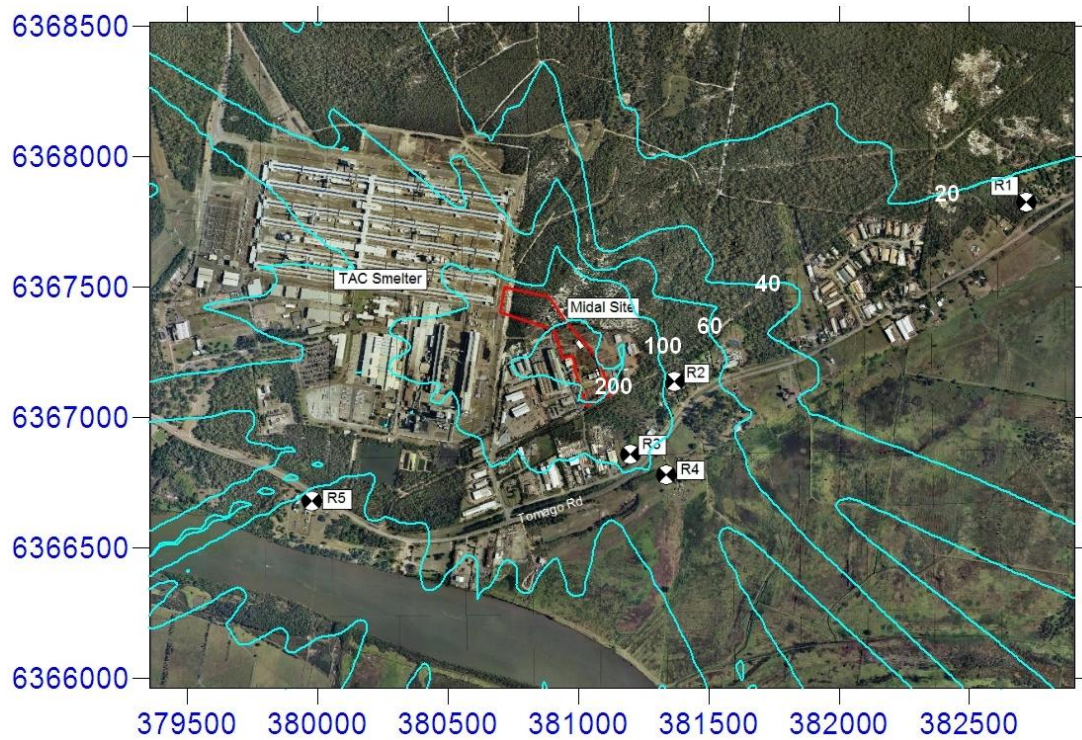


Figure C – NO₂ 1-hour concentration contours (µg/m³)

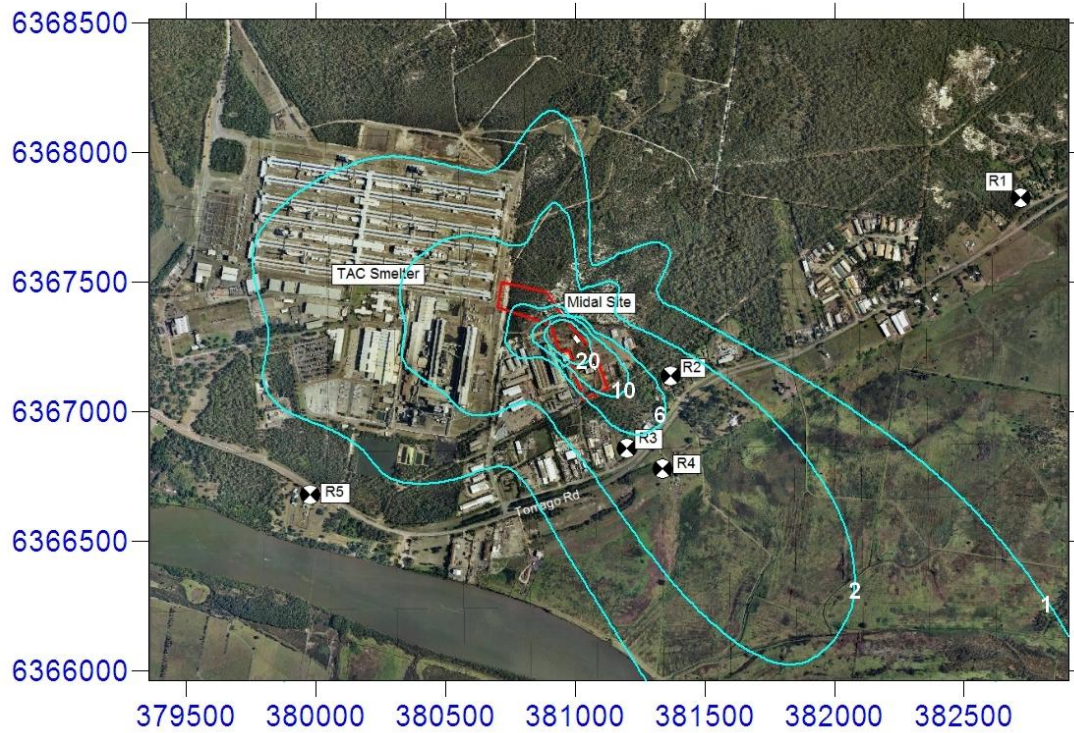


Figure D – NO₂ annual average concentration contours (µg/m³)

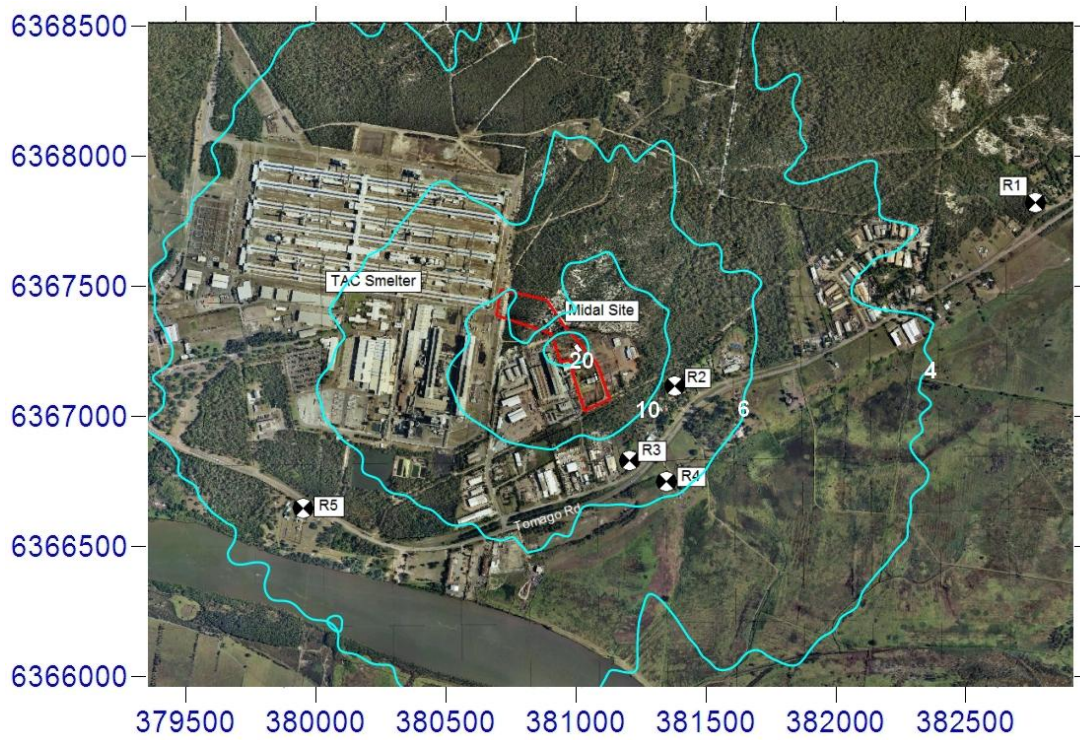


Figure E – SO₂ 1-hour concentration contours (µg/m³)

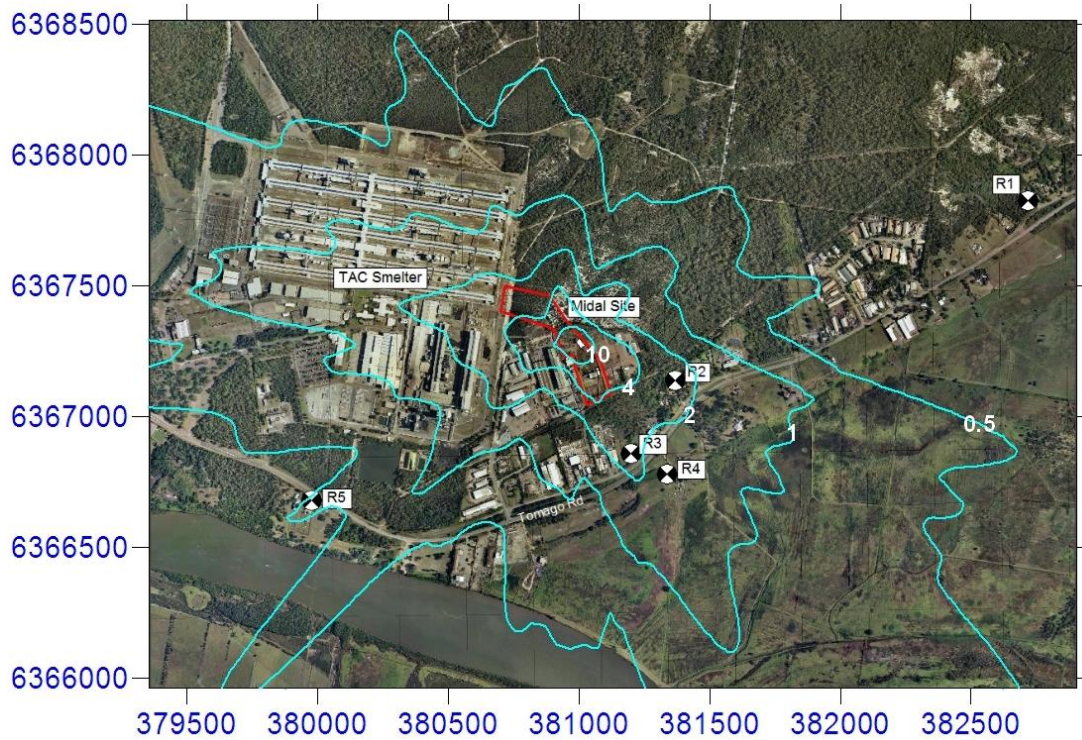


Figure F – SO₂ 24-hour concentration contours (µg/m³)

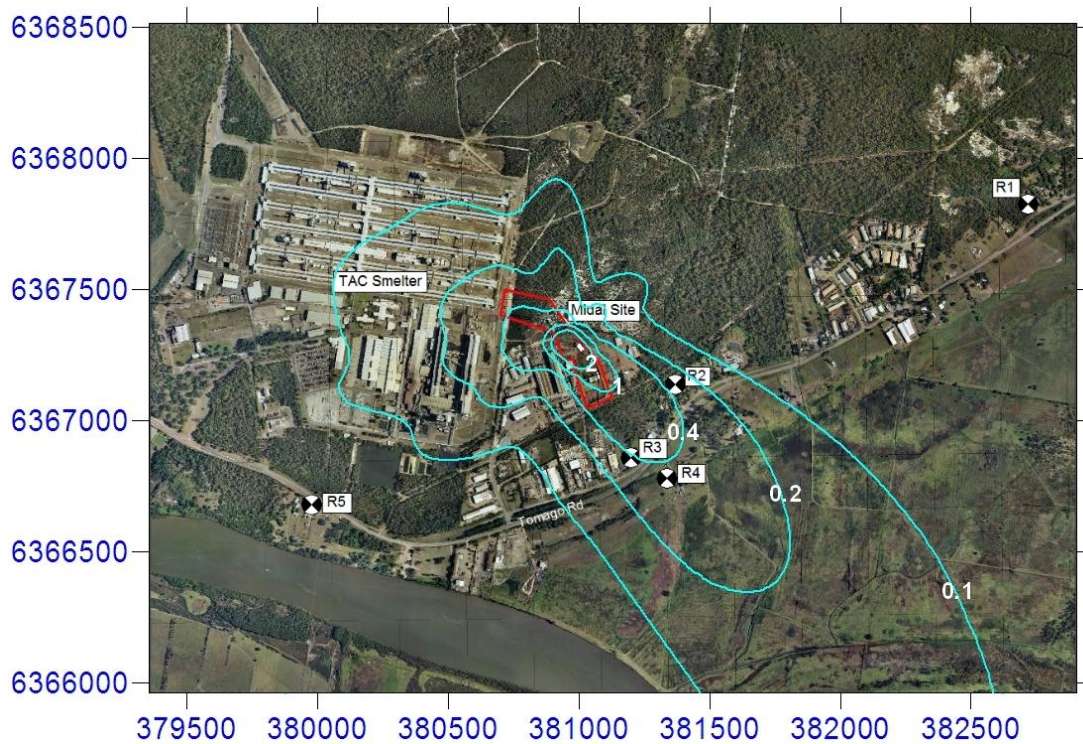


Figure G – SO₂ annual average concentration contours (µg/m³)

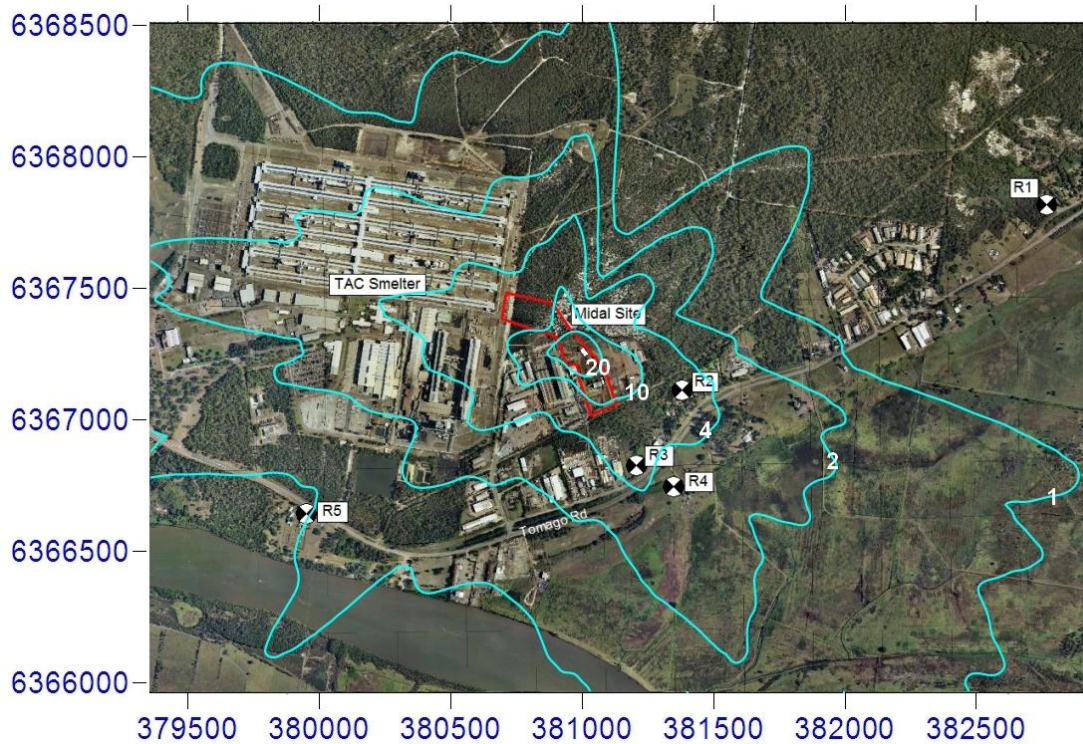


Figure H – PM₁₀ 24-hour concentration contours (µg/m³)

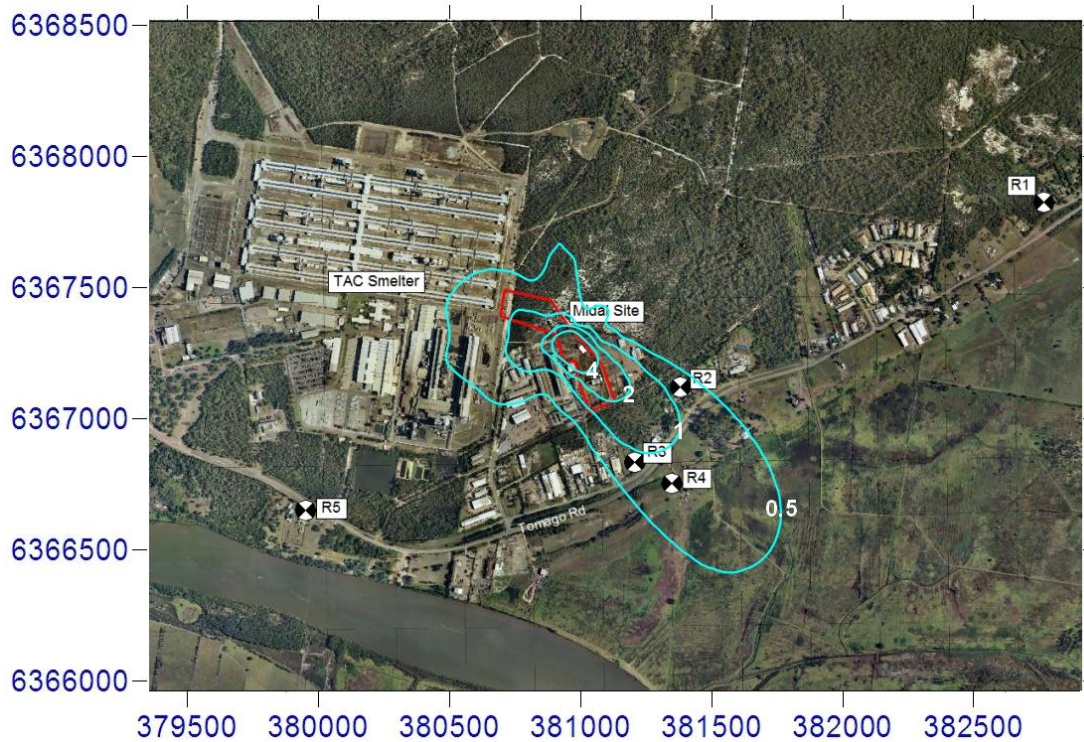


Figure I – PM₁₀ annual average concentration contours ($\mu\text{g}/\text{m}^3$)

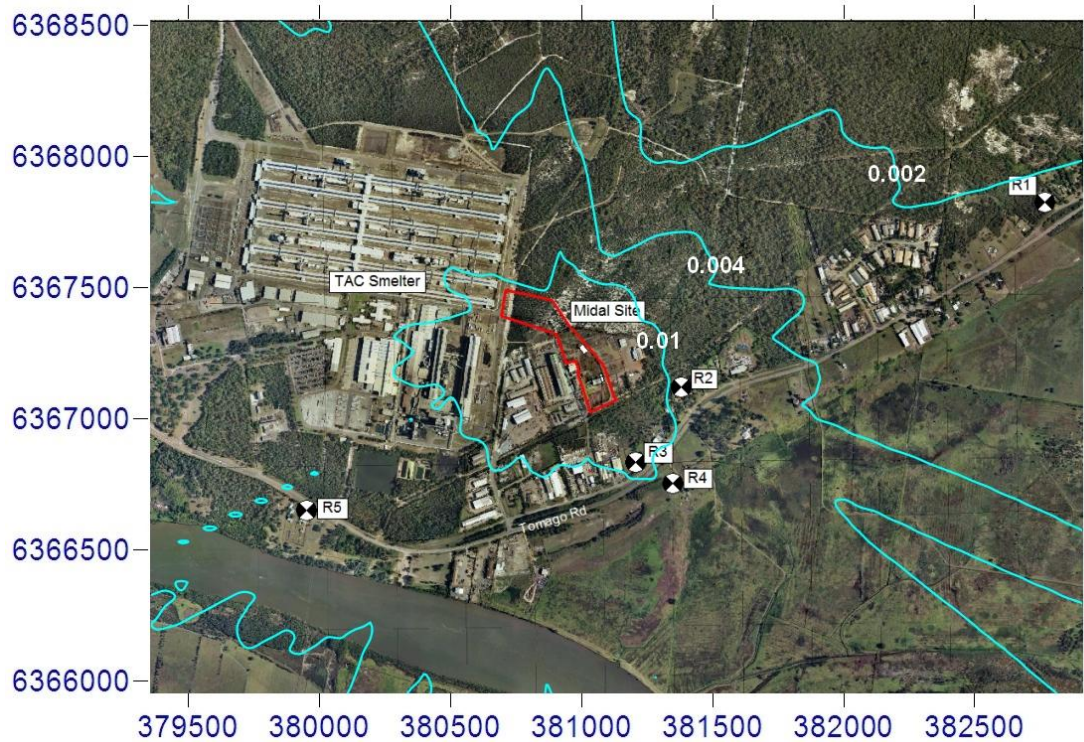


Figure J – VOC (total) 1-hour concentration contours (mg/m^3)



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

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	T Gribble	B Cook		R Pollock		12/05/11
1	T Gribble	B Cook		P Carson		29/07/11
2	T Gribble	B Cook		P Carson		20/12/11
3	T Gribble	B Cook		P Carson		08/02/12