AIR EMISSIONS MANAGEMENT PLAN

Bombala Sawmill Project
September 2021

Dongwha

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DOCUMENT CONTROL

Title	Air Emissions Management Plan
Description	A plan to manage air emissions from the facility in accordance with Schedule 3, condition 6 of Project Approval MP07_0161.
Created By	Beca AMEC in consultation with Dongwha Australia (formerly Tasco)
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Version Number	Modified By	Modifications Made	Date Modified	Status
Revision A	Beca AMEC	Issue of draft	20/12/2011	For comment
Revision B	Beca AMEC	Second draft incorporating comments	17/01/2012	For comment
Revision C	Beca AMEC	Final incorporating comments	20/02/2012	Final for submission
Revision D	Beca AMEC	Modified to incorporate NSW EPA comments	03/09/2012	For Approval
Revision E	Beca AMEC	Additional modifications to incorporate comments from DPIE	11/09/2012	Approved
Revision F 12515318_Rep-0	GHD	Revision and update of plan following MOD3	25/09/2019	Approved
Revision G 12515318-Rev-1	GHD	Revision and update of plan following MOD4	01/06/2020	Approved
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GLOSSARY AND ABBRIEVIATIONS

AEMP	Air Emissions Management Plan
AMMAAP	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW
AMSAAP	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW
BOM	Bureau of Meteorology
DWAU	Dongwha Australia
DPIE	Department of Planning, Industry and Environment
ECO	Emergency Control Organisation
EMS	Environmental Management Strategy
EPA	Environment Protection Authority
EPC	Emergency Planning Committee
EPL	Environment Protection Licence
N/A	Not applicable
NGER	National Greenhouse and Energy Reporting
NPI	National Pollutant Inventory
NRC	Natural Resources Commission
NOW	New South Wales Office of Water
NSW	New South Wales
OSD	On-site detention
PIRMP	Pollution Incident Response Management Plan
PM_{10}	Particulate matter of size 10 μm
RAP	Remediation Action Plan
RNP	NSW EPA Road Noise Policy
SEPP	State Environmental Planning Policy
WHS	Work, Health and Safety

1. INTRODUCTION

1.1 OVERVIEW

Dongwha Australia Pty Ltd (DWAU) owns and operates a sawmill and timber processing facility at 1 Sandy Lane, Bombala. Products manufactured at the site include structural, landscaping, fencing and decorative timbers. Timber processing operations commenced at the site in 1979 and the operations have been progressively expanded since commencement of operations.

A major expansion of the sawmill operations was approved in September 2010 (PA_0161) by the NSW Minister for Planning under Part 3A of the Environmental Planning and Assessment Act 1979 (EP&A Act). A condition of the Project Approval included that all previous consents for the sawmill operations were surrendered within 12 months of the determination. PA 07_0161 is the applicable project approval for the operations and has been modified on three occasions to allow alternative construction staging and boiler configurations.

Modification 3 was approved on 19 February 2019 and included a new 15 megawatt (MW) biomass boiler to replace the gas fired boilers approved at the site as part of the mill expansion project.

The most recent modification (Modification 4) was approved on 24 April 2020 which included allowance for Installation and operation of H2F Timber Spray System. Post Commissioning testing of the system was carried out to address condition 5G of Modification 4.
Condition 6 of Project Approval no. 07_0161 requires DWAU to prepare and implement an Air Emissions Management Plan subject to the following conditions:

Table 1-1: Project Approval MP07_0161 (MOD4) – Schedule 3, Condition 6

Condition	Section of Document Addressing Condition
6. The Proponent shall prepare and implement an Air Emissions Management Plan to the satisfaction of the Director-General. This plan must:	
(a) be prepared in consultation with the EPA and approved by the Secretary prior to operation of the new: dry mill or treatment plant or green mill or boiler/s or kiln or steamer/s or vacuum pump or wastewater tank flue (as described in the EA and 07_0161 MOD 1);	Revision E of the AEMP was approved 11/09/2021
(b) be updated prior to the operation of the 15 MW Wood-fired Boiler, to the satisfaction of the Secretary and the EPA;	Revision F of the AEMP
(c) be prepared in accordance with the requirements of the "Approved methods for the sampling and analysis of air pollutants in NSW"	Section 4.5
(d) identify the air emission limits for the project;	Sections 4.2 and 4.3
(e) demonstrate that the ground level concentration would comply with the requirements of the "Approved methods for the modelling and assessment of air pollutants in New South Wales";	Section 6.1.1
(f) describe the treatments, controls and operational practices to be implemented to manage air emissions, demonstrating best practice process design and emission control;	Section 6
(g) include a program for the ongoing monitoring and reporting of air emissions from the project, describing the location, frequency, method and pollutants to be monitored; and	Section 7 and 11

Table 1-1: Project Approval MP07_0161 (MOD4) – Schedule 3, Condition 6

Condition	Section of Document Addressing Condition
(h) outline the contingency measures that would be implemented should any air emission limits be exceeded.	Section 6

The site is also operated in accordance with Environment Protection Licence (EPL) no. 11205 (EPL11205) issued by the New South Wales Environment Protection Authority (NSW EPA) under the Protection of the Environment Operations Act 1997 (POEO Act). The licence authorises the carrying out of wood preservation and wood or timber milling or processing activities at Sandy Lane, Bombala, NSW 2632 ("the site"). The current version of the licence at the time of preparation of this air emission management plan (AEMP) is EPL11205 version dated 18 August 2021.

This air emissions management plan has been updated to include licence limit changes associated with POINT 23 for nitrogen oxides, removal of POINT 38 from the EPL and update of the pollution studies and reduction programs for the 2.5MW Wood Fired Redry Boiler Improvement Works and LOSP Vacuum Pump Environmental Risk Assessment.

Requirements related to air emissions detailed in EPL11205 and PA07-0161 are discussed in further detail in Section 4of this AEMP.

1.2 Scope of the Management Plan

The scope of this AEMP is as follows:

- Review the existing AEMP (GHD, June 2020). This included a review of EPL licence conditions, relevant legislation, monitoring standards and sampling methods and site details.
- Review the relevant consent conditions.
- Liaise with DWAU to discuss recent monitoring events and what may need to be included in the plan.
- Revise the AEMP, including where necessary an updated activity description and air discharge points, review of boiler discharge parameters, update the summary of emission controls, contingency measures and monitoring requirements.
- Update AEMP (dated June 2020) to reflect changes associated with EPL11205, and include any relevant results of recent air monitoring undertaken at the site.
- Further details on the Environmental Management Framework for DWAU's operations at this site are provided in section 4.

2. PROJECT DESCRIPTION

2.1 SITE AND LOCAL ENVIRONMENT

The Bombala Sawmill is located between Sandy Lane and Delegate Road, as shown on Figure 2-1, and occupies the following allotments, referred to as "the site":

- Lot 2 DP 1016573.
- Lot 27 DP 1061792.

Surrounding land use is mixed rural, including grazing, cultivation and plantation forestry. The township of Bombala is located approximately 2 km away, and several rural dwellings are located closer to the site.

2.2 SITE WIND CONDITIONS

DWAU installed a meteorological station at the project site in June 2010 as per the requirements of condition 7 of Schedule 3 of PA07_0161:

During the life of the project, [DWAU] shall ensure that there is a suitable meteorological station in the vicinity of the site that complies with the requirements in the latest version of Approved Methods for Sampling and Analysis of Air Pollutants in New South Wales *guidelines*.

EPL11205 Condition M4 specifies the parameters, frequency, and sampling methods required for the meteorological monitoring.

The data collected from the meteorological station from 30 July 2015 to 4 September 2019 has been graphed as a wind rose and is shown in Figure 2-2, and seasonal wind roses are provided in Figure 2-3.

Wind data from the meteorological station on site show that:

- Prevailing winds are from the southwest, south and northeast sectors.
- Wind speeds below <2 m/s occur for approximately 52% of the time.
- Wind speeds between 2-6 m/s, which typically have the highest potential for elevated downwind air quality impacts due to stack emissions, are predominantly from the southern quadrants and occur for approximately 41% of the time.

Figure 2-1: Regional Context

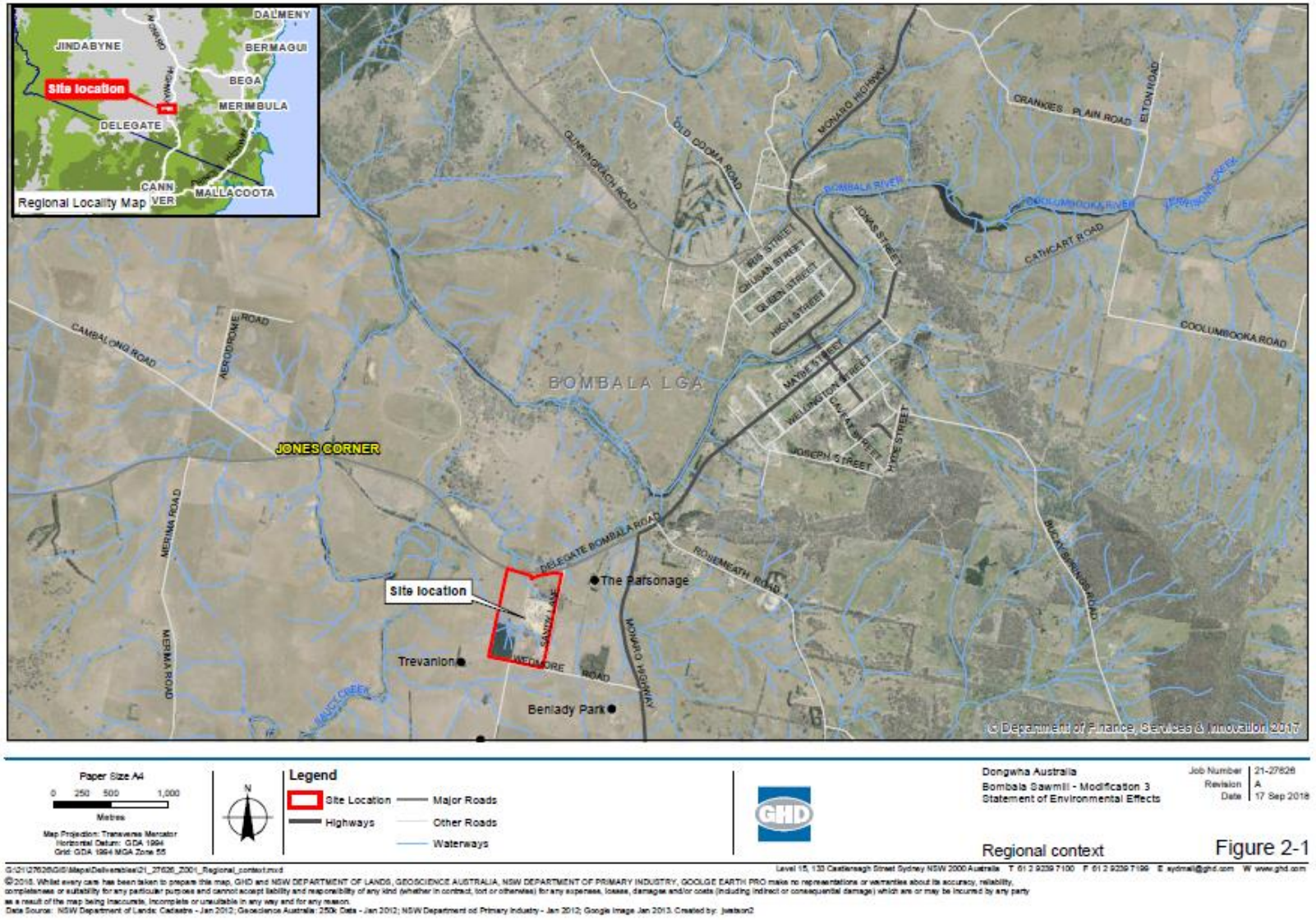


Figure 2-2: Wind rose for onsite weather station (2015-2019)

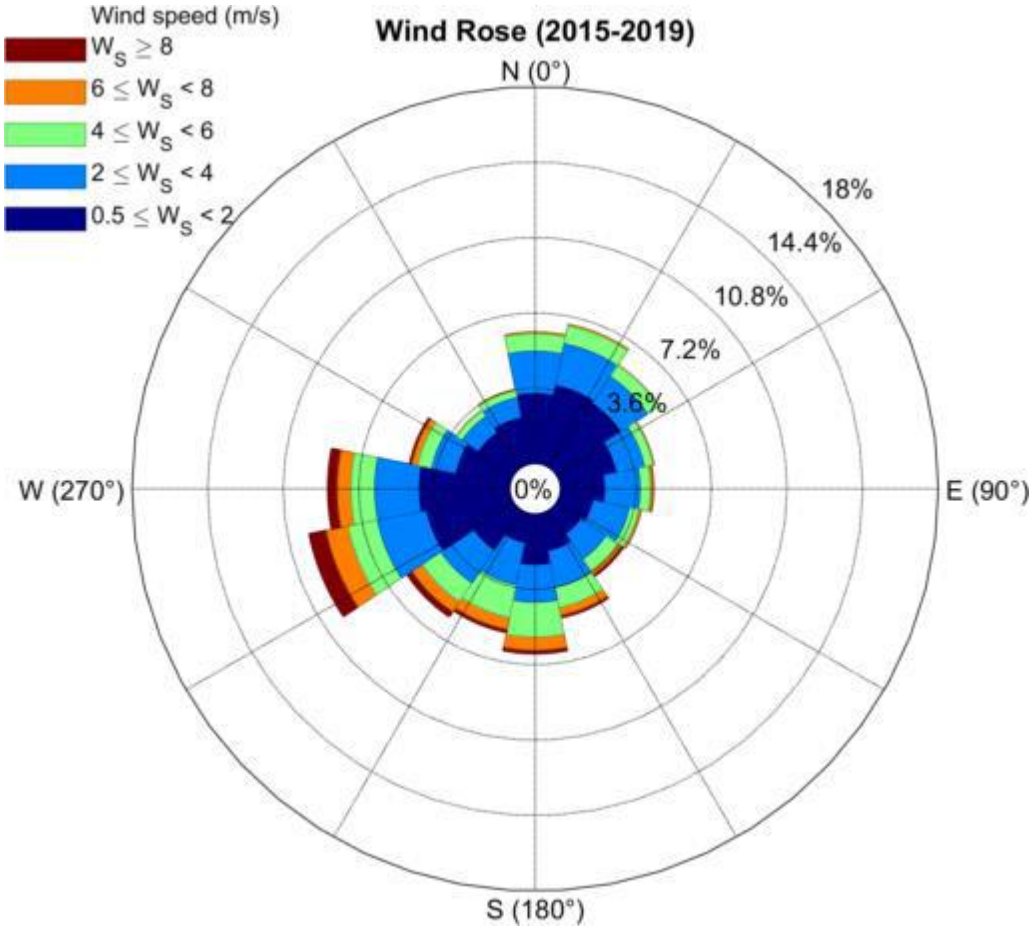
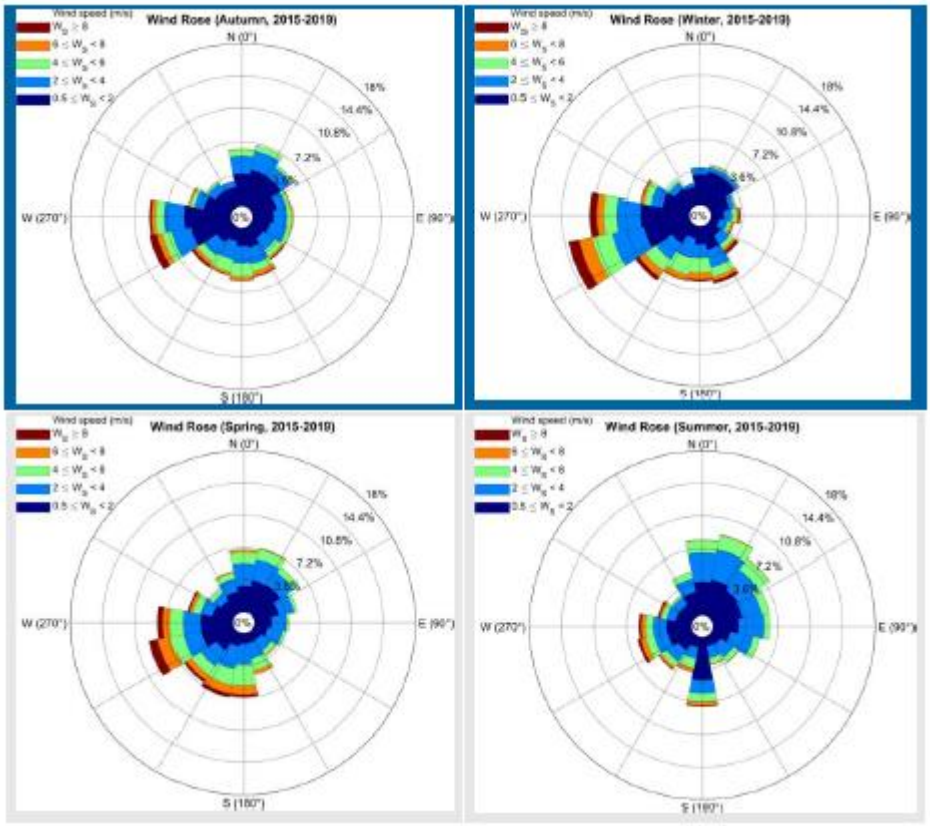


Figure 2-3: Seasonal wind roses for onsite weather station (2015-2019)



2.3 ACTIVITY DESCRIPTION

2.3.1 Processes

The timber mill is comprised of a primary timber sawing plant, timber dry mill, timber drying in kilns, and timber treatment facilities and associated site infrastructure to produce softwood timber products. The site is permitted to process up to 350,000 tonnes per annum of sawlogs and treat up to 120,000 tpa of timber for improved durability. The sawmill operations currently produce up to 500 tonnes of wood residue per day as a by-product of the milling activities.

Uncontaminated wood residue is used as boiler fuel in the 15 MW and 2.5 MW boilers. Key processes with emissions to air currently include:

- 15MW biomass boiler which includes a biomass feed system, gasification combustion process, feedwater pump system and an emissions control system. The boiler creates hot water for use in the green off sawn (GOS) kilns at the site.
- 2.5MW wood-fired boiler servicing the redry kilns
- Vents on each of the Re-Dry Kiln 1 and 2, of which there are 10 located on the roof of each Re-Dry Kiln building for a total of 20 vents
- Two separate exhausts to atmosphere of vacuum pumps attached to the Treatment Plant
- Bifenthrin Demisting System Stack associated with H2F Timber Spray System

The GOS kilns have previously been identified to only emit steam, heat and minor odours and that emissions and odour from this source are not a significant risk to the local air quality and community.

2.3.2 Treatment Chemicals

The treatment chemicals used on site are MicroPro, CCA and Bifenthrin:

- MicroPro: MicroPro is a chemical timber treatment containing copper carbonate and Tebuconazole.
- CCA: Copper Chrome Arsenate, containing active ingredients copper, chromium (V) and arsenic. Copper and arsenic in the preservative protect the wood from insect and fungal attack. Chromium binds the copper and arsenic into the timber and reduces the risk of chemicals leaching out.
- Bifenthrin: Bifenthrin is an insecticide which is utilised in the H2F Timber Spray System.

The MOD3 Development Consent (19 February 2019) states that copper chrome arsenate treated timber is not to be utilised as a fuel within the 15 MW wood-fired boiler and 2.5 MW wood-fired boiler.

3. DESCRIPTION OF AIR DISCHARGES

3.1 OVERVIEW

The existing sawmill at Bombala has a number of fixed plant components that discharge directly to atmosphere as described in Section2.3.1. The timber mill has additional emissions to atmosphere, primarily from timber sawmilling, treatment and drying. These emissions may be in the form of chemicals with the potential to adversely affect human health (such as from the timber treatment chemicals CCA and MicroPro), or dust or odour with the potential to create nuisance impacts for neighbouring residents.

Each significant emission source and potential contaminants are described in Section 3.2. Emissions from the vents on each of the re-dry kilns have been identified to be very low and are not required to be monitored under EPL11205, however are discussed in more detail below.

3.2 FIXED PLANT COMPONENTS

3.2.1 Nature of Emissions

Fixed plant components with air discharges to the atmosphere and the potential pollutants produced by their operation are listed in Table 3-1. Where applicable, the corresponding EPA sampling point identification number has also been included. Detailed descriptions of the boiler release parameters and emissions are summarised in Section 5.2.

The redry kiln vents and Bifenthrin Demisting System Stack, although not required to be monitored, have been included below for completeness. The location of these items on site are shown in Figure 3-1.

The table below excludes emissions of dust, which could potentially occur from a number of sources across the site. Dust emissions are discussed in Section 3.3.

Table 3-1: Sources of potential emissions to air and potential pollutants

EPA Identification Point	Source of Potential Emissions	Potential Pollutants
EPA 23	2.5 MW chip fired redry boiler	Nitrogen oxides, Volatile organic compounds
EPA 36	15 MW biomass boiler	Nitrogen oxides, solid particles, volatile organic compounds, Type 1 and Type 2 substances
EPA 37	C1 treatment plant vacuum pump	Type 1 and 2 substances, copper
N/A (Previously EPA 38)	C2 treatment plant vacuum pump	Type 1 and 2 substances, copper
N/A (Previously EPA 28)	Redry kiln 1 vents (not a current EPA point)	Nitrogen oxides, solid particles, volatile organic compounds, ammonia Type 1 and Type 2 substances, copper
N/A (Previously EPA 29)	Redry kiln 2 vents (not a current EPA point)	Nitrogen oxides, solid particles, volatile organic compounds,

Table 3-1: Sources of potential emissions to air and potential pollutants

EPA Identification Point	Source of Potential Emissions	Potential Pollutants
		ammonia Type 1 and Type 2 substances, copper
N/A	Bifenthrin Demisting System Stack (H2F Timber Spray System)	Bifenthrin, volatile organic compounds

3.2.2 Venting Characteristics – Redry Kilns

The redry kilns discharge steamy vapours to air on a batch-wise basis through a number of openings in the roof of the kilns. A report prepared by Ektimo (2018), who undertake the stack sampling, describe these sources as "Vents on each of the Re-Dry Kiln 1 and 2, of which there are 10 located on the roof of each Re-Dry Kiln building for a total of 20 vents. These vents are located closely grouped together."

3.2.3 Venting Characteristics – Treatment Plant

The treatment plant has been designed as a turn-key plant by Koppers in accordance with all relevant Australian Standards. The only potential source of air emissions is from the vacuum pumps, and these will be mitigated by virtue of their compliance with AS/NZS 2843.1:2006 Timber Preservation Plants -Timber Preservation Plant Site Design, which states:

Vacuum pumps shall be fitted with condensing traps capable of catching any preservatives contained in their exhausts. Any contaminated water issuing from vacuum pumps shall be transferred to mixing, storage, or waste tanks in the treatment area for recycling, recirculation or disposal. A mist eliminator shall be installed on the vent to atmosphere line from any vacuum system. Such discharge points shall be located well away from working areas used by personnel.

Koppers has advised that the air emissions from the treatment plant are likely to involve the following vents and discharge patterns:

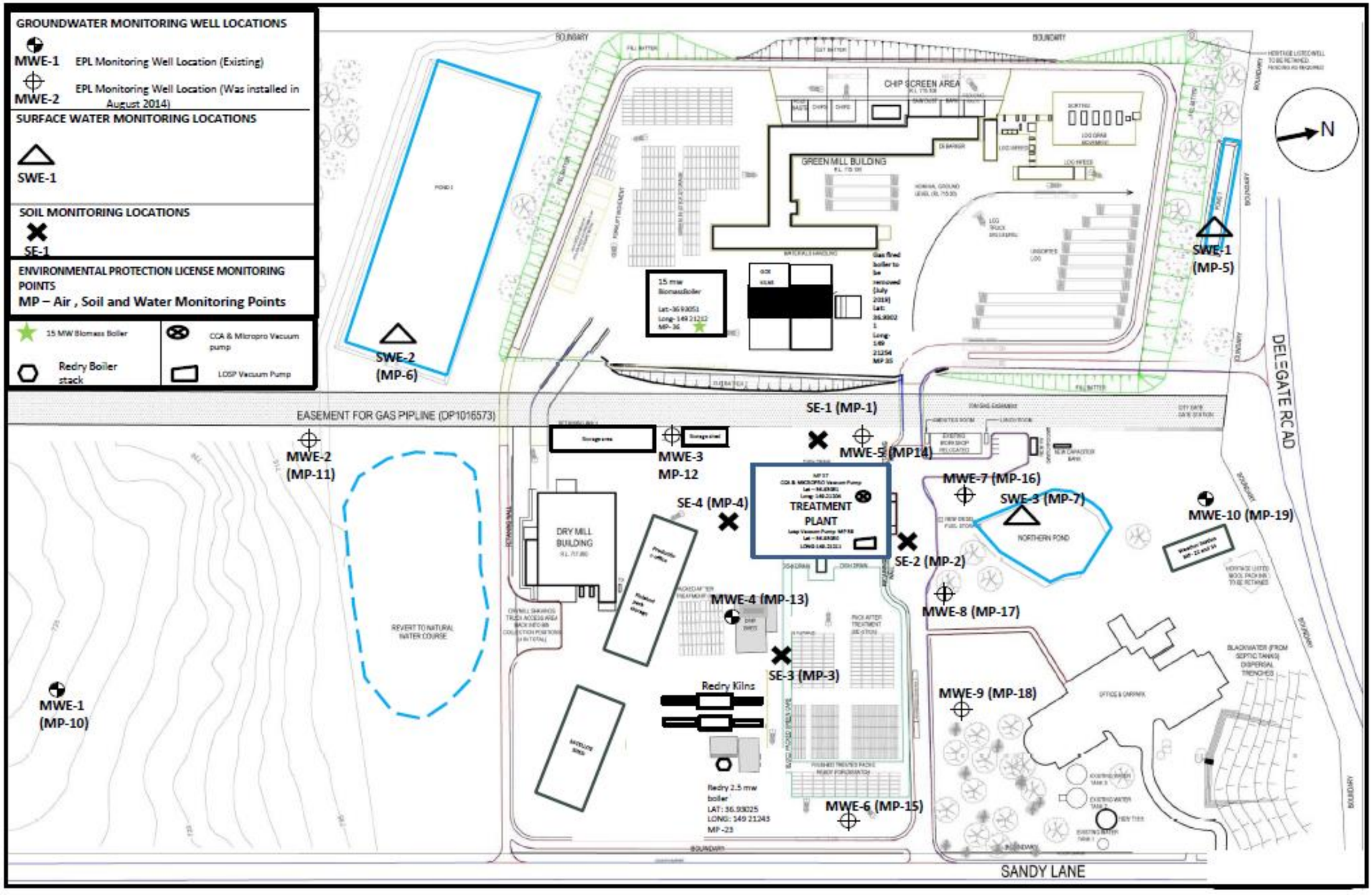
- Venting of air from work tanks during draining of treatment vessel:
  - Vent type - 200 mm nominal bore vertical pipe from top of plastic effluent tanks up towards roof (vent to be mesh covered). The pipe terminates inside building. The release will be from either of two plastic tanks depending on process being run.
  - Volume of discharge - approximately 40 m^3 of air
  - Discharge frequency-once every 1.5 hrs
  - Length of discharge -5.5 minutes
- Venting of air from treatment vessel after draining of treatment vessel:
  - Vent type -100 mm nominal bore vertical pipe up towards roof (vent to be mesh covered). The pipe terminates inside building.
  - Volume of discharge - approximately 100 m^3
  - Discharge frequency-once every 1.5hrs
  - Length of discharge - 2 minutes

- Venting of air from Vacuum pumps

  - Vent type -100 mm nominal bore vertical pipe through roof with 180° bend on the top (vent to be mesh covered). This vent has a liquid separator to direct any overflow liquid into the sump.
  - Volume of discharge - approximately 35 m^3 of air
  - Discharge frequency – twice every 1.5 hours
  - Length of discharge – 5 minutes

Sampling has been undertaken of the C1 vacuum pump exhaust over a period of 70 minutes to allow for a full production cycle.

Figure 3-1: Location of EPA Air Monitoring Points



3.3 DUST

3.3.1 Nature of Dust Emissions

Dust that may arise at the sawmill site will be comprised of a wide variety of particle size fractions. The larger depositable dust is material generally greater than 50 µm in diameter. It poses a nuisance potential due to soiling of surfaces and can cause irritation to eyes and nose. Because it is relatively large in size, deposited particulate usually falls out of the air within a short distance of the source.

Finer dust material (generally less than 20µm) and can travel large distances downwind. The portion of this dust that poses the greatest potential health effect is particulate less than 10µm in diameter (known as PM10) as it can penetrate the upper respiratory tract and consequently has the potential to impact on public health.

The particulate generated from processes and surfaces at the sawmill is likely to be predominantly made up of sizes larger than the PM10 fraction, because the major source of PM10 in the atmosphere is combustion of liquid and solid fuels rather than grinding, abrasive or erosion-type processes.

Therefore, management of dust at the sawmill site is focussed on emissions of depositable dust.

3.3.2 Sources of Dust

Potential sources of dust at the sawmill site include the following:

- Process dust (e.g. from debarking, sawmilling) including wood residues
- Fugitive dust (e.g. from movement of trucks/forklifts or wind erosion)
- Dust associated with ash storage and transport.

Management of process dust sources including word residues is included in this AEMP. Wood residues at the site include bark, untreated and treated damaged boards, woodchips, sawdust and wood shavings. Any processes involved in cutting, chipping or shaving wood, or handling shavings, chips and sawdust have the potential to release dust emissions into the air. Management and control of these sources of dust is covered in Section 6.3 of this AEMP.

3.3.3 Fugitive Dust

The major factors that influence dust emissions from surfaces are:

- **Wind speed across the surface.**

  Dust emissions from exposed surfaces generally increase with increasing wind speed. However, dust pick up by wind is only significant at wind speeds above 5 m/s. Above 10 m/s pickup increases rapidly.

- **The percentage of fine particles in the material on the surface.**

  The smaller the particle size of the material on the surface of a road or an exposed surface, the more easily the particles are able to be picked up and entrained in the wind.

- **Moisture content of the material on the surface.**

  Moisture binds particles together preventing them from being disturbed by wind or vehicle movements.

- **Area of the exposed surface.**

  The larger the area of the exposed material the more potential there will be for dust emissions. Vegetated surfaces are less prone to wind erosion than bare surfaces.

- **Disturbances such as traffic, excavation, loading and unloading of materials**

  Vehicles travelling over exposed surfaces trend to pulverise any surface particles. Particles are lifted and dropped from the rolling wheels and the road surface is exposed to strong air currents due to turbulence between the wheels and the surface. Dust is also sucked into the turbulent wake created behind moving vehicles.

4. STATUTORY COMPLIANCE REQUIREMENTS

4.1 REGULATORY CONTEXT

The Environmental Planning and Assessment Act 1979 (EPA Act) is the key planning legislation in NSW, and defines the mechanism by which to obtain development consent for a project.

A major expansion of the sawmill operations was approved in September 2010 (PA_0161) by the NSW Minister for Planning under Part 3A of the EP&A Act.

A modification to PA 07_0161 was granted in February 2012 ("Modification 1") following the acquisition of the operations by DWAU. The modification allowed for alternate construction staging and modification to several conditions of the consent.

Modification 2 to PA 07_0161 was approved on 15 July 2015 to replace four boilers (three being gas-fired boilers and one wood-fired boiler) with a single 18 megawatt (MW) wood-fired boiler. The modification also proposed to convert the green off sawn (GOS) kilns to steam, thereby allowing all kilns to operate with one energy source. However, implementation of the 18 MW boiler was not progressed as no cost effective way to construct and set up the steam supply across the site was available.

Modification 3 to PA 07_0161 was approved on 19th of February 2019 to install a new 15MW wood-fire boiler to replace the 18 MW boiler previously proposed as part of Modification 2. The existing 2.5MW wood-fired boiler servicing the redry kilns was retained and the existing 10MW gas fired boiler installed as part of the original project approval was decommissioned as part of the modification.

Modification 4 to PA 07_0161 was approved on 24th of April 2020 for installation and operation of H2F Timber Spray System. This system is a linear spray system to allow for the treatment of finished timber framing material with a preservative chemical known as Determite, a non-dangerous good which provides protection from termite and borer attack.

The Protection of the Environment Operations Act 1997 (POEO Act) is the key piece of environmental protection legislation administered by NSW EPA. As mentioned earlier in Section 1.1, DWAU has an existing Environment Protection Licence (EPL, number 11205) under the POEO Act to authorise the carrying out of a scheduled activity at the Bombala premises. DWAU's operation is considered to be a scheduled activity under Schedule 1 of the POEO Act in the categories of Wood or timber milling or processing works and Wood preservation.

The facility is considered as general activities and plant under Schedule 4 of the Protection of the Environment Operations (Clean Air) Regulation 2010 (POEO (Clean Air) Regulation). The new plant at the site is required to meet Group 6 emission limits under the Schedule 4 of the Regulation. These limits are discussed in the following section.

4.2 EMISSION CONCENTRATION LIMITS IN THE POEO (CLEAN AIR) REGULATION

The Group 6 limits in Schedule 4 of the POEO (Clean Air) Regulation that are relevant to the DWAU site wood fired boilers are listed in Table 4-1. The reference conditions are also provided in the table.

Table 4-1: Standards of concentration for Group 6 emissions to air

Substance	Group 6 limit for any activity or plant or boilers operating on a fuel other than gas
Solid particles (total)	50 milligram/m^3, STP, dry, 7% oxygen
NOx as NO2	500 milligram/m^3, STP, dry, 7% oxygen
Dioxins and furans	0.1 nanogram/m^3, STP, dry, 7% oxygen
Type 1 and 2 substances in aggregate	1 milligram/m^3, STP, dry, 7% oxygen
Total Volatile Organic Compounds, as n-propane	40 milligrams/m^3 or 125 milligrams/m3 Carbon Monoxide, at STP, dry, 7% oxygen

4.3 EMISSION LIMITS SPECIFIED IN PA AND EPL

The two regulatory approval documents that are relevant to air discharges from the DWAU Bombala site operations after the mill expansion are the Environmental Protection Licence (EPL11205), and the Planning Approval (PA07_0161-MOD4). Current versions of these documents can be downloaded online from the EPA website and Major Projects website respectively.

Condition 5 of Schedule 3 of MOD4 of the PA states that "[DWAU] shall ensure the emissions from the project do not exceed the emissions limits specified by the EPA in the EPL(s) for the site". The air concentration limits in the EPL are shown in Table 4-2 below. This table also shows the comparable Group 6 limits in the POEO (Clean Air) Regulation. The emission concentration limits specified in the EPL for oxides of nitrogen and VOCs are significantly lower than the Group 6 limits specified for comparable general plant in the POEO (Clean Air) Regulation.

Table 4-2: Air concentration limits in the EPL and comparative Group 6 limits

Emission point	Pollutant	Unit of measurement	100 percentile concentration limit in EPL	Group 6 limit in POEO (Clean Air) Regulation
EPA 23 – DP1 Chip fired redry boiler	Nitrogen oxides	Milligrams per cubic metre	200	500
	Volatile organic compounds		5	40
EPA 36 – 15MW woodfired Boiler	Nitrogen oxides		500	500
	Solid particles		50	50
	Volatile organic compounds		40	40
	Type 1 and Type 2 substances in aggregate		1	1

Table 4-2: Air concentration limits in the EPL and comparative Group 6 limits

Emission point	Pollutant	Unit of measurement	100 percentile concentration limit in EPL	Group 6 limit in POEO (Clean Air) Regulation
EPA 37 – C1 treatment plant	Type 1 and Type 2 substances in aggregate Copper		1 TPD	1 No limit specified

More detail on the test methods for each monitoring point are provided in Section 7.3.

4.4 AEMP Review

In the annual review of the AEMP (see Section 8), it will be necessary to incorporate any amendments to the AEMP that may be required due to modifications to EPL11205 or PA07_0161 occurring since the previous review.

In addition, if the modifications to the EPL or PA were significant for management of air emissions, it may be necessary to carry out an immediate review of the AEMP outside of the timetable for the annual review.

4.5 Approved Methods for the Sampling and Analysis of Air Pollutants in NSW

This AEMP has been prepared in accordance with the Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (AMSAAP). This document lists the methods to be used for the sampling and analysis of air pollutants for statutory purposes. All monitoring to show compliance with limits specified above must be done as follows:

- in accordance with the methods specified in this document
- in accordance with the methods specified in the relevant statutory instrument
- if no method is specified in either this document or the statutory instrument, in a manner approved by the EPA in writing before any tests are conducted.

Section 7 details the monitoring to be undertaken as part of this AEMP with reference to this document.

5. AIR IMPACT ASSESSMENT

5.1 OVERVIEW

A detailed assessment of air emissions (Air Quality Assessment of Various Emissions to Air from a Proposed Biomass Boiler within an existing Timber Mill, Bombala, NSW, Ektimo 2018) was undertaken as part of the environmental assessment to support Modification 3 to the consent. DWAU engaged Ektimo to conduct testing of various emissions to air from the notable discharge points at the facility. The new 15 MW boiler has been designed by Justsen Pacific who have provided system geometries and specifications, including emission test data for another biomass boiler in NSW with identical technology that is fuelled by comparable feedstock woodwaste. DWAU also have an on-site automatic weather station that has continuously recorded surface meteorological data over the past several years. This information has been used to inform the Air Quality impact assessment summarised below, and attached in Appendix 1.

This assessment was conducted to the requirements of the:

- NSW EPA Approved Methods for the Modelling and Assessment of Air Pollutants in NSW of 2016 ("AMMAAP")
- Protection of the Environment Operations (Clean Air) Regulation of 2010 (POEO Regs) for emission standards.

The primary emissions source for assessment is the proposed 15 MW biomass fired boiler. Other existing sources on site with emissions that include the same pollutant substances are:

- A 2.5 MW wood-fired boiler, servicing the re-dry kilns, that emit particulate matter (TPM as TSP, PM10 & PM2.5), combustion gases (NOX as NO2, CO and SO2) and residual products of combustion (Dioxins and Furans, and volatile organic compounds) and residual metals (Type 1 and 2 substances in aggregate).
- Vents on each of the Re-Dry Kiln 1 and 2, of which there are 10 located on the roof of each Re-Dry Kiln building for a total of 20 vents. These emit particulate matter (TPM as TSP, PM10 & PM2.5), residual volatile organic compounds and residual metals (Type 1 and 2 substances in aggregate).

The Ektimo report did not include reference to EPA points 37 and 38 which are the vacuum pumps attached to the treatment plant. The original air quality assessment in the EA report (Environmental Assessment for a Major Project, 2009) identified the key potential emission to air generated during MicroPro treatment as ammonia, with potential trace quantities only of copper compounds. Monitoring of Type 1 and Type 2 substances in the aggregate and copper are required by EPL11205 for Point 37. Monitoring requirements are outlined in this AEMP.

Modification 4, which includes the use of a H2F timber spray unit and its associated Bifenthrin emissions was described in the Bombala Sawmill Modification 4 Modification Report (GHD, 2020). The report states that based on the enclosed system, controls proposed and the sampling results provided from a similar site, the proposed modification represents a low risk of having any impacts on the local air quality.

5.2 Boiler Discharge Parameters Used in Air Impact Assessment

The discharge parameters and emission rates for the various boiler emission points that were included in the dispersion model are summarised in Table 5-1 and Table 5-2.

The two boiler discharge points assessed in the SEE report were as follows:

- EPA 23 – 2.5 MW chip fired redry boiler
- EPA 36 – 15MW wood-fired boiler.

The mass emission rates for the 2.5 MW boiler were based on the higher of the sampled results (as undertaken by Ektimo) or estimated emissions. Estimated emissions were determined using US-EPA emission estimation tables (AP42).

Emissions of PM10, PM2.5, NOX and Dioxins and Furans assessed at Group 6 POEO Reg 2010 in-stack emission concentration limits for the 15 MW biomass boiler. Mass emission rates were used to scale emissions for CO, SO2 and VOC from sampling of a 5 MW boiler.

Any changes to the discharge parameters in Table 5-1 may adversely affect the rate of dispersion from the stacks, and the potential impact of such changes on the air quality assessment should all be considered in the annual AEMP review (refer Section 8).

Table 5-1: Summary of boiler discharge points used in the SEE

Parameter	EPA23	EPA36
Fuel	Wood	Wood
Size	2.5 MW	15 MW
Stack Height (m)	10.35	18
Stack tip diameter (m)	0.4	1.1
Exhaust discharge temperature (°C)	219	210
Discharge velocity m/s	27	18

Table 5-2: Summary of boiler discharge point emissions used in the SEE

Parameter	EPA23	EPA36
TSP	0.24	0.35
PM_{10} (g/s)	0.22	0.35
$PM_{2.5}$	0.13	0.35
NO_x as NO_2 (g/s)	0.24	3.5
SO_2 (g/s)	0.027	0.15
CO (g/s)	0.022	0.0034
Dioxins and furans (ng/s)	1.5E-10	6.9E-10
Type 1 and Type 2 substances in aggregate	-	0.00018

When the boiler stack emissions are tested post-commissioning (Section 7.3), the actual emission concentrations may vary from those assumed in Table 5-2. If this causes an exceedance of the

concentration limits in the SEE, that would not necessarily mean that an adverse health impact could occur as there was a substantial buffer between the predicted air quality impacts and the air impact assessment criteria.

However, if the concentration limits in the SEE are exceeded, the air quality assessment would need to be reviewed.

Any exceedances of the emission rates used in the SEE air quality assessment, or exceedances of the air concentration limits specified in EPL11205 (refer Table 4-2) would be identified in post commission monitoring, EPL monitoring (every 6 months) as well as the following pollution studies required under EPL11205:

- 2.5 MW wood fired boiler pollution study (completed 19 February 2020)
- 15 MW wood fired boiler pollution study (completed)

The 2.5MW wood fired boiler pollution study was undertaken by Etkimo (Report R008832) and resulted in a NOx limit of 200 mg/Nm3 at point 23 and further pollution reduction programs for improvement works for the 2.5MW redry boiler.
The 15MW wood fired boiler pollution study was completed by Etkimo (Report R006226) in 2018 on EPA point 36.
The dispersion modelling also incorporated building downwash effects, with a range of building heights of 8, 10 and 12 m, as per design drawings current at the time of the modelling study (August 2018).

Subsequent changes to proposed or actual building heights or locations have the potential to adversely affect the rate of dispersion from the emission points, and the "as-built" building data should be incorporated in the AOIA review report (Section 7.3). The potential impact of such changes on the air quality assessment should also be considered in the annual AEMP review (Section 8) if changes to building dimensions are made during the year.

6. EMISSION CONTROLS AND CONTINGENCY MEASURES

6.1 BOILERS

6.1.1 Emission Controls

The wood fired boilers generate products of combustion which are emitted though a stack, and off-site air quality impacts were predicted in the SEE to be much lower than NSW EPA ground level impact assessment criteria. This is demonstrated in Table 10 of the MOD3 Air Quality Assessment provided as Appendix 1.

Emission concentrations of contaminants are expected to be lower than the Group 6 concentration limits specified in the POEO Act, and air concentration limits outlined in EPL11205. Subsequent stack testing results have confirmed emission concentrations.

6.1.2 Contingency Measures

For the reasons described in Section 6.1.1 above, and provided that the boilers are serviced and tuned at least annually, it is not likely there will be any exceedances of the EPL air concentration limits. Monitoring is required every six months of both the 2.5 MW and 15 MW boilers.

If any emission tests on the boilers exceed emission limits in the EPL, the following contingency measures will be employed:

1. Within one month of the DWAU Environmental Coordinator receiving the test results, the equipment supplier will complete a review of the operation of the equipment to confirm that boiler is operating in accordance with performance expectations and/or warranties. Any remedial measures identified in this review will be carried out as soon as reasonably practicable following the review.
2. Within one month after the completion of the review and/or remedial measures in (1) above, the emissions will be retested.
3. If the emissions still exceed limits in the EPL following the retesting, then the portion of the AQIA relating to discharges of the affected pollutants will be reviewed. This review of the AQIA will be completed within two months of the DWAU Environmental Coordinator receiving the results of the retesting in (2).
4. If the review of the AQIA finds that concentrations of the affected pollutants in the air beyond the DWAU site boundary exceed the NSW EPA Impact Assessment criteria then a pollution study will be required to identify necessary works to achieve compliance with the Clean Air Regulation or EPL licence limits and nominate a timeframe for any necessary works to be completed.

6.2 TIMBER TREATMENT PLANT AND REDRY KILNS

6.2.1 Emission Controls

Emissions to air from the timber treatment plant and redry kilns are low because the treatment chemicals are water-based. Sampling requirements of the redry kilns were removed in Licence Variation dated 21 February 2017 and it states “Monitoring Points 26 - 31 have been removed from the licence, along with any relevant limit conditions or monitoring conditions”.

The nature of venting from the timber treatment plant and redry kilns is described in Sections 3.2.2 and 3.2.3. No additional controls on emissions to air are necessary for these items of plant.

6.2.2 Contingency Measures

For the reasons described in Section 6.2.1 above, and provided the kilns are serviced and tuned at least annually, it is not necessary to have any contingency measures in place for the kiln vent emissions.

6.3 DUST CONTROLS

6.3.1 Control Measures for Process Dust Sources

The following measures are in place for control of fine particles that have the potential to create an airborne dust nuisance:

Shavings

Shavings produced from the mill are disposed in a fully sealed system. An extraction process removes the shavings from the planer and is captured by a collector/filter. The shavings are then blown into a special-purpose semi-trailer. In order to fully seal the system, a return air pipe is fitted to the back door of the semi-trailer to draw positive air out. There will be no shavings stored in open areas.

Woodchips and sawdust

Green Pine woodchips and sawdust are produced by the Hew saw line that is fully enclosed within a specifically designed building. Due to the nature of the chipping head and combined saws the process line emits very little dust (if any) and what is generated is controlled within the building.

The woodchips are transferred via conveyers to the storage bunker/loading area to await loading and removal from site. Sawdust is transferred internally to the biomass storage bunkers. Due to the wood chips and sawdust being green and of high moisture content it is expected that little to no dust will be generated during this process.

6.3.2 Fugitive Dust Controls

All operations and activities occurring at the premises must be carried out in a manner that will minimise the emission of dust from the premises. Systems for controlling dust emissions will be methods that modify the condition of the materials so that there is less potential to lift with the wind or disturbances such as vehicle movements, and methods that reduce the velocity of the wind at the surface.

Watering of exposed surfaces and materials that may be disturbed is a primary method of control throughout Australia. Watering of surfaces is most effective when the water is applied prior to strong winds occurring and prior to particularly dust generating activities commencing.

The following methods of fugitive dust control will be employed at the site where practicable and taking into account occupational safety and health requirements:

1. Seal surfaces that are used frequently by vehicles. The process of sealing these surfaces will occur progressively over time during and following the construction period.
2. For surfaces (roads, yards and landscaping) that cannot or do not need to be paved, or for which paving is scheduled in the future:
   (a) Retain as much vegetation as possible, and revegetate exposed surfaces where practical.
   (b) Cover surfaces with coarse materials such as gravel.
   (c) Keep yard and road maintenance up to date, such as repairing pot holes and laying of fresh gravel.
   (d) Keep road and exposed surfaces damp as far as practicable with water carts or fixed sprinklers.
   (e) Limit vehicle speeds on unpaved surfaces to a maximum or 20km/h.
   (f) Use of dust suppressant “dustex” in the watercart for additional dust control applied to the general site area. This method is used during high winds or on an as needs basis to prevent visual dust emissions.

3. Limit load size to avoid spillages and cover loads of fine materials.

Install wind fences (either in the form of mesh screens or plated fences) where practicable if windblown dust is problematic in any areas.

7. MONITORING REQUIREMENTS

All air monitoring shall be undertaken in accordance with the Approved Methods for the Sampling and Analysis of Air Pollutants in NSW. For the purposes of this section, these are referred to as the "AMSAAP".

7.1 METEOROLOGY

7.1.1 Monitoring equipment

A meteorological mast with sensors attached was commissioned at the site in June 2010 and subsequently moved to its current location in September 2011. The sensors are solar powered.

The monitoring station is shown in Figure 7-1. It is located to the west of the site of the new administration building, as shown earlier in Figure 3-1.

Data relating to the monitoring station equipment and installation is as follows:

- Height of sensor on mast: 10 m
- Equipment supplier: Pacific Data Systems Pty Ltd
- Equipment specification
  - Data logger: dataTaker DT82E Series 2 Data Logger
  - Wind sensor: Gill Instruments Windsonic Ultra Sonic Wind Sensor.
- Wind speed: Range 0-60 m/s, accuracy ±4%, resolution 0.01m/s, start speed 0.01m/s
- Wind direction: Range 0-360 degrees, no dead-band, accuracy ±4%, resolution 1 degree.
  - Rain gauge: Environdata RG12 Series tipping bucket rain guage.
  - Temperature and relative humidity: Vaisala Probe HMP155 with radiation shield.

7.1.2 Monitoring requirements

EPL11205 Section M4 includes conditions relating to weather monitoring. The meteorological parameters to be measured and sampling methods are outlined in Table 7-1. Data should be continuously stored at the mast site and at minimum downloaded by the DWAU Environmental Manager monthly.

Table 7-1: Sources of potential emissions to air and potential pollutants

Parameter	Unit of measurement	Frequency	Averaging Period	Sampling method
Temperature at 2 m	°C	Continuous	15 minute	AM-4
Wind direction at 10 metres	°	Continuous	15 minute	AM-2 & AM-4
Wind speed at 10 metres	m/s	Continuous	15 minute	AM-2 & AM-4
Sigma theta at 10 metres	°	Continuous	15 minute	AM-2 & AM-4
Rainfall	mm	Continuous	15 minute	AM-4

Table 7-1: Sources of potential emissions to air and potential pollutants

Parameter	Unit of measurement	Frequency	Averaging Period	Sampling method
Temperature at 10 m	^{o}C	Continuous	15 minute	AM-4
Solar radiation	W.m2	Continuous	15 minute	AM-4

Figure 7-1: Meteorological monitoring mast

7.2 Wind Monitoring Site Location Suitability

Location of the instrument is critical for wind measurement. The DWAU weather station is suitably located on the site premise. The weather station is located away from buildings and vegetation, on a flat area of land considered representative of the local wind area.

Guidance for mast siting to minimise wind interference from obstacles is provided in Australian Standard AS3580.14-2014-Methods for Sampling and Analysis of Ambient Air; Part 14:

Meteorological monitoring for ambient air quality monitoring applications. (Standards Australia Ltd, 9 August 2011).

The following describes the key attributes described in AS3580.14-2014 that define a suitable monitoring site:

1. For optimal measurement, representative wind is the wind measured at a height above 10 m over a flat open area substantially free of obstructions, where the anemometer is distant from any obstruction by at least 10 times the height of the obstruction.
2. As a general rule, obstructions should not project above the horizon by more than 6° at the sensor height. Therefore, it should be located away from obstructions which are higher than the anemometer, at distances not less than 10 times the difference of the heights of the anemometer and the obstructions.
3. Failing the above two conditions, the anemometer may be placed among the obstructions, typically 5 m to 10 m above their general level but, if on a building, well above the disturbed flow.

The main potential obstruction near the weather station is the new administration building, which is about 75 m to the southeast of the mast site. The roofline of the administration building is a maximum height of about 7.3 m above local ground level.

The weather station at the mill site is mounted 10 m above ground level, and ground level at the mast location is about 2 m lower than ground level at the administration building so the sensor height is effectively 8m above ground level relative to the administration building.

The location of the weather station is therefore suitable, and in compliance with the guidelines in AS3580.14- 2011 as described above.

7.3 BOILERS

7.3.1 Post-Commissioning and Ongoing Sampling

Each boiler stack has been tested after commissioning to confirm the discharge characteristics and emission rates and confirm compliance with the limit concentrations for these substances listed in the EPL11205. For EPA36 (15 MW wood fired boiler), within 6 months of post commissioning of the 15MW wood fired boiler, the licensee must provide the NSW EPA with an Air Emissions Monitoring Report. This was prepared by Etkimo in 2018 (Report No. R006226)

Ongoing sampling requirements for both boilers under M2.2 of EPL11205 are listed in Table 7-2.

Table 7-2: Sampling requirements for EPA23 and EPA36 (2.5 MW and 15 MW boilers)

Pollutant	Units of measure	Frequency	Sampling Method
Carbon dioxide	Percent	Every 6 months	TM-24
Carbon monoxide	milligrams per cubic metre	Every 6 months	TM-32
Dry gas density	Kilograms per cubic metre	Every 6 months	TM-23
Moisture	Percent	Every 6 months	TM-22
Molecular weight of stack gases	Grams per gram mole	Every 6 months	TM-23
Nitrogen Oxides	Milligrams per cubic metre	Every 6 months	TM-11
Oxygen (O2)	Percent	Every 6 months	TM-25
Solid Particles	Milligrams per cubic metre	Every 6 months	TM-15
Temperature	Degrees Celsius	Every 6 months	TM-2
Type 1 and Type 2 substances in aggregate	Milligrams per cubic metre	Every 6 months	TM-12, TM-13 & TM-14
Velocity	Metres per second	Every 6 months	TM-2
Volatile organic compounds	Milligrams per gram	Every 6 months	TM-34
Volumetric flowrate	Cubic metres per second	Every 6 months	TM-24

7.3.2 Sampling Ports

Sampling ports are required in each boiler stack to allow access to the stack for sampling.

Sampling locations are defined in test method TM-1 (see Table 7-2 above) which refers to AS 4323.1-1995. Guidelines in AS 4323.1-1995 specify the following optimum locations for sample ports and will be followed when the ports are installed in the stacks at the mill site.

The standard also requires that a work platform with safe and reasonable access shall be provided for stack emission testing. The platform may be a permanent or temporary structure. A safe and suitable means of access to the work platform is also required. Depending on the location of the platform, access to the work platform may be a walkway, stairway or fixed ladder or a suitable combination of these. The required access will be arranged by DWAU in consultation with the stack testing contractor, prior to the testing being carried out.

Compliance with OH&S requirements will be the responsibility of the DWAU Health and Safety Manager.

7.3.3 Reporting

The testing contractor will be required to prepare a report on any stack testing results, consistent with the NSW EPA requirements in Chapter 4 of the "AMSAAP" guideline.

The contractor will be responsible for preparing the report in compliance with the NSW EPA guidelines.

The NSW EPA "AMSAAP" guideline states that the results of any monitoring required by a statutory instrument must be provided to NSW EPA as a summary report signed by the licence holder.

7.4 Treatment Plant and Redry Kilns

There are no sampling requirements under EPL11205 for the redry kilns. Sampling requirements were removed in Licence Variation (Notice No 1537266) dated 21 February 2017 which states “Monitoring Points 26 - 31 have been removed from the licence, along with any relevant limit conditions or monitoring conditions”. If any future updates occur where sampling is required of the kiln exhausts, then this AEMP will need to be updated as per Section 9.

There are monitoring requirements for the treatment plant, which includes EPA point 37 (refer Section 3). Point 38 was removed in Licence Variation (Notice No 1605544). Ongoing sampling requirements for point 37 under L2.2 of EPL11205 are listed in Table 7-3.

Table 7-3: Sampling requirements for EPA37 (Treatment plant vacuum pumps)

Pollutant	Units of measure	Frequency	Sampling Method
Copper	milligrams per cubic metre	Yearly	TM-12, TM-14 & TM-14
Moisture	Percent	Yearly	TM-22
Temperature	Degrees Celsius	Yearly	TM-2
Type 1 and Type 2 substances in aggregate	Milligrams per cubic metre	Yearly	TM-12, TM-13 & TM-14
Volumetric flowrate	Cubic metres per second	Yearly	TM-2

DWAU has contracted Ektimo in the past to undertake sampling of the vacuum pump exhaust. Sampling of these sources requires deviations from the standard methods due to the practicalities of vent size, lack of stack access holes, up and downstream turbulence and venting duration. Given the nature of the sampling location it is not likely that a sampling method that is fully compliant with the Approved Methods for the sampling and analysis of air pollutants in NSW will be achievable.

Post-commissioning testing of the H2F Timber Spray System to demonstrate performance of the demister has been carried out in May 2020 as discussed in Section 8.

8. EMISSION SAMPLING

8.1 EMISSION SAMPLING EVENTS

Since the AEMP dated 25 September 2019, emission sampling has been carried out at key emission sources as described below:

- Ektimo sampling November 2019 – Report Number R008357 dated 2 January 2020 – conducted to satisfy post commissioning and six monthly sampling requirements for EPA23 and EPA36 (2.5 MW and 15 MW boilers) as well as annual sampling requirements for EPA37 (EPA38 is not currently in use and as such sampling was not carried out on this source)
- Ektimo sampling May 2020 – Report Number R009170 dated 16 June 2020 – conducted to satisfy post-commissioning sampling requirement (condition U1 of license) for Bifenthrin Demisting System Stack (H2F Timber Spray System)
- Ektimo sampling May 2020 – Report Number R009176 dated 17 June 2020 - conducted to satisfy six monthly sampling requirements for EPA23 and EPA36 (2.5 MW and 15 MW boilers)
- Ektimo sampling May 2021 – Report Number R0010222 dated 3 May 2021 – conducted to satisfy six monthly sampling requirements for EPA23 and EPA36 (2.5 MW and 15 MW boilers)

The second round of air emission testing for the redry boiler and biomass boiler (Points 23 and 36) was not undertaken in 2020 due to COVID restrictions, the consultant could not visit the site. Testing was undertaken outside the licensing period. EPA were notified.

Key findings of the emission sampling data is summarised below.

8.2 EMISSION SAMPLING RESULTS

8.2.1 Ektimo Sampling Report - R008357 – 2 January 2020

Key sampling results relating to EPL license limits are shown in Table 8-1 below.

Table 8-1: Sampling results - R008357 – 2 January 2020

Emission point	Pollutant	Unit of Measurement	100 percentile concentration limit in EPL	Measured concentrations (corrected to 7% O_2)
EPA 23 – DP1 Chip fired redry boiler	Nitrogen oxides	Milligrams per cubic metre	125	130[1]
	Volatile organic compounds		5	0.99
EPA 36 – 15MW wood-fired boiler	Nitrogen Oxides		500	120
	Solid particles		50	14
	Volatile organic compounds		40	0.69
	Type 1 and Type 2 substances in aggregate		1	<0.034

Table 8-1: Sampling results - R008357 – 2 January 2020

Emission point	Pollutant	Unit of Measurement	100 percentile concentration limit in EPL	Measured concentrations (corrected to 7% O_2)
EPA 37 – C1 treatment plant	Type 1 and Type 2 substances in aggregate		1	<0.019
	Copper		TBD	0.0032
EPA 38 – C2 treatment plant	Type 1 and Type 2 substances in aggregate		1	Not sampled
	Copper		TBD	Not sampled
1. Whilst the EPL limit is exceeded by 5 mg/m^3, the source is readily compliant with POEO limit of 500 mg/m^3				

8.2.2 Ektimo Sampling Report - R009170 – 16 June 2020

Key sampling results relating to EPL license limits are shown in Table 8-2 below.

Table 8-2: Sampling results - R009170 – 16 June 2020

Emission point	Pollutant	Unit of Measurement	Group 6 limit in POEO (Clean Air) Regulation	Measured concentrations (corrected to 7% O_2)
Bifenthrin Demisting System Stack	Bifenthrin	Milligrams per cubic metre	No Limit	<0.004
	Volatile organic compounds		40	2.5

8.2.3 Ektimo Sampling Report - R009176 – 17 June 2020

Key sampling results relating to EPL license limits are shown in Table 8-3 below.

Table 8-3: Sampling results - R009176 – 17 June 2020

Emission point	Pollutant	Unit of Measurement	100 percentile concentration limit in EPL	Measured concentrations (corrected to 7% O_2)
EPA 23 – DP1 Chip fired redry boiler	Nitrogen oxides	Milligrams per cubic metre	125	120[1]
	Volatile organic compounds		5	5.9
EPA 36 – 15MW wood-fired boiler	Nitrogen Oxides		500	130
	Solid particles		50	8.5
	Volatile organic compounds		40	3.6
	Type 1 and Type 2 substances in aggregate		1	<0.11
EPA 37 – C1 treatment plant	Type 1 and Type 2 substances in aggregate		1	<0.0074
	Copper		TBD	0.0019
EPA 38 – C2 treatment plant	Type 1 and Type 2 substances in aggregate		1	Not sampled
	Copper		TBD	Not sampled

8.2.4 Ektimo Sampling Report - R0010220 – 3 May 2021

Key sampling results relating to EPL license limits are shown in Table 8-3 below.

Table 8-4: Sampling results - R010222 – 3 May 2021

Emission point	Pollutant	Unit of Measurement	100 percentile concentration limit in EPL	Measured concentrations (corrected to 7% O_2)
EPA 23 – 2.5MW redry boiler	Nitrogen oxides	Milligrams per cubic metre	200	88
	Volatile organic compounds		5	0.94
EPA 36 – 15MW wood-fired boiler	Nitrogen Oxides		500	130
	Solid particles		50	32
	Volatile organic compounds		40	1.2
	Type 1 and Type 2 substances in aggregate		1	<0.21

8.3 DISCUSSION OF EMISSION SAMPLING

8.3.1 Nitrogen Oxides Exceedance November 2019 Sampling

An exceedance of the EPL limit for nitrogen oxides was recorded at EPA23 during November 2019 sampling. The sampling result was 130 mg/m³ in comparison to an EPL limit of 125 mg/m³ representing a minor exceedance of the limit. The relevant Group 6 limit in POEO (Clean Air) Regulation for this pollutant is 500 mg/m³.

8.3.2 Post Commissioning Result for Bifenthrin Demisting System Stack

The May 2020 sampling for the Bifenthrin Demisting System Stack (H2F Timber Spray System) found that volatile organic compound emissions were 2.5 mg/m³, significantly below the 40 mg/m³ Group 6 limit in POEO (Clean Air) Regulation.

No emission standard for Bifenthrin is provided in New South Wales.

8.3.3 Volatile Organic Compounds Exceedance May 2020 Sampling

An exceedance of the EPL limit for volatile organic compounds was recorded at EPA23 during May 2020 sampling. The sampling result was 5.9 mg/m³ in comparison to an EPL limit of 5 mg/m³ representing a minor exceedance of the limit. The relevant Group 6 limit in POEO (Clean Air) Regulation for this pollutant is 40 mg/m³.

8.3.4 May 2021 Sampling

All sampling results in the latest round of sampling were found to be below the EPL limits.

9. REVIEWS

This AEMP will be reviewed at least annually, with the annual review to be completed by 30 September of each year. The Operations Manager shall undertake the review in consultation with the Environmental Coordinator and staff.

The annual review will consider:

- Changes to EPL and Development Consent conditions, including but not limited to emission limits and monitoring/reporting requirements.
- Changes to discharge parameters e.g. stack height, diameter, and temperature etc, compared to SEE Report assumptions.
- Stack testing results and comparison to assumed emission rates in SEE Report.
- Changes to building heights and layouts that have the potential to adversely impact on dispersion.
- New dwellings or other potentially sensitive developments constructed within about 700 m of the site boundary that may be impacted by air emissions from the site to a greater extent than existing houses.

10. RESPONSE TO COMPLAINTS

10.1 COMPLAINT INVESTIGATIONS

Complaints about air quality impacts may be referred by one or more of the regulatory authorities, a member of the public, a member of the construction team, or a DWAU employee or contractor. Complaints will usually relate to dust or odour. It is the responsibility of the Environmental Manager to respond to and follow up all complaints. The Environmental Manager is responsible for ensuring that suitably qualified personnel are available to respond to complaints at all times.

Actions to be taken as soon as possible by the Environmental Manager or delegate include:

- Fill out a complaint form.
- Note the time, date, identity and contact details of complainant (if provided). Wind direction and strength (from data recorded at the onsite weather station) and weather conditions are recorded. Note if complaint has been referred from a regulatory authority.
- Ask complainant to describe the nature of the problem - is it constant or intermittent, how long has it been going on for, is it worst at any time of day, does it come from an identifiable source
- As soon as possible after receipt of a complaint undertake a site inspection. Note all activities taking place that have the potential to discharge the contaminant in question (e.g. odour or dust), and the mitigation methods that are being used. If complaint was related to an event in the recent past, note any related activities that were underway at that time, if possible. Order any remedial action necessary.
- As soon as practical (preferably within two hours) visit the area from where the complaint originated to ascertain if the alleged impact is still a problem.
- If it becomes apparent that there may be a source of air emissions other than the mill activities causing the air quality impact it is important to verify this. Photograph the source and emissions.
- As soon as practicable after the initial investigations have been completed contact the complainant to explain any problems found and remedial actions taken. Initiate a damage assessment if required (e.g. dust deposition).
- If necessary update any relevant procedures in the relevant Management Plan to prevent any recurrence of problems.
- Complete complaint form and file on complaint register.

10.2 IF ADDITIONAL RESPONSES ARE REQUIRED

If frequent complaints are received and verified as indicating that impacts of odour or dust are excessive at nearby houses, DWAU will engage the services of a suitably experienced consultant to carry out the following:

- Review the nature of the impacts and the effectiveness of the odour and dust mitigation measures used on site.
- If appropriate, review the mitigation measures described in this AEMP and audit the site's effectiveness at implementing those measures.

10.3 TELEPHONE COMPLAINTS LINE

DWAU operates during its opening hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

The number is +61 2 6459 5560, and the webpage is kept up to date if this changes.

11. REPORTING REQUIREMENTS

DWAU is required under EPL11205 to complete an Annual Return in the approved form comprising:

- a statement of compliance
- a Monitoring and Complaints Summary,
- a Statement of Compliance - Licence Conditions,
- a Statement of Compliance - Load based Fee,
- a Statement of Compliance - Requirement to Prepare Pollution Incident Response Management Plan
- a Statement of Compliance - Requirement to Publish Pollution Monitoring Data; and
- a Statement of Compliance - Environmental Management Systems and Practices.
- Requirements are detailed in Section 6 of the EPL and must include all air quality monitoring and complaints.

APPENDICES

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REPORT

Air Quality Assessment of Various Emissions to Air from a Proposed Biomass Boiler within an existing Timber Mill, Bombala, NSW

Dongwha Australia Pty Ltd

Report Number R006226

Document Information

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Address:	Sandy Lane, Bombala, NSW. 2632

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Report Authorisation

Ektimo
A. Lewis
Air Quality Environmental Consultant

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1 EXECUTIVE SUMMARY

1.1 Context

Dongwha Australia Pty Ltd (DAU) propose to replace an existing natural-gas fired boiler with a 15 MW biomass fired boiler at their timber mill facility at Bombala in the south-east tablelands of NSW. The proposed boiler is to be fuelled by uncontaminated timber waste from the timber mill and will have emissions to air of combustion gases, particulate matter and other compounds in trace quantities. This report represents an air quality assessment of the impact of the notable emissions to air from the facility, inclusive of the emissions from the proposed boiler, upon receiver locations beyond the facility boundary. This assessment may be used to inform the approval and subsequent licencing of the proposed boiler within the current NSW EPA *Environment Protection Licence* for the Bombala facility (EPL number 11205).

1.2 Approach

Ektimo have recently conducted testing of the various emissions to air from the notable discharge points at the facility. The proposed boiler has been designed by *Justsen Pacific* who have provided system geometries and specifications, including emission test data for another biomass boiler in NSW with identical technology that is fuelled by comparable feedstock wood-waste. DAU also have an on-site automatic weather station that has continuously recorded surface meteorological data over the past several years. All this information was used to inform this assessment.

This assessment has been conducted to the requirements of the NSW EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW of 2016*. **Section 2** of this assessment describes the surrounding land use including the nearest sensitive receivers. **Section 3** details relevant EPA policy in the *approved methods* for the impact assessment and also the *Protection of the Environment Operations (Clean Air) Regulation of 2010* (*PEO Regs*) for emission standards. **Section 4** details the assessment methodology including the emissions inventory, the existing baseline background air quality, the local meteorology and the dispersion model configuration. **Section 5** details the ground level concentration criteria assessment.

Ektimo have conducted this air quality assessment subject to the limitations detailed in **Section 6**.

1.3 Conclusions

The assessment has determined that with a **minimum** vent stack height of 18 m above ground level for the proposed 15 MW biomass fired boiler, the combined emissions to air from the notable sources within the facility will comply with the various relevant ground level concentration criteria within the *approved methods*. This is based upon the notable emissions of particulate matter, oxides of nitrogen and the trace amounts of dioxin and furans being emitted at or below the relevant scheduled *PEO Reg* Group 6 limits for standards of concentrations for scheduled premises. The emissions of Type 1 and 2 Substances (in aggregate) and total Volatile Organic Compounds (VOC's) represented 2.5% or less of their respective emission limits when emitted at the expected levels and therefore these low risk emissions were not directly assessed. The emissions of sulphur dioxide and carbon monoxide were readily compliant when emitted at expected levels.

The emissions of Oxides of Nitrogen (NOX) were the most constraining based on compliance with the 1-hour assessment criterion for Nitrogen Dioxide (NO2) at the nearest sensitive receiver (the DAU guest-house accommodation on the western boundary of the facility). However, this comparison is considered conservative based on:

- Emission testing for a comparable 5 MW biomass boiler, with the emissions extrapolated to that for the proposed 15 MW boiler, indicate a mass emission rate ~34% of that when based on the higher PEO Regs in-stack concentration limit of 500 mg/m3 (STP, dry, 7% oxygen) which was assessed for ground level concentrations. Ektimo note that the comparable biomass boiler in NSW on which the test data was based was licenced at 400 mg/m3 (STP, dry, 7% oxygen) NOX as NO2.
- The NOX is expected to be predominantly (>90%) Nitric Oxide (NO) at the point of emission and then convert gradually to NO2 further downwind after dilution and in the presence of ozone. The NOX was assessed as 100% NO2 at emission.
- The lack of site representative ambient air monitoring data required an assessment whereby peak predicted ground level concentrations were added to peak hourly ambient air concentration monitored at the nearest air quality monitoring station (Kembla Grange) for comparison with the criterion. Background levels of NO2 at Bombala would be typically lower.

Peak predictions of particulates were readily compliant with criteria when combined with peak monitored levels as recorded recently in the region (at Bega), and when emitted at the Group 6 limit of 50 mg/m3 (STP, dry, 7% oxygen) and when assessed as nuisance Total Suspended Particulate (TSP) or as inhalable particles of either 2.5 or 10 micron or less (PM2.5 or PM10).

In accordance with Good Engineering Practice guidance, this minimum proposed stack height is more than 2.5 times the height of the adjacent building which the boiler services and is also >6 metres higher than any other building on the site.

The emissions for each pollutant substance are subject to testing upon commissioning of the 15 MW biomass boiler to confirm the estimates adopted in this assessment.

2 SURROUNDING LAND USE

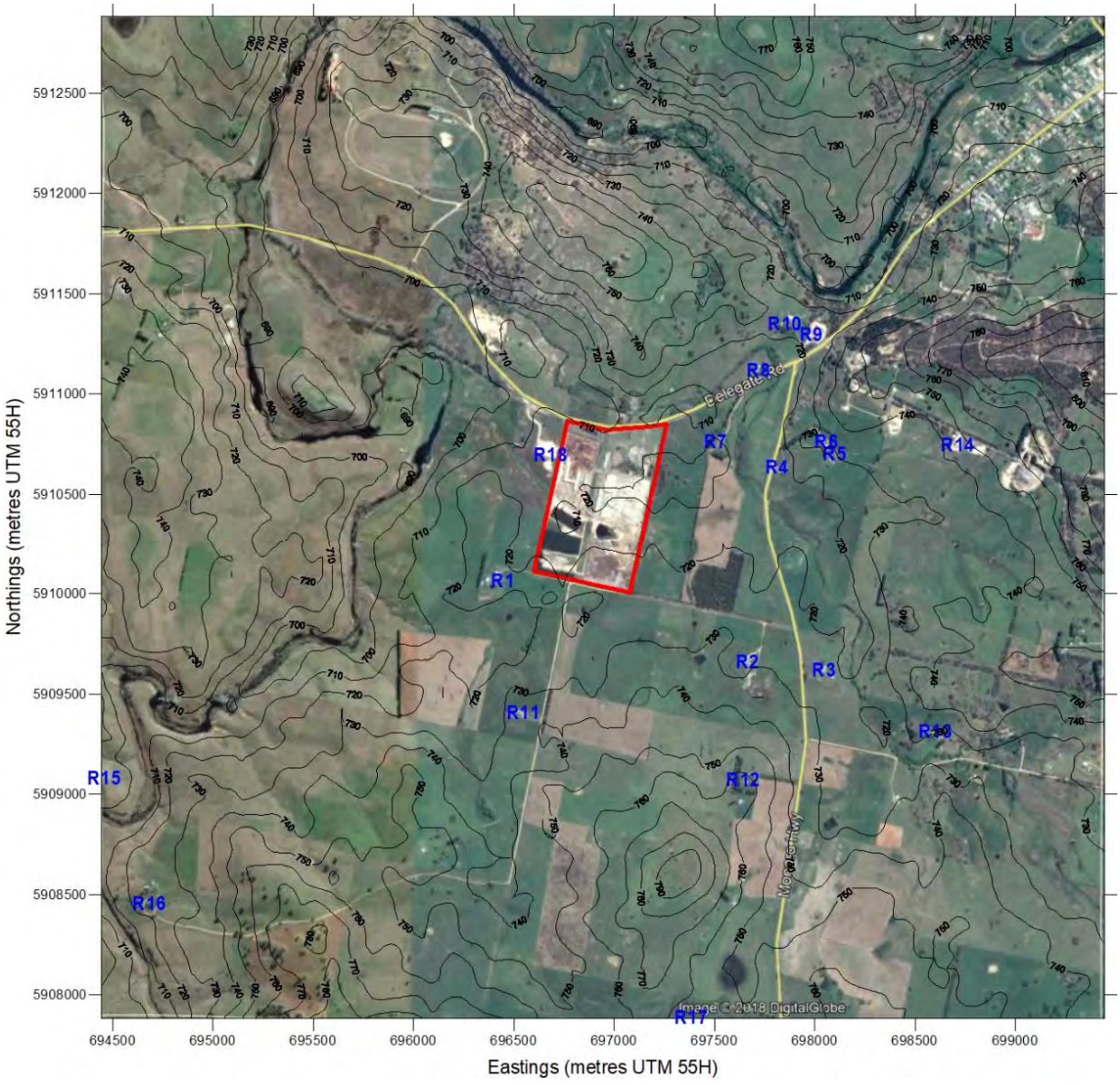
The town of Bombala is located approximately 485 km south of Sydney, in the south-west tablelands of NSW at an elevation of approximately 720 metres above sea level. The population of Bombala as noted in the 2016 Census was 1,387. Commercial activities in the area are predominantly agricultural cropping, livestock and timber related, with the DAU timber mill operations representing the most significant commercial activity local to the township.

The DAU timber mill is located 2 km south-west of the Bombala township residential area in an area of slightly undulating terrain. The facility is located within cropping farmland that include isolated rural dwellings that comprise most sensitive receivers[1]. Note **Figure 1** for an aerial image of the region including the township, facility and nearest receivers. The nearest receiver, R18 beyond the western boundary of the facility, is a commercial guest house that DAU use for visiting staff or contractors who stay over-night. **Table 1** lists these identified sensitive receivers for assessment.

Table 1: Identified sensitive receivers within the study area.

Receptor	Eastings (metres, UTM 55H)	Northings (metres, UTM 55H)	Elevation (m.a.m.s.l.)	Receptor Type	Receptor	Eastings (metres, UTM 55H)	Northings (metres, UTM 55H)	Elevation (m.a.m.s.l.)	Receptor Type	Receptor	Eastings (metres, UTM 55H)	Northings (metres, UTM 55H)	Elevation (m.a.m.s.l.)	Receptor Type
R1	696448	5910062	724	Residence	R7	697508	5910760	720	Residence	R13	698603	5909310	730	Residence
R2	697665	5909658	728	Residence	R8	697721	5911116	714	Residence	R14	698714	5910743	745	Residence
R3	698048	5909616	723	Residence	R9	697986	5911294	725	Residence	R15	694457	5909078	715	Residence
R4	697813	5910634	717	Residence	R10	697853	5911348	727	Residence	R16	694684	5908451	725	Residence
R5	698101	5910697	730	Residence	R11	696548	5909403	734	Residence	R17	697386	5907886	755	Residence
R6	698060	5910761	732	Residence	R12	697645	5909068	765	Residence	R18	696684	5910696	718	Commercial

Figure 1: Aerial image of the assessment area including the DAU facility and the nearest identified receivers. Contours of terrain elevation are indicated in 10 metre increments above mean sea level.



[1] Sensitive receivers are defined as residences, schools and hospitals.

3 POLICY

Emissions from discharge stacks in NSW are subject to regulations that limit the concentration of pollutant substances within the discharge flue gas (based on minimum controls), and also the resultant peak ground level concentrations for each substance that may occur as the results of those controlled emissions (based on potential impacts upon amenity, human health or biodiversity) under all meteorological conditions expected to occur at the site.

The proposed 15MW biomass boiler in-stack concentrations for some pollutant substances are subject to the Group 6 limits scheduled in *Protection of the Environment Operations (Clean Air) Regulation of 2010* (*PEO Regs*) for scheduled premises. These are detailed for the relevant emission substance in **Table 2.**

Table 2: PEO Regs in-stack emission Concentration Limits for substances relevant to the proposed Biomass Boiler.

Substance	Group 6 limit for any activity or plant or boilers operating on a fuel other than gas
TPM	50 milligram/m3, STP, dry, 7% oxygen
NOX as NO2	500 milligram/m3, STP, dry, 7% oxygen
Dioxins and Furans	0.1 nanogram/m3, STP, dry, 7% oxygen
Type 1 and 2 substances in aggregate	1 milligram/m3, STP, dry, 7% oxygen
Total Volatile Organic Compounds	40 milligrams/m3 or 125 milligrams/m3 Carbon Monoxide, at STP, dry, 7% oxygen

The EPA's current *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* define ground level concentration impact assessment criteria for the substance emitted from the proposed biomass boiler.

Emissions of Total Particulate Matter (TPM) include sub-set coarser particle sizes that are Totally Suspended Particulate (TSP) that are assessed for amenity (i.e. visible plume or soiled surfaces) and finer proportions of 10 or 2.5 micron or less aerodynamic equivalent (PM10 and PM2.5) which are assessed for toxicity. The EPA also defines amenity criteria for deposited dust, expressed as 4 grams per square metre per month as an annual average limit. However, particulate emissions from combustion processes are typically >80% less than 50 micron which is in the totally suspended size range and so the constraining criterion that limits the emissions to air is not expected to be deposited dust. Therefore, this amenity criterion is not considered directly with this assessment, i.e. compliance with criteria for PM2.5, PM10 and with TSP will also see compliance with deposited dust after the required abatement of the particulate emissions to air.

The relevant EPA assessment criteria, inclusive of existing ambient levels, is to be met at either sensitive receiver locations or at and beyond the site boundary. The criteria for the relevant emitted substances are summarised in **Table 3**.

Table 3: Ground level concentration assessment criteria for notable substances as emitted from the proposed biomass boiler.

Substance	Assessment	Criteria
TSP	Predicted annual average at nearest sensitive receiver	90 µg/m^3
PM10	1st Highest predicted 24-hour average at nearest sensitive receiver	50 µg/m^3
	Predicted annual average at nearest sensitive receiver	25 µg/m^3
PM2.5	1st Highest predicted 24-hour average at nearest sensitive receiver	25 µg/m^3
	Predicted annual average at nearest sensitive receiver	8 µg/m^3
NO2	1st Highest predicted 24-hour average at nearest sensitive receiver	246 µg/m^3
	Predicted annual average at nearest sensitive receiver	62 µg/m^3
SO2	1st Highest predicted 10-minute average at nearest sensitive receiver	712 µg/m^3
	1st Highest predicted 1-hour average at nearest sensitive receiver	570 µg/m^3
	1st Highest predicted 24-hour average at nearest sensitive receiver	228 µg/m^3
	Predicted annual average at nearest sensitive receiver	60 µg/m^3
CO	1st Highest predicted 15-minute average at nearest sensitive receiver	100 µg/m^3
	1st Highest predicted 1-hour average at nearest sensitive receiver	30 µg/m^3
	1st Highest predicted 8-hour average at nearest sensitive receiver	10 µg/m^3
Dioxins and Furans	99.9th percentile predicted, 1-hour average at and beyond the site boundary	2 x 10^{-6} µg/m^3

Note: Gas volumes are expressed at 25°C and at an absolute pressure of 1 atmosphere (101.325 kPa).

The height of the proposed boiler vent stack is to be no less than 2.5 times the height of the associated building that it services to minimise the effect of building induced downwash of the vent stack plume during the initial stages of emission plume rise and dispersion, as per good engineering practice.

4 ASSESSMENT METHODOLOGY

4.1 Emissions Inventory

The primary source for assessment is the proposed 15 MW biomass fired boiler. Other existing sources on site with emissions that include the same pollutant substances are:

- A 2.5 MW wood-fired boiler, servicing the re-dry kilns, that emit particulate matter (TPM as TSP, PM10 & PM2.5), combustion gases (NOX as NO2, CO and SO2) and residual products of combustion (Dioxins and Furans, and volatile organic compounds) and residual metals (Type 1 and 2 substances in aggregate).
- Vents on each of the Re-Dry Kiln 1 and 2, of which there are 10 located on the roof of each Re-Dry Kiln building for a total of 20 vents. These emit particulate matter (TPM as TSP, PM10 & PM2.5), residual volatile organic compounds and residual metals (Type 1 and 2 substances in aggregate).

There also currently exists a natural gas fired boiler on site although this will be decommissioned after the installation of the proposed biomass boiler, and the emissions from this source are therefore not included in this assessment.

Note **Figure 2** for an aerial view of the site with the location of the emission sources indicated within the site boundary.

Ektimo conducted testing of these emissions sources at the site during January and April of 2018. Note the Ektimo emission test reports for DAU in **Appendix A**. The test results for the 2.5 MW wood-fired boiler and for the Re-Dry kiln vents are detailed in the adopted emissions inventory for the assessment detailed in **Table 4** for source geometry and discharge conditions and **Table 6** for mass emission rates. Ektimo note the following:

- The ten identical vents on each Re-Dry Kiln roof are clustered close together and so are represented as a single source for each kiln in the dispersion modelling. A representative vent on each of the two kilns was tested and the adopted mass emission rate for each of these tested sources was multiplied by 10 for use in the assessment.
- During the testing of the 2.5 MW wood-fired boiler stack (see test report R005733 in **Appendix A**), the sampling ports could not be removed and so the testing was conducted at the stack tip rather than at the compliant sampling plane. This has introduced some uncertainty in the substance mass emission rate test results. Therefore, the notable pollutant substance mass emission rates were also estimated based on the US-EPA emission estimation tables (AP42) for this source type, and the maximum of either the test data or the estimates were adopted in the assessment. Note **Table 5** for the estimation of the emission rates for each notable pollutant substance, with these rates also included in **Table 6**.

The layout of the proposed 15 MW biomass boiler is illustrated in **Figure 3**, to be located on the south side of the GOC Kiln building. The estimated emissions from the proposed 15 MW biomass boiler were based upon design geometry and discharge flow conditions as provided by the technology vendor *Justsen Pacific* for this proposed boiler. The emission rates for the notable pollutant species were estimated based upon test data from a smaller 5MW biomass boiler of the same design that uses comparable feedstock as recently installed and tested at *Family Fresh Farms* at Peats Ridge, NSW. Note Ektimo test report R005320 in **Appendix B**. With reference to **Table 6**, Ektimo note the following:

- Those pollutant substances to be emitted from the proposed boiler that have POE Reg Group 6 in-stack limits comprise TPM, NOX, Dioxins and Furans, Type 1 and 2 Substances in aggregate, and total VOC's with its associated limit for CO;
- The notable emissions for TPM (and hence TSP, PM10 and PM2.5) and for NOX as 100% NO2 were assessed for ground level concentrations at the Group 6 in-stack emission limits rather than at the emission rates scaled directly from the testing of the smaller biomass boiler at *Family Fresh Farms;*
- The residual emissions of Dioxins and Furans were assessed for ground level concentrations at their Group 6 in-stack limit. These were not tested from the *Family Fresh Farms* boiler;
- The proposed emissions of Type 1 and 2 Substances (in aggregate) and total Volatile Organic Compounds (VOC's) represented 2.5% or less of their respective POE Reg Group 6 emission limits based on the testing of the comparable *Family Fresh Farms* boiler emissions and therefore these low risk emissions were not assessed for ground level concentration. With reference to compliance for CO levels when assessing VOC's, the in-stack concentration of CO as tested on the comparable Family Fresh Farms boiler was 8.1 mg/Nm3 (dry, STP, 7% O2) which is only 6.5% of the Group 6 limit of 125 mg/Nm3;
- The combustion gas emissions of SO2 and CO were assessed based on emissions concentrations from the testing of the comparable *Family Fresh Farms* boiler multiplied by the higher design flue gas volumetric flow rate for the larger proposed 15 MW boiler at 100% load;
- The emissions of NOX as 100% NO2 were assessed as the most constraining for compliance with ground level concentration criteria for a mass emission rate calculated for the Group 6 Limit in-stack concentration. For comparative purposes, the **expected** emission rate has been estimated from the lower tested in-stack concentration for the *Family Fresh Farms* boiler

combined with the higher design flue gas volumetric flow rate at 100% 15MW load (note **Table 7**). This lower NOX mass rate is ~34% of that when calculated at the higher PEO Regs Group 6 limit of 500 mg/Nm3; and

- The minimum vent stack height for the proposed boiler was determined to be 18 metres above ground level (agl), which is greater than 2.5 times the height of the adjacent building which the boiler services (the 6.7 m high GOS Kiln enclosure) as per Good Engineering Practice guidance. This height is also more than 6 metres taller than the highest structure on the site (the 11.6 metre high Green Mill building) which reduces the risk of impingement of the discharged plume gas on this structure.
- ***The emissions for each pollutant substance are subject to testing upon commissioning of the 15 MW biomass boiler to confirm the estimates adopted in this assessment.***

Figure 2: Extent of the DAU timber mill with emissions sources and prominent buildings indicated within the site boundary.

Figure 3: Layout of the proposed 15 MW biomass boiler to be located externally on the south side of the 6.7-metre-tall GOS Kiln building (source: *Justsen Pacific*).

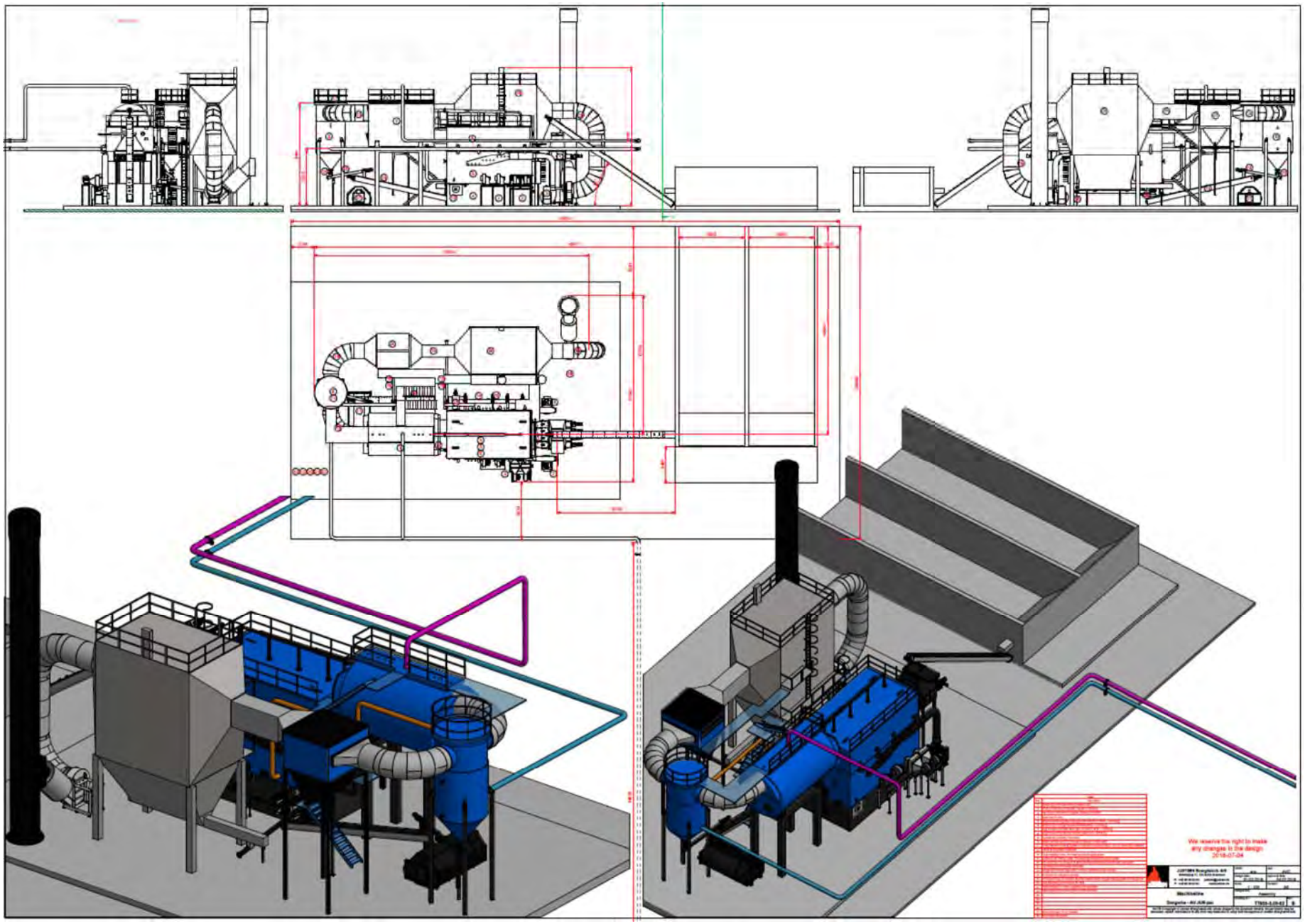


Table 4: Summary of assessed stack conditions.

Source	Release Type	Location			Geometry		Discharge Conditions							Notes
		Eastings (m, UTM 56H)	Northings (m, UTM 56H)	Base Elevations (m amsl)	Height a.g.l (m)	Internal Diameter (m)	Temp (degC)	Velocity (m/s)	Oxygen Concentration (%v/v, dry)	Moisture Content (%)	Flow Rate (Am3/sec)	Flow Rate (Nm3/sec), wet	Flow Rate (Nm3/sec), dry	
Redry Kiln 1 EPA 28	Wake-affected	697076	5910479	720	6.9	0.37	75	3.4	not tested	18	0.37	0.27	0.22	Ektimo test report R005733, one of 10 vents closely grouped together and modelled as a single source.
Redry Kiln 2 EPA 29	Wake-affected	697088	5910476	720	6.9	0.37	80	6.6	not tested	41	0.71	0.51	0.3	Ektimo test report R005733, one of 10 vents closely grouped together and modelled as a single source.
2.5 MW Wood Fired Boiler	Wake-affected	697098	5910473	720	10.35	0.4	219	27	7.2%	17%	3.4	1.8	1.5	Ektimo test report R005733
Proposed 15MW Biomass Boiler	Partially wake-affected	696853	5910546	720	18	1.1	210	18	9.4%	15%	17.5	9.9	8.4	***Minimum*** stack height. Design flow rate. Oxygen content and moisture based on that tested for 5MW boiler with identical technology and comparable feedstock (Ektimo test report R005320).

Table 5: Estimated emissions inventory for 2.5 MW wood fired boiler with multicyclones using USEPA AP-42 emission estimation tables at tested flow conditions.

EMISSIONS INVENTORY FOR A 2500 KW WOOD RESIDUE FIRED BOILER					
System parameters as tested			**Units**		
A	Power rating	2500	kw		
B	Flue gas flow rate at maximum continuous rating, wet, STP (0 degC, 1atm)	6700	Nm3/hour		
C	Typical moisture content	17%	% v/v		
D	Flue gas flow rate at maximum continuous rating, dry, STP [(1.0 - C) x B *)]*	5561	Nm3/hour		
E	*unit conversion (D* /3600*)*	1.5	Nm3/sec		
F	Flue gas Oxygen at maximum continuous rating, dry	7.2%	% v/v		
G	Ref. oxygen level for testing, dry [for a non-scheduled premise, Group C, *PEO Clean Air reg 2010*)]	7%	% v/v		
H	Flue gas temperature at maximum continuous rating	219	degC		
I	Flue gas flow rate at maximum continuous rating, actual, wet, 1 atm [B x (273+ H)/273]	12075	m3/hour		
J	*unit conversion (I* /3600*)*	3.4	m3/sec		
K	Internal flue diameter at exhaust exit	0.40	m		
L	Cross-sectional area of flue exhaust	0.126	m2		
M	Exit velocity (J/L)	27	m/sec		
PARTICULATE MATTER		**Filterable PM**	**Filterable PM10**	**Filterable PM2.5**	**Units**
N	Emission factor for wet wood with mechanical collector (multicyclones) [Table 1.6-1, USEPA AP-42 9/03]	0.22	0.2	0.12	lb/MMbtu
O	*unit conversion* (N x 4.3E-10)	9.46E-11	8.60E-11	5.16E-11	kg/J
P	Emission rate for wet wood with no control	0.00024	0.00022	0.00013	kg/sec
Q	*unit conversion* (P x 1000)	0.24	0.22	0.13	g/sec
X	In-stack concentration of particulates, dry, STP, at flue gas O2% (1000 x *Q/E*)	153	139	84	mg/Nm3
Y	***In-stack concentration of particulates, dry, STP at ref. O2% [X x (20.9% - F)/(20.9% - G)]***	***151***	***137***	***82***	***mg/Nm3***
COMBUSTION GASES		**NOX as NO2**	**SO2**	**CO**	**Units**
Z	Combustion gas emission factor [Table 1.6-2, USEPA AP-42 9/03]	0.22	0.025	0.6	lb/MMbtu
AB	*unit conversion* (Z x 4.3E-10)	9.46E-11	1.08E-11	2.58E-10	kg/J
AC	Emission rate for wet wood fired boiler	0.00024	0.000027	0.0006	kg/sec
AD	*unit conversion* (AC x 1000)	***0.24***	***0.027***	***0.6***	g/sec
AE	In-stack concentration, dry, STP, at flue gas O2% (1000 x AD/E)	153	17	418	mg/Nm3
AF	***In-stack concentration, dry, STP at ref. O2% [AE x (20.9% - F)/(20.9% - G)]***	***151***	***17***	***412***	***mg/Nm3***

Table 6: Summary of tested emissions for existing sources and assessed emissions for the 15 MW biomass boiler.

Pollutant	Existing Redry Kiln 1 vents		Existing Redry Kiln 2 vents		Existing 2.5 MW Wood Fired Boiler			Proposed 15 MW Biomass Boiler					Notes
	Emission Concentration (mg/Am3)	Combined Emission Rate (g/s)	Emission Concentration (mg/Am3)	Combined Emission Rate (g/s)	Tested Emission Concentration (mg/Nm3, dry)	Tested Emission Rate (g/s)	USEPA AP42 Estimated Emission Rate (g/s)	Tested Oxygen Content (%)	Group 6 PEO Reg 2010 Emission Concentration Limit (mg/Nm3 at Reference Conditions at 7% O2, dry)	Concentration (mg/Nm3, dry) at tested O2	Assessed Emission Concentration (mg/Nm3 at reference 7% O2, dry)	Assessed Emission Rate (g/s)	
TSP as TPM	7	0.016	<3	0.0042	81	0.12	0.24	9.4%	50	41	50	0.35	Where below detection, half of detection limit adopted from a test of a single Redry Kiln vent. For each of the Redry kilns, the emission rate is multiplied by 10 to represent 10 closely grouped vent sources on each Redry kiln. Proposed biomass boiler total particulate emissions calculated at Group 6 limits and assumed as 100% TSP or 100% PM10 or 100% PM2.5.
PM10	7	0.016	<3	0.0042	29	0.043	0.22	NA	NA	41	50	0.35	
PM2.5	7	0.016	<3	0.0042	7	0.010	0.13	NA	NA	41	50	0.35	
NOX as NO2	NA	NA	NA	NA	140	0.22	0.24	9.4%	500	414	500	3.5	Emission rate for proposed 15MW biomas boiler calculated at Group 6 in-stack limit at reference oxygen %
Carbon Monoxide	NA	NA	NA	NA	680	0.98	0.60	9.4%	NA	6.7	NA	0.056	Concentration as tested for 5MW biomass boiler at 104 degC, 15% moisture. Mass emission rate for 15MW boiler based on design flow at 100% load.
Sulphur Dioxide	NA	NA	NA	NA	18	0.027	0.027	9.4%	NA	18	NA	0.15	Concentration as tested for 5MW biomass boiler at 104 degC, 15% moisture. Mass emission rate for 15MW boiler based on design flow at 100% load. Mass emission rate for existing 2.5MW wood fired boiler based on tested in-stack concentration for 5MW boiler at normal conditions.
Polychlorinated dioxins and furans (TEQ)	NA	NA	NA	NA	1.0E-07	1.5E-10	NA	9.4%	1.0E-07	8.3E-08	1.0E-07	6.9E-10	Emission rate for both the existing 2.5MW wood-fired boiler and for the proposed 15MW biomas boiler calculated at Group 6 in-stack limit at reference oxygen %
Total of Type 1 and Type 2 metals	*<0.018*	*<0.0024*	*<0.027*	*<0.0042*	*Not tested*		*NA*	*9.4%*	*1*	*0.021*	0.025	*0.00018*	Concentration as tested for 5MW biomass boiler at 104 degC, 15% moisture with half of detection limit adopted. Mass emission rate based on design flow at 100% load for 15 MW. Half of detection limit adopted for Redry kiln emissions.
Total volatile organic compounds	*270*	*0.60*	*310*	*0.93*	*14*	*0.022*	*NA*	*9.4%*	*40*	*0.40*	0.48	*0.0034*	Concentration as tested for 5MW biomass boiler at 104 degC, 15% moisture. Mass emission rate based on design flow at 100% load for 15 MW. Half of detection limit adopted.

Notes: NA: Either not emitted or not applicable for this assessment.
Highlighted mass emission rate for existing 2.5MW boiler adopted in assessment (i.e. higher of tested or estimated).
Emissions of TPM (and PM10 & PM2.5), NOX and Dioxins & Furans assessed at Group 6 PEO Reg 2010 in-stack emission concentration limits for the proposed 15MW biomass boiler.

Table 7: Estimated emissions of NOX for proposed 15 MW biomass boiler at 100% load extrapolated from tested 5MW boiler at 100% load (see report R005320).

Pollutant	Tested Oxygen at 5MW (%)	Tested Moisture at 5MW (%)	Tested Temperature at 5MW (degC)	Tested Concentration at 5MW (mg/m3, STP, dry)	Concentration (mg/Nm3, dry) at reference 7% O2	Design Flow Rate at 100% load MCR (Nm3/sec), dry	Estimated Emission Rate (g/s)	Assessed Emission Rate at PEO Group 6 Limit (g/s)
NOX as NO2	9.4%	15%	104	140	169	8.4	1.2	3.5

4.2 Existing Ambient Air Quality

Environment NSW monitors the concentrations of relevant pollutant substances within ambient air in areas of NSW with concentrated population or industry. There is no ambient air monitoring conducted in the south-west tablelands representative of conditions that may be expected local to Bombala with its relatively low population and concentration of commercial activity.

The areas nearest to Bombala where ambient air monitoring has been conducted are: Kembla Grange for Nitrogen Dioxide (NO2); and Wollongong for Carbon monoxide (CO) and Sulphur Dioxide (SO2), sites that are local to concentrated population and industry. These are 300 km north-north east of Bombala.

However, in 2016/17 at Bega, NSW, Ektimo conducted ambient air monitoring for particulate matter as PM10 using a TEOM to AS3580.9.8 for a 12-month period which was subsequently adopted with an assessment of local wood-fired boiler emissions. Bombala is approximately 60 km west of Bega with a comparable geophysical setting, population and industry.

As per the *approved methods*, in the absence of local ambient air quality data monitored concurrently with the hourly meteorological data used in the assessment, peak monitored concentrations for each pollutant substance (where significant) that have not been influenced by exceptional events (e.g. bushfire, planned burns, extraneous local sources) are adopted in the assessment as constant levels. These are combined with 100th percentile prediction at nearest receivers for comparison with the *approved methods* assessment criterion for each pollutant substance (i.e. a Level 1 assessment).

Table 8 summarises the peak monitored concentrations from these locations, consistent with the assessment criterion averaging time (e.g. hourly, 8-hourly, daily or annual average). **Table 9** summarises the highest ranked and percentile distribution of the daily average PM10 concentrations recorded at Bega, with a time-series of the recordings for the period July 2016 to July 2017 presented in **Figure 4**.

The corresponding background for TSP was assumed to be double the annual average of PM10.[2]. The background of daily and annual average PM2.5 background concentration was set at 46% of that for PM10 based on a recent period of limited monitoring conducted by NSW EPA at Albury for PM2.5 concurrently with PM10. Albury is the nearest Environment NSW air monitoring station measuring ambient particulate concentrations.

Table 8: Adopted peak monitored ambient ground level concentrations of assessed pollutant substances.

Substance	Averaging Time	Peak Monitored Concentration (µg/m^3)	Source
PM10	24 hour	40	Bega, July 2016 – July 2017 to AS3580.9.8
	Annual	15	
PM2.5	24 hour	18.4	46% of PM10 based on recent comparative monitoring at conducted by Environment NSW at Albury.
	Annual	6.9	
TSP	Annual	30	Double that for PM10[2]
Nitrogen Dioxide	1 hour	80	Environment NSW monitoring at Kembla Grange 2015-2017
	Annual	10	
Sulphur Dioxide	10 minute	134	Environment NSW monitoring at Wollongong 2015-2017
	1 hour	134	
	24 hour	23	
	Annual	2.4	
Carbon Monoxide	15 minute	2400	Environment NSW monitoring at Wollongong 2015-2017
	1 hour	2400	
	8 hour	1000	

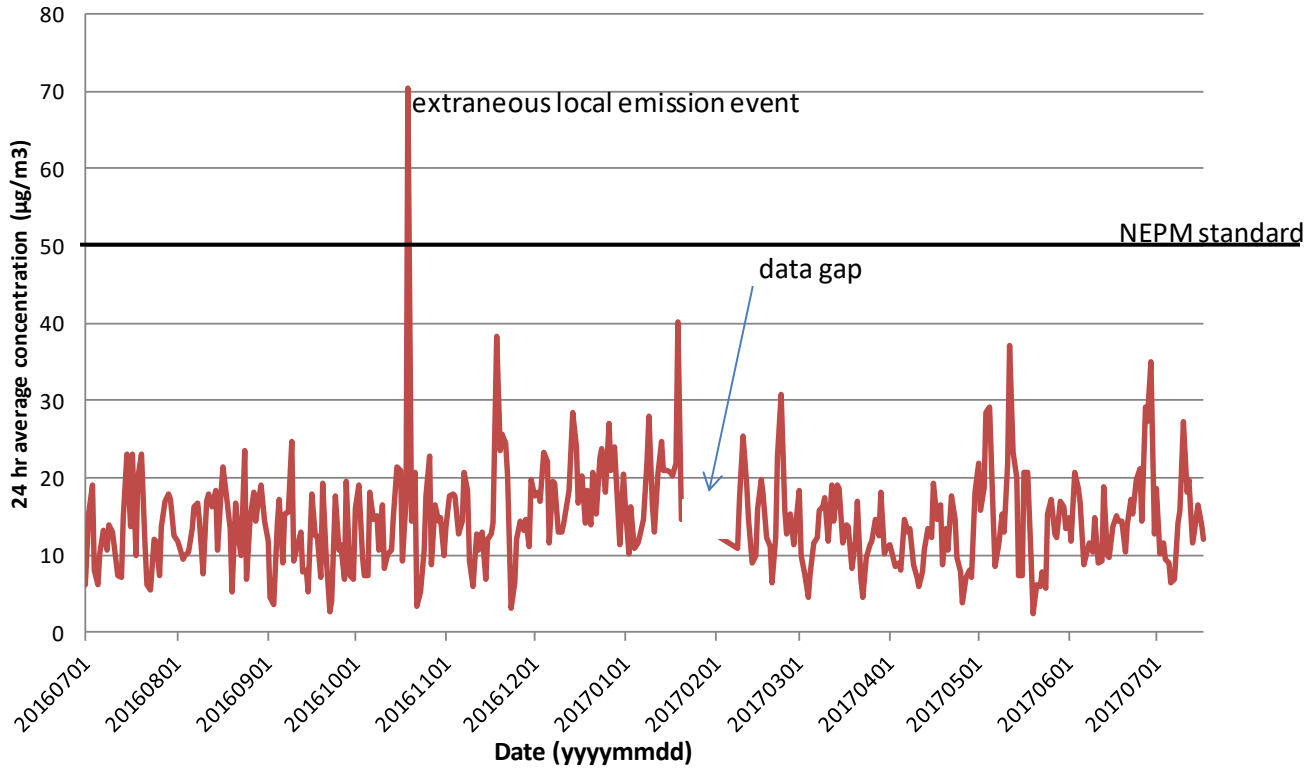
[2] Gupta, Partha Kumar, *Relationship between total suspended particulates and particulate matter of 10 microns*, Master of Engineering (Hons.) thesis, Department of Civil and Mining Engineering, University of Wollongong, 1996. http://ro.uow.edu.au/theses/2433

Table 9: Percentile distribution and ranked recordings of monitored ambient 24-hour average PM10 concentrations for 365 days of monitoring from July 2016 to July 2017 at Bega, NSW.

Percentile	24 hr average PM10 (µg/m3)	RANK	24 hr average PM10 (µg/m3)
100%	70	1	70
99.5%	39	2	40
99.0%	36	3	38
98.0%	29	4	37
95.0%	24	5	35
90.0%	22	6	31
80.0%	19	7	29
70.0%	17	8	29
60.0%	15	9	29
50.0%	14	10	28
Average	15		

Extraneous event

Figure 4: Time series of recorded ambient 24-hour average PM10 concentrations monitoring from July 2016 to July 2017 at Bega, NSW



4.3 Meteorology

Over the last three years DAU have been continuously recording surface meteorological data at the Bombala site in accordance with the conditions and test methods as detailed within their EPA licence 11205. Upon review of this site-specific data, the year 2016 was determined to be the most complete with 100% data capture.

Hourly average meteorological data was derived from the 15-minute average recordings at the weather station and synthesised for use with the AUSPLUME model in accordance with the guideline method *Construction of meteorological data files for AUSPLUME*, (Vic EPA Pub. 1459). Stability categories were derived using the solar radiation delta-T method as per the *Approved Methods*. See **Appendix C** for a summary report that includes annual and seasonal wind roses. Winds during summer and autumn periods are predominantly from the north-east, east and from the west, with a higher incidence of winds from the west during winter and spring. Stronger breezes are typically from the west driven by synoptic scale influences, with least flows from the south-east and north-west.

4.4 Dispersion Modelling

The AUSPLUME model is an approved model within the *Approved Methods* subject to geophysical limitations. When considering the applicability of this model for this assessment, the following may be considered:

- The terrain around the DAU timber mill and surrounding sensitive receivers is only slightly undulating;
- The bulk of the nearest receivers assessed are within 1.8 km of the stack sources at elevations comparable to that at the timber mill (note **Figure 1**); and
- High quality site specific meteorological data is adopted in the assessment.

Hence, no general site characteristics would warrant using a different model. Ektimo note that the AUSPLUME model has been accepted for previous assessments at the site to inform the approval of the current discharge points as per the site's EPL 11205.

The AUSPLUME ver. 6 model has been configured in accordance with the *Approved Methods*, as appropriate for this assessment. Key points are as follows:

- 50 m Cartesian grid resolution with US Geological Survey Space Shuttle survey data processed to represent terrain elevations. These were mapped to a 100 x 100 grid covering 5 km x 5km centred over the timber mill;
- 365 days of hourly site-specific meteorological data for the year 2016. See **Section 4.3** and **Appendix C**;
- Dispersion in the horizontal was determined using hourly averaged recordings of sigma-theta, the standard deviation of horizontal wind direction;
- Dispersion in the vertical was determined using categorised Pasquill dispersion categories derived from daytime recordings of solar radiation and night-time recordings of temperature difference between 2 and 10 metres, in combination with recorded wind speed (i.e. the approved Solar Radiation Delta-T method);
- A surface roughness of 0.3 metres was adopted characteristic of the slightly undulating terrain and the mix of industrial, rural and residential land-use;
- No plume depletion of the emitted particulates was assumed;
- The effects of buildings near the stack sources upon the initial dispersion of the emission plumes was characterised using the PRIME building wake algorithm informed by building dimensions derived from aerial imagery, and site plans and heights as provided by DAU;
- The emissions were assumed constant 24 hours per day, 365 days per year, for the hourly meteorological data adopted; and
- Contours of predicted peak ground level concentrations were overlaid upon an aerial image of the site and surrounds. Predictions were modelling individually at each of the 18 identified sensitive receiver locations.

Further information on the AUSPLUME configuration is provided in the output files in **Appendix D** for each assessed pollutant substance. Electronic input and output files may be provided upon request.

5 CRITERIA ASSESSMENT

In accordance with the requirements of the *Approved Methods* the assessment of TSP, PM10, PM2.5, NO2, SO2 and for CO is for compliance at the location of the nearest identified sensitive receivers, which in this case are rural residences, the border of residential areas, or a single commercial workplace. For each pollutant substance, peak predictions at these locations for each averaging time are summarised in **Table 10** below with a total inclusive of a maximum background concentration (see **Section 4.2**) for comparison with the relevant impact assessment criteria. For the assessment of Dioxins and Furans, the 99.9th percentile prediction at any location beyond the site boundary is compared with the relevant criterion.

To provide a perspective of the dispersive patterns of the emitted substances for each averaging time, contours of peak predicted ground level concentrations combined with background levels are overlaid upon an aerial image of the site and surrounds. Note the figure numbers in **Table 10** for the corresponding contour plot.

From **Table 10,** for a minimum biomass boiler stack height of 18 metres above ground level, all assessed pollutants are compliant with their respective assessment criterion. The pollutant substance with the least emission safety factor[3] was NO2 and this is discussed below, along with the other substances that had a higher assessed emission safety factor.

5.1 Nitrogen Dioxide

The peak 1-hour average prediction of NO2 at receiver R18, the DAU guest-house accommodation on the western boundary of the facility, comprised 68% of the criterion. In combination with background this comprised 99% of the criterion. The highest annual average prediction at receiver R7 beyond the eastern boundary comprised 4% of the criterion, and in combination with background comprised 20% of the criterion.

The emissions of Oxides of Nitrogen (NOX) were the most constraining based on compliance with the 1-hour assessment criterion for NO2. However, this comparison is considered conservative based on:

- Emission testing of the *Family Fresh Farms* 5 MW biomass boiler, when extrapolated to that for the proposed 15 MW boiler, indicate a mass emission rate ~34% of that assessed using the PEO Regs in-stack concentration limit of 500 mg/m3 (STP, dry, 7% oxygen). Ektimo note that the *Family Fresh Farms* biomass boiler, located in NSW, was licenced at 400 mg/m3 (STP, dry, 7% oxygen) NOX as NO2.
- The NOX is expected to be predominantly (>90%) Nitric Oxide (NO) at the point of emission and then convert gradually to NO2 further downwind after dilution. However, the absence of local ambient air monitoring data for both NOX and ozone precludes a less conservative Level 2 assessment, and instead 100% NO2 at emission was adopted as per a Level 1 assessment.
- In accordance with the *approved methods*, the lack of site representative ambient air monitoring data required a Level 1 assessment whereby the peak predicted ground level concentrations were added to the peak hourly ambient air concentration monitored at the nearest air quality monitoring station (Kembla Grange with a substantially larger population and industry) for comparison with the assessment criterion.

5.2 Particulates

Peak predictions of particulates were readily compliant with criteria when combined with peak monitored levels as recorded recently in the region (at Bega), and when emitted at the Group 6 limit of 50 mg/m3 (STP, dry, 7% oxygen) and when assessed as nuisance Total Suspended Particulate (TSP) or as inhalable particles of either 2.5 or 10 micron aerodynamic equivalent or less (PM2.5 or PM10).

Peak 24-hour ground level concentrations at local sensitive receivers occurred at R18 (the guest hour on the western boundary), or R7 (a residence 400 metres from the site boundary to the north-east) downwind of the predominant wind directions from the south-west. Peak annual ground level concentrations occurred at R7.

The minimum emission safety factor was 1.5 for PM2.5 when assessed as a 24-hour average, with a peak increment over the adopted background comprising 17% of the assessment criterion.

5.3 Carbon Monoxide and Sulphur Dioxide

In combination with the adopted background, the minimum emission safety factor for these two substances was 61, with 1.2% of the 1-hour average criterion for SO2 predicted at receiver R18, the DAU guest-house accommodation on the western boundary of the facility.

Peak sub-hour (i.e. 10 or 15-minute average) increments were predicted to occur at receptor R12, 1200 metres from the site boundary to the south-south-east, where the terrain is slightly elevated and plume strike under light-wind stable night-time conditions may occur. Peak 24-hour average increments occurred at R18, and peak annual average increments occurred at R7.

[3] Defined as the assessment criterion less the maximum monitored background (i.e. the available gap in the airshed) divided by the peak predicted concentration.

5.4 Dioxins and Furans

When assessed as a peak predicted 1-hour average at the 99.9th percentile, the highest prediction anywhere on the modelling domain for Dioxins and Furans was 2% of the assessment criterion.

Table 10: Summary of assessment at either the worst affected identified sensitive receiver or at anywhere beyond the site boundary.

ASSESSMENT	TSP	PM10	PM2.5	NOX as NO2	SO2	CO	Dioxin and Furan
Highest predicted annual average glc (µg/m3) at sensitive receptors	0.7	0.7	0.6	2.6	0.1		
peak measured background	30	15	6.9	10	2.4		
Total	30.7	15.7	7.5	13	2.5		
NSW EPA assessment criterion	90	25	8	62	60		
Emission safety factor	86	14	1.8	20	411		
Compliant ?	YES	YES	YES	YES	YES		
	Figure 9	Figure 6	Figure 8	Figure 10			
Highest predicted 24 hour average glc (µg/m3) at sensitive receptors		5.2	4.2		1.4		
peak measured background		40	18.4		23		
Total		45.2	22.6		24		
NSW EPA assessment criterion		50	25		228		
Emission safety factor		1.9	1.5		150		
Compliant ?		YES	YES		YES		
		Figure 5	Figure 7				
Highest predicted 8 hour average glc (µg/m3) at sensitive receptors						25	
peak measured background						1000	
Total						1025	
NSW EPA assessment criterion						10000	
Emission safety factor						360	
Compliant ?						YES	
Highest predicted 1 hour average glc (µg/m3) at sensitive receptors				164	7.1	56	
peak measured background				80	134	2400	
Total				244	141	2456	
NSW EPA assessment criterion				246	570	30000	
Emission safety factor				1.0	61	496	
Compliant ?				YES	YES	YES	
				Figure 11			
Highest predicted 15 minute average glc (µg/m3) at sensitive receptors						180	
peak measured background						2400	
Total						2580	
NSW EPA assessment criterion						100000	
Emission safety factor						542	
Compliant ?						YES	
Highest predicted 10 minute average glc (µg/m3) at sensitive receptors					6.8		
peak measured background					134		
Total					141		
NSW EPA assessment criterion					712		
Emission safety factor					85		
Compliant ?					YES		
99.9th percentile 1 hour average glc (µg/m3) at and beyond site boundary							4.6E-08
peak measured background							Not measured
Total							4.6E-08
NSW EPA assessment criterion							2.0E-06
Emission safety factor							43
Compliant ?							YES
Lowest emission safety factor	86	1.9	1.5	1.0	61	360	43

Figure 5

Highest predicted 24-hour average PM10
with a maximum background of 40 ug/m3.
Contours: 42, 44, 46, 48 & 50 ug/m3. Assessment criteria is 50 ug/m3 (bold contour).
Highest predicted at sensitive receiver R18 is 45.2 ug/m3.

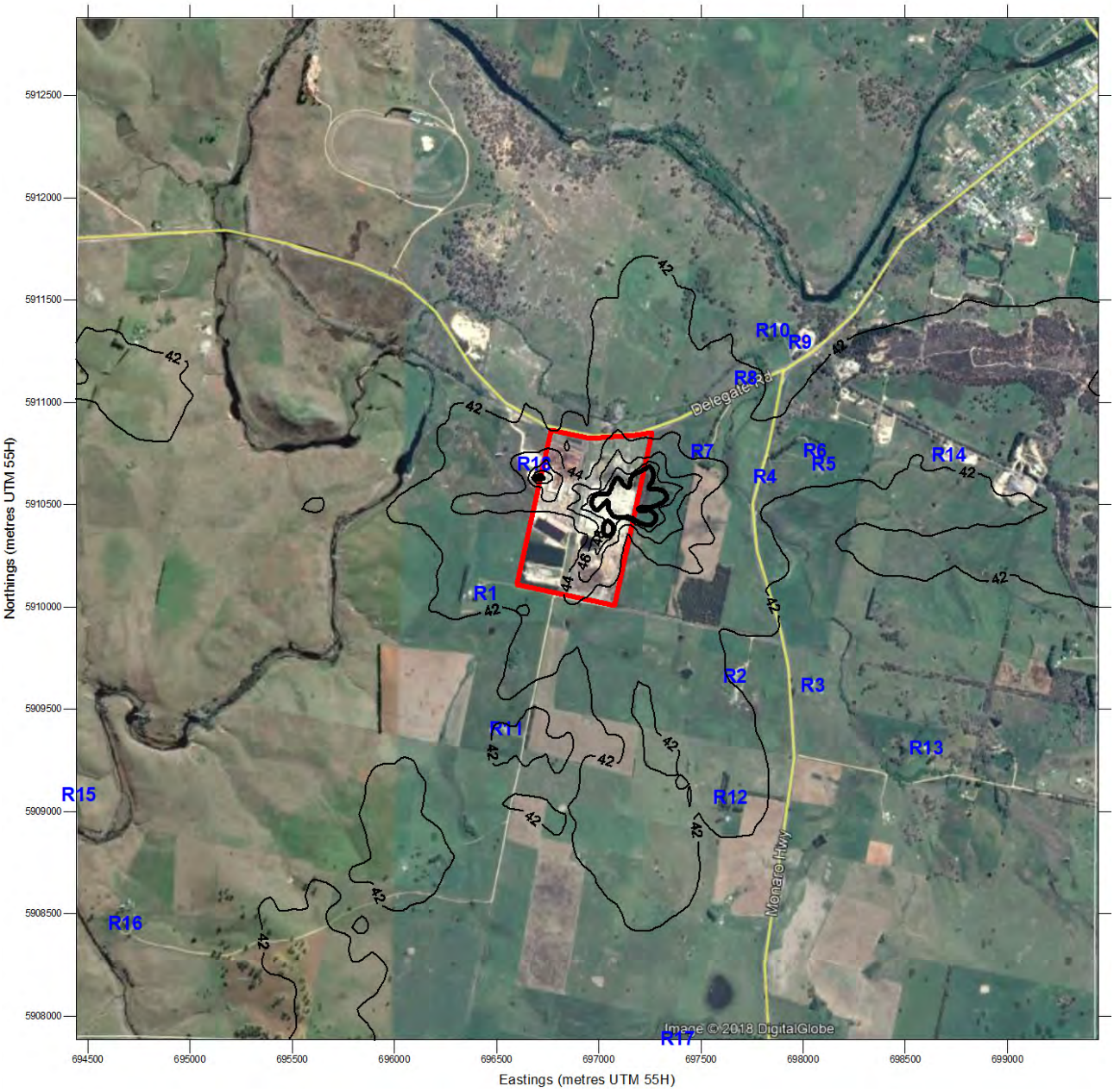


Figure 6

Predicted Annual Average PM10
with an average background of 15 ug/m3.
Contours: 15.5, 16 and 16.5 ug/m3. Assessment criteria is 25 ug/m3
Highest predicted at sensitive receiver R7 is 15.7 ug/m3.

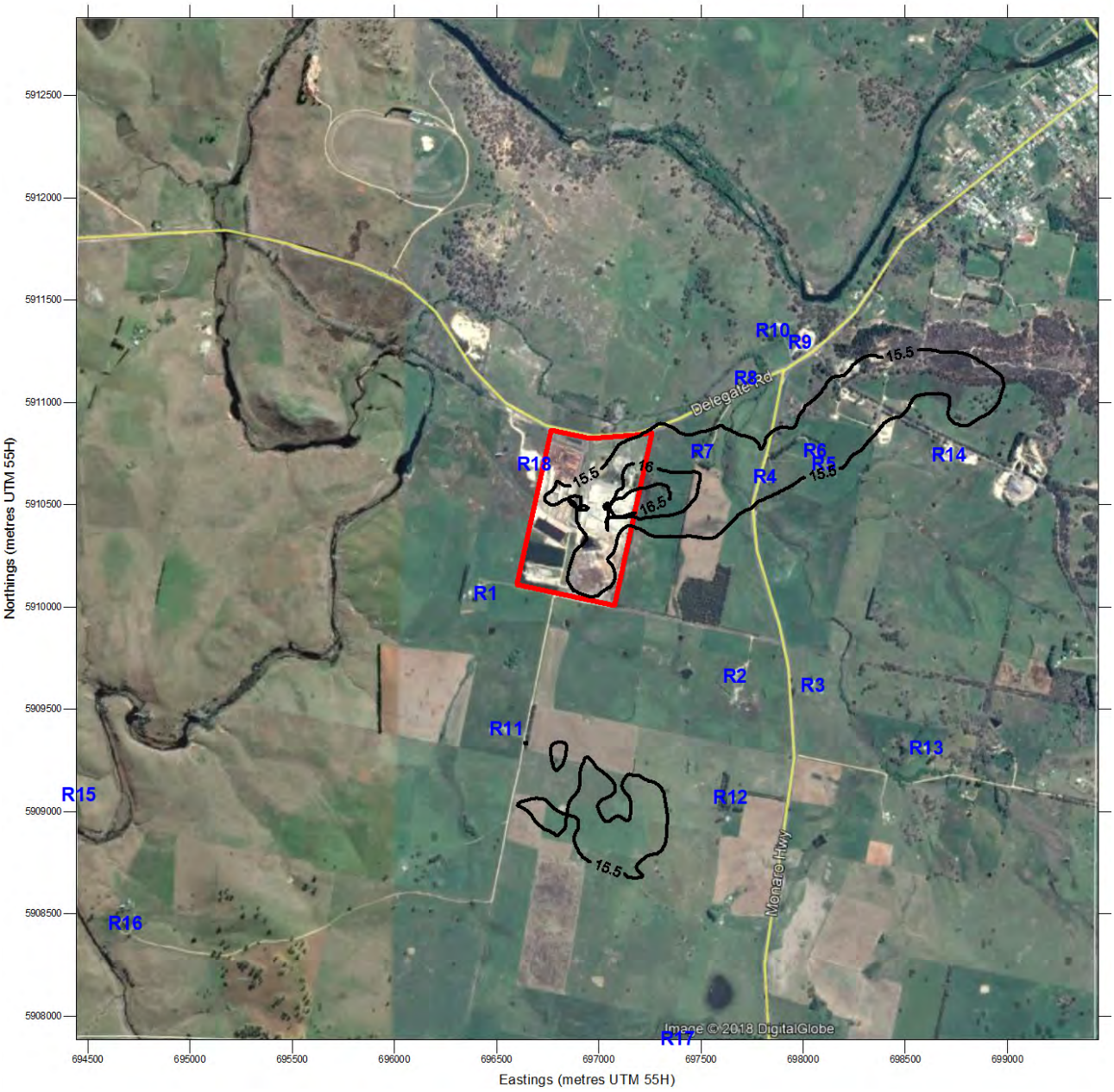


Figure 7

Highest predicted 24-hour average PM2.5
with a maximum background of 18.4 ug/m3.
Contours: 20, 22 & 25 ug/m3. Assessment criteria is 25 ug/m3 (bold contour).
Highest predicted at sensitive receiver R7 is 22.6 ug/m3.

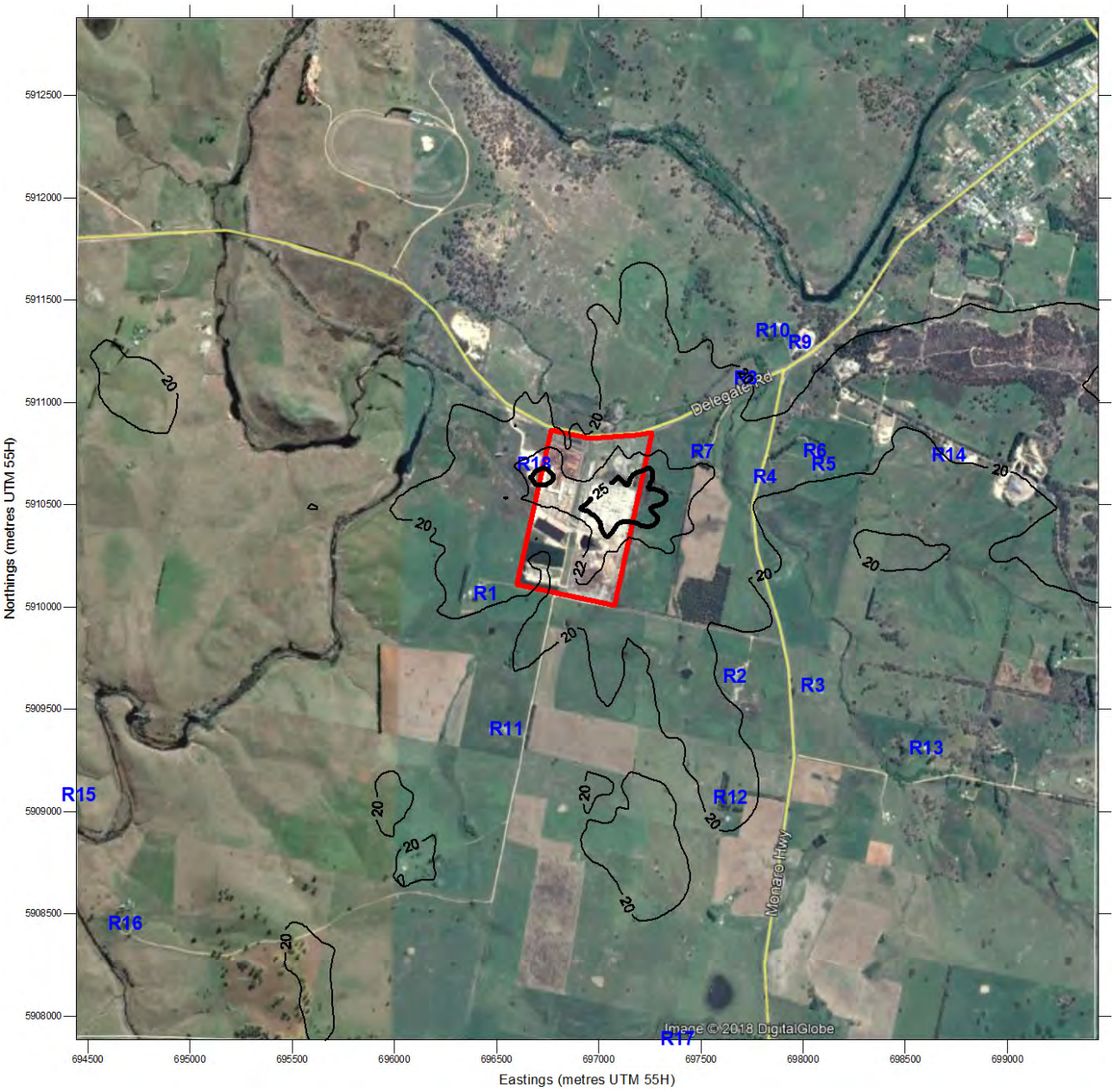


Figure 8

Predicted Annual Average PM2.5
with an average background of 6.9 ug/m3.
Contours: 7.2, 7.5, 7.8 and 8 ug/m3. Assessment criteria is 8 ug/m3 (bold contour)
Highest predicted at sensitive receiver R7 is 7.5 ug/m3.

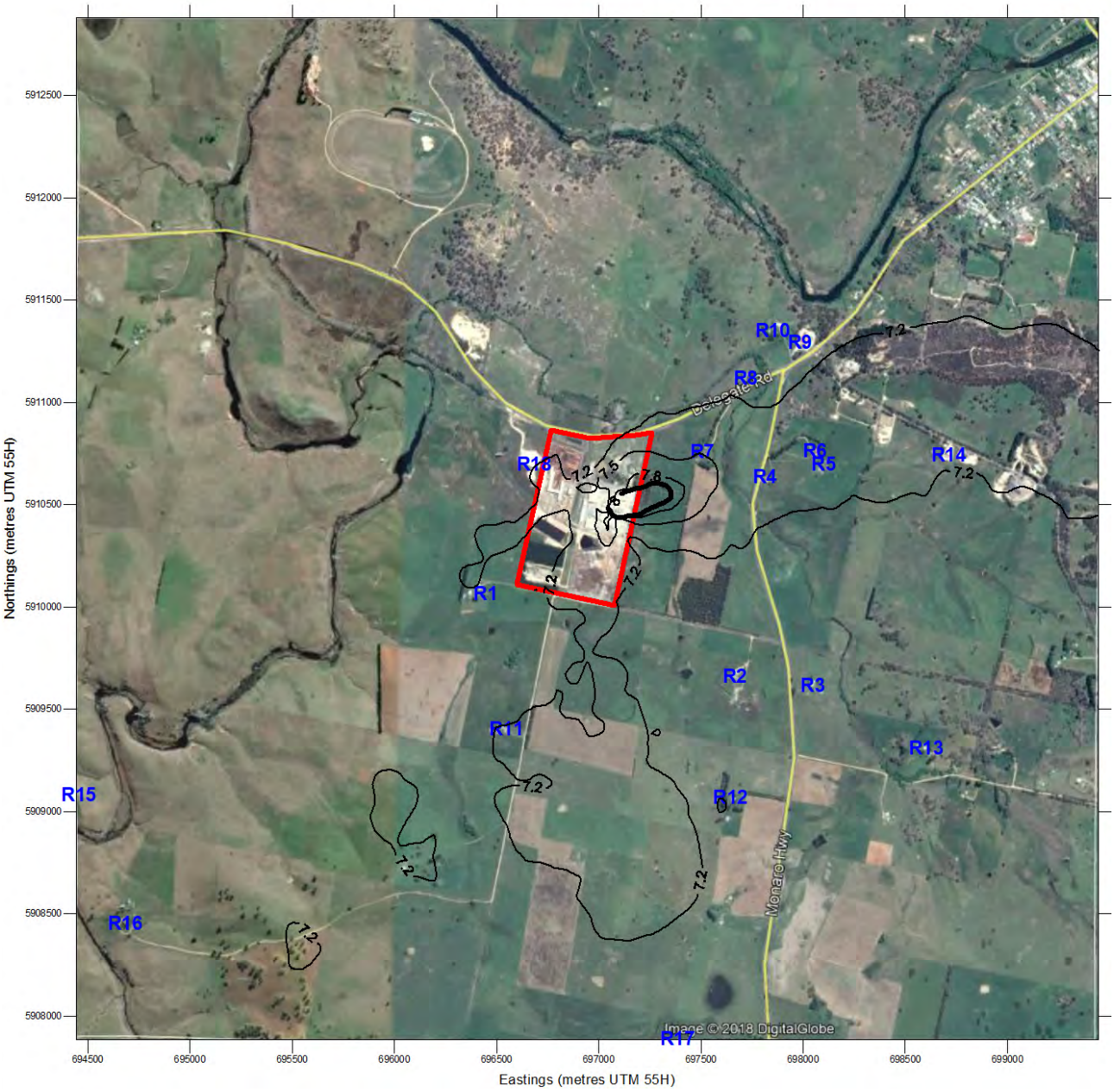


Figure 9

Predicted Annual Average TSP
with an average background of 30 ug/m3.
Contours: 31 and 32 ug/m3. Assessment criteria is 90 ug/m3
Highest predicted at sensitive receiver R7 is 30.7 ug/m3.

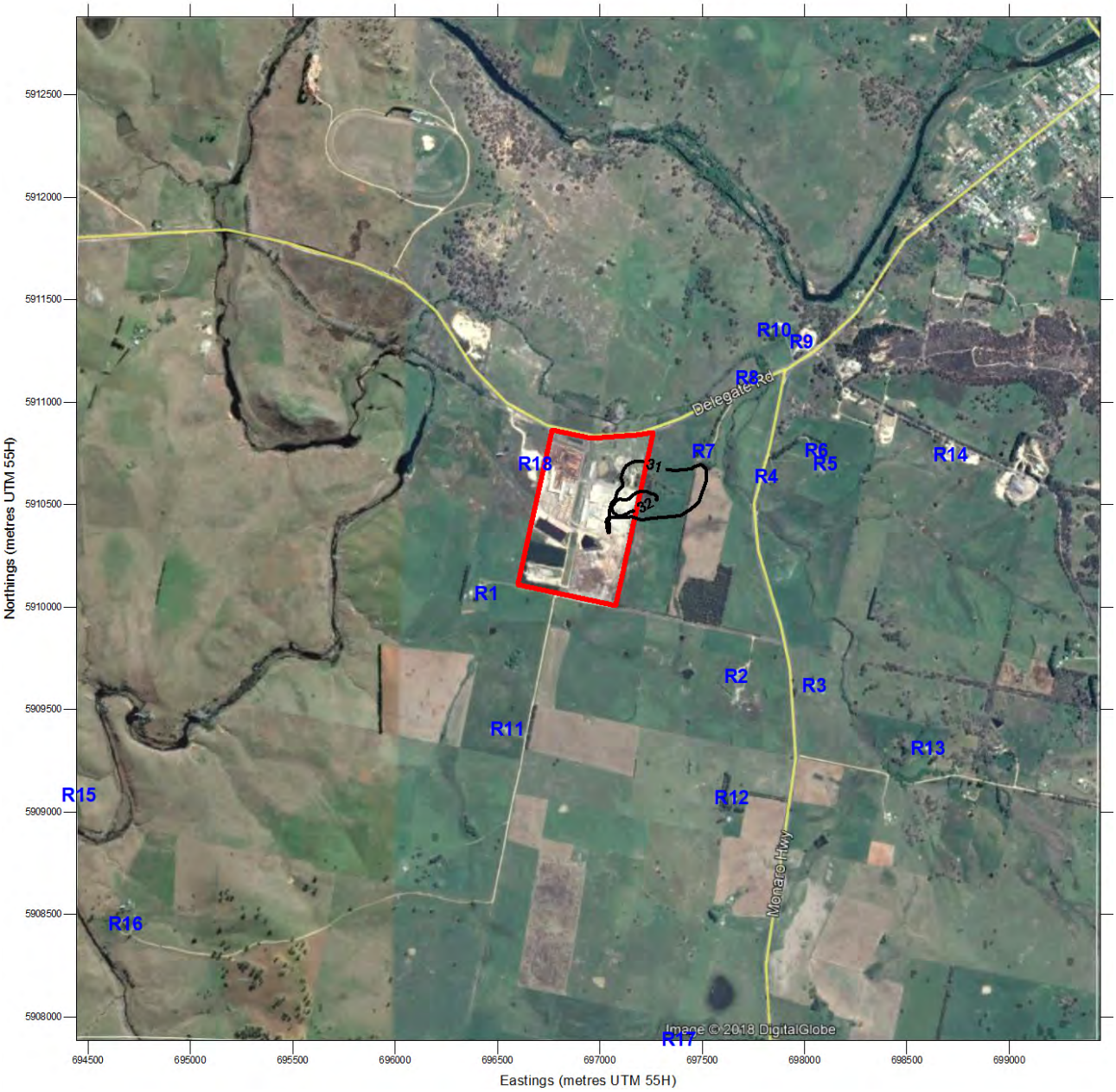


Figure 10

Maximum predicted hourly average NO2 as 100% NOX
with a maximum monitored background of 80 ug/m3.
Contours: 80, 120, 160, 200, 246 and 300 ug/m3. Assessment criteria is 246 ug/m3 (bold contour)
Highest predicted at sensitive receiver R18 is 244 ug/m3.

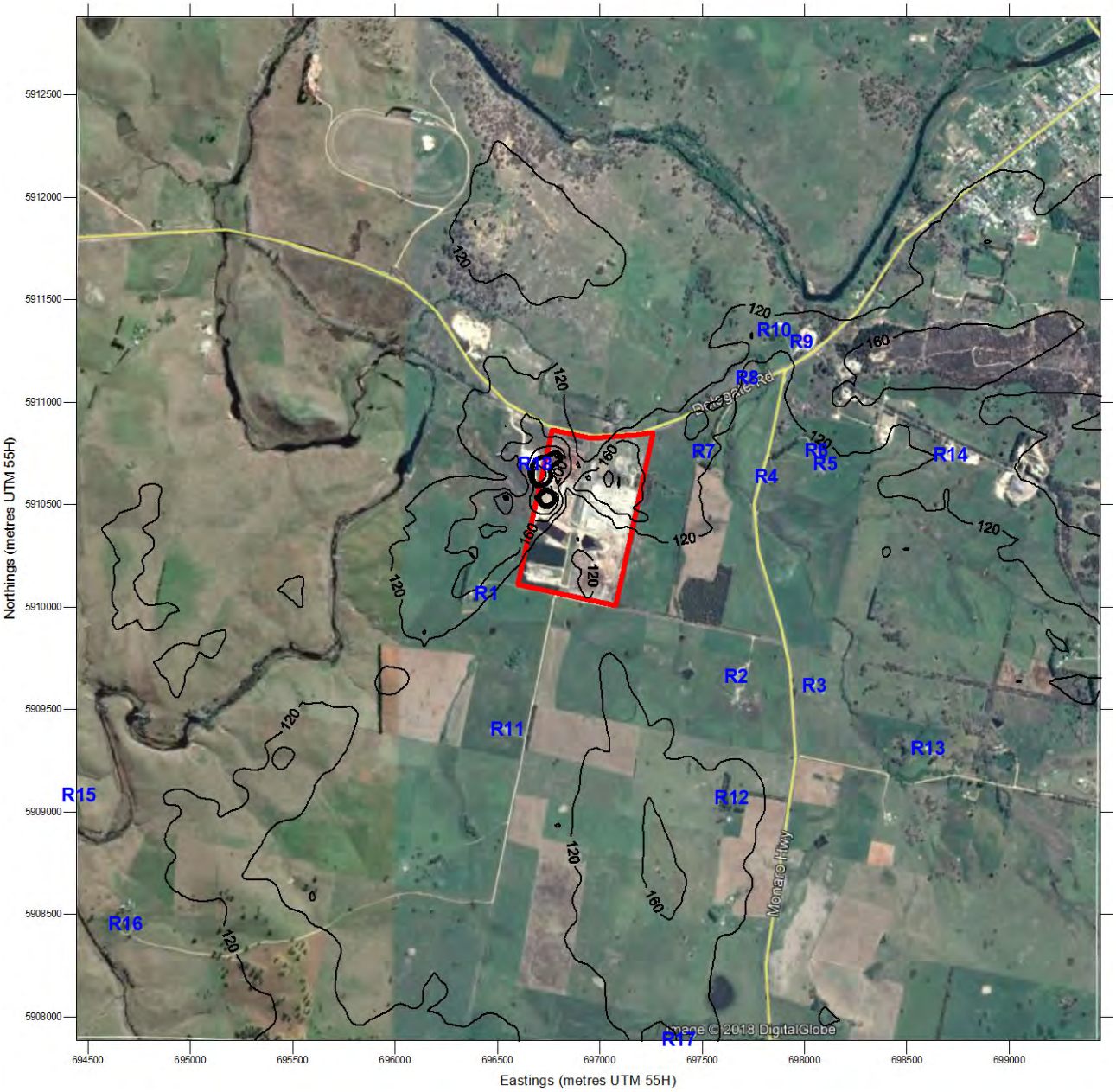
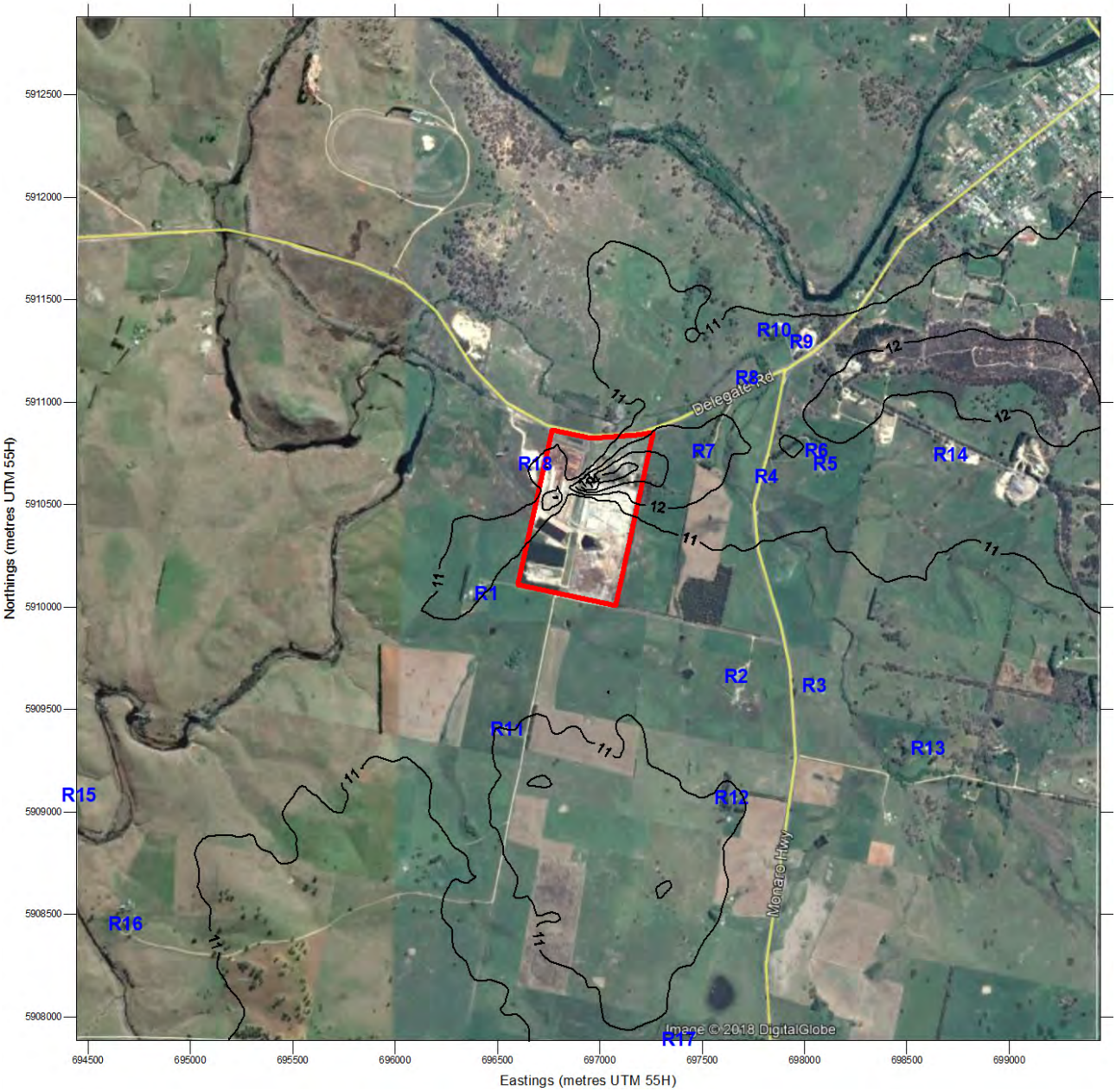


Figure 11

Predicted Annual Average NO2
with an average background of 10 ug/m3.
Contours: 11, 12, 13 and 14 ug/m3. Assessment criteria is 62 ug/m3
Highest predicted at sensitive receiver R7 is 12.6 ug/m3.



6. LIMITATIONS

This report represents the results of an air dispersion modelling assessment for the purposes of this commission. The data and assessment outcomes provided herein relate only to the project and structures described herein and must be reviewed by a competent engineer/scientist before being used for any other purpose. Ektimo accept no responsibility for other use of the data and assessment outcomes.

An understanding of a site's air quality impact depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experienced based. Hence this report should not be altered, amended or abbreviated, issued in part or issued incomplete in any way without prior checking and approval by Ektimo. Ektimo accepts no responsibility for any circumstances which arise from the issue of the report which has been modified in any way as outlined above.

Appendix A – Emission Test Reports R005336 & R005733 For Dongwha Australia, Bombala, NSW

Ektimo

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Report Number R005336

Emission Testing Report
Dongwha Australia, Bombala

Document Information

Client Name:	Dongwha Australia
Report Number:	R005336
Date of Issue:	17 August 2018
Attention:	Michael Dyer
Address:	PO Box 146 Bombala NSW 2632
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Status

Format	Document Number	Report Date	Prepared By	Reviewed By (1)	Reviewed By (2)
Preliminary Report	-	-	-	-	-
Draft Report	R005336[DRAFT]	19/02/2018	DBu/JWe	ADa	SCo
Final Report	R005336	17/08/2018	DBu/JWe	ADa	SCo
Amend Report	-	-	-	-	-

Template Version: 081217

Amendment Record

Document Number	Initiator	Report Date	Section	Reason
Nil	-	-	-	-

Report Authorisation

Aaron Davis
Ektimo Signatory

NATA Accredited Laboratory
No. 14601

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

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1 EXECUTIVE SUMMARY

Ektimo was engaged by Dongwha Australia to perform emission testing at EPA 23 – DP1 Gas Fired Boiler Exhaust, EPA 27 – C2 Vacuum Pump Exhaust, EPA 28 – Redry Kiln 1 Exhaust and EPA 29 – Redry Kiln 2 Exhaust.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
EPA 23 DP1 Gas-Fired Boiler Exhaust	16 January 2018	Volatile organic compounds (VOCs), nitrogen oxides, carbon dioxide, oxygen
EPA 27 C2 Vacuum Pump Exhaust		Type 1 and 2 substances, copper
EPA 28 Redry Kiln 1 Exhaust		
EPA 29 Redry Kiln 2 Exhaust		

* Flow rate, velocity, temperature and moisture were determined unless otherwise stated.

The sampling methodologies chosen by Ektimo are those recommended by the NSW Office of Environment and Heritage (as specified in the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales, January 2007*).

All results are reported on a dry basis at STP. Unless otherwise indicated, the methods cited in this report have been performed without deviation.

Plant operating conditions have been noted in the report.

2 LICENCE COMPARISON

The following licence comparison table shows that all analytes highlighted in green are below the licence limit set by the NSW EPA as per licence 11205 (version 8 May 2014 below). Note subsequent licence amendment on 21 February 2017 however there are possible inconsistencies in specific clauses of this version which are the subject of current negotiation.

EPA	Parameter	Units	Licence limit	Detected values 16/01/2017	Detected values (corrected to 3% O_2)
EPA 23 - DP1 Gas Fired Boiler Exhaust	Nitrogen Oxides	mg/m^3	125	89	120
	Volatile Organic Compounds	mg/m^3	5	<0.09	<0.1
EPA 27 - C2 Vacuum Pump Exhaust	Type 1 and Type 2 substances in aggregate	mg/m^3	1	≤0.044	-
	Copper	mg/m^3	TBD	0.0071	-
EPA 28 - Redry Kiln 1 Exhaust	Type 1 and Type 2 substances in aggregate	mg/m^3	1	≤0.018	-
	Copper	mg/m^3	TBD	0.014	-
EPA 29 - Redry Kiln 2 Exhaust	Type 1 and Type 2 substances in aggregate	mg/m^3	1	≤0.027	-
	Copper	mg/m^3	TBD	0.0022	-

3 RESULTS

3.1 EPA 23 - DP1 Gas-Fired Boiler Exhaust

Date	16/01/2018	**Client**	Dongwha Timbers
Report	R005336	**Stack ID**	EPA 23 - DP1 Gas Fired Boiler Exhaust
Licence No.	11205	**Location**	Bombala
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Normal operationg conditions		*180111*

Sampling Plane Details		
Sampling plane dimensions	700 mm	
Sampling plane area	0.385 m²	
Sampling port size, number	4" BSP (x2)	
Access & height of ports	Elevated work platform	10 m
Duct orientation & shape	Vertical	Circular
Downstream disturbance	Exit	3 D
Upstream disturbance	Junction	8 D
No. traverses & points sampled	2	8
Sample plane compliance to AS4323.1	Ideal	

Stack Parameters		
Moisture content, %v/v	9.6	
Gas molecular weight, g/g mole	28.5 (wet)	29.7 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.32 (dry)
% Oxygen correction & Factor	3 %	1.39
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1430 & 1530	
Temperature, °C	263	
Temperature, K	536	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, discharge, m³/s	6.5	
Volumetric flow rate (wet STP), m³/s	3.1	
Volumetric flow rate (dry STP), m³/s	2.8	
Mass flow rate (wet basis), kg/hour	14000	
Velocity difference, %	-2	

Gas Analyser Results	Average		
Sampling time	1429 - 1528		
	Concentration mg/m³	Corrected to 3% O2 mg/m³	Mass Rate g/min
Combustion Gases			
Nitrogen oxides (as NO_2)	89	120	15
	Concentration %		
Carbon dioxide	7.6		
Oxygen	8		

Total VOCs (as n-Propane)	Results		
Sampling time			
	Concentration mg/m³	Corrected to 3% O2 mg/m³	Mass Rate g/min
Total	<0.09	<0.1	<0.01

VOC (speciated)	Results		
Sampling time	1430-1530		
	Concentration mg/m³	Corrected to 3% O2 mg/m³	Mass Rate g/min
Detection limit(1)	<0.09	<0.1	<0.02

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-trimethylbenzene, tert-Butylbenzene, 1,2,4-trimethylbenzene, 1,2,3-trimethylbenzene, Acetone, Pentane, Acrylonitrile, n-Hexane, Methyl ethyl ketone, Ethyl acetate, Cyclohexane, 2-Methylhexane, 2,3-Dimethylpentane, Isopropyl acetate, 3-Methylhexane, Ethyl acrylate, Heptane, Methyl methacrylate, Propyl acetate, Methylcyclohexane, MIBK, 2-Hexanone, Octane, Butyl acetate, 1-methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

3.2 EPA 27 - C2 Vacuum Pump Exhaust

Date	16/01/2018	**Client**	Dongwha Timbers
Report	R005336	**Stack ID**	EPA 27 - C2 Vacuum Pump Exhaust
Licence No.	11205	**Location**	Bombala
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Normal operationg conditions with autoclave charging CCA treated timber		*180111*

Sampling Plane Details	
Sampling plane dimensions	85 mm
Sampling plane area	0.00567 m²
Sampling port size, number	sampled at exit
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	1 2
Sample plane compliance to AS4323.1	Non-compliant

Comments

Note: Test duration was 70 minutes to allow for full production cycle
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal or non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	2.3	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0955 & 1105	
Temperature, °C	23	
Temperature, K	296	
Velocity at sampling plane, m/s	13	
Volumetric flow rate, discharge, m³/s	0.075	
Volumetric flow rate (wet STP), m³/s	0.064	
Volumetric flow rate (dry STP), m³/s	0.063	
Mass flow rate (wet basis), kg/hour	300	
Velocity difference, %	<1	

Isokinetic Results	Results	
Sampling time	955-1105	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.007	<0.00002
Arsenic	0.0081	0.00003
Beryllium	<0.001	<0.000005
Cadmium	<0.0007	<0.000003
Chromium	0.01	0.000039
Cobalt	<0.0009	<0.000003
Lead	<0.002	<0.000006
Manganese	<0.002	<0.000008
Mercury	0.00032	0.0000012
Nickel	<0.002	<0.000006
Selenium	<0.007	<0.00002
Tin	<0.003	<0.00001
Vanadium	<0.002	<0.000006
Type 1 & 2 Substances		
Upper Bound		
Total Type 1 Substances	≤0.017	≤0.000064
Total Type 2 Substances	≤0.027	≤0.0001
Total Type 1 & 2 Substances	≤0.044	≤0.00017
Copper	0.0071	0.000027
Isokinetic Sampling Parameters		
Sampling time, min	70	
Isokinetic rate, %	98	

3.3 EPA 28 - Redry Kiln 1 Exhaust

Date	16/01/2018	**Client**	Dongwha Timbers
Report	R005336	**Stack ID**	EPA 28 - Redry Kiln Exhaust 1
Licence No.	11205	**Location**	Bombala
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Normal operating conditions with CCA treated timber		*180111*

Sampling Plane Details		
Sampling plane dimensions	370 mm	
Sampling plane area	0.108 m²	
Sampling port size, number	sampled at exit	
Access & height of ports	Elevated work platform 7 m	
Duct orientation & shape	Vertical Circular	
Downstream disturbance	Exit 0 D	
Upstream disturbance	Change in diameter 0 D	
No. traverses & points sampled	2 12	
Sample plane compliance to AS4323.1	Non-compliant	

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal or non-compliant due to the following reasons:

The downstream disturbance is <1D from the sampling plane

The upstream disturbance is <2D from the sampling plane

The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	27	
Gas molecular weight, g/g mole	26.0 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.16 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1155 & 1255	
Temperature, °C	72	
Temperature, K	345	
Velocity at sampling plane, m/s	3.8	
Volumetric flow rate, discharge, m³/s	0.4	
Volumetric flow rate (wet STP), m³/s	0.3	
Volumetric flow rate (dry STP), m³/s	0.22	
Mass flow rate (wet basis), kg/hour	1200	
Velocity difference, %	2	

Isokinetic Results	Results	
Sampling time	1155-1255	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.0003	<0.000004
Arsenic	0.00093	0.000012
Beryllium	<0.0002	<0.000002
Cadmium	<0.00003	<0.0000004
Chromium	0.00062	0.0000081
Cobalt	<0.0003	<0.000004
Lead	0.00062	0.0000081
Manganese	<0.002	<0.00002
Mercury	0.012	0.00016
Nickel	<0.0003	<0.000004
Selenium	0.00093	0.000012
Tin	<0.0003	<0.000004
Vanadium	<0.0003	<0.000004
Type 1 & 2 Substances		
Upper Bound		
Total Type 1 Substances	≤0.014	≤0.00018
Total Type 2 Substances	≤0.0045	≤0.000059
Total Type 1 & 2 Substances	≤0.018	≤0.00024
Copper	0.014	0.00018
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	107	

3.4 EPA 29 - Redry Kiln 2 Exhaust

Date	16/01/2018	**Client**	Dongwha Timbers
Report	R005336	**Stack ID**	EPA 29 - Redry Kiln Exhaust 2
Licence No.	11205	**Location**	Bombala
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Normal operating conditions with CCA treated timber		*180111*

Sampling Plane Details		
Sampling plane dimensions	370 mm	
Sampling plane area	0.108 m²	
Sampling port size, number	sampled at exit	
Access & height of ports	Elevated work platform	7 m
Duct orientation & shape	Vertical	Circular
Downstream disturbance	Exit	0 D
Upstream disturbance	Change in diameter	0 D
No. traverses & points sampled	2	12
Sample plane compliance to AS4323.1	Non-compliant	

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal or non-compliant due to the following reasons:

The gas temperature of the sampling plane is below the dew point
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	32 (saturated)	
Gas molecular weight, g/g mole	25.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.14 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1305 & 1405	
Temperature, °C	69	
Temperature, K	342	
Velocity at sampling plane, m/s	4.8	
Volumetric flow rate, discharge, m³/s	0.51	
Volumetric flow rate (wet STP), m³/s	0.38	
Volumetric flow rate (dry STP), m³/s	0.26	
Mass flow rate (wet basis), kg/hour	1600	
Velocity difference, %	-3	

Isokinetic Results	Results	
Sampling time	1305-1405	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.0006	<0.000009
Arsenic	<0.0006	<0.000009
Beryllium	<0.0003	<0.000004
Cadmium	<0.00006	<0.0000009
Chromium	<0.0006	<0.000009
Cobalt	<0.0006	<0.000009
Lead	<0.0006	<0.000009
Manganese	<0.003	<0.00004
Mercury	0.019	0.00029
Nickel	<0.0006	<0.000009
Selenium	0.0011	0.000017
Tin	<0.0006	<0.000009
Vanadium	<0.0006	<0.000009
Type 1 & 2 Substances		
Upper Bound		
Total Type 1 Substances	≤0.02	≤0.00032
Total Type 2 Substances	≤0.0069	≤0.00011
Total Type 1 & 2 Substances	≤0.027	≤0.00042
Copper	0.0022	0.000034
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	91	

4 PLANT OPERATING CONDITIONS

Unless otherwise stated, the plant operating conditions were normal at the time of testing. See Dongwha Australia's records for complete process conditions.

5 TEST METHODS

All sampling and analysis was performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Method Detection Limit	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sample plane criteria	NSW TM-1	NA	-	✓	NA
Flow rate, temperature and velocity	NSW TM-2	Location specific	8%, 2%, 7%	✓	NA
Moisture content	NSW TM-22	1.0%	19%	✓	✓
Carbon dioxide	NSW TM-24	0.1%	13%	✓	✓
Nitrogen oxides (NO_x)	NSW TM-11	0.004 g/m³	12%	✓	✓
Oxygen	NSW TM-25	0.1%	13%	✓	✓
Speciated volatile organic compounds (VOC's)	NSW TM-34	0.3 mg/m³	19%	✓	✓†
Total (gaseous and particulate) metals and metallic compounds including Copper	NSW TM-12, NSW TM-13, NSW TM-14	Analyte specific	15%	✓	✓‡
Type 1 substances (Sb, As, Cd, Pb, Hg)	NSW TM-12	Analyte specific	15%	✓	✓‡
Type 2 substances (Be, Cr, Co, Mn, Ni, Se, Sn, V)	NSW TM-13	Analyte specific	15%	✓	✓‡

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

† Analysis performed by Ektimo, NATA accreditation number 14601. Laboratory analytical results were reported on 2 February 2018 in report number R005336_SVOCs.

‡ Analysis performed by Envirolab, NATA accreditation number 2901. Results were reported to Ektimo on 23 January 2018 in report number 183477.

6 QUALITY ASSURANCE/ QUALITY CONTROL INFORMATION

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APLAC (Asia Pacific Laboratory Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through the mutual recognition arrangements with both of these organisations, NATA accreditation is recognised world –wide.

A formal Quality Control program is in place at Ektimo to monitor analyses performed in the laboratory and sampling conducted in the field. The program is designed to check where appropriate; the sampling reproducibility, analytical method, accuracy, precision and the performance of the analyst. The Laboratory Manager is responsible for the administration and maintenance of this program.

7 DEFINITIONS

The following symbols and abbreviations may be used in this test report:

~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American public health association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM	Continuous Emission Monitoring
CEMS	Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone defined as the particle diameter at which the cyclone achieves a 50% collection efficiency ie. half of the particles are retained by the cyclone and half are not and pass through it to the next stage. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra Red
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response).
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis
RATA	Relative Accuracy Test Audit
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test Method
TOC	The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Vic EPA	Victorian Environment Protection Authority
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray Diffractometry

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Report Number R005733

Emission Testing Report
Dongwha Australia, Bombala

Document Information

Client Name:	Dongwha Australia
Report Number:	R005733
Date of Issue:	17 August 2018
Attention:	Michael Dyer
Address:	PO Box 146 Bombala NSW 2632
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Status

Format	Document Number	Report Date	Prepared By	Reviewed By (1)	Reviewed By (2)
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Final Report	R005733	17/08/2018	JWe/DBu	ADa	SCo
Amend Report	-	-	-	-	-

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Amendment Record

Document Number	Initiator	Report Date	Section	Reason
Nil	-	-	-	-

Report Authorisation

Aaron Davis
Client Manager

NATA Accredited Laboratory
No. 14601

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

Table of Contents

1 EXECUTIVE SUMMARY

Ektimo was engaged by Dongwha Australia to perform emission testing at EPA 28 - Redry Kiln 1 Exhaust, EPA 29 - Redry Kiln 2 Exhaust and Wood-fired Boiler.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
EPA 28 Redry Kiln 1 Exhaust	4 April 2018	Solid particles, volatile organic compounds, ammonia
EPA 29 Redry Kiln 2 Exhaust		Solid particles, volatile organic compounds, ammonia
Wood-fired Boiler		Solid particles, particulate matter < 10µm (PM_{10}) by particle size analysis, particulate matter < 2.5µm ($PM_{2.5}$) by particle size analysis, volatile organic compounds, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen, ammonia

* Flow rate, velocity, temperature and moisture were determined unless otherwise stated.

All results are reported on a dry basis at STP. Unless otherwise indicated, the methods cited in this report have been performed without deviation.

Plant operating conditions have been noted in the report.

2 POEO REGULATION COMPARISON TABLE

The following comparison table shows that all analytes highlighted in green are below the likely limits as set by the NSW EPA as per *Protection of the Environment Operations (Clean Air) Regulation* 2010.

EPA	Parameter	Units	POEO limit	Detected values 04/04/2018	Detected values (corrected to 7% O_2)
Wood-Fired Boiler	Solid particles	mg/m^3	100	81	82
	Nitrogen oxides	mg/m^3	500	140	150
EPA 28 - Redry Kiln 1 Exhaust	Solid particles	mg/m^3	100	7	-
EPA 29 - Redry Kiln 2 Exhaust	Solid particles	mg/m^3	100	<3	-

Note we understand that the locations above would be classed as “Group 5 Activities” based on commissioning dates between 1997 and 2005 and are thereby likely subject to emission limits as set out in *POEO Regulation; Schedule 4 General Activities and Plant* and also reference conditions as set out in *Schedule 5 Part 3*.

3 RESULTS

3.1 EPA 28 – Redry Kiln 1 Exhaust

Date	4/04/2018	**Client**	Dongwha Australia
Report	R005733	**Stack ID**	EPA 28 - Redry Kiln Exhaust 1
Licence No.	11205	**Location**	Bombala
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Kiln operating with raw pine ("hardwood" portion)		190322

Sampling Plane Details	
Sampling plane dimensions	370 mm
Sampling plane area	0.108 m²
Sampling port size, number	sampled at exit
Access & height of ports	Elevated work platform 7 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Non-compliant

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal or non-compliant due to the following reasons:

The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	18	
Gas molecular weight, g/g mole	27.0 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.21 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0915 & 1025	
Temperature, °C	75	
Temperature, K	348	
Velocity at sampling plane, m/s	3.4	
Volumetric flow rate, discharge, m³/s	0.37	
Volumetric flow rate (wet STP), m³/s	0.27	
Volumetric flow rate (dry STP), m³/s	0.22	
Mass flow rate (wet basis), kg/hour	1200	
Velocity difference, %	<1	

Ammonia	Results	
Sampling time	920-1020	
	Concentration mg/m³	Mass Rate g/min
Ammonia	0.25	0.0033

Isokinetic Results	Results	
Sampling time	920-1020	
	Concentration mg/m³	Mass Rate g/min
Solid Particles	7	0.093
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	99	

Total VOCs (as n-Propane)	Results	
Sampling time	915-1015	
	Concentration mg/m³	Mass Rate g/min
Total	270	3.6

VOC (speciated)	Results	
Sampling time	915-1015	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.04	<0.0005
Ethanol	3.2	0.043
Toluene	0.075	0.001
Acetone	1.5	0.021
alpha-Pinene	370	4.9
beta-Pinene	420	5.5
D-Limonene	40	0.54

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-trimethylbenzene, tert-Butylbenzene, 1,2,4-trimethylbenzene, 1,2,3-trimethylbenzene, Pentane, Acrylonitrile, n-Hexane, Methyl ethyl ketone, Ethyl acetate, Cyclohexane, 2-Methylhexane, 2,3-Dimethylpentane, Isopropyl acetate, 3-Methylhexane, Ethyl acrylate, Heptane, Methyl methacrylate, Propyl acetate, Methylcyclohexane, MIBK, 2-Hexanone, Octane, Butyl acetate, 1-methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, Decane, 3-Carene, Undecane, Dodecane, Tridecane, Tetradecane

3.2 EPA 29 – Redry Kiln 2 Exhaust

Date	4/04/2018	**Client**	Dongwha Australia
Report	R005733	**Stack ID**	EPA 29 - Redry Kiln Exhaust 2
Licence No.	11205	**Location**	Bombala
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Kiln operating with raw pine ("sapwood" portion)		

180322

Sampling Plane Details	
Sampling plane dimensions	370 mm
Sampling plane area	0.108 m²
Sampling port size, number	sampled at exit
Access & height of ports	Elevated work platform 7 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 0 D
Upstream disturbance	Change in diameter 0 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Non-compliant

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal or non-compliant due to the following reasons:

The downstream disturbance is <1D from the sampling plane

The upstream disturbance is <2D from the sampling plane

The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	41	
Gas molecular weight, g/g mole	24.5 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.09 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1055 & 1205	
Temperature, °C	80	
Temperature, K	353	
Velocity at sampling plane, m/s	6.6	
Volumetric flow rate, discharge, m³/s	0.71	
Volumetric flow rate (wet STP), m³/s	0.51	
Volumetric flow rate (dry STP), m³/s	0.3	
Mass flow rate (wet basis), kg/hour	2000	
Velocity difference, %	<1	

Ammonia	Results	
Sampling time	1100-1200	
	Concentration mg/m³	Mass Rate g/min
Ammonia	0.3	0.0054

Isokinetic Results	Results	
Sampling time	1100-1200	
	Concentration mg/m³	Mass Rate g/min
Solid Particles	<3	<0.05
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	

Total VOCs (as n-Propane)	Results	
Sampling time	1105-1205	
	Concentration mg/m³	Mass Rate g/min
Total	310	5.6

VOC (speciated)	Results	
Sampling time	1105-1205	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.04	<0.0007
Ethanol	9.7	0.18
Toluene	0.062	0.0011
Acetone	1.2	0.021
alpha-Pinene	380	7
beta-Pinene	510	9.3
D-Limonene	34	0.62

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-trimethylbenzene, tert-Butylbenzene, 1,2,4-trimethylbenzene, 1,2,3-trimethylbenzene, Pentane, Acrylonitrile, n-Hexane, Methyl ethyl ketone, Ethyl acetate, Cyclohexane, 2-Methylhexane, 2,3-Dimethylpentane, Isopropyl acetate, 3-Methylhexane, Ethyl acrylate, Heptane, Methyl methacrylate, Propyl acetate, Methylcyclohexane, MIBK, 2-Hexanone, Octane, Butyl acetate, 1-methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, Decane, 3-Carene, Undecane, Dodecane, Tridecane, Tetradecane

3.3 Wood-fired Boiler

Date	4/04/2018	**Client**	Dongwha Timbers
Report	R005733	**Stack ID**	Wood-fired Boiler
Licence No.	11205	**Location**	Bombala
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Normal operating conditions		180322

Sampling Plane Details		
Sampling plane dimensions	400 mm	
Sampling plane area	0.126 m²	
Sampling port size, number	sampled at exit	
Access & height of ports	Elevated work platform 15 m	
Duct orientation & shape	Vertical Circular	
Downstream disturbance	Exit 0 D	
Upstream disturbance	Change in diameter 0 D	
No. traverses & points sampled	2 12	
Sample plane compliance to AS4323.1	Non-compliant	

Comments

Existing sample port could not be opened so testing had to be conducted at stack exit.

The sampling plane is deemed to be non-ideal or non-compliant due to the following reasons:

The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	17	
Gas molecular weight, g/g mole	28.3 (wet)	30.4 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.36 (dry)
% Oxygen correction & Factor	7 %	1.01
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1315 & 1430	
Temperature, °C	219	
Temperature, K	492	
Velocity at sampling plane, m/s	27	
Volumetric flow rate, discharge, m³/s	3.4	
Volumetric flow rate (wet STP), m³/s	1.8	
Volumetric flow rate (dry STP), m³/s	1.5	
Mass flow rate (wet basis), kg/hour	8000	
Velocity difference, %	<1	

Gas Analyser Results		Average		
	Sampling time		1417 - 1516	
			Corrected to	
		Concentration	7% O2	Mass Rate
		mg/m³	mg/m³	g/min
Combustion Gases				
Nitrogen oxides (as NO_2)		140	150	13
Carbon monoxide		680	690	59
		Concentration		
		%		
Carbon dioxide		12.3		
Oxygen		7.2		

Ammonia		Results		
	Sampling time		1320-1420	
			Corrected to	
		Concentration	7% O2	Mass Rate
		mg/m³	mg/m³	g/min
Ammonia		0.74	0.75	0.065

Isokinetic Results		Results		
	Sampling time		1325-1425	
			Corrected to	
		Concentration	7% O2	Mass Rate
		mg/m³	mg/m³	g/min
Solid Particles		81	82	7.1
Fine particulates (PM10)	(PSA)	29	30	2.6
Fine particulates (PM2.5)	(PSA)	7	7.1	0.62
Coarse Particulates		51	52	4.5
Isokinetic Sampling Parameters				
Sampling time, min		60		
Isokinetic rate, %		96		

Total VOCs*		Results		
(as n-Propane)	Sampling time		1325-1425	
			Corrected to	
		Concentration	7% O2	Mass Rate
		mg/m³	mg/m³	g/min
Total		14	15	1.3

* Total VOCs does not include methane

VOC (speciated)		Results		
	Sampling time		1325-1425	
			Corrected to	
		Concentration	7% O2	Mass Rate
		mg/m³	mg/m³	g/min
Detection limit(1)		<0.1	<0.1	<0.009
Ethanol		1.6	1.7	0.14
alpha-Pinene		15	15	1.3
beta-Pinene		23	24	2
D-Limonene		1.5	1.5	0.13

(1) Unless otherwise reported, the following target compounds were found to be below detection:

Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-trimethylbenzene, tert-Butylbenzene, 1,2,4-trimethylbenzene, 1,2,3-trimethylbenzene, Acetone, Pentane, Acrylonitrile, n-Hexane, Methyl ethyl ketone, Ethyl acetate, Cyclohexane, 2-Methylhexane, 2,3-Dimethylpentane, Isopropyl acetate, 3-Methylhexane, Ethyl acrylate, Heptane, Methyl methacrylate, Propyl acetate, Methylcyclohexane, MIBK, 2-Hexanone, Octane, Butyl acetate, 1-methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, Decane, 3-Carene, Undecane, Dodecane, Tridecane, Tetradecane

4 PLANT OPERATING CONDITIONS

Unless otherwise stated, the plant operating conditions were normal at the time of testing. See Dongwha Australia's records for complete process conditions.

5 TEST METHODS

All sampling and analysis was performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sample plane criteria	NSW TM-1	NA	-	✓	NA
Flow rate, temperature and velocity	NSW TM-2	NA	8%, 2%, 7%	✓	NA
Moisture content	NSW TM-22	NSW TM-22	19%	✓	✓
Carbon dioxide	NSW TM-24	NSW TM-24	13%	✓	✓
Carbon monoxide	NSW TM-32	NSW TM-32	12%	✓	✓
Nitrogen oxides (NO_x)	NSW TM-11	NSW TM-11	12%	✓	✓
Oxygen	NSW TM-25	NSW TM-25	13%	✓	✓
Ammonia and ammonium compounds	ETC 330	Envirolab Inorg-057	18%	✓	✓[1]
Speciated volatile organic compounds (VOC's)	NSW TM-34	Ektimo 344	19%	✓	✓[2]
Particulate matter < 10µm (PM_{10}) by particle size analysis	-	HRL In-house	-	-	×[3]
Particulate matter < 2.5µm ($PM_{2.5}$) by particle size analysis	-	HRL In-house	-	-	×[3]

180404

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

1 Analysis performed by Envirolab, NATA accreditation number 2901. Results were reported to Ektimo on 16 April 2018 in report number 188989.

2 Analysis performed by Ektimo, NATA accreditation number 14601. Laboratory analytical results were reported on 24 April 2018 in report number R005733_SVOCs.

3 Analysis performed by HRL Technology using a Malvern Instruments Mastersizer laser particle size analyser. NATA Accreditation does not cover the performance of this service.

6 QUALITY ASSURANCE/QUALITY CONTROL INFORMATION

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

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7 DEFINITIONS

The following symbols and abbreviations may be used in this test report:

~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American public health association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM	Continuous Emission Monitoring
CEMS	Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone defined as the particle diameter at which the cyclone achieves a 50% collection efficiency ie. half of the particles are retained by the cyclone and half are not and pass through it to the next stage. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra Red
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response).
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis
RATA	Relative Accuracy Test Audit
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test Method
TOC	The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Vic EPA	Victorian Environment Protection Authority
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray Diffractometry

Appendix B – Emission Test Report R005320 For Family Fresh Farms, Peats Ridge, NSW

Ektimo

Address (Head Office)
7 Redland Drive
MITCHAM VIC 3132

Postal Address
52 Cooper Road
COCKBURN CENTRAL WA 6164

Office Locations
VIC NSW WA QLD

Freecall: 1300 364 005
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ABN: 86 600 381 413

Report Number R005320

Emission Testing Report
Family Fresh Farms Pty Ltd, Peats Ridge

Document Information

Client Name:	Family Fresh Farms Pty Ltd
Report Number:	R005320
Date of Issue:	30 January 2018
Attention:	Andrew Young
Address:	13 Kilpa Road Peats Ridge NSW 2250 Peats Ridge NSW 2250
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Status

Format	Document Number	Report Date	Prepared By	Reviewed By (1)	Reviewed By (2)
Preliminary Report	-	-	-	-	-
Draft Report	R005320[DRAFT]	29 January 2018	ADo	DHi	ADa
Final Report	R005320	30 January 2018	ADo	DHi	ADa
Amend Report	-	-	-	-	-

Template Version: 081217

Amendment Record

Document Number	Initiator	Report Date	Section	Reason
Nil	-	-	-	-

Report Authorisation

David Hill
Client Manager

NATA Accredited Laboratory
No. 14601

Aaron Davis
Ektimo Signatory

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

Table of Contents

1 EXECUTIVE SUMMARY

Ektimo was engaged by Family Fresh Farms Pty Ltd to perform emissions to air monitoring for EPA compliance purposes.

Results from this stack emission monitoring program indicate that Family Fresh Farms Pty Ltd was compliant with the proposed 100 percentile concentration limits prescribed by the NSW Environment Protection Authority during the sampling period.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
Boiler Exhaust	19 December 2017	Solid particles, metals (Type 1 & Type 2 in aggregate), hydrogen chloride, chlorine, sulfur trioxide, sulfur dioxide, speciated volatile organic compounds, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen

* Flow rate, velocity, temperature and moisture were determined unless otherwise stated

The sampling methodologies chosen by Ektimo are those recommended by the NSW Office of Environment and Heritage (as specified in the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales, January 2007*).

All results are reported on a dry basis at STP. Unless otherwise indicated, the methods cited in this report have been performed without deviation.

Plant operating conditions have been noted in the report.

2 RESULTS SUMMARY

The following licence comparison table shows that all analytes highlighted in green are below the emission limits proposed by the NSW EPA.

Location Description	Pollutant	Units	100 percentile concentration limit	Detected Values 19/12/17
Boiler Exhaust	Nitrogen oxides	mg/m^3	400	140
	Volatile organic compounds	mg/m^3	30	<0.8
	Solid particles	mg/m^3	50	26
	Type 1 & Type 2 substances in aggregate	mg/m^3	0.5	≤0.042
	Chlorine	mg/m^3	10	<0.02
	Hydrogen Chloride	mg/m^3	20	4.1

3 RESULTS

3.1 Boiler Exhaust

Date	19/12/2017	**Client**	Family Fresh Farms Pty Ltd
Report	R005320	**Stack ID**	Boiler Exhaust
Licence No.	-	**Location**	Peats Ridge
Ektimo Staff	David Hill & Steven Weekes	**State**	NSW
Process Conditions	Please refer to client records.		*171217*

Sampling Plane Details		
Sampling plane dimensions	620 mm	
Sampling plane area	0.302 m²	
Sampling port size, number	4" BSP (x2)	
Access & height of ports	Step ladder 4 m	
Duct orientation & shape	Horizontal Circular	
Downstream disturbance	Bend 2 D	
Upstream disturbance	Inlet 4 D	
No. traverses & points sampled	2 12	
Sample plane compliance to AS4323.1	Compliant but non-ideal	

Comments

The sampling plane is deemed to be non-ideal or non-compliant due to the following reasons:

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	13	
Gas molecular weight, g/g mole	28.6 (wet)	30.2 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.35 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1041 & 1156	
Temperature, °C	104	
Temperature, K	377	
Velocity at sampling plane, m/s	5.5	
Volumetric flow rate, discharge, m³/s	1.6	
Volumetric flow rate (wet STP), m³/s	1.2	
Volumetric flow rate (dry STP), m³/s	1	
Mass flow rate (wet basis), kg/hour	5500	
Velocity difference, %	-9	

Date	19/12/2017	**Client**	Family Fresh Farms Pty Ltd
Report	R005320	**Stack ID**	Boiler Exhaust
Licence No.	-	**Location**	Peats Ridge
Ektimo Staff	David Hill & Steven Weekes	**State**	NSW
Process Conditions	Please refer to client records.		*171217*

Isokinetic Results	Results	
Sampling time	1048-1152	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.004	<0.0003
Arsenic	<0.002	<0.0001
Beryllium	<0.001	<0.00006
Cadmium	<0.0004	<0.00003
Chromium	0.0015	0.00009
Cobalt	<0.0007	<0.00004
Lead	0.0034	0.00021
Manganese	0.017	0.001
Mercury	0.00059	0.000036
Nickel	0.002	0.00013
Selenium	<0.005	<0.0003
Tin	0.0032	0.0002
Vanadium	<0.001	<0.00007
Type 1 & 2 Substances		
Upper Bound		
Total Type 1 Substances	≤0.011	≤0.00067
Total Type 2 Substances	≤0.031	≤0.0019
Total Type 1 & 2 Substances	≤0.042	≤0.0026
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	

Total VOCs	Results	
(as n-Propane) Sampling time	1055-1157	
	Concentration mg/m³	Mass Rate g/min
Total	<0.8	<0.05

VOC (speciated)	Results	
Sampling time	1055-1157	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.2	<0.01

(1) Unless otherwise reported, the following target compounds were found to be below detection:

Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m +p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-trimethylbenzene, tert-Butylbenzene, 1,2,4-trimethylbenzene, 1,2,3-trimethylbenzene, Acetone, Pentane, Acrylonitrile, n-Hexane, Methyl ethyl ketone, Ethyl acetate, Cyclohexane, 2-Methylhexane, 2,3-Dimethylpentane, Isopropyl acetate, 3-Methylhexane, Ethyl acrylate, Heptane, Methyl methacrylate, Propyl acetate, Methylcyclohexane, MIBK, 2-Hexanone, Octane, Butyl acetate, 1-methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

Date	19/12/2017	**Client**	Family Fresh Farms Pty Ltd
Report	R005320	**Stack ID**	Boiler Exhaust
Licence No.	-	**Location**	Peats Ridge
Ektimo Staff	David Hill & Steven Weekes	**State**	NSW
Process Conditions	Please refer to client records.		*171217*

Sampling Plane Details	
Sampling plane dimensions	620 mm
Sampling plane area	0.302 m²
Sampling port size, number	4" BSP (x2)
Access & height of ports	Step ladder 4 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 2 D
Upstream disturbance	Inlet 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The sampling plane is deemed to be non-ideal or non-compliant due to the following reasons:

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	13	
Gas molecular weight, g/g mole	28.7 (wet)	30.4 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.36 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0925 & 1041	
Temperature, °C	105	
Temperature, K	379	
Velocity at sampling plane, m/s	6	
Volumetric flow rate, discharge, m³/s	1.8	
Volumetric flow rate (wet STP), m³/s	1.3	
Volumetric flow rate (dry STP), m³/s	1.1	
Mass flow rate (wet basis), kg/hour	6000	
Velocity difference, %	-9	

Isokinetic Results	Results	
Sampling time	0932-1037	
	Concentration mg/m³	Mass Rate g/min
Sulfur dioxide	18	1.2
Sulfur trioxide	2.3	0.16
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	94	

Date	19/12/2017	**Client**	Family Fresh Farms Pty Ltd
Report	R005320	**Stack ID**	Boiler Exhaust
Licence No.	-	**Location**	Peats Ridge
Ektimo Staff	David Hill & Steven Weekes	**State**	NSW
Process Conditions	Please refer to client records.		*171217*

Sampling Plane Details	
Sampling plane dimensions	620 mm
Sampling plane area	0.302 m²
Sampling port size, number	4" BSP (x2)
Access & height of ports	Step ladder 4 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 2 D
Upstream disturbance	Inlet 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The sampling plane is deemed to be non-ideal or non-compliant due to the following reasons:

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	15	
Gas molecular weight, g/g mole	28.5 (wet)	30.3 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.35 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1156 & 1305	
Temperature, °C	104	
Temperature, K	378	
Velocity at sampling plane, m/s	5.2	
Volumetric flow rate, discharge, m³/s	1.6	
Volumetric flow rate (wet STP), m³/s	1.1	
Volumetric flow rate (dry STP), m³/s	0.97	
Mass flow rate (wet basis), kg/hour	5200	
Velocity difference, %	<1	

Gas Analyser Results	Average		Minimum		Maximum	
Sampling time	1155 - 1254		1155 - 1254		1155 - 1254	
	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Combustion Gases						
Nitrogen oxides (as NO_2)	140	8.1	120	6.9	160	9.2
Carbon monoxide	6.7	0.39	2.5	0.15	15	0.88
	Concentration %		Concentration %		Concentration %	
Carbon dioxide	11.5		10.5		12.7	
Oxygen	9.4		8.2		10.4	

Isokinetic Results	Results	
Sampling time	1158-1302	
	Concentration mg/m³	Mass Rate g/min
Solid Particles	26	1.5
Hydrogen chloride	4.1	0.24
Chlorine	<0.02	<0.001
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	101	

4 PLANT OPERATING CONDITIONS

Unless otherwise stated, the plant operating conditions were normal at the time of testing. See Family Fresh Farms Pty Ltd's records for complete process conditions.

5 TEST METHODS

All sampling and analysis was performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sample plane criteria	NSW TM-1	NA	-	✓	NA
Flow rate, temperature and velocity	NSW TM-2	NA	8%, 2%, 7%	✓	NA
Moisture content	NSW TM-22	NSW TM-22	8%	✓	✓
Molecular weight	NSW TM-23	NSW TM-23	not specified	✓	✓
Carbon dioxide	NSW TM-24	NSW TM-24	13%	✓	✓
Carbon monoxide	NSW TM-32	NSW TM-32	12%	✓	✓
Nitrogen oxides (NO_X)	NSW TM-11	NSW TM-11	12%	✓	✓
Oxygen	NSW TM-25	NSW TM-25	13%	✓	✓
Sulfur dioxide	NSW TM-4	Ektimo 235	16%	✓	✓[1]
Speciated volatile organic compounds (VOC's)	NSW TM-34	Ektimo 344	19%	✓	✓[2]
Chlorine	NSW TM-7	Ektimo 235	14%	✓	✓[3]
Hydrogen chloride	NSW TM-8	Ektimo 235	14%	✓	✓[3]
Particulate matter	NSW TM-15	NSW TM-15	5%	✓	✓
Sulfuric acid mist (including sulfur trioxide)	NSW TM-3	Ektimo 235	16%	✓	✓[1]
Total (gaseous and particulate) metals and metallic compounds	NSW TM-12, NSW TM-13, NSW TM-14	Envirolab inhouse	15%	✓	✓[4]
Type 1 substances (Sb, As, Cd, Pb, Hg)	NSW TM-12	Envirolab inhouse	15%	✓	✓[4]
Type 2 substances (Be, Cr, Co, Mn, Ni, Se, Sn, V)	NSW TM-13	Envirolab inhouse	15%	✓	✓[4]

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2) *171221*

1. Analysis performed by Ektimo, NATA accreditation number 14601. Laboratory analytical results were reported on 22 December 2017 in report number R005320-SOx
2. Analysis performed by Ektimo, NATA accreditation number 14601. Laboratory analytical results were reported on 18 January 2018 in report number R005320_SVOCs
3. Analysis performed by Ektimo, NATA accreditation number 14601. Laboratory analytical results were reported on 22 December 2017 in report number R005320-Halides_Halogens
4. Analysis performed by Envirolab, NATA accreditation number 2901. Results were reported to Ektimo on 4 January 2017 in report number 182559

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EPA	Environment Protection Authority
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STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test Method
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USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Vic EPA	Victorian Environment Protection Authority
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray Diffractometry

Appendix C – Meteorological Data Synthesis Report, PDS Consulting

Site-Specific Input Meteorological data file for AUSPLUME

Bombala -2016

This file was exclusively compiled for **EKTIMO** By pDs Consultancy Service.

pDs Consultancy
@1999-2018

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Introduction

Gaussian plume models such as AUSPLUME/AERMOD require hourly averaged meteorological data from a single site that is preferably within the model domain ('on-site' or site-specific data). However, data from the nearest 'off-site' meteorological station can be used when no on-site data are available, and the off-site data are representative of the area of concern (i.e. the meteorological parameters characterise the transport and dispersion conditions of the location in question).

It is also preferable that:

- The compilation of the input meteorological data file is done in accordance with 'best practice', with procedures and algorithms recommended or set by environment regulators.
- The instrumentation collecting mandatory data such as wind speed, direction, sigma-theta (calculated from wind direction measurements) and ambient temperature, meet Australian Standards AS2923 (ambient air guide for measurement of horizontal wind for air quality applications).

pDs Consultancy has been engaged by **EKTIMO** to compile an 'AUSPLUME-type' meteorological file for a site; **Dongwaha, Australia** at Bombala in New South Wales.

Industrial facility at Bombala has Automatic Weather Station which has gathered mostly needed data. The upper air (Radio Sonde) data obtained from BoM's **Sydney Airport** weather station was also used to compile site-specific input meteorological data file for intended AUSPLUME modelling work over **Bombala**.

Vertical Temperature and Moisture Profiles from **Sydney** Airport (maintained by Australian Bureau of Meteorology) were used to determine convective mixing height.

This input meteorological data file has been compiled following the EPA, Victoria guideline: "Construction of meteorological data files for AUSPLUME (Publication No.1459)" as well as EPA, NSW approved method.

LOCATION: DONGWHA, AUSTRALIA,BOMBALA, NSW

DATA PROCESSING

Data Source

1. **Dongwha Australia, AWS** Data
    2. **Sydney** Airport Vertical Temperature Profiles –National Climate Centre– Bureau of Meteorology, Melbourne.

Input Information

- Mandatory (Bombala)parameters
    - Wind speed (m/s)
    - Wind direction
    - Ambient Temperature
    - Relative Humidity
    - Total Solar Radiation(TSR)
    - Vertical Temperature Difference(DT)
    - Sigma Theta

Wind was measured at 10m (Anemometer Height), surface roughness assumed to be 0.3m at the wind measurement site.

Sydney Airport (NSW)

1. Vertical temperature profiles; Temperature, Dew point (1 profiles per day)

www.pdsconsultancy.com.au metfile@pdsconsultancy.com

QA/QC ON RAW DATA

This data set was treated as follows

- Hourly averages were calculated from 15-minute average data
- Vector averaging was done for Wind Direction
- Square Averaging was used to calculate 60-minute average of SigmaTheta from 15-minute average SigamaTheta

SYDNEY AIRPORT (BOM)VERTICAL TEMPERATURE PROFILES

- Gaps in vertical temperature profiles were filled with previous or following day data for the completeness.

VERTICAL STABILITY

Solar Radiation for day time and Delta T (Vertical Temperature Difference) for night time were used to determine night-time stability class.

Table 1 for daytime and Table 2 for night-time were used.

TABLE 1: STABILITY CLASSIFICATION FOR DAYTIME USING SOLAR RADIATION AND WIND SPEED

	Solar Radiation (W/m²)			
Wind Speed(m/s)	≥925	≥675	≥175	< 175
< 2	A	A	B	D
< 3	A	B	C	D
< 5	B	B	C	D
< 6	C	C	D	D
≥ 6	C	D	D	D

Table 2: Pasquill stability calsses during night time

Night-time		
Wind Speed (m/s)	Vertical Temperature Gradient	
	< 0	≥ 0
< 2.0	E	F
2.0 - 2.5	D	E
≥ 2.5	D	D

MIXING HEIGHT (CONVECTIVE & MECHANICAL)

DEFINITION:

The mixing height, the depth of the surface mixed layer is the height of the atmosphere above the ground, which is well mixed due either to mechanical turbulence or convective turbulence. The air layer above this height is stable.

The mixing height was determined by using the methodology of Benkley and Schulman (Journal of Applied Meteorology, Volume 18, 1979, pp 772-780). **Sydney Airport** upper air observation containing temperature and moisture profiles were used to determine daytime mixing height.

Surface wind speeds and roughness at the site were used to calculate the depth of the mechanically forced boundary layer during the night time.

MixHm=0.185* Ustar/Cterm

Where Ustar=.35*Usfc/Ln (Htanemo/Z0)

Cterm = Coriolis Term =2 Ω Sin(ϕ)

Where Ω is the angular velocity of the earth

ϕ is the latitude

Htanemo= Anemometer Height, Z0 is the roughness

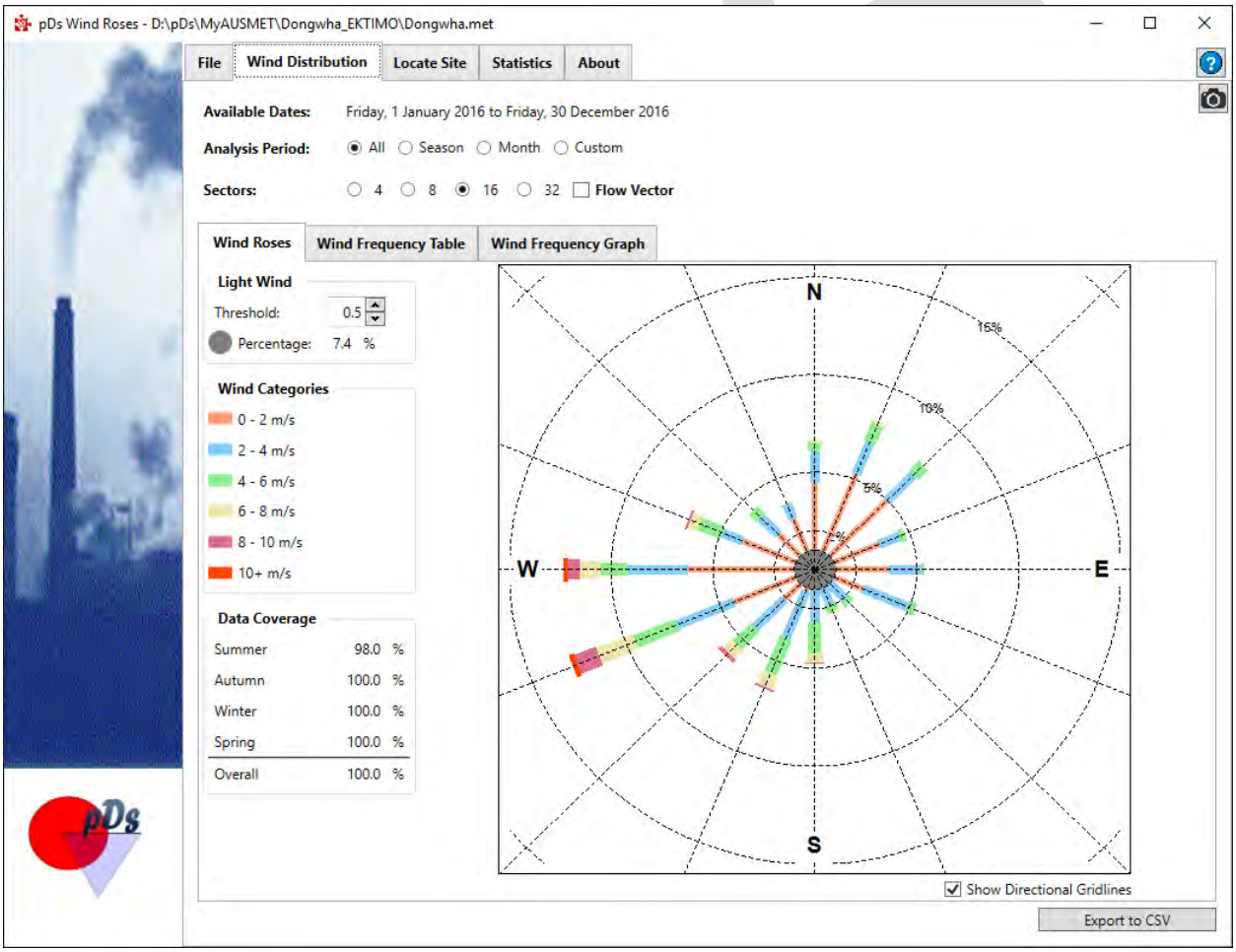
Height of the convective boundary layer was determined using daytime temperature sounding (Vertical temperature and dewpoint profiles) in between sunrise and sunset. Surface meteorological conditions at Dongwha, Australia in **Bombala** and temperature profiles at **Sydney Airport** were used to estimate hourly mixing heights. Larger value of the mechanical turbulence or convective turbulence was taken as mixing height for the daylight hours.

ANALYSIS

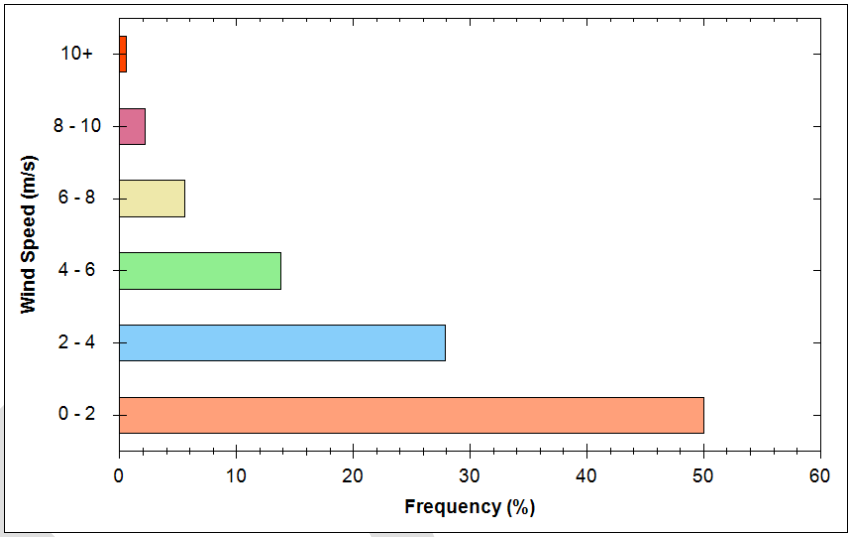
DATA COVERAGE

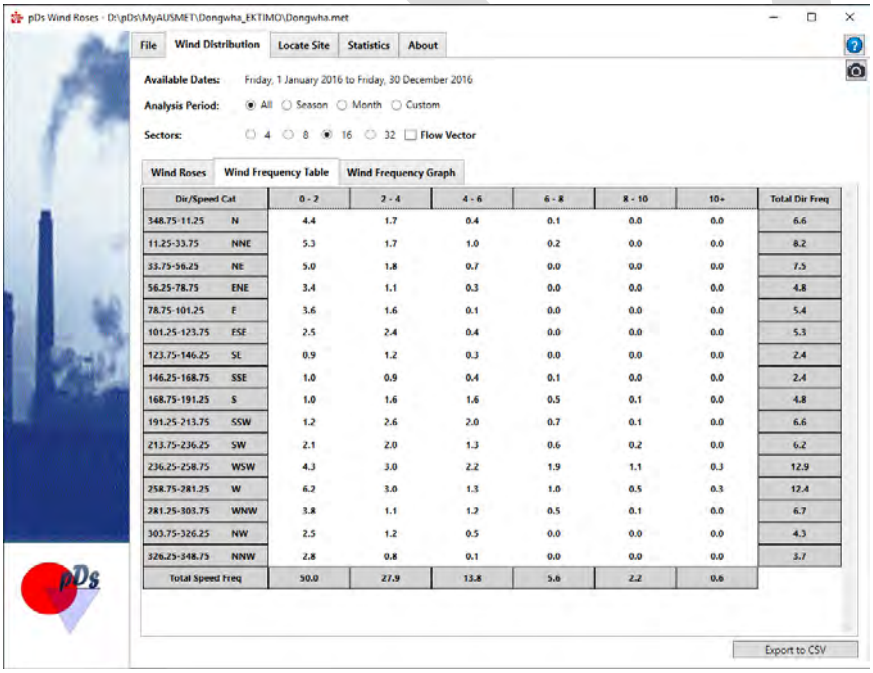
All data in the date ranged recovered (100%). Annual data coverage is meeting the regulatory requirements (~90%).

ANNUAL WINDROSES



WIND SPEED FREQUENCY



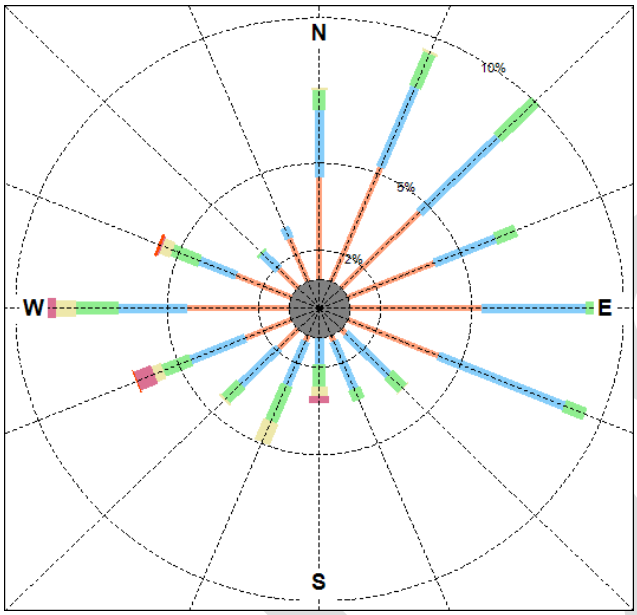


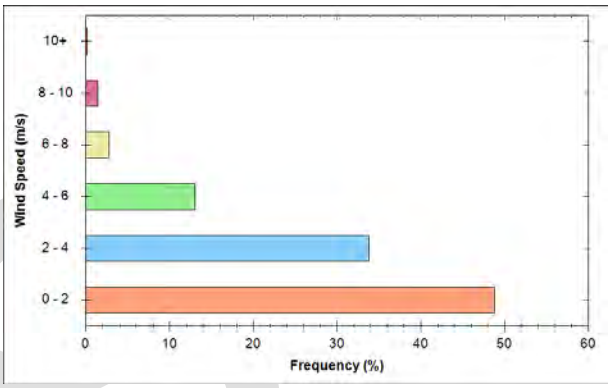
Dir/Speed Cat		0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10+	Total Dir Freq
348.75-11.25	N	4.4	1.7	0.4	0.1	0.0	0.0	6.6
11.25-33.75	NNE	5.3	1.7	1.0	0.2	0.0	0.0	8.2
33.75-56.25	NE	5.0	1.8	0.7	0.0	0.0	0.0	7.5
56.25-78.75	ENE	3.4	1.1	0.3	0.0	0.0	0.0	4.8
78.75-101.25	E	3.6	1.6	0.1	0.0	0.0	0.0	5.4
101.25-123.75	ESE	2.5	2.4	0.4	0.0	0.0	0.0	5.3
123.75-146.25	SE	0.9	1.2	0.3	0.0	0.0	0.0	2.4
146.25-168.75	SSE	1.0	0.9	0.4	0.1	0.0	0.0	2.4
168.75-191.25	S	1.0	1.6	1.6	0.5	0.1	0.0	4.8
191.25-213.75	SSW	1.2	2.6	2.0	0.7	0.1	0.0	6.6
213.75-236.25	SW	2.1	2.0	1.3	0.6	0.2	0.0	6.2
236.25-258.75	WSW	4.3	3.0	2.2	1.9	1.1	0.3	12.9
258.75-281.25	W	6.2	3.0	1.3	1.0	0.5	0.3	12.4
281.25-303.75	WNW	3.8	1.1	1.2	0.5	0.1	0.0	6.7
303.75-326.25	NW	2.5	1.2	0.5	0.0	0.0	0.0	4.3
326.25-348.75	NNW	2.8	0.8	0.1	0.0	0.0	0.0	3.7
Total Speed Freq		50.0	27.9	13.8	5.8	2.2	0.6	

www.pdsconsultancy.com.au metfile@pdsconsultancy.com

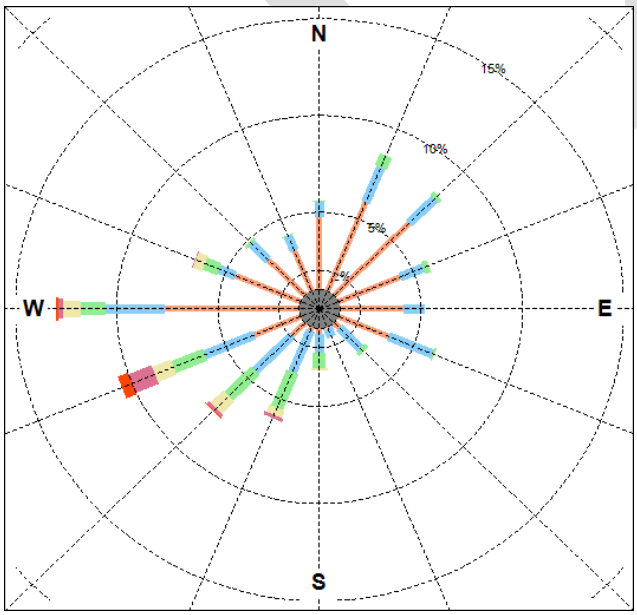
SEASONAL WINDROSES

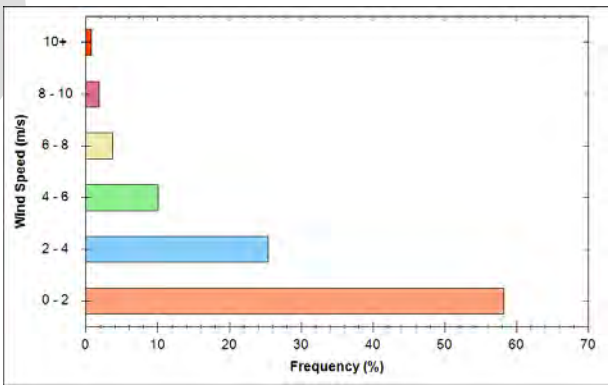
Summer



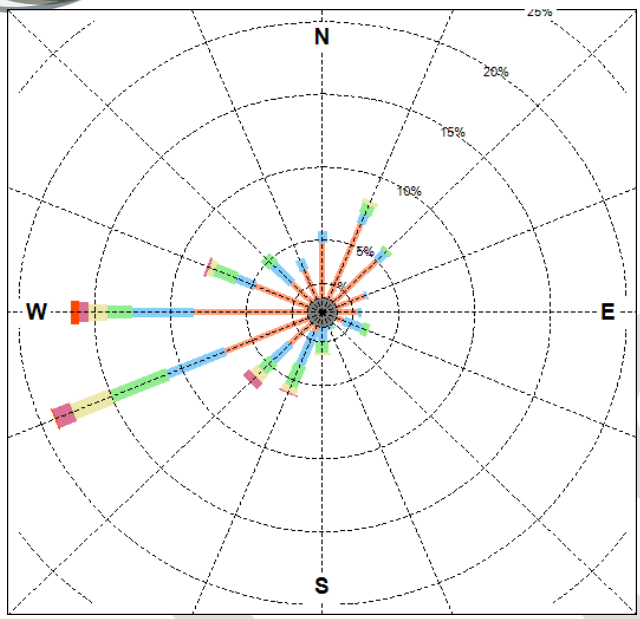


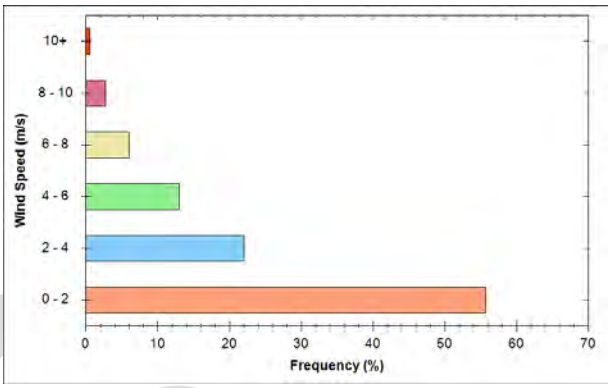
Autumn



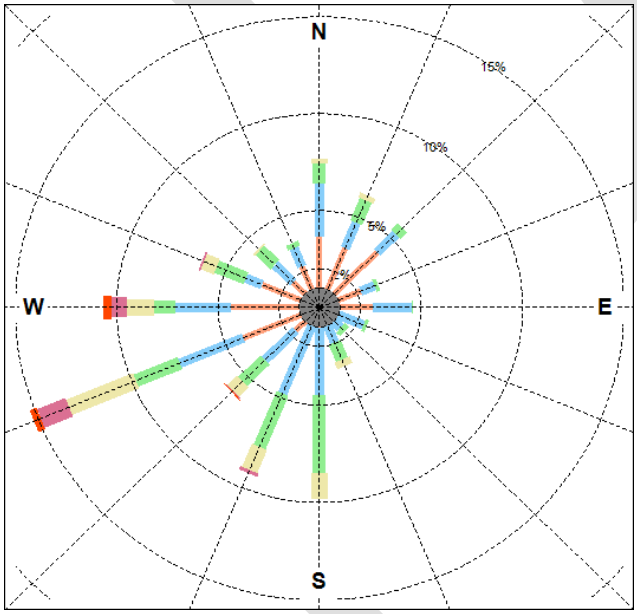


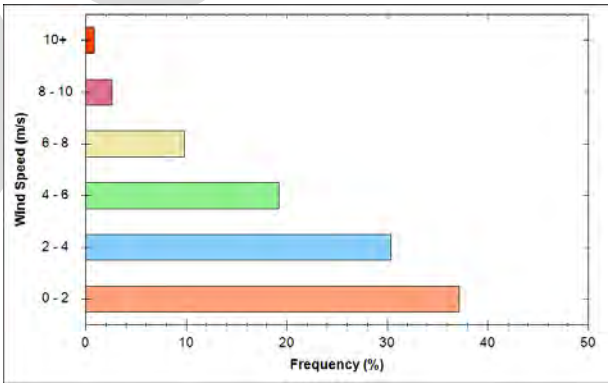
Winter





Spring





ANNUAL STABILITY DISTRIBUTION

Stability	Stability Distribution %	Avg. Temp(C)	Avg. Wind Speed(m/s)	Avg. Mixing Height(m)
A	2	22.3	1.5	1597.0
B	10	15.6	1.9	1098.2
C	11	16.3	3.6	1215.9
D	46	11.5	3.7	891.7
E	2	10.5	2.2	468.4
F	29	8.0	1.0	231.7

DISCLAIMER

Compilation of input meteorological data file for AUSPLUME was done under the supervision of qualified and experienced meteorologists. Although all due care has been taken, we cannot give any warranty, nor accept any liability (except that required by law) in relation to the information given, its completeness or its applicability to a particular problem. These data and other material are supplied on the condition that you agree to indemnify us and hold us harmless from and against all liability, losses, claims, proceedings, damages, costs and expenses, directly or indirectly relating to, or arising from the use of or reliance on the data and material which we have supplied.

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Appendix D – Ausplume Output Files

TPM AS TSP EMISSIONS WITH ANNUAL AVERAGE

```
1 ------------------------------------------------------------------------

  Dongwha - TPM as TSP emissions including proposed 15 MW Biomass Boiler

 ------------------------------------------------------------------------

Concentration or deposition                 Concentration
Emission rate units                         grams/second
Concentration units                         microgram/m3
Units conversion factor                     1.00E+06
Constant background concentration           0.00E+00
Terrain effects                             Egan method
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
Averaging time for sigma-theta values       60 min.

              DISPERSION CURVES
Horizontal dispersion curves for sources <100m high  Sigma-theta
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                            0.300m
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          Stability Class
 Category     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 Rural" values (unless overridden by met. file)

AVERAGING TIMES
 average over all hours
 ------------------------------------------------------------------------

1 ------------------------------------------------------------------------

  Dongwha - TPM as TSP emissions including proposed 15 MW Biomass Boiler

              SOURCE CHARACTERISTICS

 ------------------------------------------------------------------------

          STACK SOURCE: WFBOIL

  X(m)     Y(m)   Ground Elev.  Stack Height  Diameter Temperature  Speed
697098  5910473      720m          10m        0.40m     219C    27.0m/s

      _____ Effective building dimensions (in metres) _____
Flow direction              10°  20°  30°  40°  50°  60°  70°  80°  90° 100° 110° 120°
Effective building width     7   9   11   13   14   15   16   14   13   11   12   14
Effective building height    7   7   7   7   7   7   7   7   7   7   7   7
Along-flow building length   14   15   15   15   15   14   13   11   9   12   14   15
Along-flow distance from stack  -7  -9  -9 -10 -11 -11 -11 -22 -22   1   0  -1
Across-flow distance from stack  5   5   5   5   5   4   3   8   5   1   2   3

Flow direction              130° 140° 150° 160° 170° 180° 190° 200° 210° 220° 230° 240°
Effective building width     15  15  14  13  11   9   7   9  11  13  14  15
```

Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 11 14 15 15 16 15 15 15 15 15 15 14
Along-flow distance from stack -22 -12 -11 -11 -10 -9 -8 -7 -6 -5 -4 -3
Across-flow distance from stack -8 -4 -4 -5 -5 -6 -5 -5 -5 -5 -4 -4

Flow direction 250° 260° 270° 280° 290° 300° 310° 320° 330° 340° 350° 360°
Effective building width 16 14 13 11 13 14 15 15 14 13 11 9
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 13 11 9 12 14 15 11 14 15 16 16 15
Along-flow distance from stack -2 11 13 -13 -14 -14 11 -3 -4 -5 -6 -6
Across-flow distance from stack -3 -8 -5 -1 -1 -3 9 3 4 5 5 6

(Constant) emission rate = 2.40E-01 grams/second
No gravitational settling or scavenging.

STACK SOURCE: BMBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
696853	5910546	720m	18m	1.10m	210C	18.0m/s

_____ Effective building dimensions (in metres) _____
Flow direction 10° 20° 30° 40° 50° 60° 70° 80° 90° 100° 110° 120°
Effective building width 20 22 26 29 162 173 178 178 172 162 151 136
Effective building height 7 7 7 7 12 12 12 12 12 12 12 12
Along-flow building length 28 30 32 33 104 99 98 93 86 78 103 127
Along-flow distance from stack 10 10 8 7 -63 -77 -88 -97 -103 -108 -129 -146
Across-flow distance from stack -5 -1 3 7 86 83 79 72 62 51 38 24

Flow direction 130° 140° 150° 160° 170° 180° 190° 200° 210° 220° 230° 240°
Effective building width 117 104 99 98 93 24 20 22 26 29 162 173
Effective building height 12 12 12 12 12 7 7 7 7 7 12 12
Along-flow building length 147 162 173 178 178 30 28 30 32 33 104 99
Along-flow distance from stack -159 -167 -170 -167 -160 -37 -38 -39 -40 -40 -41 -22
Across-flow distance from stack 9 -11 -27 -39 -51 9 5 1 -3 -7 -86 -84

Flow direction 250° 260° 270° 280° 290° 300° 310° 320° 330° 340° 350° 360°
Effective building width 178 178 172 0 0 136 117 104 99 98 93 24
Effective building height 12 12 12 0 0 12 12 12 12 12 12 7
Along-flow building length 98 93 86 0 0 127 147 162 173 178 178 30
Along-flow distance from stack -9 4 17 0 0 19 12 5 -3 -10 -18 7
Across-flow distance from stack -79 -72 -62 0 0 -24 -9 11 27 39 51 -9

(Constant) emission rate = 3.50E-01 grams/second
No gravitational settling or scavenging.

STACK SOURCE: REDRY1

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697076	5910479	720m	7m	0.37m	75C	3.4m/s

_____ Effective building dimensions (in metres) _____
Flow direction 10° 20° 30° 40° 50° 60° 70° 80° 90° 100° 110° 120°
Effective building width 19 7 9 11 12 13 14 14 13 14 15 15
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 14 15 15 15 15 14 13 11 9 7 7 9
Along-flow distance from stack -9 -8 -7 -6 -5 -4 -3 -1 0 1 1 0
Across-flow distance from stack -11 -5 -5 -4 -4 -4 -3 -2 -2 -1 0 0

Flow direction 130° 140° 150° 160° 170° 180° 190° 200° 210° 220° 230° 240°
Effective building width 15 15 14 13 11 9 19 7 9 11 12 13
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 11 12 13 13 13 13 15 15 15 15 15 14
Along-flow distance from stack -1 -2 -3 -4 -5 -5 -6 -7 -8 -9 -10 -10
Across-flow distance from stack 2 2 3 4 4 5 11 5 5 4 4 4

Flow direction 250° 260° 270° 280° 290° 300° 310° 320° 330° 340° 350° 360°
Effective building width 13 14 13 11 13 14 15 15 14 13 11 9
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 13 11 9 12 14 15 11 12 13 13 13 13
Along-flow distance from stack -10 -10 -9 -36 -36 -36 -10 -10 -10 -10 -9 -8
Across-flow distance from stack 3 2 2 2 -3 -9 -1 -2 -3 -4 -4 -5

(Constant) emission rate = 1.60E-02 grams/second
No gravitational settling or scavenging.

STACK SOURCE: REDRY2

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697088	5910476	720m	7m	0.37m	80C	6.6m/s

_____ Effective building dimensions (in metres) _____
Flow direction 10° 20° 30° 40° 50° 60° 70° 80° 90° 100° 110° 120°
Effective building width 7 9 9 11 12 13 14 14 13 11 12 14
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 14 15 15 15 15 14 13 11 9 12 14 15
Along-flow distance from stack -8 -8 -10 -12 -13 -13 -13 -13 -12 11 10 9
Across-flow distance from stack -5 -5 7 7 6 5 4 3 2 -1 2 5

Flow direction 130° 140° 150° 160° 170° 180° 190° 200° 210° 220° 230° 240°

Effective building width 15 15 14 13 11 9 7 9 9 11 12 13
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 11 12 15 13 16 13 15 15 15 15 15 14
Along-flow distance from stack -12 -12 -4 -11 -6 -8 -7 -7 -5 -4 -3 -1
Across-flow distance from stack -4 -5 3 -7 4 -8 5 5 -7 -7 -6 -5

Flow direction 250° 260° 270° 280° 290° 300° 310° 320° 330° 340° 350° 360°
Effective building width 13 14 13 11 13 14 15 15 14 13 11 9
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 13 11 9 12 14 15 11 12 13 13 13 13
Along-flow distance from stack 0 2 3 -24 -24 -24 2 0 -2 -3 -4 -5
Across-flow distance from stack -4 -3 -2 1 -2 -5 4 5 6 7 7 8

(Constant) emission rate = 4.20E-03 grams/second
No gravitational settling or scavenging.

---

1 ---

Dongwha - TPM as TSP emissions including proposed 15 MW Biomass Boiler

RECEPTOR LOCATIONS

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	696448	5910062	724.0	0.0	10	697853	5911348	727.0	0.0
2	697665	5909658	728.0	0.0	11	696548	5909403	734.0	0.0
3	698048	5909616	723.0	0.0	12	697645	5909068	765.0	0.0
4	697813	5910634	717.0	0.0	13	698603	5909310	730.0	0.0
5	698101	5910697	730.0	0.0	14	698714	5910743	745.0	0.0
6	698060	5910761	732.0	0.0	15	694457	5909078	715.0	0.0
7	697508	5910760	720.0	0.0	16	694684	5908451	725.0	0.0
8	697721	5911116	714.0	0.0	17	697386	5907886	755.0	0.0
9	697986	5911294	725.0	0.0	18	696684	5910696	718.0	0.0

METEOROLOGICAL DATA : Other Dongwha AWS Data SRDT Mtd SydneyAP Uair Z0-0.3

AVERAGE OVER ALL HOURS AND FOR ALL SOURCES
in microgram/m3

Concentrations at the discrete receptors (No. : Value):

1:3.55E-01 2:2.17E-01 3:1.82E-01 4:5.79E-01 5:5.51E-01 6:5.92E-01 7:7.37E-01 8:3.20E-01
9:2.99E-01 10:2.86E-01 11:4.40E-01 12:4.50E-01 13:1.73E-01 14:4.61E-01 15:1.33E-01 16:1.78E-01
17:2.54E-01 18:3.63E-01

PM10 WITH 24 HOUR AND ANNUAL AVERAGES

1 ---

Dongwha - PM10 emissions including proposed 15 MW Biomass Boiler

---

Concentration or deposition Concentration
Emission rate units grams/second
Concentration units microgram/m3
Units conversion factor 1.00E+06
Constant background concentration 0.00E+00
Terrain effects Egan method
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
Averaging time for sigma-theta values 60 min.

DISPERSION CURVES
Horizontal dispersion curves for sources <100m high Sigma-theta
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 0.300m
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 Rural" values (unless overridden by met. file)

AVERAGING TIMES
24 hours
average over all hours

1

Dongwha - PM10 emissions including proposed 15 MW Biomass Boiler

SOURCE CHARACTERISTICS

STACK SOURCE: WFBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697098	5910473	720m	10m	0.40m	219C	27.0m/s

Effective building dimensions (in metres)

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	7	9	11	13	14	15	16	14	13	11	12	14
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	14	15	15	15	15	15	14	13	11	9	12	14	15
Along-flow distance from stack	-7	-9	-9	-10	-11	-11	-11	-22	-22	1	0	-1
Across-flow distance from stack	5	5	5	5	5	4	3	8	5	1	2	3

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	15	15	14	13	11	9	7	9	11	13	14	15
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	11	14	15	15	16	15	15	15	15	15	15	14
Along-flow distance from stack	-22	-12	-11	-11	-10	-9	-8	-7	-6	-5	-4	-3
Across-flow distance from stack	-8	-4	-4	-5	-5	-6	-5	-5	-5	-5	-4	-4

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	16	14	13	11	13	14	15	15	14	13	11	9
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	13	11	9	12	14	15	11	14	15	16	16	15
Along-flow distance from stack	-2	11	13	-13	-14	-14	11	-3	-4	-5	-6	-6
Across-flow distance from stack	-3	-8	-5	-1	-1	-3	9	3	4	5	5	6

(Constant) emission rate = 2.20E-01 grams/second
No gravitational settling or scavenging.

STACK SOURCE: BMBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
696853	5910546	720m	18m	1.10m	210C	18.0m/s

Effective building dimensions (in metres)

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	20	22	26	29	162	173	178	178	172	162	151	136
Effective building height	7	7	7	7	12	12	12	12	12	12	12	12
Along-flow building length	28	30	32	33	104	99	98	93	86	78	103	127
Along-flow distance from stack	10	10	8	7	-63	-77	-88	-97	-103	-108	-129	-146
Across-flow distance from stack	-5	-1	3	7	86	83	79	72	62	51	38	24

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	117	104	99	98	93	24	20	22	26	29	162	173
Effective building height	12	12	12	12	12	7	7	7	7	7	12	12
Along-flow building length	147	162	173	178	178	30	28	30	32	33	104	99
Along-flow distance from stack	-159	-167	-170	-167	-160	-37	-38	-39	-40	-40	-41	-22
Across-flow distance from stack	9	-11	-27	-39	-51	9	5	1	-3	-7	-86	-84

Flow direction 250° 260° 270° 280° 290° 300° 310° 320° 330° 340° 350° 360°
Effective building width 178 178 172 0 0 136 117 104 99 98 93 24
Effective building height 12 12 12 0 0 12 12 12 12 12 12 7
Along-flow building length 98 93 86 0 0 127 147 162 173 178 178 30
Along-flow distance from stack -9 4 17 0 0 19 12 5 -3 -10 -18 7
Across-flow distance from stack -79 -72 -62 0 0 -24 -9 11 27 39 51 -9

(Constant) emission rate = 3.50E-01 grams/second
No gravitational settling or scavenging.

STACK SOURCE: REDRY1

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697076	5910479	720m	7m	0.37m	75C	3.4m/s

_____ Effective building dimensions (in metres) _____
Flow direction 10° 20° 30° 40° 50° 60° 70° 80° 90° 100° 110° 120°
Effective building width 19 7 9 11 12 13 14 14 13 14 15 15
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 14 15 15 15 15 14 13 11 9 7 7 9
Along-flow distance from stack -9 -8 -7 -6 -5 -4 -3 -1 0 1 1 0
Across-flow distance from stack -11 -5 -5 -4 -4 -4 -3 -2 -2 -1 0 0

Flow direction 130° 140° 150° 160° 170° 180° 190° 200° 210° 220° 230° 240°
Effective building width 15 15 14 13 11 9 19 7 9 11 12 13
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 11 12 13 13 13 13 13 15 15 15 15 14
Along-flow distance from stack -1 -2 -3 -4 -5 -5 -6 -7 -8 -9 -10 -10
Across-flow distance from stack 2 2 3 4 4 5 11 5 5 4 4 4

Flow direction 250° 260° 270° 280° 290° 300° 310° 320° 330° 340° 350° 360°
Effective building width 13 14 13 11 13 14 15 15 14 13 11 9
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 13 11 9 12 14 15 11 12 13 13 13 13
Along-flow distance from stack -10 -10 -9 -36 -36 -36 -10 -10 -10 -10 -9 -8
Across-flow distance from stack 3 2 2 2 -3 -9 -1 -2 -3 -4 -4 -5

(Constant) emission rate = 1.60E-02 grams/second
No gravitational settling or scavenging.

STACK SOURCE: REDRY2

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697088	5910476	720m	7m	0.37m	80C	6.6m/s

_____ Effective building dimensions (in metres) _____
Flow direction 10° 20° 30° 40° 50° 60° 70° 80° 90° 100° 110° 120°
Effective building width 7 9 9 11 12 13 14 14 13 11 12 14
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 14 15 15 15 15 14 13 11 9 12 14 15
Along-flow distance from stack -8 -8 -10 -12 -13 -13 -13 -13 -12 11 10 9
Across-flow distance from stack -5 -5 7 7 6 5 4 3 2 -1 2 5

Flow direction 130° 140° 150° 160° 170° 180° 190° 200° 210° 220° 230° 240°
Effective building width 15 15 14 13 11 9 7 9 9 11 12 13
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 11 12 15 13 16 13 15 15 15 15 15 14
Along-flow distance from stack -12 -12 -4 -11 -6 -8 -7 -7 -5 -4 -3 -1
Across-flow distance from stack -4 -5 3 -7 4 -8 5 5 -7 -7 -6 -5

Flow direction 250° 260° 270° 280° 290° 300° 310° 320° 330° 340° 350° 360°
Effective building width 13 14 13 11 13 14 15 15 14 13 11 9
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 13 11 9 12 14 15 11 12 13 13 13 13
Along-flow distance from stack 0 2 3 -24 -24 -24 2 0 -2 -3 -4 -5
Across-flow distance from stack -4 -3 -2 1 -2 -5 4 5 6 7 7 8

(Constant) emission rate = 4.20E-03 grams/second
No gravitational settling or scavenging.

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1 _____

Dongwha - PM10 emissions including proposed 15 MW Biomass Boiler

RECEPTOR LOCATIONS

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	696448	5910062	724.0	0.0	10	697853	5911348	727.0	0.0
2	697665	5909658	728.0	0.0	11	696548	5909403	734.0	0.0
3	698048	5909616	723.0	0.0	12	697645	5909068	765.0	0.0
4	697813	5910634	717.0	0.0	13	698603	5909310	730.0	0.0
5	698101	5910697	730.0	0.0	14	698714	5910743	745.0	0.0
6	698060	5910761	732.0	0.0	15	694457	5909078	715.0	0.0

```
 7  697508 5910760   720.0   0.0       16  694684 5908451   725.0   0.0
 8  697721 5911116   714.0   0.0       17  697386 5907886   755.0   0.0
 9  697986 5911294   725.0   0.0       18  696684 5910696   718.0   0.0

_____________________________________________________________________________

METEOROLOGICAL DATA : Other Dongwha AWS Data SRDT Mtd SydneyAP Uair Z0-0.3

_____________________________________________________________________________

              AVERAGE OVER ALL HOURS AND FOR ALL SOURCES
                   in microgram/m3


Concentrations at the discrete receptors (No. : Value):

  1:3.41E-01   2:2.07E-01   3:1.73E-01   4:5.50E-01   5:5.22E-01   6:5.61E-01   7:7.04E-01   8:3.06E-01
  9:2.86E-01  10:2.73E-01  11:4.15E-01  12:4.22E-01  13:1.63E-01  14:4.36E-01  15:1.26E-01  16:1.68E-01
 17:2.39E-01  18:3.47E-01

_____________________________________________________________________________


1      HIGHEST RECORDINGS FOR EACH RECEPTOR  (in microgram/m3)
       AVERAGING TIME = 24 HOURS


At the discrete receptors:

 1: 2.41E+00 @Hr24,05/01/16   10: 1.79E+00 @Hr24,17/02/16
 2: 1.91E+00 @Hr24,08/05/16   11: 2.04E+00 @Hr24,14/06/16
 3: 1.39E+00 @Hr24,29/04/16   12: 2.48E+00 @Hr24,08/05/16
 4: 2.76E+00 @Hr24,14/07/16   13: 1.22E+00 @Hr24,29/04/16
 5: 2.64E+00 @Hr24,07/06/16   14: 2.17E+00 @Hr24,28/07/16
 6: 2.79E+00 @Hr24,07/06/16   15: 8.99E-01 @Hr24,13/03/16
 7: 3.46E+00 @Hr24,05/10/16   16: 8.27E-01 @Hr24,21/05/16
 8: 2.19E+00 @Hr24,17/02/16   17: 1.22E+00 @Hr24,21/07/16
 9: 1.73E+00 @Hr24,17/02/16   18: 5.22E+00 @Hr24,06/07/16

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PM2.5 FOR 24 HOUR AND ANNUAL AVERAGE

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1      ____________________________________________________________

       Dongwha - PM2.5 emissions including proposed 15 MW Biomass Boiler

       ____________________________________________________________


Concentration or deposition                    Concentration
Emission rate units                           grams/second
Concentration units                           microgram/m3
Units conversion factor                        1.00E+06
Constant background concentration                     0.00E+00
Terrain effects                               Egan method
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
Averaging time for sigma-theta values           60 min.

                DISPERSION CURVES
Horizontal dispersion curves for sources <100m high  Sigma-theta
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                              0.300m
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             Stability Class
  Category      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 Rural" values (unless overridden by met. file)

AVERAGING TIMES
24 hours
average over all hours

1

Dongwha - PM2.5 emissions including proposed 15 MW Biomass Boiler

SOURCE CHARACTERISTICS

STACK SOURCE: WFBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697098	5910473	720m	10m	0.40m	219C	27.0m/s

_____ Effective building dimensions (in metres) _____

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	7	9	11	13	14	15	16	14	13	11	12	14
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	14	15	15	15	15	14	13	11	9	12	14	15
Along-flow distance from stack	-7	-9	-9	-10	-11	-11	-11	-22	-22	1	0	-1
Across-flow distance from stack	5	5	5	5	5	4	3	8	5	1	2	3

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	15	15	14	13	11	9	7	9	11	13	14	15
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	11	14	15	15	16	15	15	15	15	15	15	14
Along-flow distance from stack	-22	-12	-11	-11	-10	-9	-8	-7	-6	-5	-4	-3
Across-flow distance from stack	-8	-4	-4	-5	-5	-6	-5	-5	-5	-5	-4	-4

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	16	14	13	11	13	14	15	15	14	13	11	9
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	13	11	9	12	14	15	11	14	15	16	16	15
Along-flow distance from stack	-2	11	13	-13	-14	-14	11	-3	-4	-5	-6	-6
Across-flow distance from stack	-3	-8	-5	-1	-1	-3	9	3	4	5	5	6

(Constant) emission rate = 1.30E-01 grams/second
No gravitational settling or scavenging.

STACK SOURCE: BMBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
696853	5910546	720m	18m	1.10m	210C	18.0m/s

_____ Effective building dimensions (in metres) _____

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	20	22	26	29	162	173	178	178	172	162	151	136
Effective building height	7	7	7	7	12	12	12	12	12	12	12	12
Along-flow building length	28	30	32	33	104	99	98	93	86	78	103	127
Along-flow distance from stack	10	10	8	7	-63	-77	-88	-97	-103	-108	-129	-146
Across-flow distance from stack	-5	-1	3	7	86	83	79	72	62	51	38	24

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	117	104	99	98	93	24	20	22	26	29	162	173
Effective building height	12	12	12	12	12	7	7	7	7	7	12	12
Along-flow building length	147	162	173	178	178	30	28	30	32	33	104	99
Along-flow distance from stack	-159	-167	-170	-167	-160	-37	-38	-39	-40	-40	-41	-22
Across-flow distance from stack	9	-11	-27	-39	-51	9	5	1	-3	-7	-86	-84

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	178	178	172	0	0	136	117	104	99	98	93	24
Effective building height	12	12	12	0	0	12	12	12	12	12	12	7
Along-flow building length	98	93	86	0	0	127	147	162	173	178	178	30
Along-flow distance from stack	-9	4	17	0	0	19	12	5	-3	-10	-18	7
Across-flow distance from stack	-79	-72	-62	0	0	-24	-9	11	27	39	51	-9

(Constant) emission rate = 3.50E-01 grams/second
No gravitational settling or scavenging.

STACK SOURCE: REDRY1

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697076	5910479	720m	7m	0.37m	75C	3.4m/s

_____ Effective building dimensions (in metres) _____

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°

Effective building width 19 7 9 11 12 13 14 14 13 14 15 15
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 14 15 15 15 15 14 13 11 9 7 7 9
Along-flow distance from stack -9 -8 -7 -6 -5 -4 -3 -1 0 1 1 0
Across-flow distance from stack -11 -5 -5 -4 -4 -4 -3 -2 -2 -1 0 0

Flow direction 130° 140° 150° 160° 170° 180° 190° 200° 210° 220° 230° 240°
Effective building width 15 15 14 13 11 9 19 7 9 11 12 13
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 11 12 13 13 13 13 15 15 15 15 15 14
Along-flow distance from stack -1 -2 -3 -4 -5 -5 -6 -7 -8 -9 -10 -10
Across-flow distance from stack 2 2 3 4 4 5 11 5 5 4 4 4

Flow direction 250° 260° 270° 280° 290° 300° 310° 320° 330° 340° 350° 360°
Effective building width 13 14 13 11 13 14 15 15 14 13 11 9
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 13 11 9 12 14 15 11 12 13 13 13 13
Along-flow distance from stack -10 -10 -9 -36 -36 -36 -10 -10 -10 -10 -9 -8
Across-flow distance from stack 3 2 2 2 -3 -9 -1 -2 -3 -4 -4 -5

(Constant) emission rate = 1.60E-02 grams/second
No gravitational settling or scavenging.

STACK SOURCE: REDRY2

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697088	5910476	720m	7m	0.37m	80C	6.6m/s

_____ Effective building dimensions (in metres) _____
Flow direction 10° 20° 30° 40° 50° 60° 70° 80° 90° 100° 110° 120°
Effective building width 7 9 9 11 12 13 14 14 13 11 12 14
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 14 15 15 15 15 14 13 11 9 12 14 15
Along-flow distance from stack -8 -8 -10 -12 -13 -13 -13 -13 -12 11 10 9
Across-flow distance from stack -5 -5 7 7 6 5 4 3 2 -1 2 5

Flow direction 130° 140° 150° 160° 170° 180° 190° 200° 210° 220° 230° 240°
Effective building width 15 15 14 13 11 9 7 9 9 11 12 13
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 11 12 15 13 16 13 15 15 15 15 15 14
Along-flow distance from stack -12 -12 -4 -11 -6 -8 -7 -7 -5 -4 -3 -1
Across-flow distance from stack -4 -5 3 -7 4 -8 5 5 -7 -7 -6 -5

Flow direction 250° 260° 270° 280° 290° 300° 310° 320° 330° 340° 350° 360°
Effective building width 13 14 13 11 13 14 15 15 14 13 11 9
Effective building height 7 7 7 7 7 7 7 7 7 7 7 7
Along-flow building length 13 11 9 12 14 15 11 12 13 13 13 13
Along-flow distance from stack 0 2 3 -24 -24 -24 2 0 -2 -3 -4 -5
Across-flow distance from stack -4 -3 -2 1 -2 -5 4 5 6 7 7 8

(Constant) emission rate = 4.20E-03 grams/second
No gravitational settling or scavenging.

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1 _____

Dongwha - PM2.5 emissions including proposed 15 MW Biomass Boiler

RECEPTOR LOCATIONS

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	696448	5910062	724.0	0.0	10	697853	5911348	727.0	0.0
2	697665	5909658	728.0	0.0	11	696548	5909403	734.0	0.0
3	698048	5909616	723.0	0.0	12	697645	5909068	765.0	0.0
4	697813	5910634	717.0	0.0	13	698603	5909310	730.0	0.0
5	698101	5910697	730.0	0.0	14	698714	5910743	745.0	0.0
6	698060	5910761	732.0	0.0	15	694457	5909078	715.0	0.0
7	697508	5910760	720.0	0.0	16	694684	5908451	725.0	0.0
8	697721	5911116	714.0	0.0	17	697386	5907886	755.0	0.0
9	697986	5911294	725.0	0.0	18	696684	5910696	718.0	0.0

METEOROLOGICAL DATA : Other Dongwha AWS Data SRDT Mtd SydneyAP Uair Z0-0.3

AVERAGE OVER ALL HOURS AND FOR ALL SOURCES
in microgram/m3

Concentrations at the discrete receptors (No. : Value):

1:2.79E-01 2:1.60E-01 3:1.32E-01 4:4.16E-01 5:3.93E-01 6:4.23E-01 7:5.56E-01 8:2.47E-01
9:2.27E-01 10:2.14E-01 11:3.03E-01 12:2.98E-01 13:1.20E-01 14:3.24E-01 15:9.62E-02 16:1.26E-01
17:1.73E-01 18:2.73E-01

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1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 24 HOURS

At the discrete receptors:

1: 1.90E+00 @Hr24,05/01/16
2: 1.32E+00 @Hr24,08/05/16
3: 1.04E+00 @Hr24,29/04/16
4: 1.96E+00 @Hr24,14/07/16
5: 1.93E+00 @Hr24,07/06/16
6: 2.06E+00 @Hr24,07/06/16
7: 2.64E+00 @Hr24,05/10/16
8: 1.66E+00 @Hr24,17/02/16
9: 1.33E+00 @Hr24,17/02/16
10: 1.41E+00 @Hr24,17/02/16
11: 1.42E+00 @Hr24,14/06/16
12: 1.87E+00 @Hr24,08/05/16
13: 9.04E-01 @Hr24,29/04/16
14: 1.63E+00 @Hr24,28/07/16
15: 6.81E-01 @Hr24,13/03/16
16: 6.15E-01 @Hr24,21/05/16
17: 8.90E-01 @Hr24,21/07/16
18: 4.23E+00 @Hr24,06/07/16

NOX WITH 1 HOUR AND ANNUAL AVERAGE

1

Dongwha - NOX as NO2 emissions including proposed 15 MW Biomass Boiler

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Concentration or deposition Concentration
Emission rate units grams/second
Concentration units microgram/m3
Units conversion factor 1.00E+06
Constant background concentration 0.00E+00
Terrain effects Egan method
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
Averaging time for sigma-theta values 60 min.

DISPERSION CURVES
Horizontal dispersion curves for sources <100m high Sigma-theta
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 0.300m
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 Rural" values (unless overridden by met. file)

AVERAGING TIMES
1 hour
average over all hours

1

Dongwha - NOX as NO2 emissions including proposed 15 MW Biomass Boiler

SOURCE CHARACTERISTICS

STACK SOURCE: WFBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697098	5910473	720m	10m	0.40m	219C	27.0m/s

_____ Effective building dimensions (in metres) _____

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	7	9	11	13	14	15	16	14	13	11	12	14
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	14	15	15	15	15	14	13	11	9	12	14	15
Along-flow distance from stack	-7	-9	-9	-10	-11	-11	-11	-22	-22	1	0	-1
Across-flow distance from stack	5	5	5	5	5	4	3	8	5	1	2	3

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	15	15	14	13	11	9	7	9	11	13	14	15
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	11	14	15	15	16	15	15	15	15	15	15	14
Along-flow distance from stack	-22	-12	-11	-11	-10	-9	-8	-7	-6	-5	-4	-3
Across-flow distance from stack	-8	-4	-4	-5	-5	-6	-5	-5	-5	-5	-4	-4

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	16	14	13	11	13	14	15	15	14	13	11	9
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	13	11	9	12	14	15	11	14	15	16	16	15
Along-flow distance from stack	-2	11	13	-13	-14	-14	11	-3	-4	-5	-6	-6
Across-flow distance from stack	-3	-8	-5	-1	-1	-3	9	3	4	5	5	6

(Constant) emission rate = 2.40E-01 grams/second
No gravitational settling or scavenging.

STACK SOURCE: BMBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
696853	5910546	720m	18m	1.10m	210C	18.0m/s

_____ Effective building dimensions (in metres) _____

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	20	22	26	29	162	173	178	178	172	162	151	136
Effective building height	7	7	7	7	12	12	12	12	12	12	12	12
Along-flow building length	28	30	32	33	104	99	98	93	86	78	103	127
Along-flow distance from stack	10	10	8	7	-63	-77	-88	-97	-103	-108	-129	-146
Across-flow distance from stack	-5	-1	3	7	86	83	79	72	62	51	38	24

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	117	104	99	98	93	24	20	22	26	29	162	173
Effective building height	12	12	12	12	12	7	7	7	7	7	12	12
Along-flow building length	147	162	173	178	178	30	28	30	32	33	104	99
Along-flow distance from stack	-159	-167	-170	-167	-160	-37	-38	-39	-40	-40	-41	-22
Across-flow distance from stack	9	-11	-27	-39	-51	9	5	1	-3	-7	-86	-84

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	178	178	172	0	0	136	117	104	99	98	93	24
Effective building height	12	12	12	0	0	12	12	12	12	12	12	7
Along-flow building length	98	93	86	0	0	127	147	162	173	178	178	30
Along-flow distance from stack	-9	4	17	0	0	19	12	5	-3	-10	-18	7
Across-flow distance from stack	-79	-72	-62	0	0	-24	-9	11	27	39	51	-9

(Constant) emission rate = 3.50E+00 grams/second
No gravitational settling or scavenging.

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1 ---

Dongwha - NOX as NO2 emissions including proposed 15 MW Biomass Boiler

RECEPTOR LOCATIONS

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	696448	5910062	724.0	0.0	10	697853	5911348	727.0	0.0
2	697665	5909658	728.0	0.0	11	696548	5909403	734.0	0.0
3	698048	5909616	723.0	0.0	12	697645	5909068	765.0	0.0
4	697813	5910634	717.0	0.0	13	698603	5909310	730.0	0.0
5	698101	5910697	730.0	0.0	14	698714	5910743	745.0	0.0
6	698060	5910761	732.0	0.0	15	694457	5909078	715.0	0.0
7	697508	5910760	720.0	0.0	16	694684	5908451	725.0	0.0
8	697721	5911116	714.0	0.0	17	697386	5907886	755.0	0.0
9	697986	5911294	725.0	0.0	18	696684	5910696	718.0	0.0

METEOROLOGICAL DATA : Other Dongwha AWS Data SRDT Mtd SydneyAP Uair Z0-0.3

AVERAGE OVER ALL HOURS AND FOR ALL SOURCES
in microgram/m3

Concentrations at the discrete receptors (No. : Value):

1:1.03E+00 2:5.07E-01 3:4.79E-01 4:1.67E+00 5:1.73E+00 6:1.92E+00 7:2.62E+00 8:1.40E+00
9:1.29E+00 10:1.17E+00 11:9.94E-01 12:1.18E+00 13:4.85E-01 14:1.55E+00 15:4.68E-01 16:6.03E-01
17:7.81E-01 18:1.07E+00

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1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 1 HOUR

At the discrete receptors:

1: 5.39E+01 @Hr02,15/08/16 10: 5.14E+01 @Hr04,29/06/16
2: 1.70E+01 @Hr04,25/02/16 11: 1.81E+01 @Hr22,27/01/16
3: 1.79E+01 @Hr18,08/06/16 12: 6.04E+01 @Hr03,27/08/16
4: 2.86E+01 @Hr10,07/06/16 13: 1.88E+01 @Hr03,04/03/16
5: 3.32E+01 @Hr19,14/05/16 14: 4.56E+01 @Hr02,20/03/16
6: 3.58E+01 @Hr19,28/08/16 15: 2.38E+01 @Hr22,15/04/16
7: 4.59E+01 @Hr08,05/12/16 16: 3.21E+01 @Hr02,15/08/16
8: 3.95E+01 @Hr04,29/06/16 17: 4.02E+01 @Hr04,12/12/16
9: 4.99E+01 @Hr04,29/06/16 18: 1.64E+02 @Hr15,14/02/16

CO WITH 1 HOUR AND 8 HOUR AVERAGES

1 ---

Dongwha - CO emissions including proposed 15 MW Biomass Boiler

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Concentration or deposition Concentration
Emission rate units grams/second
Concentration units microgram/m3
Units conversion factor 1.00E+06
Constant background concentration 0.00E+00
Terrain effects Egan method
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
Averaging time for sigma-theta values 60 min.

DISPERSION CURVES
Horizontal dispersion curves for sources <100m high Sigma-theta
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 0.300m
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 Rural" values (unless overridden by met. file)

AVERAGING TIMES

1 hour
8 hours

1

Dongwha - CO emissions including proposed 15 MW Biomass Boiler

SOURCE CHARACTERISTICS

STACK SOURCE: WFBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697098	5910473	720m	10m	0.40m	219C	27.0m/s

Effective building dimensions (in metres)

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	7	9	11	13	14	15	16	14	13	11	12	14
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	14	15	15	15	15	14	13	11	9	12	14	15
Along-flow distance from stack	-7	-9	-9	-10	-11	-11	-11	-22	-22	1	0	-1
Across-flow distance from stack	5	5	5	5	5	4	3	8	5	1	2	3

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	15	15	14	13	11	9	7	9	11	13	14	15
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	11	14	15	15	16	15	15	15	15	15	15	14
Along-flow distance from stack	-22	-12	-11	-11	-10	-9	-8	-7	-6	-5	-4	-3
Across-flow distance from stack	-8	-4	-4	-5	-5	-6	-5	-5	-5	-5	-4	-4

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	16	14	13	11	13	14	15	15	14	13	11	9
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	13	11	9	12	14	15	11	14	15	16	16	15
Along-flow distance from stack	-2	11	13	-13	-14	-14	11	-3	-4	-5	-6	-6
Across-flow distance from stack	-3	-8	-5	-1	-1	-3	9	3	4	5	5	6

(Constant) emission rate = 9.80E-01 grams/second
No gravitational settling or scavenging.

STACK SOURCE: BMBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
696853	5910546	720m	18m	1.10m	210C	18.0m/s

Effective building dimensions (in metres)

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	20	22	26	29	162	173	178	178	172	162	151	136
Effective building height	7	7	7	7	12	12	12	12	12	12	12	12
Along-flow building length	28	30	32	33	104	99	98	93	86	78	103	127
Along-flow distance from stack	10	10	8	7	-63	-77	-88	-97	-103	-108	-129	-146
Across-flow distance from stack	-5	-1	3	7	86	83	79	72	62	51	38	24

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	117	104	99	98	93	24	20	22	26	29	162	173
Effective building height	12	12	12	12	12	7	7	7	7	7	12	12
Along-flow building length	147	162	173	178	178	30	28	30	32	33	104	99
Along-flow distance from stack	-159	-167	-170	-167	-160	-37	-38	-39	-40	-40	-41	-22
Across-flow distance from stack	9	-11	-27	-39	-51	9	5	1	-3	-7	-86	-84

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	178	178	172	0	0	136	117	104	99	98	93	24
Effective building height	12	12	12	0	0	12	12	12	12	12	12	7
Along-flow building length	98	93	86	0	0	127	147	162	173	178	178	30
Along-flow distance from stack	-9	4	17	0	0	19	12	5	-3	-10	-18	7
Across-flow distance from stack	-79	-72	-62	0	0	-24	-9	11	27	39	51	-9

(Constant) emission rate = 5.60E-02 grams/second
No gravitational settling or scavenging.

1

Dongwha - CO emissions including proposed 15 MW Biomass Boiler

RECEPTOR LOCATIONS

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	696448	5910062	724.0	0.0	10	697853	5911348	727.0	0.0
2	697665	5909658	728.0	0.0	11	696548	5909403	734.0	0.0
3	698048	5909616	723.0	0.0	12	697645	5909068	765.0	0.0

4	697813	5910634	717.0	0.0	13	698603	5909310	730.0	0.0
5	698101	5910697	730.0	0.0	14	698714	5910743	745.0	0.0
6	698060	5910761	732.0	0.0	15	694457	5909078	715.0	0.0
7	697508	5910760	720.0	0.0	16	694684	5908451	725.0	0.0
8	697721	5911116	714.0	0.0	17	697386	5907886	755.0	0.0
9	697986	5911294	725.0	0.0	18	696684	5910696	718.0	0.0

METEOROLOGICAL DATA : Other Dongwha AWS Data SRDT Mtd SydneyAP Uair Z0-0.3

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1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 1 HOUR

At the discrete receptors:

1: 3.04E+01 @Hr21,03/06/16
2: 2.25E+01 @Hr02,21/10/16
3: 1.83E+01 @Hr02,21/11/16
4: 3.00E+01 @Hr21,10/10/16
5: 4.10E+01 @Hr23,07/06/16
6: 4.34E+01 @Hr24,27/05/16
7: 3.93E+01 @Hr17,12/08/16
8: 1.81E+01 @Hr05,23/01/16
9: 2.36E+01 @Hr01,26/03/16
10: 2.19E+01 @Hr03,25/08/16
11: 3.95E+01 @Hr06,03/07/16
12: 5.57E+01 @Hr02,14/04/16
13: 1.85E+01 @Hr03,04/03/16
14: 4.66E+01 @Hr19,28/08/16
15: 1.50E+01 @Hr18,26/06/16
16: 1.78E+01 @Hr23,14/04/16
17: 2.36E+01 @Hr02,21/07/16
18: 3.21E+01 @Hr20,17/12/16

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1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 8 HOURS

At the discrete receptors:

1: 9.90E+00 @Hr24,26/01/16
2: 9.95E+00 @Hr08,31/08/16
3: 8.72E+00 @Hr24,29/04/16
4: 1.31E+01 @Hr08,17/05/16
5: 1.50E+01 @Hr08,12/04/16
6: 1.58E+01 @Hr08,28/05/16
7: 2.03E+01 @Hr08,17/02/16
8: 9.24E+00 @Hr08,15/01/16
9: 9.41E+00 @Hr08,15/07/16
10: 8.93E+00 @Hr08,03/04/16
11: 1.60E+01 @Hr08,14/06/16
12: 1.96E+01 @Hr08,13/06/16
13: 7.26E+00 @Hr24,29/04/16
14: 1.40E+01 @Hr08,20/03/16
15: 4.24E+00 @Hr08,13/03/16
16: 6.40E+00 @Hr24,21/05/16
17: 9.34E+00 @Hr08,21/07/16
18: 2.52E+01 @Hr24,06/07/16

CO WITH 15 MINUTE AVERAGE

1 ---

Dongwha - CO emissions including proposed 15 MW Biomass Boiler

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Concentration or deposition Concentration
Emission rate units grams/second
Concentration units microgram/m3
Units conversion factor 1.00E+06
Constant background concentration 0.00E+00
Terrain effects Egan method
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 0.300m
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 Rural" values (unless overridden by met. file)

AVERAGING TIME: 15 minutes.

1

Dongwha - CO emissions including proposed 15 MW Biomass Boiler

SOURCE CHARACTERISTICS

STACK SOURCE: WFBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697098	5910473	720m	10m	0.40m	219C	27.0m/s

Effective building dimensions (in metres)

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	7	9	11	13	14	15	16	14	13	11	12	14
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	14	15	15	15	15	14	13	11	9	12	14	15
Along-flow distance from stack	-7	-9	-9	-10	-11	-11	-11	-22	-22	1	0	-1
Across-flow distance from stack	5	5	5	5	5	4	3	8	5	1	2	3

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	15	15	14	13	11	9	7	9	11	13	14	15
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	11	14	15	15	16	15	15	15	15	15	15	14
Along-flow distance from stack	-22	-12	-11	-11	-10	-9	-8	-7	-6	-5	-4	-3
Across-flow distance from stack	-8	-4	-4	-5	-5	-6	-5	-5	-5	-5	-4	-4

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	16	14	13	11	13	14	15	15	14	13	11	9
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	13	11	9	12	14	15	11	14	15	16	16	15
Along-flow distance from stack	-2	11	13	-13	-14	-14	11	-3	-4	-5	-6	-6
Across-flow distance from stack	-3	-8	-5	-1	-1	-3	9	3	4	5	5	6

(Constant) emission rate = 9.80E-01 grams/second
No gravitational settling or scavenging.

STACK SOURCE: BMBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
696853	5910546	720m	18m	1.10m	210C	18.0m/s

Effective building dimensions (in metres)

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	20	22	26	29	162	173	178	178	172	162	151	136
Effective building height	7	7	7	7	12	12	12	12	12	12	12	12
Along-flow building length	28	30	32	33	104	99	98	93	86	78	103	127
Along-flow distance from stack	10	10	8	7	-63	-77	-88	-97	-103	-108	-129	-146
Across-flow distance from stack	-5	-1	3	7	86	83	79	72	62	51	38	24

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	117	104	99	98	93	24	20	22	26	29	162	173
Effective building height	12	12	12	12	12	7	7	7	7	7	12	12
Along-flow building length	147	162	173	178	178	30	28	30	32	33	104	99
Along-flow distance from stack	-159	-167	-170	-167	-160	-37	-38	-39	-40	-40	-41	-22
Across-flow distance from stack	9	-11	-27	-39	-51	9	5	1	-3	-7	-86	-84

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	178	178	172	0	0	136	117	104	99	98	93	24
Effective building height	12	12	12	0	0	12	12	12	12	12	12	7
Along-flow building length	98	93	86	0	0	127	147	162	173	178	178	30
Along-flow distance from stack	-9	4	17	0	0	19	12	5	-3	-10	-18	7
Across-flow distance from stack	-79	-72	-62	0	0	-24	-9	11	27	39	51	-9

(Constant) emission rate = 5.60E-02 grams/second
No gravitational settling or scavenging.

1

Dongwha - CO emissions including proposed 15 MW Biomass Boiler

RECEPTOR LOCATIONS

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	696448	5910062	724.0	0.0	10	697853	5911348	727.0	0.0
2	697665	5909658	728.0	0.0	11	696548	5909403	734.0	0.0
3	698048	5909616	723.0	0.0	12	697645	5909068	765.0	0.0
4	697813	5910634	717.0	0.0	13	698603	5909310	730.0	0.0
5	698101	5910697	730.0	0.0	14	698714	5910743	745.0	0.0
6	698060	5910761	732.0	0.0	15	694457	5909078	715.0	0.0
7	697508	5910760	720.0	0.0	16	694684	5908451	725.0	0.0
8	697721	5911116	714.0	0.0	17	697386	5907886	755.0	0.0
9	697986	5911294	725.0	0.0	18	696684	5910696	718.0	0.0

METEOROLOGICAL DATA : Other Dongwha AWS Data SRDT Mtd SydneyAP Uair Z0-0.3

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1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 15 MINUTES

At the discrete receptors:

1: 3.80E+01 @Hr19,07/08/16
2: 4.83E+01 @Hr02,09/05/16
3: 3.55E+01 @Hr02,21/11/16
4: 3.14E+01 @Hr01,07/11/16
5: 5.51E+01 @Hr23,07/06/16
6: 5.85E+01 @Hr19,10/08/16
7: 3.05E+01 @Hr03,17/02/16
8: 2.07E+01 @Hr03,12/06/16
9: 3.89E+01 @Hr04,30/03/16
10: 4.38E+01 @Hr03,27/03/16
11: 5.77E+01 @Hr04,30/08/16
12: 1.80E+02 @Hr02,02/03/16
13: 4.93E+01 @Hr04,20/10/16
14: 8.53E+01 @Hr06,15/05/16
15: 2.73E+01 @Hr04,28/09/16
16: 3.60E+01 @Hr24,05/03/16
17: 7.96E+01 @Hr19,16/05/16
18: 3.40E+01 @Hr17,07/03/16

SO2 WITH 1 HOUR, 24 HOUR AND ANNUAL AVERAGE

1

Dongwha - SO2 emissions including proposed 15 MW Biomass Boiler

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Concentration or deposition Concentration
Emission rate units grams/second
Concentration units microgram/m3
Units conversion factor 1.00E+06
Constant background concentration 0.00E+00
Terrain effects Egan method
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
Averaging time for sigma-theta values 60 min.

DISPERSION CURVES
Horizontal dispersion curves for sources <100m high Sigma-theta
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 0.300m
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 Rural" values (unless overridden by met. file)

AVERAGING TIMES
1 hour
24 hours
average over all hours

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1 ---

Dongwha - SO2 emissions including proposed 15 MW Biomass Boiler

SOURCE CHARACTERISTICS

STACK SOURCE: WFBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697098	5910473	720m	10m	0.40m	219C	27.0m/s

_____ Effective building dimensions (in metres) _____

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	7	9	11	13	14	15	16	14	13	11	12	14
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	14	15	15	15	15	14	13	11	9	12	14	15
Along-flow distance from stack	-7	-9	-9	-10	-11	-11	-11	-22	-22	1	0	-1
Across-flow distance from stack	5	5	5	5	5	4	3	8	5	1	2	3

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	15	15	14	13	11	9	7	9	11	13	14	15
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	11	14	15	15	16	15	15	15	15	15	15	14
Along-flow distance from stack	-22	-12	-11	-11	-10	-9	-8	-7	-6	-5	-4	-3
Across-flow distance from stack	-8	-4	-4	-5	-5	-6	-5	-5	-5	-5	-4	-4

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	16	14	13	11	13	14	15	15	14	13	11	9
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	13	11	9	12	14	15	11	14	15	16	16	15
Along-flow distance from stack	-2	11	13	-13	-14	-14	11	-3	-4	-5	-6	-6
Across-flow distance from stack	-3	-8	-5	-1	-1	-3	9	3	4	5	5	6

(Constant) emission rate = 2.70E-02 grams/second
No gravitational settling or scavenging.

STACK SOURCE: BMBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
696853	5910546	720m	18m	1.10m	210C	18.0m/s

_____ Effective building dimensions (in metres) _____

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	20	22	26	29	162	173	178	178	172	162	151	136
Effective building height	7	7	7	7	12	12	12	12	12	12	12	12
Along-flow building length	28	30	32	33	104	99	98	93	86	78	103	127
Along-flow distance from stack	10	10	8	7	-63	-77	-88	-97	-103	-108	-129	-146
Across-flow distance from stack	-5	-1	3	7	86	83	79	72	62	51	38	24

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	117	104	99	98	93	24	20	22	26	29	162	173
Effective building height	12	12	12	12	12	7	7	7	7	7	12	12
Along-flow building length	147	162	173	178	178	30	28	30	32	33	104	99
Along-flow distance from stack	-159	-167	-170	-167	-160	-37	-38	-39	-40	-40	-41	-22
Across-flow distance from stack	9	-11	-27	-39	-51	9	5	1	-3	-7	-86	-84

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	178	178	172	0	0	136	117	104	99	98	93	24
Effective building height	12	12	12	0	0	12	12	12	12	12	12	7
Along-flow building length	98	93	86	0	0	127	147	162	173	178	178	30
Along-flow distance from stack	-9	4	17	0	0	19	12	5	-3	-10	-18	7
Across-flow distance from stack	-79	-72	-62	0	0	-24	-9	11	27	39	51	-9

(Constant) emission rate = 1.50E-01 grams/second
No gravitational settling or scavenging.

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1 ---

Dongwha - SO2 emissions including proposed 15 MW Biomass Boiler

RECEPTOR LOCATIONS

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	696448	5910062	724.0	0.0	10	697853	5911348	727.0	0.0
2	697665	5909658	728.0	0.0	11	696548	5909403	734.0	0.0
3	698048	5909616	723.0	0.0	12	697645	5909068	765.0	0.0
4	697813	5910634	717.0	0.0	13	698603	5909310	730.0	0.0
5	698101	5910697	730.0	0.0	14	698714	5910743	745.0	0.0
6	698060	5910761	732.0	0.0	15	694457	5909078	715.0	0.0
7	697508	5910760	720.0	0.0	16	694684	5908451	725.0	0.0
8	697721	5911116	714.0	0.0	17	697386	5907886	755.0	0.0
9	697986	5911294	725.0	0.0	18	696684	5910696	718.0	0.0

METEOROLOGICAL DATA : Other Dongwha AWS Data SRDT Mtd SydneyAP Uair Z0-0.3

AVERAGE OVER ALL HOURS AND FOR ALL SOURCES
in microgram/m3

Concentrations at the discrete receptors (No. : Value):

1:5.57E-02 2:3.04E-02 3:2.82E-02 4:9.65E-02 5:9.82E-02 6:1.08E-01 7:1.40E-01 8:7.11E-02
9:6.60E-02 10:6.08E-02 11:6.34E-02 12:7.35E-02 13:2.87E-02 14:8.75E-02 15:2.57E-02 16:3.37E-02
17:4.57E-02 18:5.94E-02

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1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 1 HOUR

At the discrete receptors:

1: 2.36E+00 @Hr02,15/08/16 10: 2.25E+00 @Hr04,29/06/16
2: 1.03E+00 @Hr02,21/10/16 11: 1.13E+00 @Hr22,03/07/16
3: 1.02E+00 @Hr18,08/06/16 12: 3.32E+00 @Hr02,14/04/16
4: 1.48E+00 @Hr10,26/06/16 13: 1.12E+00 @Hr03,04/03/16
5: 1.97E+00 @Hr03,12/04/16 14: 2.70E+00 @Hr19,28/08/16
6: 1.96E+00 @Hr22,14/09/16 15: 1.26E+00 @Hr22,15/04/16
7: 2.05E+00 @Hr08,05/12/16 16: 1.58E+00 @Hr02,15/08/16
8: 1.73E+00 @Hr04,29/06/16 17: 1.94E+00 @Hr04,12/12/16
9: 2.36E+00 @Hr04,29/06/16 18: 7.12E+00 @Hr15,14/02/16

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1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 24 HOURS

At the discrete receptors:

1: 5.46E-01 @Hr24,05/01/16 10: 4.47E-01 @Hr24,17/02/16
2: 3.34E-01 @Hr24,09/09/16 11: 3.72E-01 @Hr24,13/09/16
3: 3.23E-01 @Hr24,19/08/16 12: 5.49E-01 @Hr24,08/05/16
4: 4.83E-01 @Hr24,11/05/16 13: 2.35E-01 @Hr24,19/08/16
5: 4.72E-01 @Hr24,28/07/16 14: 4.54E-01 @Hr24,28/07/16
6: 5.40E-01 @Hr24,14/07/16 15: 1.87E-01 @Hr24,13/03/16
7: 9.02E-01 @Hr24,11/05/16 16: 1.66E-01 @Hr24,21/05/16
8: 4.86E-01 @Hr24,17/02/16 17: 2.45E-01 @Hr24,20/01/16
9: 4.06E-01 @Hr24,17/02/16 18: 1.37E+00 @Hr24,04/02/16

SO2 WITH 10 MINUTE AVERAGE

1 ---

Dongwha - SO2 emissions including proposed 15 MW Biomass Boiler

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Concentration or deposition	Concentration
Emission rate units	grams/second
Concentration units	microgram/m3
Units conversion factor	1.00E+06
Constant background concentration	0.00E+00
Terrain effects	Egan method
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 0.300m
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 Rural" values (unless overridden by met. file)

AVERAGING TIME: 10 minutes.

1

Dongwha - SO2 emissions including proposed 15 MW Biomass Boiler

SOURCE CHARACTERISTICS

STACK SOURCE: WFBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697098	5910473	720m	10m	0.40m	219C	27.0m/s

Effective building dimensions (in metres)

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	7	9	11	13	14	15	16	14	13	11	12	14
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	14	15	15	15	15	14	13	11	9	12	14	15
Along-flow distance from stack	-7	-9	-9	-10	-11	-11	-11	-22	-22	1	0	-1
Across-flow distance from stack	5	5	5	5	5	4	3	8	5	1	2	3

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	15	15	14	13	11	9	7	9	11	13	14	15
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	11	14	15	15	16	15	15	15	15	15	15	14
Along-flow distance from stack	-22	-12	-11	-11	-10	-9	-8	-7	-6	-5	-4	-3
Across-flow distance from stack	-8	-4	-4	-5	-5	-6	-5	-5	-5	-5	-4	-4

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	16	14	13	11	13	14	15	15	14	13	11	9
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	13	11	9	12	14	15	11	14	15	16	16	15
Along-flow distance from stack	-2	11	13	-13	-14	-14	11	-3	-4	-5	-6	-6
Across-flow distance from stack	-3	-8	-5	-1	-1	-3	9	3	4	5	5	6

(Constant) emission rate = 2.70E-02 grams/second
No gravitational settling or scavenging.

STACK SOURCE: BMBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
696853	5910546	720m	18m	1.10m	210C	18.0m/s

Effective building dimensions (in metres)

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	20	22	26	29	162	173	178	178	172	162	151	136
Effective building height	7	7	7	7	12	12	12	12	12	12	12	12
Along-flow building length	28	30	32	33	104	99	98	93	86	78	103	127
Along-flow distance from stack	10	10	8	7	-63	-77	-88	-97	-103	-108	-129	-146
Across-flow distance from stack	-5	-1	3	7	86	83	79	72	62	51	38	24

Flow direction 130° 140° 150° 160° 170° 180° 190° 200° 210° 220° 230° 240°
Effective building width 117 104 99 98 93 24 20 22 26 29 162 173
Effective building height 12 12 12 12 12 7 7 7 7 7 12 12
Along-flow building length 147 162 173 178 178 30 28 30 32 33 104 99
Along-flow distance from stack -159 -167 -170 -167 -160 -37 -38 -39 -40 -40 -41 -22
Across-flow distance from stack 9 -11 -27 -39 -51 9 5 1 -3 -7 -86 -84

Flow direction 250° 260° 270° 280° 290° 300° 310° 320° 330° 340° 350° 360°
Effective building width 178 178 172 0 0 136 117 104 99 98 93 24
Effective building height 12 12 12 0 0 12 12 12 12 12 12 7
Along-flow building length 98 93 86 0 0 127 147 162 173 178 178 30
Along-flow distance from stack -9 4 17 0 0 19 12 5 -3 -10 -18 7
Across-flow distance from stack -79 -72 -62 0 0 -24 -9 11 27 39 51 -9

(Constant) emission rate = 1.50E-01 grams/second
No gravitational settling or scavenging.

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1 ---

Dongwha - SO2 emissions including proposed 15 MW Biomass Boiler

RECEPTOR LOCATIONS

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	696448	5910062	724.0	0.0	10	697853	5911348	727.0	0.0
2	697665	5909658	728.0	0.0	11	696548	5909403	734.0	0.0
3	698048	5909616	723.0	0.0	12	697645	5909068	765.0	0.0
4	697813	5910634	717.0	0.0	13	698603	5909310	730.0	0.0
5	698101	5910697	730.0	0.0	14	698714	5910743	745.0	0.0
6	698060	5910761	732.0	0.0	15	694457	5909078	715.0	0.0
7	697508	5910760	720.0	0.0	16	694684	5908451	725.0	0.0
8	697721	5911116	714.0	0.0	17	697386	5907886	755.0	0.0
9	697986	5911294	725.0	0.0	18	696684	5910696	718.0	0.0

METEOROLOGICAL DATA : Other Dongwha AWS Data SRDT Mtd SydneyAP Uair Z0-0.3

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1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 10 MINUTES

At the discrete receptors:

1: 2.29E+00 @Hr22,17/01/16
2: 1.61E+00 @Hr03,30/10/16
3: 1.62E+00 @Hr04,07/03/16
4: 1.32E+00 @Hr19,27/08/16
5: 2.45E+00 @Hr23,07/06/16
6: 2.80E+00 @Hr06,07/08/16
7: 2.59E+00 @Hr04,27/11/16
8: 2.48E+00 @Hr02,03/11/16
9: 3.23E+00 @Hr02,03/11/16
10: 3.49E+00 @Hr18,17/06/16
11: 1.73E+00 @Hr04,30/08/16
12: 6.77E+00 @Hr05,21/04/16
13: 2.72E+00 @Hr01,22/02/16
14: 4.74E+00 @Hr01,14/01/16
15: 1.65E+00 @Hr22,13/04/16
16: 2.16E+00 @Hr20,05/02/16
17: 4.41E+00 @Hr05,29/08/16
18: 4.46E+00 @Hr17,17/12/16

DIOXINS AND FURANS with emission rates x 1e-10

1 ---

Dongwha - Dioxins & Furans emissions, Emission rates x 1e-10

Concentration or deposition Concentration
Emission rate units grams/second
Concentration units microgram/m3
Units conversion factor 1.00E+06
Constant background concentration 0.00E+00
Terrain effects Egan method
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
Averaging time for sigma-theta values 60 min.

DISPERSION CURVES
Horizontal dispersion curves for sources <100m high Sigma-theta
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 0.300m
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 Rural" values (unless overridden by met. file)

AVERAGING TIMES
1 hour

1

Dongwha - Dioxins & Furans emissions, Emission rates x 1e-10

SOURCE CHARACTERISTICS

STACK SOURCE: WFBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
697098	5910473	720m	10m	0.40m	219C	27.0m/s

Effective building dimensions (in metres)

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	7	9	11	13	14	15	16	14	13	11	12	14
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	14	15	15	15	15	15	14	13	11	9	12	14	15
Along-flow distance from stack	-7	-9	-9	-10	-11	-11	-11	-22	-22	1	0	-1
Across-flow distance from stack	5	5	5	5	5	4	3	8	5	1	2	3

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	15	15	14	13	11	9	7	9	11	13	14	15
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	11	14	15	15	16	15	15	15	15	15	15	14
Along-flow distance from stack	-22	-12	-11	-11	-10	-9	-8	-7	-6	-5	-4	-3
Across-flow distance from stack	-8	-4	-4	-5	-5	-6	-5	-5	-5	-5	-4	-4

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	16	14	13	11	13	14	15	15	14	13	11	9
Effective building height	7	7	7	7	7	7	7	7	7	7	7	7
Along-flow building length	13	11	9	12	14	15	11	14	15	16	16	15
Along-flow distance from stack	-2	11	13	-13	-14	-14	11	-3	-4	-5	-6	-6
Across-flow distance from stack	-3	-8	-5	-1	-1	-3	9	3	4	5	5	6

(Constant) emission rate = 1.50E+00 grams/second
No gravitational settling or scavenging.

STACK SOURCE: BMBOIL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
696853	5910546	720m	18m	1.10m	210C	18.0m/s

Effective building dimensions (in metres)

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	20	22	26	29	162	173	178	178	172	162	151	136
Effective building height	7	7	7	7	12	12	12	12	12	12	12	12
Along-flow building length	28	30	32	33	104	99	98	93	86	78	103	127
Along-flow distance from stack	10	10	8	7	-63	-77	-88	-97	-103	-108	-129	-146
Across-flow distance from stack	-5	-1	3	7	86	83	79	72	62	51	38	24

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	117	104	99	98	93	24	20	22	26	29	162	173
Effective building height	12	12	12	12	12	7	7	7	7	7	12	12

Along-flow building length 147 162 173 178 178 30 28 30 32 33 104 99
Along-flow distance from stack -159 -167 -170 -167 -160 -37 -38 -39 -40 -40 -41 -22
Across-flow distance from stack 9 -11 -27 -39 -51 9 5 1 -3 -7 -86 -84

Flow direction 250° 260° 270° 280° 290° 300° 310° 320° 330° 340° 350° 360°
Effective building width 178 178 172 0 0 136 117 104 99 98 93 24
Effective building height 12 12 12 0 0 12 12 12 12 12 12 7
Along-flow building length 98 93 86 0 0 127 147 162 173 178 178 30
Along-flow distance from stack -9 4 17 0 0 19 12 5 -3 -10 -18 7
Across-flow distance from stack -79 -72 -62 0 0 -24 -9 11 27 39 51 -9

(Constant) emission rate = 6.90E+00 grams/second
No gravitational settling or scavenging.

1

Dongwha - Dioxins & Furans emissions, Emission rates x 1e-10

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
694444.m 694494.m 694544.m 694594.m 694644.m 694694.m 694744.m
694794.m 694844.m 694894.m 694944.m 694994.m 695044.m 695094.m
695144.m 695194.m 695244.m 695294.m 695344.m 695394.m 695444.m
695494.m 695544.m 695594.m 695644.m 695694.m 695744.m 695794.m
695844.m 695894.m 695944.m 695994.m 696044.m 696094.m 696144.m
696194.m 696244.m 696294.m 696344.m 696394.m 696444.m 696494.m
696544.m 696594.m 696644.m 696694.m 696744.m 696794.m 696844.m
696894.m 696944.m 696994.m 697044.m 697094.m 697144.m 697194.m
697244.m 697294.m 697344.m 697394.m 697444.m 697494.m 697544.m
697594.m 697644.m 697694.m 697744.m 697794.m 697844.m 697894.m
697944.m 697994.m 698044.m 698094.m 698144.m 698194.m 698244.m
698294.m 698344.m 698394.m 698444.m 698494.m 698544.m 698594.m
698644.m 698694.m 698744.m 698794.m 698844.m 698894.m 698944.m
698994.m 699044.m 699094.m 699144.m 699194.m 699244.m 699294.m
699344.m 699394.m 699444.m

and these y-values (or northings):
5907882.m 5907932.m 5907982.m 5908032.m 5908082.m 5908132.m 5908182.m
5908232.m 5908282.m 5908332.m 5908382.m 5908432.m 5908482.m 5908532.m
5908582.m 5908632.m 5908682.m 5908732.m 5908782.m 5908832.m 5908882.m
5908932.m 5908982.m 5909032.m 5909082.m 5909132.m 5909182.m 5909232.m
5909282.m 5909332.m 5909382.m 5909432.m 5909482.m 5909532.m 5909582.m
5909632.m 5909682.m 5909732.m 5909782.m 5909832.m 5909882.m 5909932.m
5909982.m 5910032.m 5910082.m 5910132.m 5910182.m 5910232.m 5910282.m
5910332.m 5910382.m 5910432.m 5910482.m 5910532.m 5910582.m 5910632.m
5910682.m 5910732.m 5910782.m 5910832.m 5910882.m 5910932.m 5910982.m
5911032.m 5911082.m 5911132.m 5911182.m 5911232.m 5911282.m 5911332.m
5911382.m 5911432.m 5911482.m 5911532.m 5911582.m 5911632.m 5911682.m
5911732.m 5911782.m 5911832.m 5911882.m 5911932.m 5911982.m 5912032.m
5912082.m 5912132.m 5912182.m 5912232.m 5912282.m 5912332.m 5912382.m
5912432.m 5912482.m 5912532.m 5912582.m 5912632.m 5912682.m 5912732.m
5912782.m 5912832.m 5912882.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	696448	5910062	724.0	0.0	10	697853	5911348	727.0	0.0
2	697665	5909658	728.0	0.0	11	696548	5909403	734.0	0.0
3	698048	5909616	723.0	0.0	12	697645	5909068	765.0	0.0
4	697813	5910634	717.0	0.0	13	698603	5909310	730.0	0.0
5	698101	5910697	730.0	0.0	14	698714	5910743	745.0	0.0
6	698060	5910761	732.0	0.0	15	694457	5909078	715.0	0.0
7	697508	5910760	720.0	0.0	16	694684	5908451	725.0	0.0
8	697721	5911116	714.0	0.0	17	697386	5907886	755.0	0.0
9	697986	5911294	725.0	0.0	18	696684	5910696	718.0	0.0

METEOROLOGICAL DATA : Other Dongwha AWS Data SRDT Mtd SydneyAP Uair Z0-0.3

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1 Peak values for the 100 worst cases (in microgram/m3)
Averaging time = 1 hour

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)
1	5.40E+02	16,05/03/16	(696744, 5910532, 0.0)
2	5.09E+02	19,17/12/16	(696694, 5910632, 0.0)
3	5.07E+02	21,06/07/16	(696694, 5910632, 0.0)
4	5.06E+02	12,14/01/16	(696694, 5910632, 0.0)
5	4.87E+02	18,17/12/16	(696694, 5910632, 0.0)
6	4.78E+02	17,07/11/16	(697194, 5910532, 0.0)
7	4.73E+02	24,06/07/16	(696694, 5910632, 0.0)
8	4.62E+02	16,29/03/16	(696744, 5910532, 0.0)
9	4.59E+02	17,14/05/16	(697194, 5910532, 0.0)
10	4.57E+02	15,18/11/16	(697194, 5910532, 0.0)

11	4.53E+02	16,24/01/16	(696744, 5910532,	0.0)
12	4.47E+02	14,18/11/16	(697194, 5910532,	0.0)
13	4.43E+02	02,07/07/16	(696694, 5910632,	0.0)
14	4.39E+02	14,29/03/16	(696744, 5910532,	0.0)
15	4.36E+02	15,20/08/16	(697194, 5910532,	0.0)
16	4.36E+02	18,19/02/16	(696744, 5910532,	0.0)
17	4.33E+02	13,31/07/16	(697194, 5910532,	0.0)
18	4.32E+02	16,21/11/16	(697194, 5910532,	0.0)
19	4.31E+02	11,13/07/16	(697194, 5910532,	0.0)
20	4.30E+02	15,25/01/16	(696744, 5910532,	0.0)
21	4.30E+02	14,15/09/16	(697194, 5910532,	0.0)
22	4.28E+02	16,13/11/16	(697194, 5910532,	0.0)
23	4.26E+02	17,10/10/16	(697194, 5910532,	0.0)
24	4.25E+02	14,14/02/16	(696694, 5910632,	0.0)
25	4.24E+02	16,18/10/16	(697194, 5910532,	0.0)
26	4.24E+02	16,14/02/16	(696694, 5910632,	0.0)
27	4.23E+02	17,01/11/16	(697194, 5910532,	0.0)
28	4.23E+02	17,01/05/16	(697194, 5910532,	0.0)
29	4.21E+02	19,10/10/16	(697194, 5910532,	0.0)
30	4.17E+02	15,14/02/16	(696694, 5910682,	0.0)
31	4.13E+02	19,06/07/16	(696694, 5910632,	0.0)
32	4.11E+02	16,06/07/16	(696694, 5910632,	0.0)
33	4.11E+02	16,20/08/16	(697194, 5910532,	0.0)
34	4.10E+02	14,18/12/16	(696794, 5910732,	0.0)
35	4.08E+02	15,04/11/16	(697194, 5910532,	0.0)
36	4.08E+02	09,06/10/16	(697194, 5910532,	0.0)
37	4.06E+02	12,13/12/16	(697194, 5910532,	0.0)
38	4.05E+02	20,06/07/16	(696694, 5910632,	0.0)
39	4.04E+02	13,28/08/16	(697194, 5910532,	0.0)
40	4.03E+02	16,07/03/16	(696694, 5910632,	0.0)
41	4.01E+02	14,28/02/16	(696694, 5910632,	0.0)
42	4.01E+02	08,21/06/16	(697194, 5910532,	0.0)
43	3.99E+02	17,14/02/16	(696694, 5910632,	0.0)
44	3.98E+02	16,09/01/16	(696694, 5910682,	0.0)
45	3.98E+02	15,01/11/16	(697194, 5910532,	0.0)
46	3.98E+02	14,06/07/16	(696694, 5910632,	0.0)
47	3.98E+02	17,10/11/16	(696694, 5910632,	0.0)
48	3.97E+02	17,06/07/16	(696694, 5910632,	0.0)
49	3.95E+02	16,02/12/16	(696694, 5910632,	0.0)
50	3.94E+02	11,23/07/16	(697194, 5910532,	0.0)
51	3.91E+02	13,03/01/16	(696744, 5910532,	0.0)
52	3.88E+02	16,13/12/16	(697194, 5910532,	0.0)
53	3.88E+02	08,31/10/16	(697194, 5910532,	0.0)
54	3.87E+02	11,14/12/16	(697194, 5910532,	0.0)
55	3.87E+02	10,21/06/16	(697194, 5910532,	0.0)
56	3.86E+02	13,28/02/16	(696694, 5910632,	0.0)
57	3.83E+02	18,21/08/16	(697194, 5910532,	0.0)
58	3.82E+02	17,27/03/16	(696694, 5910632,	0.0)
59	3.80E+02	16,26/02/16	(696744, 5910532,	0.0)
60	3.80E+02	18,10/10/16	(697194, 5910532,	0.0)
61	3.78E+02	11,10/09/16	(696744, 5910682,	0.0)
62	3.78E+02	15,26/02/16	(696744, 5910532,	0.0)
63	3.78E+02	15,28/02/16	(696694, 5910682,	0.0)
64	3.78E+02	16,28/02/16	(696694, 5910632,	0.0)
65	3.77E+02	18,04/02/16	(696694, 5910632,	0.0)
66	3.76E+02	14,10/05/16	(697194, 5910532,	0.0)
67	3.76E+02	16,03/01/16	(696744, 5910532,	0.0)
68	3.75E+02	15,04/01/16	(696744, 5910532,	0.0)
69	3.74E+02	05,23/07/16	(697194, 5910532,	0.0)
70	3.74E+02	16,05/10/16	(697194, 5910532,	0.0)
71	3.73E+02	14,23/10/16	(696744, 5910682,	0.0)
72	3.73E+02	19,04/02/16	(696694, 5910632,	0.0)
73	3.73E+02	15,27/02/16	(696744, 5910532,	0.0)
74	3.72E+02	12,14/11/16	(696794, 5910732,	0.0)
75	3.72E+02	12,06/07/16	(696744, 5910682,	0.0)
76	3.72E+02	11,11/06/16	(697194, 5910532,	0.0)
77	3.70E+02	17,17/12/16	(696744, 5910632,	0.0)
78	3.68E+02	11,21/06/16	(697194, 5910532,	0.0)
79	3.68E+02	16,15/02/16	(696744, 5910532,	0.0)
80	3.67E+02	14,28/08/16	(697194, 5910532,	0.0)
81	3.67E+02	13,15/09/16	(697194, 5910532,	0.0)
82	3.66E+02	02,19/03/16	(697194, 5910532,	0.0)
83	3.63E+02	17,20/03/16	(696694, 5910632,	0.0)
84	3.63E+02	16,04/01/16	(696744, 5910532,	0.0)
85	3.63E+02	04,05/11/16	(696694, 5910632,	0.0)
86	3.62E+02	11,10/05/16	(697194, 5910532,	0.0)
87	3.62E+02	07,07/07/16	(696694, 5910632,	0.0)
88	3.61E+02	19,18/10/16	(697194, 5910532,	0.0)
89	3.61E+02	15,15/05/16	(697194, 5910532,	0.0)
90	3.61E+02	18,06/07/16	(696694, 5910632,	0.0)
91	3.60E+02	13,06/07/16	(696744, 5910632,	0.0)
92	3.60E+02	16,31/10/16	(697194, 5910532,	0.0)
93	3.60E+02	17,04/02/16	(696694, 5910632,	0.0)
94	3.58E+02	12,18/10/16	(697194, 5910532,	0.0)
95	3.57E+02	22,06/07/16	(696694, 5910632,	0.0)
96	3.57E+02	13,23/05/16	(697194, 5910532,	0.0)
97	3.56E+02	16,02/04/16	(696694, 5910682,	0.0)
98	3.55E+02	16,17/12/16	(696694, 5910632,	0.0)
99	3.54E+02	17,08/02/16	(696744, 5910532,	0.0)
100	3.53E+02	17,13/12/16	(697194, 5910532,	0.0)