Dongwha Australia

Bombala Sawmill Modification 3

Statement of Environmental Effects

October 2018

Submission of a Statement of Environmental Effects

Prepared under Section 4.55 of the *Environmental Planning and Assessment Act 1979* (EP&A Act)

	Submission of a Statement of Environmental Effects (SEE)	
SEE prepared by		
Names	Karl Rosen	Sophie Lovett
Qualification	BSc (Hons) …	B. URP
Address	GHD, Level 15, 133 Castlereagh St, Sydney, NSW 2000	
Development application		
Proponent name	Dongwha Australia (DAU)	
Proponent address	1 Sandy Lane, Bombala NSW 2632	
Land to be developed	Bombala Sawmill site located on Lot 2 DP 1016573 and Lot 27 DP 1061792	
Proposed development	Modification of PA 07_0161 for installation of 15 MW biomass boiler.	
Environmental assessment	A SEE is attached which was prepared under Section 4.55 of the EP&A Act We certify that we have prepared the contents of this SEE and to the best of our knowledge: • The statement contains all available information that is relevant to the environmental assessment of the proposed development • The information contained in the statement is neither false or misleading.	
Signatures		
	Karl Rosen	Sophie Lovett
	2 October 2018	2 October 2018

Executive summary

Dongwha Australia (DAU) propose to modify the existing project approval to install a new wood-fired boiler within its existing saw milling facility located south-west of Bombala in the Monaro Region of NSW.

The proposal involves the installation of a 15 megawatt (MW) bio mass boiler to replace the approved 18MW biomass boiler and gas fired boilers approved at the site as part of the mill expansion project. The new boiler would be designed to comply with statutory emissions requirements and be supplied with clean timber residual products currently generated by the sawmill operations at the site. The proposal would allow DAU to proactively manage their ongoing energy costs and residual timber management requirements.

The proposal represents an alteration to the development forming the basis of the current project approval and therefore requires approval from the NSW Minister for Planning in the form of a modification under Section 4.55 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Bombala Sawmill currently produces up to 800 tonnes of wood residue per day as a by-product of milling activities. Wood residue products, including fresh sawdust, pine bark, dried wood shavings and fresh woodchips are temporarily stored in purpose built bunkers on site prior to being transported off-site for sale or disposal.

The demand for sawdust in the local market is typically low so sawdust tends to be held in the bunkers at the site until it is transported to Sydney and Canberra for sale.

The installation of a 15MW wood fired boiler to allow use of timber residue products is considered to have a number of benefits including:

- Beneficial re-use of a residual timber product within the mill operations
- Use of renewable timber resource in place of consumption of fossil fuels
- Demand for residual timber would not be driven by external market forces
- Proactive management of residue product stockpiles to minimise dust emissions from the site
- Minimising heavy vehicle movements associated with the transport of waste products
- Improved safety performance by minimising interaction between mobile plant operations and road haulage vehicles.

The proposal would result in limited changes to the majority of site operational processes and is considered consistent with the objectives of the EP&A Act.

The proposal would improve the efficiency of the sawmill operations by minimising operating costs associated with natural gas consumption and transport of residual timber products. The ongoing viability of the operations would ensure employment is maintained together with associated indirect benefits to sustaining the local and regional economy.

Results of the air quality impact assessment show that the emissions from the proposed 15MW wood fired boiler would meet the Clean Air Regulation Group 6 limits and impact assessment criteria at all surrounding receivers.

The use of the timber residue products as a fuel source would result in a reduction in heavy vehicle movements required for waste removal from the site. The proposal is anticipated to improve the amenity for local residents living on the main transport routes through Bombala, by

reducing the number of heavy vehicle movements required for the transport of residual timber products.

The proposal would also replace the use of fossil fuels with a renewable timber resource resulting in a considerable reduction in greenhouse emissions from the sawmill operations.

Potential environmental impacts associated with the proposal are not considered significant and can be appropriately managed through the adoption of the proposed management procedures.

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1. Introduction

1.1 Background

Dongwha Australia (DAU) operate a saw milling facility approximately two kilometres south-west of Bombala in the Monaro region of NSW. 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 modification to PA 07_0161 was granted in February 2012 ("Modification 1") following the acquisition of the operations by DAU. The modification allowed for alternate construction staging and modification to several conditions of the consent.

GHD subsequently prepared an environmental assessment to support a modification application to PA 07_0161 ("Modification 2"), 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. This modification was approved on 15 July 2015, however has not been developed.

It is now proposed to modify the application to install a new 15MW wood-fire boiler to replace the 18 MW boiler proposed as part of Modification 2. The existing 2.5MW wood-fired boiler servicing the redry kilns will be retained and the existing 10MW gas fired boiler currently installed as part of the original project approval will be decommissioned.

The 18MW boiler proposed as part of Modification 2 was not progressed as no cost effective way to construct and set up the steam supply across the site was available. The location of the proposed 15MW boiler would be within the centre of the site, east of the previously approved 18MW boiler. The 15MW boiler would be designed to comply with statutory emissions requirements and be supplied with clean timber residual products currently generated by the sawmill operations at the site. Similar to Modification 2, the proposal would allow DAU to proactively manage their ongoing energy costs and residual timber management requirements.

The proposal represents an alteration to the development as described in the original project application and therefore requires approval from the NSW Minister for Planning in the form of a modification under Section 4.55 of the EP&A Act. The Department of Planning and Environment (DP&E) have issued a list of assessment requirements to be included in the Modification 3 application, included in Appendix A.

1.2 Purpose of this report

This Statement of Environmental Effects (SEE) has been prepared by GHD Pty Ltd (GHD) to support the application to the DP&E to modify the existing approval under Section 4.55 of the EP&A Act. The SEE provides a description of the proposal, reviews the applicable legislative framework and includes a detailed assessment to determine the potential environmental impacts of the proposal. The SEE subsequently proposes management measures to be implemented to mitigate any impacts associated with the proposal.

This SEE report only considers the components of the proposed modifications from the approved development, the potential environmental impacts of these modifications and the environmental management and mitigation measures proposed to manage these potential environmental impacts.

Where components of the modified proposal do not differ from the approved development, they are not detailed within this document as they are considered to have been addressed as part of the original assessment or subsequent modifications.

1.3 The applicant and land ownership

Bombala Sawmill is owned and operated by DAU. DAU is a global manufacturer of wood materials with timber processing and marketing operations in Korea, Hong Kong, New Zealand, Malaysia, Vietnam, U.A.E, Japan, United States and Australia.

1.4 The site and land ownership

DAU is the applicant of the project for the purposes of the development application. The relevant postal address for Bombala Sawmill is:

1 Sandy Lane

Bombala

New South Wales

2632

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

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

1.5 Scope and limitations

This report: has been prepared by GHD for Dongwha Australia and may only be used and relied on by Dongwha Australia for the purpose agreed between GHD and the Dongwha Australia as set out in section 1.2 of this report.

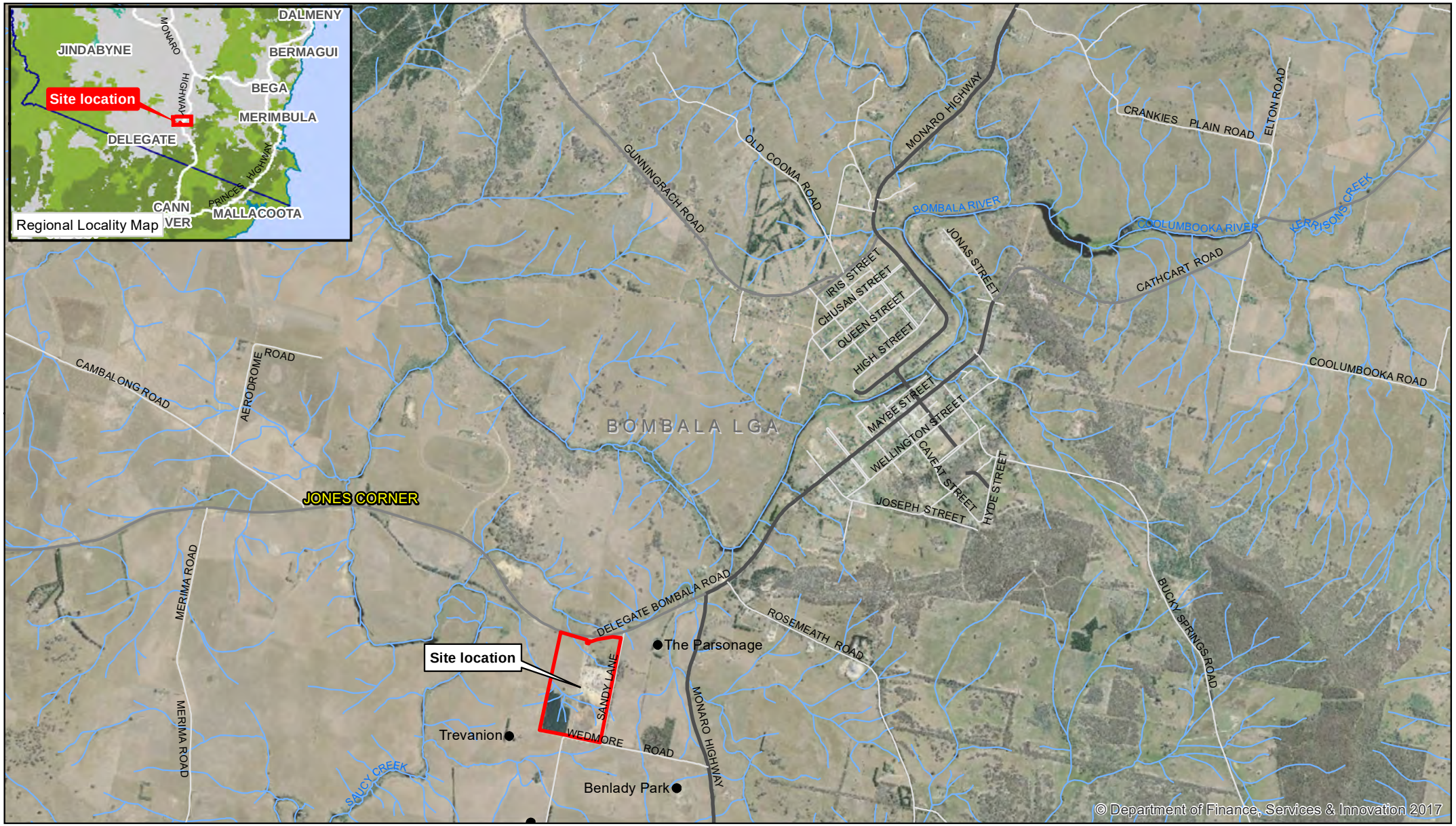
GHD otherwise disclaims responsibility to any person other than Dongwha Australia arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Dongwha Australia and others who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Legend

- Site Location
- Highways
- Major Roads
- Other Roads
- Waterways

Dongwha Australia
Bombala Sawmill - Modification 3
Statement of Environmental Effects

Job Number 21-27626
Revision A
Date 17 Sep 2018

Regional context

Figure 1-1

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Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com W www.ghd.com

Data Source: NSW Department of Lands: Cadastre - Jan 2012; Geoscience Australia: 250k Data - Jan 2012; NSW Department od Primary Industry - Jan 2012; Google image Jan 2013. Created by: jwatson2

2. Proposal description

2.1 Existing development and approvals

Timber processing operations commenced at the site in 1979 and have been subject to more than 20 development consents throughout the progressive development on the site.

A major expansion of the sawmill operations was approved as PA 07_0161 on 7 September 2010 by the NSW Minister for Planning under Part 3A of the EP&A Act, 1979. The major project application was accompanied by an EA prepared by The Fifth Estate and Peter J Ramsay and Associates on behalf of Willmott Timbers titled “Expansion of Bombala Integrated Sawmilling and Value Adding Facility” (referred to as the Sawmill Expansion EA throughout this environmental assessment). A detailed description of historical timber processing operations at the site is provided in Section 5 of the Sawmill Expansion EA.

A condition of the Project Approval included that all previous consents were effectively surrendered within 12 months of the determination and PA 07_0161 is the applicable project approval for the operations. A modification to PA 07_0161 was granted in February 2012 following the acquisition of the operations by Dongwha, which allowed for alternate construction staging and modification to a number of approval conditions.

A second modification was submitted to the DP&E in August 2014. This modification sought to alter the boiler configuration described in the Project Approval EA, as referenced in Condition 2 of Schedule 2 in the Project Approval. The modification also required modification to Condition 5 of Schedule 3 in the Project Approval to align with Environment Protection Authority (EPA)’s Clean Air Group 6 limits for a biomass boiler installed after 1st September 2005 as specified within Schedule 4 of the Protection of the Environment (Clean Air Regulation) 2010 (Clean Air Regulation). This modification (Modification 2), was approved in July 2015.

The modification subject to this SEE (the proposal), would result in an alteration to the boiler configuration described in the Project Approval EA (as amended by Modification 2), as referenced in Condition 2 of Schedule 2 in the Project Approval.

2.2 Proposed modification (“the proposal”)

The proposal involves installing a 15MW wood-fired biomass boiler, utilising residual sawdust, to fuel and operate the existing timber milling activities on site. The proposed boiler would be located on the southern side of the green off sawn kilns, as shown in Figure 2-1. This new location is about 100 metres south of the previously approved 18MW boiler in Modification 2.

It is estimated that the proposed 15MW wood-fired boiler would require approximately 40,000 tonnes of wood residue per annum, around 3,000 tonnes less than the previously approved 18MW boiler. The proposed 15MW boiler would generate hot water to operate, rather than the previously approved 18MW boiler which would have generated steam.

Residual timber in the form of sawdust would be transferred from the residual handling bunkers by Front End Loader, to a receiving hopper for the new boiler. The proposed 15MW boiler would include the following elements:

- Biomass feed system
- Gasification combustion process
- Feedwater pump system
- Emission controls system.

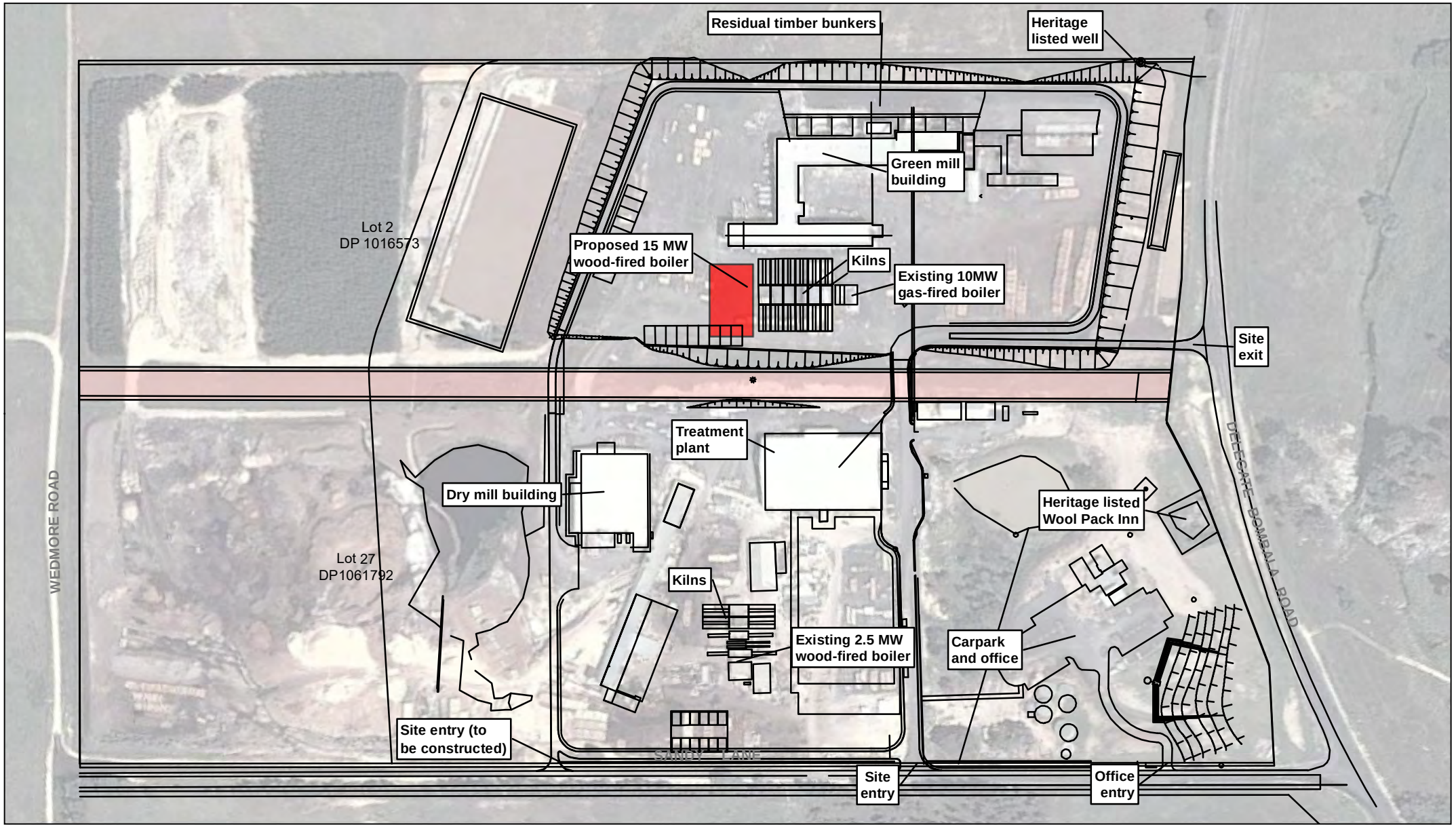
The approximate footprint of the proposed boiler would be approximately 50 metres x 30 metres, and the majority of the boiler infrastructure would reach about 10 metres in height. The minimum vent stack height for the proposed boiler would be 18 metres above ground level, in accordance with good engineering practice guidance.

The boiler would be designed to comply with the relevant EPA Group 6 limits included in Schedule 4 of the *Protection of the Environment Operations (Clean Air) Regulation 2010*.

The proposal would be located entirely within the previously approved sawmill site as shown in Figure 2-1. The site has been previously disturbed as a part of the progressive development of the site and the ground surface consists of hardstand, concrete or pavement. Minimal earthworks would be required during construction of the proposal, as the site foundations are suitable for the proposed boiler.

The existing gas fired boiler would be decommissioned following installation of the biomass boiler.

The proposal is substantially the same development as approved and described in the Sawmill Expansion EA and the project approved at the time of repeal of Part 3A of the EP&A Act. The proposal requires an alteration to the boiler configuration described in the EA, as referenced in Condition 2 of Schedule 2 in the Project Approval.



Paper Size A4

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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LEGEND

Boiler location

Site Layout

Dongwha Australia
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Revision C
Date 18 Sep 2018

Site layout

Figure 3-1

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Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com W www.ghd.com

Data Source: NSW Department of Lands: Cadastre - Jan 2012; Geoscience Australia: 250k Data - Jan 2012; NSW Department od Primary Industry - Jan 2012; Google image Jan 2013. Created by: mking3

2.3 Justification and need for modification

DAU was granted approval to construct a 18MW biomass boiler in Modification 2. The boiler was envisaged to replace the existing 10MW gas-fired boiler and the existing 2.5MW chip fired boiler that are operational on site. The Modification 2 was not progressed as there was no cost effective way to construct and set up the steam supply across site.

DAU have considered relocated the approved 18MW boiler, however a 15MW wood-fired boiler has been selected as suitable to meet the energy requirements for the GOS kilns and the redry kilns. The boiler would be designed to achieve compliance with EPAs Clean Air Group 6 limits and would allow for proactive management of residual timber products, and would utilise existing steam sources. Table 2-1 provides a summary and justification for the modification.

Table 2-1 Summary and justification of the modification

Description	2015	2018	Comments
Size of Biomass Boiler	18mw	15mw	To run just GOS.
Biomass boiler use	GOS and redry kilns	GOS kilns only	Excessive costs to connect both GOS and redry, and therefore not viable.
Fuel source to operate biomass boiler	Most residues	Sawdust	An alternative supplier has been sourced to deliver a biomass boiler to run on sawdust.
Sawdust use	Portion 20%	100%	Sawdust is very hard to move off site, and the proposed 15MW biomass boiler will eliminate a site issue.
Biomass Boiler generation	Steam	Hot water	The current GOS Kilns run with hot water so need to convert
Site location	On the north west corner of site	North of GOS kilns	To minimise pipe lengths to supply hot water to kilns and close proximity to green mill where the saw dust is generated

2.4 Existing compliance

DAU are implementing the staged expansion of the sawmill in accordance with PA 07_0161. The project approval includes a number of conditions which to be implemented as part of the progressive construction and operation of the sawmill. It is noted noise has been raised as an ongoing concern, with existing activities on site.

Condition 8 in Schedule 3 of the project approval includes noise limits which must not be exceeded by noise generated by the operation of the mill. Compliance monitoring undertaken by Blackett Acoustics in August 2018 found that the level of noise emissions from the site exceeded the acceptable noise limits at the two closest receptor points ('Parsonage' and 'Trevanion') on some occasions. While complaints have previously been received from the landowner of the Parsonage, no complaints have been received in recent times.

DAU are currently working with the EPA to minimise existing noise on site, and currently have a noise pollution reduction programme in place.

DAU notified neighbouring properties in August 2018 to notify them of the proposed plans, attached in Appendix B. No correspondence has been received from sensitive receivers at the time of writing this report.

2.5 Construction

2.5.1 Staging

Construction activities for the boiler installation are likely to be undertaken in two stages. Enabling works including establishment of formwork and associated infrastructure such as water supply is anticipated to be completed over a period of approximately 20 weeks.

The installation and commissioning of the boiler is anticipated to be completed over a period of 12 to 16 weeks. It is anticipated that many boiler components would be constructed off-site in modules and transported to the site for final assembly and configuration.

2.5.2 Equipment

Construction equipment likely to be required for the boiler installation is similar to the range of equipment considered within the assessment for the Sawmill Expansion EA and typical for the construction of an industrial style facility. Equipment used is likely to include:

- Excavator
- Concrete pump
- Delivery and concrete trucks
- Front end loader
- Compressor
- Hoist or crane
- Concrete cutter
- Jackhammer
- Hammer drill

Construction would be anticipated to generate up to around 15 two way heavy vehicle movements per day associated with the transportation of construction machinery, equipment and materials to the site and for the removal of waste and the existing boiler components.

3. Statutory framework

3.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) provides the statutory basis for planning and environmental assessment in NSW. All development is assessed in accordance with the provisions of the EP&A Act and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

Approval for expansion of the sawmill was granted by the Minister for Planning in 2010 under the former Part 3A of the EP&A Act.

Part 3A of the EP&A Act was repealed and a new assessment system for projects of State significance commenced in NSW on 1 October 2011. The Project was transitioned to SSD by an order made under clause 6 of Schedule 2 of the *Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017* ("Savings Regulations") which was gazetted on 6 July 2018. As a result:

- clause 6(3)(a) of the Savings Regulations operates so that the Project Approval is taken to be a SSD development consent granted under Part 4 of the EP&A Act; and
- the Project Approval may be modified under section 4.55(1A) of the EP&A Act.

Section 4.55 of the EP&A Act allows for modification if consents to be made, subject to and in accordance with the regulations. In particular Section 4.55(1A) states:

(1A) Modifications involving minimal environmental impact

A consent authority may, on application being made by the applicant or any other person entitled to act on a consent granted by the consent authority and subject to and in accordance with the regulations, modify the consent if:

(a) it is satisfied that the proposed modification is of minimal environmental impact, and

(b) it is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which the consent was originally granted and before that consent as originally granted was modified (if at all), and

(c) it has notified the application in accordance with:

(i) the regulations, if the regulations so require, or

(ii) a development control plan, if the consent authority is a council that has made a development control plan that requires the notification or advertising of applications for modification of a development consent, and

(d) it has considered any submissions made concerning the proposed modification within any period prescribed by the regulations or provided by the development control plan, as the case may be.

Subsections (1), (2) and (5) do not apply to such a modification.

(3) In determining an application for modification of a consent under this section, the consent authority must take into consideration such of the matters referred to in section 4.15 (1) as are of relevance to the development the subject of the application. The consent authority must also take into consideration the reasons given by the consent authority for the grant of the consent that is sought to be modified.

(4) The modification of a development consent in accordance with this section is taken not to be the granting of development consent under this Part, but a reference in this or any other Act to a development consent includes a reference to a development consent as so modified.

The proposed modification is considered to be substantially the same development as that approved upon transition from Part 3A:

- It will continue to use residual biomass as a fuel source for the boiler, within a modified configuration and reduced scale from previously approved.
- it would not alter the approved use or intensify activities beyond the current approved development.
- The construction methodology remains largely the same.
- It would comply with specific air quality limits of the original consent during operation of the facility.
- There would be no greater traffic movements or access during construction and operation.
- The overall footprint size would remain largely the same.

In determining an application for modification, Section 4.55(3) of the EP&A Act provides that a consent authority is to take into consideration matters referred to in Section 4.15 (1) of the EP&A Act namely:

In determining a development application, a consent authority is to take into consideration such of the following matters as are of relevance to the development the subject of the development application:

(a) the provisions of:

(i) any environmental planning instrument, and

(ii) any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Planning Secretary has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved), and

(iii) any development control plan, and

(iiia) any planning agreement that has been entered into under section 7.4, or any draft planning agreement that a developer has offered to enter into under section 7.4, and

(iv) the regulations (to the extent that they prescribe matters for the purposes of this paragraph),

(v) (Repealed) that apply to the land to which the development application relates,

(b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,

(c) the suitability of the site for the development,

(d) any submissions made in accordance with this Act or the regulations,

(e) the public interest.

When assessing an application under Section 4.55 for modifications involving minimal environmental impact, the consent authority is required to take into consideration the relevant matters outlined in Section 4.15 of the EP&A Act.

This SEE considers the likely impacts of the development, including environmental impacts on both the natural and built environments and the social and economic impacts in the locality.

Therefore, a request for modification of consent is made under section 4.55 of the EP&A Act to the DP&E for approval by the Minister.

3.2 Environmental Planning and Assessment Regulation 2000

Pursuant to Clause 115 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation), the following information is required to be supplied as part of the proposed modification:

Table 3-1 Requirements for application for modification of development consent

Requirement	Response / Reference
(1) An application for modification of a development consent under section 4.55 (1), (1A) or (2) or 4.56 (1) of the Act must contain the following information:	
(a) the name and address of the applicant,	Section 1.3
(b) a description of the development to be carried out under the consent (as previously modified),	Section 2.1
(c) the address, and formal particulars of title, of the land on which the development is to be carried out,	Section 1.4
(d) a description of the proposed modification to the development consent,	Section 2 and Section 2.2
(e) a statement that indicates either: *(i) that the modification is merely intended to correct a minor error, misdescription or miscalculation, or* *(ii) that the modification is intended to have some other effect, as specified in the statement,*	Section 3.1
(f) a description of the expected impacts of the modification,	Section 5
(g) an undertaking to the effect that the development (as to be modified) will remain substantially the same as the development that was originally approved,	Section 3.1
(h) if the applicant is not the owner of the land, a statement signed by the owner of the land to the effect that the owner consents to the making of the application (except where the application for the consent the subject of the modification was made, or could have	NA, the applicant, and owner of the land is Dongwha Australia.

Requirement	Response / Reference
been made, without the consent of the owner),	
(i) a statement as to whether the application is being made to the Court (under section 4.55) or to the consent authority (under section 4.56),	Section 1.1 and Section 3.1.

The proposal would not alter any aspect of the permissibility or regulatory framework for the project presented in the Sawmill Expansion EA.

The above information has been present in this report to satisfy Clause 115 of the EP&A Regulations.

3.3 State Environmental Planning Policy (Major Development) 2005 (repealed)

The Sawmill Expansion project was defined as a Major Project under the former *State Environmental Planning Policy (Major Development) 2005* for which Part 3A applies for the initial project application in 2009. The mill expansion met the definition of a class of development included within the former SEPP which included:

4 Timber milling, timber processing, paper or pulp processing

Development that employs 100 or more people or has a capital investment value of more than $30 million for the purpose of:

(a) milling plants, sawmills, wood-chipping or particle board manufacture, or

(b) manufacture of paper, pulp, cardboard or newsprint, or

(c) paper recycling, or

(d) wood preservation, or

(e) charcoal plants,

but not including development for the purpose of plantations (unless it is ancillary to other development).

As described in Section 3.1, although Part 3A of the EP&A Act has been repealed, Section 4.55 now applies for the purpose of modification to the approval.

3.4 State Environmental Planning Policy 33 – Hazardous and Offensive Development

SEPP 33 presents a systematic approach to planning and assessing proposals for potentially hazardous and offensive development for the purpose of industry or storage. Through the policy, the permissibility of a proposal to which the policy applies is linked to its safety and pollution control performance. The policy ensures that only those proposals which are suitably located, and able to demonstrate that they can be built and operated with an adequate level of safety and pollution control are permitted to proceed.

SEPP 33 applies to any proposals which fall under the policy's definition of 'potentially hazardous industry' or 'potentially offensive industry'. Potentially hazardous industries refer to developments which involve handling, storing or processing a range of substances which without appropriate operating measures would pose a significant risk in relation to human

health, life, property or the biophysical environment. Potentially offensive industry includes a development which if the development were to operate without appropriate management and mitigation would emit a polluting discharge in a manner which would have a significant adverse impact in the locality or on existing of future development. A proposal cannot be considered to be a hazardous or offensive industry unless it is first identified as potentially hazardous or offensive industry respectively.

The sawmill expansion project was considered a potentially hazardous industry due to the requirement to store and use a range of chemicals on site for use in the timber process and associated activities. A detailed Preliminary Hazard Analysis (PHA) was therefore undertaken as part of the Sawmill Expansion EA and identified the following high risk scenarios:

- Loss of containment or spills from chemicals used in the treatment plant
- Operational noise associated with the log store, debarker and transport
- Onsite vehicle collision associated with vehicle movements at the log store, debarker, transport incoming, finish store and dispatch
- Collection of dust on hot machinery resulting in a fire of explosion in the sawmill, stacker, dry mill and planer operations
- Noise from trucks entering or leaving the site.

The PHA concluded that with the adoption of the management controls proposed for the mill, there would be no unacceptable risks to surrounding land users and the expanded operations were not considered a hazardous or offensive industry.

The proposal does not introduce the requirement for storage or use of any additional hazardous materials than previously assessed within the PHA and would not trigger the SEPP 33 screening criteria in its own right. The proposed 15MW boiler is not considered to introduce a new hazard to the site that would alter the conclusions of the PHA.

SEPP 33 states that in most cases compliance with the EPA requirements should be sufficient to demonstrate that the proposal is not an offensive industry. The information provided throughout this EA satisfies these requirements and demonstrates that the proposal is not considered an offensive industry.

3.5 Protection of the Environment Operations Act

The objectives of the *Protection of the Environment and Operations Act 1997* (PoEO Act) are to protect, restore and enhance the quality of the environment, in recognition of the need to maintain ecological sustainable development.

The PoEO Act provides for an integrated system of licensing and contains a core list of activities requiring Environmental Protection Licenses (EPL) from the Environmental Protection Authority (EPA). These activities are called ‘scheduled activities’ and are listed in Schedule 1 of the Act. The Bombala Sawmill operations meet the definition of scheduled activities for wood or timber milling or processing and wood preservation and operation under the provisions of EPL 11205.

A modification to the EPL would also be required as a consequence of the modification to the project approval.

The PoEO Act also includes requirements for the protection against water, air and noise pollution, waste disposal and incident reporting requirements for actual or potential pollution incidents.

The Protection of the Environment (Clean Air Regulation) 2010 (PoEO Regs) provides regulatory measures to control emissions from wood heaters, open burning, motor vehicles and fuels and industry. The regulation outlines the grouping of activities and plant into 6 groups

based on when the activities commenced operation. EPAs Clean Air Group 6 standards of concentrations for a biomass boiler installed after 1st September 2005 are specified within Schedule 4 of the Clean Air Regulation. The applicable Group 6 limits for the proposal are discussed outlined in Table 3-2.

Table 3-2 EPAs Clean Air Group 6 standards of concentrations for a biomass boiler

Pollutant	Standard of concentration (mg/m3)
Solid Particles	50
Nitrogen (NO2)	500
Carbon dioxide (CO)	125
Volatile organic compounds (VOCs)	40
Dioxins and furans	0.1

3.6 Relevant environmental planning instruments

3.6.1 Bombala Local Environmental Plan 2012

Under the Bombala LEP 2012, the proposed site is zoned RU1 Primary Production. The objectives of the RU1 zoning are:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To encourage diversity in primary industry enterprises and systems appropriate for the area.
- To minimise the fragmentation and alienation of resource lands.
- To minimise conflict between land uses within the zone and land uses within adjoining zones.
- To enable other land uses that are associated with primary industry and that require an isolated or rural location or that support the tourism industry.

The sawmill fulfils the definition of a rural industry which is permissible with consent under the Bombala LEP 2012. However the sawmill expansion project was defined as a Major Project for which Part 3A applied and the proposal is therefore being assessed as a modification in accordance with Section 4.55 of the EP&A Act.

The proposal is located entirely within the boundary of the approved sawmill site and is considered to be consistent with the objectives of the RU1 land zoning by improving the sustainability and operating efficiency of the sawmill operations.

3.6.2 Bombala Development Control Plan 2012

The site is located on land zoned RU1 Primary Production under the *Bombala Development Control Plan 2012* (DCP). The proposal would not alter the use of the site, and would replace infrastructure on site, as previously approved. The proposed modification is in keeping with the existing use of the site, and development controls outlined in the DCP are not considered relevant.

3.6.3 Draft local environmental planning instruments

There are currently no draft plans for the Snowy Monaro Regional Council relevant to the site and surrounds.

3.7 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires the approval of the Commonwealth Minister for the Environment for actions that may have a significant impact on matters of national environmental significance. The EPBC Act also requires Commonwealth approval for certain actions on Commonwealth land. Matters of national environmental significance under the Act comprise:

- World Heritage areas.
- National Heritage Places.
- Ramsar wetlands of international importance.
- Threatened species or ecological communities listed in the EPBC Act.
- Migratory species listed in the EPBC Act.
- Commonwealth marine environments.
- Great Barrier Reef Marine Park
- Nuclear actions
- A water resource in relation to a coal seam gas or large coal mining development.

The proposal is located entirely within the approved development boundary for the Bombala Sawmill and is not considered to have potential to impact up any matters of national environmental significance hence a referral under the EPBC Act is not considered to be warranted.

4. Issue Identification

4.1 Stakeholder consultation

The proposed boiler is located entirely within the existing footprint of the existing site and is considered beneficial to the local community, particularly in regards to local employment opportunities and a reduction in heavy vehicle movements associated with the transport of residual timber products.

Near neighbours have therefore been informed of the proposed modification by letter box drop. A copy of the letter is provided in Appendix B, which includes a description of the proposal and contact details to request any further information regarding the proposal.

During preparation of an EA to support Modification 2, significant consultation was undertaken with the EPA. Key issues were raised by the EPA including:

- Level of design detail and performance specification of the proposed boiler
- Adequacy of the air quality assessment in regards to the requirements of the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (Approved Methods)
- Details of noise generated by the proposed boiler
- Waste streams to be created as a result of the proposed boiler

- Requirement for a variation to the existing Environmental Protection Licence (EPL) including upgraded monitoring conditions.

Consideration of the above has been included in the impact assessment in Section 5. The additional conditions of consent in Schedule 3 included in the Modification 2 approval, are considered appropriate for the proposal.

The timber mill has a history of generating noise emissions which exceed relevant noise criteria at two closest properties. These exceedances have been attributed to specific mill operations and are being dealt with separately by the EPA and the Department's Compliance Team.

It is also noted the proposal comply with the EPAs Clean Air Group 6 standards of concentrations for a biomass boiler installed after 1st September 2005 in accordance with the Clean Air Regulation as discussed in Section 5.1.

4.2 Environmental risk assessment

A preliminary environmental risk assessment was undertaken at the commencement of the investigation to screen the potential environmental impacts that may arise as a result of the proposed modification.

The analysis was undertaken in the form of a preliminary, desktop-level risk assessment, to broadly assess the potential environmental risks that may arise as a result of the construction and operation of the proposed modification to identify key areas for the assessment and assist in streamlining the assessment process. Key issues identified within the risk assessment include air and noise emissions. .

4.3 Methodology

The environmental risk analysis for the proposed modification involved:

- Identifying environmental aspects.
- Identifying the source of potential risks associated with each of these aspects.
- Identifying the potential impact associated with each risk.
- Evaluating the likelihood of occurrence and consequence of each risk with the definitions provided below.
- Assigning a risk ranking.
- Identifying priority issues for the SEE.

The potential risks were given a ranking with regard to the likelihood of it occurring (assuming that the proposed modification is designed and implemented with standard environmental controls) in accordance with the definitions provided in Table 4-1 and Table 4-2.

Table 4-1 Likelihood of occurrence definitions

Likelihood	Description
Almost certain	Expected to occur in most circumstances
Likely	Will probably occur in most circumstances
Possible	Could occur
Unlikely	Could occur but not expected
Rare	Occurs only in exceptional circumstances

Potential risks were given a ranking with regard to the perceived consequence if left unmanaged, in accordance with definitions in Table 4-2.

Table 4-2 Consequence of impact

Consequence	Definition
Extreme	Irreparable/long-term damage/ widespread environmental effects may include major pollution incident, unauthorised damage to significant cultural or heritage sites. Occurrence may result in significant regulatory intervention
High	Serious damage to the environment, medium-long term impact, rehabilitation at considerable expense. Possible legal non-compliance and/or damage to corporate reputation.
Medium	Localised, short term damage/disturbance to the environment requiring relatively short-term remedial action (<1 month)
Low	Noticeable impact on the natural environment/corporate reputation requiring little to no remedial action
Negligible	Negligible impact on the environment which is difficult to notice and does not require remedial action

Based on the assessment of likelihood and consequence, a foreseeable impact/risk was assigned a risk rating. This enabled higher rating risks to be identified early in the process for the purpose of focusing the preliminary environmental assessment process. The matrix shown in Table 4-3 was used to prioritise potential environmental risks as either category A, B or C.

Table 4-3 Impact priority matrix

	Consequence level				
Likelihood level	**Negligible**	**Low**	**Medium**	**High**	**Extreme**
Almost certain	*Medium*	*High*	*Extreme*	*Extreme*	*Extreme*
Likely	*Low*	*Medium*	*High*	*Extreme*	*Extreme*
Possible	*Negligible*	*Low*	*Medium*	*High*	*Extreme*
Unlikely	*Negligible*	*Negligible*	*Low*	*Medium*	*High*
Rare	*Negligible*	*Negligible*	*Negligible*	*Low*	*Medium*

4.4 Environmental risk analysis

Table 4-4 provides the environmental risk analysis for the proposed modification. It includes:

- A summary of the potential key impacts/risks (columns 2 and 3).
- Likelihood of occurrence and consequence levels (columns 3 and 4).
- The risk rankings that were assigned (column 5).
- A discussion regarding the findings of the risk analysis (column 6).

Table 4-4 Preliminary environmental risk analysis results

Environmental aspect	Source of risk	Potential impact (without mitigation)	Likelihood	Consequence	Risk rating	Discussion
Air emissions	Emissions from proposed 15 MW wood-fired boiler	NO_x and PM_{10} emissions exceeding the relevant criteria.	Possible	High	High	The new wood-fired boiler would be designed to comply with the EPA Group 6 limits. An air quality assessment has been undertaken. This includes a quantitative assessment of emissions from the proposed modification and a comparison against the relevant EPA criteria.
		Impacts on nearby sensitive receivers.	Unlikely	High	Medium	Air modelling would be undertaken as part of the SEE to compare the potential emissions against the EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC, 2005).
	Sawdust stockpiles	Dust emissions causing nuisance to sensitive receptors.	Rare	Medium	Low	The proposed modification would utilise the sawdust as the main fuel source for the boiler, which would reduce the volume of sawdust stored onsite and hence the potential for dust generation. Existing dust management is included in the Air Emissions Management Plan (AEMP) required by Condition 6 of the Project Approval.
	Air emissions (dust and exhaust) during construction.	Dust and exhaust emissions causing nuisance to sensitive receptors.	Possible	Medium	Medium	Construction activities would be minor and temporary in nature. With the implementation of standard controls provided in the Sawmill Expansion EA, potential impacts on air quality during construction would be appropriately minimised. Emissions during construction are considered to be negligible due to the small scale of the proposed modification and the implementation of standard controls. No further assessment on construction dust is proposed as part of the EA.

Environmental aspect	Source of risk	Potential impact (without mitigation)	Likelihood	Consequence	Risk rating	Discussion
Traffic and transport	Operation of construction equipment and vehicles	Increase in traffic on the local road network as a result of construction activities.	Possible	Medium	Medium	The proposed modification would result in a minor increase in traffic during construction, which would be managed with the implementation of standard traffic controls provided in the Sawmill Expansion EA. The generation of traffic during construction is considered to be negligible due to the small scale of the proposed modification and the implementation of standard controls. Detailed assessment of construction traffic is not considered to be required as part of the SEE.
	Movement of heavy vehicles during operation	Increase in traffic as a result of operation impacting safety and traffic along the local road network.	Unlikely	Medium	Negligible	Heavy vehicle movements to and from the site are predicted to decrease as wood residue would be used to fuel the boiler. The reduction in heavy vehicle movements would result in an improvement in traffic and safety on the local road network.
Noise	Noise emissions from the proposed 15 MW wood-fired boiler	Noise emissions during operation exceed noise limits and affect sensitive receptors.	Unlikely	High	Medium	The Sawmill Expansion EA which assessed the operation of four boilers operating 24 per day and 7 days per week, concluded that the operation of the facility would be below the *Industrial Noise Policy* (DECC, 1999) noise criteria. A noise assessment for the proposed 15MW boiler concluded cumulative noise levels would comply with the EPL limits. Ongoing annual noise monitoring is required as part of the original consent.

Environmental aspect	Source of risk	Potential impact (without mitigation)	Likelihood	Consequence	Risk rating	Discussion
	Operation of construction equipment and vehicles	Noise emissions exceeding noise limits and affecting sensitive receptors.	Unlikely	High	Medium	Construction activities would generate only minimal noise emissions as the proposed modification would be undertaken within the existing facility shielded from surrounding land uses. With the implementation of standard controls provided in the Sawmill Expansion EA, potential noise impacts during construction would be appropriately minimised.
	Movement of heavy vehicles during operation	Noise emissions exceeding noise limits and affecting sensitive receptors.	Unlikely	High	Medium	Heavy vehicle movements to and from the site are predicted to decrease as wood residue would be used to fuel the boiler. The reduction in heavy vehicle movements would result in an in improvement in traffic noise from the site and the local road network. No further assessment on operational traffic noise is proposed as part of the SEE
Flora and fauna	Damage to flora and fauna from equipment, vehicles, site sheds during construction.	Loss of habitat and degradation to landscape.	Unlikely	Low	Negligible	No endangered species have previously been recorded on site. The proposed modification would be undertaken within the boundary of the existing mill. No flora or fauna would be impacted by the proposed modification. No further assessment on flora and fauna is required.

Environmental aspect	Source of risk	Potential impact (without mitigation)	Likelihood	Consequence	Risk rating	Discussion
Heritage	Impacts on items of Aboriginal and non-Aboriginal heritage significance.	Encounter and disturb items of cultural heritage during construction and operation.	Unlikely	Medium	Low	Items previously identified in the Sawmill Expansion EA include two sites of potential heritage value (Wool Pack Inn ruins and a filled well). These items would not be impacted by the proposed modification. One Aboriginal site, previously identified within the site and is understood to have been relocated as part of the original PA. Impacts on previously unidentified cultural heritage items are considered unlikely due to the level of subsurface disturbance of the site. In the unlikely event that items of potential heritage significance are encountered, procedures provided in the original PA would be implemented. No further assessment on heritage is proposed as part of the SEE.
Odour	Odour from the wood-fired boiler	Odour emissions impacting nearby sensitive receivers	Unlikely	Low	Negligible	The proposed modification is not likely to result in an increase in odours from the site. The proposed odour management measures in the Sawmill Expansion EA would be implemented in the event that odour complaints are received.
Chemical usage and storage	Chemicals used during construction and maintenance of the proposed modification.	Chemical spill or leak during transport or usage, impacting on soil, groundwater or stormwater.	Possible	Medium	Medium	The proposed modification would not result in additional impacts from chemical usage and storage to those considered in the Sawmill Expansion EA. No treated timber residual products would be used in the boiler operations.

Environmental aspect	Source of risk	Potential impact (without mitigation)	Likelihood	Consequence	Risk rating	Discussion
Soil	Erosion of soils during construction.	Sedimentation of adjacent drainage lines and dust generation impacting nearby receivers.	Unlikely	Medium	Low	The proposed modification is unlikely to result in additional impacts to soils to those considered in the Sawmill Expansion EA. Construction activities would be minor and temporary in nature. There is only minimal potential for disturbance of soils during construction as a result of the construction of the boiler. With the implementation of standard controls provided in the Sawmill Expansion EA, potential impacts on soils during construction would be appropriately minimised.
Surface water	Impacts to water quality	Contamination of surface water or ground water during construction activities.	Possible	Medium	Medium	The proposed modification is unlikely to result in additional impacts to water quality to those considered in the Sawmill Expansion EA. Impacts to water quality during construction would be adequately managed with the implementation of controls provided in the Sawmill Expansion EA.
Water usage	Water usage for the boiler	Increase in water demand for the site.	Unlikely	Medium	Low	The proposed modification will not significantly increase water demand on-site. .
Wastewater	Wastewater generation from the boiler	Increase in wastewater generated from the boiler.	Unlikely	Medium	Low	The proposed modification is unlikely to result in an increase in wastewater generation.
Solid waste	Waste generation as a result of the proposed modification	Increase in the generation of solid waste from the site.	Unlikely	Medium	Low	The proposed modification would result in a reduction in wood residue waste removed from the site. A quantitative analysis is proposed to be undertaken as part of the SEE to demonstrate the reduction of waste from the mill operations.

Environmental aspect	Source of risk	Potential impact (without mitigation)	Likelihood	Consequence	Risk rating	Discussion
Socio-economic	Construction of the proposed boiler.	Impacts to local community through increased noise and traffic.	Unlikely	Medium	Low	Construction activities would be minor and temporary in nature and would be appropriately mitigated with the implementation of controls provided in the Sawmill Expansion EA. No further assessment on the community is proposed as part of the SEE.
	Emissions from the boiler	Impacts to the local community as a result of reduced air quality.	Unlikely	High	Medium	As described above, emissions would be considered in the air quality assessment undertaken as part of the SEE.
Visual amenity	Visibility of the proposed boiler.	Impacts to the visual amenity of the surrounding area.	Unlikely	Medium	Low	The proposed modification would be located within the existing facility and is consistent with the existing land use/operations of the facility. There would be no visual impacts on adjoining lands. No further detailed assessment on visual amenity is proposed as part of the SEE.

5. Impact assessment

5.1 Air quality

A detailed assessment of air emissions was undertaken as part of the Sawmill Expansion EA. DAU engaged Ektimo to conduct testing of 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. This information has been used to inform the Air Quality impact assessment summarised below, and attached in Appendix D.

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* ("EPA's *Approved Methods*")
- *Protection of the Environment Operations (Clean Air) Regulation of 2010* (PoEO Regs) for emission standards.

Emissions from discharge stacks in NSW are subject to regulations that limit the concentration of pollutant substances within the discharge flue gas. The proposed 15MW biomass boiler in-stack concentrations for some pollutant substances are subject to the Group 6 limits scheduled PoEO Regs for scheduled premises. These are detailed for the relevant emission substance in Table 5-1.

Table 5-1 PoEO 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	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 *Approved Methods* define ground level concentration impact assessment criteria for the substance emitted from the proposed biomass boiler. The relevant EPA assessment criteria is to be met at either sensitive receiver locations or at and beyond the site boundary. The criteria for relevant emitted substances are summarised in Table 3 of Appendix D.

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. This would be decommissioned after the installation of the proposed biomass boiler, and the emissions from this source have not been included in the assessment.

5.1.1 Existing environment

Any emissions from the sawmill have potential to impact upon a small number of rural residential properties in the locality surrounding the site as shown on Figure 5-1, including:

- Residences, identified as receptors 1 to 17 (R1 – R17)
- Commercial property, identified as receptor 18 (R18).

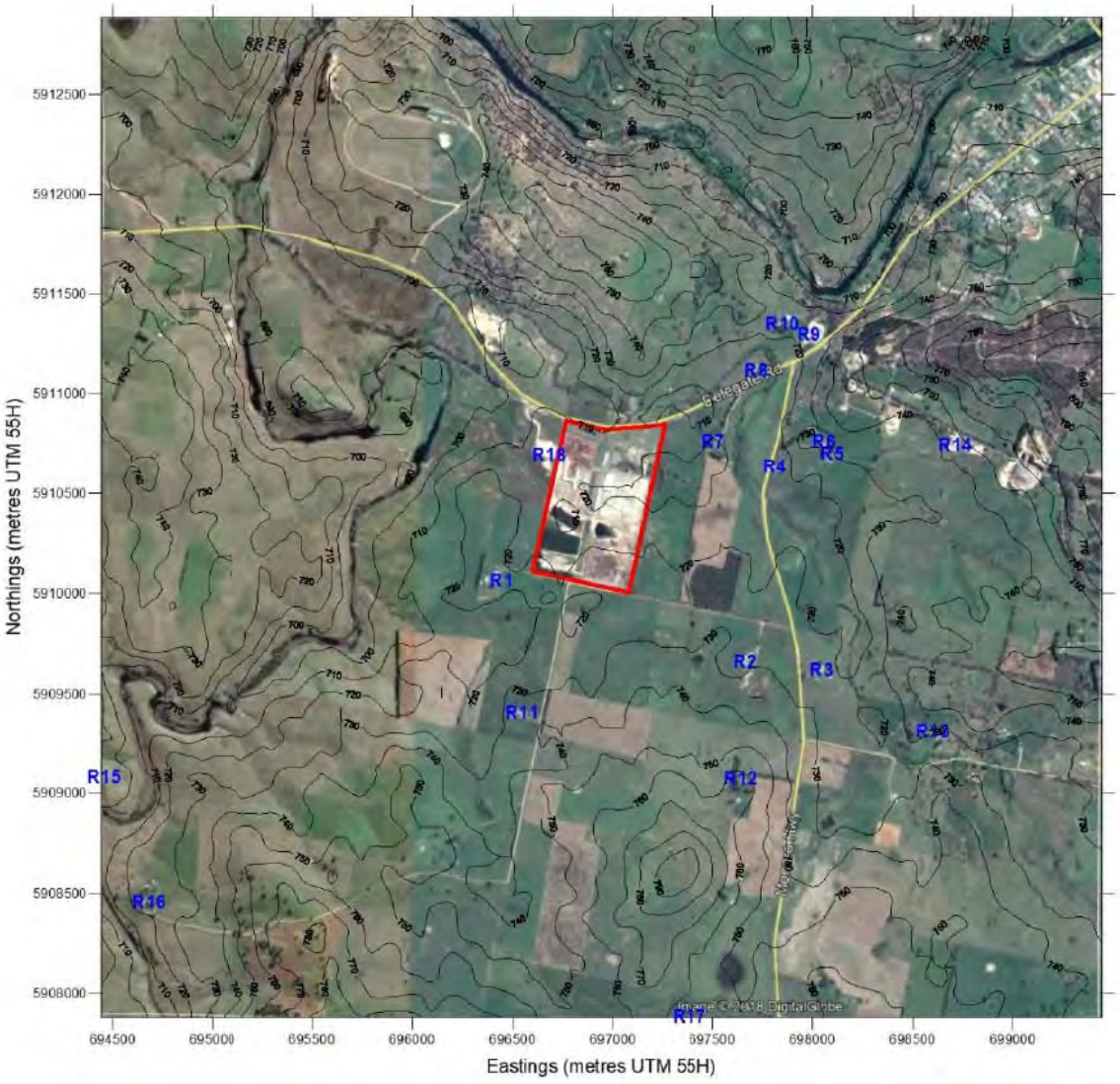
The nearest receivers, R18 beyond the western boundary of the facility, is a commercial guest house that DAU use for visiting staff or contractors who stay over-night.

Existing and proposed emissions

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.

Table 5-2 provides a summary of tested emissions for existing sources and assessment emissions for the proposed boiler.

Figure 5-1 Identified nearby receivers including contours of terrain elevation as 10 metre increments



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

Table 5-2 Tested emissions for existing sources and assessed emissions for the proposed boiler

Pollutant	Existing Redry Kiln 1 vents		Existing Redry Kiln 2 vents		Existing 2.5MW wood fired boiler			Proposed 15MW biomass boiler				
	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 PoEO Reg 2010 Emissions 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 NA	41	50	0.35
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	500	41	50	0.35
NOX AS NO2	NA	NA	NA	NA	140	0.22	0.24	9.4	NA	414	500	3.5
Carbon monoxide	NA	NA	NA	NA	680	0.98	0.60	9.4	NA	6.7	NA	0.056
Sulphur dioxide	NA	NA	NA	NA	18	0.027	0.027	9.4	NA	18	NA	0.15
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
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
Total Volatile Organic Compounds (VOCs)	270	0.60	310	0.93	14	0.022	NA	9.4	40	0.40	0.48	0.0034

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 PoEO Reg 2010 in-stack emission concentration limits for the proposed 15MW biomass boiler.

The combined emissions to air from the notable sources within the facility would comply with the various relevant ground level concentration criteria within the approved methods. This is based upon the notable emissions of particulate matter (TSP, PM10 and PM2.5), oxides of nitrogen (NOX as NO2) and the trace amounts of dioxin and furans being emitted at or below the relevant scheduled PoEO Reg Group 6 limits (see Table 5-1 for limits).

The emissions of Type 1 and 2 Substances (in aggregate) and total Volatile Organic Compounds (VOC's) easily complied with PoEO Reg limits, represented 2.5% or less of their respective emission limits when emitted at the expected levels. The emissions of sulphur dioxide and carbon monoxide were readily compliant when emitted at expected levels.

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.

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).

In the absence of local data, data has been used from location with a comparable geophysical setting, population and industry, including Bega, Kembla Grange and Wollongong, see Appendix D for details. Table 5-3 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 5-3 Adopted peak monitored ambient ground level concentrations of assessed pollutant substances.

Substance	Averaging Time	Peak Monitored Concentration (µg/m3)	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 minutes	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	

5.1.2 Impact Identification

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.

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.

Dispersion modelling

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 5-4 below with a total inclusive of a maximum background concentration (see Table 5-3) for comparison with the relevant impact assessment criteria. 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. The contours are shown on figure 5 to 11 in Appendix D.

Table 5-4 demonstrates all assessed pollutants are compliant with their respective assessment criterion. The pollutant substance with the least emission safety factor (the available gap in the airshed), and closest to exceeding the NSW EPA assessment criterion, was NO2. The ground level concentration assessment criteria for notable substances as emitted from the proposed boiler are included in Table 3 of Appendix D.

Table 5-4 Predicted maximum pollutant concentrations at worst effected sensitive receiver (R18)

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		
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		
Highest predicted 8 hour average glc (µg/m3) at sensitive receptors						25	
peak measured background						1000	

ASSESSMENT	TSP	PM10	PM2.5	NOX as NO2	SO2	CO	Dioxin and Furan
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	
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

Nitrogen dioxide

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 (R18), 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 PoEO Regs in-stack concentration limit of 500 mg/m3 (STP, dry, 7% oxygen) which was assessed for ground level concentrations.
- 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.

5.1.3 Mitigation measures

The following air mitigation measures would be implemented:

- The emissions for each pollutant substance shall be tested upon commissioning of the 15 MW biomass boiler to confirm the estimates adopted in this assessment.
- As required in the EPL, DAU shall report air quality monitoring results to the Department annually. Where non-compliances are identified in these report, details of actions to improve the air emissions from the site are required to ensure compliance.
- The Air Emissions Management Plan (AEMP) required by Condition 6 of the Project Approval shall be updated to include the management of the new boiler, and to ensure that contingency measures are implemented should an exceedance of the criteria be identified during performance monitoring.

5.2 Noise and vibration

5.2.1 Existing environment

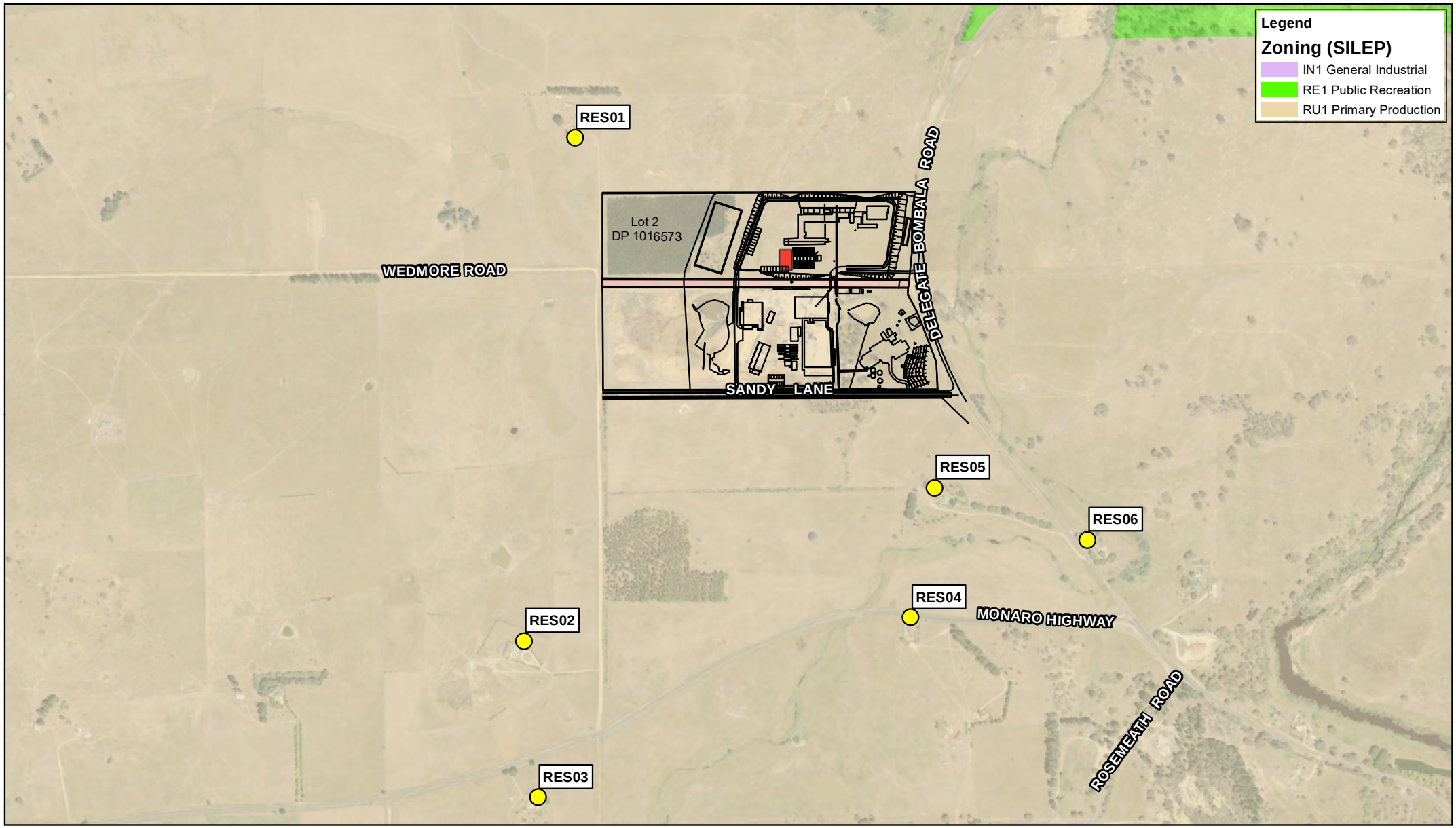
A detailed assessment of noise emissions from the proposed 15MW biomass boiler has been prepared by GHD and included in Appendix E. The report has been prepared with consideration to the following documents:

- Environment Protection Licence number 11205
- *Interim Construction Noise Guideline* (EPA, 2009) (ICNG)
- *Road Noise Policy (DECCW, 2011)* (RNP)
- *Noise Policy for Industry (EPA, 2017)* (NPI)
- Assessing Vibration: technical guideline

The residential sensitive receivers in Table 5-5 have been included in this assessment to determine potential impacts during construction and operation. No other sensitive land uses were identified within one kilometre of the site. The locations of the assessed sensitive receivers are provided in Table 5-5.

Table 5-5 Modelled sensitive receivers

Receiver ID	Receiver type	Approximate distance to project site boundary, m
RES01	Residential	150 m south-west
RES02	Residential	600 m south-east
RES03	Residential	1,000 m south-east
RES04	Residential	600 m east
RES05	Residential	300 m east
RES06	Residential	550 m north-east



Paper Size A4

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Sensitive receivers
- Site Layout

Dongwha Australia
Bombala Sawmill - Modification 3
Statement of Environmental Effects

Site layout, sensitive receiver locations and land zone usage

Job Number 21-27626
Revision C
Date 19 Sep 2018

Figure 5-2

G:\21\27626\GIS\Maps\Deliverables\21_27626_Z004_Site_layout_sensitivereceivers.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com W www.ghd.com

Data Source: Esri; NSW DFSI 2018, 2017, 2015, 2012; General topo - NSW LPI DTDB 2012. Created by: jwatson2

Background noise levels and assessment criteria

Construction noise management levels

The method to determine construction noise management levels (NML) for residential receivers is provided in the ICNG. The minimum rating background levels (RBL) assumed for the proposal include 35dBA during the day, 30dBA during the evening and 30dBA at night.

The project construction noise management levels are provided in Table 5-6.

Table 5-6 Project construction noise management levels, dBA

Receiver type	Time of day	Noise management level
Residential	Recommended standard hours	45
		75
	Outside recommended standard hours	40
		35
		35

Construction vibration criteria

The nearest residential receiver is located over 600 metres from the proposed construction footprint. The potential construction vibration levels have not been assessed as vibration impacts would not be expected at this distance.

Operation noise and vibration criteria

The Noise Policy for Industry (NPI) (EPA, 2017) provides guidance on the assessment of operational noise impacts from existing industrial premises. The application of the NPI to existing industrial premises allows established industries to adapt to changes in the noise expectations of the community where required.

Project noise trigger levels

The operational noise criteria to assess the potential impacts due to the addition of a 15 MW boiler is provided in Table 5-7. The 15 MW boiler project noise trigger level has been set at 10 dBA below the existing noise limit as per the principles of the NPI to existing industrial premises.

Table 5-7 Project noise trigger levels, dBA

Time period	Existing site noise1	EPL noise limit	15 MW boiler project noise trigger level
All hours	44-54	35	25

Note 1: Noise levels at Location A based on the *Operational Noise Monitoring* report prepared by Blackett Acoustics (Report No BA180521, August 2018).

5.2.2 Impact identification

Construction

Construction activities would be undertaken over a period of 24 weeks during the recommended standard construction hours. Plant and equipment needed for the construction work would be determined during the construction planning phase. The anticipated plant and equipment used is shown in Table 5-8, and have been based on data provided in Australian Standards *AS2436 – Guide to noise and vibration control on construction, demolition and maintenance sites*. Other equipment may be used, however, it is anticipated that they would produce similar net noise emissions when used concurrently with the listed equipment.

The activity sound power level has been calculated based on the two noisiest plant to determine the worst-case noise impacts during construction. The activity noise levels have been used to predict the noise levels that would be expected during construction works.

Table 5-8 Construction scenario staging

Scenario	Description	Equipment	Equipment sound power level	Activity sound power level
CS01	Foundation works	Compressor	101	127
		Excavator	107	
		Front end loader	113	
		Jackhammer	126[1]	
		Trucks	107	
CS02	Establishment of formwork	Compressor	101	123[1]
		Concrete cutter	122[1]	
		Concrete pump	108	
		Crane	104	
CS03	Infrastructure works	Excavator	107	114
		Front end loader	113	
		Trucks	107	
CS04	Boiler installation and commissioning	Compressor	101	109
		Crane	104	
		Hammer drill	102	
		Trucks	107	

Note 1: A 5 dBA addition has been applied to the jackhammer and concrete cutter as these activities have the potential to increase annoyance at the affected residences.

Construction noise impacts

Predicted construction noise levels from the scenarios outlined in Table 5-8 are presented in Table 5-9.

Table 5-9 Predicted construction noise levels, dBA

Receiver ID	Receiver Type	NCA	CS01	CS02	CS03	CS04
Residential: Exceeds noise management level Bold Highly noise affected						
RES01	Residential	NCA01	53	49	40	35
RES02	Residential	NCA01	44	40	31	26

Receiver ID	Receiver Type	NCA	CS01	CS02	CS03	CS04
Residential: Exceeds noise management level Bold Highly noise affected						
RES03	Residential	NCA01	40	36	27	22
RES04	Residential	NCA01	48	44	35	30
RES05	Residential	NCA01	50	46	37	32
RES06	Residential	NCA01	46	42	33	28

The predicted construction noise levels are below the construction noise management levels for all works that do not involve the use of a jackhammer or concrete cutter. The predicted exceedance of the noise management levels are:

- 8 dBA during jackhammering works (CS01). Residential receivers located within 1.1 kilometres of the construction equipment have the potential to be noise impacted.
- 4 dBA during concrete cutting works (CS02). Receivers located within 700 metres of the construction equipment have the potential to be noise impacted.

Exceedances of the construction noise management levels are typical for construction projects. The noise impacts would be limited to the construction period only and would not have lasting effects on the community.

Construction traffic would be anticipated to generate up to around 15 two way heavy vehicle movements per day associated with the transportation of construction machinery, equipment and materials to the site and for the removal of waste and the existing boiler components. A significant increase in traffic volume would be needed in order to increase road traffic noise. Further assessment of construction traffic noise is not required.

Construction noise management measurements have been provided in Section 5.2.3 to minimise the potential noise impacts on the surrounding community.

Operation

Existing compliance

Compliance noise monitoring was undertaken by Blackett Acoustics in August 2018. The compliance noise monitoring report indicate non-compliance with the noise limits at receiver RES01 (Location A in the compliance report) and RES05 (Location B) during existing operations. This non-compliance due to existing mill operations and not related to the proposed modification of the 15 MW boiler.

Proposed operation

The primary noise source from the boiler is due to a blower fan contained inside the unit. The manufacturer of this unit has confirmed a sound power level of 60 dBA. The fan would be housed within an enclosing structure however details of this structure is unknown at this stage. Noise from the boiler has been modelled without the enclosing structure for a conservative assessment.

The predicted noise levels at all modelled receivers due to the 15 MW boiler is below 20 dBA. This level of noise is below the project noise trigger level of 25 dBA and therefore would not create cumulative noise contributions to existing noise emission from the site.

Condition 4 of the environment protection licence (EPL) number 11205 provides noise level criteria for all hours, and night. The 15 MW blower is expected to be a continuous noise source with no impulsive characteristics therefore there would also be compliance with the 45 dBA LAmax EPL noise limit.

Therefore, the proposed modification to alter the boiler type and location would not affect the acoustic amenity of the residential receivers surrounding the site during any time periods.

Heavy vehicle movements to and from the site are predicted to decrease as wood residue would mostly be used to fuel the boiler. The reduction in heavy vehicle movements would result in an in improvement in traffic noise from the site and the local road network.

5.2.3 Mitigation measures

Construction

The following noise mitigation measures would be implemented during construction:

- All work will be carried out within standard construction hours:
  - Monday to Friday: 7 am to 6 pm
  - Saturday: 8 am to 1 pm

  Sunday and public holidays: No construction activities.
- Should jackhammering and sawing be required, compliance noise monitoring shall be undertaken during the work.
- Provide notification to potentially affected receivers about upcoming construction activities which are predicted to exceed the noise management levels. This includes jack hammering and concrete sawing, should these be required. The notification should include:
  - Details and timeframe of construction works
  - Noise control measures implemented
  - Provision of site contact details

    Note that if compliance monitoring confirm that jack hammering and concrete sawing are below the noise management levels then further community consultation may not be required unless a complaint is received.
- A complaints register should be maintained throughout construction detailing:
  - Contact details and address of the complainant
  - The time and nature of complaint
  - Review of work activities
  - Measures undertaken in response to the complaint.

  Staff should be briefed on current and future construction activities and notified of any complaints from the community.
- All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include:
  - all relevant project specific and standard noise mitigation measures
  - relevant licence and approval conditions
  - permissible hours of work
  - location of nearest sensitive receivers
  - construction employee parking areas

- designated loading/ unloading areas and procedures
- construction traffic routes
- site opening/closing times (including deliveries)
- environmental incident procedures.

- The noise levels of plant and equipment should have operating Sound Power or Sound Pressure Levels compliant with the levels in Table 4 2. If the levels are greater than those provided in Table 5-8 an acoustic consultant should confirm they will not result in an exceedance to the noise management levels.

Operation

No project specific operational noise management measures are recommended to reduce noise emission from the proposed 15 MW boiler.

5.3 Traffic and transport

5.3.1 Existing environment

The site is located approximately two kilometres southwest of Bombala, with access available from Sandy Lane and the Delegate Bombala Road. Separate site entrances are maintained for heavy vehicles entering the sawmill site and light vehicles for access to the office and carpark. A separate site access has been provided as part of the expansion project to allow heavy vehicles to exit directly to the Delegate Bombala Road providing for a circulating one way network of heavy vehicles within the site.

The Delegate Bombala Road (MR93) links the town centre of Delegate to the Monaro Highway located approximately 800 metres to the east of the Bombala Sawmill. The Monaro Highway is classified as State Highway (number 23) and runs in an approximate north-south alignment through the centre of Bombala. Sandy Lane is classified as a local road and runs along the eastern boundary of the site predominantly servicing the existing mill site and a small number of neighbouring properties as shown on Figure 5-3.

The majority of major roads in the local area have all been constructed or modified to accommodate heavy vehicle activity, which is primarily associated with commercial forestry activities in the region. The majority of inbound logs come from forests located to the south of the site and the majority of finished products and timber residue products are transported to the north through the township of Bombala.

The major highway network utilises the main street of Bombala with full commercial and residential frontages. There are no restrictions on semi-trailer access to the surrounding road network. The majority of roads surrounding the site are also classified B-doubles routes, which includes the main street and number of local roads within the urban areas of Bombala as shown on Figure 5-3.

Summary of Sawmill Expansion EA traffic generation

A detailed traffic assessment was undertaken as part of the Sawmill Expansion EA, which included the predicted daily truck movements from the proposed development. The assessment found that at full production, heavy vehicle movements would consist of approximately 92 two way movements per day consisting of 46 in-bound logging trucks with 16 outbound product trucks and 30 waste residue trucks.

The sawmill expansion project was predicted to result in the mill generated heavy vehicle traffic on the Delegate Bombala Road increasing to 21% of the total traffic on the road and amount to approximately nine to 10 trucks per hour over a 10 hour working day. The proportion of heavy

vehicle traffic generated by the mill was predicted to dissipate once the trucks reached the Monaro Highway where truck movements would split and volumes would be more influenced by the regional road network. A summary of the total daily average truck movements on the local road network predicted in the Sawmill Expansion EA is reproduced in Table 5-10.

Table 5-10 Average daily truck movements predicted in EA

Summary of daily truck movements	Assumed 2008/2009	Full Production
Monaro Highway (N of Bombala)	19	43.5
Delegate Bombala Road west	4	4.5
Cann Valley Highway (S of Bombala)	10.5	35
Bucky Springs Road	0	8
Mount Darragh Road	1.5	1
Total Movements/day (two way)	35	92

Employment at the mill was predicted to increase from a workforce of 71 to 80 persons to 94 staff on site at full production with an associated small increase in vehicles accessing the site associated with staff movements. The peak arrivals and departures at the mill are not concurrent with the peak traffic flows on the Delegate Bombala Road.

The traffic assessment concluded that there was significant spare capacity on the local road network and the additional traffic movements associated with sawmill expansion project could adequately be serviced by the road network. Several potential improvements to the road network such as increased pavement widths and bridge and intersection specifications were identified within the road network.

Paper Size A4

0 250 500 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

- Site Location
- Heavy Vehicle Routes
- Highways
- Major Roads
- Other Roads
- Waterways

Dongwha Australia
Bombala Sawmill - Modification 3
Statement of Environmental Effects

Job Number 21-27626
Revision A
Date 17 Sep 2018

Surrounding road network

Figure 6-2

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Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com W www.ghd.com

Data Source: NSW Department of Lands: Cadastre - Jan 2012; Geoscience Australia: 250k Data - Jan 2012; NSW Department od Primary Industry - Jan 2012; Google image Jan 2013. Created by: jwatson2

5.3.2 Impact Identification

Construction

Construction would be anticipated to generate up to around 15 two way heavy vehicle movements per day associated with the transportation of construction machinery, equipment and materials to the site and for the removal of waste and the existing boiler components

The site has undergoing a progressive expansion in accordance with the original project approval, and majority of the infrastructure has been installed to date. As such, there would be a minimal cumulative impact on the surrounding road network as a result of the proposed construction activities.

Operation

The proposal involves the use of 40,000 tonnes of residual sawdust from timber milling activities annually. The use of timber residues on site as the primary fuel source would result in a considerable reduction in the associated heavy vehicle movements for the removal of the waste products.

The majority of truck movements for the transport of timber residue products is currently to the north and pass directly through Bombala and other towns on the regional road network.

Based upon the bulk density and the volume of sawdust as previously set out in the Sawmill Expansion EA, it is estimated that there would be a reduction of 2,759 heavy vehicles transporting fresh sawdust product from the site per year as shown in Table 5-11.

While all roads in the vicinity of the site have been previously assessed to have considerable spare capacity and are suitable for the use of semi-trailers and B-doubles, the proposal would reduce truck movements associated with waste disposal from the site. This reduction in vehicle movements from the local road network would therefore be anticipated to result in improvements to the safety and amenity for local residence particularly in the urban areas of Bombala.

Table 5-11 Estimated heavy vehicle movement reduction

Wood residue	Quantity (tonnes)	Assumed bulk density (kg/m^3)	Volume (m^3)	Heavy Vehicles
Fresh sawdust	40,000	290	137,931	2,759

Notes: Assumed average truck capacity of 50m^3

Vehicles required for construction and delivery of materials and equipment associated with the proposed 15 MW boiler is not anticipated to be significantly greater than required for the approved project and would be adequately accommodated on the local road network.

5.3.3 Mitigation Measures

No additional mitigation measures are proposed as a part of the proposed modification.

5.4 Waste

5.4.1 Existing environment

A detailed analysis of the anticipated wastes and by-products generated at the site was undertaken for the Sawmill Expansion EA which included:

- General solid waste (non-putrescible) including steel waste and wood residue products

- General solid waste (putrescible) including general domestic waste from the sites workforce
- General hazardous waste from the bunded timber treatment operations and treated timber waste from the handling of treated timber following the treatment process
- Waste oils from maintenance activities within the workshop areas.

Wood residues including bark, untreated timber waste, woodchips, sawdust, pole waste and shavings made up by far the greatest volume of waste with an estimated 186,900 tonnes per annum of residual timber produced at maximum production at the sawmill.

5.4.2 Impact Identification

The proposed wood fired boiler would not result in a significant change to the overall site operational processes that would alter the volume of the waste streams generated at the site.

The proposal would however result in the reuse of approximately 40,000 tonnes per annum of residual timber products (sawdust) as a fuel source for the proposed boiler. This would provide a steady ongoing site demand for the residual timber products improving site efficiencies and reducing the reliance on an external market for residual timber products.

Treated timber waste products or hazardous waste would not be used as a fuel source for the boiler operations.

The proposal would result in additional fly-ash or soot as a by-product of the combustion process which would be reused or disposed in accordance with current practices. The supplier of the proposed boiler, Justsen, has advised the boiler would generate 1.1 tonnes of ash per day.

Wetted ash for temporary storage on site would occupy around 1.6 tonnes per cubic metre and would be initially stored in a concrete bunker on-site prior to reuse or disposal.

The ash produced from a biomass boiler is relatively clean and considered suitable for a range of potential reuse opportunities including use as fertiliser or as a liming agent for forest soils.

DAU intend to investigate partnership options with a waste disposal contractor for use of the ash for input to a fertiliser supply company. If reuse opportunities cannot be negotiated then the ash would be disposed of as a waste in accordance with EPA's Waste Classification Guidelines (DECCW, 2009).

The existing boilers for removal at the site would be decommissioned following installation of the proposal, and sold to an alternate facility or disposed of in accordance with EPA's *Waste Classification Guidelines* (DECCW, 2009).

5.4.3 Mitigation Measures

All waste disposal at the site would continue to be undertaken in accordance with the EPA's *Waste Classification Guidelines* (DECCW, 2009).

5.5 Other environmental considerations

5.5.1 Visual

Existing environment

The existing sawmill development is visible from a small number of rural residential receivers and from vantage points on the Delgate Bombala Road.

Potential impacts

The proposed boiler would be located behind the GOS kiln and existing 10MW boiler, and views from the road would be obscured by this existing infrastructure and the setback distance. The vent stack would reach about 18 metres above the ground, and visually would be integrated within the existing sawmill structures. The proposal would have a minimal impact on the local environment and surrounding receivers.

Mitigation measures

No additional mitigation measures are proposed.

5.5.2 Heritage

Existing environment

Detailed investigations were undertaken as part of the original approval to investigate the potential impacts upon Indigenous and non-Indigenous heritage values from the development of the project.

The Indigenous assessment resulted in the discovery of artefacts in the form of seven stone shards from tools or toolmaking. It is understood that these were uncovered during previous excavation work. An AHIMS database search was carried out on 4 September 2018 and yielded no further results.

The non-Indigenous assessment identified two potential sites of heritage value on the sawmill site. These included the following:

- Ruins of a Wool Pack Inn (circa 1850)
- A filled in well (potentially associated with the inn).

An updated database and register search was carried out on 4 September 2018 and yielded no further results.

Both heritage sites are located within the boundary of the sawmill site approximately 25 metres away from Delegate Road.

Potential impacts

Both non-Indigenous heritage sites are located well outside the works footprint of the proposal (over 400 metres away) and would not be impacted by the construction or operations of the new boiler.

The foundation for the proposed boiler is existing, and the site has been highly modified. As such, undiscovered heritage items are unlikely to be encountered during construction.

Mitigation measures

The following mitigation measures would be implemented to minimise potential impacts to any heritage items which may be discovered during construction works:

- If an item (or suspected item) of Indigenous and non-Indigenous heritage is discovered during works, all work in that area would cease and the relevant regulator would be notified as soon as possible to determine the subsequent course of action.
- Construction activities and machinery would be restricted to designated work areas.

5.5.3 Flora and fauna

Existing environment

A detailed assessment of the potential ecological impacts associated with the expansion of the sawmill was provided in the Sawmill Expansion EA. The proposed location of the new wood-fired boiler and all associated infrastructure would be entirely within the existing footprint of the sawmill site in an area which has been previously cleared for development and consists of hardstand pavement.

No endangered species have previously been recorded on site.

Potential impacts

The proposal is unlikely to have any additional impact on flora or fauna.

Mitigation measures

No additional mitigation measures are proposed.

5.5.4 Greenhouse

Existing environment

A detailed assessment of greenhouse gas emissions was undertaken as part of the original Sawmill Expansion EA. The site operations contribute to greenhouse emissions through a combination of energy use and activities such as transport and waste disposal. A summary of the greenhouse gas emissions predicted to be emitted directly and indirectly by the approved project are discussed in the Sawmill Expansion EA.

Potential impacts

The major greenhouse gas emissions from the approved project were associated with electricity use and natural gas consumption. The proposal is not anticipated to have any impact upon electricity use and would replace the consumption of natural gas with biomass resulting in considerably less greenhouse emissions than the approved project.

Mitigation measures

No additional mitigation measures are proposed.

5.5.5 Socio-economic

Existing environment

The existing socio-economic setting of the area is discussed in detail in the Sawmill Expansion EA. Bombala has historically been associated with timber forestry and timber production and the ongoing expansion of the sawmill has resulted in the provision of additional jobs within the local community.

Potential impacts

The proposal would improve the efficiency of the sawmill operations by minimising operating costs associated with natural gas consumption and transport of residual timber products. The ongoing viability of the operations would ensure employment is maintained together with associated indirect benefits to sustaining the local and regional economy.

The proposal is anticipated to improve the amenity of local residents living on the main transport routes through Bombala, by reducing the number of heavy vehicle movements required for the transport of residual timber products.

Mitigation measures

No additional mitigation measures are proposed.

6. Conclusion

DAU is seeking a modification to PA_0161 in accordance with Section 4.55 of the EP&A Act to facilitate a minor design change to the approved project description.

The design changes would improve the operational efficiency and improve the reduce the risk profile of the project.

The proposed minor design change, to use existing offcuts from sawmilling activities, would improve the operational efficiency of the site, while reducing the number of heavy vehicles exporting waste from the site, thereby improving the local environment.

To evaluate the impacts of the proposed modification, an assessment of potential impacts has been completed for the proposal. The potential impacts are considered consistent with those described in the Sawmill Expansion EA and Modification 2.

Given the minor nature of the proposed modifications, it is considered that the modification is consistent with the original project approval. The environmental impacts from the modification are negligible to minor and it is considered appropriate that the modification be considered under Section 4.55 of the EP&A Act.

7. References

Blackett Acoustics 2018. Operational Noise Monitoring. Report No BA180521, Version A, August 2018.

DECCW, 2009 Waste Classification Guidelines.

DECCW, 2009. Interim Construction Noise Guidelines (ICNG).

GHD, 2014. Bombala Sawmill, Section 75W Modification, Environmental Assessment. August 2014.

Landcom, 2006: Managing urban stormwater: Soils and construction Volume 1 (Blue Book), 4th Edition (Reprinted July 2006).

NSW EPA 2016. *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*.

NSW EPA 2017. *Noise Policy for Industry*.

The Fifth Estate 2009, Environmental Assessment for a Major Project – Expansion of Bombala Integrated Sawmilling and Value-adding Facility, prepared for Dongwha Timbers Pty Ltd, November 2009.

Appendices

Appendix A – Environmental assessment requirements

Department of Planning and Environment – 20 April 2018

Sophie Lovett

From: Olivia Hirst (InTouch)
Sent: Friday, 20 April 2018 4:15 PM
To: Michael Dyer (Michael)
Cc: KwangByeong Chae 채광병 (KB); Pamela Morales
Subject: Proposed Construction of new Bio Mass Boiler 2018 - Environmental Assessment Requirements

Hi Michael,

Please see below Environmental Assessment Requirements (EARs) for Dongwha Timbers proposed construction of a new 13mw biomass boiler (Modification no. 3).

These EARs have been developed in consultation with the EPA and cover minimum requirements for our consideration of your proposed modification.

Details of Modification

- Background information regarding application and existing approvals
- Clear description of proposed modification including site plan and specific details of construction, installation, operation and maintenance of proposed 13mw biomass boiler
- Details regarding continued operation and performance of existing 2.5mw chip fired boiler
- Justification and need for proposed modification
- Compliance with either Section 4.55(1A) or Section 4.55(2) of the *Environmental Planning and Assessment Act 1979 (EP&A Act)*
- Details of any desired changes to approved conditions of consent

Environmental Impacts

- Assessment of any additional environmental impacts resulting from the proposed modification and proposed management and mitigation measures
- In particular consideration of **air quality** and **noise** and **vibration** impacts and the proposed mitigation and management measures *Note: these assessments should be undertaken with reference to the EPA's guidance documents (Air - Approved methods for modelling and assessment of air pollutants in NSW 2016, POEO (Clean Air) Regulation 2010) (Noise – Interim Construction Noise Guideline, Assessing Vibration: technical guideline, Industrial Noise Policy Application Notes)
- Details of **waste generation** from the proposed modification and proposed management measures including types and volumes of waste
- Details of **visual** impacts from the proposed modification and proposed management measures including details of **landscape management**
- Details of any additional **hazards** and/or **risks** associated with proposed modification and proposed management measures

Existing and Future Compliance Issues

- Current and likely future compliance of existing 2.5mw chip fired boiler
- Update on current status of compliance including noise, soil and water contamination and stockpile management (wood residue and sawdust from milling operations)
- Details regarding role of new biomass boiler in addressing existing timber stockpile management issue

It is recommended that you consult with the EPA, Council and any other relevant agencies in preparing the Environmental Assessment for the proposed modification.
Consultation with all surrounding land owners and residents is also recommended.

As you have an approval granted under the now repealed Part 3A of the EP&A Act, you will be required to transition the project to State significant development (SSD). Please contact the Department prior to lodgement of your modification application as we will need to discuss the transitional arrangements.

If you have any questions regarding the above please contact me on the details below or Pamela Morales on 9274 6386.

Kind regards,

Olivia Hirst
Planning Officer
Industry Assessments
320 Pitt Street | GPO Box 39 | Sydney NSW 2001
T 02 9274 6583 **E** olivia.hirst@planning.nsw.gov.au

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Appendix B – Letter to nearby receivers

Sent 29 June 2018

Dongwha Australia 1 Sandy Lane, Po Box 146, Bombala NSW 2632. Australia
Tel. 02 6459 5555 Fax. 02 6458 3756 www.dongwha.com.au

Dear ……

We are writing to inform you of our intentions to construct a 15mw bio mass boiler. As a courtesy to our neighbors we are providing the following information for your perusal. The biomass boiler will reduce the buildup of sawdust and residue products within the Dongwha site. We anticipate to complete this project by September 2019.

Introduction

Dongwha Australia (DAU) initially successfully applied in 2015 for a Mod 2 approval to allow the construction of an 18mw Biomass Boiler. This Boiler was envisaged to replace the current 10mw gas fired boiler and the 2.5mw chip fired Boiler that are currently operational on site.
However no cost effective way to construct and set up the steam supply across site was available, therefore the Project never proceeded.
The 10mw Boiler currently operates the Green off sawn (GOS) Kilns whilst the 2.5mw Boiler operates the Redry Kilns.
The original plan linked to Mod 2 in 2015 was to convert the GOS Kilns to steam, the Redry Kilns were already functioning under steam so all Kilns would then operate with one energy source, steam.

Summary

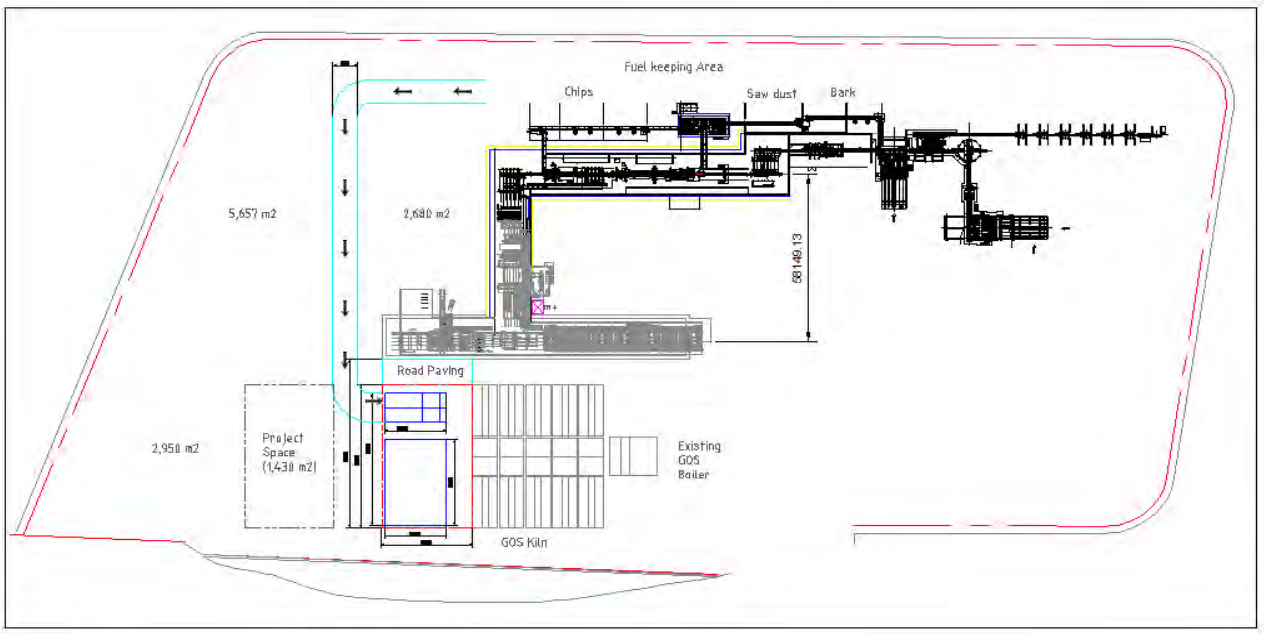
DAU has now been able to source a cost effective option for our Biomass installation. The new proposed Boiler will generate hot water from our residue products, mainly sawdust.
Due to the geographical location of the new Biomass Boiler being located adjacent to the GOS it will feed directly in to the Kilns and allow the return water to circulate efficiently.
We therefore need to maintain the current 2.5mw chip fired Boiler that currently supplies energy, by the way of steam to the Redry Kilns.
We have engaged Ektimo to carry out testing to establish where this Boiler is at in regard to meeting the standards. Results were obtained and have been forwarded to DoP and EPA.

Points

- DAU will utilize sawdust – 90% of requirement then oversize chip and bark as fuel.
- Construction of new Biomass Boiler will be adjacent to GOS area so as to make efficient.
- Thomas Strang and the EPA have met on site to discuss the proposed Biomass Boiler.
- Thomas Strang, MD of Justen Pacific is providing information to EPA as required.
- Ektimo have completed testing on the existing 2.5mw Redry Boiler for compliance.

Dongwha Australia 1 Sandy Lane, Po Box 146, Bombala NSW 2632. Australia
Tel. 02 6459 5555 Fax. 02 6458 3756 www.dongwha.com.au

The following diagram shows the location of the new bio mass boiler.



This is not our actual bio mass boiler but depicts the proposed construction.

Dongwha Australia 1 Sandy Lane, Po Box 146, Bombala NSW 2632. Australia
Tel. 02 6459 5555 Fax. 02 6458 3756 www.dongwha.com.au

If you require any further information please don't hesitate to contact myself through the following options:

Michael Dyer
Dongwha Australia | Engineering / Compliance Manager
PO Box 146 Bombala, NSW, Australia
Tel.02 6459 5510
Mobile:0439 638 273
michael.dyer@dongwha.com (Preferred)

Regards,
Michael Dyer

Appendix C – Design plans

JUSTSEN Energiteknik

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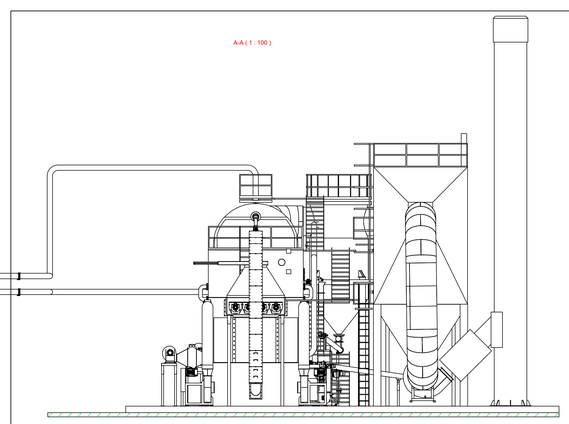
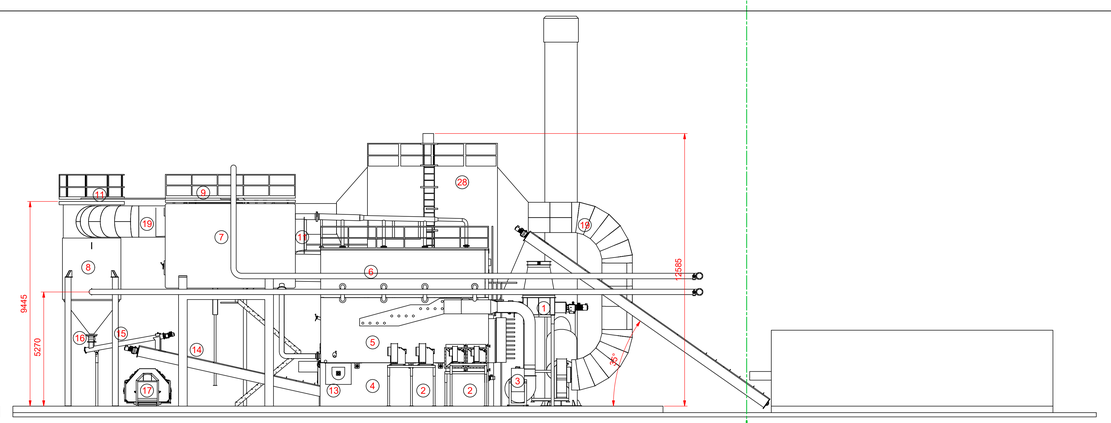
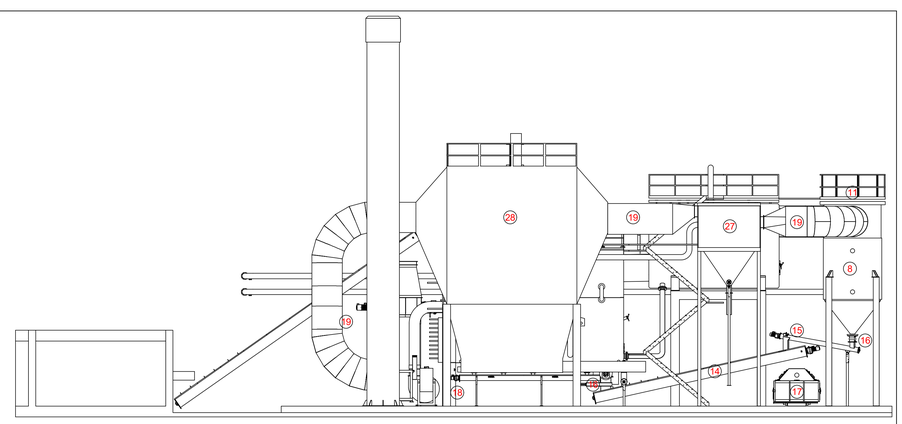
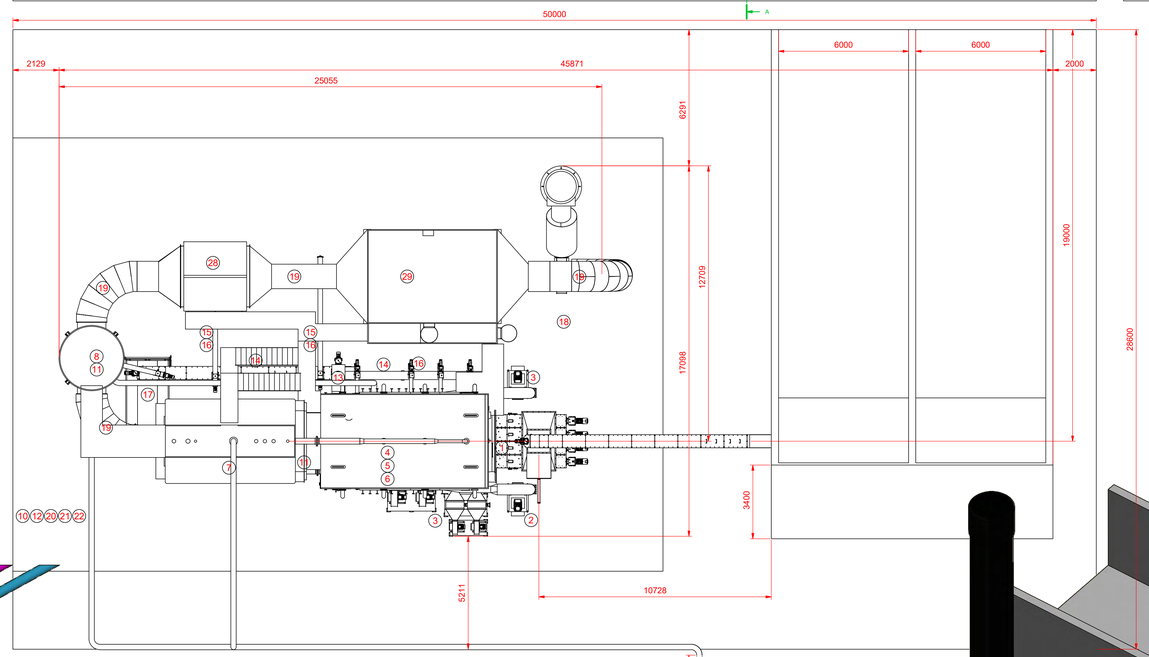
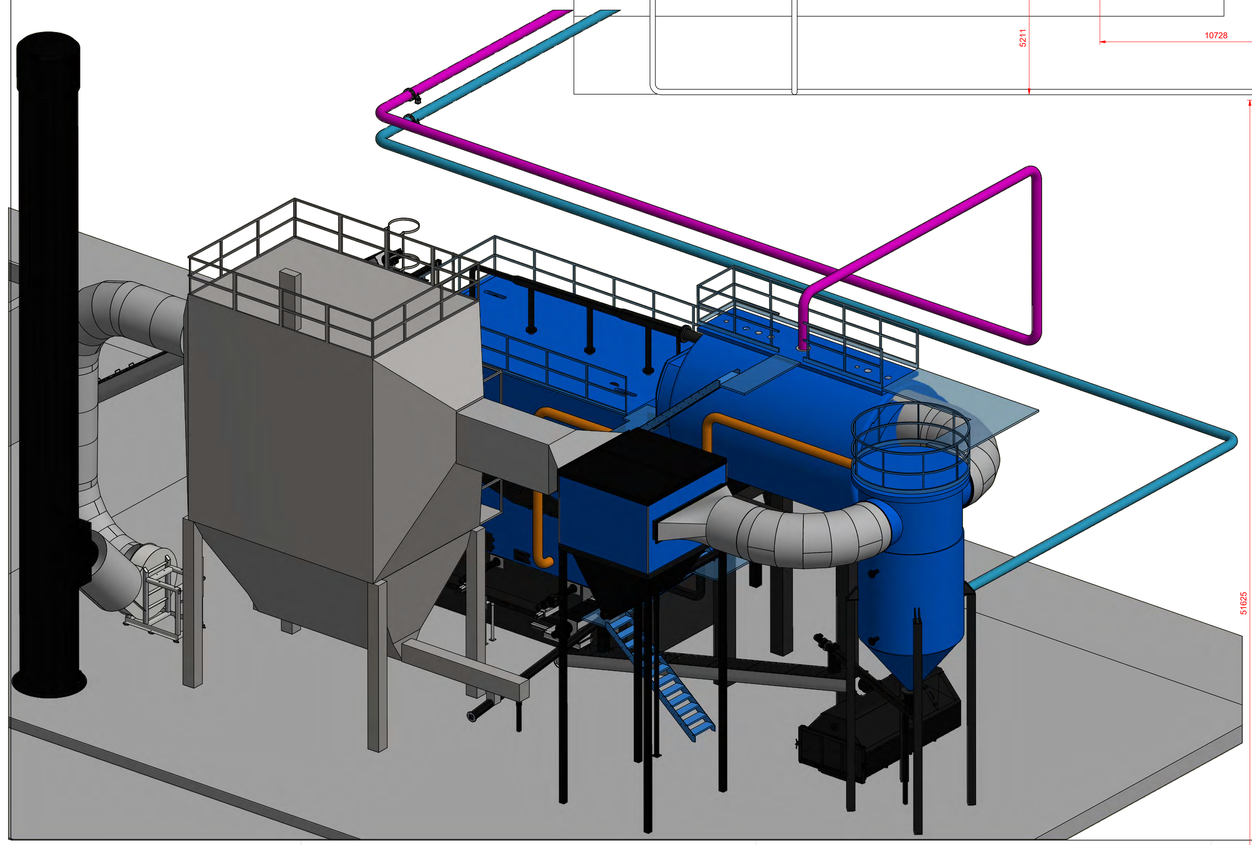
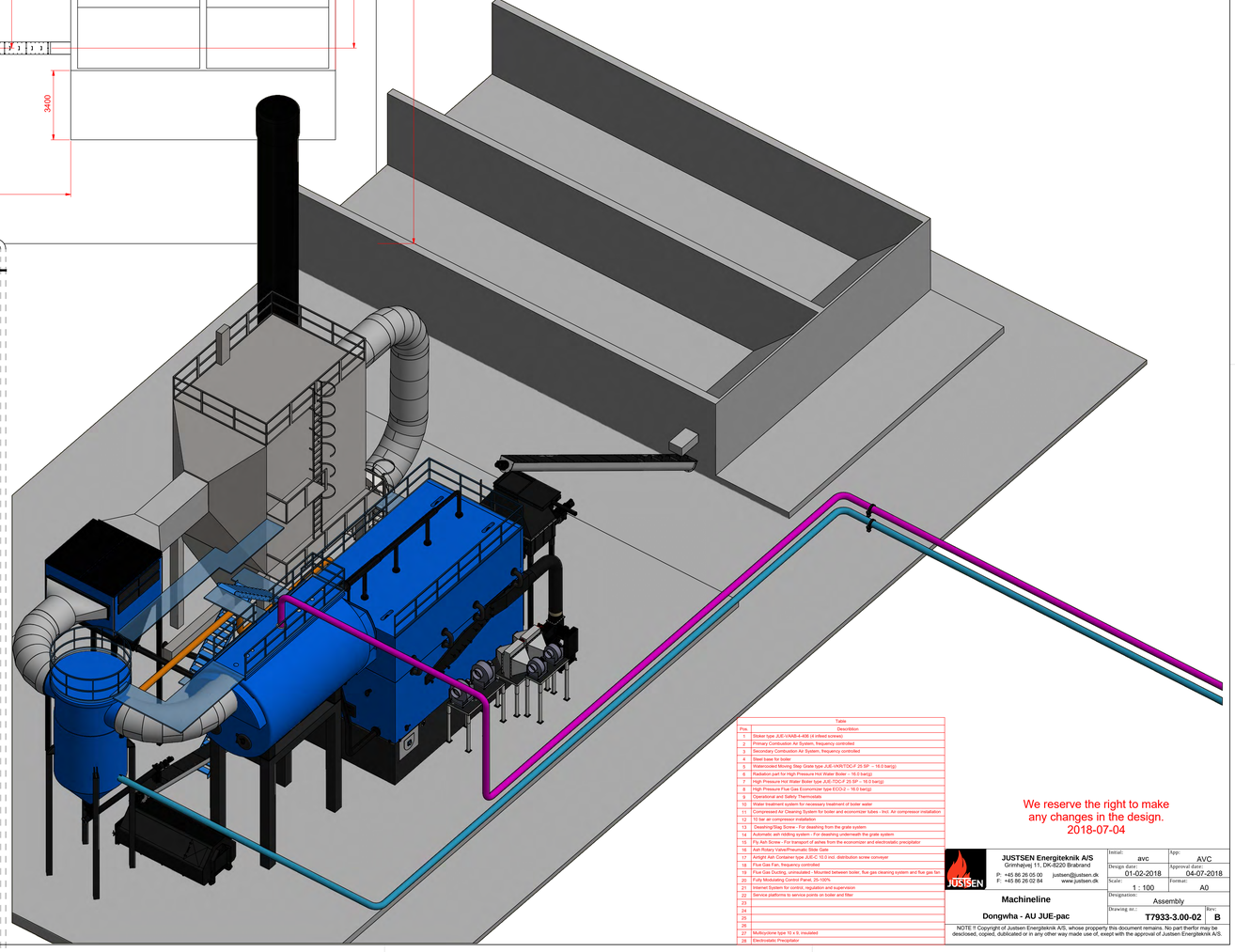












51625

Table	
Pos.	Description
1	Stoker type JUE-VAIB-4-40K (4 infeed screw)
2	Primary Combustion Air System, frequency controlled
3	Secondary Combustion Air System, frequency controlled
4	Steel base for boiler
5	Watercooled Moving Step Grate type JUE-VWT/DC-F 25 SP – 16.0 bar(g)
6	Radiation part for High Pressure Hot Water Boiler – 16.0 bar(g)
7	High Pressure Hot Water Boiler type JUE-TDC-F 25 SP – 16.0 bar(g)
8	High Pressure Flue Gas Economizer type ECO-LF – 16.0 bar(g)
9	Operational and Safety Thermostats
10	Water treatment system for necessary treatment of boiler water
11	Compressed Air Cleaning System for boiler and economizer tubes - Incl. Air compressor installation
12	10 bar air compressor installation
13	Deashing/Slag Screw - For deashing from the grate system
14	Automatic ash riddling system - For deashing underneath the grate system
15	Fly Ash Screw - For transport of ashes from the economizer and electrostatic precipitator
16	Ash Rotary Valve/Pneumatic Slide Gate
17	Airtight Ash Container type JUE-C 10.0 incl. distribution screw conveyer
18	Flue Gas Fan, frequency controlled
19	Flue Gas Ducting, uninsulated - Mounted between boiler, flue gas cleaning system and flue gas fan
20	Fully Modulating Control Panel, 20-100%
21	Internet System for control, regulation and supervision.
22	Service platforms to service points on boiler and filter
23	
24	
25	
26	
27	Multicyclone type 10 x b. insulated
28	Electrostatic Precipitator

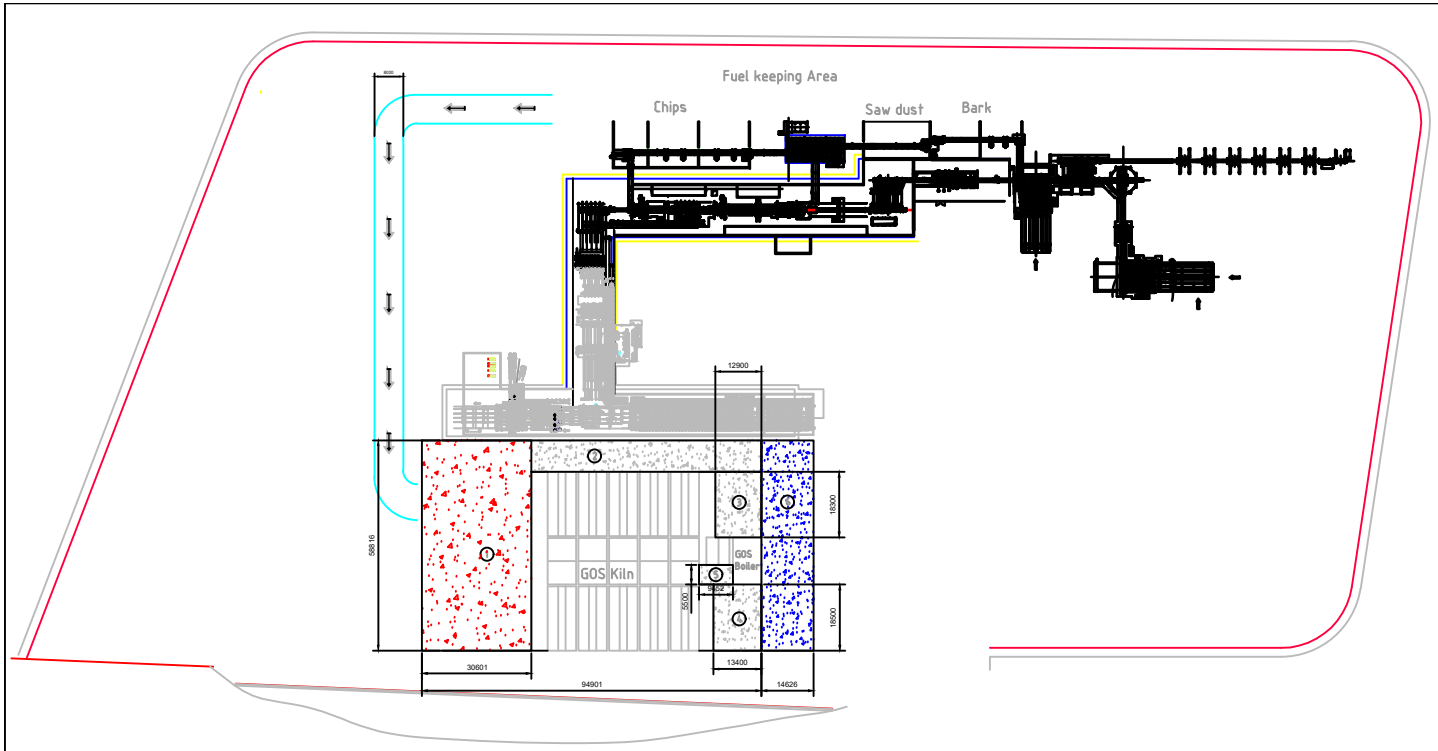
We reserve the right to make any changes in the design.
2018-07-04

JUSTSEN Energiteknik A/S
Grimhøjvej 11, DK-8220 Brabrand
P: +45 86 26 05 00 justsen@justsen.dk
F: +45 86 26 02 04 www.justsen.dk

Machineline

Dongwha - AU JUE-pac

Initial:	avc	App:	AVC
Design date:	01-02-2018	Approval date:	04-07-2018
Scale:	1 : 100	Format:	A0
Designation:	Assembly		
Drawing nr.:	T7933-3.00-02	Rev:	B


Fuel keeping Area
Chips
Saw dust
Bark
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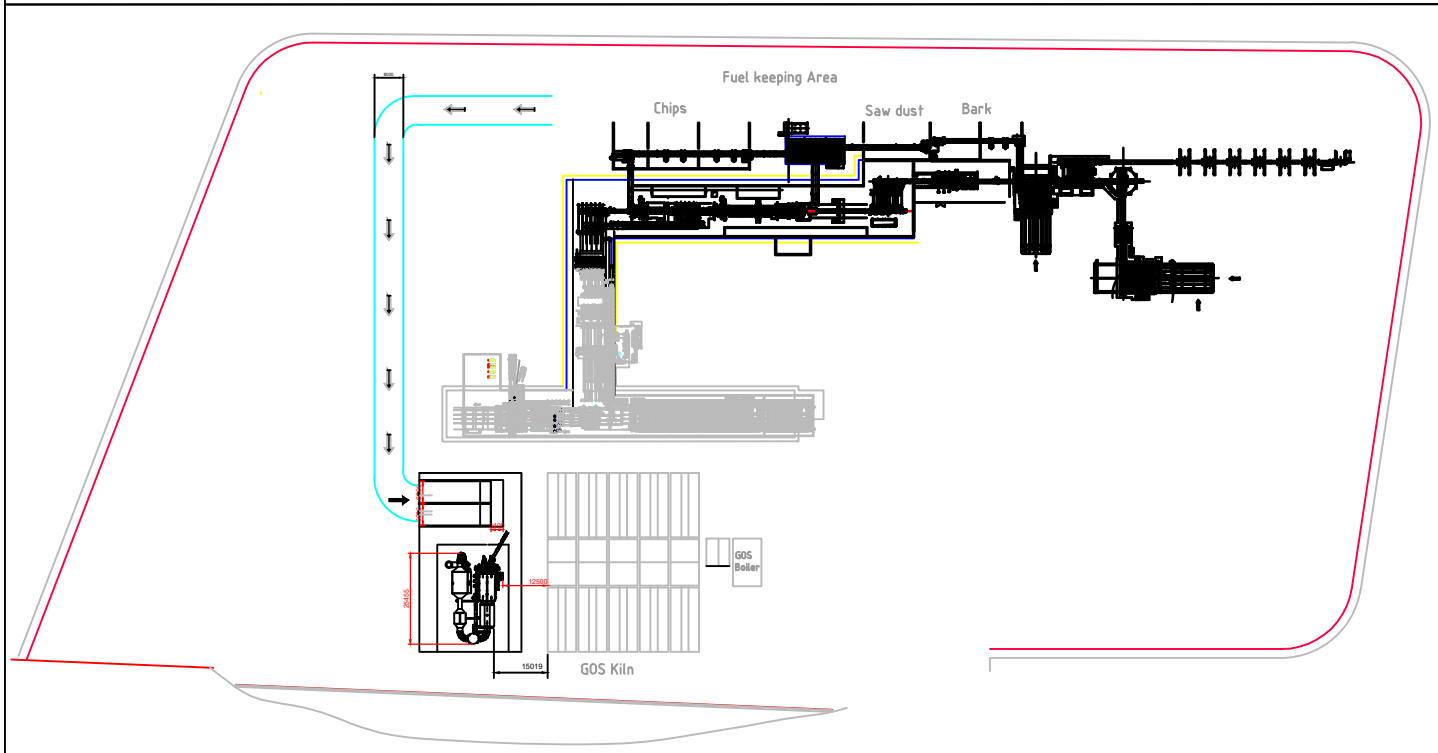
18300
GOS Boiler
GOS Kiln
5500
18500
588.16
30601
13400
94901
14626


Fuel keeping Area
Chips
Saw dust
Bark
GOS Boiler
12500
29455
15019
GOS Kiln

Appendix D – Air Quality Assessment

Ektimo

August 2018

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
www.ektimo.com.au
ABN: 86 600 381 413

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

Client Name:	Dongwha Australia Pty Ltd
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Attention:	Michael Dyer
Address:	Sandy Lane, Bombala, NSW. 2632

Report Status

Format	Document Number	Report Date	Prepared By	Reviewed By
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Final Report	R006226	17 August 2018	A. Lewis	D. Corbett

Amendment Record

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

Report Authorisation

Ektimo
A. Lewis
Air Quality Environmental Consultant

Table of Contents

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

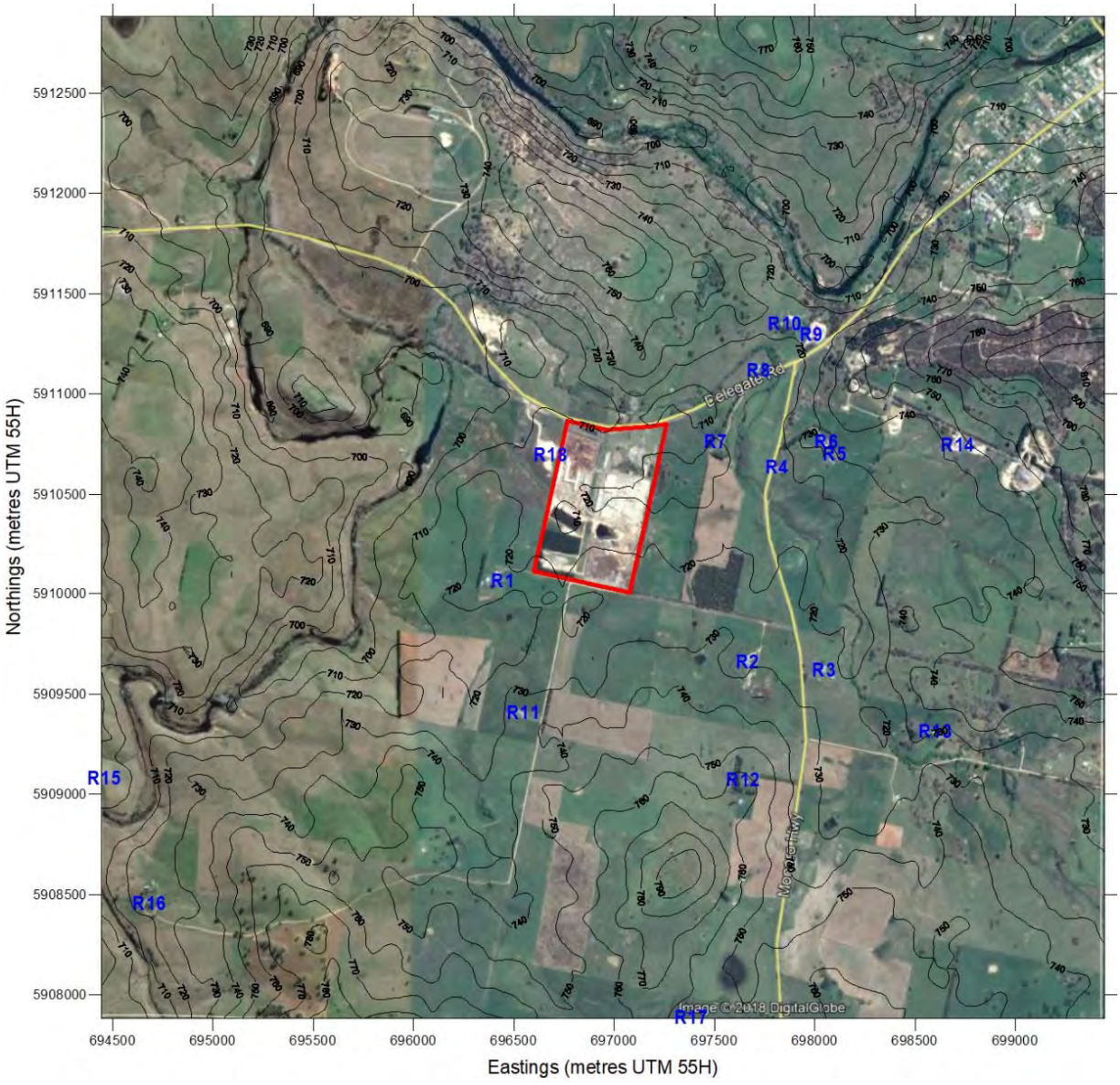
The town of Bombala is located approximately 485 km south of Sydney, in the south-west tablelands of NSW at an elevation of approximately 720 metres above sea level. The population of Bombala as noted in the 2016 Census was 1,387. Commercial activities in the area are predominantly agricultural cropping, 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*).

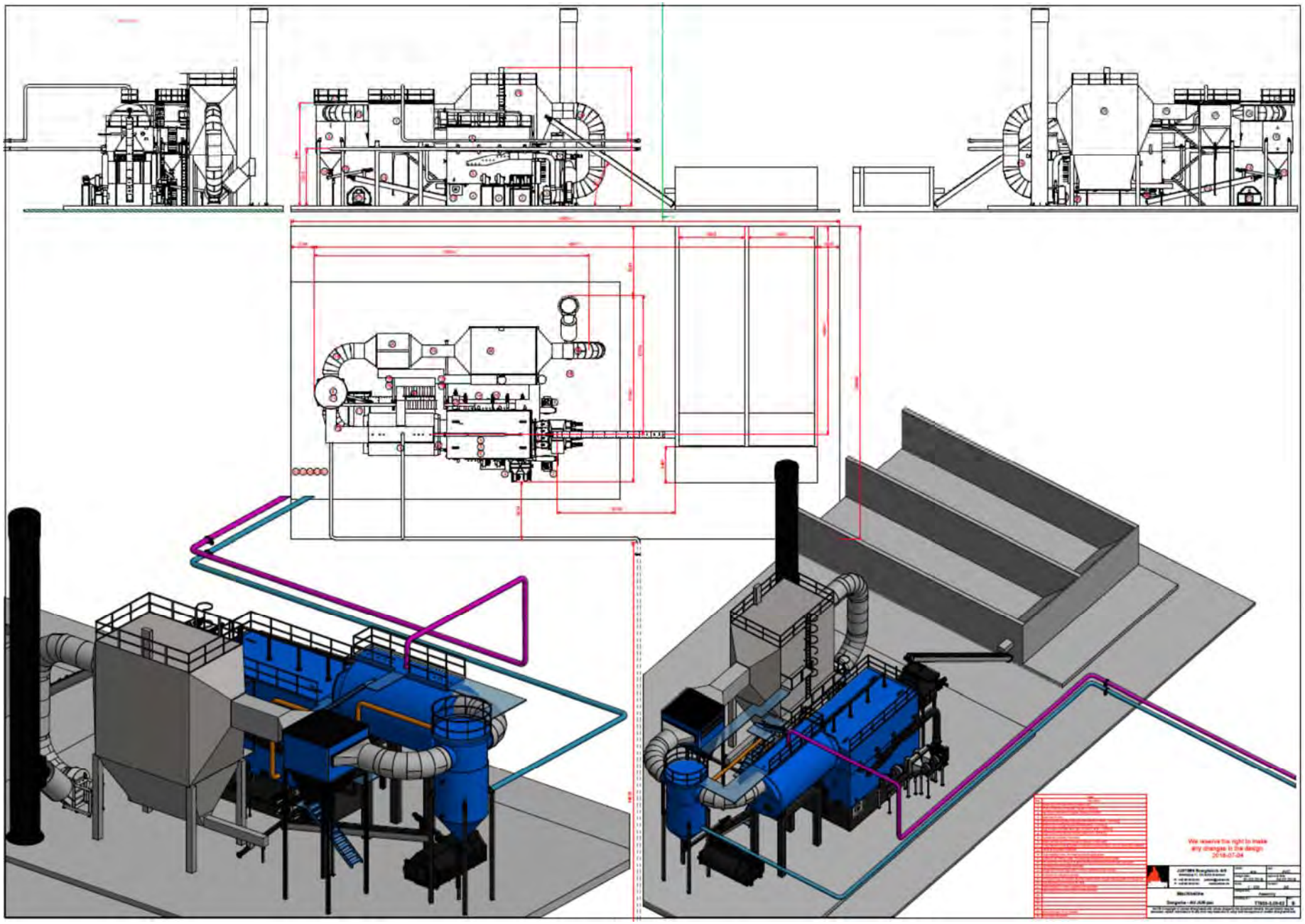


Table 4: Summary of assessed stack conditions.

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	

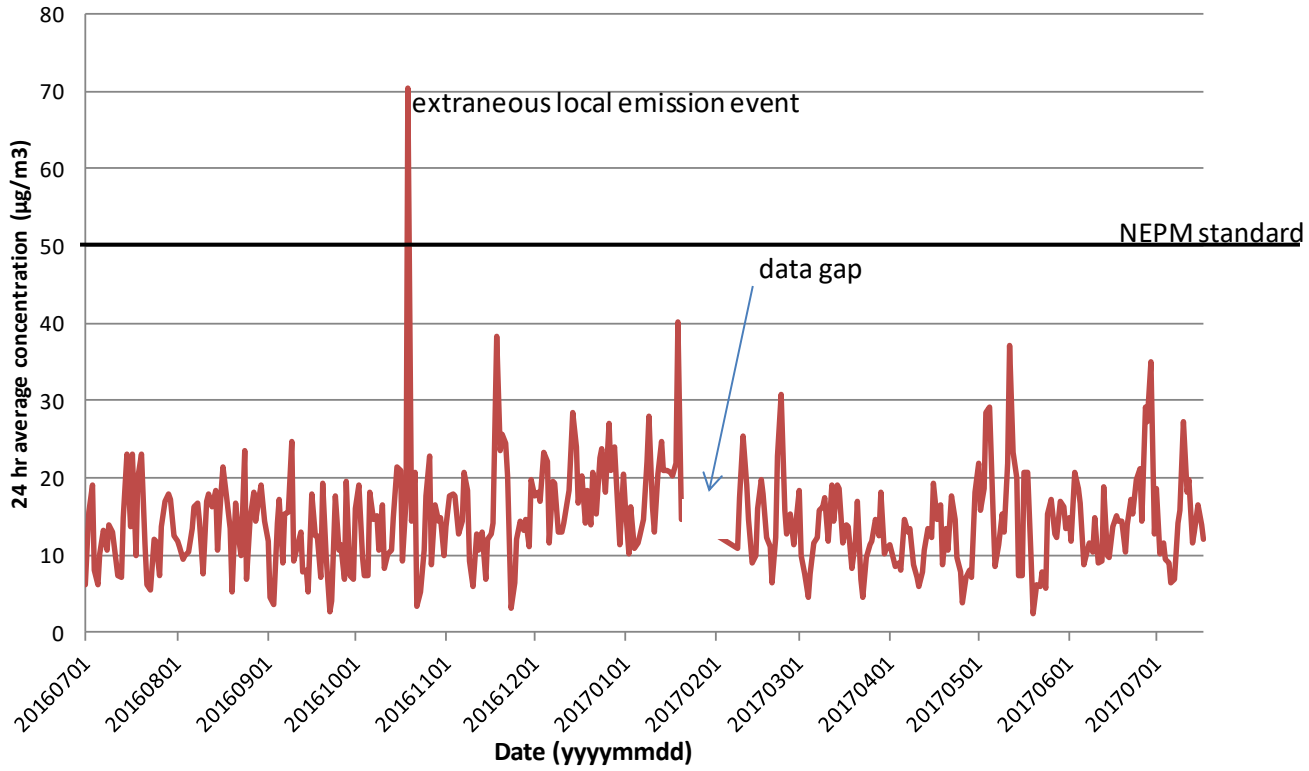
[2] Gupta, Partha Kumar, *Relationship between total suspended particulates and particulate matter of 10 microns*, Master of Engineering (Hons.) thesis, Department of Civil and Mining Engineering, University of Wollongong, 1996. http://ro.uow.edu.au/theses/2433

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.

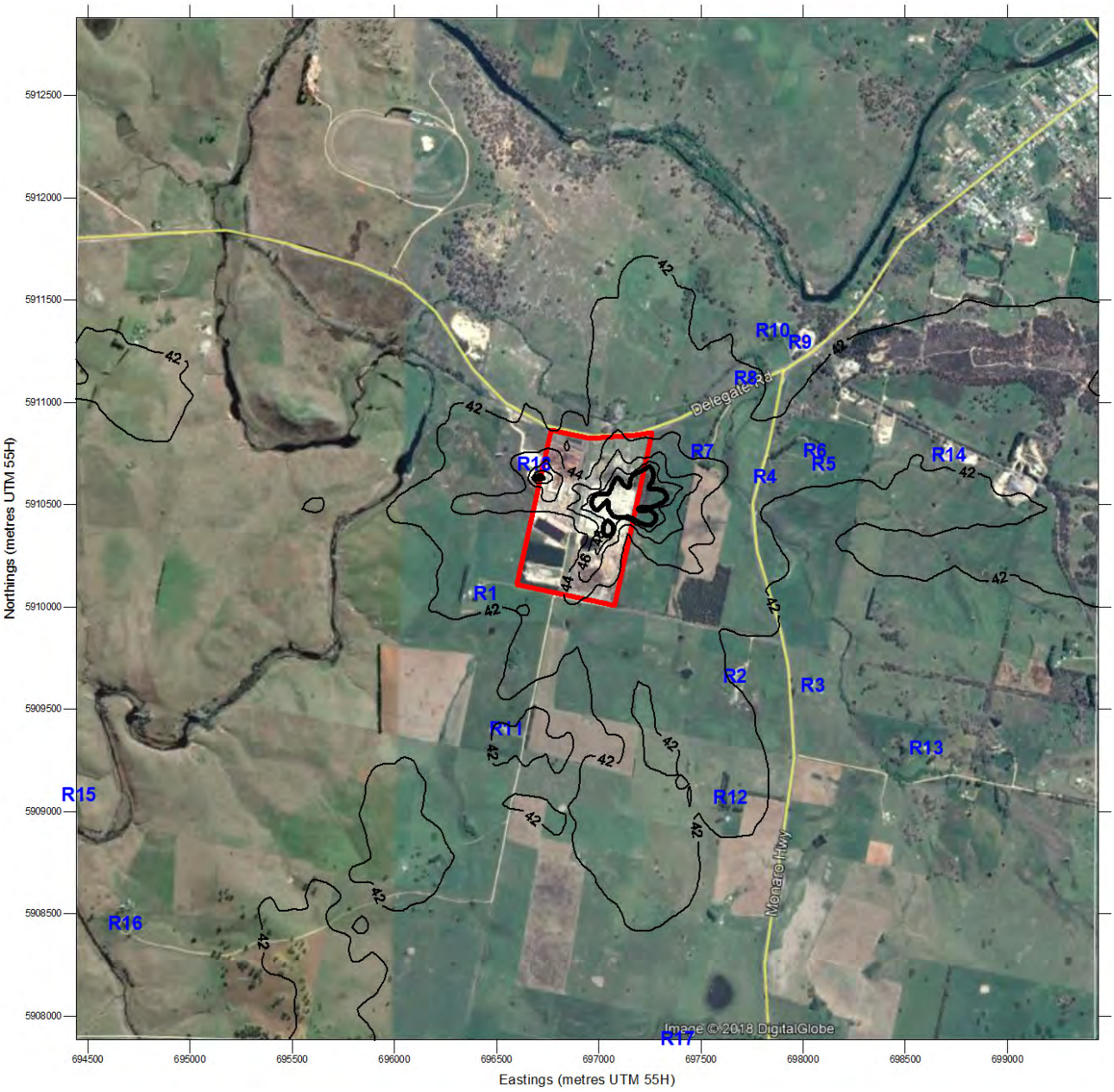


Figure 6

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.

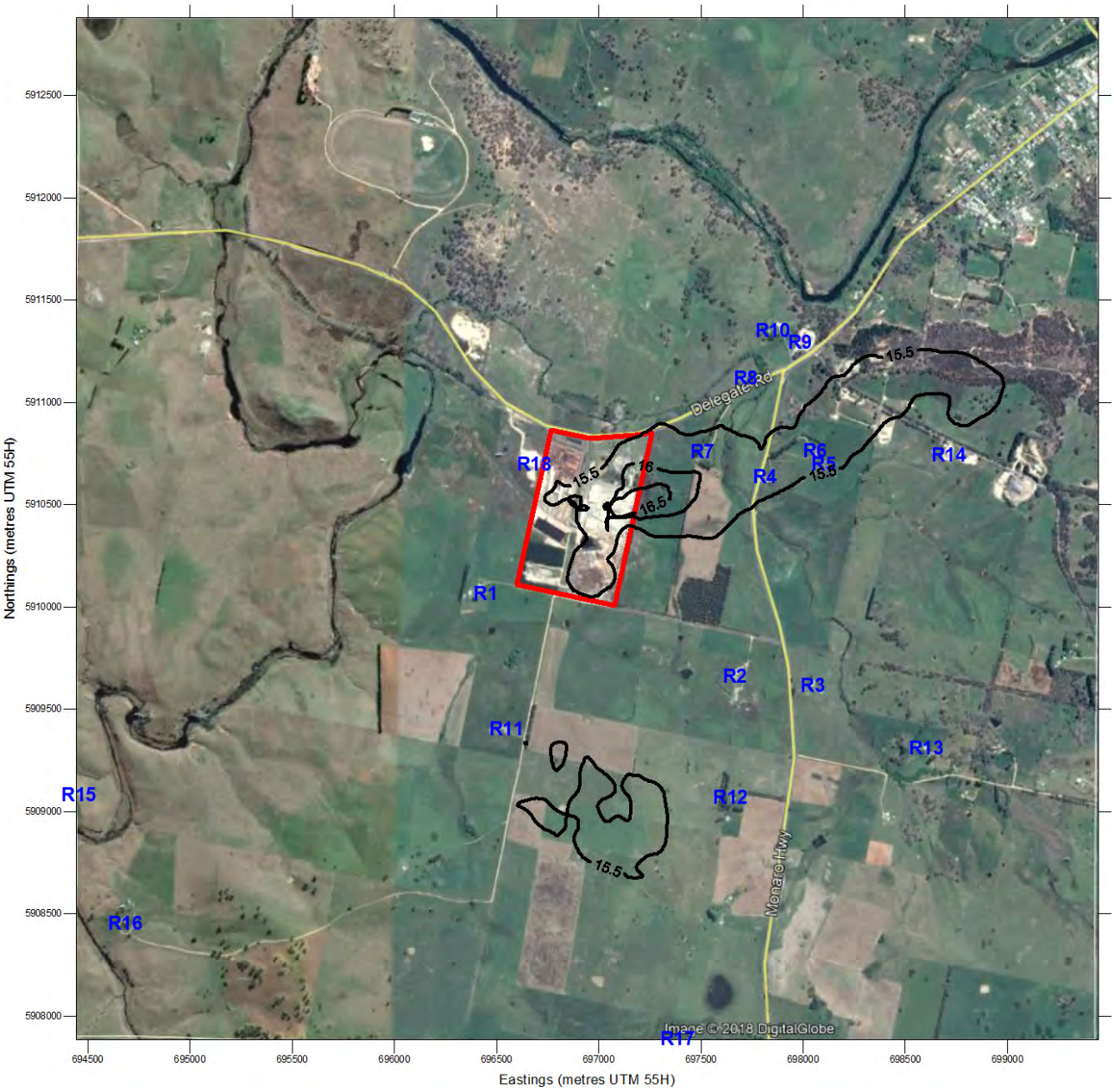


Figure 7

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.

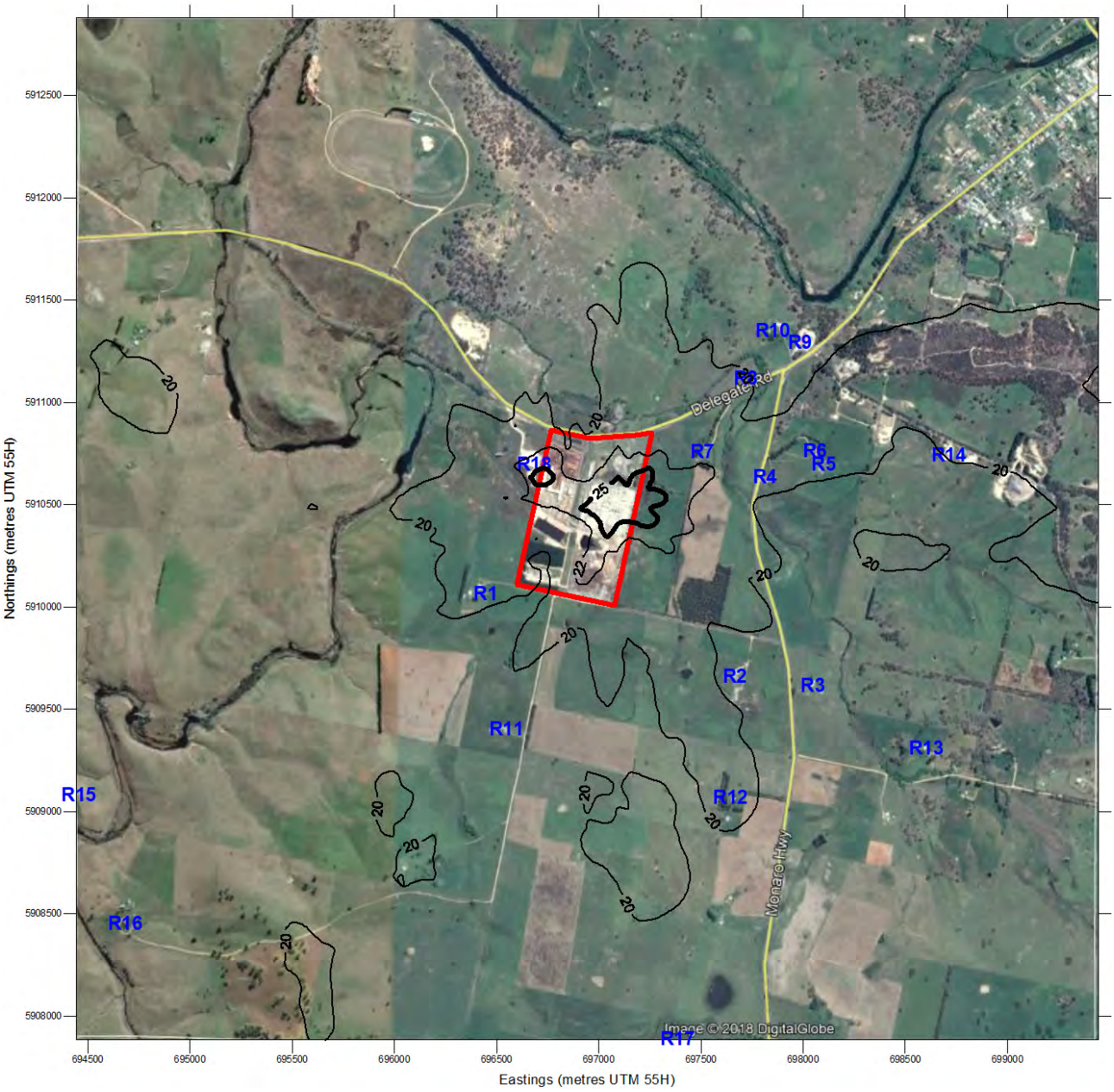


Figure 8

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.

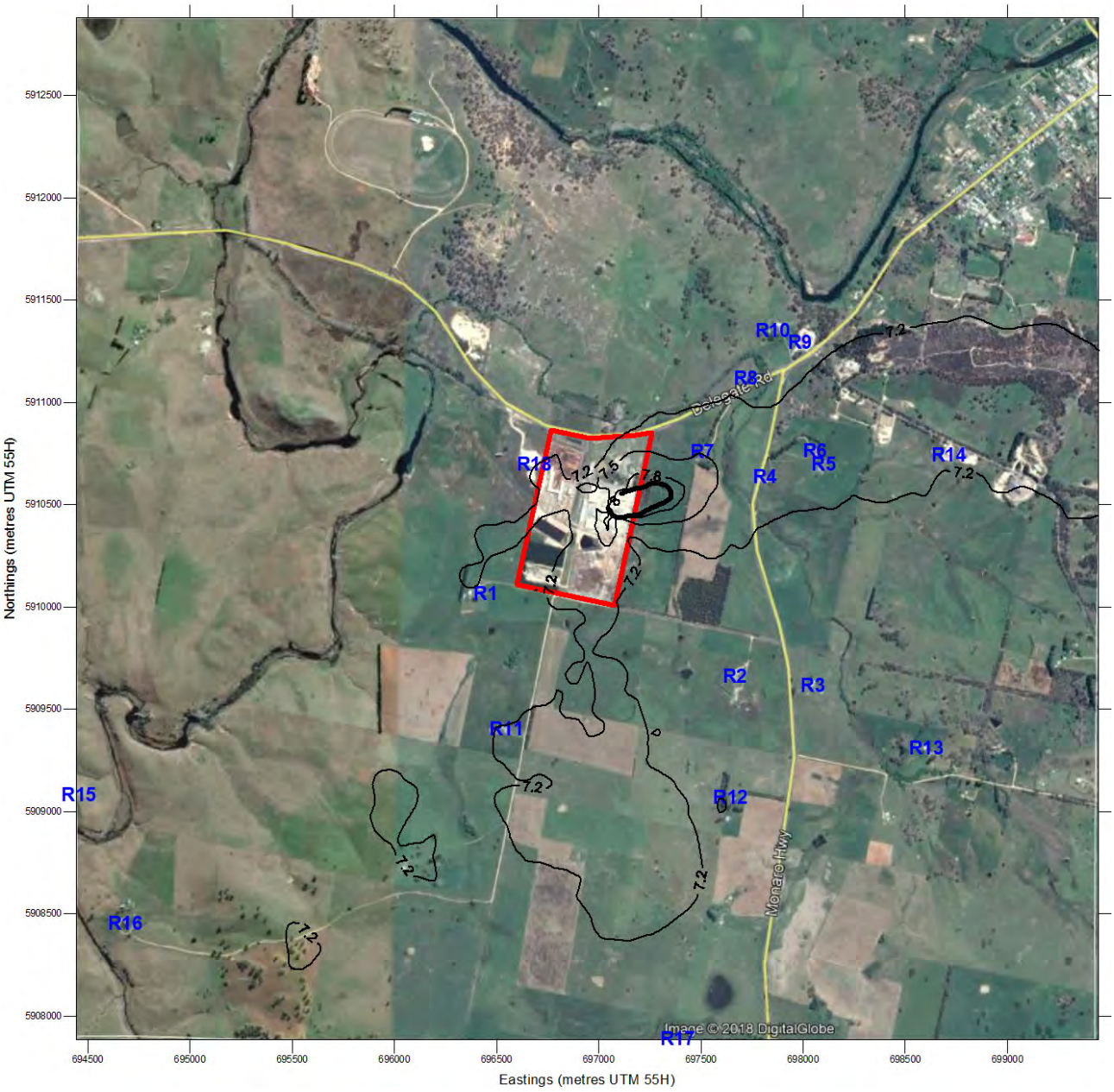


Figure 9

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.

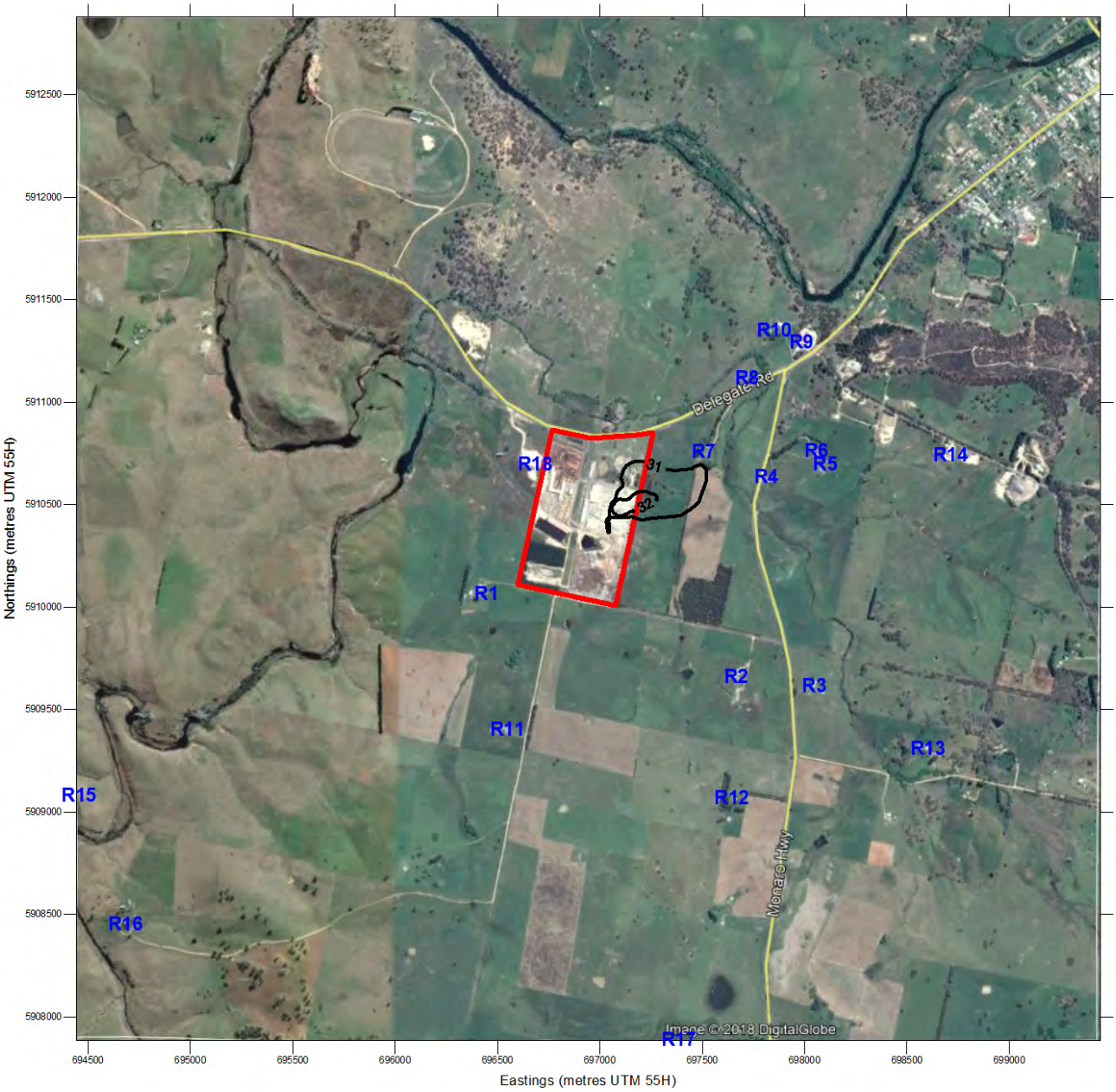


Figure 10

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.

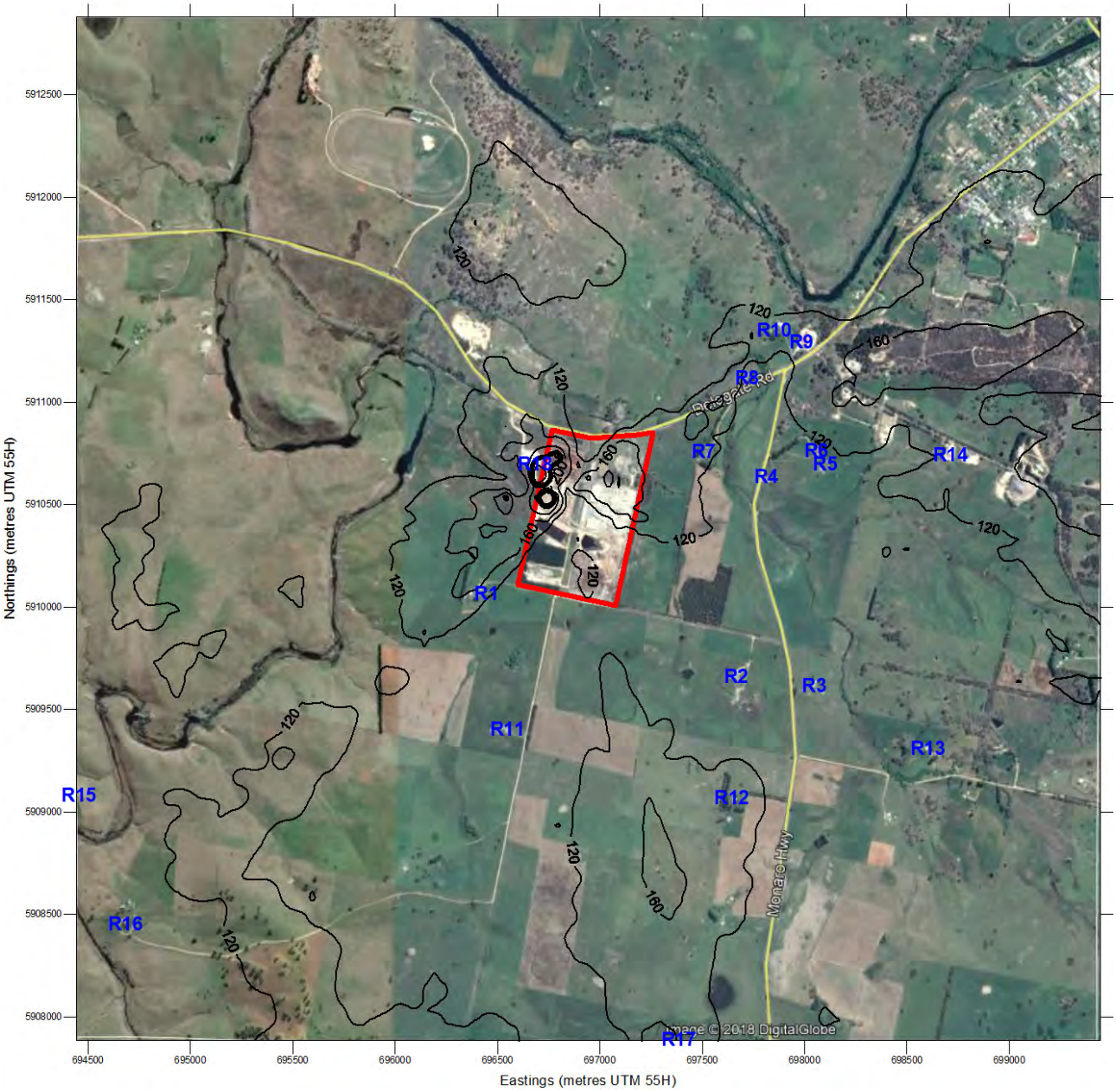
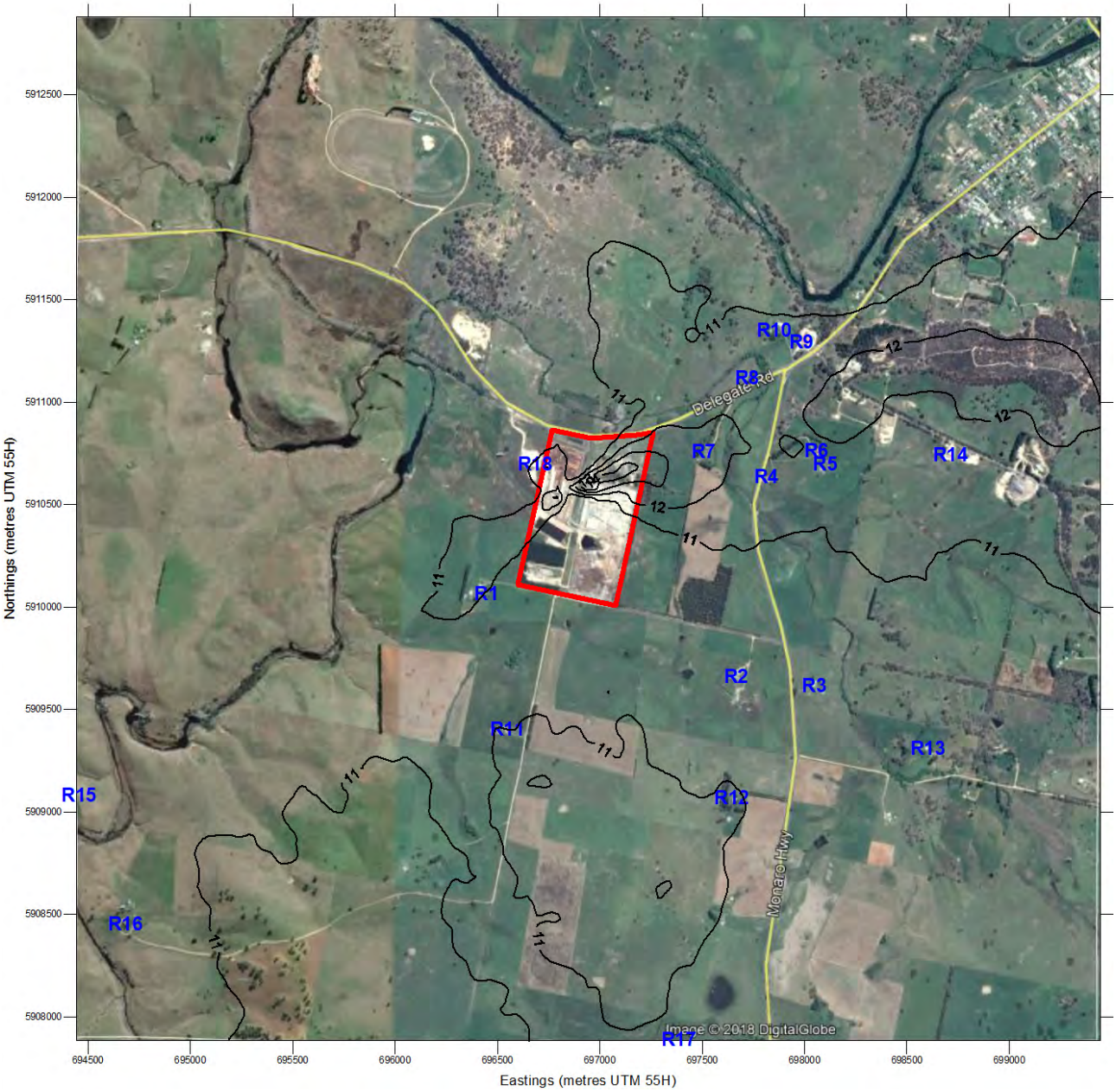


Figure 11

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

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
www.ektimo.com.au
ABN: 86 600 381 413

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.

Table of Contents

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

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
www.ektimo.com.au
ABN: 86 600 381 413

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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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.

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 worldwide.

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

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
www.ektimo.com.au
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

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

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

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

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

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

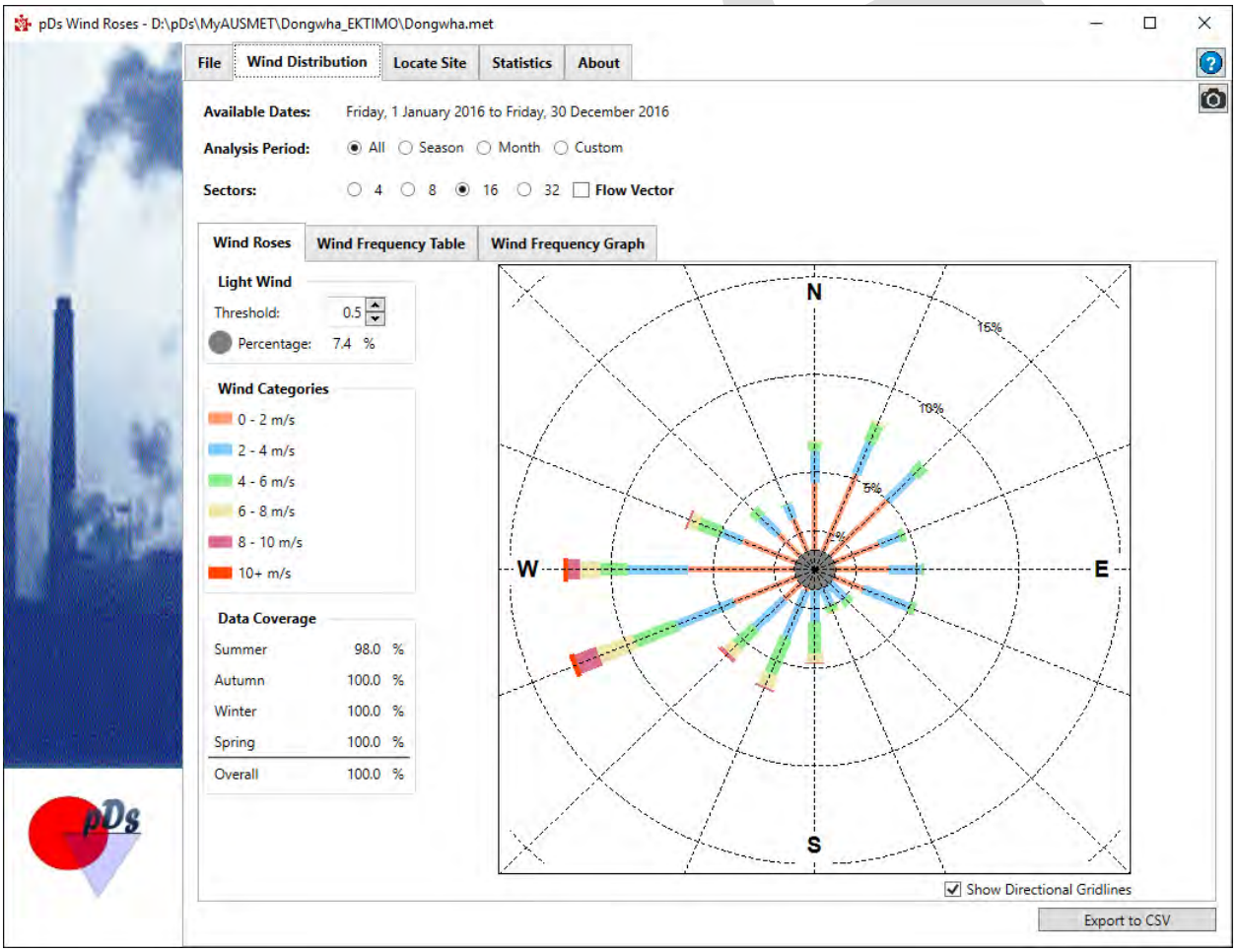
Height of the convective boundary layer was determined using daytime temperature sounding (Vertical temperature and dewpoint profiles) in between sunrise and sunset. Surface meteorological conditions at Dongwha, Australia in **Bombala** and temperature profiles at **Sydney Airport** were used to estimate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

ANALYSIS

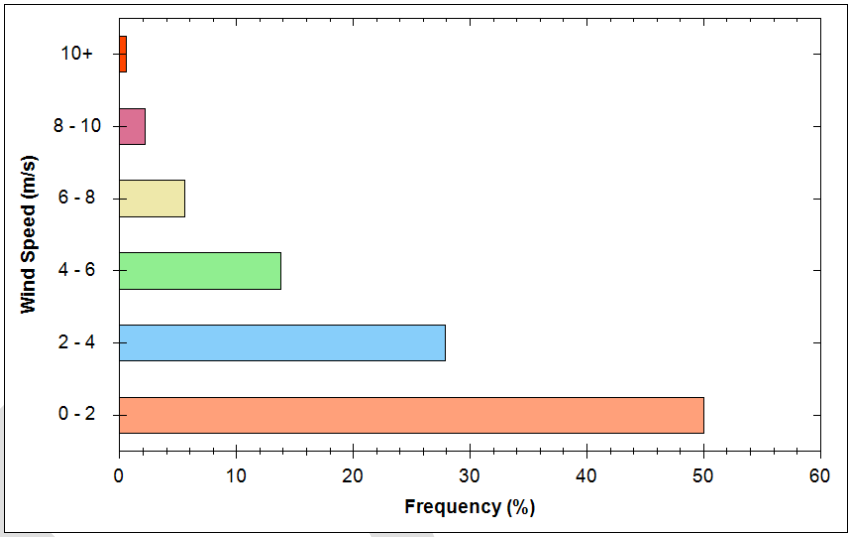
DATA COVERAGE

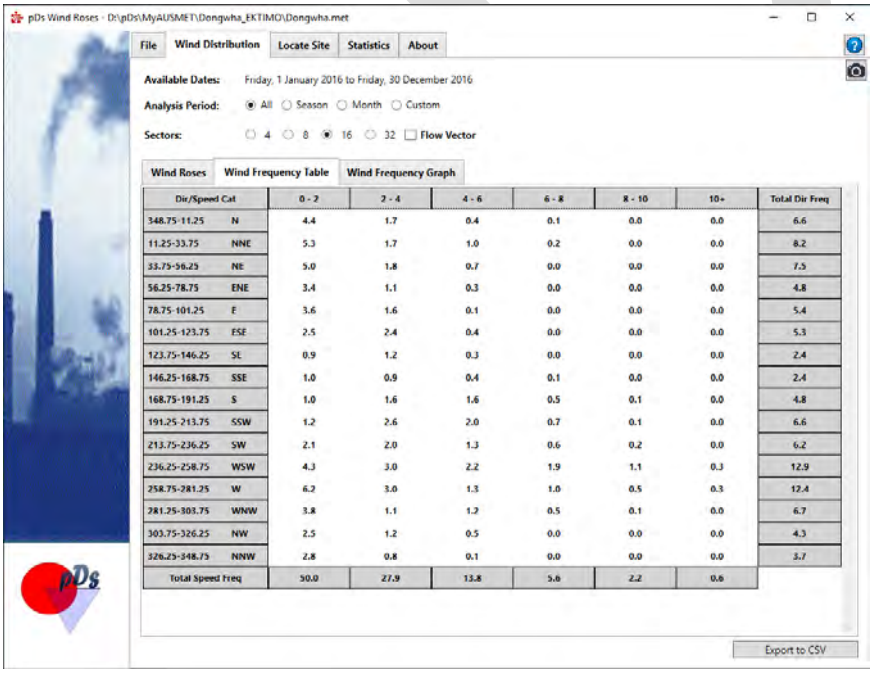
All data in the date ranged recovered (100%). Annual data coverage is meeting the regulatory requirements (~90%).

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	

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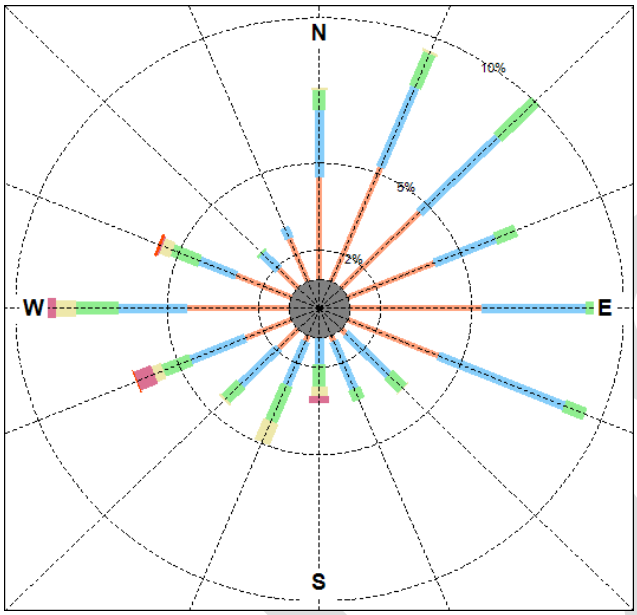
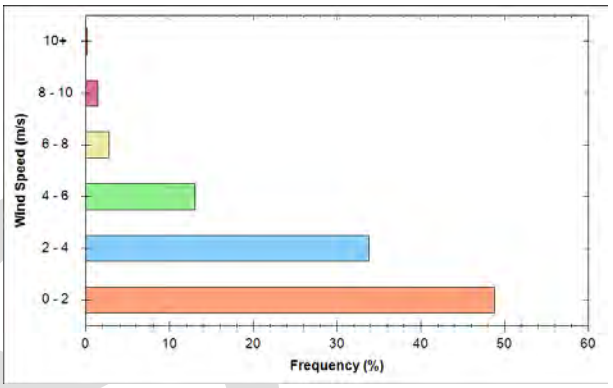
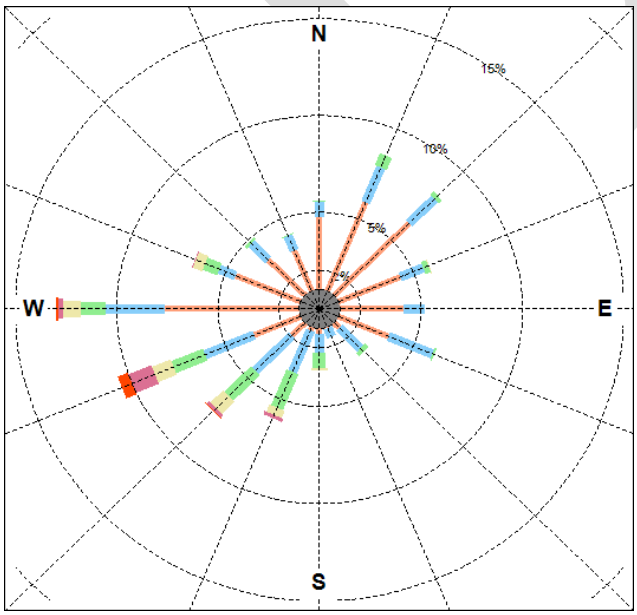
SEASONAL WINDROSES

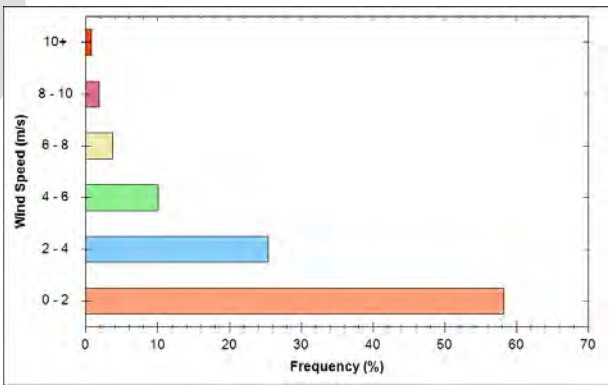
Summer



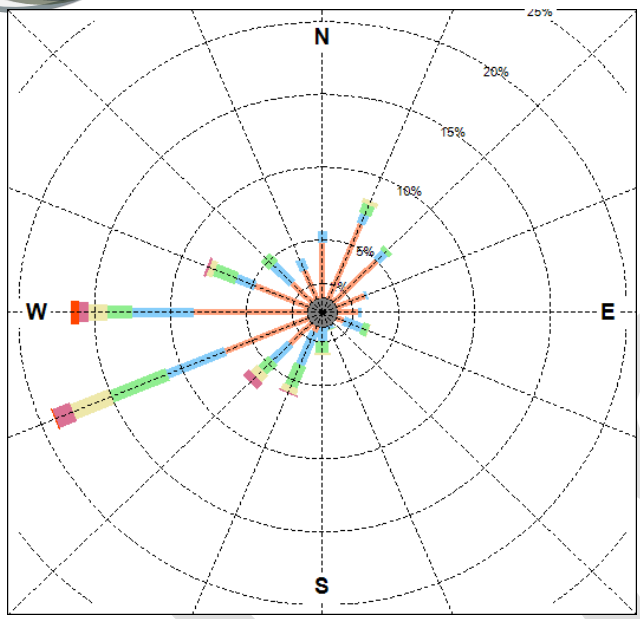


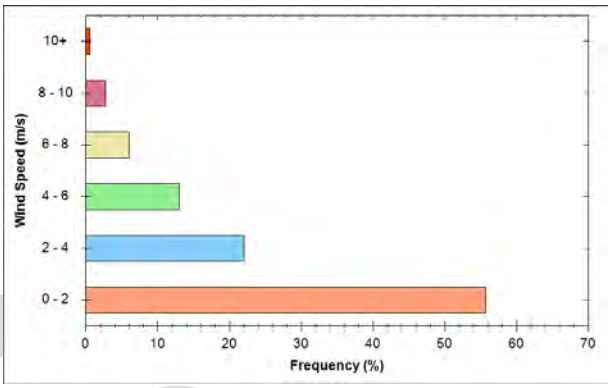
Autumn



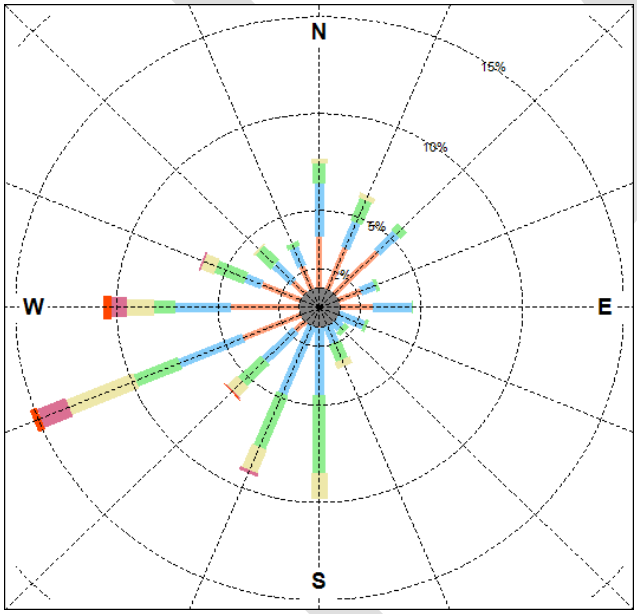


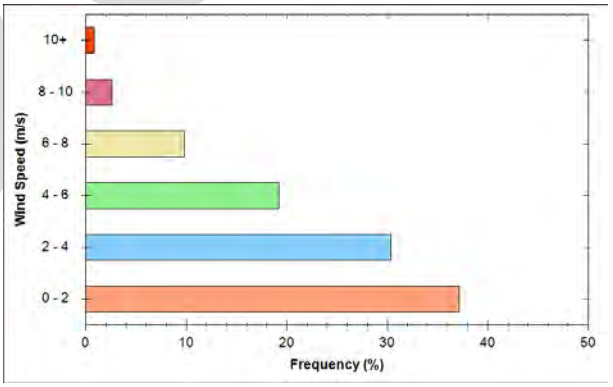
Winter





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.

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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

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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
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)

Appendix E – Noise and vibration assessment

GHD

September 2018

Dongwha Australia Holdings Pty Ltd

Bombala Sawmill modification 3 SEE

Noise and Vibration Impact Assessment

October 2018

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Table index

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Appendices

1. Introduction

1.1 Overview

Dongwha Australia (Dongwha) operate a saw milling facility approximately two kilometres south west of Bombala in Monaro region of NSW. 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 modification to PA 07_0161 was granted in February 2012 ("Modification 1") following the acquisition of the operations by Dongwha. The modification allowed for alternate construction staging and modification to several conditions of the consent.

GHD subsequently prepared an environmental assessment to support a modification application to PA 07_0161 ("Modification 2"), to replace four boilers (three being gas-fired boilers and one wood-fired boiler) with one 18 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. This modification was approved on 15 July 2015, however has not been developed.

It is now proposed to alter the boiler configuration with the installation of a 15 MW wood fire boiler. Modification 2 was not progressed as no cost effective way to construct and set up the steam supply across the site was available. The location of the proposed 15 MW boiler would be within the centre of the site, east of the previously approved 18 MW boiler. The proposed 15 MW boiler would be designed to comply with statutory emissions requirements and be supplied with clean timber residual products currently generated by the sawmill operations at the site. Similar to Modification 2, the proposal would allow Dongwha to proactively manage their ongoing energy costs and residual timber management requirements. The current 2.5 MW chip fired boiler would be retained, as approved in the original application, to supply energy in the form of steam to the redry kilns.

This Noise and Vibration Impact Assessment (NVIA) has been prepared to provide an assessment of noise and vibration impacts as an input to the Statement of Environmental Effects (SEE).

1.2 Scope of work

The scope of work for the NVIA include:

- review the proposed change in operations
- determination of the rating background level (RBL) and noise criteria for the project
- assessment of the potential construction noise and vibration impacts
- assessment of the potential operational noise impacts
- provide construction noise and vibration mitigation measures to minimise impacts on the community.

This report has been prepared with consideration to the following documents:

- Environment Protection Licence number 11205
- *Interim Construction Noise Guideline* (EPA, 2009) (ICNG)
- *Road Noise Policy* (DECCW, 2011) (RNP)
- *Noise Policy for Industry* (EPA, 2017) (NPI)

1.3 Report structure

The report is comprised of the following sections:

- **Section 1 – Introduction:** provides the background and an overview of the project and the assessment
- **Section 2 – Existing environment:** summarises the existing noise conditions and details the noise monitoring methodology
- **Section 3 – Compliance criteria:** provides an overview of the construction noise, construction vibration and operational noise criteria
- **Section 4 – Construction impact assessment:** presents a summary of the noise modelling and identifies potential noise and vibration impacts during construction
- **Section 5 – Operational noise assessment:** presents a summary of the noise modelling and identifies potential noise impacts during operation
- **Section 6 – Noise management measures:** provides an overview of the proposed noise management measures during the construction and operational phases of the project
- **Section 7 – Conclusion:** presents a summary of the NVIA findings and sets out the principal conclusions for the assessment.

1.4 Limitations

This report: has been prepared by GHD for Dongwha Australia Holdings Pty Ltd and *may only be used and relied on by Dongwha Australia Holdings Pty Ltd for the purpose agreed between GHD and the Dongwha Australia Holdings Pty Ltd as set out in section 1.2 of this report.*

GHD otherwise disclaims responsibility to any person other than Dongwha Australia Holdings Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

2. Existing environment

2.1 Project location

The site is located on Lot 2 DP 1016573 and Lot 27 DP 1061792 in the Snowy Monaro Regional Council Local Government Area. The site is located in Primary Production (RU1) land zone usage. Other land zones in proximity to the site are Public Recreation (RE1) to the north-west and General Industrial (IN1) to the north-east. The site is accessed on Sandy Lane off Delegate Road which is located to the north.

Existing noise levels are due to industrial noise from the subject site and from road traffic noise along Delegate Road.

2.2 Sensitive receivers and land uses

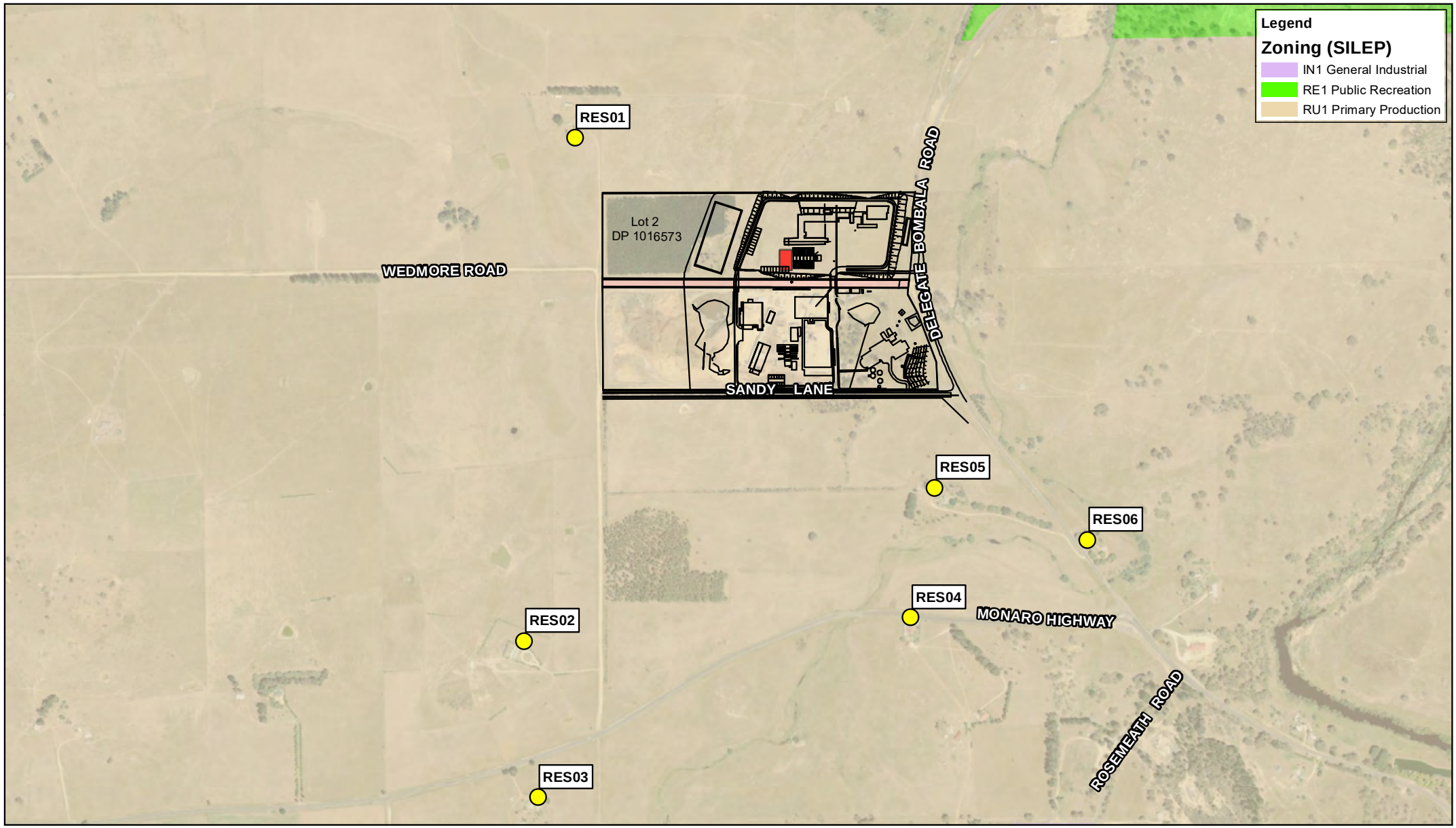
Noise and vibration sensitive receivers are defined based upon the type of occupancy and the activities performed within the land parcel. The receivers are classified within the following categories:

- residential premises
- educational institutes
- hospitals and medical facilities
- places of worship
- passive and active recreation areas
- commercial or industrial premises.

The residential sensitive receivers in Table 2-1 have been included in this assessment to determine potential impacts during construction and operation. No other sensitive land uses were identified within 1,000 m of the project site. The locations of the assessed sensitive receivers are provided in Figure 2-1.

Table 2-1 Modelled sensitive receivers

Receiver ID	Receiver type	Approximate distance to project site boundary, m
RES01	Residential	150 m south-west
RES02	Residential	600 m south-east
RES03	Residential	1,000 m south-east
RES04	Residential	600 m east
RES05	Residential	300 m east
RES06	Residential	550 m north-east



Paper Size A4

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

LEGEND

- Sensitive receivers
- Site Layout

Dongwha Australia
Bombala Sawmill - Modification 3
Statement of Environmental Effects

Site layout, sensitive receiver locations and land zone usage

Job Number 21-27626
Revision C
Date 19 Sep 2018

Figure 2-1

G:\21\27626\GIS\Maps\Deliverables\21_27626_Z004_Site_layout_sensitivereceivers.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com W www.ghd.com

Data Source: Esri; NSW DFSI 2018, 2017, 2015, 2012; General topo - NSW LPI DTDB 2012. Created by: jwatson2

3. Compliance criteria

3.1 Construction noise criteria

3.1.1 Construction hours

Construction noise management levels for the project are based on the *Interim Construction Noise Guideline* (ICNG) (DECCW, 2009). Construction works would be conducted during the recommended standard hours listed in Table 3-1.

Table 3-1 Construction hours

Construction hours	Monday to Friday	Saturday	Sunday / Public Holiday
Standard hours	7 am to 6 pm	8 am to 1 pm	No work

3.1.2 Construction noise management levels

The method to determine construction noise management levels (NML) for residential receivers is provided in the ICNG. The rating background levels (RBL) in Table 3-2, are based on the minimum assumed background levels provided in the *Noise Policy for Industry* (NPI) (EPA, 2017), have been used to determine the construction NML

Table 3-2 Minimum assumed RBL (NPI), dBA

Item	Day	Evening	Night
Minimum assumed RBL	35	30	30

The project construction noise management levels are provided in Table 3-3.

Table 3-3 Project construction noise management levels, dBA

Receiver type	Time of day	Noise management level
Residential	Recommended standard hours	45
		75
	Outside recommended standard hours	40
		35
		35

3.2 Construction vibration criteria

The nearest residential receiver is located over 600 m from the proposed construction footprint. The potential construction vibration levels have not been assessed as vibration impacts would not be expected at this distance.

3.3 Operational noise criteria

3.3.1 Environment protection licence conditions

The noise consent conditions are provided under Condition 4 of the environment protection licence (EPL) number 11205.

L4.1 Noise generated at the premises that is measured at each noise monitoring point established under this licence must not exceed the noise levels specified in Column 4 of the table below for that point during the corresponding time periods specified in Column 1 when measured using the corresponding measurement parameters listed in Column 2.

Time period	Measurement parameter	Measurement frequency	Noise level, dBA
All hours	LAeq	Continuous	35
Night	LAmax	Continuous	45

L4.2 For the purpose of Condition L4.1:

a) Day is defined as the period from 7 am to 6 pm Monday to Saturday and 8 am to 6 pm Sunday and Public Holidays;

b) Evening is defined as the period 6 pm to 10 pm; and

c) Night is defined as the period from 10 pm to 7 am Monday to Saturday and 10 pm to 8 am Sunday and Public Holidays.

L4.3 The noise limits set out in Condition L4.1 apply under all meteorological conditions except for the following:

a) Wind speeds greater than 3 metres/second at 10 metres above ground level; or

b) Stability category F temperature inversion conditions and wind speeds greater than 2 metres/second at 10 metres above ground level; or

c) Stability category G temperature inversion conditions.

L4.4 For the purposes of Condition L4.3:

a) The meteorological data to be used for determining meteorological conditions is the data recorded by the meteorological station identified as EPA Identification Point 22 must be used to determine meteorological conditions; and

b) Temperature inversion conditions (stability category) are to be determined by the sigma-theta method referred to in Part E4 of Appendix E to the New South Wales Industrial Noise Policy (EPA 2000).

L4.5 For the purposes of determining the noise generated at the premises a Class 1 or 2 noise monitoring equipment as defined in AS IEC61672.1-2004 and AS IEC61672.2-2004, or other noise monitoring equipment accepted by the EPA in writing must be used.

L4.6 To determine compliance:

a) with the Leq(15 minute) noise limits in Condition L4.1, the noise measurement equipment must be located:

(i) approximately on the property boundary, where the dwelling is situated 30 metres or less from the property boundary closest to the premises; or

(ii) *within 30 metres of a dwelling façade, but not closer than 3m, where any dwelling on the property is situated more than 30 metres from the property boundary closest to the premises; or, wherever applicable*

(iii) *within approximately 50 metres of the boundary of a National Park, Nature Reserve or State Conservation Area.*

b) *with the LAmax noise limits in Condition L4.1, the noise monitoring equipment must be located within 1 metre of a dwelling façade*

c) *the noise monitoring equipment must be located in a position that is:*

(i) *at the most affected point at a location where there is no dwelling at the location; or*

(ii) *at the most affected point within an area at a location prescribed by conditions L4.6(a) or L4.6(b)*

L4.7 *A breach of this Environment Protection Licence will still occur where the noise generated from the premises in excess of the appropriate limit specified in the condition L4.1 is detected:*

- *in an area at a location other than an area prescribed by condition L4.6; and/or*
- *at a point other than the most affected point at a location.*

L4.8 *For the purposes of determining the noise generated at the premises, the modification factors in Section 4 of the NSW Industrial Noise Policy must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.*

3.3.2 Noise Policy for Industry

The *Noise Policy for Industry* (NPI) (EPA, 2017) provides guidance on the assessment of operational noise impacts from existing industrial premises. The NPI recognises that existing industrial sources may have been designed for higher noise emission levels that the project noise trigger levels (PNTL) outlined in the NPI. The application of the NPI to existing industrial premises allows established industries to adapt to changes in the noise expectations of the community where required.

The process for applying the NPI to existing sites and the section where the item is addressed is provided in Table 3-4.

Table 3-4 NPI application to existing sites

Item	Description	Section addressed
1	Undertake an initial evaluation, including whether approvals/licences include noise limits and whether they are being met.	Section 5.1.1
2	Establish relevant project noise trigger levels, in accordance with the policy, to establish a benchmark level to assess the need to consider noise mitigation.	Section 3.3.3
3	Measure/predict the noise levels produced by the source in question, having regard to meteorological effects such as win and temperature inversions. Noise from both the whole premises and the upgraded section in isolation should be presented.	Section 5.2 Appendix B

Item	Description	Section addressed
4	Compare the measured/predicted noise level with the project noise trigger levels.	Section 5.3
5	Where the project noise trigger levels are exceeded, assess feasible and reasonable noise mitigation strategies.	Section 6.2
6	Develop and refine achievable noise limits that will become goals for pollution reduction programs from the site.	Section 6.2

The NPI states that the following principle should be applied when determining the assessment requirements for existing industry.

"Where a development proposal involves a discrete process, and premises-wide mitigation has or is to be considered outside of the development proposal, a project noise trigger level for noise from new or modified components (not the whole site) of the operation may be set at 10 dBA or more below existing site noise levels or requirements. This approach means that the increase in noise from the whole site is minimised and provides scope for existing components to achieve noise reductions over time"

This approach has been applied for this assessment to develop a project noise trigger level for the 15 MW boiler.

3.3.3 Project noise trigger levels

The operational noise criteria to assess the potential impacts due to the addition of a 15 MW boiler is provided in Table 3-5. The 15 MW boiler project noise trigger level has been set at 10 dBA below the existing noise limit as per the principles of the NPI to existing industrial premises.

Table 3-5 Project noise trigger levels, dBA

Time period	Existing site noise[1]	EPL noise limit	15 MW boiler project noise trigger level
All hours	44-54	35	25

Note 1: Noise levels at Location A based on the *Operational Noise Monitoring* report prepared by Blackett Acoustics (Report No BA180521, August 2018).

4. Construction impact assessment

4.1 Construction works methodology

Construction activities for the boiler installation are likely to be undertaken in two stages detailed in Table 4-1

Table 4-1 Construction staging

Stage	Activities	Timeframe	Hours
Enabling works	Establishment of formwork	20 weeks	Recommended standard hours
	Infrastructure works		
Boiler installation and commissioning	Component transport	12 to 16 weeks	Recommended standard hours
	Assembly		

The construction staging has been modified into the scenarios in Table 4-2 and have been used to assess the potential construction noise impacts. The equipment noise levels have been based on data provided in Australian Standards *AS2436 – Guide to noise and vibration control on construction, demolition and maintenance sites*. Other equipment may be used, however, it is anticipated that they would produce similar net noise emissions when used concurrently with the listed equipment.

Construction machinery would likely move about the project site altering the received noise for individual receivers. During any given period, the machinery items to be used would operate at maximum sound power levels for only brief stages. At other times, the machinery would produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all construction equipment would be operating at their maximum sound power levels at any one time. Certain types of construction machinery would be present in the study area for only brief periods during construction. Therefore, noise predictions are considered conservative.

The activity sound power level has been calculated based on the two noisiest plant to determine the worst-case noise impacts during construction. The activity noise levels have been used to predict the noise levels that would be expected during construction works.

Table 4-2 Construction scenario staging

Scenario	Description	Equipment	Equipment sound power level	Activity sound power level
CS01	Foundation works	Compressor	101	127
		Excavator	107	
		Front end loader	113	
		Jackhammer	126[1]	
		Trucks	107	
CS02	Establishment of formwork	Compressor	101	123[1]
		Concrete cutter	122[1]	

Scenario	Description	Equipment	Equipment sound power level	Activity sound power level
		Concrete pump	108	
		Crane	104	
CS03	Infrastructure works	Excavator	107	114
		Front end loader	113	
		Trucks	107	
CS04	Boiler installation and commissioning	Compressor	101	109
		Crane	104	
		Hammer drill	102	
		Trucks	107	

Note 1: A 5 dBA addition has been applied to the jackhammer and concrete cutter as these activities have the potential to increase annoyance at the affected residences.

4.2 Noise modelling inputs

Noise modelling was undertaken using SoundPlan Version 7.4. SoundPlan is a computer program for the calculation, assessment and prognosis of noise exposure. SoundPlan calculates environmental noise propagation according to *ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors'.* The following noise modelling assumptions were made:

- surrounding land was modelled assuming a mix of 75% soft and 25% hard ground with a ground absorption coefficient of 0.75
- atmospheric absorption was based on an average temperature of 10°C and an average humidity of 70%
- atmospheric propagation conditions were modelled with noise enhancing wind conditions for noise propagation (downwind conditions) or an equivalently well-developed moderate ground based temperature inversions
- receivers were modelled at a height of 1.5 m above ground level.

4.3 Construction noise impacts

Predicted construction noise levels from the scenarios outlined in Table 4-2 are presented in Table 4-3. A summary of the exceedances of the noise management levels for sensitive receivers is presented in Table 4-4. Exceedances of the construction noise management levels are typical for construction projects. The noise impacts would be limited to the construction period only and would not have lasting effects on the community.

Table 4-3 Predicted construction noise levels, dBA

Receiver ID	Receiver Type	NCA	CS01	CS02	CS03	CS04
Residential: Exceeds noise management level Bold Highly noise affected						
RES01	Residential	NCA01	53	49	40	35
RES02	Residential	NCA01	44	40	31	26
RES03	Residential	NCA01	40	36	27	22
RES04	Residential	NCA01	48	44	35	30
RES05	Residential	NCA01	50	46	37	32
RES06	Residential	NCA01	46	42	33	28

Table 4-4 Exceedance summary

	Construction scenario			
	CS01	CS02	CS03	CS04
Number of exceedances	4	0	0	0
Highest noise level	53	49	40	35
Highest exceedance	8	4	-	-
Worst affected receiver	RES01	RES01	RES01	RES01

The predicted construction noise levels are below the construction noise management levels for all works that do not involve the use of a jackhammer or concrete cutter. The predicted exceedance of the noise management levels are:

- 8 dBA during jackhammering works (CS01). Residential receivers located within 1,100 m of the construction equipment have the potential to be noise impacted.
- 4 dBA during concrete cutting works (CS02). Receivers located within 700 m of the construction equipment have the potential to be noise impacted.

Construction noise management measurements have been provided in Section 6.1 to minimise the potential noise impacts on the surrounding community.

4.4 Construction traffic

Construction is anticipated to generate up to 15 two-way heavy vehicle movements per day. These movements are associated with the transportation of construction machinery, equipment and materials to the site and for the removal of waste and the existing boiler components. The site would be accessed from Delegate Road which has significant existing traffic flows.

A significant increase in traffic volume would be needed in order to increase road traffic noise by 2 dBA (a doubling in traffic corresponds to an approximate 3 dBA increase. The construction traffic impacts on these roads would be less than 2 dBA and further assessment of construction traffic noise is not required.

4.5 Construction vibration

No construction vibration impacts are expected as the nearest residential receiver is located over 600 m from the proposed construction footprint.

5. Operational noise assessment

5.1 Operational noise overview

5.1.1 Existing operations

Compliance noise monitoring was undertaken by Blackett Acoustics in August 2018. The compliance noise monitoring report is provided in Appendix B. The compliance noise monitoring report indicate non-compliance with the noise limits at receiver RES01 (Location A in the compliance report) and RES05 (Location B) during existing operations. This non-compliance due to existing operations is from the mill operations and not related to the proposed modification of the 15 MW boiler.

5.1.2 Proposed operations

The proposed modification includes the installation of a 15 MW wood-fired boiler in place of the previously approved 18 MW boiler. The 15 MW boiler is located within the center of the site, east of the previously approved 18 MW boiler.

The primary noise source from the boiler is due to a blower fan contained inside the unit. The manufacturer of this unit has confirmed a sound power level of 60 dBA. The fan would be housed within an enclosing structure however details of this structure is unknown at this stage. Noise from the boiler has been modelled without the enclosing structure for a conservative assessment.

This operational noise assessment has been undertaken to ensure there are no resulting cumulative noise impacts due to the introduction of a 15 MW boiler by assessing to a 25 dBA project noise trigger level (refer to Section 3.3).

5.2 Noise modelling inputs

Noise modelling was undertaken based on the same noise modelling methodology used for the construction noise assessment with the 15 MW noise source data provided in Section 5.1.2.

5.3 Operational noise impacts

The predicted noise levels at all modelled receivers due to the 15 MW boiler is below 20 dBA. This level of noise is below the project noise trigger level of 25 dBA and therefore would not create cumulative noise contributions to existing noise emission from the site.

The 15 MW blower is expected to be a continuous noise source with no impulsive characteristics therefore there would also be compliance with the 45 dBA LAmax EPL noise limit.

The modification to install the 15 MW boiler should be acceptable from an acoustic perspective.

6. Noise management measures

6.1 Construction noise

The following construction noise management measures in Table 6-1 are recommended to minimise the impact on the surrounding environment:

Table 6-1 Construction noise management measures

Action required	Details
Construction hours	All work will be carried out within standard construction hours: • Monday to Friday: 7 am to 6 pm • Saturday: 8 am to 1 pm • Sunday and public holidays: No construction activities.
Compliance noise monitoring	It is recommended that compliance noise monitoring is undertaken at the commencement of jack hammering and concrete sawing.
Implement community consultation	Provide notification to potentially affected receivers about upcoming construction activities which are predicted to exceed the noise management levels. This includes jack hammering and concrete sawing. The notification should include: • Details and timeframe of construction works • Noise control measures implemented • Provision of site contact details Note that if compliance monitoring confirm that jack hammering and concrete sawing are below the noise management levels then further community consultation may not be required unless a complaint is received.
Complaints handling	A complaints register should be maintained throughout construction detailing: • Contact details and address of the complainant • The time and nature of complaint • Review of work activities • Measures undertaken in response to the complaint. Staff should be briefed on current and future construction activities and notified of any complaints from the community.
Site inductions	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • all relevant project specific and standard noise mitigation measures • relevant licence and approval conditions • permissible hours of work • location of nearest sensitive receivers • construction employee parking areas • designated loading/ unloading areas and procedures • construction traffic routes

Action required	Details
	• site opening/closing times (including deliveries) • environmental incident procedures.
Maximum noise levels	The noise levels of plant and equipment should have operating Sound Power or Sound Pressure Levels compliant with the levels in Table 4-2. If the levels are greater than those provided in Table 4.2 an acoustic consultant should confirm they will not result in an exceedance to the noise management levels.
Plan worksites and activities to minimise noise	Plan traffic flow, parking and loading/ unloading areas to minimise reversing movements within the site.
Construction movements	All deliveries and movements should be during standard construction hours.
Minimise disturbance arising from delivery of goods to construction sites	Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.

6.2 Operational noise

No project specific operational noise management measures are recommended to reduce noise emission from the proposed 15 MW boiler.

7. Conclusion

7.1 Conclusion

GHD has been engaged by Dongwha to prepare a NVIA as an input to the SEE. The NVIA has been prepared to assess the potential noise impacts due to construction and operation and the potential vibration impacts during construction.

Construction noise impacts are expected at four residential receivers during jackhammering works and two residential receivers during concrete cutting works. The noise management level at these receivers are expected to be exceeded by up to 8 dBA.

The predicted construction noise levels are below the construction noise management levels for all other construction works. Construction noise management measures have been recommended to minimise the potential construction noise impacts at the surrounding receivers.

Road traffic noise impacts are not expected as the traffic generation during construction would not cause an increase of 2 dBA above existing road traffic noise levels.

The operational assessment has been undertaken based on the Noise Policy for Industry approach for assessing existing industrial premises. Operational noise from the 15 MW boiler is predicted to comply with the project noise trigger levels and would not cumulatively contribute to the existing noise emission from site. The modification to install the 15 MW boiler should be acceptable from an acoustic perspective.

Appendices

Appendix A – Glossary

Abbreviation	Definition
Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the LA90 descriptor.
dB	Decibel is the logarithmic unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dBA	Frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at very low and very high frequencies.
dBC	Frequency weighting filter used to measure 'C-weighted' sound pressure levels, which is designed to be more response to low frequency noise
dBZ	Frequency weighting filter used to measure 'Z-weighted' sound pressure levels. This filter is used to assess tonal noise.
DECCW	Department of Environment, Climate Change and Water
EPA	Environment Protection Authority
EPL	Environment Protection Licence
$L_{Aeq(period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{A90(period)}$	The sound pressure level exceeded for 90% of the measurement period.
L_{Amax}	The maximum sound level recorded during the measurement period.
NML	Noise management level
Noise sensitive receiver	An area or place potentially affected by noise including residential dwellings, schools, child care centres, places of worship, health care institutions and active or passive recreational areas.
NPI	*Noise Policy for Industry* (EPA, 2017)
PNTL	Project noise trigger level
Rating background level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period.
RNP	*Road Noise Policy* (DECWW, 2011)

Appendix B – Compliance noise monitoring report

Blackett Acoustics

Noise & Vibration Consultants

DONGWHA AUSTRALIA

OPERATIONAL NOISE MONITORING

Report No BA180521
Version A

August 2018

Prepared for

Dongwha Australia Pty Ltd
1 Sandy Lane
BOMBALA, NSW 2632

Association of Australian Acoustical Consultants

Blackett Acoustics is an AAAC Member Firm Since 2014

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GLOSSARY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are defined below.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

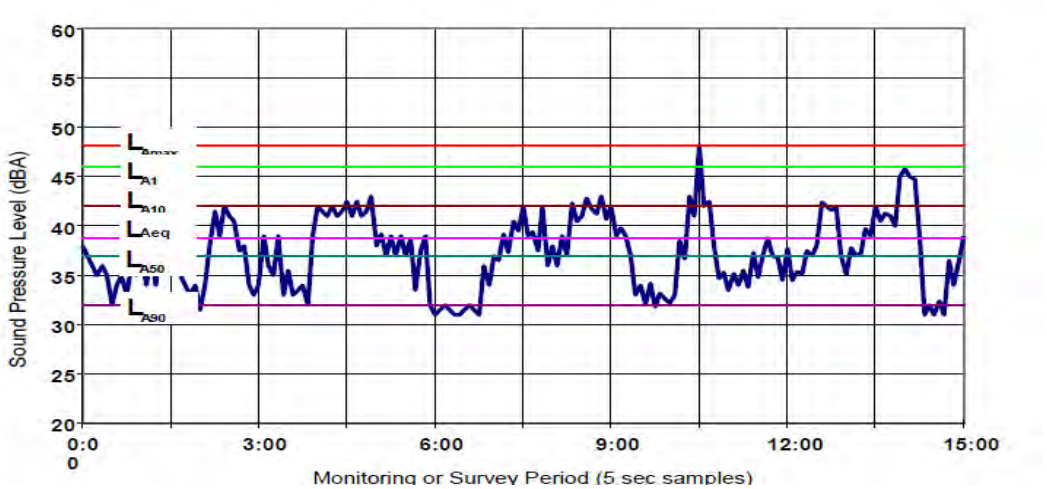
L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.



1 INTRODUCTION

Blackett Acoustics has been commissioned to carry out annual noise monitoring at residences surrounding Dongwha Australia (DA) located at 1 Sandy Lane, Bombala. This includes monitoring of noise from onsite facilities which includes the following:

- Green Mill
- Dry Mill
- Satellite
- Treatment Plant
- Log Yard
- Boilers
- Kilns
- Administration Building

The identify nearest surrounding noise sensitive receiver locations are located at the following addresses:

- **Location A** – 114 Wedmore Road, Bombala
- **Location B** – The Parsonage

The monitoring is conducted to satisfy the requirements of the Environment Protection Licence (EPL) 11205 issued by NSW Environment Protection Authority. Although the EPL does not require unattended noise monitoring, unattended noise monitoring with a direction noise monitor over a period of 72 hours at Location B was conducted to provide a more accurate estimate of the contribution from DA.

This report provides a summary of the results and conclusions from the monitoring which was conducted during the four days from Monday, 23 to Thursday, 26 July 2018.

2 NOISE CRITERIA

Appendix B contains the requirements of the Environment Protection Licence issued by the NSW Environment Protection Authority for DA. Noise criteria for DA for daytime, evening and night time periods are summarised in Table 2-1.

The table states the maximum acceptable $L_{Aeq,15min}$ and L_{Amax} noise levels measured under moderate weather conditions within 30m of any residence surrounding the sites of DA.

Table 2-1 EPL 11205 Acceptable Noise Limits

Time Period	Measurement Parameter	Measurement Frequency	Noise Level dBA
All Hours	L_{Aeq}	Continuous	35
Night	L_{Amax}	Continuous	45

The EPL requires operator attended noise monitoring to occur during the relevant time periods as defined in the NSW Industrial Noise Policy (EPA 2000) for a minimum of 1.5 hours during daytime, 30 minutes during the evening and 1 hour during the night time for three consecutive days.

3 NOISE MEASUREMENT SURVEY

Figure 3-1 shows the measurement locations for DA. Table 3-1 is a summary of measurement locations where attended and unattended monitoring was conducted.

Noise criteria listed in Table 2-1 were used for the assessment of these monitoring locations.

Figure 3-1 Locality Map of Measurement Locations

Table 3-1 Summary of Measurement Locations

Location	Residential Location as Identified in EPL	Attended Noise Monitoring	Direction Noise Monitoring
A	114 Wedmore Rd, Bombala	Yes	No
B	The Parsonage	Yes	Yes

4 NOISE MEASUREMENT PROCEDURE

4.1 Directional Noise Monitoring (*BarnOwl®*)

Real time noise monitoring was conducted from Monday, 23 to Thursday, 26 July 2018 at the receiver location *The Parsonage* using a *BarnOwl®* directional noise monitor. Figure 4-1 presents the "arc of measurement" and the measurement location.

Figure 4-1 Location Aerial of The Parsonage

4.2 Attended Operational Noise Monitoring

Attended monitoring was conducted at all operational noise locations as listed in Table 3-1. These locations were visited during the daytime, evening and night time period from Monday, 23 to Thursday, 26 July 2018. Noise levels were measured over two consecutive periods of approximately 15-minutes on each occasion.

All attended noise measurements were conducted using a NTi XL2 Sound Level Meter (SLM). The sound level meter conforms to Australian Standard 1259 *Acoustics - Sound Level Meters* as a Type 1 Precision Sound Level Meter which has accuracy suitable for field and laboratory use. The A-Weighting filter of the meter was selected and the time weighting was set to "Fast". The calibration of the meter was checked before and after the measurements with a sound level calibrator and no significant drift was noted. Wind speed was measured using a hand held anemometer at 1.5m above ground level and any rainfall was noted.

5 NOISE MONITORING RESULTS

5.1 Directional Noise Monitoring

Real time noise monitoring was conducted at receiver location *The Parsonage* between Monday, 23 and Thursday, 26 July 2018, using a *BarnOwl®* directional noise monitor, in addition to attended noise measurements using a conventional sound level meter.

Directional noise data provide a more accurate estimate of the contribution from DA to the total noise received at the monitoring position. Directional noise data recorded are used to compare against the relevant time period operational noise criteria. The contribution from these areas can then be graphed throughout the monitoring period.

The graphs present three different colour coded lines representing:

- ***Leq All Noise (Blue)*** - The blue line represents the total noise arriving at the *BarnOwl* unit. This is equivalent to the total L_{10} level which would be measured by a standard unattended noise logger or measured with a sound level meter during attended measurements.
- ***Leq Selected Source (Red)*** - The red line represents the sum of identified sources in the direction of interest. This only includes levels from detected sources within a user specified range of angles.
- ***Site and Time Specific Noise Criterion (Black)*** - The black line presents the site and time specific criterion established.

Figure 5-1 to Figure 5-4 show these results for monitoring conducted at *The Parsonage* during the entire monitoring period.

Figure 5-1 Directional Noise Data from The Parsonage - Monday 23 July 18

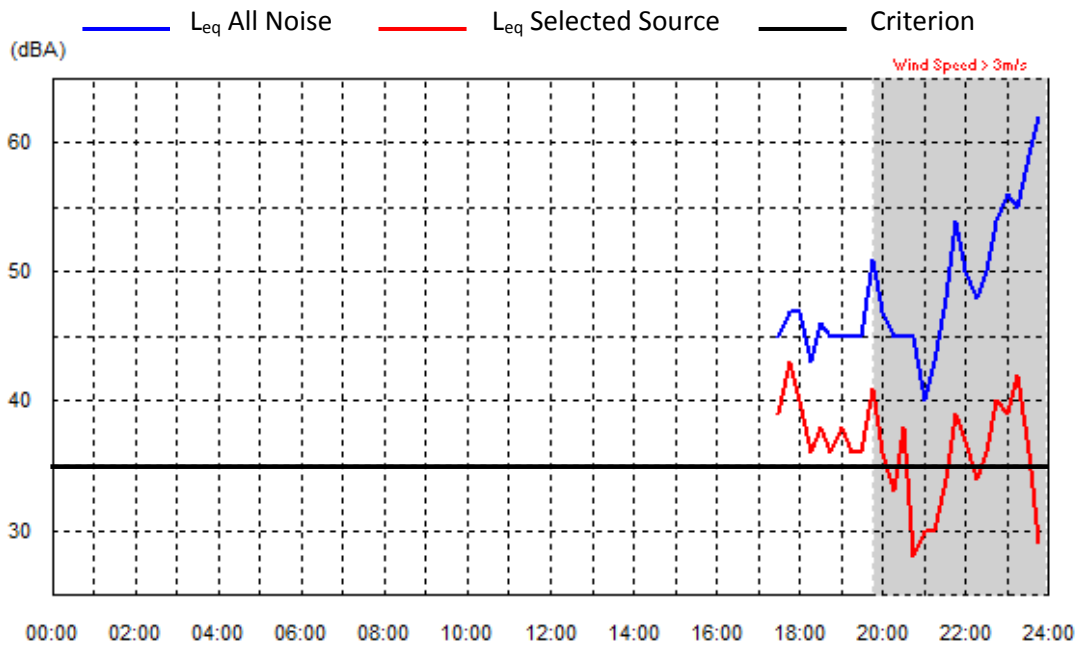


Figure 5-2 Directional Noise Data from The Parsonage - Tuesday 24 July 18

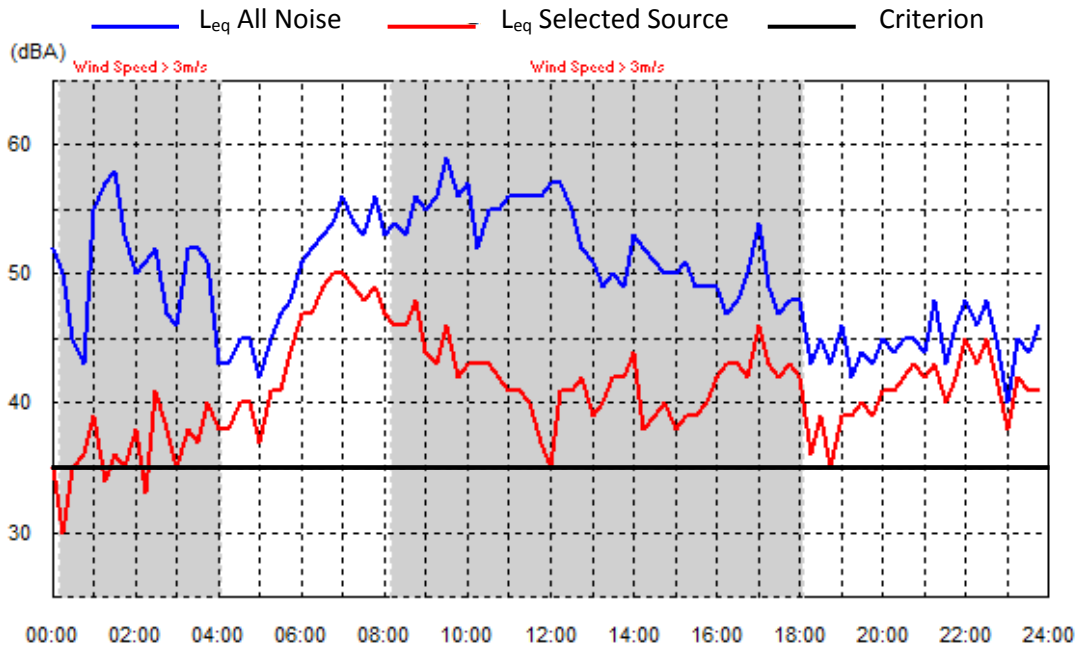


Figure 5-3 Directional Noise Data from The Parsonage - Wednesday 25 July 18

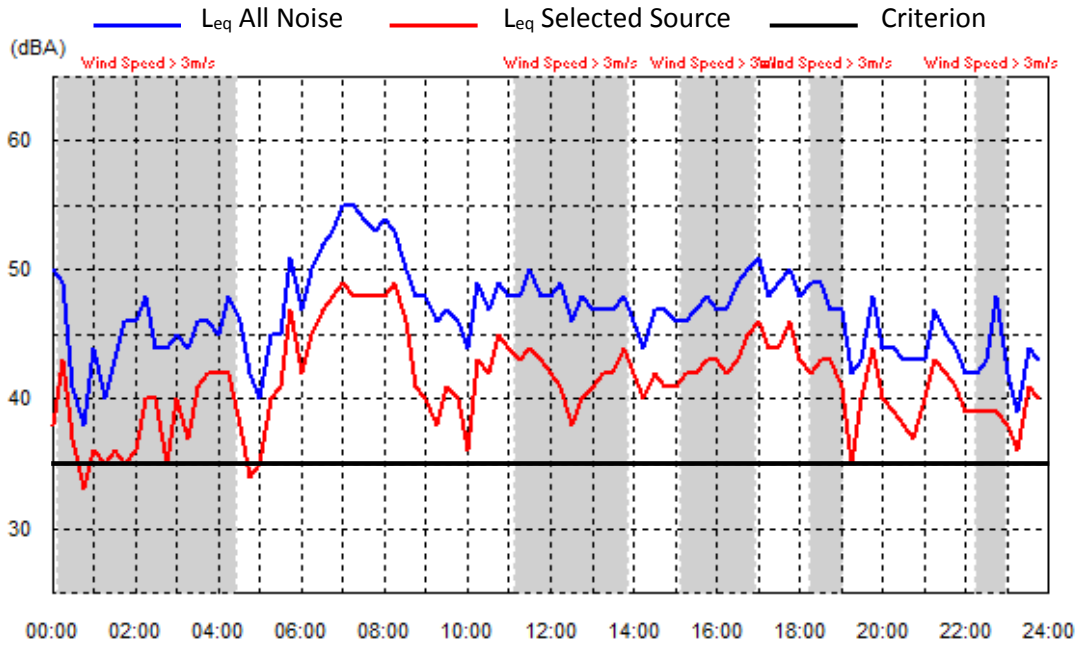
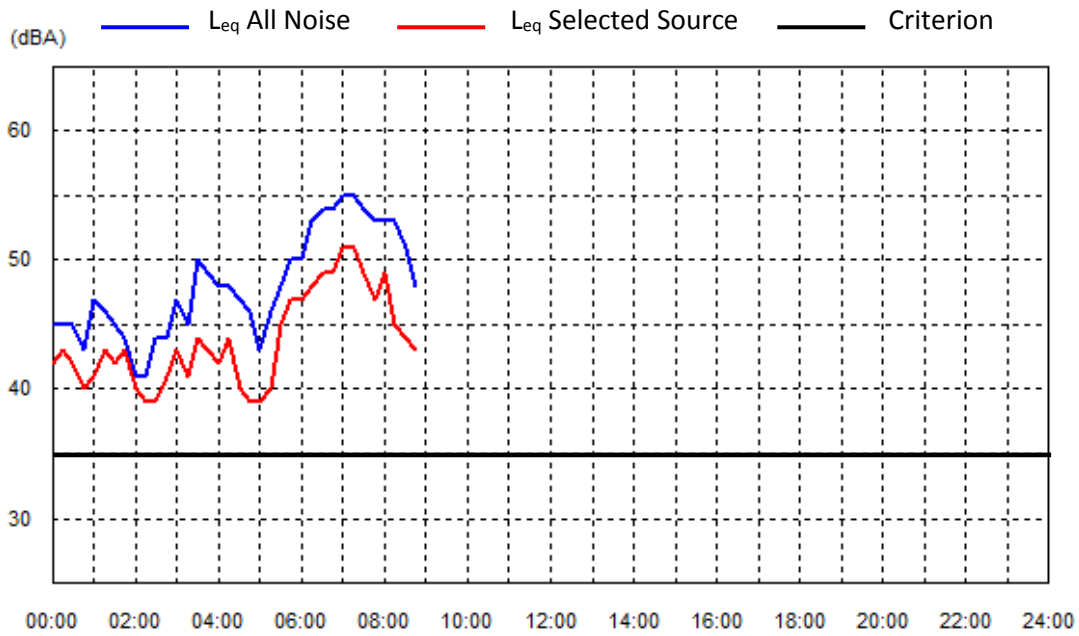


Figure 5-4 Directional Noise Data from The Parsonage - Thursday 26 July 18



Review of the results presented in Section 5.3 showed that the directional noise data (shown as Selected Source L_{eq}) indicated non compliance to the operational noise criteria on numerous occassions during the monitoring period from Monday, 23 to Thursday, 26 July 2018 at monitoring location *The Parsonage*.

The noise levels recorded by an environmental noise logger is generally higher than the *BarnOwl®* measured noise levels as it only has the capability to record the total noise arriving at the measurement location.

The *BarnOwl®* directional noise monitor has the capability to record the noise arriving from each of 72 five degree segments (360 degrees) and then calculate the sum of identified noise sources in the direction (range of 5 degree angles) of interest only. Hence, directional noise data will provide a more accurate estimate of the contribution of noise from Dongwha Australia to the total noise received at the monitoring position.

The *BarnOwl®* directional noise monitoring system has the ability to identify noise contribution from a selected direction to provide useful noise data to establish if compliance is achieved with relevant noise criteria.

Based on the noise measurement data presented in Figure 5-1 to Figure 5-4, the L_{Aeq} noise contribution from DA only shows non-compliance with relevant time period L_{Aeq} noise criteria on most occasions during this round of monitoring.

5.2 Attended Operational Noise Monitoring Results

Appendix B of this report shows the overall measured $L_{Aeq,15min}$ and L_{Amax} noise levels, and the estimated levels from DA only, over the 15-minute monitoring periods at each location, as well as comments recorded during the measurements.

The estimated $L_{Aeq,15min}$ level is calculated by noting the level and duration of mine activity and accumulating the noise from these individual events over the 15-minute period. This relies heavily on the judgement of the survey engineer.

Figure 5-5 shows an aerial photo with measurement locations and a summary of the range of estimated DA $L_{Aeq,15min}$ and L_{Amax} levels during this survey.

Figure 5-5 Measurement Locations & Summary of DA Noise Levels

A review of the detailed data shown in the tables in Appendix B indicates the following:

At Location A

- Marginal 1dBA non-compliance to the $L_{Aeq,15min}$ with daytime recorded on several occasions;
- Non-compliance to the $L_{Aeq,15min}$ with evening and night time criteria were recorded with noise level up to 44dBA recorded during evening time period and 54dBA during night time period recorded during time of survey; and
- Non-compliance to the L_{Amax} criterion was recorded with L_{Amax} noise levels of up to 54dBA recorded. The L_{Amax} noise levels recorded were associated with the dropping of timber logs within the Satellite Building.

At Location B

- Non-compliance to the $L_{Aeq,15min}$ with daytime criterion were recorded with noise level up to 52dBA recorded during time of survey;
- Non-compliance to the $L_{Aeq,15min}$ with evening and night time criteria were recorded with noise level up to 43dBA recorded during evening time period and 49dBA during night time period recorded during time of survey; and
- Non-compliance to the L_{Amax} criterion was recorded with L_{Amax} noise levels of up to 58dBA recorded. The L_{Amax} noise levels recorded were associated with the dropping of timber logs within the Satellite Building or Green Mill Building.

6 CONCLUSION

Compliance noise monitoring was conducted at residences surrounding the Dongwha Timbers Operations in Bombala during the month of July 2018. This included attended and unattended noise monitoring of operational noise from Dongwha Australia.

Review of the results presented in Section 5.1 showed that the measured directional noise monitoring levels indicated non-compliance were recorded on most occasions.

In relation to attended noise monitoring data, it is considered that the current Dongwhat Australia does not comply with the EPL conditions for the daytime, evening and night time periods on most occasions. Non-compliance with the maxima noise requirement of L_{Amax} of 45dBA were also recorded at the surrounding residential receiver locations.

Note

All materials specified by Blackett Acoustics have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose.

Version	Status	Issue Date	Prepared by
A	Final	13 August 2018	Jimi Ang

Appendix A

Noise Criteria

The following paragraphs present the noise limits for DTO extracted from EPL 1120 issued by the NSW Environment Protection Authority.

"L4 Noise Limits

L4.1 Noise generated at the premises that is measured at each noise monitoring point established under this licence must not exceed the noise levels specified in Column 4 of the table below for that point during the corresponding time periods specified in Column 1 when measured using the corresponding measurement parameters listed in Column 2.

Point 21, 32, 33

Time Period	Measurement Parameter	Measurement Frequency	Noise Level dBA
All Hours	L_{Aeq}	Continuous	35
Night	L_{Amax}	Continuous	45

L4.2 For the purpose of Condition L4.1:

a) Day is defined as the period from 7.00am to 6.00pm Monday to Saturday and 8.00am to6.00pm Sunday and Public Holidays;

b) Evening is defined as the period 6.00pm to 10.00pm; and

c) Night is defined as the period from 10.00pm to 7.00am Monday to Saturday and 10.00pm to 8.00am Sunday and Public Holidays.

L4.3 The noise limits set out in Condition L4.1 apply under all meteorological conditions except for the following:

a) Wind speeds greater than 3m/second at 10m above ground level; or

b) Stability category F temperature inversion conditions and wind speeds greater than 2m/second at 10m above ground level; or

c) Stability category G temperature inversion conditions.

L4.4 For the purpose of condition L4.3:

a) The meteorological data to be used for determining meteorological conditions is the data recorded by the meteorological weather station identified as EPA Identification Point 22 must be used to determine meteorological conditions; and

b) Temperature inversion conditions (stability category) are to be determined by the Sigma-theta method referred to in Part E4 of Appendix E to the NSW Industrial Noise Policy (EPA 2000).

L4.5 For the purpose of determining noise generated at the premises a Class 1 or 2 noise monitoring equipment as defined by AS IEC61672.1-2004 and AS IEC61672.2-2004, or other noise monitoring equipment accepted by the EPA in writing must be used.

L4.6 To determine compliance

a) With the $L_{Aeq,15min}$ noise limit in Condition L4.1, the noise measurement equipment must be located:

   i) Approximately on the property boundary, where any dwelling is situated 30m or less from the property boundary that is closest to the premises; or

   ii) Within 30m of a dwelling façade, but not closer than 3m, where any dwelling on the property is situated more than 30m from property boundary closest to the premises; or, where applicable;

   iii) Within approximately 50m of the boundary of a National Park or Nature Reserve.

b) With the L_{Amax} noise limits in Condition L4.1, the noise measurement equipment must be located within 1m of a dwelling façade;

c) The noise monitoring equipment must be located in a position that is :

   i) At the most affected point at a location where there is no dwelling at the location; or

   ii) At the most affected point within an area at a location prescribed by conditions L4.6(a) or L4.6(b).

L4.7 A breach of the Environment Protection Licence will still occur where noise generated from the premises in excess of the appropriate limit specified in the condition L4.1 detected:

- In an area at a location other than an area prescribed by Condition L4.6; and/or
- At a point other than the most affected point at a location.

L4.8 For the purposes of determining the noise generated at the premises the modification factors in Section 4 of the NSW Industrial

Noise Policy must be applied, as appropriate, to the noise levels measure by the noise monitoring equipment.

M7 Other Monitoring and Recording Conditions

M7.1 To determine compliance with Condition L4.1, attended noise monitoring must be undertaken in accordance with Conditions L4.5 and L4.6 and:

a) At the locations EPA Identification Point 32 and 33, as listed in Condition L4.1;

b) Occur annually;

c) Occur during each day, evening and night period as defined in the NSW Industrial Noise Policy (EPA 2000) for a minimum of :

- 1.5 hours during the day;
- 30 minutes during the evening; and
- 1 hour during the night.

d) Occur for three consecutive days.

Appendix B

Noise Measurement Results

Table D-1 Location A – Daytime Operational Noise Measurements Results (Day 1)

Daytime (7.00am to 6.00pm)					
Measurement No.	**Date & Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	24/07/2018 11.00am	35	60	50	<50 (barely audible)
2	24/07/2018 11.15am		62	50	<50 (barely audible)
3	24/07/2018 11.30am		62	52	<52 (barely audible)
4	24/07/2018 11.45am		61	49	<49 (barely audible)
5	24/07/2018 12.00pm		59	51	<51 (barely audible)
6	24/07/2018 12.15pm		60	50	<50 (barely audible)

Average Wind Speed (m/s): High wind with speed up to 8m/s.

Meet Criterion (Yes/No) & Comments

1. Yes – Noise emanating from DA barely audible during time of survey due to high wind condition.
2. Yes – Noise emanating from DA barely audible during time of survey due to high wind condition.
3. Yes – Noise emanating from DA barely audible during time of survey due to high wind condition.
4. Yes – Noise emanating from DA barely audible during time of survey due to high wind condition.
5. Yes – Noise emanating from DA barely audible during time of survey due to high wind condition.
6. Yes – Noise emanating from DA barely audible during time of survey due to high wind condition.

Table D-2 Location A – Daytime Operational Noise Measurements Results (Day 2)

Daytime (7.00am to 6.00pm)					
Measurement No.	**Date & Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	25/07/2018 4.30pm	35	41	35	36
2	25/07/2018 4.45pm		40	35	35
3	25/07/2018 5.00pm		42	34	34
4	25/07/2018 5.15pm		40	33	33
5	25/07/2018 5.30pm		41	32	32
6	25/07/2018 5.45pm		40	33	33

Average Wind Speed (m/s): Wind with speed up to 4m/s.

Meet Criterion (Yes/No) & Comments

1. No – Noise associated with Green Mill Building and boiler/klin constantly audible during time of survey. Onsite trucks movements audible for approximately 1 minute with typical instantaneous sound pressure level in the range of 39-41dBA.
2. Yes – Noise associated with Green Mill Building and boiler/klin constantly audible during time of survey.
3. Yes – Noise associated with Green Mill Building and boiler/klin constantly audible during time of survey.
4. Yes – Noise associated with Green Mill Building and boiler/klin constantly audible during time of survey.
5. Yes – Noise associated with Green Mill Building and boiler/klin constantly audible during time of survey.
6. Yes – Noise associated with Green Mill Building and boiler/klin constantly audible during time of survey.

Table D-3 Location A – Daytime Operational Noise Measurements Results (Day 3)

Daytime (7.00am to 6.00pm)					
Measurement No.	**Date & Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	26/07/2018 7.00am	35	41	36	36
2	26/07/2018 7.15am		40	36	36
3	26/07/2018 7.30am		40	35	35
4	26/07/2018 11.45am		40	35	35
5	26/07/2018 8.00am		40	36	36
6	26/07/2018 8.15am		40	36	36

Average Wind Speed (m/s): Wind with speed up to 2m/s.

Meet Criterion (Yes/No) & Comments

1. No – Noise associated with Green Mill Building and boiler/klin constantly audible during time of survey.
2. No – Noise associated with Green Mill Building and boiler/klin constantly audible during time of survey.
3. Yes – Noise associated with Green Mill Building and boiler/klin constantly audible during time of survey.
4. Yes – Noise associated with Green Mill Building and boiler/klin constantly audible during time of survey.
5. No – Noise associated with Green Mill Building and boiler/klin constantly audible during time of survey.
6. No – Noise associated with Green Mill Building and boiler/klin constantly audible during time of survey.

Table D-4 Location A – Evening Operational Noise Measurements Results (Day 1)

Evening (6.00pm to 10.00pm)					
Measurement No.	**Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	23/07/2018 9.15pm	35	43	35	35
2	23/07/2018 9.30pm		41	35	35

Average Wind Speed (m/s): Wind with speed up to 3m/s.

Meet Criterion (Yes/No) & Comments

1. Yes– Noise associated with boiler/klin constantly audible during time of survey. Onsite trucks movements audible for approximately 20 seconds with typical instantaneous sound pressure level in the range of 39-41dBA.
2. Yes – Noise associated with boiler/klin constantly audible during time of survey.

Table D-5 Location A – Evening Operational Noise Measurements Results (Day 2)

Evening (6.00pm to 10.00pm)					
Measurement No.	**Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	24/07/2018 9.00pm	35	36	27	29
2	24/07/2018 9.15pm		37	27	27

Average Wind Speed (m/s): Wind with speed up to 1.5m/s.

Meet Criterion (Yes/No) & Comments

1. Yes– Noise associated with boiler/klin constantly audible during time of survey. Satellite Building just audible in the range of 30-38dBA for approximately 1 minute.
2. Yes – Noise associated with boiler/klin constantly audible during time of survey.

Table D-6 Location A – Evening Operational Noise Measurements Results (Day 3)

Evening (6.00pm to 10.00pm)					
Measurement No.	**Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	25/07/2018 6.45pm	35	44	42	44
2	25/07/2018 7.00pm		44	42	44

Average Wind Speed (m/s): Wind with speed up to 2m/s.

Meet Criterion (Yes/No) & Comments

1. No– Noise associated with Satellite Building constantly audible during time of survey with typical sound pressure level in the range of 43-45dBA.
2. No – Noise associated with Satellite Building constantly audible during time of survey with typical sound pressure level in the range of 43-45dBA.

Table D-7 Location A – Night Time Operational Noise Measurements Results (Day 1)

Night Time (10.00pm to 7.00am)					
Measurement No.	**Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	24/07/2018 5.15am	35	44	41	44
2	24/07/2018 5.30am		45	41	45
3	24/07/2018 5.45am		45	41	45
4	24/07/2018 6.00am		46	42	46
5	24/07/2018 6.15am		45	41	45
6	24/07/2018 6.30am		45	41	45

Average Wind Speed (m/s): Wind with speed up to 2m/s.

Meet Criterion (Yes/No) & Comments

1. No – Noise associated with Satellite Building constantly audible during time of survey with typical sound pressure level in the range of 43-45dBA. Typical L_{Amax} associated with dropping of timber in the range of 45-47dBA.
2. No – Noise associated with Satellite Building constantly audible during time of survey with typical sound pressure level in the range of 43-45dBA. Typical L_{Amax} associated with dropping of timber in the range of 45-47dBA.
3. No – Noise associated with Satellite Building constantly audible during time of survey with typical sound pressure level in the range of 43-45dBA. Typical L_{Amax} associated with dropping of timber in the range of 45-47dBA.
4. No – Noise associated with Satellite Building constantly audible during time of survey with typical sound pressure level in the range of 44-46dBA. Typical L_{Amax} associated with dropping of timber in the range of 45-47dBA.
5. No – Noise associated with Satellite Building constantly audible during time of survey with typical sound pressure level in the range of 43-45dBA. Typical L_{Amax} associated with dropping of timber in the range of 45-47dBA.
6. No – Noise associated with Satellite Building constantly audible during time of survey with typical sound pressure level in the range of 43-45dBA. Typical L_{Amax} associated with dropping of timber in the range of 45-47dBA.

Table D-8 Location A – Night Time Operational Noise Measurements Results (Day 2)

Night Time (10.00pm to 7.00am)					
Measurement No.	**Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
2	25/07/2018 5.30am	35	49	35	44
	25/07/2018 5.45am		50	35	23
	25/07/2018 6.00am		49	35	23
	25/07/2018 6.15am		51	36	23
	25/07/2018 6.30am		52	35	28
	25/07/2018 6.45am		59	35	34

Average Wind Speed (m/s): Wind with speed up to 2m/s.

Meet Criterion (Yes/No) & Comments

1. No – Noise associated with onsite vehicular movements audible for approximately 1 minute during time of survey with typical sound pressure level in the range of 55-57dBA. Typical L_{Amax} associated with clanking of metal in the range of 51-53dBA.
2. Yes – Noise associated with onsite vehicular movements audible for approximately 35 seconds during time of survey with typical sound pressure level in the range of 38-40dBA. Typical L_{Amax} associated with clanking of metal in the range of 51-53dBA.
3. Yes – Noise associated with onsite vehicular movements audible for approximately 30 seconds during time of survey with typical sound pressure level in the range of 38-40dBA.
4. Yes – Noise associated with onsite vehicular movements audible for approximately 30 seconds during time of survey with typical sound pressure level in the range of 38-40dBA.
5. Yes – Noise associated with onsite vehicular movements audible for approximately 2 minutes during time of survey with typical sound pressure level in the range of 38-40dBA.
6. Yes – Noise associated with onsite vehicular movements audible for approximately 4 minutes during time of survey with typical sound pressure level in the range of 38-40dBA. Typical L_{Amax} associated with clanking of metal in the range of 51-53dBA.

Table D-9 Location A – Night Time Operational Noise Measurements Results (Day 3)

Night Time (10.00pm to 7.00am)					
Measurement No.	**Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	26/07/2018 5.30am	35	53	47	53
2	26/07/2018 5.45am		54	47	54
3	26/07/2018 6.00am		52	48	52
4	26/07/2018 6.15am		53	47	53
5	26/07/2018 6.30am		51	46	51
6	26/07/2018 6.45am		53	47	53

Average Wind Speed (m/s): Wind with speed up to 2m/s.

Meet Criterion (Yes/No) & Comments

1. No – Noise associated with Satellite Building clearly audible during time of survey with typical sound pressure level in the range of 51-53dBA. Typical L_{Amax} associated with dropping of timber in the range of 51-54dBA.
2. No – Noise associated with Satellite Building clearly audible during time of survey with typical sound pressure level in the range of 51-54dBA. Typical L_{Amax} associated with dropping of timber in the range of 51-54dBA.
3. No – Noise associated with Satellite Building clearly audible during time of survey with typical sound pressure level in the range of 51-53dBA. Typical L_{Amax} associated with dropping of timber in the range of 51-54dBA.
4. No – Noise associated with Satellite Building clearly audible during time of survey with typical sound pressure level in the range of 51-53dBA. Typical L_{Amax} associated with dropping of timber in the range of 51-54dBA.
5. No – Noise associated with Satellite Building clearly audible during time of survey with typical sound pressure level in the range of 51-53dBA. Typical L_{Amax} associated with dropping of timber in the range of 51-54dBA.
6. No – Noise associated with Satellite Building clearly audible during time of survey with typical sound pressure level in the range of 51-53dBA. Typical L_{Amax} associated with dropping of timber in the range of 51-54dBA.

Table D-10 Location B – Daytime Operational Noise Measurements Results (Day 1)

Daytime (7.00am to 6.00pm)					
Measurement No.	**Date & Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	24/07/2018 11.15am	35	56	44	<44 (barely audible)
2	24/07/2018 11.30am		57	44	<44 (barely audible)
3	24/07/2018 11.45am		56	46	<46 (barely audible)
4	24/07/2018 12.00pm		56	44	<44 (barely audible)
5	24/07/2018 12.15pm		56	46	<46 (barely audible)
6	24/07/2018 12.30pm		54	44	<44 (barely audible)

Average Wind Speed (m/s): Wind with speed up to 8.5m/s.

Meet Criterion (Yes/No) & Comments

1. Yes – Noise emanating from DA barely audible during time of survey due to high wind condition.
2. Yes – Noise emanating from DA barely audible during time of survey due to high wind condition.
3. Yes – Noise emanating from DA barely audible during time of survey due to high wind condition.
4. Yes – Noise emanating from DA barely audible during time of survey due to high wind condition.
5. Yes – Noise emanating from DA barely audible during time of survey due to high wind condition.
6. Yes – Noise emanating from DA barely audible during time of survey due to high wind condition.

Table D-11 Location B – Daytime Operational Noise Measurements Results (Day 2)

Daytime (7.00am to 6.00pm)					
Measurement No.	**Date & Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	25/07/2018 11.00am	35	48	44	44
2	25/07/2018 11.15am		48	43	43
3	25/07/2018 11.30am		51	43	44
4	25/07/2018 11.45am		48	43	43
5	25/07/2018 12.00pm		48	44	44
6	25/07/2018 12.15pm		49	44	44

Average Wind Speed (m/s): Wind with speed up to 5m/s.

Meet Criterion (Yes/No) & Comments

1. No – Noise associated with Satellite Building clearly audible during time of survey with typical sound pressure level in the range of 42-44dBA.
2. No – Noise associated with Satellite Building clearly audible during time of survey with typical sound pressure level in the range of 42-44dBA.
3. No – Noise associated with Satellite Building clearly audible during time of survey with typical sound pressure level in the range of 42-44dBA.
4. No – Noise associated with Satellite Building clearly audible during time of survey with typical sound pressure level in the range of 42-44dBA.
5. No – Noise associated with Satellite Building clearly audible during time of survey with typical sound pressure level in the range of 42-44dBA.
6. No – Noise associated with Satellite Building clearly audible during time of survey with typical sound pressure level in the range of 42-44dBA.

Table D-12 Location B – Daytime Operational Noise Measurements Results (Day 3)

Daytime (7.00am to 6.00pm)					
Measurement No.	**Date & Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	26/07/2018 7.00am	35	52	46	52
2	26/07/2018 7.15am		52	46	52
3	26/07/2018 7.30am		51	45	51
4	26/07/2018 7.45am		49	44	49
5	26/07/2018 8.00am		49	45	49
6	26/07/2018 8.15am		47	45	47

Average Wind Speed (m/s): Wind with speed up to 2m/s.

Meet Criterion (Yes/No) & Comments

1. No – Noise associated with Satellite Building and Green Mill Building were clearly audible during time of survey with typical sound pressure level in the range of 51-53dBA.
2. No – Noise associated with Satellite Building and Green Mill Building were clearly audible during time of survey with typical sound pressure level in the range of 51-53dBA.
3. No – Noise associated with Satellite Building and Green Mill Building were clearly audible during time of survey with typical sound pressure level in the range of 50-52dBA.
4. No – Noise associated with Satellite Building and Green Mill Building were clearly audible during time of survey with typical sound pressure level in the range of 48-50dBA.
5. No – Noise associated with Satellite Building and Green Mill Building were clearly audible during time of survey with typical sound pressure level in the range of 48-50dBA.
6. No – Noise associated with Satellite Building and Green Mill Building were clearly audible during time of survey with typical sound pressure level in the range of 45-48dBA.

Table D-13 Location B – Evening Operational Noise Measurements Results (Day 1)

Evening (6.00pm to 10.00pm)					
Measurement No.	**Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	23/07/2018 8.30pm	35	45	36	<36 (barely audible)
2	23/07/2018 8.45pm		45	36	<36 (barely audible)

Average Wind Speed (m/s): Wind with speed up to 4m/s.

Meet Criterion (Yes/No) & Comments

1. Yes – Noise emanating from DTO barely audible during time of survey due to high wind condition.
2. Yes – Noise emanating from DTO barely audible during time of survey due to high wind condition.

Table D-14 Location B – Evening Operational Noise Measurements Results (Day 2)

Evening (6.00pm to 10.00pm)					
Measurement No.	**Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	24/07/2018 8.00pm	35	46	38	41
2	24/07/2018 8.15pm		45	38	41

Average Wind Speed (m/s): Wind with speed up to 4m/s.

Meet Criterion (Yes/No) & Comments

1. No – Noise associated with boiler/klin constantly audible during time of survey, estimated range of SPL 37-39dBA. Satellite Building clearly audible for approximately 5min with typical sound pressure level in the range of 42-44dBA.
2. No – Noise associated with boiler/klin constantly audible during time of survey, estimated range of SPL 37-39dBA. Satellite Building clearly audible for approximately 5min with typical sound pressure level in the range of 42-44dBA.

Table D-15 Location B – Evening Operational Noise Measurements Results (Day 3)

Evening (6.00pm to 10.00pm)					
Measurement No.	**Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	25/07/2018 6.30pm	35	49	46	43
2	25/07/2018 6.45pm		48	46	43

Average Wind Speed (m/s): Wind with speed up to 5m/s.

Meet Criterion (Yes/No) & Comments

1. No – Noise associated with boiler/klin constantly just audible during time of survey, estimated range of SPL 40-43dBA.
2. No – Noise associated with boiler/klin constantly audible during time of survey, estimated range of SPL 40-43dBA.

Table D-16 Location B – Night Time Operational Noise Measurements Results (Day 1)

Night Time (10.00pm to 7.00am)					
Measurement No.	**Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	24/07/2018 5.30am	35	49	44	42
2	24/07/2018 5.45am		49	44	44
3	24/07/2018 6.00am		51	45	47
4	24/07/2018 6.15am		52	44	47
5	24/07/2018 6.30am		54	45	49
6	24/07/2018 6.45am		54	44	49

Average Wind Speed (m/s): Wind with speed up to 2m/s.

Meet Criterion (Yes/No) & Comments

1. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 1 minute with typical sound pressure level in the range of 53-55dBA. Typical L_{Amax} associated with dropping of timber in the range of 51-54dBA.
2. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 1.5 minute with typical sound pressure level in the range of 53-55dBA.
3. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 3 minutes with typical sound pressure level in the range of 53-55dBA.
4. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 3 minutes with typical sound pressure level in the range of 53-55dBA.
5. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 2 minutes with typical sound pressure level in the range of 55-58dBA. Typical L_{Amax} associated with dropping of timber in the range of 55-58dBA.
6. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 2 minutes with typical sound pressure level in the range of 55-58dBA. Typical L_{Amax} associated with dropping of timber in the range of 55-58dBA.

Table D-17 Location B – Night Time Operational Noise Measurements Results (Day 2)

Night Time (10.00pm to 7.00am)					
Measurement No.	**Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	25/07/2018 5.30am	35	46	44	41
2	25/07/2018 5.45am		51	45	47
3	25/07/2018 6.00am		48	45	42
4	25/07/2018 6.15am		50	46	45
5	25/07/2018 6.30am		52	48	47
6	25/07/2018 6.45am		53	46	48

Average Wind Speed (m/s): Wind with speed up to 2m/s.

Meet Criterion (Yes/No) & Comments

1. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 50 seconds with typical sound pressure level in the range of 53-55dBA. Typical L_{Amax} associated with dropping of timber in the range of 51-54dBA.
2. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 3 minutes with typical sound pressure level in the range of 53-55dBA.
3. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 1 minute with typical sound pressure level in the range of 53-55dBA.
4. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 2 minutes with typical sound pressure level in the range of 53-55dBA.
5. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 1.5 minutes with typical sound pressure level in the range of 55-58dBA. Typical L_{Amax} associated with dropping of timber in the range of 55-58dBA.
6. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 2 minutes with typical sound pressure level in the range of 55-58dBA. Typical L_{Amax} associated with dropping of timber in the range of 55-58dBA.

Table D-18 Location B – Night Time Operational Noise Measurements Results (Day 3)

Night Time (10.00pm to 7.00am)					
Measurement No.	**Start Time**	**Criterion**	**Overall Measured Level**		**Estimated DTO L_{Aeq}**
			$L_{Aeq,15min}$	**L_{A90}**	
1	26/07/2018 5.00am	35	44	40	40
2	26/07/2018 5.15am		48	43	40
3	26/07/2018 5.30am		48	43	45
4	26/07/2018 5.45am		51	46	47
5	26/07/2018 6.00am		50	46	47
6	26/07/2018 6.15am		53	48	48

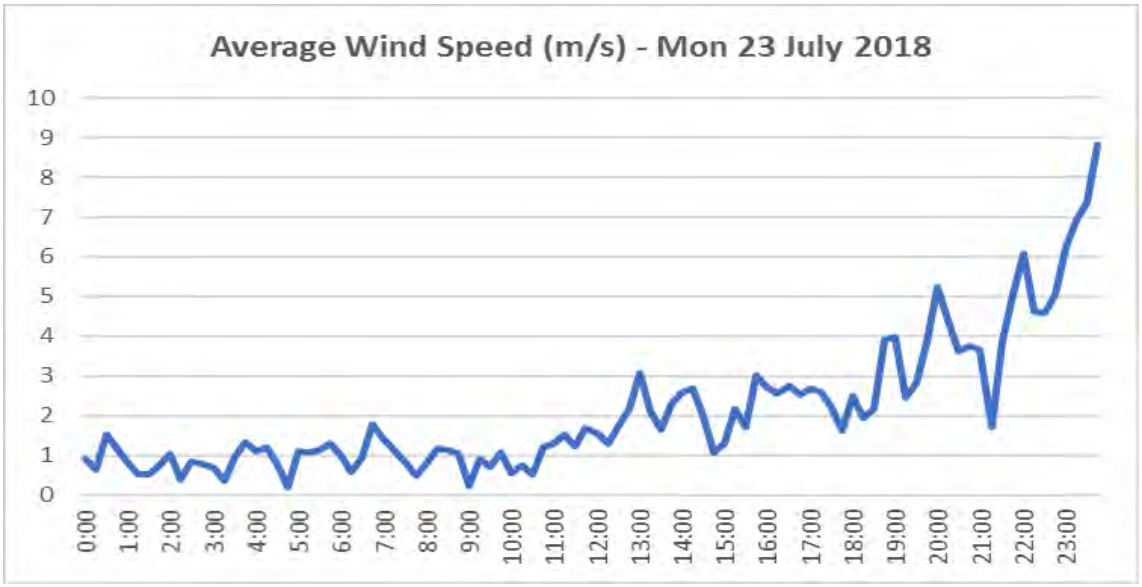
Average Wind Speed (m/s): Wind with speed up to 2m/s.

Meet Criterion (Yes/No) & Comments

1. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 1 minute with typical sound pressure level in the range of 50-53dBA. Typical L_{Amax} associated with dropping of timber in the range of 50-53dBA.
2. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 1 minute with typical sound pressure level in the range of 50-53dBA. Typical L_{Amax} associated with dropping of timber in the range of 50-53dBA.
3. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 2 minutes with typical sound pressure level in the range of 53-55dBA.
4. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 3 minutes with typical sound pressure level in the range of 53-55dBA.
5. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 3 minutes with typical sound pressure level in the range of 53-55dBA.
6. No – Noise associated with Satellite Building and Green Mill Building were clearly audible for approximately 3 minutes with typical sound pressure level in the range of 53-55dBA.

Appendix C

Onsite Meteorological Data


Average Wind Speed (m/s) - Mon 23 July 2018
10
9
8
7
6
5
4
3
2
1
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
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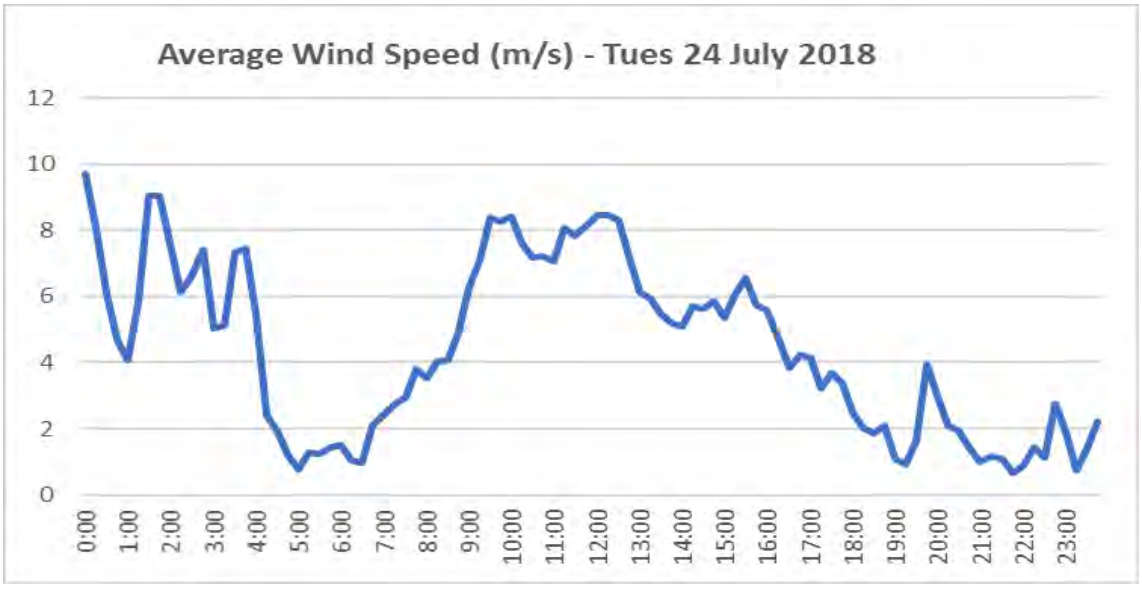
18:00
19:00
20:00
21:00
22:00
23:00


Average Wind Speed (m/s) - Tues 24 July 2018
12
10
8
6
4
2
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
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15:00
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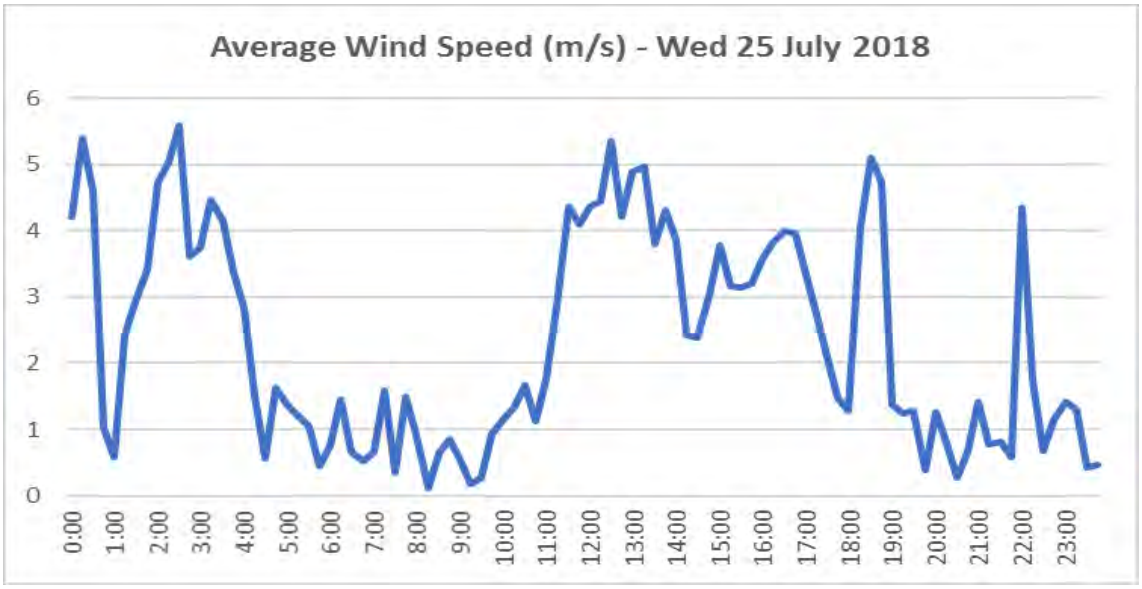
17:00
18:00
19:00
20:00
21:00
22:00
23:00


Average Wind Speed (m/s) - Wed 25 July 2018
6
5
4
3
2
1
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
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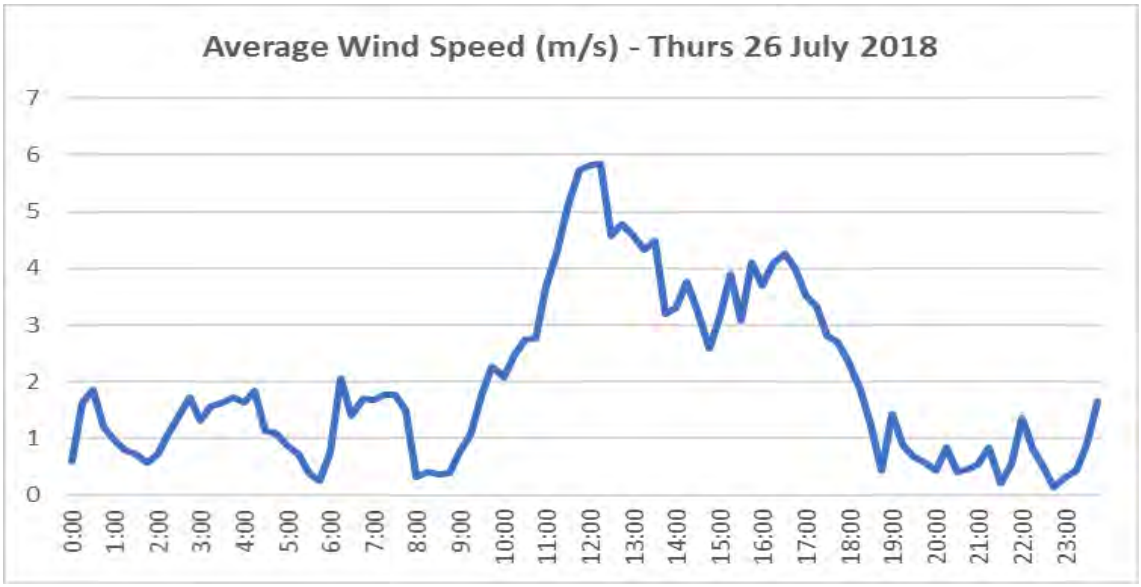
22:00
23:00


Average Wind Speed (m/s) - Thurs 26 July 2018
7
6
5
4
3
2
1
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
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23:00

GHD

Level 15
133 Castlereagh Street
T: 61 2 9239 7100 F: 61 2 9239 7199 E: sydmail@ghd.com

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www.ghd.com

GHD

133 Castlereagh St Sydney NSW 2000

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T: +61 2 9239 7100 F: +61 2 9239 7199 E: sydmail@ghd.com.au

Document1

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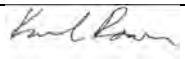
1	Sophie Lovett	Karl Rosen		Karl Rosen		02/10/18

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