Ground floor 20 Chandos Street
St Leonards NSW 2065
PO Box 21
St Leonards NSW 1590
02 9493 9500
www.emmconsulting.com.au

20 June 2024

Erik Larson
Senior Consultant
Jackson Environment and Planning Pty Ltd
Suite 102, Level 1, 25-29 Berry St
North Sydney NSW 2060

Re: Response to NSW Environment Protection Authority submission comments - Redbank Power Station Restart - air quality impact assessment, greenhouse gas mitigation plan and climate change adaptation plan

Dear Erik,

An environmental Impact Statement (EIS) was prepared by Jackson Environment and Planning Pty Ltd (JEP) on behalf of Verdant Earth Technologies Limited (Verdant Earth) who are seeking approval to restart the Redbank Power Station using ecologically sustainable biomass fuel. The EIS submitted to the NSW Department of Planning, Industry and Housing (DPHI) was dated 20 February 2024.

On behalf of Verdant Earth, EMM Consulting Pty Ltd (EMM) were engaged by Verdant Earth to prepare an air quality impact assessment, and a greenhouse gas mitigation plan and climate change adaptation plan for the EIS. These documents were included with the EIS as Appendix O and Appendix P respectively.

Following the completion of the public exhibition period for the EIS, all submissions received by DPHI have been collated by JEP. The NSW Environment Protection Authority (EPA) has prepared a written submission, dated 4 April 2024, relating to reports prepared by EMM (i.e. the air quality impact assessment, and greenhouse gas mitigation plan and climate change adaptation plan) seeking additional clarifying information. This document provides a response to the comments received by the NSW EPA. For reference, the full EPA comments are provided in Appendix A.

Yours sincerely

Francine Manansala	**Dr Paul Boulter**	**Scott Fishwick**
Associate – air quality	Associate Director – air quality	National technical lead – air quality

1 Air quality impact assessment

EPA comment:

a) The proponent to provide the manufacturers performance specifications for the furnace and pollution control equipment. This must include the performance specifications for each type of proposed fuel.

EMM response:

As the Redbank Power Station is not currently operating using biomass fuels, there are no manufacturer performance specifications data available. As described in the following sections, the emissions inventory for the AQIA is predominantly based on the use of publicly-available emission factors. Individual air toxics were estimated using fuel specification reports provided by Verdant Earth. The AQIA included a 99% control for PM_{10} and $PM_{2.5}$ emissions to represent the baghouse filters installed at Redbank Power Station. The AQIA report stated that a control efficiency of 99% was a conservative assumption, with performance specifications for the baghouse filters indicating a control efficiency of 99.5%. The control efficiency of 99% was adopted from Table 34 of the *National Pollutant Inventory (NPI) emission estimation technical manual for combustion in boilers* (NPI 2011). Corresponding emission rates for PM_{10} and $PM_{2.5}$ were taken from Table 32 of the same document. Concentrations associated with the biomass combustion would be verified through testing on restart of the Redbank Power Station.

EPA comment:

b) The proponent to demonstrate that a reasonable worst-case assessment of impacts has been undertaken based on performance specifications or manufacturers guarantees.

The Air Quality Impact Assessment (the AQIA) has considered two scenarios when the facility is operating using biomass as a fuel. The scenarios are:

- The expected case scenario, which is based on emissions that are estimated using emission factors and biomass composition data.
- The regulatory worst-case scenario, which is based on emissions at the prescribed limits for Group 6 plant in the Protection of the Environment Operations (Clean Air) Regulation 2022 (the Clean Air Regulation).

The Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (the Approved Methods) outlines a number of methods that can be used to estimate the emission rates from sources. The EPA's preferred methods are direct measurement for existing sources and manufacturers design specifications for proposed sources. Emission factors are generally used when there is no other information available or when emissions can reasonably be demonstrated to be negligible. Manufacturers' design specifications or performance guarantees, provide a more reliable means of determining the upper limit to the emission rate or concentration of air pollutants for sources that are maintained and operated in a proper and efficient manner.

EMM response:

The modelling assessment for the expected case scenario for the boiler as presented in the AQIA was based predominantly on publicly available emission rates (presented in Table 7.1 of the AQIA report). Historically, Redbank Power Station has operated on coal/ beneficiated dewatered coal tailings (BDT) and therefore there are no site-specific stack emission measurements relevant to biomass combustion that could be applied at the time of modelling. As highlighted in the AQIA and in the response to EPA comment a), emissions of individual air toxics were estimated using biomass sample analysis (HRL 2023a) combined with PM_{10} emission rates.

Emission rates for the RWC scenario were calculated using the NSW Protection of the Environment Operations (POEO) (Clean Air) Regulation 2022 (the Clean Air Regulation) (presented in Table 7.2 of the AQIA report). The Clean Air Regulation provide emission concentration limits under which a project must operate under and therefore, the RWC scenario presents a worst-case assessment of potential impacts from the project. In reality, the project is expected to operate below these emission limits, which would be confirmed post-approval through data recorded by the installed continuous emissions monitoring system (CEMS) and periodic emissions sampling campaigns. The modelling for the RWC scenario conservatively assumes that these maximum emission rates are occurring for every hour of the year.

EPA comment:

c) The proponent must update the emissions inventory to include the emission concentrations of pollutants emitted from the furnace and include an assessment of compliance with the Clean Air Regulation.

The AQIA presents the estimated emission rates for the furnace. Table 7.1 of the AQIA provides estimated emission rates for the expected case scenario, and Table 7.2 provides estimated emission rates for the regulatory worst-case scenario. The Approved Methods requires the emission inventory to include emission concentration of pollutants emitted from point sources. Additionally, it requires the inventory to be used to demonstrate compliance with the Clean Air Regulation.

The emission concentration of pollutants emitted from the furnace for the expected case scenario are not presented. Therefore, the above further information is required to demonstrate compliance with the Clean Air Regulation.

EMM response:

The pollutant concentrations for the expected case scenario are presented in Table 1.1. The concentrations for the RWC scenario are as presented in the Clean Air Regulation column of Table 1.1. A flow rate of 153.3 Nm^3/s was used to calculate the concentrations.

The Clean Air Regulation emission concentration limits adopted for the assessment were taken from Schedule 2 of the Clean Air Regulation for electricity generation, using the Group 6 concentration limits.

The calculated expected case scenario emission concentrations for all pollutants were below the Clean Air Regulation emission limits with the exception of CO.

It is noted that the applicable Clean Air Regulation limit for CO is grouped under volatile organic compounds (VOC), which specifies limits for VOCs of 40 mg/Nm^3 or for CO of 125 mg/Nm^3. Per point 10.2 of the Clean Air Regulations frequently asked questions document[1], a project only needs to comply with the VOC emission limit or the CO emission limit. The expected case emission concentration for VOC complies with the Clean Air Regulations emission limit of 40 mg/Nm^3.

[1] Department of Environment and Conservation 2006. https://www.environment.nsw.gov.au/resources/air/FAQPOEP4/faqpoeocarpart4.pdf

Table 1.1 Concentrations for combustion sources – expected case

Pollutant	Emission rate (g/s)	Emission concentration (mg/Nm³)	
		Derived concentration from emission rate	POEO Clean Air Regulation emission limit
CO	20.7	134.8	125[a]
NOx	29.5	192.5	500
SO_2	5.0	32.7	N/A
Solid particles (TSP)	1.0	4.1	50
VOCs	3.5	15.1	40
HF	0.94	6.1	50
Type 1 substances and Type 2 substances (in aggregate)	0.02	0.16	1
Dioxins and furans	1.6E-08	1.0E-07	1.0E-07
Cadmium (Cd) or mercury (Hg) individually	Cadmium - 0.0001 Mercury - 0.00001	Cadmium – 0.0009 Mercury - 0.0001	0.2

Reference conditions: 273K, 1atm, 7% O_2
N/A = not available
[a] Noted under VOCs in the Clean Air Regulations.

EPA comment:

d) The proponent must revise the AQIA to provide further clarity on the methodology applied for estimating metal emissions and include all data used in the emission estimation.

Section 7.3 of the AQIA outlines the methodology for estimating emissions of metals. The expected case scenario emission rates provided in Table 7.5 of the AQIA have either been derived from a fuel specification or data from thirty (30) samples taken for the proposed biomass material. However, it is not clear which data set (fuel specification or sample data) has been used to derive the emission estimates. Furthermore, the data used in the estimation has not been presented.

For the regulatory worst case scenario emission rates provided in Table 7.6. The emission rates were derived from the Clean Air Regulation limits and sample data. However, the sample data has not been provided.

EMM response:

The approach taken to estimate metal emissions for the expected case scenario was as follows:

1. The concentrations presented on page 14 of the September 2023 fuel specification report (HRL 2023a) were averaged across all 30 samples. An average percentage was then calculated for each metal.

2. The average percentage for each metal was multiplied by the PM_{10} emission rate in g/s (as presented in Table 7.1 of the AQIA report) to produce the final metal emission rate in g/s.

The following note is made:

- The emission rate for mercury was calculated without the 99% control assumed on the PM_{10} emission rate for the baghouse filter. This conservatively assumed that all mercury emissions were emitted in vapour form.

The approach taken to estimate metal emissions for the RWC scenario was as follows:

3. The concentrations presented on page 14 of the September 2023 fuel specification report were averaged across all 30 samples.

4. The metals were identified as either Type 1 or Type 2 in line with the definitions provided on page 72 of the Clean Air Regulations.

5. The ratio of the average concentration for each metal to the total for all metals was calculated.

6. The ratio was multiplied by the Type 1 and 2 emission rate in g/s (i.e. 0.2 g/s) to produce the final metal emission rate in g/s.

The followings notes are made:

- The emission rate for cadmium was calculated using the actual Clean Air Regulations emission limit of 0.2 mg/m^3.

- Copper is not listed as a Type 1 or 2 substance in the Clean Air Regulations. Therefore, the emission rate for copper was determined in the following way:

    - the ratio of expected case metals (other than copper) emission rates to the RWC metal rates was calculated

- this ratio was applied to the expected case emission rate for copper to determine the emission rate to be used for the RWC.

The sample data has been provided in response to EPA comment a) however, a table presenting the data as well as the average calculations described above is presented in Appendix B.

EPA comment:

e) The AQIA does not include an assessment of impacts from all proposed waste derived fuel.

EPA understands that data used for estimating metal emissions (as mentioned in Air Impact Assessment point d) above) is from the biomass that has not been derived from waste material (including construction and demolition waste). The AQIA has not included an assessment of emissions associated with Domestic biomass. This is not an eligible waste or standard fuel (referred to in 'Waste and Resource Recovery' section above).

EMM response:

DBF is not currently prescribed as an 'eligible waste fuel' under current EPA guidelines and cannot be used until the applicant can demonstrate that DBF is homogeneous and low in contaminants. The applicant also understands that the EPA must review and list DBF as an eligible waste fuel prior to the applicant applying for an Resource Recovery Order Exemption (RROE) in order to use it.

Verdant Earth will seek to demonstrate this prior to its use through a post-approval Specific RROE application under Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014.

Emissions for metals were estimated using sample data provided by Verdant Earth, which contained DBF materials. This provides a conservative estimate of potential emissions from the project.

To address this matter Verdant Earth agrees to only use standard or eligible waste fuels. Verdant Earth also wishes to reserve the right to apply to the EPA in the future to seek approval for the use of DBF if it can be demonstrated that the fuel is acceptable as an Eligible Waste Fuel (EWF) and listed an EWF by EPA.

EPA comment:

f) The proponent must revise the AQIA to include all data for estimating emissions.

Emission estimates for the expected case scenario are based on emission factors and biomass composition data that is not provided. This data is required (including emission factors) to allow for a clear and transparent assessment.

EMM response:

The emission factors for the expected case scenario boiler emissions are provided in Table 1.2. The information provided in Table 1.2 is provided in Table 7.1 of the AQIA (with the exception of the emission factors).

Table 1.2 Emissions factors for combustion sources – expected case

Pollutant	Emission factor (kg/t)	Emission rate (g/s)	Source	Type	Notes
CO	0.7	20.7	NPI 2011, Table 32	Bark fired boiler, fluidised bed combustion	Selected from Table 32 for the fluidised bed combustion option.
NO_x	1.0	29.5	NPI 2011, Table 32	Bark fired boiler, fluidised bed combustion	Selected from Table 32 for the fluidised bed combustion option.
SO_2	0.17	5.0	NPI 2011, Table 32/Table 33	Wood/bark fired boilers	-
PM_{10}	3.24	1.0	NPI 2011, Table 32	Wood/bark fired boilers, uncontrolled	Selected from Table 33 as the fuel will be a mixture of wood and bark. 99% control applied for the upstream baghouse filter.
$PM_{2.5}$	2.74	0.8	NPI 2011, Table 32	Wood/bark fired boilers, uncontrolled	
TSP	3.24	1.0	NPI 2011, Table 32	Wood/bark fired boilers, uncontrolled	As there was no emission rate for TSP, PM_{10} was selected.
VOC	0.12	3.5	NPI 2011, Table 32	Wood/bark fired boilers, uncontrolled	-
HF	-	0.94	Fuel specification	-	Historical assessment for project (EMM 2021)
HCl	-	31.2	Fuel specification	-	

A fuel specification report provided by Verdant Earth was used to develop the emission rates (as a percentage of PM_{10} emissions) for the boiler for individual air toxics only. The report used as available to EMM at the time of emissions estimation was prepared by HRL - *Biomass Fuel Characterisation and Specification Proposed for use at the Redbank Power Station* (27 September 2023) (HRL 2023a). The sample data used in the emissions estimation is provided in Table 3.3e of the report. The average of all samples for each air toxic was used to develop

emission rates for modelling (this is further detailed in section g below). The samples correspond to biomass material types as given in Table 2.2 of the same report.

EPA comment:

g) The proponent must revise the AQIA to describe the assessment methods for all air pollutants assessed.

Predicted ground level concentrations for metals and speciated VOCs are provided in Table 8.5 (expected case scenario) and Table 8.13 (regulatory worst-case scenario) of the AQIA.

For the expected case scenario predicted ground level concentrations are provided for formaldehyde, benzene, toluene, ethylbenzene, xylene, dioxins and furans, and Benzo(a)pyrene. However, it is not clear how the assessment has been undertaken for these individual compounds, including emission estimation methods.

Similarly for the regulatory worst-case scenario predicted ground level concentrations are provided for formaldehyde, benzene, toluene, ethylbenzene, and xylene. However, it is not clear how assessment has been undertaken for these individual compounds including emission estimation methods. Further information is required on the assessment methods for these pollutants.

EMM response:

The ground-level concentrations for benzene, formaldehyde, toluene, ethylbenzene, and xylene for the expected case and RWC were calculated by applying a scaling emission factor to a modelled unit emission rate result. The scaling emission factors were determined using emission factors from Table 1.6-3 of USEPA AP-42 document for Wood residue combustion in boilers. The following approach was used:

1. The emission factors for benzene, formaldehyde, toluene, ethylbenzene, and xylene were calculated as a percentage of the volatile organic compounds (VOC) emission factor. The emission factors are as follows:

- VOC: 0.017 lb/MMBTu
- Benzene: 0.0042 lb/MMBTu (0.2471% of VOC)
- Formaldehyde: 0.0044 lb/MMBTu (0.2588% of VOC)
- Toluene: 0.00092 lb/MMBTu (0.0541% of VOC)
- Ethylbenzene: 0.000031 lb/MMBTu (0.0018% of VOC)
- Zylene: 0.000025 lb/MMBTu (0.0015% of VOC)

2. The emission factor for total VOCs (0.12 kg/t) was taken from Table 32 of National Pollutant Inventory emission estimation technique manual for combustion in boilers (NPI 2011).

    a) For the expected case, this factor was converted to g/s by multiplying it by the fuel rate (106.25 tonnes per hour) and converting it to seconds. This resulted in an expected case emission rate of 3.54 g/s.

    b) For the RWC, the VOC emission rate of 6.1 g/s (using the POEO emission limit) was used.

3. Emission factors for each individual VOC where then calculated by multiplying the VOC emission rates in g/s (as explained in step 2) by the percentages calculated in step 1.

EPA comment:

h) The proponent must revise the AQIA to include an assessment of potential impacts for proposed diesel fuel.

Diesel fuel is proposed to be used during plant start-up. However, as assessment of potential impacts from proposed diesel fuel has not been provided.

EMM response:

Verdant Earth has noted that diesel will be used for an average of 40 hours per year which accounts for two outages per year (one minor and one major). Additional diesel may be used during unpredicted outages.

To understand the potential emissions during the operation of diesel fuel burners, Verdant Earth has provided historical CEMS data from the project corresponding to a noted start-up phase of the boiler that occurred in October 2012. Emission concentrations of SO_2, NO_x and particulate matter are illustrated in Figure 1.1 relative to stack emission flow rate and boiler electricity generation.

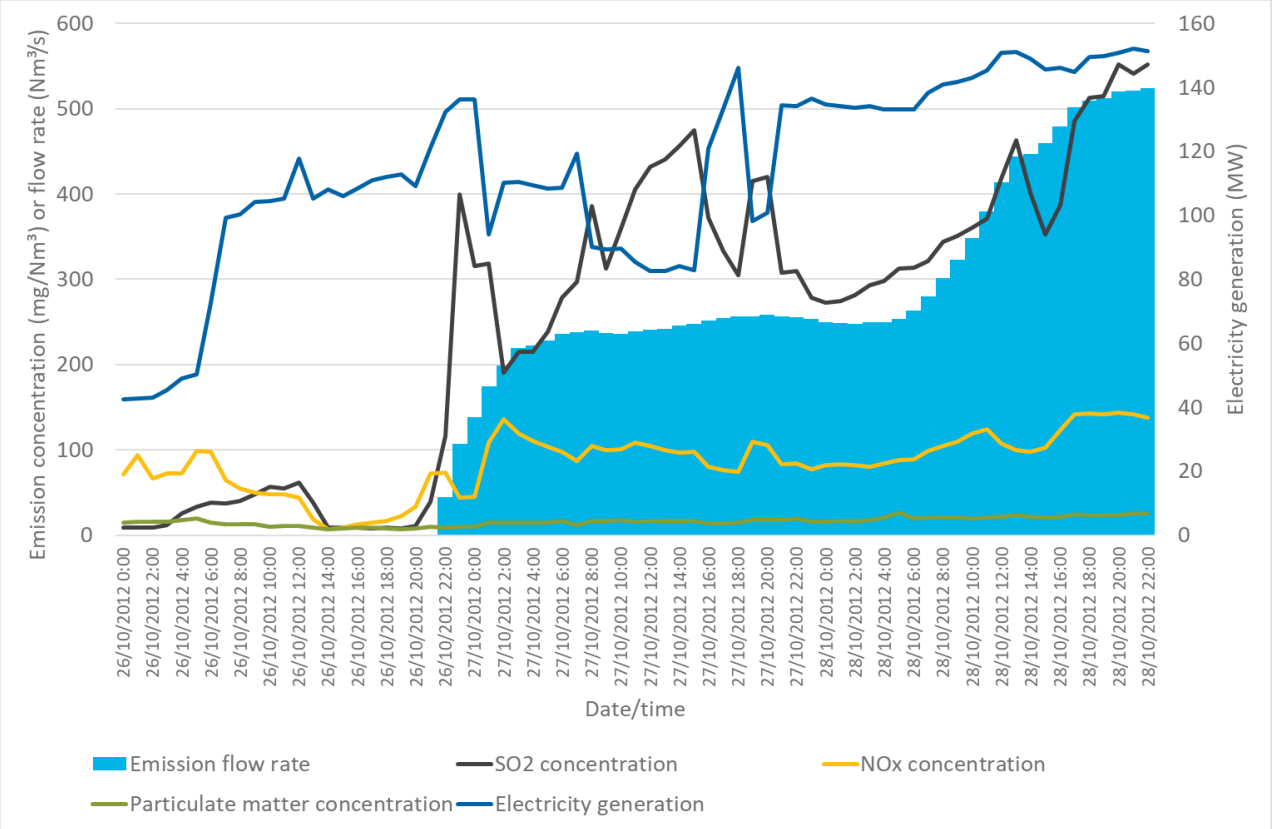

Figure 1.1 Diesel burner emissions during boiler start-up – SO_2, NO_x and particulate matter

Figure 1.1 shows the following:

- The phase of diesel burner operation begins after the recommencement of stack emission flow rate measurements on 26 October 2012 and continues until the ramp up in BDT/coal use and increasing electricity generation on 27 October 2012.
- During the period of diesel combustion, emission concentrations of NO_x, SO_2 and particulate matter are less than 98 mg/Nm^3, 62 mg/Nm^3 and 20 mg/Nm^3, respectively.

Relative to the modelling scenarios presented in the AQIA, the following is noted:

- The modelled expected case biomass combustion emission concentration for NO_x was 192.5 mg/Nm^3, which is higher than the measured concentration during diesel combustion of 98 mg/Nm^3. Therefore, the predicted ground-level concentrations for NO_2 for the expected case biomass combustion can also be viewed as conservatively high for periods of diesel combustion emissions.

- The modelled expected case biomass combustion emission concentration for SO_2 was 32.7 mg/Nm^3, which is approximately 1.9 times lower than the measured SO_2 concentration during diesel combustion of 62 mg/Nm^3. On review of the model predicted 1-hour maximum ground level SO_2 concentrations presented in the Table 8.3 of the AQIA, a doubling of the predicted maximum 1-hour average SO2 concentrations would not change the precited compliance with the applicable NSW EPA impact assessment criteria. It is reminded that the operation of the diesel burners would be an infrequent occurrence at the power station.

- The modelled expected case biomass combustion emission concentration for particulate matter was 6.2 mg/Nm^3, which is approximately 3.2 times lower than the measured particulate matter concentration during diesel combustion of 20 mg/Nm^3. It is noted that the modelling for the regulatory worst case scenario adopted a particulate matter emission concentration of 50 mg/Nm^3. All predicted incremental particulate matter concentrations for the expected case biomass combustion and regulatory worst case scenarios are low, and this would therefore be applicable for periods of diesel burner operation.

On the basis of the comparison of historical recorded stack emission concentrations during diesel combustion with quantified emissions for the combustion of biomass material at the power station, it is considered that the air quality impact assessment provides suitable range in modelled emission rates to account for potential ground level concentrations during the operation of the diesel burners during shut-down/start-up periods. It is considered that this comparison is conservative on the basis that diesel burners would only be used for approximately 40 hours of the year.

2 Greenhouse gas assessment

2.1 Comments from EPA

GREENHOUSE GAS ASSESSMENT

a) The proponent must provide more information on the heating value (or energy content) of the various biomass to be used in the proposal (i.e., the range in values depending on the biomass source).

The 'Biomass Fuel Characterisation and Specification Proposed for use at the Redbank Power Station' Report (or Fuel Characterisation report) contained the results of biomass testing for combustion characteristics and elemental analysis. The tests excluded GHG emissions, particulates, and volatile organic matter. Five standard fuel samples and 13 samples of eligible fuel waste were tested. Fuels classed as Domestic Biomass Fuels were not tested.

If there is a possibility that the proposed waste biomass fuel from land clearing will have a wider range of heating values, this could impact on the power stations operation and possible GHG emissions for the proposal (particularly biomass with heating values as low as 15 MJ/kg). Therefore, the energy content (with the variance in fuel source) and masses of each type of biomass used per annum should be given.

b) the proponent needs to present calculations on the sensitivity of the total scope 1 and 3 greenhouse gas emissions considering the variations in the energy content of the biomass.

The SEARS require credible estimations of greenhouse gas emissions. The EPA recognises that scope 2 emissions are minimal. It is suggested that the total scope 1 and 3 emissions be calculated using both the maximum and minimum energy content values (and not the average value) based on the "waste biomass from land clearing" results from Table 3.4 of the Fuel Characterisation report. The proponent should use the gross, dry basis ash free energy content data.

c) the proponent must provide further information and an explanation on whether the mass of biomass required by the power station is fixed or varies. Further information is needed to understand the relationship between the energy content of the biomass and tonnes biomass required per annum. If the mass of biomass increases or decreases the impact this has on scope 1 and 3 emissions should also be commented on.

The technical specification is 850,000 tonnes per annum at 25% moisture content. However, it is unclear how this varies with biomass energy and moisture content. If it does vary further information and justification should be provided as described above. Consideration should also be given on the impact this will have on ash production and how this will relate to third party processing and transport.

d) Recalculation of Scope 3 emissions for the offsite processing and third-party transport of the biomass

Scope 3 emissions were included for indirect emissions from on-site diesel consumption as well as third party processing and truck transport of the biomass (although an incorrect emission factor was used for this source). The proponent uses the scope 3 diesel emissions factors, but this assumes indirect fuel use by the proponent for these activities which is not the case. It is suggested that Scope 1 factors be used, as the emissions arise from direct fuel use by third parties whose activities are within the emissions boundary for the proposal.

2.2 EMM response

Given that there is some overlap between the various comments from EPA, the comments have been addressed below by theme.

2.2.1 Feedstock masses in GHG calculations

As a general point, the feedstock masses used in the calculations have been revised. Previously, a feedstock mass of 850,000 t/year was used for all activities associated with GHG emissions. This value has been retained

for upstream handling activities involving 'as received' wood, as it was considered to be credible for these activities. However, for power generation at Redbank it was too conservative, as it was used in conjunction with the feedstock energy content and emission factors for dry wood. To give a more credible estimate of GHG emissions for power generation only, and noting that EPA's comment (b) for the GHG assessment requests the use of a dry, ash-free energy content, the 850,000 t/year has been replaced with the dry-equivalent feedstock mass of 700,000 t/year.

2.2.2 Treatment of domestic biomass in the GHG assessment

For the purpose of the GHG calculations, the mass of domestic biomass has been reallocated to 'invasive native species', thus ensuring that the total dry-equivalent feedstock throughput of 700,000 t/year is maintained. As explained below, this does not affect the results of the GHG calculation. This reallocation was done because there is no assumption of DBF use until EPA designates the fuel as an eligible waste fuel and a specific RROE is obtained by the applicant.

2.2.3 Source of feedstock data

On the advice of Verdant Earth, information relating to the operation of the boiler and energy content properties of the likely feedstock at Redbank should be taken from reports by Boiler & Power Plant Services Pty Ltd (B&PPS), rather than the HRL fuel characterisation report mentioned by EPA. B&PPS were the original designers of the power plant, and have been maintaining the thermal model for Redbank since 2012. All proposed design improvements and modifications are also explored with B&PPS. Verdant Earth therefore considers the B&PPS data to be more relevant to the assessment with regards to the energy content of the fuel.

In particular, B&PPS (2020) provides performance data relating to the use of bushfire-damaged tree samples from the Hunter Valley, and at various moisture levels. The fuel samples had an energy content (dry, ash-free) of 20.4 GJ/t, which is very close to the value of 20.2 GJ/kg used in the original GHG calculations by EMM. The GHG calculations have been revised using the value of 20.4 GJ/t from the B&PPS report, on the assumption that this relates to 'typical' feedstock.

2.2.4 Effects of feedstock moisture content

Table 2 of the B&PPS report gives the mass of feedstock samples ('as fired' and 'bone dry'), with a nominal throughput of 700,000 t/year of dry wood, as shown in Table 2.1 and Figure 2.1. The 'as fired' samples have moisture contents ranging from 15% to 45%.

Table 2.1 Anticipated performance firing fire-damaged trees (two boilers operating) (B&PPS 2020)

Column		16	17	18	19	A
Case		Hunter Tree Analysis SGS 15% H2O	Hunter Tree Analysis SGS 25% H2O	Hunter Tree Analysis SGS 35% H2O	Hunter Tree Analysis SGS 45% H2O	BDT/BUF 80%/20% Warkworth 2005 33.4%/9.7% H2O
% Boiler MCR (261 t/h)		100%	100%	100%	100%	100%
No of Boilers Operating		2	2	2	2	2
Total Steam Flow	t/h	522	522	522	522	522
Steam Press	Mpa	10.60	10.60	10.60	10.60	10.60
Steam Temp	°C	513	513	513	513	513
Feed Temp	°C	189	189	189	189	189
Excess air	%	25	25	25	25	25
Combustion air	t/h	620.1	638.1	663.2	701.6	642.4
	% of Base	96.5%	99.3%	103.2%	109.2%	100.0%
Heat to Steam	MW	376.7	376.7	376.7	376.7	376.7
Boiler Efficiency	% GCV	81.63	79.32	76.32	72.14	83.00
	% of Base	98.3%	95.6%	92.0%	86.9%	100.0%
Fuel						
Total Fuel	MW	461.5	474.9	493.6	522.2	453.9
	% of Base	101.7%	104.6%	108.7%	115.1%	100.0%
		100%	103%	107%	113%	
"As fired" Flow	t/h	96.2	112.2	134.6	168.3	96.8
(8000hrs @ MCR)	t/year	769,752	897,718	1,076,550	1,346,089	774,783
	% of Base	100%	117%	140%	175%	
"Bone Dry" Flow	t/h	81.8	84.2	87.5	92.5	
(8000hrs @ MCR)	t/year	654,289	673,288	699,758	740,349	
	% of Base	100%	103%	107%	113%	
BDT Flow	t/h					81.6
CO2	kg/h					113.9
Moisture	% mass					33.4
Ash	% mass					19.08
GCV	MJ/kg					16.01
RWW Flow	t/h	96.2	112.2	134.6	168.3	
CO2	t/h	149.7	154.1	160.1	169.4	
Moisture	% mass	15	25	35	45	
Ash	% mass	0.45	0.40	0.35	0.29	
GCV	MJ/kg	17.24	15.21	13.18	11.15	
BUF Flow	t/h					15.3
CO2	t/h					28.2
Moisture	% mass					9.7
Ash	% mass					26.05
GCV	MJ/kg					21.40
Flue Gas Flow	t/h	714.3	748.2	795.6	867.6	718.3
Flow	% of Base	99.4%	104.2%	110.8%	120.8%	100%
at A/H exit	°C	156	161	168	178	152
Flow	Am3/h	868,509	930,324	1,018,498	1,154,826	862,289
Flow	% of Base	100.7%	107.9%	118.1%	133.9%	100%
Bed SEF		0.99	0.93	0.99	1.00	0.91
Bed Temp	°C	830	830	790	760	851
Cyclone Exit	°C	945	943	918	898	851
Overbed Comb.	%	20	20	20	20	11
Attemp Flow	% Steam Flow	7.7%	10.0%	11.0%	13.6%	0.0%
Limestone flow	kg/h	0	0	0	0	960
	% of Base					100%
Sulpur removal	%					46.5
SOx to Stack	kg/h	81	84	87	92	346
	mg/Nm3*	144	144	144	144	600
CO2 Flow	kg/h	149,746	154,086	160,132	169,405	142,141
Flow	% of Base	105.4%	108.4%	112.7%	119.2%	100%
		100%	103%	107%	113%	
Exclude from Wood	kg/h	0	0	0	0	142,141
Exclude from Wood	% of Base	0.0%	0.0%	0.0%	0.0%	100%
Dust to baghouse	kg/h	1,913	1,968	2,045	2,164	15,085
Dust Stack Exit	mg/Nm3*	<50	<50	<50	<50	<50
Total residue flow	kg/h	2,013	2,072	2,153	2,278	21,550
	% of Base	9.3%	9.6%	10.0%	10.6%	100%

*= dry at 7% O2

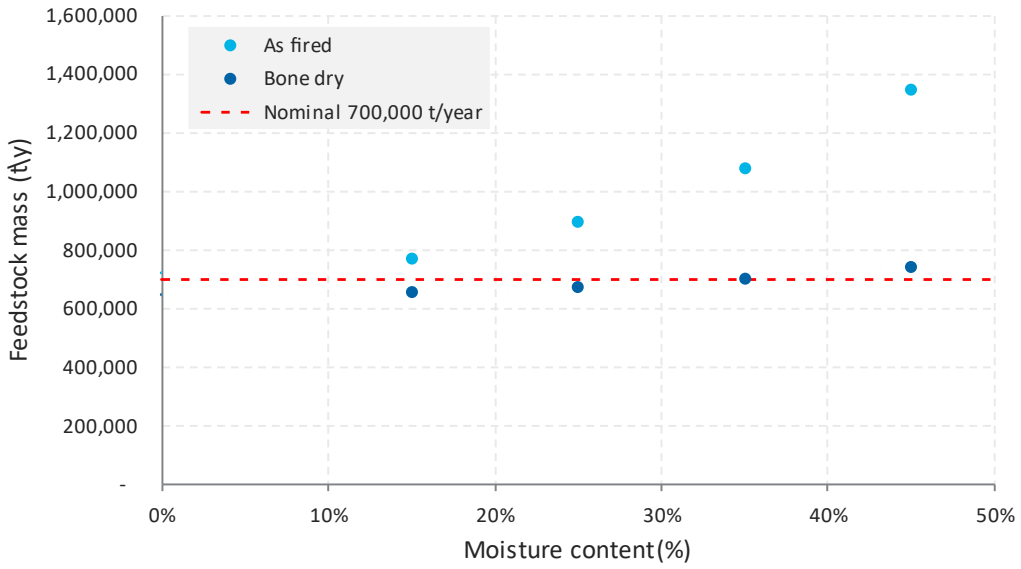

Figure 2.1 Feedstock throughput

The GHG calculations are based on effective dry feedstock mass (also requested by EPA. However, the boiler efficiency changes with moisture content due to design conditions and limitations in the steam generator. For the different feedstock moisture levels in Figure 2.1, B&PPS (2021) gives the output of the generation system, stated as the maximum continuous rating (MCR) of the steam generation and hence the plant power output. The data, summarised in Table 2.2, show that the MCR reduces from 100% at 15% and 25% moisture, to 85% at 45% moisture.

Table 2.2 Maximum continuous rating of Redbank power output by feedstock moisture level

Feedstock moisture level (%)	%MCR
15	100
25	100
35	94
45	85

The data in the table give the derating of the steam output (hence the power output for Redbank) with variations in fuel moisture. The boiler plant steam flow rate, expressed as MCR, is limited to the values given in the table by the performance of the ID fan and baghouse due to the flue gas flow increasing moisture levels. It will vary at the same rate as the MCR boiler rating.

2.2.5 Effects of feedstock energy content

In principle, the electricity output of the plant would be affected by the mass and energy content of the dry feedstock. The annual electricity output is reported in the GHG assessment as 1,168,000 MWh/y). This is based on the dry feedstock mass (700,000 t/year) with a given energy content (revised to 20.4 GJ/t). The range of values for energy content for dry feedstock in the HRL fuel characterisation report (as referenced by EPA) is 15.7 to 26.4 GJ/t. In practice, however, Verdant Earth anticipates that the fuel supplier will comply with the fuel specification, there would only be a small amount of variation in the energy content of the feedstock (with a

smaller range than that stated by HRL), and this would have a correspondingly small effect on electricity production.

2.2.6 Ash processing and transport

According to the Waste Management Plan in the EIS, the combustion of biomass for electricity generation will produce residual ash of approximately 3-5% of the feedstock by weight (on an "as fired" design fuel basis). For a worst-case scenario (5%), there will be a requirement to remove 42,500 t/year of ash from the site. Based on a round-trip distance to a disposal location of 600 km, and a truck capacity of 42.5 tonnes, the removal of ash would be responsible for a diesel consumption of 318.6 kL/year, and a Scope 3 GHG emission of 865.8 t CO_2-e/year. It is noted that the calculations are considered conservative on the basis that generated ash will likely be backfilled to incoming trucks for dispatch from the site, and sent to a disposal facility much closer than 300 km from the site. The ash would be stored temporarily on site in silos, although it is likely that the on-site handling would represent a negligible contribution to GHG emissions.

2.2.7 Recalculation of Scope 3 emission for offsite processing and third part transport of biomass

This was an error in the original calculations, and has now been corrected in line with the EPA comment.

2.3 Revised activity data and results

2.3.1 Proposed activities

The revised GHG-generating activities for the Proposal (now including ash transport) are listed in Table 2.3.

Table 2.3 Proposed activities generating GHG emissions

Scope	Activity[a]	IPCC sector	IPCC sub-sector	NGAF source used in emission calculations
Scope 1 (on-site)	1A: Electricity generation	Electricity (public electricity generation)	Other	Stationary combustion of solid fuels (dry wood/green and air dried wood) with fuel energy content of 20.4 GJ/t applied.
	1B: Biomass handling	Electricity (public electricity generation)	Other	Stationary combustion of liquid fuels (diesel)
	1C: Start-up	Electricity (public electricity generation)	Other	Stationary combustion of liquid fuels (diesel)
Scope 3 (off-site)	3A: Biomass processing	Electric utilities	Fuel-and-energy-related activities	Stationary combustion of liquid fuels (diesel)
	3B: Biomass transport	Electric utilities	Upstream transportation and distribution	Transport fuel combustion (diesel Euro III truck)
	3C: Biomass handling (associated with on-site diesel use)	Electric utilities	Fuel-and-energy-related activities	Stationary combustion of liquid fuels (diesel)
	3D: Start-up (associated with on-site diesel use)	Electric utilities	Fuel-and-energy-related activities	Stationary combustion of liquid fuels (diesel)
	3E: Ash transport	Electric utilities	Upstream transportation and distribution	Transport fuel combustion (diesel Euro III truck)

(a) Note that the codes used here are defined for the purpose of this report, and are not IPCC nomenclature.

2.3.2 Activity data

For the Proposal sources, the revised activity data are given in Table 2.4.

Table 2.4 Activity data

Financial year	On-site (Scope 1)			Off-site (Scope 3)		
	1A: Electricity generation	1B: Biomass handling[(a)]	1C: Start-up[(a)]	3A: Biomass processing	3B: Biomass transport	3E: Ash transport
	Biomass (all types)	Diesel	Diesel	Diesel	Diesel	Diesel
	(t/year)	(kL/year)	(kL/year)	(kL/year)	(kL/year)	(kL/year)
2025/26 to 2054/55	700,000	175.0	60.0	850.0	6,372.0	318.6

(a) Also used to calculate the corresponding Scope 3 emissions.

2.3.3 Scope 1 emissions by gas and by source

The revised Scope 1 emissions for the Proposal, and for the two on-site activities, are given by year and by gas in Table 2.5, Table 2.6 and Table 2.7. Total Scope 1 emissions are given in Table 2.8.

Table 2.5 Scope 1 emissions for electricity generation

Financial year	CO_2	CH_4	N_2O	Total
	(t CO_2-e/year)	(t CO_2-e/year)	(t CO_2-e/year)	(t CO_2-e/year)
2025/26 to 2054/55	0	1,428.0	15,708.0	17,136.0

Table 2.6 Scope 1 emissions for biomass handling

Financial year	CO_2	CH_4	N_2O	Total
	(t CO_2-e/year)	(t CO_2-e/year)	(t CO_2-e/year)	(t CO_2-e/year)
2025/26 to 2054/55	472.2	0.7	1.4	474.2

Table 2.7 Scope 1 emissions for start-up

Financial year	CO_2	CH_4	N_2O	Total
	(t CO_2-e/year)	(t CO_2-e/year)	(t CO_2-e/year)	(t CO_2-e/year)
2025/26 to 2054/55	161.9	0.2	0.5	162.6

Table 2.8 Scope 1 emissions – total

Financial year	CO_2 (t CO_2-e/year)	CH_4 (t CO_2-e/year)	N_2O (t CO_2-e/year)	Total (t CO_2-e/year)
2025/26 to 2054/55	634.1	1,428.9	15,709.8	17,772.8

2.3.4 Scope 1 emissions intensity

The revised energy intensity of the Proposal is 0.016 t CO_2-e/MWh.

2.3.5 Scope 1 emissions compared with NSW Net Zero Emissions Dashboard

In Table 2.9 the revised projected annual Scope 1 emissions of the Proposal are compared against the projected emissions for NSW from the Dashboard.

The Proposal will be a small contributor to GHG emissions in NSW. Under the 'current policy' scenario for NSW, the project would represent 0.02% of state-wide emissions in 2030, and 0.07% in 2050.

Table 2.9 Comparison with NSW Net Zero Emissions Dashboard (Scope 1 emissions)

Financial year	NSW[(a)]		Proposal Scope 1	Proposal as % of NSW	
	Base case (Mt CO_2-e/year)	Current policy (Mt CO_2-e/year)	(Mt CO_2-e/year)	Base case (%)	Current policy (%)
2025/26	114.08	101.34	0.018	0.02%	0.02%
2026/27	112.42	96.77	0.018	0.02%	0.02%
2027/28	112.91	89.45	0.018	0.02%	0.02%
2028/29	111.56	79.27	0.018	0.02%	0.02%
2029/30	111.49	75.18	0.018	0.02%	0.02%
2030/31	109.63	71.55	0.018	0.02%	0.02%
2031/32	106.39	65.68	0.018	0.02%	0.03%
2032/33	104.96	60.84	0.018	0.02%	0.03%
2033/34	103.54	55.91	0.018	0.02%	0.03%
2034/35	102.46	50.90	0.018	0.02%	0.03%
2035/36	101.53	48.33	0.018	0.02%	0.04%
2036/37	85.16	44.61	0.018	0.02%	0.04%
2037/38	82.95	42.07	0.018	0.02%	0.04%
2038/39	82.59	40.16	0.018	0.02%	0.04%
2039/40	80.65	36.93	0.018	0.02%	0.05%
2040/41	80.32	32.22	0.018	0.02%	0.06%
2041/42	79.02	32.03	0.018	0.02%	0.06%
2042/43	76.40	31.69	0.018	0.02%	0.06%
2043/44	68.54	28.36	0.018	0.03%	0.06%
2044/45	66.81	27.86	0.018	0.03%	0.06%

Table 2.9 Comparison with NSW Net Zero Emissions Dashboard (Scope 1 emissions)

Financial year	NSW[a] Base case ($Mt CO_2$-e/year)	NSW[a] Current policy ($Mt CO_2$-e/year)	Proposal Scope 1 ($Mt CO_2$-e/year)	Proposal as % of NSW Base case (%)	Proposal as % of NSW Current policy (%)
2045/46	65.73	27.81	0.018	0.03%	0.06%
2046/47	64.44	26.83	0.018	0.03%	0.07%
2047/48	63.48	27.35	0.018	0.03%	0.06%
2048/49	62.83	26.94	0.018	0.03%	0.07%
2049/50	62.02	27.31	0.018	0.03%	0.07%
2050/51	61.02	26.96	0.018	0.03%	0.07%
2051/52	N/A[b]	N/A	0.018	N/A	N/A
2052/53	N/A	N/A	0.018	N/A	N/A
2053/54	N/A	N/A	0.018	N/A	N/A
2054/55	N/A	N/A	0.018	N/A	N/A

(a) The data in the NSW Net Zero Emissions Dashboard are presented by calendar year. Here, it assumed that a calendar year in the Dashboard corresponds to the first year of any financial year.

(b) N/A = not available

2.3.6 Scope 3 emissions by source

The revised Scope 3 emissions for the two off-site activities, and the total for the Proposal, are given by year in Table 2.10.

Table 2.10 Scope 3 emissions by source

Financial year	3A: Off-site processing Diesel ($t CO_2$-e/year)	3B: Off-site transport Diesel ($t CO_2$-e/year)	3C: On-site handling Diesel ($t CO_2$-e/year)	3D: On-site start-up Diesel ($t CO_2$-e/year)	Total ($t CO_2$-e/year)
2025/26 to 2054/55	2,303.3	17,315.5	116.9	40.1	20,641.5

2.3.7 GHG emissions targets for the Proposal

The revised emission reductions for the Proposal are given in Table 2.11.

Table 2.11 Scope 1 emission reduction targets for the Proposal

Financial year	Scope 1 emission reduction ($t CO_2$-e/year)	Financial year	Scope 1 emission reduction ($t CO_2$-e/year)
2025/26	573	2040/41	12,040
2026/27	1,147	2041/42	12,613
2027/28	1,720	2042/43	13,186

Table 2.11 Scope 1 emission reduction targets for the Proposal

Financial year	Scope 1 emission reduction ($t CO_2$-e/year)	Financial year	Scope 1 emission reduction ($t CO_2$-e/year)
2028/29	2,293	2043/44	13,760
2029/30	2,867	2044/45	14,333
2030/31	3,440	2045/46	14,906
2031/32	4,587	2046/47	15,480
2032/33	5,733	2047/48	16,053
2033/34	6,880	2048/49	16,626
2034/35	8,026	2049/50	17,199
2035/36	9,173	2050/51	17,773
2036/37	9,746	2051/52	17,773
2037/38	10,320	2052/53	17,773
2038/39	10,893	2053/54	17,773
2039/40	11,466	2054/55	17,773

3 Climate change adaptation plan

3.1 Comments from EPA

a) The proponent to define the scope of the Climate Change Risk Assessment

There is no detail as to initial stages of the assessment including defining the scope – whilst the scope is ostensibly linked to the requirements in The Secretary's Environmental Assessment Requirements (SEARs), stage 1 must spell out the full scope of the assessment, for example whether impacts on feedstock were also considered.

b) The proponent to include information about sectors represented at the workshop.

A climate risk and adaptation workshop (CCRA) was held with Verdant Earth in June 2023. However, the stakeholders who were present for the CCRA workshop were not specified. To ensure that this engagement was inclusive, and representative of all internal and external stakeholders please provide this information.

c) The proponent to revise the risk assessment to consider drought and provide evidence of consultation with appropriate stakeholders.

The impact of drought has not been adequately considered when reviewing issues with water availability and feedstock. Hence engagement with the relevant Water Authority in the assessment is critical to ensure all risks are appropriately considered. The assessment provided only looks at rainfall as the driver of drought and does not consider drought history. Drought is anticipated to pose a risk to feedstock availability and access to water. This also causes an over reliance on additional water access licensing in the case of drought for dust suppression etc, which may not be an adequate treatment.

d) The proponent to revise the hazards and their impacts on workforce disruptions.

There is no risk considering workforce disruptions from non in-situ events. As workforce is likely to live in the surrounding region and the Forest Fire Danger Index is 100%, there may be staffing impacts from other climate driven events meaning that workforce disruptions may be broader than just travel to the plant itself. For example, the workforce may be volunteer responders. Given this, it is recommended further consideration is given for all potential hazards and their impacts on workforce disruptions.

3.2 EMM response

3.2.1 Scope of the Climate Change Risk Assessment

A new section 4.2.1 is proposed to address this point, as described below.

4.2.1 Scope of assessment

General considerations for the scope of CCRA, and how these relate to the Proposal, are summarised in Table 3.1. These considerations have been adapted from guidance documents (e.g. DPIE 2021; Australian Government 2006; DCCEEW 2023).

Table 3.1 Considerations for CCRA scope

Consideration	Relevance to project
Objectives of CCRA	The purpose of the CCRA is to assess the Proposal's vulnerability to climate change, and its ability to adapt to the change. This includes: • The projected changes in climate variables in the area of the Proposal. • The potential impacts of climate hazards on the Proposal and its environmental performance. • An assessment of the risks to the Proposal of the climate hazards. • Adaptation/mitigation measures to address the risks. • Consideration of residual risks.
Timeframe of the CCRA	The CCRA covers (at least) the estimated 30-year lifetime of the Proposal (from 2025/26 to 2054/55). The CCRA is based on climate projections for the following periods: • A near-future period (2020 to 2039). • A far-future period (2060 to 2079).
The geographical area and physical locations covered by the CCRA	The CCRA focusses mainly on risks at the project location, as defined by the site boundary in section 1.3 of the EIS, and (less explicitly) the surrounding land and access roads. The locations of upstream activities are considered in less detail. For example, there is no separate climate analysis for fuel (feedstock) growth areas.
Types of risk included in the CCRA	The CCRA covers physical risks resulting from climate change. These relate to the plant infrastructure, the operation of the plant, and the workforce. The CCRA does not cover transition risks, such as those relating to changes in government policy, or technological changes.
Values at risk	'Values at risk' are the elements that are important to Verdant Earth, and could be affected by climate change. In the case of the Proposal, the main values at risk are the physical asset (Redbank power station and its supporting infrastructure), and the operation of the asset (i.e. its ability to provide baseload electricity at the required level, compliance with agreements and regulations).
Operational activities/aspects included in the CCRA	The operations covered by the CCRA include: • Provision of feedstock (availability, properties). • The operation of the power station and equipment (e.g. damage/corrosion of buildings, boilers, electrical equipment). • The workforce (e.g. health and safety of workers, drivers, and plant operators). • Transport (e.g. impacts on access roads). • Environmental impacts (e.g. lack of water for dust mitigation).
Risk assessment methods and limitations	The CCRA used approved standards, the latest publicly available climate change modelling, and stakeholder consultation. The CCRA should be viewed as indicative. The climate change projections have a varying degree of uncertainty, depending on the variable. Therefore, it cannot be stated with absolute confidence that the risk is accurate, or that the identified control measures will be effective.
Stakeholders and responsibilities	The CCRA was prepared in consultation with the Proposal personnel from Verdant Earth listed in response to comment (b) from the EPA (see below). The Proposal personnel were required to provide input on hazards, risk and planned controls and adaptation measures. The Proposal personnel consulted were specialists in the operation of the Proposal.

3.2.2 Sectors represented at workshop

The participants in the workshop were:

- Scott Fishwick (EMM Consulting)
- Paul Boulter (EMM Consulting)
- Francine Manansala (EMM Consulting)
- Mark Jackson (Jackson Environment and Planning)
- Erik Larson (Jackson Environment and Planning)
- Mike Haywood (Verdant Earth Technologies)
- Costa Tsiolkas (Verdant Earth Technologies)

These participants were considered to be 'internal' stakeholders for the purpose of the EIS. 'External' stakeholders were not considered for the workshop.

3.2.3 Drought history and projections

Section 4.2.3iii of the report considers drought as follows:

> *Rainfall is also generally associated with extreme events such as floods and droughts. The Proposal area is not prone to flooding. Parts of the Upper Hunter Valley can be very dry and experience drought conditions. The combined changes in temperatures, rainfall and evaporation and climate systems is likely to make drought conditions in south-east Australia worse. Projections show that droughts in NSW will be more severe and last longer, and that water flows into Sydney dams decreasing.*
>
> [Note: The words at the end of this paragraph (i.e. ' … and that water flows into Sydney dams decreasing') are not directly relevant to the Proposal, and should be removed].

One reason why the history of drought was not described in any detail is that there has been no clear pattern in drought events. Time between severe droughts have varied from four to 38 years and the impacts of climate change will mean longer dry periods, particularly in inland areas of NSW[2].

The Climate Change in Australia project summarises the history of drought in the East Coast Cluster (CSIRO & BoM 2015a). The report notes that during much of the early part of the 20th century, the cluster experienced extensive drying, including the Federation drought at the start of the century (from about 1895–1902) and the World War II drought from about 1935–1945. The latter part of the 20th century saw a continuation of these variable conditions with individual years of very high rainfall, and sequences of years with below average rainfall. Around the beginning of the 21st century there was a period of below average years, often referred to as the Millennium drought. Further detail on specific Australian droughts is provided by the Bureau of Meteorology[3].

3.2.4 Consideration of drought in the risk assessment

Drought was not considered separately in the risk assessment, but it was considered under temperature-related impacts (Risk R02). The potential impact for risk R02 is described as follows:

> *Fuel - Specifically grown fuel crops may not be as available during drought or periods of elevated temperatures. May result in reduced growing capacity.*

2 https://water.dpie.nsw.gov.au/our-work/allocations-availability/drought-and-floods#:~:text=With%20one%20of%20the%20most,in%20inland%20areas%20of%20NSW.

3 http://www.bom.gov.au/climate/drought/knowledge-centre/previous-droughts.shtml

Risk R02 essentially addresses reduced feedstock availability, and notes that there is a management strategy in place to deal with reduced availability. This management strategy would apply during drought conditions.

Specific risks (R18 and R19) have been added to the climate change risk register (see Table 3.2) to cover the potential impacts of drought. However, it should be noted that these are identical to the existing risks R02 and R06 respectively.

Verdant Earth's goal is to build a feedstock supply chain containing an overall volume of material that is greater than that required by Redbank, and with stockpiles at different locations to allow flexibility of supply without having to resort to reduced power generation. The aim of this is to minimise the effects of adverse events such as floods or droughts. Verdant Earth is considering a range of fuel crop types that are suitable for drought conditions, and at different locations. For example, Verdant Earth is planning to use Australian native mallees, which are less susceptible to drought that other species.

3.2.5 Consultation with stakeholders

There has been no engagement with water authorities to date on the subject of water availability during drought conditions.

An analysis of the water market in relation to the Proposal was prepared by EMM (2024). This included a historical review of water entitlement availability and trading in the water source for the past 20 years, as well as streamflow in the Hunter River for the past 25 years. This time period included the previous two droughts in the Hunter Valley region. The overall outcome was that the Proposal requires around 2% of the general security and 15% of the high security regulated river entitlement available, and represents less than 5% of the annual Hunter River streamflow. The report concludes that the risk of water availability during drought conditions is low, given the location of the Proposal (at the downstream end of the regulated river system, which gives flexibility in water trading options from other zones) and the assumption that sufficient entitlement will be held.

Should approval for the Proposal be granted, Verdant Earth will engage with water authorities and other water licence holders, as appropriate.

3.2.6 Wider workforce impacts

The CCRA considered the risks to the workforce at the Proposal site and in the surrounding area. These included fire-related danger during travel to site (risk R09), and disruption to access via damage to roads (risk R08).

Specific risks have been added to the climate change risk register (see Table 3.2) to cover the following potential wider (general workforce) impacts, and in particular the availability of emergency services and volunteers to respond to fire-related disruptions (risk R09a) and storm-related disruptions (risk R17a).

Table 3.2 Additions to climate change risk register

Risk ID	Climate hazard	Impact on project asset or function	Impact on environment	Risk assessment (no measures) 2030 Likelihood	2030 Consequence	2030 Rating	2070 Likelihood	2070 Consequence	2070 Rating	Planned measures Description	Type	Effectiveness	Additional measures	Residual risk 2030 Rating	Residual risk 2070 Rating
R18	**Drought** Increase in severity and duration of droughts	Fuel - Specifically grown fuel crops may not be as available during drought or periods of elevated temperatures. May result in reduced growing capacity.	N/A	Possible	Major	High	Likely	Major	High	Fuel strategy management plan already developed. Considering a range of fuel crop types suitable for drought conditions	Management strategy	Substantially effective	N/A	Low	Low
R19		Water - Lack of water for general processes and dust mitigation, need to truck more water in leading to increased project costs.	May increase dust generation.	Possible	Catastrophic	High	Likely	Catastrophic	Extreme	Water is taken from two dams near the site. In the last 14 years these have not run out of water. As needed, water will be drawn from the Hunter River under the water license.	Design	Substantially effective	Plan to acquire additional water licensing.	Low	Low
R09a	**Fire danger**	Response of emergency services and volunteers to fire-related disruption	N/A	Possible	Major	High	Possible	Major	High	The plant operators and most other site personnel will be trained for emergency responses within the power plant. Should any personnel have duties to attend as volunteers, there will be sufficient internal trained resources to assist.	Management strategy	Substantially effective	N/A	Low	Low
R17a	**Storms**	Response of emergency services and volunteers to storm-related disruption	N/A	Possible	Major	High	Possible	Major	High	Verdant Earth has an active safety training program at the power plant, with identified available back-up if needed.	Management strategy	Substantially effective	N/A	Low	Low

4 References

Australian Government 2006, Climate Change Impacts & Risk Management – A Guide for Business and Government, Australian Greenhouse Office, Department of the Environment and Heritage, Canberra.

B&PPS 2020, Hunter Energy - Redbank Power Station FiCirc Boiler Performance for Bush Fire Damaged Tree Trunk Sample at Various Moisture Levels, B&PPS Report C12148-01.

B&PPS 2021, Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels, B&PPS Document C12198-01, Boiler & Power Plant Services, Chatswood NSW 2067.

CSIRO & BoM 2015, Climate Change in Australia: Projections for Australia's NRM regions – East Coast Cluster Report, CSIRO and Bureau of Meteorology, Australia,

DPIE 2021, Climate Risk Ready NSW Guide, Practical guidance for the NSW Government sector to assess and manage climate change risks, Department of Planning, Industry and Environment, Parramatta, March 2021.

DCCEEW 2023, Climate Risk Management Guide, Australian Government Department of Climate Change, Energy, the Environment and Water, Canberra.

EMM 2024, Restart of Redbank Power Station – Water market analysis, Report E240435 RP#1, EMM, Newcastle.

Appendix A

EPA comments on the air quality impact assessment, greenhouse gas assessment, and climate change adaptation plan

EMM
creating opportunities

DOC24/180778-15

4 April 2024

NSW Department of Planning, Housing and Infrastructure
Attention: Joe Fittell

Email: Via the Major Projects Portal

Dear Mr Fittell,

Restart of Redbank Power Station (SSD-56284960)
Additional Information required following review of Environment Impact Statement

I am writing in reply to your request for comment from the Environment Protection Authority (EPA) regarding the Restart of Redbank Power Station (SSD-56284960) Environmental Impact Statement (EIS) received via the Major Projects Portal on 5 March 2024.

The EPA has reviewed the following documents:

- *Restart of Redbank Power Station and Use of Biomass (Excluding Native Forestry Residues from Logging) as a Fuel, Environmental Impact Statement*, dated 20/02/2024, prepared by Jackson Environment and Planning Pty Ltd on behalf of Verdant Earth Technologies Limited (Verdant Earth) and supporting appendices.

The EPA will be providing its comments in two submissions. This first submission includes comments on additional information required before the EPA can complete its assessment. These requirements are attached and relate to:

- Waste and Resource Recovery
- Greenhouse Gas Assessment
- Climate Change Adaptation Plan
- Air Quality Assessment
- Forestry

It is anticipated that a second submission relating to the Human Health Risk Assessment will be provided to Department of Planning, Housing and Infrastructure by 16 April 2024.

Should you require any further information, please contact Gabby Sutherland (02) 6640 2508 or email environmentprotection.planning@epa.nsw.gov.au.

Yours sincerely

DAMIEN ROSE.

DAMIEN ROSE
Unit Head – Environment Protection Planning

Phone 131 555
Phone 02 9995 5555
(from outside NSW)

TTY 133 677, then
ask for 131 155

Locked Bag 5022
Parramatta NSW
2124 Australia

Click or tap here to
enter StreetAddress

info@epa.nsw.gov.au
www.epa.nsw.gov.au
ABN 43 692 285 758

GREENHOUSE GAS ASSESSMENT

a) The proponent must provide more information on the heating value (or energy content) of the various biomass to be used in the proposal (i.e., the range in values depending on the biomass source).

The '*Biomass Fuel Characterisation and Specification Proposed for use at the Redbank Power Station'* Report (or Fuel Characterisation report) contained the results of biomass testing for combustion characteristics and elemental analysis. The tests excluded GHG emissions, particulates, and volatile organic matter. Five standard fuel samples and 13 samples of eligible fuel waste were tested. Fuels classed as Domestic Biomass Fuels were not tested.

If there is a possibility that the proposed waste biomass fuel from land clearing will have a wider range of heating values, this could impact on the power stations operation and possible GHG emissions for the proposal (particularly biomass with heating values as low as 15 MJ/kg). Therefore, the energy content (with the variance in fuel source) and masses of each type of biomass used per annum should be given.

b) the proponent needs to present calculations on the sensitivity of the total scope 1 and 3 greenhouse gas emissions considering the variations in the energy content of the biomass.

The SEARS require credible estimations of greenhouse gas emissions. The EPA recognises that scope 2 emissions are minimal. It is suggested that the total scope 1 and 3 emissions be calculated using both the maximum and minimum energy content values (and not the average value) based on the "waste biomass from land clearing" results from Table 3.4 of the Fuel Characterisation report. The proponent should use the gross, dry basis ash free energy content data.

c) the proponent must provide further information and an explanation on whether the mass of biomass required by the power station is fixed or varies. Further information is needed to understand the relationship between the energy content of the biomass and tonnes biomass required per annum. If the mass of biomass increases or decreases the impact this has on scope 1 and 3 emissions should also be commented on.

The technical specification is 850,000 tonnes per annum at 25% moisture content. However, it is unclear how this varies with biomass energy and moisture content. If it does vary further information and justification should be provided as described above. Consideration should also be given on the impact this will have on ash production and how this will relate to third party processing and transport.

d) Recalculation of Scope 3 emissions for the offsite processing and third-party transport of the biomass

Scope 3 emissions were included for indirect emissions from on-site diesel consumption as well as third party processing and truck transport of the biomass (although an incorrect emission factor was used for this source). The proponent uses the scope 3 diesel emissions factors, but this assumes indirect fuel use by the proponent for these activities which is not the case. It is suggested that Scope 1 factors be used, as the emissions arise from direct fuel use by third parties whose activities are within the emissions boundary for the proposal.

CLIMATE CHANGE ADAPTATION PLAN

a) The proponent to define the scope of the Climate Change Risk Assessment

There is no detail as to initial stages of the assessment including defining the scope – whilst the scope is ostensibly linked to the requirements in *The Secretary's Environmental Assessment Requirements (SEARs),* stage 1 must spell out the full scope of the assessment, for example whether impacts on feedstock were also considered.

b) The proponent to include information about sectors represented at the workshop.

A climate risk and adaptation workshop (CCRA) was held with Verdant in June 2023. However, the stakeholders who were present for the CCRA workshop were not specified. To ensure that this engagement was inclusive, and representative of all internal and external stakeholders please provide this information.

c) The proponent to revise the risk assessment to consider drought and provide evidence of consultation with appropriate stakeholders.

The impact of drought has not been adequately considered when reviewing issues with water availability and feedstock. Hence engagement with the relevant Water Authority in the assessment is critical to ensure all risks are appropriately considered. The assessment provided only looks at rainfall as the driver of drought and does not consider drought history. Drought is anticipated to pose a risk to feedstock availability and access to water. This also causes an over reliance on additional water access licensing in the case of drought for dust suppression etc, which may not be an adequate treatment.

d) The proponent to revise the hazards and their impacts on workforce disruptions.

There is no risk considering workforce disruptions from non in-situ events. As workforce is likely to live in the surrounding region and the Forest Fire Danger Index is 100%, there may be staffing impacts from other climate driven events meaning that workforce disruptions may be broader than just travel to the plant itself. For example, the workforce may be volunteer responders. Given this, it is recommended further consideration is given for all potential hazards and their impacts on workforce disruptions.

AIR IMPACT ASSESSMENT

a) The proponent to provide the manufacturers performance specifications for the furnace and pollution control equipment. This must include the performance specifications for each type of proposed fuel.
b) The proponent to demonstrate that a reasonable worst-case assessment of impacts has been undertaken based on performance specifications or manufacturers guarantees.

The Air Quality Impact Assessment (the AQIA) has considered two scenarios when the facility is operating using biomass as a fuel. The scenarios are:

- The expected case scenario, which is based on emissions that are estimated using emission factors and biomass composition data.
- The regulatory worst-case scenario, which is based on emissions at the prescribed limits for Group 6 plant in the *Protection of the Environment Operations (Clean Air) Regulation 2022* (the Clean Air Regulation).

The *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (the Approved Methods) outlines a number of methods that can be used to estimate the emission rates from sources. The EPA's preferred methods are direct measurement for existing sources and manufacturers design specifications for proposed sources. Emission factors are generally used when there is no other information available or when emissions can reasonably be demonstrated to be negligible. Manufacturers' design specifications or performance guarantees, provide a more

reliable means of determining the upper limit to the emission rate or concentration of air pollutants for sources that are maintained and operated in a proper and efficient manner.

c) The proponent must update the emissions inventory to include the emission concentrations of pollutants emitted from the furnace and include an assessment of compliance with the *Clean Air Regulation*.

The AQIA presents the estimated emission rates for the furnace. Table 7.1 of the AQIA provides estimated emission rates for the expected case scenario, and Table 7.2 provides estimated emission rates for the regulatory worst-case scenario. The Approved Methods requires the emission inventory to include emission concentration of pollutants emitted from point sources. Additionally, it requires the inventory to be used to demonstrate compliance with the Clean Air Regulation.

The emission concentration of pollutants emitted from the furnace for the expected case scenario are not presented. Therefore, the above further information is required to demonstrate compliance with the *Clean Air Regulation*.

d) The proponent must revise the AQIA to provide further clarity on the methodology applied for estimating metal emissions and include all data used in the emission estimation.

Section 7.3 of the AQIA outlines the methodology for estimating emissions of metals. The expected case scenario emission rates provided in Table 7.5 of the AQIA have either been derived from a fuel specification or data from thirty (30) samples taken for the proposed biomass material. However, it is not clear which data set (fuel specification or sample data) has been used to derive the emission estimates. Furthermore, the data used in the estimation has not been presented.

For the regulatory worst case scenario emission rates provided in Table 7.6. The emission rates were derived from the Clean Air Regulation limits and sample data. However, the sample data has not been provided.

e) The AQIA does not include an assessment of impacts from all proposed waste derived fuel.

EPA understands that data used for estimating metal emissions (as mentioned in Air Impact Assessment point d) above) is from the biomass that has not been derived from waste material (including construction and demolition waste). The AQIA has not included an assessment of emissions associated with Domestic biomass. This is not an eligible waste or standard fuel (referred to in 'Waste and Resource Recovery' section above).

f) The proponent must revise the AQIA to include all data for estimating emissions.

Emission estimates for the expected case scenario are based on emission factors and biomass composition data that is not provided. This data is required (including emission factors) to allow for a clear and transparent assessment.

g) The proponent must revise the AQIA to describe the assessment methods for all air pollutants assessed.

Predicted ground level concentrations for metals and speciated VOCs are provided in Table 8.5 (expected case scenario) and Table 8.13 (regulatory worst-case scenario) of the AQIA.

For the expected case scenario predicted ground level concentrations are provided for formaldehyde, benzene, toluene, ethylbenzene, xylene, dioxins and furans, and Benzo(a)pyrene. However, it is not clear how the assessment has been undertaken for these individual compounds, including emission estimation methods.

Similarly for the regulatory worst-case scenario predicted ground level concentrations are provided for formaldehyde, benzene, toluene, ethylbenzene, and xylene. However, it is not clear how

assessment has been undertaken for these individual compounds including emission estimation methods. Further information is required on the assessment methods for these pollutants.

h) The proponent must revise the AQIA to include an assessment of potential impacts for proposed diesel fuel.

Diesel fuel is proposed to be used during plant start-up. However, as assessment of potential impacts from proposed diesel fuel has not been provided.

FORESTRY

a) The proponent to provide further information on the expected purpose grown plantation volumes including consideration of how low timber availability or increased timber prices may impact on the proposal.

The proponent proposes to source various types of biomass as fuel including that sourced from invasive native species. The invasive native species part of the *Land Management (Native Vegetation) Code 2018* allows the removal of invasive native species that have reached unnatural densities and dominate an area. This is regulated through Local Land Services (LLS) and is subject to a number of conditions and in some cases reporting requirements.

Considering the volume of feedstock required for the proposal, sourcing of feedstock should not incentivise native species land clearing that would otherwise have not occurred.

Appendix B

HRL 2023a fuel specification sampling data

EMM
creating opportunities

Individual air toxics	Sample number and concentration (mg/kg)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
As	36	14	16	30	10	21	23	22	36	32	25	15	1	1	1
Be	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cd	1	1	1	1	1	1	1	1	6	1	1	8	1	1	1
Co	2	1	1	15	3	1	1	9	7	11	8	8	1	1	1
Cr	62	23	32	27	24	35	28	40	82	66	81	52	1	1	1
Hg	0.07	0.05	0.05	0.69	0.12	0.05	0.05	0.48	0.06	0.06	0.05	0.21	0.05	0.05	0.05
Mn	58	48	31	82	85	41	45	112	81	88	85	62	19	6	13
Ni	3	1	1	6	4	1	1	5	7	7	6	5	1	1	1
Pb	118	43	20	1632	208	282	33	212	107	161	129	134	1	1	1
Sb	2	1	1	16	2	10	1	106	20	45	14	19	1	2	1
Se	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1
Sn	2	1	2	3	1	1	1	7	5	15	6	14	1	1	1
V	12	3	1	7	9	1	1	13	4	4	5	4	1	1	1

Individual air toxics	Sample number and concentration (mg/kg)															AVERAGE	Average %	Type 1 or 2	Ratio of T1/T2
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30				
As	1	1	149	63	110	153	1	1	1	1	1	1	1	1	1	25.6	0.0026	T1	0.0984
Be	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0	0.0001	T2	0.0038
Cd	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.4	0.0001	T1	0.0054
Co	1	1	1	1	1	1	5	3	1	4	1	1	1	1	1	3.1	0.0003	T2	0.0120
Cr	2	2	242	96	163	243	1	1	3	1	1	1	1	1	1	43.8	0.0044	T2	0.1682
Hg	0.15	0.05	0.05	0.05	0.05	0.08	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.0000	T1	0.0004
Mn	74	36	49	37	43	66	27	15	11	29	25	142	15	31	92	51.6	0.0052	T2	0.1982
Ni	1	1	1	1	1	9	21	11	6	18	5	1	1	1	1	4.3	0.0004	T2	0.0165
Pb	18	1	66	112	96	30	1	1	1	1	1	1	1	1	1	113.8	0.0114	T1	0.4370
Sb	1	1	4	2	3	4	1	1	1	1	1	1	1	1	1	8.8	0.0009	T1	0.0339
Se	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0	0.0001	T2	0.0040
Sn	1	1	2	2	2	10	1	1	1	1	1	1	1	1	1	2.9	0.0003	T2	0.0113
V	1	1	1	1	4	1	1	1	1	1	1	1	1	1	1	2.8	0.0003	T1	0.0109