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Kentbruck Green Power Hub

Preliminary Wind Farm Noise Impact Assessment - Redacted

Attachment 5

Kentbruck Green Power Hub

Preliminary Wind Farm Noise Impact Assessment

Client: Neoen Australia Pty Ltd

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19-Jul-2019

Job No.: 60591699

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Table of Contents

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was commissioned by Neoen Australia Pty Ltd (Neoen) to undertake a preliminary Noise Impact Assessment (NIA) for the proposed development of a wind energy facility in Kentbruck, south west Victoria.

This NIA was developed in accordance with the requirements of the Department of Environment, Land, Water and Planning (DELWP) guideline: *Development of Wind Energy Facilities in Victoria - Policy and Planning Guidelines* (DELWP Planning Guidelines). The DELWP Planning Guidelines prescribes New Zealand Standard 6808:2010 *Acoustics – Wind Farm Noise* (the Standard) as the basis for the NIA.

The proposed Kentbruck Green Power Hub (the project) site is approximately 7,500 hectares in size and is located about 30 kilometres north west of Portland and about five kilometres east of Nelson, in south west Victoria. The project site is located primarily within an area that has been substantially modified for commercial forestry use (Radiata Pine). Small sections of grazing also exist within the project site boundary. The project site is within Glenelg Shire. Portland – Nelson Road bisects the project site in a generally east – west direction. The project site is bounded by forestry to the north, highly-modified land used for grazing purposes, Discovery Bay Coastal Park to the south and the Glenelg River National Park and Cobboboonee National Park to the east and north east. The closest locality is Mount Richmond, at the south eastern end of the site. The township of Nelson is around five kilometres west of the western extent of the project site.

For the purposes of the preliminary noise impact assessment, the wind farm component of the project consists of 157 wind turbines with each turbine having an individual electrical power output of up to six megawatts. The hub height of each turbine is 175 metres with a rotor diameter of 155 metres. The final selection and location of turbines will be determined as part of the detailed design following the obtainment of the planning permit for the project and a commercial tendering process. However, for the purposes of this preliminary NIA the project site has been designed to accommodate the maximum turbine dimensions in order to represent a likely worst-case outcome in terms of potential noise impacts of the project on noise sensitive locations.

1.1 Wind turbine technical specification

This preliminary NIA has been prepared using a candidate wind turbine that is representative of the type of turbine that is being considered by Neoen for the project. Neoen will decide on a final wind turbine to be used for the project following planning approvals being obtained and subsequent detailed design work, as well as a tender process to procure the preferred turbine. Notwithstanding, the final turbine that is selected for use by the project would need to comply with planning approval requirements and other relevant criteria, as they relate to noise levels at surrounding noise sensitive locations. An updated noise compliance assessment would also typically be required once final turbines for the project are selected. This would be carried out prior to construction of the project.

The key objective of this preliminary NIA is therefore to assess noise levels at surrounding receptor locations and to demonstrate that noise limits can be practically achieved, taking into consideration typical noise emissions levels that are representative of the turbines that may be used for the project.

Neoen has advised that the Siemens Gamesa 6.0 megawatt wind turbine generator (Developer Package information, Document ID: WP TE 10-0000009946-03 dated 18 December 2018) has been selected for the purposes of this preliminary NIA. The general specification of this reference turbine is set out in Table 1. It is understood that all technical data contained in the Developer Package is subject to change and as such any significant changes to the wind turbines technical specifications as reproduced in Table 1 as well as noise emission details will require reassessment of the impacts of noise of this proposed wind energy facility.

Table 1 Siemens Gamesa SG 6.0-155 wind turbine technical specifications

Component	Specification
Manufacturer	Siemens Gamesa Renewable Energy
Model	SG 6.0 - 155
Type	3-bladed, horizontal axis
Power output	6.0 MW
Hub height	175 m
Rotor diameter	155 m
Tip height	252.5 m
Cut-in wind speed (hub height)	3 m/s
Rated power wind speed (hub height)	11.3 m/s
Cut-out wind speed (hub height)	27 m/s
Noise level	Values reported correspond to the average estimated Sound Power Level emitted by the wind turbine generator at hub height, called L_W in IEC TS 61400-14. To obtain L_{Wd} (declared Sound Power) value, as defined in IEC TS 61400-14, it must be applied a 2 dB increase to L_W.

1.2 Scope of work

The preliminary NIA for Kentbruck Green Power Hub includes:

- Establishment of the project specific operational noise emission limits.
- Quantitative impact assessment of wind turbine noise at nearby noise sensitive locations (this includes wind turbine noise only).
- Noise contours for maximum wind turbine sound power levels (i.e. at wind turbine rated power).
- Comparison of predicted noise levels against established regulated noise emission limits to determine whether any of the noise limits are expected to be exceeded.
- Recommendation for undertaking background noise monitoring based on the preliminary noise impact assessment.

The acoustic terminology used in this report is summarised in Appendix A

1.3 Reference documents

The following documents are considered applicable to this project and have been utilised or referenced where appropriate:

- *Development of Wind Energy Facilities in Victoria, Policy and Planning Guidelines* - Department of Environment, Land, Water and Planning, October 2018

- New Zealand Standard NZS 6808:2010 – *Acoustics – Wind farm noise*, 2010
- International Standard ISO 9613-2:1996 – *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*, 1996
- *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* – Institute of Acoustics, May 2013
- Developer Package SG 6.0-155 revision 3, Document ID: WP TE 10-0000009946-03, Siemens Gamesa Renewable energy, December 2018

2.0 Noise limits

2.1 DELWP Planning Guidelines wind farm operational noise limits

The DELWP Planning Guidelines states that noise emissions at noise sensitive locations from a wind energy facility must comply with the noise limits specified in New Zealand Standard NZS 6808:2010 *Acoustics – Wind farm noise* (the Standard).

Noise sensitive locations are defined in the Standard as, "*The location of a noise sensitive activity, associated with a habitable space or education space in a building not on a wind farm site*", and include:

- any part of land zoned predominantly for residential use
- residential uses including land uses listed in the accommodation group at Clause 73.04 of the Victoria Planning Provision
- education and child care uses listed in the child care centre group and education centre group at Clauses 73.04 of the Victoria Planning Provision.

The DELWP Planning Guidelines recommends a less stringent noise limit of 45 dB $L_{A90(10\ min)}$ for Stakeholder dwellings. The DELWP Planning Guidelines defines a Stakeholder dwelling as "*one on the wind energy facility site, or one that has an agreement with the wind energy facility to exceed the noise limit*". All other noise sensitive residential locations will be referred to as "Non-Stakeholder dwellings" in this report.

Further to this, the DELWP Planning Guidelines outline that as part of a proposed wind energy facility, a turbine must not be within one kilometre of an existing dwelling unless the owner of the dwelling provides written consent. Therefore, this assessment considered all dwellings within one kilometre of a proposed wind turbine as Stakeholders. Neoen has advised that this is the case. For this preliminary NIA, these dwellings are subject to the less stringent noise limit of 45 dB $L_{A90(10\ min)}$ in accordance with the DELWP Planning Guidelines. There is one dwelling (Receiver ID 825546) further than one kilometre from a proposed turbine which Neoen has advised is also a Stakeholder dwelling.

Layout modifications will be carried out by Neoen as part of detailed design. Revised noise predictions and compliance assessments will be carried out during the preparation of the development application to assess changes to the wind turbine layout. Neoen will ensure that, where required, written consent from the owners of dwellings within one kilometre of a proposed wind turbine is obtained.

2.1.1 High amenity areas

The DELWP Planning Guideline also notes that a 'high amenity noise limit' of 35 dB $L_{A90(10\ min)}$ may be applicable in special circumstances. The DELWP Planning Guideline requires that all wind energy facility applications must be assessed using Section 5.3 of the Standard to determine whether a high amenity noise limit is justified for specific locations, following procedures outlined in 5.3.1 of the Standard. Guidance on the application of the 'high amenity noise limits' issue can be found in the Victorian Civil and Administrative Tribunal (VCAT) determination for the Cherry Tree Wind Farm[1].

[1] Cherry Tree Wind Farm v Mitchell Shire Council (2013).

2.2 NZS 6808:2010 noise limits

Section 5.2 of the Standard specifies the following outdoor noise levels at noise sensitive locations:

> *"As a guide to the limits of acceptability at a noise sensitive location, at any wind speed wind farm sound levels ($L_{A90(10\ min)}$) should not exceed the background sound level by more than 5 dB, or a level of 40 dB $L_{A90(10\ min)}$, whichever is the greater."*

2.3 NZS 6808:2010 Section 5.3 High Amenity Areas

Section C5.3.1 of the Standard provides the following steps as guide on whether a high amenity noise limit may be justified:

a. *There is no need to consider noise sensitive locations outside the predicted 35 dB $L_{A90(10\ min)}$ wind farm sound level contour;*

b. *Using predicted wind farm sound levels and measured background sound levels relating to any particular; noise sensitive location under investigation, calculate for each 10-minute time interval in the evening or night-time prescribed time frames the arithmetic difference between the estimated post-installation sound level and the background sound level. The post-installation sound level should be estimated by an energy addition of the background sound level and predicted windfarm sound level. The background and wind farm sound levels should be for a range of wind conditions representative of long-term wind sampling at the wind farm;*

c. *The differences calculated in (b) for all 10-minute time intervals in the prescribed time frame· should be arithmetically averaged;*

d. *If the average difference in an evening or night-time prescribed time frame is less than 8 dB then a high amenity noise limit is unlikely to be justified;*

e. *If the average difference in an evening or night-time prescribed time frame is greater than 8 dB then a high amenity noise limit is likely to be justified;*

The Standard goes on to say that where a high amenity noise level has been shown to be justified in accordance with Section 5.3, it is appropriate to restrict application of this limit based on a windfarm wind speed fixed threshold. The Standard recommends 6 m/s to be the threshold at which a high amenity noise limit may apply. An alternative threshold may be applied, however a justification based on meteorological, topographical, and acoustical grounds is required.

2.4 Project noise limits summary

Noise sensitive locations considered in this assessment are all within the Farming Zone established under the Glenelg Planning Scheme. There are 26 dwellings within the assessment area of three kilometres from the project site with an additional 66 buildings classified as 'sheds'. As this is a preliminary study, the building uses have yet to be confirmed and as such their uses may change following ground-truthing. The locations of the noise sensitive locations assessed are shown in Appendix B.

A high amenity noise limit is not considered justifiable for the noise sensitive locations used in this assessment as the noise sensitive locations are within the Farming Zone. The Farming Zone is not considered an inherently quiet land use area. This is supported by Agriculture Victoria which states on their website that "*The FZ [Farming Zone] is to ensure that non-agricultural uses, particularly dwellings, do not adversely affect the use of land for agriculture,"* and is also supported by the VCAT determination for the Cherry Tree Wind Farm which is referenced by the DELWP Planning Guidelines in relation to whether a high amenity noise limit may be justified.

However, for the purpose of this preliminary NIA the project's proposed turbine layout was initially assessed using the noise limit of 35 dB $L_{A90(10\ min)}$ in accordance with the DELWP Planning Guidelines and the Standard (refer to Section 4.0).

For the purpose of this preliminary NIA a baseline noise limit of 45 dB and 40 dB $L_{A90(10\ min),}$ for Stakeholder and Non-Stakeholder dwellings respectively, was conservatively applied to assess the

impacts from the proposed wind farm layout. As such there are three noise sensitive locations assessed in this report as Stakeholder dwellings, one of which has been designated as abandoned.

This preliminary NIA does not rely on background noise measurements to demonstrate compliance with the DELWP Planning Guidelines acoustic requirements, refer to Section 4.0 for wind farm operational noise impact.

Should the predicted noise levels show compliance with the minimum noise limits at all noise sensitive locations, for wind speed from cut-in to rated power of the wind turbine and each integer wind speed in between, referenced to hub height, then background noise monitoring would not be required at the noise sensitive locations during the pre-construction noise impact assessment in accordance with Section 7.1.2 of the Standard. However, changes to the wind energy facility layout and/or wind turbine specifications will require reassessment of noise and depending on the results, may require background noise monitoring to be carried out.

3.0 Wind farm operation noise modelling

3.1 Methodology

A three-dimensional computer noise model of the project site was created in SoundPLAN Version 8.0, industry standard acoustic modelling software, to predict operational noise levels at 26 noise sensitive locations in the vicinity of the project site, refer to Appendix B and Appendix C for wind farm layout and noise sensitive locations. The NIA assessed noise levels at nearby Stakeholder and non-Stakeholder locations up to three kilometres from the project site.

Environmental noise predictions were carried out using the algorithms from ISO 9613.2:1996 *Acoustics – Attenuation of Sound during propagation outdoors – Part 2: General method of calculation* and UK Institute of Acoustics - *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (2013) (IoA Wind Turbines 2013) as implemented within the SoundPLAN software package and allowed by the Standard. The IoA Wind Turbines 2013 was utilised as it provides modelling parameters specific to the calculation of noise from wind turbines such as atmospheric conditions and ground factor and takes into account the potential for additional reflection paths from concave ground profiles. The modelling parameters of the IoA Wind Turbines 2013 are further discussed in section 3.2.

Results from the model are discussed in section 4.0.

3.2 Noise model inputs

The following data was used to create the computer model:

- Topographical ground contours (two metre and five metres resolution) for the project site and surrounding area.
- Proposed project layout containing 157 wind turbines, developed in March 2019. The wind turbines were entered at hub height of 175 metres above ground level (AGL). The coordinates of the wind turbines are presented in Appendix D.
- Twenty-six noise sensitive locations provided by Neoen. These locations are preliminary and have been identified by Neoen using aerial photography and have yet to be ground-truthed. Noise sensitive locations are therefore subject to change. The locations of these noise sensitive locations are shown in the figure in Appendix B and the coordinates of the noise sensitive locations are presented in Appendix C.

An aerial view of the project showing the location of turbines used for this preliminary NIA and noise sensitive locations is provided in Appendix B.

The following parameters were entered in the computer model, in accordance with the IoA Wind Turbines 2013:

- Atmospheric conditions at 10 degrees Celsius temperature and 70 per cent relative humidity.

- 50 per cent acoustically hard ground and 50 per cent acoustically soft ground (i.e. ground factor (G) = 0.5). It is acknowledged that there is a large amount of pine forest and farming land in vicinity of the wind energy facility and nearby noise sensitive locations, however the IoA Wind Turbines 2013 specifically recommends the use of G = 0.5. This value is deemed to be conservative and provides a conservative representation of the upper noise levels expected in real situations.
- Barrier attenuation of no greater than 2 dB.
- 1.5 metres receiver height. It is noted that IoA Wind Turbines 2013 recommends a receiver height of 4 metres, however 1.5 metres is generally a more realistic representation of single storey receiver heights.
- Application of a 3 dB correction where a concave ground profile exists between a wind turbine and a receiver. This was applied to areas where it is observed that $h_m \geq (1.5 \times |h_s - h_r| \times 0.5)$ where h_m is the mean height above ground of the direct line of sight from the receiver to the source (as defined in ISO 9613-2) and h_s and h_r are the heights above the local ground level of the source and receiver respectively.
- Wind turbine generator overall sound power levels were provided by Neoen from cut-in (3 m/s) to cut–out (27 m/s) wind speeds, rated power wind speed reached at 11.3 m/s, refer to Table 2. For the purposes of this preliminary NIA and in accordance with IoA Wind Turbines 2013, a plus 2 dB correction has been made to convert the provided sound power levels to declared sound power levels (L_{wd}) in the absence of test reports and uncertainty data.
- Octave band sound power spectrum for a Siemens Gamesa 6.0-155 6 MW wind turbine of 105.5 dB(A) at the rated wind speed of 12 m/s was provided by Neoen, refer to Table 3. This spectrum corresponds to the average estimated sound power level emitted by the wind turbine at hub height. As spectra for all hub height wind speeds was not available at the time of writing this report, the sound power spectrum at 12 m/s was utilised for lower wind speeds by scaling the spectrum based on the overall sound power levels.

Table 2 Sound power levels and declared sound power levels for different hub height wind speeds

Wind speed, m/s	3 (Cut-in)	4	5	6	7	8	9	10	11	11.3 (Rated power)	Up to cut-out (27)
Sound power level, dB											
Declared sound power level, dB											

Table 3 Sound power level spectra provided by Neoen for 12 m/s hub height wind speed

Wind speed m/s	Overall dB(A)	Octave frequency band (Hz) sound power level, dB							
		63	125	250	500	1000	2000	4000	8000
12									

- No penalty for special audible characteristics (tonality, impulsiveness, low frequency, and amplitude modulation) was applied (i.e. 0 dB penalty) as 1/3 octave band sound power level spectra was not available at the time of this assessment. However, it is worth noting that the Standard states:

  "Wind farms shall be designed so that wind farm sound does not have special audible characteristics at noise sensitive locations. However, as special audible characteristics cannot always be predicted, consideration shall be given to whether there are any special

audible characteristics of the wind farm sound when comparing measured levels with noise limits."

It is expected that tonality would not be an audible feature at the distances separating the turbines from the noise sensitive locations, however, it will be a requirement of the manufacturer of the selected turbine model that the measured noise levels resulting from the operation of the wind turbines do not exhibit tonal characteristics. It will also be required that the wind turbines are properly maintained by the wind farm operator to ensure that the noise emission of the turbines is not adversely affected by turbine wear, resulting in audible tonality. Similarly, should amplitude modulation be detected upon commissioning, the wind farm operator would be required to alter the operating parameters of some turbines to remove this effect.

3.3 NZS 6808:2010 Documentation summary

Table 4 NZS 6808:2010 sound level prediction documentation summary

Documentation	Parameters	Location in this report
A map showing the topography in the vicinity of the wind farm, the position of the wind turbines, and noise sensitive locations	-	Appendix B
Noise sensitive locations for which wind farm sound levels are calculated	-	Appendix C
Wind turbine sound power levels	Overall sound power level of L_w = 105.5 dB(A) at rated power	3.2
	Declared overall sound power level of L_w = 107.5 dB(A) at rated power	3.2
The make and model of the wind turbines	Siemens Gamesa Renewable Energy SG 6.0 - 155	1.1
The hub height of the wind turbines	175 metres	3.2
Distance of noise sensitive locations from wind turbines	Within three kilometres of the project site	Appendix C
Calculation procedure used	ISO 9613.2:1996 and IoA Wind Turbines 2013	3.1
Meteorological conditions assumed	10 degrees Celsius temperature, 70 per cent relative humidity and 1013.3 mbar	3.2
Air absorption parameters used	As per ISO9613.2:1996	3.2
Ground attenuation parameters used	G = 0.5	3.2
Topography/screening assumed	Two and five metre contours	3.2 and Appendix B
Predicted far-field wind farm sound levels	-	Table 5

4.0 Wind farm operational noise impact

Table 5 presents the results from the preliminary NIA for the proposed wind turbine layout using the candidate turbine described in Table 1. These predicted outdoor noise levels were obtained through noise modelling, as outlined in section 3.0. The noise levels presented are free field $L_{A90(10\ min)}$ noise levels at the noise sensitive locations. The predicted $L_{A90(10\ min)}$ levels were assessed against the base noise limit of 45 dB and 40 dB $L_{A90(10\ min)}$ for project Stakeholders and Non-Stakeholders respectively.

The high amenity noise limit of 35 dB $L_{A90(10\ min)}$ at 6 m/s and below was also considered.

Noise contour maps showing $L_{A90(10\ min)}$ contours at 1.5 metres AGL for the operation of the wind farm facility for the following conditions are presented in Appendix D:

- Rated power at hub height wind speed of 11.3 m/s
- High amenity noise limits (35 dB $L_{A90(10\ min)}$) at hub height wind speed of 6 m/s.

It is noted that the noise contour maps are generated based on a grid of calculations which are interpolated to generate the contours. Single point noise level calculations, as shown in Table 5, should be referred to for specific noise levels at each noise sensitive receiver locations.

Table 5 Noise compliance assessment. $L_{A90(10\ min)}$ noise prediction of wind turbines noise emission assessed against the hub height wind speeds noise limit

Receiver ID	Stakeholder	Predicted $L_{A90(10\ min)}$ noise level at different hub height wind speeds (m/s), from cut-in to rated power wind speeds										$L_{A90(10\ min)}$ noise limit, dB(A)	Complies with noise limit
		3 (cut-in)	4	5	6[1]	7	8	9	10	11	11.3 (rated power)		
1008315[2]	Yes	34	34	34	38	41	44	46	46	46	46	45	**No**
825540	No	27	27	27	31	35	38	39	39	39	39	40	**Yes**
825692	No	27	27	27	31	34	37	39	39	39	39	40	**Yes**
825530	Yes	26	26	26	30	34	37	38	38	38	38	45	**Yes**
825546	Yes	24	24	24	28	31	34	36	36	36	36	45	**Yes**
825531	No	23	23	23	26	30	33	34	34	34	34	40	**Yes**
825608	No	23	23	23	26	30	33	34	34	34	34	40	**Yes**
825569	No	23	23	23	26	30	33	34	34	34	34	40	**Yes**
825527	No	22	22	22	26	29	32	34	34	34	34	40	**Yes**
825565	No	22	22	22	26	29	32	34	34	34	34	40	**Yes**
825532	No	22	22	22	26	29	32	34	34	34	34	40	**Yes**
825562	No	22	22	22	26	29	32	34	34	34	34	40	**Yes**
825528	No	22	22	22	25	29	32	33	33	33	33	40	**Yes**
825526	No	21	21	21	25	28	31	33	33	33	33	40	**Yes**
825557	No	20	20	20	24	28	31	32	32	32	32	40	**Yes**
825556	No	20	20	20	24	27	30	32	32	32	32	40	**Yes**
825525	No	20	20	20	24	27	30	32	32	32	32	40	**Yes**
825603	No	19	19	19	22	26	29	30	30	30	30	40	**Yes**

Receiver ID	Stakeholder	Predicted $L_{A90(10\ min)}$ noise level at different hub height wind speeds (m/s), from cut-in to rated power wind speeds										$L_{A90(10\ min)}$ noise limit, dB(A)	Complies with noise limit
		3 (cut-in)	4	5	6[1]	7	8	9	10	11	11.3 (rated power)		
825578	No	19	19	19	22	26	29	30	30	30	30	40	**Yes**
825524	No	19	19	19	22	26	29	30	30	30	30	40	**Yes**
825549	No	18	18	18	22	26	29	30	30	30	30	40	**Yes**
825523	No	18	18	18	21	25	28	29	29	29	29	40	**Yes**
825587	No	17	17	17	21	25	28	29	29	29	29	40	**Yes**
825571	No	17	17	17	21	25	28	29	29	29	29	40	**Yes**
825594	No	15	15	15	18	22	25	26	26	26	26	40	**Yes**
825595	No	14	14	14	18	22	25	26	26	26	26	40	**Yes**

Notes:

1. NZS 6808:2010 (the Standard) recommends 6 m/s to be the threshold at which a high amenity noise limit may apply for a wind farm facility.
2. AECOM has been advised by Neoen that this house is abandoned. This will be confirmed prior to the preparation and lodgement of the development application for the Project.

4.1 Cumulative noise impacts from other wind farms in the region

4.1.1 Portland Wind Energy Project

The Portland Wind Energy Project (PWEP) is comprised of five wind farms as presented below and was completed in 2015:

- Yambuk Wind Farm (PWEP I)
- Cape Bridgewater Wind Farm (PWEP II)
- Cape Nelson South Wind Farm (PWEP III)
- Cape Nelson North and Cape Sir William Grant Wind Farm (PWEP IV)

The closest PWEP wind farm to the project is Cape Bridgewater Wind Farm (PWEP II) located approximately 20 kilometres south east of the eastern extent of the project site. At such distance, potential cumulative noise impacts at noise sensitive receivers from the operation of the project and the Cape Bridgewater Wind Farm would be negligible.

5.0 Conclusion

This preliminary NIA has been prepared using a candidate wind turbine that is representative of the type of turbine that is being considered for the project. Neoen will decide on a final wind turbine to be used for the project following planning approvals being obtained and subsequent detailed design work, as well as a tender process to procure the preferred turbine.

The preliminary NIA has been prepared in accordance with the requirements of the DELWP Planning Guidelines which prescribes New Zealand Standard 6808:2010 *Acoustics – Wind Farm Noise* as the basis for the NIA.

A three-dimensional noise model of the indicative layout of the project, which consists of 157 wind turbines, was developed to predict noise levels from the wind turbines at 26 noise sensitive locations that were identified by Neoen as being near the project site. This assessment only considers noise emissions from the wind turbines. Noise from construction of the project and the operation of ancillary facilities will need to be further assessed in a later stage of this project.

Based on the predicted noise levels, the noise emissions from the project are expected to comply at all noise sensitive locations with the base noise limit of 45 dB and 40 dB $L_{A90(10\ min)}$ for Stakeholder and Non-Stakeholder dwellings respectively across all wind speeds, except for one location (Receiver ID 1008315). This location exceeds the Stakeholder dwelling noise limit of 45 dB by 1 dB at rated power hub height wind speed but complies at all other wind speeds below this. This location has been designated by Neoen as an abandoned dwelling, however it is not clear what the official usage of this dwelling is, therefore it has been considered as a noise sensitive location in this assessment. The official usage of this dwelling will require confirmation.

The high amenity noise limit of 35 dB $L_{A90(10\ min)}$ at 6 m/s and below was also considered and only one location exceeds this noise limit (Receiver ID 1008315). This is the same noise sensitive location which is predicted to exceed the base noise limit and has been identified as an abandoned dwelling by Neoen. Notwithstanding, this receiver is a Stakeholder dwelling located within one kilometre of a proposed wind turbine meaning the high amenity noise limit does not apply.

Based on the results of this preliminary NIA, background noise monitoring is not required. However, changes to the wind energy facility layout and/or wind turbine specifications will require reassessment of noise and depending on the results, may require background noise monitoring to be carried out.

Cumulative noise impacts associated with operation of the project and the nearby Portland Wind Energy Project (PWEP) were considered in this assessment. No potential cumulative impacts were identified due to significant distance between the two wind farm developments.

The final turbine model that is selected for use by the project would need to comply with planning approval requirements and other relevant criteria as they relate to noise levels at surrounding noise sensitive locations. An updated noise compliance assessment would also typically be required once final turbines for the project are selected. This would be carried out prior to construction of the project.

Wind turbines will need to be properly maintained by the wind farm operator to ensure that the noise emission of the turbines is not adversely affected by turbine wear, resulting in audible tonality. Similarly, should amplitude modulation be detected upon commissioning, the wind farm operator would be required to alter the operating parameters of some turbines to remove this effect.

Compliance measurements will need to be undertaken at a selected number of potentially most affected noise sensitive locations following the commissioning of the project. Testing should be undertaken once all noise sources associated with the project are in operating mode, i.e. all turbines have been commissioned and are operating correctly.

Appendix A

Acoustic terminology

Appendix A Acoustic terminology

'A' Weighted	Frequency filter applied to measured noise levels to represent how humans hear sounds.
Ambient Noise	Total noise at a site comprising all sources such as industry, traffic, domestic, and natural noises.
Attended Measurement	Measurements that are attended by a person and measured with a sound level meter.
dB(A)	'A' Weighted overall sound pressure level.
Frequency	The number of cycles per second, where 1 cycle per second is equal to 1Hz. The human ear responds to sounds of frequency 20 Hz to 20,000 Hz.
Impulsiveness	Noise that comprises distinct impulses in the noise (bangs, clicks, clatters, or thumps) etc.
Intermittent	Stopping and starting at irregular intervals.
L_{Aeq}	The 'A' Weighted energy-averaged noise level over the measurement period.
$L_{Aeq,10min}$	The energy-averaged level of the total noise measured without adjustment for the character of the noise (e.g. tonal or impulsive), over a period of 10 minutes.
L_{90}	Noise level exceeded for 90% of the measurement period. This represents the background noise level excluding nearby sources.
L_w	The sound power level is a measure of the total acoustic energy produced by a source and is independent of distance and source location. The sound power level is expressed as a ratio against a reference level of 10^{-12} watts.
L_{wd}	The declared sound power level of a wind turbine which is based on two or more tests.
Tonality	A characteristic of noise, describing a sound that contains a perceptible pitch or tone. As a general rule, a prominent tonal component may be detected in one-third octave spectra if the level of a one-third octave band exceeds the level of the adjacent bands by 5 dB or more.
Unattended Measurement	Measurements that are taken by a noise logger at a given location unattended.

*Definitions of a number of terms have been adapted from New Zealand Standard NZS 6808:2010 *"Acoustics – Wind farm noise"* and the DELWP's *Development of Wind Energy Facilities in Victoria, Policy and Planning Guidelines.*

Appendix B

Wind farm layout and noise sensitive locations

NEOEN BOUNDLESS ENERGY

AECOM

DATUM GDA94 VICGRID94

0 2 4

Kilometers

1:100,000 (when printed at A3)

Legend

- Indicative Wind Farm Site Boundary
- Work Exclusion Area
- Overhead Line Development Envelope
- Stakeholder Dwelling
- Non-Stakeholder Dwelling
- Wind Turbine
- Town
- Underground Line Option
- Roads
- Watercourses

Planning Zones

- FZ - Farming
- PCRZ - Public Conservation & Resource
- PPRZ - Public Park & Recreation
- RDZ1 - Road - Category 1

Data Sources:
1. Locality, Railway, Drainage Line, Streets, Features © StreetPro 2014
2. State Controlled Roads © (VICMAP) 2018
3. Essential Habitat © (VICMAP) 2018
4. Conservation Areas © (VICMAP) 2018
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Environmental Effects Statement Referral
Kentbruck Green Power Hub

Noise Sensitive Locations

PROJECT #:	60578607
CREATED BY:	JB
LAST MODIFIED:	brierej: 17/07/2019
VERSION:	1

Figure 1

A3 size

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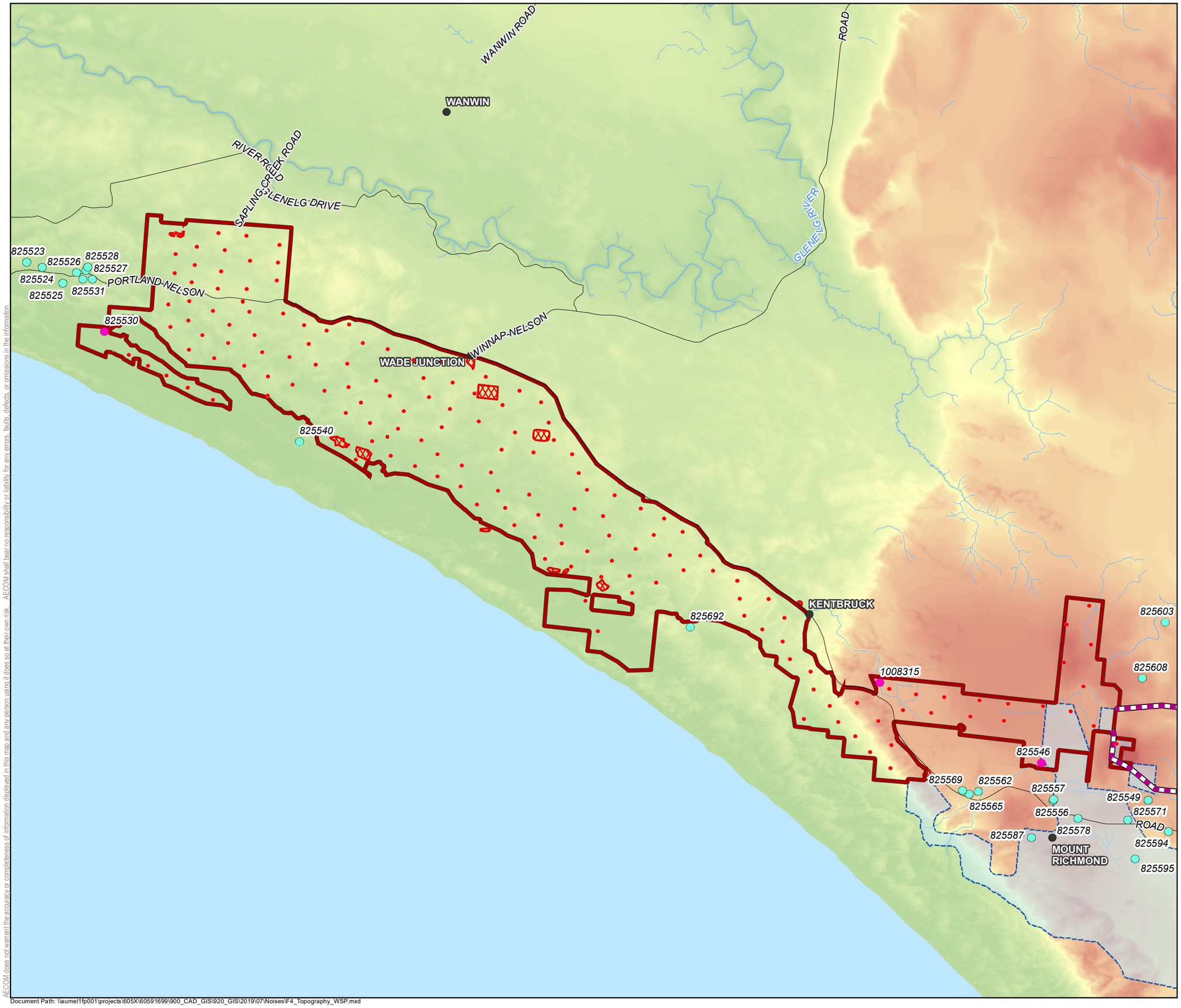

NEOEN Boundless Energy

AECOM

DATUM GDA94 VICGRID94

0 2 4

Kilometers

1:100,000 (when printed at A3)

Legend

- Indicative Wind Farm Site Boundary
- Work Exclusion Area
- Overhead Line Development Envelope
- Stakeholder Dwelling
- Non-Stakeholder Dwelling
- Wind Turbine
- Town
- Underground Line Option
- Roads
- Watercourses

Elevation (m)

221

0

Data Sources:

1. Locality, Railway, Drainage Line, Streets, Features © StreetPro 2014
2. State Controlled Roads © (VICMAP) 2018
3. Essential Habitat © (VICMAP) 2018
4. Conservation Areas © (VICMAP) 2018
5. Protected Area © (VICMAP) 2018
6. Regional Ecosystems v8 © (VICMAP) 2018
7. Protected Plants Flore Survey Trigger © (VICMAP) 2018
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Environmental Effects Statement Referral

Kentbruck Green Power Hub

Wind Farm Layout - Topography

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VERSION:	1

Figure 2

A3 size

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Appendix C

Noise sensitive locations coordinates

Appendix C Noise sensitive location coordinates

Table 6 Noise sensitive locations within three kilometres from the project site

Receiver	Stakeholder	Distance from nearest turbine, **m**	Easting[(1)]	Northing[(1)]
1008315	Yes	319	2175022	2364832
825540	No	1525	2158855	2371541
825692	No	1544	2169737	2366378
825530	Yes	950	2153420	2374612
825546	Yes	1567	2179519	2362593
825531	No	2236	2153081	2376070
825608	No	1652	2182334	2364954
825569	No	2076	2177317	2361827
825527	No	2480	2152904	2376312
825565	No	2171	2177505	2361720
825532	No	2470	2152818	2376063
825562	No	2102	2177761	2361794
825528	No	2436	2152953	2376404
825526	No	2708	2152644	2376253
825557	No	2334	2179862	2361578
825556	No	2373	2179842	2361545
825525	No	2723	2152259	2375955
825603	No	2145	2182962	2366513
825578	No	2346	2180534	2361044

Receiver	Stakeholder	Distance from nearest turbine, **m**	Easting[(1)]	Northing[(1)]
825524	No	3444	2151681	2376401
825549	No	1799	2182492	2361551
825523	No	3851	2151252	2376541
825587	No	3347	2179238	2360508
825571	No	2144	2181926	2361001
825594	No	2832	2183056	2360682
825595	No	3243	2182128	2359920

Notes:

1. Eastings and northings are defined based on the GDA 1994 Projection VICGRID94.

Appendix D

Wind turbine coordinates

Appendix D Wind turbine coordinates

Table 7 Wind turbine coordinates

Wind turbine ID	Easting(1)	Northing(1)
1	2172914	2363824
2	2174395	2364271
3	2155779	2374108
4	2174980	2363761
5	2165703	2368282
6	2157981	2373355
7	2174338	2363337
8	2173184	2364639
9	2156482	2373864
10	2175666	2364062
11	2173633	2364186
12	2160887	2371554
13	2175291	2364661
14	2160822	2372062
15	2166431	2368066
16	2173094	2365139
17	2176457	2363990
18	2156157	2374511
19	2163806	2369793
20	2161402	2371146
21	2155762	2374919
22	2176823	2364427
23	2157318	2373651
24	2167261	2367780
25	2164843	2369222
26	2155858	2375984
27	2173867	2363734
28	2155788	2375461
29	2171248	2366700
30	2162702	2370586
31	2160566	2372633
32	2162076	2370873
33	2176036	2364502

Wind turbine ID	Easting(1)	Northing(1)
34	2165414	2368879
35	2168132	2367329
36	2155998	2376970
37	2172518	2365486
38	2156875	2374293
39	2163350	2370304
40	2159310	2373689
41	2156603	2377352
42	2172318	2365975
43	2155941	2376462
44	2171125	2367174
45	2160221	2373066
46	2171749	2366319
47	2171055	2367670
48	2164590	2369700
49	2159117	2374262
50	2158301	2377026
51	2156587	2375803
52	2158580	2373899
53	2157824	2374032
54	2156445	2375185
55	2157604	2374512
56	2161604	2371905
57	2160244	2374807
58	2158263	2376533
59	2156906	2374797
60	2165512	2369504
61	2169020	2369405
62	2166162	2368712
63	2171927	2367161
64	2158987	2374793
65	2162819	2371945
66	2163381	2370884
67	2170376	2367952
68	2164493	2371318
69	2168056	2367805
70	2157382	2377274

Wind turbine ID	Easting(1)	Northing(1)
71	2156777	2376882
72	2161379	2372815
73	2164384	2370182
74	2168793	2367619
75	2167563	2368231
76	2157391	2375793
77	2167484	2368933
78	2162252	2371583
79	2166144	2369213
80	2172372	2366638
81	2160994	2373243
82	2164190	2370691
83	2157466	2375162
84	2164047	2373346
85	2168365	2369689
86	2156677	2376284
87	2162706	2371195
88	2160192	2373714
89	2166640	2370680
90	2158401	2375114
91	2166879	2368489
92	2165593	2372636
93	2166453	2371190
94	2161318	2374122
95	2168220	2368560
96	2162031	2373812
97	2157481	2376586
98	2160619	2374287
99	2162829	2373754
100	2162467	2372780
101	2167320	2369472
102	2165259	2370079
103	2164860	2371799
104	2166869	2370213
105	2161764	2372395
106	2163047	2372457
107	2162313	2373317

Wind turbine ID	Easting[1]	Northing[1]
108	2166523	2369679
109	2169562	2367971
110	2165374	2371240
111	2159616	2374635
112	2165797	2372070
113	2169175	2368382
114	2167636	2370055
115	2168731	2368953
116	2169537	2369030
117	2164987	2372960
118	2158228	2376034
119	2163853	2372104
120	2164516	2372561
121	2165945	2371593
122	2163130	2373187
123	2163738	2372886
124	2170021	2368372
125	2160424	2371037
126	2160151	2372344
127	2159557	2372963
128	2158665	2373133
129	2157970	2372824
130	2155412	2377353
131	2155405	2376772
132	2155383	2376239
133	2155202	2375362
134	2155262	2374741
135	2166823	2367115
136	2167171	2366266
137	2156445	2372704
138	2155748	2373048
139	2155153	2373380
140	2154107	2373956
141	2177799	2364341
142	2177545	2363890
143	2178602	2364244
144	2178482	2363768

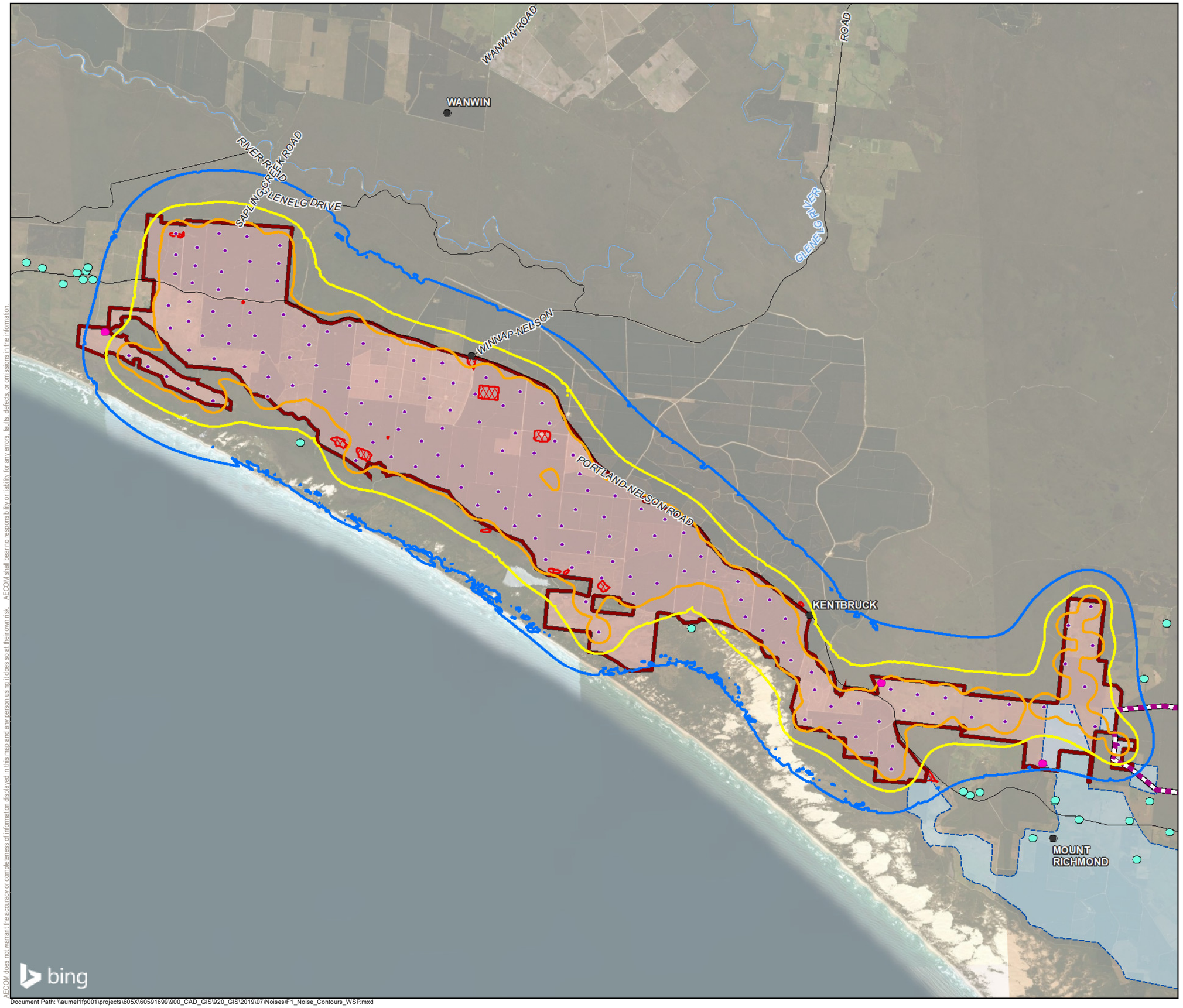
Wind turbine ID	Easting[1]	Northing[1]
145	2179570	2364179
146	2180338	2364034
147	2180982	2363626
148	2180698	2364723
149	2180151	2365398
150	2180909	2365892
151	2180234	2366453
152	2180860	2366979
153	2174757	2362900
154	2175350	2363096
155	2175321	2362447
156	2154636	2373655
157	2181620	2363124

Notes:

1. Eastings and northings are defined based on the GDA 1994 Projection VICGRID94.

Appendix E

Noise contour maps



NEOEN Boundless Energy

AECOM

DATUM GDA94 VICGRID94

0 2 4

Kilometers

1:100,000 (when printed at A3)

Legend

- Indicative Wind Farm Site Boundary
- Work Exclusion Area
- Overhead Line Development Envelope

Houses

- Stakeholder Dwelling
- Non-Stakeholder Dwelling
- Wind Turbine
- Underground Line Option
- Town
- Roads
- Watercourses

Noise Levels at 1.5m Above Ground Level, $L_{A90(10min)}$

- 35 dB(A)
- 40 dB(A)
- 45 dB(A)

Data Sources:
1. Locality, Railway, Drainage Line, Streets, Features © StreetPro 2014
2. State Controlled Roads © (VICMAP) 2018
3. Essential Habitat © (VICMAP) 2018
4. Conservation Areas © (VICMAP) 2018
5. Protected Area © (VICMAP) 2018
6. Regional Ecosystems v8 © (VICMAP) 2018
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Environmental Effects Statement Referral
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$L_{A90(10min)}$ Noise Contour Map at Rated Power (11.3 m/s)

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Figure 3

A3 size

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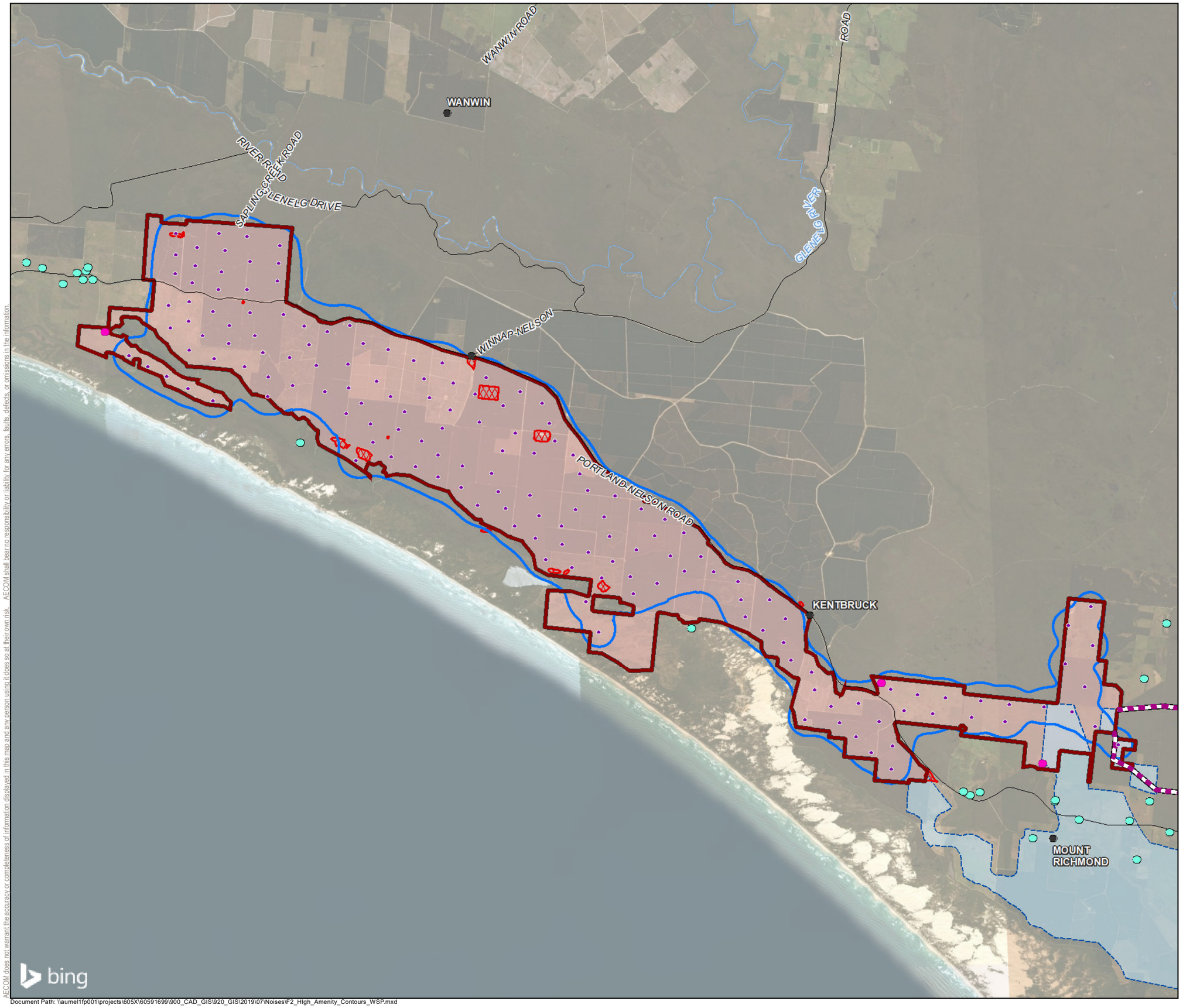

NEOEN BOUNDLESS ENERGY

AECOM

DATUM GDA94 VICGRID94

0 2 4

Kilometers

1:100,000 (when printed at A3)

Legend

- Indicative Wind Farm Site Boundary
- Work Exclusion Area
- Overhead Line Development Envelope

Houses

- Stakeholder Dwelling
- Non-Stakeholder Dwelling
- Wind Turbine
- Town
- Underground Line Option
- Roads
- Watercourses

High Amenity Noise Levels at 1.5m Above Ground Level, $L_{A90(10min)}$

- 35 dB(A)

Data Sources:
1. Locality, Railway, Drainage Line, Streets, Features © StreetPro 2014
2. State Controlled Roads © (VICMAP) 2018
3. Essential Habitat © (VICMAP) 2018
4. Conservation Areas © (VICMAP) 2018
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Environmental Effects Statement Referrals
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$L_{A90(10min)}$ High Amenity Contour Map at Threshold Wind Speed (6 m/s)

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LAST MODIFIED:	brierej: 23/07/2019
VERSION:	1

Figure 4

A3 size

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