Rampion 2 WIND FARM

Rampion 2 Wind Farm

Category 6: Environmental Statement

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1. Introduction

1.1.1 This Appendix presents preliminary predicted operational noise levels (dB L_{A90}) from the proposed Rampion 2 offshore wind farm extension.

1.1.2 The purpose of this exercise is to indicate the extent that worst case operational noise levels are predicted to exceed the applicable lower noise limit of 35 dB L_{A90} free field. If noise levels are predicted to exceed this at receptor positions, baseline noise surveys are required to inform the application of noise limits in accordance with ETSU-R-97 *The Assessment and Rating of Noise from Wind Farms* (The Working Group on Noise from Wind Turbines, 1996).

1.1.3 As the final number and positions of the turbines were not known at the time of this assessment, a series of worst case models had been developed to predict worst case noise levels at positions along the shoreline. The final design of the wind farm is substantially smaller than the scenarios modelled for this report. It should be noted that there are no residential receptors directly on the shoreline, so the results presented within this technical note are a worst case scenario with levels at residential receptors likely to be lower. Furthermore, screening attenuation due to topography and buildings has not been accounted for at this stage.

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2. Modelling

2.1.1 The SoundPLAN v8.2 acoustic modelling software has been used to apply the prediction method of the Danish Statutory Order no. 1284, which is an option within the software[1]. The ground absorption of water is set to 0 (completely reflective) and set to 0.5 on land (partially absorptive in accordance with the Institute of Acoustics (IoA) Good Practice Guide (GPG) (Institute of Acoustics, 2013)). However, the Danish method applies a ground correction of 3.0 dB for transmission over water (identified as ground assigned G=0) and 1.5 dB for transmission over the land (identified as ground assigned any non-zero value). This magnitude of correction for ground absorption is applied regardless of propagation distance.

2.1.2 The results are presented with and without the calculated contribution of the existing Rampion 1 offshore wind farm. The Rampion 1 contribution has also been presented in isolation. In accordance with the assumption of ETSU-R-97 and noted in the IoA GPG, the predicted L_{Aeq} values are corrected to L_{A90} values by subtracting 2 dB. In all cases, flat earth predictions are made at a height of 4 m and, in the absence of specific advice within the referenced turbine noise emission data, an allowance of +2 dB has been included for calculation uncertainty, as recommended by the IoA GPG. The atmospheric parameters used are a temperature of 10°C and relative humidity of 70%. The turbine layout of the extension is defined in 'Rampion 2 Small WTG EIA Node Layout 1' provided by RWE (This has since been superseded, but with a smaller number of turbines and therefore, the below forms a conservatively high estimate of noise levels). The scenarios considered are:

- **Rampion 2:** 155no. Vestas V295 19MW with 177.5m hub height, 295m rotor diameter and 126.0 dB A-weighted sound power level (L_{WA});
- **Rampion 2:** 65no. Vestas V295 19MW with 177.5m hub height, 295m rotor diameter and 126.0 dB L_{WA} and 90 no. Siemens SG DD 222 14MW with 124m hub height, 222m rotor diameter and 119.0 dB L_{WA};
- **Rampion 1:** 116no. Vestas V112 3.45MW with 80m hub height, 112m rotor diameter and 107.8 dB L_{WA} and **Rampion 2:** 155no. Vestas V295 19MW with 177.5m hub height, 295m rotor diameter and 126.0 dB L_{WA};
- **Rampion 1:** 116no. Vestas V112 3.45MW with 80m hub height, 112m rotor diameter and 107.8 dB L_{WA} and **Rampion 2:** 65no. Vestas V29519MW with 177.5m hub height, 295m rotor diameter and 126.0 dB L_{WA} and 90 no. Siemens SG DD 222 14MW with 124m hub height, 222m rotor diameter and 119.0 dB L_{WA}; and

[1] SoundPLAN UK has confirmed that the v9.0 version of the software will replace the procedures of the Danish Statutory Order 1284 with those of the Danish BEK135 methodology.

- **Rampion 1**: 116no. Vestas V112 3.45MW with 80m hub height, 112m rotor diameter and 107.8 dB L_{WA}.

2.1.3 **Table 2-1** presents the details for the different turbine types, indicating which types of turbines the data is used to represent.

Table 2-1 Turbine parameters

Turbine model	Turbine used in modelling	Hub height (m)	Rotor diameter (m)	Maximum A-weighted sound power level dB L_{WA}
Vestas V112 3.45MW (no serrated edge)[2]	Rampion 1 turbines	80.0	112.0	107.8
Siemens Gamesa SG DD 222 (no serrated edge)[3]	Rampion 2 'small' turbines	124.0	222.0	119.0
Vestas V236 15MW[4] (no serrated edge) normalised to the maximum level for the V295 19MW turbine[5]	Rampion 2 'large' turbines	177.5	295.0	126.0

2.1.4 **Table 2-2** presents the maximum A-weighted sound power levels (L_{WA}) for each of the turbine types, which have been applied within the acoustic model. As spectral data for the Vestas V295 19MW turbine are currently unavailable, data for the Vestas V236 15MW turbine have been normalised to the overall value of 126.0 dB(A) for the purposes of this assessment.

2.1.5 The GE Haliade-X type turbine is also considered as a candidate for the small turbine. The one-third octave band sound power levels of GE Haliade-X turbine exceed that of SG-DD 222 turbine by a small margin within eight bands in the low/mid-frequency range. However, the overall A-weighted sound power level of SG DD-222 turbine is 2.5 dB greater than that of the GE Haliade-X turbine. Therefore, the SG-DD 222 is considered to represent the worst case of the candidate small turbine.

2.1.6 The receptor positions considered within the model are shown in **Figure 21.3.1** and are located along the shoreline.

[2] Vestas Wind Systems (2018).
[3] Siemens Gamesa (2021).
[4] Vestas Wind Systems (2021).
[5] The sound power level of the larger turbine was estimated using regression analysis with a graph curve created using known wind turbines, their size and sound power levels. This was considered a conservative approach to estimating noise from a turbine which was yet to be tested for a sound power level as it is likely that technical improvements would mean the sound level was below the curve created for the given power.

Table 2-2 Turbine noise emission data (not inclusive of the +2 dB uncertainty correction)

Turbine type	One-third octave band A-weighted sound power level L_{WA} dB (band centre frequencies in Hz)												
	31.5	**40**	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**
Rampion 1	71.2	74.8	79.1	81.5	84.1	87.3	92.4	91.5	92.3	95.2	95.7	95.6	96.3
Rampion 2 (Small turbines)	84.1	87.7	90.3	93.5	97	95.2	96.2	96.8	99.2	102.4	104.2	104.9	105.5
Rampion 2 (Large turbines)	86.1	90.8	94.9	98.7	102.3	105.3	107.9	110.4	112.3	113.9	115.1	116.0	116.5

Turbine type	One-third octave band A-weighted sound power level L_{WA} dB (band centre frequencies in Hz)													
	630	**800**	**1k**	**1.25k**	**1.6k**	**2k**	**2.5k**	**3.15k**	**4k**	**5k**	**6.3k**	**8k**	**10k**	**Total**
Rampion 1	99	99.7	98.8	96.6	95.6	93	92.2	90.6	90.6	87.2	82.2	75.4	-	**107.8**
Rampion 2 (Small turbines)	107.4	107.1	108.5	110.3	109.5	110.6	108.7	106.9	104.5	100.1	95.5	88.2	-	**119.0**
Rampion 2 (Large turbines)	116.7	116.4	115.8	114.9	113.4	111.7	109.7	107.3	104.3	101.2	97.7	93.6	89.4	**126.0**

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2.2 Model scenario 1: Rampion 2 19MW turbines

2.2.1 A model of 155no. proposed turbines as 'large' turbines described above, both as Rampion 2 only and in combination with Rampion 1 (as previously specified, the submitted design is smaller than this model). **Table 2-3** shows the single point predicted receptor noise levels for this scenario. Single point predicted receptor noise levels for Rampion 1 in isolation have also been presented for reference. **Figure 21.3.2** shows the 35 dB L_{A90} (37 dB L_{Aeq}) noise contour for Rampion 2 only, whilst **Figure 21.3.3** shows the 35 dB L_{A90} (37 dB L_{Aeq}) noise contour for the combined impact of Rampion 1 and Rampion 2.

Table 2-3 Worst case predicted noise levels: Rampion 2 large turbines only

Shoreline receptor position	Predicted receptor noise levels, dB L_{A90} free field		
	Rampion 2 only	Rampion 1 only	Rampion 1 and Rampion 2
R00	17.5	0.5	17.6
R01	20.8	3.5	20.9
R02	25.8	8.3	25.8
R03	28.7	11.5	28.8
R04	31.5	15	31.6
R05	33.6	18.2	33.7
R06	32.6	18.4	32.8
R07	34.4	19.5	34.5
R08	**35.6**	16.6	**35.6**
R09	34.8	12.6	34.8
R10	32.4	8.7	32.5
R11	32.5	7.5	32.5
R12	25.5	2.6	25.5
R13	23.6	1.3	23.6

2.2.2 The predicted worst case noise level at the shoreline receptor positions is 35.6 dB L_{A90} at position R08. It should be noted that this proposed layout of turbines is not finalised, therefore should the layout change, the worst case predicted noise levels will also change.

2.3 Model scenario 2: mixture of 19MW turbines and 14MW turbines for Rampion 2

2.3.1 A model of 65no. 19MW 'large' turbines and 90no. 'small' turbines has also been created. As the final positioning of each type of turbine is not known, a generalised worst case assumption of placing the larger turbines closer to the shore and the smaller turbines further away has been made. **Table** 2-4 presents the single point predicted receptor noise levels for this scenario. Single point predicted receptor noise levels for Rampion 1 in isolation have also been presented for reference. **Figure 21.3.4** shows the 35 dB L_{A90} (37 dB L_{Aeq}) noise contour for Rampion 2 only, and **Figure 21.3.5** shows the 35 dB L_{A90} (37 dB L_{Aeq}) noise contour for the combined impact of Rampion 1 and Rampion 2.

Table 2-4 Worst case predicted noise levels: Rampion 2 mixed large and small turbines

Shoreline receptor position	Predicted receptor noise levels, dB L_{A90} free field		
	Rampion 2 only	Rampion 1 only	Rampion 1 and Rampion 2
R00	15.4	0.5	15.5
R01	18.5	3.5	18.7
R02	23.5	8.3	23.6
R03	26.6	11.5	26.7
R04	29.7	15	29.8
R05	31.9	18.2	32.1
R06	30.8	18.4	31.0
R07	32.5	19.5	32.7
R08	33.7	16.6	33.8
R09	32.5	12.6	32.5
R10	29.5	8.7	29.6
R11	29.1	7.5	29.2
R12	22.5	2.6	22.6
R13	20.8	1.3	20.8

2.3.2 The predicted worst case noise level at the shoreline receptor positions is 33.8 dB L_{A90} (33.7 dB for Rampion 2 only) at position R08. It should be noted that this

proposed layout of turbines is not finalised, therefore should the layout change, the worst case predicted noise levels will also change.

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3. Conclusion

3.1 Summary of findings

3.1.1 This preliminary modelling study of operational noise from the Rampion 2 offshore wind farm has shown that the predicted turbine noise levels of Rampion 2 only is 35.6 dB L_{A90} at the nearest shoreline receptor. This is representative of a level which is higher than the submitted design for Rampion 2 based entirely of the large Vestas V295 19MW turbines.

3.1.2 Another scenario where a mixture of 90no. 14MW turbines and 65no. 19MW turbines are installed with the larger turbines closer to the shoreline results in a predicted worst case value of 33.7 dB L_{A90} at the worst-affected shoreline receptor.

3.1.3 This indicates that, based on the data available at this stage, operational noise levels of Rampion 2 are expected to comply with applicable noise limits in accordance with the ETSU-R-97 screening limit of 35 dB L_{A90}.

3.1.4 The cumulative scenario (i.e. Rampion 2 comprising a mixture of 90no. 14MW turbines and 65no. 19MW turbines, and the existing Rampion 2 turbines) is predicted to have a noise level of 33.8 dB L_{A90} at the worst-affected shoreline receptor. This indicates, based on the data available at this stage, cumulative operational noise levels of Rampion 2 and Rampion 1 are expected to be below the cumulative limit of 40 dB L_{A90}.

3.1.5 The modelling scenarios presented in this report assume that the maximum sound power level is emitted from each turbine, regardless of wind speed. In practice, this scenario is unlikely to occur, with different wind turbines emitting the highest sound power level at different wind speeds. Furthermore, the limit applies at residential receptors, which are more remote than the shoreline and therefore receptor noise levels are expected to be slightly lower. Attenuation due to buildings and topography have not been accounted for at this stage.

3.2 Recommendations

3.2.1 It is recommended that while updating the predictions to account for the assignment of turbine types to specific positions in the layout, the modelling is updated to consider turbine noise as a function of standardised wind speed, and to account for spectral sound power levels specifically for the 19MW turbines, if available.

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4. Glossary of terms and abbreviations

Term (acronym)	Definition
ANC	Association of Noise Consultants
Baseline	Refers to existing conditions as represented by latest available survey and other data which is used as a benchmark for making comparisons to assess the impact of development.
Baseline conditions	The environment as it appears (or would appear) immediately prior to the implementation of the Proposed Development together with any known or foreseeable future changes that will take place before completion of the Proposed Development.
BS	British Standard
Cumulative effects	Additional changes caused by a Proposed Development in conjunction with other similar developments or as a combined effect of a set of developments.
dB	Decibel
Development Consent Order (DCO)	This is the means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects, under the Planning Act 2008.
Development Consent Order Application	An application for consent to undertake a Nationally Significant Infrastructure Project made to the Planning Inspectorate who will consider the application and make a recommendation to the Secretary of State, who will decide on whether development consent should be granted for the Proposed Development.
Environmental Statement (ES)	The written output presenting the full findings of the Environmental Impact Assessment.
IoA	Institute of Acoustics
Nationally Significant Infrastructure Project (NSIP)	Nationally Significant Infrastructure Projects are major infrastructure developments in England and Wales which are consented by DCO under the Planning Act 2008. These include proposals for offshore wind farms with an installed capacity over 100MW.
NWG	Noise Working Group

Term (acronym)	Definition
Proposed Development	The development that is subject to the application for development consent, as described in **Chapter 4: The Proposed Development, Volume 2** of the ES (Document Reference: 6.2.4).
Receptor	These are as defined in Regulation 5(2) of The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 and include population and human health, biodiversity, land, soil, water, air, climate, material assets, cultural heritage and landscape that may be at risk from exposure to direct and indirect impacts as a result of the Proposed Development.
RED	Rampion Extension Development Limited (the Applicant)

5. References

Institute of Acoustics (2013). *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise*. [online] Available at: https://www.ioa.org.uk/sites/default/files/IOA%20Good%20Practice%20Guide%20on%20Wind%20Turbine %20Noise%20-%20May%202013.pdf [Accessed 15 March 2022].

Siemens Gamesa (2021). *Acoustic Emission, SG DD-222 (Document number AE-TW00033-110000085417-00)*. Siemens Gamesa, Spain

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Annex A Figures

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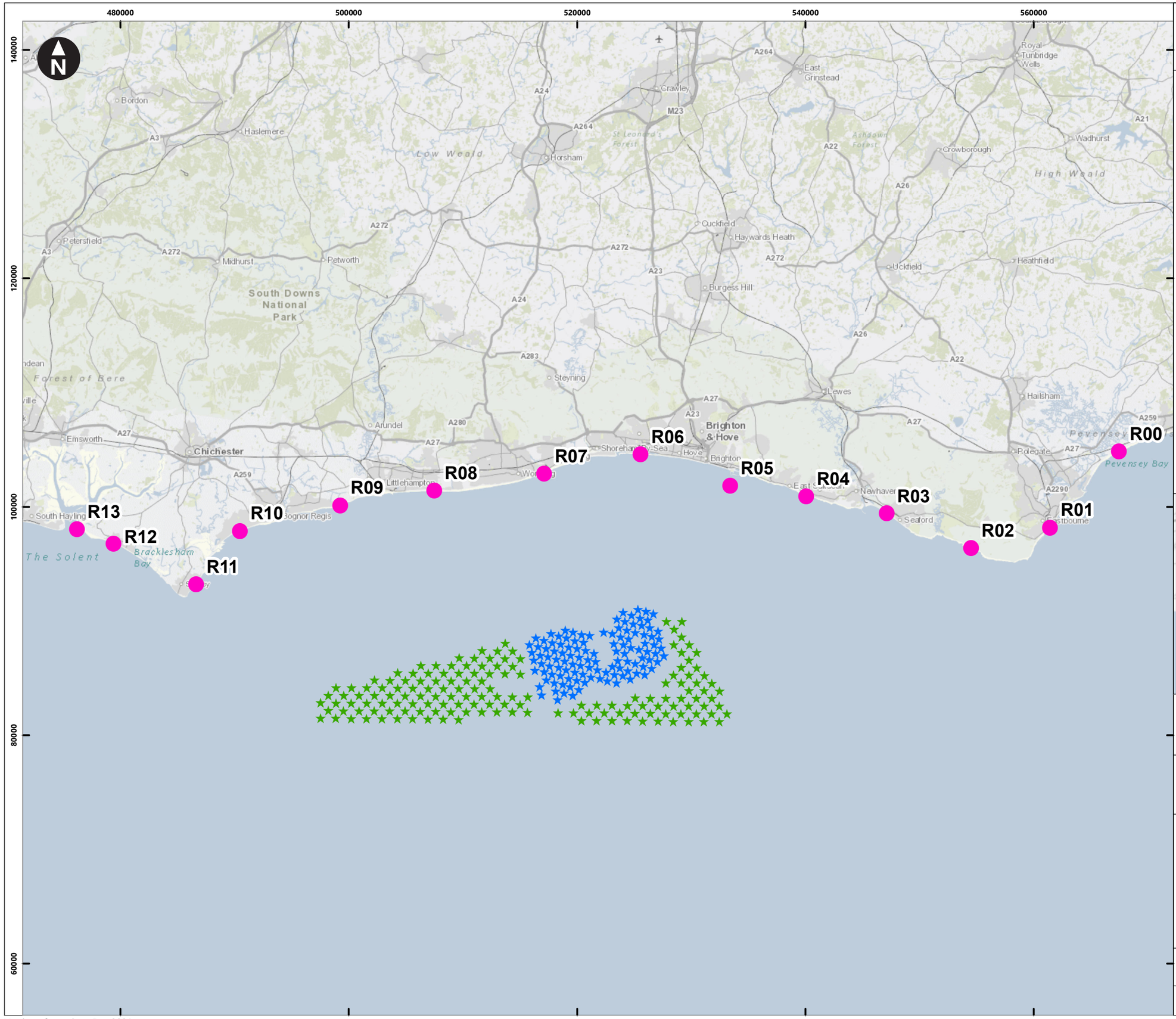

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Key

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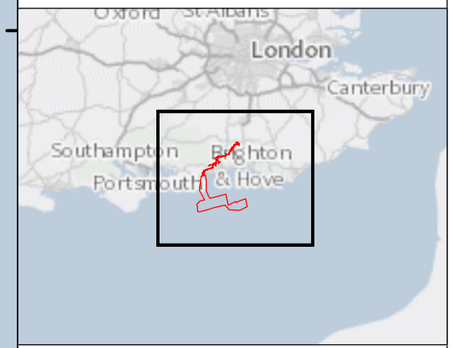
- Rampion 2 turbines
- Receptors



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British National Grid Transverse Mercator

Rampion Extension Development

Rampion 2 WIND FARM

Rampion 2 Offshore Wind Farm

Figure 21.3.1 Receptor locations

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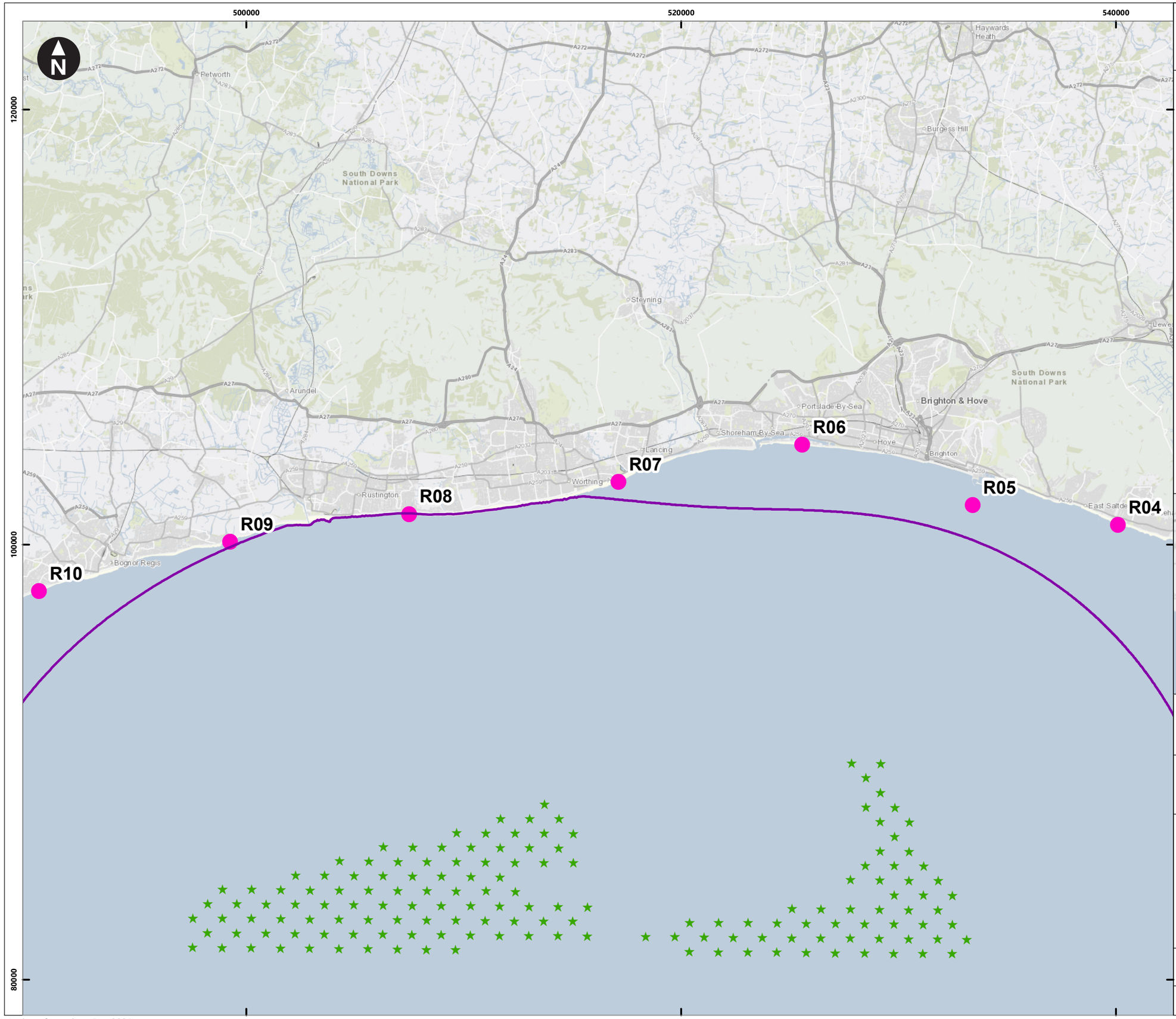

Key

- ★ Rampion 2 'large' turbines
- 35db LA90
- Receptors

Note. As the final number and positions of the turbines were not known at the time of this assessment, a series of worst case models had been developed to predict worst case noise levels at positions along the shoreline. The final design of the wind farm is substantially smaller than the scenarios modelled

Kilometres
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British National Grid Transverse Mercator

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Rampion 2 WIND FARM

Rampion 2 Offshore Wind Farm

Figure 21.3.2 Rampion 2 only - large turbine scenario

Environmental Statement

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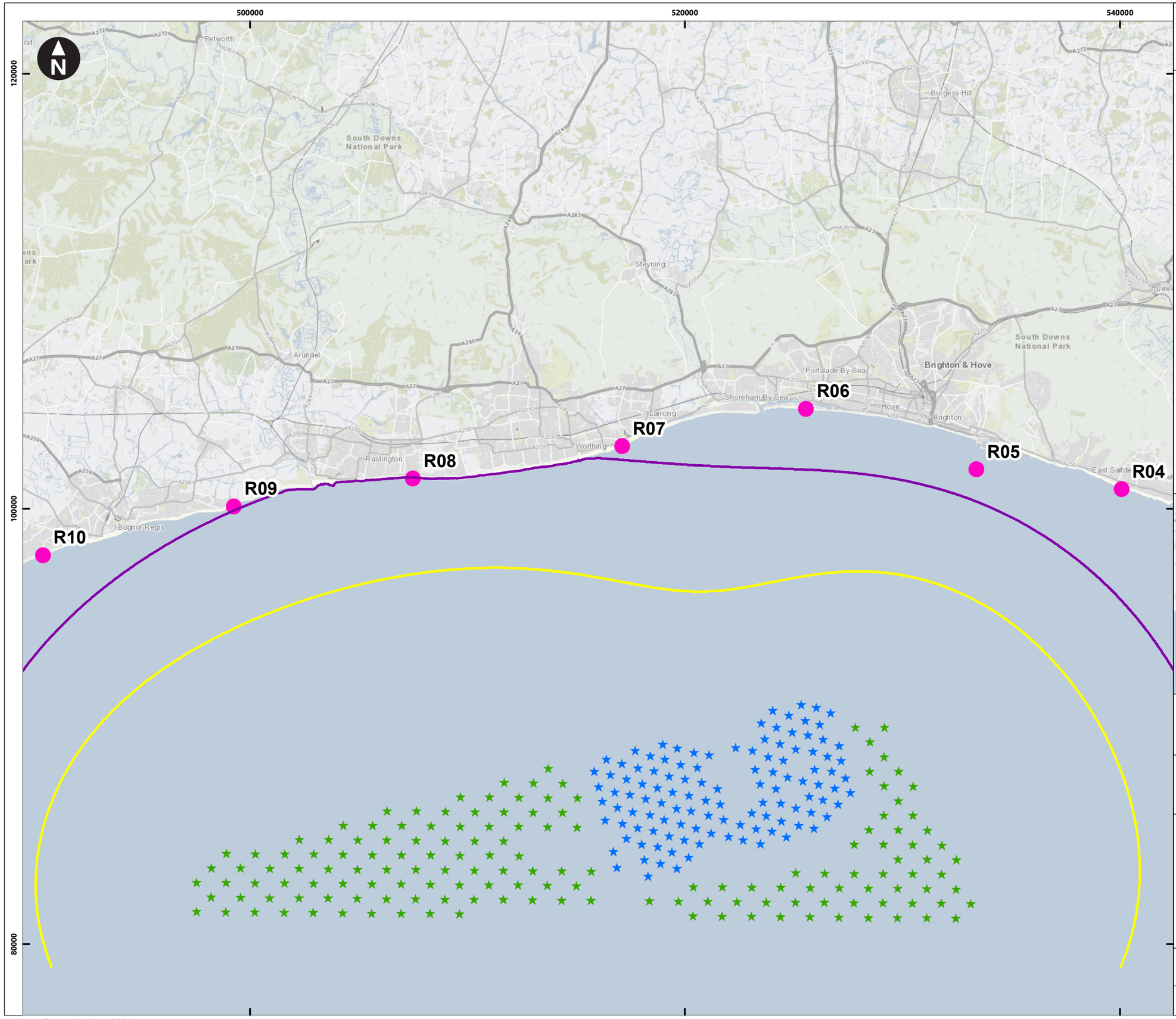

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Key

- Rampion 1 turbines
- Rampion 2 'large' turbines
- 35db LA90
- 40db LA90

Note. As the final number and positions of the turbines were not known at the time of this assessment, a series of worst case models had been developed to predict worst case noise levels at positions along the shoreline. The final design of the wind farm is substantially smaller than the scenarios modelled

Kilometres
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British National Grid Transverse Mercator

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Rampion 2 WIND FARM

Rampion 2 Offshore Wind Farm

Figure 21.3.3 Rampion 1 & 2 cumulative impact - large turbine scenario

Environmental Statement

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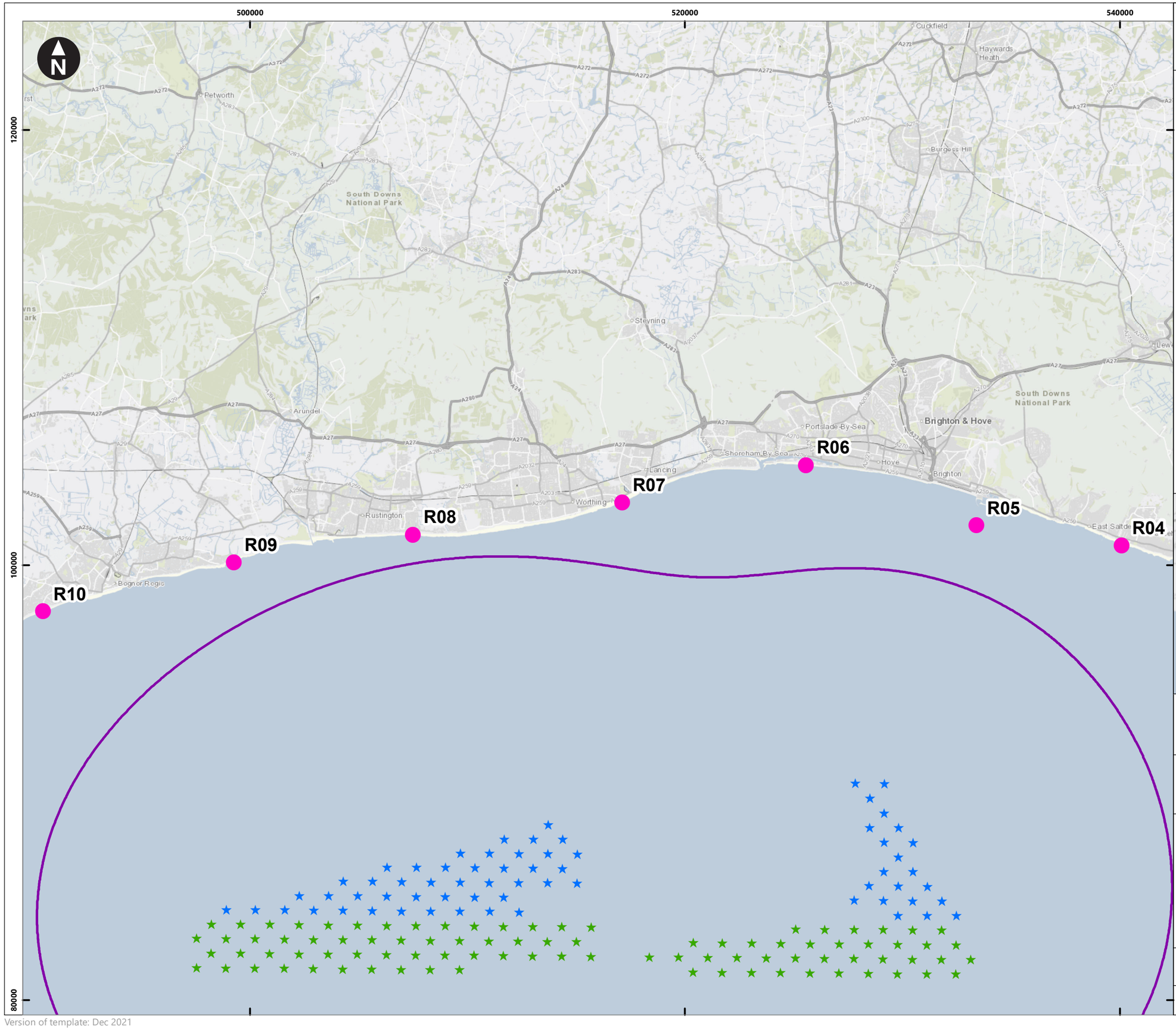

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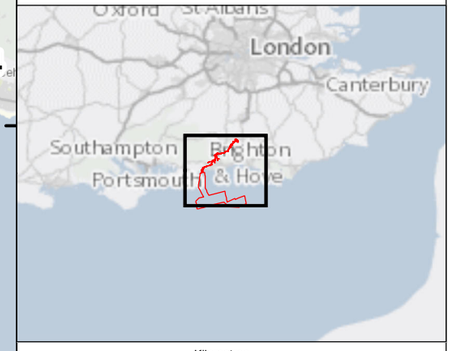
Key

- Rampion 2 'small' turbines
- Rampion 2 'large' turbines
- 35db LA90
- Receptors

Note. As the final number and positions of the turbines were not known at the time of this assessment, a series of worst case models had been developed to predict worst case noise levels at positions along the shoreline. The final design of the wind farm is substantially smaller than the scenarios modelled



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British National Grid Transverse Mercator

Rampion Extension Development

Rampion 2 WIND FARM

Rampion 2 Offshore Wind Farm

Figure 21.3.4 Rampion 2 only - mixed turbine scenario

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N

R04

R05

R06

R07

R08

R09

R10

Midhurst

Petworth

Cuckfield

Haywards Heath

Burgess Hill

South Downs National Park

Steyning

Arundel

Lewes

Portslade-By-Sea

Brighton & Hove

Shoreham-By-Sea

Hove

Brighton

Lancing

Worthing

Rustington

East Saltdean

Bognor Regis

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Key

- Rampion 2 'small' turbines
- Rampion 2 'large' turbines
- Rampion 1 turbines
- 35db LA90
- 40db LA90
- Receptors

Kilometres

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Figure 21.3.5 Rampion 1 & 2 cumulative impact - mixed turbines scenario

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