The Great Grid Upgrade

Sea Link

Sea Link

Volume 9: Examination Submissions

Document 9.49 Seals and Airborne Sound Disturbance Technical Note

Planning Inspectorate Reference: EN20026

Version: A
November 2025

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 Regulation 5(2)(a)

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1. Seals and Airborne Sound Disturbance - Applicant's Response to Natural England

1.1 Introduction and Purpose of this Technical Note

1.1.1 To support the assessment of airborne sound effects on seals in Pegwell Bay, provided in **Application Document 6.2.4.4 (D) Part 4 Marine Chapter 4 Marine Mammals [AS-095]**, the Applicant completed site-specific airborne sound calculations to determine the effect of noise from construction plant operating in Pegwell Bay on a seal haul-out site situated within the River Stour (flowing into Pegwell Bay), as part of the National Grid Sea Link project (hereafter referred to as the Proposed Project).

1.1.2 The presence and location of seals within the River Stour was confirmed through site-specific surveys completed by the Applicant (see **Application Document 6.3.4.4.A (B) ES Appendix 4.4.A Pegwell Bay Seal Survey Report**, submitted at Deadline 1). The site-specific seal surveys have shown that the seal haul-out site in the River Stour primarily supports a breeding harbour seal (*Phoca vitulina*) population but there are occasionally small numbers of grey seal (*Halichoerus grypus*) also present.

1.1.3 The original airborne sound calculations provided in **Application Document 6.2.4.4 (D) Part 4 Marine Chapter 4 Marine Mammals [AS-095]** at Application used A-weighting (typically used for human receptors) to predict Sound Exposure Levels (SELs) produced by construction equipment and plant in several different potential scenarios (i.e. differing numbers and type of plant).

1.1.4 Following review of Relevant Representation F17 from Natural England regarding airborne sound modelling on seals, Natural England have requested that the modelling be updated using M-weighted (applicable to phocid seal hearing in air) data and methodology provided in Southall *et al*. (2019), so that noise levels produced by the construction activities can be more accurately compared to auditory injury thresholds also provided by Southall *et al*. (2019).These auditory injury thresholds indicate that a temporary threshold shift (TTS) in seal hearing could occur at 24 hour SEL of 134 dB re (20 µPa)2^s and above. For a permanent threshold shift (PTS) in seal hearing to occur, the SEL would be required to reach 154 dB re (20 µPa)2^s.

1.1.5 The modelling has now been updated to use M-weighting for the determination of the distance to which the TTS and PTS criteria are met.

1.1.6 Furthermore, since the results of the initial A-weighted sound calculations were provided in **Application Document 6.2.4.4 (D) Part 4 Marine Chapter 4 Marine Mammals [AS-095]** at Application, the equipment and plant lists required during the Construction phase of the Proposed Project in Pegwell Bay have been further refined. The specific location of the horizontal directional drilling (HDD) exit pits has also now been more precisely defined as well as the expected movements of plant and equipment across the Pegwell Bay mudflats.

1.1.7 The requirement to include M-weighted sound propagation and the additional project description information, which also considers local bathymetry and topography, has

enabled a more detailed 3D airborne noise model (see Section 1.3) to be produced for Pegwell Bay and the River Stour haul-out site.

1.2 Previous Sound Calculations for Auditory Effects

1.2.1 The previous A-weighted modelling provided at Application assessed the worst case scenario of the operation of four tracked excavators and a vibratory piling rig in Pegwell Bay operating simultaneously, using a simple point-to-point calculation over a distance of 1.063 km[1]. Sound calculations were used to assess the distance from the excavators and piling rig at which TTS and PTS would be met.

1.2.2 Considering the worst-case scenario of four tracked excavators and one vibratory piling rig operating at the same time using A-weighted parameters (Table 1.1), the TTS threshold of 134 dB re (20 µPa)2^{s} (Southall, et al., 2019) was expected to be met at a maximum distance of 17 m away from the construction activities in Pegwell Bay. The PTS threshold of 154 dB re (20 µPa)2^{s} (Southall, et al., 2019) was expected to be met at a maximum distance of 1.7 m away from the construction activities. For context, the haul-out site was calculated to be located a minimum of 1 km away from the construction activities.

Table 1.1 Sound source data used in previous A-weighted modelling

Construction Plant Type	L_{pA} at 10 m (dB)
Tracked excavator 226 40 t	79
Vibratory piling rig – 52 t / 14 m length / soft clay	88

1.3 Updated Modelling Using M-weighting

1.3.1 Additional M-weighted acoustic modelling has been undertaken to assess construction-related noise impacts on seals, applying the TTS and PTS parameters outlined in Southall et al. (2019). A more refined modelling methodology has also been implemented, as detailed below.

Modelling Assumptions

1.3.2 A 3D computer model was constructed using Datakustik CadnaA (version 2025) (Datakustik, 2025), which incorporates the prediction methodology for the propagation of sound set out in ISO 9613-2:2024 (International Organization for Standardization, 2024).

1.3.3 The modelling includes 3D ground height data from the National LiDAR Scheme (Department for Environment, Food and Rural Affairs, 2022), with all ground assumed to be ‘soft’ (i.e. subject to attenuation from the ground effect), except for areas of water (including intertidal areas at low water) which are assumed to be ‘hard’ (i.e. reflective). The modelling has also considered the low number of acoustically reflective surfaces

[1] In other words, assuming a single point location for the construction plant, and a single point location for the seal-haul-out site, at an estimated distance of 1063 metres from each other.

such as buildings in the area of focus. Source heights of 1.5 m, and receiver heights of 0.5 m have been used.

1.3.4 The 'pass by' function of the noise modelling software has been used to identify the points which would give the highest noise levels at the haul-out site, and these points have been used in the modelling exercise for three key operational activities: construction of the cofferdam at the HDD exit pit, placement of anchors during cable pull-in and simultaneous movements of a number of plant and vehicles.

1.3.5 Excavators will be required during the drilling at the HDD exit pits, to help secure the four anchor points for the cable laying barge across the intertidal mudflats, and for transport of material across the intertidal mudflats. The closest possible anchor points to the haul-out site is approximately 670 m away (Figure 2). Excavators are only expected to be operational at each anchor point for around 1 hour at a time.

1.3.6 Thus, to provide a robust worst-case assessment, the M-weighted modelling has considered the following scenarios based on the equipment list clarified in **Application Document 9.13 Pegwell Bay Construction Method Technical Note** (submitted at Deadline 1) in line with the worst-case scenario of the Project description:

- drilling by vibratory piling rig continuously for 12-hour shifts, using one piling rig and four tracked excavators located at the 'worst-case' point on the HDD exit boundary;
- installation of anchor points – four anchors, each requiring one excavator to operate for one hour, and each requiring four excavator trips between the anchor and the barge; and
- movement of vehicles across the intertidal area of Pegwell Bay, assuming 36 two-way movements of vehicles at 5 miles per hour per each 12-hour day.

1.3.7 Up to three hovercrafts will also be on standby on a land-based trailer and only deployed onto the mudflats in the highly unlikely event of an emergency. Therefore, due to the highly unlikely nature of hovercraft being required, they have not been included in the airborne noise modelling.

1.3.8 Seals do not only haul-out at one specific point in the river and are spread across the mudflats (Figure 1 – Figure 3 showing August 2025 seal location data), as provided in **Document 6.3.4.4.A (B) ES Appendix 4.4.A Pegwell Bay Seal Survey Report**, submitted at Deadline 1. The results of the noise modelling are presented using noise contour plots which show the spread of noise levels across the haul-out site, however the summary results provided below are at the northernmost extent of the haul-out site, giving an absolute worst-case scenario for seal exposure to airborne sound in the River Stour.

Modelling Results

1.3.9 The results of the updated and refined modelling based on the above assumptions are provided in Table 1.2. At the seal haul-out site on mudflats in the River Stour, the worst-case predicted noise level, resulting from drilling, is $L_{Aeq,12hour}$ 49 dB over the duration of the activity at a location within the Limits of Deviation that results in the greatest sound propagation (Table 1.2). For this scenario, the sound level for TTS of 134 dB is expected to occur at a shorter distance of approximately 13 m from the sound source in Pegwell Bay (compared to 17 m for A-weighted sound propagation). The sound level for PTS of 154 dB is expected to be met up to a distance of less than 1 m from the sound

source (compared to 1.7 m for A-weighted). The TTS and PTS distances for all other scenarios modelled are negligible.

1.3.10 Contour plots illustrating the A-weighted airborne noise generation in Pegwell Bay for disturbance under each scenario are provided below (Figure 1 to Figure 3).

Table 1.2 Predicted M-weighted modelling results for construction activities in Pegwell Bay

Activity	Assumed plant	Activity sound power L_{wA} / L_{wM} dB	Duration (*T*)	Activity level at north of seal haul-out mudflat $L_{Aeq,T}$ dB	Approximate closest approach to seal haul-out mudflat (m)	TTS distance (m)	PTS distance (m)
Drilling	4 x excavator 1 x piling rig	118 / 116[#]	12 hours	49	880	13	< 1
Anchor installation *4 x anchors each one hour, and 4 x excavator trips to/from barge at five miles per hour*	1 x excavator	107 / 104	4.75 hours	41	670	2	-
Vehicle movements *36 two-way movements per 12-hour day, assumed 5 mph*	Typical construction plant (e.g. excavator, dozer, telehandler)	76 / 73 per metre Using 107 dB L_{wA} for each item of plant	12 hours	39	850	-	-

[#] This is based on the addition of the sound powers of 4 x excavator (L_{wA} 107 dB / L_{wM} 104 dB) and 1 x piling rig (L_{wA} 116 dB / L_{wM} 114 dB)

1.4 Discussion of Modelling Results

1.4.1 The updated modelling has shown that auditory injury will not occur to the seals hauled-out in the River Stour, even for construction activity occurring within 700 m of the haul-out. On a worst-case activity scenario basis, the distances within which TTS and PTS could occur are very small (≤ 13 m), and for other construction activities noise levels are not high enough to trigger TTS or PTS.

1.4.2 Although injury effects from project activities can be excluded, the primary concern relates to potential disturbance of hauled-out seals. Such disturbance may involve interruption of normal feeding or resting behaviours, or displacement from the haul-out site. However, there are currently no quantitative criteria for assessing disturbance in marine mammals, including seals; consequently, no modelled distances can be provided for predicting the occurrence of such effects.

1.4.3 However, the propagation of sound created by project activities has been modelled and the values predicted to occur at the haul-out location plotted (see Figure 1 – 3 in Appendix A). The sound levels at the haul-out location have been investigated to make a more qualitative assessment of the potential for disturbance. This approach is described and discussed in Section 1.5 below.

1.5 Disturbance Effects

1.5.1 There are no disturbance criteria for seals, as responses are highly variable and there is a critical and complex role in the context of sound exposure, which means there is not a single received sound level at which disturbance may occur (Gomez, et al., 2016). There are, however, received sound levels at which a number of disturbance effects are recognized in humans.

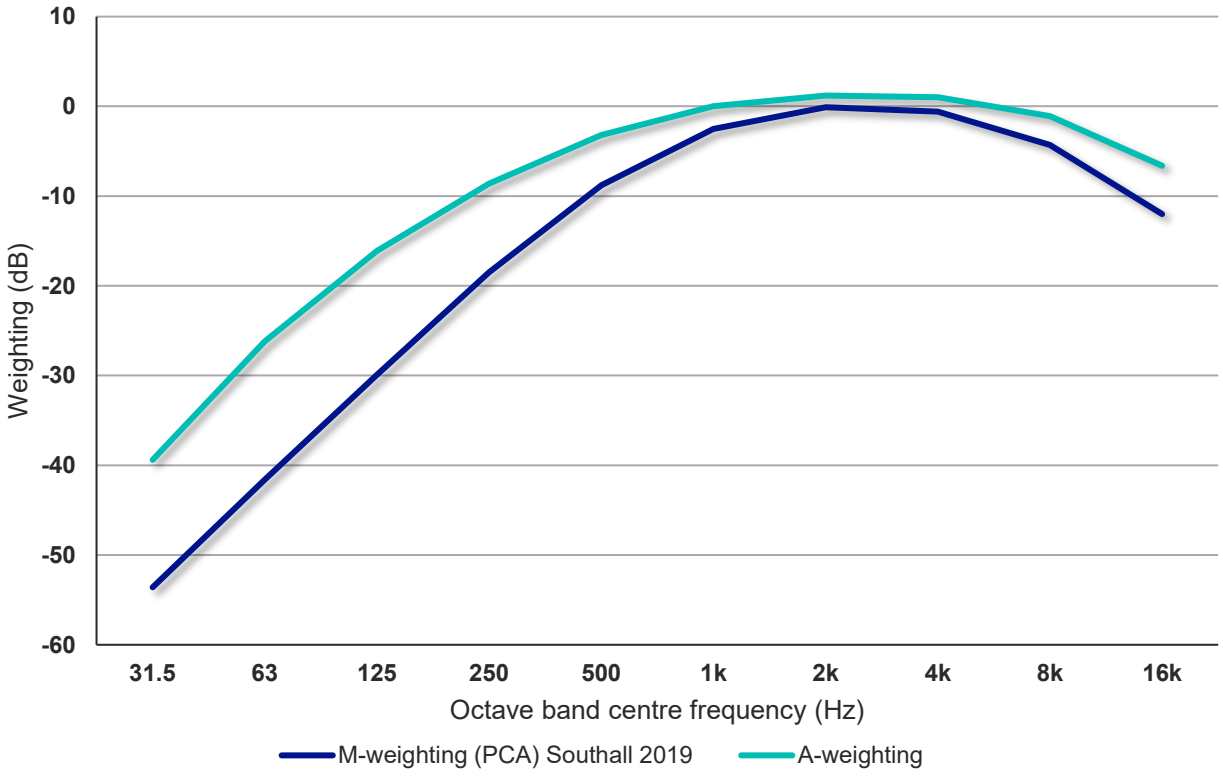

Plate 1.1 Comparison of A-weighted (humans) and M-weighted (seals) curves used for sound predictions for the Proposed Project

1.5.2 A comparison of the hearing weighting curve for humans (A-weighting) with that for seals (M-weighting) shows it is evident the curves, and therefore hearing sensitivities, are very similar (Plate 1.1) especially around the region of peak sensitivity from 1 to 4 kHz. At both low and high frequencies, seals are less sensitive to sounds than humans, with a greater difference in sensitivity for low frequency dominant sounds.

1.5.3 For noise produced by construction plant, the overall M-weighted value is typically 3 to 4 dB lower than the A-weighted value[2]. Also, of note, is that there is no situation in which the M-weighted value can be higher and therefore using A-weighting for sound propagation is always going to be precautionary for seals.

1.5.4 Sound source levels are readily available as A-weighted values, but the individual frequency bands required to convert to M-weighted values are not always available. In these scenarios, A-weighting is a conservative equivalent (and likely worst-case scenario and precautionary approach) to M-weighting (phocid-weighted) when considering seal hearing. This is also evident in the determination of distances at which the thresholds were met for TTS and PTS as reported in Section 1.3.

1.5.5 Therefore, in the absence of disturbance threshold data, and considering the very similar hearing range and sensitivity in humans and seals, design criteria to minimise impacts of construction activity noise in humans (Plate 1.2) can be reviewed to give **an indication** of the likelihood of disturbance to seals.

[2] Based on comparison of 373 spectra in BS 5228-1:2009+A1:2014 Appendix C, typical difference was 3 to 4 dB, with 95% of values falling within the range 2 to 5 dB.

1.5.6 When considering sound intensity at the seal haul-out site on mudflats in the River Stour, the worst-case noise from the piling operations at the HDD exit, is predicted to be $L_{Aeq,12hours}$ 49 dB. Using noise design criteria for human hearing, an 'average' daytime noise level of 50 dB $L_{Aeq,16hour}$ in outdoor environments is considered a suitable and comfortable noise limit (Plate 1.2) with no adverse effects and negligible disturbance.

1.5.7 As human hearing (A-weighted) and seal hearing (M-weighted) curves are very similar (as shown by Plate 1.1), this is also considered to be applicable to seals. Therefore, the worst-case sound level of $L_{Aeq,12hours}$ 49 dB on the seal haul-out site in the River Stour is in the region that is in the comfortable range, and not likely to result in disturbance in humans. Thus, it is also considered to be unlikely to result in disturbance of the seals during construction activity, particularly considering the context at the haul-out location.

1.5.8 As widely reported in the literature, and as detailed in Gomez et al. (2016), ecological context is an important determinant of disturbance. Seals hauled out in the River Stour have demonstrated significant habituation to airborne noise due to the regular, year-round use of the River Stour by seal spotting tour boats and other vessels which often come within 20 to 30 m of the seals. The site-specific seal observation surveys conducted for the project in September to November 2024 and August 2025 observed no reaction, including from the few pups observed, to the presence of the survey vessel, as reported in **Application Document 6.3.4.4.A (B) ES Appendix 4.4.A Pegwell Bay Seal Survey Report**, submitted at Deadline 1.

1.5.9 Taking a precautionary approach to an investigation of potential disturbance, the absolute worst-case scenario that has been modelled which is the construction of the cofferdam, is something that would be experienced by seals for only very short periods of time for several reasons:

- At the haul-out site in the River Stour, the location of highest noise levels is at the northernmost extent of the mudflats where seals have been observed. However, seals are known to be present across a wide area of the mudflat in the River Stour, with sound levels for the worst-case scenario ranging from $L_{Aeq,12hours}$ 40 to 49 dB, and so many, if not most, seals are not anticipated to be subject to the highest predicted noise levels.
- The position of the Proposed Project's noise generating activities have also used a very worst-case scenario placing equipment at the closest point to the mudflats possible, though the majority or maybe all of the construction will be elsewhere.
- The Proposed Project activities generating this modelled level of sound will be very short-term, lasting for a matter of weeks during the overall construction programme; and
- Sound levels during most of the construction period will be significantly lower, as shown on the contour plots in Figure 1 to Figure 3.

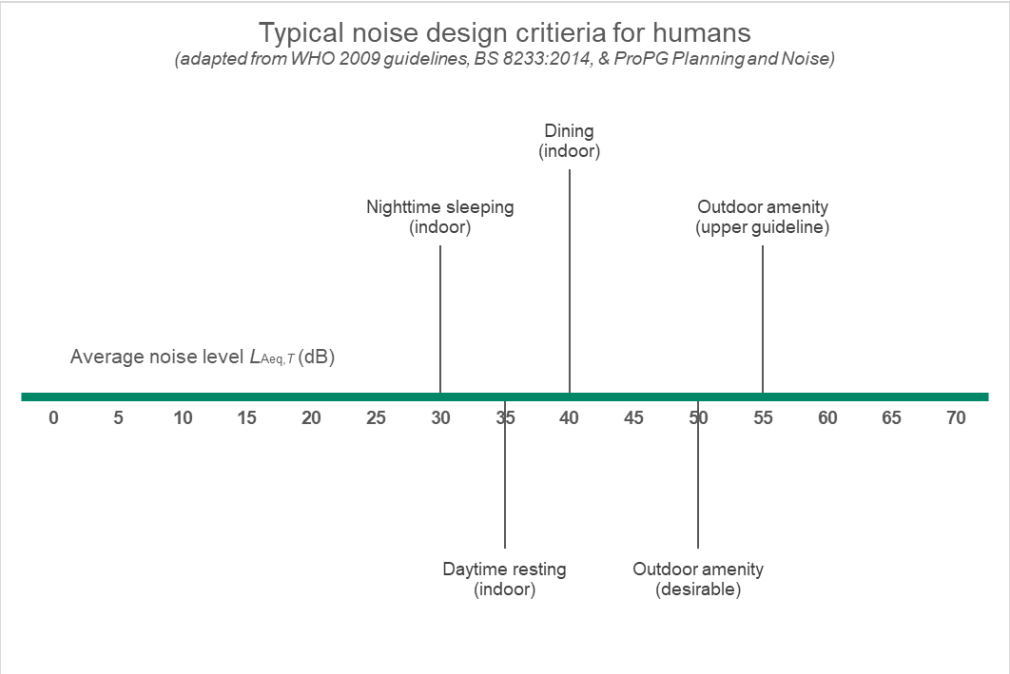

Plate 1.2 Typical noise design criteria for humans (*adapted from WHO* (1999)*, BS 8233:2014* (British Standards Institution, 2014)*, & ProPG Planning and Noise* (Association of Noise Consultants, Institute of Acoustics, & Chartered Institute of Environmental Health , 2017))

1.6 Conclusion

1.6.1 Underwater noise modelling has shown that the potential for TTS and PTS effects in seals is not likely as thresholds are met only within 13 m of construction activities and the seal haul out location will be at least 880 m away.

1.6.2 For the placement of anchors during cable pull-in and for the movements of plants and vehicles across the project area TTS and PTS thresholds are not met at all.

1.6.3 There are no established threshold criteria for seal disturbance, and behavioural responses are highly variable and context-dependent. In areas where seals are habituated to background noise and visual activity, the disturbance threshold is significantly higher compared to locations with lower ambient noise levels.

1.6.4 However, human and seal hearing sensitivity is similar enough, particularly for the frequency range of noise produced during construction, that the design thresholds for noise effects in humans, as a means of estimating likely disturbance in seals, is considered appropriate.

1.6.5 The highest 12-hour average sound level that could be experienced by seals hauled out within the River Stour is $L_{Aeq,12hours}$ 49 dB which is a level considered comfortable for seals. This maximum sound will only occur during cofferdam construction should it occur at the boundary of the Limits of Deviation and will be very short-term over a matter of days for the cofferdam closest to the river, and only experienced at the very northern extent of the much wider area of the mudflats in the River Stour where seals have been observed to haul-out.

1.6.6 The assessment for airborne noise has been updated to reflect the results of the M-weighted modelling, and the qualitative review of disturbance, and is provided in **Application Document 6.2.4.4 (E) Part 4 Marine Chapter 4 Marine Mammals**, submitted at Deadline 1.

1.7 References

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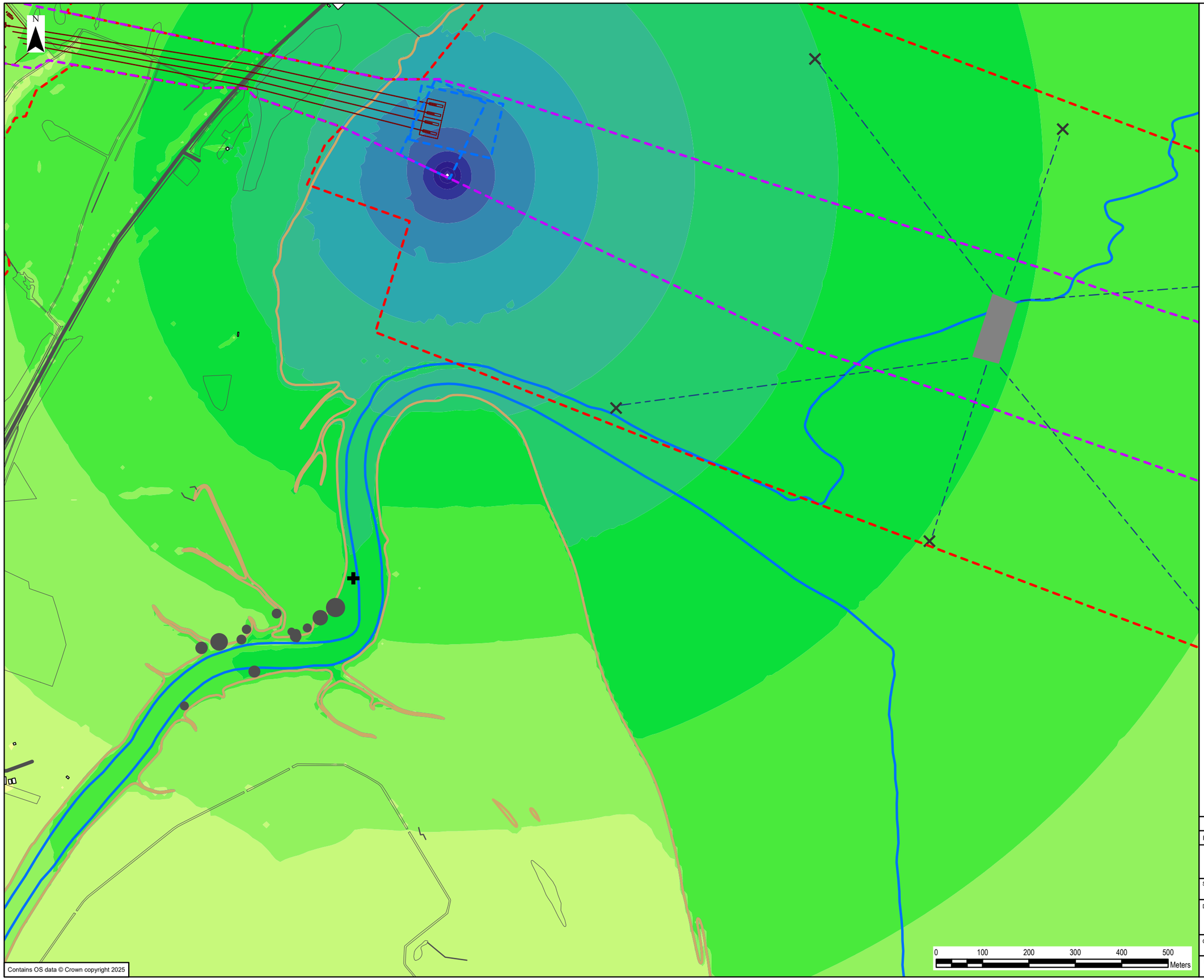

Legend

- Order Limits
- Limits of Deviation
- Site Plan
- HDD Exit
- Foreshore
- Water channel
- Barge
- Anchor locations
- Anchor lines
- Calculation point
- Hauled-out seals August 2025

Noise level (dB)

- < 20
- 30 to <35
- 35 to <40
- 40 to <45
- 45 to <50
- 50 to <55
- 55 to <60
- 60 to <65
- 65 to <70
- 70 to <75
- 75 to <80
- >=80

Construction scenario assumes 4x tracked excavator and1x vibratory piling rig, all located at closest approach to seal habitat and operating continuously

Rev	Date	Description	GIS	Chk	App
0	18/11/2025	ORIGINAL ISSUE	AP	AB	JH

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Scheme: SEA LINK

Document Title: Predicted noise levels - piling (worst-case location) - $L_{eq,T}$ A-weighted

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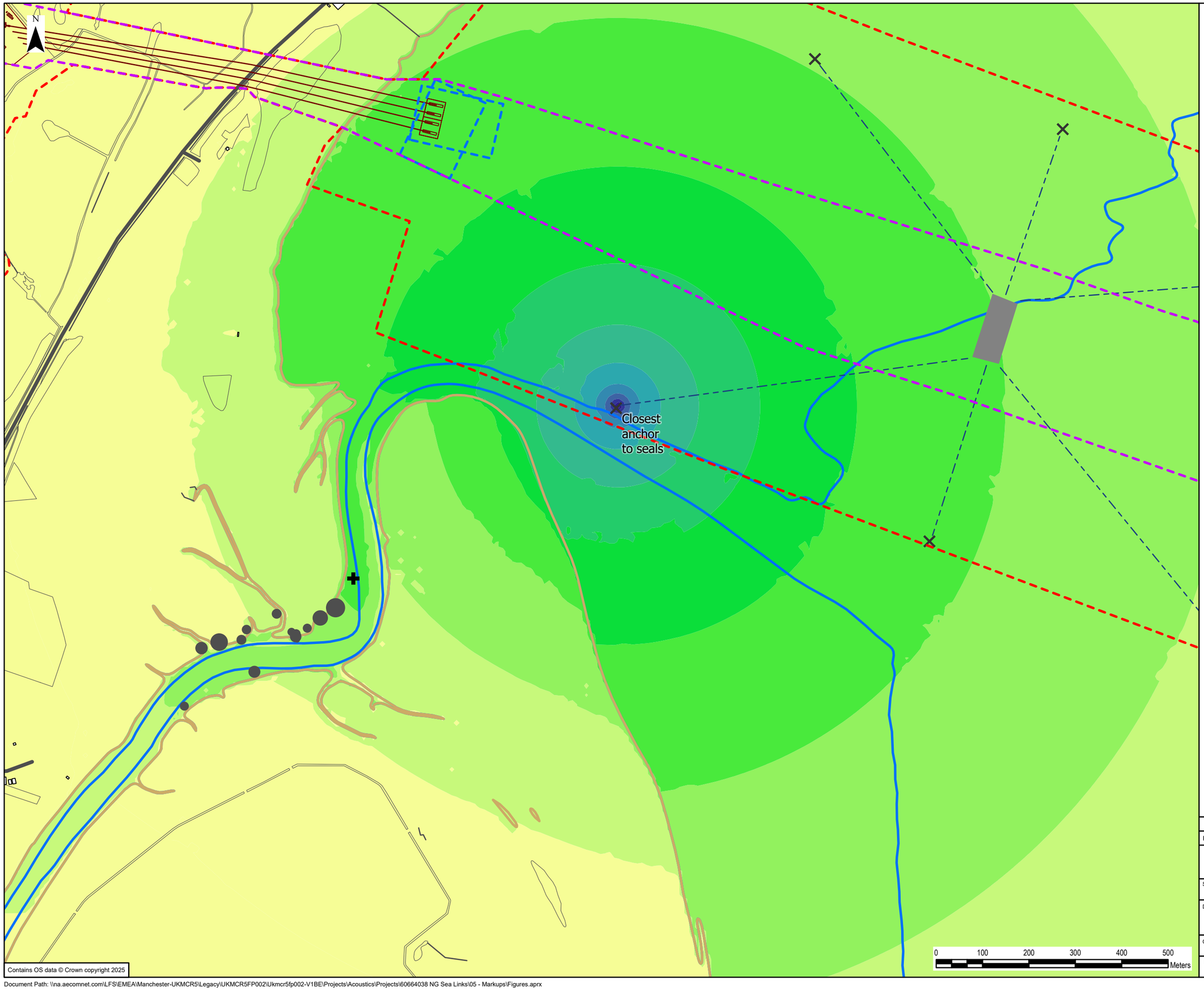

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Noise level (dB)

- < 20
- 30 to <35
- 35 to <40
- 40 to <45
- 45 to <50
- 50 to <55
- 55 to <60
- 60 to <65
- 65 to <70
- 70 to <75
- 75 to <80
- >=80

Illustrative scenario assuming 1x excavator operating continuously at the anchor point closest to seal habitat

Rev	Date	Description	GIS	Chk	App
0	18/11/2025	ORIGINAL ISSUE	AP	AB	JH

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Scheme: SEA LINK

Document Title: Predicted noise levels - anchor installation (worst-case location) - $L_{eq,T}$ A-weighted

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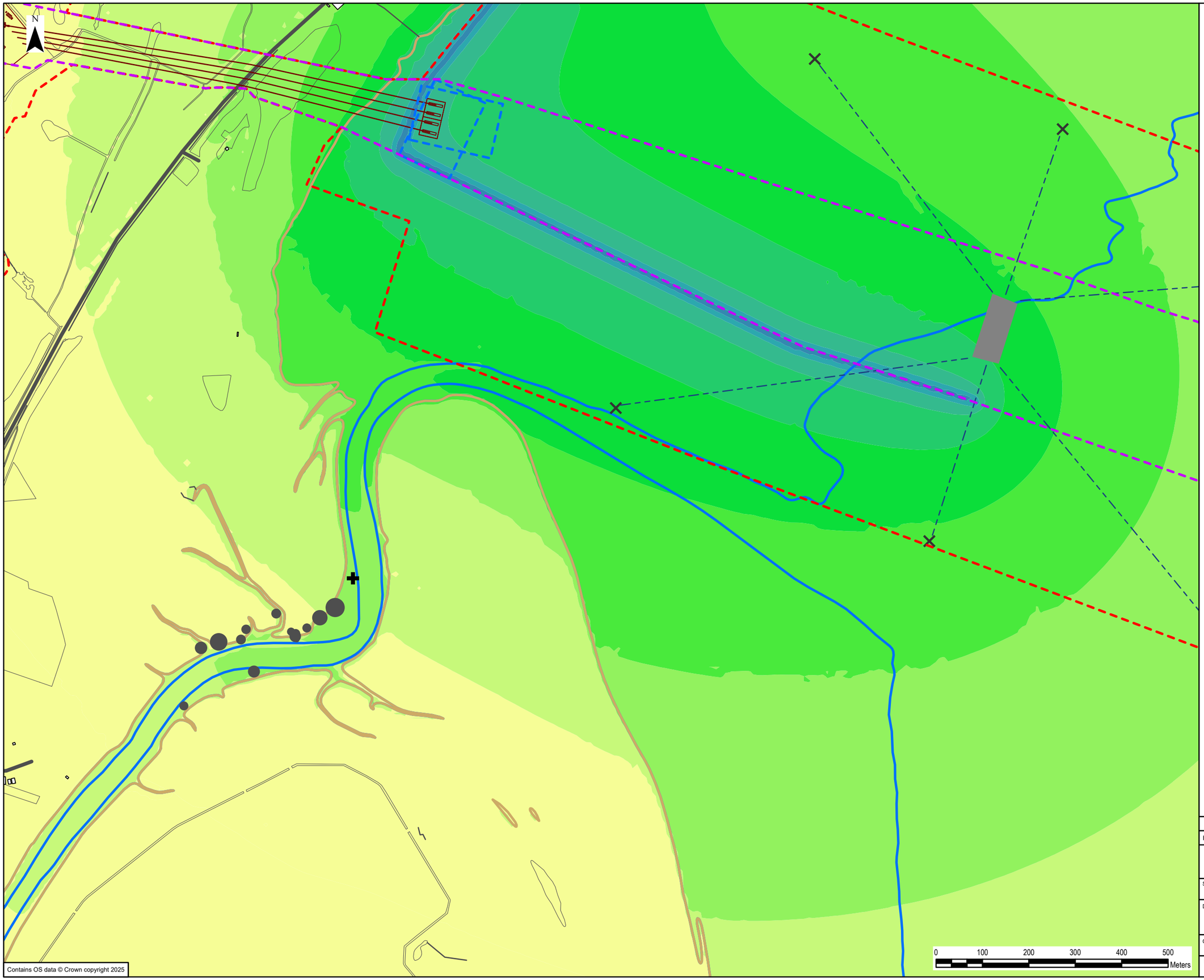

Legend

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Noise level (dB)

- < 20
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- 40 to <45
- 45 to <50
- 50 to <55
- 55 to <60
- 60 to <65
- 65 to <70
- 70 to <75
- 75 to <80
- >=80

Illustrative scenario assuming 36x two-way vehicle movements over 12 hour day, at the closest extent of the LoD to seal habitat

Rev	Date	Description	GIS	Chk	App
0	18/11/2025	ORIGINAL ISSUE	AP	AB	JH

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Scheme: SEA LINK

Document Title: Predicted noise levels - vehicle movements (worst-case location) - $L_{eq,T}$ A-weighted

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